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# DICTIONARY

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# SCIENCE, LITERATURE, & ART.

# DICTIONARY

OF

# SCIENCE, LITERATURE, & ART:

COMPRISING THE

HISTORY, DESCRIPTION, AND SCIENTIFIC PRINCIPLES

OF EVERY BRANCH OF

## Human Knowledge;

WITH THE

DERIVATION AND DEFINITION OF ALL THE TERMS IN GENERAL USE


EDITED BY

## W. T. BRANDE, F.R.S. L. & E.

**Of Her Majesty's Mint;**

HONORARY PROFESSOR OF CHEMISTRY IN THE ROYAL INSTITUTION OF GREAT BRITAIN,
ETC. ETC. ETC.

ASSISTED BY

## JOSEPH CAUVIN, M.A., & PH.D.

OF THE UNIVERSITY OF GÖTTINGEN, ETC. ETC.

THE VARIOUS DEPARTMENTS BY EMINENT LITERARY AND SCIENTIFIC GENTLEMEN.


ILLUSTRATED BY NUMEROUS ENGRAVINGS ON WOOD.

SECOND EDITION, WITH A SUPPLEMENT.


LONDON:
LONGMAN, BROWN, GREEN, AND LONGMANS.

# PREFACE

TO

# THE FIRST EDITION.

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THE advantages of Encyclopædias are now so universally acknowledged that it would be wholly superfluous to endeavour to recommend the present work by dwelling on their peculiar merits. But though the utility of such works be no longer in dispute, it may, notwithstanding, be reasonably supposed that at a period when so many voluminous Encyclopædias, and special Dictionaries, have recently issued, and are still daily issuing from the press, this department of literature must be fully occupied, and that there can be no well-founded call for any farther addition to the number.

It will be found, however, on a little consideration that this is by no means the case. By far the greater number, or rather, perhaps we might say, all the Encyclopædias and Dictionaries of modern times, are either too voluminous or too special for ready reference and general use. The *Encyclopédie Française*, *Rees's Cyclopædia*, the *Encyclopædia Britannica*, the *Encyclopædia Metropolitana*, and the *Penny Cyclopædia*, are all works of vast extent, comprising many volumes, and embracing an infinite variety of articles, or rather treatises, which, if published separately, would each make a considerable work. Now it is obvious that such voluminous publications, whatever may be their merits in other respects, want that facility of reference and precision of statement which ought to be the distinguishing features of a useful Dictionary. No man can carry about with him any of the great modern Encyclopædias; while the extensive plan on which they are compiled renders them at once far too expensive for general circulation, and wholly unsuitable for ready consultation. The supply, indeed, of that concise and authentic information on the various subjects of science, literature, and art, which a book of reference should furnish with the utmost facility to all classes of readers, has been but a secondary object with the compilers of our great Encyclopædias; and though it had been otherwise, the length, theoretical character, and frequent obscurity of the articles in such works, must have effectually precluded their ever being used for mere purposes of reference. They are valuable as substitutes for libraries, as repositories of the various knowledge connected with the different departments of which they treat; and being so, they cannot be convenient manuals.

Special Dictionaries, on the other hand, though they may exhaust some one branch or department of science, literature, or art, and be invaluable to those engaged in its cultivation, and to those who wish to become acquainted with its details, are not intended to supply information on other branches. A work therefore like that now offered to the public, possessing the com-

affording in a convenient form an abstract of the principles of every branch of knowledge, and a definition and explanation of the various terms in science, literature, and art which occur in reading and conversation, appears to be still wanting.

May we hope that this desideratum which has been long felt to exist in encyclopedical literature, has been at length supplied! Such at least will be the case, should the present work answer the expectations of its authors and publishers. They have endeavoured to produce a condensed and compendious Dictionary, of a convenient size, and adapted to the wants and means of all classes, that may be advantageously used as a manual or reference book in every department of science, literature, and art: and they flatter themselves that by rejecting all discussion and details not indispensable to the proper elucidation of the different topics, the work will be found, notwithstanding its comparatively narrow limits, to furnish, in the readiest possible manner, precise and accurate information on the all but infinite variety of subjects which it embraces. Great pains have been taken to make the definitions and explanations correct, clear, and concise. The principles of the most popular and important departments of science, literature, and art are also distinctly though briefly explained; and notices are given of their rise, progress, and present state.

Neither must it be supposed that because these articles are for the most part brief and compendious, they are either flimsy or superficial. On the contrary, they have been compiled throughout with the greatest care. Popularity has not been sought for at the expense of science, nor brevity by the sacrifice of useful facts or appropriate illustrations. The work contains not a few new and original views; and it is confidently believed that in every department it will be found to embody the latest information, and to be on a level with the most advanced state to which knowledge has attained, not merely in this but also in other countries. No statement has been made as to any unusual or doubtful matter, without referring to the authority whence it has been derived; and when subjects of general interest and importance are noticed, the reader is referred to the works relating to them in which they are handled with the greatest ability. Not only, therefore, will those who may consult this work have a guarantee for the authenticity of its information, but they will learn the sources to which they may resort with the greatest advantage, should they wish to make farther inquiries.

Such, in a few words, is the design of this work; and, unless its publishers be greatly deceived as to its execution, it can hardly fail to be useful to individuals of all ranks and conditions — to the man of business, and the man of pleasure, the student and the superficial reader, the busy and the idle. Every one who takes any share in conversation, or who dips, how cursorily soever, into any newspaper or other publication, will every now and then find the advantage of having access to the DICTIONARY OF SCIENCE, LITERATURE, AND ART.

In finally submitting the work to the judgment of the public, the publishers may, perhaps, be allowed to say that they have left no means untried that appeared likely to insure the accuracy and excellence of the work. It was distributed into divisions or departments, each embracing a single subject,

or a class of closely allied subjects; and these were respectively assigned to gentlemen distinguished by their attention to, and proficiency in, the topics to be treated of. This seemed the most likely means to avoid mere compilation; to insure accuracy and adequate information; and to make the work not only a comprehensive and correct, but in some measure also an original, digest and synopsis of human knowledge.

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# PREFACE

TO

# THE SECOND EDITION.

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THE objects of this Dictionary are so fully set forth in the Preface to the First Edition, that it would be superfluous to recapitulate them here. In preparing a New Edition for the press, the Editor saw no reason to change or modify the general system on which the work had been originally constructed; but he has availed himself of the suggestions with which the kindness of friends and the vigilance of correspondents have supplied him, to correct mistakes that had crept into the text, and to make such alterations in the body of the work as seemed called for by the lapse of time and the progress of science. A SUPPLEMENT has also been added, containing, (1.), terms that had been omitted *per incuriam*, or that appeared on further reflection to deserve a place in a Dictionary of Science, &c., and (2.),— and these are by far the most numerous and important, — the chief scientific terms, processes, and improvements that have come into general use since the publication of the First Edition.

*List of the principal Authors of the work, with the departments for which they are respectively responsible.*

General Editor,

## W. T. BRANDE, F.R.S.L. & E.

Of Her Majesty's Mint; Honorary Professor of Chemistry in the Royal Institution of Great Britain, &c &c &c.

Assisted by Dr. JOSEPH CAUVIN.

| | |
|---|---|
| 1. Architecture, Music and the Fine Arts | Joseph Gwilt, F.S.A. & F.R.A.S. |
| 2. Botany | J. Lindley, Esq., Ph. D. F.R.S.L.S. &c. Professor of Botany in University College, and in the Royal Institution |
| 3. Chemistry, Geology, Mineralogy, Medicine, and the Arts and Sciencls depending on Chemical Principles | W. T. Brande, Esq. (Editor). |
| 4. Gardening and Agriculture | J. C. Loudon, F.L.S.L.S. &c. |
| 5. Law | Herman Merivale, A.M. Late Fellow of Baliol College. |
| 6. General Literature | J. R. M'Culloch, Esq., Member of the Institute of France, &c , &c. Dr. Joseph Cauvin. |
| 7. Mathematics, and the Arts and Sciences depending on Mathematical Principles | Thos Galloway, M.A.F.R.S |
| 8. Nautical Science | Lieutenant Raper, R.N. &c. |
| 9. Political Economy and Statistics | J. R. M'Culloch, Esq Member of the Institute of France, &c., &c |
| 10. Theology | The Rev. Chas. Merivale, M A. |
| 11. Zoology, Anatomy, and Physiology | Richard Owen, F.R.S. &c. |

# DICTIONARY

OF

# SCIENCE, LITERATURE, AND ART.

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## A.

A. The first letter of the Alphabet, in all known languages, with the exception of the Amaric, a dialect of the Ethiopian, in which it is the 13th, and of the Runic, in which it is the 10th. It was called *Alpha* by the Greeks, and *Aleph* by the Hebrews.

ABACI'SCUS (*see* ABACUS). In Architecture, any flat member. The square compartment of a mosaic pavement.

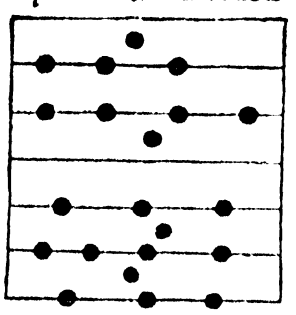
ABA'CK, in sea language, denotes the position of the sails when flatted against the mast by the force of the wind. This may happen either by a sudden change of the wind, or an alteration of the ship's course; or the sails may be *laid aback* for the purpose of avoiding some imminent danger.

A'BACOT. A cap of state worn by the old English kings.

A'BACUS. (Gr. αξαξ, *a slab.*) In Architecture, the upper part or crowning member of the capital of a column. This member alone seems to have constituted the primitive capital. It is an essential and constituent part of the capital. In the Tuscan, Doric, and Ionic orders it is square, and in the Corinthian and composite curved inwards on its plane and truncated at the quoins or angles at 45 degrees with the face of the entablature. The use of the abacus is to give breadth to the top of the column, and present a larger surface of level bed for the reception of the architrave.

ABACUS. An ancient instrument used for assisting numerical calculations. This term has been variously derived; from the Greek word, *abax*, signifying a table; a Phœnician word, *abak*, signifying sand (because when covered with sand it served for the purposes of writing); but its derivation is most probably to be referred to the three first letters of the Greek alphabet.

The use of the abacus will be readily understood from the annexed figure. A parallelogram is divided by parallel bars, on which small pebbles or counters are placed. The counters on the lowest bar denote units, those on the second tens, those on the third hundreds, and so on; one counter on a superior bar being equal to ten on the bar immediately below it. By means of nine counters for each bar, it is obvious that any number may be thus expressed. But the number of counters may be diminished by placing a counter on the intermediate space between two bars, giving it the value of five on the bar below. When seven bars are used, any number may be expressed under ten millions. The number represented in the figure is 845,398. It will be observed that the artificial value given to the counters, according to the positions which they occupy, is entirely analogous to our numerical system of digits. The form of the instrument admitted of considerable variety. The Grecian abacus





## ABATON.

was an oblong frame, having wires stretched across it, strung with perforated beads or little ivory balls. In the Roman abacus the counters were slid along grooves. Its use formed an essential part of the education of every noble Roman youth: —

> Nec qui *abaco numeros, et secto in pulvere metas,*
> Scit risisse vafer —— *Pers. Sat.* I. 132.

The Chinese, like the Greeks, employ wires with beads; and with them the abacus or Swan-pan is in universal use, as it conveniently adapts itself to their decimal divisions of weights and measures. The abacus continued to be used in European countries during the middle ages. Instead of a board, however, with bars or wires, it became the practice to cover a bench or *bank* with chequered cloth, on which the counters were disposed. Hence our terms exchequer, bankrupt, &c. A chequered board, such as is still sometimes seen as a sign at the doors of public houses, was formerly used in this country as an abacus. For an excellent account of the abacus, and of palpable arithmetic generally, see the article on Arithmetic, in the Supplement to the Encyclopædia Britannica, by Sir John Leslie.

ABA'FT, or AFT, in sea language, signifies towards the stern, or hinder part of the vessel. Thus a thing is abaft the foremast when it is between the foremast and the stern.

ABA'NDONMENT. A term used in insurances, where, before compensation can be demanded, the insurer must abandon his interest in any portion of the rescued property. It is also used in the language of the customs, to signify the abandonment of an article by the importer to avoid payment of the duty.

ABA'TEMENT, Plea of, in Law, is pleaded to a declaration, writ, &c., on account of some defect in form. (*See* PLEADING.)

ABATEMENT. In Heraldry, symbols of disgrace introduced into arms: mentioned for the most part only by English heraldic writers. A *delf*, or *quadrant* spot, is the sign of a revoked challenge: an *escutcheon reversed*, belongs to an ungallant person or deserter: a *point dexter parted*, to a boaster: a *point in point*, to a coward: a *point champain*, to one who kills a prisoner of war: a *gore sinister*, to effeminate persons: a *gusset dexter* denotes voluptuousness, a *gusset sinister* intoxication. The only abatement now used in practice is the *baston*, which belongs to bastards; it is in the form of the bend sinister, contains one fourth of its dimensions, but does not reach quite to the circumference of the escutcheon.

A'BATIS. (Fr. abattre, *to knock down.*) A military term, signifying trees cut down, and laid with their branches towards the enemy, so as to form a defence for troops stationed behind them. *Abatis*, among the writers of the barbarous ages, denotes an officer in the stables, who had the care and distribution of the provender.

A'BATON. (Gr. αβατον, *an inaccessible place*) An edifice at Rhodes so called by Vitruvius, lib. 2., the

entrance whereof was forbidden to all persons, because it contained a trophy and two bronze statues erected by Artemisia in memory of her triumph on surprising the city.

ABATTOIR. (Fr. abattre, *to knock down*.) A building appropriated to the slaughtering of cattle. In Great Britain we have no example of such a structure, our slaughter-houses not deserving the appellation as applied by the French. Paris possesses some fine specimens of this sort of architecture, constructed in 1809; the most magnificent is that in the neighbourhood of Montmartre.

ABBE'. The French term for the superior of an abbey. Before the Revolution the title was assumed also by a class of persons who had not in all cases received the tonsure, or undertaken to connect themselves with the church. They held a conspicuous place in society, and generally attached themselves to fashionable or literary patrons. This anomalous class seems to have taken its rise from the great number of abbeys, the revenues of which were allowed to be bestowed upon laymen, upon condition of their taking orders within a year after their preferment, which latter clause was frequently evaded.

A'BBESS. (Fr. *Abbesse*) The governess or superior of a monastery or abbey for females. By a decree of the Council of Trent she must be of the age of forty years, and have professed eight years at least.

A'BBEY. (Fr. *Abbaie*.) In Architecture, properly, the building adjoining or near a convent or monastery, for the residence of the head of the house, abbot or abbess. It is often used for the church attached to the establishment. In ecclesiastical history an Abbey was a monastery under the superintendence of an abbot, maintaining in later times the highest rank among religious houses, and enjoying some superior privileges.

A'BBOT. The superior of a monastery for men. Monastic societies, being originally composed of laymen, were obliged to have recourse to the assistance of a neighbouring priest to administer the sacraments and perform other clerical functions among them. Afterwards the superior of the society in many cases entered into orders, and exercised the ministerial office for the convenience of his community, under the title of abbot. (Heb abba, *father*.) From the beginning of the sixth century this practice became universal, the abbot having absolute power within his own monastery, but being himself subject to the authority of his diocesan. This subjection, however, the abbots gradually threw off to a great extent, and in many places themselves assumed the titles and authority of bishops. Such were the mitred abbots, and the crosiered abbots; the former of whom, to the number of 26, sat in the English parliament with the bishops and two priors in the reign of Henry VIII.

Abbots are properly superior in rank to Priors; the latter being often appointed by the abbot to superintend a dependent foundation. But the distinction does not appear to have been regularly observed, and there are certain orders whose superiors are always called priors, —as the monks of Vallombrosa, the Cistercians, Bernardists, Feuillants, Trappists, Grandmontanists, and Præmonstratenses

ABBREVIA'TION. (Lat. brevis, *short*.) In Arithmetic. The process by which a fraction is reduced to lower terms; thus the division of the numerator and denominator of $\frac{16}{24}$ by 8 reduces or abbreviates the fraction to $\frac{2}{3}$.

ABBREVIATION. In Music. A stroke which, placed over or under a note, divides it into quavers if there be only one; if two, into semiquavers; if three, into demisemiquavers.

ABBREVIATION. In Writing. Before the invention of printing, a variety of abbreviations were used, most of which have gradually fallen into disuse: they generally consisted in substituting the initials for the words. Of the abbreviations at present in use, the following are those which most commonly occur:—in Titles,

A. M., Master of Arts.
A. B., Bachelor of Arts.
B. C. L., Bachelor of Civil Law.
B. D., Bachelor of Divinity.
Clk., Clerk or Clergyman.
C. B., Companion of the Bath.
D C. L., Doctor of Civil Law.
D D., Doctor of Divinity.
F. R. S., Fellow of the Royal Society.
G. C. B., Grand Cross of the Bath.
G. C. H., Grand Cross of Hanover.
K. B., Knight of the Bath.
K. C. B., Knight Commander of the Bath.
K. C. H., Knight Commander of Hanover.
K. G., Knight of the Garter.
LL. D., Doctor of Laws.
M. A., Master of Arts.
M. D., Doctor of Medicine
M. P., Member of Parliament.
M. R. I. A., Member of the Royal Irish Academy.
R. A., Royal Academy.
R. E., Royal Engineers.
R. M., Royal Marines.
R. N., Royal Navy.
S. T. P., Doctor of Divinity, or Sanctæ Theologiæ Professor.
E. I. C., East India Company.
W. S., Writer to the Signet.

Miscellaneous, Diplomatical, &c.

A. D., the year of our Lord.
A. H., the year of the Hegira.
A. M., the year of the world.
i. e., that is to say.
ib., in the same place.
id., the same.
N. B., observe.
viz., for videlicet, to wit.
L. S., (in a deed) the place of the seal.
R. S. and L. S., right and left side.
N. S., new style, (since 1752.)
O. S., old style, (before 1752, and in the Greek calendar.)
A. C. or B. C., the year before Christ.
A. U. C., the year from the building of Rome.
Nem. con., no one contradicting.
Nem. dis., no one dissenting.
M. S., manuscript.
A. M., morning.
P M, afternoon.
H. M. S., His Majesty's ship, or service.
D. G., by the grace of God.
F. D., Defender of the Faith.
H. R. E., Holy Roman Empire.
U. S, United States of America.

ABDICA'TION. (Lat. abdico, *I abdicate*.) In Politics, the renunciation of an office or dignity by its holder; but it is commonly meant to express the voluntary renunciation of supreme power. The most famous examples of this on record, are the abdication of the dictatorship by Sylla, 75 years B. C.; of the imperial throne, by Diocletian, anno 305; of the emperor Charles V., in 1556, and of Christina, queen of Sweden, in 1654 — Of all the sovereigns who have made voluntary abdications, Diocletian, is, perhaps, the only one who did not regret the step. Examples of forced or involuntary abdication are too numerous to require to be pointed out. The modern history of France and England furnish some very striking instances with which every one is familiar. The convention parliament of 1688 used the word abdication to express the act of James II. in abandoning the government and kingdom. The word "desertion" was rejected, as implying the possibility of a return The Scottish convention of estates declared that James had "forfeited" the kingdom. Abdication is said to differ from resignation, the former being unconditional, the latter done in favour of some other person.

ABDO'MEN (Lat. abdo, *I conceal*) The great cavity of the animal body, which is liable to temporary changes in its dimensions, independently of respiration. In entomology it forms, in insects the third, in arachnidans the second, in both classes the most posterior, of the sections into which the body is externally divided, and contains the principal digestive and respiratory, and the whole of the generative organs. The enlargements of the abdomen, in relation to the activity of the generative functions, is most remarkable in insects; in some of which, as the white ant, or termite, it constitutes at the full development of the ova an immense proportion of the entire body of the female In vertebrates the abdomen is not divided externally from the thorax; and only in one class, the mammalia, by an internal partition, or diaphragm.

The abdomen is the first-formed cavity in the development of the animal body, and is the most constant in its existence throughout the animal series. (*See* CRANIUM and THORAX)

ABDO'MINALS *Abdominales* An order of malacopterygous fishes, including those which have the ventral fins situated under the abdomen, behind the pectorals.

ABDU'CTION. (Lat. ab, *from*, and duco, *I lead*.) In Law, the forcible carrying away of a woman, for the purpose of marriage or defilement. Where the female has property, or is presumptively entitled to it, such abduction is felony: and in all cases the taking of a girl under sixteen from under the protection of her parents is a misdemeanour. The crime of abduction, according to Sir W. Scott (see his Notes and Introduction to Rob Roy), was at one period extremely common on the border of the Scottish Highlands; it is now an ordinary offence in Ireland: the number of convictions in the last 7 years amounts to 61; executions, 5.

ABDU'CTOR. Abductor muscles are those which pull back or separate the limbs to which they are affixed.

A'BELITES, or *Abelians*, in ecclesiastical history, a sect mentioned by St. Augustine, in Africa. They are said to have enjoined marriage and virginity, after the pretended example of Abel. (*See* Mosheim, *Eng. Trans* i.233.)

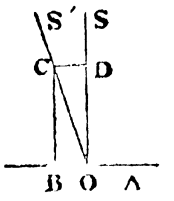
A'BER A Celtic term, implying the mouth of a river; as Aberdeen, the mouth of the Dee; Aberystwith, the mouth of the Ystwith, &c.

ABE'RDEVINE, or European Siskin; (*Carduelis spinus*, Cuv.) A small green and yellow finch, belonging to the same sub-genus as the goldfinch of this country. Its song is similar to that of the goldfinch, but is not so sweet, and ends with a harsh jarring note. Its flight is a series of successive undulating courses, accompanied by a chirp, at each propelling motion of the wings, as in other species of *Carduelis*. The Aberdevine winters in the south of England, and flies northward in the month of March, to breed in the pine forests of Scotland. The

nest is built among the higher branches of the pine: the eggs are four or five in number; of a bluish-white colour, speckled with purplish-red. They begin to re-appear in the south in the month of September. The Aberdevine resembles in the markings of its plumage the common redpole, (*Linaria pusilla*, Cuv.) but the colours are different.

ABERRA'TION. (Lat. ab, *from*, and erro, *I wander*.) A term used in astronomy, to denote a change in the positions of the celestial bodies arising from the combined effects of the motion of light and the motion of the earth in its orbit.

To explain the cause of this remarkable phenomenon, conceive a ray of light to proceed from a star S to an observer at O. If the station of the observer were at rest, or if the motion of light were instantaneous, the star would be seen in its true place at S. But neither of these circumstances has place; the observer is carried rapidly forward by the motion of the earth in its orbit, and light occupies a certain time in coming from any of the heavenly bodies to the earth. Suppose, then, that while a particle of light advances from D to O, the observer has been carried forward by the earth's orbital motion from A to O. At O the particles of light will strike the eye with a velocity proportional to D O, and the eye will impinge against the particle with a velocity proportional to A O. Thus a double effect will be produced: first, that of the motion of light proportional to D O, and, secondly, that arising from the motion of the observer proportional to A O. But it is obvious that the question will in no way be affected if we suppose that, instead of the observer having been carried forward from A to O he had remained at rest in O, and the light had advanced to him in the opposite direction, and with a velocity B O = A O. Thus the eye would receive two simultaneous impressions in the directions D O and B O of the parallelogram B C D O; and by the theory of the composition of velocities the effect would be exactly the same as if the eye had received a single impression from a particle proceeding in the direction of the diagonal C O, and with a velocity proportional to C O. Hence the apparent place of the star will be at S', in advance of its true place at S.




The angle C O D is the *aberration*, and its magnitude can easily be determined when we know the relative magnitudes of D O and B O, and the inclination of those lines; that is, when we know the relative velocities of light and of the earth, and the relative direction of their motions. It is obvious that the aberration will be greatest when those lines are perpendicular to each other; when they are parallel it vanishes altogether.

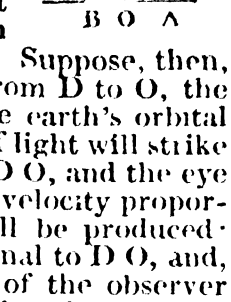
From the eclipses of Jupiter's satellites, and other phenomena, it has been ascertained that light is transmitted through space with a velocity of 192,000 miles per second. The mean velocity of the earth in its orbit is about 19 miles per second, we have, therefore, when B O and D O are at right angles, the proportion

$$192{,}000 : 19 = DO : BO = \text{rad.} : \text{tan. } COD;$$

hence the tangent of C O D, or the aberration (or in so small an angle the tangent is equal to the arc), is found by the Trigonometrical Tables = 20″·5. This being the greatest value of the angle, is called the *Constant of Aberration*.

From Bradley's observations the Constant of Aberration was determined by Bessel (*Fundamenta Astronomiæ*) to be 20″ 25. Dr. Brinkley found it = 20″ 37. Mr. Richardson, from a series of 2000 observations made with the two mural circles in the Greenwich Observatory, found the value of this important element = 20 307 (*Memoirs Royal Astr. Society*, vol. iv.)

The effect of aberration on any particular star depends on the position of the star with reference to the ecliptic. Let A B C D be the orbit of the earth, and S a star in the plane of the ecliptic. When the earth is at A the star will be thrown forward by the effect of aberration to *s*. When the earth arrives at the opposite point of its orbit C, the star will be thrown back to *s'*. At B and D the earth is moving in a direction parallel to the ray of light proceeding from the star, and there is, consequently, no aberration. Hence a star situated in the plane of the ecliptic appears to oscillate backwards and forwards in a straight line, always returning to its former position at the end of a year.




A ray of light proceeding from a star situated in the pole of the ecliptic, is always at right angles to the direction of the earth's motion; consequently, a star having this position will appear to describe annually, about the pole of the ecliptic, a circle of which the radius = 20″·3.

In any other position the apparent path of a star, so far as depends on aberration, is an ellipse whose major axis = 40″·6, and its minor axis = 40″·6, multiplied by the sine of the star's latitude.

The apparent places of the planets are also affected by aberration; but in this case, as the body from which the light emanates is also in motion, we must consider that the ray of light which enters the eye has proceeded, not from the place which the planet occupies at the instant of the observation, but from that which it did occupy at as long an interval previously as light requires to traverse the distance between the planet and the earth. To this small variation in the place of the planet must be added the space described by the earth in the same interval; and it is easy to see that the sum is the apparent or relative motion of the planet during the time which light takes to pass from it to the earth.

The aberration was discovered, and its physical cause first explained, by Dr. Bradley. It is the most direct proof which astronomy furnishes of the motion of the earth round the sun.

ABERRATION. In *Optics*, denotes the deviation of the rays of light from the true focus of a curved lens or speculum; in consequence of which they do not unite in a single point, but are spread over on a small surface, and form a somewhat confused image of the object. This arises from two causes: 1st, the figures of the lenses or specula; and, 2dly, from a difference in the physical nature of the rays of light.

The surfaces of the lenses or mirrors of optical instruments are worked into a spherical form, because there is no practical means of accurately obtaining the parabolic curvature which theory shows to be necessary to collect parallel rays into a single point or focus. Hence the rays meet the axis of the lens at different points, the amount of deviation depending on the magnitude and curvature of the lens. This is called the *Aberration of Sphericity*. The second cause of aberration arises from the different degrees of refraction which the rays composing a beam of light undergo in passing from one medium into another. On account of this difference of refrangibility, the rays of light are separated, and the colours of the spectrum appear. It was long believed, and even by Newton himself, that it was impossible to refract, without decomposing, light; and hence the attempts that have been made to perfect reflecting telescopes, and adapt them to circular instruments. But it has since been discovered that the refractive and dispersive powers of different diaphanous substances are in different proportions, and that the decomposition of the light may be prevented by combining substances of different refractive powers; for example, crown and flint glass, in the same lens. (*See* ACHROMATISM.)

ABE'TTOR (Sax. abedan, *to incite*.) In *law*. An instigator or inciter; a person who promotes or procures the commission of an offence or felony, by his advice or encouragement. If an abettor, or as he is then termed, an aider and abettor, be present at the commission of the crime, he is treated as a principal; if absent, he becomes an *accessory* before the fact. But in almost all cases of felony the abettor is considered as much a principal as the actual felon, especially in the case of murder; and the abettors of offences punishable summarily by justices of the peace, are subjected to the same penalties as the principals.

ABE'YANCE. (Norm. Fr. beyer, *to expect*.) In *law*. The fee simple, or inheritance of lands is said to be in abeyance, when there is no person *in esse* in whom it can vest and abide, although limited and ready to vest whenever the proper heir appears. Thus, in a grant to A for life, and afterwards to the heirs of B, the inheritance remains in abeyance until the death of B, as there can be no heir to a living person. A peerage descending to coheiresses is said to be in abeyance.

A'BIB. The first month of the Hebrew year, more generally known by the Chaldean name of *Nisan*. It is first mentioned in the 4th verse of the 13th chapter of Exodus.

A'BIES. (Lat. abies, *a fir tree*.) The name of all those fir trees which, like the spruce, the larch, the cedar of Lebanon, have their leaves growing singly upon the stem, and the scales of the cones round and thin. The wood called by timber-merchants "white deal" is produced by Abies excelsa, and a resinous, or terebinthaceous substance by others; as Canadian balsam by A. balsamea, the balm of Gilead. Strasburgh turpentine by A. pectinata, the silver fir; Venetian turpentine by A. larix, the larch. Besides these, the substance called extract of spruce is furnished partly by A. canadensis, and partly by A. nigra. All the species are hardy, and, with the exception of larches, are evergreen, and in cultivation in this country. The most valuable for the timber are, A. Douglasii, A. excelsa, and A. larix; the most ornamental are, A. cedrus, the cedar of Lebanon, deodara, and larix. The most worthless in Great Britain are, A. canadensis, picea, balsamea, and pectinata; the three latter form, however, fine trees in favourable situations. The wood of the fir is in very extensive use, and it is, perhaps, the most serviceable of all trees.

ABIETI'NÆ. A division in the natural order of coniferous plants, comprehending the true firs, pines, and

araucaria-like pines, all which have cones with many rows of scales in which the seeds are formed.

ABJURA'TION, *Oath of.* (Lat. ab. *from*, and juro, *I swear.*) Introduced by stat. 13 W. III., and regulated by 6 G. III. An oath asserting the title of the present royal family to the crown of England. By this oath the juror recognises the right of the king under the Act of Settlement; engages to support him to the utmost of his power; promises to disclose all traitorous conspiracies against him; and expressly disclaims any right to the crown of England in the descendants of the Pretender.

ABJURATION *of the Realm* (in law) signifies a sworn banishment; or the taking of an oath to renounce and depart from the realm for ever.

ABJURATION also signifies a solemn recantation of opinion: as, the abjuration of heresy required by the Romish Church. Henry IV. abjured Protestantism at Saint Denis in 1593. Galileo was compelled to abjure his philosophical opinions by the Inquisition at Rome, in 1633.

A'BLATIVE *case.* (Lat. ablatus, *taken away.*) The sixth case of the Latin nouns implied in English by the preposition *from.* (See Grammar.)

A'BLU'TION. (Lat. ablutio, *washing.*) A religious ceremony, consisting in bathing the body, or part of it. It constituted a part of the Mosaic ceremonial, and was afterwards practised among the Jews, both by the priests and people. But ablutions are most rigidly enforced by the Mahometans. The term is also applied to the cup given, without consecration, to the laity in the popish churches.

ABNO'RMAL. (Lat. ab, *from*, and norma, *a rule.*) Any thing without, or contrary to, system or rule. Thus Horace calls a well-informed sagacious countryman, —

Rusticus, abnormis sapiens, crassâque Minervâ.

In *botany*, if a flower has five petals, the rule is that it should have the same number of stamens, or some regular multiple of that number; if it has only four or six stamens, then, in such a case, the flower would be abnormal.

ABOA'RD, within the ship; also one vessel is said to get aboard of another when she gets foul of her.

ABORI'GINES. The first, or original (*a prima origine*) inhabitants of a country, that is, those who occupied it at the period when it began to be known, and who either were indigenous to the soil or had immigrated thither before the dawn of history. Some of the ancients supposed they had always inhabited the same soil, and were created from it, as the Athenians, who thence called themselves *autochthones*, co-eval with and sprung from the land. But the Romans and modern nations use the word Aborigines to designate those inhabitants of a country of whose origin nothing certain is known. Thus the Indians of America are properly called Aborigines, because they were found there at its discovery, and we have no accounts of their having immigrated from any other quarter

ABO'RTION. (Lat. abortus, *miscarriage.*) This term is usually applied to the morbid or unnatural expulsion of the fœtus in the human subject after the sixth week, and before the sixth month, of pregnancy. Before the sixth week it is called a *miscarriage*, and after the sixth month, *premature labour.*

ABO'RTIVE. Is said of parts in plants that do not acquire their usual state of perfection; a flower only partially formed, a stamen whose filament has no anther, a seed which contains no embryo, or which consists only of skin, are cases of abortion. The term is also applied to parts which, although perfect in the beginning, cease to grow, and so end in being imperfect; thus ovules, which are not impregnated, and which shrivel up instead of growing into seed, are called abortive.

ABO'UHANNES. An African bird, supposed to be the Ibis of the ancients.

ABRACADA'BRA. A celebrated term of incantation: especially used as a spell against fevers. The manner in which it was written and carried for that purpose may be seen in Defoe's History of the Plague at London. The word seems to be connected with *Abrasax* or *Abraxas;* a name found inscribed on certain stones or amulets, in such characters, together with the figure of a human body, with the head of a cat and feet of a reptile. Various explanations have been attempted of the object of these curiosities: some from the cabalistic and an Egyptian derivation. Bellermann (Berlin, 1817,) and Neander, have written on the subject of the Abraxas stones.

ABRA'DING. In Agr. (Lat. ab, *from*, and rado, *I scrape or rub off.*) Applied to the sloping surface of banks of earth, which crumbles down from the effects of frost, or the alternate action of drought and moisture.

ABRA'MIS. (*Abramis*, Cuv.) The name of a subgenus of Malacopterygious or soft-finned abdominal fishes, characterized by the absence of spines and barbels; by the dorsal fin being short and placed behind the ventrals, and the anal fin being long. The common bream is a species of this genus.

ABRA'NCHIANS. *Abranchia*, Cuv. (Gr. α, *without*, βραγχια, *gills.*) An order (the third in Cuvier's arrangement) of anellidans, so called because the species composing it have no external organs of respiration; they are divided into the setigerous abranchians, or worms, and the non-setigerous abranchians, or leeches.

ABRA'SION. (Lat. abrado, *I rub off.*) In Numismatology, implies the waste of coins, or the loss by wear and tear in the pocket. This forms a considerable item in the expense of a metallic currency; and various means have been employed to lessen it, by alloying the coins so as to render them harder, by raising the borders so as to lessen the surface exposed to be rubbed, &c.

ABRA'XAS. A genus of Lepidopterous insects, of the family Geometridæ; founded by Dr Leach for the common magpie moth (*Abraxas glossulariata*) and other allied species. It is the larvæ of the *Abr glossulariata* which commit the well-known ravages upon the gooseberry trees of our gardens; consuming the leaves almost as soon as they appear. They feed early in the morning, before the dew is off or the sun has much power; and it is at this time that they should be sought for and removed.

ABRI'DGEMENT. In Literature. (Lat. abbrevio, *I shorten.*) A compendious arrangement of the matter contained in a larger work. Before the invention of printing, when manuscripts were valuable, and the labour of writing them great, the compiling abridgements of considerable works was an important branch of authorship; and it has been doubted whether we have lost or gained more by the practice: since, on the one hand, the contents of many lost authors are thus partially preserved to us, and, on the other, the abridgement becoming popular may, in some cases, have caused the loss of the original Among the best known abridgements of antiquity are the History of Justin, being an abridgement of the lost History of Trogus Pompeius: the Natural History of Solinus, chiefly abridged from that of Pliny, &c Few modern abridgements, taking the phrase in its strict sense, merit peculiar notice, or have been compiled with any other view than that of assisting education. This, however, is not the case with some of those works called abridgements, intended to exhibit a summary view of some science or department of literature. The *Abrégé Chronologique de l'Histoire de France*, by the president Henault, is a work of this kind It has, perhaps, been praised beyond its deserts, but still it possesses uncommon merit. Its success led to the publication of various works of the same kind, of which the *Abrégé Chronologique de l'Histoire de l'Allemagne*, by Pfeffel, is probably the best. Dr. Robertson drew from it most of his knowledge of the constitution of the German empire. To abridge well requires a thorough knowledge of the subject, with tact to seize upon the prominent points, and ability to state them clearly and succinctly. Tacitus, says Montesquieu, "*abridged all because he knew all,*" but Tacitus's are rare.

ABROGA'TION. The annulment of a law by competent authority. (From the Latin ab, *from*, and rogo, *I ask*) A phrase derived from the practice of the Roman popular assemblies, in which the several tribes, curiæ, &c. were said rogare suffragia, to demand the suffrage: whence also the modern word *prerogative.* (See COMITIA)

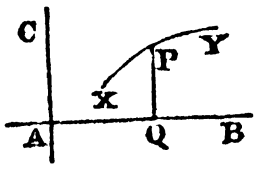
ABRU'PT. (Lat. abrumpo, *I break off.*) A term in Botany, applied to any thing which happens suddenly. A leaf which is suddenly terminated without tapering to a point, a stem which is suddenly bent, a pinnated leaf without a terminal leaflet, are all abrupt.

ABRUPT. In Ichthyology is applied to the lateral line when divided into two or more parts not contiguous.

A'BRUS. (Gr ἁβρος, *delicate*, or *elegant.*) A West Indian tree with papilionaceous flowers, and pods containing bright red seeds with a broad black scar on one side of them. The seeds are often strung into necklaces for children.

A'BSCESS. (Lat. abscedo, *I separate.*) Inflammation in the membranous or fleshy parts of the body, attended by the formation of *pus*, and the consequent separation or distension of the parts affected; thus the integuments separate from the parts beneath, and form a tumour.

A'BSCISS, or ABSCISSA. (Lat. ab scindo, *I cut off.*) A term used in geometry to denote a segment cut off from a straight line, by an ordinate to a curve. The position of a point on a plane is perfectly determined when its distances, measured in given directions, from two straight lines given by position, are known; and as curve lines may be regarded as formed by the continuous motion of a point, their various properties may be investigated by means of the relation common to all points of the same curve between the two distances so measured. Thus, let A B and A C be two straight lines given by position, and P any point in a curve X Y. Draw P Q parallel to A C, and meeting A B in Q, then P Q is called the ordinate of the point P, and A Q is the *absciss.* The absciss and ordinate, considered together, are called the co-ordinates



of the curve, and the point A, where they intersect, is called the origin of the co-ordinates. For every point of the same curve a certain unavoidable relation exists between A Q and P Q, which is called the equation of the curve. In order to represent this equation algebraically, the absciss A Q is represented by $x$, and the ordinate P Q by $y$. The co-ordinates may be inclined to each other at any angle, but in general the investigations are much simplified by assuming them at right angles. The origin of the co-ordinates, or the point from which the absciss is reckoned, may be taken any where in the plane of the curve. When a particular curve, however, is to be investigated, it is often convenient to place the origin at some point which is related to the other parts of the curve. Thus, if the curve is a circle, the co-ordinates are conveniently reckoned from the centre.

ABSENTE'E. In Politics, a word which has received, from usage, a peculiar signification: a landed proprietor who habitually resides at a distance from the district in which his property is situate: especially applied to Irish landlords and clergy. In 1715 a tax was imposed on absentees from Ireland, in all cases where their residence within it was for less than six months in the year; power of dispensation being secured to the crown. But it ceased to be levied in 1753, and has not since been renewed. Whether or not the absence of a landed proprietor be injurious to a country, in an economical sense, is a question which has been much debated of late years. See the evidence of Mr. J. R. M'Culloch before the Committees of the Lords and Commons, to inquire into the state of Ireland, 1825; and the controversy occasioned by that evidence, in the Edinburgh Review. No. 85., and Quarterly Review, Vol. 33. See also Mr. M'C.'s evidence before the Committee on the state of Ireland in 1830, and Mr. Senior's Outline of Political Economy, Encyclopædia Metropolitana

A'BSIS, or APSIS. (Gr. ἀψις, *an arch.*) In Architecture, a word used by ecclesiastical authors to signify that part of the church wherein the clergy were seated, or the altar was placed. This part of the church was so called from its usually being domed or vaulted, and not, as Isidorus imagines, from its being the lightest part, from *apta* The apsis was either circular or polygonal on the plan, and domed over at top as a covering. It consisted of two parts, the altar and the presbytery, or sanctuary, at the middle of the semicircle was the throne of the bishop; and at the centre of the diameter was placed the altar, towards the nave, from which it was separated by an open balustrade, or railing. On the altar was placed the cibarium and cup. The throne of the bishop having been anciently called by this name (apsis), some have thought that thence this part of the edifice derived its name, but the converse is the real truth.

A'BSOLUTE ABSOLUTISM In Politics, a government is strictly said to be absolute when the supreme head is above the control of law, and has unrestricted power of legislation. "El rey assoluto," is the common watchword of the anti constitutional party in Spain Yet in that country, as in almost every other, the theory of absolute sovereignty has some limit. since we find the same party denying the king the right of altering by his single will the fundamental laws of succession to the throne. (*See* DESPOTISM.)

ABSOLU'TION. (Lat. ab, *from*, solvo, *I loose.*) A ceremony practised in various Christian churches. In the Roman Catholic, the priest not only declares absolution to the repentant sinner, but is believed to have the power of actually releasing him from his sins: and this authority is declared by the council of Trent to belong to him in its full extent. The Church of England, in the Order for the Visitation of the Sick, has retained nearly the same words; but her authorities seem not to be exactly agreed as to the force and effect of the absolution so conferred. In the daily service, the words of the absolution are merely declaratory.

ABSO'RBED. (Lat. absorbeo, *I suck up.*) In Painting. Sucked up, imbibed. A term applied by the French connoisseurs to a picture in which the oil has sunk into the canvass or ground whereon it is painted, leaving the colour flat, and the touches indistinct. Our picture dealers used the term *chilled* to express the same thing. It may be remedied by rubbing the picture over with oil, and varnishing, after it has been well cleaned.

ABSO'RBENT *Ground.* In Painting. A ground prepared for a picture, either on board or canvass, chiefly with distemper or water-colour mixture, by which expedient the oil is immediately taken or sucked in from the colours, expedition gained, and a brilliancy imparted to the colours.

ABSORBENTS. In Medicine, substances which remove acid at the stomach, such as magnesia and chalk.

ABSO'RPTION. In Physiology, is one of the vital organic functions, the object of which is primarily to convey to the circulating organs the due supply of the materials for the growth and support of the system; and, secondarily, to remove and carry to the same organs the decayed and useless parts of the body. *See* LACTEALS.

A'BSTRACT (Lat. abstraho, *I take away*), signifies a general view or analysis of a whole work, or part of a work. It differs from *abridgment* chiefly in this, that while in the latter it is often necessary to enter into somewhat minute details, the former is always confined to a notice only of the leading particulars. *See* ABRIDGMENT.

A'BSTRACT MATHEMATICS, or PURE MATHEMATICS. That branch of science which treats of the relations or properties of magnitudes or quantities, considered generally, and without restriction to any individual magnitude. Thus, the proposition that the three angles of a triangle are, together, equal to two right angles, is an abstract truth, not confined to an individual triangle, or to a particular species of triangles, but belonging to all triangles whatever. Abstract mathematics is opposed to *mixed mathematics*, wherein abstract properties or relations are applied to sensible objects.

ABSTRACT NUMBERS. Numbers considered in themselves, and without reference to any particular thing. The operations of common arithmetic are performed on abstract numbers.

ABSTRA'CTION. (Lat. abstraho, *I draw off.*) In Metaphysics and Logic, the faculty by which, in contemplating any object, we can attend exclusively to some circumstances or qualities belonging to it, and withhold our attention from the rest. It is by the means of this faculty that we generalise, and arrive at the common terms or predicables (*see* PREDICABLES) which belong to a number of objects. Thus, in considering a horse, by abstracting mentally the qualities which belong to that particular animal, we arrive at the notion of a quadruped, thence at that of an animal, &c. &c.; which notions constitute, in logical language, the successive genera and species of the individual horse.

ABSU'RDUM, or REDUCTIO AD ABSURDUM. A term used in geometry to denote a mode of demonstration in which the truth of a proposition is established, not by a direct proof, but by proving that the contrary is *absurd*, or impossible. There are many examples of this mode of demonstration in the Elements of Euclid.

ABU'NDANT NUMBER (Arithmetic) is a number such that the sum of its divisors is greater than the number itself Thus, 12 is an abundant number, because its divisors being 1, 2, 3, 4, and 6, their sum, which is 16, is greater than 12. An abundant number is opposed to a *deficient* number, of which the sum of the divisors is less than the number itself; and to a *perfect* number, of which the sum of the divisors is equal to itself.

ABU'TMENT. (According to some, from the French, abouth, *to abut*, among whom the learned Spelman; but according to others, with more probability, from the Saxon abutan, *about.*) In Architecture, the solid part of a pier from which the arch immediately springs. Abutments are either artificial or natural. The former are usually formed of masonry or brickwork, and the latter are the rock or other solid materials on the banks of a river, in the case of a bridge, which receive the foot of the arch. It is obvious that they must be of sufficient solidity and strength to resist the arch's thrust.

ABU'TTALS. The buttings or boundings of land, showing by what other lands, highways, rivers, &c. they are bounded.

ACA'CIA. (Gr. ακακια.) A genus of spiny leguminous trees, with pinnated leaves, and small flowers collected in balls or spikes, of a white, red, or yellow colour. They are all inhabitants of the warmer parts of the world; some of them, as A. vera, arabica, &c., yield gum arabic; others gum senegal: the bark of A. catechu furnishes the astringent substance called catechu, or terra japonica. The flowers of A. farnesiana are exceedingly fragrant, and form one of the principal ingredients in Italian perfumery. The bark of many species abounds in tanning principles. New Holland, and some other countries, produce great number of species in which true leaves are not formed, but in their stead the branches are furnished with broad dilated petioles looking like leaves.

ACADE'MICS. A name given to a series of philosophers, who taught in the Athenian Academy, the scene of Plato's discourses. They are commonly divided into three sects, which go under the names of the Old, the Middle, and the New Academy. 1. The Old Academy, of which Plato was the immediate founder, was represented successively by Speusippus, Xenocrates, and Polemo. These philosophers, as far as the scanty notices remaining of them allow us to form a judgment, seem to have confined themselves to the task of elucidating and defending the doctrines of their great master. (*See* PLATONISM.) A list of their works is given us by Diogenes Laertius, b. iv. To them succeeded Arcesilaus, the founder of (2) the Middle Academy. Under his hands, the Platonic method assumes an almost exclusively polemical character. Whatever may have been his belief regarding the positive part of Plato's doctrines, he confined himself in public to the support of the negative portion; that, namely, which relates to the uncertainty

of the impressions on the senses, and, consequently, of the judgments founded on them. His main object was to refute the Stoics, who maintained a doctrine of perception identical with that promulgated by Dr. Reid in the last century. (*See* PERCEPTION.) Socrates is said to have professed, that all he knew was, that he knew nothing. Arcesilaus denied that he knew even this. Wisdom he made to consist in absolute suspension of assent; virtue, in the probable estimate of consequences; in the latter doctrine combating the ethical dogmatism of the stoics, as in the former the intellectual. He was succeeded by Lacydes, Telecles and Evander, and Hegesinus. 3. The New Academy claims Carneades as its founder. It is not easy to define the limits between this and the Middle Academy. Like Arcesilaus, Carneades appears to have taken up a negative and polemical position. His system is a species of mitigated scepticism. He considers probability to be the sole legitimate object, alike in speculation and in practice. The doctrines of this school were adopted by Cicero, more, probably, in consequence of the advantage which, as an orator, he would derive from the practice of discussing both sides of a question, than from any solid conviction. Carneades was succeeded by his disciple, Clitomachus. Charmides, the third and last of the New Academicians, appears to have been little more than a teacher of rhetoric: an accusation, indeed, to which the whole school is in no small degree liable. To these three academies a fourth and fifth are added, by some writers: of which Philon and Antiochus are produced as the representatives. The latter was the friend of Cicero and other distinguished Romans. Neither of them can in any justice be named academics, their doctrines being, in fact, in most points, of a diametrically opposite nature.

ACA'DEMY. (Gr. ἀκαδημια.) A society of learned men, associated for the advancement of the arts or sciences. The name is derived from that of a place near Athens, where there was a famous school for gymnastic exercises (*see* GYMNASIUM), at which also philosophy was taught, and the sophists gave their lectures. But the first institution of which we read, at all resembling our modern academy, was the society of scholars established at Alexandria by Ptolemy Soter. The Jews in various cities, the Constantinopolitan emperors, and the Arab caliphs, founded societies of the same description. Charlemagne, among his various efforts for the propagation of literature, collected an association of learned men, who read and compared the works of antiquity, and gave themselves, in their academic intercourse, the assumed names of different ancient authors. But this institution was dissolved at the death of Alcuin; nor do we find any memorial of a similar society, except a few among artists, chiefly in France, until after the taking of Constantinople by the Turks, when the Greek scholars driven into Italy held literary meetings, which gradually assumed a more regular form. About 1560 a society, called the Academia Secretorum Naturæ, was founded at Naples, in the house of Baptista Porta, but was abolished by a papal interdict. It was, however, succeeded by the Academia Lynceï at Rome, of which Galileo was a member, the objects of which, like those of the former, were chiefly connected with the pursuit of natural history. From the beginning of the 17th century academies multiplied in Italy. Among the most eminent of those which bore a philosophical character, was the A. del Cimento, at Rome, in that century; the Academy of Orossano, in the kingdom of Naples, &c.: and, in more recent times, the Academy of Sciences at Bologna deserves to be mentioned with honour. But Italy has been most prolific in academies of literature and philology, which form by far the greatest number in the catalogue of 550 such institutions which have been enumerated as existing or having existed in that country. A general and somewhat ridiculous fashion prevailed in the 17th and 18th centuries among literary men of that country, of forming themselves into societies for the promotion of literary objects, to which they gave fanciful symbolic names, every member assuming in his own person some analogous appellation. Some of these societies have done real service to literature, but by far the greatest number have contented themselves with multiplying insipid addresses and sonnets. Among the most celebrated was the A. degli Arcadj, at Rome, of which the meetings were held in a meadow, and the members enacted shepherds and shepherdesses: it was founded about 1690, and still subsists, having various affiliated societies in other places. The A. degli Umidi, one of the oldest of these associations, became afterwards the Florentine Academy. The A. degli Intronati (of the Deaf), degli Umoristi (of the Humourists), and many others with similar quaint appellations, have acquired celebrity in Italy. Of her philological academies, the most illustrious is that della Crusca (of the Sieve), at Florence, which, by the publication of its dictionary, established the Tuscan dialect as the standard of the national language; it is now incorporated with the A. Florentina. In France, the Académie Française was founded in 1635 by cardinal Richelieu. It was an association formed for the purpose of refining the French language and style; and, although in its first period it was chiefly remarkable for the adulation which it bestowed on its vain though able founder, it became, in process of time, by far the most celebrated and influential of all European literary societies. It consisted of 40 members, and a place among them was eagerly sought after, for a long period, as one of the highest honours which could be attained by an author. Like that of Crusca, it published a dictionary of the French language, in 1694. The Royal Academy of Sciences was founded by Louis XIV., in 1666, and published 130 volumes of memoirs, up to the year 1793, when it was abolished by the Convention. The Academies of Painting and Sculpture, and that of Inscriptions and Belles Lettres, were the other two principal academies of Paris. The latter was founded by Colbert in 1663, and remodelled in 1701. At the Revolution all four were abolished: and, in 1795, at the suggestion of Condorcet, the National Institute of France was established in their stead. It consisted of four classes, arising out of the four academies of which it was composed. According to its re-organisation by Napoleon, in 1806, these classes were remodelled, and each of them consisted of a certain number of sections, each furnished with a specified number of acting and corresponding members. The first class, or that of sciences, had sixty-three members, and 100 correspondents; that of languages, forty, and 60 correspondents; that of history and antiquities, forty, and 60 correspondents; that of the arts, twenty-eight, and 36 correspondents. The first, third, and fourth, named each eight foreign associates. In 1816, the Institute was again remodelled by Louis XVIII. The four classes again took the name of academies, and became more independent of each other, their joint property being managed by a commission of eight members, two from each, under the superintendence of the minister of the interior. The first academy (that of sciences) retained the same number of members. The second and third were reduced to thirty-eight and thirty-seven respectively; the fourth, increased to forty. The Academy of Inscriptions and Belles Lettres, and that of Sciences, had added to them a class of free academicians, of the number of ten, with no privilege except that of attendance; the Academy of Arts had the right to choose its own number of free members.

Of similar institutions in Germany, the oldest was the Academia Naturæ Curiosorum, a scientific association, founded in 1652, in Franconia; afterwards taken under imperial protection, when it received the name of the A. Cæsareo Leopoldina. The Royal A. of Sciences, at Berlin, was founded in 1700, by Frederic I. of Prussia: Leibnitz was its first director. The Imperial Academy of Sciences at St. Petersburgh was founded by Catharine I., and endowed by Catharine II. with great munificence, but established on the French model: she separated from it the Academy of Arts.

In England, the name academy has been chiefly confined to associations for promoting the arts. The Royal Academy of Arts was founded in 1768, and consists of forty members: it has separate professors of painting, architecture, anatomy, and perspective; and a council of nine is elected annually. The Academy of Ancient Music was founded by private association, in 1710: the Royal Academy of Music, under the patronage of George III., but dissolved shortly after. Our principal literary and philosophical societies, answering in character to the branches of the French Institute, are, 1. The Royal Society of London, which is confined to objects of a scientific character. It had its origin as early as 1645, but was established by royal charter in 1662. Its acts have been published, under the name of Philosophical Transactions, from 1665 to the present day. 2. Those of the Antiquarian Society, which was established in 1751, are published under the title of Archæologia. 3. The Royal Society of Arts originated in 1718. 4. That of Literature, in 1823. Besides these, there are numerous societies which bear the name of the peculiar branch of science to which their exertions are confined. The Royal Society of Edinburgh obtained a charter in 1783, and another, with more liberal provisions, in 1811. Among the most valuable published transactions of academies and similar societies, besides those already mentioned, are those of Colbert's A. des Inscriptions et Belles Lettres (50 vols. 4to. from 1701 to 1793): those of the Institute, being continuations of the memoirs of the former academies of which it was composed: those of the A. Royale des Sciences and Belles Lettres at Berlin; at first in Latin, then in French (from its remodelling in 1744 by Frederick the Great), now in German. The "Acta" of the Imperial Academy of St. Petersburgh. The "Commentarii" of the A. of Bologna. The Antichita d'Ercolano, published by the Herculanean Academy of Naples.

ACADEMY. In the sense of a place of instruction, is now in this country a term chiefly appropriated to schools for students in the fine arts. The fourth division of the Institute at Paris consists of the Académie

des Beaux Arts. In London, an Academy of Painting seems to have been established in 1712, under the presidency of Sir G. Kneller, but to have shortly after fallen into decay. The present Royal Academy of Arts, founded in 1768, has been already mentioned. In France the old universities were suppressed at the Revolution; but most of them, with some recent ones, have since been restored under the title of *Académies Universitaires*. Their collective body, represented by the re-union of their rectors, inspectors, deans, &c., constitutes the University of France, at the head of which is the Minister of Public Instruction. Colleges in France are equivalent to high schools in this country.

ACADEMY FIGURE. In Painting. A drawing usually made with black and white chalk, on tinted paper, after the living model,

ACALE'PHANS, Acalephæ. (Gr. *ακαλη*φη, *a nettle*.) A class of radiate invertebrate animals, so called on account of the singular property possessed by most of the species therein comprehended, of irritating and inflaming the skin when touched. The class includes the animals called 'medusæ,' 'sea-nettles,' 'jelly-fish, 'Portuguese men-of-war,' &c.; these are divided by Cuvier dichotomously into those which have air-bladders for swimming, or the 'hydrostatic acalephans,' and those which have not, or the 'simple acalephans,' and which swim by means of external cilia, or by the contractions and dilatations of their gelatinous body. All the species are aquatic and marine.

ACA'MPTOSO'MES. (Gr. *ἀ*, *without*, *καμπ*τω, *I bend*, *σωμα*, *the body*.) An order of cirripeds including all those in which the body is entirely enveloped in a calcareous compound shell, and so attached that it cannot be unfolded and protruded.

ACANTHA'CEÆ. (*See* ACANTHUS.) A natural order of monopetalous exogenous plants, in which the genus acanthus is stationed. They have irregular didynamous flowers, and are particularly known by their calyx being imbricated in two broken whorls, and by their seed growing from hooks on the placenta. Many of this species have beautiful flowers, others are mere weeds. They are found wild only in hot or temperate climates.

ACA'NTHIA. (*See* ACANTHUS.) The name of a genus of hemipterous insects of the tribe *Geocorisæ*, characterised by a long and straight rostrum, sheathed at its base, or through its entire length; labrum very prominent; eyes of large size; and the head presenting, at its junction with the thorax, neither a neck nor a sudden constriction. In some of the species (subgenus *Syrtis*) the anterior pair of legs terminate in a monodactyle chela, or forceps claw, like that of the crustacea, adapted for seizing a living prey.

ACA'NTHOCE'PHALANS, Acanthocephala. (Gr. *ἀκανθος*, *a thorn*, and *κεφαλη*, *a head*, *spiny-headed*.) An order of intestinal worms, or entozoons, which attach themselves to the mucous coat of the intestines by means of a proboscis surrounded with minute recurved spines.

ACA'NTHOPHIS. (Gr. *ἀκανθος*, *spine*, and *οφις*, *serpent*.) A genus of venomous serpents, allied to the viper, peculiar to Australia, and characterised by a horny spine, simulating a sting, at the end of the tail.

ACA'NTHOPODS, Acanthopoda. (Gr. *ακανθος*, and *τους*, *a foot*, *spine-footed*.) This name is applied to a tribe of clavicorn coleopterous insects, including those species which have spiny legs.

ACA'NTHOPTERY'GIANS, Acanthopterygii. (Gr. *ακανθος*, and *πτερυξ*, *a wing or fin*, *spiny-finned*.) Cuvier's first order of fishes, characterised by the bony spines which form the first rays of their dorsal and anal fins, and generally, also, the first ray of the two ventral fins.

ACA'NTHU'RUS. (Gr. *ακανθος*, *a spine*, and *ουρα*, *a tail*.) A genus of spiny-finned fishes, characterised by trenchant and serrate teeth, and by having a strong movable spine, sharp as a lancet, on each side of the tail, by means of which these fishes have the power of inflicting very severe wounds.

ACA'NTHUS. (Gr. *ακανθος*, *a spine*.) A spiny herbaceous plant with pinnatifid leaves, and large whitish flowers enveloped in spiny bracts, found in various parts of the Levant. Its leaf is said by Vitruvius to have been the model on which the architects of Greece formed the leaves of the Corinthian capital, and that the idea of so applying it was derived from the following circumstance:—The leaves of acanthus grow in a tuft close to the ground, and sprout annually. It happened that a basket covered with a tile was left upon the crown of the root of an acanthus plant, which, when it began to grow in the spring, finding itself unable to arrange its leaves in the usual manner, turned them up round the sides of the basket, till encountering the edges of the tile, they gradually curved back in a kind of volute. Other leaves, besides those of the acanthus, are employed in the decoration of capitals; those, for instance, in the composite order of the arches of Titus and Septimius Severus, at Rome, have, from their strong indentations, more resemblance to parsley than to acanthus leaves, whilst those to the Temple of Vesta, at Rome, have a resemblance to laurel leaves. In Egyptian architecture, the palm leaf frequently occurs.

ACA'RDIA. (Gr. *ἀ*, *without*, and Lat. cardo, *hinge*.) A term applied to a genus of fossil ostracean bivalves, in which the hinge is wanting, and the flat valve is applied to the convex valve, like a lid to a vessel; the two having been connected only by the adductor muscle.

A'CARI. (Gr. *ακαρι*, *a mite*.) In Entomology the term is restricted to the tracheary arachnidans which have, either a single-jointed chelicer, or pincer representing an antenna, or a suctorious mouth. All the species are extremely minute, or even microscopic, as the cheese-mite (*Acarus domesticus*), and many of them parasitic; of the latter, the itch-insect (*Sarcoptes scabiei*) is a remarkable example. The mites are active insects, and possess great powers of life, resisting for a time the application of boiling water, and living long in alcohol.

ACCE'DAS AD CU'RIAM. In Law, the title of a writ which removes a plaint from an inferior court, generally the county court, as the issuing of which is a preliminary to trying a question of right upon a distress of goods by the proceeding called REPLEVIN (which see).

ACCELERA'TION. (Lat. acceleratio, *hastening*.) In Mechanics, an increase in the velocity of bodies in motion. Acceleration is uniform or variable, according as the force by which the motion is produced acts regularly or irregularly.

The most familiar instances of uniformly accelerated motion, are those which are occasioned by the earth's attraction, and are exhibited in the falling of heavy bodies, or their descent along inclined planes. In both these instances, the observer cannot fail to perceive that the velocity becomes greater as the body falls from a greater height, or continues a longer time in motion. In order to explain the theory of acceleration from the action of gravity, it is necessary to recollect that, in virtue of the inertia of matter, a body always perseveres in its state of rest, or of uniform motion in a straight line, till, by some external influence, it is made to change its state. This is Newton's first law of motion, which is admitted as a principle or axiom in mechanics, and from which it follows, that as a body cannot accelerate its own motion, any change in the rate of velocity of a moving body must arise from the action of an extraneous force. Now, suppose a body to be carried to a considerable height above the earth, and abandoned to the action of gravity; and let us examine the circumstances which take place. In this supposition, gravity may be regarded as a force acting uniformly; for, though its intensity diminishes as the distance from the centre of the earth increases, yet any height to which we can reach is so small, compared with the radius of the earth, that the variation in the intensity of gravity depending on it may be disregarded. Let the time which the body takes to fall to the earth be divided into equal and small intervals. During the first interval an impulse is given to the body, and a certain motion is communicated. If gravity now ceased to act, the body would continue to descend uniformly with the velocity it had acquired; but the impulse is renewed with exactly equal vigour during the second interval, and, consequently, the velocity of the body is exactly doubled. The same thing is repeated in the third interval, and, consequently, the velocity of the body is then tripled. In the fourth interval it is quadrupled, and so on; the body continually receiving, during equal and successive intervals of time, equal increments of velocity from the action of the accelerating force, and preserving its acquired velocity in consequence of its inertia. Hence we infer the first great law of uniformly accelerated motion, namely, the velocity at any given moment is proportional to the number of impulses that have been received, or to the number of intervals that have elapsed since the commencement of the motion; in other words, *the velocity is proportional to the time*.

Let us now consider the spaces passed over by the falling body. Suppose the space through which the body falls during the first interval, or second of time, to be one pole. As the velocity is supposed, at the commencement of the motion, to be nothing, and to increase uniformly during the interval, it is evident that the space passed over will be the same as if the body had continued during the interval to move uniformly with the mean velocity, or the velocity it had at the middle of the interval. But the velocity has been shown to be proportional to the time. Hence, at the end of the first second the velocity is the double of what it was at the middle of the second; and, therefore, if gravity ceased to act, the body, during the second interval or second, would descend through two poles. In consequence, however, of the renewed action of gravity, the body receives a fresh impulse during the second interval equal to that which it received during the first, and is, consequently, carried through a space equal to one pole, in addition to that

through which it is carried by its previously acquired velocity. Hence, during the second interval the body falls through three poles. At the end of this time the velocity is the double of what it was at the end of the first interval, and, consequently, during the next second would carry the body through four poles. Add, again, the effect of the renewed impulse, and the space passed over by the body in the third second is five poles. In the same manner, we find the space passed over in the fourth second to be seven poles; in the fifth, nine poles, and so on; the spaces described in the successive seconds being proportional to the series of odd numbers, 1, 3, 5, 7, 9, 11, &c. Adding, therefore, these numbers successively, we shall have the spaces passed over, since the commencement of the motion, represented by the series of square numbers, 1, 4, 9, 16, 25, 36, &c. Whence the second great law of uniform acceleration, namely, *the spaces described are proportional to the squares of the times.*

Galileo was the first who discovered the laws of acceleration of falling bodies. He supposed the acceleration to take place by equal degrees, or to be uniform; and experiment has confirmed his hypothesis. (*See* GRAVITY, GRAVITATION.)

What has now been said, with respect to motion uniformly accelerated, applies equally (*mutatis mutandis*) to motion uniformly retarded. It will also be perceived that the effect of the resistance of the air has been neglected.

ACCELERA'TION OF THE FIXED STARS denotes the apparent greater diurnal motion of the fixed stars than of the sun; in consequence of which they daily come to the meridian of any place at an earlier hour of the solar day than they did on the day preceding. Thus, a star which to-day passes the meridian at six o'clock, mean time, will pass the meridian to-morrow three minutes and fifty-six seconds before six o'clock. The reason of this is, that the sun, which appears to make a complete revolution of the heavens, from west to east, in the course of a year, advances daily nearly a degree eastward among the stars; and the apparent diurnal motion, being from east to west, the sun's passage over the meridian is retarded daily about three minutes and fifty-six seconds of time, in respect of the stars. But our clocks are regulated by the sun; consequently, in reference to them, the daily transit of the stars over the meridian is accelerated. (*See* DAY, SIDEREAL.)

ACCELERA'TION OF THE MOON. An increase of the mean angular velocity of the moon about the earth; in consequence of which, the time of her mean periodic revolution is somewhat shorter than it was many centuries ago. This acceleration is exceedingly small, amounting only to about ten or eleven seconds of a degree in a century. It was discovered by Dr. Halley, from a comparison of very ancient with modern observations, and was confirmed by an examination of the observations of the Arabians in the 9th and 10th centuries. Its physical cause long occasioned great perplexity to mathematicians, and was at length detected by the genius of Laplace. It depends on a very slow secular diminution of the eccentricity of the earth's orbit. One of the greatest discoveries in physical astronomy is, that all variations in the elements of the planetary system are periodic. Some centuries after the present time, the eccentricity of the earth's orbit will arrive at its minimum value, and then begin to increase. When this period arrives, the mean motion of the moon, which for many centuries has been accelerated, will begin to be retarded. (*See* PERTURBATION.)

ACCELERA'TION OF THE PLANETS. The motion of a planet in its orbit is variable, being quicker or slower, according as the planet is at a less or a greater distance from the sun. Hence, in moving from the apogee to the perigee of the orbit, the motion of a planet is accelerated; and, on the contrary, in moving from the perigee to the apogee, the motion is retarded.

A'CCENT. (Lat. ad, *to*, and cano, *I sing.*) In ordinary language, the greater or less stress laid in pronouncing on each syllable of a word is termed the accent of that syllable. But the accent of a Greek syllable is a species of tone, respecting which very contradictory notions prevail among modern commentators, and of which it is indeed difficult to form any accurate conception. The history of the employment of accentual marks in writing the Greek language, is extremely obscure. They are found in manuscripts of considerable antiquity. In our pronunciation of Greek, they are wholly neglected, quantity being our only guide in the stress which we lay on the syllable of each word. But the modern Greeks pronounce their language, in general, laying the stress on the accented syllables, and neglecting the quantity. The mark of the acute accent is ′; of the grave ‵; of the circumflex, which is a compound of the other two, ^, or ~. But every syllable which has no accentual mark is said to have the grave accent; the grave being only marked on final syllables of words which have no acute accent on any syllable. These three accentual marks are also employed in the French language; but in it they are only employed, for convenience, to mark a difference in the pronunciation, not in the accent; the modifications of the vowel sounds not being all of them expressed by distinct letters.

ACCENT. In Music, a certain stress or forced expression laid on certain parts of a bar or measure.

ACCE'NTOR. A genus of seed and insect-eating passerine birds, of which the hedge-chanter, or as it is commonly called, the hedge-sparrow (*Accentor modularis*), is a well known example.

ACCE'PTANCE. *See* BILL OF EXCHANGE.

ACCE'PTOR. (Law.) *See* BILL OF EXCHANGE.

A'CCESSARY. (Lat. accedo, *I approach.*) In Law, an accessary to an offence is one who is not the chief actor, or present at its performance, but is concerned therein, either before or after the fact. An accessary before the fact, is one "who, being absent at the time of the crime committed, doth yet procure, counsel, or command another to commit a crime." An accessary after the fact, is one who, knowing that a felony has been committed by another, receives, relieves, comforts, or assists the felon. (*See* LAW, CRIMINAL.)

ACCESSARY, or ACCESSORY. (Fr. *accessoire*). In Painting, and the fine arts, is a term which extends to every thing introduced into a work that is not absolutely necessary. In an historical picture, for instance, the figures which are in action are the principal objects; by them the story is told, all the rest are accessories. Especial care is to be taken, that they be so selected and disposed, as not to interfere with the principal group; hence the ancient painters and sculptors were very shy of using them, lest the eye should be drawn away from the principal group, and its interest be thus lessened or destroyed.

ACCE'SSION. In international law, the act by which one power enters into engagements originally contracted between other powers. The accession of a sovereign is the period at which he assumes the sovereignty, and in hereditary monarchies takes place immediately on the decease of his predecessor.

ACCIA'CCATU'RA. (It. acciaccare, *to squeeze.*) In Music, a grace note, one semitone below that to which it is prefixed or, as it were, squeezed in.

A'CCIDENS, *per accidens.* A term used by the older philosophers to denote an effect not following from the nature or essence of the thing, but from some accidental quality. It is opposed to *per se.* Thus, fire burns *per se;* heated iron burns *per accidens.*

A'CCIDENT. In Logic, one of the predicables: in its strictest logical sense, it is that which may be absent from or present in the subject, the essence of the species to which the subject belongs remaining the same. Thus, it may be predicated of a man, that he is "walking," or that he is "a native of Paris:" the first of which examples expresses what is termed a separable accident; the latter, an inseparable; i. e. the individual may cease to walk, but cannot cease to be a native of Paris: but neither of these alter the species, man, to which the individual belongs. But it is to be observed, with regard to the accident, as well as the other predicables, that they exist only relatively to each other; so that the same quality may be accidental when predicated of the species, which is a property when predicated of the individual. Thus, "malleability" is an accident of the subject "metal," because many metals are not malleable. But it is one of the properties of gold, iron, &c., as distinguishing these from the non-malleable metal. (*See* PREDICABLE.)

ACCIDE'NTAL COLOURS. Colours depending on some affection of the eye, and not belonging to light itself, or any quality of the luminous object. If we look for a short time steadily with one eye upon any bright-coloured spot, as a wafer on a sheet of paper, and immediately after turn the same eye to another part of the paper, a similar spot will be seen, but of a different colour. If the wafer be red, the imaginary spot will be green; if black, it will be changed into white, the colour thus appearing being always what is termed the complementary colour of that on which the eye was fixed.

ACCIDE'NTAL POINT. Perspective. The point in which a straight line drawn from the eye, parallel to another straight line, cuts the perspective plane. It is the point in which the representations of all straight lines parallel to the original straight line concur when produced. It is called the accidental point, to distinguish it from the principal point, or point of view.

ACCIDE'NTALS. (Lat. accidentalis, *happening by chance*). In Painting, are those fortuitous or chance effects, occurring from luminous rays falling on certain objects, by which they are brought into stronger light than they otherwise would be, and their shadows are consequently of greater intensity. This sort of effect is to be seen in almost every picture by Rembrandt, who used them to a very great extent. There are some fine instances of accidentals in Raphael's Transfiguration, and particularly in the celebrated picture, the *Notte* of Coreggio, in which the light emanates from the infant Christ. With these effects may be classed such acci-

dental lights as those from a forge or a candle, or some such object, of which the use is extremely important to the painter of still life.

ACCIDENTALS. In Music, are those flats and sharps which are prefixed to the notes in a movement, and which would not be considered so by the flats and sharps in the signature.

ACCI'PITRES. (Lat. accipiter, *a hawk*) The name of the Linnæan order, including the birds of prey.

ACCLI'MATISE. (Lat. ad, *to*, and clima, *a climate*.) The art of cultivating exotic plants so as to inure them to a climate different to that which is natural to them. An acclimatised plant or animal differs from a naturalised one, in always requiring the assistance of art for its continuance in the adopted climate; the naturalised plant or animal continuing its kind without any care from man. The capacities of different plants and animals for being acclimatised, or naturalised, vary, but not to the extent that at first sight may be imagined; what passes under these terms being frequently nothing more than the fortunate discovery that some plant or animal, which had hitherto been found in a warm climate, would thrive equally well in a cold one.

ACCOLA'DE. (Lat. ad, *to*, and collum, *the neck*.) The slight blow given to the neck or shoulder, on dubbing a knight.

ACCO'MPANIMENT. In Music. The instrumental part of a composition which moves with the voice, to which it is to be kept subordinate. Also, the parts which in a concerted piece move with a particular instrument, whose powers it is the object of the composition to exhibit.

ACCOMPANIMENT. In Painting. Any object accessary to the principal subject, and serving to its ornament or illustration.

ACCO'MPLICE. In Law, is defined to be one of many concerned in a felony. (*See* ACCESSARY, APPROVER.)

ACCO'RD. (*See* CONCORD.)

ACCOU'NTANT-GENERAL. The principal or responsible accountant in the offices of Excise and Customs, India House, Bank of England, &c. The accountant-general of Chancery is an officer appointed by act of parliament to receive all the money lodged in court. He keeps his account with the Bank of England, which is responsible for all the sums lodged there by him.

ACCRE'SCIME'NTO. (It. accrescere, *to increase*.) In Music, the increase, by one half of its original duration, which a note gains by having a dot appended to the right of it.

ACCU'MBENT. (Lat. accumbere, *to lie down*.) Is a term applied, in botany, to cases where one part of an organ is applied to another by its edge; it is chiefly used in contradistinction to *incumbent*, where one part is applied to another by its back or face. These terms are principally employed among brassicaceous (cruciferous) plants.

ACCU'SATIVE CASE. That inflexion of the noun which expresses the passing over of an action from one substance to another: it consequently follows verbs active in all languages. In English it survives only in pronouns; and is used after all prepositions without distinction. (*See* GRAMMAR.)

ACE'PHALANS, Acephala. (Gr. ακεφαλος, *headless*.) A term applied to a class of molluscous animals, comprehending those which are without a head. The class is subdivided, according to the modifications of the respiratory organs, into the 'Lamelli-branchiate,' 'Pallio-branchiate,' and 'Hetero-branchiate,' or tunicate orders. (*See* those words.) The oyster, lamp-cockle, and squirter, or ascidia, are their several representatives. In the system of Cuvier it includes only the lamelli-branchiate and hetero-branchiate orders, or the acephala testacea, and the acephala nuda.

ACE'PHALOPHO'RES, Acephalophora. (Gr. ἀκεφαλος, and φερω, *I bear*.) The name given by Blainville to a class of molluscous animals corresponding to the acephala and brachiopoda of Cuvier.

ACE'PHALOUS. A botanical term, occasionally employed to designate ovaries, the style of which springs from their base, instead of their apex, as in lamiaceæ.

ACEPHALOUS. In Anatomy, is applied to those malformed fœtuses which are without a head.

A'CER. (Celt. ac, *a point*; Lat. acer, *sharp*. Pikes were made from the wood.) A genus of hardy trees, comprehending the common maple, the sycamore, and various kinds of American maples. Their wood is not of much value, being usually light and perishable; but the knotted parts of Acer campestre furnish the pretty bird's-eye maple of cabinet makers. The sap of Acer saccharinum is so sweet that sugar, of good quality, is prepared from it in North America. Acer platanoides, the Norway maple, is one of the best trees for planting in places exposed to the sea air.

ACERA'CEÆ (*see* ACER), or ACERINEÆ. A small natural order of polypetalous exogenous plants, comprehending the genus acer, and three others. It consists of trees, or at least of woody plants, inhabiting the temperate parts of the world; their most essential character consists in their samaroid dicarpellary fruit, connected with a broken whorled calyx, and unsymmetrical flowers without scales at the base of the petals. The uses of the order are the same as those of acer.

A'CERANS, Acera. (Gr. ἀ, *without*, and κερας, *a horn*.) A name applied to a family of apterous insects, characterised by the absence of antennæ: and to a family of gastropodous mollusks, including those species which have no tentacles.

A'CERIC ACID. (Lat. acer, *the maple*.) An acid obtained from the sap of that tree.

ACERO'SE. This word literally means chaffy (Lat. panis acerosus, *chaffy* or *brown bread*). Botanists apply the term to leaves of a narrow, stiff, and pungent nature, like those of fir trees.

ACETA'BULUM. (Lat. *a little cup*, or *dish*.) A term applied to the suckers on the arms of the cuttle-fish, and other dibranchiate cephalopods, which have been, hence, recently termed *acetabulifera*. These suckers were called by Aristotle *kotuloi*, which Taylor has erroneously rendered 'joints,' in the English translation of the History of Animals. In anatomy, *acetabulum* signifies the cavity of the hip-joint. In entomology it is the socket on the trunk in which the leg is planted.

ACETA'RIOUS PLANTS. (Lat. acetaria, *a salad*.) Plants used in salading; such as lettuce, mustard and cress, endive, &c.

ACE'TATES. Salts containing acetic acid. (*See* VINEGAR.)

ACE'TIC ACID. The pure acid contained in vinegar. It is a pungent acrid liquid; its odour, when diluted, is agreeable and refreshing; when perfumed, it is known under the name of *aromatic vinegar*.

ACHÆ'AN LEAGUE. A confederacy which existed from very early times among the twelve states of the province of Achaia, in the north of the Peloponnesus. It was broken up after the death of Alexander the Great, but was set on foot again by some of the original cities, B. C. 280, the epoch of its rise into great historical importance; for from this time it gained strength, and finally spread over the whole Peloponnesus, though not without much opposition, principally on the part of Lacedæmon. It was finally dissolved by the Romans, on the event of the capture of Corinth by Mummius, B. C. 147. The two most celebrated leaders of this league were, Aratus, the principal instrument of its early aggrandisement; and Philopæmen, the contemporary and rival, in military reputation, of Scipio and Hannibal. (*See* Polybius, i. ii. Pausanias, l. vii. Schlosser's Universal History. Clinton's Fasti Hellenici.)

ACHÆ'NIUM, or ACHENIUM. (Gr. ἀ, *without*, and χαινω, *I gape*.) A small bony fruit, containing a single seed, which does not adhere to the shell or pericarp, nor open when ripe.

ACHA'TMA. A genus of terrestrial gastropods, known by the trivial name of agate-snails: characterised by an oval oblong ventricose shell, striated longitudinally; with the aperture ovate and never thickened or reflected, and a smooth, straight columella, truncated at the base. All the species are oviparous, and one, the *Achatma zebra*, produces eggs with a hard, white, calcareous shell, and as large as those of the sparrow.

A'CHERON. (Gr. αχος, *grief*.) The river of sorrow which flowed round the infernal realms of Hades, according to the mythology of the ancients. There was a river of Thesprotia, in Epirus, of the same name, and also one in Italy, near which Alexander, king of the Molossi, was slain; both of which, from the unwholesome and foul nature of their waters, were supposed to communicate with the infernal stream.

ACHIE'VEMENT. (Fr. achever, *to accomplish*.) In Heraldry, denotes generally a shield of armorial bearings; but is more particularly applied to the funeral shield, commonly called hatchment, affixed to the dwelling-house of a recently-deceased person. The achievement is various, according not only to the rank of the deceased party, but to his situation as single, married, or widower.

ACHLAMY'DEOUS. (Gr. ἀ, *without*, and chlamys, *a tunic*.) Plants which have neither calyx nor corolla, and whose flowers are consequently destitute of a covering, or naked.

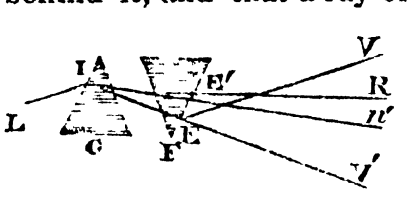
ACHROMA'TIC. (Gr. ἀ, *without*, χρωμα, *colour*.) Free from colour.

ACHRO'MATISM. The destruction of the primary colours which accompany the image of an object seen through a prism or lens. Light is not homogeneous, but compounded of rays unequally refrangible, and differing from one another in other physical properties. In passing into a refracting medium, some of the rays are more refracted, or bent out of their course, than others; whence the image of an object, seen through a lens, is rendered confused and indistinct, and appears encircled by a coloured ring. This circumstance presented a formidable obstacle to the use of the telescope; and, accordingly, soon after the invention of that admirable instrument, the utmost efforts

of mathematicians and artists were exerted to remove the imperfection. The compound nature of light, and, consequently, the theory of unequal refrangibility, were, however, not known till the time of Newton; and after the true source of the difficulty had been made known, it continued for a long time to be believed that achromatism was impossible, or that light could not be deflected without being decomposed. Newton himself was conducted to this conclusion by imperfect experiments. Subsequent discoveries have proved that the conclusion was erroneous, and that the rays of light may be bent without being separated; but, after all, the progress that has been made in the arts, as well as in the theory of colours and light, the subject of achromatism continues to be one of the most delicate and embarrassing, both in regard to theory and practice.

The principles on which achromatism is effected, may be briefly explained, as follows. On observing the spectra formed by prisms of different substances, it is soon perceived that the different colours, though always ranged in the same order, do not occupy the same relative lengths. A prism of flint glass, for example, exhibits proportionally less red, and more violet, than a prism of crown glass; and, in some other substances, the difference is still more remarkable. Hence it follows, that the primary coloured rays, in passing through different substances, do not undergo the same relative refractions; that is to say, the angle formed by two rays, the red and the violet, for example, is greater when the light is refracted by some substances than when it is refracted by others, though in all substances the violet is more refracted than the blue, the blue more than the green, and so on. The angle formed between the extreme rays of the spectrum measures the *dispersion* of the rays; and it is found by experiment that the dispersive power of common flint glass is to that of crown glass in the ratio of about 3 to 2; so that if a prism of flint glass give a spectrum three inches long, a similar prism of crown glass will give a spectrum of only two inches.

Now, suppose a prism of crown glass, C, the faces of which make an angle of 25°, and a prism of flint glass, F, of 20° 21′ 43″, to be placed behind it, and that a ray of direct or white light, L I, falling on the first prism at I, emerges from the second between the points E and E′. It is known by experience, that when the angles of the two prisms are as above stated, the violet ray E V, on emerging from the second prism, is parallel to the incident ray L I; and that the red ray E′ R must fall below E V, because the red ray only emerges parallel to the incident ray when the angle of the prism of flint glass is 20° 56′ 28″. But if the prism of flint glass were removed, or, which would be the same thing, if its sides became parallel, and, consequently, its angle = 0, the red ray E′R′ would fall above the violet ray E V′, the violet being more refrangible than the red. While the angle F, therefore, increases from 0° to 20° 56′ 28″, the emerging rays E′ R and E V change their relative positions; whence it follows, that at some intermediate angle of the prism F they will be parallel, and this is the angle of achromatism. It is found by experience to be 11° 58′ 3″; varying, however, between narrow limits according to the peculiar constitution of the two refracting substances; and, therefore, in determining the ratio of the angles of the two prisms, recourse must generally be had to particular experiments on the individual substances of which the prisms are composed.




The achromatism of lenses depends on the same principles, and is determined in the same manner, as that of prisms; but in the case of lenses, the compensation is attended with great practical difficulties, on account of its being necessary to have regard to the spherical aberration.

If the ratios of the dispersion of the different spectral colours were all equal, the achromatism would be perfect when the extreme rays, or, indeed, any two rays, emerge parallel. This, however, is not generally the case; these ratios are in general variable, and, therefore, the angle which renders the red and violet rays parallel is not that which is required for the intermediate colours. It is possible, however, to remedy this defect, by combining a greater number of prisms or lenses. Theoretically speaking, indeed, the number of rays united or rendered parallel is the same as the number of prisms. The achromatic object-glasses of telescopes formerly made in this country, were generally triple; that is to say, consisted of three lenses, namely, a concave lens of flint glass placed between two lenses of crown glass: but almost all the large object-glasses lately constructed consist of only two lenses; the achromatism produced by this combination, though not rigorously exact, being sufficient for optical purposes.

The possibility of refracting light without producing colour was discovered and experimentally proved by Mr. Hall, a country gentleman of Worcestershire, under





whose directions an achromatic telescope was made by a London artist in 1733. But, from whatever cause, no notice was taken of Hall's discovery; indeed, it appears to have been entirely forgotten, and contributed nothing whatever to advance subsequent researches. The merit of the discovery of achromatic compensation belongs to John Dollond, who arrived at it through a long course of skilful and systematic experiments undertaken for the express purpose. Its possibility had, indeed, been previously asserted by the celebrated Euler, who, reasoning from the construction of the eye, which, indeed, is a perfect achromatic instrument, proposed various hypotheses for destroying the coloured images. After Dollond's discovery, the subject was examined theoretically by Euler, Clairaut, and D'Alembert, but their profound mathematical investigations led to no practical improvement. The object-glasses made by Peter Dollond (a son of the inventor) were long celebrated throughout Europe as the best that were manufactured. Of late years, however, the science of light has been vastly extended; and the discoveries of Fraunhofer, in particular, have opened up an entirely new view of the composition of the spectrum. The largest and best achromatic glasses have recently been made in Bavaria and Switzerland. (See Chromatics, Refraction.)

ACI′CULAR. (Lat. acicula, *a needle*.) Any thing that is slender, sharp-pointed, and rather stiff; as many kinds of prickles on the leaves of plants, &c.

A′CID. In common language, any *sour* substance; in chemistry the term is less restricted, and often applied to all substances which saturate and neutralise the alcalies and other salifiable bases, without other obvious acid properties.

ACIDIFI′ABLE. Convertible into an acid.

ACI′DULOUS. *Dim.* of acid. Subacid; a term frequently applied to mineral waters containing carbonic acid.

ACI′NACIFORM. (Lat. acinaces, *a scimitar*, and forma, *shape*.) A name applied to certain succulent leaves and fruits, which resemble the blade of a curved sword or Turkish scimitar.

A′CINUS. (Gr. ἄκινος, *the stone of a grape*.) The separate carpels of a succulent fruit consisting of many carpels; as the raspberry. This term is also applied in anatomy to a cluster of the ultimate secerning follicles of certain conglomerate glands; as the liver.

ACIPE′NSER. (Lat. acipenser, *a sturgeon*.) The name of a Linnæan genus of the amphibia nantes, characterised by solitary, lateral, linear gill-openings; the mouth situated beneath the head, retractile and edentulous, feelers under the snout, in front of the mouth. The sturgeon (acipenser sturio), and most of the other amphibia nantes of Linnæus, form the order chrondropterygii, cartilaginous fishes of Cuvier. The genus acipenser is separated by Agassiz from the other cartilaginous fishes. It forms a link between the osseous and cartilaginous fishes, having its gills protected by an operculum, and only a single issue, or gill-opening, on each side for the respiratory currents; but at the same time having the rays to the branchiostegal membrane, and having the whole of its true internal skeleton in a cartilaginous state. By Cuvier, therefore, the genus acipenser is placed in the cartilaginous division of fishes, but separated from the rays, sharks, and lampreys, which have five or more gill-openings on each side, to form, along with the genera spatularia and chimæra, the order eleuthero-branchiata, or those which have the branchiæ free at the outer circumference. In the system of Agassiz the sturgeons are joined with the sauroid fishes, siluri, polypterus, and some other genera, to form the order Ganoidei (*See* that word.) And it is worthy of observation, that the polypterus (a ganoid fish of the Nile) has a spiral valve in the intestine like that of the sturgeon.

There are several distinct species of acipenser in the Danube, and other great rivers of Europe; but that which is occasionally caught on our east coast, and commonly brought to the London market, is the Acipenser Sturio of Linnæus, or the common sturgeon.

The largest specimen ever caught in this country was probably, that which is recorded by Pennant as having been taken in the Esk, and which weighed four hundred and sixty pounds.

In England the sturgeon is considered a royal fish, and its use is exclusively as an article of luxury for the table; its flesh, like that of most cartilaginous fishes, is firmer than is usual among osseous fishes, and having little peculiar flavour of its own, affords ample scope for the skill of the cook in imparting to it an extrinsic zest.

In the northern parts of Europe this fish is much more numerous than in the British rivers, and extensive fisheries are established for its capture. The best isinglass is manufactured from the sound, or air-bladder; and caviare is prepared from the roe of the female.

ACKNOW′LEDGEMENT-MONEY, in Law, payment according to the custom of some manors by copyhold tenants, on the death of a lord.

A′CME. (Gr. ἀκμή, *a point*.) In Rhetoric, the extreme

height, or farthest point of pathos, or sentiment, to which the mind is judiciously conducted by a series of impressions gradually rising in intensity. (*See* CLIMAX.)

ACO'LOGY, or AKOLOGY. (Gr. *ἀκος*, *a remedy*, and *λογος*, *a discourse*.) The doctrine of remedies, or of the materia medica.

A'COLYTE. (Gr. *ακολουθος*, *disciple*.) The second of the inferior orders of clergy in the primitive church, according to the Roman Catholic authorities. The Council of Trent declares the inferior orders to be five—subdeacons, acolytes, exorcists, readers, and doorkeepers; considering them all to be of apostolical institution. By the Protestants they are supposed to be merely occasional or local officers. The office of the acolytes, according to the Roman Catholic Catechismus ad Parochos, is to follow and serve the superior orders, the subdeacons and deacons, in the ministry of the altar. Besides this, they carry lights when the sacrifice of the mass is celebrated, whence they are called also ceroferarii (wax-bearers).

ACONI'TA, ACONITINA. A poisonous vegetable principle or alkaloid extracted from the aconite.

A'CONITE. (Acone, a place in the Crimea famous for its poisonous herbs.) A genus of exogenous plants belonging to the natural order ranunculaceæ, with showy purple or yellow helmet-shaped flowers, growing in panicles, deeply cut leaves, and perennial roots of a highly poisonous nature. Those of Aconitum lycoctonum are used for the destruction of wolves, and of A. napellus for certain medicinal purposes; they are exceedingly acrid, and act as violent drastic purgatives. The bish root, with which the natives of Nepal poisoned their wells, during the advance of the British army into their territory, during the last war, was furnished by Aconitum ferox. The name aconite has also been given to another plant related to the original genus, namely, eranthis hyemalis, or winter aconite.

ACO'NTIA. (Gr. *ἀκων*, *a dart*.) A genus of non-venomous ophidian reptiles, allied to the snakes proper (anguis), but destitute of the bony rudiments of the scapular and pelvic arches. They are known by the trivial name of "Dart-snakes;" are numerous in species, and distributed over the warmer and more arid parts of the old world. They were the subjects of fabulous accounts by the ancient naturalists and poets, who attributed to them the power of projecting themselves with so much force and velocity as to transfix the object aimed at, like a hurled javelin, or arrow shot from a bow. This is as untrue as the assertion that they are venomous. The Dart-snakes are amongst the most harmless of their order; their food consists of small worms, insects, and larvæ.

ACORA'CEÆ, or ACOROIDEÆ. The natural order of plants which includes the genus acorus. It is distinguished from araceæ only by having its carpels separate, and its leaves in the bud state arranged in an equitant manner.

A'CORN. (Accorn, Sax. of aac, *an oak*, and cern, *grain*.) The well-known fruit of the oak, and therefore not a term of art, though belonging to architecture from its use as an ornament. In the early ages acorns constituted a principal part of the food of man. (Ovid. Metamorph. i. 106.; Virgil, Georg i. 8. &c.) At present they are occasionally used in different parts of the Continent during scarcities; but in England they are never used, except for the feeding of pigs, poultry, &c.

A'CORUS. (Gr. *ἀκορος*.) A plant with sword-shaped leaves and aromatic stems, found abundantly in the meadows of some parts of England. It bears, but very rarely, its flowers in a little greenish yellow spadix, which appears at a short distance below the end of a leaf-like scape. The leaves, when crushed, exhale a pleasant odour, and are still used for strewing the floors of churches upon the occasion of certain ancient ceremonies. Its stem, or rhizoma, is like that of an iris, and is the calamus aromaticus of the druggists.

A'COTYLE'DONS. (Gr. *ἀ*, *without*. and *κοτυληδων*, literally, a hollow or concave part, but applied by botanists to the seed-lobe.) Plants whose seeds have no distinct cotyledons. The term is usually applied to what are more commonly named cryptogamic plants, such as ferns, mosses, lichens, &c., in which there are no seeds, properly so called, but which are propagated by undivided spherical bodies called spores. The word acotyledon is occasionally used for such plants as cuscuta, cactus, &c., whose seeds, although really of the same nature as those in which cotyledons are usually present, have no obvious division; this mode of applying the term is, however, seldom employed.

ACOU'STICS. (Gr. *ἀκουω*, *I hear*.) The science of hearing, or of sound. (*See* SOUND.)

ACQUI'TTAL. In Law. (Lat. acquietare, *to render tranquil*.) Freedom from services to a superior lord. Also, deliverance from a criminal charge by the verdict of not guilty. This verdict may always be pleaded in answer to a second charge on the same offence: the plea is termed "autrefois acquit"

ACQUI'TTANCE. In Law, the discharge in writing of a sum of money due. An acquittance not under seal is admissible only in evidence, and is not pleadable. An acquittance in full of all demands, is an answer to all debts, except such as are on specialty, which can only be discharged by an instrument of equal force.

A'CRE. A measure of land, that formerly varied in different parts of the United Kingdom. The magnitude of the imperial or statute acre may be referred to that of the square yard, by recollecting that a square, whose side is 22 yards long, is the *tenth* part of an acre; whence the latter contains $22 \times 22 \times 10$, or 4,840 square yards. The *chain* with which land is measured is 22 yards long, so that ten square chains are one acre. The acre is divided into 4 roods, and each rood into 40 perches; so that each perch contains $30\frac{1}{4}$ square yards.

| *Acre.* | | *Rood.* | | *Perch.* | | *Square yards.* | | *Side of equivalent squares in yards.* |
|---|---|---|---|---|---|---|---|---|
| 1 | = | 4 | = | 160 | = | 4840 | = | 69·5701 |
| | | 1 | = | 40 | = | 1210 | = | 34·7851 |
| | | | | 1 | = | $30\frac{1}{4}$ | = | 5·5 |

121 Irish acres are equivalent to 196 English acres.
48 Scotch acres are equal to 61 English acres.
The French are is a square, whose side is 10 metres: and 1000 English acres are equivalent to 40·466 ares.

ACRI'DIANS, ACRIDIA. (Gr. *ἀκρις*, *a locust*.) A family of orthopterous insects, having the genus acridium for the type.

A'CRITES, ACRITA. (Gr. *ἀκριτος*, *indiscernible*.) The lowest division of the animal kingdom, in which there is no distinct discernible nervous system; and in which the alimentary canal is not separated from the parietes of the body, or contained in a distinct abdominal cavity. It is composed of the classes spongiæ, polypi, polygastrica, sterelmintha, acalepha. (*See* those words.)

ACRODA'CTYLUM. (Gr. *ἀκρος*, *highest* or *extreme*, and *δακτυλος*, *a digit*.) In Zoology, the upper surface of each digit.

A'CRODUS. (Gr. *ἀκρος*, *extreme*, *οδους*, *tooth*.) The name of a genus of sharks, characterised by the presence of large polygonal obtuse enamelled teeth; aggregated at the extremity of the jaws. The fishes of this genus are found exclusively in the fossil state.

A'CROGENS. (Gr. *ἀκρος*, and *γιγνω*, *I grow*.) Plants, otherwise called cryptogamous and acotyledonous. They correspond to ferns, mosses, lichens, &c.; have no sexes; are multiplied by spores instead of seeds; and are remarkable for increasing chiefly in length, by additions to their end, and not in diameter, by the addition of fresh matter to their outside, as in exogens, or to their inside, as in endogens.

ACRO'LITHOS. (Gr. *ἀκρος*, and *λιθος*, *stone*.) In Sculpture, a statue whose extremities are of stone, the body being made of wood. According to Vitruvius, there was a temple at Halicarnassus dedicated to Mars, and built by Mausolus, king of Caria, wherein was an acrolithan statue of the god. And from Trebellius Pollio we learn that Calpurnia set up an acrolithan statue of Venus, which was gilt.

ACRO'NYCAL, or ACHRONYCHAL. (Gr. *ἀκρος*, and *νυξ*, *night*.) A star or planet is said to be acronycal when it is opposite to the sun, or passes the meridian at midnight. It rises acronycally, when it rises as the sun sets; and sets acronycally, when it sets as the sun rises. The Greek poets designated these different positions of a star, at its rising or setting, with respect to the sun, by the terms *acronycal*, *cosmical*, and *heliacal;* and thereby indicated, in a rude way, the position of the sun in the ecliptic, or the season of the year.

ACROPO'DIUM. (Gr. *ἀκρος*, and *πους*, *foot*.) In Zoology, the upper surface of the whole foot.

ACRO'POLIS. (Gr. *ἀκρος*, and *πολις*, *city*.) The upper town or citadel of a Grecian city. It was usually the site of the original settlement, and was chosen by the colonists for its natural strength. The most celebrated were those of Athens, Corinth, and Ithome; the two latter of which were termed the horns of the Peloponnesus, as if their possession was enough to insure the submission of the whole peninsula.

A'CROSPIRE. (Gr. *ἀκρος*, and *σπειρα*, *a curved line*.) When seeds begin to grow, the part of the germ which afterwards produces the stem shoots forth in the form of a delicate curved fibre, and, gradually bursting the outer covering, makes its appearance at the end of the seed. Maltsters, especially, call this the acrospire of barley.

ACRO'STIC, or ACROSTICH. (Gr. *ἀκρος*, and *στιχος*, *line*, or *rank*.) A composition in verse or prose, in which the first or last letter of every line, or of every word, read collectively, form a name or a sentence. Great labour and ingenuity have been exercised in inventing varieties of this and similar curious trifles. Such, for example, is the pentacrostic, in which the initial letter of each verse is repeated five times in every verse, so as to form five repetitions of the same acrostic, as it were, in different columns.

ACROTA'RSIUM. (Gr. *ἀκρος*, and *ταρσος*, *tarsus*.)

In Zoology, the upper surface of the tarsus. (*See* that word.)

ACROTE'RIA. (Gr. *ἀκρωτηριον, the extremity of any thing.*) In Architecture, the pedestals, often without base or cornice, which are placed on the centre and sides of pediments, and which are so placed for the reception of figures. Vitruvius gives the rules for their dimensions. The same word is applicable to the ridge of a building. Some have used the word acroterion to signify the statues on the pedestals, but it is strictly the pedestals themselves only to which it is applicable. The word acroteria is also used to denote the small pieces of wall in balustrades between the pedestal and the balusters.

ACRY'DIUM. (Gr. *ἀκρις, a locust.*) The name applied by Fabricius to a genus of locusts, characterised by a carinate thorax; filiform antennæ, shorter than the thorax: and equal palps or feelers.

ACT. In Dramatic literature, a division of a drama, subdivided into scenes. The Greek dramas of the old model were naturally divided into separate portions by the stasima, or choric odes, which occur at intervals, during which the stage was left to the sole occupation of the chorus. Nevertheless, the Grecian writers do not notice this division in express terms; nor do we know the origin of the famous rule of Horace, that every dramatic piece should be restrained within the limits of five acts, neither more nor less. The division into acts must be in great measure arbitrary, although rules have been laid down, by various writers, to define the portion of the story or plot which should be contained in each of them. Thus, Vossius lays it down as a rule, that the first act presents the intrigue, the second develops it, the third is filled with incidents forming its knot or complication, the fourth prepares the means of unravelling it, which is finally accomplished in the fifth. (*See* DRAMA.)

ACT. In the Universities, an exercise performed by students before they are admitted to degrees. The student proposes certain questions to the presiding officer of the schools, who then nominates other students to oppose him. The discussion is syllogistical and in Latin, and terminates by the presiding officer questioning the respondent, or person who is said to keep the act, and his opponents, and dismissing them with some remarks upon their respective merits.

ACT OF PARLIAMENT. *See* STATUTE.

A'CTA DIURNA, *daily proceedings.* Among the various important improvements effected by Julius Cæsar may be ranked that of his furnishing the Romans with a species of newspaper. He was the first to order that the *acta diurna* of the senate and the people should be drawn up in a regular form and published. This publication must consequently have, in many important respects, closely resembled a modern newspaper. — (Sueton. in Cæs. cap. 20.)

A'CTA ERUDITORUM. The title of a celebrated literary and scientific journal, which was commenced at Leipzig, in 1682, by professor Mencke, of that university. The last volume was that for 1776.

A'CTIAN GAMES. (Lat. *Ludi Actiaci.*) Games celebrated in antiquity at Actium in honour of Apollo, hence surnamed *Actius.* The temple of the god was repaired, and the games restored and celebrated with increased splendour by Augustus, in memory of his victory over Mark Antony off Actium.

ACTI'NIA. (Gr. *ἀκτις, a ray.*) A genus of polypi with very numerous tentacles, which extend, like rays, from the circumference of the mouth. They are amongst the most highly organised of the class, having the alimentary sac distinct from the parietes of the body; feeding on shellfish and other marine animals, which they draw into their mouth with their tentaculæ, and in a short time rejecting, through the same aperture, the shells and indigestible parts. They are of a soft gelatinous texture, and they assume various forms when the tentacles are all expanded, having the appearance of full-blown many-petalled flowers; whence they are called "sea anemones," "sea sunflowers," &c. (*Phil. Trans.* lxiii. p. 361.)

ACTI'NOCA'MAX. (Gr. *ἀκτις, a ray, καμαξ, a pale.*) A name applied by Miller to the fossil shells of an extinct genus of Cephalopodous Molluscs, apparently connecting the *Belemnites* with the existing *Sepiæ.* The remains of the *Actinocamax* appear, as yet, to be peculiar to the chalk formations of England and Normandy.

ACTI'NOCRI'NITES. (Gr. *ἀκτις, a ray, κρινον, a lily.*) The name of a subgenus of extinct Crinoidean radiated animals, or Encrinites, characterized by the numerous rows of angular plates, which, being articulated by their margins, constitute the body.

ACTI'NOLITE. (Gr. *ἀκτις, a ray,* and *λιθος, stone.*) A variety of hornblende, which usually occurs in fascicular crystals.

ACTINO'METER. (Gr. *ἀκτις,* and *μετρον, measure.*) An instrument invented by Sir John Herschel for measuring the intensity of the sun's rays. *See* PHOTOMETER.

A'CTION. (Lat. ago, *I act*) In Painting and Sculpture, the state of the subject as imagined in the artist's mind at the moment chosen for representation. It must not be confounded with motion, which relates to the mobility of a single figure. Action must be true, simple, natural, and connected; and its unity must be preserved, or the action is weakened.

ACTION. In the Military Art, an engagement or battle between opposing forces; hence *partial* actions, *general* actions, &c.

ACTION. In Oratory, the accommodating or suiting of the countenance, voice, and gesture of the speaker to the matter to be spoken or delivered. This *sermo corporis*, as Cicero calls it, has always been regarded as a most important part of oratory. The ancient masters laid the greatest stress upon it. Demosthenes said that action was "the beginning, the middle, and the end of the orator's office;" and Cicero admits, that "*what* an orator says is not of so much importance as *how* he says it." Hamlet's advice to the players should be kept in mind by those who desire to excel in this art.

ACTION. In Poetry, an event either real or imaginary, forming the subject of an epic poem or play, &c. Thus the wrath of Achilles forms the action or subject of the Iliad, the wanderings of Æneas the action or subject of the Æneid, &c.

ACTION. In the Stock Market in Paris, and other places in France, *action* is the name given to a share of the capital stock of a joint stock company.

ACTION. In Mechanics, denotes sometimes the effort which a body or power exerts against another body, sometimes the effect or motion resulting from such effort. Mechanical action is exerted either by percussion or by pressure; in the former case the effect is instantaneous, in the latter it is continued. In all cases of mechanical action, the effect of the acting body is resisted in an equal degree by the inertia of the body acted upon, which resistance is termed reaction; and it is an axiom in mechanics, that action and reaction are always equal, and exerted in opposite directions. Thus, in driving a nail with a hammer, the stroke acts against the face of the hammer exactly with the same energy as against the head of the nail; and in pressing the hand against a stone, the pressure on the hand and on the stone is precisely the same.

A'CTIONS, in Law, are real, personal, or mixed. Actions, real or mixed, for the recovery of real property, are very numerous, but so prolix and difficult that they are almost wholly abandoned as a means of obtaining justice, and questions relating to title to land are now tried by the simple form of ejectment. The only case in which they have been resorted to, of late years, has been when, from the shorter period to which the action of ejectment was limited (*see* LIMITATIONS), a right survived for the purpose of the former, which was barred as to the latter. But the recent acts on this subject have much reduced the distinction. Actions in common use, *i. e.* personal actions, are also divided into actions of contract and actions of tort, and into local and transitory, in the former of which the place or county where the cause of the action arose must be accurately alleged, for the purpose of the trial taking place there. This allegation is termed the *Venue* of the action, from the Norman-French *visne*, vicinetum, neighbourhood, because the jury impanelled to try an action came originally from the neighbourhood. In the latter it is immaterial. Actions of tort to the person, and all actions of contract, are generally transitory, but under certain circumstances the latter may be local.

ACTI'VITY. The virtue or faculty of acting. The term is used in physics to denote the promptitude of the action of one body on another. Thus we speak of the activity of an acid, of poisons, of the electric fluid, &c.

*Sphere of activity*, the space within which the action of a body (of a magnet, for example) produces any sensible effect.

A'CTOR, ACTRESS. In the flourishing period of the early Greek drama, so long as a certain remnant of religious solemnity was attached to it, there was no degradation in the character of an actor: in fact, the parts of the chorus were often filled by volunteer performers of birth and station. But when the dramatic performers began to form a profession apart, they appear soon to have been regarded with disrespect. In Rome, the first actors were buffoons (known by the Tuscan name of *histriones*), who enacted the grotesque farces imported from Etruria, and the qualification of actor was among the most dishonourable in the period of the republic; and no circumstance was considered to indicate more decisively the intention of Nero to degrade and subject all classes in the state, than his having persuaded a Roman knight, Laberius, to appear on the stage in the performance of one of his own mimi. Under the dissolute reigns of the first emperors, especially Nero, much favour and countenance was shown to actors. Nero was, however, obliged at last to banish the *pantomimi*, the most popular species of actors, entirely from Italy, together with their performances, in consequence of the strong party spirit which was excited about them. (Sueton. Nero. c. 16.) It seems from Tacitus, that they were soon afterwards restored: again banished

Domitian; restored by Nerva, and finally expelled by rajan; but, by the time of the reign of the last-men- ned emperor, the dramatic stage was nearly aban- ned, and its place wholly occupied, by gladiatorial ows and other pageants. In England, the first actors ere the servants of great nobles, who performed for eir diversion; and when regular theatrical companies ere formed, they were long in the habit of putting emselves under the protection of distinguished person- es: the companies of the greater theatres, as is well own, retain the custom of calling themselves servants His Majesty. Actresses were not known on the En- sh stage until some time after the Restoration: al- ough ladies of quality had frequently, under James and harles I., performed parts in masques, &c. Kynaston as the last celebrated male performer of female parts. singular notice of him will be found in Pepys's Me- irs. In Roman Catholic countries, actors, even to is time, are under the ecclesiastical restriction of ex- mmunication. (*See* DRAMA.)

ACTIVE MOLECULES. (*See* MOLECULES.)

ACTS OF SEDERUNT. (Scotch law.) Statutes ade by the Lords of Session sitting in judgment, by rtue of a Scottish act of parliament, passed in 1540, powering them to make such constitutions as they ay think expedient for ordering the procedure and rms of administering justice.

A'CTUARY. Originally a public officer in the Roman urts of justice, who drew up writings, contracts, &c., the presence of the magistrate; whence his name, om actus, *an instrument*. The clerk who registered e acts and constitutions of the convocation, in the semblies of that body, was termed actuary. The man- ing officer of an insurance company is usually termed England an actuary. (*See* INSURANCE.)

ACU'LEATE. (Lat. aculeus, *a prickle*.) In Botany, y thing covered with prickles; that is, with sharp pro- nences which originate in the cellular system and have connection with wood.

ACU'LEATES. In Zoology, a tribe of hymenopterous sects, in which the females and neuters are provided th a sting, generally concealed within the last segment the abdomen.

ACU'MINATE. (Lat. acumen, *the point of any ng*.) When a leaf or any other body is very much ered to a point; it is thus distinguished from acute, ich means sharp-pointed without any tapering.

ACUPU'NCTURA'TION. (Lat. acus, *a needle*, and nctura, *a puncture*.) Pricking with a needle. In the st this is a common remedy for painful affections of ferent parts of the body. It has lately been extensively ctised here for the cure of chronic rheumatism, a long d sharp needle being thrust into the affected muscles.

ACU'TE. The opposite of obtuse. An acute angle is t which is less than a right angle; an acute-angled angle is one of which each of the angles is acute; an te-angled cone is one whose opposite sides form an te angle at the vertex.

ACUTE. (Lat. acutus, *sharp*.) In Music, the height pitch of a sound or tone, in respect of another. It is posed to grave.

AD LI'BITUM. In Music (*at pleasure*), a term plied to an accompaniment which is not essential, and y or may not be performed without interfering with composition.

AD QUOD DAMNUM. (Lat. *to what damage*.) A it sued before the grant of certain liberties and fran- ses, as a fair, market, &c., which may be prejudicial to king who grants, or the public; by it the sheriff is ected to inquire what damage may accrue from the nt in question.

ADA'CTYLE (Gr. ἀ, priv. and δακτυλος, *a digit*.) Zoology, signifies a locomotive extremity without its.

A'DAGE. (Lat. adagium, *a proverb*.) (See PROVERB.) e proverbs of antiquity are collected by Erasmus in a rk entitled *Erasmi Adagia*.

ADA'GIO. (Ital. adagio, *leisurely*.) In Music, the west of musical time, grave only excepted. (*See* LEGRO.)

ADAMA'NTINE SPAR. (Gr. ἀ, *without*, and δαμαω, *reak*, or *conquer*.) A variety of crystallised alumina, arly resembling the sapphire in composition, and of reme hardness. The finest specimens come from lia and China. At Bombay it is called corundum.

A'DAMITES. (Theology.) A sect in the early ages of Christian church who are said to have professed an ict imitation of the primitive state of innocence. They appeared in the 15th century in Bohemia. (*Moshcim*, . 233, &c.)

ADANSO'NIA. A remarkable African tree, named er Adanson, a celebrated French botanist and travel- It is called by the negroes *Baobab*.

A'DAPIS. A name originally applied by Gesner to the rax or coney of Scripture, and adopted by Cuvier to ignate another small pachydermatous quadruped, now inct, but the existence and nature of which that great naturalist detected and deduced from three fragments of the head, which were discovered in that immense depository of fossil bones, the gypsum quarries of Montmartre. The dentition of the Adapis is as follows:—each jaw has four trenchant incisors; two conical canine teeth, the upper ones straight, the lower inclined obliquely forwards; and apparently fourteen molar teeth, of which the first is trenchant, and the three or four posterior ones, on each side, like the posterior molars of the Anoplotheriam. Cuvier supposes the animal to have been about the size of a rabbit, and to have closely approximated the Anoplotheria.

A'DDER. (*See* VIPER.)

ADDI'TION. In Arithmetic. The operation by which a number is found equal to several others taken together. It is the first of the four fundamental rules. Addition, in algebra, is the uniting or incorporating of several algebraic quantities into a simple or contracted expression.

A'DDITIVE. Something to be added, in contradistinction to subtractive, which denotes something to be taken away. The terms additive and subtractive are sometimes applied to algebraic quantities, to denote those relations to other quantities which are more commonly, though less correctly, expressed by positive and negative.

ADDU'CTOR. (Lat. adduco, *I draw towards*.) The adductor muscles are opposed to the abductors: they draw the parts to which they are attached, together.

ADE'LPHIA. (Gr. ἀδελφος, *a brother*.) A collection of stamens into a bundle. Linnæus employed this term for those plants in which the stamens, instead of growing singly, combine into one or more parcels, or brotherhoods; thus, monadelphia signified stamens all connected into one parcel, diadelphia into two parcels, and so on.

ADE'NOSTY'LEÆ. (Gr. ἀδην, *a gland*, and στυλος, *a column*, or *style*.) A subdivision of composite plants, comprehending tussilago, liatris, eupatorium, and some other genera, in which the branches of the style are covered with long glandular hairs.

ADE'PHAGANS, ADEPHAGA. (Gr. ἀδηφαγος, *voracious*.) A family of carnivorous and very voracious coleopterous insects.

A'DEPT. (Lat. adipiscor, *I obtain*.) A distinctive term applied to those alchemists who were supposed to have attained the great object of their researches, or to have discovered the philosopher's stone.

ADFE'CTED, or AFFECTED. (*See* the latter term.)

ADHE'SION, (Lat. adhæreo, *I adhere*,) is a property of vegetable matter by which contiguous parts grow together; and is one of the causes of the great diversity of appearance in the organs of plants. Two opposite leaves grow together and form apparently one, through which the stem passes; several in a whorl adhere, and form an involucre; a number of petals adhere, and thus constitute a monopetalous corolla; several stamens adhere, and an adelphia is the result; some carpels contract an adhesion with one another, and form a compound fruit; finally, the calyx adheres to the sides of the ovary, and then seems as if it grew from the apex of it. Irregularity in flowers and fruit is also in many cases produced by the unequal manner in which adhesion takes place between similar parts; of the calyx, two of the sepals adhere into one parcel, and three into another; the result of which is a two-lipped calyx; the same thing occurs in the corolla, and elsewhere.

ADHESION. (Physics.) A term used to denote the force with which different bodies remain attached to each other, when they are brought into contact. Adhesion has often been confounded with cohesion; but the two terms are essentially distinct. Adhesion is the force with which two bodies of different kinds cling to each other when united; cohesion is that which unites the particles of a homogeneous body with each other. Thus, the particles which form a drop of water or quicksilver are united by cohesion; the particles of water which wet the surface of any body are united to it by adhesion.

Adhesion may exist between two solid bodies, between a solid and a fluid, or between two fluid bodies. The adhesion of solid bodies is exemplified in the force required to separate two pieces of marble, whose polished surfaces have been brought into contact. The suspension of water above its level in capillary tubes, or between two plates of glass very nearly in contact, shows the adhesion of a fluid to a solid body; and an instance of the adhesion of two liquids is obtained by covering a plate of glass with oil, and bringing it into contact with the surface of water; a very sensible force is required to raise it perpendicularly from the water.

Dr. Brook Taylor appears to have been the first who undertook to estimate experimentally the force of adhesion; and the method which he employed, was to determine the weight necessary to separate fir-boards from the surface of water. This method, however, unless proper precautions are taken, is apt to give inaccurate results. On separating a fir-board from water, the whole

surface of the board may be observed to be wetted; that is to say, a thin film of water remains attached to the wood, so that the force by which the separation was effected is not the force necessary to overcome the adhesion of the water to the board, but the cohesion of the particles of water to each other. This is fully established by the experimental fact, that, when discs of different substances are applied to a liquid, by which they are perfectly wetted, their adhesion to it is the same, whatever may be their nature, and exactly equal to the cohesive force of the fluid. Discs of glass and discs of copper of the same diameter adhere to water with precisely the same force.

The adhesion of discs to the surfaces of liquids is demonstrated by Laplace to be a capillary phenomenon, arising from the action of attractive forces which are sensible only at very small distances. Supposing the diameter of the disc to be known, and the height to which the same liquid rises in a capillary tube of the same matter, and of a given diameter, Laplace determined from theory the force necessary to detach the disc. The results of his determination, applied to different liquids, as water, oil of turpentine, and alcohol, at different densities, agreed exactly with the numbers found by M. Gay-Lussac, in a series of very accurate experiments on this subject. The perfect identity of the forces producing adhesion and capillary attraction, is also proved by the following experiment: — It is well known that the height to which fluids rise in capillary tubes depends on the angle which the fluid makes with the sides of the tube. But the surface of mercury covered with water in a capillary tube is exactly spherical; consequently, the angle which the mercury makes with the sides of the tube vanishes, and the force is reduced to zero. If, therefore, adhesion depends on a force of the same nature, it follows that, on applying a disc of glass to the surface of mercury, and covering them both with water, no force should be required to separate the disc, excepting what is necessary to overcome its weight. Now, this was found by Gay-Lussac to be exactly what takes place. When the mercury and disc were covered with water, no resistance was offered to their separation; without the interposition of the water, a weight of 296 or even 400 grammes was required to overcome the adhesion. (Laplace, *Mécanique Céleste*, tome iv. Biot, *Traité de Physique*, tome iv. p. 464.)

The adhesion of the polished surfaces of solid bodies is proportional to the extent of the surface, or to the number of points brought into contact. It was formerly believed that the resistance to separation in this case arises solely from the pressure of the atmosphere; but the difference of its amount in different substances proves this opinion to be erroneous; besides, it is found to be the same in a vacuum. (*See* CAPILLARY ATTRACTION.)

ADIA'NTUM. (Gr. ἀδιαντος, *dry*.) A genus of thin-leaved ferns, having their fructification in short marginal lines. The leaflets are usually wedge-shaped and placed upon slender shining petioles. One of the species (A. capillus veneris) was formerly employed in the manufacture of syrup of capillaire.

ADIA'PHORITES. (Gr. ἀδιαφορος, *indifferent*.) A name given to Melancthon, and the party that agreed with him, in submitting, in things indifferent, to an imperial edict. The controversy which gave rise to this name had its origin in the imposition by Charles V., in 1548, of an edict, styled the Interim, because it proposed to accommodate for a time the differences of the papists and protestants, until the whole matter could be set at rest by the authority of a council. The opposite side was maintained by Flavius and the primitive Lutherans; and in the debate which followed there were two principal questions: first, whether it is lawful to yield to the enemies of truth, even in matters which are not of themselves essential; and, secondly, whether, granting the affirmative, the points in which the Interim required compliance, and in which Melancthon yielded it, are properly indifferent. Those points related chiefly to the doctrine of justification by faith, in which Luther and his genuine followers went to a great extreme; while Melancthon, although ostensibly the head of the Lutheran church, after the death of the great Reformer, adopted much more moderate views. Out of this controversy a great variety of other debates were engendered, and from these quarrels many schisms and divisions among protestants derived their origin.

A'DIPOCE'RE. (Lat. adeps and cera, *fat* and *wax*.) A fatty substance produced by the decomposition of the flesh of animals in moist situations, or under water, resembling, in some of its properties, a mixture of fat and wax.

A'DIPOSE. (Lat. adeps, *fat*.) Unctuous, or containing fat. Adipose membrane is the cellular membrane in which fat is deposited.

A'DIT. (Lat. adeo, *I approach*.) A horizontal shaft or passage in a mine, either for access, or carrying off water.

ADJA'CENT ANGLE. In Geometry, an angle immediately contiguous to another, so that one side is common to both angles. It is more particularly used when the two angles, besides having a common side, have their other sides in the same straight line. In this case, the adjacent angle is the same as the supplemental angle.

A'DJECTIVE. (Lat. ad, *to*, and jaceo, *I lie*.) In Grammar, that part of speech which is annexed to substantives, to define more accurately the conceptions intended to be denoted by them. *See* GRAMMAR.

ADJECTIVE COLOURS. Colours which require to be fixed by some base or mordant, in order to be applied as permanent dye-stuffs.

ADJOURNMENT, in Parliamentary language, means a postponement of the sittings or proceedings of either House of Parliament from one time to another specified for its re-assembling. Adjournment differs from prorogation in this, that the latter is an act of royal authority, whereas the power of adjournment is vested in each house respectively, no definite limits being prescribed to it by the constitution. *See* PROROGATION.

ADJU'DICATION. In Scottish Law, the diligence (*i. e.* process) by which land is attached as security for payment of debt. Adjudication for debt is a species of mortgage, redeemable, except in the cases of what are termed general adjudications, or adjudications contra hæreditatem jacentem.

ADJU'STMENT. In Marine Insurance, the settlement of a loss incurred by the insured.

A'DJUTANT. A military officer, attached to every regiment, who relieves the major of part of his duty, and performs it in his absence.

A'DJUTANT-GENERAL. A staff officer, who is to the army what the adjutant is to a regiment. He assists the general, and distributes his orders.

A'DJUTANT-GENERAL OF THE JESUITS. A title given to certain fathers who resided with the general of the order.

A'DJUVANT. (Lat. adjuvare, *to help*.) In Medicine, a substance which assists and promotes the operation of others.

ADMINISTRA'TION. (In Law.) If a person die intestate as to his personalty, letters of administration are granted by the ordinary (*see* LAW, tit. ECCLESIASTICAL COURTS) to such person as is pointed out by the statutes 31 E. 3., and 21 H. 8. These empower the ordinary to grant these letters to the widow, if there be one, or next of kin, at his discretion. Of persons equally near in degree the ordinary may grant to which he please. If none of the kindred take out administration, a creditor may do it. When the will is made without the nomination of any executor, the ordinary grants administration cum testamento annexo. Where a person dies intestate, his personal property descends (subject to his debts) as directed by the statute of Distributions, 22 & 23 C. 2. c. 10., explained by 29 C. 2. c. 30. One-third goes to the widow; the residue in equal proportions to the children, or, if they are dead, to their representatives, i. e. their lineal descendants. If there are none of these, then the widow takes a moiety, and the next of kin in equal degree, and their representatives take the other; if there be no widow, they take the whole. But of representatives none are admitted among collaterals farther than the children of the intestate's brothers and sisters. The order of nearness of kin, with reference to the distribution of intestates' estates, is thus arranged according to the rules of the civil law — children, parents, brothers, grandfathers, uncles or nephews (and the females of each class respectively), and, lastly, cousins.

ADMINISTRATION. (Lat. administratio, *care of an affair*.) In its general sense means the conduct or management of any affair; but in this country the term is usually applied to the management of the public or national affairs by the government, which is thence called *the Administration*.

A'DMIRAL. A great naval officer, who has the same power and authority over the maritime forces of a state that a general has over its land forces; and who also tries himself, or appoints officers to try, maritime cases. There are three ranks of Admirals, the Admiral (or full Admiral), Vice Admiral, and Rear Admiral. Each of these again has three gradations, of red, white, and blue, the colours of the flags they bear. — The Admiral carries his flag at the main, the Vice at the fore, and the Rear at the mizen mast.

ADMIRAL, *Lord High*. The ninth great officer of state in England. The office has been usually given, at least since the reign of Henry IV., to some of the king's youngest sons, near kinsmen, or of the higher nobility. Since the reign of Charles II. it has been, with occasional exceptions, always in commission, and the commissioners are styled 'Lords of the Admiralty.' It was held by the late sovereign William IV., when Duke of Clarence, from 1827 to the following year.

A'DMIRALTY, the Board of Commissioners for executing the Office of Lord High Admiral, and having authority over naval affairs generally.

ADMIRALTY, *Court of*. In Law, is a court of record,

of which the proceedings are carried on, at least to a certain extent, according to the course of the civil law; although, as the judge may have in some cases the assistance of a jury, it has also a resemblance to the courts of common law. It has jurisdiction principally for the determination of private injuries to private rights arising at sea, or intimately connected with maritime subjects; and in most cases, to which its authority extends, it has concurrent jurisdiction, either with the common law courts, or those of equity. Suits may be instituted in this court for assault and battery at sea; for collision of ships; for the restitution of goods piratically taken not under colour of war. It has also an equitable jurisdiction between part owners of a ship, It adjudicates in suits for mariners' wages, and for pilotage. It has a peculiar jurisdiction in cases of bottomry bonds, and other deeds in the nature of a mortgage of the ship; having an exclusive power to grant warrants to arrest the ship itself. It has also jurisdiction in cases of salvage, and incidentally of wreck.

The prize court, which decides prize causes in time of war, is a separate tribunal, although usually presided over by the same judge as that of admiralty. To that able and philosophical jurist, Sir W. Scott (Lord Stowell), who sat in these courts (as well as the ecclesiastical) for many years during the late war, and after its close, the country is indebted, not only for the high character and value of these tribunals, but also for the light thrown on the difficult and important questions of national law, by the most profound and lucid decisions ever applied to that subject.

A'DNATE. (Lat. adnascor, *I grow to any thing.*) Is said when one organ grows to the face of another, and not to its apex, in which case it would be innate. This term is chiefly employed in speaking of anthers.

ADO'NIS. In Mythology. A beautiful youth, son of Cinyras, king of Cyprus, beloved by Venus, and killed by a wild boar, to the great regret of the goddess. It is, also, the name of a river of Phœnicia, on the banks of which Adonis, or Thammuz, as he is called in the East, was supposed to have been killed. At certain seasons of the year this river acquires a high red colour, by the rains washing up particles of red earth. The ancient poets ascribed this to a sympathy in the river for the death of Adonis. This season was observed as a festival in the adjacent country. Facciolati, *Lexicon;* Calmet, *Dictionnaire de la Bible*, art. *Thammuz.*) Milton has beautifully alluded to these circumstances: —

> "——— Thammuz came next behind,
> Whose annual wound in Lebanon allured
> The Syrian damsels to lament his fate
> In am'rous ditties all a summer's day.
> While smooth *Adonis* from his native rock
> Ran purple to the sea, supposed with blood
> Of Thammuz yearly wounded."
>
> *Parad. Lost,* I. v. 415.

ADO'NIC. (Gr. Ἀδωνις, *Adonis.*) A species of verse consisting of a dactyle and a spondee; as in Horace, lib I. Od ii. v. 5. *Terruit urbem, visere montes,* &c It was invented by Sappho, and derived its name from being principally sung at the festivals in memory of Adonis. (Facciolati, *Lexicon.*)

ADO'PTER. A vessel with two necks placed between a retort and a receiver, serving to increase the length of the neck of the former.

ADO'PTION (Lat. adopto, *I adopt.*) In the Civil Law, signifies the admission of a stranger to the rights and privileges of a son. Adoption was a common custom among the Romans, by whose law a relation, nearly resembling that of master and slave, was constituted between father and son, so that a child, adopted from one family into another, passed, in effect, from the power of his parent to that of his adopter. Adoption is said, in Justinian's institutes, to be of two sorts: the one, also called arrogation, where a person, independent of parental control, is adopted into a family by virtue of an imperial rescript; the other, where, by the authority of a magistrate, a child passes from one family to another. But unless the adopter possessed a certain right by blood over the person adopted (as a grandfather), the parental power of the father was not extinguished. Adoption exists in the jurisprudence of various countries, where derived from the civil law; as in the German states and in France: in the latter country, the person adopting must be one having neither children nor other legitimate descendants.

A'DRAGANT. Gum Tragacanth.

ADRI'FT. Not fastened; as a ship that has parted from her anchor, a boat that has broke from her ship, a gun from the ship's side, &c.

A'DVENT. (Lat. advenio, *I approach.*) The holy season, comprising four Sundays before Christmas. It begins on St. Andrew's day, the 30th of November, or on the Sunday next before or after it, according to the day of the week on which the 25th of December falls.

ADVENTI'TIOUS. (Lat. adventitius, *extraordinary.*) In Botany, when any thing appears out of the ordinary course of nature: if a bud appears where buds do not usually appear, it is adventitious. This term must not be confounded with abnormal, which is used when any thing is *constructed* out of the ordinary course.

A'DVERB. A word annexed to an adjective or verb, to define more closely the modifications of the quality or action denoted. *See* GRAMMAR.

ADVE'RSA. A medallic term, applied to two heads facing each other.

A'DVERSE. (Lat. ad, *to*, and verto, *I turn.*) In Botany, leaves are so called when they present their under surface to the sun.

ADVE'RTISEMENT. (Lat. adverto, *I attend to.*) In its general sense, means any information as to any fact or circumstance. But it is more particularly used to designate notices made by competent authority in the daily papers, and otherwise, of events of local or general interest, as the publication of new books, sales of estates and produce, meetings of creditors, formation and dissolution of partnerships, &c. Such notices, when inserted in the gazette, or in newspapers and literary works published in numbers, pay a duty of 1*s.* 6*d.* each for each time of insertion.

ADULA'RIA. A resplendent crystallised felspar, of a pearly lustre. The finest specimens came from Adula, at the summit of St. Gothard.

ADU'LT. (Lat. adultus, *grown up.*) In its general sense it means any thing grown up, or arrived at maturity. It is that period of human life that extends from youth to old age.

ADU'LTERY. (Lat. adulterium, a word of very uncertain derivation.) The sin of incontinence committed by a married person: adultery between two married persons is termed *double* by some jurists. By the law of Moses, adultery was punished by death, Lev. xx. 10., Deut. xxii. 22.; and passages in Proverbs (c. vi.) and Ezekiel (xvi. 38. 40.) prove that the law was observed in this respect down to the overthrow of the Jewish monarchy, as we know it to have been in the time of our Saviour. The mode of punishment was by stoning; but it is observable that this mode is not ordained in Deuteronomy, as it is for various other offences. The test or ordeal of adultery is detailed in Numbers v. 11—31. Under the Grecian and Roman republics adultery was variously treated; but the celebrated Lex Julia de Adulterio, under Augustus, punished it with banishment (deportatio vel relegatio), Tacit. lib. ii. Annal. It was not until the reign of Constantine, when some tincture of Judaism had been introduced into the state along with the establishment of Christianity, that the punishment of death was formally enacted for it. This penalty was again mitigated under Leo and Marcian; and by the laws of Justinian the adulterer was punishable with death, the adultress with flagellation, imprisonment, &c. But about the same period, the gradual increase of episcopal authority in civil cases seems to have drawn crimes of incontinence almost wholly within the cognizance of the ecclesiastical courts; and the canons contain a variety of directions on the subject of adultery. On the other hand, the jurisprudence of the Northern nations, which visited this as well as other crimes of freemen with very little severity, as mere offences against individuals, reduced the penalty in most of the Western kingdoms to a mere pecuniary one, sometimes attended with public disgrace or corporal punishment. The customs of the several French provinces contain a great variety of penalties and fines; at Castelnaudari, in the fourteenth century, the fine for adultery was fixed at "five sous only!" Such penalties, of course, fell rapidly into disuse; and in the sixteenth century we find it observed by a French civilian (quoted by Thuanus), that "it was never heard that any body had been punished for adultery in France." This observation is quoted by the historian when relating an event which created great sensation at the time, namely, the capital punishment at Orleans of two offenders by St. Cyr, the governor, a rigid Calvinist. The protestants of that sect, in France as well as in Scotland and England, made it their endeavour to introduce primitive severity of manners by severity of punishment. De Thou, the father, appears also to have made some efforts toward putting in force the laws against adultery: but from the time of the religious wars, penal cognizance of adultery may be said to have nearly ceased in France, although, by various arrêts (1637, 1701, &c.), besides the civil consequences of an action of adultery by husband against wife, the latter might be condemned to seclusion in a house of correction for two years, or more. In Geneva, Strasbourg, and other places where the reformed religion prevailed, a temporary strictness of law was introduced about the same period, but with little permanent effect. In England, by the old common law, mutilation was the punishment of this as well as other offences; but under the Plantagenets it became matter of ecclesiastical cognizance (except so far as civil consequences were concerned), and visited

only by the spiritual censure of the church. "The rules of the canon law," says a recent writer, "have manifested an indulgence towards this offence which is chiefly to be accounted for by reference to the constrained celibacy of its early compilers." But in 1650 the puritans, under Cromwell, succeeded in obtaining an ordinance by which adultery, as well as simple fornication, was made felony, without benefit of clergy; an absurd decree, which was soon repealed. In 1694, and again in 1801, the subject of adultery and divorce was discussed at length in parliament, but without producing any enactment. (See Tebbs's Essay on the Scriptural Doctrines of Adultery and Divorce, and on the Criminal Character and Punishment of Adultery, 8vo. Lond. 1822.) For the civil consequences of Adultery, *see* MARRIAGE, LAW OF.

A'DVOCATE. (Lat. advocatus, *he who is called in to plead in a court of law the cause of another.*) The original pleaders of causes at Rome were the patricians, who defended gratuitously their clients: but even before the downfal of the republic, the class had degenerated into a profession, its members receiving rewards for their services, although still among the most honourable of employments. But from the original gratuitous character of advocates arose the peculiar custom by which, among ourselves, the fees of barristers are still regarded as honorary, and cannot be recovered at law. In the later ages of the empire the advocati appear to have formed a distinct class from the jurisconsulti, or chamber-counsel, and to have much declined in reputation. In France the avocats, or counsel, form a separate order, of which each member is attached to a particular local court The lord advocate, in Scotland, is a public officer, who prosecutes crimes before the court of justiciary.

ADVOW'SON. (Lat. advocatio, *a calling.*) Properly, the relation in which a patron (advocatus) stands towards the living to which he presents, i e. the patronage of a church. The earliest provision for divine worship, in England and in other countries, was derived from the offerings of the laity, which were distributed by the bishop of each diocese among his clergy, whom he sent from place to place to preach and administer the sacraments. By degrees he was enabled, by the bequests of the faithful, and the customary offering of tithes, to subdivide his diocese, or parochia, as it was originally called, into various districts, and to build churches and establish permanent ministers in each. At the same time it became a common practice among the nobles to build and endow churches for the benefit of themselves and their own dependants; in which case they were allowed to present to the benefice, subject to the licensing power of the bishop and the canons of the church. Advowsons, in legal phraseology are either appendant, where immemorially annexed to a manor; or in gross, where they form separate subjects of property. If the patron of a rectory fails to present within six months after the vacancy happens, the right falls to the bishop; and by similar neglect on his part, to the archbishop, and thence to the king. The presentation is by letter to the bishop; institution, by an instrument registered in the bishop's court; and induction, which completes the incumbent's title, is performed by the archdeacon.

A'DYTUM. (Gr. ἄδυτον, *a recess.*) In Architecture, the secret dark chamber in a temple, to which none but the priests had access. It was from this part that the oracles were delivered. Seneca, in his tragedy of Thyestes, says,

> "Hinc orantibus
> Responsa dantur certa, dum ingenti sono
> Laxantur Adyto fata."

Among the Egyptians, the Secos was the same thing of which Strabo has given a description. The only well preserved adytum of the ancients is in the little temple at Pompeii. It is raised some steps above the level of the temple itself, and is without light,

Æ'DES. (Lat.) In architecture. A small temple consecrated to a god which was not afterwards dedicated by the augurs, from which circumstance, according to Varro, it was different from the templum. This distinction among the Romans in the early ages was afterwards lost, and the words were used indiscriminately.

ÆDI'CULA. (Lat.) A diminutive of the preceding.

Æ'DILE. The title of certain Roman magistrates, so called from their care of buildings (ædes). They were divided into two classes, distinguished by the epithets plebeian and curule. The two plebeian ædiles were, as their name imports, elected from the commonalty (plebs), and were subordinate to the tribunes of the commons, having jurisdiction over lesser causes, submitted to them by those magistrates. The two curule ædiles, so called from their privilege of giving judgment on ivory seats (sellæ curules), were originally elected from the patricians, but afterwards from both plebeians and patricians promiscuously. This magistracy was one of the most dignified in the state, and was allowed the use of the robe of honour (toga prætexta), and a certain precedence in the senate. The peculiar office of the ædiles was the superintendence of public works, markets, &c., in the city. They had also, particularly the curule ædiles, to exhibit public games, which they often did at a vast expense, in order to court popularity. Julius Cæsar added two other plebeian ædiles, called cereal, to inspect the public stores of provisions.

ÆGICE'REÆ. (Gr. αἴξ, *goat*, κέρας, *horn.*) A division of myrsinaceous plants, the type of which is the genus ægiceras. It is distinguished by the absence of albumen; the species grow in maritime swamps in tropical countries, and have the embryo germinating within the pericarp, after the manner of mangroves.

Æ'GIS. (Gr. αἴξ, *a goat.*) The mythological shield of Jupiter, which was covered with the skin of the goat Amalthæa, and given by him to Minerva, who, by fixing on it the head of Medusa, gave it the power of petrifying all persons who looked at it. The word is also used sometimes for the breast-piece of a god.

Æ'GYLOPS. (Gr. αἴξ, *a goat*, and ὤψ, *an eye.*) A sore in the inner angle of the eye, frequently terminating in fistula lachrymalis. Goats were supposed to be very subject to an analogous affection. — Also the name of a kind of grass.

Æ'NEID. The epic poem of Virgil, relating the wanderings of Æneas after the capture of Troy, and his settlement in Italy.

Æ'OLIPILE. (Lat. Æolus, *the god of the winds*, and pila, *a ball.*) An hydraulic instrument, contrived for the purpose of exhibiting the convertibility of water into steam. It consists of a hollow ball of metal, having a slender neck or pipe, with a very small orifice inserted into it. The ball, having been filled with water, is placed over the fire; and the heat gradually converts the water into vapour, which rushes out of the pipe with great violence till the whole is discharged. The experiment is not unattended by danger; for should the small orifice by any accident be stopped, the steam would burst the ball. The æolipile was known to the ancients, being mentioned by Vitruvius. Descartes and others have used it to account for the natural cause and production of the wind; hence its name, Æolipile, that is, pila Æoli, the ball of Æolus, the god of the winds. The æolipile is sometimes filed with alcohol, and the jet of its vapour being inflamed, it serves the purpose of a blowpipe.

Æ'OLUS. The god of the winds, who was fabled by the early poets to have his seat in the floating island of Æolia; but the Latin and later Greek poets placed him in the Lipari isles. Here the winds were pent up in vast caves, it being the duty of Æolus to let them loose, and to restrain their violence at the pleasure of Jupiter. Virgil has described the power and functions of Æolus, in one of the finest passages of the Æneid: —

> —— "Hic vasto rex Æolus antro,
> Luctantes ventos tempestatesque sonoras
> Imperio premit, ac vinclis et carcere frænat.
> Illi indignantes magno cum murmure montis
> Circum claustra fremunt. Celsâ sedet Æolus arce
> Sceptra tenens, mollitque animos, et temperat iras:
> Ni faciat, maria ac terras cœlumque profundum
> Quippe ferant rapidi secum, verrantque per auras."
> *Æneid*, I. i. 52.

ÆOLUS' HARP, or ÆOLIAN HARP. A well-known instrument, which produces a pleasing combination of sounds, by the action of the wind. Its construction is very simple, consisting of merely a number of catgut or wire strings, stretched in parallel lines over a box of thin deal, with sounding holes cut in the top. The strings being tuned in unison, the effect is produced by placing the instrument in a current of air. The invention of the Æolian harp is generally given to Kircher, by whom it was first described.

Æ'ON. *See* GNOSTICS.

Æ'RA, or 'ERA. (A word of doubtful derivation) In Chronology, the term æra denotes the account of time reckoned from some particular date or epoch, chosen for the commencement of the æra. — Thus the Christian æra began at the birth of Christ, the Mohammedan æra at the flight of Mohammed from Mecca to Medina, the æra of Diocletian at the coronation of that emperor, &c.; and the period of the occurrence of any event is ascertained by reckoning from one or other of these epochs. When, for example, it is said that Queen Victoria ascended the throne of Great Britain in 1837, it is meant that this event took place in the 1837th year of the Christian æra, or of that æra which began with the birth of Christ. It is plain that the epoch, or point of time selected for the commencement of an æra, is necessarily arbitrary; and different nations have adopted different epochs coincident with some important event in their civil or religious history. Some chronologers reckon from the creation of the world; and this event, were its date well ascertained, would be the best epoch that could be selected. But the sacred writings are not explicit on this point, and there are great discrepancies in the estimates

of the number of years since elapsed. The Greeks used to reckon by the æra of the Olympiad (*see* the word), which began at the summer solstice, anno 776, B.C. The Romans reckoned from the building of the city, generally held to be the 24th of April, B C. 753. The Julian æra dates from the reformation of the calendar by Julius Cæsar, B. C. 45. All Christian nations now adopt for their æra the birth of Christ, which took place on the 1st of January, in the middle of the 4th year of the 194th Olympiad, and the 753d year of the building of Rome. The æra of most Mohammedan nations is that of the Hegira, or flight of Mohammed to Medina, corresponding with the 16th July, A. D. 622. The æra of Sulwanah, in common use in a great part of India, corresponds to A. D. 78. The æra of Yezdegird, used in Persia, began 16th June, A D. 632.

Subjoined are the names of some of the principal æras, with the year of the Christian æra in which they began, and the abbreviations by which they are commonly distinguished.

| Æras. | Commenced | Abbreviations |
|---|---|---|
| Year of the World (Constantinopolitan account) - | B C. 5509 | A.M. Const. |
| — (Alexandrian account) | — 5492 | A M. Alex. |
| — (Jewish account) - | — 3760 | A.M. |
| Æra of Nabonassar - - - - - | — 747 | Ær. Nab. |
| Olympiads - - - - - - | — 776 | Olymp. |
| Year of Rome - - - - - | — 753 | A. U. C. |
| Julian Æra - - - - - - | — 45 | Jul Ær. |
| Christian Æra - - - - - | — — | A. D. |
| Æra of Sulwanah - - - - | A. D. 78 | Saca |
| Æra of Diocletian - - - - - | — 284 | Ær Dioc. |
| The Hegira - - - - - | — 622 | A. H. |
| Æra of Yezdegird - - - - | — 632 | A. Pers. |

The term *æra* is frequently used as synonymous with *epoch*, but it would seem incorrectly. (See Scaliger, *De Emendatione Temporum*.)

ÆRA'RIAN. The term applied to a Roman citizen who had been degraded to the lowest rank compatible with personal freedom. He, however, still paid taxes, but enjoyed no privileges, and could not serve in the army, or, consequently, participate in the distribution of land granted to such classes as did.

ÆRA'RIUM. (Lat.) The public treasury of the Roman people, the care of which was vested in the quæstors. After the fall of the republic the ærarium was kept distinct from the treasury of the emperor, which was called fiscus. The ærarium sanctius, or more sacred treasury, was appointed to provide for cases of extreme emergency, and might not be opened on other occasions.

AE'RIAL. (Gr. ἀηρ, *air*.) In Painting, a term applied to the diminishing intensity of colour on objects receding from the eye. Aerial perspective is the relative apparent recession of objects from the foreground, owing to the quantity of air interposed between them and the spectator, and must accompany the recession of the perspective lines.

AERIAL ACID, *Carbonic acid*.

A'ERO-DYNA'MICS. (Gr. ἀηρ, and δυναμις, *power*.) The science which treats of the motion of the air, and of the mechanical effects of air in motion. This is an experimental science, and there are two ways in which it may be investigated. The first is, by ascertaining the effects which air moving with a certain velocity, that is, wind, produces on a body against which it strikes; and the second, by ascertaining the resistance which air at rest offers to a solid body rapidly passing through it. The problem is exactly the same, whether the body is considered as moving against the air at rest, or the air is supposed to move against the body with the same velocity.

Conceive a body to be moved forward in a straight line, displacing successively the particles of air opposed to it; the effect which it produces is proportional to the number of particles against which it strikes, and to the quantity of motion communicated to each. Suppose now the velocity of the body to be doubled, the motion communicated to each particle of air displaced will be twice as great as before, and twice as many particles will receive the impulsion in the same time. Hence we infer that the effect will be four times as great, or that the effect is proportional to the square of the velocity. This result of theory agrees tolerably well with experiments made to determine the resistance of the air when the velocity is not very great, or not exceeding eight or nine hundred feet in a second. When the velocity is much greater than this, the effect is modified by circumstances which require further explanation.

When a solid body is moved out of its position, the space which it occupied is not filled with air instantaneously, but only after a sensible, though very short time. Theory, confirmed to a certain degree by experience, shows that air, under the ordinary atmospheric pressure, rushes into a vacuum with a velocity of between 1300 and 1400 feet in a second of time. But this velocity is very speedily checked; for the instant that any portion of air is admitted, or the vacuum ceases to be perfect, that portion resists the entrance of more with a force proportional to its density. Suppose, for example, the air in a receiver to be reduced to one-fourth of its natural density; the effort of the exterior air to enter the receiver will be reduced to three-fourths of its amount when the receiver was perfectly exhausted; and consequently the velocity, which is proportional to the square root of the effort or the resistance, will be reduced in the proportion of 1 to $\sqrt{\frac{3}{4}}$; or of 100 to 87, very nearly. In this manner, as the air continues to enter, the velocity will rapidly diminish.

Now, conceive a body, for example a cannon ball, to be moving rapidly through the air, but with a less velocity than 1300 feet per second. The air in front of the ball will remain in its natural state, because the condensation produced every instant by the contact of the ball, is propagated more quickly than the ball moves (the velocity of the propagation being equal to that with which air enters a vacuum). But there is a certain space behind the ball in which the air has not entirely recovered its equilibrium, but remains more or less rarefied, the ball having passed through it in less time than is required for the surrounding air entirely to fill it. In addition, therefore, to the resistance which arises from the communication of motion to the particles of air, there is a pressure on the front part of the ball, not counterbalanced from behind; in consequence of which, we may infer that the resistance will increase in a quicker ratio than the square of the velocity. This deduction is also confirmed by experience; for it is found that the resistance continues to increase with the square of the velocity only while the velocity is less than 900 or 1000 feet per second. Above this velocity the ratio begins to fail; and when the velocity exceeds that with which air enters a vacuum, the ratio is entirely altered. At a velocity of 1600 feet per second, the resistance is found to be more than twice that given by theory. The reason is obvious: the density of the air before the body is increased by the rapid motion, and, consequently, presses more on the fore part of the body than air in its natural state.

The resistance of the air on the motion of projectiles, was first examined experimentally by M. Robins (see his Principles of Gunnery), and afterwards by Dr. Hutton, of Woolwich (see his Tracts, vol. 3., and Math. Dictionary), whose experiments were carried on to a greater extent, and varied in a greater number of ways. The following are the principal results deduced by Dr. Hutton, from his experiments on bodies moving very slowly, not more than 20 feet per second:—

1st. "That the resistance is nearly in the same proportion as the surfaces, a small increase only taking place in the greater surfaces and for the greater velocities.

2d. "The resistance of the air to the same surface with different velocities, is, in these slow motions, nearly as the square of the velocity, but gradually increases more and more above that proportion as the velocity increases.

3d. "The round ends and sharp ends of solids suffer less resistance than the flat or plane ends of the same diameter; but the sharper end has not always the less resistance.

4th. "When the hinder parts of bodies are of different forms the resistances are different, though the fore parts be exactly alike and equal; owing, probably, to the different pressures of the air on the hinder parts."

Dr. Hutton likewise found, that although in slow motions the experimental resistance is nearly equal to that computed by theory, yet, "as the velocity increases, the experimental resistance gradually exceeds the other more and more, till, at the velocity of 1300 feet, the former becomes double the latter; after which, the difference increases a little further, till, at the velocity of 1600 or 1700 feet, when that excess is the greatest, and is rather less than 2 and 1-10th; and, after this the difference decreases gradually, as the velocity increases; and at the velocity of 2000 the former resistance again becomes just double the latter." For further information on this subject, *see* PROJECTILES, WIND.

AERO'GRAPHY (Gr. ἀηρ, *the air*, and γραφω, *I write*.) The description of the atmosphere, its nature, properties, limits, &c. (*See* ATMOSPHERE.)

A'EROLI'TE. (Gr. ἀηρ, *the air*, and λιθος, *a stone*, *stones of the air*.) The origin of these singular substances is involved in the greatest mystery. Some philosophers, among whom is Laplace, the illustrious author of the "Mécanique Céleste," suppose them to be ejected from volcanos in the moon; others suppose them to exist ready formed in the celestial space, circulating about the sun with great velocity, like planets, and falling to the earth when its attraction upon them preponderates; others regard them as fragments of rocks which have been propelled by terrestrial volcanos to an immense height above the limits of the atmosphere, and again descend after having described several revolutions about the earth.

On examining and comparing the aerolites, the first circumstance that strikes us as remarkable is their perfect resemblance to one another in their composition, whatever be their form or magnitude. Their exterior surface is black, as if they had been exposed to the heat of a furnace. Internally they are of a greyish white. Their specific gravity, which is very nearly the same in all of them, varies between 3·352 and 4·281, that of water being taken as unit. Their chemical analysis gives, in almost every instance, the same substances, combined in very nearly the same proportions. They are composed of silex, magnesia, sulphur, iron in the metallic state, nickel, and some traces of chrome. Sometimes they are formed of a spongy or cellular texture, the cavities being filled with a stony substance. They have occasionally been found without nickel. These common and constant characters indicate with the greatest evidence a common origin, and their composition renders it probable that it is to be sought elsewhere than in the earth. Iron is scarcely ever found (if, indeed, it is found at all) in the metallic state in terrestrial substances; volcanic matter contains it only in the state of an oxide. Nickel is also very rare, and never found on the surface of the earth; and chrome is still more rare.

The fall of the aerolites is accompanied by meteors, named bolides, or fire balls. They are, in fact, inflamed globes, which appear instantaneously in the atmosphere, and move through it with extreme velocity, sometimes even equal to that of the earth in its orbit. The direction of their motion is inclined to the horizon. After shining with great splendour for a few instants, they explode with a loud noise, and often at a great height, 30 or 40 miles above the surface of the earth. They do not affect any peculiar direction with respect to the motion of the earth, but seem to come from all points of the heavens indifferently.

With regard to the hypothesis which explains the origin of the aerolites, by supposing them to be propelled from lunar volcanos, it may be remarked, that no improbable amount of mechanical force would be required. As there is no atmosphere about the moon sufficient to offer a sensible resistance to the motion of a solid body, the force required is only that which would be sufficient to overcome the moon's attraction, which is found by calculation to be about four times the force with which a ball is expelled from a cannon with the ordinary charge of gunpowder. A body projected with a velocity of about 7770 feet per second from the lunar surface, would be detached from the moon, and be brought to the earth by terrestrial gravitation. But philosophers seem now disposed to assign the aerolites a different origin. From the phenomena of comets there is reason to believe that portions of chaotic matter are dispersed in the planetary regions in detached parcels, or perhaps in considerable masses. The earth in describing its orbit may meet with such masses directly, or pass so near to them as to carry them along with it by virtue of its attraction. On plunging into the atmosphere with the velocity due to the height from which they have fallen, which is that of their distance from the earth, when they begin to obey its attractive force, an enormous heat is evolved by the rapid and powerful condensation of the air; the matter becomes inflamed, and the aerolite is the product of the combustion. In the same manner shooting stars, and other igneous meteors of frequent occurrence, are explained. The chaotic matter may be entirely consumed long before it reaches the earth, in which case the appearance of the bolide will not be accompanied with the fall of an aerolite. (*See* FIREBALLS.)

Philosophers were long inclined to disbelieve in the fall of stones through the atmosphere. The fact, however, is now placed beyond all doubt by numerous and well authenticated instances which have occurred in almost all quarters of the world, even within the present century. A very complete list of the falls of stony or earthy matters, with the times and places of their occurrence, and the appearances they exhibited, is published in the Edinburgh Philosophical Journal, from a work by Chladni, in German, in which the whole subject of meteoric stones is ably and fully treated.

**AERO'LOGY.** (Gr. *ἀηρ*, *air*, and *λογος*, *a discourse.*) The doctrine of air, generally applied to medical discussions respecting its salubrity.

**AERO'METER.** (Gr. *ἀηρ*, *air*, and *μετρον*, *a measure.*) An instrument for making the necessary corrections in pneumatic experiments, to ascertain the mean bulk of gases

**A'ERONAUT.** (Gr. *ἀηρ*, *air*, and *ναυτης*, *a sailor.*) One who travels in a balloon.

**A'ERONAUTICS.** (Gr. *ἀηρ*, *air*, and *ναυτικος*, *of or belonging to ships.*) The art of sailing in and navigating the air. From the earliest ages men have been actuated by a wish to be able to participate in the advantages conferred on the lower animals, and having succeeded in navigating the sea, to be able also to mount, like the eagle, into the air. The story of Dædalus, who is said to have escaped from Crete to Sardinia, by means of wings contrived to assist him, is known to every classical reader and proves, at least, the antiquity of attempts of this sort But the fate of his companion Icarus, seems to have had a greater influence in deterring from similar attempts than the reported success of the artificial dove, constructed by the geometer Archytas, which is said to have wafted itself through the air by means of internal springs During the middle ages, when the nature of the atmosphere and the sound principles of mechanical philosophy were alike unknown, many rude and necessarily unsuccessful attempts were made to realize this difficult problem. But it was not till the composition of the atmosphere had begun to be ascertained, and that means had been devised of filling vessels with heated air, or other air lighter than atmospheric air, and consequently capable of floating on it, that there came to be a rational prospect of succeeding in the "audacious attempt" of riding in the air. At length, in 1782, the brothers Montgolfier succeeded in constructing a balloon; and on the 21st of October, 1783, Pilatre de Rozier, a young naturalist and the Marquis d Arlandes, ascended from Paris to an elevation of more than 3000 feet, and alighted safely from their "ærial tour," after describing a circuit of about six miles. Since that time ascents in balloons have become comparatively common. (*See* BALLOON, and the article Æronautics in the *Encyclopædia Britannica*, 7th edit.)

**A'EROPHY'TES.** (Gr. *ἀηρ*, *air*, and *φυτον*, *a plant.*) Plants which live exclusively in air; in distinction to hydrophytes, which live as constantly under water.

**A'EROSTA'TICS.** A term sometimes used to denote the science which treats of the equilibrium of elastic fluids. (*See* PNEUMATICS.)

**A'EROSTA'TION.** (Gr. *ἀηρ*, *air*, and *σταω*, *I stand.*) Means simply the weighing of the air; but it has been employed, though incorrectly, in the science of æronautics, or as the art of raising substances into the atmosphere by the buoyancy of heated air, or of very light gases enclosed in a bag of a spheroidical form; hence called a balloon, which see.

**ÆSCULA'CEÆ** A natural order of exogenous plants, consisting of the horse-chesnut, Æsculus hippocastanum, and other nearly allied species. They are all either shrubs or trees inhabiting temperate regions, and nearly correspond with Æsculus hippocastanum in the structure of the flowers. Their seeds contain starch, and their bark is in some cases bitter and astringent.

**ÆSCULA'PIUS, or ASCLE'PIUS,** as he was called by the Greeks, was a mythological deity of the Greeks and Romans, according to whom he was the son of Apollo and the nymph Coronis. He was worshipped as the god of surgery and medicine; but the older poets, as Homer and Pindar, mention him only as a hero well skilled in these arts. The chief seat of his worship was Epidaurus, where he was represented as an old man, with a mantle and staff, round which a serpent is twined.

**AESTHE'TICS.** (Gr. *αἰσθητικος*, *having the power of perception by means of the senses.*) In the fine arts, that science which derives the first principles in all the arts from the effect which certain combinations have on the mind, as connected with nature and right reason. It is intimately related to sentiment, which links together with feeling the different parts of a composition. All art, considered as imitation of nature, is affected by the same relations, and subject to the same laws, which govern nature herself; and if it could be satisfactorily proved that those rules of art which are the result of reason were necessarily connected with sensation, it might be possible to lay down laws from which the principles of art might be satisfactorily deduced. As an illustration of this, in architecture we might take the rule which forbids the position of a heavy mass over a void, when it may appear to have no ostensible and immediate support; in which case it might almost seem possible to connect the unpleasant sensation produced on the mind with the rules of reason; but in architecture it is difficult to conceive how this could be effected, without recurring to primitive types, and on them pursuing the reasoning into all its details. In the other arts it might not, perhaps, be so difficult to establish a set of rules, inasmuch as the immediate type is nature herself. The Germans have written much on the doctrine of aesthetics; it would, however, seem, that the fundamental principles of taste in all the arts depend on the laws of gravitation, and their balances, equipoise and counterpoise; the necessary resultants whereof are symmetry and proportion. We shall here lay before the reader a synoptical view of this science: to do more would occupy a space much more than would fill this volume; for, under other names, it is a subject which has much engaged the attention of writers on the philosophy of the arts. The essence of the polite arts lies in expression, or the power of representation, whether by lines, words, or other media, and that expression arises from an exercise of the inventive faculty; their end being the production of pleasurable sensations; thus being distinguished from the end sought in the sciences, whose object is to produce instruction and utility. And here we are to observe, that though

in some of the polite arts, such as eloquence, poetry, and architecture, the end may be to instruct, or to be applicable to useful objects, yet that the expression on which they depend brings them within the laws which govern the fine arts. The object of the fine arts is beauty, which is the result of all the various perfections whereof an object is susceptible. such perfections arising, first, from the agreeable proportions between the several parts of the same object; and, second, from the proportions between each part and the object taken as a whole. Genius, or the power to invent, is the faculty of the mind by which it is enabled to conceive and express its conceptions, and is, consequently, necessary to the production of beauty; while taste, or the natural sensation of a mind refined by art, is the guide to genius in discerning, embracing, and producing beauty. Hence a general theory of the polite arts must be founded on a knowledge of all that they contain truly agreeable and beautiful. They are usually said to include eloquence, poetry, music, painting, sculpture, and architecture. By some, dancing has been added to the number; but, for reasons too long to be advanced here, we cannot include it. The rules have been reduced to six, for the guidance of the artist, who is to recollect that, in every art, what is low, indecent, or disagreeable, must be banished from his work. First, he must consult his genius —

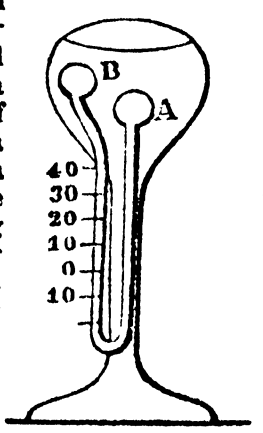
Quid ferre recusent,
Quid valeant humeri;

second, he must constantly labour to improve his taste; third, nature must be the constant object of his imitation; fourth, he must attain perspicuity, so that his end may be free from ambiguity and obscurity; fifth, he must elevate his sentiments above all common or commonplace objects, by which an expansion of the imagination supervenes and stamps his works with an air of sublimity, which, sixthly, results from a concurrent observance of the fourth and fifth rules. We close this with the following observation of Menzel: "Art is not the result of understanding alone; the inspiration of the artist has been, and ever must be, the source of that which gives æsthetic value to his productions."

*Æ'STHNA.* A name applied by Fabricius to a genus of dragon-flies, characterised by having the wings expanded when at rest, and the divisions of the lip equal.

AE'THEO'GAMOUS. (Gr. *ἀηθὴς*, *unusual*, and *γαμος*, *marriage*.) A name contrived to express more clearly the nature of what are called cryptogamic plants; it being the opinion of the author of the name that the mode of propagation among such plants was not hidden, but only of an unusual nature. It has been confined by De Candolle to such as have vessels, as well as cellular tissue, in their organisation. In this sense they are the same as ferns, lycopodiums, mosses, and their allies.

*Æ'THRIOSCO'PE.* (Gr. *ἀιθριος*, *clear*, and *σκοπεω*, *I view*.) An instrument invented by Sir John Leslie for measuring the relative degrees of cold produced by the pulsations from a clear sky. It consists merely of a differential thermometer, adapted to the cavity of a spheroidal cup of metal, the interior of which is highly polished, in such a manner that one of the balls occupies a focus of the spheroid; while the orifice of the cup is formed by a plane passing through the other focus, perpendicular to the axis. A lid of the same metal is fitted to the mouth of the cup, and only removed when an observation is to be made. Suppose the cup exposed to a clear sky: the cold pulses darted from the upper regions of the atmosphere, which enter the orifice of the cup, are reflected from polished surface upon the ball A in the focus, while the ball B, lodged at the side of the cup in its widest part, is nearly screened from them, or receives only the small number which fall obliquely upon it. The two balls are thus exposed to different degrees of cold, the effect of which is immediately apparent, by the rise of the liquor in the stem of the thermometer, in consequence of the contraction of the air in the ball A. The effect may be augmented by covering the ball B, which is out of the focus, with a coat of gold or silver leaf. It is evident that the instrument is equally adapted to measure the effects of the radiation of heat, which will be manifested by the descent of the liquor in the stem. When applied to this purpose, however, the metallic cup becomes unnecessary; the hot pulses being mostly thrown back from the bright surface of the gilt ball, while they produce their full effect on the naked or sentient one. The æthrioscope is thus converted into a pyroscope. (See *Encyc. Brit.* article Climate.)




ÆSTIVA'TION. (Lat. æstivus, *of or belonging to summer*.) A figurative expression, employed to indicate the manner in which the parts of a flower are arranged before they unfold. Botanists speak of the æstivation of the calyx, of the corolla, of the stamens.

*Æ'STUARY.* (Lat. *Æstuarium*.) In Geography, was anciently understood to be any creek, frith, or arm of the sea, in which the tide ebbs and flows (Plin. Epist. lib. 9. ep. 33.); but it is now applied to designate those parts of the channels of certain rivers contiguous to the sea in which the water is either salt or brackish, and in which the ebb and flow of the sea is distinctly perceptible, and there is little or no current.

*Æ'THER.* *See* ETHER.

A'ETIA'IOI. (Gr. *ἀιτος*, *an eagle*.) In Architecture, the name given by the Greek architects to the slabs forming the face of the tympanum of a pediment. This word occurs in the Athenian inscription now in the British Museum, brought to England by Dr. Chandler, and relating to the survey of some temple at Athens.

ÆTIO'LOGY. (Gr. *ἀιτια*, *a cause*, and *λογος*, *discourse*.) The doctrine of the causes of disease.

AETO'MA, or A'ETOS. (Gr. *ἀιτος*, *an eagle*.) In Architecture, the name given by the Greek architects to the tympanum of a pediment. It seems to have derived its name from the custom of decorating the apex or ridge of the roof with figures of eagles, and that the name thence first given to the ridge was afterwards transferred to the pediment itself.

AFFECTA'TION. (Lat. affectare, *to seek for overmuch*.) In the fine arts, an artificial show arising from the want of simplicity either in colouring, drawing, or action. Also, the overcharging any part of a composition with an artificial or deceitful appearance.

AFFE'CTED, or ADFECTED. A term of algebra. When applied to an equation, it signifies that two or more several powers of the unknown quantity enter into the equation: thus, $x^3 - ax^2 + bx - c = o$, in which there are three different powers of $x$, namely, $x^3$, $x^2$, and $x$. When the term is applied to a quantity, it implies that the quantity has a coefficient, or a proper sign: thus, in the quantity $+ 2x$, $x$ is said to be affected with the coefficient 2, and with the sign $+$. Dr. Hutton thinks the term affected was introduced into algebra by Vieta.

AFFE'TTO, or AFFETTUOSO. (It. affetto, *affection*.) In Music, a term prefixed to a movement, showing that it is to be performed in a smooth, tender and affecting manner, and, therefore, rather inclining to slowness than the reverse.

AFFIDA'VIT. (Lat. affido, *I confirm by oath*.) In Law, is an oath in writing, sworn before some person who has authority to administer it.

AFFILIA'TION. (Lat. ad, *to*, filius, *a son*.) In Law, the assignment of a child to a parent by legal authority; as where the father of a bastard child is designated on the testimony of the woman, and the expenses of maintaining it cast upon him. By the Poor Law Amendment Act, s. 72., this can now only be done, after sufficient notice to the party intended to be charged, by an order of the court of quarter sessions, on the testimony of the woman, corroborated as to some material fact by other evidence. (See BASTARD.) *Affiliated societies*, in politics, are local societies, depending on a central society with which they correspond, and from which they receive directions. Such were the provincial jacobin clubs, founded on the model of the jacobin club of Paris. Such, also, were the corresponding societies in England, for the suppression of which the statute 39 G. 3. c. 79. was chiefly passed.

AFFI'NITY. (Lat. affinis, *related*.) A relation of animals to one another, in the similarity of a greater proportion of their organisation: thus, a porpoise is said to have an affinity to man, because of its resemblance to him in the respiratory, circulating, and generative systems, in the brain, eye, and ear, &c.; while it is said to have an analogy to a fish, because the resemblance is confined to external form. In short, affinity is that degree of relationship by which, in forming a concatenated series of animals, we pass from one to another by the closest gradations.

AFFINITY, CHEMICAL. The attractive force by which dissimilar substances combine with each other to produce chemical compounds. All natural and artificial substances are either simple or compound. The metals, for instance, are simple substances, — no one of them having been as yet decomposed: water is a compound; it may be resolved into oxygen and hydrogen gases, which are therefore called its component parts. To enable substances to exert their mutual affinities, or to act chemically upon each other, the opposing powers of matter must be overcome, and they must be placed under circumstances favourable to the exertion of their mutual chemical attractions. Two solid bodies seldom combine, in consequence of their imperfect contact, and the immobility of their particles; hence the old axiom, *corpora non agunt, nisi fluida*. But to this there are exceptions: ice and salt, for instance, run down into liquid brine; oxalic acid and dry lime unite; and when sulphur and chlorate of potash are rubbed together, they act violently on each other. Even when one or both substances are fluid, heat is often requisite to diminish cohesion, and promote affinity: thus, mercury and iron combine with melted sulphur; and oxygen and hydro-

gen, and oxygen and carbon, require heat to effect their union. In some cases the action of the solar rays excites and increases affinity, as in the combination of hydrogen and chlorine.

The investigation of the relative proportions in which bodies combine, forms the basis of the atomic theory, or doctrine of chemical equivalents.

Many substances seem to unite in all proportions; but these are not strict cases of chemical combination: thus, water and sulphuric acid, and alcohol and ether, mix together in any quantities. Others unite indefinitely, up to a certain point: water, for instance, dissolves salt, in variable quantity, till the solution is saturated: we thus find that a given quantity of water is only able to retain a certain weight of salt in permanent solution. In these cases of indefinite combination, the affinities of the combining substances are usually feeble; but where their affinities or attractive powers are energetic, there is a remarkable tendency to combine in certain proportions only. Thus, sulphuric acid and lime unite in the proportions of 40 of the acid to 28 of the lime, and in no other or intermediate quantity: in such cases the acid and the base are said to neutralise each other; and such compounds are often called neutral salts, that is, salts in which the leading characters of the component parts are no longer perceptible, which are neither acid nor alkaline. When such bodies combine in more than one proportion, which is often the case, the second, third, &c. proportions are simple multiples of the first: thus, 16 parts of sulphur combine respectively with 8, 16, and 24 of oxygen; in these compounds the relative proportions being as 1, 2, and 3. Again, 14 parts of nitrogen combine with 8, 16, 24, 32, and 40 of oxygen, forming five distinct compounds, in which the relative proportions of the oxygen are as 1, 2, 3, 4, and 5.

Where the combining substances are either naturally gaseous, or where they may be hypothetically so considered, it is obvious that, as their weights bear these simple relations to each other, their bulks or volumes will do so likewise: thus, in the case of the compounds just noticed, 1 volume of nitrogen will combine respectively with $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, and $2\frac{1}{2}$ volumes of oxygen; or, what amounts to the same thing, 2 volumes of nitrogen will combine with 1, 2, 3, 4, and 5 volumes of oxygen.

As bodies thus combine with each other in definite proportions, it is obvious, that if we select any one substance as unity, or = 1, all other substances may be represented by numbers equal to the weights in which they respectively combine with each other, and with the unit. Upon this principle of numeric representation, hydrogen, which is the lightest known substance, is assumed as unity; the compound of hydrogen with oxygen is water, in which 1 part by weight of hydrogen is combined with 8 of oxygen, to form 9 of water: hence, in a table of atomic numbers, definite proportionals, or chemical equivalents, (for all these terms have been applied to such numbers,) we have —

| | |
|---|---|
| Hydrogen represented by | 1 |
| Oxygen . . | 8 |
| Water . . | 9 |

And in the above series of nitric compounds we have, in the first of them, 14 of nitrogen combined with 8 of oxygen; and, accordingly, calling 14 the equivalent of nitrogen, and 8 the equivalent of oxygen, we have the following equivalents of their compounds; and it may be presumed that these numbers represent the weights of the combining atoms of those bodies. —

| *Atoms of nitrogen.* | | *of oxygen.* | *Equivalents, or combining weights, of nitrogen.* | | *of oxygen.* | | *Equivalents of the compounds.* |
|---|---|---|---|---|---|---|---|
| 1 | + | 1 | 14 | + | 8 | = | 22 nitrous oxide. |
| 1 | + | 2 | 14 | + | 16 | = | 30 nitric oxide. |
| 1 | + | 3 | 14 | + | 24 | = | 38 hyponitrous acid. |
| 1 | + | 4 | 14 | + | 32 | = | 46 nitrous acid. |
| 1 | + | 5 | 14 | + | 40 | = | 54 nitric acid. |

This table also shows the nomenclature commonly applied to the compounds; the termination *ous* indicating the minimum of oxygen, the termination *ic* the maximum; the term oxide implying generally all those combinations of oxygen which are not sour, such being called acids. More frequently the relative proportions of oxygen in the oxides are designated by the first syllable of the Greek ordinal numerals: thus we have protoxides, deutoxides, tritoxides, &c.; and when the base is saturated with oxygen, the compound is termed a peroxide. When the same substance forms three or four acids, the term hypo is conveniently introduced with the termination *ous* or *ic*, as shown in the following table of the acids of sulphur: —

| *Atoms of sulphur.* | | *oxygen.* | *Equivalents of sulphur.* | | *oxygen.* | | *Equivalents of the acids.* |
|---|---|---|---|---|---|---|---|
| 1 | + | 1 | 16 | + | 8 | = | 24 hyposulphurous. |
| 1 | + | 2 | 16 | + | 16 | = | 32 sulphurous. |
| 1 | + | 3 | 16 | + | 24 | = | 40 sulphuric. |

There is also an acid of sulphur intermediate between sulphurous and sulphuric, composed of 1 atom of hyposulphurous acid and 1 of sulphurous acid; (24 + 32 = 56) or of 2 atoms of sulphur and 3 of oxygen: this is appropriately called the hyposulphuric acid. The terms *sesqui* and *bi* are sometimes used to designate intermediate and double compounds of acids, or other bodies with bases: thus, we have three compounds of carbonic acid with ammonia, in which 1 proportional or atom of ammonia is respectively combined with 1, $1\frac{1}{2}$, and 2 of carbonic acid, and these we call the carbonate, sesquicarbonate, and bicarbonate of ammonia. For a table of the equivalent numbers of the simple substances, *see* EQUIVALENTS.

Change of form and change of properties are the common consequences of chemical affinity. We observe, 1. Solids forming liquids (ice and salt). 2. Solids forming gases (explosion of gunpowder). 3. A solid and a liquid producing a solid (lime and water). 4. A solid and a liquid producing a liquid (all common cases of solution; as of salt and sugar in water). 5. Liquids producing solids (solution of carbonate of potassa mixed with muriate of lime). 6. Liquids producing gases (alcohol and nitric acid). 7. Gases producing solids (ammonia and muriatic acid). 8. Gases producing liquids (chlorine and olefiant gas).

The density of bodies is also materially affected by chemical combination; the density of a compound is very rarely the mean of its components, but generally increased: thus, almost all gaseous compounds occupy less bulk than their elementary gases in a separate state; there are, however, cases in which 1 volume of one gas, combined with 1 volume of another, produce exactly 2 volumes of a compound gas, the density of which is, of course, the mean of that of its components; and again, in the combinations of some of the metals with each other, and with sulphur, the density of the compound is below the mean of its elements. When certain liquids are mixed, great and immediate increase of density ensues, and much heat is evolved (sulphuric acid and water). Change of form and of density are often attended by remarkable changes in other qualities thus, tasteless bodies produce active compounds (oil of vitriol is composed of oxygen, sulphur, and water), and active substances produce inert compounds (sulphuric acid and caustic potash produce the inert salt, sulphate of potash), so that it is utterly impossible, by any *à priori* reasoning, to determine what will be the consequence of chemical combination: useless elements produce useful compounds, and useless compounds yield useful elements.

Another important and curious consequence of chemical action is change of colour: the vegetable blues are generally reddened by acids, and rendered green by alcalis; the alcalis render many of the reds purple; and of the yellows, brown: chlorine destroys most colours; so does the joint action of light, air, and moisture (bleaching, &c.).

AFFI'RMATIVE. In Logic, denotes the quality of a proposition which asserts the agreement of the predicate with the subject.

AFFIRMATIVE QUANTITY. In Algebra, denotes a quantity to be added, in contradistinction to one to be taken away.

AFFIRMATIVE SIGN, or POSITIVE SIGN. The sign of addition, marked +, meaning plus, or more. Dr. Hutton observes, that the early writers on algebra used the word plus in Latin, or più in Italian, for addition, and afterwards the initial *p* only as a contraction; like as they used minus or meno, or the initial *m* only, for subtraction, and thus their operations were denoted in Italy by Lucas de Burgo, Tartalea, and Cardan, while the signs + and — were employed much about the same time in Germany by Stifelius, Scheubelius, and others, to denote the same operations.

A'FFIX. In Grammar, a syllable attached to the end of a class of words, determining their meaning. Thus, a class of adverbs in English are determined by the affix *ly*; strongly, weakly, &c. Prefix is a syllable so attached at the beginning.

AFRA'NCESADOS. In Modern History, a denomination given in Spain to the party which attached itself to the cause of the French, or of the intrusive King Joseph, during the war of independence, 1808—1814.

AFT. *See* ABAFT.

A'FTERMATH. In Agr. Grass which is mown, after the first crop of hay has been taken away, instead of being eaten off by stock.

A'GA. A title of dignity among the Turks and Persians, given to various officers: as, the aga of the janissaries, while that corps subsisted; the capi-aga, or chief eunuch of the seraglio, &c. It is also a common epithet of respect in addressing a distinguished person.

AGA'LMATOLI'TE. (Gr. ἀγαλμα, *image*, and λιθος, *a stone*.) The mineral which the Chinese carve into images.

AGA'MA. (Gr. ἀγαμαι, *I wonder at*.) The name of a lizard, employed by Cuvier to designate the

first section of the Iguanian sauria, or *Agamidæ*; which section is characterised by the absence of palatal teeth. The Agamoid lizards include several genera, which are numerous in species, and they are distributed over the warmer parts of America, Africa, Asia, and Australia. They have all the power of inflating the body, and of producing, but in a less degree than in the chamæleon, changes of colour, whence, probably, the origin of the name.

A'GAMOUS. (Gr. ἀ, *without*, and γαμος, *nuptials*.) A term substituted by some writers for cryptogamic, because such plants have in reality no organs analogous to sexes: it is, however, usually limited to such groups as confervæ, lichens, and fungi, because they have in reality nothing either analogous or similar to the sexes of more perfect plants; while, on the contrary, ferns and mosses, although they have not any real sexes, nevertheless are considered by some writers to possess parts of an analogous nature.

A'GAPÆ. (Gr. ἀγαπη, *love*.) Love feasts, in use among the primitive Christians. After the celebration of the communion, the oblations which had been made in the temple, consisting of meat and bread which the rich had brought from their houses, were consumed at a common feast. There is some dispute whether in the apostolic times this feast did not take place before the communion, in more exact accordance with the circumstances attending the institution of the sacrament. The agapæ or feasts in churches, were prohibited by the Council of Laodicea, A. D. 361, and the third of Carthage, A. D. 397.

A'GAPHITE. *See* TURQUOISE.

A'GARIC. (Agaria, *a kingdom in Sarmatia*.) A genus of fungi comprehending many hundred species, among which are, A campestris, the common mushroom, and some others, which are delicate articles of food; A. muscarius and others that are dangerous poisons; many of the disgusting deliquescent fungi called toadstools; and numerous beautiful little ephemeral species, which appear to be harmless: A. olearius is remarkable for being phosphorescent. These plants uniformly grow in decaying animal or vegetable matter, among which their stem, or spawn, as it is commonly called, ramifies. After the spawn has arrived at the proper age, it ceases to branch, collects into parcels, and generates from those parcels the fructification, which forces its way into the light under the form of the agaric. The cap is the part where the spores or seeds for reproducing the species are generated; they are formed within the plates or gills that lie on the under side of the cap, and are little grey round bodies, which, when they are collected in great quantities upon a sheet of white paper, have the appearance of exceedingly fine dust. "Fairy rings" are caused by the underground stems of agarics which branch from a common centre, and only protrude their fructification at the circumference.

AGARIC MINERAL. A very soft mealy variety of carbonate of lime.

AGA'STRICS, AGASTRIA, AGASTRICA. (Gr. ἀ, *without*, γαστηρ, *a stomach*, *stomachless*.) A term which has been applied to certain animalcules, on the erroneous supposition that they were devoid of internal digestive cavities. (*See* POLYGASTRICS.) The term is still applied to a family of medusæ.

A'GATE. An aggregate of certain siliceous minerals, possessing hardness, and variety of colour and mixture, and admitting of a good polish. Chalcedony generally appears to be the base of agate; carnelian, jasper, amethyst, and other similar minerals, often enter into their composition.

A'GATHODÆ'MON. (Gr. ἀγαθος, *good*, and δαιμων.) A good spirit. (*See* DÆMON.)

AGA'VE. (Gr. ἀγαυος, *admirable*.) A genus of plants found in the temperate parts of America, resembling aloes in their mode of growth and general appearance, but differing in having an inferior ovary, and in their sensible properties. The best known species is Agave americana, called the American aloe, which has been naturalised on the coasts of the Mediterranean, where it assists, with Cactus opuntia, the palmetto, and date palms, to give a tropical air to European scenery. It is many years preparing the materials for its gigantic pyramid of flowers, and is so exhausted by the effort, that it quickly afterwards perishes. A sweet sap flows from its inward stem, and upon fermentation becomes an intoxicating beverage, yielding by distillation a powerful ardent spirit. Hemp of considerable strength is manufactured from its leaves. The genus agave is the type of one of the subdivisions of amaryllidaceous plants.

AGE. (Fr. *age*.) Means, generally, a definite period or length of time.

AGE. As applied to man, age may either mean the whole of his life, or a portion of it. It is usual to divide the whole period of human life into four parts or ages. The first, or infancy, extending to the fourteenth year; the next, or youth, from the fourteenth to about the twenty-fifth; manhood, from the twenty-fifth to the fiftieth or sixtieth; and the last, or old age, filling up the remainder. Ovid ingeniously compares these four ages to the four different seasons of the year.—(Metamorph. xv. ver. 200.) These divisions are, however, in a great degree arbitrary; and very frequently they have been extended to six, the first being divided into infancy and childhood, and the last into old age and extreme old age. Sometimes, also, the life of man is supposed to be divided into seven ages, the leading characteristics of which have been most admirably depicted by Shakespeare:—

"His acts being seven ages. At first, the infant,
Mewling and puking in the nurse's arms.
And then, the whining schoolboy, with his satchel,
And shining morning face, creeping like snail
Unwillingly to school. And then the lover;
Sighing like furnace, with a woeful ballad
Made to his mistress' eyebrow: then a soldier,
Full of strange oaths, and bearded like the pard,
Jealous in honour, sudden and quick in quarrel,
Seeking the bubble reputation
Even in the cannon's mouth and then, the justice;
In fair round belly, with good capon lin'd,
With eyes severe, and beard of formal cut,
Full of wise saws and modern instances,
And so he plays his part. The sixth age shifts
Into the lean and slipper'd pantaloon,
With spectacles on nose, and pouch on side;
His youthful hose well sav'd, a world too wide
For his shrunk shank; and his big manly voice,
Turning again toward childish treble, pipes
And whistles in his sound. Last scene of all,
That ends this strange eventful history,
Is second childishness, and mere oblivion;
Sans teeth, sans eyes, sans taste, sans every thing."

For a scientific discussion of this subject, *see* MORTALITY.

AGE. In Law, is the period at which individuals are qualified to undertake certain duties and offices. By the common law of England, a man at fourteen is at the age of discretion, and may then appoint guardians, and marry with their consent: at twenty-one he is of full age, and may, consequently, exercise any civil privilege to which he may otherwise be entitled, that is, he may elect or be elected to parliament, be appointed a judge, alienate lands, &c. But no person can be admitted in England to deacon's orders till he be twenty-three years of age, nor to priest's till he be twenty-four. At twelve years a woman may marry, provided she have the consent of her parents or guardians; and at twenty-one she is her own mistress, and may dispose of herself and her estates.

Infants under seven years are held by the law of England to be incapable of committing felony. If persons above that age, and under fourteen, commit felony, they are *prima facie* entitled to an acquittal; but if it appear to the court and the jury that the accused was *doli capax*, or clearly understood the nature of the crime he was committing, they may proceed on the principle that *malitia supplet ætatem*, and subject the offender, as, in point of fact, has been repeatedly done, to the extremest penalty of the law. Persons above fourteen are treated in this respect as if they had arrived at full age.—(*Blackstone*, book iv. cap. 2.)

At Rome, the *consular age*, or the age at which a person became capable of holding the consular dignity, was fixed at forty-three, though in extraordinary cases this rule might be set aside. In France, at this moment, a man is not allowed to exercise the elective franchise till he be twenty-five years of age; nor to be elected a deputy till he be thirty. In some of the American states judges are obliged to retire when they have attained to a certain age, which is sometimes so early as sixty.

AGE. In Mythology, age means one or other of the four ages as described by the ancient poets. The first or golden age, *aurea ætas*, when there was an eternal spring, and when the earth spontaneously poured forth her harvests, and man

——"vindice nullo,
Sponte suâ sine lege fidem rectumque colebat,"

was coeval with the reign of Saturn on earth. The next, or silver age, *argentea ætas*, was marked by the change of seasons, and the division and cultivation of lands. The third, or brazen age, *aenea ætas*, is described as

"Sævior ingeniis, et ad horrida promptior arma:
Nec scelerata tamen."

And then came the last, or iron age, *ferrea ætas*, full of all sorts of hardships and wickedness, which still continues. (*Ovidii Metamorph.*, i. lin. 89., &c.)

AGE. In Literature, age is a period distinguished by great improvements and eminence in arts and sciences, usually bearing the name of some powerful sovereign, or other prominent person, who flourished during that period. Of these ages, the most memorable are the age of Pericles, the Augustan age, the age of Leo X., the age of Louis XIV., &c.

AGE. In Chronology and History, age is sometimes used as synonymous with a century, and sometimes also with a generation. Writers differ in respect to the period included under what is called the *middle ages*; but they are commonly understood to begin with the reign of Constantine, and to extend to the fifteenth or the early part of the sixteenth century. The æra of the invention

of printing, 1450—1455, might, we think, be advantageously adopted as the termination of the middle ages.

AGE'NDA. (Lat. *things to be done.*) Small books are now published under this title, in which individuals may set down, under their proper heads, the things to be daily attended to.

AGENDA. In Divinity, articles of moral practice, in opposition to *credenda*, articles of faith. Also, the ritual of a church, and the books containing it.

A'GENT. In Law, is a person authorised to do some act or acts in the name of another, who is called his principal. An agent may, in general, be appointed by bare words, or his appointment will be inferred from circumstances; but, for some purposes specified by the statute of frauds, his appointment must be in writing. The agent of a corporation must, in general, be appointed by deed. If an agent has engaged to perform certain duties for a consideration, the performance may be enforced in law. But against an unremunerated agent, the principal can only recover damages for misconduct in the performance, and cannot compel him to proceed. With respect to the dealings of third parties with an agent, some general rules of law are, that the extent of an agent's authority is, as between his principal and third parties, to be measured by the extent of his usual employment; that the representation of an agent about the subject-matter of a contract which he is negotiating for his principal, will, if made during the course of the negotiation, bind the latter; that payment to an agent, in the course of his employment, is payment to the principal; that the principal is, under many circumstances, responsible in civil actions for the negligence or fraud of his agent, but not criminally liable for his acts, unless done under an express command.

AGENT. In Diplomacy, a general name, comprising several ranks:—as, 1. Ambassadors. 2. Envoys extraordinary and ministers plenipotentiary. 3. Ministers resident. 4. Chargés d'affaires. 5. Secretaries of legation, &c. In common language, however, the highest officer employed by one power at the court of another, is usually termed the agent of that power at the court in question. (*See* DIPLOMACY.)

A'GGREGATE ANIMALS. This term is applied to those animals which are collected together in a common enveloping organised substance containing numerous compartments, from each of which a distinct occupant sends forth a circle of organs to collect food, which, after assimilation, is carried by a common and continuous system of vessels for the support and enlargement of the common dwelling. Examples of animals so associated or aggregated occur in the class polypi, where they form most of the orders; also in the class acalephæ, forming the polytoma; and in the acephalous mollusca, forming the genera botryllus, pyrotoma, and polyclinum.

AGI'LIA. (Lat. agilis, *swift*) A family of rodents in the system of Illiger, including the squirrels and dormice.

A'GIO. A mercantile term, denoting the percentage difference existing between the values of the current and standard moneys of any place. Also, the rate of premium which is given, when a person having a claim which can only be legally demanded in one metal, chooses to be paid in another. Thus, in countries where silver is the only legal standard, a large payment in silver is so inconvenient, that the receiver will often pay a small premium for the convenience of receiving gold: this premium constitutes the agio on gold.

A'GIOTAGE. A term employed to designate the sort of manœuvres by which speculators in the public funds contrive, by disseminating false rumours, or otherwise, to lower or enhance their price. It is sometimes also, though less commonly, applied to the machinations of those who endeavour, by similar artifices, to raise or depress the prices of commodities.

AGI'STMENT. In Law. From the old French word, *agister*, which signifies a licence granted for cattle, viz. to be harboured, or, in legal phrase, levant and couchant, on the land. A contract by which A.'s cattle are taken into B.'s ground, to remain there at a stipulated sum, paid periodically. Agistment is also used for the profits of such feeding. The "Tithe of Agistment," or of cattle and other produce of grass lands, demanded by the Irish clergy, was resisted, in 1729, by the landlords, and in effect abolished by a resolution of the Irish house of commons (1735). By the act of union, this resolution was passed into law; and thus the tithes of Ireland have, in effect, been thrown on the poorest part of the agricultural population, the owners and cultivators of arable land. (See *Ed. Rev.*, vol. xxxiv.: Wakefield's *Ireland*, vol. ii.)

A'GNATE. (Lat. agnatus.) In Roman Law, *agnates* are those who descend through males from a common ancestor; in opposition to *cognates*, i. e. all the descendants of a common ancestor, whether through males or females. Thus, in France, the hereditary crown passes by right of *agnation*, females being excluded.

AGNO'MEN. Besides the prænomen, nomen, and cognomen, the Romans sometimes had a fourth name (agnomen), which was derived from some illustrious action or remarkable event. Thus, two Scipios had the name Africanus given them, on account of their victories over the Carthaginians in Africa. The younger of these celebrated generals had a second agnomen, viz. Æmilianus, because he was the son of L. Paulus Æmilius, and adopted into the family of the Scipios.

A'GNON. A name applied by Fabricius to a genus of dragon-flies, having the wings erect when at rest, the eyes distinct, and the outer divisions of the lip bifid.

AGNO'STUS. (Gr. ἄγνωστος, *unknown.*) A name devised to express the obscure nature of a genus of trilobites (fossil crustaceans), to which it is attached; the genus is characterised by the semicircular or reniform shape of the body, which in all other trilobites is ovate or elliptical.

A'GNUS DEI. (Lat. *Lamb of God.*) 1. A prayer of the Roman Catholic church, which begins with the words, "Agnus Dei qui tollis peccata mundi." 2. An image of wax, impressed with the figure of the Lamb, consecrated by the pope, and distributed to the faithful.

AGO'MPHIANS, AGOMPHIA. (Gr. ἀ, *without*, and γομφιος, *a tooth.*) A term applied by Ehrenberg to those rotifers of which the jaws are deprived of teeth.

A'GONY. (Gr. ἀγωνια, *contest.*) In Divinity, the suffering of our Saviour in the garden on the night preceding his crucifixion. Luke, xxii. 24.

A'GORA. The market place of a Greek town, which was generally used also as the place where the assemblies of the people met. It answers to the Latin term forum. From the verb ἀγειρειν, *to collect*, or *assemble.* From agora is derived

AGORA'NOMUS. The title of an Athenian magistrate, forming one of a body of ten, or, as some say, fifteen, persons whose duty it was to superintend the markets, and collect the customs imposed on certain articles.

AGOU'TI. The Indian name of some South American herbivorous rodent quadrupeds, now included in the genus *Dasyprocta*

AGRA'RIAN LAWS. (Lat. ager, *field.*) Under this term are comprehended the enactments which were carried or attempted to be carried at Rome by the plebeians and their partisans, in opposition to the patricians, touching the distribution made of the public lands accruing to the state by conquest. These were leased out to the patricians by the state at a moderate or nominal rent, while the plebeians gained nothing by them. The object of the agrarian laws, which did not interfere with private freehold property, was to obtain for the plebeians a share in these lands, to restrict the quantity occupied by individuals, and to cause a real rent to be paid from them for the support of the army. The most celebrated movers of these laws were, Sp. Cassius, Licinius, and the two Gracchi, whose reputation has suffered with posterity, from being intrusted to the hands of writers who favoured the party whose unjust encroachments were sought to be moderated by these laws. For a more impartial investigation of them than can be found in ancient writers, (for Cicero, from his aristocratic partisanship, has much misrepresented the objects of these reformers, and the character of the laws they sought to introduce,) see Niebuhr's *Roman History*. In consequence of the misrepresentations here alluded to, an "Agrarian law" now generally serves to denote a law for the spoliation of individuals, by reducing landed property in private hands to a fixed amount. The law of partibility of real estates, as it obtained in the Roman jurisprudence, and still more in countries where it cannot be controlled by testamentary disposition, has, in some measure, the effect of an Agrarian law, although free from its injustice.

AGREE'MENT. (Fr. agrément, *agreeableness.*) In the fine arts, a certain degree of resemblance between the parts, in style and character, so that they may seem to belong to each other.

AGREEMENT. In Law, that which is consented to by two or more parties. Agreements are divided into executed and executory. By the statute of frauds, 29 Car. 2. c. 3. no action can be brought to charge a defendant on any agreement upon consideration of marriage, or on any contract or sale of lands, &c., or any interest therein, or any agreement not to be performed within one year, unless such agreement or some memorandum or note of it be in writing, signed by the party to be charged therewith, or some other person by him thereunto lawfully authorised.

The remedy which law affords for the breach of an agreement is only by way of damages. But equity will in general compel the specific performance of any contract or agreement for the non-performance or breach of which a court of law could have awarded damages. The principal exception to this rule is, where the agreement is of such a nature that its breach can be or was intended to be compensated by damages.

A'GRICULTURE. (Lat. ager, *a field*, and colo, *I till.*) This art may be defined as that of cultivating land in fields, or in large quantities; as opposed to horticulture, which is the art of cultivating land in gardens, or in

small quantities: or, agriculture may be defined as the art of cultivating land with the plough; and horticulture that of cultivating it with the spade. The restricted meaning of the word agriculture, therefore, is simply the art of cultivating fields; but its more extensive and general meaning includes the whole business of the farmer, which comprehends, in addition to raising corn, and other crops, the management of live stock. As a general term, the word agriculture is also frequently considered as including every description of territorial improvement; thus it is made to comprehend embanking, road-making, draining, planting, and sometimes even horticulture. In this sense the word agriculture is used by the French writers on the subject.

We shall here consider the term agriculture in its general acceptation in Britain, and in other countries where the English language prevails, as only including the culture of field crops, and the rearing and managing of domestic animals, on a large scale; and we shall give a very concise outline of its origin, history, theory, and practice.

*The origin of Agriculture* must doubtless have been coeval with that of fixed property. In the primæval state of society, the sole riches of the husbandman consisted of flocks and herds, which were kept in a state of movement from one point to another, in search of pasturage and water; but as population increased, mankind adopted a fixed abode; this could only be done by bestowing on the site a certain degree of labour and care, which became, as it were, the price paid for constituting it private property. At this point in the progress of civilisation agriculture may be said to have commenced. Previously, the natural products of the soil were merely consumed where they were found; but now man sought to increase them by culture.

*History of Agriculture.*—The culture of the land will be found to have depended, in every country, principally on its climate, and its civilisation; though partly, also, on its government and population. In the warmer climates, where nature produces fruits in the greatest abundance for the food both of men and animals, and where very little care is required to procure shelter or clothing, agriculture has made little progress; because it is comparatively unnecessary for the prosperity of the inhabitants. In climates of a directly opposite character, agriculture has made equally slight progress, from the natural obstacles opposed to it. In such countries, for example, as Greenland and Kamschatka, only one or two kinds of corn crops can be cultivated, and perennial grasses can scarcely exist; because the ground is covered with snow for eight months in the year: and in these countries agriculture is but little practised, as the chief resources of the inhabitants for food are found in the sea and the forest. In intermediate climates, such as those of the south of Britain, the middle of France, and the north of Italy, the soil may be laboured by man throughout the whole year; and there is scarcely any limit to the kind of crops that may be raised on it. In such climates, agriculture is calculated to attain the highest degree of perfection; and comparing the different parts of the zones of this description of climate in both hemispheres, perhaps it may be asserted, that the best agriculture in the world is to be found in Britain and in the north of Italy; viz. in East Lothian and Norfolk, in the vale of Arno, and on the banks of the Po. The kind of agriculture practised in different countries is also of course adapted to the difference of climate. Thus, towards the north, the great art of the cultivator would consist in supplying heat; or, rather, in adopting such measures as would best guard plants and animals against cold, rains, and the vicissitudes of the weather. Towards the south, on the other hand, the art of the cultivator would be chiefly directed to moderating extreme heat, and supplying moisture. It thus appears that the agriculture of any country necessarily depends on its latitude; and that in high and low latitudes, where there are greater extremes of temperature and climate to contend with, agriculture must be of a more difficult and hazardous description than in intermediate or temperate climates: such as that of Syria, where the art is supposed to have originated, or in Europe, where it may be considered as having attained its highest degree of perfection.

In tracing the progress of this art in civilised countries, we have only to follow the chronology of general history. As the Greeks and Romans appear to have arrived at as great a degree of perfection in legislation as the moderns, so they appear to have attained nearly equal excellence in the practice of agriculture. Till within the present century, very little difference existed between the most approved agriculture of climates analogous to that of Italy, and the agriculture of the Romans as described by Cato, Columella, and other ancient writers. The chief superiority of the moderns consists in their machinery, and in their knowledge of the science of the art; the last being of very recent date, and by no means general among practitioners. By science, improved breeds, both of plants and animals, have been originated; and by improved machinery, a more perfect tillage has been produced, and also a more complete separation of the produce from the soil, from the refuse of the plants which bore it, and from all impurities.

The history of agriculture in Britain begins with that of the Roman conquest. Julius Cæsar found the inhabitants in a state of semi-barbarism; but Agricola left them in possession of all the arts of civilisation then known. Agriculture declined with the invasion of the Saxons; but was preserved through the dark ages after the establishment of Christianity, by the intelligence of the religious establishments, who gradually became possessed of the greater part of the landed property of the country. Agriculture revived in the reign of Henry VIII., and in that of Elizabeth, during the long period of peace which then prevailed, and the consequent security of property; and it afterwards declined during the civil wars: it again revived during the reigns of William and Mary, Queen Anne, and George I., in consequence of the introduction of the Flemish husbandry, which included the culture of turnips and clover. A still greater stimulus to the art was given during the reign of George III. by the introduction of ploughs drawn by two horses instead of four or six; of the drill system, and its application to the culture of turnips and potatoes; and by the improvement made in the breeding and rearing of live stock by Bakewell and Culley. Early in the present century, the threshing machine was an important addition to agricultural machinery; the reaping machine, the frequent drain system, and the subsoil plough, are improvements just coming into use; and the next grand attempt will probably be the general application of steam, instead of horses or cattle, in tillage and other field operations.

The literature of agriculture commences with the works of the Romans, of which Columella's work, "*De Re rustica*," may be considered the most comprehensive. In the dawn of modern agriculture, the principal writers were, Crescentius in Italy, Herrera in Spain, Olivier de Serres in France, Hereshbachius in Germany, and Fitzherbert in England. At the beginning of the present century the most comprehensive author on agriculture in Italy, was Filippo Re; in France, Tessier; in Germany, Thayer; and in England, Marshall. The best work from which a general idea may be obtained of the agriculture of France and corresponding climates, is "*Maison Rustique du xix^e^ siècle; ou, Encyclopédie d'Agriculture pratique*," complete in one thick volume, 8vo. and the corresponding work in Britain is Loudon's "*Encyclopedia of Agriculture*."

*The principles of Agriculture* are derived from a knowledge of the nature of plants and of animals, of soils and manures; and of the climate, the seasons, and the weather. Plants are organised beings, which take up their food, by means of roots, from the interior of the soil; animals are organised beings which select their food from vegetables growing on the surface of the soil, or from other animals, and this food is prepared before being absorbed into the system, by means of a stomach. The climate of a country determines both the plants and the animals which can be produced in it; and the season and the weather, the time when the plants and animals of the given climate are in particular states of vigour or torpidity; and when certain operations of culture can be performed on them, or on the soil.

The nature of these elementary materials being understood, even though imperfectly, certain improvements can be effected in them by art, which are greatly conducive to the increase of agricultural produce. The kinds of plants and animals suitable to any given climate, soil, or season, are determined by the laws of nature; but from among these kinds it is in the power of man to make selection; and with the plants and animals so selected to originate others, adapted to his purposes in a superior degree. Hence the importance of selecting certain breeds of animals rather than others; and of making choice, not merely of one kind of bread-corn rather than another, but of particular varieties of that corn. Thus, in the case of wheat, there are some kinds the grains of which, under no circumstances, weigh more than from 50 to 55 pounds a bushel; while there are others which never weigh less than 60 pounds a bushel. The nourishment of plants has been found to depend chiefly on organised matters contained in the soil, and produced chiefly by the decay of other plants. This is a law of nature, which, followed up by man, has led to the use of manures; as the fact, every where observed, that no plant can live without water, has led to irrigation; and, as the observation that the excess of water is injurious, has led to surface and under draining. The influence of temperature and shelter over the growth of plants, and the thriving of animals, is every where observable in wild nature; and though the temperature of a climate cannot be changed, yet that of most localities may be improved by shelter from cold winds, and by diminishing the evaporation from the surface, by means of surface and under draining, to draw off the superfluous water. The most important principles in the theory of agriculture are those which relate

to the improvement of plants and animals, and of the soil.

The improvement of the soil may be comprised under two heads — the improvement of its earthy part, and the increase of the organised matter added to the earths. The improvement of the soil, considered as a mixture of different earths, consists in rendering it more or less retentive of water, by diminishing or increasing the size of the particles of which it is composed: for example, by the addition of clay in some cases, and sand in others; and by improving the earthy composition of the soil by the addition of such earths as may be in too small quantities, or wanting altogether. It has been found, from experience, that those soils which are composed of several primitive earths are naturally more productive than such as consist of only one earth, all other circumstances being the same; and it has also been found that no soil will maintain its fertility for any length of time that does not contain a certain portion of calcareous earth in its composition. Hence one of the most common means of improving all soils not calcareous is, by the addition of lime; and of all other soils, by mixing them with such as are of an opposite description.

All soils whatever are rendered more productive by the addition of organised matter, or what are called manures. Manures may either be composed of animal or of vegetable matter; and these may either be applied separately or together, and in a fresh state, or in a state of decay. It has been found from experience, and explained by chemical experiments, that every description of manure is rendered more effective by being made to undergo putrefactive fermentation before it is applied; and this process is carried on with solid manure in heaps or dunghills, and with liquid manure in tanks or wells. In the application of manure to soils, the great object of the cultivator is to apply enough for the ensuing crop, and as little more as possible; because all that is applied and not immediately used, is liable, to a certain extent, to have its particles carried off by evaporation into the atmosphere, or by rains into rivers or the sea. But, even if this were not the case, to apply manure to a soil where it would not be immediately turned into a crop, would be an expenditure of capital without interest.

The operation of freeing a soil from superfluous water is of equal or perhaps more importance than supplying it with manure; because, though without manure plants will not grow with great luxuriance and vigour, yet with too much water they will not grow at all, or will become sickly. The excess of water may proceed from three causes: an extremely moist climate, the only alleviation to which is arranging the surface with frequent furrows, and short slopes between them, so as to carry off the rain as soon as it falls; a soil very retentive of moisture, so as to hold it like a sponge, in which frequent under drains, as near together as the surface furrows, are required; and, lastly, a soil lying over a subsoil which abounds in springs, or, in other words, which has the substrata charged with water, which is continually oozing out through the surface soil. The remedy for this last evil is by under drains of considerable depth, so directed as to collect the water from the substrata, and carry it off before allowing it to reach the surface soil.

A soil, after being drained and rendered of a proper texture and composition by the admixture of such earthy ingredients as may be wanting, requires, to render it fit for being penetrated by the roots of plants, to be frequently stirred and comminuted. This is done by the mechanical operations of ploughing, harrowing &c.; which, aided by the alternate action of droughts and rains, frosts and thaws, and summer and winter, have the effect of pulverizing the soil. To maintain a soil in a fertile state, it is not only necessary to supply it with manure in proportion to the crops which have been carried from it, but to vary the crops which it is made to produce. It has been found from experience that crops of plants belonging to the same natural family do not succeed so well after each other, as when crops of a different family are made to intervene. Thus, the several grasses alternate better with root or herbage crops than with one another; or, one of those grasses of which the seed is ripened will alternate better with another in which the herbage only constitutes the crop, than with one of the same kind as itself. Something analogous to the succession of crops takes place also with regard to the pasturage of animals, and it is found advantageous to put cattle in a field that has been grazed by horses, rather than to put horses after horses, and cattle after cattle.

Thus, the principles of agriculture may be comprised under the selection of breeds of plants and animals; the improvement of the soil and subsoil; the culture or movement of the soil; the improvement of the local climate by shelter and drying; and the succession of crops. All these principles have been derived from experience; and they are only in part accounted for by chemistry or natural philosophy. They are not, however, on that account, the less true and useful. It is singular that they should all have been known to the Romans, and, to all appearance, as fully so as they are to modern cultivators.

*The practice of Agriculture* in Britain may be included under the heads of the choice, hiring, and stocking of a farm; and its general culture and management. In the choice of a farm in any given country, the object of greatest importance is the nature of the soil; because, though this may be improved by art and expense to such a degree as almost to render a bad soil equal to a good one, yet in practice this would be so expensive as by no means to answer the purpose of the farmer. It may be thought that the vicinity of good roads, of a canal, a river, or a market-town, are objects of more importance than the nature of the soil; but this is not the case, because, supposing the roads to be bad, and the market at a distance, it is only necessary to change the system of cultivation and management, and to turn the produce of the farm into some description of live stock which may be driven to any distance, even over a country without roads. If it be alleged that the nature of the climate is of paramount importance to the soil in the choice of a farm, we allow that in an extended sense it is; for example, if a cultivator had the choice of any part of Europe, there are doubtless many districts where the climate is far more favourable for all the operations and products of agriculture than others; and even if he had the choice of every part of Britain, he might find some localities much more favourable than others. In general, however, the actual choice of any cultivator lies within a given locality, where the climate, in a practical point of view, is every where the same. Next to soil and climate in the choice of a farm, the state of the buildings and fences on it, the state of the roads, and the distance from a market-town, a canal, or a sea-port, are of importance. Without buildings of a sufficient extent, properly situated, and of the proper kinds, the business of a farm cannot be carried on; and though some farms, and some kinds of farming, may be conducted without fences, yet, in general, fences are as necessary as roads. The last circumstance which we shall mention in this cursory glance is, the nature of the tenure by which the farm is to be held, and the covenants and conditions of the lease. No cultivator, who calculates on the employment of a considerable capital, will risk it on the lands of another without some security for having it returned, and this security is a lease for a fixed number of years. On the other hand, no proprietor of lands will delegate the possession of them to another for a fixed number of years, without a valuable consideration; and this he reserves to himself in the lease, under the denomination of rent. As lands in a state of cultivation, and buildings and fences in a state of repair, are liable to be injured and deteriorated in value by bad management or neglect, the proprietor guards against these accidents by certain conditions in the lease.

*The kind of culture and management* adopted in any farm depends jointly on the soil and climate; and on the kind of produce most in demand, or reckoned most profitable. In the mountainous districts of Great Britain, where the climate is cold, almost the only kind of farming practised is that of breeding and rearing different kinds of live stock; such as sheep or cattle, which are sold for being fattened in more favourable districts; or horses, in order to supply the demand for these animals for the purposes of draught, or the saddle. The mountainous districts of Scotland and Wales are chiefly devoted to the breeding and rearing of sheep and black cattle; which are sold to the farmers of the low country in both kingdoms, in order to be fattened for the shambles. The hilly districts of Yorkshire and Lancashire are chiefly employed in the breeding and rearing of horses. In the low country of the east coast of Great Britain, the climate being dry, is favourable for the culture of corn; while on the west coast, and in Ireland generally, the climate being moist, is more favourable for pasture. The farm products most universally in demand are, corn and butcher's meat; and these may be produced on every farm the fields of which admit of being kept alternately in tillage and in grass. The butcher's meat may, however, be produced in much greater abundance, on such soils as admit of the culture of root and herbage crops, such as turnips, potatoes, clover, &c; while corn may be produced most abundantly in strong loamy soils, within reach of extensive sources of manure. The most profitable description of crop will frequently be found to be different from that which is most generally in demand: for example, in the neighbourhood of a large town, the culture of culinary vegetables, on a large scale, in what are called farm-gardens, is generally far more profitable than the raising of corn or butcher's meat. Even the raising of food for cattle, in such situations, is found to yield more profit than common farming. There are also particular crops which may be occasionally cultivated which yield extraordinary profits; such as plants used in dying, or in some manufacture not common; plants of some new and improved variety of the kinds in general cultivation for their seed, &c.

A farm being fixed on, all preliminary matters settled,

and the farmer in possession, his first business will be to fix on the general system of cultivation that he means to adopt. In this, as already observed, he will be guided by what the farm is capable of producing, and what he can dispose of. One of the first points that he will determine after this, will be the quantity of land that he can have under each particular kind of crop that he intends to grow; and next, the order in which these crops are to succeed one another. No point, indeed, in the whole system of farm management, is of more importance than the succession, or, as it is usually called, the rotation, of crops. The principle on which the succession of crops is founded has been already hinted at; and in here treating it practically, it may be sufficient to state, that all agricultural crops whatever may be reduced to three kinds — exhausting crops, restoring crops, and cleaning crops; and that the perfection of a rotation consists in always having an exhausting crop followed by a restoring or a cleaning crop; or, what is best, by both combined. All crops which are allowed to ripen their seeds, or which are carried wholly off the ground, are considered exhausting, though in different degrees. Thus, the most exhausting crops in general cultivation are those of corn; but clover, tares, or even hay cut green, are also exhausting, though in a much less degree. Restoring crops are those where the produce is suffered to decay on the ground, or is consumed on it; as in the case of pasture, crops of tares, turnips, &c. Cleaning crops are such as are grown in drills, sufficiently wide to admit of hoeing and other operations of cleaning between. Some of these are at once cleaning and exhausting, as where corn is sown in drills; while others are cleaning and restorative, such as where herbage plants, as clover and lucerne, or roots, as turnips, are drilled, and the plants are to be eaten off on the spot. Other principles which enter into consideration in fixing on a rotation of crops are, that plants which are nearly allied should not succeed each other; because, whether from exhausting the soil of one particular kind of nutriment, or by depositing in it one injurious kind of secretion, certain it is, that the same kind of plants cultivated without intermission on the same soil soon become sickly. Thus three or four crops of any kind of corn in succession will not only unfit the soil for that variety or species of corn, but in a great measure for every other

The farmer having determined on the crops which he is to grow, and the order of their succession, his next business is to calculate the quantity of stocking which will be required for his farm. By stocking is to be understood the number of horses, cattle, and other live stock; and the kind and number of machines, implements, and tools that will be required. In addition to these, he must take into calculation the number of male and female servants which it will be necessary for him to keep, either permanently by the year, or to hire occasionally by the week. Lastly, he will have to take into consideration the sum of money which he will require to lay out for servants' wages, housekeeping, rent, and all other expenses, before he receives any return from his farm produce. The sum total is the amount required for what is called stocking a farm; and it amounts, in different parts of the country, to from 5*l.* to 10*l.* per acre. Poor soil under pasture requires the smallest sum per acre; and rich soil under tillage the largest sum.

The farm being entered on, and the system of culture determined, the future business during the lease is one uniform routine of preparing, sowing, reaping, threshing, and marketing; including, where the breeding or fattening of live stock enters into the system, their purchase, fattening, and sale; or, their rearing, breeding, and sale.

The agriculture of Britain, and especially of the low country of Scotland, excels that of most other countries having similar climates, from the superior skill, intelligence, and capital of the farmer; the considerable length of lease which is granted by the landlord; the superiority of the machines and implements employed; and the improved breeds of animals and plants which are reared or cultivated. Perhaps the nearest approach to perfection in the culture of arable land in any part of Britain, is made in some parts of East Lothian; where, in consequence of deep ploughing, substituting under drains for furrows; regularly supplying manure, and alternating cleaning and restoring crops with exhausting crops, as great an amount of produce is obtained as can stand on the surface at one time. The agriculture of Britain is most defective in the southern districts of the island; in consequence of the farmers being the very opposite of those in the northern districts, the want or the shortness of leases, and the restrictive clauses in those leases, by which the tenant is prevented from exercising his own judgment, and is obliged to follow in the routine prescribed in the leases of a former age.

A'GRIMONY. A wild plant with sawed pinnated leaves, and a long spike of yellow flowers, followed by burlike fruit. It has had the reputation of keeping old age away from those ladies who persevere in the use of it in decoction. At least, it has the merit of being harmless, and from its slightly tonic qualities it would probably form a good kind of diet drink.

AGRIO'NIDÆ. (Gr. *αγρος, a field.*) The name of a family of neuropterous insects, including the various kinds of dragon-flies (*Libellula*, Linn.; *see* that word). The blue dragon-fly (*Agrion puella*) frequents the rushy sides of ditches, and is one of the commonest of the British species of this family.

AGRO'NOMY. (Gr. *ἀγρος, a field*, and *νομος, a rule.*) The art of cultivating the ground: sometimes used, particularly by the French, as synonymous with agriculture.

AGROSTO'LOGY. (Gr. *ἀγρωστις, a grass*, and *λογος, a speech or writing.*) That part of botany which comprehends what relates to the grasses.

AGRY'PNIA. (Gr. *ἀγρυπνος, sleepless.*) Watchfulness or restlessness.

A'GUE. An intermittent fever, which comes on at certain intervals, leaving the person in the intermediate periods in apparent health. The febrile attacks are often remarkably regular, whence the division of agues into quotidians, which are daily attacks; tertians, which appear every third day, having an intermission of forty-eight hours; and quartans, the intermission of which is about every seventy-two hours. The period during which the fever continues is called the paroxysm or pyrexial period; and the intermission, the apyrexial period. The febrile paroxysm consists of three stages, which follow each other in regular succession; namely, the cold, the hot, and the sweating stage: during the latter, the febrile symptoms abate and disappear.

AGUE CAKE. An enlargement of the liver or of the spleen produced by the ague.

AGY'RATE. (Gr. *ἀ, without*, and *γυρος, a circle.*) A name given to osmundaceous plants by Swartz, in consequence of their having no true elastic annulus.

A'HRIMAN, or ARIMANIUS. (East. theology.) One of the chief deities of the ancient Persians. Their philosophers entertained the opinion subsequently held by the Manicheans, that there were two principles, one of good and one of evil. To the latter they gave the name of Ahriman, and ascribed to his agency all the evils existing in the world. The two principles were not, however, supposed to be co-eternal or alike powerful, at least such was not the orthodox belief; but it was supposed that in the end, the principle of good, Oromasdes, would finally prevail over and utterly destroy the principle of evil. — (*Bayle*, arts. ARIMAN, MANICHE'ENS, and ZOROASTER.)

AI. A word which is a pretty close imitation of the plaintive cry of the three-toed sloth (*Acheus tridactylus*, F. Cuv.). of which it is the trivial name. *See* BRADYPODÆ.

AID. A pecuniary tribute paid by feudal vassals to their lords in certain cases of emergency. (*See* FEUDAL SYSTEM.)

AIDE-DE-CAMP. An officer appointed to attend a general officer in the field, in winter-quarters, and in garrison, to receive and carry orders. A field-marshal is entitled to four, a lieutenant-general to two, and a major-general to one. The king appoints as many as he pleases, and this situation gives the rank of colonel.

AIGRETTE, in Botany. *See* PAPPUS.

AIR, *Atmospheric.* (Gr. *ἀηρ, air.*) The air which surrounds our globe to a height of about forty miles, and which is essential to all living beings, was one of the elements of the ancient philosophers. its weight and several of its mechanical properties were discovered by Galileo and Torricelli about the middle of the seventeenth century; but its composition was not accurately determined till more than a century afterwards.

The air is transparent, colourless, inodorous, and tasteless, essential to the respiration of animals and vegetables, and to the support of combustion. It is 816 times lighter than its bulk of water; 1000 cubic inches, at mean temperature and pressure, weighing about 305 grains.

The air is a mixture of nitrogen and oxygen gases, with a small portion of carbonic acid gas and of the vapour of water: in particular situations, other substances exist in it; as, over marshes, miasmata; over sulphureous springs, sulphuretted hydrogen; over and near the sea, in dry weather, muriatic acid, either free or combined; and a substance, probably of organic origin, which, aided by light, reddens solution of silver; peculiar organic combinations, sometimes infectious, where people, especially the sick, are confined; sulphurous acid and ammonia, in London and other places where large quantities of coal are burned; and traces of nitric acid during severe thunder-storms.

The leading constituents of the air are nitrogen and oxygen, which are to each other in the relative bulks of about 79 and 21, or 80 and 20; and these proportions are probably not liable to any appreciable change, either dependent on season, wind, weather, situation, or height from the surface. Berthollet found 21 per cent. of oxygen in Cairo and in Paris; Saussure, the same in Geneva; De Martyr, in Catalonia, and in all winds, weather, seasons, and states of the barometer; in wet and dry, and in

inhabited and uninhabited places; Davy, in Bristol and other places in England and upon the coast; also in air brought from the coast of Guinea; Brande, in air from Behring's Straits and from Otaheite: Berger, in the Jura, and in the mountains and valleys of Savoy: Configliachi, on the Simplon and Mont Cenis (20·8 of oxygen over rice-fields); Gay Lussac and Humboldt, in Paris, and in all seasons and weathers, and at 6,636 mètres above the surface, from 20·9 to 21·5.; Dalton, in England, from 20·7 to 20·8.: Selden, 21.: on the 8th of January, 1835, the barometer being 30·9 inches and a north-east wind, 21·15. In crowded and confined places, the relative proportion of oxygen may be a little below the proper standard, but is soon again restored. Air collected at the back of the upper gallery in Covent Garden Theatre, on a full night, gave 20 oxygen, and rendered lime-water more than usually turbid.

The relative proportion of carbonic acid is more variable; yet this gas is found in air from the most elevated regions and purest sources. Saussure and Beauvais found it on the top of Mont Blanc, and in the same proportion in the streets of Paris, and at 650 toises above the city. At sea, carbonic acid has sometimes not been discoverable. Saussure found it vary with the seasons, and no doubt vegetation may affect it. In August, over a meadow, the air contained 0·000,713, in January, 0·0.0,425. Dalton estimates the mean proportion of carbonic acid at 1 in 1000; Configliachi, the maximum at 8, and Humboldt at from 5 to 18: this is probably in excess.

The aqueous vapour is the most variable constituent of the atmosphere. It is more abundant with a south and west wind in summer and in warm weather, than with a north and east wind in winter and cold weather. In this climate it usually fluctuates between 1 and 1·5 per cent.

Dr. Prout, in his Bridgewater Treatise (p. 350.), has suggested the possibility of the occasional existence of extremely minute portions of foreign and poisonous matters in the air during the prevalence of epidemic disorders; and, in reference to this subject, a remarkable observation occurred during the prevalence of the cholera. For more than six weeks previous to the appearance of cholera in London, he had been almost every day engaged in accurately determining the weight of a given quantity of air under precisely the same circumstances of temperature and pressure. On the 9th of February, 1832, the weight of the air suddenly rose above the usual standard, and it continued so for six weeks. On the 9th of February, the wind, which had been west, veered round to the east, and the first cases of epidemic cholera made their appearance.

Without reference to the occasional presence of foreign matters, the average ordinary constitution of the atmosphere may be stated as follows:—

| | *By measure.* | *By weight.* |
|---|---|---|
| Nitrogen | 77·50 | 75 55 |
| Oxygen | 21·00 | 23 32 |
| Aqueous vapour | 1·42 | 1·03 |
| Carbonic acid | 0·08 | 0·10 |
| | 100 00 | 100·00 |

AIR. In Music, signifies the *melody*, or treble part of a musical composition.

The word is also used for a tune, or song itself, that is, for a series of sounds whose movement is regular and graceful.

AIR. In Painting, the medium in nature through which every object is viewed, and hence to be transferred to the imitation on canvass. The effects which it produces are an indispensable part of the knowledge of every artist. It affects the sizes and colour of objects according to their distance.

AIR-BLADDER, called also *Air-bag*, sound, swim, &c. An organ situated in the abdomen of most osseous fishes, which, by altering its dimensions, and the quantity or density of its contents, regulates their relative position to the surface of the water, and is supposed to represent the rudimental condition of the lungs of the higher vertebrates.

AIR-CELLS. Are cavities in the stems and leaves of plants, constructed of cellular tissue, and intended to render the part in which they reside buoyant in water.

AIR-CELLS. In birds, are membranous receptacles communicating with the lungs, eight of which, of large size, occupy the interspaces of the thoracic and abdominal viscera; the smaller ones extend around the principal joints of the four extremities, penetrate the substance of the bones, insinuate themselves between the skin and subjacent muscles, and enter the quills of the feathers, so that the whole body of the bird is permeated by the atmosphere; whereby its specific gravity is diminished, its respiration extended, its circulation accelerated, and its muscular energies increased, and thus it is finally adapted to wing its way through aërial space. In the flying insects the air-vessels are more or less dilated into air-cells at different parts of their course, in order to diminish the specific gravity of the general mass of the body.

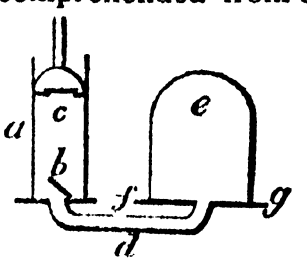
AIR-GUN. An instrument for projecting bullets or other missiles, the moving power being the elastic force of condensed air. A strong vessel of metal is constructed, into which air is forced by means of a condensing syringe, through a small hole with a valve opening inwards, and the greater the quantity of air thrown into the vessel, the greater will be the effect, the elastic force of air being nearly in proportion to its condensation. The magazine of condensed air is then detached from the syringe, and screwed to the breech of the barrel; and a trigger, adapted to the stock of the gun in the usual way, is constructed so as to be capable of opening the valve. The bullet is placed near the breech, and should fit the barrel very exactly, so as to leave no windage. On pulling the trigger the condensed air escapes through the valve, and rushes with violence into the barrel, propelling the bullet before it; and the instant the finger is withdrawn from the trigger the valve is closed by the pressure of the air in the magazine, which remains in a somewhat less condensed state for the next discharge. Thus the same supply of air in the magazine will serve for several successive discharges, but the force becomes weaker and weaker after each.

The air vessel may be of any form, but it is most conveniently disposed of by placing it within the stock; and this circumstance usually determines its shape and dimensions. Sometimes, also, a reservoir of bullets is placed in a channel under the barrel; and by a simple mechanism these are successively transferred into the barrel, whereby the gun is quickly loaded after each discharge. The instrument thus constructed is called the magazine air-gun.

The elastic force of inflamed gunpowder is from 1000 to 2000 times greater than that of common air. It would seem, therefore, that air would require to be condensed upwards of 1000 times beyond its natural state, in order to exert the same propulsive force as gunpowder. Now the velocities communicated are as the square roots of the forces; therefore, if the air in the magazine be condensed only ten times, it consequently exerts a force only equal to 1-100th of that of inflamed gun-powder, and communicates a velocity of 1-10th. There is a circumstance, however, which adds considerably to the effect of the air-gun, namely, that as the magazine is large in proportion to the cavity of the barrel, and the valve remains open a sensible portion of time, the ball is urged all the way through the barrel with nearly the same force as at the first instant; whereas, in the case of gunpowder, the gas produced by the inflammation occupies a small space in proportion to the capacity of the barrel, and the force ceases to act before the ball has quitted the barrel. On this account it happens that air condensed only ten times in a magazine of considerable size, projects a ball with a velocity not greatly inferior to that given by gunpowder. The time and labour necessary for effecting the condensation of the air prevents the instrument from being employed as an engine of war; but, as it produces its effect with less noise than the ordinary gun, it has sometimes been made subservient to the purpose of the assassin.

AIR-PLANTS. A name given to plants of any kind which grow without their roots penetrating the earth. They have been so called, from its being supposed that they derive their nourishment exclusively from the atmosphere; but as they are usually found in places where they are in contact with at least minute quantities of vegetable matter, or even with the juices of the plants upon which they grow, it is probable that their existence is in part maintained much in the same way as that of other plants. The most extensive natural order in which air-plants are found is orchidaceæ, thousands of species of which literally crowd the forests of some of the damp and hot parts of the world. Next to these range bromeliaceous plants, some of which will live for months suspended freely in the air, or tied to iron or stone balconies. Various species of ficus, and some Gesneraceæ, have similar habits. The only real air-plant that grows wild in Great Britain is cuscuta.

AIR-PUMP. A pneumatic machine for removing the air out of a vessel. The principle of this important philosophical instrument is very simple, and may be easily comprehended from a brief explanation. The essential part of the machine consists of an exhausting syringe (*a*), formed of a tube or barrel of brass, closed at one end with the exception of a small orifice, to which a valve (*b*), opening inwards, is attached. An air-tight piston is worked up and down in the barrel by a rack and pinion turned by a winch. The piston has also an orifice with a valve (*c*) which opens upwards, or in the same direction as the valve of the tube. The syringe communicates, by means of a small pipe (*d*) fitted into the opening at its lower extremity, with a vessel (*e*) called the receiver, from which the air is to be extracted.




The receiver is placed on a brass plate (*f*, *g*,) over a

small hole, into which the other end of the pipe is inserted; and in order that the contact may be air-tight, the edge of the glass is previously rubbed with lard or some unctuous matter.

Suppose the piston at the bottom of the tube. As it begins to be drawn up, the valve *c* of the piston is immediately shut by the pressure of the exterior atmosphere, so that no air can enter the barrel, and a perfect vacuum would be left under it, were it not that the valve at the bottom of the barrel is forced open by the pressure of the air in the receiver, which rushes into the barrel till its density becomes the same both in the receiver and barrel. When the piston has been drawn to the top of the barrel, the whole of the air which occupied the barrel has been removed, and the receiver and barrel are now both filled with the air which was previously contained in the receiver alone.

Suppose the capacity of the receiver to be six times that of the barrel, the air which at first occupied six measures now occupies seven, and is consequently reduced to 6-7ths of its former density. Let the piston now be returned to its first position. The instant it begins to descend, the valve *b* shuts, so that no air can enter the receiver. As soon as the piston has descended through one-seventh of the barrel, the air in the barrel is restored to the density of the exterior atmosphere; and as it descends further, the air in the interior of the barrel is condensed, till it acquires an elasticity sufficient to open the valve *c* in the piston, when it rushes out, and continues to do so till the piston has quite returned to the bottom of the barrel. Thus by one stroke of the piston the density of the air in the interior of the receiver is reduced to 6-7ths of its previous density; and it is evident that each succeeding stroke will produce the same effect, or remove 1-7th part of the remaining air. Consequently, after the second stroke, the density of the air in the vessel will be reduced to 6-7ths of 6-7ths = 36-49ths of the exterior air; after the third stroke it will be reduced to 6-7ths of 36-49ths = 216-343ds, and so on. After twenty-one strokes, it will be reduced to about 1-25th of its first density; after one hundred strokes, to 1-5,000,000th part. But so high a degree of rarefaction cannot in practice be obtained; for as soon as the elasticity of the air in the receiver is reduced so far that it has not sufficient force to lift the valves, no more air can escape from the receiver into the tube, and the exhaustion cannot be carried further.

What has now been said applies to all air-pumps, though the form of construction admits of great variety. The better sorts have two exhausting barrels, and the pistons are worked by a rack and pinion, so that when the one piston is ascending in the barrel, the other is descending, by which means an uninterrupted discharge of the air is kept up. The receiver is placed on a smooth plate of brass, having a small hole in the middle to receive the end of a pipe communicating with the syringe. Various contrivances have been employed to continue the exhaustion after the air has been rarefied to that degree that it does not retain sufficient elasticity to lift the valves. In order to determine the degree to which the rarefaction is carried, a barometric tube is adapted to the machine, the upper end of which communicates with the receiver, while the lower end is plunged into an open basin of quicksilver. As the receiver is exhausted, the air is withdrawn from the tube at the same time, and the external air presses up the mercury in the tube to a height proportional to the degree of rarefaction.

This is called a *gauge*; but the following form is more frequently employed. A tube six or eight inches in length, sealed at one end and filled with mercury, is inserted in a basin of the same liquid. The mercury is of course supported by the pressure of the atmosphere, and continues to fill the tube. This apparatus is placed beneath a second receiver, communicating with the pipe *d*. During the first stages of the exhaustion, the mercury still remains supported; but so soon as the tension of the contained air becomes less than is sufficient to support the column of mercury, the liquid begins to fall, and the height at which it stands above the level of that in the basin is the measure of the tension of the remaining air. This is called the short Barometer Gauge.

Otto Guericke, a magistrate of Magdeburg, was the first who conceived the idea of rarefying the air in a vessel by means of a pump, about the year 1654. The machine which he constructed was of a very rude kind, but it enabled him to exhibit experiments which at that time were regarded as astonishing. The air-pump was afterwards greatly improved by Hooke and Boyle; and has attained its present state of perfection through the successive inventions of Hauksbee, Smeaton, Cuthbertson, and others.

AIR-VESSELS. Are minute tubes composed of an exceedingly fine transparent membrane, closed at each end, and furnished internally with a delicate elastic thread twisted spirally, whence they are now commonly called spiral vessels. They occur in the medullary sheath, the veins of leaves and of flowers, in the stamens, the ovary, and the seed: their office is to convey oxygenated air.

AIR-VESSELS. In insects, the atmospheric air is conveyed through all parts of the body, for the purposes of respiration, chiefly by means of air-vessels, or *tracheæ*. (*See* that word.)

AISLE, or ALA (Lat. ala, *a wing*.) In Architecture, a term used by the English, more especially, to signify the side subdivisions in a church, usually separated from the nave, or centre division, by pillars or columns; but among different nations it bears different significations as applied to architecture. Strabo informs us, that among the Egyptians, the alæ of the temple were the two walls that inclosed the two sides of the pronaos, and which were of the same height as the temple itself. The walls, he observes, from above ground, were a little farther apart than the foundations of the temple, but, as they rose were built with an inclination towards each other. The right understanding, however, of this passage is attended with difficulty, and seems to have puzzled Pocock no less than ourselves. The Greek alæ, called ptera, were the colonnades which surrounded the cell of the temple, the monopteros temple being the only species which had columns without an interior (to them) wall. The peripteral had one tier of columns round the cell, the dipteral two, and the pseudo or false dipteral, which Hermogenes invented, was that in which the ala was single, but occupied the same space on the sides of the cell as the dipteral, though one of the tiers of columns was left out; thus, by metaphor, the columns were called the alæ, or wings, of the temple. This term is also applied to the sides of a building which are subordinate to the principal, and central division, and are vulgarly called wings.

AITS. Islets, or little islands, commonly planted with osiers, and which are then called willow aits.

AKE'NIUM. *See* ACHÆNIUM.

A LA MIRE. In Music, the name of one of the notes in the modern scale of Guido. (*See* MUSIC.)

A'LA. (Lat. ala, *a wing*.) In Ornithology, the pectoral extremity, the bones of which support broad folds of skin, covered with feathers, and are modified for flight. The under part of the base of the wing, where it joins the body, is termed the *axilla*; the joint between the antibrachium and carpus is termed the flexure or *plica*. The wing is said to be armed (ala calcarata) when the carpus bears one or two horny spurs; to be impennate (ala impennata) when provided with equal, lax plumes, unfit for flight; to be elongate (ala elongata) when, in the folded state, it equals or exceeds in length the body from the base of the bill to the root of the tail; to be middle-sized (ala mediocris) when, in the folded state, the extremity covers the base of the tail; to be short (ala brevis) when, in the folded state, the extremity reaches the sides of the coccyx.

In Entomology, the wings, or organs of aërial progression, are tegumentary productions simply, and consist of a double membrane of a tender and generally transparent consistence, inclosing numerous nervures, or branched tubes of a firmer substance.

These organs present considerable differences of form and structure in the different orders of insects, and also vary in number from two to four.

A'LABASTER. A white semitransparent variety of gypsum or sulphate of lime. It is a mineral of common occurrence, and is manufactured into ornamental vases, and occasionally into small statues. The ancients used it for ointment and perfume boxes. Perhaps the term is derived from ἀ, privative, and λαβον, *a handle*, as opposed to vessels with handles. This stone is not slippery, and therefore the derivation is incorrectly referred to ἀ and λαμβανω, as if it were difficult to grasp.

ALANGIA'CEÆ. (Alangi, *the Malabar name of one species*.) A natural order of plants closely akin to myrtaceæ. It consists of Indian species, with aromatic roots and eatable fruit. Their long strap-shaped petals afford one of the principal distinctions between them and myrtaceæ.

ALA'NTINE. An amylaceous substance extracted from the root of the Angelica archangelica.

ALA'RMISTS. In a general point of view, means all those individuals who are particularly prone to take alarm at, and to circulate and exaggerate, any sort of bad news; but the designation is more peculiarly applied to those who take alarm at political innovations or changes.

ALA'TE. (Lat. ala, *a wing*.) When any solid body is bordered by a membranous or leafy expansion.

ALAU'DA. (Lat. alauda, *a lark*.) The name of a Linnæan genus of passerine birds, characterised by the claw of their hinder toe, which is straight, strong, and longer than the others. The birds of this genus are granivorous, and nidificate on the ground. The field-lark Alauda arvensis, L., is a well-known example: they appertain to the conirostral division of the passerine order of Cuvier.

ALB. (Lat. albus, *white*.) A vestment worn by priests in the Roman Catholic church, which differs from the surplice in fitting more closely to the body, and being tied with a girdle: it is also commonly embroidered on the breast with crosses.

**ALBA'RIUM OPUS.** (Lat.) In ancient Roman architecture, a term imagined by some to have been nothing more than a species of whitewash applied to walls, but not, as we think, correctly. In the passage of the tenth chapter of the fifth book of Vitruvius where he recommends the use of the albarium opus, for the ceilings of baths, he allows tectorium opus as a substitute, so that it was clearly a species of stucco. Its employment at the baths of Agrippa, knowing, as we do, the extent to which luxury was carried in the baths of the ancients, seems to prove that it was a superior sort of stucco, and it is by no means improbable that it was susceptible of taking a polish.

A'LBATROSS. (*See* DIOMEDEA.)

A'LBIGENSES. A sect which arose in the south of France in the latter half of the twelfth century. They have been confounded with the Waldenses, with whom, however, they do not appear to have had any real connection. Their tenets have been very differently described, and probably misrepresented, by their opponents; and great obscurity is thrown upon the subject, by the fact of the appearance of various dissenters from the church of Rome in England and elsewhere, about the same time, whose respective views have not been very accurately discriminated. It is probable that the reformers of the south of France opposed themselves originally to the corruptions in discipline, which began first at that period to draw general attention and animadversion upon the clerical order. Hence a very easy step would lead them to think slightingly of many ecclesiastical ordinances, and the ceremonial observances of religion would seduce them into the adoption of mystical notions about an internal light and assurance, and finally betray them into the wildest extravagancies. Thus they are charged with perpetuating the Manichean doctrines: but Bossuet, who accuses them of inclining to that system on certain points, acquits them of holding what is, after all, the distinguishing tenet of the Oriental heresy—the monstrous doctrine of the two principles.

The origin of the name is doubtful. The Latin name by which Narbonnese Gaul was known in the twelfth century, was Albigesium, which seems to put forth a better claim to the derivation than the town of Alby in Languedoc. In the year 1163, Alexander III. published a decree against these sectarians in a council held at Tours, and another in 1179. On neither occasion, however, did he invoke the assistance of the secular arm At the close of the century, when the sect was still flourishing, and seemed to be more particularly under the protection of Raymond, count of Thoulouse, Innocent III commenced the work of its extirpation. He appointed two legates to go through the country and excite the zeal of the clergy and laity against the innovators: he instituted the Dominican order of friars, purposely to preach them down; and finally, in 1207, he addressed himself to Philip Augustus, king of France, exhorting him to eradicate the heresy with the sword The chief leader of the expedition, which soon assumed the character and name of a crusade, was Simon de Montfort, earl of Leicester, to whom the earldom of Thoulouse was promised by the pope as a stimulus to his exertions. In the siege of that city, however, he was killed. The contest, which was carried on with more or less vigour for many years, and which furnishes the first evidence of the disposition of the church of Rome to employ the extreme of violence against those who dissent from its doctrines, ended in the entire destruction of the Albigenses, about the middle of the thirteenth century. (*See especially* Sismondi, *Hist. des Français*, tom. vi )

ALBI'NISM. A state in which the skin is white, the hair flaxen, and the iris pink. (*See* ALBINO.)

ALBI'NO. A term originally applied by the Portuguese to negroes who were born mottled or discoloured with white spots. It is now generally applied to persons of a preternatural whiteness of the skin and hair, and a peculiar redness of the pupil of the eye, which is so weak as to be of little use in broad daylight, so that albinos sleep in the daytime, and are only capable of seeing distinctly in the twilight or by moonlight. The disease appears to depend upon a deficiency or morbid state of the rete mucosum over the whole body.

**A'LBUM.** Literally means any thing white. The term is now generally applied to a book in which persons collect autographs, literary essays, &c. The prætor's album was a white board, on which the edicts of that functionary were inscribed.

**ALBUM GRÆCUM.** When dogs are fed upon bones, they digest the animal portion, and the earthy parts (chiefly phosphate of lime) are voided in the form of white excrement. This inert matter was formerly used in medicine under the above title.

ALBU'MEN. A peculiar animal matter entering largely into the composition of animal bodies, such as the blood, muscles, bones, &c.; also the chief component of white of egg, to which the term albumen was originally applied, and which well and familiarly illustrates its leading peculiarity, namely, that at a certain temperature it coagulates into a soft white solid, no longer soluble in water. It may be obtained pure by coagulating the white of egg by alcohol, washing it thoroughly with that fluid, and then carefully drying it at 120°. It then appears as a yellow, shining, transparent and brittle substance composed of—

| | | | | |
|---|---|---|---|---|
| Nitrogen | 1 atom | = 14 | 15·05 |
| Carbon | 8 | = 48 | 51·61 |
| Hydrogen | 7 | = 7 | 7·53 |
| Oxygen | 3 | = 24 | 25 81 |
| | 1 | 93 | 100·00 |

The albumen of birds' eggs coagulates at a temperature of 145° to 165°; and when dried, shrinks and becomes brittle and semitransparent, in all respects resembling horn. One hundred parts of the albumen of the hen's egg lose, upon careful drying, about 86 of water, and leave 34 of solid residue. Alcohol, most of the acids, and several metallic salts, also coagulate albumen, and some of the latter are very delicate tests of its presence in animal fluids: subacetate of lead, for instance, renders a solution of 1 part of fresh white of egg in 2000 of water turbid, so that it detects 1 part of dry albumen in 10,000 of water. Corrosive sublimate is also an excellent test of albumen, forming with it a white insoluble compound; hence white of egg has been proposed as an antidote in cases of poisoning by corrosive sublimate.

ALBUMEN. A solid fleshy, bony, or horny substance, secreted in some seeds between the embryo and the seed-skin. It is supposed to be intended for the nutriment of the young embryo when it first springs into life. The part that furnishes the flour of corn, the flesh of the cocoa-nut, the great mass of the seeds of coffee, are albumen. Botanists have remarked that this substance is never deleterious, however poisonous the plant may be by which it is borne.

ALBUMEN OF VEGETABLES. Is a proximate principle, having some of the leading chemical characters of animal albumen.

ALBU'RNUM. (Lat. alburnum, *sap-wood.*) The newly formed and soft part of the wood of exogenous trees, consisting of empty or nearly empty tubes and cells, the sides of which are thin and not indurated; however durable the timber of a plant may be, this part of it is in all cases perishable, the vegetable matter of which it consists having but little power of adhesion, and readily yielding up its carbon to the oxygen of the atmosphere, the consequence of which is speedy decomposition It is only when the tissue of this part becomes consolidated by the addition of resins, tannin, and various other products, which change its colour from a pale yellow to various other deeper colours, that timber really becomes valuable. In some species this is effected rapidly, as in oak, teak, lignum vitæ, &c.; in others very slowly, or not at all, as in the poplar and willow. Hence the wood of the latter class of trees never acquires any durability. By some writers the alburnum is defined to be "wood only one year old;" this is, however, erroneous. It is through the alburnum principally that the ascending sap of a plant moves; the course of the sap is not, however, confined to the alburnum, but is effected wherever the woody tubes are sufficiently open for it to pass.

A'LCA. The name of a Linnæan genus of anserine birds, characterised by a short, compressed, vertically extended, convex beak, edged along the upper surface, and generally transversely furrowed, feet toti-palmate, and wanting the hinder toe. Recent ornithologists have divided the Linnæan awks or penguins into the subgenera fratercula and alca.

ALCABA'LA, or ALCAVA'LA. A tax formerly imposed in Spain and her colonies, consisting originally of 10, and subsequently of 14 per cent. ad valorem, on all property sold, and payable as often as it changed hands. This monstrous impost, by preventing the sale and transfer of property, necessarily proved in the highest degree injurious. (*See* Ulloa, *Rétablissement des Manufactures d'Espagne*, cap. 3.)

ALCA'LDE. A Spanish officer of justice; from the Arabic kadí, *judge*. In Portugal, Alcayde.

ALCALI'METER. A graduated glass tube employed in determining the quantity of real alkali in commercial potash and soda, by the quantity of dilute sulphuric acid of a known strength which a certain weight of these saturates.

ALCA'MPHORA. A Brazilian herb, the croton perdicipes, whose leaves are used in decoction against syphilis, and as a diuretic.

ALCANTA'RA, Order of: otherwise called of Saint Julian, or of the Pear-tree. An order of knighthood, instituted in 1156 at Alcantara, a town of Estramadura, by Hadrian II. king of Leon. The king of Spain is sovereign of this order

ALCARA'ZZA A porous vessel used in Spain for cooling water by its transudation and consequent superficial evaporation.

ALCE'DO. (Lat. alcedo, *supposed to be the king-fisher.*) The name of a Linnæan genus of picæ, charac

terised by a long, straight, angular and pointed beak; the tongue and tail very short. The feet have the structure which is the basis of Temminck's order Syndactyli, viz. the external toe is nearly as long as the middle one, and is united thereto as far as the penultimate articulation. The kingfisher, Alcedo ispida, is a familiar example of that genus. The Alcedo tridactyla, and some others, are remarkable for the absence of the inner toe; these have accordingly been separated from the Linnæan genus under the subgeneric term ceyx. A third subgenus, dacelo, receives the great laughing kingfisher of New Holland.

A'LCHEMY. An imaginary art, once much practised among modern nations, and even now perhaps not wholly exploded. The name is a mixture of Greek and Arabic; the last syllables being from the same root with *chemistry, chemist*, Fr. *chimie:* probably the verb cheein, *to pour*, although the intermediate stages of its derivation are disputed: the prefix being the Arabic article al, *the*. Whether alchemy was followed as an art among the classical ancients, seems questionable: some suppose it to have originated among the Arabs of the Califate. Its object was the production of gold and silver. The principle of the alchemists was, that the baser metals were all convertible into these two precious substances by a long series of processes. To this fundamental notion the common followers of the art added an infinity of fantastic imaginations respecting the influence of the planets, &c. in hastening or retarding the work. The instrument by which it was supposed that this mighty change was to be effected, was a certain mineral to be produced by these processes, which, being mixed with the base metal, would transmute it; and this was called the lapis philosophorum or philosopher's stone. Hence the term *adept*, adeptus, for him who was supposed to have attained the secret of alchemy; who had, in the Latin force of the word, gained or discovered the philosopher's stone. Innumerable instances are on record of persons who practised on the credulity of former times by professing to possess this stone, and who actually wrought the transmutation required; and it is supposed that the philosopher's stone employed by these personages was nothing more than an amalgam of gold, which, if projected into tin and cupellated, would leave a portion of the precious metal. Dr. Price, of Guildford, is said to have been the last person in this country who professed himself able to turn mercury into gold: he destroyed himself in 1782, to avoid, it was supposed, the detection of his deceptions. The alchemists, in the course of their endless experiments, are said to have served the cause of true science in many ways. To various adepts is ascribed the discovery of the concentrated acids and of phosphorus. Another object of the adepts, often pursued by them, together with their research after transmutation, was the discovery of the elixir vitæ, or supposed universal medicine. Alchemy is also denominated the Hermetic Art, from the imaginary sage, Hermes Trismegistus.

A'LCOHOL. A term of Arabic origin, implying the spirit, or essence, and originally applied to several chemical preparations. It is retained in modern chemistry to signify pure spirit of wine.

Fermented liquors were known in the earliest ages. The northern nations were probably acquainted with the art of obtaining spirits before the Greeks or Romans. Albucasis, in the twelfth century, taught the method of procuring spirit from wine; and Raymond Lully, in the thirteenth century, concentrated spirit of wine by carbonate of potash. The composition of alcohol was first accurately demonstrated by Lavoisier, and its analysis was perfected by Saussure.

Alcohol is exclusively produced by the process of fermentation: it is obtained in combination with water by distilling fermented liquors, such as wine, beer, wash, &c.; the liquor thus obtained (brandy, for instance, if from wine,) is redistilled, and the spirituous portion, being most volatile, first passes over; in this state it is called ardent or rectified spirit, and often contains acetic acid and a peculiar flavouring principle, probably of an oily nature: these are got rid of by redistillation with alkaline substances, charcoal, chloride of lime, &c.

Pure or absolute alcohol is obtained by distilling the purest rectified spirit off dry and warm carbonate of potash, or dry quicklime. The specific gravity of rectified spirit is 820 to 828; that of alcohol, 792, at the temperature of 60°.

Pure alcohol has an agreeable odour, a strong pungent taste, and is eminently intoxicating. It consists of

| | | | |
|---|---|---|---|
| Carbon - | - 2 atoms = 12 | 52 18 |
| Hydrogen - | - 3 = 3 | 13·04 |
| Oxygen - | - 1 = 8 | 34 78 |
| | 1 | 23 | 100·00 |

Alcohol burns with a pale flame, and produces carbonic acid and water; the weight of the water thus formed to that of the alcohol consumed, is as 27 to 23. It produces no smoke or soot, and hence forms a cleanly lamp, giving much heat with little light. Mixed with water and certain vegetable substances, especially gluten, and exposed to air and a due temperature, alcohol becomes vinegar. It is the intoxicating principle of wine and of fermented and spirituous liquors, and of important use in medicine and in some of the arts, being the solvent of various resins for varnishes, &c. When alcohol and water are mixed, heat is evolved, and condensation ensues, and it is some hours before the two liquids perfectly unite. So that the bulk of a pint of alcohol and a pint of water falls far short of two pints. A series of tables by Mr. Gilpin will be found in the Philos. Trans. for 1797, exhibiting much information upon the subject of the specific gravities and composition of various mixtures of alcohol and water, — a subject of great importance, as bearing upon the levying of duties upon spirituous liquors.

Alcohol has never been frozen; hence its use in the construction of thermometers for measuring low temperatures. It boils at the temperature of 176°, and is converted into a vapour, the specific gravity of which is to that of air as 16 to 10.

A'LCOHOLATES. Salts in which alcohol appears to replace the water of crystallisation.

A'LCORAN, or ALKORAN (Al Koran, or *the Book*, Arabic.) The sacred book of the Mohammedans; which, according to their belief, was dictated to their prophet by the angel Gabriel. The Koran consists of 114 chapters; which are distinguished, not by their numerical order, but by certain titles, under which they are respectively known. Every chapter is divided into smaller portions, analogous to the verses of our Scriptures. There are, however, seven principal ancient copies of the Koran; and in all of these the number of verses is not the same. The Koran is written in what may be termed a species of chiming or jingling prose. It is regarded among the Mohammedans as in itself a standing miracle, and a proof of the truth of their religion; and hence the division between those who believe the Koran to be eternal and uncreated (the Sonnites or orthodox), and various sects of heretics.

ALCO'VE. (Alcoba, Sp., Elcaut, Arab., *a sleeping chamber.*) In Architecture, that part of a sleeping chamber where the bed is placed. The use of alcoves, though not by that name, is ancient. They were frequently designed in the form of a niche; such, for instance, as those that Winckelman notices at Hadrian's villa at Tivoli, of which species some are also to be seen at Pompeii. They were often formed by an enclosure or balustrade, sometimes high and sometimes low, through which, by means of draperies, this part was separated from the large chamber, whereof it was a part. A notion of it may be obtained from many of the ancient bassi rilievi, especially from the celebrated one known by the name of the Nozze Aldobrandine. In modern architecture, this part of a room differs according to the rank and taste of the proprietor; in England it is rarely used, but in France and Italy it forms frequently a beautiful feature in the apartments of their palaces.

A'LCYONITES. A collective term for the fruit-like spongiform flint fossils common in chalk formations.

ALCYO'NIUM. A Linnæan term for an aggregate genus of marine polypes, having a fleshy, coriaceous, spicular axis, beset with stellate cells, containing each a polype with eight radiate denticulate arms. The axis is fixed to foreign bodies, and in some species rises in short branches or lobes, as in that commonly known by the name of "Dead Man's Hand" (Alcyonium digitatum, *Lin.*; Lobularia digitata, *Lam.*)

A'LCYONS. (Gr. ἀλκυων, *a kingfisher.*) The name given by Temminck to an order of birds of which the kingfisher (alcedo) is the type.

A'LDER. (Ellarn in Anglo-Saxon) A native tree belonging to the natural order Betulaceæ. It is chiefly found in damp situations, and is of little value except for hurdle wood, and for the manufacture of charcoal.

A'LDERMAN Originally written ealdor-man, meaning elder-man, which was used in the earlier parts of the Saxon period as a name of dignity unconnected with office; it was also the original title of the officer who was subsequently styled earl, whence counties were sometimes called alderman-shires. It seems also to have been the designation of the chief magistrate or judicial functionary of minor districts, in which sense it first appears in connection with boroughs. Its application is now confined to the class of municipal officers in a borough next in order to the mayor. By 5 & 6 W. 4. c. 76., the aldermen are to be in number one-third of the councillors in every borough (London alone being excepted from the provisions of the act), one part to be elected triennially, on the 9th of November, from among councillors or persons qualified to be such; and to form, with the mayor and councillors, the council of the borough.

A'LDINE EDITIONS. In Bibliography, those which proceeded from the press of the family of Aldus Manutius. The first of that name established his press at Venice, not

long after the year 1490; and to his industry and zeal we owe several of the first editions of Greek authors, and many other valuable works. The Italic characters used in Roman printing by Aldus and his family, first appear in his Virgil of 1501; and from that period a series of works, chiefly classical, both Greek and Latin, proceeded from his press in a duodecimo form: these are the best known and most common Aldine editions. The family press is said to have been broken up in 1597, after producing 908 editions. There are, however, Venetian publications of the beginning of the 17th century which bear the impress of the Aldine family (an anchor and dolphin engraved on the last page). A branch of the Aldine press was for a short period established in Rome. (*See* Raynouard, *Annales de l'Imprimerie des Aldes.*)

ALE. *See* BEER.

ALEATO'RIUM. (Lat.) In ancient Roman architecture, an apartment appropriated to the use of players with dice or aleæ.

ALECTO'RIDES. (Gr. ἀλεκτωρ, *a cock.*) A tribe of rasorial or gallinaceous birds, including the curassow, and the species which, like it, resemble the common fowl in the form of the beak.

ALE'MBIC. (From the Arabic particle al, *the*, and ambeeq, corrupted from the Greek word ἀμβιξ, *a cup or vessel.*) An obsolete form of still. Constructed upon a small scale in glass, it is sometimes used in the laboratory.

ALE'MBROTH, or Salt of Wisdom. A term applied by the old chemists to a salt composed of ammonia, muriatic acid, and oxide of mercury. It is poisonous.

ALEXA'NDRIAN SCHOOL. An academy for literature and learning of all kinds, instituted at Alexandria by Ptolemy, son of Lagus, and supported by his successors. The grammarians and mathematicians of this school were particularly celebrated. In the former class occur the noted names of Aristarchus, Harpocration, and Aristophanes; and among the latter were numbered the astronomer Ptolemy, and geometer Euclid. The grammarians of Alexandria exercised a universal literary jurisdiction, publishing canons of those who were to be considered standard authors, and revised editions of ancient writers. For some account of the famous collection of books at Alexandria, *see* LIBRARY.

ALEXA'NDRINE. The French heroic verse of twelve syllables or six Iambic feet. In English poetry it is occasionally used: by Dryden, sometimes as a second line in a heroic couplet, more frequently as a third line in a triplet; and the Spenserian stanza necessarily concludes with an Alexandrine. The lines of Pope, defining the Alexandrine by an example, are well known:

"A needless Alexandrine ends the song,
Which, like a wounded snake, drags its slow length along."

ALEXIPHA'RMIC. (Gr ἀλεξω, *I avert*, and φαρμακον, *a poison.*) Antidotes to poisons.

ALEXITE'RICS. (Gr. ἀλεξω, *I avert.*) Preservatives against contagious and infectious diseases and the effects of poisons in general

A'LGÆ. (Lat alga, *sea-weed.*) Plants which are destitute of all signs of sexual organs, and which vegetate exclusively under water. When they grow in salt water they are called sea-weeds, when in fresh water they are named confervæ. They comprehend in the division Zoospermeæ some of the lowest known forms of vegetable life, plants consisting of simple cells adhering in different degrees, and emitting at maturity spores or seeds having a distinct animal motion. In the case of Oscillatorias, the whole mass of the plant writhes and twists spontaneously; and Zysmenas actually copulate. It is in this part of the vegetable kingdom that plants approximate to animals in the most striking degree. An excellent account of the salt-water species is given in Greville's Algæ Britannicæ; the fresh-water kinds may be studied in the third volume of the English Flora.

ALGARO'BA. (Arab. al, *the*, and garoba, *a bean-tree.*) A tree found in the southern parts of Europe, and in Palestine, having pods filled with a sweetish nutritious powder: they are supposed to have been the locusts on which St. John fed in the wilderness. It is the ceratonia siliqua of botanists.

A'LGAROTH, POWDER OF. The white powder which falls when chloride of antimony is dropped into water: it is a submuriate of antimony, virulently purgative and emetic.

A'LGEBRA. An important branch of the mathematical sciences, and may be defined to be the method of calculating indeterminate quantities. It is a sort of universal arithmetic, founded on the same principles as common arithmetic, and proceeding by rules and operations precisely similar. But it is not confined merely to questions relating to numbers, being applied generally to investigate the relations that subsist among quantities of all kinds, whether arithmetical or geometrical. The reasoning is carried on by general symbols; and it is to the complete system of notation, which has been introduced by its successive cultivators and improvers, that it owes its immense superiority over the ancient analysis.

The symbols employed in algebra are of two kinds: those which denote quantities; and those which denote the affections or relations, or properties of quantities, and operations to be performed on them. For representing quantities or magnitudes, the letters of the alphabet are employed. Thus, in the solution of an arithmetical problem, a number may be represented by the letter $a$; in geometry, $a$ may represent a line or an angle; in mechanics, a force. The relations of quantities are expressed by other conventional symbols. The relation of equality is expressed by the sign $=$; thus, to express that the quantity represented by $a$ is equal to the quantity represented by $b$, we write $a = b$. The symbol $>$ or $<$ coming between two quantities denotes inequality; thus, $a > b$ signifies that $a$ is greater than $b$, and $a < b$ denotes that $a$ is less than $b$. The two primary operations of which quantities are susceptible, are addition and subtraction, and these are respectively indicated by the symbols + plus, and — minus. For example, $a + b$ denotes the sum of the two quantities $a$ and $b$, or that $a$ is to be increased by $b$; and $a - b$ denotes the difference between $a$ and $b$, or that $a$ is to be diminished by $b$. Multiplication is indicated by the symbol $\times$, or by simply placing the letters beside each other without an intervening symbol. Thus, in numbers, $a \times b$ or $ab$ denote the same thing, namely, the product arising from the multiplication of the number $a$ into $b$. In geometry, two letters joined together, as $ab$, denote a rectangular parallelogram, one of the sides of which is represented by $a$, and the other by $b$. Division is indicated by $\div$; or more frequently by placing one of the numbers above the other in the form of a fraction, thus:

$$30 \div 10, \text{ or } \frac{30}{10}.$$

In addition and subtraction, the quantities connected by the appropriate symbols must be homogeneous, or of the same kind; for it is only such quantities that admit of addition or subtraction. Of two quantities connected by the symbol of multiplication, one must necessarily be an abstract number, for a quantity can only be multiplied by a number, or, which is the same thing, added to itself once or twice, or some other number of times. When division is to be performed, the divisor may either be a quantity of the same kind as the dividend, or it may be an abstract number; in the former case, the quotient is an abstract number; in the latter, it is a quantity of the same kind as the dividend.

In the multiplication of quantities, the frequent repetition of the same symbol would become inconvenient; it is usual, therefore, to write the root only once, and to place over it, on the right, the exponent or number indicating the power: thus, $a^2$ denotes the same thing as $aa$, or the square of $a$; $a^3$ is the same as $aaa$, or the cube of $a$, and $a^n$ denotes the $n$th power of $a$, or $a$ multiplied by $n$ times into itself. By analogy, $a^{\frac{1}{2}}$ denotes the square root of $a$; $a^{\frac{1}{3}}$ the cube root of $a$, and so on. (*See* NOTATION, SYMBOL.)

Algebra is in its nature essentially distinct from arithmetic. In arithmetic absolute numbers are given, from which other absolute numbers are required to be determined. But in algebra the symbols that are employed are perfectly general, and may represent any numbers whatever; and the expressions which result from combining them according to the conditions of the problem, indicate the solution not of a particular question, but of all questions whatever, in which numbers are subjected to the same series of operations. In this manner the general properties of numbers are discovered. For example, the expression $(a + b)(a - b)$, which signifies that the sum of the two numbers $a$ and $b$ is to be multiplied by their difference, becomes, on performing the multiplication, $a^2 - b^2$; whence we infer this general or universal truth, namely, that the product of the sum and the difference of any two numbers, is equal to the difference of the squares of those numbers. Arithmetic could only prove the property to be true in respect of particular numbers. The systematic notation, to which algebra owes nearly the whole of its power as an instrument of research, is only of recent introduction. Indeed, the science itself, if known at all to the ancient Greek mathematicians, was known only as a higher species of arithmetic. The first writer on the subject, with whose works we are acquainted, is Diophantus, who lived about the middle of the fourth century of our era, and his work relates only to a peculiar class of arithmetical questions, in the solution of which he displayed considerable address, but the symbols which he used were only abbreviations (such as the initial or terminating letters) of the ordinary words. The treatise of Diophantus passed into the hands of the Arabians; but algebra received from them no improvement or extension. From the Arabians, it was transplanted into Italy, in the beginning of the 13th century, by Leonardo Bonacci, a merchant of Pisa, who had travelled frequently in the East, and become acquainted with the science of those countries. A treatise on arithmetic, comprehending algebra as it was then

known, was written by him in the year 1202, and from that time the science appears to have been cultivated with some assiduity in Italy. The earliest printed book on the subject was composed by Lucas Paciolus, or Lucas de Burgo, a minorite friar, and appeared in 1494. It contains a pretty complete treatise on algebra for the time; but exhibits the science in nearly the same state in which it was left by Diophantus. Its application was confined to questions relating to numbers of no great interest, and its power extended only to the solution of equations of the first and second degrees. But after this epoch it began to be cultivated extensively, and to undergo rapid improvement. Scipio Ferreus, a professor of mathematics at Bononia, about the year 1505, first broke through the boundary within which it had so long been confined, and accomplished the solution of a problem of the third degree. A general method of solving cubic equations was soon after discovered by Tartalea, who communicated it, under an oath of strict secrecy, to the celebrated Cardan. Presuming on some improvements he had made in the rules given to him by Tartalea, and on the demonstrations which he certainly had the merit of inventing, Cardan, with a remarkable (though, unfortunately, in the history of science not singular) instance of bad faith, published the whole as a supplement to a treatise which he had composed several years before. Cardan, however, considerably extended the methods given to him by Tartalea, and, besides, contributed to improve the notation, by frequently employing the letters of the alphabet. Lewis Ferrari, a disciple of Cardan, had the honour of making the next important improvement in the science, by the discovery of a method of solving biquadratic equations, or equations of the fourth degree; and it is remarkable that all the efforts of modern mathematicians have not yet been able to pass this barrier, or effect the general solution of equations of a higher order than the fourth.

The first great step to the improvement of algebra, by the introduction of a concise and systematic notation, was made in Germany, by Stifel, or Stifelius, a protestant minister, whose work, "Arithmetica Integra," was published in 1514. Stifel adopted the symbols + and — for plus and minus, to represent addition and subtraction, and also √ (the contraction of r) for radix, or root: he likewise introduced the numeral exponents of the powers, $-3, -2, -1, 0, +1, +2, +3$, &c. The symbol =, denoting equality, was first used by our countryman, Robert Recorde.

In following the chain of the principal discoveries, our attention is next arrested by Vieta, a native of France, who first applied algebra to the improvement of geometry, and thereby laid the foundation of the modern analysis. He was also the first who employed general symbols to represent known, as well as unknown, quantities, and thus introduced what has been called the specious algebra, in contradistinction to the literal, where known quantities are represented by numbers. This improvement, simple as it may appear, was attended by important consequences, as it rendered the methods quite general, and enabled the algebraist to comprehend whole classes of problems in a single formula. Vieta likewise gave a method of solving algebraic equations by approximation; and from his doctrine of angular sections have been derived the arithmetic of sines, and some of the most valuable processes of trigonometry.

Vieta was followed by Albert Girard, who first showed the use of the negative sign in the solution of equations; and by Harriot, to whom the science is indebted for the very important discovery, that every algebraic equation may be regarded as the product of as many simple equations as there are units in the number expressing its order. An equation, for instance, of the fifth degree may be regarded as the product of five simple equations. Descartes followed soon after, and opened up vast fields of discovery, by the application of the algebraic analysis to define the nature and investigate the properties of curve lines. By referring every point of a curve to co-ordinate or perpendicular axes, he expressed the relation between its different points by means of an equation, which served as a characteristic to distinguish the curve, and from which its different properties could be investigated by the ordinary operations of algebra. Descartes also pointed out the method of constructing or representing geometrically, equations of the higher orders; gave a rule for solving a biquadratic equation by means of a cubic and two quadratics; and improved the methods of reducing and treating equations which had been adopted by Cardan, Girard, Harriot, and others who had preceded him.

Algebra, as a science, has undergone no revolution since the time of Harriot and Descartes; but it has been improved in all its details, and greatly varied and extended in its applications. During the last century, and the latter part of the preceding, the method of infinite series, so useful in many applications of mathematics, particularly in the calculation of probabilities, was successfully cultivated by Wallis, Newton, the Bernoullis, Euler, De Moivre, Stirling, Simpson, and others. The nature and composition of algebraic equations has been fully investigated, and the methods of approximating to their roots reduced to order and system. The investigation of the relations of angular sections, begun by Vieta, conducted Euler to the arithmetic of sines and a complete theory of plane and spherical trigonometry. Applied to problems concerning the motion of bodies or points, algebra has given rise to the doctrine of fluxions, and the refined methods of the differential and integral calculus. It has completely superseded the use of the elegant, but comparatively feeble, ancient analysis, and may be now regarded as forming the basis of the whole edifice of mathematical science. (*See* BINOMIAL THEOREM, EQUATION, NOTATION.)

ALGEBRA'IC CURVE. A curve of which the relation between the abscissa and the ordinates is expressed by an equation which contains only algebraic quantities. The term algebraic is here used in contradistinction to transcendental, under which is comprehended infinite series and quantities of the following kind: log. $x$, $a^x$, sin. $x$, cos. $x$, tan. $x$, &c.

ALGEBRAIC EQUATION. An equation of which the terms contain only algebraic quantities. (*See* EQUATION.)

A'LGORITHM, signifies the art of computing in reference to some particular subject, or in some particular way; as the algorithm of numbers; the algorithm of the differential calculus.

A'LGUAZIL. A Spanish officer corresponding with the English bailiff, having power to place persons in custody, and apprehend criminals.

A'LIAS. (Lat. *otherwise*.) In Law, when a defendant sued on a specialty, or a prisoner, had more than one common appellation, he was designated in the Latin forms of instruments, as "A. alias dictus B." When it is necessary for a second writ of the same description with a former one to issue, it is headed "alias," as, an alias capias, &c.

A'LIBI. (Lat. *elsewhere*.) A cant law phrase, used to express the species of defence set up by one charged with a criminal offence, who offers evidence to prove that he was elsewhere at the time of the act committed.

A'LIDADE. An Arabic name given to the index or ruler which moves about the centre of an astrolabe or quadrant, carrying the sights or telescope, and showing on the limb of the instrument the number of degrees and minutes the object observed is elevated above the horizon.

A'LIEN (Lat. alienus, *foreign*), generally speaking, is one born in a country out of the allegiance of the sovereign, unless his father were a natural born subject, in which case he will himself be deemed a natural born subject, to all intents and purposes. By 7 & 8 V. c. 66. various statutory disabilities by which aliens were incapacitated from possessing property in England were mitigated; and they are now enabled, on memorialising the home secretary and taking a prescribed oath, to acquire nearly all the rights of natural-born subjects, with the exception that they cannot become members of the privy council, of either houses of parliament, or of a municipal corporation. (*See* DENIZEN.)

ALIEN WATERS. Any stream of water carried across an irrigated field or meadow, but which is not employed in the process of irrigation.

ALIENA'TION. In Law, the act of parting with property: more especially real property. The alienation of real property takes place by deed, or in pais. (*See* REAL PROPERTY.)

ALIME'NTARY CANAL. A cavity in the interior of an animal body in which the nutriment is taken to be digested, before it is conveyed by the nutritive vessels to the system: it affords the best organical characteristic of an animal, but presents various modifications of structure. Sometimes it is a simple cavity with one opening; sometimes a true canal, with an outlet or anus, distinct from the inlet or mouth; this canal may be divided into stomach and intestine, as in the oyster; or a mouth, pharynx, and œsophagus may precede the stomach; the œsophagus, again, may have one or two sacculi appended to it, called crops. The stomach may be subdivided into four bags, as in the ruminants, or into seven, as in the bottle-nose whale; and the intestines into small, blind, and large, forming, with their subdivisions, what are termed duodenum, jejunum, ileum, cæcum, colon, and rectum. The cæcum, again, may be single, or double as in most birds; or a single cæcum may exist in addition to a double one, as in the hyrax, a small pachydermatous quadruped. Lastly, the various glandular organs which communicate with the alimentary canal are to be regarded as cæcal processes of that tube, since these are developed from it, and in this condition they are permanently retained by one or other of the lower animals: thus, in the sea-mouse, the liver is represented by long, branched, lateral processes of the intestine; in the cod fish, &c. the pancreas is similarly represented by numerous cæcal processes of the duodenum.

A'LIMONY. In Law. The allowance for which a

married woman is entitled to sue on separation from her husband. (*See* MARRIAGE.)

A'LIQUOT PART of a number. A number which divides the given number without leaving a remainder. Thus 2, 3, 4, and 6, are aliquot parts of 12. To find the aliquot parts of any number, divide the given number by its least divisor; divide the quotient also by its least divisor, and so on, always dividing the last quotient by its least divisor till the quotient is 1. The divisors thus used are the prime aliquot parts of the given number; and the products of every two, every three, every four, &c. of the prime aliquot parts, give the compound aliquot parts of the given number. Suppose the given number 30; divide 30 by its least divisor, which is 2, and the quotient is 15; divide 15 by its least divisor 3, and the quotient is 5; divide 5 by itself (it has no smaller divisor) and the quotient is 1. Therefore, 2, 3, and 5, are the prime aliquot parts of 30. The compound aliquot parts are, $2\times3=6$, $2\times5=10$, $3\times5=15$.

ALISMA'CEÆ. (Alisma, from alis, *water*, in Celtic.) A small natural order of endogenous plants, marked by the presence of numerous distinct carpels in a tripetaloideous flower. They form a near approach to ranunculaceæ among exogens. Alisma and sagittaria are common genera

ALI-TRUNCK, ALITRUNCUS. In Entomology, the posterior segment of the thorax of an insect to which the abdomen is affixed, and which bears the legs, properly so called, or the two posterior pairs, and the wings.

ALIZARINE. From Ali-zari the commercial name of madder in the Levant; a peculiar colouring principle obtained from madder.

A'LKAHEST. A term of obscure Arabic origin, applied by the alchemists to a supposed universal solvent.

A'LKALI, or ALCALI, derived from the Arabic article al, and kali, the name of a plant in the same language. A term originally applied to the ashes of plants; now generally used to designate potash, soda, and ammonia, which are also termed vegetable, mineral, and volatile alcali. These substances have certain properties in common, such as neutralising and forming salts with the acids, reddening several vegetable yellows, and changing some blues to green, and ready solubility in water. Lime, baryta, strontia, and magnesia, have been called alcaline earths, from their analogous action on vegetable colours. Lithia is also one of the alcalis. A singular class of bodies have been discovered in vegetables which have been termed alcahs, or alkaloids, chiefly in consequence of their power of saturating and forming definite salts with the acids. Morphia, quinia, &c. are substances of this description.

ALKALI, FOSSIL or MINERAL. Soda.

ALKALI, PHLOGISTICATED. Ferrocyanuret of potassium.

ALKALI, VEGETABLE. Potash.

ALKALI, VOLATILE. Ammonia.

A'LKALOI'DS. Substances analogous to alcaline bases of vegetable origin, and generally possessed of great medicinal activity. Their ultimate elements are carbon, hydrogen, oxygen, and nitrogen. The principal substances of this class, together with the plants from which they are obtained, are the following:—

| | |
|---|---|
| Aconita | Aconitum napellus. |
| Aricina | A bark from Arica. |
| Atropia | Atropa belladonna. |
| Brucia | Strychnos nux vomica. |
| Cinchonia | Cinchona lancifolia. |
| Codeia | Opium. |
| Conia | Conium maculatum. |
| Corydalia | Corydalis tuberosa. |
| Cynapia | Æthusa cynapium. |
| Daturia | Datura stramonium. |
| Delphia | Delphinium staphisagria. |
| Digitalia | Digitalis purpurea. |
| Emetina | Cephaelis ipecacuanha |
| Hyoscyamia | Hyoscyamus niger. |
| Meconia | Opium. |
| Morphia | Opium. |
| Narcotina | Opium. |
| Nicotina | Nicotiana tabacum. |
| Picrotoxia | Menispermum cocculus. |
| Quinia | Cinchona corditolia. |
| Sanguinaria | Sanguinaria canadensis. |
| Solania | Solanum nigrum. |
| Thebaia and Narceia | Opium. |
| Veretria | Veratrum sabadilla. |

A'LKANET. (A corruption of the French *orcanette*; orca, *a rouge pot.*) A kind of reddish purple dye, obtained from the roots of Anchusa tinctoria: it was formerly used for staining the face.

ALKANET The Anchusa tinctoria. The root of this plant, which is a native of the warmer parts of Europe, contains a red resinous colouring matter which it imparts to alcohol and oils: it is used to tinge some ointments, especially lip-salves, of a red colour.

ALKOO'L. A preparation of antimony used by the women of eastern nations, to tinge the eyelids and lashes of a black colour. Dr. Shaw, speaking of the women in Barbary, says, "None of these consider themselves dressed, till they have tinged the edges of their eyelids with alkoohl."

A'LLA BREVE. (Ital. according to the breve.) In Music, the name of a movement whose bars or measures consist of the note called a breve, equal therefore to two semibreves or four minims. It is denoted at the beginning of a staff by a C with a bar drawn through it vertically.

A'LLA CAPELLA. (Ital. according to the chapel.) In Music, the same as alla breve. The name originates in the circumstance of this time being principally employed for movements used in the church or chapel.

A'LLAH. The Arabic name of the Supreme Being. It signifies the True God, as opposed to the deities of idolaters.

A'LLANITE. A silico ferriferous oxide of cerium from Greenland; named after the late Mr. Allan of Edinburgh.

ALLA'NTOIC ACID. A white crystallisable acid, obtained by evaporating the allantoic liquid of the fœtal calf.

ALLA'NTOIS. (Gr. αλλας, *a sausage* and ειδος, *form.*) A thin membranous sac developed from the termination of the alimentary canal of the embryo, situated between the amnion and chorion, and organised by the hypogastric arteries and umbilical vein. Its function, as a temporary respiratory organ, is of most importance in those oviparous vertebrates where the embryo has no branchiæ; in the mammalia, its use is more or less superseded by the chorion and placenta. In some quadrupeds the allantois has the form of a sausage, whence its name.

ALLE'GIANCE. (Fr. ligence, from the Latin ligare and allegare, *to bind.*) The obedience which a citizen owes to his prince or country. The allegiance of a born subject of the English Crown is inseparable, and follows him every where: nor can he by any act of his own free himself from it. There is also a temporary allegiance, which foreigners incur so long as they reside within the king's dominions. By common law, all persons above the age of twelve years were required to take the oath of allegiance at the court leet; and the oaths of allegiance and supremacy have since been imposed by many statutes. The present form of the oath of allegiance was introduced by the Convention Parliament of 1688. In the United States, it appears to be regarded as a doubtful point, whether the allegiance of the citizen is necessarily perpetual, as with us The American laws also require a foreigner to have renounced (as far as possible by his own act) allegiance to his former government, two years before he takes the oath of allegiance to that of his acquired country.

A'LLEGORY. In Rhetoric and Literature (from the Greek words αλλο, *another thing*, and αγορεω, *I declare*) has been defined, "a figurative representation, in which the signs (words or forms) signify something beyond their literal or direct meaning. In this sense allegory may be addressed to the eye, in painting and sculpture, by means of forms, intended to convey, besides the notion of those sensible objects which they represent, certain abstract ideas to which these objects are supposed to bear analogy. Allegory differs, 1. from symbolical writing or representation; because in the first, the type and antitype, or thing exhibited and thing intended, have some real or natural resemblance, relation, or analogy: in the latter, the resemblance is merely conventional. Thus, to take an instance from modern literature: if it be true, as is now alleged, that the earlier Italian poets of the middle ages, and Dante in particular, attached a conventional meaning to certain ideas frequently recurring in their poems; as, for example, that Satan signified the papal power,—the three beasts mentioned in the commencement of Dante's poem three States — love, loyalty to the emperor, &c. &c.; then their poems, considered with reference to this occult sense, must be regarded as specimens not of allegory but of symbolical writing. But if, as in the more ordinary interpretation of Dante's poem, Satan represents the abstract idea of eternal misery, the beasts particular vices, &c., which in common acceptation are supposed to have some natural analogy with their representatives, the poem is in this respect to be regarded as an allegory. Thus, also, critics have endeavoured to give a symbolical sense to the sixth book of Virgil's Æneid; while, independently of that sense, if it really exist, there is an obvious allegorical meaning running through the whole. (In ancient criticism, however, the words allegory and symbol were not so accurately distinguished; and in our translation of the Bible, St. Paul is made to use the word allegory in the clear sense of type. Gal. iv. 24.) Allegory differs, 2. from parable, only inasmuch as the latter is a species of the former: a parable being a short, sententious, allegorical narration. And, 3. it is different from metaphor, being in effect a chain of metaphors, or a single metaphor continued and wrought out into a lengthened discourse.

4. Fables may also be mentioned as a species of allegory. (*See* FABLE.) An allegory, or allegorical tale, in the somewhat narrower sense in which the term is used in literature, is generally a tale in which abstract ideas are personified: such (to cite one of the earliest instances of this species of composition) as the Choice of Hercules, or human youth, between virtue and vice, in the shape of two females: an allegory which descends to us from Greek antiquity. Entire poems are sometimes strictly allegorical, as that of Spenser; or entire narratives, as Bunyan's Pilgrim's Progress; in which case it requires consummate art to keep up the propriety of the allegory, which is in fact a compound of two opposite, and sometimes scarcely compatible, qualities—consistency running through its several incidents, when considered merely as a narrative and without reference to the ulterior meaning, and consistency of analogy between the thing represented and the thing answered.

ALLEGR'ETTO, and ALLEGRO. (Ital. *a little merry*, and *merry*.) In Music. The first term is a diminutive of the second, which, prefixed to a movement, signifies that it is to be performed in a brisk and lively manner; not, however, with hurry or precipitation, but quicker than any other time in music, except that marked presto. The different times used in music are arranged as follows: proceeding from slow to quick, namely grave, adagio, allegretto, allegro, and presto. The word più, *more*, added to any of these, and the word poco, *little*, strengthen the significations in their various kinds.

A'LLEMAND. (Fr.) In Music. A species of slow grave music or movement in common time and performed slow. From its name it would seem to belong to Germany, but it is now altogether disused.

ALL-HA'LLOWS. The old English name for All Saints' day (the 1st of November).

ALLIA'CEOUS. (Lat. allium, *garlic*.) Any thing having the smell of onions or garlic.

ALLIACEOUS PLANTS. Plants which partake more or less of the qualities of garlic and onions; such as onions, shallots, rocambole, chives, leeks, garlic, &c.

ALLI'ANCE. In Politics and International Law, a league between two or more friendly powers; which may be either offensive and defensive, or defensive only. Of the former species is the alliance of 1813 against Napoleon, subsequently called the Holy Alliance. Of the latter, the Quadruple Alliance, concluded in 1833 between England, France, Spain, and Portugal. Alliances are divided by publicists into three classes. 1. Those in which the allied parties agree to prosecute a war with their whole force. 2. Alliances in which auxiliary states pledge themselves to grant to a principal state a fixed contingent of men, money, &c. 3. Treaties to furnish troops for stated subsidies, to make advances of money, &c.

ALLIGA'TION. (Lat. alligo, *I bind*, or *tie together*.) A rule of Arithmetic, for the solution of questions concerning the compounding or mixing together of different ingredients, or ingredients of different qualities. There are two cases, one of which is alligation medial, and the other alligation alternate. To the first case belongs a question of this sort: Suppose 4 gallons of wine at 12 shillings per gallon, to be mixed with 6 gallons at 17 shillings per gallon, what is the worth of a gallon of the mixture. But if it were asked, how many gallons of wine, at 17 shillings per gallon, must be mixed with 4 gallons at 12 shillings per gallon, in order that the worth of a gallon of the mixture may be 15 shillings, the question would belong to alligation alternate. Questions of this kind are, however, most easily resolved by elementary algebra; of which they form an easy class of indeterminate problems, admitting in general of an indefinite number of solutions.

A'LLIGATOR. (A corruption of the Portuguese word 'lagarto,' which is derived from lacerta, *a lizard*.) In modern Zoology, the term is limited to those species of crocodile which have a wide obtuse muzzle, unequal teeth, the fourth pair of which, counting backwards in the lower jaw, pass into corresponding cavities in the upper jaw, where their points are concealed when the mouth is closed. In the true crocodiles, the corresponding teeth pass into open grooves in the margin of the upper jaw, and are consequently exposed. In the alligators the head is less oblong, its length being generally as to its breadth as 3 to 2: the teeth are more numerous than in the crocodiles, sometimes amounting to twenty-two in the lower jaw, and to twenty in the upper. The hind legs and feet are rounded, and have neither crests nor dentations; the interspaces of the toes are only occupied for half their extent by a short membrane. The alligators, so far as is yet known, are peculiar to the New World.

ALLITERA'TION. In Composition. The frequent recurrence of the same letter, chiefly at the commencement of different words. This is sometimes resorted to, especially in poetry, for the production of effect. In the Celtic languages, alliteration was a recognised ornament in versification: it was so likewise in the early Gothic tongues; and in old English there are entire poems composed in alliterative metre, of which the celebrated Vision of Piers Ploughman is the most remarkable.

ALLOCA'TION. In Law. The allowance of an account in the Exchequer. The writ *de allocatione facienda* is for allowing an accountant sums expended by him in his office. The certificate of allowance of costs of taxation granted by the master, prothonotary, or other officer of court, is termed in practice an *allocatur*.

ALLO'CHROITE. A massive mineral allied to the garnet. Melted with phosphate of soda before the blowpipe, it exhibits several changes of colour, hence its name, from ἄλλος, *another*, and χροια, *colour*.

ALLO'DIUM. In feudal Law. A word of uncertain derivation (deduced by some writers from the old Teutonic "aloud," denoting the antiquity of the tenure). Land held by an individual in his own absolute right, discharged of all feudal obligation: opposed, therefore, to fee, fief, or feud. No allodial property can exist in England, where the king, in the eye of the law, is lord paramount of all lands and hereditaments. In ancient France the rule was, "nulle terre sans seigneur," and the presumption was in some parts of that country always in favour of a fief, unless the land were shown to be allodial. In Germany, on the contrary, the legal presumption was in favour of the allodium.

ALLO'TMENT OF LANDS. Any piece of land, set apart or allotted for any particular purpose. When more land is laid to a cottage than suffices for a garden, it is commonly called a cottage allotment.

ALLOY', or ALLAY. (From the French verb alloyer, *to mix one metal with another, in order to coinage*; derived perhaps from *à la loi*, the proportions of the metals being regulated by law; perhaps from allier, *to unite*; or allocare, *to put together*.) A term applied to compounds of the precious metals with others of less value, or to the least valuable of the metals in such compounds: thus, gold is said to be alloyed with silver, and silver with copper. Chemists generally apply the term to all combinations obtained by fusing metals with each other: thus, brass is an alloy of copper and zinc; and bronze, of copper and tin; except when mercury is one of the combining metals, in which case they call the compound an amalgam. Many of the alloys are importantly useful in the arts: thus, gold and silver, which in their pure state are too soft and flexible for the manufacture of plate, coin, trinkets, &c., are hardened by the addition of a certain portion of copper; while their colour and other valuable qualities are not materially impaired. The standard gold in circulation in this country, is an alloy of 11 parts of pure gold, and one of copper. Sometimes the alloy consists partly of silver, especially in the older coins; and it is to the preponderance of one or other of these alloys that the different colour of gold coin is owing; the paler containing silver, the deeper coloured, copper. A little palladium is sometimes present, which gives the gold a disagreeable brownish hue, as seen occasionally in some sovereigns. Our standard silver, used for coin, consists in 12 parts, of $11\frac{2}{20}$ silver, and $\frac{18}{20}$ copper: in these alloys it is necessary to employ copper of the utmost purity; for a very minute portion of some of the other metals, especially of lead, renders the precious metal brittle. The silver alloy used for plate is the same as that for coin, and the purity is guaranteed by the stamp of the Goldsmiths' Company. The subject of alloy for coin underwent an elaborate investigation at the beginning of the present century by order of government, the inquiry was intrusted to Mr. Cavendish and Mr. Hatchett, and the latter gentleman has published a valuable account of his experiments in the "Philosophical Transactions" for 1803, to which the reader is referred.

Some curious circumstances ensue in the combination of metals, as affecting their densities; the specific gravity of an alloy being sometimes greater and sometimes less than the mean of its components,—showing that in some cases expansion has taken place, and in others contraction.

Alloys generally melt at a lower temperature than that required for the fusion of their component metals separately; and in some cases the most refractory metals form very fusible alloys. There are some alloys which are crystallisable, and probably of definite composition; but the atomic doctrine applies only in a few cases to the alloys, and it is often difficult to get a mass of alloy of similar composition throughout; thus, gold made standard with copper, and then cast into bars in upright moulds, does not yield an uniform compound except under due precautions; for the upper end of the bar, containing the metal from the bottom of the crucible, will be the purest.

A'LLSPICE. The dried immature berry of the Myrtus Pimenta; called also Jamaica Pepper. It is supposed to possess the mixed flavour of several spices, amongst which that of the clove predominates.

ALLU'SION, in Rhetoric. (Lat. ad, *to*, and ludo, *I*

*play*.) Strictly, a covert indication, as by means of a metaphor, a play of words, &c. of something not openly mentioned and extrinsic to the principal meaning of the sentence. In common language, to allude to any thing merely means to mention it indirectly or incidentally.

ALLU'VIUM. (Lat. alluo, *I wash upon*.) Gravel, sand, and other transported matter washed down by rivers and floods, upon land not permanently submerged beneath water.

ALMACA'NTAR. (From the Arabic.) A term used by the old astronomers to denote a small circle of the sphere parallel to the horizon.

ALMAGE'ST. A name given by the Arabs to the celebrated work of Ptolemy, the astronomer of Alexandria: it signifies the greatest work. The best edition of this work is that of Paris, 1813-15, two vols. 4to., Greek and French, by M. Halma.

A'LMANACK. (Probably from the Arabic particle al and manach, *to count*; whence Al Manach, *The Diary*.) An annual publication containing a calendar of the days and months of the year, the ecclesiastical feasts, the time of the sun's rising and setting, the age of the moon, the solar and lunar eclipses. To these (the most essential matters) are frequently added information on various subjects of astronomy, chronology, meteorology, the tides, statistics, lists of posts, offices, public institutions, &c., according to the views or fancy of their respective authors. Almanacks correspond in some respects to the Fasti of the Romans, and are of very ancient date. The first printed almanack appeared in 1474, and was drawn up by Regiomontanus, nearly, at least so far as regards the calendar, in the form now used. Till within a few years, the numerous almanacks published in England were little creditable to the taste or morals of the country. They had for a long time been monopolised by the Stationers' Company. This monopoly was at length broken through by the publication of a new almanack under the superintendence of the Society for the Diffusion of Useful Knowledge: and since that time the more exceptionable ones have entirely disappeared, and their place been supplied by others which abound in useful and valuable information. The removal of the heavy stamp duty of fifteen pence per copy, to which they were subjected till 1834, has been attended with all the advantages which usually result from the exercise of free competition.

The Nautical Almanack is published by order of the board of the admiralty for the use of seamen, and contains a copious list of astronomical phenomena, and of the elements which are used in finding the longitude at sea. This work is also a very complete astronomical ephemeris, showing the instants of time at which the planets and principal stars daily pass the meridian of Greenwich; the sun's right ascension, and the logarithms of his distances; the moon's place at intervals of three hours, &c. This valuable work first appeared in 1767, under the superintendence of Dr. Maskelyne.

A'LMOND. (Gr. ἀμυγδαλον. Fr. amande.) The seed or kernel of the Amygdalus communis. Sweet almonds afford, in the 100 parts, 54 of fixed oil, 24 of albuminous matter, 9 gum and sugar, 4 woody fibre, 5 husk, and 4 water and loss. Bitter almonds contain less fixed oil, and a peculiar principle termed *Amygdalin*. When bitter almonds are cold pressed, the oil which exudes contains no trace of prussic acid; when hot pressed, its flavour may be perceived: the cake remaining after pressure yields a volatile oil by distillation, the quantity and strength of which in prussic acid is variable. The oil of bitter almonds is about the specific gravity of water; that which passes first over is most poisonous. It changes when exposed to air, and forms benzoic acid: in close vessels it may be long kept without deterioration. When used in medicine, great care is requisite on account of its varying strength. Half an ounce of oil of bitter almonds was put into the mouth of a Newfoundland dog (in a diseased state and moaning with pain), with the intention of immediately killing it; but after some slight convulsions the animal became tranquil, appeared easier, and recovered the effect: about a drachm of recently and carefully prepared oil was then administered, when the animal fell upon its side, became convulsed, and died in three minutes. The distilled oil of peach leaves and of the cherry laurel also contain prussic acid, and the water distilled from them is poisonous. By digesting these oils with finely powdered peroxide of mercury, crystals of cyanuret of mercury are formed.

A'LMONER. An officer in a religious house, to whom the distribution of alms was committed. The term is still retained by officers in some of our hospitals.

ALMS. Charitable offerings; from the Greek ἐλεημοσυνη, *pity*; which came in the early ages of the church to be used in the plural number in the peculiar sense which is represented in our language by the word Alms.

A'LOE. (Arabic, alloch.) A small tree with endogenous stems, and stiff, fleshy, hard pointed leaves, abounding in a purgative principle which is obtained by simple pressure of the bruised leaves, or by boiling. The juice when inspissated becomes the medicinal drug of the shops. It varies much in quality. (See the following article.)

A'LOES. The inspissated juice or extract of several species of aloe. This article is largely imported for medical use from Bombay. It is of a brown colour, a peculiar and somewhat aromatic odour, and a nauseous and intensely bitter flavour: it consists of extractive and resin, and is nearly soluble in boiling water, but the solution as it cools deposits flakes of resin. The best aloes was formerly brought from the island of Socotorah, in the Indian Sea, and hence all the finer aloes of commerce is frequently termed Socotorine aloes. Another variety of this drug comes from Barbadoes, in large gourd-shells containing upwards of half a hundred weight each; it is deep coloured, opaque, and has a nauseous and peculiar odour, especially when breathed upon. Aloes is a warm stimulating purgative, operating as such in the dose of four to eight grains. It stimulates the large intestines, and should be administered with caution in habits where there is tendency to piles, and in cases in females in which uterine stimulants are improper.

ALO'NSINE, or ALPHONSINE TABLES. An astronomical work, which appeared in the year 1252, under the patronage of Alonso X., in the first year of his reign.

ALO'PECU'RUS, (Gr. ἀλωπηξ, *a fox*, and οὐρα, *a tail*.) A genus of grasses, called by the farmer *foxtail*; the flowers are arranged in compact tail-like stalks. It is very like Phleum or *catstail*, from which it differs in its glumes being acute, not truncate, and its lower pales awned. *Alopecurus pratensis* forms a part of all the richest pastures in this country.

ALO'SA. The name of a genus of Clupeoid fishes, including the alose, or shad; separated from the herring and pilchard, with which it was classed by Linnæus. The shad ascends large rivers to the fresh water, where it spawns. The white-bait used to be regarded as the young of the shad, but is now ascertained to be a distinct species of the present genus.

A'LPHABET. (From the Gr. ἀλφα, βητα, the two first Greek letters.) The letters of a written language, disposed in their regular order. An alphabetical language is one possessing an alphabet.

1. The first and most obvious mode by which thought can be expressed and conveyed to the eye, is by the representation of actual objects. Hence the species of writing which the learned have termed *ideographic*, i. e. in which knowledge is conveyed, first, by representations of the objects of thought; secondly, by symbols. The origin of designing is coeval with that of mankind; and men early availed themselves of this art to make their thoughts visible. To make it be understood, for example, that one man had killed another, they drew the figure of a dead man stretched on the ground, and of another standing by him upright, with some deadly weapon in his hand. To let it be known that some one had arrived by sea, they drew the figure of a man disembarking from a ship; and so on. This kind of writing, if we may so employ the word, was very early used in Egypt, and most probably, also, in most of the ancient nations. In Greek, the word γραφειν signifies indifferently either to write or to paint. In Mexico, when the Spaniards landed, the inhabitants of the sea coast conveyed intelligence of the event to Montezuma by sending him a large cloth, on which they carefully painted what they had seen. It is unnecessary to insist on the difficulty and inconvenience of this method of writing; and to lessen these, recourse was had to the *symbolic* or *emblematic* variety of ideographic writing. In this method abbreviations or characteristic parts were introduced instead of the entire object. Thus, the ancient Egyptians are said to have represented a siege by a scaling-ladder; a battle, by two hands holding a buckler and a bow, &c. Abstract ideas were, also, represented by symbols, or sensible objects, supposed to have a certain analogy to them: as, ingratitude by a viper, providence by an eye, the head of a hawk, &c.

2. From ideographic was derived syllabic writing. It must have been early remarked that the sounds formed by the voice in speaking are articulate and well-defined; and the idea occurred of endeavouring to represent such sounds by appropriate signs. Thus the word *republic*, in the writing of which we use eight letters, would be written with three syllabic characters. The President de Goguet suspects that originally all the Asiatic nations, known to the ancients under the names of Syrians and Assyrians, used the syllabic mode of writing. We may, he thinks, discern the vestiges of this in an ancient tradition which ascribes the invention of writing to the Syrians; but acknowledges that the Phœnicians improved, made it more simple, and brought the characters to perfection. But this mode of writing, though a vast improvement on what is purely ideographic, is still very imperfect and cumbersome. The vast number of characters required in it overburdens the memory, and occasions the greatest confusion. The existing language of the Chinese, which is partly ideographic and partly syllabic, is an example of

this. In it there are a certain number of *elementary signs* or *keys* (two hundred and fourteen), which are strictly hieroglyphic or symbolical; that is, they are abridged representations of visible objects. From these 214 elements, all the characters of the language (80,000, it is said) are formed by varying and combining their figures; every compound character representing one or more syllables having a distinct meaning. 3. The defects incident to ideographic and syllabic writing being thus obvious, ingenious individuals would early endeavour to find out some more simple and precise method of communicating their ideas. And at length the method of Alphabetic writing, the greatest of all the inventions made by man, and which has been the great instrument of his civilisation, was introduced and perfected. In this method syllables are decomposed into their elements; and the few simple sounds emitted by the voice being represented each by its appropriate mark or letter, syllables and words are formed by their combination; the latter serving not only to describe external objects, but to depict the workings of the mind, and every shade and variety of thought. Before entering into the much disputed question respecting the origin of this mode of writing, it is necessary to indicate the new light thrown upon the subject by the recent discoveries of Dr. Young, and more especially of M. Champollion, as to the phonetic writing of the Egyptians. We have already seen that the hieroglyphical characters of that people denoted, in the first place, *objects* either of sense or thought; i. e. they were ideographic. But, according to the new theory, they came in the course of time to denote sounds; and those not syllabic merely, but alphabetical. For example, the Egyptian word Ahom signified an eagle; the figure of an eagle, therefore, stood for the letter A, with which that word begins. B was represented by a censer (Berbe). R sometimes by a mouth (Ro), sometimes by a tear (Rimé). According to the views of these recent discoverers, a great proportion of the inscriptions on Egyptian monuments and papyri are partly ideographic, partly alphabetical; i. e. some characters represent objects or ideas; and these are intermingled with others which merely stand for letters. Dr. Young, who first conceived the notion of the phonetic alphabet, imagined that it was only employed when foreign words or names (as those of Greek kings) were introduced. M. Champollion carried the discovery further, and applied it to the deciphering of words and names in the language of the country. The name of the ancient king Sabaco, among others, being found by this mode of interpretation, would appear to show that the phonetic writing was used as early as 700 years B. C. (See Dr. Young's writings, especially the article EGYPT in the Appendix to the *Encyclopædia Britannica;* those of Champollion; M. Klaproth's *Examen Critique des Travaux de Champollion; Quarterly Review*, vol. liii. p. 110.; Salt's *Essay on the Phonetic System of Hieroglyphics*, 8vo. London, 1825, &c.) It is not within our present province to discuss the question, upon what ground of probability this theory rests. But if a complete phonetic alphabet should be discovered, in the language of that country in which the earliest germs of knowledge and civilisation seem to have been developed, it is probable that we shall have made a considerable step towards tracing the origin of pure alphabetical writing in other languages. As it is, although various attempts have been made to show the symbolical origin of the letters in the most ancient alphabets, it cannot be said that any very satisfactory result has been obtained. And, from the total want of all recorded knowledge concerning the invention of alphabetical writing, and the difficulty of accounting for it on any known principle of mental association, the hypothesis of divine revelation has obtained considerable currency; but it need hardly be observed, how ill such a doctrine agrees with all that we know by analogy of the dealings of Providence with man.

It is clear that writing was known to the Hebrews at the period when the Mosaic books were composed, from many allusions contained in them. Exodus, xxxii. 15, 16. Numbers, xvii. 18., xxxi. 9. 19., xxxiii. 1., &c. And although it cannot be positively asserted, that the writing there alluded to may not have been of the symbolical description in use among the Egyptians, there seems, on the other hand, little reason for supposing that the Hebrew alphabet was not in use even at that remote period. And the question of superior antiquity seems to lie entirely between that alphabet and the Phœnician. The claims of the latter are supported by Mr. Astle (*Essay on the Origin of Writing*, 4to. London, 1803); but apparently on little better authority than what may be derived from the traditions of the Greeks respecting Cadmus and his alphabet; and the extreme antiquity of Hebrew civilisation and literature seems to give probability to the supposition, that the Phœnician alphabet may have been derived from theirs. The belief, however, was all but universal among the Greeks and Romans, that the Phœnicians were the inventors of letters. According to Lucan,

> "Phœnices primi (famæ si credimus) ausi
> Mansuram rudibus vocem signare figuris."

And Pliny says (lib. v. cap. 12.), "Ipsa gens Phœnicum in gloria magna est literarum inventionis." But whether the Phœnicians were or were not the inventors of alphabetic writing, there can be little or no doubt that the knowledge of it was brought by Cadmus, from Phœnicia, into Greece, about 1500 years B. C. From the Phœnician, therefore, or the Hebrew, are incontestably derived, 1. The Oriental alphabets used in Asia, West of the Indus; written, like Hebrew, from right to left; the principal being the Syriac, Arabic, and Persian. 2. The Pelasgic, or original Greek alphabet. Were there nothing else by which to establish the fact, the eastern origin of the Pelasgic language would be obvious from its being originally written, like the Phœnician and other eastern languages, from right to left. It was afterwards written consecutively from right to left, and left to right, in the manner that land is ploughed. This procured for it the name of *βουστροφηδον*, or furrowed writing. This species of writing maintained its ground for a lengthened period. The laws of Solon, promulgated about 594 years B. C., were written in it; and it was used till the 5th century B. C. But writing from left to right was introduced for a considerable period before the alternate or furrowed method was abandoned. Inscriptions dated 742 years B. C. have been found written from left to right, or in the way now practised. (Goguet, *Origin of Laws*, Eng. trans. ii. p. 32. &c.) From the Pelasgic alphabet were derived the Etruscan and Oscan. From the Ionic, a later variety of the Greek, came the Arcadian, the Coptic, and Ethiopic, the Mæso-Gothic and Runic; and, in comparatively modern times, the Armenian, Illyrian, Sclavonic, Bulgarian, and Russian. With regard to Greek writing, it is to be observed that the most ancient mode was in capitals. The small letters now in use seem to have been introduced gradually; for, in our oldest Greek MSS., even as early as the fifth century, they appear intermixed with capitals. But the latter were principally employed, until the seventh or eighth century. 3. The Latin alphabet is also derived from the Ionic Greek; it is said to have been introduced about the time of Tarquinius Priscus. In the earliest inscriptions which we possess, the forms of the letters scarcely differ from those in use at the present day; but, great varieties have been in subsequent times introduced: first, in the ordinary method of writing it; as, the Uncial, Semi-Uncial, Lombard, Italic, &c. (*See* CHARACTER.) Secondly, in the number and form of the letters contained in the numerous alphabets derived from it. 4. A fourth class of alphabetical languages consists of the Sanscrit and its derivatives. These are very numerous, and are spoken in the continent and islands of India. The antiquity of the Sanscrit alphabet is undoubtedly great; but those who assign to it a separate origin are probably in error. Its derivation from the Hebrew, or some of its cognate alphabets, admits of little doubt. Indeed, the great regularity of the Devanagaree, or most elegant form of the Sanscrit alphabet, and its copiousness (it contains 100 letters), seem to afford strong presumption that it was compiled by some learned individual, or body, (like the Russian and other modern Western alphabets,) from other forms of writing then in use, and imported into India from the West. The Sanscrit and its derivative languages are written, like European, from left to right. These four classes comprehend all the alphabetical languages in existence. The following table exhibits the number of letters in some of the principal.

Class 1. Hebrew, Samaritan, Syriac, and Chaldean, 22 each. Phœnician (known), 17. Arabic, 28. Persian, 32.

Class 2. Greek, 24. Armenian, 38. Ethiopic, or Abyssinian, 202. Modern Russian, 41.

Class 3. (which is only a subdivision of Class 2.) Latin, 22. English, 26. French, 28. Italian, 20. German, 26.

Class 4. Sanscrit (Devanagaree), 100.

Various learned persons have proposed the adoption of an universal alphabet; and have shown that the elementary sounds are reducible to a still smaller number than those employed in our western alphabets. Harris (*Hermes*, book iii. c. 2.) estimates them at twenty. Wachter (*Naturæ et Scripturæ Concordia*) conceives that the number may be diminished to ten. But the celebrated Bishop Wilkins, in his *Essay towards a real Character and Philosophical Language*, fol., London, 1668, estimates the necessary number at thirty-four.

The following Table contains specimens of the principal alphabets.

# ALPHABETS.

## ARABIC.

| Final. | Medial. | Initial. | |
|---|---|---|---|
| ا | ا | ا | Elif. |
| ب | بـ | بـ | Be. |
| ج | جـ | جـ | Jim. |
| د | د | د | Dal. |
| ذ | ذ | ذ | Dsal. |
| ه | ه | ه | He. |
| و | و | و | Wau. |
| ز | ز | ز | Ze. |
| ح | حـ | حـ | Ha. |
| خ | خـ | خـ | Kha. |
| ط | ط | ط | Ta. |
| ظ | ظ | ظ | Tza. |
| ي | يـ | يـ | Ye. |
| ك | كـ | كـ | Kef. |
| ل | ل | لـ | Lam. |
| م | م | مـ | Mim. |
| ن | ن | نـ | Nun. |
| ع | عـ | عـ | Ain. |
| غ | غـ | غـ | Gain. |
| ف | فـ | فـ | Fe. |
| ص | ص | صـ | Tsad. |
| ض | ض | ضـ | Dhad. |
| ق | ق | قـ | Kaf. |
| ر | ر | ر | Re. |
| س | س | سـ | Sin. |
| ش | ش | شـ | Shin. |
| ت | ت | تـ | Te. |
| ث | ث | ثـ | The. |

## SANSCRIT.

*Vowels.*

| | | | |
|---|---|---|---|
| अ | a short. | उ | u long. |
| आ | a long. | ऋ | ri short. |
| इ | i short. | ॠ | ri long. |
| ई | i long. | ऌ | lri short. |
| उ | u short. | ॡ | lri long. |

*Compound Vowels.*

| | | | |
|---|---|---|---|
| ए | e short. | ओ | o short. |
| ऐ | ai. | औ | au. |

*Consonants.*

| | | | |
|---|---|---|---|
| क | ka. | झ | jha. |
| ख | kha. | ञ | da. |
| च | cha. | ट | dha. |
| छ | ch'ha. | ठ | da. |
| ट | ta. | ड | dha. |
| ठ | tha. | ढ | ba. |
| त | ta. | ण | bha. |
| थ | tha. | ल | la. |
| प | pa. | व | va. |
| फ | pha. | स | sa. |
| य | ya. | ह | ha. |
| र | ra. | क्ष | ksha. |
| श | sa. | ङ | nga. |
| ष | sha. | ञ | nya. |
| ग | ga. | ण | na. |
| घ | gha. | न | na. |
| ज | ja. | म | ma. |

## GERMAN.

| Characters. | Significations. | Name. |
|---|---|---|
| A a | A a | Au. |
| B b | B b | Bey. |
| C c | C c | Tsey. |
| D d | D d | Dey. |
| E e | E e | Ey. |
| F f; ff | F f; ff | Ef; Ef-ef. |
| G g | G g | Gey, or Gay. |
| H h; ch | H h; ch | Hau; Tsey-hau. |
| I i | I i | E. |
| J j | J j | Yot. |
| K k; ck | K k; ck | Kau; Tsey-Kau. |
| L l | L l | El. |
| M m | M m | Em. |
| N n | N n | En. |
| O o | O o | O. |
| P p | P p | Pey. |
| Q q | Q q | Koo. |
| R r | R r | Err. |
| S ſ s; ſſ ß; ſt | S ſ s; ſſ sz; st | Ess; Ess-ess. Ess-tset; Ess-tey. |
| T t | T t | Tey. |
| U u | U u | Oo. |
| V v | V v | Fou. |
| W w | W w | Vey. |
| X x | X x | Iks. |
| Y y | Y y | Ypsilon. |
| Z z; ʒ | Z z; ʒ | Tset; Tey-tset. |
| å ǒ ů or ä ö ü | ae oe ue | |

## HEBREW AND CHALDEE.

| | | | |
|---|---|---|---|
| א | Aleph. | מ ם | Mem. |
| ב | Beth. | נ ן | Nun. |
| ג | Gimel. | ס | Samech. |
| ד | Daleth. | ע | Ain. |
| ה | He. | פ ף | Phe. |
| ו | Vau. | צ ץ | Tzaddi. |
| ז | Zain. | ק | Koph. |
| ח | Cheth. | ר | Resch. |
| ט | Teth. | ש | Sin. |
| י | Yod. | שׁ | Shin. |
| כ ך | Caph. | ת | Thau. |
| ל | Lamed. | | |

## GREEK.

| | | | |
|---|---|---|---|
| A α | Alpha. | N ν | Nu. |
| B β ϐ | Beta. | Ξ ξ | Xi. |
| Γ γ ϝ | Gamma. | O ο | Omicron. |
| Δ δ | Delta. | Π ϖ π | Pi. |
| E ϵ | Epsilon. | P ρ ϱ | Rho. |
| Z ζ ϛ | Zeta. | Σ σ ς | Sigma. |
| H η | Eta. | T τ ϯ | Tau. |
| Θ ϑ θ | Theta. | Υ υ | Upsilon. |
| I ι | Iota. | Φ φ | Phi. |
| K κ | Kappa. | X χ | Chi. |
| Λ λ | Lambda. | Ψ ψ | Psi. |
| M μ | Mu. | Ω ω | Omega. |

## SAXON.

| | | | |
|---|---|---|---|
| A | a | P | p |
| B | b | Q | p |
| C | c | R | ɲ |
| D | ð | S | ſ |
| E | e | T | t |
| F | f | U | u |
| G | ȝ | W | þ |
| H | h | X | x |
| I | ı | Y | ẏ |
| K | k | Z | z |
| L | l | | Đ and. |
| M | m | | ð th. |
| N | n | | þ that. |
| O | o | | |

ALPHO'NSIN. An instrument for extracting balls: so called from the name of its inventor, Alphonso Ferrim, a Neapolitan surgeon.

A'LPINE PLANTS. Low plants which grow naturally in hilly or mountainous situations, where they are covered with snow during great part of the winter; and for which reason, in gardens, they require the protection of frames and glass during winter. In this respect alpine plants differ from rock plants; which, in gardens, only require to be grown among rocks or stones, without the protection of a frame and glass.

ALPINIA'CEÆ. One of the names of the natural order of plants called Zingiberaceæ.

ALRU'NÆ. (Germ. Alraun, Alraun-bilder.) Small images carved out of the roots of trees, exhibiting rude representations of the human figure, generally female. The veneration paid to these figures formed a peculiar feature in the superstition of the northern nations. They were looked on as the Penates, or household gods, of families; laid in boxes, and presented with meat and drink. They are supposed by some to represent female magicians or druidesses.

ALSEGNO. (It. *To the mark.*) In Music, a notice to the performer that he must recommence from that part of the movement to which the sign or mark 𝄋 is prefixed.

ALSINA'CEÆ. A rather extensive order of weedy plants, allied to the much more beautiful Silenaceæ, from which they are known by their calyx consisting of distinct sepals. The order derives its name from Alsine (aloos, *a sacred gem*, in which places it is found), the common chickweed.

ALT. (Lat. altus, *high.*) In Music. A term applied to the high notes of the scale.

A'LTAR. (From alta ara, Lat.; or, according to some, from אל, *God*, and תאר, *described*, or *appointed.*) In Architecture, a sort of pedestal whereon sacrifice was offered. Servius tells us that among the ancients there was a difference between the ara and altare, the latter being raised on a substruction, and used in the service only of the celestial and superior divinities, whilst the former was merely on the ground, and appropriated to the service of the terrestrial gods. To the internal gods the altars were made by excavations, which were termed scrobiculi. Some authors have maintained that the ara was the altar before which prayers were uttered, whilst the altare was used for sacrifices. It does not, however, appear that ancient authors made these distinctions, but that the words were used by them indiscriminately. The earliest altars were square polished stones, on which were placed the offerings to the gods. Whilst sacrifices were confined to libations, perfumes, and offerings of that sort, the altar was not of large dimensions, and was even portable; but as soon as man thought he was doing honour to the Divinity by an offering of blood, the altar necessarily expanded in dimensions. Different forms were contrived, according to the nature of the sacrifice, on which the throat of the victim was cut and the flesh burnt. Of this sort is the circular altar of the villa Pamphili at Rome, one of the largest and most elegant of existing remains of that class. Upon it is to be seen the cavity for holding the fire, and the grooves for carrying off the blood. The varieties of altars follow the service to which they were assigned by difference in their forms, ornaments, and situations. Some, as we have already observed, served for burning incense and receiving libations. Some were for the sacrifices of blood, and others for receiving offerings and sacred vases. Many were erected merely as monuments of the piety of the devotee, whilst others were constructed to perpetuate some great event. They served for adjuration, as well as for an asylum to the unfortunate and evil-doer. The forms varied from square to oblong, from triangular to circular. Those of metal were usually tripodial. When of brick or stone, they were generally square on the plan. According to Pausanias, wood was occasionally a material of which they were composed. They do not seem to have been of any standard height, inasmuch as we sometimes see them on bassi relievi reaching little above a man's knee, whilst in others they appear to reach his middle, though it would seem that the circular altar was generally the highest in proportion to its diameter. Vitruvius says they should be kept down in height, so that they may not intercept the statues of the gods; and he gives the relative height of those used for the different divinities. Those of Jupiter and the celestial gods the highest; next, those of Vesta and the terrestrial gods; then the sea gods were to have theirs a little lower, and so on. On festivals they were decorated for the occasion with such flowers and leaves as were sacred to the particular divinity. But besides this casual decoration, the ancient altars furnish us with some of the most elegant bassi relievi and foliage ornaments that are extant, still serving as models of taste, which have escaped the hands of the barbarian destroyer. According to Vitruvius, their fronts were turned towards the east, though often little regard seems to have been paid to their position, as they were occasionally deposited under the peristyle of a temple, and not unfrequently in the open air. In the larger temples there were often three different altars: the first was in the most sacred part, in front of the statue of the god; the second was before the door of the temple; and the third was portable, called anclabris, on which the offerings and sacred vases were placed. Amongst Christians, the altar is a square or oblong table or tablet, placed at the east end of the church, for the celebration of the mass, or, in Protestant churches, for the celebration of the sacrament. These are varied in their form almost as much as those we have already described.

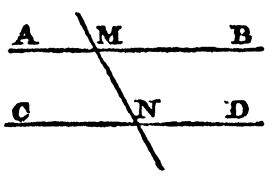
The word *Altar* was adopted by the early Christians, together with the corresponding Greek term θυσιαστηριον, (but not, unless, perhaps, in a single instance, βωμος,) to express the table of the Lord (1 Cor. x. 21.). But the word altar is stated to have been used by the fathers in four different senses (v. Suicer, in voc. θυσιαστηριον): for, 1. Christ himself, from Hebr. xiii. 10. 2. The church of Christ in general. 3. Individual members of the church. 4. The Lord's table. It is observed that the fathers of the first three centuries universally speak of the altar, and not of the table, although constantly admitting the charge which the heathens made against them of their having no altars, conceiving the term as used by the heathens to imply the offering of a sacrifice upon the altar, and the presence of the statue of the deity to whom the offering is made. From the fourth century the word table is frequently adopted, as by St. Chrysostom, St Augustin, &c.

In King Edward I's Book of Common Prayer, the word altar was retained in the communion service: but great opposition being raised against it, especially by Bishop Hooper, on account of the ambiguity of its meaning, and the colour it might seem to lend to the Romish notions of the eucharist, it was abandoned, and table substituted throughout. This, however, did not satisfy the more violent party; and on the restoration of the reformed worship at the accession of Elizabeth, the people proceeded to take the first step towards a real and not a verbal substitution, by pulling down the altars in many churches. Hereupon the queen issued an injunction, wherein she declares that "it is no matter of great moment whether there be altars or tables, so that the sacrament be duly and reverentially administered;" and directs that where the altars had been pulled down, tables should be erected in the same place.

A'LTERATIVES. (Lat. altero, *I change.*) Medicines which cure diseases by slow and imperceptible degrees, without producing sensible evacuations.

ALTE'RNATE. (Lat. alternatus, *changed by turns.*) In Botany, parts are said to be alternate with each other when one is placed upon the stem a little higher or a little lower than the other; the word is chiefly applied to leaves, and is used in distinction to opposite, in which parts arise from the same plant on opposite sides of the stem.

ALTERNATE. (Geometry.) When two straight lines are intersected by a third, the interior angles on the opposite sides of the intersecting line are said to be alternate. Thus A M N and M N D are alternate angles; and so also are B M N and M N C. If the two straight lines A B and C D be parallel, the alternate angles are equal. In proportion, the alternate terms are the first and third, and also the second and fourth, and the terms of a proportion are said to be taken alternately, or by alternation, when the second and third are made to change places: and it is a well-known theorem, that a proportion subsisting among four quantities of the same kind is not disturbed by this change. Thus, if $a : b :: c : d$, then, alternately, $a : c :: b : d$.




A'LTICA. A name applied by Fabricius to a subdivision of the Linnæan Chrysomelæ, characterised by the oblong body, bifid lip, and thickened hind legs.

A'LTITUDE (Lat. altus, *high*, altitudo, *height.*) In Astronomy, denotes the angle of elevation of a celestial object, or the angle of the visual ray with the horizon. The altitude of a star is apparent or true. The apparent altitude is the angle ascertained immediately from observation; the true altitude is found by correcting the apparent altitude for refraction, parallax, &c. Altitude is frequently used in Elementary Geometry instead of height. The altitude of a triangle is measured by a straight line drawn from the vertex perpendicular to the base; and the altitude of a cone by the straight line drawn from the vertex perpendicular to the plane of the base.

ALTO. (Lat. altus, *high.*) In Music, the counter-tenor part, or that immediately below the treble or highest. It is a word also used to denote the tenor violin.

ALTO RILIEVO. *See* RILIEVO.

A'LUDEL. A piece of chemical apparatus used in the process of sublimation, and much resembling the ancient alembic.

A'LULA. (Lat. ala, *a wing*.) In Ornithology, the group of ill-feathers, attached to the joint of the carpus; as in the snipe. These are also called the 'bastard wings' (*ala spuria*).

A'LUM. A salt composed of alumina, potash, and sulphuric acid, and in its usual form containing a large quantity of water of crystallisation. Its octohedral crystals consist of

| | | | |
|---|---|---|---|
| Alumina - | - 3 atoms = 54 | | 10·76 |
| Potassa - | - 1 = 48 | | 9·95 |
| Sulphuric acid | - 4 = 160 | | 33 74 |
| Water - | - 24 = 216 | | 45·55 |
| Crystallised alum | - 1 = 478 | | 100·00 |

Alum dissolves in about five parts of water at 60°. The solution has a sweet and astringent taste, and is a powerful styptic. When crystallised alum is heated, it melts, and, gradually losing water of crystallisation, becomes a white spongy mass, called burned alum.

Alum is largely manufactured for the uses of the arts, especially dying and calico printing. What is termed alum ore, is an aluminous slate containing sulphuret of iron; it is calcined, exposed to air, lixiviated, and the solution so obtained mixed with sulphate of potash, and crystallised. The alum-works near Paisley, and at Whitby, in Yorkshire, are the largest in this country.

Milk, curdled by stirring it with a lump of alum, furnishes alum whey, which is sometimes taken as a remedy for relaxed bowels. Alum curd is made by beating the white of egg with a piece of alum till it coagulates.

ALU'MINA. Aluminous earth; earth of alum; argil. When a solution of ammonia is dropped into a solution of alum, a white precipitate falls, which, thoroughly washed, dried, and heated, is pure aluminous earth. There are two properties of this earth which render it of great importance in the arts: one is, that it forms a plastic mixture with water, and, though it is not the predominant ingredient in, yet it confers the valuable property of plasticity upon, all natural clays, which enables them to be moulded into the various forms of pottery and earthenware; the other is the remarkable affinity of alumina for colouring and extractive matter, whence its use in the arts of dyeing and calico printing

In a pure and crystalline form, alumina constitutes the sapphire, one of the hardest and most valuable of the gems. In its common state, aluminous earth is a soft white powder, strongly attractive of moisture: hence, aluminous fossils are often recognised by adhering to the tongue, and many of them exhale an earthy smell when breathed upon, as we observe in common slate. Alumina consists of 52·94 aluminum, and 47 06 oxygen; like the other earths, as they are usually called, alumina, therefore, is a metallic oxide. Aluminum is with difficulty obtained, and in small quantities, by heating chloride of aluminum with potassium; it is a grey, difficultly fusible metal, not easily acted on by water, and which, when heated in the air, burns with great brilliancy, and forms alumina by the absorption of oxygen.

Alumina has but a feeble attraction for acids, and does not fully neutralise them; and when it has been heated red hot, or is in an indurated state, as it exists in the sapphire, in corundum, and some other minerals, it is absolutely insoluble.

The aluminous salts are mostly colourless, soluble in water, and of a sweetish astringent taste. Exclusive of alum, the acetate of alumina is the most important of these salts, being used as a base or mordant by the dyers. (*See* DYEING.) It is usually prepared by mixing a solution of 190 parts of acetate of lead with one of 487 parts of alum: a white precipitate of sulphate of lead falls, and acetate of alumina remains in solution.

ALU'MINITE. Native subsulphate of alumina.

ALU'MINUM. The metallic base of alumina.

A'LUMSTONE. A silicious subsulphate of alumina.

ALU'RNUS A genus of coleopterous insects, characterised by having short filiform antennæ; palpi four to six, very short; maxillæ horny and short.

ALUTA'CEOUS. (Lat. aluta, *tanned leather*.) A pale brown colour.

ALVE'OLAR. (Lat. alveolus, diminutive of alveus, *a cavity*.) Belonging to the alveoli, or sockets of the teeth.

ALVE'OLATE. In Botany. When the surface is covered with numerous deep hollows, as in the receptacle of some Compositæ.

ALVEO'LITES. A genus of fossil zoophytes, allied to the corallines; one species of which (*Alv. suborbicularis*) occurs in the Portland stone.

A'LVINE. (Lat. alvus, *the belly*.) A term generally used as relating to the intestinal excretions.

A'MADOU. German tinder; a fungus found chiefly in old oaks and ash trees. It is boiled in water, dried, beaten, soaked in a solution of nitre, and again dried for use.

A MA'IN. A sea term, signifying *to yield, to let go*. Thus, to strike amain is to lower or let fall the topsails, in token of surrender. To wave amain is to make a signal to a vessel to strike its topsails. Amain is also a term used in letting down a thing into the hold or elsewhere, or in lowering a yard, or the like, to denote that the sailors are to let go that part of the rope which they held before, and let down the thing easily and by degrees.

AMA'LGAM. A combination of mercury with other metals. Medallists apply the term to soft alloys generally.

AMALTHÆ'A. In Mythology. The name of a goat in Crete, alleged to have suckled Jupiter: or of the nymph who tended the goat. The *cornu Amalthææ*, or horn of the goat in question, was the magic *cornu copiæ*, or horn of plenty.

A'MARANTH. (Gr. ἀ, priv., μαραίνω, *I wither*, and ἄνθος, *a flower*.) Plants with richly coloured flowers, whose parts are of a thin dry texture, so that they are a long while before they wither. They give their name to the natural order of Amaranthaceæ. Amaranthus melancholicus, hypochondriacus, caudatus, &c., are the annuals known in gardens by the names of Love lies bleeding, Prince's feather, &c. The name, in composition with other words, is used to designate plants not belonging to the same genus, but to the same natural order. Globe-amaranth is Gomphrena globosa.

AMARANTHA'CEÆ. The order which comprehends the amaranthus, and other similar dry-flowered genera. Some of the species are objects of ornament, as cockscombs (*Celosia coccinea*), globes (*Gomphrena globosa*) various species of amaranthus, trichinum, &c.; but the principal part consists of tropical kinds. The order participates in the harmless qualities of Chenopodiaceæ, from which it is not very different.

AMARYLLIDA'CEÆ. (Amaryllis, one of its genera.) A natural order of beautiful Endogens, with inferior fruit, six stamens, and six nearly equal segments of the flower The greater part consists of bulbous species inhabiting the Cape of Good Hope, and the tropical parts of both hemispheres. Snowdrops are the most northern form A few, such as agave and doryanthes, are trees in stature, although only herbaceous plants in duration.

A'MATEUR. (Fr.) A person familiar with, and who encourages any particular art or pursuit, without being professionally engaged in it, is said to be an amateur. But the term is usually restricted to those who are skilled in and patronize the fine arts

AMAURO'SIS. (Gr. ἀμαυρός, *dark*.) A loss of sight dependent upon defective action of the nerve of vision, and independent of visible injury. It is also called gutta serena: drop serene of Milton.

AMAZO'NIAN STONE. A beautiful green felspar, found in rolled masses near the Amazon river.

A'MAZONS. (Gr. ἀ, *without*, and μαζός, *breast*.) Female warriors. Tribes, either real or imaginary, belonging to Africa and Asia, among which the custom prevailed for the females to go to war; preparing themselves for that purpose by destroying the right breast, in order to use the bow with greater ease. According to Greek tradition, an Amazon tribe invaded Africa, and was repulsed by Theseus, who afterwards married their queen. Hence, all female warriors have been called Amazons; and the river of that name owes its appellation to one of the early Spanish navigators, who fancied he beheld armed women on its banks. The wars of the Athenians and Amazons formed favourite subjects for Attic art: they were depicted in the Pœcile or painted chamber of the Parthenon. See Justin, Diod. Siculus, Strabo, &c.

AMBARVA'LIA. (Lat. ambire arva, *to go round the fields*.) In Roman Mythology, religious fêtes to propitiate Ceres; so called from the victims being carried round the fields (*ter circum ibat hostia fruges*, Virg. G. i. 345.). These sacred rites were performed by an order of priests, *Fratres Ambarvales*, twelve in number. They were celebrated in the end of May, when the blessing of the goddess was invoked on the coming harvest. The victims were accompanied by crowds of country people, having their temples bound with oak leaves, dancing, and singing the praises of Ceres, to whom libations were made of honey and wine. (*Facciolati; Adam's Antiq.*)

AMBA'SSADOR, or EMBASSADOR. In Politics, the name of the highest order of foreign ministers. An ambassador is not only the agent of the country which sends him, but also represents personally the dignity of its sovereign. The greater powers of Europe send ambassadors to each other, with the exception of Prussia, which never employs ministers of this class. The word ambassador is of very uncertain derivation, but is supposed to be derived from the Italian word ambasciare, *to solicit*. In charters and diplomas of later date than the ninth century, the names of those who had solicited the grants are frequently signed at the foot with the designation of "ambasciatores," or solicitors; and it may hence be presumed that the title was originally given to envoys who attended at a court to solicit some favour for another party. As to the rights and privileges of ambas-

sadors in England; if an ambassador commit any act which is a crime against the law of all countries, as treason, felony, &c., he is punishable as a private alien. But an ambassador is not criminally liable for such acts as are only mala prohibita against statute or custom; as, infringements of the laws of the exchequer. By 7 Anne, c. 12., an ambassador or public minister, and his domestic servants, *bonâ fide* registered according to the act, are privileged from arrest; and the goods of an ambassador cannot be taken in distress. This statute was passed in consequence of the arrest and ill treatment of Count Matuschef, the Russian ambassador. As to the rights and duties of ambassadors in modern international usages, see the elaborate work of M. de Wicquefort, *L'Ambassadeur et ses Fonctions*, 2 tomes, 4to, 1746; F. von Moshamon (*Law of European Embassies*, Landshut, 1806); and the valuable *Manuel Diplomatique* of Von Martens (Leipzig, 1822), may also be consulted.

A'MBER. A yellow resin-like substance, found occasionally in detached pieces on the sea-coast, but most generally dug up in diluvial soils: it is probably an antediluvial resin, and often contains leaves and insects. Its specific gravity is about 1070. It is hard, and becomes strongly electro-negative by friction. It contains a trace of odorous volatile oil, a resin easily soluble in alcohol, a resin difficultly soluble in alcohol, and an insoluble resin, which is its chief constituent (80 to 90 per cent.). When burned, it exhales a fragrant odour. Distilled per se, it yields inflammable gases, water holding succinic and acetic acids, and empyreumatic oil in solution (the spirit of amber of old Pharmacy), sublimed succinic acid (salt of amber), and an empyreumatic oil (oil of amber). The acid, when purified, amounts to from 3 to 5 per cent. The residual charcoal amounts to 12 or 13 per cent., and, when strongly heated, yields a little volatile matter resembling camphor

A substance resembling amber, called fossil copal, sometimes occurs with it; it is less soluble in alcohol, and yields no succinic acid.

The largest known mass of amber was found near the surface of the ground in Lithuania, about twelve miles from the Baltic; it weighs eighteen pounds, and is in the royal cabinet at Berlin.

The chief use of amber is as an article of ornament, cut into beads for necklaces, and in the manufacture of varnish.

A'MBERGRIS. (From ambre, and gris, *grey amber*) This substance has been found in the intestines of the spermaceti whale: it is probably a product of disease; perhaps a kind of gallstone. It has also been found upon the coasts of various tropical countries, in masses of various sizes, of a grey, speckled appearance, and interspersed throughout its substance with the beaks of the sepia octopoda, which is the common food of the whale. When genuine, ambergris has a peculiar odour, not easily described or imitated, and which is exceedingly diffusive, especially in solution, so that a very minute quantity of ambergris is perceptible in perfumes, and is thought to exalt their odour. A grain or two, when rubbed down with sugar, and added to a hogshead of claret, is very perceptible in the wine and gives it a flavour, by some considered as an improvement. The best ambergris is softish and somewhat waxy when cut; its specific gravity varies from 780 to 896: it fuses at 140° or 150°, and at a higher temperature gives out a white smoke, which condenses into a crystalline fatty matter. Its chief component (about 80 per cent.) is a peculiar fatty matter (ambreine), which may be obtained by boiling it in alcohol; as the solution cools, it deposits crystals, which may be purified by pressure in folds of blotting paper. Ambreine fuses at 100°; its odour is agreeable, and it rises in vapour at 220°.

AMBIDE'XTER. (Lat. ambo, *both*, and dexter, *right hand*.) One who uses both hands alike, the left as well as the right. Numerous theories have been advanced to explain the preference so generally given to the right over the left hand; but, generally, they seem to be more specious than solid.

A'MBITUS. (Lat. ambio, *I encompass*, or *circumvent*.) The circumference or extreme edge of any thing; the encompassing border of a leaf.

AMBITUS. In Politics. A term used by the ancient Romans to designate the soliciting and canvassing for offices and honours. It was of two kinds, the one, *ambitus popularis*, laudable; as, where a candidate openly avowed his pretensions, publicly stated the grounds on which he solicited the suffrages of the electors, and left them to form their opinion upon his claims without privately soliciting their votes. The other, and more common kind of *ambitus*, was either disreputable or unlawful. It consisted in using artful solicitations, cajolery, offers of money and preferment, and all those resources for corrupting the free choice of electors, so well understood, and successfully practised, in our own times. The bribery of electors was forbidden, although to very little purpose, by repeated acts of the Roman legislature. (Facciolati *Lexicon*, Adam's *Antiquities*, &c.)





A'MBLE, AMBLING. (In Horsemanship, Terme de Manège.) A peculiar kind of a pace in which a horse's two legs of the same side move at the same time.

AMBLO'TIS. (Gr. ἀμβλωσις, *abortion*.) The generic name, in the system of Illiger, of the Marsupial genus, including the wombat.

AMBLYO'PIA. (Gr. ἀμβλυς, *dull*, and ὤψ, *the sight*.) Imperfect vision.

AMBLY'PTERUS. (Gr. ἀμβλυς, *obtuse*, and πτερον, *a fin*.) The name of a fossil genus of fishes, with obtuse and rounded pectoral and ventral fins, and characterised by having small and numerous teeth, set close together like a brush, which shows the habit of these fishes to have been to feed on decayed sea-weed and soft animal substances at the bottom of the water.

A'MBO. (Gr. ἀμβον, *a boss*, or *knob*.) In Architecture. The elevated place, or pulpit, in the early Christian churches, from whence it was usual to address the congregation, and on which certain parts of the service were chanted.

A'MBREIN. The fatty matter of ambergris; convertible by nitric acid into ambreic acid.

AMBRO'SIA. (Gr. signifying, *immortal*.) The food of the gods, as nectar was their drink, the use of which conferred immortality.

AMBROSIAN CHANT. In Music. So called from St. Ambrose, archbishop of Milan, who composed it for the church there in the fourth century: it is distinguished from the Gregorian chant by a great monotony and want of beauty in its melody.

A'MBUBAIÆ. A Syrian or Arabic term, meaning musical girls from Syria, who prostituted themselves at Rome. See Hor. *Sat.* lib. i. sat. 2. v. 1. and Facciolati *Lexicon*.

AMBULA'CRA. (Lat. ambulacrum, *an alley*.) The narrow longitudinal portions of the shell of the sea-urchin (*Echinus*), which are perforated with a number of small orifices, giving passage to tentacular suckers, and alternate with the broad tuberculate spine-bearing portions.

AMBULATO'RES. (Lat. ambulo, *I walk*.) The name of an order of birds in the system of Illiger, corresponding nearly with the *Passeres* of Linnæus.

A'MBULATORY. Formed for walking. In Ornithology, the term is applied to the feet of birds where the toes are placed three before and one behind.

AMBU'SCADE. A military term derived from the Italian imboscata, concealed in a wood. It is also applied to any snare laid for an enemy.

AMBU'STION. (Lat. amburo, *I burn*.) A medical term for a burn or scald.

A'MEN (Heb אמן, signifying, *let it be*, or rather, *let it be irrevocably fixed*.) It is understood to express belief and assent at the end of a prayer. It is sometimes translated, verily, as when used at the beginning of a discourse.

AME'NDE HONORABLE. In French Law, a species of infamous punishment, to which criminals guilty of an offence against public decency or morality were condemned under the ancient system, and are so still in some instances. Such were, sedition, forgery, sacrilege, fraudulent bankruptcy, &c. The *simple* or *dry* amende honorable consisted merely of an acknowledgment by the criminal of his offence in open court, bare-headed and kneeling. The *amende honorable in figuris* was made by an offender, kneeling in his shirt, a torch in the hand, a rope round the neck, and conducted by the executioner. It was, and still is, usually conjoined with some other punishment; sometimes capital, as in the case of parricides, &c.

AME'NDMENT. In a general sense, is any change made in any thing for the better. In Parliamentary Proceedings, it is an alteration in the words of any bill or motion, which it is competent for any member to move when the bill or motion has been read. (*See* PARLIAMENT.)

AMENDMENT. In Law. The correction of an error committed in any process: as the amendment of a declaration, plea, &c. The deficiency of means of amendment in pleading at common law, led to the statutes of amendments and jeofails, beginning with that of 14 E. 3. All amendments are held to be within the discretion of the court, and allowed in furtherance of justice according to the particular circumstances of each case.

AME'NORRHŒA. (Gr. ἀ, *without*, μην, *a month*, and ῥέω, *I flow*.) Morbid irregularity or deficiency of the menstrual discharge.

AMENTA'CEOUS. Having amenta; a name formerly applied in Systematic Botany to such plants as have their flowers arranged in amenta. But as very different kinds of structure were combined by this character, the order Amentaceæ of Jussieu is broken up in several others, and the term is but little used.

AME'NTHES. In Eastern Mythology. the kingdom of the dead, or Tartarus of the ancient Egyptians.

AMENTIA. (Lat. amens, *deprived of mind*.) Idiotism.

AME'NTUM. (Lat. amentum, *a thong*, or *loop*.) A kind of inflorescence such as is found on willows and poplars: it differs from a spike only in being deciduous.

AME'RCIAMENT. (From the French *merci*.) The pecuniary punishment of an offender against the king or other lord in his court, when by his offence he is said to stand at the mercy of the king or lord.

AMETABO'LIANS, AMETABOLIA. (Gr. ἀ, *without*, and μεταβολη, *change*.) A sub-class of insects which do not undergo any metamorphosis.

A'METHYST. Purple rock crystal. The finer varieties are in great request for cutting into seals and brooch stones. Some of the ancient vases and cups are composed of this mineral, and it was an opinion among the Persians that wine drank out of an amethystine cup would not intoxicate: hence its name, from the Greek ἀμεθυστος.

A'MIA. The name of a Linnæan genus of abdominal fishes founded on a single species (*Amia calva*, Linn.) a native of the freshwater streams of Carolina, North America; and which is still its sole representative. It is an example of the Sauroid fishes of Agassiz, and is remarkable for the cellular structure of its air-bladder, which, as Cuvier remarks, is similar to the lung of a reptile.

AMIA'NTHUS. (Gr. ἀμιαντος.) A term applied to asbestus, in consequence of the resistance which it affords to the action of fire.

A'MIDES. Compounds containing a base apparently composed of 1 atom of nitrogen, and 2 of hydrogen. The term Ammonide, from their resemblance to ammonia, would perhaps be more correct.

A'MIDINE. The soluble part of starch.

AMID-SHIPS. A nautical term, denoting the middle of the ship, either with respect to her length or breadth.

A'MMOCŒTES. (Gr. ἀμμος, *sand*, and κοιτη, *a bed*.) The name of a genus of Cyclostomous fishes, of which the 'pride,' or 'stone grig' (*Amm. branchialis*), is a well-known example. This fish buries itself in the sand or clay of the banks of rivers; has many of the habits of a worm; possesses a skeleton reduced to membraneous consistence; and ranks among the lowest of organised vertebral animals.

A'MMODYTES. (Gr. ἀμμος, *sand*.) The name of a Linnæan genus of apodal fishes, characterised by a compressed head, narrower than the body; and both elongated. Gill-openings large, with seven branchiostegal rays; dorsal fin extending nearly the whole length of the back; anal fin of considerable length; dorsal and anal fins separated from the caudal fin. The sand-eel (*Ammodytes tobianus* Lin.) and the sand-launce (*Ammodytes lancea* Cuv.) are examples of this genus.

A'MMON. In Mythology, apparently a Libyan divinity, adopted by the Greeks, and by them identified with their Jupiter.

> —— "stat corniger illic
> Jupiter, ut memorant, sed non aut fulmina vibrans,
> Aut similis nostro, sed tortis cornibus Ammon."

The name appears to be derived from ἀμμος, *sand*; and the situation of his celebrated temple in an oasis, surrounded by African deserts, indicates his origin. Alexander visited the temple, and assumed the title of son of his divinity, in order to impose on oriental imagination. It possessed a celebrated oracle. The lines of Lucan, partly quoted above (*Pharsal.* lib. ix. lin. 510. &c.), describing the temple, and the refusal of Cato to visit it, and consult the Fates respecting an enterprise, of the justice of which he was convinced, are among the finest and best known portions of his poem.

AMMO'NIA, Volatile alcali. This important compound is chiefly produced artificially. It exists, combined with acids, in some of the saline products of volcanos, and, in very small quantities, it is discoverable in sea-water. It is found in putrid urine and in the salts produced by the decomposition of animal matter; it exists occasionally in very minute quantities in the air, especially in large towns where pit-coal is burned; and the small stellated crystals which are sometimes observed on dirty windows in London, consist of sulphate of ammonia.

Ammonia was originally obtained (in the form of muriate of ammonia) by burning the dung of camels, which was collected for the purpose in Egypt, especially about the temple of Jupiter Ammon (whence the term sal ammoniac). It was afterwards procured by the distillation of putrid urine: at present, the demand for ammonia in its various states and combinations is in this country chiefly supplied from two sources; the distillation of pit-coal, and that of refuse animal substances, such as bone, clippings and shavings of horn, hoof, &c.

When coal is distilled (*see* GAS), a large quantity of ammoniacal liquor, as it is called, is formed, to which sulphuric or muriatic acids are added so as to form a sulphate or a muriate of ammonia. When the animal substances just mentioned are distilled, a quantity of impure ammonia passes off with the other products, which is also converted into sulphate or muriate of ammonia.

Pure ammonia is obtained in the form of a gas, by heating a mixture of quicklime and muriate of ammonia. It is very pungent and acrid; and so soluble, that one measure of water absorbs nearly 500 of gaseous ammonia: this solution is known under the name of liquid ammonia, and is used in medicine. Ammonia is a compound of nitrogen and hydrogen; it consists of

| | | | | |
|---|---|---|---|---|
| Nitrogen | 1 atom | = | 14 | 82·35 |
| Hydrogen | 3 . . | = | 3 | 17·65 |
| | 1 | | 17 | 100·00 |

It is decomposed when passed through a red-hot tube, and every 100 volumes of ammonia are resolved into 200 volumes of a mixture of 3 volumes of hydrogen and 1 of nitrogen.

Carbonate of ammonia is used in medicine as a stimulant, and frequently employed, under the name of smelling salt, as a restorative in faintness. It is obtained by sublimation from a mixture of muriate of ammonia and carbonate of lime. Muriate of ammonia has been above referred to as the common source of pure ammonia. Sulphate of ammonia is also manufactured for the same purposes.

Ammonia is recognised by its pungent smell, by its transient alcaline effect upon vegetable colours, and by producing white fumes when approached by muriatic acid. Thus, if we burn a piece of quill, and hold a glass rod dipped in muriatic acid near the smoke of it, dense white fumes appear, announcing the presence of ammonia, formed by the action of heat upon the animal matter.

AMMONI'ACUM. A gum resin used in medicine: it is imported in drops and cakes from Africa and the East Indies, and is said to be the produce of the Dorema ammoniacum. It is of a pale buff colour, and stands in the materia medica among the mildly stimulating but uncertain expectorants. It is sometimes applied externally in the form of a plaster.

A'MMONITE, AMMONITES. An extinct genus of molluscous animals which inhabited convoluted chambered siphoniferous shells, sometimes called Cornua ammonis, and vulgarly snake-stones. From their affinity to the nautilites, and the known organisation of the animal of the pearly nautilus, fossil shells of this genus are referred to the Tetrabranchiate order of Cephalopods, and constitute the typical genus of the second family of that order (*Ammonitidæ*). They are characterised by their conspicuous whorls, and the marginal-external position of the siphon. They abound in the strata of the secondary formation, varying from the size of a bean to the dimensions of a coach-wheel. Their name is derived from their resemblance to the horns upon the statue of Jupiter Ammon.

AMMONI'TIDÆ. A family of Cephalopods, with chambered syphoniferous shells, characterised by the septa being sinuous, with lobated margins.

AMMO'NIUM. A name given by Davy to the hypothetical base (supposed to be metallic) of ammonia. According to the hypothesis of Berzelius, ammonium is a compound of 1 volume of nitrogen with 4 volumes of hydrogen.

AMMO'PHILA. (Gr. ἀμμος, *sand*, and φιλεω, *I love*.) The name of a genus of hymenopterous insects, called sand-wasps. The generic characters are, proboscis conic, inflected, concealing a bifid, retractile, tubular tongue; jaws forcipated, 3-toothed at the tip; antennæ filiform in each sex, with about 14 articulations; eyes oval; wings plane; sting pungent, concealed within the abdomen.

AMMUNI'TION. In Military Language, signifies all sorts of warlike stores and provisions, but more especially powder and ball.

A'MNESTY. (Gr. ἀμνηστια, *oblivion*.) In Politics, freedom from penalty, granted by a solemn act to those guilty of some crime. Usually, by an act of amnesty is meant one passed to comprehend a number of individuals guilty of offences of a political nature, as rebellion, &c. Among remarkable amnesties in modern European history, may be cited, that granted on the restoration of Charles II., from which were excepted those concerned in the death of Charles I.; that granted on the second restoration of the Bourbons, in January, 1816, from which, besides the regicides, several others were excepted by name; and the law of amnesty for political offences in France, in 1836.

A'MNION. (Gr. ἀμνος, *a lamb*.) The membrane which surrounds the fœtus in utero: it includes a thin watery fluid, the liquor amnii.

A'MNIOS. In Botany, a thin, semitransparent, gelatinous substance in which the embryo of a seed is suspended when it first appears, and on which the embryo appears to feed in its early stages. Sometimes it is wholly absorbed; sometimes a portion of it is solidified in the form of albumen; occasionally, as in the cocoa-nut, a portion is consolidated into albumen, and a portion remains always in a fluid state.

AMNIO'TIC ACID. An acid supposed to be peculiar to the liquor amnii of the cow, but now known to belong to the liquor of the allantois.

AMO'MEÆ. (*See* AMOMUM.) One of the names of the plants more commonly called Zingiberaceæ.



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**AMO'MUM.** (hhamâmâ, Arabic; ἄμωμον, of the Greeks.) A Zingiberaceous plant, with aromatic seeds, much employed under the name of cardamoms, grains of Paradise, &c. The species occur exclusively in the hottest parts of India and Africa.

**AMO'RPHOUS.** (Gr. ἀ, without, and μορφη, *form*.) Bodies devoid of regular forms.

**AMPELI'DEÆ.** In Botany. (Gr. ἀμπελος, *a vine*.) One of the names of the natural order Vitaceæ.

**A'MPELIS.** The name of a Linnæan genus of Passerine birds, characterised by a straight convex beak, of which the upper mandible is the longer, and is subincurved, and emarginate on both sides. The Bohemian chatterer, or wax-wing (*Ampelis garrulus*), Linn., is a well known species of this genus; but is referred in the recent systems of Ornithology to a distinct section or subgenus, retaining the name of Bombycilla, originally applied to it by Brisson.

**AMPHI'BIANS, AMPHI'BIA.** (Gr. ἀμφι, *both*, and βιος, *life*; having the faculty of existing both in water and on land.) In modern Zoology, this term is restricted in its application to those animals which possess organs for breathing water, and organs for breathing air, or gills and lungs conjointly. Many cold-blooded animals, from the slowness of their circulation and the great capacity of their lungs in proportion to the vascular surface which alters the chemical state of the contained air, can remain a long time under water without being necessitated to seek the surface for a fresh supply: such are all the Vertebrata called Reptilia by modern zoologists, and which Linnæus, from the above mentioned faculty, included under the term Amphibia: yet if these animals were kept submersed longer than the period necessary for renewing the air in their lungs, they would inevitably be drowned; they are, therefore, not strictly amphibious. Not so, however, with that small portion of the order which retain their branchiæ throughout life;—these perennibranchiate reptiles suffer nothing from a prolonged aquatic existence, but, on the contrary, are most affected by a too long continuance on dry land; a desiccation of their external fringed gills, according to some recent experiments on the Siren lacertina, occasioning their death. Those warm-blooded mammalia which have their general form and locomotive instruments adapted for aquatic life, as whales, porpoises, walrusses, and seals, are, from the rapidity of their circulation and the prodigious extent of the vascular and respiratory membrane of the lungs, still more dependent upon a fresh supply of air for their existence than the pulmonated reptiles, and are consequently further removed from a true amphibious organisation. This is, in fact, enjoyed by a very small proportion of the animal kingdom; besides the perennibranchiate reptiles, a few species of mollusca, as the Ampullaria, and some insects and crustaceans, are the only examples.

**AMPHI'BIOLI'TE.** (Gr. ἀμφιβια, and λιθος, *a stone*.) The name given by Linnæus to the parts of reptiles, or amphibia, which were changed to a fossil substance.

**AM'PHIBOLE.** (Gr. ἀμφιβολος, *equivocal*.) A name which some mineralogists apply to hornblende, because it may be mistaken for augite.

**AMPHI'BOLI.** In Ornithology, the name of a family of scansorial birds, in the system of Illiger, including those in which the external posterior toe is versatile.

**AMPHIBO'LOGY.** (Gr. ἀμφι, *about*, and λογος, *discourse*.) In Rhetoric, an equivocal phrase or sentence, of which the sense may bear more than one interpretation.

**AMPHI'CTYO'NIC COUNCIL.** This was a congress of the deputies of twelve northern Greek tribes, viz. Thessalians, Bœotians, Dorians, Ionians, Perrhæbians, Magnetes, Locrians, Œnianians, Achæans of Phthia, Malians, Phocians, and Dolopians, or Delphians. In the Dorians and Ionians were included the Lacedæmonians and Athenians, who each sent one deputy. Each of these tribes had two representatives in the council called the Hieromnemon (ἱερομνημων) and Pylagoras (πυλαγορας). The congress met twice every year; in the spring at Delphi, and at Thermopylæ in the autumn. Its functions do not seem to have been of a political nature, further than to see that no member of the union was destroyed; but were chiefly directed to religious matters, and more especially the protection of the temple of the Delphian Apollo. The principal ancient authorities which we possess respecting the objects and constitution of the amphictyonic council, are to be found in the orations of Æschines and Demosthenes: the 16th book of Diodorus Siculus; 9th of Strabo; and 10th of Pausanias. See also Ant. Van. Dale's *Dissertationes*, Amst. 1702: Paper by Valois, in the *Mém. de l'Ac. des Inscriptions, &c.*, iii. 191. v. 405.; St. Croix, *Des Gouvernemens Fedératifs*; Tittmann's *Prize Essay on the Amphictyons*; and Müller's *Hist. of the Dorians*.

**AMPHI'GAMOUS.** (Gr. ἀμφι, in the sense of *doubtful*, and γαμος, *marriage*.) The most imperfect of all plants, having no trace whatever of sexual organs They form one of the classes in De Candolle's Natural System. (See BOTANY.)

**AMPHI'PNEUSTS.** (Gr. ἀμφις, *on both sides*, and πνεω, *I breathe*.) Merrem so calls a tribe of reptiles comprehending those which have both lungs and gills at the same time, as the true amphibia or perennibranchiates.

**A'MPHIPODS.** (Gr. ἀμφις, *on both sides*, and πους, *a foot; feet diversely conformed*.) The third order of crustaceans in Latreille's arrangement, and the only one in which subcaudal natatory feet co-exist with sessile eyes.

**AMPHI'PROSTYLE.** (Gr. ἀμφι, *both or double*, προ, *before*, στυλος, *a column*.) In Architecture, a term applied to a temple having a portico or porch in the rear as well as the front, but without columns at the sides. This species of temple never exceeded the number of four columns in front and four in the rear. It differed from the temple in antis, in having columns instead of antæ at the angles of the portico.

**A'MPHISBÆ'NA.** (Gr. ἀμφι, *both*, βαινειν, *to walk*.) A genus of serpents or Ophidian reptiles, in which the tail and head are equally obtuse, and the scales of the head so similar to those on the back, as to render it difficult, on a cursory inspection, to distinguish one extremity of the body from the other. Hence these reptiles have been supposed to have the power of creeping backwards or forwards with equal facility.

**AMPHI'SCII, or AMPHI'SCIANS.** (Gr. ἀμφι, *about*, and σκια, *shadow*.) A term used by the ancient geographers, to denote the inhabitants of those climates in which the shadows, at noon-day, fall in opposite directions at different times of the year; that is to say, towards the north when the sun at noon is to the south of their zenith, and towards the south when the sun is to the north of their zenith. The term consequently applies to the people who live between the tropics.

**AMPHITHE'ATRE.** (Gr. ἀμφι, *about*, and θεατρον, *a theatre*.) In Architecture, a double theatre, or one of an elliptical figure; being, as its name imports, two theatres joined at the line of the proscenium; by which contrivance all the spectators, being ranged round on seats rising the one above the other, saw equally well what was passing in the arena, or space inclosed by the lowest range of seats. The origin of the amphitheatre was among the Etruscans, to whom also are attributed the first exhibitions of gladiatorial fights. From these the Romans acquired the taste for such shows, which they communicated to every nation subject to their dominion. Athenæus says, "Romani, ubi primum ludos facere cœperunt, huic asciti artifices ab Etruscis civitatibus fuerunt, sero autem ludi omnes qui nunc a Romanis celebrari solent, sunt instituti." (L. iv. cap. 17.) The most extraordinary edifice remaining in Rome is the amphitheatre, generally called the Coliseum, begun by Vespasian and finished by his son Titus. Words are inadequate to convey a satisfactory idea of its stupendous and gigantic dimensions.

> "Omnis Cesareo cedat labor amphitheatro,
> Unum pro cunctis fama loquatur opus,"

says Martial. It covers five English acres and a quarter of ground; the walls are of the height of 166 feet; it had seats for 87,000 spectators, with standing room for 22,000 others; and a vast arena, where thousands of gladiators and wild beasts contended at once—

> "Butcher'd to make a Roman holiday!"

This magnificent ruin has suffered much from earthquakes, and the destroying influence of time; and to the disgrace of the Papal government, it was allowed to be used, in comparatively recent times, as a convenient quarry, whence the materials of many modern edifices have been derived.—Still, however, its remains are such as to astonish the spectator;—

> A ruin—yet what ruin! From its mass,
> Walls, palaces, half-cities, have been rear'd;
> Yet oft the enormous skeleton ye pass,
> And marvel where the spoil could have appear'd.

Latterly, more attention has been paid to the preservation of this noblest monument of Imperial Rome. The walls have been propped up in some places, and sentinels have been placed for its protection.—Besides this amphitheatre, there were three others in Rome, namely, the Amphitheatrum Castrense, probably built by Tiberius, on the Esquiline; that of Statilius Taurus; and that built by Trajan, in the Campus Martius. The other principal amphitheatres were those of Otricoli, on the Garigliano, of brick, Puzzuoli, Capua, Verona, the foot of Monte Casino, Pæstum, Syracuse, Agrigentum, Catanea, Argos, Corinth, Pola in Istria, Hipella in Spain, Nismes, Arles, Fréjus, Saintes, and Autun. This last has four stories, similar in that respect to the Coliseum. But that in the most perfect state is the amphitheatre of Verona, which, with the exception of the exterior wall, is still perfect. The first that were erected, were, as we learn from Pliny, constructed of wood, and usually seated in the Campus Martius, or in some place out of the city. Accidents occurring from their insecurity, they were abandoned for the more substantial species of fabric whereof we have been speaking. The first person

who is said to have erected an amphitheatre in Rome, was Caius Scribonius Curio, in the games he gave to the people on the occasion of his father's funeral obsequies. Determined to surpass, in the way of games, all that had hitherto been seen, he constructed two theatres of wood, back to back, which, after the theatrical representations had been finished, were turned round with the spectators still in them, leaving the stages and scenery behind, and, by their opposite junction, forming a perfect amphitheatre, in which the people were gratified with a show of gladiators. The part in which the gladiators fought was called the arena, from being usually covered with sand to absorb the blood spilt in the conflicts for which it was used. The arena was encompassed by a wall, called the podium, fifteen or sixteen feet in height, immediately round which sate the senators and ambassadors. As in the theatres, the seats rose at the back of each other; fourteen rows in the rear of the podium being allotted to the equites, and the remainder for the public generally, who sate on the bare stone, cushions being provided for the senators and equites. Though generally open to the sky, there were contrivances for covering the whole space with a sort of awning. The avenues by which the public entered were many in number, and bore the name of vomitoria. See the work of Maffei, *Degli Amfiteatri;* and the section on Amphitheatres in his learned and excellent work, Verona Illustrata. The modern history of the Coliseum is given at considerable length in Hobhouse's Illus. to Childe Harold.

AMPHITRI'TE. (Gr. *a goddess of the sea.*) The name of a genus of cephalo-branchiate or tubicular Annelides, characterised by golden-coloured short bristles, arranged like a crown, in one or two rows, on the anterior part of the head. One species inhabits the south coast of England, and forms for its habitation a very delicate, straight, conical tube of grains of sand, agglutinated together by the mucus exuded from the skin: this is the *Amphitrite auricoma.*

AMPHI'TROPAL. (Gr. ἀμφι, *round*, and τρεπω, *I turn.*) In Botany. This is said of an embryo which is turned round albumen, or curved upon itself in such a manner that both its ends are presented to the same point.

AMPHIU'ME, AMPHIU'MA. (Gr. ἀμφι and ὑμην, a membrane.) A genus of true amphibious reptiles, with a persistent branchial orifice on each side of the neck; palatal teeth in two longitudinal rows; a lengthened body, and four rudimental extremities, each divided either into three or two toes according to the species.

AM'PHORA. (Gr. ἀμφορευς, *two-handled.*) In Sculpture and ornamental Architecture, a vase or measure having two handles, used as a measure for liquids by the Greeks and Romans: they are frequently applied as ornaments on sarcophagi, &c.

AMPHORA. A kind of earthenware vase with two handles, used by the Romans to hold wine and other liquids. Also a liquid measure, containing probably about nine gallons; but its exact size is not satisfactorily made out.

AMPLE'XICAUL. (Lat. amplecto, *I embrace*, and caulis, *a stem*) A leaf or bract whose base projects on each side, so as to clasp the stem with its lobes.

AMPLIFICA'TION. In Rhetoric, the lengthening a discourse or a passage by the enumeration of minute circumstances, the employment of epithets, particularity of description, &c., with a view to produce a deeper impression. *Exaggeration* is properly a species of amplification, in which circumstances and facts are not merely dwelt upon but represented beyond their true dimensions.

A'MPLITUDE. In Astronomy, denotes the angular distance of a celestial body, at the time it rises or sets, from the east or west points of the horizon. The amplitude of a fixed star remains the same all the year round; that of the sun or moon is constantly changing. At a given latitude, it depends on the declination of the object. Amplitude is sometimes used to denote the horizontal distance to which a projectile is expelled from a gun, or what is more frequently termed the range of the gun.

A'MULET. A substance worn about the person, and supposed to have the effect of protecting the wearer against some real or imaginary evils. Those of the Persians and Egyptians are said to have been small cylinders ornamented with figures and hieroglyphics. The Greeks and Romans employed for the same purpose a great variety of gems and small figures of deities, heroes, or animals, the bulla, and various other articles. Some of these were hung around the necks of children, to defend them from the evil eye. In more modern times, scraps of paper or parchment inscribed with verses of the Bible, or with magical characters and jargon, have often been used for the same purposes. The celebrated Arabian talismanic medals are called by the Arabs Ain, from the first letter of the inscription always beginning with that character.

AMYGDA'LEÆ. (Gr. ἀμυγδαλον, *an almond.*) A division of Rosaceous plants, comprehending the peach, the plum, the apricot, and similar objects. The species have all a fleshy or succulent fruit, gum in their bark, and hydrocyanic acid in their leaves. They occur principally in cold and temperate latitudes.

AMY'GDALOI'D. (Gr. ἀμυγδαλον, *an almond*, and εἰδος, *a form.*) Almond-shaped. The term is applied to certain rocks in which other minerals are occasionally imbedded like almonds in a cake.

AMYRIDA'CEÆ. Balsamic exogenous plants, consisting of shrubs or trees, found almost exclusively in the Tropics. Bdellium, balsam of copaiva, gum elemi, and balsam of Tolu, are all produced by species of this order, the type of which is the genus amyris (myrrha, *myrrh*).

A'NA. A termination of the neuter plural form in Latin, used in English and French to denote anecdotes of eminent persons, or selections from their works. The first of the French collections termed "Ana," and from which that denomination originated, is the Valesiana; containing detached observations on passages of classical antiquity by the celebrated scholar Valois, or Valesius: it appeared at Paris in 1695. The Menagiana (Paris, 1715) is a more amusing work, consisting of anecdotes, criticisms, and miscellaneous observations on all possible subjects, attributed to the academician Ménage. The popularity of this work produced a multitude of other "Ana:" among which may be mentioned the Huetiana, 1723; the Scaligerana, Thuana, Poggiana, and a variety of similar books, consisting of extracts from the works of distinguished writers, or of thoughts or sayings attributed to them.

ANA, or AA (contracted from ana). In Medical prescriptions, implies "of each."

ANABA'PTISTS. Properly, all sects are so called, that insist upon the repetition of baptism upon admission into their communion, from a notion of the invalidity of the religious ceremonies of other denominations. There were several such in the early period of the church, as the Cataphrygians and Novatians: but they are to be distinguished from the sects which arose in the 15th and the beginning of the 16th centuries, under the papal dominion, especially in Germany; and adopted, in their ignorance and fanaticism, preposterous notions of the qualifications requisite for admission into the visible church. Their idea of primitive society consisted in the rejection of all the customs and decencies of life; in the community of goods and of women; in uncompromising hostility to all modes of artificial life, and to government generally, as the foundation and sanction of social distinctions. They had, of course, no indulgence for the ordinances of any church but their own, and required baptism for themselves as the essential preliminary for admission within their pale. Early in the progress of the Reformation, finding their numbers daily increasing under the licentiousness of opinion which the unrestricted abuse of private judgment produced among a rude and uneducated people, they united in a hostile league against all existing institutions, and declared open war against the governments of Lower Germany. After committing the greatest atrocities, and causing an universal panic throughout Europe, their progress was arrested by a complete defeat in Saxony, in which their leader, Muncer, perished. The remnant, however, escaping, established their opinions with more or less moderation of tone in Holland and elsewhere. Some of the party seized, soon after, upon the town of Munster, overthrew the magistracy, and established society upon their own principles; but eventually were put down with great slaughter. (See, as to the Munster Anabaptists, *Mosheim's Ecclesiastical History*, sect. ii. part ii. c. 3., where reference is made to the best works on the subject.) It should be observed, that the anabaptists were not dependent upon religious views only for their support, but that the war soon assumed the character of a struggle between the lower and upper classes; and the enormities committed by the insurgents must be attributed as much to revenge for oppression as to religious fanaticism. (*See* BAPTISTS.)

A'NABAS. A genus of Acanthopterygious fishes, in which the surface of the pharynx is broken into numerous little branched appendages and cells, capable of retaining water, and of gradually dropping it into the branchial cavity, so as to moisten the gills; whereby these fishes have the curious faculty of voluntarily quitting the water, creeping about on land, and even, it is said, of climbing trees. The only known species (*Anabas testudineus*) is the *Perca scandens*, or climbing perch, of the older naturalists.

A'NABLEPS. (Gr. ανα βλεπω, *I raise the eyes.*) A name applied to a genus of malacopterygiar viviparous fishes, characterised by a remarkable projection of the eyes from the sides of the head, and a still more singular structure of the cornea and iris, from which there result two pupils, and the eyes appear to be double on each side, although they have but one crystalline lens, one vitreous humour, and one retina.

ANACA'RDIA'CEÆ. A natural order of exogens, founded upon the *Anacardium occidentale*, or cashew nut. It consists of tropical trees, often abounding in a fluid

resin of extreme acridity, but forming a valuable varnish in some cases. Marking nuts, the fruit of Semicarpas anacardium, black Burmen varnish from Melanorhœa usitatissima, mastich, Scio turpentine, pistacia nuts, sumach, are all produced by various species of this order.

ANA'CHORITE. See ANCHORITE.

ANA'CHRONISM. (Gr. *ἀνα*, *backward*, and *χρονος*, *time*.) An inversion or disturbance in the order of time: as where, in Shakspeare's King John, cannon are introduced, which were not employed until 100 years later.

ANACLA'STICS. (Gr. *ἀνα*, *up*, and *κλαω*, *I break*.) That part of Optics in which the refraction of light is considered, commonly called Dioptrics. The term was applied by De Mairan to the apparent curves formed by the bottom of a vessel when looked at through a body of water.

A'NACOLU'THON. (Gr. *ἀνακολουθον*, *not following*.) A Grammatical term, denoting the want of sequence in a sentence, one of whose members corresponds not with the remainder. This figure recurs more frequently in the Greek than in any other language.

ANA'CREO'NTIC. In Poetry, a species of ode devoted chiefly to the praises of love and wine: —

> "Quid nisi cum multo venerem confundere vino,
> Præcipit lyrici Teia musa Senis?"

The name is derived from Anacreon of Teos, who flourished in the sixth century B C. The genuineness of the Odes which pass under his name, has, however, been questioned by some critics; but some of them are, at all events, very ancient; and they have been universally admired for their sprightliness. The poems of Anacreon have been rendered familiar to the English reader by the translations of Cowley and Moore. The best editions of the original are those of Fischer and Brunck.

ANÆSTHE'SIA. (Gr. *ἀ*, *without*, and *αἰσθανομαι*, *I feel*.) Diminution or loss of the sense of touch.

ANÆSTHETICS. (Gr. *ἀ*, *without*, and *αἰσθανομαι*, *I feel*.) Substances which produce insensibility, apparently by suspending certain of the functions of the nervous system: among these, the vapour of ether and of chloroform are the most manageable, and have lately attracted much notice in reference to the performance of surgical operations under their influence. *See* ETHER, CHLOROFORM in Supplement.

ANAGLY'PHIC. (Gr. *ἀνα*, *upon*, and *γλυφω*, *I carve*.) In antique Sculpture, chased or embossed work on metal, or any thing worked in relief. When raised on stone, the production is a cameo. When sunk or indented, it is a diaglyphic or an intaglio.

ANAGNO'STA. (Gr. *ἀναγινωσκω*, *I read*.) A domestic servant employed by wealthy Romans to read to them at their meals and on other occasions. The ancient monks and clergy preserved the same custom, and name.

A'NAGRAM. (Gr. *ἀνα*, *back*, and *γραφω*, *I write*.) The most proper, and most difficult, species of anagram is that which is formed by the reading of the letters of a word or words backwards: as "evil," "live."

> "Live, vile, and evil, have the self-same letters;
> He lives but vile, whom evil holds in fetters."

A less perfect anagram is that which is made by transposition of letters ad libitum: and an anagram in which the transposition is helped out by the admission of letters not in the original word, or the rejection of some of those which it contains, is termed impure. The manufacture of anagrams, particularly out of proper names, formed a favourite exercise of ingenuity in the 16th and 17th centuries; when a common mode of flattery was by inventing some complimentary transposition of the letters of the name of the person addressed. But none of the anagrams of that period exceed, in felicity, Dr. Burney's on Lord Nelson: "Horatio Nelson," "Honor est a Nilo." Of all the extravagances occasioned by the anagrammatic fever, when at its height, none probably equals what is recorded of an eccentric Frenchman in the 17th century, André Pujom. He read in his own name the anagram "pendu à Riom" (the seat of criminal justice in the province of Auvergne), felt impelled to fulfil his destiny, committed a capital offence in Auvergne, and was actually hung in the place to which the omen pointed.

ANAL. In Ichthyology, the fin which is placed between the vent and tail, and expands perpendicularly.

ANAL GLANDS. Comp. Anat. Organs for secreting substances, sometimes attractive, but generally repulsive in their properties, and applied to purposes of defence; they present every grade of the glandular structure, from the simple cæcum, or tube, to the conglomerate mass; developed from, and consequently always opening into, the termination of the intestine, near the anus. In insects, the sweet fluid ejected by the aphides, and of which the ants are fond, is, at least in some species, the product of secerning tubules opening near the anus. Odorous substances, — sometimes fragrant, sometimes fetid, — are in different species of insects respectively emitted from the same part; and the singular defensive acrid vapours discharged explosively by the insects called "bombardiers," are the products of anal glands. In the mollusks, the most remarkable example of the anal glands is presented by the higher organised cephalopods, where they are represented generally by a single, sometimes by a bilobed or trilobed, cyst, with part of its parietes spongy and glandular, and which secretes the inky fluid which these animals eject to blacken the water around them for the purpose of concealment in time of danger. Among fishes, an anal bag opens by a single narrow duct, as in cephalopods, into the termination of the rectum, in rays and sharks; but it no longer exercises the function of a secerner of colouring matter. In reptiles, the anal bags are either single, double, or triple; and in many species, as in frogs and tortoises, are developed to a great size, and serve for aquatic respiration. In crocodiles they are two in number, and emit into the cloaca a muco-caseous secretion, without any strong odour. In birds, the anal follicles have a similar function, but they are aggregated into a single cavity, which is called the "bursa Fabricii." In quadrupeds, the anal follicles are generally collected into two sacciform groups, each having an opening near the verge of the anus. The insupportably disgusting odour of the secretion of these glands has rendered some of the viverrine quadrupeds, as the skunk, &c., proverbial; in others, the odour is not stronger than serves to attract the individuals of the same species to one another, which is the common function of the anal glands in this class of animals.

ANAL VALVES. A mechanical structure for defending the terminal orifice of the intestines in some of the cephalopods, which swim forwards, from the retrograde entrance of foreign or noxious substances. This mechanism is required from the position and direction of the anal opening, which is turned forwards towards the base of the funnel or respiratory channel.

ANA'LCIME. A variety of zeolite, which by friction becomes weakly electric: from *ἀναλκις*, *weak*.

ANALE'CTA. A servant in great Roman houses, whose duty it was to collect the scraps after a meal; whence he derived his name, from the Greek *ἀναλεγω*, *I pick up*. Also, a collection of short pieces, extracts, &c.

ANALE'MMA. (Gr. *ἀναλαμβανω*, *I take up*.) In Geometry. An orthographic projection of the sphere on the plane of the meridian. In this projection the eye is supposed to be placed at an infinite distance. Every great circle whose plane is perpendicular to the plane of projection, — the horizon, for example, — is represented by its diameter; every small circle perpendicular to the same plane is represented by the chord which forms its diameter. A small circle parallel to the plane of projection, is represented by a circle. Every circle, great or small, of which the plane when produced does not pass through the eye, or is not perpendicular to the plane of projection, will be seen obliquely and under the form of an ellipse.

The word analemma also denotes an instrument of brass or wood on which the projection is made (the plane of projection being the solstitial colure), with a moveable horizon attached to it, by means of which some of the common astronomical problems may be solved, though not very exactly. Ptolemy wrote a treatise on the Analemma, of which there is a Latin translation from an Arabic version, with a commentary by Commandine. According to Delambre, it contains only some complicated rules for computing the true values of the arcs of the sphere from the straight lines by which they are represented on the analemma. Since the invention of trigonometry, contrivances of this sort have become useless.

A'NALE'PSY. (Gr. *ἀναλαμβανω*, *I recover*.) A species of epileptic attack of sudden and frequent recurrence; but not considered dangerous.

ANALE'PTIC. (Same derivation as the above.) A restorative medicine.

A'NALOGUE. (Gr. *ἀναλογος*, *according to rule or proportion*.) A body that resembles another. A fossil shell of the same species as a recent one, is its analogue.

ANA'LOGY. (Gr. *ἀναλογος*, *according to rule or proportion*.) In ordinary language, denotes a relation or similarity between different things in certain respects. The conclusions to which we are led concerning one thing, by reasoning from our experience concerning another similar thing, form what is termed analogical knowledge. The word analogy is generally employed to designate an imperfect degree of similarity. Thus, a physician, arguing, from the effects which he had seen produced by a drug on one man, to its probable effects on another man, would be said to reason from experience: but reasoning from the effects produced on an inferior animal, to the probable effects on man, would be, more properly, reasoning by analogy.

In Rhetoric, the word analogy is employed in a somewhat stricter sense; it designates, not the specific resemblance between two objects, but a resemblance between the relations in which they stand to other objects. Thus, to term youth "the dawn of life," is said to be a metaphor by analogy; not because of any

actual resemblance between youth and morning, but because the one is to life, what the other is to the day. Thus, a hat too is analogous to a turban, and both are analogous to a bonnet, having a similar relation to the head of the wearer. In this sense, a porpoise is analogous not only to a fish, but to every other animal which habitually moves and seeks its food in the water. It often happens, however, in Zoology, that a similarity of relationship to a medium of locomotion, a kind of food, &c., is accompanied with a certain amount of corporeal and organic resemblance; and this is necessary to constitute an analogy in the zoological sense, though by no means in the strictly logical application of the word.

In Grammar, analogy means a conformity in the principles of organisation of different words or collections of words.

In Geometry, analogy signifies the same thing as proportion, or the equality or similitude of ratios. (*See* PROPORTION, and RATIO.)

In modern Zoology, the term analogy is restricted to the relation which animals bear to one another in the similarity of a smaller proportion of their organisation: thus, the Ascalaphus italicus, in the length and knobbed extremities of its antennæ, the colouring of its wings, and its general aspect, exhibits a striking resemblance to a butterfly; but in all the essential parts of its organisation it adheres to the neuropterous type of structure; its relation to the Lepidoptera is therefore said to be one of analogy, while it is connected to the ant-lions by the order of affinity. As it has been found in some instances, that two series of animals, arranged according to the greater amount of resemblances, or the relation of affinity, are connected to one another by analogical resemblances at given points of the series, the relation of analogy has been regarded as differing from that of affinity not only in degree, but in kind. If a zoologist, for example, were led, by a too superficial glance at the external resemblances of two animals, to place them in the same series contiguous to one another, and it were discovered that the resemblance was but skin-deep, or limited to a temporary state of being, as a stage of metamorphosis, but contradicted by a dissimilarity of a greater proportion of the internal organisation, then it would be said that he had mistaken a relation of analogy for one of affinity; a phrase which the reader, however, will readily perceive, merely expresses the fact, that a false judgment had been formed, from not taking into consideration the whole of the points of comparison necessary for determining the mutual relation of animals to each other.

AÑA'LYSIS. (Gr. ἀναλυω, *I dissolve.*) A Greek word, which signifies the resolution of a thing into its component parts. In Logic, analysis is used in opposition to synthesis, as a method of arriving at adequate definitions. In the synthetical method, we begin by assuming some quality which the subject is known to possess. Finding this to be common to other subjects than the one we wish to define, we add some further property, and so on, until we have adequately distinguished it from all other things. Thus man is an animal, man is a hot-blooded animal, man is a hot-blooded viviparous animal, &c. &c., may be taken as a specimen of a synthetical process. In analysis we should reverse the method: assuming the most distinguishing characteristic, and descending, through successive gradations, to that which is least so. Correspondently with this distinction, an analytical proposition is one in which the subject is implied in the predicate:—*e. g.* "matter is extended." A synthetical proposition, on the contrary, is that in which the terms have no necessary connection:—*e. g.* "John is tall;" "the world is round." As applied to mental phenomena, analysis is the referring them to the acts or faculties of the mind which they necessarily imply, either as contemporaneously contributing to their production, or as rendering their production possible by their past operation. (See *infra*, ANALYSIS, in Geometry.)

The distinction frequently made between analytic and synthetic reasoning rests on a somewhat vague use of language. Strictly speaking, all reasoning can be but of one kind. A process of ratiocination admits, however, of being reversed: *i. e.* we may make certain assumptions, and from them form certain legitimate deductions; and we may then proceed to take the truths thus deduced for granted, and by a counter-process arrive, as inferences, at what, in the former case, were the grounds from which we started. Here it is evident that the distinction lies not in the reasoning, but in the subject-matter concerning which we reason.

ANALYSIS. In Chemistry, this term is applied to the resolution of compound bodies into their elements. It is either qualitative or quantitative. Qualitative analysis consists in the determination of the component parts merely as respects their nature, and without reference to their relative proportions: it is an imperfect, and often a very easy operation, as compared with quantitative analysis, by which we determine not merely the





components of a compound, but their relative proportions: to effect this, much scientific skill and practical dexterity are required, more especially in the identification of new substances. The theory of definite proportionals, or the Atomic Theory, as it is usually called, has materially facilitated many analytical processes, and is especially valuable as furnishing an unerring test or criterion of the general accuracy of the results.

In reference to chemical analysis generally, but more especially as regards organic products, we often employ the terms proximate and ultimate analysis: the former referring to the immediate combinations which form the subject of experiment; the latter, to their final resolution into elementary principles. Thus, in regard to sulphate of lime, it is resolved by proximate analysis into sulphuric acid and lime, and these are called its proximate elements; but sulphuric acid is itself a compound of oxygen and sulphur; and lime, of oxygen and calcium; oxygen, sulphur, and calcium, therefore, are the results of the ultimate analysis of sulphate of lime; and there are many theoretical points in chemistry dependent upon the views which are taken of the various groupings of these ultimate principles. Wheat flour is a compound of starch and gluten; starch is compounded of oxygen, hydrogen, and carbon; and gluten, of the same elements with the addition of nitrogen; so that the ultimate components of wheat, are oxygen, hydrogen, carbon, and nitrogen.

ANALYSIS. In Geometry, a method of conducting geometrical inquiries, invented by the philosophers of the school of Plato, or, according to Theon of Alexandria, by Plato himself, and one of the most ingenious and beautiful contrivances in the Mathematics. The essence of the analytic method of establishing the truth of a proposition consists in assuming the proposition enunciated to be true, and deducing consequences from that supposition till a conclusion is arrived at manifestly true or manifestly false; or at least known to be true or false by its agreement or disagreement with some proposition which has already been demonstrated. Analysis is thus the converse of synthesis, or composition,—a form of reasoning by which we ascend, through a series of propositions, from some known truth to the conclusion we are in search of. The distinction between analysis and synthesis, as well as the definition of the two terms in the sense in which they were understood by the ancient geometers, is concisely given by Pappus, in the Preface to the Seventh Book of his Mathematical Collections. "Analysis," says Pappus, "is the course which, setting out from the thing sought, and which for the moment is taken for granted, conducts by a series of consequences to something already known, or placed among the number of principles admitted to be true. By this method, therefore, we ascend from a truth or a proposition to its antecedents; and we call it analysis, or resolution, as if indicating an inverted solution. In synthesis, on the contrary, we set out from the proposition which is the last in the analysis; and proceed by arranging, according to their nature, the antecedents which present themselves as consequents in the analytic method, and combining them together till we arrive at the conclusion sought. Analysis may be distinguished into two kinds: in the first, which may be called contemplative analysis, we propose to discover the truth or falsehood of an affirmed proposition; the other belongs to the solution of problems, or the investigaton of unknown truths. In the first we assume the subject of the proposition advanced to be true, and proceed through the consequences of the hypothesis till we arrive at something known. If this result is true, the proposition is true also, and the direct demonstration is obtained by stating in an inverse order the different parts of the analysis. If the ultimate consequence at which we arrive is false, the proposition was also false. In the case of a problem, we first suppose it to be resolved, and deduce the consequences resulting from that proposition till we arrive at something known. If the last consequence involves only something which can be executed, or is comprised among what geometers called data, the proposed problem can be solved; and the demonstration, or rather in this case the construction, is obtained, as in the former case, by taking the different parts of the analysis in an inverse order. If the last result is impossible, the thing demanded is also impossible."

The names of the ancient writers on the geometrical analysis have been preserved by Pappus in the preface before referred to: they are, Euclid, in his Data and Porismata; Apollonius, in his treatise De Sectione Rationis, and in his Conic Sections; Aristæus, De Locis Solidis; and Eratosthenes, De Mediis Proportionalibus; but of these only the Data of Euclid, and some fragments of Apollonius, have come down to our times. The subject has, however, been fully investigated by the moderns, and a complete system of the ancient geometrical analysis may be found in the works of Dr. Simson of Glasgow. (See also Leslie's Geometrical Analysis.)

By the term analysis the ancient geometers understood

a certain mode of reasoning altogether independent of signs or symbols, and which might be carried on by ordinary language. In its modern acceptation, analysis is synonymous with algebra, or the calculus, and is opposed, not to synthesis, but to geometry. In this sense the original meaning of the word is entirely lost sight of; and, instead of being used to denote a particular mode of reasoning, it rather indicates the instrument by which the reasoning is carried on. Algebra may be employed with advantage, whether the method of demonstration be analytical or synthetical.

One great advantage arising from the use of algebra in the solution of geometrical questions, consists in this, —that the demonstration is reduced to certain rules, and carried on by systematic processes; in consequence of which, the analyst, having reduced his problem to equations, can generally determine at a glance, whether the solution is possible or not. It must be admitted, that the demonstrations of many of the propositions of elementary geometry by the ancient methods have a peculiar elegance which the algebraic methods cannot always reach; but, in point of power and applicability, the modern analysis is vastly superior to the ancient. "The geometrical synthesis," says Laplace, "has the advantage of never losing sight of its object, and of illuminating the whole path which leads from the first axioms to their last consequences; whereas the algebraic analysis soon causes us to forget the principal object in order to occupy us with abstract combinations. But in thus isolating the objects, after having abstracted from them what is indispensable to arrive at the result he is in search of, in abandoning himself to the operations of analysis, and reserving all his forces to overcome the difficulties which it presents, the analyst is conducted to results inaccessible to synthesis. Such is the fecundity of analysis, that it is sufficient to translate particular truths into this universal language, in order to perceive a series of other new and unexpected truths arise from their mere expressions. No language is equally susceptible of the elegance which results from the development of a long series of expressions intimately connected with one another, and all flowing from the same fundamental idea. Analysis also unites with these advantages that of being always capable of leading to the simplest methods; for this purpose it is only required to apply it suitably, by a skilful choice of indeterminate quantities, and to give the results the form the most convenient for geometrical construction or numerical calculation. Modern geometers, convinced of the superiority of analysis, have especially applied themselves to extend its domain, and enlarge its limits."—(*Exposition du Système du Monde*, 4to. p. 423.)

Analysis is in general the instrument of invention; and it is supposed, not without reason, that the greater part of the discoveries, for which the mathematicians of the 17th century were distinguished, were made by its means, though they were given to the world in a synthetical form. It is evident, from the posthumous works of Pascal and Roberval, that they first obtained the solution of many of their problems by the method of indivisibles, and afterwards demonstrated the truth of their results in the manner of the ancients. Newton himself thought that a mathematical proposition ought not to be made public, or was not fit to be seen, till invested in a synthetic dress. Synthetic demonstration is now rarely met with in any other than the most elementary works; the algebraic analysis has become the ordinary intrument of mathematical investigation. "Nevertheless," says Laplace, "geometrical considerations ought not to be entirely abandoned; they are of great utility in the arts. Besides, it is interesting to figure to one's self in space the divers results of analysis; and reciprocally to read the affections of lines and surfaces, and all the variations of the motion of bodies, in the equations which express them. This connection of geometry and analysis throws a new light over both sciences; the intellectual operations of the latter, rendered sensible by the former, are more easily apprehended, and more interesting to follow; and when the imagination realises these images, and transforms geometrical results into laws of nature; when those laws, while they embrace the universe, unveil to our eyes its past and future conditions; the sight of this sublime spectacle affords the noblest of the pleasures reserved for the human race."—(*Exposition du Système du Monde*, p. 424.)

ANAMORPHO'SIS. (Gr. ἀνα, *backward*, and μορφη, *form*.) A term employed in Perspective, to denote a drawing executed in such a manner that, when viewed in the common way, it presents a confused or distorted image of the thing represented, or an image of something entirely different; but when viewed from a particular point, or as reflected by a curved mirror, or through a polyhedron, it recovers its proportions, and presents a distinct representation of the object.

ANAMORPHOSIS. In Botany, when any part assumes an appearance unusual with it. The calyx of the rose assuming the appearance of a fruit, the stipule of a propsis become spiny, the stem of a cactus when succulent and tube-like, are cases of anamorphosis.

ANA'NAS. (Ananas, *Brazilian*.) The plant that produces the delicious pineapples of the gardens. It is of South American origin, but has been gradually dispersed through similar climates till it has become apparently wild in Africa and many parts of Asia, especially the Malayan Archipelago, where it arrives at a greater degree of excellence than in its native woods.

ANA'NDROUS. (Gr. ἀ, *without*, and ἀνηρ (genitive ἀνδρος), *a male or stamen*.) When flowers are destitute of stamens, they are usually called female flowers.

A'NAPÆST. (Gr. ἀναπαιστος.) A foot in Greek and Latin metre, consisting of two short syllables followed by a long being the name of the dactyle.

ANA'PHORA. (Gr. ἀναφορα, *raising up*.) In Rhetoric, a repetition of words or phrases at the commencement of sentences or verses. Thus in Cicero, Verr. iv. c. 10., *Verres calumniatores apponebat, Verres adesse jubebat Verres cognoscebat, Verres judicabat*.

ANAPLOTHE'RIUM. *See* ANOPLOTHERIUM.

A'NARCHY. (Gr. ἀ, *without*, ἀρχω, *I govern*.) In Politics, the constitution of a country in which not only lawful government, but regular government *de facto*, is superseded by force. Hence Milton metaphorically terms his personified Chaos an "Anarch."

ANA'RRHICHAS. A name conceived by Gesner and applied by Linnæus to a genus of spiny-finned osseous fishes, characterised by having their mandibular, palatine, and vomerine bones armed with large osseous tubercles, bearing on their summits small enamelled teeth; anteriorly the jaws support longer and more conical teeth: by means of this powerful dental apparatus the species of this genus, which inhabits the northern seas, called the "wolf-fish," is enabled to break and bruise the testaceous defensive coverings of shellfish, the soft parts of which form its ordinary food.

A'NAS. (Lat. anas, *a duck*.) The name of a Linnæan genus of Anserine birds, characterised by a large, broad, obtuse bill, furnished at the margin with numerous thin, transverse, projecting plates, and an obtuse papillose or ciliate tongue. The subdivisions of this extensive group of web-footed birds, which were indicated by Linnæus, have since been raised to the rank of genera (*see* ANATIDÆ), and the term Anas is now restricted to the species which present a flattened bill, the base of which is always of greater breadth than depth, as wide (or wider) at the extremity as at the beginning; with nostrils placed nearer the upper margin and base of the bill. The legs are shorter and placed farther back than in the geese (*Anser*); they have a shorter neck, and the windpipe is dilated at its lower end into two osseous capsules, of which the left is usually the larger. The ducks, thus characterised, are subdivided into those which have the hind toe provided with a membrane, and those in which it is naked. Both divisions are again broken up into numerous minor groups, which are distinguished by generic terms.

ANASA'RCA. (Gr. ἀνα, *through*, and σαρξ, *flesh*.) A diffusion of water through the cellular membrane of the limbs, as in dropsy.

ANA'STOMO'SING. When two parts, growing in different directions, meet and grow together, as the veins in leaves.

ANA'STOMO'SIS. (Gr. ἀνα, *through*, and στομα, *a mouth*.) The communications of the vessels of the body with each other.

ANA'STROPHE. A name given in Classical Philology to some species of inversion (*see* INVERSION) or departure from the usual order of succession in words. From the Greek ἀναστρεφω, *I overturn or invert*. Such phrases as mecum, vobiscum, &c., in which the preposition follows the word governed by it, or in which it is placed between two words governed by it, &c., are instances of anastrophe.

ANA'THEMA. (Gr. ἀναθημα.) Properly, a thing laid by, consecrated, or devoted: hence a person upon whom the ban of the church is laid, is said to be anathematised, or in the Jewish phrase, to be "anathema." St. Paul says, "If we or an angel from heaven preach any other gospel to you than that which we have preached, let him be anathema:" and upon the authority of this and similar passages, the church assumed from the first the power of anathematising or excommunicating evildoers and heretics.

ANA'TIDÆ. The name of a family of web-footed birds, of the swan, goose, and duck kind, of which the genus Anas is the type.

ANA'TOMY. (From ἀνα, *through*, and τεμνω, *I cut*.) This term literally means *dissection*, but is generally understood to signify a knowledge of the internal structure of the human body, in the acquisition of which dissection is essentially necessary. The anatomy of other animals is usually designated Comparative Anatomy; and that of plants, Vegetable Anatomy; which see.

Although some anatomical knowledge must have been accidentally acquired by the earliest inhabitants of the

globe, and although there are several allusions in the early books of the Old Testament to the subject, no dissections of the human body were performed with a view to ascertain the position and structure of its internal organs, or to elucidate their functions, till a much later period.

Homer has, it is true, been complimented, and in some respects justly so, for the precision with which he describes the wounds of his heroes; and the ancient Egyptians are said to have acquired great anatomical skill by their practice in the art of embalming; but these, and similar statements, have no bearing upon the pursuit of anatomy as a science, or in connection with surgery, medicine, and physiology. Thales, Socrates, Xenophon, and Plato, are each quoted by anatomical historians, as having acquired no inconsiderable anatomical knowledge; Plato is even said to have anticipated the celebrated discovery of the circulation of the blood. "The heart," he says, "is the centre of the blood-vessels, the spring of the blood, whence it flows rapidly round: blood is the pabulum of the flesh, in order to the nutriment of which the body is intersected by canals, like those of gardens, to convey the blood like water from a fountain, to the remote parts."

The first author who is supposed to have written on human anatomy is Hippocrates; and the first recorded dissection was, probably, made by his contemporary Democritus of Abdera. This carries us back to about 400 years before the Christian era, from which period, to that of Galen, (that is, in the space of 600 years,) little progress seems to have been made in the knowledge even of the structure and position of the viscera of the body, much less in their uses and diseases.

It would appear from Galen that the most eminent anatomists of antiquity were Erasistratus and Herophilus, who taught anatomy in the celebrated school of Alexandria, and are said to have been the first who were authorised to dissect human bodies: hence, probably, the high rank which the school, founded by the Ptolemies, acquired, and maintained for several hundred years. The works of the above-mentioned anatomical professors have been lost, but they are abundantly quoted by their more immediate successors.

Among the Romans the first anatomist was, probably, Asclepiades, who flourished in the time of Pompey; and soon afterwards Rome became a celebrated seat of medical science. Celsus, Aretæus, and Galen, are the ornaments of this period; especially the latter, as an anatomist; though it appears probable that his descriptions were often taken from dissections of inferior animals, and applied to the corresponding organs of the human body: it is, however, said, that he anticipated many subsequent discoveries, and that a great part of his writings were for a long time unintelligible, till cleared up and explained by the labours of his successors.

During the dark ages anatomy sustained the fate of other branches of knowledge; and, with few exceptions, little progress was made in it, till the revival of learning in Europe. the prejudice, too, against the dissection of the human body was not only maintained, but sanctioned by the highest existing authorities. In the year 1315, a System of Anatomy was drawn up by Mundinus, chiefly, it is said, founded upon such parts of Galen's doctrines as had been preserved by the Arabians. This work deserves notice, as having been the anatomical text-book of the schools of Italy for a period of nearly 200 years. Mundinus is, indeed, celebrated by his contemporaries as the restorer of anatomy. Early in the fifteenth century, when learning began to revive in Europe, in consequence chiefly of the introduction of the writings of the Greek authors, numerous treatises on the Sciences made their appearance, amongst which anatomy formed a prominent subject; and among its most successful followers, the name of the celebrated Leonardo da Vinci may be recorded, although he apparently only pursued it in reference to his own art. (See the sketches annexed to Memorie Storiche di L. da Vinci, by C. Amoretti, Milano, 1804.) In reference to some of the drawings and their descriptions, preserved in the library of George III., and which he had access to, Dr. Hunter observes, that he saw with astonishment that Leonardo had been a deep student, "and was at that time the best anatomist in the world." We must give the fifteenth century the credit of Leonardo's anatomical studies, as he was fifty-five years of age at its close. At the beginning of the sixteenth century Berengarius and Massa wrote upon human anatomy; but such was the authority of Galen, even at that time, that few dared publish any statement or opinions contradicting those of their infallible master. About the middle, however, of the sixteenth century, this spell was broken by the celebrated Vesalius of Brussels, who taught anatomy at Paris and Louvain, and afterwards in Italy. He boldly demonstrated the errors of Galen; described accurately the dissections of the body, corrected and improved anatomical nomenclature, and insisted upon the necessity of diligence and actual observation in dissection, as the only solid foundation of successful medical and surgical practice. He had many opponents, and is said to have been detected in the very mischievous error for which he blames Galen; namely, that of describing the human viscera from dissections made upon quadrupeds.

Among the most remarkable contemporaries or immediate successors of Vesalius, were Fallopius and Eustachius,— the former of Padua, the latter of Venice; whose names, as annexed to their discoveries, have been handed down to posterity. Indeed, the schools of Italy seem to have been the only accessible sources of practical anatomy at that period: in France and England an antipathy to dissection prevailed, which was fatal to all anatomical improvement. Cortesius, who wrote at the beginning of the seventeenth century, and who, after having been professor of anatomy at Bologna, filled the chair of medicine at Massana, complains that he was prevented finishing a treatise on Practical Anatomy, in consequence of having only been able twice to dissect a human body in the course of twenty-four years, "whereas in the academies of Italy there is that opportunity once every year."

About this time the name of the renowned Harvey becomes conspicuous in the annals of anatomy: he, like his most eminent contemporaries, studied medicine in Italy. Fabricius ab Aquapendente, who was his master, had just made the highly important discovery of the valves of the veins; and it was this which, probably, more especially directed Harvey's attention to the use of the heart, and the vascular system: for at that time the liver was considered as its great centre, and the veins were supposed to convey the blood from it to the remote parts of the body. Harvey's great discovery of the circulation of the blood was taught by him in his lectures as early as 1616, though not published till 1628, in consequence of his desire to demonstrate the subject in detail, and to collect proofs and illustrations of the correctness of his doctrines. This discovery was not only of vast intrinsic importance, but, as is the case in all similar instances, it led to others; and the route of the blood had no sooner been traced and described, than the manner in which the nutritious part of the food is conveyed into the circulation became an object of research: this was successfully developed by Asellius, an Italian physician, in the year 1627. He was so fortunate as to see the lacteals filled with chyle, and to trace them to their common trunk, the thoracic duct, and thence into the blood-vessels. The lymphatic system was also soon afterwards detected, and first described by T. Bartoline, a Danish anatomist; and this was followed by important details bearing upon the anatomy of the gravid uterus and of the generative system, in which nearly all the celebrated anatomists of Europe had a share; and among them Harvey was conspicuous, though Dr. Hunter attributes, with apparent injustice, his knowledge upon this subject, and even the merit of detecting the use of the arteries, to his master Fabricius. The physiology of generation was more especially followed up by Swammerdam, Malpighi, and Leuenhoek, who were enabled greatly to extend the bounds of anatomical knowledge by their ingenious use of the microscope.

Although this country has produced many celebrated anatomists, there is no one to whom we are so deeply indebted as Dr. William Hunter, who was born in 1718, at Kilbride, in Lanarkshire, and was contemporary with the celebrated Cullen. Dr. Hunter came to London in 1741, bringing with him an introduction to Dr. Douglas, who was then engaged in a work upon the bones, and was in search of a young man who might assist in his dissections. He found in William Hunter a person so exactly suited to his purpose, that he not only engaged him as an assistant, but received him into his family and made him his son's tutor. As our object here is to give a brief historical Outline of Anatomy, rather than the biography of its successful cultivators, we must pass over many interesting points in Dr. Hunter's early history, till he came before the public as an anatomist, which was in the year 1743, when he communicated to the Royal Society an Essay "On the Structure and Diseases of Articulating Cartilages;" and was remarked for his diligence, ingenuity, and skill in the arrangement of anatomical preparations, of which he had accumulated a considerable collection, with a view of pursuing his favourite object, namely, that of publicly teaching anatomy. He commenced this arduous task in 1746, under the auspices of Mr. Sharpe, of Covent Garden, in whose theatre he made his first appearance as a public lecturer. In 1747 he became a member of the Corporation of Surgeons; and in the spring of the following year, having concluded his course of lectures, he accompanied his pupil, Mr. James Douglas, into Holland and France. He returned in time to begin his winter course, during which he not only acquired a high character as an anatomist, but commenced the practice of midwifery, in which he soon attained eminence, founded not merely upon his person and address, both of which were agreeable and well suited to that line of the profession, but upon his anatomical skill; so that in all cases of danger and difficulty it soon became customary to call in his aid. In this respect his celebrity became so extended, that he afterwards acquired great

and merited reputation as a general anatomical physician. In 1762 Dr. Hunter entered into a spirited vindication of his claims to certain anatomical discoveries, in a work entitled "Medical Commentaries;" and in the same year he was appointed physician to the queen of George III. His professional avocations now became so numerous and urgent, that he was obliged to take a partner in his lectures, and for that purpose selected his pupil, William Hewson, who afterwards joined Mr. Cruickshank, two gentlemen whose names occupy no unimportant place in the history of practical and structural anatomy.

In 1754 Dr. Hunter began his great and splendid work on the "Anatomy of the Gravid Uterus," which was not completed till 1775. This gave him a high rank among European anatomists, and foreign and domestic honours were abundantly conferred upon him in consequence; but it is to the establishment of his Museum, and School, that we are principally to look for the new impulse which was given to the study of anatomy in London, and for the celebrity which this metropolis has since maintained. The account of the origin and progress of this Museum, therefore, deserves to be briefly recorded here. When Dr. Hunter had acquired a competent fortune, the result entirely of his high professional merit and unwearied diligence, he found wealth still pouring in upon him, and became desirous of applying this surplus to some great national purpose of public utility; and what more important or useful than "A Metropolitan School of Anatomy?" He accordingly, in the year 1765, during the administration of Mr. Grenville, presented a memorial to that minister, in which he requested the grant of an unemployed piece of ground near the King's Mews, at Charing Cross, for the site of his intended building; upon which he undertook to expend 7000*l.* and to endow a professorship of anatomy in perpetuity. After waiting for some time without a reply, he renewed his request, or rather repeated his proposal; and his second application, which was even in more liberal terms than the former, shared the same supercilious treatment. Although disgusted, as he well might be, at this unaccountable neglect, he determined that the town in which he had acquired his wealth and reputation should not be without some useful and honourable memorial of his labours: he accordingly purchased a piece of ground in Great Windmill Street, near the Haymarket, where he erected a spacious dwelling-house, behind which was a magnificent fire-proof room, fitted up as a museum and library, and communicating with a good anatomical theatre, and an extensive series of apartments for dissection and for the preparation of anatomical specimens. This building was completed in 1770.

Dr. Hunter expended upon this Museum a sum exceeding 20,000*l.*: it included, besides its unrivalled anatomical treasures, a splendid and valuable collection of books, coins, medals, and antiquities; of minerals, shells, and other articles of natural history. By his will, the use of this Museum, under the direction of trustees, devolved upon his nephew, Dr. Matthew Baillie; and in case of his death, to Mr. Cruickshank, for the term of thirty years; at the end of which period the entire collection was bequeathed to the University of Glasgow, together with a sum of 8000*l.* for its preservation. Dr. Hunter died on the 20th of March, 1783; so that his will, in regard to his Museum, has long since been carried into effect, and it is now in Glasgow. To say nothing of the books, antiquities, and objects of natural history, it contained, when sent to its final destination, the finest series of anatomical specimens in Europe. Thus, through the apathy of the administration of that day, was this unrivalled collection lost to this metropolis. Dr. Hunter's munificent intentions must, however, never be forgotten: he furnishes a noble and rare example of a man who, as soon as he had rendered himself independent by his own exertion, in a laborious and difficult profession, applied the whole of his large income to a great public object; and, though thwarted in his original desire, that it should remain in the metropolis in which the fortune expended upon it had been amassed, as a monument of his gratitude, and an example to his successors, he was, nevertheless, sufficiently liberal and patriotic to devote it to the use of the public, by bequeathing it to the university which had granted him his degree.

Dr. Hunter not only gave a new impulse to anatomical science, the effects of which have been transmitted to the present time, but his zeal in behalf of his favourite pursuit tended to make many converts. Among these, the celebrated John Hunter stands foremost. Hearing of his brother's reputation, he offered his services as an assistant in his inquiries, and his proposal was kindly accepted. Accordingly, in September, 1748, he left Lanarkshire, being then twenty years of age. His disposition to excel in anatomical pursuits soon became evident. In the course of the succeeding year he had rendered himself sufficiently master of the subject to instruct his brother's pupils in the dissecting-room; and in 1755 was admitted to a partnership in the lectures. His ardour and enthusiasm as an anatomist were most extraordinary, and he became as eminent in surgery as his brother was in physic; yet his more lucrative professional avocations were never allowed to supersede his scientific zeal; and the result was, the formation of a Museum of Comparative Anatomy, which is at once a memorial of a scientific mind and a skilful hand. Mr. Hunter died suddenly on the 16th of October, 1793, at the age of 65. He directed by his will that his Museum, upon which he had expended nearly the whole of his large professional income, should be offered to the purchase of government; and, fortunately for the credit of our country, the proposal met with a very different reception to that which we have above recorded in reference to his brother. It was purchased for the sum of 15,000*l.*, and made over, under certain conditions, which have been not only faithfully, but liberally, fulfilled, to the Royal College of Surgeons, in London. It is one of the most splendid collections in the world, and in many respects unrivalled; it is open, under proper regulations, to public inspection, in the magnificent building erected by the College for its reception, on the south side of Lincoln's Inn Fields.

Another convert to anatomical pursuits, educated in the school of William Hunter, was his nephew, the late Matthew Baillie. His virtues and his talents placed him high in public estimation, his anatomical knowledge was the foundation of his professional eminence; and the excellence of his lectures, both as regards matter and manner, tended to exalt the reputation of his uncle's school, and to establish the importance of anatomy as the basis of medical, no less than of surgical practice.

We have dwelt upon the Hunterian School, from the conviction that it gave a character to anatomical pursuits, which has materially and beneficially influenced their subsequent progress, not only in London, but throughout the kingdom. Their importance and their necessity as the basis of the sciences of medicine and surgery are now publicly felt and acknowledged; the aversion to the dissection of the human body is on the wane; and the degrading and disgraceful practice of allowing the schools of anatomy to be supplied with subjects for dissection, by the revolting process of exhumation, has been superseded.

Human anatomy is usually subdivided into *descriptive*, and *morbid*, or, more correctly, *pathological*.

*Descriptive Anatomy* embraces a description of the different organs of the body, together with their relative situations and connections, it examines the textures of which they are formed, enumerates the nerves and vessels by which they are supplied, and gives all general and particular details concerning their organisation. Having done this, it proceeds to the analogies that subsist among the materials of which different organs are composed; and is thus led to specify the proximate constituent parts of the living body.

*Morbid* or *Pathological Anatomy* comprehends all that relates to the effects of disease upon healthy structures; and carefully traces and describes the changes of texture and of composition which they thus suffer, in reference to the entire organ, as well as to its individual parts.

We shall now proceed to give a short description of the parts of which the human body is constructed, referring for the account of individual organs to the separate terms under which they are enumerated.

Anatomical teachers generally first direct the student's attention to that branch of the subject which is termed *Osteology;* in other words, to the bones or skeleton, constituting the hardest and most durable part of the whole structure, and that which gives it its stability and general form. At the period of birth, the bones, for obvious reasons, could not exist with the degree of induration and firmness which they possess in the adult; we accordingly find that, at that period, they are mostly soft and flexible, resembling cartilage, with certain specks of osseous matter, which gradually extend and increase, as the process of ossification advances during the growth of the young animal. In contemplating this bony skeleton when it has thus become perfect, we are struck with the admirable adaptation and mutual connection of the various parts of which it consists; the separate bones being extremely numerous, (including the teeth, amounting to about 250,) and attached to each other by unequal surfaces, the cavities and eminences of which mutually correspond. These connections, termed *articulations*, are extremely various; some admitting of every variety of motion, others of limited motion, and others, as it were, continuously united. In the former case the evils of friction are perfectly provided against by the peculiarity of the articulating surfaces, which are covered with an extremely smooth and elastic substance, called *cartilage;* and lubricated, or as it were oiled, by a slippery fluid termed *synovia*, which here performs precisely the same office as that of the various anti-attritions which are used in machinery. But as the bones must be more or less restricted in their range of motion, there are peculiar means by which that end is attained: some being prevented from changing their relative situations by certain

modes of articulation; others, where a slight motion is required, being united by cartilage; and others, where extensive and varied motions are wanted, being connected by ligaments, membranes, or flesh.—*Ligaments* are white, fibrous, glistening, and flexible substances, occurring in an infinite variety of forms and situations. They are, for the most part, exterior to the joint, and, by their great strength and trifling elasticity, preserve the relative position or connection of the bones in their various movements.—*Membranes* are thin, whitish webs or textures, more flexible and elastic than ligament. They not only assist in the security and motion of joints, but fulfil a variety of other offices. They surround or line the cavities and the organs of the body, and contribute to unite and combine the whole; and, at the same time, interpose, and preserve a distinction, enabling separate parts either to co-operate or to act independently of each other. They vary in strength and texture, and different terms are applied to them in different parts of the body: two within the skull are called *matres;* those which envelope muscular fibres are called *aponeuroses;* that which covers the lungs and lines the cavity of the chest is termed *pleura;* that which lines the cavity of the abdomen and its included viscera is named *peritoneum;* those which inclose articular surfaces are termed *capsules;* that which covers bone, *periosteum;* and, in other cases, they are called *coats*, or *tunics*. The remaining substance concerned in the connection of the bones is *flesh:* it is thus, that the upper extremities are connected with the body, and that many of the joints are rendered secure. But flesh performs another and more important office, inasmuch as it constitutes a principal part of the organs termed *muscles*, through the medium of which the various movements of the body are effected. Many of the muscles contain, besides flesh, a substance analogous to ligament, through the medium of which they are attached to the bones, and to which the term *tendon* is applied: muscles and tendons are composed of bundles of fibres, which may be unravelled to extreme minuteness; and when what appears to be a single fibre is viewed under the microscope, it resembles a chain of infinitely small globular particles. But though the muscles are the immediate organs of motion, they are dependent for their powers of contraction and relaxation upon the *nerves* with which they are supplied. These, when separately examined, appear in the form of white cords or threads; and, when traced to their origin, are found to issue as it were from the brain, and from its elongation, termed the *spinal marrow*. The trunks of the nerves are subdivided into branches, and these again into filaments, which enter into, and are, as it were, lost in the substance of the muscles and other organs of the body. Their functions are in some cases obedient to, and in others independent of the will: to the former belong the nerves of the locomotive muscles; to the latter, those of the heart, viscera, &c. When they are divided, the peculiar functions of the organs which they supply are impaired or impeded: thus, the muscles may be deprived of the power of contracting, the glands of secretion, the eye of sight, the ear of hearing, and the skin of feeling. The nervous trunks, which issue in pairs from the brain or spinal marrow, amount to about forty; and in tracing them and their branches, they are found in certain different places to swell into knots, which are termed *gangliæ*, or they are reticularly aggregated into *plexuses*.

Having thus shown how the bones are connected and put into motion, and from what sources their motion is derived, it may next be inquired how they and the other organs of the body grow and are nourished. This brings us to consider the blood and its vessels.

The composition and properties of the blood, and the extraordinary changes which it suffers in its passage through the pulmonary vessels, are elsewhere defined. (*See* BLOOD, and RESPIRATION.) Without this exposure to the action of the air in the lungs, the blood is unfit for the support of life. We accordingly find that the heart is so constructed as to propel the blood which it receives through the structure of the lungs, and after it has there been aërated, to transmit it over the body: in fact, the heart is a hollow muscle: when it relaxes, its two principal cavities, or ventricles, are enlarged, and the blood flows in; when it contracts, they are diminished, and the blood is propelled into two large tubes or arteries, one leading to the lungs, and called the pulmonary artery, and the other to the system generally, and called the aorta: these arteries are not only elastic, but also muscular, so that they drive the blood onwards from the heart, its retrograde motion being effectually prevented by valves placed at their origin.

The arteries are divided and subdivided into an infinite number of ramifications; and the branches from the same trunk are frequently observed to unite or anastomose in their course; so that when, by any accident, some are obstructed, an adequate supply of blood may be kept up by the others. As, however, the blood cannot return to the heart by these vessels or arteries, we find that they inosculate, or communicate at their extremities with another series of tubes or vessels, which are called veins. These are more numerous than the arteries, and generally accompany them in their course. They have a less muscular power; and as they are not assisted by the heart in propelling the blood, they open to it larger and larger channels as it advances, and are supplied with valves by which its reflux is prevented. This is, in fact, the circulation of the blood (first made out by Harvey, as before mentioned); the veins ultimately terminating in two large trunks which pour the blood into the right auricle of the heart; whence it is propelled into the right ventricle, from which arises the pulmonary artery, transmitting it through the lungs; from the lungs the blood (having been aërated) returns by the pulmonary vein into the left auricle of the heart, which contracting, propels it into the left ventricle, from which arises the aorta. Such, then is the extraordinary mechanism by which the circulation of the blood is effected; but it must not be supposed that the whole of the blood is thus directly returned from the arterial into the venous system: a part of it is transmitted by minute arterial ramifications into the different structures and organs of which the body is composed, each of which is gifted with the power of assimilation, that is, of converting the blood, or a part of it, into a substance of its own kind. Some of these minute or capillary vessels also terminate upon the surface of the body, where they exhale perspirable matter; others, upon the membranes lining the cavities of the body, where they secrete the fluids which lubricate and moisten the interior surfaces; and others again go to the glands,—those peculiar organs or structures, which have not only the power of separating certain parts of the blood, but of converting it into new forms, which are called secretions, some of which are ejected, others retained, for the purposes of the animal economy.

Thus, then, it appears that the blood nourishes and preserves the body and all its parts, and that it is continually tending to the renovation and reproduction of the different organs; but this very process implies another, and no less extraordinary, function, which is performed by a distinct system; namely, that of absorption. There are, in short, a series of vessels which are continually carrying away the useless and worn-out materials; removing them in a state of solution; furnished, like the veins, with valves; terminating in a common trunk, called the thoracic duct; and pouring its contents into the veins, just before they enter the right auricle of the heart.

It appears, therefore, that a continual system of deposition and removal is carrying on within the living body; that the ramifications of the arterial system are constantly renovating the different organs, whilst the absorbents are as constantly removing the materials of which they consist. Nothing, therefore, is stationary or permanent; and as the blood, on the one hand, conveys the materials required, so, on the other, it receives those which are removed: and such as are useless, or would be hurtful if retained, are thrown off either by the intestines, the kidneys, the lungs, or the skin. It now only remains to show how this waste is compensated for, and by what means those materials which are thrown off in one form are replaced in another: this leads us to the functions of another branch of the animal machinery, called the organs of digestion; those organs, namely, by which the food is converted into blood.

Different animals require different kinds and quantities of food; some living almost exclusively upon animal, others upon vegetable substances; hence their division into carnivorous and graminivorous tribes. Man partakes of both; and, accordingly, the structure of his digestive organs is intermediate between the comparative simplicity of the truly carnivorous, and the complexity of the graminivorous classes. In all the higher orders of animals, however, the mechanism of digestion is of a complicated character.

The first change which the food undergoes is in the mouth, where it is torn, ground, and moistened by machinery expressly adapted to those operations. The teeth are admirably contrived for this purpose; some of them cutting, and as it were mincing, others rubbing and grinding, whilst a fluid is supplied by the salivary glands so as to render the mixture of a proper consistency to be swallowed: this is effected by the organs of deglutition: the food is propelled from the mouth into the tube which conveys it to the stomach, and which is called the œsophagus; and is, at the same time, prevented, by an extraordinary and complicated arrangement of the parts concerned, from passing in any other direction, and, more especially from entering the trachea or air-passage into the lungs. In the stomach the food is subjected to the secretions of that organ, called gastric juice, which is acid, and by which it is gradually converted into a greyish homogeneous semi-fluid substance, termed chyme; so that by the time the food has reached the right end of the stomach, or the pylorus, its original characters are entirely changed; its separate materials are no longer discernible, and it has acquired distinct properties; it is, in short,

*digested.* How these changes are effected we know not, though many attempts have been made to explain them upon chemical and mechanical principles. Dr. Hunter, in his Introductory Lecture, has the following apposite remarks, in reference to this and similar phenomena, "I must therefore expect," he says, "that you will not hereafter be surprised, when you find me avowing great ignorance in many of the most considerable questions relating to animal operations, such as sensation, motion, respiration, digestion, generation, &c. In my opinion, all these subjects are much less understood than most people think them. Our vanity deceives us, and persuades us that we have got the whole as soon as we have acquired a smattering of natural knowledge. Hence it is that the different sects of physiologists have endeavoured to explain animal functions upon such different principles. Hence, for example, to account for digestion, some have made the stomach a mill; some would have it to be a stewing-pot, and some a wort-trough; yet, all the while, one would have thought that it must have been very evident that the stomach was neither a mill, nor a stewing-pot, nor a wort-trough, nor any thing but a *stomach*."

When the food has been thus far digested in the stomach, it passes into the duodenum, or upper end of the intestinal canal; a tube, the whole length of which is about six times that of the body, and which, therefore, is variously and strangely convoluted to enable it to be packed into the abdominal cavity. Into this portion of the intestines, various vessels and glands deliver their secretions, partly for the purpose of lubricating its surface, and partly to assist in the further changes which are to be brought about in the chyme. Of these fluids, two are especially remarkable, from the importance and size of the glands by which they are secreted, and of the ducts by which they are conveyed; namely, the *bile*, which is of a green colour and bitter taste, and is secreted in the liver; and the *pancreatic juice*, which appears to resemble saliva, and which is secreted by a gland called the pancreas. The influence of these fluids upon the chyme is direct and important: the pancreatic secretion probably acts as a diluent merely; but the effect of the bile is more complicated; and it appears to be essential to the further change of the chyme into *chyle*, which is a white milk-like fluid, formed in the upper part of the intestine, and absorbed by a distinct set of vessels which, from the colour of their contents, have been called lacteals, and which convey the chyle, that is, the portion of the products of digestion fitted for nutrition, into the above-mentioned trunk of the lymphatics, whence it is transmitted into the veins, which open through the medium of the right auricle into the right ventricle of the heart. The bitter principle of the bile, and its colouring matter, are obviously not absorbed by the lacteals, but remain with the residue of the food, which is slowly propelled along the whole of the intestinal tube, and, having undergone certain changes in its passage, is ultimately voided as excrementitious.

Having now enumerated the various classes of organs in the human body, and adverted to their leading functions; having seen how the bones are united by articulations, and connected by ligaments, flesh, and membranes, forming a variety of levers adapted to the motions of the limbs, and supporting and protecting the soft parts, as in the skull and spine; how the brain and nerves are concerned in the sentient energies, and in presiding over and directing muscular motion, and influencing the functions of the viscera; having likewise seen how each part of the body is nourished by the blood, which is sent from the heart by the arteries, and conveyed back to it by the veins; how the useless and decayed parts are removed by the lymphatics; how the nutritious part of the food is carried into the blood by the lacteals; and how venous is changed into arterial blood in the course of its passage through the pulmonary vessels; it only remains to observe, that the whole fabric is as it were protected from external injuries by its *integuments*. Of these the most exterior is a covering, varying in thickness and induration on different parts of the body, but every where without feeling, and called the *epidermis*; immediately beneath it is a soft mucous substance termed *rete mucosum*; and under it the *cutis*, or true skin. These external coverings of the body are attached to and connected with the parts beneath, by cellular membrane. But though the animal owes much of its general security to these textures, it owes more to the senses, instincts, and appetites, with which it is so miraculously endowed. "By these it is led to pursue what is useful, and to guard against danger, inconvenience, and want. Nor is this all; there has likewise been conferred, to a certain extent, upon all living bodies, the power of reproduction, by which they are frequently able to repair the slighter injuries to which the different organs are exposed; and if this power be exceedingly languid in the latter periods of old age, it is because the author of nature never intended that the animal structure should be immortal. He has fixed its bounds, which it cannot pass; and has measured out the time when the fairest fabric must crumble into dust, and its animating spirit return unto Him, the great Almighty Incomprehensible Being, who first bestowed it." (See Dr. Barclay's Introductory Lectures to a Course of Anatomy; and Dr. William Hunter's Two Introductory Lectures, for details respecting the history, uses, and importance of the study of Anatomy.)

ANATOMY, COMPARATIVE. So called because the organisation of the lower animals was first principally studied with immediate reference to that of the human subject. Galen, who visited the schools of Alexandria at a period when the dissection of the human body was no longer permitted, sought in the anatomy of the ape to acquire a vicarious knowledge of the anatomy of man. Vesalius, after the revival of literature, dissected various quadrupeds, and compared their organisation with that of man, in order to correct the errors of Galen, and to establish the true knowledge of the peculiarities of the human structure.

Succeeding anatomists have investigated the structure of the lower animals, to acquire the knowledge necessary for experimenting upon them with success; and still more important discoveries in physiological science have resulted from tracing the modification and disappearance of different organs in the descending series of animals, as the only means by which we can obtain just notions of the uses and relative importance of the different organs in the animal economy, and a perception of the laws which regulate their co-existence in the same individual.

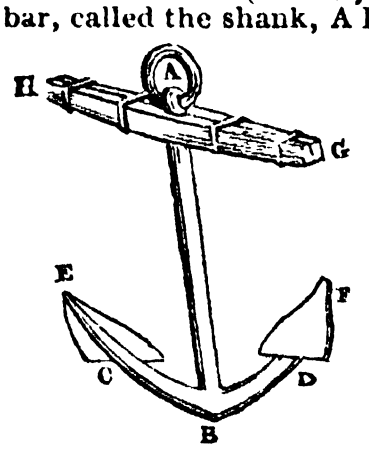
Aristotle, Harvey, and Hunter combined the investigation of the mature animals of different classes with observations of the different stages of development of the embryo, and their example has been assiduously and successfully followed by the ablest comparative anatomists of the present day, whereby some of the general laws of animal organisation, of development, and of the analogies which apparently different parts bear to one another throughout the great scheme, have been discovered.

A very important application of comparative anatomy is to the determination of the relative degrees of complexity in the organisation of different animals, and of the number and value of the points of resemblance which different species manifest to each other in the totality of their organisation. A study of the anatomy of animals, guided by these views, is essential to the determination of their natural affinities, which is the highest aim of the philosophic naturalist.

Lastly, the labours of the comparative anatomist continually tend to bring to light examples of structures, designed with reference to especial purposes, of the most striking and forcible description; and thus provide for the moralist and divine a storehouse of facts peculiarly adapted to the illustration of the doctrine of final causes.

ANA'TRŌPOUS. (Gr. *ἀνατρεπω, I invert.*) A very common kind of embryo, produced by one side of the ovule growing upon itself, while the other remains immoveable, till, at last, that part of the ovule which was originally next the apex, is brought down to the hilum, the base of the nucleus in such cases being at the apex of the ovule. The common apple, and the greater part of plants, offer an example of this.

A'NCHOR. (Gr. *ἀγκυρα.*) Consists of a straight bar, called the shank, A B, which ends in two arms, B C, B D, on which are placed the triangular plates called flukes, or palms; the extremity E or F is called the pea (peak) or bill; the point B is called the crown. At the end A is placed the stock G H, which, when of wood, consists of two pieces of oak, hooped together. When the stock is of iron, it passes through a hole in the end of the shank. The stock is at right angles to the plane of the flukes, and is a little longer than the shank. At A is the ring, which is of iron, to which the cable is attached, and by which the anchor is lifted or hung.




When a hemp cable is used, the ring to which it is bent (fastened in a particular way) is covered first with tarred canvas, and then with pieces of rope secured firmly round it; this is called a puddening, and protects the hemp from the iron. When a chain cable is used, it is shackled to the ring, which is not then puddened.

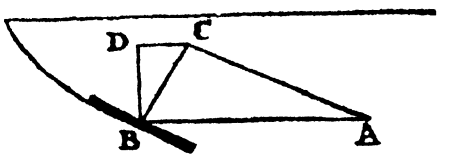
Men of war and large ships carry two large anchors of equal size, at the bows, called, thence, bower anchors; and two others, of the same size, called the sheet and the spare anchors; besides two or three others, which are much smaller, for temporary occasions.

The anchor, after being let go from the ship's bow or side, whether the shank be vertical or horizontal when it enters the water, arrives upright at the bottom, in consequence of the resistance of the water on the stock,

when it falls over, and rests on the crown, one corner of a fluke, and the end of the stock. From this position of stable equilibrium on three points, forming a long narrow triangle, a small force disturbs it, when the stock, falling flat, one of the bills must pierce the ground, penetrating deeper as the cable pulls, until the arm is partly or entirely buried.

Since the security of the vessel depends on the hold the anchor has of the ground, it is evident that the direction of the fluke should be such that the reaction of the soil against it, from the pull of the cable, may tend most effectually to keep it down.

The pressure on the fluke being perpendicular to the surface, take A B to represent the pull of the cable, then the resolved portion of this perpendicular to the fluke is B C or A B cos. A B C; and the effect of this in keeping the fluke down is B D = B C cos. C B D = B C sin. A B C, because A B is horizontal, and B D vertical, C B D is 90° — C B A; hence B D = A B sin. A B C cos. A B C, which is maximum when A B C = 45°. The flukes of anchors in general make the angle with the shank much greater than this; but Lieut. Rodger, R. N., has, among other improvements, adopted this angle in his patent anchor, having established the above conclusion by experiment.




Anchors are made of broad flat bars forged together. As the greatest strain upon the shank takes place during the act of weighing, the diameters of the shank are made unequal, the longest being placed vertical. This improvement is, we believe, due to Mr. Pering, on whose plan anchors have of late years chiefly been made.

The weight of an anchor in men of war is estimated roughly at about 1 cwt. to a gun; in merchantmen, about 1 cwt. for each 15 tons. The weight of the anchor is not strictly proportional to the size of the vessel, as large vessels are less affected by sudden or violent motions than smaller ones are. Large anchors are thicker in proportion to their length than smaller ones are; that is, the weight increases faster than the cubes of the dimensions.

When an anchor is left behind, it is recovered either by lifting it by the buoy rope, or, where that is not possible, by sweeping for it; which is dragging a hawser, hung between two boats, slowly over the bottom till it catches the upper fluke, by which the anchor is then weighed.

When one anchor is down the ship is said to be at single anchor; when two are down, the ship is generally moored. (*See* MOORED; CABLE; BUOY.) Ships rarely ride by more than two anchors; in bad weather a third is often let go under foot, as a precaution in case of one of the cables parting.

When the anchor is dragged by the pulling of the cable, it is said to come home. When the cable gets twisted round the anchor or stock, the anchor is said to be foul. The anchor is sometimes hove up without one of the flukes, which has either been fixed in a cleft of the rock and wrenched off by the force of weighing, or been snapped off, as some think, by striking against a point of rock in its rapid descent.

When the ship is at single anchor, the wind or tide may carry her over the anchor; if the water is deep, she may so drag the cable as to foul the anchor, in which case it may not hold again; if the water is very shallow, she may get upon the anchor, the fluke entering the ship's bottom, or she may break the shank by striking upon it. Keeping the ship clear of her anchor is, therefore, an important, as it is also a nice point of seamanship.

When the anchor is lifted out of the ground, it is said to be aweigh; when hove up to the surface of the water, it is awash. The anchor being hove up by the cable only to the hause holes, is lifted by the ring to the cathead; this is called catting it. The fluke next the ship's side is then lifted up to its resting-place, called the bill board; it is now said to be fished. When the ship is fairly at sea, the ring is lashed close up to the cathead, and the fluke brought close to the ship's side, or inside the bulwark, and the cable and buoy rope unbent; the anchor is then secured.

ANCHOR. In Architecture, an ornament applied to mouldings somewhat resembling an anchor intermixed with eggs, and by some called a tongue, from the resemblance it bears to the forked tongue of a serpent. It is found in the mouldings of all the orders, but is only applied to that called the echinus or quarter round.

A'NCHORAGE. Ground fit to hold a ship's anchor, so that she may ride safely. The ground best suited for this purpose is hard sand, or stiff clay; and the best position is that which is land-locked, or out of the tide.

AN'CHORITE. (Lat. anachoreta. Gr. ἀναχωρεω, *I retreat*, or *withdraw*.) More properly, anachoret, a hermit, or person who has retired from the world with the purpose of devoting himself entirely to meditation and prayer. Such was the case with many of the early Christians, beginning, perhaps, with such as fled from the persecutions of Decius and Diocletian, and retired into forests and deserts, at first with a view to security merely, and afterwards continued, from religious motives, the mode of life they had there adopted. The adoption of perfect solitude was essential to the character of an anchorite: but they were not necessarily bound by vows. The origin of this class of religionists preceded that of the Cœnobites, or monks living in societies; but in later times the monks used frequently to leave their monasteries, with the permission of their superior, and devote themselves for a time, or for their whole lives, to the solitude of anchorites.

ANCHO'VY. *See* ENGRAULIS.

ANCHYLO'SIS. (Gr. ἀγκυλοω, *I bend*.) A stiff, immoveable, or bent joint.

A'NCIENT DEMESNE. In Law, all lands which, having been in possession of Edward the Confessor, and from him having passed to William the Conqueror, are named in Doomsday Book as Terra Regis, are said to be held in ancient demesne. The tenure is peculiar, resembling copyhold in some respects.

A'NCIENTS. (Fr. anciens.) In the more general sense of the term, Ancients means those who lived long ago, or before the *moderns*. But the term is now usually employed to designate the Greeks and Romans; and if any other people be meant, it is customary to specify them, as the ancient Germans, the ancient Jews, &c.

ANCIENTS, COUNCIL OF. In French History, one of the two assemblies composing the legislative body in 1795. It consisted of 250 members; and derived its name from each of them being at least forty years of age. It was put an end to by the Revolution of the 18th *Brumaire*.

ANCI'LE. The shield of Mars, which, according to tradition, fell from heaven in the reign of Numa, and was accompanied by an oracle, which declared that, while it remained in Rome, the city could never be taken. Its figure was that of an oval compressed in the middle, so as to be widest near the two extremities. Numa had it preserved in the temple of Mars, to whose priests, the Salii, its care was committed; and at the same time had eleven more shields made to exactly the same pattern, in order to prevent the genuine one from being distinguished and stolen.

Every year, in the month of March, these ancilia were carried round the city by the Salii, with solemn dances and music, for thirty consecutive days, during which time no business connected with war was allowed to be carried on in the city.

ANCI'PITAL. Having two opposite edges or angles.

ANCI'PITOUS. (Lat. anceps, *two-edged*.) When any thing is compressed, with the two opposite edges thin. It is chiefly applied in Botany to leaves and stems.

ANCO'NES. (Gr. ἀγκων, *the point of the elbow*.) In Architecture, the consoles or ornaments cut on the keystones of arches, or on the side of door-cases. They are sometimes used to support busts or other figures.

ANDALU'SITE. A mineral composed of 52 alumina, 38 silica, 8 potass, 2 oxide of iron. It is very hard and infusible, by which characters it is distinguished from felspar. It was first observed in Andalusia in Spain.

ANDA'NTE. (Ital. *going*.) In Music, signifies that the notes are to be played distinctly.

ANDRÆA'CEÆ. (Andræa, one of the genera.) Little moss-like plants, differing from the mosses in the want of an operculum and peristome, and in having a four-valved theca.

A'NDREASBE'RGOLITE. From Andreasberg, in the Hartz. A mineralogical name of a species of Harmotome.

ANDRE'NA. The name of a Fabrician genus of bees, including those which have the tongue 3-cleft, and the labium cylindrical, with two membraneous bristles on each side.

ANDROCÆ'UM. (Gr. ἀνηρ, *a male*, and οἰκος, *a house*.) All that part of a flower to which the male organs appertain. The ring of stamens in a plant is an androcæum; so is the fringe at the mouth of the tube in the passion flower, taken together with the true stamens. The term may be literally translated the male apparatus.

ANDRO'GYNOUS. (Gr. ἀνηρ, *a man*, and γυνη, *a woman*.) An animal whch possesses the organs of both sexes, as the snail. An hermaphrodite.

In Physiology, the possession of the organs of both sexes in the same individual, either naturally, as in the snail; or preternaturally, as in the free martin and similar monsters. An hermaphrodite.

In Botany, a union of both males and females, either in the same flower, which is also called hermaphrodite; or upon the same plant, the sexes being in different flowers, as in the birch and similar trees. The latter is what Linnæus called moncecious.

A'NDRON. (Gr. ἀνηρ, *a man*.) In Grecian and Roman Architecture, the apartment appropriated to the reception of the male branches of the establishment, and always in the lower part of the house: the gynœcea, or women's apartments, being in the upper part.

ANDROPE'TALOUS. (Gr. *ἀνηρ, a man*, and *πεταλον, a petal.*) Is used in speaking of double flowers which are produced by the conversion of the stamens into petals, as the garden ranunculus. Most double flowers are of this nature.

ANDRO'PHORUM. (Gr. *ἀνηρ, a man*, or, in Botany, *a stamen*, and *φερειν, to bear.*) A columnar expansion of the centre of the flower, on which the stamens seem to grow, as in the passion flower. In reality, it is formed partly of the adhering filaments, and partly of an elevation of the growing point.

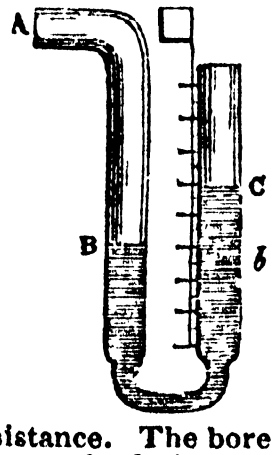
A'NECDOTE. (Gr. *ἀνεκδοτον, something inedited*, or *unpublished.*) In its original sense, some particular relative to a subject to which publicity had not been given in previous works on that subject. In its secondary sense, the narrative of a particular action or saying of an individual.

ANE'LLIDES, ANELLA'TA. (Lat. anellus, *a little ring.*) Generally, but improperly, written Annelidans or Annelides. A class of articulate animals with a long cylindrical body divided into ring-like segments, having red blood, and respiratory organs, but no jointed extremities. The class is divided, according to modifications of the respiratory system, into, Cephalobranchiates. Dorsibranchiates, and Abranchiates, of which the *Serpula*, or tube-worm, the *Aphrodita*, or sea-mouse and the *Lumbricus*, or earth-worm, are respectively examples.

ANELY'TROUS. (Gr. *ἀ*, priv., and *ἐλυτρον, a sheath.*) A name sometimes given to those insects which have two or four membranous wings, either naked or covered only with hairs or scales.

ANEMO'METER. (Gr. *ἀνεμος, the wind*, and *μετρον, measure.*) An instrument for measuring the force or velocity of the wind. An instrument of this sort was first invented by Wolfius, and described by him in his *Elementa Metheseos.* It consists of four sails, like those of a windmill, turning on a horizontal axis. On the axis is a perpetual screw, which turns a cog-wheel, to the axis of which a lever, carrying a weight at its extremity, is attached. When it is calm, the lever and weight assume the vertical position. When the wind acts on the sails, the lever is raised in a vertical circle, to an elevation at which the weight exactly counterbalances the force of the wind. The angle of elevation of the weight is measured on a dial, the index of which turns on the axis of the cog-wheel. Several improvements have been made on this form of the instrument. The sails have sometimes been placed horizontally; and Mr. Benjamin Martin gave the axis the form of the fusee of a watch, having a cord winding upon it with two weights at the ends, which answers the same purpose as the lever and weight.

Dr. Lind's anemometer consists of a glass tube, bent into the form of the letter U, and open at both extremities. One of the extremities, A, is also bent round to the horizontal direction, in order that the wind may blow into it. The tube being partially filled with water and exposed to a current of air, the water in the branch at which the wind enters is depressed, for example, to B, and consequently rises in the other branch to C, and the difference, *b* C, of the levels at which it stands in the two branches, is the height of a column of water, the weight of which forms a counterpoise to the force of the wind. The relative velocities of the wind are thus ascertained, the variation of the velocity being nearly proportional to the square root of the resistance. The bore of the tube is diminished at the bottom to check the undulations of the water caused by a sudden gust of wind. Various other contrivances have been proposed, of which one of the simplest is to expose a flat board of given dimensions to a current of wind, and observe to what extent it will force back a spring attached to it, and resting against an immoveable obstacle.




ANEMO'NIN, or ANEMO'NIA. An acrid crystallisable substance obtained from some species of anemone. It burns like camphor.

A'NEMOSCO'PE. (Gr. *ἀνεμος, wind*, and *σκοπεω, I look.*) An instrument for indicating the direction of the wind. A common vane, or weathercock, is an instrument of this kind. Sometimes the vane turns a spindle which descends through the roof of the building into the chamber where the observation is to be made. An index fixed to the spindle points out the direction of the wind, on a compass card fixed to the ceiling. By means of wheel-work, the direction of the spindle, or the axis of the index, may easily be changed, so that the compass card may be placed on a wall of the chamber, or in any convenient position for observation.

A'NEURISM. (Gr. *ἀνευρυνω, I dilate.*) A tumour formed by the morbid dilatation of an artery, and which is therefore distinguished by its pulsatory motion.

ANFRA'CTUOUS. (Lat. anfractus, *a winding backward and forward.*) When the lobes of an anther, of the margin of any thing, is folded back upon itself, and doubled and bent till all trace of its normal character is lost. The anther of a cucumber is anfractuous.

A'NGEL. A coin of the value of about ten shillings. It was impressed with the figure of an angel, in commemoration of a saying of Pope Gregory, that the pagan Angli or English were so beautiful, that if they were Christians they would be angels.

ANGEL, GOLDEN, or ST. GEORGE, or ST. CONSTANTINE. An ancient order of knighthood, fabulously reported to have been instituted by Constantine, but probably by the imperial house of Comnenus at Constantinople, and revived by the Emperor Charles V. The grand mastership of this order was resigned by the last representation to the house of Comnenus to that of Farnese, dukes of Parma; and now belongs to the crown of Naples.

ANGEL-WATER. A mixture of rose, orange-flower, and myrtle water, perfumed by musk and ambergris. It is made in Portugal.

AN'GELS. Spiritual beings ministering to God. In the Scriptures they appear as messengers, which the word properly denotes (Gr. *ἀγγελος*), by whom God conveys his commands to men. The term seems also to be applied to the highest order of ministers in the Church of Christ, if we may so interpret the "Angel of the Church of Ephesus, of Pergamus," &c., and the passage in the Epistle to the Corinthians, "A woman ought to have power (a veil, as some interpret) on her head, for fear of the angels." We read also of the devil and his angels.

ANGI'NA. (Gr. *ἀγχω, I strangle.*) A disease attended with a sense of anxiety and suffocation: the term is applied to sorethroat, and to certain symptoms arising from organic disease of the heart; the latter gives rise to a distressing difficulty of respiration, and is hence termed Angina Pectoris.

A'NGIOCA'RPOUS. (Gr. *ἀγγειον, a case*, and *καρπος, fruit.*) When seed-vessels are inclosed within a covering that does not form a part of themselves; as the filbert, which is covered by its husk, the acorn seated in its capsule. The word is also applied sometimes to such fungi as have their spores included in a peridium, or hollow-shell, as Lycoperdon.

ANGIO'LOGY. (Gr. *ἀγγειον, a vessel*, and *λογος, a discourse.*) The doctrine of the vessels of the body.

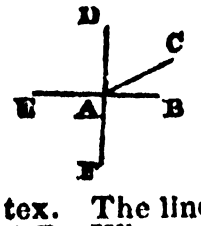
ANGIOSPE'RMOUS. (Gr. *ἀγγειον, a vessel*, and *σπερμα, seed.*) When seeds are inclosed within a pericarp, as in most plants. The word is now chiefly used in opposition to gymnospermous, when seeds are not included in a pericarp, as in fir-trees and others. Linnæus intended to apply it in the same sense; but he contrasted it with small-lobed seed-like fruits, which he mistook for naked seeds.

ANGIO'SPOROUS. (Gr. *ἀγγειον, a vessel*, and *σπορα, a seed.*) A term applied to such fungi as Lycoperdon, which have their spores inclosed in a hollow shell or bag.

ANGIO'TOMY. (Gr. *ἀγγειον, a vessel*, and *τεμνω, I cut.*) The dissection of vessels.

A'NGLE. (Lat. angulus, *corner.*) In Geometry, this term is employed in several senses, and to signify very different things. Euclid defines a plane angle to be "the inclination of two lines to one another, which meet together, but are not in the same direction;" a definition somewhat obscure, and also defective, inasmuch as in strictness it can apply only to acute angles, and gives no idea whatever of angular magnitude. The definition given by Apollonius, namely, "the collection of space about a point," is still more exceptionable. In fact, it is extremely difficult to form a correct idea of its nature from any description that can be given in the terms of a definition.

The simplest way, perhaps, of obtaining a clear conception of angular magnitude is by means of revolving motion. Suppose a straight line A B to revolve about the point A from right to left, and to occupy successively the different positions A B, A C, A D, A E, and A F. At A C it forms angle B A C with its first position A B, of which A B and A C are the sides, and the point A the summit or vertex. The line A C is then inclined to its first direction A B. When at A D, it is perpendicular to its first direction, and the angle formed by A B and A D is called right. At A E the separation is equal to two right angles, and the line lies in the same direction as at first, or A E and A B are in the same straight line. When it arrives at A F, three right angles have been described; and, on returning to A B, a whole circuit or four right angles. The right angle B A D is considered the unit of angular magnitude B A C, which is less than the right angle, is called acute; and E A C, which is greater than the right angle, is called obtuse. The angle D A C, or the defect of B A C from the right angle, is called the complement of B A C; and E A C, or the defect of B A C, from two right angles, is called the supplement of B A C.




When an angle is considered in this manner as result-

ing from revolving motion, it is obvious that two straight lines meeting in a point, form not only one, but an indefinite number of angles. Thus A B may pass into the position A C after describing merely the angle B A C, or after describing that angle together with one, two, three, or any number of revolutions. If we assume A to represent the measure of the angle B A C, and C that of the whole circuit, then the same angle B A C will be represented not only by A, but also by A + C, A + 2 C, A+3 C, and so on. This extension of the signification of an angle is of very great importance in Trigonometry.

A solid angle is defined by Euclid to be "made by the meeting of more than two plane angles not in the same plane in one point." These magnitudes are of a very peculiar kind; and, unlike all other subjects of geometrical investigation, admit of no accurate comparison one with another. No multiple or submultiple of such angles can be taken, and we have no way of expounding, even in the simplest cases, the ratio which one of them bears to another. Hence all our reasoning concerning them must be chiefly confined to the plane angles by which they are contained.

ANGLE, FACIAL. In Zoology, signifies the angle made by the intersection of two lines drawn, the one from the most prominent part of the frontal bone over the anterior margin of the upper jaw, the other from the external orifice of the ear-passage along the floor of the nasal cavity.

ANGLE, FRONTAL. In Ornithology, signifies the angle which the culmen, or upper line of the beak, makes with the forehead.

ANGLE, SPHERICAL. In Trigonometry, signifies the angle made on a sphere by the intersection of two great circles, or the inclination of the planes of these circles to each other. A spherical angle is measured by the arc of a great circle intercepted between those two points of its sides which are at the distance of 90° from the point of intersection, or the vertex of the angle.

ANGLE, VISUAL. (Optics.) The angle formed by two rays of light, or two straight lines drawn from the extreme points of an object to the centre of the eye. The apparent magnitude of objects depends on the magnitude of the angle under which they are seen; nevertheless, in observing distant objects, our ideas of their magnitude are greatly modified by the judgment which we form of their distances. (*See* APPARENT MAGNITUDE.)

A'NGULAR MOTION. The motion of a body moving circularly, or oscillating about a fixed point. The angular motion of a planet is measured by the angle described at the centre of the sun, by a straight line drawn from that point to the planet, called the radius vector; and its amount is reciprocally proportional to the periodic time of the planet.

A'NGULAR SECTION. The division of an angle into any number of equal parts. The bisection of an angle is accomplished by elementary geometry. The trisection requires the aid of the solid geometry, being equivalent to the solution of a cubic equation. The general division of an angle into any proposed number of equal parts, is a problem which Mathematicians have not yet been able to solve. In modern Mathematics, the term Angular Sections is used to denote that branch of analysis which is employed in the investigation of the properties of circular functions.

ANGUI'LLIFORM. (Lat. anguilla, *an eel*, forma, *shape*.) Eel-shaped fishes, or those belonging to the tribe of eels.

A'NGUIS. The name of a Linnæan genus of Amphibia serpentes, characterised by having subcaudal and abdominal imbricated scales; which scales consequently form a uniform covering over the whole body. The genus is now subdivided into the subgenera Pseudopus, Ophisaurus, Acontias, and Anguis, properly so called; the reptiles comprehended under the latter denomination have the tympanum concealed beneath the skin; the maxillary teeth compressed and hooked, and no teeth on the palate. The *Anguis fragilis*, or slow-worm, is a well-known example of this genus.

ANGUSTU'RA BARK. The bark of the Cusparia febrifuga, originally imported from Angustura in South America; it is occasionally used in medicine as a tonic, and in the case of diarrhœa. It was first described by Mr. Brande in the year 1791. A poisonous bark is occasionally found in commerce under the name of spurious Angustura, which appears to be the produce of a species of strychnos.

ANGU'STATE. (Lat. angustus, *narrow*.) When any part sensibly diminishes in breadth. (*See* ATTENUATED.)

ANHELA'TION. (Lat.) Difficulty of breathing.

A'NHYDRITE. An anhydrous sulphate of lime.

A'NHYDROUS. (Gr. ἀ, *without*, and ὕδωρ, *water*.) Without water. A term often applied to salts, and to certain acids when deprived of water.

A'NIL. One of the plants yielding indigo.

ANIL. (Sanscr. nili, *indigo*.) A kind of indigo, said to be a native of America, although now cultivated in the





East Indies. It is very like Indigofera tinctoria, the true indigo, from which it chiefly differs in having compressed legumes which are not torulose.

ANILLE'ROS. In Politics, the name given to the moderate party among the principal actors in the Spanish revolution from 1820 to 1823. They had the greatest influence, and directed the Cortes. Arguelles and Martinez de la Rosa were at their head.

A'NIMAL. (Lat. anima, *soul*, or *life*.) The name of the higher division or kingdom of organised beings, distinguished by endowments of sensation and voluntary motion, superadded to the organic functions which animals possess in common with plants.

It has been objected to this definition, that the so called sensitive plant is susceptible of impressions which cause action and motion of its parts, and that the embryos of Algæ and Confervæ have locomotion, while many of the lower animals are fixed as immoveably to the earth as plants. But these objections have no real value; and could only have arisen from confounding irritability with sensation, which are two very different phenomena. It is the property of all living organised beings, and essential to their existence as such, to be susceptible of the impressions of certain stimuli, which occasion a reaction of the part stimulated; and the main object of physiology is to determine the precise mode in which each organ of a plant or animal reacts when stimulated. But it is here only necessary to state, that the muscular fibre in animals reacts when stimulated by an angular puckering called contraction, and this property is termed irritability. It is independent of the nerves and of sensation, for a portion of muscle removed from an animal body manifests the same contraction when irritated, whether mechanically, galvanically, or chemically. In the living animal the most common stimulus of the muscular contraction is the operation of the nerves, excited by the will, and is commonly the consequence of an act of sensation; but this is by no means the only stimulus by which the irritable property of the muscle is or can be called into play. In plants, universally, there are also irritable parts, or parts which react when stimulated by producing motion of a part or the whole of the body. It is this property which occasions the motion of the cambium or sap; it is by the same endowment that growing plants incline to the light, and extend their roots to the most congenial soil; or entwine their tendrils around the bodies which serve as their support; or move the stamens in regular succession towards the female part or pistil (saxifrage), or incline the pistil successively to each stamen (lily). By a modification of the same irritable property some plants close their leaflets or flowers at sunset, while others, like the nocturnal animals, go to sleep, as it were, at the approach of day. By a higher degree of this irritability the leaflets of the fly-trap (*Dionæa*) approximate each other, and inclose the irritating insect which has alighted upon them; and the Mimosa pudica withdraws its leaves from the offending touch;—while the Desmodium exhibits during the day a constant alternate movement of the lesser folioles, analogous to the quicker vibration of the cilia which beset the respiratory organs of many molluscous animals, and which is equally independent of the nerves and of the will. The conditions of all these vegetable motions, which essentially distinguish them from the voluntary movements of animals, are, that they never proceed from an internal impulse, but are invariably the consequences of external stimulus, and take place, as it were, mechanically, and in the self-same manner; while in animals the motions arise out of an internal determination from parts not moving to the moving powers. There is also an essential difference in the nature of the motion itself, even when we compare the simplest animal with the plant. If we touch the feeler of a polype, it recedes from the irritant by a true contraction of the part within itself; but in the case of the sensitive plant, there is nothing like this contraction of the part touched, but only an articular plication of a contiguous part, without the dimensions of the irritated leaf being altered. Experiment has also shown that the intumescent parts of the mimosa, in which the irritable property is concentrated, move the leaf by an extension of cells, and not a contraction of fibres.

It is true that many of the lower aquatic animals are rooted to the bottom; and these are often aggregated, and grow in a branched or plant-like form, as the serpularia and other corallines; but, although voluntary motion of the whole is impossible, yet it is sufficiently conspicuous in the different parts, and the vital endowments of the individual polypus manifest a multiplied animal enjoyment, not the condition of a vegetable. The simplest monad of infusions exhibits the voluntary characteristics of the animal, by varying its movements to avoid obstacles or seize its food, while the locomotive embryo of the Conferva dilatata proceeds blindly onwards in an unvarying course, till its irritability is exhausted, and excites no idea of animality in the mind of an observer who has had any experience in the observation of animalcules. Ehrenberg has asserted that he can distin-

guish a moving embryo of the Algæ from a polygastric monad as easily as a tree from a bird.

The nerves are the organs on which spontaneous motion and sensation depend, and they chiefly distinguish the animal from the vegetable. Hence the nervous system has been termed the essence of an animal. All the other systems of organs appear in their plan of arrangement to be subject to the modification of the nervous system; and it is upon this system, therefore, that, in the classification of animals, their primary division is founded. Recent and more accurate researches have proved the existence of nerves in many of the lower organised animals, where their presence had been denied; and, as in every species in which the nerves have been detected, sensation has been found to depend exclusively upon them, we are hence led to assume that all animals in which sensation is observable must have it depending on nervous matter present in some condition or other in their tissue; even where, as in the freshwater polype, this is apparently homogeneous, and where, from the extreme divisibility of the individual without loss of vitality in the detached parts, we may reasonably conclude the nervous molecules to be dispersed throughout the corporeal mass.

The attributes of sensation and voluntary motion modify, as might be expected, all the other functions which animals possess in common with plants. For example, as regards nutrition: vegetables which are fixed to the soil absorb immediately by their root the nutritive parts of the surrounding fluid. These roots are indefinitely subdivided; they penetrate the smallest interspaces, and seek, as it were, at a distance, the nourishment of the plant to which they belong. Their action is tranquil, but unintermitting; being only interrupted when dryness has deprived them of the juices which are necessary for them.

Animals, on the contrary, which are rarely stationary, but which have the power of moving, not only parts of the body, but the entire body, from place to place, require the means of transporting the provision necessary for their subsistence; accordingly, they have received an internal cavity, appropriated for the reception of the nutriment, and upon the parietes of which open the pores of the absorbent vessels, which have been justly compared to internal roots.

An internal cavity is requisite for animals on another ground; — their food must first be digested. Plants are supported by water containing carbonic acid, or the already dissolved organised material of the soil. But nutrition in animals does not immediately commence by the absorption of such fluids as the soil or the atmosphere furnishes, but their food consists of substances already in organic combination, which must be prepared and submitted to instruments for dividing and comminuting it, and to the action of solvent fluids. Thus digestion, or the preparatory assimilation of the food, is entirely peculiar to animals. They alone are endowed with organs of sensation, which guide them in the choice of aliment. They alone possess labial and other prehensile organs for seizing the food; teeth and jaws for comminuting and destroying its vitality if living; muscular actions, by which it is swallowed, and a reservoir for its reception endowed with chemical and vital powers for dissolving and assimilating such parts as are proper for nourishment, and which are selected and taken into the system through the purely vital sensibilities of the absorbent internal surface, while such parts as are unfit for nourishment are expelled.

A still more important difference, in connection with the digestive functions, arises out of the limitation of the powers of assimilation in the animal kingdom. Animals can convert into their own substance only matter which has already been organised; while plants have the power of assimilating the inorganic binary compounds, carbonic acid and water. This property of plants is more important than perhaps at first sight might be suspected; for in the vital operations of animals a great quantity of organised matter is constantly decomposed, and is rendered, at all events, useless as nutriment for other animals; while, by means of combustion and other decomposing processes, an incalculable quantity of vegetable matter is continually resolved into binary compounds, or the ultimate elements of matter: hence, if the power of producing new ternary organised compounds out of carbonic acid and water had not been given to plants, both these and animals must, in process of time, inevitably have been annihilated, and successive creations of animals and vegetables would have been indispensable to maintain the present system of things. It is a beautiful instance of the harmony which pervades the relations of nature, that animals contribute as essentially to the support of vegetables, by a process of excretion, as these to the maintenance of animal life, by their powers of assimilation. The product of the respiratory interchange which takes place between the circulating fluids and the atmosphere in animals, is carbonic acid; which is the essential aliment of plants; and which, when in health, and exposed to the influence of the sun's rays, plants absorb from the atmosphere by their respiratory organs, the leaves, and exhale the superfluous oxygen which is extricated in their assimilative processes. Thus the constitution of the atmosphere is maintained by the different products which are evolved in the respiratory processes of plants and animals.

The circulation of the nutrient juices is much more independent of the external influences of light and heat in animals than in plants; and in most classes of the animal kingdom, the motion of the blood is principally determined by the contractions of an express muscular organ called the heart.

From a general review, therefore, of the nature and properties of living animals, their distinguishing characteristics may be summed up as follows: —

Animals are the only beings in nature which manifest sensation and spontaneous movements. They digest organised substances alone, and are always provided with a mouth, and an internal digestive cavity or canal.

Their nutrient fluids are received by an absorbent internal surface; while in plants they are taken up by an absorbent external surface.

Animals at all times, in respiration, exhale carbonic acid and absorb oxygen. See ZOOLOGY.

ANIMAL'CULES. *See* INFUSORES.

ANIMAL SUBSTANCES. The principal products of the animal kingdom are chemically characterised by the presence of nitrogen as one of their ultimate elements, which is generally in combination with carbon, hydrogen, and oxygen. When, therefore, they are subjected to destructive distillation, ammonia is a common product; it is also often evolved when they are triturated with caustic potash, or quicklime.

ANIMA'TION. (Lat. animare, *to enliven.*) In Painting, the expression given to a figure when indicating activity in its members. Thus a figure truly and vigorously executed, is said to be animated.

A'NIME. A resin which exudes from the Hymenæa Courbaril. It is brought from South America. It was formerly used in medicine, but is inert.

A'NIONS. (Gr. ἀνα, *upwards*, and ἰων, *going.*) Substances which in electro-chemical decompositions are evolved from their combinations at the surface by which the electricity enters the electrolyte. (*See* ELECTRODE.)

A'NISE. (Arab. anisun. Gr. ἀνισον.) The aromatic fruit of an eastern annual umbelliferous plant called Pimpinella anisum. It is principally employed in the manufacture of liqueurs, and against flatulence. Star-anise is a very different thing, the produce of Illicium anisatum, a tree belonging to Winteraceæ.

ANISE'TTE. A French liqueur, made by distilling anise, fennel, and coriander seed with brandy, and sweetening the produce.

ANISO'BRYOUS. (Gr ἀνισο-, *unequal*, and βρυω, *I grow.*) A name given by some writers to monocotyledonous plants: having only one colytedon they grow at first with more force on one side of their axis than the other.

ANISODAC'TYLES, ANISODAC'TYLÆ. (Gr. ἀνισος, *unequal*, and δακτυλος, *a digit.*) The name given by Temminck to an order of birds, including those Insessorial species the toes of which are of unequal length, as in the nuthatch.

ANISODY'NAMOUS. (Gr. ἀνισος, *unequal*, and δυναμις, *power.*) A name given to monocotyledonous plants, for the same reason as anisobrious, which see.

ANISOSTE'MONOUS. (Gr. ἀνισος, *unequal*, and στημων, *a stamen.*) When the number of stamens in a flower neither corresponds with the calyx nor corolla in number or power; as, for instance, when a flower having five sepals has three or seven stamens; in such a case the stamens are neither equal to the number of sepals nor any power of their number.

ANISO'STOMOUS. (Gr. ἀνισος, *unequal*, and στομα, *a mouth.*) When the divisions of a calyx or a corolla are unequal. Seldom used; the term unequal or irregular is usually employed instead.

ANISOTO'MIDÆ. (Gr. ἀνισος, *unequal*, and τεμνω, *I cut*) A family of Coleopterous insects, having moniliform, or beaded, antennæ, subelongate, slender at the base, gradually increasing towards the apex, with a terminal club-shaped multiarticulate joint; palpi various, generally filiform; head small and ovate; body convex, never linear. This family includes eight genera: *Tritoma*, of which we have one indigenous species, *Tr. bipustulatum*; *Phalacrus*, of which Stephens describes twenty-eight British species, remarkable for their brilliant colours, and faculty of rolling up the body into a ball; *Ephistemus*, of which only three species are known, which have been detected in the neighbourhood of London; *Leiodes*, abundant in species, of which twenty-six are British; *Agathidium*, of which we have twelve species, inhabiting putrid wood and fungi, also found near London, *Clambus*, of which various species, all extremely minute are known; *Clypeaster*, a term already appropriated to a genus of *Echinidæ*; lastly, *Sericoderus*; distinguishable from the rest of the family by its truncate elytra.

**A'NKER.** A measure of wine or spirits equal to 10 of the old gallons, or 8¾ imperial gallons, = 2310·6 cubic inches.

**A'NNALS.** A chronological history: derived from the Roman "Annales Pontificum," or "Annales Maximi," which were annual records of passing events connected with religious observances, kept by the Pontifex Maximus.

Annals are a species of historical writing; but they seem, notwithstanding, to differ materially from history, as the latter is now understood. Annals should comprise a succinct account of the events having reference to some peculiar subject, as they occur in successive years. Inquiries as to the remote causes and consequences of events seem to be misplaced in them; though they are the essence of history. Cicero, when speaking of annalists, says, "*Unam dicendi laudem putant esse brevitatem, non exornatores rerum, sed tantum narratores.*" Annals are, in fact, rather materials for history, than history. In the one, events only are narrated, in the other they are narrated and reasoned upon. The annalist may, no doubt, reason upon facts as well as the historian; but such reasonings are not so well or happily placed in a book divided into years, as in one that depicts the continuous stream of events, without breaking it into limited compartments. Hailes's "Annals of Scotland" is, perhaps, the best work of its class in English literature.

**ANNA'TES, or FIRST FRUITS.** A fine paid to the king, as head of the church, by one promoted to an ecclesiastical benefice, and supposed to amount to one year's value of that benefice. This, however, is evaded by assuming as the basis of the valuation that made in 1535, and contained in what is termed the "Liber Regis." In England, first fruits go to the augmentation of Queen Anne's bounty.

**ANNEA'LING.** (Anhelan, Sax.) There are many substances which, when rapidly cooled, after having been heated, become exeeedingly brittle; an inconvenience often prevented by very slow cooling: this is especially the case with glass, which is therefore suffered to cool very gradually in an oven constructed for the purpose, and the process is called annealing. Many of the metals which have become harsh and hard in the process of manufacture, are softened in the same way; thus the blank pieces for coinage, several metallic wires, &c. are annealed.

**ANNE (ST.), ORDER OF.** An order of knighthood, originally established in Holstein, and carried with the princes of that country into Russia. It was made a Russian order in 1796; and is now widely diffused.

**ANNO'TTA.** Is the pulp of the seeds of the Bixa Orellana, an exogenous tree common in Cayenne and other parts of America: it is made into a pulp, which, after having fermented, is rolled into pieces of two or three pounds' weight: it is imported under the names annotto, Roucou, or Orleans, and is used occasionally as an orange dye and for colouring cheese. It imparts little colour to water, but dissolves in alcohol and in alkaline solutions; its colour is not materially altered by acids or alkalis.

**ANNO'NA.** In Roman writers, means, in a general sense, the year's increase, or the fruits of the year; and it also means the contribution or tax payable in corn, imposed on some of the more fertile provinces of the empire, as Sicily, Egypt, &c., for the use of the army and of the capital. The poorer class of citizens were entitled to a share of this tribute; and their habitual dependence on it was not only a fruitful source of idleness, but of all sorts of disorder. To grant an increased allowance of corn was one of the surest methods by which to attain popular favour.

> ——— *Summa favoris*
> *Annona momenta trahit.* Namque asserit urbes
> Sola fames, emiturque metus, cum segne potentes
> Vulgus alunt. Nescit plebes jejuna timere.

The office of Præfectus Annonæ was of great importance at Rome, and was generally, indeed, exercised by the emperors. (See, for further particulars, Contarenus, *De Re Frumentaria*, passim.)

**A'NNUAL.** (Lat. annus, *a year.*) A plant which arrives at perfection, passing from a seed into a perfect plant, yielding its fruit, and perishing, within the space of a year. The term also applies to all cases where duration is for one growing season only. Many plants have perennial roots and annual stems; that is, stems perishing and being renewed annually: such plants are usually denominated Herbaceous.

**ANNUAI'RE.** A name given by the French to publications on continuous or similar subjects, which appear in yearly parts or numbers. Of the existing *Annuaires*, that published by the *Bureau des Longitudes* is the most celebrated. There are also an *Annuaire Historique*, corresponding to our *Annual Register*, an *Annuaire de l'Etat Militaire*, an *Annuaire du Clergé de France*, &c.

**ANNU'ITY.** A rent or sum receivable yearly for a term of years.

An annuity may be receivable during a definite number of years, or during a period of uncertain length; for example, during the life of one or more individuals. In the former case it is called an *Annuity Certain*; in the latter, a *Contingent Annuity*.

An annuity which is not to be entered upon immediately, but after a certain number of years, is called a *Deferred Annuity*; if it is not to be entered upon till after the death of some person or persons now living, it is called a *Reversionary Annuity*. When limited by the duration of a given life or lives, it is called a *Life Annuity*; and when it is to continue only for a term of years, provided an individual or individuals now living shall survive that term, it is called a *Temporary Life Annuity*.

The practice of raising or investing money on annuities is attended with many advantages in the ordinary affairs of the world. A merchant or trader thus finds the means of clearing off his engagements gradually by the profits of his trade, and without losing possession of the capital necessary for carrying on his speculations; and one who possesses unemployed capital is thus enabled to convert it into an equivalent annual income for life, and thereby derive the utmost benefit from it while he lives, without risk of destitution from its failure. The accurate determination of the value of annuities in present money, is therefore a subject of very considerable importance. We propose to explain the principles on which the calculation is made, and to apply them to a few of the cases of most frequent occurrence.

*Annuities Certain.*—The values of annuities of this kind depend only on the rate of interest of money, and the number of years during which they are payable; and are easily calculated. Suppose it were required to determine the value, in present money, of an annuity of £100 per annum, to continue five years, or till five payments have been made, the interest of money being 5 per cent., we should reason as follows.—The first payment of £100 becomes due at the end of a year from the present time; but since £100 in hand is equal to £105 receivable at the end of a year, the present value of the first annual payment is £100 reduced in the proportion of 100 : 105, or of 1 to 1·05; that is, it is equal to $£\frac{100}{1\cdot05}$. In like manner, the present value of £100, to be received at the end of two years, is less than if it were receivable at the end of one year, in the proportion of $\frac{1}{1\cdot05}$; consequently, the present value of £100, to be received at the end of two years, is $£\frac{100}{(1\cdot05)^2}$. Pursuing the same reasoning, the present value of £100, to be received at the end of three years, is $£\frac{100}{(1\cdot05)^3}$; at the end of four years, it is $£\frac{100}{(1\cdot05)^4}$; and so on till the end of the term. But it is evident that the present value of the whole annuity is the sum of the values of all the annual payments; hence the required value of the proposed annuity is—

$$\frac{100}{1\cdot05} + \frac{100}{(1\cdot05)^2} + \frac{100}{(1\cdot05)^3} + \frac{100}{(1\cdot05)^4} + \frac{100}{(1\cdot05)^5}$$

This reasoning may be easily generalised. Let $a$ denote the annual payment, $r$ the rate of interest, $n$ the number of years during which it continues, and S the present value of all the payments, we shall then have—

$$S = \frac{a}{1+r} + \frac{a}{(1+r)^2} + \frac{a}{(1+r)^3} + \cdots \frac{a}{(1+r)^n}$$

For the sake of abridging, put $v = \frac{1}{1+r}$, and the formula will become—

$$S = a\,(v + v^2 + v^3 \ldots\ldots + v^n)$$

$$\text{or } S = a\,v\,(1 + v + v^2 + v^3 \ldots + v^{n-1})$$

The sum of the series within the parenthesis is $\frac{1}{1-v}(1-v^n)$; therefore, $S = \frac{a\,v}{1-v}(1-v^n)$; or, writing $\frac{1}{r}$ for $\frac{v}{1-v}$, $S = \frac{a}{r}(1-v^n)$.

From this it is easy to see the method of proceeding in all other cases of annuities certain. For instance, let it be required to find the present value of an annuity deferred for three years, that is, not to be entered upon till after the end of three years; and to continue ten years from that time. It is evident that we have only to find the value of an annuity of the same amount for thirteen years, and also for three years, and to subtract the latter value from the former. The difference is the value of the deferred annuity. Again, suppose that the annuity, instead of being payable yearly, is to be paid half yearly, or quarterly. It is obvious that an annuity of £100 per annum for ten years, to be paid in half yearly payments, the interest of money being 5 per cent., is the same thing as an annuity of £50 per annum for twenty years, payable yearly, interest being 2½ per cent.; or an annuity of £25 per annum, payable yearly for forty years, interest being 1¼ per cent. The principle of the calculation is the same in all the cases.

*Life Annuities.* — When the annuity is to cease with the life of an individual, or any number of individuals, the calculation of its value is a little more complicated, as it becomes necessary not only to find the present value of the payment to be made at the end of any given year, but also to take into account the probability of its being received, that is to say, the probability that the individual or individuals, on the duration of whose lives it depends, will be alive at that period. Let the annuity depend on the continuance of a single life, and let us denote the probability that the life will be in existence at the end of

1, 2, 3, 4, 5, &c. years,

by $p_1$, $p_2$, $p_3$, $p_4$, $p_5$, &c.;

and, as before, let $v = \frac{1}{1+r}$. The present value of £1, to be received certainly at the end of a year, is $v$; but the probability of receiving it is $p_1$; therefore, the value of £1 at the end of the year, subject to the chance of the given life being then in existence, is $p_1 v$. In like manner, the value of £1, to be received certainly at the end of two years, is $v^2$; and the chance of its being received is $p_2$; therefore, the value subject to the contingency is $p_2 v^2$, and so on. Let A denote the value of £1 to be received yearly during the whole continuance of the given life, and we have evidently

$$A = p_1 v + p_2 v^2 + p_3 v^3 + p_4 v^4 + \&c.$$

continued till $p$ becomes nothing, or till the extremity of human life.

It is now necessary to consider the nature of the quantities represented by $p_1$, $p_2$, $p_3$, &c., and to show in what manner they are to be computed. By the doctrine of chances, the probability of the occurrence of any event is measured by the quotient that arises from dividing the number of chances favourable to its occurrence by the whole number of ways in which it can happen. Consequently, if $n$ denote the number of individuals living at a given age, $n_1$, the number of the same individuals alive at the end of one year, $n_2$ the number living at the end of two years, $n_3$ the number living at the end of three years, and so on, we shall have $p_1 = \frac{n1}{n}$, $p_2 = \frac{n2}{n}$, $p_3 = \frac{n_3}{n}$, $p_4 = \frac{n4}{n}$, and so on. The numbers $n$, $n_1$, $n_2$, &c., are taken from a table of mortality, or a table constructed to show the ratio of the number of individuals who enter upon every given year of life to the number who survive that year, or who die in the course of it.

There is no other method of finding the value of the series represented by A than that of calculating the value of its different terms separately, and adding the whole into one sum. Nevertheless, as the object in general is not to determine merely the value of an annuity on a life at a particular age, but to construct a table showing its value for all the different ages of life, there is a method of deducing the value at one age from the value at another age, which greatly abridges the labour of calculation. Thus, suppose the age of the individual on whose life the annuity depends to be 40, and the probabilities of a life of 40 continuing 1, 2, 3, &c. years to be $p_1$, $p_2$, $p_3$, &c., we have, by what is already shown,

$$A = p_1 v + p_2 v^2 + p_3 v^3 + \ldots + p_x v^x.$$

Now, let $A_1$ be the annuity on a life of 41, that is, one year older than the former; and let the probabilities of a life of 41 living over 1, 2, 3, &c. years, be $q_1$, $q_2$, $q_3$, $q_4$, &c., we shall have

$$A1 = q_1 v + q_2 v^2 + q_3 v^4 \ldots + q_4 v^{x-1}.$$

But the quantities $q_1$, $q_2$, $q_3$, &c. are not independent of $p_1$, $p_2$, $p_3$, &c.; the one set are evidently functions of the other. In fact, the probability that a life of 40 will live over 2 years, is equal to the probability that a life of 40 will live over 1 year, multiplied into the probability that a life of 41 will live over 1 year. This is evident from the manner in which the probabilities are obtained; for, $n$, $n_1$, $n_2$, being the numbers respectively alive at the ages of 40, 41, and 42, the probability that a life of 40 will live over 1 year, is $\frac{n_1}{n}$, and that it will continue 2 years, $\frac{n_2}{n}$ or $\frac{n_2}{n_1} \times \frac{n_1}{n}$. In like manner, the probability of a life of 40 living over 3 years, is equal to the probability of a life of 40 living over 1 year multiplied into the probability that a life of 41 will live over 2 years; and so on. Hence, $p_2 = p_1 q_1$, or $q_1 = \frac{p^2}{p_1}$, $q_2 = \frac{p_3}{p_1}$, $q^3 = \frac{p_4}{p_1}$, and so on. We have, therefore,

$$A_1 = \frac{p_1}{1}(p_2 v + p_3 v^2 + p_4 v^3 \ldots + p_x v^{x-1});$$

and, multiplying both sides by $p_1 v$,

$$p_1 v A_1 = p_2 v^2 + p_3 v^3 + p_4 v^4 \ldots + p_x v^x.$$

On subtracting this equation from

$$A = p_1 v + p_2 v^2 + p_3 v^3 + p_4 v^4 \ldots + p_x v^x$$

we get $A - p_1 v A_1 = p_1 v$, whence $A = p_1 v (1 + A_1)$. This formula, which was found by the celebrated Euler, gives the following rule for determining the value of an annuity on a life at any age from the value of the same annuity on a life one year older, and renders the computation of the whole table not much more laborious than the direct calculation of the annuity on the youngest life. "To the value of an annuity on a life one year older, add unit; multiply the sum by the probability that the given life will live over one year, and also by the present value of £1 to be received at the end of a year. The product is the value of the annuity on the given life."

The values of deferred and temporary annuities on single lives, are easily found from the table of the values for the whole of life. For example, let it be required to determine the present value of an annuity on the life of an individual now aged 40, but deferred 10 years, that is to say, not to commence till the expiration of 10 years. After the 10 years, if the individual be then alive, the value of the annuity on the remainder of his life is the annuity on a life of 50: let this be called B. The present value of £1 payable at the end of 10 years is $v^{10}$; and the probability of receiving it in the event of an individual now aged 40 being then alive, is $p_{10}$; therefore, the present value of B subject to the contingency, is $p_{10} v^{10}$ B. In general, the value of an annuity deferred $n$ years, is $p_n v^n A_n$, where $A_n$ represents the annuity on a life $n$ years older than that corresponding to A.

A temporary annuity on a single life for $n$ years, is found by adding together the first $n$ terms of the series

$$p_1 v + p_2 v^2 + p_3 v^3, \&c.$$

But it is frequently more easy to find it by means of the deferred annuity on the same life for the same term of years; for it is obvious that the temporary annuity and deferred annuity are, together, equal to the whole annuity. Thus, let A be an annuity for the whole of life, $A_{1n}$ a temporary annuity of the same amount for $n$ years on the same life, and $A_{dn}$ the same annuity deferred $n$ years, we shall have $A_{1n} = A - A_{dn}$.

*Annuities on Joint Lives.* — The method of calculating annuities to be paid so long as two or more individuals shall continue to live together, is equally simple. Let the probabilities that A and B will live over

1, 2, 3, 4, &c. years

be $p_1$, $p_2$, $p_3$, $p_4$, &c.

$q_1$, $q_2$, $q_3$, $q_4$, &c.

respectively, then the probability that both will live over

1, 2, 3, 4, &c. years

will be $p_1 q_1$, $p_2 q_2$, $p_3 q_3$, $p_4 q_4$, &c.,

and the value of an annuity on their joint lives, which we may denote by Æ, becomes

$$Æ = p_1 q_1 v + p_2 q_2 v^2 + p_3 q_3 v^4 + p_4 q_4 v^4 + \&c.,$$

continued till $p$ or $q$ becomes nothing, or to the last age in the table. When more lives than two are involved, the method of proceeding is obvious.

Another question of this kind frequently occurs, namely, to determine the value of an annuity on the survivor of two or more lives. Let us suppose two lives only are concerned; and let A be the value of the annuity on the first life, B that on the second, and Æ that on the joint lives (*i. e.* to be paid till one of the lives shall drop). Let $p_x$ = the probability the first will live over $x$ years, and $q_x$ = the probability the second will live over $x$ years. We shall then have

$1 - p_x$ = probability 1st will die before the end of $x$ years,

$1 - q_x$ = prob. 2d will die before the end of $x$ years,

$(1 - p_x)(1 - q_x)$ = prob. both will die before end of $x$ years;

and hence the probability that both will not die before the end of $x$ years, is $1 - (1 - p^x)(1 - q_x)$, which is equal to $p_x + q_x - p_x q_x$. This expression, therefore, is the measure of the probability that a payment will be received at the end of the $x$th year; and supposing the annuity to be £1, the present value of that payment certain is $v_x$. Multiplying this into the above probability, we get the value in present money of the payment to be made at the $x$th year, if one or both of the lives survive, viz.

$$p_x v^x + q_x v^x - p_x q_x v^x.$$

Now, if we substitute successively the numbers 1, 2, 3, 4, &c. for $x$ in this expression, we shall have the value of the 1st, 2d, 3d, 4th, &c. payment, and the sum will be the value of the annuity to continue during the life of the survivor. But it has been shown that

$$p_1 v^1 + p_2 v^2 + p_3 v^3 + p_4 v^4 + \&c. = A,$$

$$q_1 v^1 + q_2 v^2 + q_3 v^3 + q_4 v^4 + \&c. = B,$$

$$p_1 q_1 v^1 + p_2 q_2 v^2 + p_3 q_3 v^3 + p_4 q_4 v^4 + \&c. = Æ;$$

therefore, the value of the annuity is $A + B - Æ$; that is to say, *the value of an annuity on the survivor of two lives is equal to the sum of the annuities on each of the single lives diminished by the annuity on the joint lives.* (For applications of the doctrine of annuities, see the terms ASSURANCE, SURVIVORSHIP.)

*Annuity Tables.* — In consequence of the numerous and important application of the doctrine of life annuities to commercial purposes, great pains and labour have been bestowed in the formation of tables of their values at all

the different ages of human life. These tables differ very considerably, not from any difference in the methods of constructing them, but from the difficulty of estimating with numerical precision the probable duration of human life. The first table of the kind which we possess was given by Dr. Halley, in a paper inserted in the "Philosophical Transactions" for 1693, and founded on observations of mortality made at Breslaw. De Moivre, in a tract entitled "Annuities on Lives," published in 1724, gave a very elegant formula for determining the value of a life annuity at any age, founded on the hypothesis that the annual decrements of life are equal; or that out of a given number of individuals, equal numbers die every year, till the whole become extinct. In 1742, Thomas Simpson published tables of annuities on single and joint lives, calculated from observations of mortality made in London. These were extended in a supplementary work published in 1752. Deparcieux, in 1746, published his excellent "Essai sur les Probabilités de la Durée de la Vie Humaine," with tables of annuities on single lives, calculated from the probabilities deduced from the registers kept in different religious houses, and the lists of the nominees in the French Tontines. These tables were decidedly the best that had then appeared, and even now, when much more extensive observations have been obtained, are of great value. But the tables which acquired the most extensive reputation were the celebrated Northampton Tables, calculated by Dr. Price from registers kept in the city of Northampton. These, till a late period at least, have formed the guide of the transactions of all the assurance offices. They give the probabilities of life, and consequently the value of the annuities, considerably lower than all other good observations have subsequently proved them to be; but, in proportion as the annuities are too low, the premiums for assurance deduced from them are too high; and hence they were extremely safe for the offices, though proportionally unjust for the assured. In consequence of the competition resulting from the recent great increase in the number of assurance offices, they now transact their business on more equitable terms. An extensive set of annuity tables was given by Mr. Milne in his "Treatise on the Valuation of Annuities and Assurances on Lives and Survivorships," published in 1815. One of these tables, founded on observations made at Carlisle, has acquired considerable reputation, and perhaps gives a nearer representation of the value of life at present in England generally than any other which has yet been published. The annuities granted by government are now valued according to a table calculated by Mr. Finlaison from the mortality experienced among the different classes of annuitants. This table possesses a great advantage over most others, inasmuch as it is founded on observations of the actual numbers who entered upon and passed through the several years of age among a class of individuals none of which could be lost sight of, so that no uncertainty remains about the accuracy of the data. The values of the annuities are in general considerably higher than those given by the Northampton Table, at the same rate per cent., and approach to those of the Carlisle Table. The observations also indicate a considerable difference between the values of male and female life at the same ages; a fact which appears to be borne out by all the accurate registers of mortality which have been kept in this and other European countries. (*See* MORTALITY.)

The following table, extracted from Mr. Finlaison's Report to the Lords Commissioners of the Treasury (March, 1829), shows the value of a life annuity of £1 at all the different ages of male and female life to 90, according to the mortality among the government annuitants, the rate of interest being 4 per cent.

VALUE of a LIFE ANNUITY of £1, Interest being 4 per Cent.

| Age. | Male. | Female. | Age. | Male. | Female. |
|---|---|---|---|---|---|
| 1 | 19·0666 | 19·8135 | 26 | 16·8675 | 18·0175 |
| 2 | 19·1912 | 19·8981 | 27 | 16·7730 | 17·9043 |
| 3 | 19·2642 | 19·9512 | 28 | 16·6705 | 17·7878 |
| 4 | 19·2880 | 19·9795 | 29 | 16·5606 | 17·6683 |
| 5 | 19·2699 | 20·0008 | 30 | 16·4438 | 17·5456 |
| 6 | 19·2162 | 19·9902 | 31 | 16·3202 | 17·4172 |
| 7 | 19·1324 | 19·9549 | 32 | 16·1904 | 17·2861 |
| 8 | 19·0284 | 19·8923 | 33 | 16·0522 | 17·1526 |
| 9 | 18·9098 | 19·8070 | 34 | 15·9049 | 17·0171 |
| 10 | 18·7817 | 19·7014 | 35 | 15·7488 | 16·8795 |
| 11 | 18·6435 | 19·5794 | 36 | 15·5819 | 16·7439 |
| 12 | 18·4962 | 19·4485 | 37 | 15·4153 | 16·6047 |
| 13 | 18·3394 | 19·3159 | 38 | 15·2101 | 16·4607 |
| 14 | 18·1738 | 19·1848 | 39 | 15·0608 | 16·3113 |
| 15 | 18·0044 | 19·0594 | 40 | 14.8752 | 16·1560 |
| 16 | 17·8366 | 18·9587 | 41 | 14·6822 | 15·9927 |
| 17 | 17·6782 | 18·8663 | 42 | 14·4759 | 15·8229 |
| 18 | 17·5330 | 18·7797 | 43 | 14·2612 | 15·6461 |
| 19 | 17·4057 | 18·6962 | 44 | 14·0352 | 15·4615 |
| 20 | 17·2948 | 18·6130 | 45 | 13.7975 | 15·2686 |
| 21 | 17·1986 | 18·5230 | 46 | 13·5483 | 15·0661 |
| 22 | 17·1306 | 18·4298 | 47 | 13·2814 | 14·8543 |
| 23 | 17·0683 | 18·3329 | 48 | 13·0048 | 14·6331 |
| 24 | 17·0059 | 18·2320 | 49 | 12·7199 | 14·4022 |
| 25 | 16·9400 | 18·1273 | 50 | 12·4299 | 14·1610 |





| Age. | Male. | Female. | Age. | Male. | Female. |
|---|---|---|---|---|---|
| 51 | 12·1385 | 13·9061 | 71 | 6·5042 | 7·5256 |
| 52 | 11·8571 | 13·6409 | 72 | 6·2400 | 7·1980 |
| 53 | 11·5789 | 13·3656 | 73 | 5·9738 | 6·8762 |
| 54 | 11·3065 | 13·0816 | 74 | 5·6967 | 6·5655 |
| 55 | 11·0392 | 12·7904 | 75 | 5·4103 | 6·2640 |
| 56 | 10·7751 | 12·4952 | 76 | 5·1149 | 5·9590 |
| 57 | 10·5151 | 12·1916 | 77 | 4·7787 | 5·6707 |
| 58 | 10·2551 | 11·8888 | 78 | 4·4448 | 5·4058 |
| 59 | 9·9907 | 11·5778 | 79 | 4·1218 | 5·1617 |
| 60 | 9·7207 | 11·2609 | 80 | 3·8117 | 4·9358 |
| 61 | 9·4379 | 10·9328 | 81 | 3·5074 | 4·7307 |
| 62 | 9·1411 | 10·5983 | 82 | 3·2174 | 4·5213 |
| 63 | 8·8330 | 10·2597 | 83 | 2·9251 | 4·2922 |
| 64 | 8·5246 | 9·9186 | 84 | 2·6312 | 4·0372 |
| 65 | 8·2163 | 9·5765 | 85 | 2.3495 | 3·7511 |
| 66 | 7·9077 | 9·2328 | 86 | 2·0782 | 3·4410 |
| 67 | 7·6196 | 8·8903 | 87 | 1·8458 | 3·1139 |
| 68 | 7·3343 | 8·5476 | 88 | 1·6489 | 2·7743 |
| 69 | 7·0520 | 8·2022 | 89 | 1·4837 | 2·4371 |
| 70 | 6·7745 | 7·8580 | 90 | 1·3346 | 2·1133 |

ANNUITY. In Law. A sum of money paid yearly, and charged on the personal estate, or on the person, of the individual from whom it is due: thus differing from a rent-charge, which is charged on real estate. Annuities are commonly employed as a system of borrowing and lending; the borrower of the money being the grantor of the annuity, and the lender the grantee. An annuity is either for a term of years, for a life or lives, or in perpetuity; and the latter, although charged on personal property, may by the terms of the grant descend as real estate. A perpetual annuity is redeemable by the grantor, subject, however, to conditions in the grant, by which he may preclude himself from redeeming for a certain period of years. An annuity for life or years is only redeemable by consent of the parties, unless it has been rendered redeemable on specific conditions in the original grant. Annuities for life, on account of the risk to which the grantee is exposed, are not within the usury laws: they are, therefore, commonly resorted to as a mode of raising money by loan at high interest. By the stat. 53 G 3. c. 141., a memorial of every instrument by which annuities for life are granted, must be enrolled in the Court of Chancery, containing the date, names of parties and witnesses, and conditions of contract, and the grantor may have the instrument cancelled, if the consideration money is not *bonâ fide* paid him. This act is intended to relate only to annuities, granted in return for loans. Annuities created by will are general legacies, and subject to abatement, in proportion with other legacies, on a deficiency of the funds of the testator. If a person on whose life an annuity is charged dies between two days of payment, the grantee has no claim pro rata, for the proportionate amount of the yearly or quarterly sum incurred since his death. This act is further explained by 3 G. 4. c. 92., 7 G. 4 c. 75.

AN'NULAR ECLIPSE. An eclipse of the sun, in which the moon conceals the whole of the sun's disk, excepting a bright ring all round the border. (*See* ECLIPSE.)

AN'NULATE. Formed or divided into distinct rings, or marked with differently coloured annulations.

AN'NULET, (Lat. annulus, *a little ring*) In Architecture. A small square moulding which crowns or accompanies a larger. Also that fillet which separates the flutings of a column, though improperly used in that sense. It is sometimes called a list or listella; which see.

ANNULO'SA. (Lat. annulus, *a ring*.) A term used to designate, sometimes a part, sometimes the whole, of the Articulate division of Invertebrate animals.

A'NNULUS. (Lat. annulus, *a ring*.) This word is used in Botany in several different senses. In the mushroom and some other fungi it is applied to a collar which surrounds the stipes just below the hymenium; in mosses it signifies a rim external with respect to the peristome; in ferns it is an elastic rib which girds the theca nearly all round, and which by its contraction tears the theca open and disperses the spores.

ANNU'NCIA'TION, ORDER OF THE. Founded in Savoy by Amadeus VI., in 1335, as the order of the Collar: received its present name from Charles III. The reigning king of Sardinia is grand master of the order.

ANNUNCIATION, *Feast of the*. A festival of the Christian church, in commemoration of the announcement of the conception of our Saviour to the Blessed Virgin, by the angel Gabriel. (St. Luke i. 26. 38.) It is celebrated on the 25th of March, commonly called Lady-day.

ANO'BIUM. The name of a Fabrician genus of Coleopterous insects, characterised by antennæ filiform, the last joints larger; thorax nearly round, not margined, receiving the head; palpi clavate; labium entire.

A'NODE. (Gr. ἀνα, *upwards*, and ὁδος, *a way*.) The way by which electricity enters substances through which it passes: opposed to cathode, the road or way by which it goes out.

A'NODON. (Gr. ἀ, priv., ὀδους, *a tooth*.) The name of a genus of Lamellibranchiate Bivalves, including the common freshwater muscle, the shell of which has no

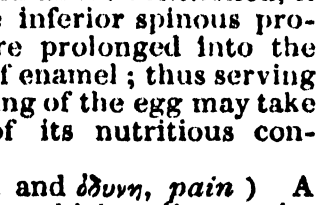
articular processes, or *teeth*, at the hinge. The name has also been applied to a genus of serpents, which have the teeth in the mouth very minute, or rudimental: the *Anodon*, *Typus* (*Coluber scaber* of Linnæus), a South African species of this genus, lives upon the eggs of birds, which, by the structure of the mouth above mentioned, it is enabled to swallow entire. The inferior spinous processes of the cervical vertebræ are prolonged into the gullet, and there receive a coating of enamel; thus serving the office of teeth where the breaking of the egg may take place without the loss of any of its nutritious contents.

A'NODYNE. (Gr. ἀ, *without*, and ὀδυνη, *pain*) A term applied in Physic to medicines which relieve pain. Anodynes are chiefly of vegetable origin, and generally come under the head of sedatives or narcotics.

ANO'LIS. *Anoli*, *anoalli*, is the vernacular name, in the Antilles, of the lizard to which the generic term *Anolis* is applied. This term is restricted in Zoology to those Iguanoid species of lizard which have minute scales on the under part of the last joints of the toes, while the next joints are extended into soft pads transversely striated, but not organised to act as a sucker, as in the Geckos. All the species of Anolis are natives of the warmer parts of the American continent; all are remarkable for their power of inflating the skin of the throat; they are light and agile in their movements; and in the beauty and brilliancy of their colour exceed all others of the Saurian order.

ANO'MALI'STIC YEAR. The interval of time in which the earth completes a revolution with respect to any point in its elliptic orbit. The tropical year is measured by the return of the earth to the same equinox; the sidereal year by its return to the same fixed star; the anomalistic year by its return to the same apsis or extremity of the greater axis of its orbit. The major axis of the diameter of the earth's orbit is not fixed, but has a progressive motion eastward among the stars. Suppose that when the earth is at its perihelion, or point nearest the sun, the other extremity of the major axis points to a given star; when the earth, after having completed a revolution, returns to its perihelion, the diameter will point 11″·8 eastward of the same star; consequently the anomalistic year is longer than the sidereal year by the time which the earth takes to describe 11″·8 of space. It is still longer than the tropical year, for the line of the equinoxes goes backwards at the rate of 50″·1 in a year; therefore, after the earth has completed a revolution with respect to the line of the equinoxes, it has still to describe 50″·1 + 11″·8 = 61″·9, before it overtakes the same point of its ellipse. The time occupied in describing this arc is 25 minutes, and the length of the tropical year is 365 d. 5 h. 48 m. 45 s.; therefore the anomalistic year is 365 d. 6 h. 13 m. 45 sec.

ANO'MALY. (Gr. ἀνώμαλος, *unequal*, or *irregular*.) A term used in Astronomy to denote the angular distance of a planet from its perihelion, as seen from the sun. There are three different anomalies; the true, the mean, and the eccentric. Let A *p* B be the orbit of a planet, S the sun, A B the transverse diameter, and C the centre. Through *p* draw *p* Q perpendicular to A B, meeting the circle circumscribed about the orbit in *x*. On account of its unequal distances from the sun, the angular motion of a planet in its orbit is irregular: conceive, therefore, that while the real planet moves from A to *p*, another planet moving in the same orbit, with an equable motion, and performing a revolution in the same time, has moved from A to P. This being supposed, the angle A S *p* is the true anomaly; A S P is the mean anomaly; and A C *x* the eccentric anomaly. The mean anomaly is proportioned to the time of description; to find the true anomaly, is a problem of considerable difficulty, requiring the aid of the higher mathematics. From the circumstance of its having been first proposed by Kepler, it is usually called Kepler's problem.




ANOMALY. In Grammar, an exception from a general rule

ANO'MIA. (Gr. ἀ, *without*, νόμος, *a law*; because not easily reduced to the ordinary laws of classification.) The name of a Linnæan genus of the Vermes Testacea, the characters of which, as given in the *Systema Naturæ*, apply to the organisation of the soft parts and shell of the modern Terebratulæ. In the system of Cuvier the term *Anomia* is limited to a genus of Acephalous Mollusca, having two unequal irregular thin valves, of which the flatter one is deeply notched at the cardinal margin. The greatest part of the central muscle traverses this opening to be inserted into a third piece, which is sometimes calcareous, and sometimes simply horny, but which is always attached to foreign bodies. The rest of the muscle serves to join one valve to the other. The animal has a small vestige of a foot, and is remarkable for the length of its labial tentacles.

AN'ONA. (Menona, the Malayan name of *the custard apple*.) A genus of trees found in hot latitudes, with large roundish pulpy fruit, which in some species is used as food. The custard apple, so named from its seeds lying in a whitish sweet cream like pulp, is produced by A. squamosa; the cherimoyer, the most esteemed of all the fruits in Peru, is yielded by another; and other kinds are known.

ANONA'CEÆ. (See ANONA.) An extensive natural order of Exogenous plants, comprehending evergreen trees or shrubs, whose fruit is sometimes eatable, as in Anona, more generally dry and aromatic, as in the genera Unona, Habzelia, &c., whose ripe carpels furnished the Piper æthiopicum of the old drug shops. The great mark of Anonaceæ is their having ternary (trimerous) flowers, and a ruminated albumen.

ANO'NYMOUS. (Gr. ἀνώνυμος, *nameless*, from ὄνομα, *a name*.) In Literature, works published without the name of the author. Those published under a false name are termed *Pseudonymous* (ψεῦδος, *falsehood*). The best catalogue of anonymous works is that of Barbier (*Dictionnaire des Œuvrages Anonymes et Pseudonymes*, 3 vols. Paris, 1822-1824). There is also the great work of Placcius, *Theatrum Anonymorum et Pseudonymorum*, t. fol. Hamburg, 1708.

ANOPLOTHE'RIUM. (Gr. ἄνοπλος, *unarmed*, and θηρίον, *beast*.) The name of a genus of extinct animals of the order Pachydermata, characterised by the shortness and feeble size of the canine teeth, which resemble the incisors, and are consequently unfitted for being used as weapons of offence. As the canines in this genus do not project beyond the level of the incisors and molar teeth, no vacant interspace is required in the dental series of the opposite jaw for the reception of their pointed extremities, and consequently the series of teeth is uninterrupted in both jaws, — a structure observable in no existing animal save man. The Anoplotherium has 6 incisors, 2 canines, and 14 molars in each jaw. The best known (*Anoplotherium commune*, Cuv.) is about the size of a wild boar, but longer in the body, with the head of an oblong form, and a tail of considerable thickness, and as long as the body. Its probable use was to assist the animal in swimming. Another species of Anoplotherium (*A. medium*) is of a size and form more nearly approaching to the light and graceful character of the gazelle; a third species was about the size of a hare. All the species, from the form of the teeth, and the absence of claws or horns, appear to have been singularly deficient in defensive organs.

ANORE'XY. (Gr. ἀ, *without*, and ὄρεξις, *appetite*.) Loss of appetite.

ANO'SMIA. (Gr. ἀ, *without*, and ὀσμη, *smell*.) Loss of the sense of smelling.

ANO'STOMA. (Gr. ἀνω, *upwards*, and στομα, *mouth*.) A genus of Pulmonate, or air-breathing Gastropods, the adult shell of which presents the following peculiarity, — the last whorl turns upwards towards the spire of the shell.

ANOU'RANS, ANOU'RA. (Gr. ἀ, priv., and οὐρα, *tail*.) A name applied to a tribe of Batrachian reptiles, which lose the tail in arriving at maturity; as the toad and frog.

A'NSERES. (Lat. anser, *a goose*.) In the Linnæan arrangement, the name of the third order of birds, having the bill broad at the top, and covered with a soft skin; the feet webbed. (*See* NATATORES.)

ANT. *See* FORMICA.

A'NTA, Æ. plur. (Lat. ante, *before*.) In Architecture, a pilaster or square projection attached to a wall. When they are detached from the wall, Vitruvius calls them parastatæ. They are not usually diminished even when accompanying columns from whose capitals, in all Greek works, they vary.

ANTA'CIDS. Medicines which neutralise the acid of the stomach.

ANTA'LGIC. (Gr. ἀντι, *against*, and ἀλγος, *pain*.) That which relieves pain.

ANTANACLA'SIS. (A compound word from the Greek prepositions ἀντι and ἀνα, and the verb κλαω, *I break*.) In Rhetoric and Composition, a figure in which a word is repeated, but in a different sense or different inflection from the first; which gives a kind of antithetical force to the expression.

"Labitur, et labetur in omne volubilis ævum."

The return to the former series of thought and diction after the interruption of a parenthesis, is also termed Antanaclasis.

A'NTAPHRODI'SIACS. (Gr. ἀντι, *against*, and Αφροδιτη, *Venus*.) Medicines which quell amorous desires.

ANTA'RCTIC. (Gr. ἀντι, *against*, and ἀρκτος, *a bear*.) Opposite to Arctic. Antarctic circle, one of the small circles of the sphere, parallel to the equator, and distant 23° 27½′ from the South pole. Antarctic pole, the South pole, or southern extremity of the axis of the earth. (*See* ARCTIC.)

**ANTECE'DENT.** In Analysis, the name given to the first of the two terms composing a ratio. Thus in the ratio *a*: *b*, *a* is the antecedent, and *b* is denominated the consequent.

ANTECEDENT. In Logic, the first member of an hypothetical proposition; followed by the consequent; as in the following instance: —

If we say we have no sin (*antecedent*),
We deceive ourselves (*consequent*).

ANTEDILU'VIAN. (Lat. ante, *before*, and deluvium, *deluge*.) Something that existed before the deluge.

ANTELOPE. *See* ANTILOPE.

ANTE'NNA. (Lat. *a yard arm*.) A moveable, tubular, and jointed sensiferous organ situated on the head; and peculiar to the Condylope Articulata. Certain Annelides carry soft tentacles or filaments upon the head, which have been termed antennæ; but improperly, according to the above definition, which would restrict the phrase to the jointed antennæ of insects and crustaceans. In the latter class the antennæ are commonly four in number, consisting each of a 'scape,' a 'pedicel,' of two joints, and a 'clavolet'; the latter is setaceous, and divided into a vast number of minute joints. It is simple in the external antennæ, but in the internal pair is always composed of two and sometimes of three setaceous filaments. The internal pair of antennæ are situated before or between the eyes, the external behind, at the outer sides of the eyes. In insects the antennæ are always two in number, and situated in the space between or before the eyes; they consequently correspond to the internal antennæ of crustaceans. The cavity or socket in which the base of the antennæ is planted is called the 'torulus,' or bed. The first, and in many cases the most conspicuous, joint of the antennæ is termed the scape. The base of the scape, by which it is articulated with the torulus, is the bulb. It often looks like a distinct joint, and is the point upon which the antenna turns. The pedicellus, or second joint of the antenna, in some insects, also acts the part of a pivot in the bed of the scape, in order to give a separate motion to the clavola, or clavolet. This, which includes the remaining joints of the antenna taken together, is occasionally terminated by a capitulum or knob; a term applied to the last joints of the clavolet when suddenly larger than the rest. (For the varieties of antennæ with respect to situation, approximation, proportion, direction, figure, termination, and appendages, the reader is referred to the 4th vol. of Kirby and Spence's *Introduction to Entomology*.)

ANTE'NNULÆ. (Dim. of antenna.) A term sometimes applied to the articulated filaments attached to the jaws or lower lip of Mandibulate insects, and which seem to be endowed with a sensiferous faculty specially adapted to distinguish kinds of food, and applied by the animal to that use: these organs are more commonly called palps, palpi, or feelers.

A'NTEPAGME'NTA. (Lat.) In Architecture, the mouldings or architraves round doors; also the jambs of a door.

ANTEPE'CTUS. In Entomology, signifies the under side or breastplate of the manitrunk, and the bed of the first pair of extremities or arms.

A'NTEPENU'LT, or ANTEPENULTIMA. In Grammar and Prosody, the last syllable of a word but two.

ANTE'RIOR. (Lat. ante, *before*.) This is said either when of two lobes of a stigma, one, the anterior, is directed towards the front of a flower, and the other, the posterior, towards the back, or in any other similar case. It is also applied to certain stipules, which stand between the petiole and stem of a plant, adhering to the former, as in some Cinchonaceous plants.

ANTESIGNA'NI. A class of soldiers in the Roman army, who were drawn up in front of the standards (*ante signa*), whence they derived their name. As their post was one that demanded great courage and firmness, they were picked troops.

ANTHE'LA. (Gr. ἀνθηλιον, *a little flower*.) A name given by Meyer to the inflorescence of rushes.

ANTHE'LIX. (Gr. ἀντι, *against*, and ἡλιξ *the helix*, or *external involute margin of the auricle*.) In Anatomy, the outer or external ridge of the auricle ear, which runs nearly parallel with the helix.

ANTHELMI'NTICS. (Gr. ἀντι, *against*, and ἑλμινς, *a worm*.) Medicines which kill intestinal worms, or effect their expulsion.

A'NTHEM. (Gr. ἀντιφωνη, *alternate singing*.) A piece of music performed in cathedral service by choristers who sing alternately. This manner of singing is very ancient in the church; some suppose it to have descended from the practice of the earliest Christians, who, according to Pliny, were accustomed to sing their Hymn to Christ in parts or by turns (*secum invicem*).

A'NTHER. (Gr. ἀνθηρα, *a flowery herb*.) A hollow case, usually consisting of two parallel cells, and constituting the apparatus that contains the pollen, or male part of a flower. Theoretically considered, an anther is the blade of a leaf, in a contracted state, with its two sides hollowed out and its parenchyma converted into pollen, while the midrib in a fleshy state divides the two lobes, and is called the connective. This part is sometimes highly developed, when the lobes of the anther are often placed at a distance from each other, as in Nymphæa; or it is altogether absorbed, when the lobes run together, and there is but one cell, as in Epacris. Other modifications produce other striking appearances: one lobe, for instance, disappears, and the connective is expanded into the state of a petal, as in Canna; or it is simply lengthened and distorted, as in Salvia; or, the anther remaining in its normal state, it is converted into a fleshy mass, as in Penæa; and it undergoes many similar transformations, either from the same or other causes. What is most curious about the anther, is its property of opening to discharge its pollen just at the very time when the stigma is ready to receive the influence of the latter. The cause of this sympathy between two really independent parts is supposed to consist in an emptying and drying up of the cellules forming the lining of the anther by the absorbent action of the ovary, which is imagined thus by its own efforts to bring about an action which is necessary to its own complete operation. The cellules lining the anther, when thus dried up, contract, and pull against certain fissures or dehiscent lines in the valves of the anther, which give way, and so form openings by which the pollen escapes.

ANTHERI'FEROUS. (Lat. anthera, *an anther*, and fero, *I bear*.) Forming a support to an anther.

ANTHERO'GENOUS. (Lat. anthera, and Gr. γινομαι, *I am produced*.) When, in double flowers, the anthers are converted into horn-like petals, as in the double columbine.

ANTHE'ROID. Resembling an anther.

ANTHE'SIS. (Gr. ἀνθησις, *the generation of flowers*.) The period when flowers expand. It is at that time that all the curious phenomena of fertilisation occur; the parts are all in their most perfect state, and consequently it is often necessary to speak of that period.

ANTHO'DIUM. (Gr. ἀνθος, *a flower*, or ἀνθωδης, *full of flowers*.) The head of flowers of a thistle or a daisy; it is the same thing as capitulum, and is applicable to all cases where a number of small flowers or florets are combined in a head, and surrounded by a common involucrum. An anthodium is nothing but a depressed spike.

ANTHO'LOGY. (Gr. ἀνθολογια.) Signifying "a garland of flowers," and metaphorically applied to a collection of short pieces of poetry, on amatory, convivial, moral, funereal, &c. subjects, called epigrams; not in the English sense of the word, which implies a pointed conceit, but in the more proper signification of "inscription." The first collection of epigrams known by the name of Anthology was made by Meleager, a Syrian Greek poet, who lived about a century before the birth of Christ; and to this several additions were made by different hands as low down as the times of the Byzantine empire. A selection from the Greek Anthology, translated into English verse by the late Mr. Bland and several friends, has gone through two editions.

ANTHO'LYSIS. (Gr. ἀνθος, *a flower*, and λυσις, *a breaking up*.) The changes of flowers from their usual to some other state, as leaves, branches, &c.

ANTHO'PHORUM. (Gr. ἀνθος, *a flower*, and φερειν, *to bear*.) A columnar process arising from the bottom of the calyx, and having at its apex the petals, stamens, and pistil. It is usually very short, and is in reality an internode between the whorls of sepals and petals.

ANTHOXA'NTHUM. (Gr. ἀνθος, *a flower*, and ξανθος, *yellow*.) A dwarf annual grass, found plentifully in pastures, and having sweet-scented leaves. It is thought that the fragrance of hay is owing to its presence. The flowers are in oval heads, which become dull yellow when ripe. Farmers call it the sweet vernal grass.

ANTHOZA'SIA. (Gr. ἀνθος, *a flower*, and ζαω, *I flourish*.) When the leaves of a plant assume the appearance of petals.

AN'THRACITE. (Gr ἀνθρακ, *charcoal*.) Mineral carbon. A difficultly combustible species of coal.

A'NTHRACOTHE'RIUM. (Gr. ἀνθρακ, *charcoal*, and θηριον, *a beast*.) A name indicative of the stratum in which the fossil genus of Pachyderms, to which it is applied, was found, viz. in the tertiary coal or lignite of Cadibona, in Liguria. The genus presents seven species, some of them approximating to the size and character of the hog; others approaching nearly to the dimensions of a hippopotamus.

A'NTHRAX. The name of a Fabrician genus of Dipterous insects, having the mouth provided with a very long straight setaceous sucker, formed of two unequal horizontal valves, and containing setaceous stings; palpi two, hairy; antennæ distant, the last joint setaceous. The genus is now raised to the rank of a family, *Anthracidæ*, characterised by a short body; wings spreading widely out; antennæ distant, two and sometimes three jointed;

the head as high as the thorax. Two of the genera (*Somatia*, and *Anthrax* proper) are British.

ANTHRE'NUS. The name of a Linnæan genus of Coleopterous insects, having the antennæ clavate, the club solid; palpi unequal, filiform; maxillæ membranaceous, linear, bifid; labium entire; head hid under the thorax.

A'NTHRIBUS. The name of a Fabrician genus of Coleopterous insects, applied to that section of the Linnæan Curculiones, which has the lip bifid, the jaw bifid and short, and the proboscis short.

ANTHROPO'GRAPHY. (Gr. ἀνθρωπος, *man*, and γραφειν, *to describe*.) A branch of Physical Geography which investigates the physical characteristics, local boundaries, and actually existing circumstances, of different races or families of men: differing from Ethnography, which examines their origin and affinities.

ANTHROPO'LOGY. (Gr. ἀνθρωπος, *man*, and λογος, *discourse*.) The science which treats of human nature, both physical and intellectual: any writing on the nature and attributes of man may be said to be anthropological. But the term is frequently used to denote the science of Anatomy in particular.

ANTHROPOMO'RPHITES. Persons who conceive the Deity to have naturally the human shape. Such sensuous conceptions of the nature of God have been always common among heathens.

ANTHROPOMO'RPHOUS. (Gr. ἀνθρωπος, *a man*, and μορφη, *form*.) A name applied to the labellum in some Orchidaceous plants, in consequence of the upper lobes having a fancied resemblance to human arms, and the lower to human legs.

ANTHROPO'PHAGI. (Gr. ἀνθρωπος, *man*, and φαγειν, *to eat*.) People who feed upon human flesh.

ANTHU'RUS. (Gr. ἀνθος, *a flower*, and ουρα, *a tail*.) A spike of minute flowers arranged closely on a long axis, as in the genus Piper.

A'NTHUS. The name of a subgenus of Passerine birds, including the pipits.

A'NTI. (Gr. ἀντι, *against*.) This Greek preposition is constantly used as a prefix; thus, antidote, antibilious, antipathy, &c.

A'NTIAR. (*See* UPAS.) A Javanese poison.

A'NTI-ATTRI'TION. A compound applied to machinery to prevent the effects of friction. It frequently consists of a mixture of plumbago with some greasy material.

ANTIBRA'CHIUM. (Gr. ἀντι, *against*, βραχιον, *arm*.) The fore-arm, or third segment of the anterior extremities, which is formed, in the skeleton, by the radius and ulna conjointly; or sometimes by the radius, either alone, or with the ulna partially developed. And the fore-arm articulates, above with the arm, below with the hand.

A'NTICHAMBER. (Fr. antichambre.) In Architecture. Any outward chamber adjoining or near a bed-chamber; also an apartment before any principal chamber; also a lobby or outer waiting room in a palace.

A'NTICHRIST. (Gr. ἀντιχριστος, *opponent of Christ*.) Mentioned by St. John, 1st Ep. ii. 18., and supposed to be the same with the "man of sin" whose coming is foretold by St. Paul, 2d Thess. ch. ii. The speculations in which theological writers have indulged respecting this great adversary of Christianity have been various and most fanciful; but the prevalent opinion among reformed divines has always connected him with the Romish church. At the council of Gap, in 1603, the reformed ministers there assembled, inserted an article in their Confession of Faith, in which the pope is pronounced Antichrist. Grotius, and most catholic divines, consider Antichrist as symbolical of Pagan Rome and her persecutions: Leclerc, Lightfoot, and others, of the Jewish Sanhedrim, or particular Jewish impostors. (See Dodsworth's *Advent Lectures*, London, 1837, for the opinion entertained by some High Church divines of the present day.)

ANTICLI'MAX. (Gr. ἀντι, and κλιμαξ, *gradation*.) In Rhetoric, when a sentence or discourse, instead of ascending from little to great, descends from great to little. Horace has given a famous example,

"Parturiunt montes, nascetur ridiculus mus."

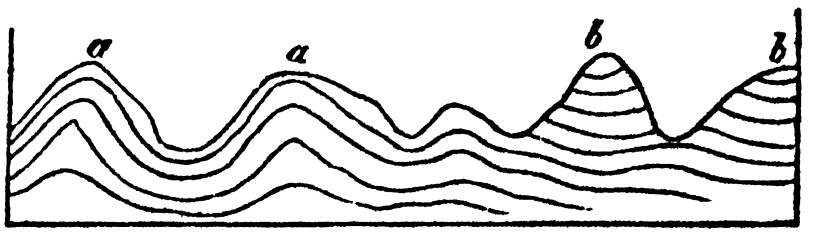
There are also several striking examples of this figure in Pope, as in the verse,

"Die, and endow a college or a cat."

But in this case the effect is heightened by the alliteration.

ANTICLI'NAL AXIS (Gr. ἀντι, *against*, and κλινειν, *to incline*.) If a range of hills or a valley be composed of strata which, on the two sides, dip in opposite directions, the imaginary line that lies between them, towards which the strata on each side rise, is called the anticlinal axis. In a row of houses with steep roofs facing the south, the slates represent inclined strata dipping north and south, and the ridge is an east and west anticlinal axis (Lyell).

In the annexed diagram, *a a* are the anticlinal, and *b b* the synclinal lines.




ANTI'COUS. (Lat.) In Botany, is applied to an anther whose lobes are placed facing the style; or to a petal which is stationed on that side of a flower which is next the eye of an observer as it grows upon its stem.

ANTI'CUM. (Lat.) In ancient Architecture. The southern porch of a building; that which was towards the north being called the posticum. It is also used to signify that part of the temple between the cell and the columns of the portico.

A'NTIDOTE. (Gr. ἀντι, *against*, and διδωμι, *I give*.) A remedy or preservative against sickness.

A'NTIFI'XA, or ANTEFIXA. (Lat. ante, *before*, and figo, *I fix*.) In Architecture. The ornaments of lions' and other heads below the eaves of a temple, through perforations in which, usually by the mouth, the water is cast away from the eaves. By some this term is used to denote the upright ornaments above the eaves in ancient Architecture, which concealed the ends of the harmi, or joint tiles.

ANTILI'THICS. (Gr. ἀντι, *against*, and λιθος, *a stone*.) Medicines used in the treatment of stone in the bladder and urinary gravel.

A'NTILOGARITHM. In its most common acceptation, denotes the number to a logarithm. Thus, in the common system of logarithms, 100 is the antilogarithm of 2, because 2 is the logarithm of 100. Sometimes the term is used to denote the complement of the logarithm, or the difference of the logarithm from the next higher term in the series, 1, 10, 100, &c.

ANTILOI'MIC. (Gr. ἀντι, *against*, and λοιμος, *contagion*, or *the plague*.) Remedies used in the prevention and cure of the plague.

A'NTILOPE. (Gr. ἀνθος, *ornament*, and ὠψ, *eye*.) Antelope; a term which, according to Cuvier, is a corruption of the word "antholops," applied by Eustathius, an ancient naturalist, to the gazelle, in allusion to its beautiful eyes. The name is now given to a division of the hollow-horned Ruminants (see CAVICORNIA), in which the bony axis of the horn is without cavities or sinuses. Antilopes are further distinguished by suborbital or maxillary glandular pouches, and their light and elegant figure. They are the natives, for the most part, of the wildest and least accessible places in the warmer latitudes of the globe; frequenting the cliffs and ledges of mountain rocks, or the verdure-clad banks of tropical streams, or the oases of the desert. They traverse the intervening wildernesses in pairs or in troops, with incredible fleetness, clearing obstacles, which would impede the course of other quadrupeds, by a succession of agile bounds.

The antilopes are now arranged under a number of subgeneric divisions, according to the form of the horns, which are peculiar to the male.

ANTIMO'NIC ACID. The peroxide of antimony. (*See* ANTIMONY.)

AN'TIMONY. A brittle metal of a silver white colour; specific gravity, 6·7. Fuses at 810°, or just at a red heat. The principal properties of this metal were first described in the "Currus Triumphalis Antimonii" of Basil Valentine, published towards the end of the thirteenth century. When heated in an open vessel, it gradually combines with oxygen, and evaporates in a white vapour. There are three oxides of antimony. The protoxide consists of 65 antimony + 12 oxygen; it is a greyish white powder, eminently purgative, sudorific, and emetic; and as such, of much importance in medicine. It is the active base of emetic tartar and of James's powder. The other oxides of antimony, from combining with certain bases, have been called antimonious and antimonic acid; they consist respectively of 65 antimony + 16 oxygen, and 65 + 20. The combination of chlorine and antimony was known to the old chemists under the name of *butter of antimony*. The principal ore of antimony is the *sulphuret:* it is met with in commerce, melted into conical ingots, under the name of crude antimony. It is of a bluish grey colour, metallic lustre, and a striated texture; specific gravity 4·62; it is much more easily fusible than the pure metal. Antimony forms brittle alloys with some of the most malleable metals: when gold is alloyed with a two-hundredth part of antimony, the compound is brittle; and even the fumes of antimony in the vicinity of melted gold are sufficient to render it brittle. Alloyed with lead in the proportion of 1 to 16, and a small addition of copper it forms the metal used for printers' types: with lead only, a white and rather brittle compound is formed, used for the plates upon which music is engraved. With iron it

forms a hard whitish alloy, formerly called *martial regulus*: 12 parts of tin and 1 of antimony form hard pewter. The white metal spoons and teapots are formed of an alloy of 100 tin, 8 antimony, 2 bismuth, and 2 copper.

Antimony is the stimmi, or stibium, of the old chemists.

ANTINO'MIANS. (Gr. ἀντι, *against*, and νομος, *law*.) Oppugners of the law. In Theology, Antinomians are such as interpret the law, to which St. Paul refers more especially in the Epistle to the Romans, as including all moral ordinances whatsoever; and push the contrast which the Apostle maintains between faith and the works of the law to an extreme extent, asserting the entire uselessness of good works, in any case, and the sole efficacy of faith. Hence the term Solifidian is applied to the same class of religionists. The name of Antinomian was first given by Luther, as a term of reproach, to the followers of the opinions of John Agricola on this subject, who complained, however, that his notions had been unfairly represented. Similar doctrines appear to have been held in England by an ephemeral sect in the time of the commonwealth: but antinomianism may now be taken rather as expressing the extreme to which the Calvinistic scheme of theology has the tendency to lead men, than as denoting any distinct sect or congregation, either in this country or abroad.

ANTIPÆ'DOBA'PTISTS. In Theology. Those who object to the baptism of infants on the ground that they are not capable of understanding the nature of the rite, and of pledging themselves to such a course of life as is required of all such as come to be baptized. (*See* BAPTISTS.)

A'NTIPATHES. A genus of Corticiferous Polypes, or corals, in which the central axis is enveloped by so soft a cortex that it falls off when the specimen is removed from the water. From the colour of the axis, it is commonly called "black coral."

A'NTIPE'DES. (Lat ante, *before*, pes, *foot*.) In Zoology, the anterior or pectoral extremities.

A'NTIPHLOGI'STICS. (Gr. ἀντι, *against*, and φλογισμος, *inflammation*.) Medicines which allay inflammatory action.

A'NTIPHLOGIS'TIC SYSTEM. In Chemistry, the system opposed to that of Phlogiston. (*See* PHLOGISTIC.)

A'NTIPHON. (Gr. ἀντιφωνειν, *to sing against*, or *mutually*.) In ancient Church Music, the short verse sung before the psalm and other portions of the Catholic service. (*See* ANTHEM.)

ANTI'PODES. (Gr. ἀντι, *against*, and ποῦς, *the foot*.) Denotes, literally, those who stand feet to feet; that is, the inhabitants of opposite parts of the earth. They live under the same parallels of latitude, on opposite sides of the equator, consequently the seasons are reversed, or, when it is summer to the one, it is winter to the other. Their longitude differs by 180°, or 12 hours, consequently their days and nights are reversed, that is, when it is mid-day to the one, it is midnight to the other. They have the same climate, in so far, at least, as climate depends on latitude

A'NTIPOPE. One that assumes the title and functions of pope without a valid election. The term more particularly refers to the popes who maintained themselves in opposition to each other, during part of the fourteenth and fifteenth centuries. The great western schism was caused by the rival jealousies of the French and Italian parties in the conclave; the French cardinals having been accustomed by their numbers, and the influence of the kings of France, to carry the election in favour of French candidates, while the popes resided at Avignon, a period of about 70 years, from 1305 to 1376. Accordingly, when the Italian party at last succeeded in the election of Urban VI., in 1389, the French cardinals retired from Rome, and there invested with the functions of pope one of their own body, under the title of Clement VII. They attempted, in the first instance, to maintain themselves in Italy, and war was proclaimed between the two rivals. After a short struggle, Clement retreated to Avignon; and there he, and his successor, Benedict XIII., held their court, while Urban, and after him, Boniface IX. and Gregory XII., reigned at Rome. They were supported respectively by different European states, of which France, Austria, Castile, Aragon, Savoy, Genoa, and Scotland sided with the party of the seceders. The schism, however, caused great scandal throughout Christendom, and measures were repeatedly taken, and baffled only by the artifices of the rival claimants, for an adjustment of the difference. There seemed to be three methods of proceeding to this end, and each liable to great difficulties:—1st. By the simultaneous resignation of both pontiffs, and a fresh election. 2d. By an arbitration between them. And, 3d. By the calling of a general council, to declare the holy see void, and recommend the conclave to fill the vacancy. This last method was finally adopted; though it has been constantly objected, that such a council could not be lawfully convened except by the summons of a reigning pope; which condition certainly was not fulfilled in the instance of the council of Pisa. However, in 1409, the rival parties were both declared guilty of heresy and schism, and thereby the validity of both claims greatly disproved. Alexander V. was then elected in due form; and the antipopes were unable long to maintain their pretensions against the authority of a general council.

A'NTIQUARY. Copiers of old books, especially in convents, were termed *Antiquarii* in the Latin of the middle ages. In modern phraseology, antiquary is defined "a person who studies and searches after monuments and remains of antiquity, as old medals, books, statues, inscriptions, &c.;" to which may be added those who make the manners and customs of ancient times an especial subject of inquiry. Henry VIII. gave Leland the title of his "Antiquary." The Royal Society of Antiquaries, in London, was founded under the reign of George II. (*See* ACADEMY.)

ANTI'QUE. In a restricted sense, pieces of ancient art, and by artists usually confined to such as were made by the Greeks and Romans of the classical age.

ANTI'QUITIES. Under this term, which has not a very definite meaning in modern European languages, we appear generally to comprehend all memorable things respecting Man in his social state in past time, except the political events, which form more properly the subject of History. Thus, manners and customs, language, literature, topographical details, the monuments of architecture, sculpture, &c. of ancient times, all fall under the general cognizance of the antiquary. His science is, as it were, subsidiary to the more general objects of the historian. In a more restricted sense, the study of antiquities is confined to the description and interpretation of the existing relics of former times, such as architectural remains, manuscripts, medals, and other objects of curious research. Among classical writers, there is, perhaps, only one who falls exactly within the definition of what in modern times we should term an antiquary; viz. Pausanias, whose work, written about the period of Marcus Antoninus, is entirely devoted to a description of the monuments of earlier periods then existing in Greece. But about the time of the revival of letters, when the study of classical writers became the main pursuit of literary men, classical antiquities became also a distinct and important branch of research. Besides the writers who employed their antiquarian knowledge in the shape of commentary on classical authors, a great number devoted their talents to the production of treatises exclusively illustrating particular points in ancient customs and usages. To enumerate the chief classical antiquaries of the 16th and 17th centuries would be impossible; but the following works may be named as among the most comprehensive and general which we possess, containing an immense repository of facts, which the more refined criticism of modern times has sifted and applied with better success: the treatises of *Sigonius* and *Meursius* — the latter chiefly on Greek antiquities — are collected in 12 folio volumes, Florence, 1741; the vast *Thesaurus Antiquitatum Græcarum* of the Dutch commentator Grævius (Leyden, 12 vols. fol. 1697, &c.); and the still more extensive work of Gronovius (*Thesaurus Antiquitatum Romanarum*, Leyden, 13 vols. fol. 1697), together with its continuations and supplements, by Burmannus, extending in the whole to 45 volumes; The works of Polenus, Pitiscus, and Gruterus, on the same plan with those two vast collections; the *Antiquité Expliquée* of Bernard de Montfaucon, extending, with the supplements, to 15 vols. folio, Paris, 1719-24. From these great works our modern Compendia in common use (in English, the Grecian Antiquities of Archbishop Potter, the Roman Antiquities of Kennett, Adam, &c.) are chiefly compiled. The names of Boeck (*Public and Private Economy of Athens*), Heeren (*History of Ancient Commerce, &c.*), Müller, Niebuhr, Creuzer, Böttiger, Wachsmuth, &c., attest the equal industry and superior critical skill of the classical antiquaries of modern Germany, the only country in which this branch of knowledge is now successfully cultivated. In that more restricted branch of classical antiquities, the description of the monuments of ancient art, among many illustrious names we may mention those of Caylus (*Recueil d'Antiquités Egyptiennes, Grecques, et Romaines*, 7 vols. 4to. Paris, 1752, &c.) and the Abbé Winkelmann. In the peculiar study of Egyptian antiquities, the names of Young, Hamilton, and Champollion stand pre-eminent. In ecclesiastical antiquities, the huge collections of Ugolinus (*Thesaurus Antiquitatum Sacrarum*, 34 t. fol. Antv. 1744) and Canisius (*Lectiones Antiquæ*, edited by Basnage, 4 t. fol. v. Antv. 1725) may be mentioned among many others. Lastly, the antiquities of the middle ages have received much and accurate attention, especially in France and England, within the last century. Besides the works of Leland and Camden, the fathers of English antiquities, of Dugdale and Hearne, &c., we may name in modern times, Fosbrooke (*British Monachism*, 2 vols. 4to. 1802, and *Encyclopædia of Antiquities*), Strutt (*Regal and Ecclesiastical Antiquities of England*, 4to.

1773, and many subsequent works), Brand, Lodge, Playfair, &c. &c., besides many who have devoted themselves to particular branches of the subject; and, among living authors, Sir Henry Ellis, Sir F. Palgrave, Sir H. Nicholas, Mr. Petie, &c. In French antiquities, the greatest name is that of Montfaucon (*Monumens de la Monarchie Française*, 5 vols. fol. Paris, 1725, &c.); while the Italians, among whom the study of national antiquities has been very sedulously cultivated, are peculiarly indebted to the indefatigable Muratori. His principal works are the *Antiquitates Italicæ Medii Ævi*, and *Rerum Italicarum Scriptores*: the whole are said to amount to 41 vols. in folio, besides 34 in 8vo.

ANTIRRHI'NEÆ. A small division of Scrophulariaceous plants, consisting of *Antirrhinum* (the snapdragon of the gardens), Linaria, and a few other genera.

ANTI'SCII, or ANTISCIANS. (Gr. ἀντι, *against*, and σκια, *shadow*.) An old term used in Geography to denote those inhabitants of the earth whose shadows fall in opposite directions. The inhabitants of the north and south temperate zones are always Antiscians; those living within the tropics may be Antiscians at one season of the year, and not at another.

ANTISCORBU'TICS. Medicines against the scurvy.

ANTISE'PTIC. (Gr. ἀντι, *against*, and σηπειν, *to putrefy*.) Antiputrefactive. Substances which prevent or check the putrefaction and decay of animal and vegetable matter, are called antiseptic.

ANTISPASMO'DICS. (Gr. ἀντι, *against*, and σπασμος, *a spasm*.) Medicines which alleviate or cure cramp and spasm.

ANTIS'TROPHE. *See* STROPHE.

ANTI'THESIS. (Gr. ἀντι, and τιθεναι, *to set*.) In Rhetoric, a figure in which two thoughts, words, or sentences are set in opposition to each other, in order to be more strikingly brought forward by the contrast; as in the following sentence from Cicero: "Quod scis, nihil prodest: quod nescis, multum obest." "Your knowledge avails you nothing: your ignorance hurts you much." Quintilian translates the Greek word ἀντιθεσις by the Latin *contrapositum*. The following well known passage of Spenser may be cited as an instance of mixed antithesis and accumulation.

> "Ah! little dost thou know, that hast not tried,
> What hell it is in suing long to bide,
> To speed to-day, to be put off to-morrow;
> To feed on hope, to pine with care and sorrow:
> To have thy prince's grace, yet want her peer's:
> To have thine asking, yet want many years:
> To fawn, to crouch, to wait, to ride, to run,
> To spend, to give, to want, to be undone."

ANTI'TRAGUS. (Gr. ἀντι, *against*, τραγος, *the marginal process of the external ear which is immediately in front of the meatus*.) In Anatomy, the process of the external ear opposite the tragus, and behind the meatus auditorius, or ear-passage.

ANTI'TROPAL. (Gr. ἀντι, *opposite*, and τρεπειν, *to turn*.) When in a seed the radicle of the embryo is turned to the end farthest away from the hilum. This, although a comparatively unusual position of parts, is nevertheless the normal position, if the exact nature of the developement of an ovule is rightly understood.

A'NTLIA. The oral instrument of Lepidopterous insects, in which the ordinary trophi, or instruments for obtaining, are replaced by a spiral, bipartite, tubular machine for suction, with its appendages. It principally consists of the solenaria, or two lateral subcylindrical tubes, and the fistula, or intermediate subquadrangular pipe, formed by the union of the two solenaria, which intermediate canal conveys the nectar to the pharynx. Theoretically, the solenaria are the maxillæ inordinately elongated, and they support at their bases two minute palpi. Rudiments of the upper lip or labrum, and mandibles, exist above the maxillæ; and below these is the labrum, attached to the head, and distinguished by a pair of large palpi.

ANTLIA PNEUMATICA. A constellation of the southern hemisphere.

ANTŒ'CI. (Gr. ἀντι, *opposite*, and οἰκος, *a house*.) Those who live over against each other; a term used in Geography to denote the inhabitants of the globe who live under the same meridian, but on opposite parallels of latitude. The hours of the day or night are the same to each, but the seasons of the year are opposite; that is, when it is summer with the one, it is winter with the other.

A'NTONOMA'SIA. (Gr. ἀντι, *instead of*, and ὀνομα, *a name*.) In Rhetoric and Composition, a figure by which a proper name is put for an appellative noun; as where a tyrant is called a Nero, an usurper a Cromwell, &c.: or, vice versâ, a complimentary periphrasis, or an appellation derived from some attribute, is put for a proper name; as where a king is called "His Majesty," or Tacitus "the prince of political historians."

A'NTRUM. (Lat. antrum, *a cave*.) An old name applied to such hollow fruits as the apple; they are now called Pomes.

ANTRU'STIONS, otherwise styled Fideles (Faithful) and Leudes (Leute, Germ. *people*). A class of people among the Franks, who were the personal vassals or dependents of the kings and counts. They were not dependent on them by reason of holding lands by their grant: but rather, in consequence of being such dependents, were favoured with donations of land, or benefices; which, in process of time, becoming hereditary, assumed the character of Fiefs. (*See* FEUDAL SYSTEM.) The original word from which Antrustion is derived, was undoubtedly the same with that from which our word *trust*, confidence, has its descent.

ANU'BIS. In Mythology, an Egyptian deity. The seventh, according to the astronomical Theology, of their eight gods of the first class. The Greeks identified him with Mercury. In Egyptian painting and sculpture he is represented as a man with the head of a dog: whence the lines in the 6th book of Virgil's Æneid, describing the conflict of Egypt with Rome:—

> Omnigenûmque Deûm monstra, et latrator Anubis,
> Contra Neptunum et Venerem, contraque Minervam,
> Tela ferunt.

A'NUS. The excrementary orifice of the alimentary canal, which sometimes opens directly on the exterior surface of the animal, as in most Mammals; sometimes into a cavity common to it with the outlets of the urinary and genital organs, called the cloaca, as in most oviparous Vertebrates; sometimes into the respiratory cavity, as in most Mollusks. In Entomology, it signifies the two last segments of the abdomen, and includes the podex, hypopygium, culus, ovipositor, and appendices. In most of the Acrites there is but one orifice to the alimentary cavity, which thus combines the functions of mouth and anus.

A'ORIST. (Gr. ἀοριστος, *indefinite*.) That inflexion of the verb which leaves the time of the action denoted uncertain.

AO'RTA. (Gr. ἀηρ, *air*, and τηρειν, *to keep*.) The great arterial trunk which issues from the left ventricle of the heart. After death it is found empty; whence the older anatomists, supposing that it was for the conveyance of air, gave it the above name. It is single in Mammals and birds; double in most reptiles, and in the Cephalopods; triple in the Crustaceans.

APA'GYNOUS. (Gr. ἀπαξ, *once*, and γυνη, *a female*.) When a plant fructifies but once, perishing immediately after it flowers. It is the same as monocarpic, and nearly the same as annual; only that, like the latter term, it includes such plants as the American agave, which live many years before they fructify.

A'PALUS. A Linnæan genus of coleopterous insects, having the antennæ filiform; the palpi equal and filiform; the maxillæ horny and one-toothed; the labium membranaceous, truncate, and entire.

A'PANAGE. An allowance to younger branches of a sovereign house out of the revenues of the country; generally together with a grant of public domains. A district with the right of ruling it, when thus conferred, is termed paragium. An apanage, in ordinary cases, descends to the children of the prince who enjoys it.

A'PATITE. Native phosphate of lime (from ἀπαταω, *I deceive*, having been confounded with other minerals). It occurs usually in six-sided prisms, of a green or greenish colour, resembling beryl, but much softer. Its powder phosphoresces on hot coals.

APATU'RIA. An Athenian festival, observed by the rest of the Ionians except Colophon and Ephesus. Two accounts are given of its origin: one of which derives its name from ἀπατη, *deceit*, because it was instituted in memory of a stratagem by which Melanthus the Athenian king overcame Icanthus king of Bœotia; the other from πατηρ, *father*, and the prefix ἀ, signifying *together*, because at this festival children accompanied their fathers that their names might be entered on the public register. The festival took place in October, and continued three days.

APE. In the Zoological sense, is restricted to those higher organised species of the Linnæan *Simiæ* which are destitute of a tail. They are included in the modern subgenera, *Pithecus*, *Troglodytes*, and *Hylobates*, or the ourangs, chimpanzees, and gibbons.

APE'LLOUS. (Gr. ἀ, priv. and pellis, *skin*.) Destitute of skin.

APE'TALOUS. (Gr. ἀ, priv., πεταλον, *a petal*.) When a flower has a calyx only, and no corolla; sometimes extended to cases in which there is neither calyx nor corolla; thus, the apetalous plants of Jussieu are either destitute of a corolla only, or of all floral envelopes.

A'PEX. The summit or highest point of any thing. Thus, the apex of a cone, of a pyramid, &c.

APHAN'ESITE. (Gr. ἀφανης, *indistinct*.) A copper ore, of a dark bluish or verdigris-green colour, consisting of arsenic acid and oxyde of copper.

APHANI'PTEROUS, APHANI'PTERA. (Gr. ἀφανης, *obscure*, πτερον, *wing*.) The name of an order of Apterous Haustellate insects, having rudimental elytra or wings in the perfect state, and undergoing a metamorphosis, resembling that of the *Tipulidæ*, or crane-flies. The common flea (*Pulex irritans*, Lin.) may be regarded as the type of this order. The female flea (*Pulex irritans*, Lin.) deposits a dozen eggs, of a white colour and rather

viscous texture, from which proceed little apodal maggots, which are very active in their motions, winding themselves in a serpentine manner through the substance in which they may be deposited: the head of the larva is protected by a firm skin, and bears two small antennæ, but no eyes; the body consists of thirteen segments, bearing little tufts of hair, and the last is armed with a pair of hooklets: the mouth presents some small moveable instruments with which the maggot hauls itself along. After having passed twelve days under this form, the larva spins itself a little silken cocoon, in which it passes into the pupa state, and in about twelve days more emerges a perfect flea; this metamorphosis distinguishes the flea and chigoe from other blood-sucking parasitic Apterous insects; and they are further distinguished by the number of segments into which their body is divided, and their pentamerous, or five-jointed, tarsi.

APHE'LION. (Gr. *ἀπο*, *from*, and *ἡλιος*, *the sun*.) In Astronomy, is that point of a planet's orbit which is at the greatest distance from the sun. It is opposed to perihelion, which signifies the point of the orbit nearest the sun. The aphelion and perihelion of an orbit are consequently the two extremities of its greater axis. In consequence of the mutual attractions of the planets, the positions and figures of their orbits are constantly undergoing a slow variation. The aphelia gradually shift their places on the planes of the orbits; and it is remarkable that these motions are direct, or eastward, in the case of all the planets excepting Venus, the aphelion of whose orbit, when referred to the fixed stars, moves westward at the rate of about 4 seconds annually. Of the old planets, Saturn is that whose aphelion undergoes the greatest annual variation; it amounts to about 18 seconds of a degree. (*See* PERIHELION, PLANET.)

APHE'LXIA. (Gr. *ἀφελκειν*, *to abstract*.) Absence of mind.

APHE'RESIS or APHÆ'RESIS. (Gr. *ἀφαιρεσις*, from *ἀφαιρεω*, *I take away*.) In Grammar, a figure by which a letter or a syllable is cut off from the beginning of a word; as in the common abbreviation, "'t is," for "it is."

A'PHIDES. (Gr. *ἀφις*, *a puceron*, or *vine-fretter*.) A family of Hemipterous insects, commonly called "plant-lice," inhabiting trees and plants, and living on their juices; remarkable for the anal saccharine secretion referred to in ANAL GLANDS, but more especially for a peculiarity of their generative economy, particularly described by Bonnet, and which consists in the first fecundation of the female influencing not merely the ova immediately developed thereafter, but those of the females resulting from that developement, even to the ninth generation, which are successively impregnated and productive without any intercourse with the male insects. Certain Coleopterous insects, which prey upon and keep in check the Aphides, are termed Aphidiphagi and Aphidivora (*φαγω*, *I eat*, voro, *I devour*).

APHLOGI'STIC. (Gr. *ἀφλογιστος*, *uninflammable*.) Without flame or fire.

APHLOGI'STIC LAMP. A lamp with a glowing wick, the combustion in which goes on without flame.

A'PHONY. (Gr. *ἀ*, priv., and *φωνη*, *voice*.) Loss of voice.

A'PHORISM. (From the Greek *ἀφορίζειν*, *to define*, or *limit*.) A term chiefly used in Law and Medicine, but occasionally also in Moral Philosophy, &c., to denote a comprehensive maxim or principle expressed in a few words.

APHRI'TE. (Gr. *ἀφρος*, *froth*.) A soft, friable carbonate of lime.

APHRODI'SIAC. (Gr. *Αφροδιτη*, *Venus*.) That which incites to venery.

APHRODI'TE. (Gr. *Αφροδιτη*, the name of *the Goddess of Love*, having reference to her supposed origin from the *foam of the sea*, *ἀφρος*.) This classical name was applied by Linnæus to a beautiful genus of Annelidans adorned with resplendent silky hairs and bristles, of which the sea-mouse (*Aphrodita aculeata*, Lin.) of our coasts is an example.

APHRODI'TIDÆ. The name of the family of Annelides of which the Aphrodita aculeata is the type.

APHYLLA'NTHEÆ. A small division of the Juncaceous order of Endogens, comprehending the genus Aphyllanthus from the South of Europe, with Calectasia and Dasypogon from New Holland.

APHY'LLOUS. (Gr. *ἀ*, priv., and *φυλλον*, *a leaf*.) Leafless. The term is, however, often applied to plants in which the leaves are present, but so small as not to look so much like leaves as mere scales. Plants are also called leafless, in which, although scales of considerable size are present, there are no true green leaves: of this description are Monotropa, Orobanche, Pyrolaaphylla, &c.

APIA'CEÆ. (Lat. apium, *parsley*.) A name recently proposed to replace that of Umbelliferæ, it being constructed with more resemblance to the plan upon which the names of other natural orders are formed in Botany, than that of Umbelliferæ.

A'PIARY. (Lat. apis, *a bee*.) A place for keeping bee-hives. Sometimes this is a small house, with openings for the bees in front, and a door behind, which is kept locked for security; and sometimes it is an area, in which each particular beehive is chained down to a post and padlocked.

API'CULATED. (Lat. apex, *a sharp point*.) When a leaf or any other other part is suddenly terminated by a distinct point.

A'PIDÆ. (Lat. apis, *a bee*.) One of the varieties resulting from the modern division of the Linnæan genus *Apis*, including those species which are distinguished by the length of the terminal parts of the inferior organs of the mouth, which constitute a proboscis.

APIO'CRINITES. (Gr. *ἀπιον*, *a pear*, *κρινον*, *a lily*.) Pear Encrinite. (*See* ENCRINITE.) The name of a subgenus of fossil Encrinites, in which the body is formed of separate pieces articulated with the stem, and supporting the rays by similar articulations, in consequence of which the stem is rounded and dilated into a pyriform figure at its upper part.

A'PION. A genus of minute Coleopterous insects, of the weevil family (*Curculionidæ*); very numerous in species; distinguishable by their elegant pear-shaped form, protruded snout, and straight antennæ.

A'PIS. In Mythology, a bull, to which divine honours were paid by the Egyptians, especially at Memphis. He was required to be black, with peculiar spots and marks. One of this description was always maintained; but not suffered to live beyond twenty-five years. He was then buried with much solemnity; and Belzoni was of opinion that the bones discovered in one of the sarcophagi disinterred by him, belonged to such an animal. The outrage made by the Persian conqueror Cambyses on the bull Apis, and the disasters which were supposed to have befallen him in consequence of that act, are detailed in the history of Herodotus, book ii.

APIS. (Lat. apis, *a bee*.) The Linnæan genus, now subdivided into different families, is thus characterised: mouth horny; jaw and lip membranaceous at the tip; tongue inflected; feelers four, unequal, filiform; antennæ short, filiform, those of the female subclavate; wings flat; sting of the females and neuters pungent, and concealed in the abdomen.

The insects of this extensive genus live, some of them, in large societies, and some are solitary; their food is the nectar of flowers, honey, and ripe fruit; the larva is soft and without feet; the pupa resembles the perfect insect.

The characters of the Linnæan genus are applicable to a variety of forms, now the types of numerous subgenera, included by Latreille in a family of Aculeate Hymenopterous insects, under the term Anthophila, or Mellifera. The habits of each of the subgenera of this family are replete with interest, arising from their social economy, and the separation of the individuals into three sexual modifications, viz., the prolific females, or queens; the unprolific females, or workers; and the males, or drones. The policy of the hive-bee (*Apis mellifica*, Lin.) has been studied with so much diligence and detail, that we penetrate this mystery of nature with astonishment, and often feel inclined to regard what Huber relates, as fabulous. Nevertheless, the highly interesting observations of the writer, and those especially on which his reputation chiefly rests, have been confirmed by subsequent observers, both scientific entomologists as well as practical apiarians.

The hive-bee is distinguished from all other species of the modern genus Apis, by having the femora of the posterior pair of legs furnished with a smooth and concave plate on the outer surface, and fringed with hair, forming a basket adapted for the conveyance of pollen; and in being destitute of spines at the extremity; by the basal joint of the tarsi, in the workers, being of an oblong form, with its inner surface clothed with hairs disposed in transverse rows; by the trophi being of an elongated form, and the maxillary palpi being almost obsolete and consisting of a single joint.

The different individuals of the social Apis mellifica more nearly resemble each other in their grade of developement—as regards their locomotive powers, organs of sense, and instinctive endowments—than the ants. No individual among them is without wings; and the industry of the workers, or imperfect females, is less astonishing, at least their tasks are less arduous, than fall to the lot of the Apterous labourers of the ant tribes.

As bees, like most other winged insects, are annuals, or go through the whole essential economy of their existence within the year, the history of a year's existence includes the whole, and we have only to choose the point in the circle at which to commence it.

As some individuals, however, always survive the winter, and begin to breed early in spring, forming a colony which quits the parent stock, we shall begin with this colony, and trace their operations through the year.

The first young swarm in this country is generally sent off in June. The migration seems to depend on want of space in the mother-hive, not on an instinctive desire of change on the part of the brood; for if there be space for the operations of the increasing community, bees will not

naturally swarm; and skilful apiarians sometimes take advantage of this circumstance, and, by making successive additions to the hive, retain the whole year's increase in the same building. The swarm consists in general of about six or seven thousand individuals, of which about 1-30th part are males, the rest females; and of these, one only, for the most part, is prolific, and she is called the queen. Her body is longer than that of either the drone or worker; her colours are brighter and purer, and generally of a darker shade; the transverse bands across the abdomen are of a deeper and brighter yellow, and are sometimes orange; the head is smaller than that of the unprolific female, and the tongue is shorter and more slender; her mandibles are notched, and her sting is curved; but the most obvious distinctive character is the proportional length of the abdominal segment of the body, which lodges the generative apparatus, and which is of an elongate conical form, tapering rather sharply to the anus. The male bee is readily distinguished by the short and thick form of his body, which is obtuse at each extremity. He has no sting. The workers, like the queen, are armed with a sting, but it is straight, and proportionally larger and stronger. The workers are essentially females in their internal structure, but their growth is arrested before arriving at the period when the full development of the sexual system takes place, and they consequently are smaller than either the queen or the drones; and their colours are less bright. According to Huber, there are two varieties of labourers, one of a larger size, which he calls 'abeilles cirières,' or makers of wax; the other, or smaller variety, he terms 'abeilles nourrices,' or nurse-bees, whose crop, or first stomach, is not capable of the distention requisite for collecting honey, but whose office is to build the combs and cells after the foundation has been laid by the cirières, and to feed the larvæ.

It is also stated there are two kinds of drones; one not larger than the workers, the other as above described. And Huber has described another variety of the inmates of the hive, which he terms 'black bees,' and which are supposed to be the superannuated workers.

The swarm, thus composed, commonly leaves the hive in the heat of the day, and often immediately after a shower. It is supposed that the queen takes the lead; and she ever afterwards exercises an inscrutable influence over all their operations. Perhaps a stronger proof that instincts do not necessarily depend on physical conformation is not afforded by any phenomenon in natural history, than by the effects which the loss or death of the queen produces on the labourers: this event does not deprive them of any organ, or paralyse any limb; yet, the moment they are conscious of her loss, all their labours are interrupted and forsaken, and, unless another queen be provided, they join another hive, or perish from inanition.

The flight of the swarm is directed to some neighbouring fixed place, and wherever the stand is made they all forthwith repair to it. In the wild state, the cavity of an old tree is commonly chosen; and this, with a seeming prudence and foresight which cannot be sufficiently admired. The first care of the bees is to cleanse it from dust and rubbish, and to gnaw off with their mandibles any asperities or projections which might interfere with the future construction of the comb. In the state of domestication in which the hive-bee is usually preserved in this country, the practice of the above instinctive actions is rendered unnecessary, by the reception of the swarm into neat artificial hives. Yet this modification of their habits, and many other interferences to which they are subject, have had no effect in inducing any varieties in the organisation of the bee, nor any change in those instinctive actions which the care of man has not rendered indispensible. The consideration of this curious exception to the ordinary consequences of domestication, and of the conditions on which the circumscribed limits of variation in the bee depend, would lead us far beyond the extent allotted to the present subject; but it is an inquiry full of interest in relation to the recondite laws which govern the variation of animals from their specific standard.

In the wild state, the young colony at first return occasionally to the parent establishment for supplies of provision; and the domesticated bees always fill their crops with honey before they leave the hive. The wax is a peculiar secretion from the working bee; and having the materials, therefore, within themselves, they immediately begin to form the comb.

Before describing the many-chambered nursery and storehouse which our bees are about to prepare, a few words are necessary regarding the material of which it is constructed.

The formation of the wax is a very singular and complex operation. Huber says, "The wax-makers, having taken a due portion of honey or sugar, from either of which wax can be elaborated, suspend themselves to each other, the claws of the fore legs of the lowermost being attached to those of the hind pair of the uppermost, and form themselves into a cluster, the exterior layer of which looks like a kind of curtain. This cluster consists of a series of festoons or garlands, which cross each other in all directions, and in which most of the bees turn their back upon the observer: the curtain has no other motion than what it receives from the interior layers, the fluctuations of which are communicated to it. All this time the nurse-bees preserve their wonted activity, and pursue their usual employments. The wax-makers remain immoveable for about twenty-four hours, during which period the formation of wax takes place, and thin laminæ of this material may be generally perceived under their abdomen. One of these bees is now seen to detach itself from one of the central garlands of the cluster, to make a way amongst its companions to the middle of the vault or top of the hive, and by turning itself round to form a kind of void, in which it can move itself freely. It then suspends itself to the centre of the space which it has cleared, the diameter of which is about an inch. It next seizes one of the laminæ of wax with a pincer formed by the posterior metatarsus and tibia, and drawing it from beneath the abdominal segment, one of the anterior legs takes it with its claws and carries it to the mouth."

The wax has, perhaps, the nearest analogy to the sebaceous secretion of the integument, than to any other animal secretion: it is formed beneath the scales on the under side of the abdomen, and when accumulated there seems to irritate the part, for the bee may then be observed wagging her abdomen, and running round, or to and fro, as if endeavouring to shake out the little scales; and she is generally followed by one or two other bees, which have been attracted by her movements, and are ready to seize upon the plates of wax as they fall. How the bees mould the scales into the walls of the cells is not yet exactly understood. Some have supposed that they bite pieces off and join them together; but the smooth and uniform surface of the cell shows that some other operation must take place: besides, the wall of the cell is sometimes thicker than a scale of wax. We must, therefore, suppose that the bees have the power of applying some dissolving or softening menstruum to the wax-scales, by which they are enabled to knead and blend them into a ductile paste. And when we remember that the secretion of the salivary tubes of insects is generally alkaline, and that wax is best dissolved by alkali, it is reasonable to suppose that it is by this means that the wax-scales are brought into a workable state. Reaumur, indeed, observed a frothy substance exuding from the mouth of a bee while working at a cell, which was applied to the proper place by the nimble tongue, and then kneaded in by the mandibles; and Huber has described the process very circumstantially: he says that the bee holds the lamina of wax with its claws vertically, —the tongue rolled up serving for a support,—and by elevating or depressing it at will, causes the whole of its circumference to be exposed to the action of the mandibles, so that the margin is soon gnawed into pieces, which drop, as they are detached, into the double cavity, bordered with hairs, of the mandibles. These fragments, pressed by others newly separated, fall on one side of the mouth, and issue from it in the form of a very narrow riband. They are then presented to the tongue, which impregnates them with a frothy liquor. During this operation the tongue assumes all sorts of forms: sometimes it is flattened like a spatula; then like a trowel, which applies itself to the riband of wax; at other times it resembles a pencil, terminating in a point. After having moistened the whole of the riband, the tongue pushes it so as to make it re-enter the mandibles, but in an opposite direction, where it is worked up anew. The liquor mixed with the wax communicates to it a whiteness and opacity which it had not before, and doubtless gives it that ductility and tenacity which it possesses in its perfect state.

Bees commonly begin at the top or roof of their chamber, and build downwards, at first working irregularly, and as it were pasting over the surface; and then building horizontal cells of a more perfect form. These at length become so numerous, that they extend downwards in the form of a vertical wall; other congeries of cells are formed in succession, until the whole comb assumes the form of a series of perpendicular plates or partitions. Each plate consists of a double set of cells, the bottoms of which are applied to each other, and form the partition between each set. The plates are not always regular, and the irregularities which may be observed are not always necessary adaptations to a peculiar form of the cavity in which they are built. The cells are not all of the same size; but a sufficient number of a given depth are reserved for receiving the eggs, and which are necessarily adapted to the size of the future maggot: the smaller or shallower cells are those in which the honey is stored. The breeding and store cells are placed horizontally, but the mouth of the cell is sometimes a little raised—the better to retain the honey. The interspace between the vertical combs is generally about half an inch: these streets, as

they may be termed, in this city of industry, being just wide enough to allow two bees busied upon the opposite cells to pass without incommoding each other. In addition to these interspaces, the combs are perforated in various places, so as to allow a passage for the bees from one street to another, thus saving them much time.

The shape of each cell is not, as might have been expected, cylindrical, or that which seems best adapted to the form of the maggot, or even of the bee constructor; but it is hexagonal, — the only form which allows the cell to be of the largest size in proportion to the quantity of matter employed, and at the same time to be so disposed as to occupy in the hive the least possible space. The form of the base of each cell, which is in apposition with the one on the opposite side, is also such as to gain greater strength, and more capacity, with less expenditure of wax; the latter consideration being one of great importance to bees, which do not secrete a very large quantity of this material; and the most profound mathematicians and most skilful geometers have found the solution of the problem, relating to the attainment of the preceding objects, as derived from the infinitesimal calculus, to have a surprising agreement with the actual measure of the different angles formed by the walls of the cell.

There may generally be observed one or more cells, wider and shallower than the rest, placed either on the edge of a comb, or partition; or placed against the mouths of the cells, and projecting beyond the general surface of the comb. — These are called the royal cells; but as they are not adapted to the form of the queen, nor ever lined with the silken covering of the chrysalis, the supposition that the queen is bred in them seems improbable.

Having now generally described the comb, we return to the consideration of those instinctive operations by which its several compartments are furnished with their destined contents.

The comb seems at first to be formed entirely for propagation, and, indeed, to be essentially related to that function; for if the workers lose their queen, they make no combs; and the reception of honey is, therefore, its secondary use. Wasps and hornets make combs, although they collect no honey.

As soon as the young colony has prepared a few combs the female begins to exclude her eggs. The first that she lays produce the imperfect females, or workers; the subsequent ones produce the males, and, perhaps, the fertile females, or queens. The eggs are deposited at the bottom of the cells, often before these are half completed; they adhere generally by one end to the cell, In about five days the little maggot is hatched, and is seen lying at the bottom of the cell, coiled up in a transparent fluid.

Now begins the additional employment of the labourers, that of feeding and nursing the young maggots, for this purpose new materials must be collected abroad, and brought into the hive.

At first the bees of a young colony fly out singly, and afterwards collectively. They direct their flight generally in a straight line, or the nearest way to the destined object, and often travel to great distances from the hive. In summer time they may be seen almost every where where flowers bloom. In April and May they are abroad the whole day; but in the hot months they venture out less frequently, generally in the morning and evening, at which times it is more easy for them to form the pellets of the pollen, the grains of which adhere together less strongly during the heat of noon-day.

Bees do not like wet weather; yet it is, perhaps, less the presence of rain, than the changes in the degree of light, which deters them from venturing abroad at this time: for they possess large and complex organs of sight, and when clouds collect quickly over the clear sky, they are seen to hurry back in great numbers to the hive; while, if the sky be uniformly overcast, it is not merely a shower of rain that will drive them back: many of the actions of the bee prove, on the contrary, how essential moisture is for them. The bee does not take honey indiscriminately from every flower; in the meadows they may be seen generally upon the Orchideæ, Polygonia, Caryophylacea, but seldom, if ever, upon the Ranunculaceæ, perhaps on account of some poisonous quality. The oleander (*Nerium oleander*, L.), which yields poisonous honey fatal to thousands of flies, is carefully avoided by bees; and the crown imperial (*Fritillaria imperialis*, L.), the white nectaries of which are so conspicuous, tempts in vain the passing bee. They are, however, extraordinarily active in spring at the blossoming of the Amentaceæ, Rosaceæ (especially the dog-rose), and the balsamic lilies, Primulaceæ, &c.; and are, above all, allured by the innumerable flowers of the lime (especially *Tilia parvifolia*), and their hum may be heard among the branches at some distance. The finest flavoured and most delicate honey is collected from aromatic plants; and it is therefore always advisable to have large beds of borage, mignionette, lemon thyme, and sage in the neighbourhood of bee-hives. Those flowers which yield a nectar innocuous to the bees themselves, but possessing poisonous qualities when taken by man, are sometimes frequented by bees, and the honey derived from them acts like a poison. The description by Xenophon of the intoxicating or maddening honey, which so violently affected a number of the ten thousand Greek soldiers in his celebrated retreat, has been confirmed by the observations of Tournefort. And Dr. Barton, in his account of the poisonous honey collected from the Kalmia latifolia by the bees in Pennsylvania, justly observes, that there is more of poetry than philosophy in the following lines of Pope: —

> "In the nice bee what sense so subtly true,
> From poisonous herbs extracts the healing dew."

The honey which is swallowed by the bee passes into the crop, where it is accumulated as in a reservoir, and upon the return of the bee to the hive is regurgitated into a honey cell. If any honey had been previously accumulated there, the bee breaks through the firm cream-like crust which always forms upon the exposed surface of the honey; and it is this crust which maintains the honey in the horizontal cells.

The collection of the farina, or pollen, of flowers, is a great object of the industry of bees. In large flowers, as the tulip, the bee dives in; and if the pollen receptacle, or anther, be not burst, she bites it open, and comes out singularly disguised, being covered over entirely with the fertilising dust, which adheres readily to the fringed hairs of her body and legs.

Aristotle, who was well acquainted with much that is interesting in the economy of the bee, was the first to observe that a bee, during each single excursion from the hive, limits her visits to one species of flower. Modern naturalists have confirmed the general accuracy of this statement, and have noticed that the pollen with which a bee comes home laden is always of the same colour. The necessity of this instinct arises out of the operation which the pollen first undergoes when collected by the bee. She rakes it out with incredible quickness by means of the first pair of legs; then passes it to the middle pair, which transfer it to the hind legs, by which it is wrought up into little pellets. Now, if the pollen were taken indiscriminately from different flowers, it is probable that the grains, being heterogeneous, would not cohere so effectually. Certain it is, that bees enter the hive, some with yellow pellets, others with orange, pink, white, or even green coloured ones; but they are never observed to be party-coloured. Through this instinct, another important end is gained, in relation to the impregnation of flowers; the production of hybrid plants by the application of the pollen of one species to the stigma of another is avoided — while those flowers are more effectually fertilised, which require the aid of insects for that purpose.

When a pollen-laden bee arrives at the hive, she generally walks or stands upon the comb beating her wings, and three or four of her fellow citizens assist in lightening her of her load; or the laden bee puts her two hind legs into a cell, and with the intermediate pair, or the extremity of the abdomen, brushes off the pellets. These are then kneaded into a paste at the bottom of the cell; and several cells are thus filled with the packed and softened pollen, which is called bee-bread.

Besides the honey and farina, bees also collect a peculiar substance, like gum-resin, which was called 'propolis' by Pliny; and this they obtain principally from the balsamic buds of the horse-chestnut, birch, and poplar, especially the *Populus balsamifera*, L. The propolis is soft, red, will pull out in a thread, and is aromatic. It is employed in the hive, not only in finishing the combs, but also in stopping up every chink or orifice by which cold, wet, or any enemy can enter. Like the pellets of pollen, it is carried on the posterior tibiæ, but the masses are lenticular. Having thus traced the operations of the working bees relating to the collection of the substances required in the economy of the hive, we shall now return to the larvæ, which are the immediate objects of all this industry.

The bees may be readily detected feeding the young maggot, which opens its lateral jaws to receive the bee-bread, and swallows it. The well-fed maggot soon grows too large for its tough outer skin, and accordingly casts it; when its bulk has increased so that it fills its cell, it then requires no more food, and is ready to be inclosed for the chrysalis state. The last care of the foster-parents is to cover over the mouth of the cell with a substance of a light brown colour, apparently a mixture of wax and farina. This takes place generally four days after the larva was excluded from the egg. The inclosed larva now begins to line the cell, and covering of the aperture before mentioned, with a silk, which it spins from glandular tubes, similar to those of the silkworm. When the first three segments of the trunk, to which the locomotive organs of the perfect insect are attached, begin to be enlarged, the last larva-skin splits along the back, and is pushed off from the head backwards, and

deposited at the bottom of the cell, and it then becomes a chrysalis. Now the wonderful changes take place, partly by a formation of new organs, partly by a development of pre-existing ones, which end at last in the completion of the perfect bee.

Mr. Hunter ascertained the duration of the pupa state of the bee to be, in one instance, thirteen days and twelve hours, exactly; making the period of immature life, from the first deposition of the egg, to be twenty-two days and a half, — a remarkably brief time for the completion of the metamorphoses, as compared with that in which the corresponding changes are effected in other metabolian insects. When the bee first comes forth it is of a greyish colour, but soon assumes the ordinary brown tints.

When the season of oviposition and the rearing of the larvæ is over, then the business of collecting honey seriously begins; and when the last chrysalis of the season has disclosed its imago, the deserted cell is immediately filled with honey, and covered over with wax, to serve as a store for winter.

In the month of August it is supposed that the prolific female, which is to produce the swarms of the following year, is impregnated. This act takes place in the air. The queen, being preceded by the drones, traverses the exterior of the hive, and suddenly rises aloft in the air, wheeling upwards in large circles, until she is out of sight. The male, unable to extricate the intromitted parts, generally perishes. The rest of this unhappy sex share a similar fate, and meet a violent death from the jaws of the unprolific females. It would seem as if the drones were conscious of their danger at this season, for they do not loiter as usual at the mouth of the hive, but hurry in or out. However, they are attacked by one, two, or three workers at a time, who do not sting them, as Huber asserts, but pinch them and pull them about, as if to wear them out. From this instinctive and indiscriminate slaughter of the males, we may infer that the impregnation of the queen has taken place before the setting in of the winter season; and that the ova, the development of which is retarded during the indolent state in which bees pass through the cold months, are in a condition to be developed and produce the larvæ at the approach of spring. Yet, although on the setting in of the cold weather the bees remain very quiet, they are not torpid, as is the case with most other insects. They cluster as close together as the comb will permit, and have the faculty of generating a degree of heat superior to that of the external atmosphere.

Mr. Hunter found, during an evening in July, when the temperature of the atmosphere was 54°, that of the interior of a hive full of bees was 82°; and in December, the external atmosphere being 35°, the bees preserved a temperature of 73°; and, what is, at this season, extremely rare in the lower animals, they maintain their digestive powers, and subsist on the produce of the summer and autumn. Accordingly, they are ready to take advantage of any fine and mild day, and may be seen then flying abroad and appearing to enjoy it. They void their excrements at this time, for they are insects of singular cleanliness and propriety; and when purposely confined in the hive, with abundance of food, they have been known to fall a sacrifice to this instinctive repugnance to defile the hive.

The continuance of the digestive actions during the winter influences the condition of the oviducts in the queen, and the impregnated ova begin early to expand, and are ready for exclusion in the month of March. This makes the bee the earliest breeder amongst the insects of this country. The labourers now resume their accustomed duties, and, as the season is too early for collecting the provision of the maggot abroad, the store of bee-bread, laid up in the preceding year, comes into use, for the sustenance of the larvæ, which are about to form the first swarm. As soon, however, as the flowers begin to blow, the bees fly forth to gather fresh pollen, propolis, and honey, and the labours of the year recommence.

It appears to be the presence of the larvæ, which are destined to become perfect females, which stimulates the old queen to leave the hive. After repeated attempts to penetrate their cells, and destroy her royal progeny, she becomes infuriated, communicates her agitation to a portion of her subjects, which, together with her, rush out of the hive, and seek a new domicile. It is stated that in every instance the old queen leads the first swarm; the labourers that remain pay particular attention to the royal larvæ that remain; and these, as they are successively excluded, lead away fresh swarms, if the hive be not sufficiently enlarged. Each swarm contains, not only the recently hatched young bees, but also a portion of the old inhabitants. Some assert that the queen, which leads each swarm, is impregnated soon after the new colony is settled; and, as this may take place early in the summer, she begins to oviposit the same year. The number of ova which are fertilised by a single coupling is prodigious: Huber calculates that the queen lays 12,000 eggs in two months; while, according to Reaumur, she oviposits at the rate of 200 a day. The duration of life of the different individuals of the





hive varies: that of the male bee is not more than two or three months; there is more doubt respecting the longevity of the workers, but it is probable that it does not extend much beyond a year. The term of the queen's existence has been stated to have been prolonged for five years; but this is rendered improbable by the fact that all insects of the same species have nearly the same duration of existence allotted to them.

The true honey-bee (*Apis mellifica* L.), was originally limited in its geographical range to the Old World, whence it has been transported to America, and other countries where European colonies have been established, and where it is now acclimated. The distinguished entomologist Latreille, on whose authority we state this fact (*Règne Animal*, tom. v. p. 365.), is even of opinion that the honey-bee of the south and east of Europe, as well as that of Egypt, differs specifically from the Apis mellifica of Western Europe.

API'STES. (Gr. ἄπιστος, *treacherous*.) A genus of Acanthopterygious fishes, notable for a strong suborbital spine, with which they are apt to inflict severe wounds when incautiously handled.

APLO'ME. (Gr. ἁπλοος, *simple*.) A mineralogical term for a variety of garnet crystallised in rhombic dodecahedra, derived by the simplest laws of decrement from the cube.

APLY'SIA. (Gr. ἁπλυσια, *uncleanness*.) A genus of Tectibranchiate Gastropods, well known to the ancients under the name of *Lepus marinus*, or sea hare, from a resemblance which the long tentacles of the Aplysia give it to the head of the hare. By Aristotle, the term Aplysia was applied to certain zoophytes, but was arbitrarily transferred by Linnæus to the molluscous animals now known under this denomination.

APO'CALYPSE. (Gr. ἀποκαλυπτω, *I reveal*.) The Book of Revelations, the last in the canon of the New Testament. Many conflicting opinions have been entertained as to the authenticity of this book; but, though rejected by Luther, and neither admitted nor rejected by Michaelis, the opinion of the great majority of critics and divines in modern times has been decidedly in favour of its genuineness. There have, also, been great varieties of opinion as to the person by whom, and the period when, the book was written: but the prevalent opinion is, that it is the work of St. John the Evangelist. Different commentators have differed widely in their interpretations of different parts of this book; and it is looked on by many as being still a "sealed book," admitting, in the present state of our knowledge, of no satisfactory explanation. The phrase apocalyptic writings is frequently used to designate those portions of the Scriptures which contain prophetic descriptions, under the form of visions, of the future state of the church: such as the book of Daniel; and, among the Apocrypha, the fourth book of Esdras.

APOCA'RPOUS. (Gr. ἀπο, *from*, and καρπος, *fruit*.) When the carpels of a flower either do not adhere to each other at all, as in the strawberry, or only by the ovaries, as in Aigella. When a carpel is altogether single in a flower, it is considered, for systematic purposes, apocarpous; the supposition being, that if another carpel were present, it would not adhere to the first.

APO'CRYPHA. (Gr. ἀποκρυπτειν, *to hide*.) Properly, things concealed or put out of sight; applied to certain books, in behalf of which a claim to inspiration has been put forth, but which are supposed to be spurious, and are therefore rejected from the canon of Scripture. One great distinction between the Roman and the Reformed churches is, that the latter reject certain books, admitted by the former on the same footing as those books about which there is no dispute, from the canon of the Old Testament; viz. the 3d and 4th of Esdras, the book of Tobias, that of Judith, the rest of the book of Esther, that of Wisdom, of Jesus the son of Sirach, Baruch the prophet, the Song of the Three Children, the story of Susanna, of Bel and the Dragon, the Prayer of Manasses, and the 1st and 2d Maccabees; reading them, as the sixth Article of the English church declares, for example of life and instruction of manners, but not applying them to establish any doctrine. The English church receives no books into the canon of the Old Testament which were not so received by the Jews; and it appears that the writings thus excluded are not quoted by the authors of the New Testament, nor are admitted into any of the earlier catalogues set forth by the Christian fathers. They are also found to contain some manifest inconsistencies, some obviously fanciful relations, and, in one or two passages, to countenance tenets at variance with the character, or even the express declarations, of revealed religion. There exist at the present day various writings purporting to be the Gospels or Epistles of Joseph, of James the Apostle, of St. Paul, an Epistle of Christ himself to king Abgarus, &c.; which are, for the most part, intrinsically absurd; and, having no external evidence or authority in their favour, have never obtained currency in the church. (*See* art. CANON.)

**APOCYNA'CEÆ.** An extensive natural order of plants, named after Apocynum, one of the more common of its genera. A few species are found in cold climates, but by far the larger part are natives of warm or tropical latitudes, in the form of shrubs or trees, or twining plants, some of which are remarkable for their beauty, as various species of Echites; others for their poisonous properties, as Cerbera, which furnishes the Tanghin poison of Madagascar, and Strychnos, from various species of which the poisons called tienté and woorary are procured in different countries; while a third set produce bark, having useful bitter and febrifugal properties; the inspissated milk that flows from these plants, when removed, constitutes their poison; the febrifugal bitter principle is an independent secretion, that becomes useful when it can be separated from the milk. Notwithstanding these dangerous properties, the fruits of some species are eatable, as that of Carissa, the cream fruit of Sierra Leone, and some others.

**A'PODE. APODA.** (Gr. ἀ, priv., and ποῦς, *a foot.*) Footless. A term applied by Latreille to a section of Saurians or lizards, by Mayer to a family of serpents, and by Oppel to a family of Batrachians; by Linnæus to his first order of fishes, which have no ventral fins; and by Cuvier a suborder of Malacopterygia, or soft-finned fishes, is thus designated, comprehending those which are devoid of the ventral fins, or the homologues of the posterior extremities. It is also indicative of those larvæ of insects which have only the soft tubercles or prolegs; and the skins of the bird of paradise, imported as an article of commerce, being always deprived of the legs, it was for some time believed that the species was naturally without feet, and it was consequently termed Paradisea apoda.

**APODO'GYNOUS.** (Gr. ἀ, priv., ποῦς, *a foot*, and γύνη, *a female.*) A name given by Richard to disks which do not adhere to the base of an ovary.

**APO'DOSIS.** (Gr. ἀποδιδωμι, *To give back.*) In Rhetoric, the second part of a period. (*See* PROTASIS.)

**APODYTE'RIUM.** (Gr. ἀποδυσθαι, *to strip one's self.*) In ancient Architecture, the apartment in the palæsta, or bath, in which a person divested himself of his dress, whether for bathing or for gymnastic exercises. In the baths of Nero, these apartments were small; but in those of Caracalla, the apodyterium was a magnificent room with columns and other decorations.

**A'POGEE.** (Gr. ἀπο, *from*, and γῆ, *the earth.*) Applied, in Astronomy, to the orbit of the moon and the apparent orbits of the sun or planets, to denote the points of those orbits most remote from the earth. It is opposed to perigee, which denotes the point nearest the earth. The apogee of the lunar orbit advances eastward among the stars, and completes a revolution in about nine years.

**APOLLIN'ARIANS.** In Ecclesiastical History, a sect who denied the humanity of Christ as far as regards the soul, believing its place to be supplied by the *Logos*, or Word of God. Apollinaris, their founder, was a bishop of Laodicea, in the latter part of the fourth century: his doctrine was condemned by the council of Constantinople, A. D. 381. (*See* Mosheim's Eccl. History, English translation, i. 423.)

**APO'LLO, or PHŒBUS.** A heathen divinity, son of Jupiter and Latona, in Homeric times the god of archery, prophecy, music, and medicine.

> Jupiter est genitor. Per me quod eritque, fuitque,
> Estque patet. Per me concordant carmina nervis,
> Certa quidem nostra, est nostra tamen una sagitta
> Certior in vacuo quæ vulnera pectore fecit;
> Inventum medicina meum est, opiferque per orbem
> Dicor, et herbarum est subjecta potentia nobis.

Later poets represent him also as the god of day and the sun. The statues of Apollo represent a young man in the perfection of manly strength and beauty, with unshorn curling locks, and a bow or lyre in his hand. The worship of this god was very general in Greece and Italy, especially in the former, where he uttered prophetic responses from many of his temples, the most celebrated of which were those of Delos and Delphi, in Phocis: in the latter of these his most esteemed oracles were delivered. The mythological tales about Apollo are very numerous. His birth took place in the island of Delos, whither his mother took refuge from the persecutions of the jealous Juno; and his first exploit was the slaughter of the dragon Python, for which, according to one tradition, he was subjected to servitude under Admetus, king of Pheræ, in Thessaly. Of his numerous amours, that with the nymph Daphne is most noted. She fled from his embraces, and, when no other means of escape from the arms of her pursuer were left, was turned by her father, the river-god Peneus, into a bay-tree, which in consequence became the peculiar emblem of Apollo.

**APOLLO BELVIDERE.** A beautiful statue of Apollo, found, towards the end of the fifteenth century, among the ruins of the ancient Antium. It was purchased by Pope Julius II., who placed it in the Belvidere of the Vatican, whence it takes its name. It is, perhaps, the noblest work of art. The god is standing, about seven feet high, and almost naked. His quiver hangs over his right shoulder; his pallium over his left arm, which is extended; and in his hand are the remains of a bow, out of which he is supposed to have just discharged the arrow that killed the serpent Python. The whole figure has about it an indescribable air of grace, beauty, and majesty.

> "Or view the Lord of the unerring bow,
> The God of life, and poesy, and light —
> The sun in human limbs array'd, and brow
> All radiant from his triumph in the fight;
> The shaft has just been shot — the arrow bright
> With an immortal's vengeance: in his eye
> And nostril beautiful disdain, and might,
> And majesty, flash their full lightnings by,
> Developing in that one glance the Deity."

This *chef-d'œuvre* of Greek sculpture has been supposed by some, but on very slight grounds, to be alluded to by Pliny (*Hist. Nat.* lib. xxxvi. § 4.). The best critics are of opinion that the artist is wholly unknown. This noble statue was conveyed to Paris by Napoleon; but, on the downfal of the latter, it was again restored to the Vatican.

**A'POLOGUE.** (Gr. ἀπόλογος.) In Literature, a fable or fiction, of which the object is moral. According to some definitions of the Apologue, it is a fable of which the interlocutors or subjects are animals: but this seems an unfounded limitation. (*See* FABLE.)

**APO'LOGY.** (Gr. ἀπολογία.) In Literature, a defence, or answer to an accusation. The two pieces of Xenophon and Plato, each commonly termed Apologia Socratis, differ in character: the first being a defence supposed to be pronounced by the philosopher himself; the last, a narration of his last hours and discourses. Treatises in defence of the Christian religion, in its early period, were denominated Apologies by their writers; as those of Justin Martyr, Tertullian, and others, both preserved and lost. The title has been retained by some writers in modern times: as by Robert Barclay, in his Apology of Quakerism, and by Bishop Watson, in his Apologies for the Bible and for Christianity.

**A'POPHTHEGM.** (Gr. ἀποφθεγμα, from φθεγγομαι *I speak.*) A short and sententious speech or saying. The apophthegms of the ancients are generally sentences expressing some truth of universal application in philosophy, the conduct of life, &c. &c. Such are Plutarch's "Apophthegmata Laconica," a collection of the brief and pointed sayings for which the Lacedæmonians were famous.

**A'POPHYGE.** (Gr., signifying *flight*, or *refuge.*) In Architecture, that part of a column between the upper fillet which rests on the base and the cylindrical part of the shaft of a column, usually moulded into a hollow or cavetto, out of which the column seems as it were to fly or shoot upwards.

**APOPHY'SIS.** (Gr. ἀποφυω, *I proceed from.*) A protuberance, process, or projection. In Anatomy, restricted to processes of the osseous system.

**A'POPLE'XY.** (Gr. ἀποπλησσειν, *to strike down.*) A sudden suspension or loss of the powers of sense or motion; the heart continues to act, and respiration is continued, though often with some difficulty.

**APOROBRA'NCHIANS, APOROBRANCHIATA** (Gr. ἀπορεω, *I want*, and βραγχια, *gills.*) A name applied by Latreille to an order of the class Arachnida, characterised by the absence of stigmata or respiratory pores on the surface of the body.

**APOSE'PEDIN.** (Gr. ἀπο, *from*, and σηπιδων, *product of putrefaction.*) A peculiar crystallised substance obtained from putrid cheese.

**A'POSIOPE'SIS.** (Gr. ἀποσιωπαω, *To leave off speaking suddenly.*) A figure in Rhetoric and Composition, by which a sentence is made to break off abruptly when unfinished either in sense or grammatical construction; so that the part which was to follow appears to be retained in the mind of the speaker or writer. In writing, the Aposiopesis is now often denoted by an horizontal line or break at the point where the sense is interrupted.

**APO'STACY.** (Gr. ἀφιστημι, *I desert.*) A deserting or abandoning of the true faith; but the word is now used to designate the renunciation of political as well as religious opinions.

**APOSTASIA'CEÆ.** A very small natural order of plants found in the tropics of India, closely allied to Orchidaceæ, from which they differ in having a three-celled ovary and diandrous flowers, the sexes of which are partly free. Apostasia is the principal genus.

**APO'STILL.** In Literature, a marginal note to a book.

**APO'STLE.** (Gr. ἀποστολος.) A person sent forth upon any business: hence applied, by way of eminence, to the twelve elect disciples of Christ, who were sent forth by him to convert and baptize all nations. In the first century, the apostles assumed the highest office in the church; and the term apostle during that period was equivalent to bishop in after times. According to Theodoret (v. Bingham, II. Q. 1.), the titles of bishop and

presbyter were originally applied promiscuously to the same, or second, order in the church.

APO'STLES' CREED. A confession of faith, supposed anciently to have been drawn up by the apostles themselves, and deriving the title "Creed" from the word with which it begins in Latin (credo, *I believe*). With respect to its antiquity, it may be affirmed, that the greater part of its clauses is quoted by the apostolic father Ignatius; and that the whole, as it now stands in our liturgy, is to be found in the works of St. Ambrose, in the fourth century.

APOSTO'LIC FATHERS. The writers of the Christian Church, who lived in the apostolic age, or were during any part of their lives contemporary with the apostles. They are five: Clement of Rome, Barnabas, Hermas, Ignatius, and Polycarp; of whom the last suffered martyrdom, A. D. 147. Of these the three first are supposed to be mentioned in the Epistles and Acts; the fourth, according to a prevalent tradition, was the child whom Christ took in his arms, whence he was called Theophorus; and the fifth, who suffered at a very advanced age, seems to be the angel or bishop of Smyrna whom St. John addresses in the Revelations.

APO'STROPHE. (Gr. *ἀποστρέφειν, to turn off.*) In Rhetoric, a figure of speech by which the orator or writer suddenly breaks off from the previous method of his discourse, and addresses himself in the second person to some person or thing, absent or present. It is not necessarily an address to the absent or dead, although often so defined. An orator, who should suddenly direct his speech to one of the audience, would be employing an apostrophe. It is, like other figures of speech, an imitation of one of the most natural effects of strong emotion. In oratory, the Apostrophe of Demosthenes to the gods, at the end of the *Oratio pro Corond* in narrative writing, that of Tacitus to the shade of Agricola, in his biography of that statesman, may be cited as splendid examples in ancient literature of the use of this figure.

APOTHE'CA. (Gr. *ἀποθηκη, a repository.*) In ancient Architecture, a storehouse for oil, wine, &c.

APO'THECARY. (Gr. *ἀποθήκη, a shop*) Apothecaries were originally the venders and preparers of drugs and compounds used in medicine. The Apothecaries' Company, or the Society of Apothecaries for the City of London, was incorporated by James I. in 1606. Their last charter bears date 6th of December, 1617. (*See* COMPANIES.)

APOTHE'CIUM. (*See* APOTHECA.) A flat disk, consisting of a nucleus surrounded by a border, in which the asci of lichens are inclosed. It is commonly called a shield.

A'POTHEO'SIS. (Gr. *ἀποθέωσις.*) The change from a mortal to a divine nature, which the ancients supposed some men to undergo after death: as the old heroes among the Greeks; and the ancient kings of Italy, and Romulus, with the Romans, who also paid divine honours, in later times, to their deceased, and, in some cases, to their living, emperors.

AP'OTOME. (Gr. *ἀποτομος, cut off.*) In Music, the remaining part of an entire tone, after a major semitone has been abstracted from it; or it is the remainder of a whole tone when diminished by a limma, or smaller semitone. As the tone major cannot be rationally divided into two equal parts, the Greeks divided it into a greater and less semitone; the greater being the apotome, and the less the limma. The proportion of the apotome to the limma is 2187 to 2048.

APOTOME. In Geometry, a term employed by Euclid and some of the ancient mathematicians to denote the remainder or difference between two lines or quantities commensurable only in power. Thus, if from the diagonal of a square, a part equal to the side of the square is cut off, the remainder is the apotome, and is represented numerically by the expression $\sqrt{2}-1$. In the tenth book of his Elements, Euclid divides apotomes into six classes.

A'POZEM. (Gr. *ἀπο*, and *ζειν*, *to boil.*) An old Pharmaceutical term for a decoction.

APPA'RENT. A term used in Astronomy to denote things as they appear to the eye, in distinction to what they really are. Thus, the apparent altitude of a star denotes the angle which its line of vision makes with the horizon; but the real altitude is found by making a correction for the effects of parallax, which causes the star to appear a little higher than it would if there were no atmosphere. The apparent diameter of a planet is measured by the angle made by two straight lines drawn from the eye to opposite points of its disk; the real diameter is a straight line joining those points; while astronomers call the angle under which the diameter would be seen from the centre of the earth, the true diameter. The apparent or sensible horizon denotes the plane which is a tangent to the earth's surface at the place of the observer; the true horizon is a plane parallel to the former, and passing through the centre of the earth. Apparent motion is the velocity and direction in which a body appears to move to an observer who is himself in motion. For example: the apparent diurnal motion of the stars from east to west arises from the rotatory motion of the earth, which carries us along with it in an opposite direction. Apparent time is the same as true time, or the hour indicated by the sun's passage over a meridian; while mean time is that which would be indicated by the sun if its angular velocity in its orbit were uniform.

APPARI'TION. In a general sense, means the appearance or semblance of any thing; but the word is now commonly used to denote a spectre, or the preternatural appearance of some spirit. A belief in the reality of such preternatural appearances has been entertained by many eminent men; but it has chiefly prevailed in times of ignorance and superstition, and has either wholly disappeared, or had a comparatively limited influence in more enlightened times.

APPEA'L. In Law, 1. The removal of a cause from an inferior court to a superior. 2. An accusation of a criminal offence by one subject against another. The bringing decisions of the courts of Scotland and Ireland, or the court of chancery in England, before the house of lords, is peculiarly termed an appeal in the first sense. Criminal appeals are now obsolete: those on charges not capital have long been so. Appeals of treason and of felony subsisted for a much longer period: the latter had doubtless their origin in the early jurisprudence of the Gothic nations, by which acts of violence or injury were redeemable by a weregild or fine to the party injured or his near estrelative. They were put an end to by stat. 59 G. 3. c. 46. (*See* WAGER OF BATTLE.)

APPEA'RANCE. In Law, the act whereby a defendant in an action recognises the process by which that action is commenced against him: originally by appearing in person, or by attorney, in court; now, by filing common or special bail to a writ of capias, by delivering a memorandum in writing to an officer of the court, in answer to a writ of summons, &c.

APPE'LLANT. In Law, the party by whom an appeal is made; as against an order of magistrates to the quarter sessions, or against the decision of a court of equity to the house of lords. The opposite party is termed respondent.

APPE'NDAGE. In Botany, all parts which are regularly arranged round any other part are called appendages; leaves are appendages of the axis: so are all the parts of a flower theoretically; the supernumerary sepals in a strawberry are appendages of the calyx; the abortive stamens that arise from the calyx of a passion-flower are appendages of the calyx; and so on.

APPEND'ICULATE. Having appendages. The word is sometimes applied to all those plants which are furnished with leaves (appendages of the axis).

APPE'NDIX. In Literature, a supplement added at the end of a work, either to contain portions of the subject which had been omitted, or separate pieces and extracts from other works bearing on it: such as are termed in French *pièces justificatives.*

APPE'NSUS. (Lat. appendo, *I hang up.*) When an ovule is not exactly pendulous, but is attached to the placenta by some point intermediate between the apex and the middle.

A'PPIAN WAY. The most celebrated of the highways leading from ancient Rome. It was constructed by the censor Appius Claudius, A. U. C. 442; and commencing at the gate of Capena, now St. Sebastian, extended to Capua, the then limit of the empire. It was formed of stones squared and jointed, and was wide enough for two chariots to go abreast. On each side was a ditch for carrying off the water.

A'PPLE. (Gr. *ἀπιος, a wild pear.*) The cultivated fruit of *Pyrus malus*, the crab apple of our hedges. All the numerous varieties that are now so common are said to have originated slowly from improvements of this wild sort. At what period its amelioration commenced is unknown; but, as Pliny was acquainted with several kinds, it is reasonably to be supposed that its improvement is to be assigned to a high antiquity. If it could be true that pippins, that is, seedling improved apples, were introduced only at the end of the 16th century, we should have to give the southern nations of Europe the credit of having furnished us with the stock from which the valuable varieties we now possess have been derived. But there is no doubt that apples of some kind have been known in England from long before the Conquest, and although they may have been of bad quality, and fit for food only when roasted, yet they could hardly have failed to produce seedlings of valuable qualities. The term apple is employed in composition to designate any large fleshy fruit, as love-apple, thorn-apple, pine-apple, &c.

APPOGIATU'RA. (Ital. appogiare, *to lean upon.*) In Music, a small note preceding a larger one of greater duration, of which it borrows one half of its value: sometimes, however, it is only one quarter in duration of the note which it precedes.

APPO'RTIONMENT. In Law, the dividing of a rent, &c. into parts, according to the number and proportion of the parties between whom the land is divided.

APPRAI'SEMENT. The valuation of goods sold under distress for rent due, by sworn appraisers, under several statutes. (*See* DISTRESS.)

APPREHE'NSION, SIMPLE. In Logic, is that act or condition of the mind in which it receives a notion of any object, and is said to be either incomplex or complex: the former being the apprehension of one object, or of several without any relation between them, as "a man," "cattle;" complex, of several, with such a relation, as "a man on horseback," "a herd of cattle."

APPRE'NTICE. (Fr. apprendre, *to learn*.) A person bound by indenture, for a certain term, to perform services for a master, receiving, in return, instruction in a trade or occupation; and, in most instances, necessary food and clothing. Apprenticeship seems to have originated, together with guilds and fraternities, in the middle ages. Seven years is a common term of apprenticeship in Germany, as well as in England; but other periods, as three and eight, have been customary in different trades, places, and times. The former period was fixed in England by the statute 5 Eliz. c. 4., which regulated apprenticeship throughout the realm in general. By 54 G. 3. c. 96, the legal force of apprenticeship was finally destroyed; that is, persons were allowed to exercise their respective trades without having served; London, and a few other corporate towns, being excepted. Apprenticeship is, therefore, now only recognised by the law as the mode of learning a trade.

APPROA'CH. In Fortification, a term given to the trench or covered way by which a besieging army may advance from its camp to the wall of a fortress without being exposed to the fire of the defenders. Approaches sometimes consist of covering masses only, formed of earth in bags, fascines, stuffed gabions, woolpacks, bales of cotton, or other materials within reach.

APPROACH, CURVE OF. In Geometry, the name given to a curve which possesses this property,—that a heavy body descending along it by the force of gravity, makes equal approaches to the horizon in equal portions of time. It was proposed by Leibnitz, and its properties investigated by Bernoulli and others.

APPROACH ROAD. In Landscape Gardening, is the road which leads from the public or main road, through a park or pleasure ground, to the mansion of a country residence. In the ancient or geometric style of gardening, this road was bounded by lines either straight or regularly curved, and was generally accompanied by one or more rows of trees on each side, at regular distances: but in the modern style, the approach road is led in graceful sweeps, which are made to appear as if they were determined by existing circumstances, either in the surface of the ground, or in the trees or other objects which are placed on it. There ought to be no bend in an approach road for which there is not an obvious and sufficient reason, either naturally existing, or created by art.

APPRO'PRIATION. In Landscape Gardening, is the art of so blending the scenery of one estate with that of the others that adjoin it, as to make the one subservient to the other, in a scenic point of view. This is effected by forming appropriate fore-grounds, in the estate at command, to the distant views, in the estates not at command; or in fields immediately adjoining, by imitating in our own field a part of what is contained in the field of our neighbour: thus, if the park of A. should be chiefly planted with pines and firs, and that of B. chiefly with oaks; A., in order to appropriate the scenery of B., must substitute oaks for a part of his pines and firs; more especially in the immediate vicinity of the grounds of B.

APPRO'VER. In Law, a person who being indicted of treason or felony, and not disabled from giving legal evidence, upon his arraignment, before any plea pleaded, confesses the indictment, and takes an oath to reveal all treasons and felonies that he knows of, and therefore prays a coroner to enter his appeal or accusation against those that are his partners in the crime contained in the indictment.

APPRO'XIMATE. In Zoology, when the teeth are so arranged in the jaws, that one passes on the side of the next, and there is no intervening vacancy.

APPROXIMA'TION. (Lat. proximus, *nearest, next to*.) A drawing near to. In Mathematics, quantities are said to be approximate which are nearly but not absolutely equal.

In a general sense, the term approximate may be applied to every result of natural philosophy or experimental science. For example, the magnitude of the earth, the distance of the sun, the masses of the planets, in fact, all the elements of astronomy, are only known nearly, or by approximation. In these cases, however, the want of absolute knowledge arises from the imperfections of our senses, or the errors of our instruments. In the language of Analysis, approximation is used to denote those methods of calculation by which we obtain near values of quantities which cannot be found accurately, either on account of the nature of their composition, or the imperfections of our methods of calculation.

The problem of finding the length of the circumference of a circle, by means of inscribed polygons, affords an instance of approximation to the values of geometrical quantities. It is a principle in Geometry, that any arc of a circle, however small, is greater than its chord. Now, suppose a regular polygon of 100 sides to be inscribed in a circle, and that we know the exact length of one of the sides; it is evident that the sum of all these lengths will give an approximation to the length of the circumference, though it would fall short of it by a very sensible quantity. But suppose that, instead of a polygon of 100 sides, one of 1000 sides were inscribed in the circle, the aggregate lengths of the sides would now approach much more nearly to the length of the circumference. By continuing to multiply the number of sides, we may obtain an approximation to any degree of nearness we please; but whatever the number of the sides of the polygon may be, their sum will never be exactly equal to the circumference, for they are only the chords of small arcs, which of necessity are smaller than the arcs to which they belong.

Numbers are formed by successive additions of unity, which is necessarily a finite quantity. In consequence of this finitude, it may be affirmed that no magnitudes which flow, or increase, by insensible degrees, can be expressed generally by numbers. For example, let a straight line be taken at random, and suppose that we wish to determine its length, our unit of linear measure being one foot. On applying successively a scale divided into feet to the different parts of the given line, the chances are infinity to one that the last division does not exactly coincide with the extremity of the line. We may diminish our unit by reducing it to an inch, or to the hundredth or the thousandth part of an inch; the chances of ultimate coincidence will not thereby be increased, though the difference between the last division of the scale and the extremity of the line may be diminished till it becomes smaller than any quantity we may be pleased to assign. Precisely similar to this is what takes place when we attempt to express by decimals a vulgar fraction whose denominator is not a measure of any power of ten. Thus, the fraction $\frac{1}{3}$, expressed decimally, is ·33333, &c. The first figure of the series gives the approximate value 3-tenths; the first two figures give 33-hundredths; the first three, 333-thousandths, and so on; the addition of every figure to the series making the difference of its value from 1-third ten times smaller. The difference may, therefore, be diminished till it becomes smaller than any assignable quantity, but it can never entirely disappear.

Another instance of the necessity of having recourse to approximation, is presented in seeking to find the roots of numbers. If a number is not an exact square, its square root cannot be expounded by rational numbers, whether integers or fractions. The same thing occurs with respect to numbers which are not cubes, and so on. In these cases, exact numerical values of the roots cannot be found. In other cases exact values may exist, though our methods of analysis are not sufficiently perfect to enable us to discover them. Notwithstanding the successive efforts of the greatest algebraists since the days of Lucas de Borgo, no general method has yet been discovered of solving equations of a higher degree than the fourth; consequently, the values of quantities involved in such equations can only be obtained approximately. It is to this subject that the attention of our best writers on analysis has chiefly been directed; in fact, the discussion of the different methods of approximating to the roots of equations of the higher degrees, forms one of the principal subjects of pure Algebra.

The method of exhaustion, by which the ancient mathematicians attempted to find the rectification and quadrature of the circle, was the first instance of a systematic method of approximation. The Indivisibles of Cavalleri effected the same object in a more rapid and general manner, and prepared the way for the differential calculus. The invention of the method of infinite series led immediately to general methods of approximating to the values of all radical quantities, and subsequently to the roots of all kinds of compound equations whatever. Vieta was the first who showed how to find successive values of the roots of equations, each approaching more nearly to the true value than the preceding; but his method was tedious and imperfect. Other methods, more easy and general, have been given by various mathematicians; among which, the best known are those of Newton, Halley, and Raphson, and those which have been proposed at a later period by Lagrange, Legendre, Budan, and others. These methods are in general drawn from the most abstruse parts of the theory of equations, and could not be explained in this place with the details necessary to render them of any use. For the best information on the subject, we may refer the reader to the excellent work of Lagrange, "Traité de la Résolution des Equations Numériques;" the "Nouvelle Méthode pour résoudre les Equations Numériques" of M. Budan; the "Supplément à l'Essai sur la Théorie des Nombres," by

Legendre; and the article *Equations*, in the Encyclopedia Britannica, by Mr. Ivory. (*See* EQUATIONS.)

A'PRICOT. (Lat. præcox, *early*, or Arab. berkhach, *butter fruit*.) The fruit of Armeniaca vulgaris, a native of Cachmere, and probably of the mountains of Caubul, and cultivated from Persia and the Oases of Egypt throughout the temperate parts of the world. In its wild state the apricot is a small round pale waxy yellow fruit, rosy on one side, and agreeably subacid; in that state it is dried in large quantities under the name of mishmish; in its most improved state it becomes three times as large and sweeter: but it is then apt to become insipid. For the confectioner's purpose, the Brussels and Breda apricots, which are near approaches to the wild fruit, are better adapted than the larger and sweeter kinds.

A'PRIL. The fourth month of the year. The name is probably derived from Lat. aperire, *to open*, either from the opening of the buds, or of the bosom of the earth, in producing vegetation.

A PRIO'RI. (The argument *à priori*.) In Philosophy and Rhetoric, is a phrase somewhat loosely applied to designate a class of reasonings. It is generally understood to apply to any argument in which a consequent conclusion is drawn from an antecedent fact, whether the consequence be in the order of time, or in the necessary relation of cause and effect; — e. g., "The mercury sinks, therefore it will rain." This is an argument drawn from an antecedent in time, not from a cause to an effect. A murder has been committed; a party falls under suspicion, as having had an interest in the death of the deceased, or a quarrel with him: this suspicion is founded on the argument *à priori*, from cause to effect; because the fact of his enmity or interest would afford a cause for his committing the murder. On the other hand, another party falls under suspicion, as having been seen to quit the house at a particular time, having marks of blood on his clothes: these are arguments *à posteriori*, in which we reason either from consequent in the order of time to antecedent, or from effect to antecedent cause. The famous *à priori* argument of Clarke and others in favour of the existence of a God, was an argument drawn from certain primary axioms in metaphysics; while the common course of reasoning to prove the same truth from the visible proofs of design in the works of nature, is an instance of the latter or *à posteriori* form.

A'PSIDES, or APSES. (Gr. ἁψις, *circle*, or *curvature*.) The two points of the orbit of a planet or satellite, at which it is moving at right angles to the straight line joining it with the primary. These two points of the orbit are the two extremities of the major axis, or the points at which a planet is at its greatest and least distance from the sun. The point at the greatest distance is called the higher apsis; that at the least is called the lower apsis; consequently, the higher apsis corresponds with the aphelion, and the lower apsis with the perihelion. The line joining these two points, which is the transverse axis of the orbit, is called the line of the apsides. It has a slow angular motion in the plane of the planet's orbit; and the time which the planet employs in completing a revolution with regard to its apsides is called the anomalistic period. (*See* APHELION. ANOMALY.)

APTENODY'TES. (Gr. ἀ, priv., πτηνος, *that can fly*.) A genus of diving web-footed birds, peculiar to the antarctic shores, having wings too short for flight, covered with short stiff feathers, resembling scales, and used as fins or paddles for swimming under water. The legs are short, thick, set far back, with four toes, all turned forwards, three of them long and webbed, the fourth very short. The bill is longer than the head, straight, and slightly curved at the tip: nostrils in the upper part of the bill, concealed in front by feathers. The Patagonian penguin is the representative of the genus.

A'PTERANS. APTERA. (Gr. ἀ, priv., πτερον, *a wing; wingless*.) A term including a proportion of the class of insects, the value of which varies in different systems of Entomology. In the Linnæan system it is the seventh order of insects, distinguished by their having no wings. Kirby makes his Aptera the twelfth order of the class of insects, but acknowledges that it is not a natural one, and limits the definition of it to those insects which are apterous, or never acquire organs of flight. In Latreille's last system, aptera is no longer applied to designate an order of insects.

A'PTEROUS. In Botany, denotes any part of a plant which is destitute of membranous expansions. The term is usually employed in distinction to alate, or winged.

A'PTERYX. (Gr. ἀ, priv., πτέρυξ, *a wing*.) A genus of birds represented by an extremely rare species, a native of New Zealand, in which the wings are reduced to a single defensive spur.

A'PTHOUS. (Gr. ἅπτειν, *to inflame*.) Resembling Aphtha or Aptha, the disease called the *thrush*.

A'PUS. A name applied by Scopolo to a curious genus of Entomostracans; characterised by a flattened, semitransparent, membranous envelope, which protects the body like a shell, having a deep cleft posteriorly; and bearing in front two large eyes, placed close together, with a third smaller one behind. The first pair of legs are long, filamentary, and branched, representing antennæ; the remaining sixty pairs are short, compressed, and modified so as to form a respiratory organ; according to the structure which characterises the Branchiopodous, or gill-footed order, to which the Apus belongs. The species of Apus appear in immense numbers in our freshwater pools; they prey chiefly on tadpoles; and some attain the length of an inch and a half.

APYRE'XIA. (Gr. ἀ, priv., and πυρετὸς, *fever*.) The intermission of feverish disorders.

A'PYROUS. (Gr. ἀ, priv., and πυρ, *fire*.) A term formerly applied to substances which resisted a strong heat without change.

A'QUA. (A Latin word of uncertain derivation, but probably from æqua, *smooth*, or *level*.) Water. It is often almost Anglicised, as in the words aquavitæ, aquafortis, aquamarine.

AQUA FORTIS. Nitric acid.

A'QUAMARI'NE. See BERYL.

AQUA REGIA. A mixture of nitric and muriatic acids, so called from its power of dissolving gold, the king of the metals.

AQUA TOFFANA. See AQUETTA.

AQUA'RIUM. (Lat. aqua, *water*.) In Horticulture. A place in gardens, in which only aquatic plants are grown. It is generally a small pond or cistern, containing shelves or benches at different depths from the surface, in which pots are placed containing the plants.

AQUA'RIUS. *The Waterbearer*. The eleventh sign of the zodiac, through which the sun moves in part of the months of January and February. Also, one of the twelve zodiacal constellations.

AQUA'TICS. AQUATILIA. (Lat. aquaticus.) A name applied by Nitzch to an order of birds; by Cuvier, to a family of Mollusks; by Latreille, to a division of Crustacea: by Lamarck to a family of bugs (*Cimicidæ*); each of which groups includes animals which live in, swim on, or frequent the margins of waters.

AQUA'TIC PLANTS. Plants which grow in water, which may be either running or stagnate. In the former case they are called river plants; in the latter, pond plants. Such as grow in the sea are called marine plants.

A'QUATINT. (Lat. aqua, *water*, tinta, *dyed*.) In Engraving, a species of execution resembling an Indian ink drawing in effect. (*See* ENGRAVING.)

A'QUEDUCT. (Lat. aqua, *water*, and ductus, a *conduit*.) A conduit or channel for conveying water from one place to another; more particularly applied to structures erected for the purpose of conveying the water of distant springs across valleys, for the supply of large cities.

The largest and most magnificent aqueducts, with the existence of which we are acquainted, were the work of the Romans; and the ruins of several of them, both in Italy and other countries of Europe, remain to the present time monuments of the power and industry of that enterprising people. The aqueduct of Appius Claudius was the most ancient, and constructed in the 442d year of Rome. It conveyed the Aqua Appia to the city, from a distance of between 7 and 8 miles, by a deep subterranean channel of more than 11 miles in length. The aqueduct of Quintus Martius was a more extraordinary structure. It commenced at a spring 33 miles distant from Rome, made a circuit of three miles, and afterwards, forming a vault of 16 feet diameter, it ran 38 miles, along a series of arcades at an elevation of 70 English feet. It was formed of three distinct channels, placed one above the other, conveying water from three different sources. In the uppermost flowed the Aqua Julia; in the second, the Aqua Tepula; and in the undermost, the Aqua Martia. The Aqua Virginia, constructed by Agrippa, passed through a tunnel of 800 paces in length. The Aqua Claudia, begun by Nero and finished by Claudius, conveyed the water from a distance of 38 miles. This aqueduct formed a subterraneous stream of 30 miles in length, and was supported on arcades through the extent of 7 miles; and such was the solidity of its construction that it continues to supply the modern city with water to the present day. The waters of the river Anio were also conducted to Rome by two different channels; the first was carried through an extent of 43 miles, and the latter through upwards of 63 miles, of which 6½ miles formed one continued series of arches, many of them upwards of 100 feet in height. Nine great aqueducts existed at Rome at the commencement of the reign of Nerva. Five others were constructed by that emperor, under the superintendence of Julius Frontinus; and it appears that at a later period the number amounted to twenty. The supply of water furnished by these different works was enormous. "According to the enumeration of Frontinus, the nine earlier aqueducts delivered every day 14,018 quinaria. This corresponds to 27,743,100 cubic feet. We may therefore extend the supply, when all the aqueducts were in action, to the enormous quantity of 50,000,000 cubic feet of water. Reckoning the po-

pulation of ancient Rome at a million, which it probably never exceeded, this would furnish no less than 50 cubic feet for the daily consumption of each inhabitant."—(*Leslie's Elements of Natural Philosophy.*)

The remains of some Roman aqueducts in other parts of Europe give evidence of the existence of works on a still more magnificent scale than those of Rome. Of these the aqueduct of Metz was one of the most remarkable. A number of its arcades still remain. It extended across the Moselle, a river of very considerable breadth at this place, and conveyed the water of the Gorse to the city of Metz. The water was received in a reservoir, whence it was conducted by subterraneous canals, formed of hewn stone, and so spacious that a man might walk in them upright. The arches appear to have been 50 in number, and 50 feet high at the deepest part. Some of the middle ones have been swept away by the descent of ice down the river; those at the extremities still remain entire.

The aqueduct of Segovia, in Spain, is in a still more perfect state than that of Metz. About 150 of its arcades remain, all formed of large stones without cement. There are two rows of arcades, the one above the other, and the height of the edifice is about 100 feet, passing over the greater part of the houses of the city.

Aqueducts have been constructed in modern times, particularly in France, which rival those of the ancient Romans. One of the most remarkable was constructed by Louis XIV., for conveying the waters of the river Eura to Versailles. It extends about 4400 feet in length, or nearly seven eighths of a mile, and is upwards of 200 feet in height. It contains 242 arcades, each divided into three rows, forming in all 726 arches of 50 feet span. The introduction of cast-iron pipes, which has only taken place within the last century, has superseded the use of such expensive structures.

A'QUEOUS SOIL. Agr. and Hort. Soil naturally abounding in water, the fluid being supplied by springs in the subsoil.

AQUE'TTA. (Ital. *little water.*) A celebrated poison used by the Romans under the pontificate of Alexander VII. It was probably a preparation of arsenic, and was also known under the name of *aqua Toffana*, from a woman of the name of Toffana, who prepared it at Naples.

AQUIFOLI'ACEÆ. (Lat. Aquifolium, *the holly.*) A natural order of Exogens, connecting the monopetalous with the polypetalous subclasses. The whole of the species are either shrubs or trees, and scattered over most parts of the world. Ilex, Prinos, and Cassia are the commonest genera.

A'QUILA. (Lat. aquila, *an eagle.*) The genus of Accipitrine or Raptorial birds, including the eagles proper, or those species of the Linnæan *Falco*, which have no trenchant tooth and corresponding notch in the beak.

A'QUILA ALBA. (Lat. *the white eagle.*) An alchemical name of *calomel.* The old chemists designated sal ammoniac and other sublimates by the term aquila.

AQUILARIA'CEÆ. (Aquilaria, *eagle wood, one of the genera.*) A very small order of Indian plants, secreting a fragrant resin, and nearly allied to Thymelaceæ. The species are but little known. The Aquillaria agallochum is the tree that produces the eagle or aggul wood, and which, in all probability, was the aloes wood of Scripture.

ARABE'SQUE. (French.) Painting and Sculpture, after the Arabian taste. This is a term applied to a species of ornament, capricious, fantastic, and imaginary, consisting of fruits, flowers, and other objects, to the exclusion, in pure Arabesques, of the figures of animals, which religion forbade. That the Arabians originated this sort of ornament is not the fact; it was known to and practised by the ancients at a very early period. Foliage and griffins, with ornaments not very dissimilar to those of the Arabians, were by no means unfrequent in the friezes of temples; and on many of the ancient Greek vases at Herculaneum, on the walls at the baths of Titus, at Pompeii, and many other places, elegant examples of this species of decoration are to be found. It is, however, to Raphael that we owe the most splendid specimens of the style, which he dignified, and left in it nothing to be desired. Since his time it has been practised with varying and inferior degrees of merit, especially by the French in the time of Louis XIV. Arabesques lose their character when applied to large objects, neither are they appropriate where gravity of style is required.

A'RABLE. (Lat. arare, *to plough.*) Land fit to be brought into a state of tillage, or of aration.

A'RABO-TEDE'SCO. (Ital. arabo, and tedescho, German.) In Painting and Sculpture, a style of art composed of Moorish, Roman, and German-Gothic.

ARA'CEÆ, or AROIDEÆ. (*Arum, one of the genera.*) Acrid Endogens, with the flowers arranged upon a spadix, inclosed within a spathe. In hot countries they sometimes become arborescent; in many cold countries they are unknown. Most commonly they arise from a fleshy underground tuber, from which an eatable fæcula is procured by washing away the acrid matter. Their flowers are almost destitute of floral envelopes: the sexes are mostly placed in different flowers, and their embryo has a slit on one side. *Caladium seguinum*, the dumb cane of the West Indies, derives its name from its juice paralysing the muscles of the mouth, if chewed; nevertheless, the leaves of certain caladiums are eaten by the negroes like spinach, but they are too acrid for an European palate.

ARA'CHNOID. (Gr. ἀραχνη, *a spider*, and εἰδος, *form.*) Cobweb-like. It is an Anatomical term, applied to the tunic of the vitreous humour of the eye, and to the thin membrane placed between the dura and pia mater of the brain.

ARACHNI'DANS. ARACHNIDA. (Gr. ἀραχνη, *a spider.*) A class of Apterous, spider-like Condylopes, having the head confluent with the chest, and, the body, consequently, consisting of but two segments, with eight legs, smooth eyes, and the sexual orifices situated on the thorax, or anterior part of the abdomen.

ARÆO'STYLOS. (Gr. ἀραιος, *wide*, and στυλος, *a column.*) In Architecture, that style of building in which the distance between the columns used is four and sometimes five diameters; the former, however, is the distance to which the term is strictly applied. It is only suited to the Tuscan order.

AR'ÆOSY'STYLOS. (Gr. ἀραιος, *wide*, συν, *with*, and στυλος, *a column.*) In Architecture, that style of building in which four columns are placed in a space equal to eight diameters and a half. In this arrangement the central intercolumniation is equal to three diameters and a half, and the others on each side only half a diameter, by which coupled columns are introduced.

ARALIA'CEÆ. (Aralia, *one of the genera.*) An order of Exogens, differing in little from the Apiaceous or umbelliferous plants, except in having more than two parts in their fruit. They are commoner in hot than in cold latitudes, and form an unexpected transition from Apiaceæ to Vitaceæ. The only state of them in Europe is the diminutive Adoxa moschatellina.

ARANEI'DANS. ARANE'IDÆ. (Lat. aranea, *a spider.*) A tribe of the Pulmonary order of Arachnidans, with a coriaceous integument; modified antennæ, or chelicers, consisting of a single joint armed with a claw, perforated near the apex for the transmission of venom; breathing by pulmonary ones, which are either two or four in number, with the abdomen pedicellate, and the arms provided with four or six spinnarets.

ARANEO'SUS. (Lat. aranea, *a spider.*) Covered with hairs crossing each other like the rays in a spider's web.

A'RAR. The Barbary name of *Thuja articulata*, the tree whose wood is chiefly used by the Mahometans of Africa for the construction of their mosques, and whose resin is the sandarach of commerce.

ARA'TION. Agr. Lands are said to be in a state of aration, when they are under tillage.

ARA'TOR. Agr. Literally a ploughman, but commonly applied to an arable farmer.

ARAUCA'RIA. (Araucanos, *a tribe of Indians in the southern parts of Chili.*) Fir trees with very rigid branches, having leaves like scales, either small and sharp pointed, or stiff, spreading, and lanceolate. The cones consist of leaves something like those of the stem, only longer, and containing large seeds. Two species occur in South America, and two in New Holland.

A'RBALEST. (Lat. arcubalista, *a cross-bow.*) This weapon is supposed to have been introduced into European armies by the crusaders, although used long before in the chase (in England as early as the reign of William the Conqueror). The arrows used with the cross-bow were short and thick (quarrels, bolts). The weapon was used in the English armies after the reign of Richard I.; but the Italians, and especially the Genoese, were most expert in the use of it at one time. A large force of Genoese cross-bow men served in the French army at Cressy, where their weapon was found very inadequate to match the English long-bow. Yet so deadly a weapon was it at one time considered, that papal bulls were issued in the twelfth century, condemning and forbidding its use in combats between Christians. It was disused in England, as a weapon of war, in the reign of Henry VIII. Cross-bows were of several sizes: the large or stirrup cross-bow was bent by the foot.

A'RBITRARY. (Lat. arbitro, *I judge.*) In a general sense, means that which is not defined by any rule or law, but is left to the sole judgment and discretion of some one individual or body of individuals. It is commonly used in political discussions to designate despotical or irresponsible power. (*See* DESPOTISM.)

ARBITRA'TION. In Law, the investigation before an unofficial person of the matters in difference between contending parties. His judgment is called an award. The reference to him may be made, whether legal proceedings concerning the question referred have been instituted or not. The reference is made by writing under seal or otherwise, and even by parole agreements but in this latter case the submission cannot, as in the others be made a rule of court. (*See* AWARD.)

A'RBOR. The principal spindle or axis which communicates motion to the other parts of a machine.

ARBOR DIANÆ. *The tree of silver*, that metal having been called Diana by old chemists; it is made by putting quicksilver into a solution of nitrate of silver, which causes the separation of the silver in a beautiful arborescent and crystalline form.

ARBO'REOUS. Woody, or growing on wood. Herbaceous plants, the stems of which take a ligneous character, are called suffrutescent, or arboreous, according to the degree of woodiness which they exhibit. Plants which grow on trees are also called arboreous, such as the arboreous lichens, arboreous mosses, arboreous fungi, &c.

ARBORE'SCENT. Stems of plants which are at first herbaceous, and afterwards become somewhat woody and tree-like.

ARBORE'TUM. In Gardening, a place in a park or pleasure ground, or in a large garden or nursery, in which a collection of trees and shrubs, one of each kind, is cultivated. In such a scene there ought to be sufficient room for each species and variety to attain something like its natural size and shape; though, from the limited space generally allowed to collections of trees and shrubs in garden scenery, this is very seldom the case. The most complete arboretums in Europe, so far as respects the number of species collected together, are those of Messrs. Loddiges, at Hackney; and of the London Horticultural Society, at Chiswick.

ARBORICU'LTURE. (Lat. arbor, *a tree*, and colere, *to cultivate*.) The art of cultivating trees and shrubs, which are chiefly grown for timber or ornamental purposes. The culture of trees and shrubs grown for their fruits as food, is included under horticulture, and is sometimes called Pomology. The origin of arboriculture may be traced to the progress of agriculture; because, as population increased in any given country, it would become necessary to clear away the natural woods in order to grow corn, and other products of the field and garden. After this was done to a certain extent, a scarcity of wood, both for fuel and building purposes, would be found, and then recourse would be had to artificial plantations, or arboriculture. This art may be considered almost exclusively as one of modern times, because, though the Greeks and Romans planted both timber and ornamental trees, yet they did so only on a very limited scale, and near their houses, for the purposes of shade or ornament. They also planted the elm and the poplar, for supports to their vines; and they cultivated osier beds for the purposes of basket-making; but there is no instance on record of their having planted trees with a view of cutting them down either for timber or fuel. Wood for these purposes they procured from the native forests, to the management of which they paid particular attention. In Britain, the first plantations of barren timber on a large scale, with a view to profit, were made during the reign of Henry VIII.; and the kind of tree planted was chiefly the oak, which was raised from the acorn where it was finally to remain. Since that period, the formation of artificial plantations has been on the increase, more especially during the latter end of the last and the beginning of the present century, when the foreign supply of timber was comparatively limited by the war, and when there was a great demand for timber for ship-building. The discovery of coal mines, and more especially the increased facility of working them after the invention of the steam-engine, by providing fuel exclusively of wood, has rendered the necessity of preserving natural woods, and of forming artificial plantations, less in Britain than in any other country in the world. In consequence of this, there is no other country in which so small a portion of its surface is covered with forests; the woods being almost every where planted and maintained for ornamental purposes. On the continent of Europe, the practice of sowing or planting barren timber was little known before the time of Louis XIV., though the natural woods both of France and Germany were appropriated, and carefully preserved, for many generations before. At the present time, in consequence of the continental nations depending almost entirely on wood for their fuel, the care of the natural forests, and the formation of artificial plantations, form an important part of the duties of government. In North America, in the oldest cultivated parts of the country the formation of artificial plantations is barely commencing, while in the back settlements, or newest parts, the felling and clearing of timber is only now taking place.

The science of Arboriculture depends on a knowledge of the nature of trees, of the different agents in cultivation, and of the purposes to which trees are applied in the arts. The practice includes nursery culture: viz. propagation by seeds, by cuttings, layers, grafting, &c., and raising in beds and rows; transplanting, pruning, thinning, and, finally, felling, and the succession of kinds. The nursery culture is carried on in limited spots, called nursery grounds, or nursery gardens, by gardeners or nurserymen; and the other operations in woods, groves, rows, hedgerows, hedges, copses, osier holts, &c., by foresters, woodmen, or hedgers.

ARBU'STUM. The classical name for an orchard, hopyard, or vineyard.

A'RBUTUS. (Arbutus, Lat.; ar, *rough*, and boise, *bush*, in Celtic, according to Dr. Thëis.) A genus of evergreen trees, with conical pallid flowers and a bullet-like succulent austere fruit, rough externally, and containing numerous minute seeds. Several species, all hardy, are known in gardens; the most common of which is Arbutus unedo, the most beautiful A. andrachne.

ARC. In Geometry, a portion of a circle or other curve line. The arc of a circle is the measure of the angle formed by two straight lines drawn from its extremities to the centre of the circle.

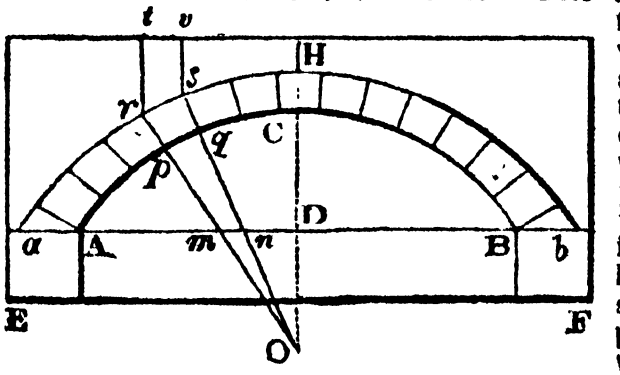
A'RCA. The name of a Linnæan genus of the Vermes Testacea, characterised by a bivalve and equivalve shell, having numerous sharp alternate teeth at the hinge. In modern systems the genus is placed among the Acephalous Lamellibranchiate mollusca, and is raised to the rank of a family (*Arcadæ*), subdivided into the subgenera Arca, Cucullæa, Pectunculus, and Nucula.

ARCA'DE. (Fr.) In Architecture, a series of arches crowned with a roof or ceiling, with a walk or passage thereunder. The piers of arcades may be decorated with columns, pilasters, niches, and apertures of different forms. The arches themselves are turned sometimes with rock-worked and sometimes with plain rustic archstones or voussoirs, or with a moulded archivolt, springing from an impost or platband, and sometimes,—though that is not to be recommended,—from columns. The key-stones are generally carved in the form of a console, or sculptured with some device. Seamozzi made the size of his piers less, and varied his imposts and archivolts in proportion to the delicacy of the orders he employed, but Vignola made his piers always of the same proportion.

ARCA'NUM. (Lat. *a secret*.) A term often applied to Chemical and Medical preparations by the old philosophers. Thus they called red oxide of mercury, obtained by the action of nitric acid, Arcanum corallanum; sulphate of potash, Arcanum duplicatum, &c.

ARCE'STHIDA. (Gr. ἀρχεύθος, *a juniper berry*.) A small cone whose scales become succulent, and grow together into a fleshy ball.

ARCH. (Lat. arcus, *a bow*.) In Building, a structure of stones or bricks, or distinct blocks of any hard material, disposed in a bow-like form, and supporting one another by their mutual pressure. In describing arches some technical terms are made use of, which it will be convenient to define. The arch itself is formed by the voussoirs, or stones cut into the shape of a truncated wedge, the uppermost of which at C is called the keystone. The seams or planes in which two adjacent voussoirs are united, are called the joints; the solid masonry, A E and B F, against which the extremities of the arch abut or rest, are called the abutments; and the line from which the arch springs at A *a* B *b*, the impost. The lower line of the arch stones, A C B, is the intrados or soffit; the upper line, the extrados or back. The [illegible] of the arch is called the spring of the arch; the middle, the crown; the parts between the spring and the crown, the haunches. The distance A B between the upper extremities of the piers, or the springing lines, is called the span, and C D is the height of the arch.




There is considerable difficulty in determining the form which an arch ought to have, in order that its strength may be the greatest possible, when it sustains a load in addition to its own weight; in fact, the determination cannot be accurately made, unless we know not only the weight of the materials the arch has to support, but also the manner in which the pressure is connected; that is to say, unless we know the amount and direction of the pressure on every point of the arch. Supposing, however, that the arch has to sustain only its own weight, and supposing, further, that the friction of the archstones is reduced to nothing, a relation between the curve and the weight of the voussoirs may be found by comparing the pressures which are exerted on the different joints. Thus the pressure on any joint, *s q* for example, arises from the weight of that portion of the arch which is between *s q* and the summit C H. Now, the portion of the arch C *q s* H is sustained by three forces: the pressure on the joint *s q*, the pressure on C H, and its own weight. Let *s q* be prolonged till it meets C D in O, and let *n* be its intersection with A B. It is

a theorem in statics, that when a body is held in equilibrium by three forces balancing each other, these forces are proportional to the three sides of a triangle formed by lines respectively perpendicular to the directions of the forces. The three forces sustaining C $q$ $s$ H are, therefore, proportional to the sides of the triangle O D $n$; for the pressure on $s$ $q$ acts in the direction perpendicular to $s$ $q$ or O $n$; the pressure on C H is perpendicular to D O, and $n$ D is perpendicular to the direction of gravity. The pressure on $s$ $q$ is, therefore, to the pressure on C H as $n$ D to D O. In like manner, the voussoir $p$ $r$ $q$ $s$ being so shaped, that $r$ $p$, when produced, meets O H in the point O; the pressure on the joint $r$ $p$ is to that on C H, as $m$ D to D O. Hence, the pressure on $s$ $q$ is to the pressure on $r$ $p$ as D $n$ to D $m$. We are thus led to infer that the voussoirs ought to increase in length, from the key-stone to the piers, proportionally to the lines D $n$, D $m$, &c.; for in this case, the surfaces of the joints being increased in proportion to the pressure they sustain, the pressure on every point of the arch will be equal. It will also be observed that the angle $n$ O D is equal to the angle made by a tangent to the curve at $q$, and the horizontal line parallel to A B; the angle $m$ O D equal to that made by the tangent at $p$ and the horizontal line; and the radius D O remaining constant, D $n$ is the tangent of the first of these angles, and D $m$ of the second; hence the pressures on the successive joints are proportional to the differences of the tangents of the arches reckoned from the crown. From this property, when the intrados is a circle given in position, and the depth of the key stone is given, the curve of the extrados may be found. When the weights of the voussoirs are all equal, the arch of equilibration is a catenarian curve, or a curve having the form which a flexible chain of uniform thickness would assume if hanging freely, the extremities being suspended from fixed points.

Such is the form which theory shows to be the best adapted to give strength to an arch, on the supposition that there is no superincumbent pressure. But it seldom if ever happens that this is the case, and therefore it is entirely unnecessary, in the actual construction of an arch, to adhere closely to the form determined on the above supposition. Indeed, on account of the friction of the materials and the adhesion of the cement, the form of the arch, within certain limits, is quite immaterial, for the deviation from the form of equilibration must be very considerable before any danger can arise from the slipping of the arch-stones. The Roman arches, which have resisted the attacks of time for so many centuries, are generally in the form of a semicircle. For bridges, it is better to employ a smaller segment of a circle; frequently the elliptic arch is preferred, on account of the beauty of its form.

It has not been satisfactorily ascertained in what country arches were first erected. They do not occur in any of the buildings of the Egyptians that can unquestionably be referred to an ancient date; and if they were not altogether unknown to the Greeks before the period of the Roman conquest, their principal uses appear to have been very little understood. They do not appear ever to have been employed in roofing the temples, or to have formed a part of ornamental architecture. By the Romans, however, the advantages of the arch were well understood at a very remote period. The Cloaca Maxima, which is an arched structure, is referred, with the greatest probability, to the age of the Tarquins; the arched dome is supposed to have originated with the Etruscans, and to have been employed for the convenience of the augurs, affording them a shelter from the weather, and permitting them at the same time to have a view of the whole range of the horizon. In the magnificent buildings erected under the empire the arch is of frequent occurrence; and it was by the Romans that it was first applied to its most useful purposes, namely, the construction of bridges and aqueducts. The Romans, however, appear to have given little attention to the graces of form in the erection of their arches, for they seldom deviated from the semicircle. It was in the middle ages that the pointed or Gothic arch was introduced, when Christians and Saracens vied with each other in giving beauty to their public buildings, by multiplying and combining arches in all possible manners. The associated architects of those ages, says Dr. Robison (*Ency. Brit.* art. *Arch*), having studied this branch of the art of building with so much attention, were able to erect the most magnificent buildings with materials which a Greek or Roman architect could have made little or no use of. There is infinitely more scientific skill displayed in a Gothic cathedral than in all the buildings of Greece and Rome; indeed, these last exhibit very little knowledge of the mutual balance of arches, and are full of gross blunders in this respect; nor could they have resisted the shock of time so long, had they not been almost solid masses of stone, with no more cavity than was indispensably necessary. It is somewhat remarkable that those architects do not appear ever to have studied or paid any regard to the theory of equilibrated arches. The form which they adopted was strong, and capable of resisting considerable inequalities of pressure, and hence the durability of their constructions. For further particulars on this subject, *see* BRIDGE. DOME.

ARCHÆO'LOGY. (Gr. ἀρχαιος, *ancient*, and λογος, *a description*.) The science or study of Antiquities, and chiefly, in ordinary language, of those minor branches of antiquities which are discarded from the contents of general history; as genealogies, national architecture, manners, customs, heraldic and similar subjects.

ARCHÆ'US. (Gr. ἀρχη, *principle*.) A term used by the old chemists and physicians to imply the occult cause of certain phenomena. Van Helmont and Stahl ascribe certain vital functions to the influence and superintendence of a spiritus archæus.

A'RCHAISM. (Gr. ἀρχαιος, *ancient*.) In Rhetoric and Literature, the use of an obsolete expression or phrase, giving an air of antiquity to the passage in which it occurs.

ARCHA'NGELS. A superior order of angels. The term occurs once in Scripture, being applied by St. Judo to Michael.

ARCHBI'SHOP, or METROPOLITAN. The primate of a province containing several dioceses. The term first came into use in the fourth century, and was then considered superior to that of metropolitan, and equivalent to patriarch, or bishop of an imperial diocese, such as Rome, Constantinople, Antioch, Alexandria, and Carthage.

ARCHDE'ACON. An Ecclesiastical officer, ranking next to the bishop. As deacons were originally attendants upon the bishop, so the archdeacon was one selected from among the deacons of several dioceses. His functions were confined to attending upon and assisting the bishop in the discharge of his spiritual duties and the management of his diocese, and had at first no jurisdiction. There are now more archdeacons than one in each diocese, the whole number in England being sixty; and they are employed by their bishops in visiting the clergy of the diocese, and in the dispatch of other matter relating to the episcopal superintendence.

ARCH-DUKE. A title originally assumed by variou dukes, but in the sequel appropriated to those of th house of Austria by the Emperor Frederic III. in 1453. I is now strictly confined to the younger sons of an Empero of Austria.

A'RCHER. (From the Latin arcus, *a bow*.) A bowman; one who uses a bow. The use of the bow in war may be traced to the earliest antiquity, and to the history of almost every people. The exact time when the English long-bow began to be used in war is not exactly ascertained: the Normans brought with them the arbalest or cross-bow, but from the reign of Edward II. the long-bow, the favourite national weapon, seems to have been fully established. When fire-arms began to come into use, various attempts were unsuccessfully made, by statute and proclamation, to prevent this ancient weapon becoming obsolete. In France the officers who attended the lieutenant of police were, before the Revolution, always called archers, although provided with carbines. Artillery is a French term, originally signifying archery, and the London artillery company were a fraternity of bowmen.

A'RCHETYPE. (Gr. ἀρχετυπος, from ἀρχη, *origin*, and τυπος, *type*.) The original of that which is represented in a picture or statue; and, figuratively, the reality which is shadowed out in prophecies or mysteries. Thus, in Theology, the death of our Saviour is said to be the archetype of the Jewish sacrifices, which were instituted as types of that event. (*See* TYPE.)

A'RCHIL. (A corruption of orseille, French.) A kind of purple dye obtained from the lichens, called *Rocella tinctoria* and *fuciformis*. It is chiefly procured in the Canaries.

ARCHIMA'NDRITE. A title of the Greek Church, equivalent to abbot; the word mandia signifying a *monastery* in the language of the Lower Empire.

A'RCHITECTURE. (Gr. ἀρχη, *beginning*, τεκτων, *artificer*.) The art of Building, according to certain proportions and rules determined and regulated by nature and taste. Architecture becomes an art at that period only in the history of nations when they have reached a certain degree of civilisation, of opulence, and of luxury. In an earlier state, it can only be reckoned among the trades or occupations necessary to the wants of mankind; its application is then very limited, its use little more than furnishing man with shelter from the waters of the heavens, and protection from the inclement vicissitudes of the seasons. At its birth, however, it assumes a character in all countries which in the sequel stamps it with such remarkable and distinguishing features, that in the summit of its grandeur the traces of its early origin are still discernible. Notwithstanding the interval of so many ages from its origin, we may even trace the general form of architecture to three distinct states of the human race, which necessarily influenced the nature of the

habitations suitable to each, and which ultimately became standard models of the art.

People whose dependence for their sustenance was on hunting the beasts of the field, as well as those who lived on the produce of the waters, from the natural indolence induced by those occupations and the little industry called for in such courses of life, would not be at an early period led to the construction of dwellings. They availed themselves of the natural caverns of the rock, or at most hollowed them out, for shelter and protection.

Nations occupied in a pastoral life, through a large portion of the year, obliged, for the sake of fresh pasturage, frequently to change their abode, and thus lead a wandering life, would find the most suitable dwelling one which they could remove with themselves; hence the use of tents.

Agriculture, which requires continued and active industry on the same spot, doubtless induced man to exert his energies in the erection of solid and durable dwellings. For his produce no less than for himself were they necessary, and the wooden hut with its sloping roof was the offspring of his wants.

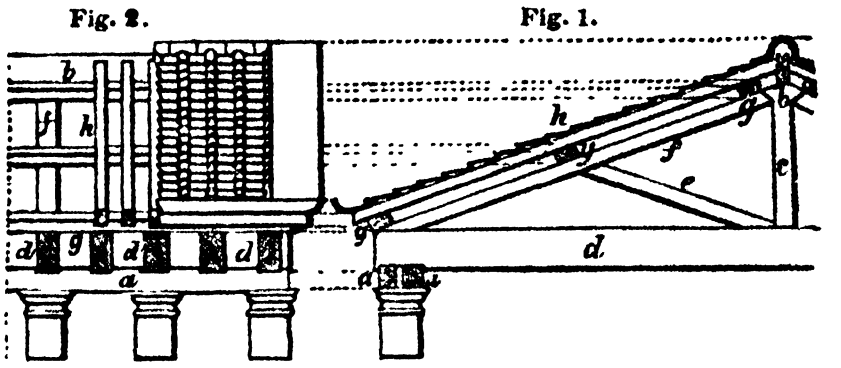
It is not, however, to be understood that in every country the art can be traced to a single principle, since among some nations, as will hereafter be seen in relation to Egyptian architecture, more than one will be found to enter into the combination. Causes, independent of the habits of the people, may have had their influence on the formation and taste of different species of architecture; yet will these in their turn be found dependent on the first named. In short, it is to the three states of mankind that we must refer to account for those striking peculiarities which prevent us from confounding the art of one people with that of another. In some of its details caprice may have had a share; but in every country the great leading forms spring from principles dependent on the different states of life we have just enumerated.

Those who have sought for the original types of this art in subterraneous temples and excavations exclusively, have fallen into error. These are found in almost every country. Many of them, such as the famous ear of Dionysius, and the quarries of Syracuse, had been the quarries that furnished stone for their neighbourhoods. By the help of history, and an acquaintance with the habits of the nation, by a knowledge of its origin and earliest mode of life, only, are we able to form a just opinion on its architecture. By the aid of these we recognise the origin of Egyptian architecture. A taste for subterraneous dwellings has existed among the Egyptians from the remotest period even to the present hour. The massive and colossal character of their edifices seems to bear a strong relation to hollow caves of rocks; and though the Egyptians grafted on this at a later period forms and details, whose types may be traced to carpentry, yet it is quite clear that the types of the masses must be found in a far different origin. The same passion for subterranean works appears in parts of Asia. The climate, and similar physical causes, would seem to have led to it. At Elephanta none of the parts appear to have been derived from imitation of any system of carpentry; the columns cut out of the rock, the short and massive proportions, the shape of the capitals, and their details throughout, point to an entirely different type for their invention.

In the architecture of China we have remarkable indications of timber construction. M de Pauw justly observes, it is impossible to mistake the objects which served as models for the earliest Chinese buildings. In them the tent is the object of imitation, and this is quite in character with the primitive habits of the Chinese, who, like all the Tartars, were Nomades or Scenitæ, encamping with their flocks ages before they gathered into cities. Their cities of the present day exhibit the appearance of a vast encampment, and the great extent of them seems to indicate an insolidity of construction that will not allow of a number of stories above each other.

The wooden hut, then, which has been universally assumed as the model or type of all styles of architecture, and among all people, could not have been that of Chinese or Egyptian, though it unquestionably was that of Grecian architecture. The Greeks, working upon this, transferred to stone the forms of an assemblage of carpentry, a construction which gave birth to the members of the orders of architecture which are to this day the ornaments of our buildings. This style, be it remembered, belongs to a nation whose chief occupation is agriculture. In pursuing this theory, a few observations only will be needed. The first trees driven into the earth for the purpose of bearing a covering for shelter, were the origin of the insulated columns of the portico of a temple, and became one of the most splendid features of the art. As the trees were wider in diameter at the bottom than the top, so were the columns diminished in thickness as they rose. Scamozzi imagines that the mouldings at the bases and capitals of columns had their origin in cinctures of iron, to prevent the splitting of the timber; others, however, think that the use of the former was to elevate the shafts from the dampness of the earth, and thereby prevent rot. The architrave or chief beam speaks its origin. It was the great beam placed horizontally on the tops of the columns, and destined to receive the covering of the entire building. The joists of the ceiling lay upon the architrave, the space in height which they occupy being called the frieze, the ends of the joists in the Doric order bearing the name of triglyphs, from their being sculptured with two whole and two half glyphs or channels. Sometimes the ends of them are sculptured into consoles, as in the composite order of the Coliseum at Rome. The space between the triglyphs was for a long period left open, as we find from a passage in the Iphigenia of Euripides, where Pylades advises Orestes to slip through the metopes in order to get into the temple. These intervals were afterwards filled up solid; and in the other orders, the whole length of the frieze becomes one plain surface. The inclined rafters of the roof formed a projecture beyond the face of the building, which delivered the rain free of the walls. The ends of these rafters are the origin of mutules and modillions, the former whereof appeared in the cornice with their undersides inclined, as in the Parthenon at Athens. The form of the pediment followed from the inclined sides of the roof, which were regulated in respect of their inclination by the nature of the climate. (*See* art. Roof.) Here, then, in the skeleton of the hut, may be traced the origin of the different members of architecture, which will be better understood by reference to the subjoined diagram. Figs. 1 and 2 exhibit the parts of

Fig. 2. Fig. 1.




a roof in section and elevation: *a a* are the architraves, or trabes; *b b* the ridge piece, or columen; *c* the king post, or columna of a roof; *d d* the tiebeam, or transtrum; *e* the strut, or capreolus; *f f* the rafters, or cantherii; *g g g g* the purlines, or templa; *h h* the common rafters, or asseres.

It has been suggested, but with less probability, that the main supports being by degrees placed at greater distances from each other than the strength of the architrave would safely admit, inclined struts were placed from the sides of the columns or supports to the underside of the architrave, to lessen its bearing, and that these gave the first notion of the use of arches in architecture. The subject has been pursued into many more details, on which our limits do not permit us to enter.

It is difficult, perhaps now impossible, to fix the exact period of the invention of architecture in Greece. Every art is perfected by slow degrees, and is the result of the labours of many. In the time of Homer, architecture does not seem to have been in so forward a state as to have been reduced to principles and proportions of a fixed nature. No mention is made by the poet of the use of the orders of architecture. The material seems with him of more importance than the form; and well selected and polished stones, more than fine proportions, are enumerated as the principal merit of the palace of Alcinous.

The Doric order, doubtless the earliest of the orders, remains without testimony which can satisfactorily assure us of the period of its invention. Its name is not alone sufficient proof that it was invented by Dorus, the son of Helen, and king of Achaia and Peloponnesus. It is possible it might have acquired its name from having been used at the celebrated temple which that prince built at Argos in honour of the goddess Juno; or it might have been, that, from the use of it by the Dorians, it obtained introduction into the other parts of Greece. Certain, however, it is that in the time of Alexander the Great the three original orders of architecture had been brought to perfection. Moral as well as physical causes had contributed to bring the arts to this state. Liberty, love of country, and ambition had made Athens the common centre of science and art. The defeat of the Persians at Marathon, with other victories, had restored peace to the country. In the period preceding the Peloponnesian war, there was a general burst of talent in Greece. In it the chisel of Phidias was employed; philosophy, eloquence, the military art, the arts and sciences, all conspired to give the epoch lustre. It was in this age that the Greeks commenced the rebuilding of the temples and edifices that had been destroyed in the Persian war, buildings whose ruins had been carefully preserved, perhaps, for the express purpose of keeping alive a remem-

brance of the danger that constantly menaced them as a nation. It was not, indeed, until after the flight of the general of Xerxes, and the victory of Themistocles, that a general restoration of their monuments was commenced, and the city of Athens rebuilt; a city whose edifices might be considered, as M. Quatremère de Quincy has well observed, as so many trophies of the victory at Salamis. This was the epoch of a pure and grand style of architecture, and, indeed, of art generally. The sculpture of that period is marked by the same character of purity, sublimity, and grandeur; and the Elgin marbles, fortunately now possessed by this country, exhibit a perfection which has never been approached by modern art, and which we scarcely conceive can be surpassed. It was in this age that the temple of Minerva, known by the name of the Parthenon (because that goddess preserved her virginity pure and inviolate), was erected; a building which displays, perhaps, the finest model of the Doric order.

The Ionic order seems, at this period, to have likewise received the finishing touches of that grace and elegance whereof it was susceptible. This order, passing from Greece to Asia Minor, seems, in that enervating climate, to have acquired elegance and finish at the expense almost of solidity. Whether we are indebted for its invention to the people whose name it bears, is of little importance. Upon the relation of Vitruvius no dependence can be placed. At the period, however, of the erection of the temple of Minerva Polias at Athens, which was about the time we have alluded to, it seems to have been brought to a state of perfection that leaves us nothing to desire. The capitals of this example are splendid specimens of decorated architecture.

By a substitution of acanthus leaves for the olive, laurel, and lotus leaves of the Egyptian capital, Callimachus is said to have invented the Corinthian capital, the feature which distinguishes the Corinthian from the Ionic order. The tale seems an idle one; but though almost threadbare, we cannot omit it, and will give it in the words of the author who has recorded it. "A Corinthian virgin, of marriageable years, fell a victim to a violent disorder. After her interment, her nurse, collecting in a basket those articles to which she had shown a partiality when alive, carried them to her tomb, and placed a tile on the basket, for the longer preservation of its contents. The basket was accidentally placed on the root of an acanthus plant, which, pressed by the weight, shot forth, towards spring, its stems and large foliage, and in the course of its growth reached the angles of the tile, and thus formed volutes at the extremities. Callimachus, who for his great ingenuity and taste was called Catatechnos by the Athenians, happening at this time to pass by the tomb, observed the basket, and the delicacy of the foliage which surrounded it. Pleased with the form and novelty of the combination, he constructed, from the hint thus afforded, columns of this species in the country about Corinth, and arranged its proportions, determining their proper measures by perfect rules."

The annexed diagram gives a representation of the circumstance, as usually found in architectural works: the reader, however is at liberty to make his own representation of it, which will most probably be as near the truth as that here given.



But few ancient examples of the Corinthian order are extant of so early a date as the age of Alexander. Its delicacy and slenderness render it very susceptible of the ravages of time; and it has been suggested, that the value of the material of which the columns and capitals of this order were made, excited the cupidity of the Romans to remove them.

The general opinion runs, that architecture, as well as the other arts, was carried into Etruria by the Pelasgi, at which period Doric was the only order in use in Greece, and was the only one, moreover, as far as can be judged of, adopted by the Pelasgi. But they changed its character, stripping it of triglyphs, and adding to it a base. — The Romans, who borrowed their earliest architecture from the Etruscans, adopted, under the name of Tuscan, this Doric order, thus cheated of its fair proportions, which is in truth but a species of Doric.

Rome appears to have been indebted to the people of Etruria for its earliest work of any note. It has always been supposed, that to an Etruscan architect was confided the construction of the immense sewer which drained the city, and in which might be discerned a presage of its future grandeur. The undecorated and simple art of Etruria suited the roughness and austerity of a warlike and then needy people. The art of architecture was long neglected among them. Their temples and palaces for a long period were protected from the seasons by a covering of nothing more than clay and straw. Marble and slavery entered Rome together, under the reign of Augustus. Effeminacy had been induced by the riches of the known world which centered in the city, whose inhabitants did not apprehend that slavery would follow in the train of the arts which were bound to the triumphal chariot.

Augustus, sensible that the only mode of tranquillising the people, when liberty was no more, would be by introducing the pleasures and luxuries attendant on the arts, exerted himself most zealously for their prosperity: his conduct on this point is sufficiently exemplified in the boast attributed to him, "That he found the city built of brick, and left it constructed with marble." Livy compliments him as the founder or restorer of temples, "Templorum omnium conditorem aut restitutorem." His patronage drew the most skilful Grecian artists to Rome, which now became the capital of the arts, and architecture reached all the perfection it could there attain. It was under Augustus that Vitruvius wrote his work on architecture, the only ancient text-book on the art that has reached us. It has been of late the fashion to decry the utility of this author. Those that have done so know little of the art. Though in matters relating to the history of architecture, our author deals somewhat in fable, the more important parts of his work are invaluable; and if one of the most profound architects that ever existed could dignify Vitruvius with the title of "our great master," it ill becomes the small fry of the present age to carp at him. Under Agrippa, the son-in-law of Augustus, the Pantheon was raised; one of the most magnificent examples of Roman grandeur. Amongst other superb structures he introduced baths, and constructed a considerable number of fountains, temples, &c. Under the successors of Augustus, the public buildings of the nation continued to increase; but the art began to degenerate in the reigns of Tiberius, Caligula, and Claudius. It could not be expected, that it would revive under such a personage as Nero, who deprived the finest statues of their heads to substitute his own portrait on their shoulders. He was, however, a great encourager of buildings on a highly decorated and colossal scale; witness the Domus Aurea, built for him by Severus and Celer, in which, from all accounts, richness and luxury themselves were exhausted. The wisdom and greatness of character of the emperor Trajan were infused into the buildings of his reign. The triumphal arches, but especially his column and forum, incontestably prove the rise of the art under his auspices, at which time his architect, Apollodorus, who raised the column to his memory, was highly patronised. Hadrian and the Antonines were also much devoted to the art, in which the former himself practised. Marcus Aurelius was so attached to the arts, that he became a pupil of Diognetus. Antoninus Pius, at ancient Lanuvium, built a country house, whose ruins at the present day astonish by their extent: as an index to its magnificence, it may be mentioned that a cock for regulating the supply of water, of the weight of forty pounds, and formed of silver, has been extracted from its ruins. The art, however, was then in its decline, and soon after disappeared under his successors. The arch of Septimus Severus is an extraordinary falling off from what it had been; and it is difficult, in such a short period, namely, since the reign of Marcus Aurelius, to conceive how the art of sculpture, more especially, could have become so debased. The details of what is called the goldsmiths' arch indicate the decay of good taste; its profiles are bad, and the ornaments overloaded.

For a short time architecture was prevented from entirely sinking, by the fostering hand of Alexander Severus; but the fall of the western empire completed its ruin: it is, however, from the reign of Gallienus, whose arch proves to what a state it was reduced, that we must reckon the total extinction of the arts. Architecture was indeed most likely to have survived the general wreck, and perhaps was not completely involved in the universal ruin. In an age when no sculptor existed, the baths erected by Diocletian exhibited a grandeur manifest even in their stupendous remains; it seems, however, that a bad taste must have reigned in the design of them, inasmuch as we learn from history, so overloaded with ornament was the edifice, that during the public games a great number of spectators lost their lives by the fall of some of the flowers from the ceilings and entablatures. Diocletian's palace at Spalatro is another proof of the enormous efforts made by that emperor, and of what the art could then do. About the same time, or in the time of Aurelian, were erected the extensive buildings in Cœlosyria, at Balbec, and Palmyra: vicious as they are in taste, one is astonished at the vastness of the plans, the boldness of the undertaking, and the funds lavished on their construction. There is nothing more instructive to a student on the rise, progress, and decline of Roman art, because the eye can almost cover it at one glance, than an examination of a series of Roman coins; and it is recommended, as likely to make an impression on the mind much stronger than the most elaborate treatises on the subject.

Though architecture, from various causes, was des-

tined to survive the other arts, its protracted existence could not extend beyond the period of the removal of the seat of empire to Byzantium. The endeavours of Constantine to erect his city into a metropolis that should rival Rome, which he spoiled of its treasures, were vain; all his efforts to embellish it with the most splendid monuments only proved how ineffectual are the attempts of kings to subject the arts to their power. That which Constantine left behind him in the eternal city and the rest of Italy fell a prey to the unrestrained fury of the Visigoths. The edifices which they afterwards reconstructed were from fragments of those they had destroyed; but their ignorance or forgetfulness of the stations and proportions in which they had originally been used, induced a sad confusion of the different members — entablatures inverted, and other grotesque arrangements, were to be seen in their buildings. The vast number of columns which the ruins supplied was used as piers for arcades, from which originated, beyond doubt, the plan of the Gothic cathedral, after its passage through various modifications. Quatremère de Quincy attributes (Enc. Method.) the use of the arch springing from columns to the ignorance of the builders of the period, who knew not, he assumes, the mode of connecting the different lengths of an architrave; but it seems scarcely probable that they, who so well knew the mode of connecting the voussoirs of an arch, should have been deficient in understanding the principle in question, which is either that of the arch itself or of the simplest joggling. From this period to the restoration of the arts at a late period, all sight of the original types seems to have been lost; and in the end arose a style under the name of Gothic, which will be separately treated of. Here occurs a considerable gap in the history of the art: all is dark on the subject, though the ancient taste does not seem to have passed away altogether. The first glimmer of returning light appears under Justinian, in the church of St. Sophia at Constantinople, in the sixth and seventh centuries. It was the chef-d'œuvre of the lower empire, and perhaps, indeed, the only specimen it has left us. The church of St. Mark at Venice rose in the tenth or eleventh century; it was the work of Greek architects. and is invaluable in tracing the history of architecture: its plan and its beautiful proportions remind the spectator of the magnificence of the ancients. Nearly about the same period other cities of Italy began to exhibit advances in the art. In 1013 the Florentines laid the foundations of the church of S. Miniato; but the most extraordinary monument of the period was the cathedral at Pisa, erected by Buschetto da Dulichio, a Greek architect, in 1016: this building is lined both inside and outside with marble, and the roof is borne on four ranks of columns of the same material. The commerce of the Pisans enabled them to explore the Levant, the islands on the coast of Asia Minor, Egypt, and Africa, for the most costly and precious marbles which were used in the work. Painters and sculptors were brought from Greece to embellish their buildings, and these contributed to introduce a better taste in the arts. Had Buschetto lived to form a school here, there can be little doubt that architecture would have been at once re-established; but such does not appear to have been the case, and the successful cultivation of it was, consequently, deferred for a time. The falling tower, as it is usually called, or campanile, at Pisa, was raised close to the cathedral in the twelfth century; its inclination evidently arises from a failure in the foundation; its style evinces but little progress as compared with the cathedral.

In the thirteenth century the church of the Virgin of Assisi was erected in Tuscany, and the castel del Ovo at Naples; the first by Lapo, and the last by Fucio, both Florentines. Nicolo da Pisa, their countryman and cotemporary, was employed on several edifices of consideration in Bologna, Padua, and Venice. His greatest work was the church at Padua, dedicated to St. Anthony, the sculpture in which is chiefly from his hand. The church, however, at Florence, della santissima Trinità, is his finest work, of which it is no small encomium to say that it was the admiration of so great a man as M. A. da Buonarotti. Arnolfo di Lapo built the church of St. Croce, and designed the cathedral also at Florence of Santa Maria de' Fiori. All the cities of Italy, indeed, at this epoch seemed to be emulous of outvying each other. Paolo Barbetta was engaged at Venice on the church of Santa Maria Formosa; many works were in progress at Bologna; the marble chapel of the church of Santa Maria Maggiore at Rome, about the year 1216, was executed by Marchione: every effort indicated the speedy restoration of pure art. These scintillations, however, of good taste were confined to Italy; in the other parts of Europe the Gothic style, — one, indeed, in some of its monuments, of stupendous grandeur, of which we shall treat in another article, — was prevalent, and soon afterwards in Germany carried to the utmost pitch of perfection. It was in the thirteenth and fourteenth centuries that the cathedral at Strasbourg was erected, under the designs of Irwin Steinbeck. The fourteenth century produced also in France and England some extraordinary Gothic structures.

In Italy architecture was fast approaching to a perfect restoration. John of Pisa son of the Nicholas whom we have just mentioned, was employed by his townsmen on the Campo Santo. This public cemetery was in the Gothic style, and is remarkable for the elegant simplicity of its plan and the beauty of its details. It is a singular link of the chain of history of this art: there is no difficulty in discerning the struggle in the mind of the architect to free himself from those Gothic shackles which seemed to hang on it as an impediment to an immediate return to the classic taste of the land, which became completely restored in Italy in the fifteenth century. The troubles throughout Europe were stilled at the time that Brunelleschi appeared as the restorer of genuine art, to which title he has a just and honourable claim. By a diligent investigation of the remains of ancient Rome, with the scale and compasses in his hand, he succeeded in reviving the ancient rules of art, the just use of the orders, and was himself the first to make a practical application of his discoveries. He well knew how to unite theory with practice, and from a profound acquaintance with the monuments of antiquity was led to the principles of sound construction, without which all other knowledge in architecture is useless.

The cathedral at Florence, begun in the Gothic style by Arnolpho, was reserved for Brunelleschi to finish, which he effected with a boldness worthy his genius. He surmounted the church with the tambour dome, which had, though projected by the original designer, been considered by the artists of the age more as a phantom of the imagination than a subject for reality. We have not room here to record the strange schemes that were proposed for carrying the project into execution; the facility with which the architect effected his object marks him as an artist, in that age, of surprising resources and ability.

The erection of the dome and cupola of Santa Maria de' Fiori opened the road for some of the grandest examples of human skill applied to the art: it was the subject of eulogy from Michael Angelo, and is still the astonishment of those who know how to appreciate the difficulties by which it was surrounded. The school formed by Brunelleschi spread by means of his disciples through Italy, and propagated the art in that revived state, which acquired liberal and enlightened protectors in the Medicis, the dukes of Milan, and many nobles of Italy, who opened their palaces to its professors, and the learned generally. These latter, who had after the arrival of cardinal Bessarion and other Greeks rendered Italy illustrious by their labours, soon opened the works of Vitruvius to the architect, in which they were considerably aided by Leo Battista Alberti, of the noble and ancient family of the Albertis of Florence, who himself did not disdain to practise architecture, as an art. Bold and ingenious as Brunelleschi his predecessor, his designs have the further charms of a grace and elegance which the former did not exhibit; and his work on the art, the only one at that period which could be put in competition with the ancient master Vitruvius, whose obscurity in many parts left much for experience to dissipate, displayed such vast stores of erudition, such a profound knowledge of construction, and so accurate an acquaintance with the works of the ancients, that it not only contributed to its firm establishment, but left little to desire on the theory and practice of architecture.

About the period that Alberti was thus engaged, an extraordinary work in the history of the art appeared from the pen of Francesco Colonna (in 1467), under the title of "Poliphili Hypnerotomachia," and published in folio by Aldus. This book is now extremely rare; it is replete with plates, some of great beauty, from wood blocks, and in it the author, in a supposed dream, promulgates sound precepts, noble ideas, and principles valuable to the amateur and architect. Felibien recommends to the artist its perusal, which he considers almost as necessary as that of Vitruvius. Indeed the poetic descriptions in it of pyramids, mausolea, colossal statues, circi, amphitheatres, temples, and palaces, seem to have made more impression at the time than the dry doctrines of Vitruvius, and Italy soon saw realised the poetic dreams of the author. In the period of a century and a half the cities of Italy were embellished with the works of Bramante, M. A. da Buonarotti, Raphael, Julio Romano, San Gallo, Baltazar Peruzzi, Giocondo, San Micheli, Sansovino, Serlio, Pirro Ligorio, Vignola, Palladio, Scamozzi, and a long list of others whose names are an honour to their country.

It was late before pure art reached this country. In it Inigo Jones is the father of architecture, and we, fortunately, still possess some of his beautiful designs. He can scarcely be said to have completely emancipated himself from the trammels of the debased Elizabethan style, as it is called, till the beginning of the reign of Charles I., which was a splendid epoch of the arts in this country. From many concurrent causes, the French

school of architecture has exhibited and still exhibits a very high degree of excellence, and may perhaps be fairly considered as holding the highest rank in the present day.

ARCHITECTURE, *Chinese*. As a description of the buildings of China would be out of place in a work of this nature, the subject of the present article is confined to a general view of the principles, the character, and the taste of Chinese architecture. To describe its general forms, for the purpose of identifying them, is unnecessary; they are universally known.

When we reflect on the limits to which in China the arts of imitation have for so long a period been confined, we are led to the conclusion, whatever be the cause, that the Chinese are deficient in that activity of mind which conducts other nations by degrees to perfection. In China the rise of the arts seems to have been constantly repressed by the state of mechanical drudgery and servitude in which the people are restricted. In their painting, for example, the most exact imitation of plants, fruits, and trees, is thought indispensable. A Chinese painter would think it necessary to count the scales between the head and tail of a carp he was about to represent; in other words, he is more of a naturalist than an artist. In China every matter relating to building is the subject of regulation by the police, which, rather than theory, governs its architecture. The laws of the empire detail and enforce with the greatest precision the mode of constructing a lou or palace for a prince of the first, second, or third rank, of a grandee, of a mandarin, &c. A man, unless he hold some office, who acquires a fortune by his own exertions is not allowed to build a house above his rank in society; his condition has nothing to do with it. According to the ancient law of the kingdom, the number and height of the apartments, the length and height of a building, are all regulated with precision, from the plain citizen to the mandarin, and from the latter up to the emperor himself. Herein alone we have sufficient to account for the poverty and want of invention in Chinese art.

In speaking of the principles of Chinese architecture, the word is not applicable in the same way as when we speak of classic architecture, but is meant to apply to those primitive causes which gave birth to it. Character and taste in every species of architecture are the necessary results of these elements. M. de Pauw has well described it, in respect of its principles and elements. It is impossible, he says, to be mistaken in the objects which were the models of imitation of their first buildings: they are imitations of tents, and that is in consonance with all our knowledge of the primitive state of the Chinese, who were, like all the Tartar tribes, nomadic. This, beyond doubt, is the true origin of their dwellings. However the missionaries of Pekin may have refuted M. de Pauw upon some inaccuracies, there canbe little hesitation in agreeing with him on this head. One of its strongest proofs is the form of the Chinese roof. Nothing but the form of a tent or pavilion could have given the idea of it; and though carpentry was for a long period made subservient to this form, reasoning from the progress of all inventions, it would be impossible to believe, where carpentry supplied the architecture, it should all at once have adopted combinations and coverings so light and at the same time so complex. There is another point of analogy with the tent construction, which is, that there is nothing like the appearance of a member of wood, similar to our architrave, destined to lie on the tops of the columns, and receive and support the remainder of the carpentry. The Chinese roofs, on the contrary, jut out beyond the columns, whose upper extremity is hidden by the eaves. hence the omission of the use of capitals. It is easy to perceive that extreme lightness must result from the imitation whereof we are speaking. The spirit and character of tents carried into the construction of cities might, at least in reality, be lost and altered by a change of materials. The semblance of lightness might be found in union with essential solidity of construction; the character would have been intellectually the same. Here, however, identity of material has contributed to the identity of the copy with the original. The Greeks, whose model was carpentry, copied in, as it were, a figurative manner, and the change from wood to stone soon removed the appearance of weakness and lightness that was found in the model. In China the material remains the same, and its architecture of wood still copies the model of wood; hence, the lightness of the original is transferred to the copy.

Lightness is the essential character of Chinese architecture; but there is another characteristic quality, both of the model and the copy, that is observable in the edifices of China, which is its gayness of appearance. In this respect scarcely any style presents a more pleasing effect. Its roofs, single and double, brilliantly painted, its gaily diapered porticos, the gloss over the whole surface, the harmony of this species of decoration, with the light and flowing forms of the buildings themselves, produce a sense of pleasure to eyes constantly accustomed to their contemplation, which would doubtless be disgusted with our cold and monotonous mode of decoration.

It is particularly in ornament and decoration that we are accustomed to investigate taste, which is the result of a combination of all the physical and moral causes that influence art. Yet, as every thing in architecture is connected by a sort of mutual relationship, it is difficult to fix the exact proportion that exists between construction and decoration, and especially in Chinese architecture. In speaking of ornament in architecture, one naturally recurs to sculpture for the purpose; but this is not found in Chinese architecture. With the Chinese ornament consists in varnishing columns, colouring roofs, coating walls with porcelain, and the like expedients. The figures painted on their buildings are connected with their religion, and the merit of the art is secondary. The art of ornamenting in China is a sort of patchwork, yet the parts of Chinese architecture are in unity with each other. A foreign style could never be made to amalgamate with it; it has been developed in a mode conformable to the wants of the country, and its duration for such a number of ages leads us to conclude that it will not lightly be abandoned by the people that have adopted it.

ARCHITECTURE, *Egyptian*. The preservation of the Egyptian monuments of architecture, in many instances so perfect as they still appear, is highly calculated to excite our surprise and admiration, inasmuch as ancient Egypt ceased to exist in its splendour long before the period of the earliest histories that have come down to us. Almost, as it were, separated from the rest of the world, by seas of sand as well as water, and bordering on the most savage tribes, it seems indebted to those circumstances for the protection its edifices have received. Had the country received as successors to its early inhabitants a powerful people, if rich and industrious cities had risen on the sites of the old ones, the temples of Egypt would doubtless have been used as quarries admirably suited to the purpose. Arabian hordes, and the almost barbarous and wretched inhabitants of the present day, have indeed built their villages on some of the ancient sites. The terraces of some of the temples serve as floors to modern habitations; and at Thebes, a town of two stories, or rather two stories of towns built on the ceilings of these everlasting ruins, indicate that the means of destruction have not been equal to the natural resistance of works of such solidity. No people ever existed whose whole feelings were so much a passion for ever-enduring monuments. Religion, a genius formed by that religion, government, habits, climate, materials, all united to confer on their buildings a durability as great as the power of man can confer; and the efforts resulting from such causes were successful.

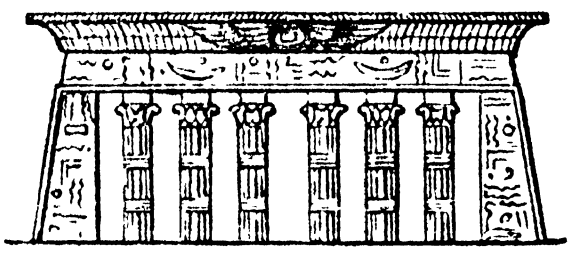
In a preceding article we have adverted to the three classes of mankind, whose different wants had an influence on their styles of architecture. It is not a forced supposition that the primitive inhabitants of Egypt used the excavations with which nature furnished them for protection against the heat of a sultry climate. As the inhabitants of Tyre, Sidon, and Palestine were indebted to their forests of cedar for becoming great workers in wood, so the Egyptians, from their earliest mode of life, from their quarries and the facility they acquired in hollowing them out, gained that aptitude for working stone, and that high degree of perfection, so manifest in their works. It is true that their country is not the only one in which excavations abound; but in most other places these excavations have been caused by working them as quarries, and no trace of architecture or human abode can be perceived in them. In Egypt, on the contrary, where the caverns still furnish dwellings for the inhabitants, immemorial custom has assigned them to the use of mankind. The immense subterraneous apartments of Egypt must not be placed to the account of luxury in sepulture. Herodotus tells us, that the priests would not allow him to visit the subterranean apartments of the labyrinth in which they dwelt, and which were considered the most beautiful. Now, if this species of dwelling was used in the refined times of Egypt, à fortiori would it have been so in the earlier ages. Throughout Egyptian architecture its origin appears. A simplicity bordering on monotony; extreme solidity, amounting to heaviness; are its principal characters. There is entire absence of every thing that can be traced to a type of carpentry, as in the Grecian orders; hence it appears certain, that at least its type was different, and that type was cavern excavation. The exception that seems to arise from the use of columns does not militate against the theory; for decoration invariably refers to nature for objects of imitation; and nothing would sooner occur in decorating pillars in every style than the imitation of trees and plants, without referring to them as a type.

The honours of sepulture seem to have been the cause of the most stupendous of the Egyptian monuments Diodorus Siculus tells us, that the kings of Egypt ex-

pended sums upon their tombs more immense than other kings did upon their palaces. They were of opinion, he observes, that the frailty of the body during life was not worthy of a substantial and solid abode. They considered a palace like an inn, which is occupied by many in succession, and in which one stops but for a day. Their tombs, however, they considered as the real palace in which the abode was to be perpetual; hence, they spared no expense in rendering them worthy of such an object. Some have supposed that the pyramids were but immense cenotaphs, and that the bodies of the kings were interred in some neighbouring subterranean spot; in short, that these masses of stone were erected to mislead one from the spot which the body occupied. This, however, would not make them the less monuments of sepulture. Some have attributed to the pyramids a mystic, others an astronomical, purpose.

From Egypt were derived the principal mysteries that passed into other religions, and it was in the darkness of subterranean apartments that those initiations had birth, in which secrecy was the first law. Secrecy was there deified under the figure of Harpocrates. According to Plutarch, the sphinxes with which the entrances of their temples were decorated, signified that Egyptian mythology was mysterious and emblematic. The number of vestibules enclosed with a series of doors, prevented the temple itself from being seen. This, which none were allowed to approach, was small in extent, and in it the sacred animal or its image was preserved. It was in the galleries, porticos, and dwellings of the priests, that the large area which the temples covered was occupied.

Excepting some varieties in the plans of their temples, a sameness of character and uniformity is observable in them, which pervade their fronts, their general forms, and the details of their decoration; which latter are mostly of the hieroglyphic species, certainly the most monotonous of all decorations. To give the reader a general idea of the temples of the country, a diagram of that at Esneh is subjoined. With the Egyptians, heaviness seemed to be



ESNEH.

synonymous with strength, height with grandeur, and size or mass with power. Uniformity of plan is universal. The right line and square was never abandoned, and, as M. de Caylus observes, there exists no circular monument in this style. In the elevations the uniformity is still more striking, no division of parts, no contrast, no effect. It would seem that the ideas we have for judging of art, were no guide with the architecture of that country. Uniformity of decoration was an almost necessary result of the institutions of the country: the edifices were destined to receive certain inscriptions in symbolic characters, and were not allowed to be left in that respect to the caprice of the architect.

As respects the materials for building which the country afforded, we shall speak as concisely as possible. Though palm trees are found about the deserts of Lybia, and near Dendera, timber of every sort is scarce; indeed the soil is not suitable to the growth of trees. The most common next to the palm tree is the acacia; but, with the exception of the palm tree, most of the trees of Egypt are unfit for building purposes. The oak does not grow in Egypt, and the modern inhabitants import that from Arabia, as well as the fir which they use in their buildings. Brick seems to have been a material used from the earliest date; it was unburnt, being merely dried in the sun. Pocock says it is made of the mud deposited by the Nile, which is of a black colour, sandy, and mixed with flints and shells. One of the pyramids described by Pocock, was constructed with this species of brick, and unconnected by any cement. Bricks, however, were used after undergoing the heat of the fire at a very early period, as we learn from Scripture, Exod. v. 6., where we find the Israelites condemned to the labour of making bricks without straw to burn them. Stone of almost every description, marbles, and granite, were to be had in profusion; and these, as we have before observed, the Egyptians were very expert in working.

In construction there must have been considerable mechanical knowledge employed, for some of the blocks of stone were of enormous dimensions; and to form an idea of the quantity used, it is only necessary to mention that the walls of some of their temples extend to the extraordinary thickness of twenty-four feet. Indeed, the walls to the principal entrance of the gate at Thebes are no less at their base than fifty feet in thickness. The stones are all squared inside as well as on the external face; no rubble-work is to be seen; another cause of the surprising durability of their monuments. The roofs are all formed of single blocks of stone from pier to pier; no trace of the arch is any where discoverable. In the pyramids the passages are covered with stones inclined to each other, terminating in a point, one stone lapping over the other.

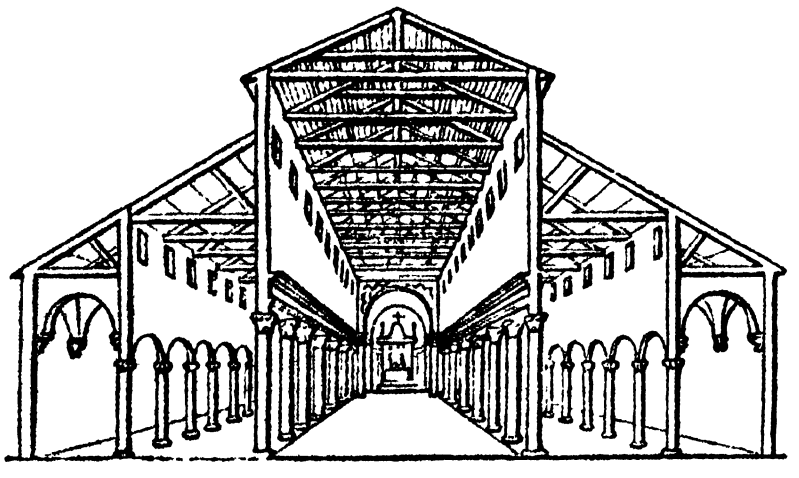
The Egyptian temple, unlike that of the Greeks, which may be almost all taken in at one view both interiorly and exteriorly, consists of an assemblage of porticos, courts, vestibules, galleries, and other apartments communicating with one another, each of which in size had little relation to the rest of the edifice. They were usually in a spot surrounded with walls; and those which were not so surrounded were inclosed in front by a wall engaged to the columns, and extending in height about a half or a third of the shaft. Strabo says that at the entrance of temples was a large paved court three or four times or even more of its width in length, which the Greeks called the dromos. This was ornamented with sphinxes in rows. Through the dromos was the propylum or fore portico; thence to another, and from that to a third, the number of them not being fixed. Beyond the propyla was situated the temple itself (or naos), which consisted of two parts, the pronaos or fore temple, and the secos or sanctuary, which in Egyptian temples was very small, and contained a figure of the divinity, usually represented under the form of some animal. Some of these temples were of very large dimensions; that of Jupiter at Thebes was more than 1400 feet long and 300 feet wide, exclusive of the porticos that led to it. The forms of all the plans are either square or rectangular. The art of designing a plan in modern architecture becomes difficult from the necessity of keeping the apartments within such bounds that they may be covered or roofed, and of arranging the decorations, and of counterpoising thrusts; but the Egyptian architect had no such difficulties to contend with. Columns were brought to the spot and covered at once with masses of stone, all combining without much contrivance with the exterior walls: hence, the abundant use of columns in the interior of their buildings. Great regularity appears in their plans. The temple at Philæ, evidently from its being suited to the form of the island on which it was built, is the only exception to the observation. Their intercolumniations are narrow, rarely exceeding twice and a half the width of the column, and usually not more than a diameter and a half. The elevation is always uniform and monotonous, always of one story, and without columns above columns. The pyramidal form seems to pervade every edifice, and the result must be great solidity. Their columns may be considered as of two sorts, circular on the plan, and polygonal; the former differ only among each other by their being sculptured or not with hieroglyphics. Those representing as it were bundles of rods or trunks, are generally encircled at different heights with bands like the hoops of a cask, generally in two or three ranges of three, four, or five each. This part of the arrangement seems to have been quite arbitrary. The polygonal column frequently occurs, but more generally where the edifice has been formed out of a rock or quarry. All the columns rise from their bases in right lines, diminishing to the top, without any appearance of entasis or swelling. One can hardly say that any precise proportion is preserved between their height and their thickness. In describing them, we can only say that they were short, thick, and of enormous diameter, the latter in some cases extending to as much as eleven feet. What are understood by pilasters are not found in Egyptian buildings, though some quadrangular columns might give that idea, excepting only in the small sepulchral chamber of the great pyramid. Bases are also rarely found; but the capitals of their columns exhibit great variety. In general form they are either square, vase-formed, or swelled; some of them are very elegantly shaped and decorated with the lotus, the palm branch, and other kinds of vegetation, and occasionally with the human head. They are usually without abacus, and are connected to the architrave by a small die or square block out of the same piece of stone as the capital. The entablature rarely, if ever, consisted of more than an architrave surmounted by a huge cavetto, which finished upward with a bead or fillet. This cavetto was frequently ornamented with glyphs and other indentations of the surface, and the wings of the vulture in the centre. The covering of the temple was a flat terrace, though there are no proofs, by the remains of steps to ascend to it, that it was so used.

Some years ago a question was proposed by the French Academy of Inscriptions and Belles-Lettres, whether the Greeks borrowed their architecture from the Egyptians; that question has been well answered by M. Quatremère de Quincy, in the Encyc. Method., to whom we are indebted for much in this article, and the substance of his answer is as follows:—There is no such thing as general human architecture, because the wants of mankind must vary in different countries. The only one in which the different species of architecture can approach each

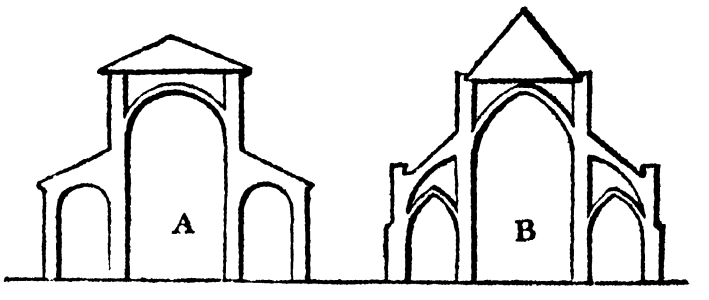
other is intellectual: it is that of impressions which the qualities whose effects the building art accomplishes can produce upon the mind of every man, of whatever country he may be. Some of these impressions result from every species of architecture. Architecture sprung as well from the huts of Greece, as from the subterraneous excavations of Egypt and the tents of Asia, and from several mixed principles to us unknown: thus the use of the word architecture is absurd. We ought to name the species; for between the idea of architecture as a genus and as a species, there is the same difference as between language and tongue; and to seek for a simple origin of architecture, is as absurd as a search would be after the primitive language. If so, the hut of Vitruvius would not be an ingenious fable, as some have said, but it would be a ridiculous falsehood if he had pretended that it was the type of all architecture. Vitruvius, however, spoke only of Grecian architecture; and if in Egypt there exists another type, that only proves that the hut was not the type of Egyptian art, but that it was that of Greek art, and that theory would be fabulous which pretended to be universal. We will conclude this article by adding that similarity between certain forms of ornament, certain details borrowed by the one from another, prove nothing more than that between the people by whom they were used there was some interchange of commerce or other intercourse, which could not long subsist without some sort of necessary transfusion of the inventions and habits of one of those countries into the habits, manners, and customs of the other.

ARCHITECTURE, *Gothic.*—To form a correct idea of the Gothic style of architecture, it will be necessary to trace its progress through one very different in its details, though not exactly so in its plan and arrangements. Its type is of a mixed character, and not, as we have seen in the two foregoing articles, founded on the habits of a people. Though a search into the origin of the pointed arch is an idle and useless inquiry, it will be necessary in the end to glance at that as incidental to the style under consideration.

The ancient basilica, which derived its name from basileus, king, and oikos, house, was the part of the king's palace in which justice was administered to the subjects. The building for this purpose retained its name long after the extinction of the kingly office, and was in use with the Romans as well as with the Grecians. Vitruvius does not, however, give us any specific difference between those erected by one or the other of those people. He has (ch. i. l. 5.) given the details of its form and arrangement, and we refer the reader to his work for the particulars of it. The name was afterwards transferred to the first monuments of Christian worship, not because, as some have supposed, the first Christian emperors used the ancient basilicæ for the celebration of their religion, but more probably with reference to the idea of sovereignty which the religion exercised, though no assertion is here advanced that such a conclusion is necessarily to be drawn. There is no doubt that the most ancient Christian basilicæ were constructed expressly for the purpose of that religion, and their architectural details sufficiently point to the epoch in which they were erected. Nevertheless these new temples of religion, both in the whole and in the details, borrowed so much of those of the ancient basilicæ, that even on this account it is not surprising that they should have retained the name. A general notion of one may be formed from the annexed diagram, which will immediately



show how admirably it was suited to the reception of an extremely numerous congregation. The numberless columns which were at hand, the remains and ruins of ancient edifices, were put in requisition for the construction of these basilicæ, of which, adopting the former buildings of that name as the type, they proportioned the elevation to the extent of the plans, and in some cases decorated it with the richest ornaments. Instead of connecting the columns together by architraves on their top, which were not at hand as were the former, arches were thrown over, not only to connect them, but that thereon walls might be carried up to bear the roofing. On this sort of substruction, vaults could not with safety have been borne. From these the obvious and natural step was to piers, connected by arches and ornamented with pilasters or columns. The piers underwent a change by being made circular on the plan; these again, for the purpose of giving the interior a lighter appearance, were made polystylic or in ribs, and ultimately received a vaulting and cross vaultings in character with their plan below. Though the practice of vaulting large areas, and the pointed arch, did not appear till a considerable time after the building of the first Christian basilicæ, it is to be observed that the Temple of Peace at Rome had previously to that period exhibited a specimen of the profound knowledge of the Romans in the practice of vaulting; in that example groined vaults of very large dimensions were borne on entablatures and columns. Nor does this knowledge appear to have been lost in almost the last stage of decline of Roman architecture under the emperor Diocletian. In the baths of this emperor are to be seen not only groined vaults in three divisions, whose span is nearly seventy feet, but at the back of each springer a buttress, precisely of the nature of a flying buttress, is contrived to counteract the thrusts of the vaulting. If a comparison be made between this large hall (now used as a church), of the baths of Diocletian, with the nave of a Gothic church, the difference will be found to be more such as must result from the nature and employment of the materials, than from difference of style. From the age of Constantine down to the ninth century, the edifices within the limits of the Roman empire are but degraded specimens of Roman architecture; and there is no evidence from their remains (few indeed they are) that the Goths and other barbarians who devastated Italy had any other influence on the arts than hastening, perhaps, that fall from which it would seem nothing could have saved them. We quite coincide in the opinion of Möller, who in the text to his Denkmaehler der Deutschen Baukunst says, "I cannot possibly agree to the opinion of those connoisseurs who ascribe an individual and peculiar style of architecture to the Goths and Lombards in Italy and Spain, to the Franks in Gaul, and to the Saxons in England." The Roman architecture of the fifth and sixth centuries was the model, and the constant correspondence from every part with Rome kept up an influence from thence over the arts and sciences. Fine proportions were lost, and the art completely degenerated into a servile imitation of earlier forms. The art of construction and the preparation of materials did not, however, fall away from solid building. The basement of the palace built, it is supposed, at Terracina, by Theodoric, the Gothic king, who reigned in Italy from A. D. 493 to 525, is in the Roman style. So also is the church of St. Apollinaris at Ravenna; and the circumstance mentioned by the writer above named, who up to the period at which we are writing, D'Agincourt excepted, is the only writer of any value on the subject, of the employment by Theodoric as architects of one Aloysius, an architect called Daniel, and the well known Boetius, a native and senator of Rome, is a strong corroborative proof that the edifices of the Goths were built by Romans and in the Roman style. Neither does it appear likely that upon the irruption of the Lombards in the year 568, after the sway of the Goths had lasted so long, they should have established a style of their own. They were a rude people, whereas the Goths, we know, had become quite a civilised nation, whose style was suited to the wants and habits of the country. It is true that D'Agincourt ascribes to the Lombards the church of St. Julian, near Bergamo, and some others; but it has not been proved that the churches in question were really erected by the Lombards. The appellation of Lombardic to the style of church building which existed in France and




9TH TO 12TH CENTURY. AFTER THE 12TH CENTURY.

Germany stands on too slender an assumption to be admitted; indeed it has been demonstrated by Maffei, Muratori, and Tiraboschi, that neither the Goths nor the Lombards introduced any style in particular, but employed the architects whom they found in Italy. The late learned Mr. Dallaway says, in his Discourses upon Architecture in England, that "at the beginning of the eighth century all Europe formed but one Gothic kingdom;" and it is certain that anterior to A. D. 800, there are very few Gothic remains. From that period to the general introduction and use of the pointed arch in the twelfth century, the leading form of the churches was a

parallelogram, consisting of a nave, side aisles, a transept on each side forming the arms of a cross, and beyond the intersection of the transept with the nave was placed a choir, terminated by a semicircular added building called the apsis. The whole of these buildings were constructed with very thick walls, pierced with comparatively small openings. In the vaulting of the nave and aisles, and over all windows and doors, the covering was semicircular. The nave was lofty, and was mostly constructed with groins. The section A shows the general appearance of the arrangement. The gables were not much inclined, and in the upper part of the building rows of small pillars appear in the walls. The profiles of the different members are all of Roman origin: many are correctly copied in their forms. In this country endeavours have been made to subdivide this style into Saxon and Norman. The subdivision is useless. Speaking of architecture as an art, they are of the same school, and the style has been by Möller called the Christian or Roman style; by others, the Romanesque style; either of which are appellations suitable, and would sufficiently carry their meaning with them.

Towards the latter end of the twelfth century and in the beginning of the thirteenth, very considerable deviations were introduced. For the flat southern gable, says Möller, was substituted the high northern roof, which brought with it the pointed arch in place of the semicircular one, being a consequence necessary for the harmony of the parts among each other. With the elevation of the roof and vaulting came a slender proportion of towers, columns, capitals, &c.; and at the latter end of the century the flat pilaster spreads outwards, and is converted into a flying buttress. At this period the edifices were in several respects anomalous, inasmuch as we have a mixture of circular and pointed arches, pillars, and vaults intersected by horizontal cornices and the like. The duration of this heterogeneous style was very limited, being immediately succeeded by the universal prevalence of the high pitched gable and the pointed arch. The plans of the edifices were not materially changed except in the omission of the apsis, and a general idea may be formed of the whole by an inspection of the section marked B in the preceding cut. It appears incontrovertible that the Germans were the first to carry this style to its highest perfection. As early as A. D. 1248, the cathedral of Cologne was begun upon its present plan, a building which, if finished, would have been the grandest and most beautiful in the world. Erwin von Steinbach, soon after 1276, built the porch of the minster of Strasburg; a building more, perhaps, esteemed than the last, because nearly brought to a state of completion. The style which we have just been describing wants no other distinctive appellation than the pointed. Imagination seems after its establishment to have been tortured to invent new combinations of ornaments and tracery. It overstepped at length the true bounds of architecture, and was abandoned in the sixteenth century for the introduction and restoration of Roman, or, more properly speaking, Italian architecture. The author above quoted says that the architects of these times were adapted to their age, and that their works are the result of the time in which they lived; and that, however we admire and imitate these works, we are not able to reproduce them, on account of the circumstances under which the style arose not being the same.

The powers of mechanical construction exhibited in the pointed style are such as to excite our admiration and astonishment; the exact calculated proportion between strength and burthen, the counteraction of thrusts of vaulting, and the consequent lightness and boldness resulting from those calculations, evince an intimate acquaintance with the most important and useful qualification which an architect can possess, namely, the production of the greatest possible effect with the most limited means. This qualification was possessed by the architects of the thirteenth century in the highest degree, and to an extent quite unknown to the Greeks and Romans.

The name Gothic, which has been given to the styles of architecture just described, is, from what has been advanced, very inappropriate. It is, however, now no longer used in its application as a term of reproach. That the Goths had no share in its invention or perfection is quite clear, and, as Mr. Dallaway justly observes, "it is not worth the dispute whether the Gothic power was ever annihilated in Europe, or whether they subsisted in the conquered countries as a separate people." We subjoin an enumeration of the different hypotheses upon which endeavours have been made to account for the invention of the pointed arch. 1st. Warburton (notes to Pope) asserts that Gothic architecture originated in Spain under Moorish architects; its type being an avenue of lofty trees, the intersecting branches at top forming the sharply pointed arch, and the stems of a clump of trees being represented by columns split into distinct shafts. Warburton, however, not only lost sight of accurate chronology in his hypothesis, but is wanting in originality. Stukely had made a similar remark. Spence (Anecdotes of Pope) puts in his claim before Warburton, and Sir Christopher Wren had a notion that the invention belonged to the Saracens; so also had Thomas Warton. 2d. The hypothesis of Sir James Hall, ingenious but far from satisfactory. He first assumes that the first English churches were made of wicker work, and then states them to have been the prototypes of those built with stone, furnishing, that is, the wicker work, from its sprouts, the original examples of every ornament or particle that was introduced. 3d. That it is founded upon the structure of framing in wooden buildings. 4th. That of Mr. Murphy, the editor of the celebrated work on the convent of Batalha, in Portugal. His reasoning is as follows: The pyramids of the Egyptians are tombs; the dead are buried in churches, and on their towers are pyramidal forms; consequently, the pyramids of the towers indicate that there are graves in the churches; and as the pyramidal form constitutes the essence of the pointed arch style, and the pyramids of the towers are imitations of the Egyptian pyramids, the pointed arch is derived from the latter. We cannot suppose the reader can require any refutation of such a set of syllogisms as this. 5th and last is that of the late Dr. Milner, who, whatever may be the opinion on his theory of its origin, was well informed upon and intimately conversant with the general subject. Dr. Milner says that it arose from the imitation of pointed arches, generated by the intersection of semicircles, thus:



There are, however, many reasons why this account is not satisfactory, though it must be admitted that in the Romanesque style this combination is frequently to be found. Dr. Milner seems entirely in his hypothesis to have lost sight of a circumstance that is quite familiar to every artist, namely, that it is a principle in all art that the details of every style are subordinate to and dependent on the masses, and not the converse; how then could it have been probable that the leading features of a style so generally used should have had its origin in an accidental and even unessential decoration like that of the learned doctor's theory. In short, none of the hypotheses mentioned can be considered satisfactory; and, as Möller observes, the solution of the question, whether the pointed style belongs to one nation exclusively, is attended with greater difficulties. After all, the problem for solution is not who invented the pointed arch, but in what way is its prevalence in the thirteenth century to be accounted for.

ARCHITECTURE, *Grecian*.—Grecian architecture, which was transplanted after its perfection to an Italian soil, where it assumed almost another form, will not require an extended notice in this place. The particular detail of the changes it underwent will be found in the articles DORIC, IONIC, and CORINTHIAN orders. The architecture of the Greeks, adopted afterwards by the Romans, has, indeed, with certain modifications, long been the architecture of the world. Its origin and types have already been considered in the article Architecture, and an explanation of its terms will be found under their several heads in this work. We shall, however, present a cursory sketch of its rise and progress.

Cadmus, about 1519 B.C., is reported to have introduced into Greece the worship of the Egyptian deities, and also the practice of quarrying stone; to him also is attributed the instruction of the Greeks in the art of fusing and working metals, from which period it is said the Greeks rapidly advanced in civilisation. According to Pausanias the Greeks at an early period had raised some extraordinary structures, such as the treasury of Minyas, king of Orchomenus, and the walls of Tiryns, which that author describes as a work worthy the admiration of every age. From the Homeric writings we find that the form of government was patriarchal, that the chief buildings were the palaces of the princes, and that the altar was the only structure for sacred use, and that even this was little more than a hearth, on which the victim was prepared for the meal; for, until after Homer's time, no regular priesthood existed in Greece. It seems probable that the temple was not used until the kingly and sacerdotal offices were separated. It would be difficult, perhaps now impossible, to trace the degrees from the use of the simple altar to the establishment of the regular temple, or when the latter became a necessary appendage to the religion of the country. Eusebius and others have conjectured that the early temples were but stately monuments, raised in honour of the primitive heroes who had conferred benefits on mankind. In respect of the houses of the Greeks, they appear to have been simple in plan, and at an early age consisted of two stories, as was indeed the case with the dwellings of the East mentioned in the Scriptures.

Between the period commonly assigned to the siege of Troy to the time of Solon and Pisistratus, we have few means of investigating the progress of Grecian art. Goguet (*Origine des Loix*) says that Asia Minor was the cradle in which architecture was nursed, and thinks that

to this country we are indebted for the invention of the Doric and Ionic orders. All authors seem to admit that the Corinthian did not appear till some time afterwards, and that it had birth in the mother country, and not in the colonies. Perhaps the earliest temple recorded is that of Jupiter, at Olympia, which, according to Pausanias, must have been built 630 years before the Christian era. If Livy be right, that of Diana at Ephesus was of a period little less remote, and at this time the science of mechanics was in its infancy; for even in the time of Thucydides, though the powers of the crane were known, they were not compendiously applied for the purpose of raising weights.

Admitting that the system of imitation in the Doric order was founded on the elementary forms and parts of the hut, it was in that case guided by the principles that nature herself adopts in her operations, otherwise no bounds would have limited the caprice and imagination of its improvers. In the copy, no part is precisely similar to the model; but an analogy, and that very strong, is observable. The proportions and parts of the Doric order, in different examples, plainly indicate that the Grecian artists considered themselves restricted only by general rules, inasmuch as we find them varying the height of the Doric column from four diameters to six and a half in height (*see* DORIC ORDER), while the height of the entablature varies in terms of the diameter from 1·72 to 1·97. Lord Aberdeen, in his Inquiry into the Principles of Beauty in Grecian Architecture, has suggested that the height of the capital of this order, in terms of the upper diameter of the shaft, will afford some indication of the comparative antiquity of an example; but there is no ground for the suggestion, as the author of this article has pointed out in a treatise on Grecian Architecture prefixed to his edition of Chambers's Civil Architecture. The intercolumniations used in the Doric order at Pæstum, Corinth, and Segesta, and the Parthenon, are equal to about one diameter of the column. They are about a quarter of a diameter more at the Temple of Theseus, whilst in an example at Syracuse they are somewhat less than a diameter.

The age of Pericles exhibited almost all that art could be imagined to accomplish; the Peloponnesians and their colonies had erected the temples at Corinth, Nemea, Pæstum, Syracuse, and other places in Sicily: thus, in a space of little more than three hundred years from its introduction, it appears that the art was raised to the summit of perfection. It is probable that the Ionic order is not far behind the Doric in antiquity. In the former, the different examples exhibit a variety not less to be noticed than that we have observed in the latter order. The height of the Ionic column varies in the three examples of the temples on the Ilyssus, Minerva Polias, and Erectheus, from eight diameters and a quarter to nine and a half in height, but in the heights of the entablatures there is not so much variance. The cornice of the Grecian Ionic may be considered as bearing a constant ratio to the whole height of the entablature, as two to nine; while the whole height of the latter seems nearly constant at two diameters in height. This order received the addition of a base to its shaft, which was wanting in the Doric order; but, for the varieties, the reader will refer to that article in this work. The volutes, which are its distinguishing features, are found with many varieties. In the temple on the Ilyssus, that of Minerva Polias at Priene, and that of Apollo Didymæus, the volute contains only one channel between the revolutions of the spiral; whereas in those of Erectheus and Minerva Polias, at Athens, each volute has two distinct spirals with channels between them. In the former of these two the column terminates with an astragal and fillet, just below the eye of the volute; in that of Minerva Polias, with a single fillet. In each, the neck of the capital is ornamented with honeysuckles. The shafts are usually cut with flutes of an elliptical form, to the number of twenty-four. These flutes vary from those of the Doric order, in their separation from each other, through the intervention of fillets.

The distinguishing feature of the Corinthian as of the Ionic order is the capital. In a preceding article the elegant story by Vitruvius of its invention has been told, because that has been rendered almost sacred by tradition; but it must be observed, that long before the age of Callimachus, its reputed inventor, perhaps even before capitals or columns themselves were known to the Greeks, the leaves of the palm tree, the flowers of the lotus, and even volutes, were applied as ornaments to the capitals of Egyptian architecture; and, be it observed, the form of the bell itself in no small degree resembles the contour of the lotus flower. The Greek Corinthian and the Egyptian capitals of this class, are more distinguishable by their respective heights than by peculiarity of other features. The former, however, has a lightness and elegance which the Egyptian, perhaps from moral and political causes, never attained; but if even a slight intercourse between the two countries existed, there would appear considerable proof of the identity of the primitive inventors.

Our knowledge of the Greek Corinthian order is unfortunately circumscribed, from the destruction and decay to which from its extreme delicacy it was exposed; nevertheless, under even these circumstances, the few examples that remain induce a supposition that it was not in such high estimation as those we have already named, inasmuch as the only examples that have come down to us are those of what is called the Tower of the Winds, and the Choragic Monument of Lysicrates, both at Athens. But the former of these is scarcely to be classed among examples of Corinthian, and the latter (as we now understand the Corinthian order) is in some respects a little outré in the species. In the Choragic Monument the height of the entablature is somewhat less than a fifth of the total height of the order. The base varies little from that of the Ionic order, excepting in the non-appearance of the horizontal fluting in the upper torus.

To the orders enumerated may be added one scarcely to be named here, because apparently under no rules which regulated its proportions, namely, the figures called Caryatides, which were employed for the support of an entablature. For the supposed account of their origin, the reader is referred to the article CARYATIDES.

The only subject remaining for notice, under this head, is that of the roofs of the Grecian temples. Their roofs consisted, of course, of two inclined sides, which at the ends formed a pediment. From experience it was soon found that the angle at which the sides of a roof should be inclined to the horizon, should be such as effectually to shelter the interior of the building from the inclemencies of the seasons. Hence greatly inclined roofs are indispensable in northern climates, the reverse as the climate approaches the equator, but this will be more fully explained under the article ROOF. Here we shall merely state that, according to the hypothesis, the inclination of the sides of a roof should, for the latitude of Athens, be 16½ degrees. The actual inclination of the roof of the temple of Erectheus is 15½ degrees, temple of Theseus 15 degrees, the Parthenon 16 degrees, and that of the Propylea 14½. Comparing the law with the Roman examples, the climate would require an inclination of the sides of the roof with the horizon of 22° degrees, and the variation between the examples remaining is from 22 to 24 degrees.

The invention of the arch does not at present appear to belong to Greek architecture. It was one of the most important inventions in the history of architecture; but so disputed a point is not to be touched upon in a work of this nature. We incline to the opinion that its invention does not belong to the Greeks, for this simple reason, that they have left us no examples of it that have come to our knowledge.

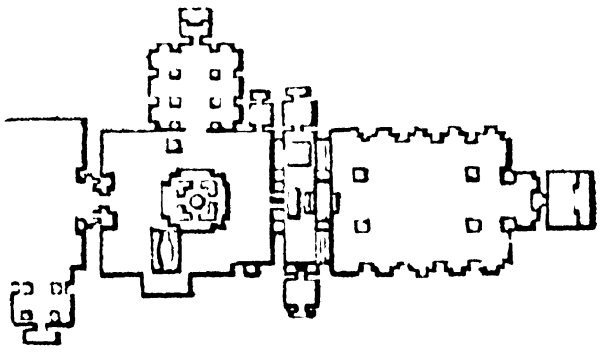
ARCHITECTURE, *Indian*.—It is very properly observed by M. Quatremère de Quincy, that, in spite of all theories, an infallible mode of estimating the state of the architecture and other arts of any people is by their representations of the human form. Every people, he says, who during a number of ages have persevered in falsely representing the figure void of all proportion, and according to a certain barbarous and ignorant routine, must be convicted of a want of that sentiment which leads to a knowledge of truth, and of that intelligence which knows how to find in nature rules for the choice of forms and arrangements applicable to the art of building. Every people who do not manifest in their works this conformity to nature must be ignorant of the arts of imitation, and all their productions must be the result of an irregular taste. These observations particularly apply to Indian architecture, whose exact antiquity is still a problematical question. In a country abounding with deserted monuments, where are found the traces of an ancient language now no longer spoken, books no longer understood, the vestiges of a religion whose creed and allegories seem to have had some resemblance to those of Greece, one is naturally led to surmise that civilisation existed at a very early period. These opinions would seem corroborated by the extraordinary chronologies which the modern Indians have produced as incontestable authorities for their remote antiquity. The chronology, however, of the Hindoos will not bear the test of strict investigation; neither has any inscription or historic monument been discovered, nor annals found, which give us an idea of the changes, revolutions, or prosperity which the country may have experienced. It is, however, certain, that India has been possessed and successively invaded by several people, and that its creeds, as well as its religious allegories, indicate such great diversity and mixture of opinions as might lead us into every species of error in matters of historical research.

It is natural to suppose, that the subterraneous or excavated monuments of India are prior in date to raised or constructed works, and yet, in point of fact, there are in the former neither less details, less caprice in form, nor less profusion of fantastic ornament, than in the latter. Hence the monuments themselves afford us no

clue to their respective antiquities. M. Meiners contends that none of them are more ancient than the vulgar era, whilst M. Langles, a critic of no ordinary sagacity, is of an opinion rather different, namely, that Indian art was brought from Egypt, and that traces of such an importation are very distinctly marked, as well as that Greek art is strongly indicated in them. If, however, those monuments, whose date we have good reason for believing is recent, exhibit the same taste as that manifest in those monuments whose date is unknown, we may fairly assume that the same style of architecture existed in this country at a period preceding the conquest of Alexander and the epoch in which this early civilised country had intercourse with the Grecians. Though we have no historical nor chronological guides to enlighten us on the subject of Indian architecture, it is to be recollected that there is some analogy between the irregular taste that prevailed in India, and that of the rest of Asia. Southern India abounds with excavated monuments of art; these are equally found in the centre as well as the sides of the vast peninsula. Throughout the region nature seems to have supplied the first associated inhabitants with excavations, either ready formed or easily converted to the purposes wanted. It therefore appears probable that the originating principal of the building art in India is found in the subterranean dwelling; and as we find constructed edifices so similar in proportion, form, and details to those that are, as it were, quarried out, it is fair to conclude that the former are the type of the latter, which are, consequently, of a later date

Construction scarcely seems a term applicable to the greater number of works of Indian architecture It means the raising of a work composed of divers materials, or of pieces joined together to form a mass, hence it cannot be properly applied to an excavated structure. The edifices of India may be divided into two classes, the quarried and constructed, the last are mostly those towers improperly called pagodas Of the unconstructed class may be ranked the seven large pagodas of Mavalipouram, which consist of large masses of stone more or less engaged to the earth, and contiguous to similar masses. These masses were shaped and sculptured exteriorly in accordance with their general form partly pyramidally and partly by irregular zones, in the same style as the pyramidal tower of the constructed pagoda. No order is apparent in the respective dispositions of the masses, neither is regularity in the plan and exterior form to be detected. These edifices are extremely small in the interior, being hollowed out of the mass, and remind us of the monolythic temples of Egypt, which were cut out of immense blocks of granite, and, as Herodotus tells us, removed to very considerable distances. In other respects, there was clearly some resemblance between the art of India and Egypt; it is found in the excavations of monuments, and in working large natural masses of stone in their original situation But to infer from this similarity of taste that there was communication between the two nations, seems too much, and still more hypothetical would it be to infer a resemblance of style in architecture from a similarity of practice, for nothing is more unlike the Egyptian than the Indian style of architecture, and in the end it will be seen that, except in the practice of excavation, there is no similarity at all The dimensions of the pagodas, as they have been called, compared with those of the Egyptian pyramids, no less than their excavated temples, have been much overrated by travellers. Of the latter, the dimensions are generally but moderate, and the difficulty of their execution could not have been very considerable. If the description that comes to us be correct, the latter are hollowed out from quarries of calcareous stone, and the dimensions are on so moderate a scale, that even the celebrated temple at Elephanta is only 130 feet long, 110 feet wide, and but 14 feet 6 inches high. The operation of hollowing out a cavern of this sort can scarcely be dignified with the name of art; but in the pagoda construction we must admit some display of that which at least approaches it. The pagodas are, in many instances, of considerable height, but to compare them with the pyramids of Egypt is out of the question these, the only buildings of much height, are pyramidal in general form Sonnerat, vol. i. p. 217., gives us some idea of them he says, "Around the most celebrated temples the surrounding walls are thick and much raised. On each side is a gate surmounted by a pyramidal tower, with a curved mass of enormous size The tower is loaded with figures," &c &c. If we may trust to the representation of the pagoda of Chillambaram by M Durocher de la Perigne, given by Caylus in the 31st vol of the Memoires de l'Academie, the pyramidal form is therein strongly marked. In it the height of the whole is but 120 feet, and at its base it is but 80 feet wide. The termination is not in a point, but is truncated at a height which makes the plan of its summit about 36 feet wide. The pyramid is unequal sided, the flanks being much narrower than the faces. But the largest of these monuments is that described by Lord Valentia, namely, the pagoda of Tanjore, which he considers the finest specimen of this species of building. This is 200 feet high, placed on a basement of 40 feet in height. The pyramidal mass rises by twelve sets off, or bands, sculptured in various ways. Such samples of masonry, however, required no great display of constructive skill for their execution, either in working or transport of the materials. At Chillambaram, for instance, the pyramidal part is constructed to the height of 30 feet only in masonry, the remainder being of brick. The mass is coated with ornaments of stone and of a species of white cement of the country. As in Egypt, none of the monuments of this country exhibit any trace of the arch: the coverings of the apartments are all horizontal, and the dimensions in all are necessarily limited by the want of that expedient which, in modern architecture, has been the parent of the most stupendous monuments whereof art was capable. The ceilings in Indian architecture are of enormous blocks of stone, laid on the supports wherewith the buildings are constructed, being the simplest and most inartificial mode of contriving a covering to an apartment. It must be apparent to every one, that the art of India was many degrees below that of Egypt. Though, in the last-named country, art was limited by the habits of the people, yet it is equally certain that their knowledge in the use of materials was of a high character, and that their skill in masonry was carried to great perfection.

That which is known to the architect by the term ordonnance, which means, in its most extended sense, the composition of a building and the due arrangement of its several parts, and which the Greeks and Romans practised in their architecture with so much success, is not perceptible in Indian architecture, as far as we are acquainted with it. It seems easy to account for this, for, notwithstanding some of the existing monuments have received the name of palaces, there is little doubt of their being all destined originally for religious purposes. Hence the architects, confined to certain established routines, were not at liberty to exercise their invention and ingenuity; and even had they been so, the system of castes, in perpetuating uniformity of practice, had a tendency to repress them. Again scarce any system could be conceived less likely to develope talent in ordonnance than the use of subterranean edifices, which admit of no variety of plan, no extent of elevation, nor lead to any of those conceptions, which the taste of the architect generates when he has length, breadth, and materials at his command. In the caves at Ellora, a plan of the Indra Subba whereof is here subjoined, if we examine what



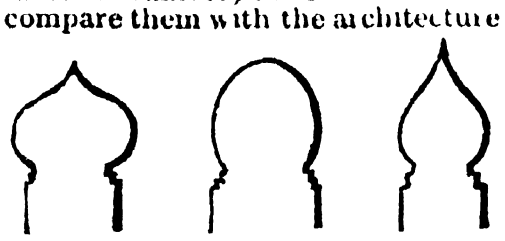
may be called the columns, we find some of them hexagonal, without base, capital, or ornament; some square, with a long cap, like carpentry. The greater number are composed of three parts, a square pedestal, running up more than one half of the total height, a small portion of shaft, if we may so term it, crowned with a capital of strange form, whereof words cannot give any definite idea. The reader who is desirous of acquaintance with the temples at Ellora, may advantageously refer to Daniel's plates of these curious objects Decoration, in architecture, consists of large and small details, which receive the name of ornaments The larger parts are columns and similar masses. In the system of Indian decoration there is no trace of what may be called an order; but among the larger masses of decorations for support, sculptured elephants very frequently occur. In one of the temples at Ellora, for instance, there are three masses of building, on the same line, whose bases are sculptured with elephants, seen in face. Lions are also much used as objects for decoration.

From information which Sir C. W. Malet obtained, the works at Ellora were said to be executed about the year 900, by Elloo, the rajah of Ellichpour, who at that period is said to have founded the town: and the late Dr. Heber, bishop of Calcutta, observing that no mention was made of these excavations, even incidentally, in any Sanscrit manuscript, and that the idols were the same as those still worshipped in India, dates them in the 13th century. But all this is conjecture, unsupported by any historical document that entitles it to any weight, and a wide field is open to the traveller and antiquary, in investigating these curious and fantastic monuments, as illustrative of the early history of the art.

ARCHITECTURE, *Moorish or Saracenic.* When the victories of the Arabians had extended their empire from

Constantinople to the confines of Spain, the magnanimity of their leaders, and the brilliant talents of their caliphs, raised the nation to a pitch of glory and power which exhibited itself in some very extraordinary productions in the architectural art. In Africa and in Spain, where their empire became firmly established, the edifices they erected sufficiently prove with what success they cultivated the arts and sciences. For the notice here given of some of the most extraordinary edifices for which Spain is indebted to its ancient conquerors, we are assisted from the celebrated work by Murphy, published in 1816, to which the reader who seeks further information may refer.

We do not, in the limited space of such an article as this, think it necessary to extend any inquiry into the earliest works of the Saracens, such as the original Mosque of Omar, built in 640. Neither of that nor other of their works (few indeed in number) have we sufficient historical evidence to compare them with the architecture of the period in other countries; but we proceed at once to that period when some of its most distinguishing features were such arches as are here exhibited.

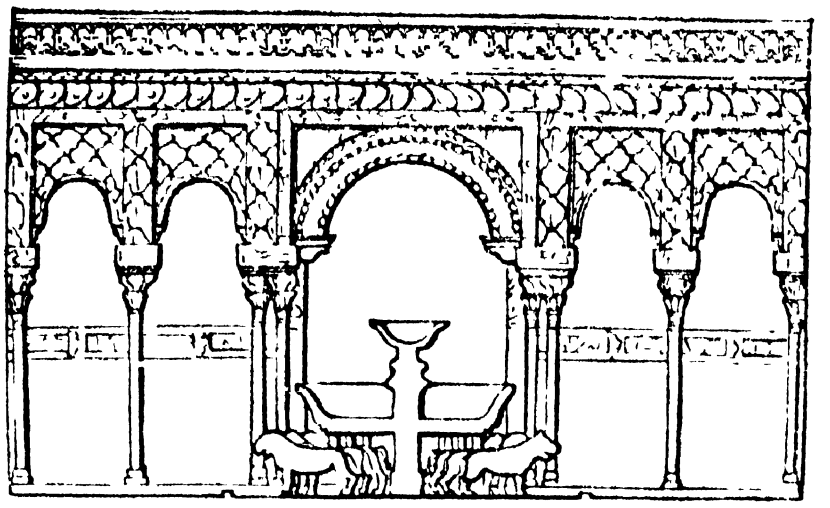


The mosque at Cordova was begun by Abdelrahmen, the second king of Cordova, and finished by his son towards the end of the eighth century. Its plan is a parallelogram of 600 feet by 400, formed by an embattled wall with counterforts also embattled, the height of this wall varies from 35 to 60 feet and its thickness is 8 feet. This large quadrangular space is divided internally into two parts, viz. a court, 200 feet long by the length of the edifice, and the mosque itself, which is about 400 feet square. The mosque consists of 19 naves, formed by 17 rows of columns, from south to north, and 32 narrower naves, from east to west. Each of these naves is 16 feet wide, from north to south, by 400 feet long, the width of them in the opposite direction is less. Thus the intersection of the naves with each other produce 850 columns, which, added to the 52 columns of the court, form a total of near a thousand columns. Their diameter is about a foot and a half, and their mean height about 15 feet, and they are crowned by capitals of a Corinthian or composite species. These columns, which have neither socle nor base, are surmounted by arches from column to column. The ceilings are of wood painted each range forming on the outside a small roof, separated from those adjoining by a gutter. One of the most striking effects of the edifice is produced by the beautiful marbles whereof the columns are composed. It seems probable that the larger portion of these columns might have been procured from the Roman ruins in the city; an opinion which is strengthened by their being without bases, or such as ill suited the style of the columns or capitals. In the commencement of the sixteenth century great changes were made in this mosque, for the purpose of converting it into a Christian church, these, it is said, ruined the original effect, but enough is left to indicate what it anciently must have been. It is always considered as one of the earliest Moorish buildings in Spain. The decorations throughout are in stucco, painted of different colours, and occasionally gilt, in imitation of the churches of the lower empire. One cannot doubt that its architects were well acquainted with the Byzantine architecture, in which the walls, the arcades, the pavements, in short all the parts were covered with paintings: and it is clear that the Arabians, who really had invented no architecture of their own, spreading themselves in those countries wherein the arts had been established, were thus led to a trial of imitating the old masters.

The Alhambra, at Granada, is perhaps the most curious and interesting Moorish edifice in Spain. It served the double purpose of palace and fortress, and is situate on the summit of a rock that commands the town. According to travellers who have visited and described this edifice, you may here fancy yourself in a fairy-built dwelling. After passing the principal entrance, you arrive at two oblong courts, one of which is called the court of the lions, and is celebrated in Arabian history. A portion of the section of this court is given below. Round these two courts, on the ground floor, are disposed all the apartments of the palace, those for state look out towards the country; the rest, cooler and more retired, have small openings for light under the interior porticos, the whole of which are decorated with painted stucco, porcelain, and the most valuable marbles.

There is on a neighbouring hill another palace, called the Generalife, now in a state of ruin; but its ruins show that it was inferior to the Alhambra neither in size nor splendour. It is precisely in the same taste, and the details are similar, proving that the two edifices are contemporaneous.

Surprising as the works we have just named must be considered we do not discover in them that real grandeur which exists in the works of the Egyptians, the Etrurians, the Grecians, or the Romans. The mode of construction, though sufficiently durable, is not scientific, as respects the working of the materials. Brick was the material



most in use, the masonry, where employed, is covered with a coating of stucco, the painting whereof, in different colours, is a great source of the admiration these buildings excite. In the combinations of the building art in these edifices, there is nothing to surprise, from the supposition of extraordinary means used in their erection. The domes which crown their apartments are neither lofty nor large in diameter, neither do they exhibit great mechanical skill. The Moorish architects seem to have had no notion of raising vaults from lofty piers. In the mosque at Cordova, the span from pier to pier would have been less than 20 feet, which to vault would not have required very extraordinary skill; yet herein we find timber ceilings throughout. The use of orders seems to have been unknown to them, they employed the antique columns which they found ready to their hands, or rude imitations of them, without any apparent acquaintance with the types from which they were derived, their principles or proportions. Hence their columns may be more appropriately termed posts. In the forms of Moorish architecture one does not discover a character of originality arising out of local causes. The Arabians had wandered far from their country, in which they had never cultivated the arts, their architecture was, therefore, necessarily formed upon models which were before them, such as the degenerated Roman and Byzantine. Such elements as these, with the materials which the lower empire afforded, formed their taste and monuments. The form of their arcades, whereof we have given some examples above, is confined to this style of architecture. They may be divided into two classes, both of them vicious in construction, from not affording the necessary resistance to thrust near the abutments. In masonry, failure would follow such forms, if practised on a large scale, but where arches are formed of brick, the large surface of cement used, if it be good and the centres not struck until the cement is set hard, allows great caprice in their forms. If the pleasure—we might almost use the word sensuality—of the eye be the sole object, it cannot be denied that success attended the efforts of the Arabian architects of Spain. The details of their decoration, and the fantasticness of their forms, cannot fail to please the eye; and though they may not satisfy the spectator, they are capable of producing on his mind some of the most seductive charms of which the art is capable. The embroidery and painted draperies of the East appear to have been transposed to their architecture. The variety and profusion with which they used their ornaments, moreover, give their masses the appearance of a congeries of painting, incrustation, mosaic, gilding, and foliage. much, perhaps, of this was induced by the law of their religion, which forbade the representation of animals or the human figure. If taste be not required to produce a reason for the admission of ornament, nothing can be more splendid and brilliant than the effects that resulted from their combinations. It cannot be denied that in this profusion of ornament we find the details beautifully executed, and some of their forms extremely fine, and the mode of piercing domes for light, which they practised by means of star-like formed openings, is attended with an almost magical effect.

ARCHITECTURE, *Mexican*. From the historian Robertson we collect, that the cities of Mexico, large and populous as they are described, were rather the asylums of men just emerged from barbarism, than the peaceable dwellings of a civilised people. Tlascala, according to its description, nearly resembles that of an Indian village. It was but a heap of low straggling huts; according to the caprice of each proprietor, built of turf and stone, and thatched with reeds, the light being received by a door so low that it could not be entered upright. In Mexico, from its peculiar situation, the disposition of the houses was more orderly, but their structure was equally mean. The Mexican temples, and other public edifices, do not appear to have deserved the high praises which Spanish

authors have bestowed upon them. The great temple of Mexico, the most celebrated in New Spain, as far as can be gathered from the obscure and inadequate descriptions of it, has been represented as a magnificent building, raised to such a height that the ascent to it was by a flight of 114 steps, yet it was but a solid square mass of earth, faced partly with stone. Its base on each side extended 90 feet: it decreased gradually as it advanced in height, terminating at top in a quadrangle of about 30 feet, whereon was placed a shrine of the deity, and two altars on which the victims were sacrificed. All the other celebrated temples of New Spain resembled that of Mexico. The temple of Cholula, which was considered the most sacred in the country, was also the most considerable; yet, according to Torquemada, it was but a solid mound of earth, about a quarter of a league in circuit

The Spanish historians lead us to suppose that the palace of the emperor and the houses of the nobles exhibited some elegance of design and convenient arrangement. we have, however, no vestiges of these remaining, and, from the mode in which Cortes conducted the siege of Mexico, it seems likely that all the monuments of any importance were destroyed Still, as at the period when Robertson wrote his history only two centuries and a half had elapsed, it seems impossible that in so short a time edifices of importance should have left no trace of their existence

The great hillock at Cholula, to which the Spaniards have given the name of temple, is without any steps to ascend it, and without any appearance of stone Perhaps it has never been more than a natural eminence of the ground. In several accounts, though under different names of places, we find descriptions of monuments pyramidal, as well as in steps, of which the ruins are sufficient to furnish a clue to the whole design. The attempt to restore them in drawing was made in 1804, and published at Rome by D Pietro Marquez, entitled "Due Antichi Monumenti di Architettura" His restoration was founded, we believe, on descriptions published in the Literary Gazette of Mexico, in 1785 and 1791, by D. Gius Ant Abzate The first monument is at a place called Papantla Its form is pyramidal, (that is, in general effect,) being built in steps or stories, of six ranks, one above the other The lower step is 100 feet long, on the four faces. The other dimensions of the steps are not given, but each had in its height a certain number of square niches, each 3 feet every way, the lowest contained 24 on every side, the second 20, the third 16 the fourth 12, the fifth 10, and the sixth 8 It is presumed there was a seventh step, which had 6 of these niches on every side. Upon one of the faces of this pyramid there were smaller steps, serving as a staircase to mount to the top, whereon, it is supposed, there was a small chapel enclosing the idols to which the sacrifices were made The author (Marquez) above mentioned gathered from the same documents some ideas upon another Mexican monument, it in architecture may be so called a hill surrounded by five or six enclosures of stone, whose object was to retain the earth in its place This also terminates by a platform at top, which is supposed to have been occupied by a small temple, after the manner of the country. Some writers have thought this last was merely a fortification, but it seems more probable that it was a religious edifice, inasmuch as the basement of it is sculptured with figures supposed to be the hieroglyphics of the country. The name (Xochicalco) of this hill, interpreted by those who possess a knowledge of the Mexican language, bears out the conjecture that it was used for the last named purpose.

ARCHITECTURE, *Roman*. It can scarcely be said that the Romans had an architecture peculiar to themselves. That which we understand by the name is a modification, some call it a debasement (we disagree with them), of the architecture of the Grecians We are ready to admit that the Romans gave to their art the lasciviousness of the courtesan, whilst the Greeks preserved in theirs the modest demeanour of the stand matron; but our senses may be charmed by the one, though the other may make a stronger appeal to the understanding In strictness, Roman and Grecian architecture are identical Wherever the Greeks penetrated, their genius, not less than their arms, extended and founded their influence. The religion, the language, the habits, and the arts of the Greeks, appear to have been carried into Italy at a period of very high antiquity. Numerous colonies of that nation established themselves on the shores of that country, and even in the interior of the peninsula, where they erected cities long before the existence of Rome. Italy, as far as we can trace, had no original arts of its own, nor can any thing be found in it whose origin was not Grecian Hence, as has been observed, there is, strictly, no such thing as Roman architecture. But as every nation which cultivates the arts, impresses them with a character peculiar to itself, so when we speak of Roman architecture, we mean that peculiar character with which Greek art was invested under the Roman empire,—that character which was manifest in a greater exuberance of ornament in all the parts of the orders, and which changed the sections of the mouldings of an order from profiles formed by the sections of a cone, to those formed by the horizontal sections of a cylinder. An intercourse of very ancient date existed between Etruria and Greece; in the former of which, at the period in question, the language and mythology of Greece prevailed to a considerable extent From what is known on this subject, we may safely state that Etrurian architecture was identical with that of Greece History tells that Rome, from its origin, borrowed from Etruria artists to execute their great works, though, afterwards, the city possessed a large number of native architects, which was not the case with the professors of the other arts. That the Romans at this period were not barbarous and ignorant of the arts, more than one memorial of their skill in architecture still attests. Livy records a circus, traced by Tarquin, between the Aventine and Palatine hills, for the celebration of feasts and games to commemorate the victory over the Latins Tarquinius Superbus soon afterwards encompassed this circus with covered porticos. This was at the epoch of the construction of the great sewer or cloaca Perhaps in no age were two more splendid undertakings carried on at the same time. This Tarquin, as Dionysius Halicarnassensis asserts, ornamented the Forum, and had centred in it all that could tend to its beauty as well as to its utility. The first Tarquin was a native of the city of Tarquinium in Etruria, and brought to Rome that taste for grandeur and solidity which were the distinguishing features of the arts in the country he had left. He constructed the immense walls of the city in regular masonry, and laid the foundations of the temple of Jupiter Capitolinus, which, in levelling the hill on which it stood, was attended with prodigious labour and expense. The temple mentioned, according to Tacitus, was continued by Servius Tullius and Tarquinius Superbus, the latter engaging workmen from Etruria, but it was not finished till after the expulsion of the kings Such was its magnificence, says Tacitus, that all the victories of the Romans added to its wealth and decoration more than to its extent. His words are, "Horatius Pulvillus dedicavit, ea magnificentiâ, quam immensæ postea populi Romani opes ornarent potius, quam augerent." The description of it by Dionysius brings to mind the Grecian temple with its two interior ranks of columns, its peristyle and pediment, eulogised by Cicero. It was twice destroyed, and twice rebuilt, on the same foundations These notices suffice to show that the Romans at an early period were inferior to no nation in those matters of architecture which were necessary and useful to a people Such was the opinion of Strabo, who adds, that in some respects, such as paving their great roads, constructing aqueducts and sewers, the Romans far excelled the Greeks. Usefulness in their enterprises, and solidity in carrying them into execution, were the characteristics of the art among the Romans at a period when magnificence of a high degree was confined to the temple

The necessary materials are wanting to enable us to follow up historically the taste of the art during the ages of the republic There is scarcely the vestige of a ruin of the period, it is, however, easy to form, either from the political state of the times, or from the encouragement given to the other arts, and especially to literature, some idea of the extent to which the architecture of the Romans flourished The conquest of Greece by the Romans produced to their city not only an importation of works of art, but the artists themselves, who, be it observed, can be created only where opulence reigns In architecture, however, the Romans at this time had erected monuments of such dimensions as were beyond the means of the little and separated states of Greece. The new state of things brought to its aid all that it needed The great use which at this period was made of the Corinthian order, is one of the proofs of the public and private wealth From the time of Augustus we see the extent to which richness of detail was carried. A small portion of the Baths of Agrippa, known to us under the name of the Pantheon, one of the most splendid examples of the art, enables us to appreciate the art of this period, though now despoiled of the bronzes of its pediment, its gilt caissons, and the profusion of sculptures that adorned it. In the time of Augustus, Rome was not only the capital of the world, but the world itself; it possessed within itself all the food that was necessary for the nourishment of the art. Private individuals in the city possessed the wealth of kings, military glory created a necessity for monuments, and the amusements of the theatre, the races and fights of the circus and amphitheatre, required accommodation for such multitudes of spectators, that art expanded from the calls to which it was subject. Rome now began to raise monuments of a description unknown to the Grecians—triumphal arches, baths as large as cities, immense porticos, amphitheatres, and naumachia. The marbles of all the quarries of the then known world were almost exhausted in supplies, and even Egypt furnished the city

with means of adding to the general magnificence. Applied to such new species of edifices, it would have been indeed surprising if architecture had preserved its original Greek purity. It was the medium for satisfying a vanity which knew no bounds, and was ultimately obliged to gain its end more by effect than purity, by richness and exuberance of ornament rather than by harmony, and by grandeur of lines rather than by beauty of forms. Architecture was at all periods a favourite art among the Romans. Not a single name of a Roman sculptor has reached us, and Pliny mentions only two or three painters. From Vitruvius we learn, that before his time several had written on the art. The names of Fussitius, Terentius Varro, Publius Septimius, Cossutius, and C. Mutius are mentioned by him

The luxury in art induced by the sculptor, aided the number of different combinations in the Corinthian capital, which we have above stated to have been a favourite with the Romans; this was carried to an excess which in the end produced a new order, known by the name of the composite. Thus, Roman architecture having, says Quatremère de Quincy exhausted all the resources of richness guided by taste in the use of ornaments, throws aside all sobriety, sacrifices the whole to details and accessaries, covers all parts of the surface without distinction, loads the different members with ornaments and sculptures, like a person who, to decorate a piece of cloth, covers it entirely with embroidery

We close this article with a few observations on the Doric order. This, in Greece itself, at the time of her subjugation, had begun to be affected by change It had lost much of the primitive simplicity of its character and the severity of its principles The various wants in edifices less simple in plan, a taste for elegance and richness which was found in the other two orders, contributed to diminish the severity of its forms and profiles Thus, in the portico of Augustus at Athens it was strangely changed in appearance In Rome it was adopted with proportions still more slender, and an aspect infinitely less severe. (For remarks on English Architecture, see the word ENGLISH.)

A'RCHITRAVE. (Gr. ἀρχειν, *to govern*, and Lat. trabs, *a beam*.) In Architecture, the lower of the three members of the entablature of an order being, as its name imports, the chief beam that is employed, and resting immediately on the columns. Its origin is given under the article ARCHITECTURE. A French writer has called it the foundation of the head of an edifice The architrave sometimes receives the name Epistylium, from the Greek words ἐπι, *upon*, and στυλος, *column*

A'RCHIVES. The repositories of the public records of a state or community sometimes the records themselves are so called The word is supposed to be derived from the Greek ἀρχειον, used for public registers by Josephus.

The following table presents a summary of the principal metropolitan repositories of English archives, and the character of their contents It is extracted from the Law Magazine, No 35 and is professedly compiled from the information furnished by the Record Commission.

| Name of Repository. | Situation | Species of Record |
|---|---|---|
| 1. Tower | Thames Street | Chancery & Parliamentary |
| 2 Chapter House | Poet's Corner, Westminster | King's Bench, Common Pleas, Parliamentary, Miscellaneous |
| 3 Duchy of Lancaster | Waterloo Bridge | Relating to the Duchy |
| 4 Duchy of Cornwall | Somerset House | Relating to the Duchy |
| 5. Roll's Chapel | Chancery Lane | Chancery & Parliamentary |
| 6 Common Pleas | Carlton Ride Stables | Belonging to the Court |
| 7 King's Bench | Rolls' House, Chancery-Lane | Belonging to the Court |
| 8 King's Remembrancer's Record | Carlton Ride Stables, Temple, Tower of Westminster Hall | Chiefly Exchequer |
| 9. Augmentation Office. | Palace Yard, Westminster | Ecclesiastical Record respecting dissolution of Monasteries |
| 10. Pipe Office | Somerset House | Exchequer Records |
| 11 Lord Treasurer's Remembrancer's Office | Somerset House | The same |
| 12 Land Revenue | Carlton Ride, and Spring Gardens | Its own department, and Exchequer Records, &c |
| 13 First Fruits | Temple | Its own department |
| 14. Exchequer of Pleas | Lincoln's Inn | Exchequer. |

A'RCHIVOLT. (Lat. arcus volutus, *a turned arch*.) In Architecture, the ornamented band of mouldings round the voussoirs or arch stones of an arch, which terminates horizontally upon the impost. The archivolt is decorated analogously with the architrave, which it may in arcades be said to represent.

A'RCHON. (Gr. ἀρχων, *ruler*.) The title of the chief magistrate of Athens. The office was originally instituted after the death of Codrus, the last King of Athens, and was vested in one person who enjoyed it for life, and was succeeded by his son. Its duties were those of a limited monarchy, accountable to the assembly of the people; its duration was afterwards limited to ten, six, and, finally, one year, when its functions were divided among nine persons, taken at first by suffrage, and afterwards by lot, from the nobles. One was chief among them, and was called Eponymus, or, naming Archon, because the year was distinguished by his name. The second, or king Archon, exercised the functions of high priest. The third, or Polemarch (polemarchos,) was originally the chief military commander. The other six were called Thesmothetæ, or setters forth of the law; they presided as judges in the courts, and the six formed a tribunal which had a peculiar jurisdiction. The nine together formed the council of state, on which the whole administration rested; but this was transferred by Solon to the senate. The exclusive right of the nobles to this office was taken away by the measures of Clesthenes, who threw it open to the people at large. *See* especially *Boeckh's Public Economy of Athens*

A'RCTIC. (Gr. ἀρκτος, *the bear*.) An epithet given to that part of the heavens, in which are situated the constellations of the Great and the Little Bear *Arctic Pole*, the north pole of the heavens, or the northern extremity of the axis of the diurnal motion *Arctic Circle*, in geography, denotes a small circle of the sphere parallel to the equator, and 23½ degrees from the north pole At this latitude, the sun, at the summer solstice, comes exactly to the horizon at midnight, without descending below it The corresponding circle in the southern hemisphere is called the *Antarctic* The arctic and antarctic circles separate the frigid from the temperate zones.

A'RCTOMYS (Gr. ἀρκτος, *bear*, μυς, *mouse*.) The name of the subgenus of *Rodentia*, or gnawers, including the marmot

ARCTU'RUS A star of the first magnitude in the constellation of Bootes, designated in the catalogues as α Bootes It has a sensible proper motion

A'RCUATE (Lat arcus, *a bow*.) A part of an animal so called which is linear and bent like a bow.

ARCUA'TION. (Lat. arcus, *a bow*.) An obsolete term for the mode of propagating trees by layers, the shoots being bent

A'RDEA The name of a Linnæan genus of *Grallæ*, or wading birds, characterised by a straight, sharp, long, subcompressed bill, with a furrow extending on each side, from the nostrils to the apex of the bill The genus was subdivided by Linnæus into the *Cristatæ*, corresponding to the modern genus *Anthropoides*, the *Grues*, or cranes, the *Ciconiæ*, or storks, and the *Ardeæ*, or herons, which latter have been subsequently subdivided into *Ardeæ*, or herons proper; *Nycticoraces*, or night-herons, and *Botauri*, or bitterns

ARDISIA'CEÆ. (Ardisia, *one of the genera*.) Exogens, which might, without much inaccuracy, be termed woody primulaceous plants They form herbs and trees in warm countries, and have a succulent fruit, but they really differ in scarcely any positive point of structure from primula and its co-ordinates. (*See* MYRSINACEÆ.)

A'RE *See* A LA MIRE

A'REÆ. In Entomology, the larger longitudinal species into which the wing may be divided they are termed cretal, intermediate, and anal, according to their relative position

ARE'CA (Areec, *the Malabar name*.) An East Indian palm tree, whose nuts are folded in the leaf of the piper betel, and, mixed with a little lime, are chewed by the natives of the country [illegible] on the Indian Archipelago, as a stimulating narcotic

ARE'NA. A Latin word signifying, in its original meaning, sand, but applied in a secondary sense to that part of the amphitheatre in which the gladiators fought, which was covered with sand The word is sometimes applied to the whole amphitheatre.

ARENA'CEOUS. (Lat. arena, *sand*.) Sandy

ARENA'RIA. (Lat. arena, *sand*.) A genus of wading birds, wanting the hinder toe: of this genus there is but one British species — the Sanderling

ARENA'RIOUS SOIL. (Lat. arena, *sand*.) In Agr and Hort, soil in which sand is the prevailing ingredient.

ARENA'TION. (Lat arena, *sand*.) The cure of diseases by sprinkling hot sand upon the body.

ARE'OLA. (Dim. of *area*.) The ring or margin which surrounds the pustule of small and cow pox.

ARE'OLÆ, in Entomology, are smaller spaces into which the wing is divided by the nervures: they are termed vasal, middle, and apical, according to their relative position.

ARE'OLATE. In Entomology, divided into small spaces, or areolations.

AREOLATE In Botany, in composite plants, when the florets are placed so completely upon the surface of the

receptacle, that many a pentagonal area, or space, is left when the ovaries drop off.

AREOLA'TION (Lat. *area*) means any small space, distinctly bounded by something different in colour, texture, &c. The spaces of parenchyma, which in leaves are bounded by veins, are areolations.

AREO'METER. (Gr. ἀραιος, *rare*, and μετρον, *measure*.) An instrument for measuring the density or specific gravity of fluids. (*See* HYDROMETER.)

AREO'METRY. The science of measuring the density or specific gravity of fluids.

AREO'PAGUS. The chief court of judicature at Athens: so called because it met in a hall on an eminence, called the hill of Mars (Αρειος παγος.) This court, which was of very early origin, was raised to the high character it afterwards enjoyed, by Solon, who appointed that it should consist of the archons who had undergone, with credit, the scrutiny they were subject to at the expiration of their office. The areopagus had cognizance of capital crimes, and from it was no appeal to the people, whose decisions it was sometimes known to annul. It controlled all issues from the public treasury, and exercised a censorship over the citizens. Its powers were much reduced by the measures of Pericles and his partizans. On the subject of this celebrated institution, our best ancient authority is the *Oratio Areopagitica* of Socrates. See also Meursius, *De Areopago*; Du Canve, *Recherches sur l'A*, in the *Mem. de l'Acad. Des Inscr.*, &c. vol. vii. p. 174. and Petitus, *Ad Leges Atticas*. See also Boeckh's excellent work on Athens and her Institutions.

A'RGEL. The Egyptian name of the leaves of the *Cynanchum oleafolium*, which are mixed with senna leaves.

A'RGENT, in Heraldry. (French, argent, *silver*.) One of the metals employed in blazonry. It is equivalent to pearl among precious stones, diamond among planets. In engraving it is represented by a plain surface.

ARGENTI'NA. A Linnæan genus of abdominal fishes, belonging to the salmon family, characterised by a small mouth, without maxillary teeth, the tongue armed with curved teeth, and a transverse row of small teeth on the vomer, branchiostegal rays six. The argentines rank in the order *Malacopterygia*, or soft-finned fishes of Cuvier. The name is derived from the silvery glistening appearance in the scales of these fishes.

A'RGENTINE. In Mineralogy, micreous carbonate of lime, so called from its silvery lustre.

ARGILLA'CEOUS SOIL. (Lat. argilla, *clay*.) Soil in which clay is the prevailing earthy ingredient.

ARGOL. The tartar of wine.

A'RGONAUT, ARGONAU'TA. Applied by Linnæus, in the singular number, to the testaceous cephalopod, designated by Aristotle and the ancients, nautilus, and commonly called at the present day the paper nautilus, from the fragile nature of the boat-like shell in which the inhabiting cephalopod occasionally floats on the still seas of the warmer latitudes. Many modern naturalists limit the application of the term argonauta to the shell, supposing that its true constructor is yet to be discovered, and that the cephalopod which has hitherto been exclusively found in it, is a parasite. (*See* OCYTHOE.)

A'RGONAUTS. The name given to the chieftains 'who accompanied Jason in the ship Argo on his fabled expedition' to Colchis, after the golden fleece of Phryxus. The original facts on which this mythological story is founded cannot now be recalled, but it is generally supposed to represent the result of some bold commercial expedition that overstepped the previous discoveries of its age, or more probably still, the series of enterprises by which "Greek maritime knowledge was extended to the furthest shores of the Euxine." We have a poem on the subject, which falsely goes under the name of Orpheus, who is said to have been one of the Argonauts himself, and an epic by Apollonius Rhodius, a Greek poet of Alexandria, and likewise one in Latin, by Valerius Flaccus, who flourished in the age of Vespasian.

A'RGUMENT. In Astronomy, denotes the angle or quantity on which a series of numbers in a table depends. For example, suppose a table were formed showing the amount of horizontal refraction at every degree, &c., of altitude; then the altitude would be termed the argument of the refraction; and the table is said to be entered with the argument.

ARGUMENT. In Logic, an expression in which, from something laid down as granted, (*i. e.* the premises,) something else (*i. e.* the conclusion,) is to be deduced. In ordinary discourse, argument is very often used for the premises alone, in contradistinction to the conclusion; *e. g.* "the conclusion which this argument is intended to establish, is, &c. &c." This word is also sometimes employed to denote what is, strictly speaking, a *course* or *series* of arguments. it is in this sense that we speak of "Warburton's argument to prove the divine legation of Moses." The word argument is frequently used to express what may be properly called a disputation: *i. e.* two trains of argument opposed to each other, as when it is said that A and B had a long argument on any subject, and that A had the best of the argument. (Vide *Whately's Logic*, p. 300.)

A'RIANS. The followers of the theological opinions of Arius, a presbyter of the church of Alexandria in the fourth century, who denied the equality of the Father and Son, and is generally considered as the author of a system which continued, under various modifications, to exercise the most extensive influence upon the Christian world of any heresy of ancient times. It was in the year 319, that these views were first promulgated at a meeting of the clergy of Alexandria; and their author, after some delay, excommunicated by the patriarch Alexander. The progress, however, which the opinions continued to make, excited, after a few years, the notice of the emperor Constantine, who addressed a letter to Alexander and Arius jointly, in which he attempted to attain the object for which on other occasions he resorted to more violent methods, that of reconciling the conflicting parties upon whatever basis, and securing harmony at all events. At the earnest desire, however, of the orthodox party at Alexandria, he convened the general council of Nicæa, which assembled in the year 325, and proceeded to institute a full investigation into the matter in dispute. On this occasion the Nicene creed was drawn up, in which the clause which principally affects this subject is the assertion of the consubstantiality of the Son with the Father, or the Omoousion. This the Arians would not concede. A middle party arose under Eusebius of Nicomedia, who proposed, but without effect, the term Omoiousios, asserting, not the identity, but the similarity of substance. This, which is generally denominated the Semi-arian scheme, satisfied neither the Catholics nor the Arians, who from their rejection of it acquired the title of Anomoion. The Catholics triumphed, and their opponents submitted to the decree of the emperor which required them to acknowledge the creed propounded for their acceptance. From this time, according to some writers, the Eusebians became a mere political party, who endeavoured to preserve the favour of the prince, for which they had already made the greatest of sacrifices by a repetition of similar unworthy arts. At this period another Eusebius, the courtly bishop of Cæsarea, and celebrated historian of the Christian church, became one of the leaders of this branch of Arianism. His talents and ingenuity are represented as being of singular service to the cause of the heretics, by inducing the emperor, after some delay, to command the restoration of Arius to the church of Alexandria, and the banishment of Athanasius. A day was appointed, upon which Alexander, the aged bishop, should admit the still suspected heretic to the holy communion. His protestations of orthodoxy were such as to satisfy the prelate that God only could discover his real sentiments, and he solemnly declared that in His hands he left the matter. In the midst of the fears and scruples of the one party, and the anticipated triumph of the other, the proceeding was suddenly terminated by the death of Arius, a deliverance of the church, in which the Catholics discovered a signal interposition of God, but which the heretics confidently ascribed to assassination by poison.

Under Constantius, the successor of Constantine, in the East, the Arian party was taken into favour, and the orthodox persecuted and proscribed. and when on the death of Constans, the whole empire fell into his single hands, the cause of heresy began to flourish in the West also, and the "whole world," says St Jerome, "groaned to find itself Arian." It was at this period, also, that many northern nations, who were just preparing to pour themselves upon the western empire, were converted to the Christian faith, in which they were instructed, according to the Arian interpretation. This circumstance contributed materially to the permanence of these opinions, for after the orthodox emperor Theodosius had re-established the doctrine of the Nicene creed throughout his dominions, the West was subjected to a second inundation of heresy in the preceding century. The conversion of Clovis to the Catholic faith at the end of the fifth, and of Theodelinda, queen of the Lombards, in the sixth century, combined with the successes of the generals of Justinian, in Italy and Africa, restored the orthodox opinions throughout the greater part of these regions, and from that period Arianism dwindled away, and all traces of it seem to have been lost for many centuries.

In modern times these opinions have been revived. The inferiority of the Son to the Father was proclaimed by Servetus, in 1531, and in Geneva, the very place in which he suffered death, these opinions took root, and have since become very prevalent among the disciples of the church which Calvin founded. The immediate followers of Servetus removed, upon his death, to Poland. In England, the principal revivers of Arianism, were Whiston and Samuel Clarke, who flourished at the be-

ginning of the 18th century. Their doctrines were embraced by great numbers of the Presbyterian and Independent preachers, and gave rise to a great deal of controversy among the members of those communities, and of the church also. It is remarkable that the congregations which in modern times have embraced any form of Arianism, whether at Geneva, in Poland, or in our own country, have in almost all cases degenerated into Unitarianism. At the present day, there exist few, if any, churches of professed Arians.

It should be remarked, that the term Arian, which is vulgarly attributed to those who conceive of the second and third persons, that though inferior to the first, they are, nevertheless, divine, admits of many distinctions and qualifications Questions arise among sects generally denominated Arian, 1st, As to the similarity of substance between the Father and Son: 2d, As to the existence of the Son; whether he was created before the world, — whether that creation was from eternity. 3d, As to the relation of the Son and Spirit, concerning whose rank among the Divine personages there are many conflicting opinions Dr. Clarke, though generally considered to hold Arian sentiments, professed himself a believer in the Trinity, and continued a member of the established church He distinguished the Son from the Father, considering the latter as the primary author of all good, to whom all honour and worship is due: the power which was original in the Father being derivative in the Son, who derives also from him his Divinity and other attributes The Holy Spirit, he considered to hold a similar subordination to the Son When the question, whether the Father can annihilate the Son, was propounded to Dr. Clarke, he confessed that he had not reflected upon this imputed consequence of his scheme, and declined to give any answer

ARICI'NA. An alkaloid discovered in 1829, by Pelletier and Coriol, in a bark from Arica, resembling a species of chinchona

A'RILL Arilla (*in low Latin*), *a piece of red cloth.* A membrane, either fleshy or otherwise, originating from the placenta, and growing on a seed either partially or entirely. Instances of it occur in the nutmeg, where it constitutes mace, and in the Euonymus Europæus, where it is a red succulent membrane It is remarkable that this part, the use of which is unknown, never appears till after the young seed is fertilised.

A'RIES (Lat *the Ram*) The first constellation of the ancient zodiac Aries also denotes the first sign or the first 30 degrees of the zodiac, the first point of Aries being the point in which the equator intersects the ecliptic, and from which the longitudes are reckoned In ancient times the signs and constellations of the zodiac coincided, but owing to the precession of the equinoxes, the twelve signs go backward among the constellations, at the rate of about 50″ annually, and the first point of Aries is now situate in the constellation Pisces

ARIES. In ancient Military Science, the Latin name of the battering ram, an instrument with an iron head used to batter and beat down the walls of besieged places.

ARIOSO *See* LEGATO.

ARISTO'CRACY (Gr. ἄριστος, *the best*, and κράτειν, *to govern*) According to the acceptation in which the word is used by ancient writers, a government in which all the *best* citizens of the state, *i e* those excelling either in hereditary distinction or in wealth, ruled their fellow-citizens. When the power was in the hands of a small class of these, who had acquired it by chance or usurpation, such a government was said to be an oligarchy. Thus aristocracy is enumerated by Aristotle among the distinct forms of government, oligarchy is only mentioned as a perversion of aristocracy and the distinction as taken by him is, that in an aristocracy the governors rule for the public good, and in an oligarchy for their own. In modern times, those governments have usually been termed aristocratic in which a small privileged class of noble or wealthy persons either governed absolutely, or shared the government in various proportions with the sovereign or with the people Thus the Republic of Venice presented the purest example of an aristocracy among the older governments of Europe: while the government of the United Provinces, before the French Revolution, might also be cited as an instance of an aristocratic commonwealth; and Great Britain of a monarchy tempered by aristocracy In a stricter sense, however, the word has been used by modern speculative politicians to signify any government in which "a minority of adult males" constitute the ruling class. In this sense, the government of France, that of England both in respect of the House of Commons and of the House of Lords, and, in short, almost every state in which a census is adopted as the qualification of those who elect representatives in the national assembly, must be cited as aristocratic The word aristocracy is also frequently used to signify a class of persons in the state: the wealthy and noble classes in a body, or the latter class by itself.

ARISTOLO'CHIA. (Gr ἄριστος, *best*, and λοχεία, *childbirth.*) A genus of exogenous plants, usually having twining stems and one-sided bent, yellow or purple variegated flowers, the odour of which is often very offensive They are reputed to be powerful stimulants and aromatics. One species, but not a twining one, is occasionally met with wild in England (A. clematitis, common birthwort): a few are natives of the South of Europe, but the principal part of the genus is tropical

ARI'STOLO'CHIA'CEÆ. The natural order of which Aristolochia is the type. Asarum (*see* ASARABACCA) is the only other common genus associated with Aristolochia; but there are several tropical forms The wood of this order is remarkable for growing without forming concentric zones, although undoubtedly exogenous.

ARISTOTE'LIAN PHILOSOPHY. In attempting to give an account of the doctrines of Aristotle of Stagira, we feel embarrassed by peculiar difficulties. The prejudices under which, until lately, the name of this philosopher has laboured, and still, perhaps, continues in a great measure to labour, would seem to render a more than usually detailed account of his writings necessary, in order to justify what, in the view we shall take of their nature and value, may contradict the ordinary opinion. At the same time, there is perhaps no ancient philosopher, the full comprehension of whose system requires so extensive a knowledge of the works of his predecessors in scientific research, and so careful a collation of detached passages in his own writings, which are composed for the most part in a fragmentary and unmethodical manner, and an obscure and concise diction The latter difficulty will be the more apparent, when we state the now unanimous opinion of the learned, that the works of Aristotle which remain to us are entirely of the *esoteric* or *acromatic* class, intended, not for publication, but to serve as notes to the oral lectures which he delivered to the more instructed of his pupils. It requires no more than a cursory glance at the titles and the bulk of Aristotle's writings, to be convinced of the comprehensiveness of his views, and the daringness of his design He divides the whole circle of knowledge into three great provinces, Metaphysics, or the Philosophia prima, including, as its instrument, Logic, Physics, or the Second Philosophy, under which term, in addition to the sciences ordinarily falling under that denomination, he embraces a great portion of the philosophy of the human mind, as the phenomena of sensation, memory, and fancy, and, thirdly, Ethics, or the science which treats of the conduct and duties of man, regarded both as an individual and as a citizen His Logic is contained in his Categories, his treatise on Interpretation or the Nature of Propositions, his former and latter Analytics, and his eight books of Topics; to which may be added his work on the exposure of Sophisms These form together what has been called the Organism of Aristotle, and seem intended as a preparatory discipline to the study of his Metaphysics (*See First Metaph.* iv 3) The common opinion, which attributes to Aristotle the discovery of the science of Logic, is, we doubt not, substantially correct The flippant objection of Locke, that this notion would represent God as having made men mere animals, and having left it to Aristotle to make them rational, hardly needs a serious refutation Natural philosophers might with equal justice be accused of asserting, that Sir Isaac Newton changed the motion of the heavenly bodies, or that Locke himself created the human understanding The logic of Aristotle is, what it professes to be, an enumeration of the leading classes, or genera, to which all our notions may be referred; an account of the various methods by which we arrive at general propositions, and reason from these when formed, and a body of rules for the conduct of the understanding in going through these processes (*See* LOGIC, CATEGORY, &c) Metaphysics is the science of being, as such, and herein is distinguished from physics, which considers only the modifications of being, and the changes to which they are subject Each of the physical sciences has its own fundamental axioms, the truth of which it is compelled to assume it is the province of metaphysics to verify these assumptions, and to discover their unity and connection. Aristotle's metaphysical system, though it may be said to owe its origin and many of its peculiarities to that of his great predecessor, Plato, yet deviates from it in many important respects. Both the one and the other admit the existence of a faculty, the sphere of which transcends the objects of sense: they differ as to the method by which this faculty is to arrive at its determinations. Plato doubtless conceived, that in virtue of the necessary connection in which all conceptions stand to each other, we are able, so soon as we have awakened one idea in our consciousness, to arrive at the knowledge of all the rest Aristotle, on the contrary, conceived all deductive science to be illusive which does not rest, for the truth of its fundamental principles, on a previous induction from particulars Agreeably to this conviction, he begins his Ontological speculations with the consideration of the individual, as it presents itself in the world of sense. To the production of each separate existence, four causes are

necessary, the material cause, the formal, the final, and the moving cause. The three latter, he seems to admit, are substantially identical, inasmuch as in Nature the end of a thing is that very thing itself in its completeness: while the moving cause may be conceived as the type pre-existing in the mind of the artificer, which is the same with the form which he communicates to the material. We should greatly misconceive Aristotle's meaning, if, as has sometimes been done, we identified his forms of things with their outward figure, or even with the notion of them apprehended by the understanding. The form of a thing may be differently expressed, as the law of its being, the principle of life within it, which animates and gives an individual existence to the matter; which, on the other hand, without its presence, would remain a mere blank potentiality, destitute of all qualities, and therefore unintelligible and imperceptible. This distinction between matter and form re-appears, under different names, in various portions of the Aristotelian philosophy, and is with him a solution of most of the difficulties in ontology and physics. He conceives it to be the only mode of explaining the possibility of a thing coming into existence, the difficulty of comprehending which had led the eclectic philosophers to deny any reality to outward phenomena. He himself conceives the universe to be eternal. With Plato, however, he strenuously asserts the existence of reason, as something immutable and universal, co-eternal with but unaffected by the shifting phenomena of the world. He differs from that philosopher, in making the universal reason identical with God, instead of being, with its correlative being, a creation of the Divine energy.

Of Aristotle's strictly physical researches we shall say little. He does not himself seem to conceive that great certainty can be attained in this department of human science. When, however, we remember, that his History of Animals has received very high praise from no less a naturalist than Cuvier, and when we reflect that this was perhaps the only branch of natural science in which he was furnished with experimental data, we shall be inclined to attribute the errors and deficiences of his physical theories rather to the deficiencies of the Greeks in the necessary mechanical apparatus, than to any disqualification in the philosopher himself. In his treatises on the Soul, on Memory and Recollection, and on the Nature of Dreams, he has earned the perhaps still higher praise of having created the science of Psychology, and of having discovered the guiding clue to the explanation of our mental phenomena, in the principle of association.

The third great division of the Aristotelian philosophy, that which regards the relations of man as a "social and political animal," is comprised in the Politics, the Œconomics, the Nicomachean and Eudemian Ethics, and those books entitled the Magna Moralia. In the true spirit of an ancient Greek, Aristotle regards the science of ethics as most intimately connected with that of politics. He repeatedly expresses his aversion from all speculations on merely ideal perfection, and his conviction that the practicable, under the existing circumstances of humanity, is the true object of ethical enquiry. Among the most influential of these circumstances on the conduct of an individual, is the constitution of the state to which he may belong, in the spirit, and according to the maxims of which he must act, if he would earn the praise of a good citizen. Not indeed that a good citizen and a good man are necessarily identical terms: they can only become so in the case of one who is a dutiful member of a rightly constituted commonwealth. The question necessarily arises, "How is this perfect form of polity to be determined?" The answer is, that form of government is the best, which affords scope for the developement of the best part of our nature, in other words, which produces the best men. Out of this circle, Aristotle cannot be said to have fairly extricated himself. He has in some measure approximated to a definite rule of morality in the doctrine, that every virtue lies between two opposite excesses. It must however be confessed, that a certain degree of vagueness prevails in his ethical speculations: a vagueness of which he was himself conscious, and apparently despaired of satisfactorily removing. Perhaps the most valuable part of his moral writings, is that in which he discusses the much vexed question of the relation of happiness to morality. Pleasure, he determines, can never be taken as a measure of actions, inasmuch as it is the uniform concomitant of all natural action whatsoever. (*Eth. Nic.* l. x.) His politics comprise a most careful review of the most celebrated Grecian constitutions, and a generalization of the leading possible forms of government, with their various merits and defects, built on a careful induction from the great mass of varied facts and instances with which the history of his country supplied him. They are consequently invaluable, alike to the curious in Grecian history, and to the political theorist; and traces of their effects are sufficiently visible in the writings of perhaps all who have arrived at eminence in the latter department.





The best edition of Aristotle's complete works is that of Bekker, 3 vols. 4to. Berlin, 1831. Of the Ethics, that of Michelet, with a commentary, 2 vols. 8vo. Berlin, 1835. Of the Politics, those of Schneider and Gottling. Of the Treatise de Animâ, with copious notes, that of Trendelenburg. Numerous editions of the Rhetoric have been published in Oxford. Of his Ancient Commentators, the best are Ammonius, Alexander Aphrodisiensis, Simplicius, and Thomas Aquinas.

ARITHMETIC. (Gr. ἀριθμος, *number*.) The science of numbers, or that part of mathematics which is concerned with the properties of numbers. The elementary operations of arithmetic, being necessary in transacting the ordinary affairs of life, are perhaps as commonly known as the art of reading and writing, and therefore require no explanation; the principles, however, on which they depend are of a very general and highly refined nature.

Every number, according to the definition of Newton, is, properly speaking, only a ratio, or relation. In order to explain this, it may be remarked, that every magnitude which we compare with another magnitude is either equal, or greater, or less, and, consequently, has a certain relation to that with which it is compared; that is to say, it either contains it or is contained in it, in a certain manner. This relation, or manner of containing or being contained, is what we call number: thus the number 3 expresses the ratio which one magnitude has to another smaller than itself, which is taken for unit, and which the greater contains three times. On the contrary, the fraction $\frac{1}{3}$ expresses the ratio of one magnitude to another greater than itself, which is taken as unit, and which contains the smaller three times.

Having distinguished the numbers or relations of magnitudes, which we have conceived in our minds by particular signs, arithmetic becomes the art of combining these relations with one another; employing for this purpose the signs themselves by which the numbers are distinguished. Hence, the four operations of addition, subtraction, multiplication, and division, include the whole science: for all the different combinations that can be formed of ratios are reduced ultimately to an examination of the excess of some above others, or of the way in which they contain one another. For the purpose, indeed of facilitating commercial accounts, astronomical calculations, &c., many other very useful rules have been invented, such as the rules of proportion, interest, discount, alligation, position, extraction of roots, progression, &c., but, on attending to the operations prescribed by these rules, it is easy to see that they are only different applications of the four principal rules.

The particular operations of arithmetic depend in their details on the system of characters by which numbers are represented. Our arithmetic, which is constructed on the denary system of notation, would be entirely changed if more or fewer characters than ten were employed. The Romans used a different notation, and their rules of arithmetic were entirely different from ours. But all arithmetic, in whatever manner numbers may be represented, is ultimately reduced to the four operations or rules already mentioned. Strictly speaking, indeed, the fundamental rules may be reduced to two, addition and subtraction; for multiplication is only an abridged method of repeatedly adding the same number to itself, and division only an abridged method of repeatedly subtracting one number from another.

The numeral system of the Romans was very ill adapted to the purposes of arithmetical calculation, and, hence, in keeping their accounts, and in all their commercial transactions, they made use of the abacus. The astronomers of Greece contrived an ingenious system, by means of which they were able to perform the most complex arithmetical operations. (*See* NOTATION.) The Indian numerals, on which the modern system of practical arithmetic is founded, were received from the Saracens of Spain, and appear to have been partially introduced into the other countries of Europe in the fourteenth century, but there is no evidence of their having come into general use before the invention of printing. The facility afforded by the Indian numerals in the performance of all numerical calculations has been one of the main causes of the great and rapid advancement of modern mathematical science.

The first complete treatise on practical arithmetic, in which the numerals now in universal use were employed, was written by Tartalea, and published in the year 1556. It consists of two books, the first containing the application of arithmetic to the purposes of civil life; and the second the foundations of the principles of algebra. A less perfect treatise had been published by Tunstall in 1526, and another by Stifel or Stifelius, 1544: since that time works on the science have been almost infinite.

Arithmetic acquires several distinctive appellations, from the particular manner in which it is used, or the purpose to which it is applied. thus,

*Binary Arithmetic.* The art of expressing and combining numbers by pairs, and by means of two cha-

racters only. A system of arithmetic of this sort was invented by Leibnitz, and also by De Lagni, and traces of it have been found in the early monuments of China. Suppose the two characters to be 1 and 0; the zero multiplying any number after which it is placed by 2, as in the denary scale, it multiplies the preceding number by 10, the first ten numbers on the binary scale would be represented thus: 1=one, 10=two, 11=three, 100=four, 101=five, 110=six, 111=seven, 1000=eight, 1001=nine, 1010=ten.

*Decimal Arithmetic*, which requires a series of ten characters, the progression proceeding according to the powers of ten. It is this which is universally employed by modern nations; the term, however, is generally applied to those operations in which fractions occur, the fractions proceeding according to the descending powers of ten; that is, the unit is considered as divided into tenths, the tenths into hundredths, and so on. It is very remarkable that the Hindoos, who have so long been acquainted with the denary notation, are still ignorant of its application to fractions. The Moors, from whom it was transplanted into Europe, were equally unacquainted with this application. The invention of decimal fractions, which has doubled the efficiency of our arithmetical system, is generally ascribed to Regiomontanus.

*Duodecimal Arithmetic*, in which the multiples and divisors of unity proceed according to the powers of 12. This is adapted to our system of lineal and superficial measures, in which the foot is divided into 12 inches, the inch into 12 lines, &c., and is accordingly generally used by artificers.

*Sexagesimal* or *Sexagenary Arithmetic*, which descends by the powers of 60. The system of subdivision was introduced into the Alexandrian school by Ptolemy, for the purposes of astronomical calculation. The partition of the circumference of the circle into 360 degrees, was probably founded on the property that the chord of one-sixth of the circumference is equal to the radius. Having divided the radius into 60 equal parts or primes, the angle of the hexagon naturally followed the same division; hence, one part or prime was equivalent to the 360th part of the whole circumference. The degree was by analogy subdivided into 60 minutes, the minute into 60 seconds, and so on. Ptolemy ascribes the reason of adopting this method of division to the facility which it affords in calculation, and his commentator Theon adds that 60 is the most convenient of all numbers, inasmuch as being sufficiently small it has a considerable number of divisors.

*Political Arithmetic*. The application of arithmetic to researches connected with civil government, such as the number of inhabitants of a country, the quantity of food necessary for their consumption, the labour they can accomplish, the mean duration of life, the produce of the soil, the frequency of fires or shipwrecks, &c. In applying arithmetic to inquiries of this sort, we have three principal objects in view, the first is to procure precise facts, the second to deduce from the observed facts the consequences to which they lead, and the third to determine the probability both of the facts and the consequences. (*See* STATISTICS.)

*Universal Arithmetic*. The name given by Newton to algebra, or the calculation of magnitudes in general. The operations of ordinary arithmetic are founded on two distinct classes of principles, the first are independent of the particular signs by which numbers are expressed, the second depend on those signs. The general properties of numbers, which are independent of any particular system of notation, form the subject of universal arithmetic.

**ARITHMETICAL COMPLEMENT** — of a number is what it wants of the next higher decimal denomination. Thus 4 is the arithmetical complement of 6, because it is what 6 wants of 10. In like manner 43 is the arithmetical complement of 57, and 432 of 568: the number and its complement, when added together, always producing a sum which is expressed by 1, followed by as many ciphers as there are digits in the number. It is used in logarithmic calculation to avoid the trouble of subtraction. for example, if two logarithms are given, and a third is to be subtracted from their sum, the whole operation may be performed at once, by writing the reciprocal of the logarithm to be subtracted, and adding the three together.

*Arithmetical Mean* between two numbers is a number such that its excess above the first is equal to its defect from the second, or it is a number equal to half their sum: thus 10 is an arithmetical mean between 7 and 13. An arithmetical mean among any number of quantities is found by adding all the quantities together, and dividing by the number. Thus, let there be six numbers, 1, 3, 4, 6, 7, 9; a mean among them is 5, for their sum is equal to 30, and 30 divided by 6 gives 5.

*Arithmetical Progression*. A series of three or more numbers, such that each differs from that which precedes or follows it by the same number: thus, 3, 5, 7, 9, 11, form an arithmetical progression, in which the common difference of the terms is 2. The general expression of this progression is $a$, $a+d$, $a+2d$, $a+3d$, &c.

*Arithmetical Proportion*. Four numbers are said to be in arithmetical proportion, when the difference between the first and second is the same as the difference between the third and fourth: for example, 2, 5, 6, 9.

*Arithmetical Ratio*. The difference between any two terms of an arithmetical progression.

ARMA'DA. (Spanish military or naval force.) This name is peculiarly applied in English history to the fleet assembled by Philip II. in 1588, for the conquest of England. The Spaniards, with their usual inflation of language, termed it "Invincible." It consisted of 150 ships, carrying 2650 guns, and having on board 20,000 soldiers, besides volunteers, and 3000 seamen. The account of its misadventures and dispersion is well known. The reader who is curious to consult a new and careful relation of this celebrated passage in history, will find it in Southey's *Naval History of Great Britain*, forming a part of the *Cabinet Cyclopædia*. The best Spanish account of the transaction will be found in Herrera.

ARMADI'LLO. A Spanish epithet, applied to a genus of small South American macronykous or edentate quadrupeds, characterised by a defensive armour of small polygonal bony plates, which covers the head, trunk, and sometimes the tail. Linnæus applied to this genus the term Dasypus, by which the Greeks, with more propriety, designated the hare and rabbit.

AR'MAMENT. (Lat. *Armamentum*.) A force equipped for war, naval or military. In Roman antiquities, armamenta comprehended the rigging and tackling of a ship, its sails, sailyards, oars, ropes, &c. Hence "Arma" denotes the sails (Virg. Æn. v. 1. 55.) and the rudder (ib. vi. 1. 353.) of a vessel.

ARMI'LLA. (Lat. armilla, *a bracelet*.) In Ornithology, the coloured circle of the distal naked end of the tibia above the tarsal joint.

ARMI'LLARY SPHERE. (Lat. armilla, *a bracelet*.) An ancient astronomical machine, composed of an assemblage of hoops or circles, representing the different circles of the system of the world, as the equator, the ecliptic, the colures, &c. put together in their natural order, and occupying their proper relative positions.

ARMI'NIAN CHURCH. The Armenians are Christians of the Eutychian or Monophysite doctrine, which recognises only one nature in the Saviour, viz. the Divine, and the procession of the Holy Ghost from the Father only. They hold the seven sacraments of the Romish Church, and the doctrine of transubstantiation: their clergy is also divided into secular and regular. From the wide dispersion of the Armenians over the commercial regions of the east, their form of Christianity is also considerably diffused, although it appears to be strictly a national church of which none but Armenians are members. Since the last war between Russia and Turkey (1829) the place where the principal of their four patriarchs resides (Etchmiadzine), has been transferred from the latter to the former government. There is also at Constantinople, and in other parts of the Levant, an Armenian Roman Catholic Church, owning the supremacy of the Pope. There is a well known congregation of Armenian monks on the island of San Lazaro, near Venice, who have published a variety of useful works in the language of their country.

ARMI'NIANS. Those who hold the tenets of Arminius, a Protestant divine, born in Holland in the year 1560. They are thus summed up —

1st. God from all eternity determined to save all who he foresaw would persevere in the faith, and to condemn all who should continue in unbelief.

2d. Christ atoned for the sins of all mankind, but those only who believe partake of the benefit of that atonement.

3d. Man is of himself incapable of true faith; therefore regeneration by the Holy Spirit, given of God through Christ, is necessary.

4th. All good works are to be attributed to the grace of the Holy Spirit, which, however, does not force a man against his own inclination.

5th. God gives to the truly faithful the means of continuing such. With respect to the possibility of a defection from this state of grace, Arminius and his immediate followers expressed themselves undecidedly, but it came afterwards to be considered a part of the character of Arminianism to affirm the possibility.

The assertors of these opinions in Holland were vehemently attacked by the Calvinistic party, which was prevalent at the time; and in 1610 the Arminians addressed a petition to the States of Holland for protection, from which they derived the name of Remonstrants. In the year 1618, nine years after the death of Arminius, the synod of Dort was convened by the States General, and a hearing given to both parties. The Arminian opinions were defended by Episcopius, divinity professor at Leyden, but his side complained that they were unfairly treated, and the conditions of the discussion violated to their prejudice. They were condemned by the Synod,

and treated in consequence with great severity, being forbidden to exercise the ministry in public: many of them fled to Antwerp, France, and other quarters.

From this period their opinions underwent a considerable change; and the articles above stated, which seem little different from the tenets of the Lutherans, began to be so explained as almost to do away entirely with the idea of the necessity of succour from the Holy Spirit. From hence they proceeded to reject many matters of faith, and to simplify materially the articles requisite for salvation. They proposed to draw up such a comprehensive and liberal scheme as should embrace all Christians, with the exclusion of the Romanists They considered it sufficient that a man should receive the Holy Scriptures as the rule of faith, and allowed each individual to interpret them for himself, only adding thereunto the necessity of moral duties and good works. The Papists were excluded on the score of morality, as admitting the lawfulness of persecution.

There is no longer any particular sect to which the name Arminian is exclusively applied; but the opinions above stated are adopted in England by one branch of the Methodists, who follow therein the views of their founder Wesley, and by many individuals of the church of England, and other denominations The articles of the English church have been represented by different parties as inclining both to Arminianism and Calvinism, and Whitby, and Taylor, bishop of Norwich, are among the most famous of her friends who have maintained the Arminian tenets

A'RMISTICE. (Lat. armistitium.) In National Law, a truce or suspension of hostilities.

A'RMOUR. (Lat. armatura) A term applied to those artificial means by which man is wont either to protect himself or to annoy his enemy, hence called defensive and offensive. *Defensive* armour includes those arms specially used for the defence or protection of the body, as cuirasses, helmets, &c. The materials used in their construction are exceedingly multifarious, varying in many instances according to the products of the country in which they are fabricated, but depending in general on the judgment and experience of the inhabitants. *Offensive* arms, or those used in attack, are of different kinds, 1. For cutting, such as the sabre, 2. For thrusting, such as the straight sword, the bayonet, pike, lance, &c., 3. For throwing, such as the mortar, rocket, howitzer, &c., and lastly, for shooting, such as guns, pistols, carabines, rifles, and cannons. Lucretius traces the progress of offensive arms very minutely. —

> "Arma antiqua manus, ungues dentesque fuere,
> Et lapides et item silvarum fragmina, rami
> Et flamma, atque ignes postquam sunt cognita primum;
> Posterius ferri vis est, aeris reperta,
> Et prior aeris erat quam ferri cognitus usus"

The history of armour is identified with that of every nation, and an elaborate discussion of this subject would throw great light upon questions of mythology, poetry, jurisprudence and civil polity, and strikingly display the progress of civilisation Into such details, however, our limits necessarily preclude us from entering, and we can only refer the reader to Meyrick's work upon this subject (3 vols 4to London, 1821), which the student of the politics, arts, manners, and wars of antiquity and the middle ages, may consult with great benefit.

ARMS, or ARMORIAL BEARINGS. In Heraldry, the name given to the devices borne on shields or coat armour. Family coats of arms are divided by heralds into perfect and imperfect. Perfect are, 1. Abstract, or warranted by regular descent 2 Terminal, belonging to the brethren of the right line. 3 Collateral, borne by brethren of the heir male 4 Fixal, in third degree by right line of male heirs Imperfect are, 1. Granted by the king, with a lordship. 2 The gift of a king, derived by a herald 3 The ensign of a Saracen won in the field 4. Heir female of close branch. 5. Arms of bastardy.

A'RMY. (Fr.) Lit. men in arms A body of men organised and disciplined for military service, commanded by a chief or leader, with subordinate officers in regular gradation, and supported both in time of peace and war for the preservation of internal quiet and defence against foreign aggression. An army is generally divided into a certain number of corps, each consisting of brigades, regiments, battalions, and squadrons. When in the field it is formed into lines: the first is called the vanguard, the second, the main body; the third, the rear-guard or body of reserve. The middle of each line is occupied by the foot; the cavalry forms the right and left wing of each line, and sometimes squadrons of horse are placed in the intervals between the battalions. In the history of armies we may distinguish those of three different periods: 1. The ancient armies, which, from the time of Sesostris downwards, underwent a series of progressive improvements under the Persians, Greeks, and Carthaginians, till they finally reached a high degree of perfection under the Romans. 2. Those of the middle ages, the offspring of the feudal system, which, however well calculated to keep alive a spirit of ferocity, opposed a formidable barrier to the revival of the military art, from their contempt of discipline and utter lawlessness. 3. Those that have existed since the invention of gunpowder and the establishment of standing armies. Since the use of gunpowder there have been seven principal periods in the history of the military art. The first extends from the early part of the fourteenth to the end of the fifteenth century. The second begins with the campaign of Charles VIII. in Italy, and extends to the commencement of the wars in the Netherlands, comprising the wars of the French, Germans, and Spaniards in Italy. The third period comprehends the great war of independence, waged by the Netherlands, in order to shake off the yoke of Spain, and extends from 1568 to the general suspension of hostilities in 1609. The fourth period comprises the celebrated Thirty Years' War, and extends from 1618 to 1648. The fifth period comprehends the wars of the French in Italy, Germany, and the Netherlands, as well as the Northern and Turkish wars, and embraces the space of 90 years, viz from 1648 to 1738. The sixth period includes the three Silesian wars, viz. from the beginning of the first Silesian war in 1740, to the breaking out of the French Revolution in 1792 During these several periods many improvements took place in the composition and discipline of armies, but these were destined to be far surpassed in the seventh and last period, which embraces the military systems and establishments of our own times In the organisation of the Continental armies great uniformity prevails, but as these are inseparably connected with the political condition of the people, a consideration of their character belongs to the history of these various nations, to which we must refer the reader. The British army, like those of the Continent, is divided into cavalry, infantry, and artillery, and these again into regiments and battalions, but in its composition and organisation an entirely different principle is adopted. While the Continental armies are recruited by conscription, and every officer must have served as a private or a cadet, or have acquired some knowledge of the military art in a preparatory establishment, the ranks of the British army are supplied by voluntary enlistment, and commissions are, with rare exceptions, only attainable, with or without purchase, as a favour from the commander-in-chief In addition to the officers attached to each separate regiment, the superintendence of the whole army in its various departments and ramifications is entrusted to a commander-in-chief, a secretary at war, a master-general of the ordnance, a paymaster-general of the forces, an adjutant-general, and a quartermaster-general There are, besides, a board of general officers for the clothing of the army, an inspector of army colours, commissioners of the military college, and commissioners of the military asylum. (For an account of armies in general, vide *Encyc Brit.* art. *Army*, of the British army, *M'Culloch's British Statistics*, of the Russian, Italian, and French armies, Tanski, Oudinot, and Daniel.)

A'RNOLDISTS. The followers, or rather partisans, of Arnold of Bresica, who in the twelfth century was the first to raise his voice against the abuses and vices of the papacy. He acquired for a time considerable influence among the lower orders, and the tumults which were raised by his supporters caused great uneasiness in Rome, which was the chief scene of his proceedings. He was finally put down by an armed force, made prisoner, and burnt by Pope Adrian IV. Certain heretical notions on the nature of the Eucharist were charged against him, but the insurrection which arose under his auspices was clearly a political disturbance, and his harangues seem to have been directed rather against the morals than the tenets of the church which he attempted to overturn

ARNOTTO. *See* ANNOTTA.

ARO'MA The characteristic odour of substances, especially the strong and peculiar odours of certain plants, whence the term *aromatic*

ARPE'GGIO and ARPEGGIA'TO. (It. arpeggiare, *to play on the harp*) In Music, the striking or bowing, if on an instrument of the violin species, the notes of a chord in quick and repeated succession, so as to imitate the harp.

ARQUEBUSA'DE. (From arquebus, *a hand gun.*) An aromatic spirituous lotion, applied to strains and bruises, but originally invented as an application to wounds inflicted by an arquebus.

A'RQUEBUSE, or HARQUEBUSE. A sort of hand gun, used by infantry before the invention of the musquet. The word is of uncertain derivation: the Italian archibuso is said to come from arco, *a bow*, and busio, or bugio, but the meaning of this last seems unsettled. The word is used very loosely in old writers for every sort of fire-arms used by infantry. Gunsmiths are still called arquebusiers in France. In the German, Spanish, and Gascon infantry of the earlier part of

the sixteenth century, the pike and arquebuse-men were intermixed in the same ranks. The barbarous English words hackbut, hackbutteer, which we find in military language in the reign of Elizabeth, are derived from arquebuse, arquebusier. The arquebuse is said to occur first in the descriptions of the battle of Morat in 1476 Arquebusiers on horseback are mentioned in that of the battle of Fornosa, 1491

ARRACA'CHA. The South American name for an umbelliferous plant, the arracacia esculenta of botanists; whose fleshy sweet roots are cultivated in Columbia and Jamaica, in the mountainous parts of those countries, in the same way as parsnips and carrots in Europe. The roots are of large size, and in quality are when cooked between a sweet chestnut and a parsnip. Attempts to introduce it into common European cultivation have uniformly failed.

ARRA'CK. A spirituous liquor, obtained by distilling the fermented produce of rice; but other spirituous liquors are called by the same name Arrack has a very strong and somewhat nauseous flavour and odour, derived from a peculiar volatile oil which it contains, and which corresponds with that which gives a sickly and disagreeable taste to our corn spirit.

ARRAI'GNMENT. In Law, the arraignment of a prisoner on a criminal charge consists in calling him to the bar, and (in treason and felony) making him hold up his hand, or otherwise own himself to be the party charged, reading the indictment to him in English, and demanding of him his plea (guilty or not guilty), and entering it accordingly.

ARRE'ST. In Law, in execution of the command of some court of record or officer of justice, may take place either in criminal or civil cases 1 For treason, felony, or breach of the peace, any person may arrest without warrant or precept. Arrests by public officers may be made either with or without process Any constable, or even private person, who has a warrant directed to him from a justice of the peace to that effect, may arrest for felony or misdemeanor, and, if the warrant was given without sufficient ground, the justice is responsible Every warrant should be under the hand and seal of a justice of peace, and specify the day on which it was made out. it seems to be rather discretionary than necessary, although it is usual to specify the cause of arrest in the warrant 2 Arrest in a civil cause is by process, in execution of the command of some court or officer of justice. On affidavit of a cause of action to the amount of £*01* (such cause of action importing a contract or liability, express or implied, and a breach of such contract, and a present debt overdue, unless in some rare cases, in which special orders to hold to bail are given for the causes of action), the plaintiff obtains a writ of capias, which is the proper process for the arrest of one or more defendants who are at large When a defendant is already in custody in one of the prisons of the superior courts, a writ of detainer to continue such imprisonment at the suit of the new plaintiff is the proper proceeding The form and effect of the writ of capias (*see* CAPIAS), on which arrest on mesne process takes place, are now regulated by the Uniformity of Process Act, 2 W 4 c 39 The sum specified in the affidavit, the sum bonâ fide claimed for debt and costs, and various other particularities, must be indorsed on the capias A writ of capias may, like a writ of summons, be merely served on the defendant; but when it is intended to arrest, a sheriff's warrant is obtained, on which the defendant is arrested, and a copy of the writ then delivered to him Arrest must be made within the county, and at any time within four months after the date of the capias, except Sundays, Christmas-day, and Good Friday If the writ or warrant is so defective as to be absolutely void, the party arrested might legally resist; but if the process were only irregular, such resistance would be an indictable offence. On arrest, the defendant and two sureties usually execute what is termed a bail-bond, conditioned for causing special bail to be put in (*See* BAIL) But instead of giving bail, he may put into court the sum indorsed on the writ, together with a further sum for costs.

Arrest on a writ of execution (*see* CAPIAS AD SATISFACIENDUM) is an absolute and perfect execution of the highest nature against the defendant, under which the debtor is imprisoned until satisfaction is made, unless discharged under the Insolvent Act.

A'RRIS. (Probably abbreviated or corrupted from a risega, Ital. *at the projection*, or from the Saxon ariran, *to arise.*) In architecture, the edge of two surfaces meeting each other, or line of concourse of two planes.

A'RROW ROOT. The commercial name of the starch obtained by washing the grated root of the maranta arundinacea, which it yields to the amount of twenty-five to thirty per cent. It is sometimes adulterated with potato starch, and the fraud is not easily detected; it, however, gives a disagreeable flavour and smell, like that of the raw potato, and forms a less firm jelly with hot water than when the arrow root is genuine.

A'RSENAL. (It. arsenale, from arx, *a citadel.*) A magazine of military stores, or public establishment where naval and military engines are manufactured or stored.

A'RSENIC. (Gr. ἀρσενικός, *strong.*) A very soft, brittle, and eminently poisonous metal, of a steel grey colour: its sp gr 5·7. It volatilizes, exhaling a strong odour of garlic, before it fuses, at a temperature of 365° F., and is easily inflammable It combines with oxygen in two proportions; and as both compounds are sour, and form salts with bases, they have been termed arsenious and arsenic acids. the former is composed of 38 arsenic and 12 oxygen, and the latter of 38 arsenic and 20 oxygen. Arsenious acid is more commonly known under the name of *white arsenic*, and is the usual state in which this poison occurs in commerce; it is obtained during the extraction of several of the metals from their ores, and is a white brittle semitransparent substance, having little taste, but is virulently poisonous. Its sp. gr is 3·7. It forms a dull white powder, and it is in this form that it is usually sold. When heated in the flame of a candle, it rises in the form of a white poisonous vapour, and exhales, in consequence of its partial reduction, a strong garlicky smell. 1000 parts of cold water dissolve about 2½ of white arsenic; but when the water is boiled with the arsenic, 1000 parts take up between 77 and 78; and this solution, after standing a few days, deposits rather more than half of the white arsenic, in the form of small crystals, retaining about 30 grains in permanent solution. White arsenic dissolves in the alkalies, and combines with the metallic oxides, forming a class of salts called *arsenites* they are all poisonous Of these the arsenite of potash is used in medicine, under the name of Fowler's mineral solution it is employed in very small doses in the cure of agues, and is an effective remedy, but requires much care in its administration.

When white arsenic is taken as a poison, that is, in large doses, it produces violent spasmodic pains of the stomach and bowels, attended by a sense of heat, and constriction in the mouth and throat, an increased flow of saliva, tightness about the head, itching of the face and neck, and nausea These symptoms are succeeded by vomiting and purging and excruciating pains, the pulse, at first full, hard, and frequent, sinks and becomes irregularly feeble, and clamminess of the skin, cold sweats, purple spots, and convulsions precede death; or if the patient escape this catastrophe, it often happens that hectic fever, paralysis, and mental and bodily debility attend him for the remainder of his days. It is often said that the bodies of persons poisoned by arsenic are very prone to putrefaction, but this does not appear to be always the case After death the stomach and bowels are usually found inflamed, but often only slightly so; and it appears from Sir B. Brodie's observations, that this poison kills by some peculiar action upon the heart and nervous system The treatment of persons thus poisoned consists in promoting the vomiting by an emetic, composed of a solution of 20 grains of sulphate of zinc in two ounces of water, aided by copious draughts of warm barley-water or gruel, but the most effective means of getting rid of the arsenic, is by the use of the stomach-pump, which, when immediately resorted to, has often saved the patient. The after treatment requires much circumspection

The only ready means of ascertaining the presence of white arsenic is by heating the suspected substance upon a red-hot coal, or in the flame of a candle or spirit lamp, when it will exhale the peculiar arsenical odour resembling that of garlic, but the treatment of persons poisoned by arsenic, and its detection in doubtful cases, must be left to the medical man and the chemist It is impossible too strongly to represent the evil which results from the unfettered sale of arsenic, and from the unwarrantable use of it as a poison for rats, and as a veterinary remedy, for it is thus that it finds its way into culinary vessels, gets accidentally mixed with articles of food, and that bottles which have contained it are used for beer, wine, vinegar, or medicine: its sale should be rigidly prohibited.

*Arsenic acid* is more soluble and sour, but equally poisonous with the arsenious acid Its salts are called *arseniates*, and the arseniate of potash obtained by deflagrating a mixture of white arsenic and nitrate of potash is occasionally used in medicine: it is the active ingredient in the tasteless ague drop.

A'RSIS and THESIS. (Gr. ἄρσις, *lifting up*, θέσις, *laying down.*) In Music, terms used in composition, as when a point is inverted or turned, it is said to move *per arsin et thesin*, that is, when it rises in one point and falls in another; properly speaking, it is the rise and fall of the hand in beating time.

A'RSON. (Lat. ardeo, *I burn.*) At Common Law, signifies the maliciously and voluntarily burning the house of another. This offence is now defined and regulated in its various degrees by the stat. 7 & 8 G. 4. c. 30. The subjects of arson are defined in two sections of this statute: the first, relating to buildings of every descrip-

tion, the latter to stacks of vegetable productions, (both these classes of offences being capitally punishable), and to crops of corn, &c. standing or cut down, plantations, heath, &c , the firing of which is punishable with transportation for seven years.

ART. (Lat. ars.) The application of knowledge or power to effect a desired purpose. The ancients divided the arts into "artes ingenuæ, bonæ" or "liberales," and "artes serviles." Under the latter were comprehended the mechanical arts, because these were practised only by slaves. The former were summed up in the Latin verse,

"Lingua, Tropus, Ratio, Numerus, Tonus, Angulus, Astra;"

and the latter in the pentameter,

"Rus, Nemus, Arma, Faber, Vulnera, Lana, Rates."

In modern times arts are divided into fine and useful, comprising under the former those which have not utility for their direct or immediate object, such as music, poetry, sculpture, &c. (For the history and description of the fine and useful arts, see the respective articles.)

ARTEMI'SIA. (Artemis, *one of the names of the goddess Diana.*) A composite genus consisting of bitter or stimulating plants, of which wormwood, southernwood, and tarragon form a part.

ARTERIO'TOMY. (Gr. ἀρτηρία, *an artery*, and τεμνω, *I cut*.) The opening of an artery: this operation is occasionally performed upon the temporal artery, with a view of relieving inflammatory symptoms about the head.

A'RTERY. (*See* AORTA.) These vessels are usually found empty in the dead body, and were supposed by the old anatomists to be air tubes; they are ramifications of the aorta, and convey the florid blood with a pulsating motion to the different organs and parts of the body.

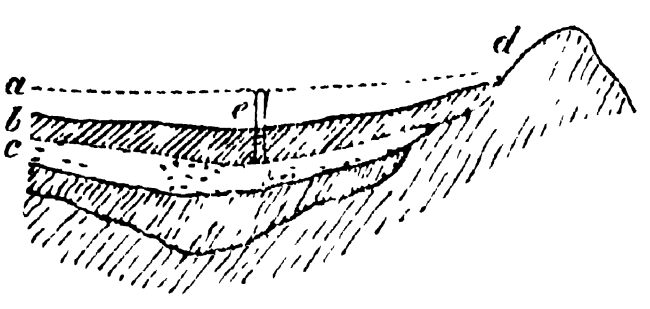
ARTE'SIAN FOUNTAINS, or ARTESIAN WELLS. (Fr. Puits Artésiens.) Vertical perforations of the exterior crust of the earth, of small diameter, and frequently of great depth through which subterraneous water arises to the surface, often forming abundant and elevated jets. The name Artesian is derived from Artois, a province of France, where especial attention has been given to this means of obtaining water; but it appears, from sufficient historical evidence, that wells of this kind were perfectly well known to the ancients. Niebuhr cites a passage from Olympiadorus, who flourished at Alexandria about the middle of the sixth century, in which it is stated that when wells are dug in the Oasis to the depth of two hundred, three hundred, or sometimes five hundred yards, rivers of water gush out from their orifices of which the agriculturists take advantage to irrigate their fields. The oldest Artesian well known to exist in France is in the ancient convent of the Chartreux, at Lillers in Artois. It is said to have been made in 1126. Others exist at Stuttgard, of great antiquity, though their dates cannot be fixed with precision. The inhabitants of the great desert of Sahara appear also to have been long acquainted with this mode of obtaining water, and the Chinese are said (but the truth of the statement is questionable) to have practised it for thousands of years.

Various conjectures have been made as to the source of the water which comes from the Artesian wells. It was long believed that the water of the sea must necessarily penetrate by way of infiltration into the interior of the continents, and at length form large bodies of subterraneous waters, which, excepting for capillary influences, would not rise above the general level of the ocean. Another opinion, maintained by Aristotle, Seneca, Cardan, and even Descartes, was, that the subterraneous water, from which the sources of rivers and springs are supplied, is the product of the condensation of aqueous vapours ascending from the interior parts of the earth in consequence of the central heat. But these hypotheses are founded on mere conjecture, unsupported by the slightest evidence, and consequently merit no attention. The simplest and most natural explanation is, that the water of ordinary wells, of Artesian fountains and rivers, is supplied by the rain which falls on the surface at a higher elevation, and which penetrates through the pores and fissures of the ground till it meets with some impermeable stratum, or is collected in subterranean reservoirs. It has been objected that springs are sometimes situated on or near the summits of mountains, which could not be supplied in this way; but on an attentive examination of all the circumstances, that is to say, on measuring accurately the extent of surface at a greater elevation than the spring, and comparing it with the quantity of rain that falls annually in the same climate, it has been found, in every instance, that the aqueous deposition from the atmosphere greatly exceeds the supply from the spring. It is computed that not more than a third part of the rain which falls in the valley of the Seine is conveyed to the sea by the river; the remaining two-thirds support vegetation, supply fountains and springs, or are returned to the atmosphere by evaporation. The immense bodies of water which some continental rivers roll towards the ocean are but a small part of the rain which falls in the surrounding countries.

Assuming, then, that the subterraneous water is supplied from atmospherical deposition, it remains to be explained how it arrives at the situation it occupies in the interior of the earth, and by what forces it is raised from great depths to the surface.

All persons who have paid the slightest attention to geology are aware that in stratified countries (and it is in such only that Artesian wells exist) different beds of rocks are superposed on one another, and ranged in a certain constant order. The strata sometimes follow a horizontal direction for a considerable extent of country; at other places they are inclined, and even placed perpendicularly to the horizon, having the appearance of having been bent and burst through by the action of a powerful force from beneath. In those cases the edges of the strata are often exposed, especially on the summits and flanks of hills, to the action of the atmosphere. Between the strata are frequently found beds of permeable sand, through which water, coming in contact with them, must necessarily pass, first, through the inclined part by virtue of its specific gravity, and then in the horizontal branches, by virtue of the pressure of the water remaining in the elevated portions of the strata. In this manner the water insinuates itself between the different strata; and hence we may expect that in localities where the tertiary stratification prevails, as many distinct sources of subterraneous water will be met with in penetrating perpendicularly through the surface, as there are distinct layers of a sandy or gravelly nature reposing on impermeable strata. This consequence of the theory is perfectly confirmed by experience. M Arago mentions, that in digging for coal near St Nicholas d'Aliermont, a short distance from Dieppe, seven distinct and copious sources of water were found, the respective depths of which were 1st, between 80 and 100 feet, 2d, 328 feet; 3d, from 570 to 590 feet; 4th, from 690 to 710 feet, 5th, 820 feet, 6th, 940 feet, 7th, 1090 feet, and the occasional force of each source was very great. Similar occurrences are frequent in the neighbourhood of London, and are familiar to all miners. But it is not enough that the structure of the country is such that water can percolate between the different strata; the phenomena of Artesian fountains could not be explained without supposing it to be collected in large quantities, and forming subterraneous reservoirs of immense extent. That such reservoirs exist, no doubt can be entertained. The celebrated fountain of Vaucluse sends forth at all times a stream of water sufficient to form a considerable river. Even in the driest seasons, when the water is least plentiful, it produces 4780 cubic feet per minute. After great rains, its product is thrice as great. The mean quantity emitted is 9360 cubic feet per minute, or about 5030 millions of cubic feet in a year. Many other examples of the same kind might be cited, showing that water must not only be collected in subterraneous cavities in immense quantities, but that it also passes freely from one place to another. In fact the disposition of the rocks in strata permits the water to be collected under the surface, and to be conveyed without waste, as if in close pipes.

According to the view which has now been taken of the manner in which subterraneous water is collected, its elevation to the surface through a natural fissure or artificial perforation is a simple result of hydrostatic pressure. Generally speaking, it is only on the acclivities of hills, or in elevated places, that the edges of the strata are exposed, and where, consequently, the rain water can be received




under beds of impermeable materials. Conceive two strata of clay or rocks as *a* and *b*, having a bed of sand or other matter permeable to water interposed, and suppose that *d* is the place where the edges of the strata crop out, or where a fissure allows a free entrance of the water to the permeable stratum. The water at first descends through the effect of gravity; it then passes along towards *b* in consequence of the pressure exercised by the superior part of the column near *d*. Now suppose a perforation to be made at *e*, and continued till it reaches through the stratum *a*, the water will naturally continue to rise till it gains the same altitude as *d*, or at least till it reaches the surface if below that altitude. The water in fact between the two impermeable strata is in the same circumstances as in an artificial pipe; and if the surface

of the ground at *e* is considerably lower than *d*, the ascensional force may be sufficient to cause a considerable jet.

Some Artesian fountains, for example that at Lillers in Artois, are situated in the middle of immense plains, where not the most insignificant hill is to be seen on any side. In such cases it may be inquired where we are to look for those hydrostatic columns whose pressure causes the rise of the subterraneous water to the level of the lowest points? The answer is obvious. we must suppose them placed beyond the limits of view; at the distance of 50, 100, or 200 miles, or even at a greater distance The necessity of supposing the existence of a subterraneous liquid column of two or three hundred miles of extent cannot appear a serious objection, when it is considered that the same geological structure has been found to prevail sometimes over even a much greater extent of country. An interesting paper on this subject is given by Arago, in the "Annuaire du Bureau des Longitudes," for 1835

ARTHRI'TIC. (Gr. ἀρθρῖτις, *the gout*, or from ἄρθρον, *a joint*) Gouty pains, chiefly affecting the joints.

ARTHRO'DIC. (Gr ἄρθρωσις, *articulation*) A connection of bones in which the head of one is received into a very superficial cavity in another, so as to admit of motion in almost all directions; as in the joint between the *humerus* and *scapula*

ARTHRO'DIEÆ (Gr. ἄρθρον, *a joint.*) A name given to those algæ which, like conferva and oscillatorias, have an articulated structure.

ARTHRODY'NIC. (Gr. ἄρθρον, *a joint*, and ὀδύνη, *pain.*) Rheumatic and other painful affections of the joints

A'RTICHOKE. (Kharchof, *the Arabic name of the plant*) A thistle-like plant, called by botanists cynara scolymus, a native of the south of Europe, and now cultivated for its 'bottom,' that is, for the sake of the fleshy sweet receptacle of its flowers. the harsh hairy substance that is pulled away consists both of the hairy palea of the receptacle, and of the feathery pappus of the ovaries The dried artichokes, called by the French "culs d'artichaut," are the receptacles deprived of the choke and the spiny hard hairs of the involucre, blanched by immersion in boiling water and dried in the sun Jerusalem artichokes are quite different, they are the tubers of helianthus tuberosus, and derive their name, not from the Holy City, but from a corruption of the Italian *girasole*, a sunflower

A'RTICLE A part of speech prefixed to substantives in order to render their signification more or less definite. (See GRAMMAR)

A'RTICLES OF FAITH are the particular points of doctrine which together make up the sum of the Christian belief The various churches of Christendom, not being agreed upon all these points, have for the most part set forth their own expositions of the whole, and it is to these creeds, symbols, or confessions, that the term articles is most commonly applied The articles of the English church are 39 in number; the substance of which was first promulgated in 42 articles by Edward VI., in 1553 Under Henry VIII a committee had been appointed for the formation of ecclesiastical laws, which was renewed under his successor, and in 1551, according to Style, "the archbishop (Cranmer) was directed to draw up a book of articles for preserving and maintaining peace and unity of doctrine in the church, that, being finished, they might be set forth by public authority" From this and the details that follow, it seems that Cranmer composed the articles in their original form, with the assistance of Ridley and others A great similarity in thought and expression may be traced between many of the articles and the language of the Augsburg Confession the XIth Article (on justification) corresponds with what Cranmer had previously written on the subject in private memoranda. There has been considerable question raised as to the authorities from which the XVIIth Article (on predestination) is derived; for while some persons have interpreted expressions in it according to the Calvinistic system, others have denied the justice of such interpretation, and have undertaken to show that Cranmer must have referred in the composition of the article to the writings and sentiments of Luther and Melancthon.

On the accession of Elizabeth these articles were remodelled by archbishop Parker, who omitted four of them, introducing four new ones, and altering seventeen These were again revised by convocation in 1563, some alterations made, and the number reduced to thirty-eight

The XXXIXth was restored in a final review by Parker in 1571, and then imposed on the clergy for subscription. It is remarkable that in the manuscripts and earliest editions there is one important variation in the admission or rejection of the first clause of the XXth Article, the authority of which may be considered as virtually recognising and establishing it.

ARTICLES OF WAR, the code of military law embodied in the Mutiny Act, which is passed each year

ARTI'CULATED. (Lat. articulus, *a joint*) Literally connected by an articulation or moveable joint; but in plants applied to cases where parts are so slightly connected that they finally fall asunder. Thus a leaf is said to be articulated with its stalk when the two finally fall asunder. A flowerstalk is articulated in the middle when it is contracted, and finally separates there into two parts. This separation is called disarticulation. It is a curious fact that the articulation of plants uniformly takes effect across the longitudinal or woody tissue, and never parallel with it; as in the petiole, in a stem at its nodes, in the middle of legumes and other kinds of seed vessels.

ARTI'CULATES, ARTICULA'TA A term applied by Cuvier to a primary division of the animal kingdom, characterised by an external skeleton in the form of a series of rings articulated together and surrounding the body; by an internal gangliated nervous system, the ganglions being arranged symmetrically along the middle line of the body (*see* HOMOGANGLIATA), and by having distinct respiratory organs.

ARTICULA'TION. The connection of the bones of the skeleton by joints.

ARTICULA'TION. In Painting and Sculpture, the moveable connection of the bones, in the representation of which by the artist the greatest skill and knowledge of anatomy is required.

ARTI'CULATE or HOMOGA'NGLIATE. Division of the animal kingdom. See those words

ARTI'FICER. (Lat ars, *art*, and facio, *I make*) Lit one who makes according to art. Among the Romans, artificers had peculiar privileges They possessed their own temples, and enjoyed an exemption from personal service. An artificer is one who requires intellectual refinement in the exercise of his profession, in contradistinction to artisan, who may practise either the fine or useful arts, but whose knowledge is limited to the general rules of his trade.

ARTI'LLERY. (Fr artiller, *to fortify*) In a general sense, denotes all kinds of missiles used in warfare, with the machines by which they are propelled Since the invention of gunpowder, however, the term has been chiefly confined to large ordnance, namely, cannon, howitzers, mortars, rockets &c., with their carriages, ammunition, and apparatus of all kinds, including also the troops especially appointed for their management

The principal military engines of the Romans, which can be properly classed under the term artillery, were the balista and catapulta, the former for throwing stones, the latter for propelling darts and arrows The invention of the balista is ascribed by Pliny to the Phœnicians, but other authors, among whom are Diodorus and Plutarch, say that both instruments were invented in Sicily. Ælian ascribes them to Dionysius the elder They were very extensively employed in the later periods of the republic, and under the empire In the middle ages, engines for assaulting and defending fortified towns or castles were greatly multiplied Among these inventions are enumerated the espringal, trebuchet, mangona, mangonel, bricolla, petrary, metafunda, belfrey, war-wolf, &c It is stated in the chronicle of Peter Langtoft, that Richard I in his wars against the Saracens, had mills in his barges and galleys which were turned by the wind, and threw fire and stones upon the enemy. If the accounts given of the effects of some of these machines may be credited, they must have been of great power, and well adapted to the purpose of battering down walls and fortifications. It is related by Hemingford, that the engines used by Edward I. at the siege of the castle of Stirling, threw stones of 300 pounds weight.

Though the explosive force of gunpowder was known to Roger Bacon in the twelfth century, it was at a considerably later period that fire-arms began to supersede the ancient artillery. Barbour, in his "Metrical Life of Robert Bruce," says that cannon were used by Edward III. in his first campaign against the Scots, A.D 1327. Du Cange says they were employed by the French at the siege of Puy Guillaume in 1338; but they must have been at that time very uncommon, for Rapin relates that the four cannon employed by Edward III at the battle of Cressy, in 1346, contributed as much by the surprise they occasioned to the French troops as by their execution to the success of the day. A few years later they seem to have been no longer rare. The most ancient cannon were formed of bars or pieces of iron, soldered to each other lengthwise, and bound together by iron hoops; occasionally lead, or even leather, protected in the same manner, appears to have been employed; and the cannon balls were made of stone. About the middle of the fifteenth century, cannon began to be cast, and it was about the end of the same century that font metal, or bronze, was first used for this purpose. In 1477, when Louis XI. was about to attack the cities of Flanders and Picardy, he ordered bombards or cannon of prodigious length and weight to be cast at Paris, Tours, Orleans, and Amiens. He also ordered iron bullets to be cast at the foundries of Creil, though stone bullets were still in use. Brass cannon appear to have been first cast in England by John Owen, in 1535. A foundery was also established about the same time in Edinburgh, by Robert Borthwick, an artist in the service of James IV. of Scotland. Mortars were

made in England under the reign of Henry VIII. and cast-iron cannon under that of Edward VI. About the beginning of the 15th century, the custom of applying to cannon the names of birds or beasts, from some fanciful analogies respecting their cruelty or swiftness, began to prevail; thence the names falconet, falcon, sacker, culverin, basilisk, dragon, syren, &c. At present cannon take their names simply from the weight of the ball they carry. Thus a piece which discharges a cast-iron ball of 24 pounds, is called a 24-pounder; one that carries a ball of 12 pounds, is called a 12-pounder; and so on. The size of the gun is determined by the service to which it is appropriated; and frequently by the means of transport, or facility of manœuvring. Ship guns and garrison guns, not requiring to be moved from place to place, admit of large sizes, and are frequently made to carry balls of 32, 36, or even 42 pounds. The largest cannon known to exist is a brass one at Beejapoor, which was cast in commemoration of the capture of that place, by Alum Geer in 1685. Its extreme length is 14 feet 1 inch, the diameter of its bore 2 feet 4 inches. An iron shot of the proper size to fill this bore would weigh 1600 pounds.

Mortars are probably as ancient as cannon, and were employed to throw red-hot iron and stones long before the invention of shells. The first account of shells used for military purposes is in 1435, when Naples was besieged by Charles VIII. The howitzer is a species of ordnance of a medium length between the cannon and the mortar, and is used for discharging either shells or large balls at point-blanc, or at a small elevation. It is said to have been invented by Belidor, and was used at the siege of Ath in 1697. It is chiefly made of brass. The carronade, a very short howitzer, was first cast at the Carron Iron Works; from which it takes its name. It began to be employed about the year 1779. Iron-rockets, the invention of Sir William Congreve, were first used at the bombardment of Copenhagen.

ARTILLERY PARK. The place in a camp, or the rear of an army, where the artillery is placed. The artillery is drawn up in lines, one of which is formed by the guns, the others by the ammunition waggons, pontoons, &c., and the whole is surrounded by a rope, which forms the park.

ARTILLERY TRAIN. A number of pieces of ordnance mounted on carriages, and ready for service.

ARTISAN. See ARTIFICER.

ARTOCA'RPEÆ. (Gr. ἄρτος *bread*, καρπος, *fruit*, *bread-fruit tree*.) A considerable division among urticaceous plants, having the fruit composed of flowers combined in fleshy heads, and the stem flowing with an acrid milk. The bread-fruit tree of the South Seas, and the jackfruit, are among the most conspicuous species. With them are associated the upas tree, and the fig, in different genera. The bread-fruit tree itself (artocarpus incisa) is a small tree with broad lobed leaves and large globular heads of fruit; the jack (artocarpus integrifolia) has oblong undivided leaves, and a larger, coarser, and oblong fruit. In all the species of artocarpeæ the flowers are unisexual.

ARTS, FINE. (Lat. artes.) Works imagined and executed by the mind and ingenuity of man. They include painting, architecture, sculpture, poetry, music, rhetoric, and, according to some, dancing. Their history, as respects the three first, will be found under several heads in this work, and a concise account of the philosophy of them under the article *Esthetics*. They are distinct from the arts simply so called, commonly called the useful arts from their general utility to mankind, because their end is pleasure. The fine arts are the offspring of genius, their model nature, and their master taste. Characterised by simplicity, they should never wander into luxury nor degenerate into extravagance.

ARUNDELIAN MARBLES. See PARIAN CHRONICLE.

ARUNDINA'CEOUS. (Lat. arundo, *a reed*.) Any thing having the general appearance of a reed.

ARU'SPICES. Roman soothsayers, who foretold future events from the inspection of the entrails of the victims offered at the altars of the gods. Their college was not held in the same respect as that of the augurs, and did not consist, like the latter, of men of high distinction; Cicero mentions the admission of one of their order to the senate, as an indignity to that body. Like that of the augurs, their art was brought from Etruria.

ARVI'COLA. (Lat. arvum, *a field*, colere, *to inhabit*.) A genus of rodent, or gnawing mammals, of the numerous family of the rat and mouse (*Muridæ*), distinguished by the prismatic form and fangless structure of the molar teeth, and of which the field campagnol (*Arvicola agrestis*) and the bank campagnol (*Arvicola riparia*) are indigenous species, these are commonly confounded with other *muridæ*, under the name of field mice.

AS. A Roman weight nearly answering to one pound, being accurately equal to 10 oz. 18 dwt. 13½ grs. troy weight. It was divided into 12 ounces (unciæ).

It was also the name of a brass coin, which originally weighed one pound; but was subsequently reduced by various degrees at different periods to half an ounce, in consequence of the gradual increase of the value of meta as compared with that of provisions and other necessaries, as civilisation advanced. Its value was a little more than three farthings of English money.

A'SAPHUS. (Gr. ἄσαφὴς, *obscure*.) A name devised to express the obscure nature of the genus of trilobites, fossil crustaceans, to which it is attached; and which is characterised by a tail-like appendage terminating the posterior extremity of the body, sometimes of a semicircular form, sometimes in the shape of a short triangle, and by tuberculate eyes, which have a granular surface arising from the number of compartments (at least 400) on the surface of the cornea, containing each a separate spherical lens.

ASARABA'CCA. (Asarum, *a kind of plant*, and bacca, *berry*.) A small, round, hard, stemless, hardy European herbaceous plant, with chocolate-coloured three-lobed flowers, belonging to the natural order Aristolochiaceæ. It is reputed to be a sternutatory. The French call it cabaret, the public-house plant, as it is said, because it was formerly used as an emetic to relieve the stomachs of people who had been drinking too hard.

A'SARIN. A crystallisable substance, somewhat resembling camphor, extracted from the roots of the Asarum Europæum.

ASBE'STUS. (Gr. ἄσβεστος, *unconsumable*.) A fibrous soft mineral, composed of easily separable filaments of a silky lustre. It consists essentially of silica, magnesia, and lime. It is sometimes woven into cloth, which is incombustible, and may therefore be purified by fire. hence the term *amianthus*, from ἀμιαντος, *undefiled*. This cloth was used in antiquity to wrap the bodies of the dead when about to be burned, to prevent their ashes being mixed with those of the funeral pile.

ASCA'LAPHUS. A Fabrician genus of insects separated from the ant-lions (*myrmeleon*) of Linnæus, and characterised by having nearly equal palpi; maxillæ ciliate, labium horny, rounded, and entire.

ASCA'RIDES. (Gr. ἀσκαρὶς, a term applied by Hippocrates to certain intestinal worms.) In modern Zoology restricted to a genus of round worms, or cælelminthans, with a trilobate or trivalvular head, and a double speculum for the intromittent organ. Two species of this genus infest the human body, one large, found in the small intestines, called Ascaris lumbricoides, the other of very small size, found in the rectum called Ascaris vermicularis.

ASCE'NDING. (Lat. ascendo, *I climb up*.) Is said of any part which, being horizontal at its base, gradually curves upwards, as is the case in many stems. If applied to ovules, it means that they are attached to the placenta by a point intermediate between the lower end and the middle.

ASCENDING NODE. In Astronomy, is that point of a planet's orbit in which it crosses the ecliptic, proceeding northward. (See NODE.)

ASCENDING SIGNS. The signs are said to be ascending when they are eastward from the meridian, and consequently approaching the meridian through the effect of the diurnal rotation.

ASCE'NSION. In Astronomy, is either right or oblique. The RIGHT ASCENSION of a star denotes the arc of the equator intercepted between the first point of Aries and that point of the equator which comes to the meridian at the same instant with the star. The most convenient way of defining the place of a star is to refer it to the equator, and to a certain fixed point in the equator from which the degrees are begun to be reckoned. For this purpose astronomers choose the point of the equator at which the sun's path crosses it when he ascends into the northern hemisphere, which is the first point of Aries, or the vernal equinox, and reckon the degrees along the equator eastward, all round the circle. Now, to determine the plane of any star, a great circle is conceived to pass through it, intersecting the equator at right angles. The distance of the star from the equator, measured on this circle, is called its declination, and the distance of the point of intersection of the equator and the circle from the vernal equinox is called the right ascension of the star. The right ascension and declination are thus the two co-ordinates by means of which the plane of any star is determined. The right ascension is reckoned in time, because it is found by observing the time on the sidereal clock which elapses between the passage of the first point of Aries and that of the star over the meridian. When the first point of Aries passes the meridian the astronomical day begins; astronomers then reckon 0 hours 0 min. 0 sec. Suppose a star to come on the meridian 5 hours 35 min. 26 sec. after this, then 5 hours 35 min. 26 sec. is the star's right ascension in time, and is equivalent to an arc of the equator of 83° 51′ 30″, because an hour in time corresponds to 15° in space, and a minute or second in time to 15 minutes or seconds in space. If the clock, therefore, is regulated to keep time with the

heavens, the time indicated by the clock at which any star passes the meridian is the right ascension of the star in time.

The OBLIQUE ASCENSION of a star is the arc of the equator intercepted between the vernal equinox and that point of the equator which comes to the horizon at the same time with the star. This varies with the latitude of the place of observation. At the equator it coincides with the right ascension. This term is now seldom used in astronomy.

ASCENSIONAL DIFFERENCE is the difference between the oblique and the right ascension. This term is chiefly used in respect of the sun, because when the arc which it denotes is turned into time it shows the time before or after six o'clock of sunrise. The sine of the ascensional difference is equal to the tangent of the latitude multiplied into the tangent of the star's declination, hence, when the declination of a star is north, its oblique ascension is found by subtracting the ascensional difference from the right ascension, and when the declination is south, by adding the ascensional difference to the right ascension.

On account of the greater precision with which observations are made with fixed meridional instruments, all astronomical elements are now computed from observations of right ascension and declination, but in ancient times the positions of the celestial bodies were chiefly referred to the horizon, and hence the *oblique ascensions* and *ascensional differences* entered constantly into the solutions of astronomical problems.

ASCE'NSION. The reception of our Saviour into glory, after his last appearance on earth, celebrated in the Christian church, from time immemorial, on the last Thursday but one before Whit-Sunday. Rogation week, that in which the ascension is celebrated, is so termed from the rogations (petitions or litanies) which were used in the perambulation of the bounds of the parish, which, according to ancient usage, took place in this week.

ASCE'TICS. (Gr. *ἀσκεω, I exercise*) Persons who, in the early ages of Christianity, devoted themselves to a solitary and contemplative life, following the system of the Essenes and Therepeutæ among the Jews, and practising great austerities, with a view to mortify the flesh and abstract the mind from worldly objects. They had their origin in Egypt and Syria, and appear to have suggested the first idea of monachism

A'SCI. (Gr. *ἀσκος, a bottle.*) Little membranous bags or bladders, in which the seed-like reproductive particles or spores of lichens, fungi, &c are enclosed.

A'SCIANS, or ASCII (Gr *α, without*, and *σκιὰ, shadow*) A term found in the older works on geography, and used to denote those inhabitants of the globe who at certain times of the year have no shadow. This can only happen with respect to the inhabitants of the torrid zone, who, twice a year, have the sun in the zenith

ASCI'DIAN, ASCIDIA. (Gr *ἀσκος, a bottle* or *pouch*) A genus of heterobranchiate acephalous molluscs, or tunicaries, characterised by a body having the form and commonly the consistence of a tough leather pouch, attached to some foreign substance, and with two openings, one branchial, and the other anal, from which streams of water are forcibly ejected when the animal is touched or irritated.

AS'CIDIUM. (Gr. *ἀσκος, a bottle*) A hollow pitcher-shaped body found upon the stems of certain plants, as nepenthes, sarracennia, &c. It usually contains water, and is sometimes clothed with reflexed hairs, which prevent the escape of insects which fall into it; its use is unknown. In nepenthes, sarracennia, cephalotus, and dischidia, it is in reality a leaf rolled up till its edges touch, when they grow together; in marcgraavia, it is a bract in the same state.

ASCI'TES. (Gr. *ἀσκὸς.*) Dropsy of the belly.

ASCLEPIADA'CEÆ (Asclepias, *one of the genera.*) Monopetalous exogenous plants, with bifollicular fruit, the stamens adhering to the stigma, which is large and pentagonal, and an acrid milk in their stems. They are exceedingly different in appearance, some being trees with showy flowers, others obscure twiners with very inconspicuous herbaceous corollas, others herbaceous plants with clusters of gaily coloured flowers, and others leafless decumbent shrubs with angular stems and brown putrescent flowers. The latter are stapelias. Hoya, with its delicate waxen flowers running with honey, is a genus of the order; and another is the curious climbing water carrier called dischidia, which mounts to the tops of lofty trees with its fleshy bags filled with a constant supply of water. Some of the species are valuable for the toughness of the fibre extracted from their stems. The milky secretion of these plants contains caoutchouc, or Indian rubber; it is of an emetic nature, and in some cases it is dangerous. Asclepias tuberosa, the butterfly weed of North America, is the handsomest of the hardy species. This order only exists in temperate climates, and is most copious in the tropics.

ASH. (Celt. ac, *a point;* its wood being used for pikes.) The fraxinus of botanists, consists of several species of hardy trees, usually valuable for their timber. The tough ash wood of carpenters is yielded by Fraxinus excelsior, and the sweet substance called manna by Raxinus ornus. They mostly bear flowers without petals; but the latter species having those organs is called, in distinction, the flowering ash.

A'SHLAR. (Ital. asciare, *to chip.*) In Architecture, common freestones, as they are brought rough and chipped or detached from the quarry, of different lengths and thicknesses. Their usual thickness is nine inches.

ASHLERING. (From same as last) In Architecture, the upright timber or quarters towards the rooms or inwards in garrets by which the slope of the roof is concealed — sometimes it is only two or three feet high, and sometimes the whole height of the room.

ASH-WEDNESDAY. The first day in Lent, called in the Latin church dies cinerum, *the day of ashes;* it being customary on that day for penitents to appear in church clothed in sackloth, upon which occasion ashes were sprinkled upon them.

ASI'LUS. A Linnæan genus of dipterous insects, in which the mouth is furnished with a horny, projecting, straight, two-valved sucker, and gibbous at the base antennæ filiform, approximate, of two articulations; body, oblong and conical in shape The insects of this genus prey on other insects, especially those of the dipterous and lepidopterous orders.

ASP. (Gr. *ἀσπὶς, an asp.*) A species of poisonous serpent frequently mentioned by ancient authors, some of whom describe its bite as being inevitably mortal, and say that the bitten die within three hours, and without pain, being thrown into a deep sleep; whence it was selected by Cleopatra as the instrument with which at once to terminate her existence, and bereave her conqueror of the chief feature of his triumph There is always much difficulty in identifying the precise species mentioned in the classical writings of antiquity, from the vague manner in which they are there alluded to. Some naturalists are of opinion that the species of hooded viper, called by the modern Arabs 'El Haje' [Vipera (Naja) Haje, Cuvier] is the 'Aspis' of the ancients, and as it possesses the power of distending the skin of the neck, like the Indian Cobra di Capello, it agrees with one of the characters assigned by Pliny to the Aspis — "Colla aspidum intumescere," lib. viii. The size, however, of the Haje, which varies from three to five feet, is greater than that which is usually attributed to Cleopatra's asp

ASPA'RAGIN A white crystallisable substance obtained from the expressed juice of asparagus It has been proposed as a diuretic in medicine.

ASPA'RAGUS (Gr *σπαραασσω, I tear.*) A genus of spiny plants, many of which are shrubs, and climb upon other plants. They all have minute scale-like leaves, small white or greenish flowers, and berried fruit, very often they produce short leafless branches, in room of leaves Asparagus officinalis, one of the few species which neither climb nor bear spines, is found wild occasionally on the seashore near Weymouth The succulent shoots which it throws up from its underground eyes are the asparagus of the market gardeners It is not a little singular, that although this plant has been an object of careful cultivation for so many years, it should never yet have produced a well-marked permanent variety, the sorts, as they are called in the shops, are produced by casual differences of soil or cultivation, and are not distinct varieties.

ASPARA'GINOUS PLANTS In Hort In a strict sense, this term ought to be applied only to such plants as belong to asparagineæ, but in horticulture it is used to signify all those culinary vegetables the points of the tender shoots of which in spring, when they nearly emerge from the soil, are eaten, in the same manner as those of asparagus such, for example, as the points of the common hop, of the sea-kale, &c.

ASPA'RTIC ACID. When asparagin is boiled with magnesia it is resolved into ammonia and a peculiar acid called as above.

A'SPECT In Architecture, the direction towards the point of the compass in which a [illegible] is placed. The aspectus is also used by Vitruvius to denote the external distribution of a temple. Thus he describes seven sorts of aspects of temples, that in Antis, the Prostyle, Amphiprostyle, Peripteral, Dipteral, Pseudodipteral, and Hypæthral; under which words they are severally described.

ASPECT. In Astrology, the angle formed by the rays of light proceeding from two planets, and meeting at the earth, and which are supposed to possess some natural influence. (*See* ASTROLOGY.)

ASPECT. In Hort. In speaking of the inclination of the surface of the ground, the word aspect is used with reference to the sun, as the word exposure is with reference to the wind. Hence, a garden, the surface of which slopes to the east, has an eastern aspect, and also an eastern exposure; but a garden on a flat surface, sheltered by plantations on the east, west, and north, cannot be said to have any aspect, while it has a southern

exposure, being open to the winds of the south, though sheltered from those blowing from the other cardinal points of the compass.

ASPERGI'LLIFORM. (Lat. aspergillus, *the brush with which holy water is scattered about in Roman Catholic places of worship.*) Any thing shaped like that instrument; it is chiefly used in speaking of the stigmas of grasses.

ASPERGI'LLUM A genus of tubicolar Bivalves, characterised by the soldering of both valves to the inner surface of the calcareous sheath; which is dilated or club-shaped at the lower end, and perforated there by many small holes, whence it has obtained the trivial name of the "Watering-pot Shell" In the system of Cuvier, this rare and remarkable genus ranks among the Family *Clausa*, of the Class *Acephala testacea.*

ASPERIFO'LIÆ. (Lat. asper, *rough*, folium, *a leaf.*) The name given by Linnæus to the plants now called Boraginaceous.

ASPE'RMOUS. (Gr. ἀ, *without*, σπέρμα, *seed.*) Destitute of seed.

ASPHA'LTUM. (Gr ἀ, priv and σφαλλω, *I slip*, from its use as a cement in ancient building) A black brittle bitumen, very fusible and inflammable; it is soluble in naphtha, and forms a good varnish. It is found upon the surface and banks of the Dead Sea (hence called Asphaltic Lake), and in large quantity in Trinidad and Barbadoes, the ancients employed it in some of their cements, and it was used also in the art of embalming.

ASPHODE'LEÆ (Asphodelus, *the principal genus*) Subdivision of the natural order Liliaceæ, comprehending the onion, the squill, the ornithogalum, anthericum, asparagus, and similar genera. They differ from true liliaceæ in little beyond their flowers being usually smaller. (*See* LILIACEÆ)

ASPHY'XIA. (Gr. ἀ, *without*, and σφύξις, *pulsation*) A fainting fit, a state of body in which the pulse cannot be felt, and in which the powers of mind and body are suspended

ASPIDORTRY'NCHUS (Gr. ἀσπὶς, *a shield* ῥύγχος, *a beak*) The name of a fossil extinct genus of sauroid fishes characterised by the length and bony covering of the upper jaw.

ASSAFŒ'TIDA A fetid gum resin obtained from the root of the *ferula assafœtida*, whence it exudes by incision in the form of a milky juice, which, when dried by exposure to the sun, acquires a mottled appearance and pink colour It is a native of the south of Persia, and is used in medicine as a stimulant and antispasmodic in hysteric and nervous disorders, and in spasmodic cough, asthma, and flatulent colic.

ASSA'I (Ital *enough*) In Music, an adverb of quantity prefixed to such words as allegro, adagio, &c, signifying that the motion of the bars or measures should be kept at a mean rate of quickness or slowness, quick or slow enough, but not too much so in one or the other case

ASSA'SSINS Those who attack and kill by treachery and violence persons unprepared for defence. The word is derived from a military and religious order, formed in Persia by Hassan Ben Sabah, about the middle of the eleventh century, and called Assassins from their immoderate use of Haschischah (henbane), which produced an excitement amounting to fury. Hammer, in his History of the Assassins, has opened some new and striking views of the origin, principles, and doctrines of this sect. Their principal seat was in the mountains; and they were subject to the control of a prince, or, according to Hammer, a grand master, who possessed such an ascendency over his fanatical subjects that they paid the most implicit deference to his commands, esteemed assassination meritorious when sanctified by his mandate, and courted danger, and even certain death, in the execution of his orders. Nor did they stoop to humble prey, for the more lofty the object of their hatred, the more sure and deadly was their aim. In the time of the crusades, they mustered to the number of 50,000, and presented a formidable obstacle to the arms of the Christians. Among the victims of their swords, at this period, may be mentioned Conrad, Marquis of Montferrat, who was murdered in the market-place of Tyre, in the year 1192. Several historians have charged upon Richard I. the instigation to this crime; but it is a point which none have succeeded in elucidating Long after this period the Assassins continued to levy contributions in return for the safety which they afforded to distinguished individuals, but they were at length, after an obstinate resistance, effectually crushed by the sultan Bibars. Scattered abroad, however, hated and despised, the order of the Assassins, like that of the Jesuits, endured long after its nominal suppression, and the mountainous regions of Kuhistan offered for a time a secure asylum to those who still lingered in their faith. Remnants of the Assassins still exist both in Persia and Syria, but merely as one of the many sects and heresies of Ismalism, and utter strangers to the murderous tactics of their predecessors.

The numerous battles and enterprises of the Assassins, their valorous defence against the armies of the crusaders and the great sultan Bibars, and the adventurous character of their whole history, opened a fertile source to the Syrian romance writers, of which, according to Hammer, they have freely and skilfully availed themselves.

ASSAU'LT. (Lat. assilio, *I leap upon.*) In Law, generally speaking, a violent kind of injury offered to a man's person. The nature of an assault has never been precisely defined; some lawyers being of opinion that a blow or an attempt to strike alone constitutes the offence, others including under this category irritating or abusive language.

ASSAULT. In War, an effort made to carry a fortified post, camp, or fortress, wherein the assailants do not screen themselves by any works. During an assault, to avoid endangering their own party, the batteries of the assailants cease to play.

ASSAULT. In Fencing, a mock engagement with foils, in imitation of a real single combat.

ASSA'Y. (Fr. essayer, *to try.*) This term is sometimes employed as synonymous with analysis, but more generally restricted to the determination of the composition and consequent value of alloys of gold and silver. From the quantity of coin, plate, and trinkets constantly fabricated, the art of assaying is of much importance, and requires considerable practical skill in its performance. At the mint there are two assay masters, the master's assayer and the king's assayer. the business of the former is to receive the gold and silver ingots brought for coinage, to cut one or more pieces from each ingot, and to make written reports of each assay. The king's assayer examines the melted bars previous to their passing into the moneyers' hands for coinage, and is responsible for their standard purity: and when the money is coined it is not allowed to go out of the mint until pixed; that is, until it has been ascertained, by the assay of one piece taken out of each journey weight of coin, that it is of standard purity: the king's assayer therefore is a check officer upon the melter and upon the moneyers, and is responsible for the standard purity of all gold and silver coin issued from the mint About twelve grains of gold, and twenty grains of silver, are usually employed for the assay.

ASSE'MBLY. In French history, the four great legislative bodies which succeeded each other during the period of the Revolution, are usually termed, 1. The *National* or *Constituent Assembly*; commenced 17th of June, 1789, by the resolution of the deputies of the communes in the States-General, constituting themselves a national assembly, to which the deputies of the nobles and clergy afterwards adhered, termed Constituent Assembly, from having framed a constitution dissolved on the acceptance of the constitution by the King, 30th of September, 1791. 2. The *Legislative Assembly:* it commenced its sittings October 1. 1791; suspended the royal authority by its decree of the 10th of August, 1792; and was dissolved September 21. 1792 3 The *Convention* (*see* CONVENTION). it commenced its sittings September 21. 1792, with a proclamation of the Republic; was dissolved 4 Brumaire, 4th year of the Republic (Oct 26. 1795). 4. Two-thirds of this assembly were then included in the new body of the "Corps Legislatif," which commenced its sittings Oct. 27. 1795, forming two councils, 1. of 500 (des Cinq-cens), 2 of the Ancients (des Anciens), 250 in number. The latter body named the Directory This assembly subsisted until the dissolution of the Directory by Bonaparte, 19 Brum 8th year of the Republic (Nov. 10 1799). (*See* DIRECTORY)

ASSEMBLY, the General, of the Kirk of Scotland, is the highest ecclesiastical court of that establishment. It meets annually in May, and sits for ten successive days, with power to appoint a commission to take cognizance of any cases undecided within that period; the commission being in fact a continuation of the assembly, with one additional minister named by the moderator. The assembly consists of representatives from the presbyteries, royal burghs, and universities of Scotland, and from the churches in the East Indies connected with the Kirk: in all about 380 members. The meeting of the assembly is attended by a nobleman as representative of the king, with the title of Lord High Commissioner; who, however, takes no part in the proceedings. The moderator, or president, is chosen by the assembly yearly. The General Assembly is a court of appeal from the Presbytery and Synod.

ASSE'SSMENT OF DAMAGES. *See* DAMAGES.

ASSE'SSOR. In Law, a person possessed of knowledge of the law, appointed to advise and direct the decision of the judge. In various inferior courts assessors are appointed by statute. Assessors were employed, previously to the Reform Act, to assist the returning officer in deciding on the cases submitted to his cognizance at the period of an election. By the Municipal Corporation Reform Act (5 & 6 W. 4. c. 76. s 37) the burgesses of every borough are directed to elect two assessors, for the purpose of assisting the mayor in his duty of revising the burgess lists and presiding at the

elections. And, by sect. 43. the burgesses of each ward are to elect two assessors for the purpose of assisting the alderman at the ward elections.

A'SSETS. In Law, are the fund out of which a deceased person's debts are to be paid. Assets by descent are liable to those debts only which are secured by specialty, as bond or covenant binding the party's heirs; but assets in the hand of executors or administrators are liable to all debts.

ASSIE'NTO TREATIES. In History, the contracts entered into by Spain with several European nations (first Portugal, then France, and after the peace of Utrecht in 1713, England), to supply her South American colonies with negro slaves from Africa, were so termed.

ASSI'GNATS. Paper-money issued by the French government at various periods during the Revolution, based on the security of the unsold lands of the clergy, emigrated nobles, &c., which had become forfeit to the nation.

ASSI'GNMENT In Law, is the total alienation of a chattel interest, which, by the third section of the Statute of Frauds, must be, if of a term of years in land, by writing and signature. *Assignee* is the party to whom an assignment is made.

ASSIMILA'TION. (Lat assimilatio.) The act by which organised bodies incorporate foreign molecules and convert them into their own proper substance.

ASSI'ZE (From the Norman French assise, *session*) 1. In a sense now obsolete, an ordinance or constitution of the sovereign, thus, the code of feudal law framed for the kingdom of Jerusalem is termed the Assizes de Jerusalem. 2 The ordinances regulating the price of bread and other necessaries, were also called Assizes. 3. The peculiar jury by which a writ of right was tried, was termed the Grand Assize 4 In the only sense in which the word is now an existing law term, the assize signifies the periodical session held by the judges of the superior courts in the counties of England, for the purpose of trying issues at nisi prius and delivering the gaols. (*See* COURTS, SUPERIOR)

ASSO'CIA'TION. In Psychology, a name given to that property of our minds, by which any object or state of consciousness (whether image, thought or emotion) has a tendency to recal other states or objects of consciousness with which it has been previously in some way connected The conditions under which this tendency exists were first stated by Aristotle, in his "Treatise on Memory and Recollection" According to him they are threefold, consisting of Resemblance, Contrast, and Contiguity. If by the last word we understand connexion in space and time, and that of cause and effect, this division is the same with that given by Hume, and adopted by modern philosophers. The principle of association has been applied by Hartley, Sir J. Mackintosh, and other writers on ethics, to explain the origin of our more complex emotions, and in particular of our moral sentiments.

ASSOCIATION. In Politics, a society formed of a number of individuals acting under common rules and an elective government, for the accomplishment of some definite object. The principle of association is so obvious as to need no comment or explanation. But its practical developement in politics and ethics in modern times, owing in great measure to the facility of communication and diffusion of intelligence, is a feature in society of vast and daily increasing importance The value of a combination of means and wills is plain and undeniable,—Firstly, in cases where the object pursued is pecuniary advantage. Undertakings which it would be impossible for individuals to embark in, either from the great actual outlay required, or the great amount of pecuniary responsibility imposed (such as the establishment of banks, great public works, distant commercial enterprises, &c.), are every day carried into effect with success and profit by companies. Secondly, in cases where the object is to raise and direct the disposal of a large amount of funds, with a view to the accomplishment of certain ends Such are associations for purposes of education, for the distribution of Bibles, charitable institutions, &c &c. And thirdly, we may mention a class of associations, common in all times, but which have far more frequently failed with actual loss than accomplished their object; associations, namely, for the purpose of controlling the rate of profit or of labour (*See* COMBINATION) But besides these ordinary instances of association, the present times appear more peculiarly favourable to the formation of societies having in view the accomplishment of political or moral objects, by controlling the action of governments or individuals. These are wholly distinct from those which we have before enumerated. Their purposes do not generally require a large outlay, nor (except in some occasional contingencies) much actual and definite co-operation. Their main object generally is to overrule by a display of associated numbers; occasionally also to bring combined energies to bear upon particular points. They serve to concentrate the action of the wills of many separate individuals, by inducing every man to abandon a portion of his own particular views, and take up instead of them the views of the majority of his co-associates. Of this character were, in France, the clubs which exercised so great a power during the Revolution; and those which, in calm times, are said to have contributed materially towards bringing about the second revolution of 1830: the society "Aide toi et le ciel t'aidera" more especially In our own country, the history of political unions and associations of late years is abundantly well known. The most powerful that we have hitherto seen was the famous Catholic Association, formed in May, 1823, dissolved in March, 1829, when its great object, the passing of the Catholic Relief Bill, was attained. Of associations having moral instead of political objects, and falling within the category last described, perhaps (if we exclude the Freemasons, from the want of any definite purpose which appears to distinguish them) the Temperance Societies of late years afford the most singular examples; the more remarkable, because their great end is one which (except in a very few instances, such as the exclusion of spirits from ships, &c.) cannot be attained by combined action, unless in so far as it may influence the action and will of individual men

It is impossible to deny the power of political associations, and it cannot be wondered at that they are regarded favourably by the state in such countries as America, where the principle of democratic associations pervades everything; with distrust by aristocratic governments, in which the power of a ruling class is exposed to danger from their attacks, and altogether suppressed as far as possible under arbitrary governments Yet it may be questioned whether the tendency of modern opinion is not greatly to overrate that power. It is essentially of a temporary character. At the moment of a doubtful crisis in politics, the expression of the will of an associated multitude will often turn the scale through the mere weight of intimidation. But even with the best organisation, they seem to be radically unfit for the accomplishment of objects requiring untired zeal and perseverance. In the first place, by fettering the individual will of their members, they destroy a great portion of the collective energy in the attempt to concentrate what remains. No mind capable of achieving great objects ever voluntarily works in the trammels of an association They become therefore, for the most part passive bodies, guided solely by the will and management of a few individuals among them, who are flattered by the exercise of a power resembling sovereignty, but who are themselves, perhaps, rather fettered than aided in their activity, by the necessity of managing the large masses which they drag along with them. Perhaps no history affords so remarkable an example of the apparent splendour and real weakness of political associations on a large scale, as that of the Jesuits. Their company was formed on an admirable organisation, it had one precise object, the spread of the Roman Catholic faith; one definite principle of union, implicit obedience the means put within its reach were enormous. It spread and flourished amazingly, exerted the most boundless activity, and excited naturally the most exaggerated fears among its opponents. And yet it would be difficult to say in what it has contributed to the objects it had in view It has made no conquests over Protestantism, for in Bohemia, France under Louis XIV. &c, where it made the greatest show of effectiveness, its operations merely followed in the train of military oppression or state persecution It has effected no permanent conversions among the heathen. It has done little or nothing, notwithstanding great show and immense expense, in the way of national education on Roman Catholic principles. Its learned men, with few exceptions, have done still less toward advancing the cause of true knowledge. Nor has a single mind of great originality and power been developed within the boundaries of the institution.

Nor is it possible to speak without great doubt of the moral good produced by the extension of the spirit of association. Some valuable remarks on this subject will be found in an article of Dr Channing, reprinted from the North American Review, with the title "Remarks on Associations." "One of the most remarkable features of our age," he says, "is the energy with which the principle of combination, or of acting by joint forces in associated numbers, is now manifesting itself. Men have learned what wonders can be accomplished in certain cases by union, and seem to think that union is competent to anything You can scarcely name an object for which some institution has not been formed Would men spread one set of opinions and crush another? they make a society Would they improve the penal code, or relieve poor debtors? they make societies. Would they encourage agriculture, or manufactures, or science? they make societies. Would one class encourage horse-racing, and another discourage travelling on a Sunday? they make societies. We have immense institutions spreading over the country, combining hosts for parti-

cular objects. We have minute ramifications of those societies, penetrating everywhere, and conveying resources from the domestic, the labourer, and even the child, to the central treasury." — "Associations often injure free action by a very plain and obvious operation. They accumulate power in a few hands, and this takes place just in proportion to the surface over which they spread. In a large institution a few men rule, a few do everything; and, if the institution happens to be directed to objects about which controversy exists, a few are able to excite in the mass strong and bitter passions, and by these to obtain an immense ascendency. Public opinion may be so combined, and inflamed, and brought to bear on odious individuals or opinions, that it will be as perilous to think or speak with manly freedom as if an inquisition were open before us. It is now discovered that the way to rule in this country is by an array of numbers, which no prudent man will like to face. Of consequence, all associations aiming or tending to establish sway by numbers ought to be opposed. They create tyrants as effectually as standing armies. Let them be withstood from the beginning. No matter whether the opinion they intend to put down be true or false, let no opinion be put down by such means. let not error be suppressed by an instrument which will be equally powerful against truth, and which must subvert that freedom of thought on which all truth depends."

A'SSONANCE. In Rhetoric and Poetical Composition, a jingle or imperfect rhyme, formed by separate words, or members of a sentence.

ASSU'MPSIT, or trespass on the case on promises, in law, is an action of an anomalous character, having the form of tort and the substance of contract. It is, properly, a claim of damages sustained through the breach of a simple contract (*i. e.* a promise not under seal), and alleges that the defendant assumpsit promised or undertook to perform the acts specified. It has become the most ordinary remedy, not only where unliquidated damages, but also where debts are sued for, the law implying a promise to pay or do whatever the defendant is legally liable to pay or do.

ASSU'MPTION. A festival of the Romish church, kept on the 15th of August, in celebration of the alleged miraculous ascent of the Virgin into heaven.

ASSU'MPTIVE ARMS. In Heraldry, such as may be assumed with the approbation of the sovereign, or grant from the proper officers of arms; also, in another sense, armorial bearings improperly assumed.

ASSU'RANCE, or INSU'RANCE. A contract for the payment of a certain sum on the occurrence of a certain event. The term assurance is generally confined to those contracts under which a certain sum is to be paid on the death of an individual or individuals now living, while insurance is applied to those which provide for the payment of a sum on the occurrence of events not depending on the duration of human life, and which may never happen, such as the loss of ships at sea, the destruction of houses by fire, &c.

*Assurances on Lives*, are contracts which stipulate for the payment of a certain sum of money on the death of one or more individuals, in consideration of an immediate payment, or, more frequently, of an annuity or annual contribution, to be continued during the existence of the lives assured. Contracts of this kind are of immense importance to society. Every man whose income depends on his own life or exertions, and on whom others are dependent for support, must be sensible of the advantages of arrangements by means of which, at a small sacrifice of immediate comfort, he is enabled effectually to provide against the casualties of life. They are of a totally different nature from gambling. Though nothing can be more uncertain than the continuance of an individual life, yet nothing is more invariable than the duration of life in the mass; consequently, the exact value of life assurances can be calculated without any uncertainty whatever, and a man, by effecting an assurance, secures to his representatives, against the risk of accident, the advantages they would have from his enjoying his exact proportion of the average duration of life. Such transactions provide against destitution, and tend directly to the accumulation of capital, they will, therefore, be encouraged and protected in all well-governed communities.

*Method of computing the Value of Assurances.* The value of assurances on lives are computed in nearly the same manner as those of annuities, the principles being the same in both cases. A table of mortality must first be selected, from which we deduce the probabilities of living over the different years of life. Having obtained these, and assumed a rate of interest, we proceed as follows: let the probabilities that an individual of a given age will live over

1, 2, 3, 4, 5, &c. years
be $p_1$, $p_2$, $p_3$, $p_4$, $p_5$, &c. respectively;

also, let $r$ be the rate of interest, and $v = \frac{1}{1+r}$, and suppose that the sum assured is to be paid at the end of the year in which the life fails. Now, the value of 1*l.* to be received at the end of the first year is $v$, but it will not be received if the life continues to the end of the year; and, as the probability that the individual will live over the year is $p_1$, the probability that he will not live over it is $1-p_1$, therefore the value of 1*l.* to be received at the end of the year, subject to the contingency of the life failing in the first year, is $(1-p_1)\,v$. The probability that the life will continue to the end of the second year is $p_2$, and that it will continue one year only, $p_1$, therefore $p_1 - p_2$ is the chance it will drop in the second year; and the value of 1*l.* to be received at the end of the second year is $v^2$, therefore the present value of 1*l.* to be received if the life fails in the second year is $(p_1 - p_2)\,v^2$. In like manner, the probability that the life will fail in the third year is $p_2 - p_3$; and the value of 1*l.* to be received at the end of three years is $v^3$, therefore the present value of 1*l.* to be received at the end of three years, if the given life fails in the third year, is $(p_2 - p_3)\,v^3$. The same process is continued from year to year, till the probability of living over a year becomes nothing. Now, the whole value of the assurance is manifestly equal to the sum of all its partial values for the different years; therefore, denoting the value by I, we get

$$I = (1-p_1)\,v + (p_1 - p_2)\,v^2 + (p_2 - p_3)\,v^3 + \&c.$$

or, separating this into two series,

$$I = v\,(1 + p_1\,v + p_2\,v^2 + p_3\,v^3 + \&c.) - (p_1\,v + p_2\,v^2 + p_3\,v^3 + \&c.)$$

But it is shown in the article ANNUITY that the series $p_1\,v + p_2\,v^2 + p_3\,v^3 + \&c$ denotes the value of an annuity of 1*l* on a life, the probabilities of the continuance of which are represented as above; therefore, calling this annuity A, we have $I = v\,(1 + A) - A$.

Since $v = \frac{1}{1+r}$, this formula becomes by substitution

$$I = \frac{1}{1+r}\,(1 - r\,A).$$

The sum now found is what ought to be paid down, in order to receive 1*l* on the failure of the given life; but by far the most usual practice is to pay for the assurance by means of an annual premium, the first payment being immediate, and the others at the end of each successive year. Let $\pi$ be the annual premium, then the value of all the premiums after the first is obviously the same thing as the value of an annuity of the same amount, and is, consequently, equal to $\pi A$. Hence, the value of all the premiums is $\pi + \pi A$, or $\pi\,(1 + A)$, which is necessarily equivalent to the assurance. We have therefore the equation $\pi\,(1 + A) = v\,(1 + A) - A$,

whence $\pi = v - \frac{A}{1+A}$.

This formula is very easily computed when we are in possession of a table of annuities, and it shows at once the annual sum which an individual of any age ought to pay, in order to secure to his representatives 1*l.* (and, consequently, any other sum) at his death.

*Temporary Assurances.* The values of temporary assurances, or engagements to pay a certain sum in case a given individual dies within a given number of years, are easily found from those on the whole of life. For example, let it be required to find what sum ought to be paid for 1*l*, to be received if an individual now aged 40 shall die within seven years. Let I be the value of 1*l* to be paid on the death of a person aged 40, and $I_7$ the present value of the same sum, to be paid on the death of a person aged 47. Seven years after this the value of an assurance of 1*l.* on the death of the person now aged 40 will be $I_7$, but the present value of 1*l*, to be received certainly at the end of seven years is $v^7$, and the probability that the life will continue seven years is $p_7$; therefore the present value of $I_7$, on the contingency that the life will not fail within seven years, is $p_7\,v^7\,I_7$; subtracting this from I, the value of 1*l.* to be received certainly at his death, there remains $I - p_7\,v^7\,I_7$, to denote the value of the temporary assurance. This may be expressed by the following rule. Multiply the assurance on a life seven years older than the given life by the present value of 1*l*, payable seven years hence, and also by the probability that the given life will survive seven years; subtract the product from the assurance on the given life, and the remainder is the value of a temporary assurance for seven years in a single payment.

In order to find the equivalent annual payment, it must be recollected that the first payment is made immediately, and that seven payments are to be made in all; consequently, all the payments after the first are equal to a temporary annuity of the same amount for six years, or one year less than the given term, consequently, if $\pi$ represent the annual premium, and A′, a temporary annuity of 1*l* for one year less than the given term, the value of all the premiums to be received is $\pi + \pi A'$ or $\pi\,(1 + A')$, which by hypothesis is equal to the assurance; consequently, to find the annual premium, we have to divide the value of the temporary assurance in a single payment by $1 + A'$.

In the same manner, the value of an assurance on any number of joint lives is found: it is only necessary to substitute for A in the above formulas, the value of an annuity on the joint lives. Thus, let M be the value of an annuity, to continue while A and B both live, then $v\ (1 + M) - M$ is the value of an assurance to be paid at the end of the year in which the first of the two lives shall fail, and the equivalent annual payment is $v - \frac{M}{1 + M}$.

A very important class of assurances comprehends those in which the contract is to pay a sum on the death of one party, provided that another party shall be then alive. The computation of the values of such contracts is somewhat more intricate, and cannot be explained without entering into details respecting the manner of combining the probabilities of life, which our limits will not permit.

For assurances on ships and goods, *see* INSURANCE.

ASSU'RGENT. (Lat. assurgere, *to rise up*.) Rising in a curve from a decurved base.

A'STACUS. (Lat. astacus, *a lobster*.) The name of a Fabrician genus of insects, and now the type of a family (*Astacidæ*) of Decapod, Macrourous, or long-tailed Crustaceans, including the lobsters (*Astacus* Leach), the craw-fish (*Potamobius* Leach), and the cray-fish or spiny lobsters (*Palinurus* Leach). The distinguishing character is derived from the antennæ, the two pairs of which are inserted in the same horizontal line; the mesial ones having moderate or long footstalks, terminated by two filaments, the outer ones naked, or furnished with a scale, which never entirely conceals the base.

A'STERISK. In Diplomatics, a sign in the figure of a star, frequently met with in ancient Latin manuscripts, and seeming to serve various purposes, sometimes to denote an omission, sometimes an addition, sometimes a passage which appeared remarkable on any account to the copyist.

A'STERISM, in Astronomy, denotes a collection of stars. It was formerly used in the same sense as constellation, but is now generally appropriated to any small cluster of stars, whether forming part of a particular constellation, or otherwise.

A'STEROI'DS. A term frequently used by writers on astronomy, to designate the group of small or telescopic planets, which circulate between the orbits of Mars and Jupiter.

ASTE'RN. (A, and stern.) A sea term, denoting, in the hinder part of the ship, or behind the ship.

ASTHE'NIC. (Gr. ἀ, *without*, and σθένος, *strength*.) Asthenic diseases are those which are prominently marked by great and direct debility.

A'STHMA. (Gr. ἀσθμαίνω, *I breathe hard*.) A disease, the leading symptoms of which are difficulty of breathing, coming on at intervals, accompanied with cough, and more or less expectoration. The fit most frequently occurs in the night during the first sleep, suddenly awaking the patient, and lasting for three or four hours or more. It is a terrible, but in itself rarely a fatal, disease, though it often lays the foundation of organic mischief. Its proximate cause has not been very clearly ascertained.

A'STOMOUS. (Gr. ἀ, *without*, and στόμα, *a mouth*.) Certain mosses whose theca has no aperture.

A'STRAGAL. (Gr. ἀστράγαλος, *a die or huckle bone*.) In architecture, a small moulding whose profile is semicircular. Some have said that the French call it talon, and the Italians tondino; but this is a mistake, and the word is only properly applied to the ring which separates the capital from the column. The astragal is sometimes cut into representations of beads and berries, and a similar sort of moulding is used to separate the faces of the architrave.

ASTRA'GALUS. (Gr. ἀστράγαλος, *a die*.) The ancle bone. The ancients used the corresponding bones of animals as substitutes for dice.

ASTRÆ'A. (Gr. ἄστεον, *a star*.) A genus of lithophytous Polypes, the polyplary or calcareous skeleton of which is characterised by sessile, star-shaped lammellate cells, crowded upon the upper surface. The species are divided into rayed Astreæ (*Ast radiatæ*), with the stars separated from the base, and toothed Astreæ, (*Astreæ denticulatæ*), with the stars contiguous.

A'STROLABE. (Gr. ἄστρον, *a star*, and λάμβανω, *I take*.) A circular instrument used for taking or observing the stars. The ancient astrolabe consisted of two or more circles, having a common centre, and so inclined to each other as to enable the astronomer to observe in the planes of different circles of the sphere at the same time. For example, if the circles were at right angles, the instrument would give both longitude and latitude, or the right ascension and declination of star. The equatorial, the altitude and azimuth instrument, and the theodolite, are instruments which answer the same purpose as the ancient astrolabe. Ptolemy changed the form of the ancient instrument, and reduced it to a plane surface, to which he gave the name of planisphere; and, from this circumstance the term astrolabe has been used in modern times to denote a planisphere, or stereographic projection of the sphere on the plane of one of its great circles.

ASTRO'LOGY. (Gr. ἄστρον, *a star*, and λόγος, *discourse*.) According to its derivation, this term should signify the science or knowledge of the stars. Originally, the terms astrology and astronomy were used indifferently in the same sense; but for a long time the former has been employed to denote the vain and superstitious study of predictions and horoscopes, while the latter has been reserved to denote the true science of the celestial motions. According to Lalande, this distinction began to be observed in the time of Clement of Alexandria, that is, in the second century. Astrology is generally coupled with the epithet judicial, from the judgments drawn from it relative to future events.

Judicial astrology is supposed to have had its origin in Chaldea, whence it passed into Egypt, Greece, and Italy. The desire of penetrating into futurity is so congenial to the human mind, that this pretended science has found favour in all ages and countries; and it is a remarkable fact, that astronomy, which demonstrates the frivolity and absurdity of its predictions, was long indebted to it for the principal part of its own progress. Kepler, in the preface to the Rudolphine Tables, observes, that astrology, though a fool, was the daughter of a wise mother, to whose support and life the foolish daughter was indispensable. At the present day it is only among the most ignorant vulgar, or the unenlightened tribes of Asia and Africa, that astrology is held in esteem; but the triumph of sound science and the spirit of philosophy has been slow and difficult. So late as the year 1705 the conductor of "The Connaissance des Tems" thought it necessary to apologise for the absence of all predictions in that astronomical work, by stating, that the Academy had never recognised the solidity of the rules which were given by the ancients for discovering the future by the configurations of the stars, and, what is still more surprising, the first lunar tables calculated according to the Newtonian theory were intended to be subservient to the calculation of nativities.

Astrological predictions are founded on the positions or aspects which the sun, moon, and planets have relatively to each other at the moment of birth, or some other critical period of a person's life, and certain arbitrary influences supposed to belong to each of those bodies. For the purpose of facilitating the determination of the aspects, the whole heaven, visible and invisible, is divided into twelve equal parts by the horizon, the meridian, and four other circles passing through the north and south points of the horizon, and the points of the equator (or rather the prime vertical, or sometimes the ecliptic, for the practice was not uniform), which are at the distance of 30 and 60 degrees from the meridian. These equal spaces are called the twelve houses of the heavens, and the circles by which they are circumscribed are called circles of position. The circles of position are supposed to remain fixed, so that a celestial body is carried through each of the twelve houses in the course of a day by the diurnal rotation. The first house is contained between the eastern horizon and the next circle of position, going to the eastward, consequently the seventh will commence with the western horizon, and the tenth with the meridian or culminating point of the ecliptic. The beginning of the first house, or the point of the ecliptic just rising, is called the horoscope. The first house is the house of life, the second, of riches; the third, of brothers, the fourth, of parents; the fifth, of children, the sixth, of health, the seventh, of marriage, the eighth, of death; the ninth, of religion, the tenth, of dignities, the eleventh, of friends, and the twelfth, of enemies. Each of the houses has one of the heavenly bodies as its peculiar lord. They have also different powers, the strongest of all being the first, and the next in power the tenth; so that if two planets are equally powerful, ceteris paribus, that will prevail which is in the stronger house.

Having made the preliminary arrangement of the heavens, the next object is to consider the aspects or configurations of the influential bodies. Aspect, as defined by Kepler, is the angle formed by the rays proceeding from two planets, and meeting at the earth, and which have the property of producing some natural influence. The ancients reckoned five aspects, namely, the conjunction denoted by the character ☌, the opposition by ☍, the trine by △, the quadrile by □, and the sextile by ⚹. These names and characters, besides several others added in more recent times, are retained in our almanacks to the present day. In the aspect of conjunction the angle made by the two planets is 0; in the opposition it is 180°. The trine is the third part of a circle, or 120°; the quadrile is 90°, and the sextile 60°. With regard to the influences of the aspects, they are benignant, malignant, or indifferent. The quadrile and opposition are considered as malignant or adverse; the trine and the sextile as benignant or propitious; and the conjunction an indifferent aspect.

It now remains only to ascribe certain influences to each of the planets, and to suppose all animals, plants, countries, &c. subject to their control, in order to obtain an idea of the nature of the astrological art. The influences ascribed to the planets were of course as arbitrary as those ascribed to the aspects. Saturn being at the greatest distance from the sun was supposed to be of a cold nature; Jupiter, Venus, and the Moon, temperate and benignant Saturn and Mars were the most dangerous. The Sun and Mercury participated in the properties of the one and the other, according to circumstances. But these influences were exerted in an infinite number of ways, according to the houses which the planets happened for the time to occupy.

It would be superfluous at the present day to adduce any serious argument against a system of imaginary influences and arbitrary rules, having no other foundation than the ignorance and superstition of mankind, and contradicted by every result of true science, and every dictate of common sense. The celestial bodies pursue their courses in obedience to unalterable laws; and the legitimate business of the philosopher is to discover those laws, to trace out their consequences, and to apply the results of his discoveries to alleviate the wants or multiply the comforts of humanity.

ASTRONOMY. (Gr *αστρον*, *a star*, and *νόμος*, *a law*.) The science which treats of the motions, distances, arrangement, and magnitudes of the celestial bodies; of their constitution and physical condition, and, in general, of whatever can be known respecting them.

There is no branch of human knowledge of which the results appear at first sight more at variance with the impressions of our senses The first aspect of the heavens leads us almost irresistibly to imagine ourselves placed in the centre of a starry sphere; which, in its diurnal revolution, carries along with it all the heavenly bodies. But the changes of relative position which some of the most remarkable among them continually undergo, soon make it evident that they do not all belong to the same sphere. Further observation and reflection lead us to conclude that the apparent daily revolution of the firmament is merely an illusion occasioned by the diurnal rotation of our own earth, which, instead of remaining fixed at the centre, is carried forward about the sun with a velocity of about 19,000,000 of miles in a second of time, or four times that of a cannon-ball when it leaves the mouth of a cannon The sun, which appears to be of very moderate dimensions, is a body whose volume is 1,384,470 times greater than that of the earth, and placed at a distance of 95,000,000 of miles, and the stars, which even in the best telescopes appear only as luminous points, are bodies of the same nature as the sun; many of them, probably, far surpassing it in magnitude.

*Different Classes of Heavenly Bodies.* By far the greater part of the celestial bodies appear to be fixed in the firmament, and to preserve invariably the same relative positions. These are the *fixed stars*. A second class comprehends a small number which are continually shifting their positions among the stars, and are perceived to accomplish a complete revolution of the sphere in stated intervals of time Hence they were called *Planets*, that is, *wandering stars*, from a Greek word signifying to wander They describe orbits, very nearly circular, about the sun. Some of them are accompanied by smaller bodies revolving round them, as the moon revolves round the earth, and which are called *Satellites*, or attendants. A third class comprehends bodies differing greatly from those now mentioned, and which sometimes exhibit very extraordinary appearances These are the *Comets*. Like the planets they are obedient to the attractive force of the sun, but the orbits which they describe are exceedingly elongated, and they are only visible when near the sun. Hence they appear at distant or uncertain intervals, and only for a short time; and consequently their physical nature is very imperfectly known. The sun, planets, satellites, and comets form a system of which all the members are connected with and act upon one another in obedience to the law of universal gravitation. (*See* PLANETS, SATELLITES, SUN, and the other terms, in their respective places.)

*Uses of Astronomy.* Mere curiosity, without reference to practical utility, would prompt mankind to study the movements of the vast machine which rolls over our heads; but the applications of astronomy to the affairs of life are so numerous and important, that an accurate knowledge of its principles is almost indispensable to society. 1st, It is by means of the celestial bodies that we are enabled to determine the relative positions of points on the surface of the earth; to fix geographical latitudes and longitudes, and ascertain the form and dimensions of our planet. 2d, It is to astronomy that we are indebted for all the advantages resulting from navigation. Without an accurate knowledge of the positions and motions of the heavenly bodies, it would be impossible for the mariner to traverse the ocean, or to venture in safety beyond the sight of the shore. With this knowledge he can direct his course with unerring certainty to any given coast; and the ocean, which, without this science, would present an insuperable barrier to the intercourse of distant countries, is rendered "the highway of nations." 3d, Astronomy also presents us with the means of establishing the divisions of time necessary for the regulation of civil affairs, and of fixing chronological epochs. The diurnal revolution of the sphere gives the smaller divisions of time; the revolution of the moon gives the month, that of the sun, the year; and the various configurations of the planets mark out periods of all magnitudes, from a few months or years to millions of ages.

*Divisions of Astronomy* The first object of the astronomer is to ascertain, with all possible precision, the apparent places of the stars, or their projections on the sphere, in order to obtain an accurate knowledge of their apparent motions and periods. But it is not enough to have ascertained their positions and motions; the results of observations made at different places and distant times must be compared, in order that we may be enabled to distinguish the movements which are real from those which are only apparent, and depend on our own position with regard to objects observed. And when the real paths described by the different bodies have thus been determined, we are next led to investigate the causes of the phenomena, and the expressions of the mechanical forces necessary to produce them. Hence, the science of astronomy may be divided into *practical*, *rational*, and *physical:* the first embracing all that is necessary for determining the apparent motions; the second being devoted to the real motions, and the third to the physical causes by which the different motions are regulated and perpetuated.

*Practical Astronomy* In order to determine the positions and motions of the celestial bodies, it is necessary to have the means of measuring time and space with the utmost precision. But neither time nor space can be measured without the aid of very refined instruments and contrivances Hence, the theory of instruments, the method of using them, and the determination of the different corrections that must be applied in order to free the observed positions from the various instrumental and physical errors by which they are affected, belong to this division of the science. A complete knowledge of the sphere and its various circles, as also of the methods of spherical trigonometry, is requisite to the practical astronomer Observation gives him the place of a star only with reference to his own zenith, or horizon, or to another star whose place is already determined. But their positions must be reduced; that is, referred to invariable planes or circles, in order that the observations made in different places may be capable of comparison with one another. Without such reductions, the observations are of no use.

*Rational Astronomy.* This division includes the determination of the real orbits, and the laws of motion which the different bodies observe, and the construction of hypotheses by the aid of which we may calculate the positions in advance In the infancy of astronomy, and before observations became very numerous, or were made with precision, various hypotheses were invented to explain the apparent motions. Thus Ptolemy explained the inequalities of the planetary motions, by supposing each of the planets to describe a circle about a centre moving uniformly round the earth in the circumference of another circle Tycho Brahe supposed the planets to revolve in circular orbits about the sun; and the sun, accompanied by the planets, to revolve round the earth Copernicus supposed the earth, as well as all the other planets, to revolve in circular orbits around the sun. All these hypotheses served to explain the phenomena that were known at the time they were respectively invented; and have been successively exploded by more accurate observations, which have proved that the planetary orbits are not circles but ellipses, having the sun in the focus which is common to all of them.

*Physical Astronomy.* By this term is generally understood the application of mathematical science to the investigation of the laws by which the motions of the celestial bodies are regulated, the nature of the forces by which their motions are maintained, and the effects of their action on one another. By comparing the momentary deflection of the moon's orbit from a straight line with the effects of terrestrial gravity, as manifested in the descent of falling bodies near the surface of the earth, Newton found that both the phenomena were produced by one and the same cause, and that the moon is retained in her orbit by the attraction of the earth. Subsequent investigations, founded on the general laws of the planetary motions, discovered by Kepler, led him to the conclusion, that a force of the same nature extends through the universe; and that all bodies in the heavens and on the earth gravitate towards each other with forces directly as their quantities of matter and inversely as the squares of their distances. By this single principle he explained the elliptic motions of all the planets and satellites; the facts which concern their figures, rotation, and the position of

their axis; and the oscillations of the fluids with which they are surrounded. The quantity of matter in the sun is vastly greater than in the largest of the planets; hence all the planets are principally controlled by the sun, and circulate about him in elliptic orbits, nearly in the same manner as if they were independent of the attractions of one another. Still their mutual influences are sufficiently perceptible; though, from being comparatively small, they are regarded merely as disturbing the sun's action. The calculation of the disturbing forces, or of the effects produced by the mutual attraction of all the bodies in the solar system, forms the most difficult and the most important problem ever submitted to mathematical analysis. Its solution has occupied the most eminent mathematicians of the last and the present century; and the successive advances made towards it by Newton, Clairaut, D'Alembert, Euler, Lagrange, and Laplace, have surrounded their names with a halo of glory.

*History of Astronomy* The study of the heavens has occupied the attention of mankind in all ages of the world At the remotest epochs of historical record, the Chaldean shepherds and the Egyptian priests had found a near approximation to the length of the solar year, and determined, by the comparison of a long series of recorded or traditional observations, periods of time after which the eclipses of the sun and moon return in nearly the same order, and were consequently able to predict these phenomena. The early philosophers of Greece exhausted their imagination in idle speculations about the formation and nature of the universe, but the names of the constellations which they have transmitted to us with their theogonies prove that they had paid considerable attention to the arrangement of the principal stars Pythagoras appears to have had a distinct notion of the true system of the world; affirming that the earth was not placed in the centre, but revolved about the sun But the first recorded observations which contributed in any way to the real progress of astronomy were made at Alexandria, under the Ptolemies, about 300 years before our era, by Aristillus and Timocharis, who determined the positions of some of the principal zodiacal stars, and thereby afforded Hipparchus the means of arriving at his important discovery of the precession of the equinoxes

Hipparchus, the founder of Grecian astronomy, observed at Rhodes about 140 years B C This illustrious man appears to have paid little regard to the theoretical speculations of his contemporaries, but adopted the only method by which a correct knowledge of nature can be obtained, namely, assiduous and accurate observation. Among his important discoveries are the precession already mentioned; the length of the solar year; the eccentricity of the sun's orbit, the periodic time of the moon's revolution with respect to the stars, to the sun, to her nodes, and her apogee, the eccentricity and inclination of the lunar orbit He invented the planisphere, determined the places of 1080 stars, and was the first who introduced into geography the method of fixing the positions of places on the surface of the earth by means of their latitudes and longitudes

The name of Ptolemy is still more celebrated than that of Hipparchus; though, as an astronomer, he occupies a far inferior rank. His principal astronomical discovery is the inequality of the moon's motion, technically called the evection; but his fame chiefly rests on his great work called Syntax, or Composition; in which he explains the apparent motions of the sun, moon, and planets, according to a hypothesis invented by Apollonius of Perga, some centuries before, and which consists in supposing each of these bodies to be carried by a uniform motion round the circumference of a circle called the epicycle, the centre of which is carried uniformly forward in the circumference of another circle called the deferent. This second circle may be the epicycle of a third, and so on as long as inequalities remain to be explained, the earth occupying a position near, but not at, the centre of the last circle. This hypothesis is utterly demolished by a few accurate observations of the present day; but in the time of Ptolemy it served to explain all the deviations from circular motion then known, particularly the phenomena of the stations and retrogradations of the planets; and it was even of service to astronomy, by offering a means of reducing the apparent irregularities of the planetary motions to arithmetical calculation. Ptolemy's share of the merit belonging to the invention of this ingenious hypothesis consists in the determination of the proportion between the radius of the epicycle and that of its deferent circle, and between the velocity of the planet and the velocity of the centre of its epicycle. The Ptolemaic system continued in vogue till the revival of astronomy and the other sciences in the fifteenth century, when it gave place to theories founded on more enlarged views and more accurate observations.

Fourteen centuries elapsed between Ptolemy and Copernicus; and during this long interval, astronomy continued nearly in the same state. The elements of the solar and lunar tables had indeed received many corrections; and various improvements in the methods of observing and calculating had been introduced, principally by the Arabs; but in respect of theory, no change had taken place. But an epoch had now arrived when men's minds could no longer be held in thraldom by reverence for ancient authority; and a spirit of investigation and inquiry had arisen, which produced the happiest results in all the departments of natural science. Copernicus, guided perhaps in some measure by the opinions of Pythagoras, but more by his own meditations on the planetary phenomena, and the comparison of the numerous observations accumulated by Purbach, Regiomontanus, and Walther, in the latter half of the fifteenth century, had the glory of establishing the system of the world on its true basis. In his great work, "De Revolutionibus Orbium Cœlestium," published in 1543, he showed that all the apparent motions are easily explained by simply attributing a double motion to the earth; a diurnal rotation about its axis, and an annual motion about the sun. The doctrine of the earth's motion was opposed to the religious dogmas of the age, and accordingly the theory of Copernicus met with great resistance; but as observations now began to be greatly multiplied, and to be performed with greater accuracy, the evidences in favour of it daily acquired strength, and in a short time commanded universal assent among astronomers. Tycho Brahe, indeed, an excellent observer, and one to whom astronomy is under the greatest obligations, made an attempt to save the ancient prejudices, while he explained the phenomena by supposing the sun, accompanied by the planets, to perform a diurnal revolution about the earth. This system, however, on account of its physical improbability, never obtained many followers.

The next important step in astronomy was made by Kepler By means of a laborious comparison and calculation of observations, Kepler discovered that the orbits of the planets are not circles but ellipses, having the sun in one of the foci He also found that the motion of any planet in its elliptic orbit is so regulated, that the spaces passed over by a straight line drawn from the planet to the sun are equal in equal times, and that the periodic times of the different planets are in a certain given ratio to their distances from the sun. It is difficult to estimate the importance of these discoveries, either with reference to the amount of prejudice they overthrow, or their influence on astronomical theory. The circular and uniform motion of the celestial bodies was an axiom that had never been disputed It was even admitted by Copernicus; who was obliged, in order to reconcile it with the observations, to suppose the sun placed at a little distance from the centre of each of the planetary circles. The elliptic motion was a proposition as bold as original; and, combined with the equal description of areas in equal times, led to the discovery of universal gravitation, and all the sublime results of physical astronomy.

About this time, or a little earlier, two discoveries were made which gave an immense impulse to astronomy. These were the logarithms, invented by Napier, and the telescope Without the aid afforded by the logarithms, it would have been impossible to accomplish the calculations which Kepler's discoveries rendered necessary, and to the telescope we are indebted not only for the enlargement of the visible boundaries of the universe, and the knowledge of numerous bodies whose existence would otherwise never have been suspected, but also for all the precision of modern observation.

From the time of these great discoveries, the progress of astronomy has been uninterrupted By combining the laws of the planetary motions discovered by Kepler, with the theory of central forces established by Huygens Newton completed the theory; and proved that all the motions of the universe, from the fall of a body on the surface of the earth, to the oscillations of the celestial sphere, are the necessary consequences of a single, invariable, and simple law. This is the law of universal gravitation; which not only affords a physical explanation of all the phenomena that have been observed, but which, in the hands of mathematicians, has led to the discovery of many important facts which observation subsequently confirmed, though it could not have detected them The progress of the practical parts of the science has, also, since the same epoch, been commensurate with the improvements of the theory Observatories were established in different countries, where a continued series of observations has been kept up. Academies and societies were founded for the purpose of effecting, by combined efforts, what surpassed individual exertion; voyages and expeditions have been undertaken to distant parts of the world for the purpose of measuring the earth, and determining other elements necessary to a complete knowledge of the planetary system

The state of perfection to which astronomy is now brought, may be regarded as the greatest triumph of human exertion and reason. The motions of the moon and the planets are known with the utmost accuracy; and the tables have all the precision which the navigator or practical astronomer can desire. Our knowledge of the planetary system may be regarded as complete. That

of the sidereal heavens must always be limited by the optical powers of the human eye and the telescope. In this department of astronomy, a boundless field has of late years been thrown open for future research and speculation. Stars are observed revolving about one another in elliptic orbits. Are they then connected with each other by forces of the same nature, and observing the same laws, as solar attraction? The periodic times, and consequently the mean distances of one or two comets, are observed to be diminished. Are we then to infer that the regions of space are filled with matter of sufficient density to resist the motions of comets? Are the comets themselves permanent bodies; or are they merely formed by the occasional collapse, as it were, of nebulous matter, and again dissipated after a few revolutions? The resistance of the ether, the nature of comets, the constitution of the nebulæ, the laws which regulate the formation and motions of sidereal systems. such are the questions (questions remote indeed from any practical application to the affairs of mankind) which astronomers now aspire to solve.

For further information on this extensive and very important science, we must refer the reader to the particular terms which belong to it, and also the general terms, COMET, MOON, PLANET, SATELLITE, STAR, SUN. The physical theory of the planetary motions will be found explained under GRAVITATION, and astronomical instruments described under their respective names Works on astronomy are so abundant in every European language, that it could serve no purpose to make any references to them in this place The best popular treatise is that of Sir John Herschel in Lardner's Cabinet Cyclopedia.

ASTA'RTE — the queen of heaven — a Phœmcian goddess called in the Scripture Ashtaroth. There is some obscurity with respect to her worship, and the attributes assigned to her, which were held by different of the ancients to correspond with those of the Grecian divinities Juno, Diana, or Venus, but most generally the latter. Indeed it is probable that the worship of this latter goddess was borrowed by the Greeks from that of Astarte, which prevailed to a great extent in the island of Cyprus, the fabled residence of Venus.

ASY'LUM (Gr ἀ, *not* and συλαω, *I rob.*) A place of refuge to which criminals might fly, and from which it was considered the greatest impiety to move them by force This privilege was given to many of the temples, altars, and statues of the gods, and its violation subjected the perpetrator, and all his posterity, to the vengeance of the tutelary deity, and consequently they were driven from their native country as accursed The sacredness of the asylums was preserved till the reign of Tiberius Cæsar, who, on account of their inconvenience, abolished many, and restricted the privileges of the rest

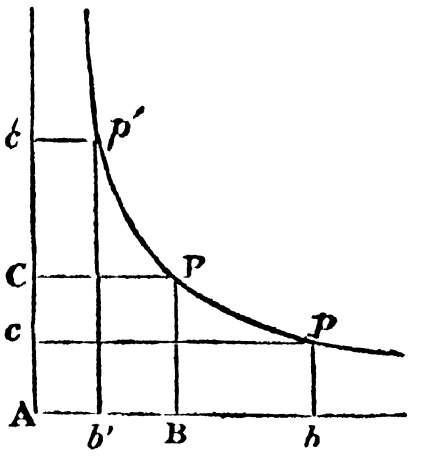
Thebes and Athens each claimed the establishment of the first asylum Romulus set apart a particular spot on the descent from the Capitoline hill for this purpose, and thereby materially augmented the population of his infant city Hence Juvenal satirically refers all the aristocracy of Rome to this ignoble stock:

> "Et tamen ut longe repetas, longeque revolvas
> Nomen ab infami gentem deducis asylo"

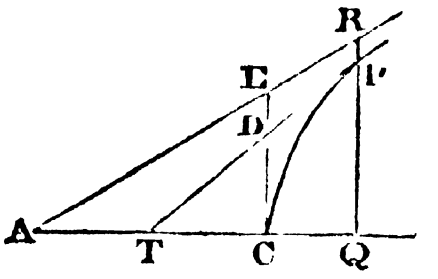
ASYLUM The modern signification of this word differs widely from its ancient acceptation, and the purposes for which it is now employed will be best inferred from the epithets with which it is connected. The most prominent of these are asylums for the blind, deaf and dumb, lunatics, and the destitute There is no feature, perhaps, which distinguishes a civilised from a savage state of society more than the establishment of institutions which tend to alleviate the condition of those whom moral or physical defects incapacitate for the purposes of self-exertion or competition with their fellow-citizens. In this view England has a right to claim a place in the foremost ranks of civilisation, whether we regard the number, the principles, or the internal management of its asylums. It would be out of place here to enter into detail upon so wide and comprehensive a question as the word asylum involves, but the reader will find in the parliamentary papers both of France and England, and in the reports published from time to time by the managers of asylums, a mass of information, on this subject, at once amusing and instructive.

ASY'MPTOTE. The name given to a straight line or curve which continually approaches nearer and nearer to the infinite branch of a given curve, in such a manner that when they are both indefinitely produced the distance between them, though it never entirely vanishes, becomes less than any assignable finite distance. The term, which was first employed by Apollonius, is derived from the Greek ἀ, priv, σὺν, *with*, and πίπτω, *I fall*, and therefore signifies literally, *not coincident*, or that which does not meet.

Beginners feel some difficulty in assenting to the truth of the proposition that lines may continue to approach each other without meeting. It is, in fact, a proposition which cannot be made evident to the senses, but this arises from our inability to effect the division of magnitude beyond certain limits. A familiar instance of continual approach to equality is afforded by a repeating decimal; for instance, ·99999, &c.; the difference of which from unity is made ten times smaller by the addition of every successive digit; but it does not become equal to unity till the number of digits is supposed infinitely great. The nature and properties of an asymptote may be illustrated geometrically by the common hyperbola, the equation of which is $x\,y = a^2$. Let A B be the abscis, and A C the ordinate of any point P, and the parallelogram A P is equal to a constant quantity $a^2$. In like manner, the parallelograms made by the co-ordinates of any other points, $p$, $p'$ will be each equal to $a^2$. It is evident, therefore, that the more the abscis A B is increased, the more the corresponding ordinate A C is diminished If A $b$ is equal to twice A B, then $p\,b$ is only half of P B, and so on. The curve, therefore, continually approaches to the axis of the abscissa, but never meets it; for supposing the point $p$ to be taken at such a distance that A $b$ would be a million of times greater than A B, $p\,b$ would be a millionth part of P B, — a small quantity, indeed, but still not zero. However great A $p$ may be supposed, $p\,b$ must always have some value, otherwise a straight line would become equal to a parallelogram, which is impossible. It is obvious that all that has now been said of the axis A B applies equally to A C, therefore the two lines A B and A C are asymptotes to the curve.




The asymptotes of curve lines are most readily determined from the properties of the rectilinear equations Let us take, for example, the equation $B^2x^2 - A^2y^2 = A^2B^2$, which is that of the common hyperbola referred to its diameters. We easily deduce $y^2 = \frac{B^2x^2}{A^2}\left(1 - \frac{A^2}{x^2}\right)$ whence the absolute value of $y$ is found, namely, $y = \frac{B}{A}x\sqrt{1 - \frac{A^2}{x^2}}$. But the quantity under the radical sign in this expression is always less than unity while $x$ retains a finite value (for $x$ cannot be less than A), the value of the ordinate $y$ is therefore always less than $\frac{B}{A}x$ Now let a straight line A R be drawn through the centre A (the origin of the co-ordinates) making




with the axis an angle R A Q, whose tangent is equal to $\frac{B}{A}$; and let the ordinate P Q be produced to meet it in R, and let R Q be denoted by Y. We shall then have the two equations $Y = \frac{B}{A}x$, $y = \frac{B}{A}x\sqrt{1 - \frac{A^2}{x^2}}$; whence it is easy to see that the more $x$ is increased, the more the difference between Y and $y$, that is R P, is diminished; and that it vanishes altogether when $x$ is infinite.

The trigonometrical value of the cotangent of the angle P T Q, which a tangent at P makes with the axis, is $= \frac{A^2}{B^2}\frac{y}{x}$; or, substituting for $y$ its value in terms of $x$, $= \frac{A}{B}\sqrt{1 - \frac{A^2}{x^2}}$ When the value of $x$ is supposed infinite, this expression is reduced to $\frac{A}{B}$; consequently, the tangent of the same angle is $\frac{B}{A}$. But this is the tangent of the angle made by the asymptote; and hence the asymptote to a curve is frequently defined and considered as a tangent at an infinite distance.

In order to discover whether a curve has an asymptote, draw C E, meeting the tangent in D. In proportion as the point P is taken at a greater distance, the point T

approaches to A, and D to E. But the asymptote is the limiting position of the tangents; therefore we have only to find whether the expressions of C T and C D, relative to the given curve, are susceptible of finite limits, and when this is the case the construction of those limits will give the points A and E, and consequently the asymptote.

An algebraic curve cannot have more asymptotes than there are units in the exponent of its order. Of the curves of the second order, the hyperbola alone has asymptotes, and they are two in number. All curves of the third order, or which are defined by a cubic equation, have some infinite branches, but these branches have not always asymptotes. With respect to curves of the fourth order, there are an infinity of them which, so far from having four asymptotes, have none at all, and which have not even infinite branches; for instance, the curve of Cassini. The conchoid, cissoid, and logarithmic, though not classed among algebraic curves, have each an asymptote.

It may appear a sort of paradox that the areas bounded by curves and their asymptotes, though indefinitely extended, have sometimes finite limits which they cannot exceed. This is the case with the logarithmic curve, and with hyperbolas of all kinds, except the common or Apollonian.

In what precedes we have regarded an asymptote always as a straight line; but two curves are sometimes said to be asymptotes of each other when they are such that on being produced they continually approach without ever meeting. Thus two parabolas, having the same parameter, and their axes in the same straight line, fulfil the conditions of asymptotism.

ASYNARTE'TA. (Gr. *ἀ*, priv., and *συναρτάω*, *to connect*.) In Grammar, sentences which follow each other immediately, without the intervention of any connecting particle; as, "I came, I saw, I conquered."

ASY'NDETON. (Gr. *ἀ*, *without*, *συνδέω*, *I connect*.) A figure by which the conjunctions in a sentence are omitted: as in the famous phrase of Cæsar, "Veni, vidi, vici."

A'TE. (Gr. *ἄτη*.) In Greek Mythology, the personification of Revenge, Punishment, or Fatality. See Hom. Il. bb xix.

A'TELES. (Gr. *ἀτελής*, *imperfect*.) A genus of South American monkeys, characterized by the absence or rudimental condition of the thumb of the anterior hands. The deterioration of these members as prehensile organs is compensated by a very efficient prehensile tail.

ATELLA'NÆ FA'BULÆ. A species of comedy which had its origin among the Oscan inhabitants of Campania, from a town of which country, Atella, it derived its name. It was much in vogue at Rome, and it was not thought disgraceful for persons of gentle blood to take parts in its exhibitions, as was the case in the other species of drama. The language used in the atellanæ fabulæ was Oscan, and the plots and style of the dialogue, unrestrained by any fixed rules, partook of the nature of comedy, farce, and burlesque, but was not stained by licentiousness, till the degenerate morals of the empire drew them too into the general vortex of corruption.

A TEMPO GIUSTO. (Ital. *in correct time*.) In music, a direction to the performer, generally after a recitative, to keep the measure true and correct, which, during the recitative, was performed to suit the action and passion of the scene.

ATHA'LAMOUS. (Gr. *ἀ*, *without*, and *θάλαμος*, *a bed*.) Lichens whose thallus is not furnished with shields or beds for the spores; in these the reproductive matter is supposed to be dispersed through the substance of the crust, as in lepraria.

ATHANA'SIAN CREED. A confession of faith, which is described in the rubric of the Common Prayer Book, which appoints it to be read on certain days, as commonly called the Creed of St. Athanasius. That it was really composed by that father is more than doubtful: modern divines seem generally to assent to the judgment of Waterland, who considers it to have been written by Hilary.

A'THEIST. (Gr. *ἀ*, *without*, and *θεός*, *God*; *without God*.) One who denies the existence of a God, or a Providence.

ATHENÆ'UM. (Greek.) In Antiquity, a public place where the professors of the liberal arts held their assemblies, the rhetoricians declaimed, and the poets rehearsed their performances. There were various places of this kind at Athens. The emperor Adrian established a famous Athenæum on the Capitoline hill at Rome, and at a later period there was another of nearly equal celebrity at Lyons. In modern times the name has been frequently bestowed upon establishments connected with learning, and upon public clubs or libraries frequented for convivial or literary purposes.

ATHERI'CERA. (Gr. *ἀθήρ*, *a point*, *κέρας*, *a horn*.) The name given by Cuvier and Latreille to one of the primary divisions of the Dipterous order of insects. It comprehends the modern families *Syrphidæ*, *Astridæ*, *Conopidæ*, and *Muscidæ*, in all of which the antennæ have only two or three joints, the last being furnished with a bristle.

ATHERI'NA. A Linnæan genus of abdominal fishes, having an elongated body, two widely-separated dorsal fins, and a very protractile mouth armed with very small teeth. All the known species have a broad silvery band along each side, six branchiostegal rays. It was to the fishes of this genus that the ancients attributed an origin by equivocal generation, and the inhabitants of the shores of France, which are washed by the Mediterranean, still call them "nonnats."

ATHEROSPERMA'CEÆ. (Atherosperma, *one of the genera*.) Incomplete aromatic exogenous shrubs found in New Holland and South America, remarkable for having their flowers in a cup-shaped involucre, and the peculiar anthers of lauraceæ.

ATHLE'TES. (Gr. *ἆθλον*, *a prize*.) Men who contended at the public games of the Greeks and Romans, in boxing, wrestling, running, leaping, and throwing the quoit. The name was more particularly applied in the two former cases. Their dress consisted merely of a linen bandage round the loins, the rest of the body being left naked, and anointed with an unctuous mixture called ceroma. The boxers used a kind of glove called cæstus, which consisted of leather thongs wrapped round the hand with pieces of lead and iron sewed into them, to give greater weight to the blows.

Among the Greeks these contests were considered highly honourable, and the victors at their national games at Olympia, and elsewhere, were received in their native states with great distinction, and were rewarded with valuable privileges; indeed, one of them most popular divinities, Pollux, was celebrated for his skill in boxing. Among the Romans they were slaves, or hired persons of lower rank or foreigners.

ATLA'NTES. (Gr. *τλάω*, *I bear*.) In Architecture, the statues of men used instead of columns to support an entablature. The word is used by Vitruvius.

ATLA'NTIDES. In astronomy, a name given to the Pleiades, because they were supposed to be daughters of Atlas, or his brother Hesperus, who were translated to heaven.

ATLA'NTIS. (Greek.) An island mentioned in Plato's Dialogue entitled Timæus, as having once existed in the Atlantic Ocean opposite to the Pillars of Hercules. It was said to have exceeded Europe and Africa jointly in magnitude, and after existing for 9000 years, during which period its inhabitants extended their conquests throughout the known quarters of the globe, to have been uprooted by prodigious earthquakes and inundations, and submerged in the ocean. The question of the reality and site of this island has been frequently discussed by modern geographers, who have displayed much critical perspicacity in its elucidation. M. Bailly supported the Platonic view of the existence and site of the island on the authority of the ancients, and cited Homer and Diodorus Siculus in corroboration of his opinion. Rudbeck, Kircher, Beckman, and others, concur in opinion respecting its reality, but each assigns to it a different locality. According to the conjectures of Buffon and Whitehurst, who regarded the Canaries and the Peak of Teneriffe as the summits of mountains belonging to some submerged continent, Atlantis was the land which, at a former period, united Ireland to the Azores and the Azores to America. On the other hand, D'Anville and Heeren regard Plato's account of the Atlantis as altogether a fanciful speculation, while there are not wanting many who discover in it proofs that the American continent was known at some remote period to the people of the Eastern hemisphere, but that the knowledge was subsequently lost.

A'TLAS, in Anatomy, is the term applied to the uppermost of the cervical vertebræ; so named from its supporting the head, as Atlas was supposed to support the globe.

ATLAS. In Literature, a name given to collections of geographical maps and charts; so called from the mythological giant who was said to support the globe. The name was first applied in this sense by Gerard Mercator, the geographer, in the 16th century. It is now used also for works in which other subjects are displayed in a tabular form: as, genealogy, chronology, ethnography, &c.

ATLAS. In Geography and Mythology, the name of an extensive chain of lofty mountains, some of their summits having an elevation of above 13,000 feet, in the N.W. of Africa. The early Phœnician and Greek navigators, who saw this vast chain from a distance, and were unacquainted with the intervening country, naturally formed the most extravagant notions of its height. This gave rise to a number of fables. The summits of the mountains were believed to pierce the skies; and the poets represented Atlas as an old man of gigantic stature who supported the heavens on his shoulders. Virgil has described Atlas, consistently with

the popular belief, in some of the finest lines of the Æneid: —

> ——— Jamque volans apicem et latera ardua cernit
> Atlantis duri, cœlum qui vertice fulcit;
> Atlantis, cinctum assiduè cui nubibus atris
> Pinifernm caput et vento pulsatur et imbri;
> Nix humeros infusa tegit, tum flumina mento
> Præcipitant senis, et glacie riget horrida barba. — IV. 246—252.

ATMO'METER. (Gr. ἀτμὸς, *vapour*, and μέτρον, *measure*) An instrument for determining the rate of evaporation from a humid surface.

ATMOSPHERE (Gr. ἀτμος, *vapour*, and σφαῖρα, *a sphere*) The assemblage of aeriform vapours which form the invisible medium which surrounds the earth. For an account of the different gases which enter into the composition of atmospheric air, see AIR. We shall here confine ourselves to an account of the mechanical properties of the atmosphere.

*Weight of the Atmosphere* The first circumstance connected with the atmosphere which attracts our attention is its weight, or the pressure which it exerts on solid bodies at the surface of the earth It is well known that the rise of water in the sucking pump, and the suspension of the column of mercury in the barometric tube, are caused by the pressure of the atmosphere, we have therefore, in either of these phenomena, the means of exactly measuring its weight The column of mercury in the tube of a barometer is exactly equal in weight to a cylinder of air of equal diameter reaching to the top of the atmosphere Now, the mean height of the barometer at the level of the sea is about 28·6 inches; and a cubic inch of mercury weighs 3126·92 grains, or 0·48956 lbs. avoirdupois It follows, therefore, that a column of mercury whose base is a square inch, and height the mean height of the barometer, weighs 0·48956 × 28·6 = 14·6 lbs avoirdupois nearly, or that the atmosphere exerts a pressure equal to 14·6 lbs on every square inch at the surface of the earth

This pressure of the atmosphere plays a very important part in the animal and vegetable economy Like that of all other fluids, it is exerted equally in all directions, thus the air in a tube presses not only on the bottom but also on the sides of the tube, with a force equal to 14·6 lbs for every square inch. The surface of a man of ordinary stature is about 15 square feet, or 2160 square inches, whence the whole atmospheric pressure which his body sustains amounts to the enormous sum of 31536 lbs This great pressure is not sensible, because it is balanced by the reaction of the elastic fluids in the interior of our bodies, but if the equilibrium were to be suddenly destroyed, the consequences might be fatal Under the exhausted receiver of an air pump, animal life is soon destroyed, on the summit of a very high mountain a man experiences extreme fatigue, respiration becomes difficult, the pulse is accelerated, and it has happened that the blood has started from the eyes and ears and other tender parts of the body, in consequence of the diminished pressure

*Density of the Atmosphere* The density of the atmosphere is not the same at different distances from the surface of the earth, but diminishes in the duplicate ratio of the altitude that is to say, if at a certain altitude above the earth's surface it be one half what it is at the surface then at twice that altitude the density will be only one fourth of what it is at the surface This may be proved as follows. Conceive a vertical tube filled with air, reaching from the surface of the earth to the limits of the atmosphere, it is evident that each particle of the inclosed air will sustain the pressure of all those above it, and as the air, in consequence of its elasticity, is condensed proportionally to the pressure, it is easy to see that the density will go on diminishing from below upwards To discover the law of this diminution, let $x$ be the height of any point of this column above the surface of the earth, $u$ = the density and $p$ = the pressure of the air at $x$, and in order to simplify the problem, we shall suppose the temperature to be the same throughout the column, and neglect the difference of pressure arising from the diminution of gravity Supposing the area of the column = 1 the volume of an infinitely thin stratum is the differential of the height, or $dx$, and therefore the weight of all the strata or the whole column above the point $x$ expressed by the integral $f - u\,dx$ ($dx$ being taken with the negative sign, because when $x$ increases the weight diminishes). But it is evident that the weight of the column above $x$ must make an equilibrium with the pressure at $x$, therefore we have the equation $p = f - u\,dx$ But the density is proportional to the pressure, therefore, A being a constant quantity, $p = Au$ and consequently $Au = f - u\,dx$. Hence $A\,du = -u\,dx$ and $dx = -A\frac{du}{u}$ Integrating this equation we get $x = C - A \log u$. Let U be the density at the surface, where $x = 0$, the equation then becomes $0 = C - A \log U$; whence eliminating C, $x = A \log U - A \log u$; or $x = A \log \frac{U}{u}$ It follows therefore that as the altitude $x$ increases, the logarithm of the density $u$ diminishes; whence we derive this important conclusion, that if the altitudes above the surface of the earth be taken in arithmetical progression, the densities of the air at these altitudes will be a geometrical progression decreasing.

By means of this theorem we can easily find the density of the atmosphere at different altitudes, with the help of a common table of logarithms. Suppose that at the height of one mile above the surface the density is represented by unity, the densities at other altitudes will be represented as follows. —

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Height in miles | 1, | 2, | 3, | 4, | 5, | 6, | 7. |
| Corresponding densities | 1 | 0·739, | 0·6309, | 0·5011, | 0·3981, | 0·3163, | 0·2511 |

So that at an elevation of seven miles the density is reduced to one-fourth, and at 14 miles to one-sixteenth, and so on. Conversely, when the variation of the density or pressure at different points is ascertained, the difference of altitude becomes known; hence by means of the barometer we are enabled to ascertain the elevations of the different countries or mountains of the earth above the level of the sea.

*Height of the Atmosphere.* If the air were of the same density throughout, it would be very easy to determine the limits of the atmosphere It has been found by accurate experiments, that at the temperature of 60° and under a pressure measured by 29·82 inches of mercury, a cubic inch of atmospheric air weighs 9·31446 grains Comparing this with the weight of a cubic inch of mercury, it is found that if the density continued the same, the height of the atmosphere would be 328,021 inches, or 5·17 miles But on account of the rapid diminution of the density, it is very evident that the height of the atmosphere must greatly exceed 5 miles, though we have no means of directly determining how much There are, however, various methods of obtaining an approximate estimate One of them, proposed by Kepler, is derived from observations on the twilight, which is occasioned by the power the atmosphere possesses of refracting and reflecting light It is generally assumed that twilight ceases when the sun has descended 18° below the horizon Now it may be considered that this takes place when a ray of light proceeding from the sun, and passing by the surface of the earth, just reaches the highest stratum of the atmosphere, and is reflected back to the earth in the direction of a tangent to its surface at the place of observation On this principle it is calculated that reflection cannot take place at a greater altitude than 45 miles. There are other considerations which lead us to infer that the height of the atmosphere cannot be much less than this sum With a good air pump, air may be rarefied 300 times, supposing this to be the utmost limit to which rarefaction can be carried, the atmosphere would still extend to an altitude of about 10 miles

*Limits of the Atmosphere.* Though we are unable to assign the precise boundaries of the atmosphere, there are phenomena which prove that it has a limit, that it does not extend indefinitely into the celestial spaces, but belongs exclusively to our earth If matter, or rather if atmospheric air, were infinitely divisible, the extent of the atmosphere would also be infinite; but in this case the fluid could not be in equilibrio unless the sun and all the planets as well as the earth had respectively portions of it condensed around them proportional to their respective attractions. But it is known, from the phenomena of the eclipses of Jupiter's satellites, that the atmosphere of that planet does not by any means exceed that of the earth in proportion to the great superiority of his mass and attractive power, hence there can be no communication between the atmosphere of the earth and that of Jupiter. It has also been shown by Dr. Wollaston, from phenomena attending the passage of Venus near the sun, that the sun has no sensible atmosphere. We are therefore warranted in concluding that the atoms of air are not infinitely divisible, and consequently that the atmosphere has a limit, and the limit must be situated at that height above the earth where the gravitation of the atoms is just equal to the force of their repulsion

*Effects of the Atmosphere on Light.* Like all other diaphanous substances, the atmosphere attracts the molecules of light, and deflects them from their rectilinear course. This phenomenon is called refraction. It increases the apparent elevation of all the celestial bodies above the horizon, but, fortunately for astronomy, its effects can be rigorously calculated The atmosphere also, notwithstanding its transparency, intercepts and reflects the rays of light, and multiplies and propagates them by an infinity of repercussions. If the atmosphere did not exist, objects would not be illuminated unless exposed to the direct light of the sun. As soon as we ceased to look at the sun, or objects illuminated by his rays, we should be left in total darkness. The solar rays reflected from the earth would be lost in the regions of space, and an excessive cold continually prevail. The

sun would continue to shine with unabated intensity, till it reached the horizon, and the transition from the glare of meridian splendour to absolute darkness would be almost instantaneous. All these effects may be judged of by what is experienced on the summits of very high mountains, where the air is greatly rarefied. The cold is insupportable. Scarcely any other light is received by the eye, than that which comes direct from the sun and the stars. The illuminating power of the atmosphere is so feeble, that to an eye placed in the shade the stars are visible in broad day.

*Colour of the Atmosphere.* The general blue colour of the atmosphere, and the brilliant and glowing tints of the morning and evening, arise from the different modifications which the different rays of light receive in passing through the air. When the sun is near the horizon, the stratum of air through which the light must pass before it reaches us is greatly thicker than when he is at a considerable altitude. Now the red rays possess a greater momentum than those of the upper portion of the spectrum, whence they force their way in greater abundance through the resisting mass of air, and penetrate to the earth, while the violet and blue are reflected or absorbed. Hence the ruddy colour of the morning and evening skies. The prevailing blue colour of the atmosphere is to be ascribed to the greater facility with which the blue and violet rays are reflected, or from possessing less power to penetrate through the aerial strata. At a great height in the atmosphere, the blue tinge disappears, and the sky becomes a deep black.

The atmosphere is the region of clouds and vapours through the agency of which the earth is fertilised and rendered fit for the support of animal and vegetable life. The various phenomena of which it is the theatre, and the effect of the changes which are continually taking place in its physical condition, form one of the most important branches of natural philosophy. (*See* CLIMATE, METEOROLOGY, VAPOUR, WIND, &c.)

*Atmosphere*, in Electricity, denotes a medium conceived to be diffused over the surface of electric bodies, and to extend to some distance from them. It is not proved that any such fluid medium exists, at least of a peculiar kind, though it figured greatly in the language of the early writers on electricity. Phenomena that were explained by the agency of a peculiar fluid, are now known to depend on the modification which common air receives from electric substances. *See* ELECTRICITY.

ATMOSPHE'RIC STONES. *See* AEROLITES.

ATMOSPHERIC TIDES. Certain changes in the barometric pressure of the atmosphere, depending on the attraction of the sun and moon. Laplace ascribes the lunar influence indicated by the observations on the diurnal variations of the barometer to the elevation and depression of the waters of the ocean, instead of the direct effect of the moon's attraction. The solar action he attributes wholly to the expansion caused by the heat of the sun. It is extremely doubtful if, in our latitudes, the attraction of the sun and moon produces any perceptible oscillation of the atmosphere.

A'TOM (Gr. *ἀ*, *not*, and *τεμνω*, *I cut*.) A part so small as not to be divisible.

ATO'MIC THEORY. (In Chemistry.) When substances combine chemically, they are found to unite in certain weights; thus, water is constituted of one part by weight of hydrogen and eight of oxygen, and the gases only combine in those proportions to form it. It is assumed that water is a compound of an atom of hydrogen and an atom of oxygen, and that the relative weight of the atom of hydrogen to the atom of oxygen is as 1 : 8, hence the atomic weight of water is 1+8, or =9. The same theoretical views are applicable to all other simple and compound bodies, and the numbers which represent their combining weights are hence called their atomic or equivalent numbers. (*See* EQUIVALENTS, and AFFINITY.)

ATOMOGY'NIA. (Gr. *ἄτομος*, *uncut*, and *γυνή*, *a female*.) A word proposed to be substituted for angiospermia, the name of the second order of the sixth class of Linnæus, signifying that the ovary is not cleft into distinct parts.

ATO'NEMENT. (From the old English verb to atone, or reconcile: the phrase is still used adverbially, as where we say that two persons are "at one," i. e. agreed.) In Theology, the reconcilement of God with man by virtue of the death of our Saviour. The sacrifices of Jewish and patriarchal antiquity were types of this great event, and were in themselves offered for the purpose of atoning for sin; and the idea attached to the practice of sacrifice by the numerous heathen nations of antiquity, and of the present time, has always been the same. (*See* SACRIFICE.)

A'TRIUM. (According to Scaliger, from the Greek *αἴθριος*, *exposed to the air*.) In ancient Architecture, the atrium is by some considered the same as the vestibule, and Aulus Gellius intimates that in his time these two words were frequently confounded. There is reason for supposing that the vestibule was not properly a part of the house, but merely a portion of the entrance, for Cicero, in a letter to Atticus, describing the attack made on him in the via sacra, says, he took refuge to defend himself in the vestibule of Tatius. "Secessi in vestibulum Cati Tatii Domionis." If, however, in the time of Aulus Gellius these words were used ambiguously, it is not probable that at this period the question will be settled; and that this was the case is quite certain, for, in describing the spot where the colossal statue of Nero stood, Martial places it in the atrium, and Suetonius in the vestibulum. That the atrium was in an inner part the verse of Virgil, "Apparet domus intus et atria longa patescunt." According to the description of Vitruvius, it seems to have been a sort of covered portico, composed of two ranks of columns, forming a centre and two side aisles, and to have been beyond the cavædium or court, and before the tablinum or cabinet. The atrium was decorated with the statues of the proprietor's ancestors. Festus derives its name from its first use at Atria in Etruria. "Dictum atrium quia id genus edificii primum Atriæ in Etruria sit institutum."

A'TROPHY. (Gr. *ἀ*, priv., and *τρέφω*, *I nourish*.) A wasting away of the flesh.

ATRO'PIA. (Gr. *Ἄτροπος*, *one of the Fates*.) A highly poisonous alkaline substance, extracted from the atropa belladonna, or deadly nightshade.

A'TTA. The name of a Fabrician genus of Hymenopterous insects belonging to the ant-tribe (*Formicidæ*), characterized by their very minute palpi, and the large size of the heads of the neuters. Some of the largest species of ant, as the visiting ant of South America, (*Formica cephalotes* L.), are included in this genus.

ATTACHMENT. In Law, a process issuing in a summary manner from a court of record against the person of any one guilty of a contempt of its rules. Attachment is most commonly granted against attorneys for malpractice, against sheriffs for making a false or no return to a writ, and against any parties neglecting to pay costs when ruled to do so.

*Foreign Attachment.* Under the custom of the city of London, whenever process for debt from the mayor or sheriffs' court is returned nihil, the plaintiff may, upon its appearing that a third person is indebted to the defendant, obtain satisfaction of his claim by attaching the debt. This is called foreign attachment.

ATTAINDER, BILL OF. A species of extraordinary proceeding against parties accused of treasons or felonies which cannot be reached by the ordinary course of justice. During the reigns of the Tudors the more constitutional process of impeachment was entirely laid aside, and attainders were generally adopted in the case of state criminals. These bills usually commenced in the Lords. They have been very unusual in later times. The last recorded in Mr. Hatsell's Precedents of Parliament was directed against some persons concerned in the Scotch rebellion in 1716. Parliament is now bound, in passing these acts, to adhere to the rules of evidence which are followed in ordinary courts of justice.

Attainder is the supposed stain or corruption of the blood of a criminal legally condemned, which, by the common law of England, immediately follows the pronouncing sentence of death. The attainder of a criminal follows upon judgment, and not upon conviction. Attainder is either on appearance (by confession or by verdict) or by process, otherwise termed by default or outlawry, in case of non-appearance. For the effect of attainder on the lands, &c. of the criminal, *see* FORFEITURE. It is enacted by 54 G. 3. c. 145 that no attainder for felony, except in cases of high treason, petty treason, or murder, or abetting and counselling the same, shall extend to the prejudice of the rights of any persons except the offender during his life.

ATTE'LABUS. The name of a Linnæan genus of Coleopterous insects, characterised by moniliform antennæ, thicker towards the tip, and situated on the rostrum: the head pointed behind, and inclined. The species thus heterogeneously grouped together are now divided into the genera Attelabus proper, Apoderus, and Rhynchites. The latter includes some of the most beautiful weevils in this country, amongst which is the rare and splendid Carculio auratus.

ATTE'NTION. (Lat. *attentio*.) In Metaphysics, a steady exertion or application of the mind to any object of sense or intellect, in order to its being thoroughly understood, and afterwards retained. Attention is regarded by Stewart as a distinct faculty of the mind; and though this arrangement does not coincide with the views of many philosophers, his illustrations of the results or effects of attention are universally considered as a masterpiece of metaphysical disquisition. (Vide *Inquiry into the Human Mind*, ch. 2.)

ATTE'NUANTS. Remedies which dilute the blood.

ATTENUA'TUS. (Lat. *made thinner*.) When the thickness of any part diminishes in some particular direction, it is often used in the sense of narrowed, or angustate.

A'TTIC. (Gr. *ἀττικὸς*, *Athenian*; derived, in the seventh edition of "Ency. Brit.," art. "Architecture," from *ἄτειχον*, *without a wall*, which, if true, would make every thing attic

that was detached from a wall.) In Architecture, a low order of architecture, commonly used over a principal order, never with columns in it, but always antæ, or pilasters. It is employed to decorate the façade of a floor of small height, terminating the upper part of a building, and is doubtless called attic from its resemblance in proportional height and concealed roof to some of the buildings of Greece. Pliny describes it, after speaking of the other orders, thus: "Præter has sunt quæ vocantur atticæ columnæ quaternis angulis pari laterum intervallo." We, however, find no examples of square pillars in the remains of ancient art, though almost all the triumphal arches exhibit specimens of pilastral attics, having no capitals save the cornice breaking round them. In modern architecture the proportions of the attic order have never been subject to fixed rules, and their good effect is entirely dependent on the taste of the architect.

ATTIC BASE. *See* BASE.

A'TTICISM. (Gr.) An elegant or concise form of expression. Milton, in his Apology for Smectymnuus, thus uses it: "They made sport, and I laughed: they mispronounced, and I misliked; and, to make up the atticism, they were out, and I hissed." The term *Sal Atticum* was employed by the Romans at once to characterise the poignancy of wit and brilliancy of style peculiar to the Athenian writers, and to designate the liveliness, spirituality, and refined taste of the inhabitants of that city, which formed the focus and central point of all the eloquence and refinement of the Greeks.

A'TTITUDE. (Fr.) In Painting and Sculpture, the gesture and position of a figure, in which the action or sentiment of the person is represented. It should be natural and unconstrained, expressive, varied. Where more than one figure occurs there should be contrast in the limbs, and at the same time a balancing of each other.

ATTO'RNEY. (From the modern Latin torno, whence attorno, attornatus, signifying one who serves the *turn*, or is set in the place of another to do his business.) An attorney is either private or public. A private attorney is a person who acts for another in the conduct of his affairs out of court; for which purpose a verbal authority is in general sufficient, but for the performance of some acts, as, to deliver seisin of land, to transfer bank stock, or to execute a deed for another, he must be authorised by a formal power of attorney. He is not necessarily of the profession of the law, and the above, and all other the various matters unconnected with actual litigation in which he may be employed, such as the preparation of legal instruments, and the giving of advice and assistance in the transfer and management of property, may be undertaken by any other person. A public attorney, or an attorney at law, has been defined to be an officer of a court of record, legally qualified to prosecute and defend actions in courts of law on the retainer of clients. The circumstance of his being an officer of the court in which he may practise is important, as bringing him immediately within its summary jurisdiction, and thereby giving rise to his peculiar privileges and disabilities. A solicitor differs from an attorney in practising in courts of equity instead of common law.

Anciently parties were not allowed to appear in court by attorney without the king's special warrant by writ or letters patent, and if this could not be obtained were compelled every day during the pendency of their suit to be present in their own proper persons. The power of suing and being sued by attorney was first given by statute in the time of Edward I. All persons may now appear in court by an attorney of their own appointment, except infants, who must appear by next friend or guardian, married women, for whom, unless when proceeding in chancery in respect of their separate estate against their husbands, the attorney must be appointed by their husbands; idiots, and persons charged with any criminal offence, must appear in person; lunatics, if of full age, and corporations, cannot appear otherwise than by attorney.

The admission and practice of attorneys is now chiefly regulated by the 2 G. 2. c. 23., and other statutes made in the same and succeeding reign. The first requisite to be complied with in order to become an attorney is to enter into a contract in writing, called articles of clerkship, on which a heavy stamp duty is payable, with an attorney or solicitor actually practising, or other officer of court specified by statute to serve him in the capacity of clerk for five years. No attorney or solicitor can take more than two articled clerks at the same time, but some of the officers above referred to are allowed to take three. Persons who have taken the degree of B. A. or B. C. L. at Oxford, Cambridge, or Dublin, within a certain fixed period after matriculation at the university, and before execution of their articles may be admitted as attorneys after a clerkship of three years. Clerks also who are bound for five years are allowed to reckon as part of their term a year passed as bonâ fide pupils to a barrister or special pleader. After the expiration of the service, and notice given of his intention to apply for admission, the clerk must go before a board of examiners recently established by the judges under rule of court, and his fitness and capacity having been approved, be sworn in open court to demean himself honestly in his practice. His name is then entered on one of the records of the court, called the roll of attorneys, and he is duly admitted an attorney of that particular court. He may, however, when admitted of any one court at Westminster, practise in any one of the other courts there, in the name of an attorney of such other court, with his consent in writing. He may, at a trifling expense, be admitted a solicitor in any of the courts of equity, as a solicitor in equity may in like manner be admitted an attorney of any of the courts of common law. After admission he must, before the 16th December in every year, pay a certain duty, and obtain his certificate. Should he for one whole year neglect to take out his certificate, he would, besides incurring a penalty for practising without one, be thenceforth incapable of acting in court in any professional character; but upon payment of all arrears of duty since the expiration of his last certificate, and of a further sum by way of penalty, may be readmitted.

An attorney actually practising is supposed to be always present in court, and has for that reason many privileges in common with its other officers. He is accordingly exempted from serving on juries and inquests, and generally from filling all offices which require personal service; he has the privilege in all personal actions of suing in his own court, and of retaining the venue in Middlesex, and as defendant is not liable to be arrested on mesne process. He is in general privileged from giving evidence of any confidential communication made to him by his client: this, however, is the privilege not of the profession but of the client, who may waive it if he please. An attorney cannot fill the office of justice of the peace, sheriff, and many other offices, and cannot be bail for another unless in criminal cases. He is not permitted to deal with his clients in the same unrestrained manner in which ordinary men may deal with each other; and when a purchaser of his client's property, is sometimes required to show affirmatively in the first instance that he has given for it its full value. To restrain him from extortionate and vexatious conduct, he is required, one month at least before bringing an action to recover fees for business done in court, to deliver to his client a bill of costs, which, upon application of the client and his undertaking to pay what shall appear due, will be taxed by an officer of the court, and if exorbitant be reduced to a fair and reasonable amount. Where an attorney has been guilty of gross ignorance, neglect, or misbehaviour, in the management of his client's business, the court will frequently interpose in a summary manner, and compel the attorney to pay the costs, or make reparation for any loss occasioned by his default; and in cases of fraudulent malpractice grant an attachment against him, or even strike him off the roll. He is besides liable to an action for any gross and culpable negligence, by which the interests of his client may have been prejudiced. In matters of difficulty, not lying within his own department of the profession, he is protected from responsibility by acting on the opinion of counsel; but in matters of simple and ordinary practice, where the law will presume him to have the requisite knowledge himself, he cannot avoid his responsibility by consulting another.

ATTORNEY-GENERAL. An officer made by letters patent. He is the public prosecutor on behalf of the crown, his duty being to exhibit informations in criminal matters which concern the crown, ex officio, or by virtue of his office. (*See* INFORMATION.) He also files bills in the exchequer for any thing concerning the king's inheritance and profits, and bills are filed against him by others. The attorney-general has precedence of all other counsel. As chief legal adviser of the crown, in all matters falling within the purview of his office, his place is one of great importance, and is usually entrusted to new hands whenever an extensive change is made in the cabinet. It is generally understood that the attorney-general for the time being has a priority of claim for preferment to any of the high law offices which may fall vacant, if he is willing to accept it, but this rule has by no means been uniformly acted on.

ATTRA'CTION. (Lat. ad, *to*, and traho, *I draw*.) Used in physics to denote the tendency which we observe in certain bodies to approach one another, and to resist separation. The meaning of this term has been greatly obscured by metaphysical disputations. When a body A, is connected with another body B, by a rod, or chain, or in general by the intervention of any mechanical means, we see, or fancy we see, the reason why B attracts A, or A is compelled to follow the motions of B. But when two distinct bodies not connected by any visible bond of union are observed to aproach one another, the phenomenon seems to assume a greater degree of mystery, from our being no longer able to perceive any mode by which the one body can act on the other. On reflecting, however, on the constitution of material substances, and considering that they are composed of

distinct particles, which there are many reasons for believing are not in contact with each other, we may soon satisfy ourselves that there is, in reality, as much difficulty in conceiving how the different particles of a body cohere, or act on each other by impulse, as in conceiving how one body can be the cause of motion in another placed at a distance.

It is well remarked by Maupertuis, that the manner in which the different properties reside in a subject is always inconceivable to us. The vulgar are not astonished when they see a body in motion communicate its motion to other bodies; we are accustomed to the phenomenon, which prevents our perceiving in it any thing marvellous. But philosophers will not readily believe that an impulsive force is more conceivable than an attractive one. What, in fact, is this impulsive force? How does it reside in bodies? Who could have predicted its existence before seeing the bodies impinge on each other? The existence of other properties in bodies is not more clear. In what way does impenetrability and the other properties become joined to extension? In these things there will always be mysteries for us.

Before the time of Sir Isaac Newton, the term attraction was used to denote a species of quality inherent in certain bodies; at the present time, however, philosophers use the word not to express any particular mode or species of action, or any physical cause of such action, but simply the fact, that the different parts of matter tend to approach each other, without any reference to the question whether the power which produces that tendency is inherent in the bodies, or consists in the expulsion of an external agent. They regard it as one of the ultimate phenomena to which the analysis of matter leads. Newton himself particularly cautions his readers against supposing that there is really an attractive force residing in the centre towards which bodies tend, the centres being only mathematical points. He takes care to mention that he uses the term to denote a fact, and not a cause, that he used it only for the purpose of avoiding systems and explications, that this tendency might be caused by some subtle matter proceeding from bodies, and be the effect of a real impulsion, but whatever its cause might be, it was clearly a primary fact from which we might set out in explaining other facts depending on it. At present, objections of the sort which Newton here attempts to avoid, carry little weight with them, but in the time of Newton they were considered of the greatest importance. Leibnitz called attraction an occult quality, a term then held in horror; and the fact is certain, that the physical or metaphysical difficulties of explaining the nature of attraction contributed not a little to retard, on the Continent, the adoption of the Newtonian theory of the universe.

Attraction, with reference to the laws which it observes, may be divided into two kinds; one, taking place among bodies, placed at measurable distances from each other; the other among the small particles of matter, where the effect is only sensible at insensible or inappreciable distances. Among the instances of attraction at sensible distances, even at the greatest distances, the most remarkable is that of the attraction of gravitation, which belongs to all matter; which determines the motions and the figures of the planets and comets, and causes the descent of heavy bodies to the ground. For an account of the law which this species of attraction observes, and the astronomical phenomena which it produces, *see* GRAVITATION. The attraction of magnetism, of electricity, &c., are also instances of the action of bodies on each other, at sensible distances. *See* MAGNETISM; ELECTRICITY.

The second species of attraction exists only among the molecules or small particles of matter, and is hence called molecular attraction. The distances to which it extends are extremely small, or insensible. This species of attraction is the cause of the coherence of solids; of crystallisation; the refraction of light; the ascent of fluids in capillary tubes; the roundness of a drop of water; and in general, of all chemical actions. (*See* CAPILLARITY, COHESION, AFFINITY, &c.) It is to Newton that we owe the first distinct announcement of this last species of attraction, as it is to him that we owe the discovery of the law of the attraction of gravitation, and that it pervades celestial as well as terrestrial matter. The law of molecular attraction is not known; all that can be positively affirmed of it is, that it decreases in a much quicker ratio than the inverse square of the distance, and in many instances becomes prodigiously great, when the distance between the particles is diminished to its utmost limit.

It would not be possible to explain the constitution of matter, or account for the different forms under which it presents itself, by molecular attraction alone, without calling to aid the antagonist principle of repulsion. If the particles of matter only attracted each other, they would continue to advance nearer and nearer to each other, till further approach was rendered impossible by their impenetrability. But this does not take place; for all bodies are capable of contraction and dilatation, and in fact do dilate and contract, by the application of heat and cold. Thus, the particles of matter being solicited at the same time by two kinds of opposite forces, naturally assume that state of equilibrium which results from the compensated energies, and approach or recede, according as the attractive or the repulsive force predominates. All terrestrial phenomena depend on forces of this kind, as the celestial phenomena depend on universal gravitation. The repulsive force appears to be produced by the principle of heat: the attraction cannot be referred to any principle with which we are more familiar than we are with itself. Some philosophers have attempted to confound molecular attraction with the general attraction of gravity, or at least to regard the former as a modification of the other, but in the laws which they obey they are totally different.

Most of the disputes which have taken place about the nature of attraction have proceeded from the indistinct ideas which we attach to the term force. By force is meant the cause of motion, but we know not in general what that cause is; we only judge of its degree by the effect which we see produced. We have no means of measuring or comparing forces directly; what we do measure and compare are the changes of motion; and when we see bodies in motion, we immediately conclude that it is occasioned by the action of a force. Attraction and repulsion are principles of action, and if they are more difficult to be conceived than any other causes of action or motion, the obscurity arises merely from their implying action at a distance.

Of all the different kinds of attraction mentioned above, there is only one of which the laws have been fully investigated, namely, the attraction of gravitation. The electric and magnetic attractions are rather terms employed in physics for the purpose of giving a name to what we imperfectly understand, than used as principles from which to deduce the phenomena to which they give rise. The laws of capillary attraction have been investigated to a considerable extent by Laplace; but molecular attractions in general, which play so important a part in the economy of the world, have seldom been made the subject of mathematical investigation.

ATTRACTION OF MOUNTAINS. That power or force by which all the celestial motions are regulated, and to which we give the name of gravitation, does not act merely on the large masses of the universe; the smallest molecules of matter equally partake of its influence, and have an inherent and natural tendency to approach one another. This mutual action, in the case of small bodies, is insensible, because the attraction resulting from the whole mass of the earth absorbs, as it were, altogether, that which they exercise on one another, and renders their mutual approach infinitely small or imperceptible. But though the attractive force of matter is insensible in regard to small masses, it may become quite appreciable in the case of large mountains acting on the plummet of a delicate astronomical instrument. Newton himself was the first who deduced this consequence from his theory of universal gravitation. In his tract "De Mundi Systemate," § 22, he computes that a plummet, at the foot of a hemispherical mountain three miles high, and six broad (at the base), would be drawn about one minute and eighteen seconds out of the perpendicular. Some time elapsed, however, before any attempt was made to investigate the subject experimentally.

Those who are unaccustomed to consider the intimate relation that subsists among the different parts of physical science, and the light which the accurate solution of one question frequently throws on a multitude of others, will naturally inquire what useful purpose is to be gained by determining the attraction of a mountain,—a determination, moreover, of an extremely nice and delicate kind, and by no means easily executed. Nevertheless, the subject is one of very great importance in astronomy, and its investigation necessary, in order to ascertain the figure of the earth, and determine its interior density. The magnitude and figure of the earth are found by comparing the lengths of lines measured at different places on its surface with the corresponding celestial arcs, the extremities of which are the zenith points of the extremities of the terrestrial line. Now if, by the attraction of a mountain, or any other local cause, the plumbline is drawn aside from the perpendicular, or the direction of gravity is not perpendicular to the general surface, the position of the apparent zenith will be altered; and a very small deviation of this kind will produce a great error, for every second of the celestial arc corresponds to about 100 feet on the ground. It is necessary, therefore, to possess the means of making a correct allowance for such causes of local irregularity where they cannot be avoided. Again, the attraction of a mountain gives the means of determining the mean density of the earth. For suppose this attraction to be known by its effect on the plumbline, as the dimen-

sions of the mountain can be determined by measurement, and the density of its materials can in general be ascertained with tolerable accuracy, the quantity of matter which it contains becomes known. But the dimensions of the earth, and the amount of its attraction, are also known; therefore we are in possession of all the data necessary to enable us to compute its mean density.

There are various ways by which the quantity of the attraction of a mountain may be ascertained. One of the most obvious is to take two stations, one on the south and the other on the north side of the mountain, and as nearly as possible in the same meridian. From the zenith distances of the same stars observed at each station, the difference of their apparent latitudes may be accurately determined. But the real difference of the latitudes can also be determined by a trigonometrical measurement on the ground of the distance between the same stations. The difference of these determinations gives the sum of the deviations of the plumbline on the opposite sides of the mountain; and when divided in the inverse ratio of the squares of the distances of the stations from the centre of gravity of the mass, will give the deflection of the plummet at each station. Another method supposes one observer to be placed at the eastern foot of the mountain, and another at the western, having the means of accurately determining astronomically the difference of their meridians. This difference, compared with the measured distance by which the one station is east or west of the other, will show the effect of the attraction of the mountain; but as there is greater difficulty in determining accurately the difference of longitude than of latitude, this method cannot be so easily applied as the former. But it is not absolutely necessary, indeed it may be impracticable, to make observations on the opposite sides of the mountain. Let the meridian altitudes of the same stars be observed first on north or south sides of it, and then at a station on the same parallel of latitude, but at such a distance from the mountain as to be out of the reach of its action. The difference of the altitudes in the two cases will show the amount of the attraction of the mountain.

The first attempt to ascertain the attraction of a mountain by actual observation was made by the French academicians, Bouguer, Godin, and Condamine, who, about the year 1738, were dispatched to Peru for the purpose of measuring the length of an arc of the terrestrial meridian. Their experiments were made on the mountain Chimbaraço, the highest of the Cordilleras, and the result seemed to show that the zenith point was altered by the attraction of the mountain to the extent of about 7½ seconds of a degree. But this quantity was much too small to determine, with certain evidence, whether the mountain had or had not a sensible effect on the plumbline, for their instruments were not so perfect but that inconsistencies, [illegible] sometimes to upwards of 20 seconds, entered into their observations. From that time no further attempt was made to determine this interesting fact in physical astronomy to the year 1774, when Dr. Maskelyne, the astronomer-royal at Greenwich, made an experiment of the same kind on the mountain Schehallien in Perthshire, with instruments capable of measuring the minute quantities in question. The difference of latitude of two stations on the north and south side of the mountain, compared with that which was inferred from the measurement of the distance on the ground, gave decidedly 5″.8 seconds on each side, for the action of the mountain on the plummet of the zenith sector. The magnitude of the mountain was accurately measured at the same time; and with the data thus obtained a laborious calculation was made by Dr. Hutton, from which it resulted that the mean density of the earth is about five times that of water, or twice that of the ordinary rockstone near its surface. A third experiment of the same kind was made in 1810 by Baron Zach on the mountain Mimet, at a little distance from the shore of the Mediterranean near Marseilles. The instrument which he employed for determining the latitudes, a repeating circle of 12 inches radius, was much less to be depended on for accurate results than the zenith sector of Dr Maskelyne, but in other respects his operations, particularly those connected with the terrestrial measurements, appear to have been conducted with far greater science and practical skill. The result was, that the deviation of the plumbline from the true vertical, caused by the attraction of the mountain, amounted to two seconds of a degree. Baron Zach did not attempt the further researches required for comparing the density on the mountain with that of the earth; such comparison, indeed, can only be made with respect to an insulated mountain, which Mimet is not.

Though the experiments hitherto made on this subject are few and imperfect, they are quite sufficient to establish the fact, that mountains are capable of producing sensible deflections of the plumblines of astronomical instruments. It is, therefore, of very great importance, in the measurement of degrees of the terrestrial meridian, to select for the station where the astronomical latitudes are observed, places remote from large mountains, and where the local irregularities of the surface are not very considerable. After every precaution of this sort has been taken, some uncertainty will still remain on account of local attraction; for it is obvious that a sudden and considerable variation of density in the strata under the surface will produce the same effect on the plumbline as a mass of matter elevated above it. To this cause is attributed, with much probability, a great part of the discrepancies among the results of the operations made to determine the figure of the earth, particularly among those for ascertaining the variations of density by means of the pendulum. See *Zach's Attraction des Montagnes*, Avignon, 1814. *Playfair's Works*, vol. iii. *Hutton's Tracts*, vol. ii. *Phil. Trans.* vol. lxviii.; also *Bouguer's Figure de la Terre*.

ATTRACTION, CHEMICAL. *See* AFFINITY.

A″TTRIBUTES. (Lat. ad, *to*, and tribuo, *I give*.) In the Fine Arts, certain symbols which are used to distinguish and characterise certain figures. Thus the eagle and thunderbolt are the attributes of Jupiter; the trident, that of Neptune; the caduceus, of Mercury; the bow and quiver attend Love; the balance and sword accompany Justice, &c. &c.

AUBAINE, DROIT D'. In French Jurisprudence, the right of the sovereign to the succession of a foreigner not naturalised, or of a naturalised foreigner dying intestate without heirs resident within the realm. The word is derived from the old French aubain, *foreigner*: said to come from the Latin alibi natus, *born elsewhere*. The droit d'aubaine still exists in various countries; and, although abolished at the Revolution, was restored by the Code Civil of Napoleon.

AUCHE′NIA. (Gr. αυχὴν, *the neck*.) In Mammalogy this term is restricted to the region of the neck, below the micha, or nape. Also, the name of a genus of Camelidæ, in which the above region of the neck is remarkably elongated.

AU′DITOR. One who examines and verifies the accounts of officers and others entrusted with money. The term is derived from the Latin audio, *I hear*: probably from the ancient practice of delivering accounts vivâ voce. Receivers-general of fee-farm rents, &c. are termed auditors. Officers with the same title are assigned by courts of law to settle accounts in actions of account, &c. The auditors of the exchequer were officers appointed to take the accounts of receivers of public revenues. The present board of commissioners for auditing the public accounts, exercising the duties formerly divided between various officers of the exchequer, was constituted in the year 1806. In Germany the junior legal functionaries are termed auditors. Its most usual sense seems to have been originally given to the word in France, where the members of the Chambres des Comptes were divided into conseillers-maîtres, and conseillers-auditeurs.

AU′GER. An instrument for boring the soil for the purpose of ascertaining the nature of the subsoil, the mineral, and, in agriculture more especially, the existence of water. There are various kinds of augers, according to the purposes to which they are to be applied, but they all consist of three parts, viz. the bit, mouth, or cutting piece, the handle, and the connecting rods. The handle is for the purpose of working the instrument by the means of two or more men. the rods for connecting the handle with the bit, or cutting piece, and the bit for penetrating the soil. When it is necessary to pass through stony soil or rocks, a chisel is substituted for the bit, and after the rock is broken in small pieces, the chisel is removed, and replaced by the common auger, by which the loose matters are drawn up.

AUGMENTA′TION, ARMS OF. In Heraldry, coats given by sovereigns to subjects as a mark of honour, to be quartered with their own; or charges, such as ordinances charged with some device, to be borne in their family shield. Such coats or devices are in general either significant, i. e. bearing some relation to the nature of the achievement for which the honour is bestowed; or they are portions of the royal arms.

AUGMENTATION OF STIPENDS. (Church of Scotland.) The stipends of ministers are under the control of the Court of Session. That court has the power to entertain applications for augmentation from clergymen, and either to grant or dismiss them. But twenty years must elapse before such application can be renewed.

AU′GSBURG, CONFESSION OF. A formulary drawn up by Luther and Melancthon, and presented to Charles V. at the diet held at Augsburg in 1530. It is adopted by the Lutheran church, but did not at the time succeed in comprehending all the reformers, and was the occasion of a separation between the followers of Luther and the party who called themselves the Evangelical Reformed Church, which has continued ever since.

AU′GURS. (Lat. augures.) Roman soothsayers, who professed to foretel events by the flying, singing, or feeding of birds. Their office was one of great importance in the state, as no enterprises or ceremonies were

performed unless they declared the omens favourable. Accordingly the members of their college were always elected from the most honourable citizens.

Their divinations were called auguries or auspices, between which there is sometimes a distinction made; the latter meaning such as were derived from the inspection of birds, the former being extended to all omens or prodigies whatever.

The Romans derived their knowledge of augury from the Tuscans, who were celebrated for their skill in this and other religious ceremonies.

AU'GUST. The eighth month of the year. The ancient Roman year commenced with March, and the sixth month was called Sextilis. The name was changed to August in compliment of Augustus Cæsar. In the calendar of Julius Cæsar, the distribution of the days through the several months was more commodious than the present arrangement. The first, third, fifth, seventh, ninth, and eleventh months consisted of thirty-one days each, and the other months of thirty, excepting February, which in common years contained twenty-nine days, but in leap years thirty. In order to gratify the frivolous vanity of Augustus, who thought it a disparagement that the month bearing his name should contain fewer days than July, which was named after the first Cæsar, a day was taken from February and given to August. Such was the origin of the capricious distribution of the days among the different months which now prevails over the whole Christian world; and which, being founded on no principle, requires some pains to be remembered.

AUGUSTA'LES. The epithet given to the priests or flamens of Augustus Cæsar. *See* FLAMEN.

AUGUSTA'LIS PRÆFE'CTUS. The præfect or governor of Egypt when it became a Roman province. This officer was a military viceroy appointed immediately by the emperor, and not selected from the senate, but from the order of knights; and he enjoyed greater power than the proconsuls and proprætors, under whose care the other provinces fell. The epithet Augustalis was derived from the circumstance of Augustus having appointed the first præfect of Egypt.

AUGUSTA'LIA. A festival instituted in honour of Augustus Cæsar on the occasion of his pacifying Sicily, Greece, Syria, Asia Minor, and Parthia.

AUGU'STAN HISTORY. A series of history of the Roman empire from the year 157 A. D. to 285 A. D., written by the following six authors: Æl. Spartianus, J. Capitolinus, Æl. Lampridius, Vulcatius Gallianus, Trebellius Pollio, and Flavius Vopiscus.

AUGU'STAN AGE. A term used to designate the reign of Augustus, the most brilliant period in the literary history of Rome. The civil wars that had long distracted the Roman empire had stifled the cultivation of literature and the arts, and when the battle of Actium had terminated internal commotion, nothing, it was supposed, could so effectually celebrate and adorn the restoration of peace and the happy reign of Augustus, as the appearance of great national poets, who might supply the chief defect in the literature of their country, and create a body of classical works, in which the ancient Roman traditions might be transmitted to posterity. To accomplish this object, men of genius were flattered, courted, and enriched, in an unexampled manner, by the liberality of Augustus; and after a brief interval, the verses of Virgil, Horace, Propertius, Ovid, and Tibullus resounded throughout the empire in their respective epic, lyric, and elegiac strains. But it was not merely for ornamental literature that the age in question was distinguished. The science of jurisprudence, the only original intellectual possession of great value to which the Romans can lay undisputed claim, then received its full development: the immense and nearly inexplicable masses of Roman statutes were perspicuously arranged; and the boundaries of strict law on the one hand, and equity on the other, were respectively ascertained. In this age, too, Rome became the seat of universal government and wealth; and so numerous and splendid were the architectural decorations with which it was embellished, as to justify the saying of Augustus — that he found Rome of brick, and left it of marble.

AUGU'STINE. In Ecclesiastical History, an order of monks and nuns established in the eleventh century, apparently in commemoration of the monastic societies assembled by Saint Augustine in the fourth, but which had long ceased to exist. *See* ORDERS, ECCLESIASTICAL.

AU'LIC COUNCIL, or REICHSHOFRATH. A council of high powers and dignity in the German empire. The Aulic Council and Imperial Chamber (reichskammergericht) were the two supreme courts in that empire. The former consisted of a president, vice-president, and eighteen councillors, six of whom were Protestants, with the peculiar privilege that, if unanimous, their votes could not be overruled by those of the Catholics. This court had exclusive jurisdiction in various affairs, principally those which concerned the imperial government.

AULO'STOMA. (Gr. *αὐλὸς, a pipe, στόμα, a mouth.*) A genus of Acanthopterygians belonging to the family called by Cuvier *Bouches en flute;* including the pipe-fishes, or those species which are characterised by a mouth which is lengthened into a kind of tube or pipe.

AU'RA. (Lat. *the air.*) The subtle essence which is contained within the grains of pollen, and in which is supposed to reside the power of fertilising the ovules. It is now generally considered that this essence is imaginary, and that fertilisation is produced by the descent of minute organic particles through the stigma to the ovules.

AURA. A sensation resembling a wind, or being breathed upon. *Aura epileptica* is a sensation often experienced by epileptic patients, resembling the ascent of a blast of cold air from the extremities upwards.

AURANTIA'CEÆ. (Lat. aurantium, *an orange.*) A considerable natural order of Exogens, with polypetalous flowers, confined to the warmer parts of Asia, or the nearest parts of Africa. They have dotted leaves filled with a fragrant oil, and succulent eatable fruit, covered by an aromatic skin. The orange, the shaddock, the lime, the lemon, are all species of the genus Citrus, and the best known in Europe. In the woods of India, there are some species that climb; and in the Himalaya exists a species, Limonia laureola, which would probably be a hardy evergreen if introduced into this country.

AURE'LIA. In Entomology, the name given to the nymph, or quiescent stage of transformation of an insect, on account of the metallic golden lustre which is reflected from the case of the nymphs of some diurnal Lepidoptera.

AURE'OLA. (Lat. *of the colour of gold.*) In Painting, the glory with which the ancient painters decorated the heads of the saints, martyrs, and confessors which they executed.

AU'REUS. A Roman gold coin worth a little more than sixteen shillings, according to the proportion given by Tacitus. But it varied, as appears from the different values assigned to it, from 1*l.* 4*s.* to 12*s.* Its weight was about 2½ oz. avoirdupois.

AU'RICLE. (Lat. auricula, *a little ear.*) Signifies, in Mammalogy, the external ears, which are said to be 'marginate' (*auriculæ marginatæ*) when bordered by a helix, or involute margin, — to be 'operculate' (*auriculæ operculatæ*) when provided with a largely developed tragus, which stands out like a subsidiary auricle, — to be 'concealed' (*auriculæ absconditæ*) when covered by the hair. In Ornithology, the circle of feathers surrounding the entry to the ear-passage are called auriculars. In Anatomy, the venous chambers of the heart are termed auricles.

AURI'CULAR CONFESSION. Confession of sins to a priest in private, distinguished from the public confession which was enjoined as a duty by the primitive church, but was early allowed to drop into disuse. It was on occasion of the scandal which the original practice produced, that Leo the Great, in the fifth century, first recommended private confession to a priest in certain cases. It was not till the fourth council of Lateran in 1215, that the doctrine of the necessity of this practice was formally established.

AURI'CULATE. (Lat. auricula, *a little ear.*) When the base of a leaf or similar part projects on each side of the axis in the form of a little round lobe.

AURO'RA. In the ancient Mythology, the goddess of the morning. She was the daughter of Titan and Terra, and was deified as the light which precedes the rising of the sun above our hemisphere. So lovely a being as she was represented to be could not fail to attract a host of admirers, and, accordingly, we find her engaged in numerous amours. But the object of her peculiar favour was Tithonus, son of Laomedon, king of Troy, for whom she cherished so permanent an attachment as to obtain for him the gift of immortality. She unfortunately neglected, however, to combine this privilege with an immunity from age, and in the course of time Tithonus became so decrepid that Aurora out of pity transformed him into a grasshopper, in which shape he still retained the garrulity of old age. She is supposed generally to rise from the couch of Tithonus: —

> Et jam prima novo spargebat lumine terras,
> Tithoni croceum linquens Aurora cubile. — VIRG.

Milton, in a passage teeming with poetic imagery and truth, thus opens the fifth book of Paradise Lost: —

> Now Morn, her rosy steps in th' eastern clime
> Advancing, sowed the earth with orient pearl;
> When Adam waked, so customed, for his sleep
> Was aëry, light, from pure digestion bred
> And temperate vapours bland, which th' only sound
> Of leaves and fuming rills, Aurora's fan,
> Lightly dispersed, and the shrill matin song
> Of birds on every bough.

AURO'RA BOREALIS. *Northern lights, Polar lights,* or *Streamers.* A luminous meteor, generally appearing in the northern part of the sky, and presenting a light somewhat resembling the dawn or break of day. The appearances which it exhibits and the forms it

assumes are so proverbially unsteady, that it is not possible to comprehend them under any general description. Most frequently the phenomenon appears to proceed from a sort of horizontal cloud or haze in the northern part of the sky, rising a few degrees above the horizon, and stretching from the north towards the east and west, so as to form an arc, which in some instances has been observed to extend upwards of 100°. The upper edge of the cloud is whitish and luminous, the lower part often dark or thick, and sometimes the clear sky may be seen between it and the horizon. From the upper part of the cloud streams of light shoot up in columnar forms, reaching sometimes only a few degrees, sometimes to the zenith, or even beyond it. Instances occur in which the whole hemisphere is covered with coruscations, but the brilliancy is greatest, and the light strongest, in the north near the main body of the meteor. The streamers have in general a tremulous motion, and, when close together, present the appearance of waves or sheets of light following each other in rapid succession. When several columns, issuing from different points, meet at the zenith, a small meteor is formed of greater brilliancy than the separate columns. The phenomenon sometimes continues a few hours, occasionally the whole night, and even for several nights in succession. It generally commences at most two or three hours after sunset, and very rarely in the morning or much after midnight. Auroras have been observed even before the evening twilight has disappeared. In the Shetland Islands, and other countries in high latitudes, the northern lights are the constant attendants of clear and frosty evenings in winter. They are most frequent in autumn.

In Captain Franklin's Narrative, the Auroras observed at Fort Enterprise, in North America, are described by Lieut. Wood as follows.—

"They rise with their centres sometimes in the magnetic meridian, and sometimes several degrees to the eastward or westward of it. The number visible seldom exceeds five, and is seldom limited to one. The altitude of the lowest, when first seen, is never less than 1°. As they advance towards the zenith, their centres (or the parts most elevated) preserve a course in the magnetic meridian, or near to it. But the eastern and western extremities vary their respective distances, and the arches become irregularly broad streams in the zenith, each dividing the sky into two unequal parts, but never crossing one another till they separate into parts. Those arches which were bright at the horizon increase their brilliancy in the zenith, and discover the beams of which they are composed, when the interior motion is rapid. This interior motion is a sudden glow, not proceeding from any visible concentration of matter, but bursting out in several parts of the arch, as if an ignition of combustible matter had taken place, and spreading itself rapidly towards each extremity. In this motion the beams are formed. They have two motions, one at right angles to their length, or sideways; and the other a tremulous and short vibration, in which they do not exactly preserve their parallelism to each other. The wreaths, when in the zenith, present the appearance of coronæ boreales. The second motion is always accompanied by colours; for it must be observed, that beams are often formed without any exhibition of colours, and I have not in that case perceived the vibratory motion."

The northern lights are sometimes seen tinged with the various prismatic colours, among which orange and green, but more frequently the different shades of red, predominate. Maupertuis describes one seen by him in Lapland, by which an extensive region of the heavens towards the south appeared tinged of so lively a red that the whole constellation of Orion seemed as if dyed in blood. Some observers of this meteor have affirmed that they have heard a rustling or crackling sound proceed from it. Doubts have, however, been entertained on this point, from the circumstance that no such noises were heard by Scoresby, Richardson, Franklin, Parry, and Hood, who observed the polar lights with great care, under the most favourable circumstances, in very high latitudes. But the testimony of other observers is of so positive a kind as to afford strong presumption that the phenomenon has, at least in particular instances, been accompanied by sounds.

From the accounts which have been collected of the polar lights, it would seem that the phenomenon was less frequent in former ages than it is now; but it must be kept in mind that meteoric observations have not always been so much attended to as at present. Aristotle describes the phenomenon with sufficient accuracy in his book of Meteors. Allusions are also made to it by Pliny, Cicero, and Seneca; so that it must have been often witnessed by the ancients, even in the climates of Greece and Italy. The descriptions of armies fighting in the air, and similar prodigies observed in the dark ages, doubtless owed their origin to the striking and fantastic appearances of the Northern Lights. It is remarkable, however, that no mention is made by any English writer of an Aurora Borealis having been observed in England from the year 1621 to 1707. Celsius says expressly that the oldest inhabitants of Upsala considered the phenomenon a great rarity before 1716. In the month of March in that year a very splendid one appeared in England, and by reason of its brilliancy attracted universal attention. It has been described by Dr Halley in the Phil. Trans., No. 347. Since then, the meteor has been much more common. A complete account of all the appearances of Auroras recorded previous to 1754 may be found in the work of Mairan, "Traité de l'Aurore Boreale."

The Aurora is not confined to the Northern hemisphere, similar appearances being observed in high southern latitudes. An Aurora was witnessed by Don Antonio d'Ulloa at Cape Horn in 1745; one appeared at Cuzco in 1711; and another is described by Mr. Forster (who accompanied Captain Cook in his last voyage round the world), which was seen by him in 1773, in latitude 58° south, and resembled, entirely, those of the northern hemisphere, excepting that the light exhibited no tints, but was of a clear white. Similar testimony is given by subsequent navigators.

There is great difficulty in determining the exact height of the Aurora Borealis above the earth, and accordingly the opinions given on this subject by different observers are widely discordant. Mairan supposed the mean height to be 175 French leagues. Bergman says 460 miles, and Euler several thousand miles. From the comparison of a number of observations of an Aurora that appeared in March 1826, made at different places in the north of England and south of Scotland, Dr. Dalton, in a paper presented to the Royal Society, computed its height to be about 100 miles. But a calculation of this sort, in which it is of necessity supposed that the meteor is seen in exactly the same place by the different observers, is subject to very great uncertainty. The observations of Dr. Richardson, Franklin, Hood, Parry, and others seem to prove that the place of the Aurora is far within the limits of the atmosphere, and scarcely above the region of the clouds, in fact, as the diurnal rotation of the earth produces no change in its apparent position, it must necessarily partake of that motion, and consequently be regarded as an atmospherical phenomenon.

No satisfactory theory has yet been given of the cause of the polar lights. Mairan ascribed the phenomenon to the sun's atmosphere, Euler, to particles of the earth's atmosphere driven beyond its limits by the impulse of solar light. Beccaria, Canton, Franklin, and others refer it to electricity, an agent to whose mysterious influence all the inexplicable phenomena of meteorology are conveniently ascribed. An absurd theory proposed by M. Libes (Dictionnaire de Physique) formerly met with considerable favour. He had observed that on passing an electric spark through a compound of oxygen and nitrogen, nitrous vapours of a reddish colour are produced. He therefore supposed that the higher regions of the atmosphere near the pole contain little or no hydrogen, and that consequently the discharges of electricity, which, by producing a combination of oxygen and hydrogen, form water in the lower strata, in the more elevated strata produce nitrous vapours, which constitute the polar lights. That some connexion subsists between the Aurora and magnetism, or rather electricity, which is now regarded as the primary cause of magnetism, is made certain by the fact that during the continuance of brilliant Auroras the magnetic needle is generally disturbed, sometimes violently agitated. The air at the same time is often observed to be highly charged with electric matter. An experiment contrived by M. Canton also seems to indicate an electric origin. If a glass tube be partially exhausted of air, hermetically sealed, and applied to the conductor of an electric machine, the whole tube is illuminated from end to end, and continues luminous for a considerable time after it has been removed from the conductor. If, after this, the tube be drawn through the hand, the light will be remarkably intense through its whole length; and if it is grasped in both hands, near the extremities, strong flashes of light will dart from one end to the other, and continue many hours without fresh excitation. The only conclusion which, in the present state of our knowledge, we are warranted in deducing, is, that the Aurora Borealis must be ascribed to the agency of electricity in the upper regions of the atmosphere: in what way the excitement is produced, it remains for future discoveries to make known.

The most systematic series of observations which we possess on the subject, was made by the Rev. James Farquharson, of Aberdeenshire, in 1829, with an apparatus furnished by the Royal Society, and of which an account is published in the Transactions for 1830.

AU'RUM MUSIVUM. An obsolete chemical name of the bisulphuret of tin.

AU'SPICES, AUSPICIA. *See* AUGURS.

AUSCULTA'TION. (Lat. auscultare, *to listen.*) A method of distinguishing healthy and diseased states of the body by the study of the sounds produced by the movements of the different organs, and which differ more

or less when the parts are diseased from those which belong to their healthy functions. *See* STETHOSCOPE.

AUTHE'NTIC, AUTHENTICATED. A word of Greek origin. In Diplomatics, ancient MSS. were formerly termed authentica when originals, in opposition to copies. In the modern acceptation of the word, it is only applied to instruments bearing marks of having been executed by the proper authority.

AUTHENTIC MELODIES. In Music, such as have their principal notes contained between the key note and its octave. This term is applied by the Italians to four of the church modes or tones in music which rise a fourth above their dominants, which are always fifths above their finals, that is, rise to complete their octaves, thus distinguished from plagal melodies, which fall a fourth below their finals.

AUTO-DA-FE, properly AUTO-DE-FE. (Span. *act of faith.*) A public solemnity held by the Court of the Inquisition in Spain and Portugal. It was a gaol-delivery, at which extracts from the trials of offenders, and the sentences pronounced by the judges, were read; after which, absolution was conferred on those who were penitent, and discharged: after which, those condemned to death (relajados) were transferred to the secular authority: and here the auto, properly so called, ended; the execution of the victims taking place immediately afterwards, under the authority of the civil judge, a secretary to the inquisition attending. The ceremonial of the autos, processions, horrible executions, &c., are amply described by many writers. See especially *Llorente's History of the Inquisition*, *A Relation of the Inquisition in Portugal*, published by Bishop Burnet; and *Olmo's Account of the Senual Auto-da-Fe at Madrid* in 1680, from which the account in the Penny Cyclopædia is abridged. Autos were of several sorts: the public general act (auto publico general), to which the above descriptions apply; the particular act, at which only the officials of the inquisition were present, autillo, or little act; and auto singular, the condemnation of a single individual. *See* INQUISITION.

AUTOBIO'GRAPHY. (This word is of Greek origin, and signifies literally *the life of a person written by himself.*) One of the most fascinating, and, if properly understood, one of the most instructive, species of composition. But none is more calculated to mislead the incautious reader, or to give more false impressions, both of men and events. These memoirs may be divided into two classes: those in which the chief object of the writer is to illustrate the history of his own mind and heart, and the manner in which these were swayed by the destinies of his life, and those in which his purpose is merely to give a sketch of the scenes and events which have occurred within his own experience, and of characters with which he has been brought in contact. Of the first class of writings, from the Confession of Saint Augustine down to the Confessions of Rousseau, and the many works which have since been produced in imitation of the latter, it may be said that the general defect is a morbid spirit of exaggeration. The mind dwells with intense recollection on its own pains and pleasures, errors and victories, it magnifies contrasts, paints every thing in extremes, and leaves out of the portrait all neutral and moderate features, because the recollection of ordinary feelings and actions passes away, while that of strong excitement is indelible. Of the more narrative class of memoirs, it is sufficient to say, that where the writer was himself a prominent actor in passing events, they are usually little better than apologies or self justifications, such as the famous Memoirs of the Cardinal de Retz, and, in our own times, the various fragments of autobiography which have been published from the hand of Napoleon.

AUTOCA'RPIOUS. (Gr. *αὐτὸς, himself*, and *καρπὸς, fruit.*) A name given to such fruit as consists of nothing but pericarp, without any additional organ, such as the calyx adhering to the outside.

AUTO'CHTHONS. (Gr. *αὐτὸς, self*, and *χθὼν, earth.*) The Greek term for the aboriginal inhabitants of a country, implying that they were sprung from the soil. The Athenians, whose territory had been held by the same race from time immemorial, chiefly on account of its sterility, which offered no incitement to foreign aggression, particularly laid claim to this title, in memorial of which they wore the emblematic grasshopper as part of their head-dress.

AU'TOCRAT. In Politics, a word derived from the Greek *αὐτοκράτως, sole* or *independent governor.* This title of Autocrator was given to Athenian generals invested with full command by the republic; also to envoys, in which case it corresponded in meaning with the barbarous Latin word plenipotentiaries. In modern political phraseology, the term autocrat, signifying a sovereign possessed of absolute power, is usually confined to the emperor of Russia.

AU'TOGRAPH. (Gr. *αὐτὸς, self*, and *γράφω, I write.*) The autograph of an individual is a piece of writing in his hand.

AUTO'MATON. (Gr. *αὐτος, self*, and *ματὴν, easily.*) A name applied to pieces of mechanism so constructed as to imitate the actions of living animals. The term Android (from the Gr. *ἀνὴρ, man*) is sometimes applied to such machines as resemble the figures and imitate the actions of mankind.

The extent to which these useless but ingenious contrivances has been sometimes carried is very surprising. Archytas of Tarentum, about 400 years before our era, is said to have made a wooden pigeon that could fly. Friar Bacon's speaking head is a well-known tradition. Albertus Magnus constructed an automaton to open his door when any one knocked; the celebrated Regiomontanus, a wooden eagle that flew forth from the city, saluted the emperor, and returned; and likewise an iron fly which flew out of his hand, and returned after flying about the room. These instances may perhaps have been exaggerated in the description; but there are some of recent date, and not less remarkable, respecting which the testimony is clear and strong. The following are a few of the best authenticated. — The flute-player of Vaucanson, described by D'Alembert in the *Encyclopedie Methodique*, was exhibited in Paris in 1738. It played on the flute exactly in the same manner as a living performer, and commanded three octaves, the fullest scale of the instrument. Its height was nearly six feet. In Hutton's *Mathematical Recreations*, a description is given of an automaton group, constructed by M. Camus for the amusement of Louis XIV., consisting of a coach and horses, with coachman and page, and lady inside, &c., by which the action of driving up, alighting, presenting a petition to the king, and setting off again, were mimicked with wonderful accuracy. In 1741, Vaucanson produced a flagelet-player, which played the flagelet with the left hand, while it beat a tambourine with the right. He also produced a duck, which dabbled in the water, swam, drank, and quacked like a real duck; raised and moved its wings, dressed its feathers with its bill, took barley from the hand and swallowed it, and even digested its food by means of materials for its solution placed in the stomach. (Montucla, *Histoire des Math.*, tome iii. p. 802.)

Automaton flute-players have likewise been exhibited in this country, of the size of real life, which performed ten or twelve duets. Maelzel, the inventor of the metronome, exhibited an automaton trumpeter at Vienna, of which a description is given in the *Journal des Modes* for 1809. It was a martial figure, in the uniform of a trumpeter of an Austrian dragoon regiment, which played not only the Austrian and French cavalry marches, and all the signals of those armies, but also a march and an allegro, by Weigl, accompanied by the whole orchestra, &c. (*Dictionary of Musicians*, London, 1827.)

Automata have also been constructed which wrote, drew likenesses, played on the pianoforte, &c. The celebrated chess-playing automaton is now considered as a solved mystery, it being supposed (and not denied) that a boy was concealed inside the figure. The machinery, however, which produced such motions must have been highly ingenious. See *Penny Cyclopædia*, *Hutton's Math. Dictionary*, *Encyc. Brit.*, article "Androides."

AU'TOPSY. (Gr. *αὐτος, self*, and *ὄψις, sight.*) Ocular evidence.

AU'TUMN. The third of the four seasons of the year. In a popular sense it denotes that period of the year in which the fruits of the earth are gathered in. Astronomically speaking, it is the time during which the sun is passing from the autumnal equinox to the winter solstice. Owing to the elliptic form of the earth's orbit, the seasons are not all of the same length; and owing to the precession of the equinoxes, their lengths vary a little from age to age. In the present century, the time which elapses between the sun's passage through the autumnal equinox and his reaching the winter solstice, or while he passes through the three signs of Libra, Scorpio, and Sagitarius, is 89 days 16 hours and 47 minutes. The autumn of the northern hemisphere corresponds to the spring of the southern.

AUTU'MNAL EQUINOX. The day on which the sun passes through the equator, going southward, or on which his declination changes from north to south. When the sun is in the equator, the day is equal in length to the night all over the world. *See* EQUINOX. The autumnal equinox falls generally on the 22d or 23d of September.

AUTU'MNAL POINT. One of the two points in which the ecliptic intersects the equator. It is the same as the first point of the sign Libra.

AVALA'NCHES. Masses of snow which collect upon the heights of mountains, and gradually sliding down their sides, acquire enormous bulk by fresh accumulations: when they ultimately reach the valleys below, they often cause great destruction.

AVA'ST. A sea term, signifying, enough; stop; cease. The etymology of this word is doubtful.

AVELLA'NA. (Abella or Avella, *a town of Campania, celebrated for its fine filberts.*) One of the names of the common hazel nut. The Spaniards in Chili apply

the name to the fruit of Quadria heterophylla, because of its resemblance to filberts.

AVENA SATIVA. (Diandria trigynia *Lin.*, Gramineæ *Juss.*) The Linnean name of the common oat. A gramineous plant characterised by a loose compound equal panicle and two-flowered spikelet. The oat is very extensively cultivated in most of the northern countries of Europe as a bread corn. It has long occupied the same place in Scotland that rye occupies in Germany and the potatoe in Ireland. In England it is chiefly used in the feeding of horses; but there, also, it is used to a considerable extent as food for man, particularly in the northern counties. There are three leading varieties of the common oat cultivated in England—black; grey, dun-brown, or red; and white. The first two varieties being comparatively hardy, may be raised on very inferior soils, and in situations unsuitable for the other. The black oat is now, however, hardly known in England; but it is still cultivated to a considerable extent in some parts of the Highlands of Scotland, and in the Western Islands. The dun or red oat is principally confined to the moors of Cheshire, Derbyshire, and Staffordshire. White oats are, speaking generally, less hardy than either of the other varieties, and require a better soil, but they are also earlier, heavier, and yield a greater quantity of meal. There are numberless, and some widely different, sub-varieties of the white oat. That which is called the potatoe oat has long enjoyed the highest reputation in this country, and is almost the only variety that is at present raised on good land in most parts of England and the south of Scotland. The produce of oats varies very greatly. When the ground is foul or exhausted, not more than 20 bushels an acre are obtained, but in a rich soil well managed and in favourable years, 60, 70, and sometimes even 80 bushels and upwards have been reaped, weighing from 35lbs. to 45lbs. a bushel, and yielding 7lbs. meal for 14lbs. oats, but the proportion of meal increases as the oats become heavier. The price of oats amounted at an average of the 7 years ending with the 31st December, 1850, to 14s. per. Imp. quarter.

A'VENUE. (Lat. ad, *to*, and venio, *I come*.) In Landscape Gardening, is a road leading from some other road, and forming the main approach to a house; but it is also applied to any broad walk or road of grass or gravel, bordered on each side by lines of trees. When the modern style of gardening began to take the place of the ancient style, the term avenue gave way to that of approach road, which subsequently became shortened into that of approach.

A'VERAGE, GENERAL. In Mercantile Law, whatever damage or loss is incurred by any part of the ship or cargo for the preservation of the rest. When such damage accrues, the several persons interested in the ship, freight, and cargo contribute their respective proportions to indemnify the owner of the part in question against the damage or necessary expense which has been incurred for the good of all. General average, therefore, cannot be unless the whole adventure has been in jeopardy. Every species of loss incurred on any part of the cargo in the course of the voyage, is somewhat loosely denominated average, or particular average. *See* INSURANCE.

AVE'RNUS. (Lat.) A lake of Italy 10 miles west of Naples, celebrated in antiquity as the entrance to the infernal regions. Strabo's description of this lake was well fitted to impress the minds of the "*profanum vulgus*" with superstitious awe. "Its steep and perilous banks were studded with mighty oaks that stretched their boughs over the watery abyss and excluded every ray of wholesome light, mephitic vapours ascending from the hot bowels of the earth floated along the surface of the lake in poisonous mist, while the dark and savage practices of the neighbouring people enhanced the horrors of the gloomy scene." A cave adjoining the lake is represented by Virgil as the habitation of the Cumæan sybil.—

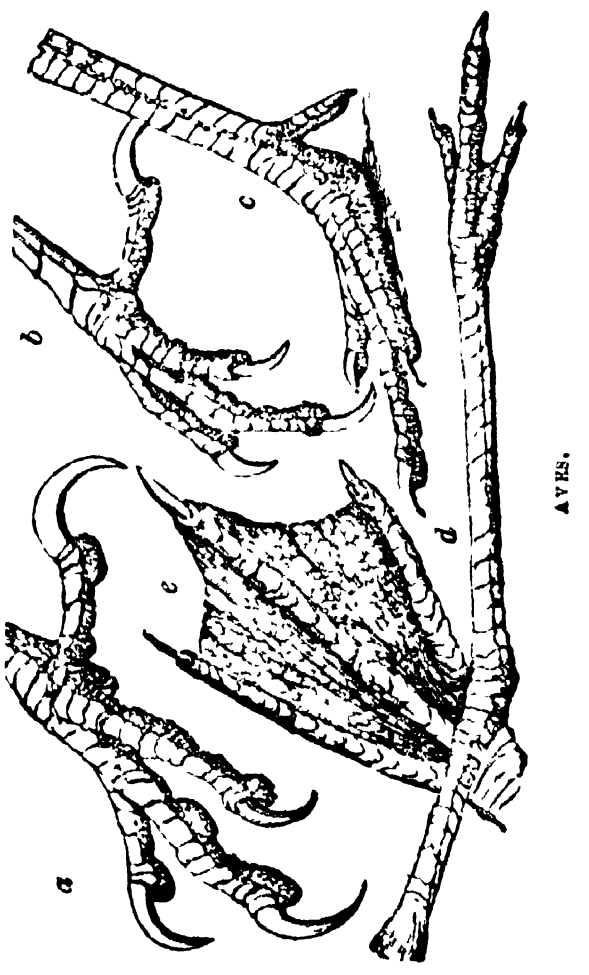
"Spelunca alta fuit, vastoque immanis hiatu,
Scrupea, tuta lacu nigro nemorumque tenebris,
Quam super haud ulla poterant impune volantes
Tendere iter pennis: talis sese halitus atris
Faucibus effundens supera ad convexa ferebat, [*out birds.*
Unde locum Grai dixerunt nomine Avernum." (Ἄορνος, *with-*

This place continued to be the favourite haunt of superstition till the time of Augustus, who violated its sanctity, and dispelled the impenetrable darkness in which it had hitherto been enshrouded, by cutting down the surrounding wood, and connecting it with the Lucrine lake, then an arm of the sea. This lake still exists under the name Lago d'Averno; it is about a mile and a half in circumference, and in many places 190 feet deep. Averni is a generic name for certain lakes or other places that infect the atmosphere with pestilential vapours, called also Mephites.

AVERRUNCA'TOR. (Lat. averruncо, *I dress* or *weed*.) In Arboriculture, is an instrument for cutting off the branches of trees, consisting of two blades fixed on the end of a rod; one of which has a moveable joint, which, by means of a line fixed to it, operates like a pair of scissors. In the improved forms of this instrument, the point on which the moving or cutting blade turns, instead of being confined to a circular opening, works in a longitudinal one; in consequence of which, instead of a crushing cut, like that produced by common hedge shears, a draw cut is formed, which leaves the section from which the branch or shoot has been amputated as clean as that produced by a pruning knife.

AVE'RSE. (Lat. aversus, *turned back*.) In Ornithology, when the posterior extremities are attached to the trunk near the anus, so that the body is supported erect, as in the penguin, they are termed "pedes aversi."

A'VES. (Lat. avis, *a bird*.) The name of a class of warm-blooded vertebrated animals, characterised by a double circulation and respiration, oviparous generation, a covering of feathers, and by their anterior extremities being organised for flight. The posterior extremities present five principal modifications, affording characters which distinguish five primary orders. In the first order the foot (*a* fig.) has three toes before and one behind, all armed with long, strong, crooked, and more or less retractile talons, adapted to seize and lacerate a living prey; this structure is associated with a strong, curved, sharp-edged and sharp-pointed beak, often armed with a lateral tooth, a very muscular body, and capability of rapid and long-continued flight. The order is termed Raptores or Accipitres. The second type of foot presents three toes before and one behind, and placed on the same level, slender, flexible, of moderate length, and provided with long, pointed, and slightly curved claws. The two external toes are united by a very short membrane. A foot so constructed (*b* fig.) is especially adapted for the delicate operations of nest building, and for grasping and perching among the slender branches of trees; hence




AVES.

the order so characterised has been termed Insessores, and, from including the smaller tribes of birds, Passeres. In the third type of foot (*c* fig.) the hinder toe is raised above the level of the three anterior ones, this deteriorates the power of perching; but the other toes are strong, straight, and terminated by robust obtuse claws, adapted for scratching up the soil, and for running along the ground, the legs are for this purpose very strong and muscular, and the order so characterised is termed Rasores, or Gallinæ. The modification by which birds are enabled to wade and seek their food in water along the margins of rivers, lakes, and estuaries, is gained simply by elongating the bones of the leg (tibia and metatarsus), which are covered with a naked scaly skin. The three anterior toes are sometimes very long and slender, as in the Parra jacana, by which the bird can support itself upon the broad floating leaves of aquatic plants; sometimes they are of moderate length. The hind toe is elevated, short, and sometimes wanting (*d* fig.). The order of birds characterised by this form of leg and foot is termed Grallatores, from the resemblance of the pos-

terior extremities to stilts. In the last form of foot (e tig ) the toes are united by intervening webs ; the legs are placed behind the centre of equilibrium ; the body is protected by a dense covering of feathers, and a thick down next the skin ; and the whole organisation is especially adapted for aquatic life. Hence the order is termed Natatores.

A'VIARY. (Lat. avis, *a bird* ) A place for keeping birds. In gardens, aviaries for singing birds are generally limited spaces attached to summer-houses or hot-houses, in which a temperature is kept up during winter suitable to the kind of bird or birds in the aviary. When an aviary contains only birds which live in climates analogous to that of Britain, it is formed in the open garden or pleasure ground, each kind of bird having a separate house ; or, instead of a house, a small enclosure covered with netting to prevent it from flying away. The most common exotic singing birds kept in aviaries are canaries ; and the most common exotic ornamental birds are turtle doves, and birds of the parrot tribe. The ornamental and curious birds which live in climates similar to that of Britain may be divided into two classes, the terrestrial and the aquatic. Of the former, the most ornamental are the gold and silver pheasants, and the common pigeon, including its numerous varieties ; and among the latter, the white and black swans, the Muscovy duck, &c. The most complete aviaries in the neighbourhood of London, exclusive of those in the Zoological Gardens, are those at Woburn Abbey, and at Knowsley.

AVI'CULA. A name applied to a genus of bivalves, in some of the species of which the shell, when expanded, offers a slight resemblance to a bird flying. The shell is equivalve, with a rectilinear hinge, notched at the anterior edge for the passage of a byssus : the anterior adductor muscle very small. To this genus belongs the celebrated pearl oyster, *Avicula margaritifera*

AVOI'DANCE. In Ecclesiastical Law, signifies the condition of a benefice when void of an incumbent, and is opposed to plenarty.

A'VOIRDUPO'IS, or AVERDUPOIS (Fr. avoir du pois, *to have weight ;* or perhaps from an old French verb, averer, *to verify* ) The name given to the common system of weights in England, by which goods in general, excepting the precious stones and medicines, are weighed. The standard weight of this country is the grain, which is ordered by act of parliament, 5 Geo. IV. c 74 , to be such that "a cubic inch of distilled water, weighed in air by brass weights, at the temperature of 62 degrees of Fahrenheit's thermometer, the barometer being at 30 inches, is equal to two hundred and fifty-two grains, and four hundred and fifty-eight thousandth parts of a grain. A pound avoirdupois contains 7000 grains. The pound is subdivided into 16 ounces, and the ounce into 16 drams The higher denominations are the quarter-hundred, the hundredweight, and the ton ; 28 pounds making a quarter, 112 pounds a hundredweight, and 20 hundredweights a ton. The pound avoirdupois is greater than the pound troy ; the latter containing only 5760 grains But the troy ounce, which contains the twelfth part of 5760, or 480 grains, is greater than the ounce avoirdupois, which contains the sixteenth part of 7000, or 437½ grains The avoirdupois ounce is considered as being the Roman uncia, which, according to Dr. Arbuthnot, contains $437\frac{1}{7}$ grains, though other authorities make it several grains less. The term averdupois occurs in some orders of Henry VIII , A D 1532 ; and Queen Elizabeth, in 1588, ordered a pound of this weight to be deposited in the Exchequer as a standard. *See* WEIGHTS.

AVOSE'T. A native wading bird, characterised by a long recurved bill. *See* RECURVIROSTRA.

AVOW'RY. In Law, the justification advanced in pleading by one who has taken a distress in his own right when sued in replevin. The avowry must contain a sufficient averment of right to have return. One who justifies as having taken in the right of another, is said to make cognizance. *See* REPLEVIN

AWA'RD. In Law, the judgment pronounced by one or more arbitrators, at the request of two parties who are at variance, for ending the matter in dispute without the decision of a public tribunal. The act of reference to an arbitrator is termed a submission.

By the stat. 9 & 10 W. 3. c. 15. it is provided that parties desirous to end a controversy may agree that their submission of the suit to arbitration shall be made a rule of any court of record ; and, after such rule the party disobeying the award is liable to be punished for a contempt of the court. But the award may be set aside for various causes, as corruption, informality, &c., by motion in court within one term after the award is made. When submission to arbitration has been made a rule of court, it is, by 3 & 4 W. 4. c. 42. s. 39., not revocable by either party without leave of the court. The arbitrators have a jurisdiction over the costs of the action as well as over the matter in controversy ; and, in case of a reference at nisi prius, they may refer the costs to be taxed by the proper officer of the court. An award must be made in writing, signed and sealed by the arbitrators.

AWN. (Derivation unknown.) A stiff, usually rough, bristle, proceeding from the end or some other part of a leaf, or of a leafy organ ; it is the beard of grasses, and often proceeds in those plants from the base of either glumes or paleæ. An awn is in reality either a vein separating from its parenchyma, or a rigid sharp-pointed barren branch of inflorescence. A part is said to be awned, or aristate, when furnished with this organ.

AW'NING. In Hort., a temporary covering for plants, generally consisting of cloth of some kind, stretched by means of ropes, cords, or wooden rods, so as to protect fruit trees against a wall, or flowers in a bed. An awning for a tulip bed is the most complete structure of this description, and is so constructed, by means of lines and pullies, that the sheeting can be either pulled up or let down over a bed of considerable length in two or three minutes.

A'XESTONE. A tough silico-magnesian stone, sometimes shaped into cutting instruments. *See* NEPHRITE.

AXI'FEROUS. (Lat. axis, *a centre*, and fero, *I bear.*) A name given to those plants which, like lichens, fungi, &c., consist exclusively of an axis, without any leaves or appendages of it.

A'XIL. (Lat. axilla, *the armpit* ) That part of a plant where a leaf fits on a branch, forming an angle with it : or where two branches diverge from each other.

A'XILE. (Axis ) Lying in the axis of any thing ; as an embryo, which lies in the axis of a seed, that is from the base to the end diametrically opposite.

AXI'LLA. (Lat. axilla, *the armpit.*) In Anatomy, the hollow below the base of the arm, at its insertion into the chest. An interesting region in topographical anatomy, containing important arteries, veins, nerves, glands, &c. which are termed 'axillary.'

AXI'LLARY. Growing in an axil. The term is modified by the prefixing different Latin prepositions : thus, infra axillary, signifies growing from below the axil ; extra axillary, on one side of it ; and supra axillary, from above it.

A'XINITE. (Gr. ἀξινη, *an axe* ) A mineral usually occurring in axeshaped crystals ; it is an alumino-silicate of lime and iron

A'XIOM. (Gr. ἀξιόω, *I demand.*) In Geometry, a proposition which it is necessary to take for granted, and which therefore admits of no demonstration. The following are among the propositions of this kind enunciated by Euclid : "Things that are equal to the same thing are equal to one another." "The whole is greater than its part." "If equals be added to equals, the sums will be equal." "If two figures when placed the one on the other entirely coincide, they are equal in every respect" The formal statement of such propositions is totally useless, or rather tends only to produce obscurity.

AXIOM In Philosophy, properly that which is demanded, or postulate It is used, in the mathematical and physical sciences, in the sense of a proposition, to which the assent of the student is demanded without proof, as a foundation for farther argument.

A'XIS. ( Lat. *an axletree.*) That part in plants about which particular organs are arranged Thus, the stem is an axis for the branches ; a branch, an axis for leaves ; the rachis, an axis for the divisions of inflorescence ; and the receptacle, gynobase, or columella, is the axis of the fruit. The term is also applied to the imaginary point round which parts of any sort are arranged.

AXIS. (Lat axis ) In Architecture, a real or imaginary straight line passing through any body on which it may revolve ; the axis of a column, for instance, is a straight line drawn down through its centre , the axis of the Ionic volute is a line drawn through the two eyes, front and rear.

AXIS. (Lat. axis.) In Mechanics, signifies in general the straight line, real or imaginary, about which a body turns. In this sense it is called the axis of rotation, of oscillation, &c., according to the motion of the body. In Geometry, the axis of a figure is a straight line about which the parts of the figure are symmetrically disposed. Thus, the axis of a cone is the line drawn from the vertex to the centre of the base ; and the axis of a cylinder, the line drawn through the centre of its two ends. In the ellipse and hyperbola, the transverse axis is the straight line drawn through the two foci ; and the conjugate axis, that drawn through the centre, perpendicular to the transverse. In general, by the axis of a curve line is meant that diameter which has its ordinates at right angles to it. We also speak of the axes of the co-ordinates of a curve, meaning the line on which the abscissa are taken.

AXIS IN PERITROCHIO. One of the five mechanical powers, consisting of a peritrochium or wheel fixed immovably to an axle, so that both turn together round the axis of motion. The power is applied at the cir-

cumference of the wheel, and the weight raised by a rope wound round the axle. The power gained is the same as that gained by a lever, the longer arm of which is equal to the radius of the wheel, and the shorter equal to the radius of the axle; so that if we suppose the radius of the wheel to be 30 inches, and the radius of the axle 6 inches, a weight of one pound suspended by a rope passing round the wheel would raise a weight of five pounds similarly suspended from the axle.

A'XOLOTL. (Axolotes, is, em, ibus.) A term derived from the Mexican language, and applied to a genus of Perennibranchiate Amphibians, found in the lake of Mexico.

AYE-AYE. The name of a singular nocturnal quadruped of Madagascar, indicative of its peculiar cry, it is placed by Cuvier in the Rodent order, under the generic name Cheiromys, from the hand-like structure of the hinder feet; a structure which approximates the genus to the monkey tribe, or Quadrumana, in which other naturalists have placed it.

AZA'LEA. (Gr. ἀζαλεος, *dry.*) A genus of beautiful plants inhabiting North America and China. They have trumpet-shaped or bell-shaped richly coloured flowers, which are in some species fragrant. The name has apparently been derived from the dry brittle nature of their branches. They differ from rhododendron chiefly in being deciduous.

A'ZIMUTH. (From the Arabic.) A term used in astronomy, to denote the arc of the horizon intercepted between the meridian and the vertical circle passing through a star or other celestial body; or the angle made at the zenith by the meridian and the vertical circle in which the body is situated. The azimuth may be counted either from the north or the south point of the horizon. modern astronomers seem to prefer beginning at the north point, and counting eastward and westward to 180°, but it is not one of those elements usually observed in astronomy, being easily deduced from the declination, which can be measured much more conveniently and accurately. In trigonometrical surveys, however, on the earth's surface, the accurate determination of the azimuth of an object is an operation of very great importance. It is usually made with the theodolite.

AZIMUTH CIRCLES, or VERTICAL CIRCLES, are great circles of the sphere passing through the zenith and intersecting the horizon at right angles.

AZIMUTH COMPASS. A compass used at sea for finding the horizontal distance of the sun or a star from the magnetic meridian.

AZIMUTH DIAL. A dial of which the stile or gnomon is perpendicular to the plane of the horizon. It is so called because the shadow marks the sun's azimuth.

A'ZOTANE. Sir H. Davy proposed to designate the compounds of chlorine by the termination *ane*, and consequently distinguished the compound of chlorine and azote, or chloride of azote, by the above name.

A'ZOTE. (Gr. ἀ, *not*, and ζωη, *life.*) A simple gaseous body, unfit for respiration; it forms four-fifths of our atmosphere. *See* NITROGEN.

A'ZURE. (Fr. azur.) In Painting, a sky-coloured blue. That made of lapis lazuli, called ultramarine, is of great value to the painter.

A'ZURE. (Fr. azur, *blue.*) In Heraldry, one of the colours, or tinctures, employed in blazonry. It is equivalent to sapphire among precious stones, and Jupiter among planets. In engraving it is represented by horizontal lines.

A'ZURITE. *See* LAZULITE.

A'ZYGOS. (Gr. ἀ, *without*, and ζυγον, *a yoke*, because it has no fellow.) In Anatomy, some single muscles, bones, veins, &c., are so called.

## B.

B. The second letter in all European alphabets, and in that of most other languages. B is one of those letters which the Eastern grammarians call labial, because the principal organs employed in its pronunciation are the lips. It has a close affinity to the other labial letters P and V; and by the Saxons it is confounded with the former, and with the latter by the modern Greeks, Spaniards, and Gascons. Hence the sarcastic remark, that in Gascony "vivere" and "bibere" are the same thing. Among the Greeks and Hebrews, B signified 2; among the Romans 300 (et B tricentum per se retinere detur); with a dash over it it denoted 3000, and with a mark of accent below it 200. The Romans also used it in inscriptions as an abbreviation for Baccho, Beleno, benemerenti, &c.; B B. for bene bene (i.e. Optime), B L. for lector benevole, B. F. (affixed to decrees or senatus consulta) for bonum factum. In modern times also it is used as an abbreviation for *before*, as B.C. (before Christ); and for *bachelor*, as, B.A., B.LL., B.D. (bachelor of arts, laws, of divinity). In music, B is the note on the second line in the bass, and the third in the treble; and in the chemical alphabet, according to Raymond Lully, it denotes mercury.

B MOLLE. (Lat. molle, *soft.*) In Music, one of the notes in the musical scale, usually called soft or flat ♭, to distinguish it from B quadro (square), ♮.

BAAL, or BEL. (Heb.) A god of the Phœnicians and Carthaginians, worshipped chiefly at Tyre. The term Baal, common to all the Eastern languages, signifies lord or master; and this circumstance has probably given rise to the various contradictory opinions that prevail respecting this divinity. Servius (in Am. I.), who is followed by Vossius (*Theol. Gent.* b. xi. c. 4.), observes that Baal in the Rune language had two significations, the one denoting Saturn, the other equivalent to the Greek Ζευς. Accordingly, if Baal and Ζευς be words of similar import in different languages, we may apply to the former what Varro relates of the latter, that the number of divinities worshipped under this title amounted to three hundred. This opinion, it would appear, was held also by Milton,

> With these came they who, from the bordering flood
> Of old Euphrates, to the brook that parts
> Egypt from Syrian ground, had general names
> Of *Baalim* and Astaroth, &c. &c.

It is probable that the Baal of the Phœnicians, and the Belus of the Babylonians, whose worship was so assiduously cultivated (*Herod.* 1.), were one and the same divinity. The priests of Baal amounted to 450, and, among other sacrifices offered upon his shrine, the bible mentions human victims. To the zealous devotion paid by the Eastern nations to this divinity, and the wide circulation of his worship, the adoption of his name in the appellation of distinguished individuals, such as Hannibal, Belshazar, Asdrubal, &c., bears ample testimony. (Selden, *de Dis Syris*, *Shuckford's Connection*, b. v.)

BA'BEL. (Heb.) A tower undertaken to be built shortly after the flood by the posterity of Noah, and remarkable for the frustration of the attempt by the confusion of languages. About 1700 years after the erection of the tower of Babel, Herodotus saw at Babylon a structure consisting of eight towers, raised one above another, and each 75 feet high (*Herod.* b. 1.), but whether this structure was the famed tower of Babel or not, it is impossible to ascertain. It is generally supposed, however, both by ancient and modern writers, that the city of Babylon afterwards occupied the site of Babel, and that the famous temple of Belus was built from its ruins. A great difference of tradition prevails as to the height of the tower of Babel. While the orientalists maintain that it was 10,000 fathoms, or about 12 miles high, St. Jerome asserts, on the authority of eyewitnesses who had examined the ruins of a tower at Babylon, that it was 4 miles high, and there are other statements still more extravagant. With regard to modern travellers who pretend to identify the ruins found on or near the site of ancient Babylon with the tower of Babel, their accounts are so discrepant and indefinite, as to render it doubtful if any of them have seen the genuine ruins of this celebrated tower. (*Rich's Travels*; *Buckingham's Travels in Mesopotamia*, *Rennel's Remarks on Herodotus.*)

BABIA'NA. A genus of Cape plants belonging to the natural order *Irideæ*. The name is derived from *Babiane*, a term given by the Dutch colonists to these plants in consequence of the avidity with which their roots are devoured by the baboons.

BA'BILLARD. The name of a small frugivorous Passerine bird, the *Curruca garrula*: also called the white-breasted or babbling fauvette, lesser white throat, and nettle-creeper.

BABOO'N. The monkeys, or quadrumana, which have projecting ridges above the eyes, long and truncate muzzles, cheek-pouches, ischiatic callosities, and generally short tails.

BABYROU'SSA. The name of an animal of the hog kind (*Sus babirussa* Cuv.) inhabiting the forests of the Indian Archipelago, with longer legs and longer tusks than the other species of hog: both the upper and the lower tusks curve upwards and backwards, and serve as a defence to the eyes while the animal forces its passage through the entangled jungles.

BA'CCA. A berry; usually a succulent fruit containing several seeds. In its most exact application it is a succulent fruit filled with pulp, in which the seeds lie loosely, as in the gooseberry.

BACCALAU'REAT. (Lat.) The first or lowest academical degree in the English and French universities. The mode by which this degree is attainable is different in different universities. Oxford and Cambridge have two ways of conferring it: 1. By examination, to which those students alone are admissible who have pursued the prescribed course of study for the space of three years. 2. By extraordinary diploma, granted to individuals wholly unconnected with the university. The former class are styled Baccalaurei Formati, the latter Baccalaurei Currentes. In France, the degree of

Baccalaureat (Baccalaureus Literarum) is conferred indiscriminately upon such natives or foreigners as, after a strict examination in the classics, mathematics, and philosophy, are declared to be qualified. In the German universities, the title "Doctor Philosophiæ," has long been substituted for Baccalaureus Artium or Literarum. In the middle ages, the term Baccalaureus was applied to an inferior order of knights, who came into the field unattended by vassals: from them it was transferred to the lowest class of ecclesiastics; and thence again, by Pope Gregory IX., to the universities. There are few words whose origin has been more controverted than that of Baccalaureat; and both the military and literary classes have asserted their claims to this honour with equal zeal and ingenuity. While the former maintain that it is either derived from the *baculus* or staff with which knights were usually invested, or from *bas chevalier* (an inferior kind of knight), the latter, perhaps with more plausibility, trace its origin to the custom which prevailed universally among the Greeks and Romans, and which was followed even in Italy till the thirteenth century, of crowning distinguished individuals with laurel: hence the recipient of this honour was styled Baccalaureus (quasi *baccis laureis* donatus)

BACCAULA'RIS. A fruit consisting of several distinct carpels, having a succulent coating, and seated upon a short receptacle.

BA'CCHA. In Entomology, a genus of the order *Diptera*, and family *Syrphidæ* The two basal joints of the abdomen are long and slender, with the remaining joints depressed and broad, they are bronze colour marked with yellow, and are found upon flowers in the neighbourhood of London.

BACCHANA'LIA (Lat.) Festivals in honour of Bacchus. In the mythology of the Greeks and Romans, allusion is constantly made to the conquest which Bacchus achieved over India, and it is generally supposed that these festivals were instituted to commemorate that event They consisted originally of a grand procession, in which the priests and priestesses of Bacchus bore the principal part, and were accompanied with games, spectacles, and theatrical representations But, at a later period of Grecian history, they assumed a totally different character. vice, debauchery, and licentiousness became their distinguishing characteristics, and Plato (*de Leg* l. i) asserts that during the celebration of these festivals he has seen the whole Athenian populace in a state of drunkenness At Athens, there were two principal Bacchanalia held annually. viz. Bacchanalia Dionysia or Majora, celebrated in the city about spring time; and Bacchanalia Lenæa or Minora (so called from ληνος, a wine press), celebrated in the country during autumn. On these occasions, the Bacchæ or priestesses of the god ran up and down the mountains in a frantic manner (*Stat Theb* vi 92), clad in doe-skins, with spears in their hands, bound at the points with ivy-leaves (thyrsi), and using the wildest gestures and exclamations (See the *Bacchæ of Euripides.*)

These festivals were introduced from Greece into Etruria, and thence by an easy transfer into Rome, where they were at first celebrated chiefly by young men on their laying aside the toga prætexta for the toga virilis But they soon after extended among all classes of the community, and in the course of time such were the enormities practised at their celebration, that the senate (A U C 566) came to the resolution of abolishing them entirely. Virgil, in the 7th book of the *Æneid*, gives a graphic description of these festivals, and says that the priestesses

——— tremulis ululatibus æthera complent,
Pampineasque gerunt, incinctæ pellibus, hastas.

And Juvenal uses the term Bacchanalia to express a dissolute and licentious life:

Qui Curios simulant, et Bacchanalia vivunt.

BA'CCHUS, or DIONY'SUS (Διόνυσος). The god of wine, and son of Jupiter and Semele daughter of Cadmus. His mother perished in the burning embraces of the god, whom she persuaded to visit her with his attribute of royalty, the thunderbolt, the embryo child was sewn up in Jupiter's thigh, whence in due time he was produced to light Mythology abounds with the adventures of Bacchus, the most noted of which are, the transformation of the Tyrrhenian pirates, who carried him off to sell for a slave, into dolphins; his revenge on the scoffing Pentheus, and his invasion and conquest of India. Bacchus was generally represented as a young man of effeminate appearance, with a garland of ivy binding his long hair, in his hand he bore a thyrsus or rod wreathed with ivy, and at his feet lay his attendant panther.

BACCI'FEROUS. Bearing berries.

BA'CHELOR. In the English Universities, the lowest degree in arts, law, divinity, medicine, and music. It is, like other university honours, of French origin. For the various derivations that have been suggested for this word, *see* BACCALAUREAT.

BACHELOR. In Heraldry. the lowest order of knighthood. *See* KNIGHT.

BACHELOR. In the Livery Companies of London, is one who is not yet admitted of the livery; also called *yeoman*.

BACILLA'REÆ. A small group of Algaceous plants, having an extremely simple structure, and in part the same as what are called Cymbelleæ. They stand on the limits of the animal and vegetable kingdoms, and are said to have a power of spontaneous motion.

BACI'LLUS A name given to the cotyledon of the hyacinth by Link.

BACK (from the Saxon bæc) OF A HIP. In Architecture, the upper faces of the hip-rafter between the two sides of a hipped roof, so formed to an angle as to be in the same plane with the rafters on each side of it.

BA'CKER. In Architecture, a term used to denote a narrow slate laid on the back of a broad square-headed slate where the slates begin to diminish in width.

BACKGA'MMON. A game played with dice by two persons on a table divided into two parts, upon which there are 12 black and as many white spaces, called *points* Each player has 15 men, black and white, to distinguish them. This game is of Welch origin, and is said to have been invented in the period preceding the Conquest (*Gloss. ad Leges Wallic*, cited by Henry, vol iv p 404) Backgammon can only be learned by observation and practice, and though much depends on chance, still great skill may be displayed in the course of the game. Hoyle, the received oracle in these matters, has evinced great accuracy in calculating the odds of backgammon, and has embodied a variety of rules and instructions respecting it, which must prove of great service to every player.

BACK THE OARS To row the oars backwards.

BACK AND FILL To keep a ship in the middle of the stream of a narrow river, by alternately advancing ahead from one shore and moving backwards from the opposite shore, while the stream carries her along, the wind being contrary to the direction of the stream.

BACK-STAFF. An instrument used before the invention of the quadrant and sextant, for taking the sun's altitude at sea In using it the observer turned his back to the sun, whence the instrument had its name It was invented by Captain John Davis, about the year 1590

BACK-STAYS. In Sea language, ropes stretched from the top-mast heads to the starboard and larboard sides of the ship, their use being to support the top-masts, and second the efforts of the shrouds. They are distinguished into *broad back-stays* and *after back-stays*, according as the strain on the mast is caused by a side-wind, or a wind further aft. *See* RIGGING.

BACO'NIAN PHILOSOPHY. The system propounded by Francis Bacon, Lord Verulam. It is usual to speak of this philosophy as if it were a new invention of its illustrious founder—as if the method of induction were a mode of philosophising unknown before his time, and in direct opposition to preceding systems, especially that of Aristotle. this opinion, we conceive, is entirely erroneous Aristotle has in many parts of his works clearly and satisfactorily explained the inductive method, and has himself, in his physical writings, given examples of its application. Lord Bacon's distinguishing merit consists, we believe, rather in the attention which, by his splendid eloquence, his wonderful power of illustration, his comprehensive views of the relations of the sciences to each other, and his unhesitating faith in the boundless progressiveness of human knowledge, he succeeded in awakening in the minds of his countrymen, than in any philosophical discoveries properly so called. No man, we admit, ever obtained a clearer insight into the nature and province of inductive research; no man, certainly, has laid down with such rigour and accuracy the rules for its successful prosecution. The various modes of experimenting and observing (in the language of Bacon *instances*) are classed under twenty-seven heads; and the circumstances under which each kind is applicable are stated with great fulness and accuracy. This is done in the second book of his *Novum Organon*; the former book of which consists of aphorisms on the errors of the human intellect generally, and in particular of preceding philosophical systems. These delusions, under the name of idols, he reduces to four classes: the *idols of the tribe*, or those common to human nature generally; the *idols of the cave*, or those generated by individual peculiarities; the *idols of the market-place*, produced by the incorrect use of words in ordinary discourse; and lastly, the superstitions introduced by false and visionary systems of philosophy, to which the name is assigned of the *idols of the theatre*. His own method he designates as holding an intermediate place between the merely empirical and the dogmatical schools. "While the one," says he, "like ants, content themselves with heaping up materials for immediate use, the latter, after the manner of spiders, spin webs out of their own

train: there is a middle and a better way — that of the bee, which derives, indeed, its material from the flowers of the garden and the field, but converts and digests it by its own proper virtue." These two books of the Organon form the second great division of his projected undertaking, the *Instauratio Magna*, or *Reform of Philosophy*, and relate to the interpretation of nature. The treatise *De Augmentis Scientiarum* (*of the Advancement of Learning*) constitutes the first division: the third was to consist of a history of the phenomena of the universe: the fourth (*Scala Intellectus*) was to comprise an account of the processes of the human understanding, with examples from various sciences. in the fifth was to be contained the introduction to the *Philosophia Secunda*, or *Active Philosophy*, which, as the combined result of history and experience, was itself to constitute the sixth and last division. (See his *Distributio Operis*; *Bacon's Works*, 4to ed. vol. iv.) Of this mighty work Bacon only completed the first two divisions. For a comprehensive and impartial estimate of the value of the Baconian philosophy, the German scholar may consult Tennemann's *Geschichte der Philosophie*, 10ter band. (Leipzig, 1817.) An account of the *Novum Organon* has been published by the Society for the Diffusion of Useful Knowledge.

BA'CTRIS. (Gr. βακτρον, *a cane*.) A genus of palms with spiny slender stems and pinnated leaves. Their fruit is succulent, and manufactured into a kind of wine; walking sticks are made from their stems.

BA'CULITES. (Lat. baculum, *a stick*.) A genus of fossil Tetrabranchiate Cephalopods, the chambered shells of which are quite straight, but differ from those of the Orthoceratites in having sinuous or undulated partitions with lobated margins: in this structure they are allied to the Ammonites.

BA'DGER. *See* MELES.

BA'DISTER. In Entomology, a genus of the order *Coleoptera*, and family *Harpalidæ*. This genus, with some others, forms a leading group among the carnivorous beetles.

BA'GGAGE. (Fr. bagage.) In the art Military, the clothes, tents, provisions, and other necessaries belonging to an army. In regard to the conveyance of baggage, a striking contrast is presented between the military systems of ancient and modern times. The Roman soldiers had four kinds of baggage (bucellatum or corn, utensils of various kinds, valli, and arms), termed by a felicity of language *impedimenta*; and were so heavily laden, that they were called by way of jest *muli Mariani*, and *ærumnæ*. In modern times, the plan is every where adopted of ridding the soldier of all unnecessary encumbrance, and with this view waggons attached to each battalion are employed for the conveyance of baggage, and guarded and regulated by a body of men set apart for the purpose, called the waggon-train.

BA'GGING. A mode of reaping corn or pulse with a hook, in which the operator effects his object by striking the straw or haulm, instead of drawing the hook through it. In other words, it is separating the straw or haulm from the root by chopping, instead of by a drawing cut.

BA'GPIPE. This instrument appears to be of ancient origin, and is very similar to the *tibia utricularis* described by Blanchinus. A representation of it is given by Luscinius in his *Musurgia* (1536), whence it appears that at that time the instrument was similar to that now in use. It consists of a leather bag, inflated through a valved tube by the mouth (or a bellows), and of three pipes, two of which give only one note each, and are called the great and little drone, and the third, somewhat like the oboe, has eight finger holes. The bagpipe is peculiar to the Scotch and Irish nations.

BA'IKALITE. A manganesian epidote from lake Baikal in Siberia.

BAIL (Old Fr. bailler, *to deliver or give up*), in Law, is the liberation of one in custody, whether for a civil or criminal cause, on surety taken for his appearance at a day and place certain. In civil cases bail is chiefly of two kinds, called bail to the sheriff, and bail to the action; or, in other terms, bail above and bail below. When a person is arrested upon an affidavit made that he is indebted to the plaintiff in the sum of 20*l*. or upwards (which, since the recent act for abolishing arrest on mesne process, 1 & 2 Vict. c. 10, must also state that there is probable cause for believing that the defendant is about to quit England), he has then, in order to regain his liberty (unless previously discharged under a judge's order), to execute a bail bond to the sheriff, the condition of which is, that he will at the proper period put in special bail, which amounts to an appearance in court: at this period he either puts in special bail, who are two or more persons, who undertake generally that if the defendant lose the verdict he shall pay the amount awarded against him, or render himself to custody, or that they will do it for him. In default of special bail he returns again into custody.

Bail, in cases of felony, is taken by two magistrates in cases where the evidence against the prisoner is not such as to raise a strong presumption of his guilt.

BAIL-BOND. in Law, is a deed executed by a party arrested on mesne process (*see* ARREST), and two persons as his sureties. to the sheriff, conditioned for his causing special bail to be put in. If the defendant neglect afterwards to put in and perfect such bail, the plaintiff usually takes from the sheriff an assignment of the bail-bond, and proceeds against the defendant in a separate action.

BA'LIE. The name by which the municipal magistrates of Scotland are designated. The term is synonymous with *alderman*.

BA'LIFF. (Fr. bailler, *to deliver*.) The term properly meant "lessee." whence it came to signify more generally deputy, and was applied to those officers who, by virtue of deputation either from the sheriff or the lords of private jurisdictions, exercised within the hundred, or whatever might be the limits of their bailiwick, certain judicial and ministerial functions. With the disuse of private and local jurisdictions, the meaning of the term became commonly restricted to such persons as were deputed by the sheriff to assist him in the merely ministerial portion of his duty, such as the summoning of juries and the execution of writs. These persons are called bound bailiffs, so termed from the obligation which they enter into to indemnify the sheriff against the consequences of his responsibility for their right conduct in the discharge of their duty.

BA'LIWICK. (Fr. bailli, *bailiff*, and Lat. vicus, *a village*.) The dwelling-place or district of the bailiff: it also signifies a county, which is the bailiwick of the sheriff, or the particular franchise of some lord who has exclusive authority within its limits.

BA'LMENT. In Law, is a delivery of goods in trust, upon a contract, express or implied, that the trust shall be faithfully executed on the part of the bailee, or receiver. Transactions with carriers, agents, pawnbrokers, and many other mercantile proceedings, are affected by the law of bailment.

BA'IRAM. A Mohammedan feast, instituted in imitation of the Easter of the Christian church, and following the Rhamaan, or month of fasting, which answers to our Lent. In consequence of the Turkish mode of reckoning by lunar months, these periods fall successively in all the seasons during a cycle of thirty-three years. Sixty days after the greater follows a second feast, termed the lesser Bairam.

BA'JADERES. The name given by the Portuguese to the Indian dancing girls, who, under various appellations, are partly employed as priestesses, and instructed in music and dancing by the priests of Schiva and Vishnu, partly employed by the grandees of India to cheer their festivities and minister to their pleasure. Their dress consists of costly materials, tastefully arranged; and their movements are most dexterous, graceful, and fascinating, at least if we may judge of them from the Bajaderes that appeared at the *Adelphi* theatre in the autumn of 1838. In their whole character and proceedings, they bear a strong resemblance to the *Hierodouloi* of the Greeks.

BA'JULUS. (Lat. *portare*.) In the Lower Greek Empire, the title of the officer to whom the education of a prince was entrusted. The name was borrowed by various Western courts which imitated the etiquette of Constantinople, and from it some have erroneously derived that of bailiff.

BALÆ'NA. (Gr. φαλαινα.) The Greenland whale; also a generic term, comprehending the species which agree with it in the presence of whalebone in the mouth and the absence of a dorsal fin.

It is to this genus that the whale, properly so called, or large-whalebone whale (*Balæna mysticetus*, Linn.), belongs, the value of which to man is such that large fleets are annually fitted out expressly for its capture. The food of the whale consists exclusively of small molluscous and crustaceous animals, but chiefly the *Clio borealis*, and as these animals abound only in the Arctic seas, the whale cannot be expected to frequent for any length of time those latitudes in which its food is scarce or altogether wanting. The long-continued annual destruction of the *Balæna mysticetus* has greatly diminished the numbers of this species, and driven those which remain to the extremest limits of the northern seas where their means of subsistence can be obtained.

The large-whalebone whale is often spoken of as the largest of existing animals, but it is inferior in magnitude to the small-whalebone whale (*Balænoptera*). The latter attains the length of from 90 to 100 feet; while the ordinary dimensions of the true whale are from 50 to 60 feet in length, and from 30 to 40 feet in circumference. The terms "large-whalebone" and "small-whalebone" relate to the size of the whalebone or baleen-plates, which is always much greater in the genus *Balæna* than in *Balænoptera*; and it is this structure, combined with the greater amount of blubber in the true whale, which renders it an object of so much more value to the whale catchers; while its less courageous habits, and less violent

efforts to escape when wounded, make it a more sure and safe prey than the small-whalebone whale.

The true whale is chiefly remarkable for the immense size of its head, which constitutes a full third of the entire length of the animal: it is narrow above, but very broad below, where it consists chiefly of a large under lip, which rises five or six feet, and completely overlaps the upper lip. The eyes are very small, and are placed just above the angles of the mouth. The external opening of the ears is scarcely perceptible. The pectoral fins are of moderate size, and placed about two feet behind the angles of the mouth. The neck is indicated by some furrowing of the skin, but there is no constriction. The greatest circumference of the cylindrical body is a little behind the pectoral fins. The tail-fin consists of two lobes of great breadth, measuring 20 feet across from tip to tip in a full-grown specimen; and wielded by muscles of enormous power. It is this part which constitutes the sole organ of offence and defence in the whale, for it has no teeth wherewith to bite or lacerate; a single blow of the tail well delivered suffices to cut a stout boat in two, or to send it whirling through the air.

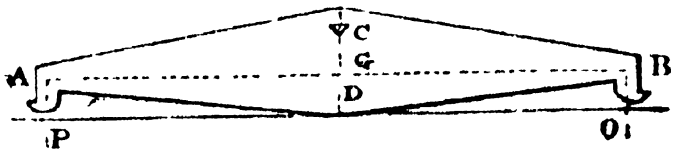
The plates of whalebone are the substitutes for teeth in the mouth, they have a similar mode of development from a pulp and external membrane, and differ only in form, and in a less proportion of earthy matter in their composition. They are arranged vertically and transversely, in two series, consisting each of 300 plates, descending from the palatal surface of the upper jaw, and terminating in a fringe of coarse hairs on their oblique lower and inner margins, which hairs are in contact with the upper surface of the bulky tongue when the mouth is closed. It is thus that the mechanism of the sieve is realised on an enormous scale, and while the water gulped at each successive mouthful is drained off through the interstices of the baleen plates, the molluscous and crustaceous animals are retained, bruised into a pulp between the muscular tongue and coarse fibres of the whalebone, and swallowed. The area of the gullet corresponds with the minute character of the food, and is relatively smaller in the whale than in any other animal. The stomach is divided into four cavities, the intestinal canal is long and narrow, and provided with a short and simple cœcum.

The whale has usually but one young at a birth, and brings forth in the early spring. The period of gestation is unknown, that of suckling lasts a year. In this stage of their growth the young are called *short heads* by the whale-fishers; at two years old, and until they are able to find their appropriate food in due abundance, they are termed *stunts*; when they begin to get fat, and until they have arrived at their full size, they are called *skull-fish*.

The interesting details of the profitable but perilous occupation of whale-fishing, will be found most amply and correctly given in *Scoresby's Account of the Arctic Regions*, from which many popular narratives have been compiled. The baleen and the blubber are the only parts of the animal of any commercial value, and the quantity of both yielded by these enormous animals is of course considerable. The length of the largest whalebone plates in a whale of 60 feet is as much as 12 feet, and the blubber of such a one will yield more than 20 tuns of pure oil, the proportion of oil to the blubber from which it is extracted being as three to four. The blubber is principally accumulated at the circumference of the body, beneath, and in the extended tissue of the skin, an immense quantity of fine oil is also lodged in the cellular substance of the tongue, and the coarse and porous bones, particularly the lower jaw, are full of pure oil.

BA'LANCE (Lat. balanx or bilanx, probably a corruption of valentia, denoting, in low Latin, *price* or *value*) A machine for weighing substances. The process of weighing may be performed in various ways, and accordingly there are several kinds of balances, as the common balance or scales, the bent lever balance, the spring balance, the steel-yard, the hydrostatic balance, &c. (for which see the respective words). The term is also applied to any apparatus employed for comparing the intensities of very small forces, as the electric balance, the balance of torsion, &c. We shall here confine our remarks to the philosophical balance, the instrument used when great accuracy is necessary; for instance in assaying, and in the more delicate investigations of physics and chemistry.

Neglecting the mere circumstance of construction, and the particular methods of suspension, the balance may be represented thus.—




A and B are the points from which the scales are suspended at the extremities of the beam, C the point of support, G the centre of gravity of the beam, D the point in which the straight line C G intersects the straight li joining A and B.

The properties required in a good balance are *sensibility* and *stability*. The balance must be sensible; that is to say, when it is properly poised a very small additio of weight to either scale should disturb the equilibrium and cause the beam to turn; and it must be stable, that is to say, when the equilibrium has been disturbed it should quickly return, and oscillate about the position of rest. These two properties are in some degree opposed to each other; in order to attain them both, as far as possible, it is necessary to attend to certain mechanical principles, as well as to the physical circumstances of construction. Let us suppose

W = the weight of the beam.
L = the load, *i. e.* the weight of the scales and whatever is in them when the beam is poised.
P = the preponderating weight, or that which causes the beam to turn.

Suppose now the beam to be poised, or that the scales being loaded the position of the line A B is perfectly horizontal. The sensibility will evidently be measured by the angular space through which the beam turns when a small weight P is added to either scale, but the force which acts in turning the beam is proportional to P × D I, that is, proportional to the weight multiplied into the length of the lever at the extremity of which it acts; therefore for a given weight P, the sensibility of the balance, all other circumstances being equal, is proportional to the length of the beam. Let us next consider the force which tends to restore the beam when the equilibrium is disturbed. This is made up of two parts, the first of which is proportional to W × C G, that is to say, proportional to the weight of the beam (which may be regarded as concentrated at the centre of gravity) multiplied into the length of the lever on which it acts, and the second proportional to L × C D, that is, to the load also multiplied into its length of lever. The whole restoring force is therefore proportional to W × C G + L × C D. Now this force is precisely that which the preponderating weight P has to overcome in turning the scale; consequently any circumstance which tends to increase it, increases the stability and diminishes the sensibility of the balance, and anything which tends to diminish it, diminishes the stability and increases the sensibility. By bending the arms of the balance, or altering the points of suspension of the scales, the points G and D may acquire different positions relatively to C. Supposing G to be above C in the vertical line joining those points, the term W × C G would become negative, and the restoring force proportional to L × C D — W × C G. In this case, if the load L, or the distance C D, were diminished till L × C D became less than W × C G, the balance would be useless, because if moved ever so little from the position of rest, it would have no tendency whatever to return. The best construction is to make C D = 0, that is, to place the three points of action A, C, D in the same straight line, and to construct the beam so that G, the centre of gravity, shall fall a little below the line A B. The sensibility is then independent of the load, and is simply in the inverse proportion of W × C G, so that by diminishing the weight of the beam, or the distance C G, it may be increased to any required degree. It is supposed that the two arms are precisely of the same length, or that C is placed exactly in the middle between A and B, and also that they are perfectly inflexible.

The conditions now determined from theory must be the guide of the artist in the construction of a good balance. It is of importance that the beam be as light as possible consistent with inflexibility, for not only the inertia, but also the friction, is increased in proportion to the weight, and the sensibility consequently diminished. In order to give lightness and strength at the same time the beam should be formed of two hollow cones of brass joined together at the broad ends. A cylinder of steel passing through the middle of the beam at right angles forms the axis; and its extremities, ground into sharp edges on the lower side, serve as the points of support. The two edges must be accurately in the same straight line, and turn on smooth planes of agate or polished steel carefully levelled. The scales should likewise be suspended from the extremities of the beam on knife edges, crossing each other at right angles; those in the beam being sharp upwards, and those to which the scales are attached sharp downwards. A needle, or tongue, is usually attached to the beam, pointing directly upwards or downwards when the beam is horizontal, for the purpose of indicating the deviations of the beam from the horizontal position on a graduated scale. It is better, however, to bring the arms to terminate in sharp points, and to place a scale behind each; in this way the slightest flexure of the beam will be rendered evident, if the zeros of the scales are placed exactly in the same level. The scale is indispensably necessary, because the balance, if very sensible, would require a long time to come to rest; but it is known to be poised, when the excursions of the needle

on both sides of the zero of the scale are equal. In order to preserve the knife edges, the beam, when not in use, is supported on rests. Props should also be placed under the scales while loading or unloading the balance. The whole apparatus must be placed under a glass case, to protect it from the disturbing influence of currents of air.

The sensibility of a balance constructed with due care, according to the principles now explained, may be carried to an almost inconceivable extent. There is one in the possession of the Royal Society, made by Ramsden, which weighs ten pounds, and is said to turn with the ten-millionth part of that load, or the thousandth part of a grain Nevertheless, whatever skill may be employed in the construction, it is plain that the conditions necessary to mathematical accuracy can never be entirely fulfilled. It is impossible to make the two arms of the beam exactly similar, or exactly equal in length. Absolute precision is unattainable in practice This difficulty, however, may be overcome by the following simple method, imagined by Borda, by which accurate results are obtained independently of extreme precision in the construction of the balance. it is only necessary that it be very sensible Let P, the substance to be weighed, be placed in the scale A; instead of placing known weights in the scale B, put into it some other substance, for instance bits of iron, chips of wire, or sand, added in minute quantities till the substance P is exactly counterpoised, or the beam becomes exactly horizontal. This being done, let the substance P be gently removed out of the scale A, and let known weights, as grains, be put into it till the substance in the scale B is again exactly counterpoised It is now of no consequence whether the balance was accurate or not or whether the body P was exactly equal in weight to the substance against which it was weighed in B The weight of P must be precisely equal to that of the gram weights; because, under exactly the same circumstances, they both formed a counterpoise to the substance placed in B.

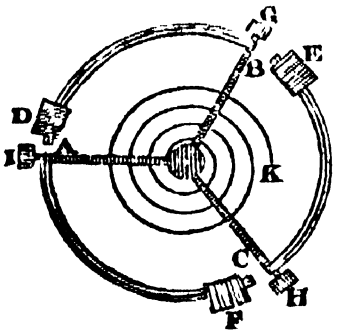
*Chinese Balance* This is formed of a slender tapering rod of wood or ivory, about a foot in length A silk thread passed through a hole perforated nearer one of its extremities than the other serves as the point of suspension. The balance has thus two unequal arms. From the extremity of the shorter a small scale is suspended to hold the substance to be weighed. A sliding weight passes along the other arm, on which divisions are marked; and when the counterpoise is made, the distance of the standard weight from the fulcrum indicates the weight of the substance. In order to procure a greater range, the rod has generally four holes or points of support, at different distances from the extremity, and a corresponding set of divisions is marked on each of its four sides The principle of this machine is exactly the same as that of the common steel-yard.

The *Danish Balance*, much used in the north of Europe for weighing coarse commodities, is usually formed of an iron bar or a batten of hard wood, having a lump of lead at one of its extremities The goods are fixed in a hook in the other end; and the whole is suspended through a loop of cord, which is passed backwards and forwards under the rod till equilibrium is obtained The weight of the goods is then to the weight of the lead reciprocally as their respective distances from the loop

*Roman Balance* or *Steel-yard* *See* STEEL-YARD.

BALANCE OF TORSION A machine invented by Coulomb for measuring the intensities of electric or magnetic forces, by establishing an equilibrium between them and the force of torsion Conceive a metallic wire suspended from a fixed point, and kept stretched by a small weight attached to its lower extremity, where also a horizontal needle or lever is fixed, which may be rendered magnetic, or is so formed that one of its ends is a conductor and the other a non-conductor of electricity The force is brought to act on the extremity of this lever, and its intensity measured by the length of the arc which the needle passes over, reckoning from the point of repose; or an index may be attached to the upper extremity of the wire, and the force measured by the number of degrees through which it can be turned before the lower lever begins to move. The force of torsion is inversely proportional to the length of the wire, and directly to the fourth power of its diameter The wire must therefore be of considerable length (two or three feet for example), and very fine; and also formed of a substance possessing considerable elasticity. Brass wire is greatly preferable to iron wire; and in some instruments recently constructed a fine thread of spun glass has been used instead of metallic wires, at the suggestion of the late Professor Ritchie. One of the most interesting applications of the torsion-balance was that made by Cavendish to measure the force of attraction of two leaden spheres, in his celebrated experiment to determine the mean density of the earth.

BALANCE OF A WATCH. That part of the machine which, by its inertia, regulates the beat and produces equable motion. It is formed of a wheel or ring, having its weight principally accumulated in its rim, and connected with a spiral spring in such a manner that when drawn aside from the position of rest it acquires an oscillatory motion from the alternate contraction and expansion of the spring. The balance answers the same purpose in watch-work as the pendulum in clock-work, and is affected in a similar manner by variations of temperature. Supposing the length of the spring to remain constant, the time of vibration is directly proportional to the distance of the centre of gyration from the axis of the balance; consequently the duration of the vibration is increased by heat and diminished by cold. To remedy this inconvenience, various contrivances have been applied; but that which is most generally adopted is the *expansion* or *compensation balance*, the principle of which depends on the unequal expansion of two different metals. It may be constructed in the following manner.




The rim consists of two laminæ, the inner of steel and the outer of brass, united by fusion. After being turned to the proper size, the rim is cut in three places, A, B, and C; and one end of each of the parts thus formed being fixed to an arm of the balance, the other is left at liberty to move inwards or outwards according to the variation of the relative lengths of the two metals. D, E, F, are three equal weights placed near the free ends, and which, when adjusted at the proper distances, are fixed in their places by means of screws Three heavy-headed screws, G, H I, enter the arms of the balance, and serve to adjust its centre of gravity to the axis of vibration, and also to increase or diminish the mean rate of motion. Now, suppose the balance to receive an increase of temperature, this will tend to lengthen the arms, and consequently to throw the centre of gyration further from the axis, and thereby diminish the velocity of vibration, but as the brass expands more than the steel, the compound bars will at the same time be bent inwards, and the weights D, E, F, thereby thrown nearer the axis, by which the velocity will be increased. When the temperature is diminished, the arms are shortened, but the weights are now thrown to a greater distance from the axis by reason of the contraction of the brass being greater than that of the steel, and the consequent tendency of the compound bars to assume a less curved form. It is easy to see that in so small a machine the adjustment of the parts to procure exact compensation is a matter of great nicety, and requiring much practical skill; in fact, it is only possible to obtain a tolerable compensation by repeated trials

BALANCE OF POWER In Politics, a system by which the relative power of different states and alliances is so maintained as to render any extensive derangement improbable. The idea of preserving a balance of power naturally suggested itself to statesmen in ancient Greece, where so large a number of independent states with opposing interests existed on a narrow territory In Europe, this portion of political science scarcely began to be understood until the 16th century, since which time the maintenance of the balance of power has formed a favourite object, often pursued with unreasonable avidity, by those who have controlled the international relations of Christendom. The great aim of neutral politicians during that century was to establish a balance between the power of France and that of Austria. the latter united with that of Spain became so enormously powerful in the course of it, as to render this an object of great anxiety But after the commencement of the 17th century the power of France steadily increased, and that of Austria abated Cromwell's alliance with Mazarin was the last result of the ancient system for the alliances of Charles II. with the French were for personal objects, and strongly reprobated by all European statesmen. At the end of the 17th century France stood predominant, and it became the great problem of European politics to find a counterpoise to her influence This was the aim of William III, Eugene, and the Whigs under Queen Anne; and the treaty of Utrecht in 1713, which acknowledged the French supremacy in Spain, was condemned as one of the severest blows ever struck at the balance of power Nevertheless, this fear, like so many others sedulously cherished by speculative statesmen, proved to have little foundation The power of France remained stationary during the 18th century, while the forces of Austria, Russia, and Britain increased; and Prussia suddenly arose from a third-rate power to the lowest, but still a respectable position, among the first-rates. During that century the alliances were formed with no very steady regard to the balance of power: France and Austria were usually, but not uniformly, rivals In 1756, the three great Continental powers were united in a fruitless endeavour to crush the new state of Prussia. The wars of the French revolution entirely altered the ancient

equilibrium; it was restored by the congress of Vienna and the long maintenance of that peaceful arrangement certainly speaks in favour of the sagacity of its constructors. At present Europe is divided, singularly enough, by two different sets of causes, producing different alliances, or rather tendencies towards alliances, for mutual defence. In the first place, the opposition between constitutional and monarchical principles has ranged on the one side Austria, Russia, and Prussia, with their dependent states: on the other, Britain and France, with the Western kingdoms which have liberal governments. In the next place, the interests engendered by purely external politics cause a different line of division. The enormous increase of Russian dominion, particularly towards the East, renders Austria necessarily distrustful, and hostile to the former power. England may be expected to take part with Austria in this quarrel; Prussia, which has no direct interest in the result, will be ranged by position against Austria; while the ultimate decision of France is doubtful, and will in effect determine the struggle.

BALANCE OF TRADE. The term commonly used to express the difference between the value of the exports from and the imports into a country. The balance is said to be favourable when the value of the exports exceeds that of the imports, and unfavourable when the value of the imports exceeds that of the exports. The notion was once entertained that the prosperity of a country depended on exporting merchandise exceeding the value of the imports, and receiving the balance in the precious metals. This mode of estimating the balance of trade, which is evidently founded on the assumption that the precious metals constitute the wealth of a country, has been proved to be completely fallacious, and it is now conceded on all hands that gold and silver are nothing but commodities, whose exportation or importation it is necessary neither to prevent nor encourage by any legislative enactments. But the theory of the balance of trade is not erroneous merely from the false notions which its advocates entertain with respect to money: it proceeds on radically mistaken views as to the nature of commerce. For it will be found that so far from an excess of exports over imports being any criterion of an advantageous commerce, it is directly the reverse, since, were the value of the exports greater than the value of the imports, merchants would lose on every transaction with foreigners and the trade with them would be speedily abandoned. For a succinct statement and exposition of the errors which were till lately generally prevalent upon this subject, see *M'Culloch's Commercial Dictionary*.

BALANI'NUS. In Entomology, the name applied by Germar to the subgenus of Weevils (*Curculionidæ*), of which the nut grub, or nut weevil (*Balaninus nucum*), is a species. In the perfect insect the rostrum or borer is nearly as long as the body. It is by means of this instrument that the parent weevil drills a hole through the soft shell of the immature filbert, into which she introduces a single brown egg: this is hatched in about a fortnight, and by the time the nut is full ripe, the grub has attained its full growth. It then proceeds to bore a hole with its jaws through the shell, and emerges from the cavity of the nut: falling to the ground it burrows into the earth, and there remains all winter, changing to the proper state, and appearing as a perfect insect in August.

BA'LANITES. (Lat. balanus, *an acorn.*) In Botany, acorn-barnacles, an order of Cirripeds, comprehending those which have a shelly tube, adherent by its base to foreign substances, and closed at its apex by four opercular valves.

BA'LANOPHORA'CEÆ. (Balanophora, one of the genera.) A natural order of Rhiganths, consisting of fungus-like parasitical plants, with small monœcious flowers collected in dense heads arranged upon fleshy receptacles.

BA'LAS RUBY. A term applied by lapidaries to the bright red varieties of the spinel. It is much less rare and valuable than the oriental ruby or red sapphire.

BALAU'STA. In Botany, a kind of fruit having a leathery rind, a superior calyx, and several cells irregularly disposed, with many drupaceous seeds in each.

BALCO'NY. (It. balcone.) In Architecture, a projection from the external wall of a house, borne by columns or consoles, usually placed before windows or openings.

BALDACHI'NO. (It. *a canopy.*) In Architecture, a species of canopy over the principal altar of a church, similar to that at St. Peter's, where it is supported by columns; or that of St. Sulpice at Paris, where it is suspended from above. It succeeded to the ancient *ciborium* (see that word), which was a cupola supported on four columns, still to be seen at many of the altars in Rome. Bernini may claim the merit of its invention. The height of that which he erected in St. Peter's is 128 feet, and being entirely of bronze weighs near 90 tons. It was built by order of the Pope Barberini, from the robbery of the Pantheon, and occasioned the bitter sarcasm — "Quod non fecerunt Barbari, fecerunt Barberini."

BA'LDRIC. (Lat. baldrellus.) A girdle used by the warriors of feudal times: it was often splendidly ornamented, and marked the rank of the wearer.

BA'LDWIN'S PHOSPHORUS. Fused nitrate of lime.

BALEA'RIC CRANE. *See* CRANE.

BALL. (Ger. bal.) Literally, any thing made in a globular form. The word signifies also at once a well-known *divertissement*, and a game familiar in Europe and America. Ball-playing was a favourite amusement among the ancients, who practised it in various ways. They had their hand-ball (*pila trigonalis*), their foot-ball (*follis* or *pila paganica*, because played by the rustics), and some other kinds not used by the moderns. In country villas a tennis-court or place for playing ball, called *Sphæristerium*, was usually to be found. (*Suc. Vesp.* 20.) In the middle ages, there were houses appropriated to ball-playing; and in Italy there are still public places where this amusement is practised, and great dexterity displayed.

BALL. In the art Military, any round substance of lead or iron which is discharged from fire-arms, as musket-balls, cannon-balls, &c. The word Ball, with a prefix more or less expressive of its purposes, such as fire-balls, chain-balls, denotes a composition of various ingredients generally combustible. (For an account of these terms see separate articles.) Cannon-balls are made of iron, balls for pistols and fusees of lead. The experiment has been tried of employing iron balls for pistols or fusees, but without effect; as their lightness prevents their flying straight, and they are apt to furrow the barrel of the pistol. As was remarked, cannon-balls are made of cast-iron, and are distinguished as follows by their respective diameters: — Thus the diameter of a

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 42 lbs. ball is | 6·684 | inches. | | 9 lbs. ball is | 4·000 | inches. | |
| 32 | — | 6·105 | — | 6 | — | 3·493 | — |
| 24 | — | 5·547 | — | 3 | — | 2·775 | — |
| 18 | — | 5·040 | — | 2 | — | 2·123 | — |
| 12 | — | 4·403 | — | 1 | — | 1·923 | — |

BA'LLAD. (It. ballata.) A species of narrative poetry, founded either in history or fiction, displaying the condition and the habits, the tastes and the sentiments of the various nations among whom it is found. The term Ballad is very indefinite in its general acceptation, including classes of composition wholly different in themselves, of which the only common characteristics are brevity of metre and simplicity and perspicuity of style. The opinion entertained by Schlegel of the ballad is, that it is not an original species of composition; but that in general poems of this kind are to be found in the greatest abundance among nations possessed of truly poetical feelings, whose legends, traditions, and national recollections have been interrupted or mutilated by long-protracted civil wars, or by some universal revolution or concussion of opinions. While some authors have assigned the ballad an Arabian, some an Armorican origin, and others have claimed this distinction for the Normans and Provencials, Percy, Bouterweck, and Schlegel concur in awarding to it a Teutonic descent. Be this as it may, it is agreed that the Scandinavian nations delighted, at a very early period, to celebrate in song the deeds of heroes, lovers, knights, &c., and the three great divisions of the Teutonic poetry of the middle ages — the stories of the Nibelungen, those of Charlemagne (particularly such as relate to his wars against the Arabians, and the battle of Roncesvalles), and the tales of King Arthur's Round Table, consist of what at a later period were called Ballads. Though the name Ballad is Italian, the spirit of chivalry had at no period during the middle ages much dominion or influence on the other side of the Alps; a circumstance that sufficiently accounts for the meagreness of the Italians in this department of poetry. The French too never attained any perfection in the ballad, as their fabliaux, legends, &c. soon degenerated into long prose romances, which were quite destitute of the spirit of the ancient minstrelsy. The Spaniards, on the other hand, are rich in ballads of a highly chivalrous character. These, however, along with some Portuguese ballads which bear infallible marks of a Spanish origin, may with more propriety be classified under the denomination of Romantic Poetry. Among the Welsh, even so early as the 12th century, music and this species of poetry seem to have attained a high degree of excellence; but the ruthless hand of Edward I., by his massacre of the bards, doomed both the one and the other to an almost total annihilation. Of all the species of ballad, the Irish, among other characteristics, appears to be pre-eminently fitted for adaptation to music, as is witnessed in the universally admired "National Melodies" of Thomas Moore. While a variety of opinion exists among the learned as to the nature and requisites of the ballad, it is admitted on all sides that England and Scotland have the honour of possessing a collection of ballads superior to that of every other nation. There

can be little doubt, too, that the home of the English and Scottish ballads is either in the north of England, or in the southern counties of Scotland, as there the influence of the Normans was less than in the south of England. To the proximity, also, of those parts of the two countries where the ballad was cultivated, and the small circle which they embraced, may be attributed the difficulty that exists in assigning to each country its proper share in the collection of ballads. In modern times, if we except the romantic legends of Sir Walter Scott (which can scarcely be denominated ballads), the Germans have cultivated this species of poetry with more success than any other nation; and they can boast of Schiller, Goethe, and Bürger, not only as distinguished poets, but as the revivers of that chivalrous spirit which formed the grand characteristic of our British ancestors. For remarks on the Ballad, vide *Aikin's History of Song; Warton's History of English Poetry; Burney's History of Music; Motherwell's Ancient and Modern Minstrelsy; Jones's Musical and Poetical Relics; Schlegel's Kritische Schriften* (article on Burger), *Sir W. Scott's Minstrelsy of the Scottish Border, Bishop of Dromore's Collection of Ballads.* (See also the *Conversations Lexicon.*)

BA'LLAST. Is a mass of weighty material placed in the bottom of a ship or vessel to give her *stiffness;* that is, to increase her tendency to return to the upright position when inclined or *heeled over* by the force of the wind or other cause. Ballast consists of shingle (the coarse gravel of the sea-beach), stones, &c. In the royal navy iron ballast alone is used, in pigs of nearly 3 cwt. This has the advantage of lying in small compass, but in consequence of its great weight it tends to give excess of stability, which renders the vessel *uneasy* from the suddenness of the motion. this defect is remedied by *unging* up the ballast, whereby its centre of gravity is raised. For the like reason in stowing the ballast it is tapered to a point at the fore and after extremities Iron ballast, from its greater cleanliness, is more healthy for the crew than that of other materials. When a ship has no other loading she is said to be *in ballast*

The quantity of ballast and the mode of its stowage differ greatly in different vessels, and the connection between the motions of a ship and her stowage has not yet been analysed sufficiently to lead to the discovery of direct rules on those important points.

BALL-COCK. A hollow sphere or ball of metal attached to the end of a lever, which turns the stop-cock of a cistern pipe, and regulates the supply of water As the surface of the water rises in the cistern, the ball is raised by its buoyancy, and as the water descends, it falls by its own weight. The cock is thus closed when the water rises to a certain height, and the supply stopped, but when a part of the water is drawn off from the cistern, the cock is again opened, and the water admitted through the pipe

BA'LLET (Fr) A theatrical representation of actions, characters, sentiments, and passions, by means of mimic movements and dances, accompanied by music. The ballet is divided into three kinds — historical, mythological, and allegorical, and consists of three parts — the entry, the figure, and the retreat (*Noverre, Lettres sur les Arts imitateurs, et sur la Danse en particulier.*) The chief merit of the ballet lies in an ingenious adaptation of music to the sentiments of the mind as developed in the dance, and in its power of representing every variety of human conduct and emotion, whether of a tragic or comic nature It has been frequently asserted that the ballet was unknown to the ancients, and yet if the meaning of the Greek term "ορχησις" and the Latin term "saltatio" be duly considered, it will be found that both these nations indulged in pantommic dances of a peculiar kind; the province of gesticulation or of dancing being assigned to one individual, that of declamation to another (*Xen Symposion* and *Anab.* vi. 1. 3. 8) Hence it would appear that the only merit which the moderns can claim in reference to the ballet consists in the substitution of music and scenery in the room of declamation. Be this as it may, it is generally admitted that the ingenious artist Baltazarini, director of music to the princess Catherine de Medicis, first gave its present form to the regular ballet, and that after a considerable interval it was introduced into France. There it continues to flourish like an indigenous plant while Germany and England, whither it was afterwards transplanted, have not been remiss in fostering its growth. There are many persons who object to the incorporation of the ballet with the opera; and in a few instances, such as the opera "Der Gott und die Bajadere," their objections may be well founded. But assuredly every one who has witnessed the dances introduced into the opera of Guillaume Tell, Robert le Diable, La Tentation de St. Antoine, and Masaniello, must be of opinion that in these cases at least the adoption of the ballet produces a peculiar charm, by enhancing the power and beauty of the representation. (*Conversations Lexicon*).

BALLI'STA. (Gr βαλλω, *I throw.*) A military engine, used by the ancients for throwing stones, darts, arrows, &c. The Ballista is sometimes confounded with the Catapulta; but a distinction is made by Polybius, who confines the latter term to those machines which throw stones only. The particular mechanism of these engines is not very certainly understood. According to Vitruvius they were made in divers manners; but the principle of all seems to have been the same. A beam of wood or plate of metal is firmly fixed at one extremity; the other extremity is drawn back by means of cords and pulleys; and being suddenly set free, the elastic force with which it seeks to recover itself propels the missiles.

BALLISTIC PENDULUM An instrument, invented by Benjamin Robins, for measuring the force or velocity of cannon and musket balls. To one extremity of an iron bar is fixed a heavy cubical block of wood, lined at the back with iron. A transverse bar of iron at the other extremity of the first bar serves as an axis of suspension, in which the pendulum swings freely backwards and forwards. The instrument being thus fitted, if the weight of the pendulum be known, and likewise the respective distances of its centres of gravity and oscillation from the axis of suspension, it is easy to determine the quantity of motion that will be communicated to the pendulum by the percussion of a body of a given weight moving with a given velocity and striking it at a given point Conversely, if the pendulum, when at rest, is struck by a body of a known weight, and the vibration which the pendulum makes after the blow is known, the velocity of the striking body may thence be determined. In order to measure the extent of the vibration, a riband is attached to the lower end of the pendulum, passing loosely through an orifice in a horizontal bar in the frame-work, when the pendulum is raised it draws the riband along with it, and the quantity which thus passes through the orifice measures the chord of the arc of vibration. (See *Robins's New Principles of Gunnery*, vol 1. Prop. 8.; also *Hutton's Mathematical Tracts*, vol II)

BA'LLIUM In the Architecture of the Middle Ages, the open space or court of a fortified castle. This has acquired in English the appellation Bailey; thus St Peter's in the Bailey at Oxford, and the Old Bailey in London, are so named from their connection with the sites of castles.

BALLOO'N. (Fr ballon, *a little ball*) The name of a machine, which, consisting of an envelope containing a gas specifically lighter than common air, rises into the atmosphere with a greater or less degree of ascensional force A car, supported by a net-work which extends over the balloon, supports the aeronaut; and a valve, usually placed at the top, to which a string is attached reaching to the car, gives him the power of allowing the gas to escape, and of descending at pleasure.

During the dark ages, and for some time after the revival of science, numerous projects were entertained for [illegible] the air; but it is only in very recent times, since 1783, that any of them have been realized The first idea was to employ some mechanical contrivance resembling the wings of birds, but Borelli demonstrated that all attempts on the part of man to fly must necessarily fail from the utter disproportion of his muscular power to the force that would be necessary to give impulsion to wings of such enormous magnitude as would be required to sustain his weight in the air.

The principle by which a balloon rises in the atmosphere is exactly the same as that which causes the ascent of a cork from the bottom of a vessel filled with water. The weight of the volume of air which it displaces must exceed the weight of the balloon and all that it carries with it That bodies must rise and remain suspended in a fluid denser than themselves was proved by Archimedes, but the weight of the air is a modern discovery; and it was only in the latter half of the last century that chemistry detected the nature and differences of specific gravities of aeriform fluids Mr. Cavendish, in 1766, by some ingenious experiments, recorded in the *Philosophical Transactions*, vol lvi, found hydrogen gas to be from about seven to eleven times lighter than common air, according to the mode of its preparation. In its pure state state it is found to be nearly sixteen times lighter than common air This substance, therefore, if prevented from diffusing itself, and allowed to obey the force by which it is impelled upwards, will continue to mount till it arrives at a stratum of the atmosphere sixteen times more attenuated than at the surface of the earth. Accordingly, no sooner had Cavendish announced his discovery, than it occurred to Dr. Black that a very thin bag filled with hydrogen gas would mount to the ceiling of a room Through some imperfection, the experiment when he attempted to execute it failed; and it was several years later before an envelope was thought of sufficiently light, and at the same time impermeable to the gas. Cavallo made a series of experiments on this subject in 1782, but did not succeed in raising any thing heavier than a soap bubble. The expense attending the preparation of the gas probably prevented the experiment from being made on a great scale.

Knowing the specific gravities of atmospheric air, of

the gas with which the balloon is to be filled, and the weight of the envelope in which it is confined, it is not difficult to compute the size the balloon must have in order to rise from the ground, or carry a given weight to a given height in the atmosphere. A globe of air, one foot in diameter, at the level of the sea and under the ordinary pressure, weighs about 1-25th of a pound avoirdupois. An equal globe of hydrogen gas, obtained in the usual way by dissolving iron filings in dilute sulphuric acid, may be assumed (making every allowance for imperfect preparation) to be about six times lighter than atmospheric air; consequently 5-6ths of its whole buoyant force will act in impelling it upwards, that is to say, the force with which a sphere of such gas, one foot in diameter, will tend to rise in the atmosphere will be $\frac{5}{6} \times \frac{1}{25} = \frac{1}{30}$ of a pound avoirdupois. The ascensional forces of different spheres will be proportional to their magnitudes, that is, to the cubes of their diameters; therefore a sphere 12 feet in diameter would rise with a force of 57 pounds, and one of 24 feet in diameter with a force of $8 \times 57 = 456$ pounds. But these determinations must be diminished by the weight of the envelope. The best material for the purpose at present known is thin silk varnished with elastic gum, or Indian rubber. The quantity of this material required to cover a globe one foot in diameter weighs about 1-20th of a pound. Now, for a globe of a greater size, the quantity required will increase with the square of the diameter, hence the covering of a balloon 12 feet in diameter must weigh about 7 pounds, and of one 24 feet in diameter 28 pounds. It follows, therefore, that a balloon of 12 feet diameter will only raise from the ground a weight of 50 pounds, and one of 24 feet 428 pounds. Computing in the same manner, it is found that a balloon 60 feet in diameter would raise a weight equal to about 6950 pounds, and that one of a foot and a half would barely float, the weight of the bag being just equal to that of the imprisoned gas

The height to which a balloon will rise is determined from the law according to which the density of the atmospheric strata diminishes as the distance from the earth is increased. The buoyant force diminishes with the density, and when it is reduced to a quantity only equal to the weight of the balloon and its appendages, no further ascension can take place. Another circumstance also confines the possible elevation within moderate limits. As the pressure of the external air is diminished, the expansive force of the confined gas becomes greater, and would ultimately overcome the resistance of any material of which a balloon can be made. A balloon quite filled at the surface of the earth would inevitably be torn to shreds at the height of a few miles in the atmosphere, unless a portion of the gas were allowed to escape. For this purpose the balloon is furnished with a safety valve, which can be opened and shut at pleasure; but to prevent unnecessary waste of gas, it ought to be made of such a size that it requires only to be partly filled. A balloon half filled at the surface of the earth would become fully distended at the height of $3\frac{1}{4}$ miles.

We have hitherto spoken only of balloons filled with hydrogen gas, but it is evident that any other substance specifically lighter than air would answer the purpose, in fact, the first balloons by which any one was raised into the atmosphere were not filled with hydrogen, but simply with rarefied air, the rarefaction being produced by kindling a fire under them; and as they thus became filled with smoke, they were called smoke-balloons. The ascensional force, however, which can be gained in this way is not great, besides, the aeronaut must carry a portion of fuel with him for the purpose of maintaining the fire, which adds sensibly to the weight to be raised. The keeping up of the fire is also attended with inconvenience, and even danger.

Two brothers, Stephen and Joseph Montgolfier, proprietors of a paper manufactory at Annonay in France, have the honour of first preparing and sending up a balloon into the air. After one or two previous trials, they announced a public ascent on the 5th of June, 1783. The balloon was prepared of linen cloth, a fire was kindled under it, and fed with bundles of chopped straw. This substance was used with a view to produce a large quantity of smoke. It would seem that they attributed the elevation of the balloon to the ascending power of the smoke, instead of its true cause, the rarefaction of the heated air. In the space of five minutes it was completely distended; and on being let slip, ascended rapidly. It reached an elevation of about a mile, remained suspended ten minutes, and fell at the distance of a mile and half from the place of its ascension. When the news of this experiment was carried to Paris, the surprise was general, and the virtuosi began immediately to consider how it could be repeated. It was determined to apply hydrogen gas on this occasion; and Charles, a celebrated lecturer on natural philosophy, undertook the superintendence of the process. On the 26th of August, 1783, the preparations were complete, and the balloon was transported with much ceremony to the Champ-de-Mars. On the following day at five o'clock in the afternoon, the report of a cannon announced to the assembled multitude that every thing was ready. "The globe, liberated from its stays, shot upwards, to the great surprise of the spectators, with such rapidity that in two minutes it reached the height of 3000 feet. It traversed successively several clouds, by which it was repeatedly obscured. The violent rain which began to fall at the moment of its ascent did not retard its rapid progress, and the experiment was attended with complete success. The satisfaction was so great that even elegantly dressed ladies remained with their eyes intently fixed on the balloon, regardless of the rain, which fell on them in torrents." (*Libes, Dictionnaire de Physique.*) This balloon remained in the atmosphere only three quarters of an hour; it fell at a distance of about fifteen miles, when it was discovered that a rent was made in its upper part, through which the gas had escaped.

The first adventurers who had courage to undertake an aerial ascent in a balloon, were Pilatre de Rosier, a young naturalist, and the Marquis d'Arlandes. On the 21st of November, 1783, they took their seats in the basket of a smoke balloon, and after rising to an elevation of upwards of 3000 feet, descended safely to the earth. The next ascent was made by MM. Charles and Robert in a balloon filled with hydrogen gas, on the 1st of January, 1784. After a flight of a hour and a half they alighted on the meadow of Nesle, about twenty-five miles from Paris, without the slightest accident. As the balloon still retained a considerable buoyant force, M. Charles resolved on another ascent alone. It rose to the height of near two miles in about ten minutes; and the aeronaut had the satisfaction of seeing the sun, which had set when he left the earth, again rise above the horizon. After remaining about thirty-five minutes in the air he descended safely, at a distance of about nine miles from the spot from which he had risen.

So many aerial voyages executed with safety encouraged other attempts, and no accident occurred till the accomplished Pilatre de Rosier, with his companion Romain, was killed in an attempt to cross the channel from France to England. On the 13th of June, 1785, they ascended from Boulogne. Under the principal balloon, which was of hydrogen gas, they had suspended, for the purpose of increasing or diminishing the ascensional power at pleasure, a smoke balloon, which occasioned the disastrous issue. Scarcely a quarter of an hour had elapsed when the whole apparatus, at the height of 3000 feet, was perceived to be on fire, and the unfortunate voyagers were precipitated to the ground. This calamitous occurrence, however, did not damp the courage of aeronauts. It was obvious that it had been occasioned by the want of proper precautions, accordingly ascents continued to be multiplied, and have since become so common as to be an ordinary spectacle in the principal cities of Europe.

When balloons first began to be constructed, it was expected that they would be found applicable to many important purposes. These expectations have been disappointed, chiefly because it has been found impossible to guide or controul their course. The only power the aeronaut possesses over his balloon is to regulate its elevation within certain limits. In one or two instances they have been successfully used for military reconnoissance. The victory which Jourdan obtained over the Austrians at Fleurus, in 1794, was ascribed to the knowledge obtained of the enemy's movements by means of a balloon. A very interesting ascent was made by Biot and Gay Lussac, in August 1804, and by Gay Lussac alone in September of the same year, with a view to make meteorological observations in the upper strata of the atmosphere. In the first voyage, the two philosophers, at an elevation of between 9,500 and 13,000 English feet, found the oscillations of the magnetic needle to be performed in the same time as at the surface of the earth. At 12,800 feet the thermometer, which stood at $63\frac{1}{2}^{\circ}$ at the observatory, had sunk to 51° of Fahrenheit, being only a decrease of 1° for every thousand feet. The hygroscope indicated increased dryness in proportion to the elevation. In the second ascent, performed by Gay Lussac alone, the variation of the compass, at the height of 12,680, was found to remain unaltered. At 14,480 feet a key held in the magnetic direction attracted with one end and repelled with the other the north pole of the magnetic needle. The same was the case at 20,150 feet. At 18,000 feet the thermometer fell to the freezing point, and at 22,912 feet to 14·9° of Fahr. Two flasks, which had been previously emptied of air, were opened and filled at an elevation exceeding 21,400 feet; and the air brought down from this region was found, on being analysed, to contain exactly the same proportions of the constituent elements as at the surface. The utmost elevation which he reached was 23,040 feet, or four miles and a quarter above the level of the sea, considerably higher than the loftiest peak of the Andes.

Excepting in these two memorable ascents of Gay Lussac, nothing has been gained to science by the use of balloons. The numerous other ascents undertaken, both

before and since, have as yet served no other purpose than to gratify idle curiosity; and from the total failure of every scheme that has been proposed for directing their course through the air, there is little reason to anticipate any great advantages from them to society. Nevertheless, the comparative cheapness and facility with which they can be filled by coal gas, now so generally used for the purposes of illumination, have been the cause of directing public attention again to the subject; and the recent feat of Mr. Green and two companions, who, with a stupendous balloon, and carrying with them a ton of ballast, ascended from Vauxhall in November, 1836, crossed the channel, and, after a journey through the air of eighteen hours, safely descended in the territory of Nassau in Germany, has contributed to revive the hope of rendering balloons available to useful purposes.

BA'LLOT. (Fr. balloter.) A method of voting at elections, &c., by means of little balls, of different colours, which are put secretly into a box, and, when counted, disclose the result of the poll without any discovery by whom each vote is given. The origin of the ballot may be traced to the commonwealth of the Israelites, from whom it was adopted by many eastern nations. The voting by tablets began with the earliest operations of Athenian polity. But it appears questionable whether the ballot at Athens, at least in its more flourishing times, was anything more than a contrivance for securing rapidity of voting, and whether any secrecy was necessarily attached to it. It was employed in judicial proceedings. Secret voting was, however, the custom of the Areopagus. (*Scott on the Athenian Ballot*, 1838.) The same system of voting prevailed also at Carthage, and to this is attributed by Ray (*Travels through Germany and Italy*) the cause of the grandeur and independence of its inhabitants. In the early periods of Roman history, the people voted by word of mouth, and, in creating magistrates, used the form — Consules, &c. nomino, or dico, and it was not until the 614th year of the city, that the Gabinian law, Lex Tabellaria, was introduced, for the purpose, as Cicero alleges (*De Off.* 2. 7.), of giving to the people more liberty in voting. But from this period, as is universally admitted, the practice of bribery made rapid strides, and notwithstanding every effort was made for its suppression by the enactment of penal statutes, such was its success that Julius Cæsar saw himself necessitated to deprive the people not only of the ballot, but even of the right of suffrage. Since the Christian era, the ballot was adopted at a very early period by the Maltese and the Venetians. At Venice, in particular, a most curious and intricate system of voting, consisting of ten previous ballotations, prevailed for the space of 1300 years, and Postellus (in a work *De Magistratibus Atheniensium*) pointedly asserts that the abolition of this practice, combined with other causes, led to the decline of this once flourishing state. Another author, after an elaborate dissertation on the advantages of the Venetian ballot, sums up his account of an election of which he had been an eyewitness in the following words — "All was easily performed in a short time, without tumult, without noise, without animosities, and the most deserving always elected." In our own times, as is well known, the system of voting by ballot in the election of representatives, magistrates, &c. is adopted in France and America, and, among ourselves, in cases of application for admission into private clubs and societies. Of all controvertible subjects, perhaps there is none which has excited the attention of all political parties so vividly, and formed so large an arena for the display of argumentative skill as the ballot. While its opponents foresee in its introduction into the public business of this country a tissue of hypocrisy and falsehood, and ultimately danger and ruin to the state, it seems to its supporters to contain the germ of all that is admirable in government and advantageous to the community. Our limits necessarily preclude us from doing more than merely noticing the principal arguments on both sides. The advocates of the ballot, on whom the onus probandi naturally rests, assume as an axiom that the great body of the electors are dependent, and consequently in an unfit condition to give a free and unbiassed vote. On this assumption is hinged not merely the validity, but even the necessity of all their demonstrations in favour of the ballot. The ballot, it is maintained, will not only place the elector on a footing of independence, but will remove all inducement to bribery, as no candidate will choose to offer a bribe when the elector is at liberty to deceive him by giving a secret vote. In a word, that it will annihilate the two species of corrupt influence by which electors are liable to be swayed, — the influence of threats, and the influence of bribes. Nor, as they allege, are their opinions upon this head merely speculative; for they point with triumph to the example of France and America, where the ballot is practised, and where it has long been regarded as the safeguard of the people's liberty. The opponents of the ballot, on the other hand, maintain that, even under the ballot, the canvassing of constituents by candidates would still be practised; in which case, the ballot would prove serviceable only to the dishonest elector, who promises his suffrage to one candidate and votes for another. Moreover, that even here secrecy would be impracticable, as the elector would not only be subjected to a process of the most searching curiosity, but that the landlord would be inclined to visit with more signal marks of his displeasure that tenant on whom his suspicions of deceit should rest, than him who came boldly forward, and voted in the face of day for the candidate of his choice. Again, that even were secrecy practicable (vide *Burke's Reflections*, p. 370.), it would not be desirable. For, as every elector holds his vote for the benefit of the community at large, he is bound to show by an open vote his opinion of the fitness of the candidate for his suffrage: that a secret vote is eminently calculated to counteract the legitimate influence of public opinion, and to lower the standard of political and moral principle, inasmuch as it removes from a public act that responsibility from which no public act ought to be exempted. And lastly, that the argument derived from the practice of France and America can have but little weight, unless it can at the same time be demonstrated that the condition of these countries in other respects is precisely analogous to that of our own: that, as far as America and France, under the republic, are concerned, vote by ballot was not engrafted upon their peculiar form of government, but, as in the case of Athens, was coeval with their existence: and that, as regarded France under Louis Philippe, only 200,000 in a population of 34 millions enjoyed the elective franchise; and these, from their rank and condition in society, were least likely either to be influenced by intimidation or seduced by bribery. Whether the opponents or the advocates of the ballot have the best of the argument, it is not for us to determine; but one thing is certain, that whether we regard the Athenian or the Roman, the French or the American form of government, it will be found that the people either stipulated for the adoption of the ballot in the original framing of their several constitutions, or, as soon as they ascertained the nature of their rights, insisted on its introduction, from some fancied security it afforded them in the exercise of their privileges. For some apposite remarks on the ballot, see *West. Review* for July 1830: see also Montesquieu, *Esprit des Lois*, ii. cap. 20.; and the Rev. Sydney Smith's *Works*, vol. iii., "The Ballot."

BA'LSAM OF SULPHUR. Solution of sulphur in olive oil. A brown fetid liquid.

BALSAMA'CEÆ. A natural order of imperfect exogenous balsamiferous trees, related to the Platanaceæ, a species of the only genus, Liquidambar, yields the fragrant resin called storax.

BALSAMINA'CEÆ. (Balsamina, one of the genera.) A natural order of polypetalous Exogens allied to Geraniaceæ. They have irregular flowers, with a spur to one of the sepals, and are chiefly annual-stemmed plants, with a succulent foliage and showy flowers. The common Impatiens nolitangere is a species of this order.

BALSAMODE'NDRON. *See* MYRRH.

BA'LSAMS. Exudations from certain plants, which are liquid or soft solid, and consist of a substance resembling a resin, either combined with benzoic acid or with an essential oil, or both.

BA'LTEUS. (Lat. *a girdle*.) In Architecture, the wide step in theatres and amphitheatres which afforded a passage round them without disturbing the sitters. Nobody sat on it, but it served as a landing or resting place. In the Greek and Roman theatres every eighth step was a balteus. Vitruvius gives the rules for constructing it in the third chapter of his fifth book. The same term is also used by that author to denote the strap which seems to bind the coussinet or cushion of the Ionic capital.

BA'LUSTER. (Said to be from balaustrum, or βαλαυστιον, the flower of the wild pomegranate, to the form of which a resemblance is pretended.) In Architecture, a species of small short column, used between piers on the upper parts of buildings, under windows, in balconies, &c. It is quite of modern introduction, that is to say, soon after the revival of architecture. The form of the most ancient that are met with in Florence and other cities of Italy is that of a column, a puerility which has even in these days found admission into some of what are called Greek buildings in this metropolis. Blondel gives rules for proportioning the baluster in its use where the orders are employed.

BALUSTRA'DE. A parapet or protecting fence formed with balusters.

BAMBO'O. An Asiatic genus of arborescent grasses, with hollow jointed stems, and a hardy woody texture. They are externally coated with silex, and sometimes secrete the same substance in the hollows of their stems, when it is called tabasheer. Bamboos grow with great rapidity, and their shoots are cut when young, and boiled like asparagus. They vary in size, according to the

species, from 6 feet to 150 feet in length. When small, they form handles to umbrellas and parasols or walking sticks; when sufficiently large, they are used for the frame-work of Indian cottages, bedsteads, floors, and a variety of domestic purposes. If split into slips, they form bow-strings, and sometimes the arrows discharged from the blow-tubes of the Malays. A few species inhabit the tropical parts of America.

BAMBUSA'CEÆ. A section of the natural order of grasses, comprehending the bamboo as its type.

BAN. A word bearing a variety of significations in the Teutonic jurisprudence and usages, but all apparently connected with the original meaning of "to proclaim, or give public notice." Hence, 1. Ban, the proclamation against an outlaw: *e. g.* the ban of the German Empire, equivalent to ecclesiastical excommunication or declaration of outlawry; whence the words banish, bandits, banditti, and to "ban" or curse; in German bannen, verbannen. 2. The *ban*, in the sense of the national army of a Teutonic people levied by proclamation: hence the French "lever le ban et l'arrière ban" (the latter word being a corruption of *heribannum*, from *heer*, an army). The French ban and arrière ban was levied for the last time in 1672, and commanded by Turenne, but behaved so ill that this feudal armament was thenceforth discontinued. 3 In the Sclavonic tongues ban means master: and the lords of some of the frontier provinces of Turkey were so styled; hence the *bannat* or lordship of Temeswar, now belonging to Austria, the viceroy or governor of which is styled the Ban of Croatia, and enjoys extraordinary privileges.

BANA'NA. A tall herbaceous endogenous plant, the *Musa sapientum* of botanists, having broad convex leaves with fine oblique veins, and growing in a tuft from the top of a stem formed by the union of the broad bases of the leaves The fruit ripens in succession in large clusters weighing many pounds, it is of the same nature as the plantain (which see). It is a native of the West Indies, where it contributes essentially to the food of the better classes

BA'NCHUS. A Fabrician genus of Hymenopterous insects, of the tribe *Pupivora*, and family *Ichneumonidæ*; characterised by long threadlike antennæ, abdomen compressed at the extremity, ovipositor not extended Of this genus there are five British species, which, like the rest of the family, are parasitic in the larva state, feeding on the bodies of other insects.

BA'NCO. In commerce, a word of Italian origin, signifying a bank, and commonly employed to describe the bank of Venice. Banco is also used to distinguish banco money from current money at Hamburg, &c. *See* EXCHANGE.

BA'NCO. In Law, superior courts of common law are said to sit in banco during term, the judges occupying the bench of their respective courts. *See* COURTS OF LAW.

BAND. (Fr. bande) In Architecture, a term used to denote what is generally called a face or fascia. To speak correctly, it signifies a flat, low, square, profiled member, without respect to its place. That member in a cornice on which modillions or dentils are cut is called the modillion band in the former, and the dentil band in the latter case.

BA'NDED. (Lat fasciatus.) When any body is striated across with coloured bands.

BANDI'TTI. (It.) Persons *declared* to be banished, exiled, or outlawed. (Horne Tooke) At the present time, bandit and robber are nearly synonymous terms. The Italian bandits formed a peculiar class, and were frequently employed by the petty princes and grandees in executing their projects either of love or ambition. As late as the year 1820, they were frequently employed as escorts; and in their case the proverb "honour among thieves" was amply verified, for, on the payment of a stipulated sum, travellers might repose in them unlimited confidence.

BANDOLE'ER. In ancient Military History, a large leathern belt worn over the right shoulder, and hanging under the left arm, to carry military weapons The term is also applied to small leather cases, of which each musketeer wore twelve, hanging upon a shoulder-belt. each of these contained the charge of powder for a musket. They are disused, but may be seen in the armoury in the Tower.

BA'NIANS. A peculiar class among the Hindus, whose office or profession is trade and merchandise. In this sense Banians stand contradistinguished from Brahmins, Cuttery (Eschatryá), and Wyse (Vaisyá), the three other castes into which the Indians are divided. (See Gemelli Carreri, and Sir W. Jones.) They are scattered over the whole of Asia, and have appropriated to themselves the sole management of traffic in the East. They retain every where their native language and religion (the doctrine of the Metempsychosis); and are distinguished by their honesty, fidelity, and goodnature.

BA'NISHMENT "Expulsion from any country, province, or town, by the judgment of some court or competent authority." Banishment as a species of punishment has been practised by all governments, both ancient and modern. Among the Greeks two kinds of banishment were in use: φυγη, which involved confiscation of property, and was inflicted only upon those convicted of certain crimes; and, at Athens, *ostracism*, by which persons were banished on mere suspicion that their power or riches might prove subversive of liberty. The Romans made use of three kinds — *relegatio*, *exilium*, and *deportatio*, — which involved various grades of punishment; the last, however, being the most severe, as it subjected the delinquent to the confiscation of his property, and the loss of his rights as a Roman citizen. The *second* was introduced by the Emperor Augustus, and formed the kind of banishment to which, among others, Ovid was condemned. During the first French revolution, banishment (*deportation*) was substituted for the guillotine, and towards the end of Robespierre's administration became very general. It still forms part of the French code, where it is classed in the third degree of infamous punishments, and gives rise to civil death. As a criminal punishment banishment was unknown to the ancient unwritten law of England, although voluntary exile was often adopted in order to evade legal prosecution. It was first towards the end of Queen Elizabeth's reign that a statute was enacted which condemned persons convicted of certain delinquencies to leave the town or village where they lived, but it was at a much later period that the punishment of *transportation* (*quod vide*) was legalised by parliamentary statute In Germany, numerous instances have recently occurred of persons convicted of treasonable practices having had their sentence commuted into perpetual banishment; and in the universities of the same country this punishment (*relegatio*) is inflicted upon those who are convicted of a gross infringement of the academical laws, and involves the forfeiture of all right to enter upon a professional career.

BANISTERIEÆ (Banisteria, one of the genera) That division of Malpighiaceous plants in which the fruit is samaroid, not baccate, and analogous to what is found in Aceraceæ.

BANK. In Natural History, an elevation of the ground. Banks at sea are indicated by a decrease of the soundings, and sometimes by the elevation of the land above low-water mark. Of these, one of the largest and best known is the great bank of Newfoundland, famous for the resort of cod-fish.

BANK. In Commerce, an establishment for the custody and issue of money The individual who manages a bank, or who carries on the business of banking, is called a banker

Banks are of various kinds, some confining themselves entirely to the custody and issue of the money deposited in their hands by their customers, while others issue notes or paper money of their own They are sometimes conducted by private individuals, and sometimes by companies consisting of an indefinite number of persons.

*Utility of Banks* — Notwithstanding the precious metals are, in many respects, admirably fitted to serve as a medium of exchange (*see* MONEY), they have two very serious drawbacks, — their cost, and the difficulty and expense of carrying them from place to place If the currency of Great Britain consisted only of gold, it would amount to at least sixty millions of sovereigns; and the expense attending such a currency, allowing only ¼ per cent. for wear and tear and loss of coins, could not be reckoned at less than £3,000,000 a year. The weight of 1000 sovereigns exceeds 21 lbs troy; so that were there nothing but coins in circulation, the conveyance of large sums from place to place to discharge accounts would be a very laborious process, and even small sums could not be conveyed without considerable difficulty; hence it is that most commercial and highly civilised nations have endeavoured to fabricate a portion of their money of less costly and heavy materials, and have resorted to various devices for economising the use of coin. Of the substitutes for coin hitherto suggested, paper is, in all respects, the most eligible. Instead of discharging their debts by a payment of the precious metals, individuals, on whose solvency the public may rely, pay them by giving a bill or draft for the sum, payable in coin at sight, or at so many days after date; and as this bill or draft passes currently from hand to hand as cash, it performs all the functions of coin, while it saves its expense to the public. A sense of the advantages that might be derived from the circulation of such bills or drafts led to the institution of banks for their regular issue.

By a bank of this description, or a bank of circulation, is meant an establishment founded by one or more individuals, known or believed to be possessed of large property, for the accommodation of the public with loans. A banker, on being applied to for a loan, does not make the advance in gold or silver, or other valuable material, but in his own promissory notes or engagements, binding him to pay the sums specified in them at

sight, when presented at the bank, or at some specified period. When a bank is in good credit, its notes are deemed by the public equivalent to a corresponding amount of gold or silver; and, being freely accepted in payment of debts of all sorts, and easily carried about or conveyed by post, they are even more useful to those who originally borrowed them from the bank, and to their subsequent holder, than an equal sum in coin. The borrowers, therefore, do not scruple to pay the same interest for the loan of a promissory note of 100*l.* or 1,000*l.* that they would do for the loan of a hundred or a thousand sovereigns. But the note costs the issuer comparatively little. He, in fact, deals in credit, or in obligations to pay, and not in real values; his profits consisting in the excess of interest derived from the notes or obligations he has issued over and above the interest of the cash or unproductive stock he is obliged to keep in his coffers to meet the demands of the public for payment of his notes, and the expenses of his establishment.

Besides this sort of bank, there are also banks of deposit, or banks for keeping the money of individuals. A merchant, or other person, using a bank of this sort, makes all his considerable payments by drafts upon his bankers, and sends all the bills due to him to them to be presented, and noted, if not duly paid. By this means he saves the trouble and expense of keeping a quantity of unemployed money at home, of receiving coins or notes that are not genuine, and of making any mistakes with respect to the presentation of due bills; and in consequence of the saving of money that is thus effected, a much less quantity serves for the demand of the public.

If a bank of circulation, or an establishment for the issue of notes, fall into discredit, its notes must obviously cease to circulate Unless when guaranteed by government, or made legal tender, no one ever takes promissory notes, except on the supposition that they will be paid when presented or when due, and that they are substantially equivalent to cash. The moment any suspicion (whether well or ill founded is so far of little consequence) arises that the issuers of notes are unable to meet their obligations there is a run upon them for payment, and their notes are rejected by every one

All banks of circulation are necessarily almost at the same time banks of deposit; but there are in all civilised and commercial countries a good many of the latter class of banks only. Banks of deposit derive their profit either from their paying no interest on the sums deposited in their hands, as is the case with most of the London banks; or from their paying a less rate of interest on deposits than that for which they lend them to the public, as is the case with the Scotch banks.

*English Banks.* — Banking establishments for the issue of notes, and for taking care of other people's money, have existed in this country since the latter part of the seventeenth century. The Bank of England was founded in 1694, and has long been the greatest bank of circulation and deposit in the world. It grew out of a loan of 1,200,000*l* for the public service, for which (such was the low state of public credit at the time) the subscribers were to receive 8 per cent interest, with 4,000*l* a year as the expense of management, and be incorporated into a banking company, denominated the Governor and Company of the Bank of England. The charter was granted for ten years; and it has since been prolonged by various renewals till the 1st of August 1855 The loans made by the Bank to government were gradually increased, till in 1800 they amounted to 14,686,800*l*. But at the renewal of the charter in 1833, a fourth part of the standing debt due to the Bank was paid off, making the sum now (1848) due by the public to that establishment, exclusive of advances on account of dead weight and other public securities, 11,015,100*l*.

From its foundation the Bank has enjoyed several peculiar privileges The principal of these was conferred upon it in 1708, by an act which prohibited any company from being established for the issue of notes payable on demand in England and Wales with more than *six* partners. This restriction continued till 1826, when it was abolished, in so far as respects all places more than 65 miles distant from London; but within that distance it still prevails.

The Bank of England is, and always has been, the government bank, transacting for it all the banking business of the nation, receiving the produce of the taxes, loans, &c.; and paying the interest of the public debt, the drafts of the treasury and other public departments, transferring stock, &c. For this the Bank receives, exclusive of the use of the balances of the public money in her hands, about 95,000*l*. a year.

In consequence of its employment by the government, of the restriction confining the number of partners in other banks to *six*, and of its great capital and credit, Bank of England notes have always been held in the highest estimation; and no bank for the issue of promissory notes payable on demand has been established in or near London. In the provinces, however, numerous *private* banks (that is, banks with not more than *six* partners) of issue and deposit have always existed. In 1792, their number is supposed to have exceeded 350. Many were destroyed by the revulsion of that year; but subsequently to 1800 they began rapidly to increase. In 1809, they amounted to 782; and in 1814, when most numerous, to 940. Since the abolition of the restriction on the number of partners, in 1826, many banks have been established; some with very large bodies of proprietors. Except in the case of the Bank of England, all the holders of stock in the other English banks are liable not merely for the amount of their share in the capital stock of the company, but for its whole debts, whatever may be their amount. All notes are made payable on demand; and since 1826 no notes for less than 5*l*. have been allowed to circulate.

From the first establishment of the Bank of England, down to 1797, she always paid her notes regularly when presented. But in the course of 1796, and the early part of 1797, there was, owing to the prevalence of reports of invasion, a pretty severe run upon the Bank of England, and it was at length apprehended that she might be obliged to make a temporary stoppage. To avert a contingency of this sort, an order in council was issued in February, 1797, authorising the Bank not to pay her notes in gold, and this order was subsequently confirmed by parliament, and prolonged till after the conclusion of a definitive treaty of peace.

Contrary to what might have been and was anticipated by many, the order referred to did not stop the circulation of Bank of England notes, or diminish the confidence of the public in that establishment. The report of a committee of the House of Commons, published soon after the suspension, showed that the bank was not merely possessed of the most ample funds to meet all her engagements but that she had a surplus stock, after all demands upon her were deducted, of no less than 15,513,000*l*. This report, and the fact that Bank of England notes became practically legal tender, secured their circulation.

The obligation on the issuers of paper to pay their notes on demand is necessary, not only to give them circulation, but to prevent their being issued in excess; for as soon as any considerable over-issue takes place, the currency becomes depreciated as compared with that of other countries, and notes are, in consequence, returned upon the banks for payment, in order to get gold and silver to send abroad, where their value is higher; and the banks, to obviate the drain, are obliged to narrow their issues London being the centre where the exchanges with other countries are adjusted, the value of its currency determines the state of the exchange; and it ultimately also determines the value of the currency of the provinces, there being a constant demand upon the country banks for gold or bills on London. While the Bank of England was obliged to pay in specie the value of her notes could not, and in point of fact did not, differ materially from that of gold But in 1799, or 1800, after the check of cash payments was removed, they began to be depreciated, partly in consequence of their own over-issue, but far more through the over-issue of the paper of the country banks. The latter were multiplied to an unprecedented extent. It is of importance, too, to observe that previously to 1797 neither the Bank of England nor any of the country banks issued notes for less than 5*l*.; but both parties having commenced their issues in the course of that year a new outlet was opened for the emission of paper that was particularly accessible to the country bankers. And such was the eagerness of the greater number of the latter to get their paper afloat, that individuals who could barely afford to buy stamps for bills frequently succeeded in getting the command of immense sums; and, as they had nothing of their own to lose, boldly ventured on the most hazardous speculations. During the last half dozen years of the war the depreciation of paper resulting from the circumstances now glanced at was such, that the ounce of standard gold, which should be worth only 3*l*. 17*s*. 10½*d*., was, in 1814, actually worth 5*l*. 4*s*., being a depreciation of 25⅓ per cent.

The difficulties which had been thrown during the latter years of the war in the way of importation from abroad, combined with deficient crops at home, caused an extraordinary rise in the price of corn. But no sooner had the northern ports been opened, in the autumn of 1814, than a large importation, accompanied by a heavy fall of prices, began to take place; which was still further increased after the general pacification in 1815. This fall proved ruinous to many farmers, who had been large borrowers from the country banks. In consequence of the losses arising from this and other causes that grew out of the altered situation of the country, a want of confidence was experienced; and the country banks being generally without the means of meeting any emergency, no fewer than 240 of these

establishments stopped payment. There is, in fact, believed to have been, in 1814, 1815, and 1816, a greater destruction of bank paper in this country, and a wider range of bankruptcy, than had ever previously taken place any where else, except perhaps in France at the breaking up of the Mississippi scheme. The contraction of the currency that had been thus violently brought about raised its value nearly to par, and paved the way for the act of 1819, the 59 G 3 c 78., commonly called "Peel's Act," from its being introduced by Sir Robert Peel, which provided for the return to cash payments by the Bank of England at the old standard. These were resumed in 1821

The policy of the act of 1819 was much questioned at the time, and since; but it has been successfully vindicated over and over again. But admitting that when enacted it might, in some respects, be objectionable, that would add nothing to the plea of those who still continue to urge its repeal. The restored standard has now (1848) been maintained for nearly thirty years; and 99 out of every 100 of the existing contracts have been entered into with reference to it. To set it aside would not be to repair former injustice, if such were committed, but to commit it afresh — to perpetuate an abuse in 1848 for no better reason than that it is alleged that a similar abuse had been perpetrated in 1819! So long as there is either common sense or common honesty in parliament, we are pretty secure against an attempt of this sort succeeding.

Notwithstanding that the bankruptcy which overspread the country in 1814, 1815, and 1816, was mainly ascribable to the defective constitution of the country banks, and to the reckless and improvident manner in which they were managed, no steps were taken when the resumption of cash payments was decided upon in 1819 to obviate any one of these sources of mischief. The consequences were such as might have been anticipated. A peculiar combination of circumstances having conspired to produce an extraordinary rage for speculative undertakings in 1824 and 1825, the country bankers gave in to the infatuation, and made the most sudden and excessive additions to their issues In consequence the currency became redundant, and this having occasioned a heavy drain for gold on the Bank of England, the latter was, in the end, obliged to contract her issues The country banks, whose engagements had in many instances been carried to an extent quite incommensurate with their capital, began to give way the moment they experienced an increased difficulty of obtaining pecuniary accommodation in London, and so rapid and sweeping was the destruction, that in less than six weeks above seventy banking establishments were swept off, and a vacuum created in the currency that absorbed from *eight* to *ten* millions of additional issues by the Bank of England!

This catastrophe seems at length to have satisfied the parliament and people of England that the private banking system was weak and vicious, and that it was imperatively necessary it should be amended and strengthened. In this view the clause in the act of 1708 already referred to prohibiting any private bank from having more than *six* partners, was repealed, and the issue of notes for less than 5*l*. was also forbidden.

The last measure shut up one of the easiest channels through which the inferior order of country bankers used to get their paper into circulation, and was in so far advantageous But abundance of other channels are still open to them, and the fact that a third part of all the private banks existing in England and Wales in 1792 were destroyed during the revulsion of that year, though no notes for less than 5*l* were then in circulation, shows how little the suppression of small notes can do to obviate the mischiefs complained of Very important advantages were, however, expected to result from the other measure, or that repealing the act of 1708, and consequently allowing the formation of joint-stock banks, or banks with any number of partners But these anticipations have proved to be nearly, if not quite, fallacious There cannot, in fact, be a greater error than to suppose that because a bank has a considerable number of partners it will necessarily be either rich or well managed. It may be neither the one nor the other A single individual may possess more wealth than a number of individuals associated together, and the chances are, that if he engage in banking, or any other business, it will be better managed than by a company Under our present system, and in fact it is impossible to prevent it under any system, the partners in joint-stocks, or in other banks, may be men of straw, or persons without property, and unable to fulfil their engagements It is of the essence of a secure and well established paper currency that the notes of which it consists should be of the exact value of the gold or silver they profess to represent, and that, consequently, they should be paid the moment they are presented But it is not enough to order that this condition shall be uniformly complied with. Such order is obeyed only by the opulent, prudent, and conscientious banker, and forms little or no check on the proceedings of those of a contrary character. It is the latter class, however, that it is especially necessary to look after; and it is needless to say that any system that permits notes to be issued without let or hindrance by speculative, ignorant, or unprincipled adventurers, must be essentially vicious.

The progress of the system of private and joint-stock banking since 1820 has been as follows: —

An Account of the Number of Private and Joint Stock Banks registered in each Year, from 1820 to 1842, both inclusive. — (*Parl. Paper* No. 85. Session 1843.)

| Years. | Number of Private Banks. | Number of Joint Stock Banks. |
|---|---|---|
| 1820 to 1821 | 521 | — |
| 1821 to 1822 | 526 | — |
| 1822 to 1823 | 547 | — |
| 1823 to 1824 | 547 | — |
| 1824 to 1825 | 541 | — |
| 1825 to 1826 | 554 | — |
| 1826 to 1827 | 465 | 6 |
| 1827 to 1828 | 456 | 7 |
| 1828 to 1829 | 460 | 11 |
| 1829 to 1830 | 439 | 15 |
| 1830 to 1831 | 436 | 19 |
| 1831 to 1832 | 424 | 25 |
| 1832 to 1833 | 416 | 35 |
| 1833 to 1834 | 416 | 47 |
| 1834 to 1835 | 411 | 55 |
| 1835 to 1836 | 407 | 100 |
| 1836 to 1837 | 351 | 107 |
| 1837 to 1838 | 311 | 104 |
| 1838 to 1839 | 332 | 108 |
| 1839 to 1840 | 332 | 113 |
| 1840 to 1841 | 321 | 115 |
| 1841 to 1842 | 311 | 118 |

In point of fact, however, the joint-stock banks have each at an average from five to six branches; and as these branches transact all sorts of banking business, and enjoy the same credit as the parent establishments, from which they are frequently at a great distance, they are to all intents and purposes so many distinct banks Hence, instead of 118, there were really above 500 joint-stock banks in England and Wales in 1842 Some private banks have latterly been converted into joint-stock banks, and others have wound up their affairs and ceased to exist; still, however, their number amounts to about 300, so that, in all, there are at this moment (ex. branches) about 400 joint-stock and private banking establishments in England and Wales. From a half to two thirds of these establishments issue notes.

Previously to 1833, the notes of the country banks were made payable in gold, but it was then enacted that they might be paid either in gold or Bank of England notes, at the option of the issuers Bank of England notes are now, in fact, legal tender everywhere except at the Bank and her branches

The dividends on Bank of England stock from 1767 to the present time have been — from 1767 to 1781, 5½ per cent per annum; from 1781 to 1788, 6 per cent, from 1788 to 1807, 7 per cent; from 1807 to 1823 10 per cent; and from 1823 to 1838, 8 per cent The dividends are exclusive of the sums occasionally advanced as *bonuses*: the latter amount since 1799 to 3,783 780*l*. over and above an increase in the capital of the Bank in 1816, which amounted to 2,910,609*l*.

*New System of* 1844 — The defects previously noticed in our banking system were again fully developed in 1836 and 1837 It is needless now to enter upon any investigation of the circumstances which led to the overtrading of these years, but it was carried to a great extent both here and in the United States In nothing, however, was this more strikingly evinced, than in the rapid increase of joint-stock banks; their number, which in 1834-35 had (as seen above) amounted in England and Wales to 55, having risen in 1835–36 to no fewer than 100! Many of these were banks of issue, and in consequence of the large additions that were thus suddenly made to the number of notes afloat, and still more to the number of bills, checks, and other substitutes for money, the currency became redundant and the exchange depressed, and the deficient harvests of 1838 and 1839, coinciding with this redundancy, occasioned a farther fall in the exchange, and a severe drain upon the Bank of England for gold. But while the latter was narrowing her issues by supplying the exporters of bullion with gold in exchange for notes, the country banks went on increasing their issues! What the former did by contracting on the one hand, the latter more than undid by letting out on the other The vacuum created by the withdrawal of Bank of England paper was immediately filled up, and made to overflow, by the issue of a more than equal amount of provincial paper; so that had it not been for the rise in the rate of interest, and the other repressive measures adopted by the Bank, the probability is that she might have gone on paying away bullion for notes, till she was drained of her last sixpence

without in any degree affecting the exchange; and as it was, the bullion in her coffers in August 1839 was reduced to 2,420,000*l.*, so that we narrowly escaped a tremendous crisis.

This perilous experience having again forcibly attracted the public attention to the state of our banking system, Sir Robert Peel was induced to attempt its improvement. The clause in the act 3 & 4 Will. 4. c. 98., for the renewal of the charter in 1833, which gave to parliament power to revise or cancel it in 1845, afforded a legitimate opportunity for the introduction of the new system. But, however desirable, the total suppression of the issue of notes by joint-stock and private banking companies would have been a measure too much opposed to popular prejudices, and to the real or supposed interests of a large and powerful class, to have had any chance of being carried; and there would also have been great, though inferior, difficulties in the way of the plan for taking security from the issuers. It was indeed indispensable, in attempting to obviate the defects inherent in our banking system, to proceed cautiously, to respect, in as far as possible, existing interests, and to avoid taking any step that might excite the fears or suspicions of the public, the grand difficulty being to reconcile the introduction of such a course with the adoption of any plan that would obviate in any considerable degree the defects complained of. Happily this difficult problem was satisfactorily solved by Sir Robert Peel, the measures he introduced and carried through parliament in 1841 and 1845, for the improvement of our banking system, having been so skilfully contrived as to provoke little opposition, at the same time that they effected very extensive and (as we think) most beneficial changes.

The measures in question consisted of the act 7 & 8 Vict. c. 32, which refers to the Bank of England, and the English country banks, and the acts 8 & 9 Vict. c. 38. 37, referring to the banks of Scotland and Ireland. The principal object of these statutes has been to obviate the chances of over-issue and of sudden fluctuations in the quantity and value of money, by limiting the power to issue notes payable on demand, and by making the amount of such notes in circulation vary more nearly than previously with the amount of bullion in the possession of the issuers. Sir Robert Peel adopted, in dealing with the Bank of England, the proposal made by Mr Loyd, in 1837, for effecting a complete separation between the issuing and banking departments of that establishment. And while the Directors are left at liberty to manage the latter at discretion, their management of the former, or issue department, is subjected to what seems to be a well-devised system of restraint. The Bank is allowed to issue 14,000,000*l.* of notes upon securities (of which the debt of 11,015,100*l.* lent by her to government is a part), and whatever paper the issue department may at any time issue over and above this maximum amount of securities, it must have an equal amount of coin and bullion in its coffers *. Hence it is impracticable for the issue department to increase its issues without, at the same time, proportionally increasing its stock of coin and bullion, or to diminish the latter without proportionally diminishing the amount of paper supplied to the public and the banking department. And therefore if the latter issued the whole notes assigned to it, the total amount issued by the issue department and the amount in circulation would be identical, and it might under such circumstances be truly said that, in so far as the currency consists of Bank of England notes payable on demand, it varied in amount and value as it would do were it wholly metallic, and, consequently, by being so closely identified with the standard, realised the *beau ideal* of a paper currency.

But, though the currency approaches to, it has not arrived at this degree of perfection. The public does not deal alone with the issue, but also, and to a far greater extent, with the banking department. And this latter department retained such a portion of the notes issued to it by the former, under the 2nd clause of the 7 & 8 Vict. c. 32, as was supposed at the time to be sufficient to carry on its business, their amount having since varied with the varying demands for bullion, the sales and purchases of securities, &c. But it is sufficient, in illustration of what is now stated, to observe that during the week ended the 4th of November, 1848, notes to the amount of 26,796,660*l.* had been issued to the public and the banking department, of which the latter had 8,242,575*l.* in its coffers, making the sum in the hands of the public 18,551,085*l.* And as it is sometimes supposed that the banking department might issue this sum of 8,242,575*l.*, or the spare notes at any time in its coffers, in the discount of bills, or any other way, it is concluded that there is still room for some, though but little, derangement of the currency from mistaken proceedings on the part of the Bank; and this, no doubt, may be sometimes true, at least to some extent. But it is idle to suppose that the banking department could carry on business without a large reserve of notes or of coin. This department may have, owing to a variety of circumstances, to meet a drain for deposits; and as it is very unsafe to trust to the sale of securities in periods of discredit, a very considerable supply of notes or of bullion, or of both, can never be advantageously or safely dispensed with.

This shows the little weight to be attached to the statements of those who contend that the late measure has laid no real restraint on the issues of the Bank, because, say they, she has a large reserve of unissued notes which she might legitimately throw on the market. But in truth and reality she can do nothing of the sort. A reserve is indispensable, not only to her safety but to her ability to carry on banking business. More vigilance and caution are now required on the part of the Bank Directors than formerly; for otherwise the banking department of the Bank may be reduced to the greatest difficulties, without its being possible for it to obtain any assistance from the issue department, however able soever the latter might be to render it. This was strikingly evinced in the autumn of 1847, and nothing but the exercise of a proper degree of foresight and caution can prevent its recurrence. No gold can now be obtained from the issue department except in exchange for notes, nor can the latter be obtained from it except in exchange for gold. Hence it is no longer, as formerly, in the power of the Bank to create paper money at pleasure to supply the place of cash in any emergency in which she may be involved; and instead of less, she requires to act with more circumspection under the new system than under the old.

But though the check on the over-issue of Bank notes be thus nearly effectual, it appears rather singular that no check should be established on the issue of bank post-bills, which amounted to 1,048,503*l.* on the 4th November 1848, and which are and may be substituted for notes. No doubt, however, were the Bank (which is hardly to be imagined) to abuse the privilege of issuing post-bills, by making advances in them which she could not have made in notes, measures would be taken to prevent the abuse, and perhaps, on the whole, it was as well to postpone devising means for the prevention of what seems so unlikely to occur.

Weekly returns are now published of the issues of the Bank, and of the securities, bullion, &c., in her possession. The sum to be deducted by the Bank from the charge on account of the management of the national debt is in future to be 180,000*l.* instead of 120,000*l.* a year, as fixed by the act 3 & 4 Will. 4. c. 98. The charter is to be continued till twelve months' notice after the 1st of August, 1855.

The provisions made in this act for restraining the country circulation were, perhaps, still more important. The maximum future issue of the joint-stock and other banks in England and Wales was limited to the average amount of the circulation of each during the twelve months preceding the 27th of April, 1844; the aggregate being 3,177,321*l.* for the joint-stock, and 5,011,097*l.* for the private banks. It was farther enacted that no new bank shall be established for the issue of notes, and that the names of the partners in joint-stock and other banks shall be periodically published.

The regulations in the statutes relating to banking in Scotland and Ireland are nearly similar. The maximum amount of notes to be issued by the banks of both countries is, in time to come, not to exceed the average amount which each bank had in circulation during the twelve months ending the 1st of May, 1845. Certain returns, including amongst others the amount of gold and silver coin held by the banks, the names of the partners, &c., are to be periodically published. The small-note currency of Scotland has not been affected by the measure.

It is impossible to doubt that these regulations interpose a formidable obstacle to over-issue; and that, consequently, they discourage over-trading, and tend to reduce both the number and the violence of those commercial revulsions and changes in the value of money, that have always been, and must necessarily continue to be, productive of the greatest mischief. No one ever pretended to say that these or any other measures which could be adopted with respect to the currency would wholly prevent unsafe speculation and over-trading. These may originate in an endless variety of circumstances; but in times past the tendency to speculation and gambling, when once set on foot, was, in most cases, powerfully stimulated by the facility which banks then possessed of issuing additional quantities of paper; and of that facility they are now all but deprived. It is, perhaps, true, that the fair and legitimate influence of the acts now referred to may be in some degree countervailed by the circulation to a greater extent than formerly of bills and other sorts of paper not payable on

* A clause is inserted in the act allowing the Bank to increase her issue upon securities in the event of her notes being used instead of those of any or all of the existing banks of issue.

demand, but at short dates; and it is not improbable that sooner or later the question may arise, whether any regulations should be adopted in regard to the issue of such paper. In so far, however, as respects the issue of *paper money*, or notes payable on demand, the regulations in the act of 1844 appear to have left little to be desired. No doubt, also, numbers of the private and other banks that now issue notes will from time to time wind up their affairs; and as no new banks of issue can be established in their stead, the vacuum caused by the withdrawal of their notes will be supplied by those of the Bank of England; so that a gradual progress will be made towards the desirable consummation of having only one bank of issue.

It is sometimes contended, by those opposed to the policy of limiting the issues, that they never can be in excess so long as they are payable on demand. Such, however, is not the case: notes payable, *and really paid*, on demand cannot, it is true, fall below the value of specie in the country in which they are issued; but the check of payment in specie does not, in fact, begin to operate till their over-issue has depreciated the value of the whole currency, gold as well as paper, in such country, below its level in the surrounding countries, and till, consequently, the exchange becomes unfavourable, and it is of advantage to export gold. Then, of course, the over-issue is stopped, but such stoppage is almost always accompanied by a great deal of public distress and inconvenience; while it by no means necessarily follows that any considerable portion of the loss thence arising will fall on those banks by whose misconduct or over-issue the fall in the exchange and the demand for bullion may have been occasioned.

The measures adopted in 1844, though they deeply affected many powerful private interests, were passed with little difficulty, and were very generally approved of. In this respect, however, the public opinion has, to some extent, changed, and the act of 1844 has been charged by various parties with having aggravated the pressure experienced by the mercantile world in 1847. But we are satisfied that there is no real ground for any such imputation The crisis of 1847 was a consequence, partly of the railway mania of the previous year, and partly of the failure of the potato crops of 1845 and 1846 The failure in the latter year deprived fully two-thirds of the people of Ireland, and a considerable portion, also, of those of Great Britain, of their accustomed supplies of food. In consequence of this deficiency, and of government having come forward to provide the means for its relief, there was an unprecedented importation of all sorts of corn; and the demand for bullion for exportation to meet this importation, occurring simultaneously with a vast railway expenditure, pecuniary accommodations were obtained with the greatest difficulty, and the rate of interest rose to an extraordinary height. Instead, however, of being increased by the act of 1844, it is abundantly certain that the operation of the latter contributed to alleviate the severity of the crisis. The restraints it imposed on the issues of the country banks had hindered them from embarking to any great extent in railway adventures, so that they were better able to assist their customers, and it also prevented the Bank of England from attempting to meet the exigencies of the case, otherwise than by raising the rate of interest, and restricting her issues And besides being the natural and proper, these were, in fact, the only means by which the value of bullion could be raised in this country, its demand for foreign remittance checked, and the exchange turned in our favour. A great many mercantile houses that had been trading upon very insufficient capitals, or which had previously been virtually insolvent, were, of course, swept off during the crisis; and the alarm that was thereby occasioned, though for the most part without any good foundation, gave rise to a species of panic. During the prevalence of the latter, Government consented (25th October, 1847) to a temporary suspension of the act of 1844; but there is, we believe, little doubt that this was an unwise proceeding. When it took place the violence of the crisis had abated. The drain for gold for exportation had not only ceased, but had begun to set in our favour, and the probability is, that in a few days all alarm would have passed off, without the dangerous precedent which was set by the interference of ministers Hence, in our view of the matter, the experience afforded by the crisis of 1847 tells strongly in favour of the act of 1844. But for its influence, it is most probable that the Bank would have attempted to meet the demand for bullion without raising the rate of interest, at least to the extent to which she did raise it; and if so, we should have been exposed to the imminent risk of a suspension of cash payments. If, therefore, the act of 1844 should be subjected to any modifications, it is to be hoped that they may be such as may tend to carry out and strengthen the principles on which it is founded.

*Scotch Banks.*—The act of 1708, preventing more than six individuals from entering into partnership for carrying on the business of banking, did not extend to Scotland. In consequence of this exemption, several banking companies, with numerous bodies of partners, have always existed in that part of the empire. The Bank of Scotland was established by act of parliament in 1695. By the terms of its charter it enjoyed, for twenty-one years, the exclusive privilege of issuing notes in Scotland. Its original capital was only 100,000*l.*; but it was increased to 200,000*l.* in 1744, and now amounts to 1,500,000*l.*, of which 1,000,000*l.* has been paid up.

The Royal Bank of Scotland was established in 1727. Its original capital was 151,000*l.*; at present it amounts to 2,000,000*l.*, which has been all paid up.

The British Linen Company was incorporated in 1746, for the purpose, as its name implies, of undertaking the manufacture of linen, But the views in which it originated were speedily abandoned, and it became a banking company only. Its paid up capital amounts to 500,000*l.*

Exclusively of the above, there are two other chartered banks in Scotland: the Commercial Bank, established in 1810; and the National Bank of Scotland, established in 1825. The former has paid up capital of 600,000*l.*, and the latter of 500,000*l.*

None of the other banking companies established in Scotland are chartered associations; and the partners are jointly and individually liable to the whole extent of their fortunes for the debts of the firms. Some of them, as the Aberdeen Town and Country Bank, the Dundee Commercial Bank, the Perth Banking Company, &c, have very numerous bodies of partners. Generally speaking, they have been eminently successful. An original share, 150*l*, of the stock of the Aberdeen Banking Company, established in 1767, is now (1838) worth no less than 2,500*l* Their affairs are uniformly conducted by a board of directors chosen by the shareholders.

There are very few banks with less than six partners in Scotland. Almost all the great joint-stock banks have numerous branches, so that there is hardly a town or village of any consequence without two or more banks.

The Bank of Scotland began to issue one-pound notes as early as 1704, and their issue has since been continued without interruption. With only one exception, all the Scotch banks issue notes, and taking their aggregate circulation at from 3,500,000*l* to 4,000,000*l*, it is supposed that from 2,000,000*l* to 2,500,000*l.* consists of notes for 1*l.* In 1826 it was proposed to suppress one-pound notes in Scotland as well as in England; but the measure having been strongly objected to by the people of Scotland, as being at once oppressive and unnecessary, was abandoned

There have been very few bankruptcies amongst the Scotch banks This superior stability is to be ascribed to a variety of causes; partly to the great wealth of the early established banks, which had a considerable influence in preventing an inferior class of banks acquiring any hold on the public confidence; partly to the comparatively little risk attending the business of banking in Scotland; partly to the facilities afforded by the Scotch law for attaching a debtor's property, whether it consist of land or moveables; and partly and principally, perhaps, to the fact of the Scotch banks being but indirectly and slightly affected by a depression of the exchange and an efflux of bullion.

The circumstances now mentioned render it unnecessary to enforce that suppression of local issues in Scotland which is so indispensable in England, where the system of provincial banking is of a very inferior description, the risk attending the business much greater, and where any excess in the amount of the currency necessarily occasions a fall of the exchange and a demand for bullion The commerce and population of Scotland are too limited, and that country is too remote from the metropolis, or from the centre of the moneyed world, the pivot on which the exchanges turn, to make it of importance that her currency should be identical with that of England. We believe that the Scotch attach much more importance than it deserves to the issue of paper, and especially to the issue of one-pound notes; still, however, we do not think that the circumstances are at present such as to call for or to warrant any attempt to introduce any material changes in their banking system.

All the Scotch banks receive deposits, even of the low amount of 10*l.*, and allow interest on them at from one to two per cent. below the market rate. But should a deposit be unusually large, as from 5,000*l.* to 10,000*l*, a special agreement is usually made with regard to it. This part of the system has been particularly advantageous. It, in fact, renders the Scotch banks a sort of savings' banks for all classes; and their readily receiving all sorts of deposits at a reasonable rate of interest, has tended to diffuse a spirit of economy and parsimony among the people that would not otherwise have existed. The total deposits in the hands of the Scotch banks are

believed at present (1848) to exceed 30,000,000*l.*, of which fully a half is understood to be in sums of from 10*l.* to 200*l.*

The Scotch banks make advances in the way of discounts and loans, and on what are called cash-credits or cash-accounts. By the latter are meant credits given by the banks for specified sums to individuals, each of whom gives a bond for the sum in his account, with two or more individuals as sureties for its payment. Persons having such accounts draw upon them for whatever sums within their amount they have occasion for, repaying these advances as they find opportunity, but generally within short periods. Interest is charged only on the average balance which may be found due to the bank. The total number of these accounts in Scotland in 1826 was estimated at about 12,000; and it may now, perhaps, be taken at about 15,000. They are believed to average about 500*l.*; few are for less than 100*l.*, and fewer still above 5,000*l.*

It has been contended by no less an authority than Adam Smith, that this species of accommodation gives the Scotch merchants and traders a double command of capital. "They may discount their bills of exchange," says he, "as easily as the English merchants, and have, besides, the additional convenience of their cash accounts." But this is an obvious error. The circulation will take off only a certain quantity of paper, and to whatever extent it may be issued by means of cash-accounts, so much the less can be issued in the way of discounts. The advantage of a cash-account does not really consist in its enabling a banker to enlarge his advances to his customers, but in the extreme facility it affords of making them. An individual who has obtained such an account may operate upon it at any time he pleases, and by drafts for any amount; an advantage he could not enjoy to any thing like the same extent, without an infinite deal of trouble and expense, were the loans and advances made to him through the discounting of bills. The Scotch banks draw upon London at twenty days' date. This is denominated the par of exchange between London and Edinburgh.

*Irish Banks* — The Bank of Ireland was established in 1783, and the same restriction as to the number of partners in other banks that formerly prevailed in England was enacted in its favour. Owing to that and other causes the bankruptcies of private banks have been more frequent in Ireland than in England. In 1821 this restriction was repealed, as respects all parts of the country more than 50 Irish miles from Dublin. Since that period several banking companies, with large bodies of partners, have been set on foot in different parts of the country: of these the Provincial Bank, founded on the Scotch model, is among the most flourishing. The charter of the Bank of Ireland has been prolonged till 1855. The Irish as well as the Scotch banks issue notes for 1*l.*

For accounts as to Foreign Banks, see *Commercial Dictionary*, and the art. "Paper Money and Banks," in the new ed. of the *Encyclopedia Brittanica*, with the authorities there referred to.

An Account of the Notes in circulation of the Bank of England, and of the other Banks of Issue in England and Wales, Scotland, and Ireland, specifying also the Bullion in the Bank of England.

| Four weeks ending | | | England. | | | Scotland. | Ireland. | | Total. | Bullion in the Bank of England. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Bank of England. | Private Banks | Joint Stock Banks. | Chartered, Private, and Joint Stock Banks. | Bank of Ireland. | Private and Joint Stock Banks. | | |
| 4 January, | 1845 | £ | 20,301,000 | 4,129,451 | 3,056,862 | 3,159,150 | 3,917,800 | 3,065,751 | 37,930,317 | 14,867,000 |
| 1 February, | — | - | 21,619,000 | 4,077,105 | 3,137,145 | 3,070,058 | 3,983,050 | 3,115,066 | 39,502,034 | 14,821,000 |
| 1 March, | — | - | 21,080,000 | 4,111,507 | 3,089,879 | 2,986,708 | 3,991,050 | 3,130,508 | 38,689,652 | 15,410,000 |
| 29 March, | — | - | 20,660,000 | 4,119,864 | 3,147,835 | 2,950,870 | 3,946,625 | 3,105,552 | 38,260,746 | 16,006,000 |
| 26 April, | — | - | 22,078,000 | 4,080,648 | 3,306,215 | 3,001,240 | 4,036,400 | 3,016,231 | 40,118,764 | 15,924,000 |
| 24 May, | — | - | 21,958,000 | 4,025,600 | 3 291,981 | 3,357,251 | 4,029,575 | 2,897,787 | 40,113,194 | 15,985,000 |
| 21 June, | — | - | 21,277,000 | 4,398,853 | 3,131,109 | 3 485,551 | 3,882,600 | 2,736,432 | 38,911,505 | 16,544,000 |
| 19 July, | — | - | 22,076,000 | 4,178,679 | 3,158,775 | 3,355,906 | 3,860,175 | 2,633,657 | 39,241,192 | 16,274,000 |
| 16 August, | — | - | 22,567,000 | 4,429,177 | 3,124,161 | 3,505,255 | 3,776,775 | 2,582,384 | 39,783,055 | 15,711,000 |
| 13 September, | — | - | 21,931,000 | 4,308,253 | 3,142,112 | 3,541,397 | 3,712,725 | 2,547,130 | 39,032,617 | 15,501,000 |
| 11 October, | — | - | 21,890,000 | 4,559,712 | 3,311,527 | 3,428,074 | 3,907,025 | 2,926,265 | 40,022,603 | 14,988,000 |
| 8 November, | — | - | 23,136,000 | 4,710,288 | 3,554,119 | 3,593,988 | 4,371,850 | 3,119,690 | 42,629,235 | 13,950,000 |
| 6 December, | — | - | 22,015,000 | 4,569,278 | 3,221,883 | 3,801,031 | 4,401,975 | 3,311,855 | 41,327,022 | 13,358,000 |
| 3 January, | 1846 | - | 21,028,000 | 4,505,823 | 3,162,742 | 3,336,109 | 4,351,200 | 3,053,166 | 39,437,340 | 13,313,000 |
| 31 January, | — | - | 22,169,000 | 4,611,062 | 3,254,215 | 3,182,225 | 4,305,975 | 3,104,776 | 40,660,253 | 13,205,000 |
| 28 February, | — | - | 21,111,000 | 4,171,256 | 3,108,580 | 3,083,792 | 4,301,350 | 3,165,379 | 39,241,337 | 13,558,000 |
| 28 March, | — | - | 20,316,000 | 4,515,107 | 3,176,935 | 3,018,771 | 4,257,200 | 3,187,760 | 38,502,073 | 13,895,000 |
| 25 April, | — | - | 21,979,000 | 4,736,786 | 3,301,184 | 3,096,317 | 4,353,025 | 3,181,298 | 39,949,610 | 13,682,000 |
| 23 May, | — | - | 21,227,000 | 4,650,873 | 3,264,753 | 3,401,882 | 4,359,400 | 3,062,680 | 39,966,088 | 14,053,000 |
| 20 June, | — | - | 20,253,000 | 4,456,629 | 3 128,185 | 3,508,655 | 4,119,850 | 2,852,176 | 38,618,195 | 15,185,000 |
| 18 July, | — | - | 21,284,000 | 4,110,585 | 3,088,619 | 3,590,060 | 3,995,875 | 2,690,616 | 38,859,755 | 15,899,000 |
| 15 August, | — | - | 21,558,000 | 4,363,182 | 3,061,680 | 3,571,906 | 3,876,700 | 2,603,847 | 38,815,285 | 15,935,000 |
| 12 September, | — | - | 21,192,000 | 4,107,765 | 3,111,556 | 3,446,787 | 3,923,675 | 2,664,600 | 38,716,263 | 16,293,000 |
| 10 October, | — | - | 21,194,000 | 4,666,748 | 3,262,518 | 3,665,155 | 4,181,576 | 3,066,980 | 40,010,046 | 15,983,000 |
| 7 November, | — | - | 22,251,000 | 4,783,501 | 3,309,356 | 3,765,264 | 4,131,000 | 3,405,825 | 41,945,926 | 14,901,000 |
| 5 December, | — | - | 21,055,000 | 4,596,549 | 3,190,417 | 3,996,861 | 4,375,025 | 3,464,905 | 40,678,357 | 14,946,000 |
| 2 January, | 1847 | - | 20,633,000 | 4,525,855 | 3,158,321 | 3,787,151 | 4,212,225 | 3,303,189 | 39,599,741 | 15,083,000 |
| 30 January, | — | - | 21,613,000 | 4,675,317 | 3,267,888 | 3,600,731 | 4,115,300 | 3,114,126 | 40,116,392 | 13,65 ,000 |
| 27 February, | — | - | 20,415,000 | 4,549,216 | 3,198,152 | 3,503,300 | 4,026,950 | 3,003,103 | 38,695,701 | 12,212,000 |
| 27 March, | — | - | 20,087,000 | 4,541,543 | 3,247,531 | 3,360,318 | 3,857,800 | 2,816,936 | 37,911,158 | 11 322,000 |
| 24 April, | — | - | 21,011,000 | 4,722,319 | 3,301,819 | 3,395,524 | 3,805,525 | 2,717,709 | 38,951,926 | 9,664,000 |
| 22 May, | — | - | 20,116,000 | 4,613,962 | 3,2 2,058 | 3 516,911 | 3,623,525 | 2,395,064 | 37,547,153 | 9,686,000 |
| 19 June, | — | - | 19,078,000 | 4,38 ,608 | 3,088,327 | 3,617,314 | 3,527,400 | 2,137,551 | 35,664,200 | 10,319,000 |
| 17 July, | — | - | 19,160,000 | 4,339,077 | 3,031,017 | 3,195,921 | 3,232,175 | 2,021,903 | 35,586,593 | 10,232,000 |
| 14 August, | — | - | 19,607,000 | 4,258,222 | 2,990,950 | 3,155,651 | 3,107,100 | 1,990,145 | 35,409,018 | 9,410,000 |
| 11 September, | — | - | 18,918,000 | 4,179,178 | 2,954,317 | 3,197,525 | 3,026,550 | 2,021,760 | 34,597,360 | 9,063,000 |
| 9 October, | — | - | 19,182,000 | 4,317,294 | 3,107,292 | 3,579,976 | 3,152,200 | 2,203,413 | 35,522,175 | 8,659,000 |
| 6 November, | — | - | 21,152,000 | 4,275,903 | 3,085,956 | 3,606,718 | 3,274,350 | 2,241,964 | 37,635,871 | 8,478,000 |
| 4 December, | — | - | 18,783,065 | 3,691,304 | 2,576,686 | 3,732,585 | 3,175,100 | 2,117,311 | 34,106,381 | 11,034,599 |
| 1 January, | 1848 | - | 17,924,990 | 3,528,197 | 2,410,276 | 3,341,317 | 3,088,700 | 2,107,116 | 32,400,896 | 12,401,250 |
| 29 January, | — | - | 19,111,920 | 3,715,500 | 2,534,885 | 3,151,022 | 3,098,425 | 2,135,191 | 33,807,213 | 13,390,314 |
| 26 February, | — | - | 18,179,755 | 3,633,388 | 2,512,053 | 3,031,367 | 3,069,500 | 2,150,580 | 32,579,613 | 14,760,815 |
| 25 March, | — | - | 17,603,075 | 3,601,089 | 2,572,329 | 2,951,937 | 2,990,875 | 2,116,520 | 31,835,825 | 15,516,794 |
| 22 April, | — | - | 18,761,865 | 3,8 3,001 | 2,761,790 | 2,931,171 | 2,988,100 | 2,020,633 | 33,322,860 | 13,228,341 |
| 20 May, | — | - | 18,095,100 | 3,816,675 | 2,782,856 | 3,1 2,319 | 2,971,825 | 1,868,847 | 32,717,922 | 13,379,219 |
| 17 June, | — | - | 17,377,495 | 3,628,563 | 2,598,625 | 3,137,587 | 2,863,800 | 1,797,546 | 31,703,616 | 14,169,427 |
| 15 July, | — | - | 19,115,060 | 3,572,240 | 2,524,999 | 3,106,615 | 2,766,125 | 1,712,799 | 32,827,868 | 14,263,176 |
| 12 August, | — | - | 18,165,725 | 3,521,613 | 2,475,012 | 3,035,903 | 2,639,000 | 1,674,304 | 31,511,557 | 13,364,991 |

An Account of the Irish Banks empowered to issue Notes, specifying the maximum authorised Issue of each, under the 8 & 9 Vict. c. 37, with other Particulars.

| Names of Banks. | Head Office. | When established. | Branches and Sub-Branches. | Number of Partners. | Capital advanced. | Circulation authorised by 8 & 9 Vict. c. 37. |
|---|---|---|---|---|---|---|
| | | | | | £ | £ |
| Bank of Ireland - - - - | Dublin | 1783 | 24 | - - | 3,000,000 | 3,738,428 |
| Provincial Bank of Ireland - - - | London | 1825 | 36 | 867 | 500,000 | 927,667 |
| National Bank of Ireland - - - | London | 1835 | 38 | 913 | 350,000 | 761,757 |
| National Bank of Ireland at Clonmel - - | - - | - - | - - | 1050 | - - | 66,428 |
| National Bank of Ireland at Carrick on Suir - | - - | - - | - - | 973 | - - | 24,084 |
| Ulster Banking Company - - - | Belfast | 1836 | 13 | 489 | 200,000 | 311,079 |
| Belfast Banking Company - - - | Belfast | 1827 | 22 | 261 | 125,000 | 281,611 |
| Northern Banking Company - - - | Belfast | 1825 | 12 | 179 | 150,000 | 243,440 |
| | | | | | | 6,354,494 |

**An Account of the Scotch Banks empowered to Issue Notes, specifying the maximum authorised Issue of each, under the 8 & 9 Vict. c. 38., with other Particulars.**

| Names of Banks. | Head Office. | When established. | Branches and Sub-Branches. | Number of Partners. | Capital advanced | Circulation authorised by 8 & 9 Vict. c 38. |
|---|---|---|---|---|---|---|
| | | | | | £ | £ |
| Bank of Scotland | Edinburgh | 1695 | 33 | 654 | 1,000,000 | 300,485 |
| Royal Bank of Scotland | Ditto | 1727 | 6 | 854 | 2,000,000 | 183,000 |
| British Linen Company | Ditto | 1746 | 43 | 206 | 500,000 | 438,024 |
| Dundee Banking Company | Dundee | 1763 | 1 | 57 | 60,000 | 33,451 |
| Perth Banking Company | Perth | 1766 | 3 | 185 | 100,000 | 38,656 |
| Aberdeen Banking Company | Aberdeen | 1767 | 15 | 370 | 240,000 | 88,167 |
| Commercial Bank of Scotland | Edinburgh | 1810 | 52 | 550 | 600,000 | 371,880 |
| National Bank of Scotland | Ditto | 1825 | 31 | 1482 | 1,000,000 | 297,024 |
| Aberdeen Town and County Bank | Aberdeen | 1825 | 10 | 489 | 150,000 | 70,133 |
| Union Bank of Scotland | Glasgow | 1830 | 30 | 598 | 1,000,000 | 327,223 |
| Ayrshire Banking Company | Ayr | 1831 | 12 | 109 | 50,000 | 55,656 |
| Western Bank of Scotland | Glasgow | 1832 | 39 | 703 | 1,000,000 | 284,282 |
| Central Bank of Scotland | Perth | 1831 | 7 | 405 | 65,000 | 42,933 |
| North of Scotland Banking Company | Aberdeen | 1836 | 27 | 1605 | 300,000 | 154,319 |
| Clydesdale Banking Company | Glasgow | 1838 | 11 | 947 | 500,000 | 101,328 |
| Eastern Bank of Scotland | Dundee | 1838 | 4 | 552 | 600 000 | 33,636 |
| Caledonian Banking Company | Inverness | 1838 | 10 | 938 | 75,000 | 53,134 |
| Edinburgh and Glasgow Bank | Edinburgh | 1839 | 20 | 1516 | 1,000,000 | 136,657 |
| City of Glasgow Bank | Glasgow | 1839 | 6 | 906 | 1,000,000 | 72,921 |
| | | | 363 | | 11,240,000 | 3,087,209 |

**Total authorised Maximum Circulation of the U. Kingdom.**

| | £ |
|---|---|
| Bank of England (variable). | |
| English Private Banks | 5,011,097 |
| ——— Joint-Stock Banks | 3,477,321 |
| Scotch Banks | 3 087,209 |
| Irish Banks | 6,354,494 |

Being 17,920,121*l*, exclusive of the issue of the Bank of England, which being, in general, about 20,000,000*l*., makes a total paper circulation of about 38,000,000*l*.

BANK FOR SAVINGS A bank established for the receipt of small sums deposited by the poorer class of persons, and for their accumulation at compound interest. Though not so well calculated as friendly societies to enable the labouring classes to provide against sickness and old age, savings' banks are very valuable institutions, and are eminently entitled to the public patronage and support. The want of a safe place of deposit for their savings, where they would yield them a reasonable interest, and whence they could withdraw them at pleasure, has formed one of the most serious obstacles to the formation of a habit of accumulation among labourers. Public banks do not generally receive a less deposit than 10*l* ; and there are but very few amongst the labouring classes who find themselves suddenly masters of so large a sum ; while to accumulate so much by the weekly or monthly saving of a few shillings, appears at first view almost a hopeless task and should an individual have the resolution to attempt it, the temptation to break in upon his little stock at every call of necessity might be too strong to resist. At all events, the progressive addition of interest is lost during the period of accumulation, and it even frequently happens that the chest of the servant or labourer is not safe from the depredations of the dishonest ; while the very feeling of insecurity which such a circumstance inspires must operate as a fatal check to habits of saving A similar effect results from the instances that have often occurred, where those poor persons who had, in despite of every discouragement, accumulated a little capital, have been tempted, by the offer of a high rate of interest, to lend it to persons of doubtful characters and desperate fortunes, whose bankruptcy has involved them in irremediable ruin It is plain, therefore, that nothing could be more advantageous with a view to the formation of those improved habits that must necessarily result from the diffusion of a spirit of frugality and forethought among the poor, than the institution of savings' banks, or places of safe, convenient, and advantageous deposit for their smallest savings. They are no longer tempted, from the want of facility of investment, to waste what little they can save from their expenditure in frivolous or idle gratifications. They now feel assured that their savings, and the interest accumulated upon them, will be faithfully preserved to meet their future wants; and as there are very few who are insensible of the blessings of independence, there is no reason to suppose that they will be slow to avail themselves of the means of accumulation now in their power.

All moneys paid into any savings' bank established according to the provisions of the act 9 Geo 4. c. 92,, are ordered to be paid into the banks of England and Ireland, and vested in bank annuities or exchequer bills. The interest payable to depositors is not to exceed 3*l*. 0*s*. 10*d* per cent. per annum. No depositor can contribute more than 30*l*., exclusive of compound interest, to a savings' bank in any one year ; and the total deposits to be received from any one individual are not to exceed 150*l*.; and whenever the deposits, and compound interest accruing upon them, standing in the name of any one individual, shall amount to 200*l*., no farther interest shall be paid upon such deposit.

BA'NKRUPTCY, in Law, is a peculiar condition, with reference to legal liabilities and disabilities, into which certain classes of persons only are liable to fall. The word is said to be of Italian origin, and derived from the ceremony usual in some towns in the middle ages of breaking the bench or counter (bancus) occupied in the public exchange by the merchant

The statutes respecting bankruptcy begin at the 34 H 8 , and end with those of the 6 G 4 and 12 & 13 Vict., in which the principles of the law on this head are now contained

All persons engaged in trade, if in other respects capable of making valid contracts, are liable to be made bankrupts. The proof of trading is, buying and selling with a view to profit by dealing generally with the public, and it is a question of fact for the decision of a jury, whether a party be a trader or no. Acts of bankruptcy are of two sorts. 1 Such as tend to defraud or delay creditors. Such as departing from the realm under suspicious circumstances, keeping house, making a fraudulent conveyance, gift, or delivery of goods and chattels (in which all conveyances without a consideration, or voluntary conveyances, are included, and also conveyances or gifts to creditors with a fraudulent preference) 2 Such as are evidence of insolvency : as, for instance, a declaration of insolvency in the Gazette, a petition of insolvency in the Insolvent Debtors' Court, lying in prison twenty-one days after being arrested for a *bona fide* debt, or compounding under certain circumstances with a petitioning creditor. An assignment of the whole of a trader's effects for the benefit of his creditors is also an act of bankruptcy, on which a commission may be supported either immediately, or, under certain circumstances, within six months after such assignment has been made. An act of bankruptcy, concerted between a trader and his creditor with fraudulent views, is a contempt of court, and also an indictable offence.

When an act of bankruptcy has been committed by a trader, a commission, or, as it is now termed, a *flat* in the nature of a commission, may be sued out (with certain exceptions) immediately, by a creditor or creditors to a stated amount: such creditor is then termed a petitioning creditor. The bankruptcy will then be held to have commenced at the time when the act of bankruptcy on which the petition is supported was committed. The striking what is termed a docket in the bankrupt office gives priority of petitioning to a creditor. The fiat when issued is opened, and the circumstances necessary to constitute a bankruptcy proved before a commissioner of bankrupts. There are six commissioners, nominated according to the act of the 1st year of W. 4 ; and of these three together form a subdivision court for the purpose of acting in concert on questions of difficulty. The assignees of the estate and effects of the bankrupt are then chosen by the creditors among themselves ; and to an official assignee appointed

by the court, the whole property of the bankrupt is transferred and vested, subject to the direction of the court. From the decision of a commissioner or subdivision court there is an appeal to the court of review in bankruptcy, instituted by the same act; and from thence to the lord chancellor, and finally to the House of Lords. The jurisdiction in bankruptcy is both legal and equitable.

By the assignment, the whole property, real and personal, of the bankrupt, is vested in the assignees from the period of the act of bankruptcy, to the avoidance of all the bankrupt's subsequent transactions, except such as have been performed *bonâ fide* with parties having no notice of such act; the notice being understood according to ordinary rules in equity. Besides the bankrupt's own property, such property of third parties as shall have been in his use and disposition, or reputed ownership, by permission of the true owner, passes to his assignees. The bankrupt's right of action of contract, and of tort to property, but not personal torts, pass likewise to his assignees. But actions against him, except for the recovery of specific real property, do not lie against the assignees, the amount claimed being proveable as a debt under the commission; unless in some cases where the right of action has accrued subsequently to the appointment of the assignees. The debts which may be proved by creditors against the bankrupt's estate are either certain or uncertain in their amount the first class including such as are either specific sums of money lent or due, or such as are originally uncertain, but capable of being liquidated or reduced to a certain amount, the second, such as can only be estimated on general principles of equity. It is the business of the assignees to collect the estate of the bankrupt, as ascertained by his examination upon oath, and by inspection of his books, but monies on account of the bankrupt's estate are received by the official assignee alone, and paid by him into the Bank of England in the name of the accountant-general of the Court of Chancery.

After the last examination, a public meeting of creditors, of which twenty-one days' previous notice must be given in the Gazette, is appointed for the purpose of making the first dividend of the net estate after certain necessary liabilities have been provided for out of it. A second dividend, if necessary, is made within eighteen months of the issuing of the fiat, such second dividend being final, except some further property come to the assignees A bankrupt refusing to surrender his estate, or to make full discovery respecting it, is liable to transportation for life While the proceedings are going on, he is entitled to maintenance out of his estate. After hearing the case and judging of the conduct of the bankrupt during his examination, it is left to the commissioner of the court to grant, either a *first class* certificate, which declares that the trader's inability to pay his debts has arisen from misfortune only, or a *second class* certificate, which shows that it has arisen partly from misfortune, or a *third class*, in which it is declared not to have arisen from misfortune; and the effect of such a certificate upon the bankrupt's future prospects must be obvious. The effect of a certificate, besides entitling the bankrupt to an allowance, where a dividend of 10s. in the pound or upwards has been paid to the creditors (being a per-centage on his estate, limited, according to circumstances, so as not to exceed in any case 600*l* per annum), is to discharge his person and future estate from all claims and debts which might have been proved under the bankruptcy It has long been proposed to unite the bankrupt and insolvent courts.

BA'NKSIA. (In honour of Sir Joseph Banks, Bart., the great patron of natural history, and one of the companions of Captain Cook in his second voyage.) A genus of Proteaceous plants forming a conspicuous feature in the landscape of Australia, where the species are called by the colonists wild honeysuckle, and reckoned a sign of bad land. They have flowers and fruit growing in close hard downy or woolly cones, and hard broad leaves on branches so close and rigid that the traveller, it is said, may literally walk without inconvenience upon the top of a wood formed of these trees.

BA'NLIEUE. (Fr.) The territory without the walls, but comprised within the legal limits of a city or town. The word is evidently derived from Ban (bannus, &c.), but the immediate origin is unknown.

BANN. A proclamation commanding or forbidding any thing. Hence the public notices of marriage given in church, derived from the civil law, are called Banns of Marriage. According to the law of England, the banns must be published three successive Sundays; and if the marriage be not performed within three months from the last publication, the same process must be repeated. Bishops have the power of appointing surrogates, who may grant a faculty or licence to parties applying to be married without banns. But this licence may only be given under certain conditions, and upon good caution and security taken, such as to supersede the necessity of public proclamation.

BA'NNER. (Swed. baner; Fr. banniere) A flag or standard under which men are united or bound for some common purpose. This word, found in all the modern languages of Western Europe, is of very doubtful origin; it is a word of which our ancient English authors were exceedingly fond, and to which they invariably attach the same meaning. (Chaucer, *the Knight's Tale*, v. 978.; *Sir Thomas More's Works*, 207; Drayton, *Battle of Agincourt; Yalden to Sir H. Mackworth*, &c.) Among the ancient Germans, the honour of bearing a banner was conferred by the emperor on that individual who could bring ten vassals into the field. In later times, petty princes assumed this privilege; and in the year 1424 Pope Eugene IV. created Count Sforza banneret (bannerherrn) of the Roman empire In the free towns on the Continent, the banner was always carried by the chief magistrate ex officio, in cases of solemnities or of grand processions. In England, a knight banneret was created by the ceremony of cutting off the four corners of his standard and making it square. Some antiquarians trace the origin of this custom to Conan, the lieutenant of Maximus, who governed Britain in the year 383 (Gwillim, *Analogia Honorum*); while others maintain it took its rise from the Black Prince on the field of Cressy. A wonderful similarity seems to exist between the duties and privileges of the old knights bannerets of England and those of the primipili (the standard bearers) among the Romans. (*Tac. Histor.* iii. 22.) Several banners are famous in history; such as the Danish banner, taken from the Danes by Alfred the Great, and the oriflamme of the French, which, after passing through various hands, became eventually the great standard of France. (Lanzelot, *Memoires de l'Academie des Inscriptions.*)

BANNER. The ordnance flag, fixed on the forepart of the drum-major's kettle-drum carriage, formerly used by the royal artillery At present, when such a flag is carried it is affixed to the carriage of the right-hand gun of the park — generally a twelve-pounder.

In the horse equipage the *banner* of the drums and trumpets must be of the colour of the facings of the regiment: it bears the royal cypher and crown, and the rank of the regiment.

BA'NNERET. A knight who in the feudal times possessed a certain amount of fiefs, and had the right of carrying a "banner." This honour was also very generally adopted among European nations, and was awarded on the field of battle to such as had there distinguished themselves. Knights bannerets were considered, in England, next to barons in precedence. The dignity has not been conferred for a long period. The banner of a banneret was oblong, that of a baron square. When a knight bachelor was made banneret on the field of battle, the ceremony was performed by cutting off the ends or tails of his pennon, and thus converting it into a banner. *See* KNIGHT.

BA'NYAN. A kind of Indian fig, the *Ficus indica* of Linnæus, forming a very large tree, which sends down roots from its branches, and those roots striking into the ground themselves become trunks, which serve as props to the extending branches; and as the tree is very long-lived, the quantity of ground an individual will thus cover is incredible. Dr. Roxburgh says, he has seen the tree 100 feet high, and full 500 yards in circumference round the extremities of the branches. It is found wild in the skirts of the Circar mountains; its leaves are used by the Brahmins as plates to eat off, a species of birdlime is obtained from its juice, and the fruit is eaten by birds.

BA'OBAB. The African name of *Adansonia digitata*, a tree inhabiting the western side of Africa, and cultivated in Egypt and Abyssinia. It increases more in proportion in diameter than in height; so that it may be seen with a trunk 10 yards in thickness and only 73 feet high, its appearance being lumpish and inelegant It is supposed that the most remarkable cases of longevity in the vegetable kingdom are afforded by this tree Adanson is quoted by De Candolle as asserting that he saw individuals which must have been 6000 years old; and other travellers declare that however ancient the individuals may be, the bark is always green and shining, and so full of life that an abundant discharge takes place at the least wound. It is probable that the data upon which these calculations are made will not bear strict investigation; nevertheless, there can be no reasonable doubt of the Baobab trees arriving at a most unusual age. The leaves are employed in powder as an ingredient in African cookery; and the fruit has a sub-acid juice, which makes it valuable in fevers.

BA'PHOMET. The imaginary idol, or rather symbol, which the Templars were accused of employing in their mysterious rites. (*See* TEMPLARS.) The distinguished orientalist Hammer has published a dissertation on this subject, in which he endeavours to revive the ancient accusations against that military order. These images, which he calls Baphomet, are to be found in some of the museums of continental cities; they are small human figures with two heads, and covered with emblems, to which Hammer attaches a very horrible signifi-

cation. He derives the name (very improbably) from the Greek words βαφη, dipping or baptism, and μητις, counsel or wisdom: as if they represented the admission of the initiated to the secret mysteries of the sect. It is proper to observe, that other writers have treated all this discovery as a mere fancy of the learned orientalist, and maintain that the figures which he terms Baphomets are in reality relics of the art magic: while the word itself is supposed to be a corruption (arising from the negligence of some transcriber) of the name Mahomet, occurring in the depositions of witnesses against those unfortunate knights.

BA'PTISM. (Gr. βάπτω, *I dip.*) The rite of initiation into the community of Christians, ordained by Christ himself, when he commissioned his apostles to go and baptize all nations in the name of the Father, the Son, and the Holy Ghost.

It is recorded by the Evangelists, that our Saviour himself received baptism from John, and the ceremony which the Baptist performed is allowed generally to have been an imitation of a rite in common practice among the Jews, who appear to have admitted proselytes by circumcision and baptism. Lustration, however, by water, as an initiatory rite, is of great antiquity and general practice, especially in the East, and Christian baptism may be considered as an adaptation of a form which was generally understood to have a symbolical meaning. Accordingly, it has been recognised by all Christian communities as a sacrament, although they have differed in their explanation of its nature and meaning. It is upon this point that the question of the validity of infant baptism principally depends; the words of Scripture in that particular not being allowed on all hands to be decisive, nor even the practice of the early church universally admitted. Those, therefore, who consider baptism to be a symbol of a covenant thereupon entered into between God and the person baptized, require the understanding of the person to accompany the act, and reject the notion of sponsors undertaking to promise on the part of infants. The more common notion, however, conceives this sacrament to have in itself a regenerative virtue, by which an infant may be received into participation in the promises made to the church, and be really and truly from that time forth put into the way of salvation.

Baptism was originally administered by immersion, which act is thought by some to be necessary to the sacrament. It is not clear, however, even in the Scripture history, that this ceremony was always adhered to. At present sprinkling is generally substituted for dipping, at least in northern climates.

BA'PTISTERY. (Gr. βαπτιζω, *I baptize.*) In Architecture, a building destined for the purpose of administering the rite of baptism. Some authors have contended that the baptistery was anciently placed in the interior vestibules of the early churches, as are in our days baptismal fonts. But this is not so: the baptistery was entirely separated from the basilica, and even placed at some distance from it. Up to the end of the sixth century, after which period the interior vestibule of the church received it, the baptistery was distinct from the church, and excepting in a few churches, such as that at Florence, and those of all the episcopal cities of Tuscany, Ravenna, and San Giovanni Laterano, and perhaps of a few other places, the practice was general. The last mentioned is perhaps the most ancient remaining. One at Constantinople was so large that on one occasion it held a very numerous council. The baptistery of Florence is nearly 90 feet in diameter, octagonal, and covered with a dome. The celebrated bronze gates by Lorenzo Ghiberti, which Buonarroti said were fit to be the gates of Paradise, enclose it. The baptistery at Pisa, designed by Diotisalvi, was finished about 1160. It is octagonal, about 129 feet in diameter, and 179 feet high. We are not aware of any building of this sort having been erected in England.

BA'PTISTS. A denomination of Christians, who deny the validity of infant baptism, and maintain the necessity of immersion. These were also the principal tenets of the Anabaptists, or Rebaptizers, with whom, however, the modern Baptists ought not to be confounded. They are subdivided into two classes, the Particular (Calvinist) and the General (Arminian) Baptists. The mode of church government is similar with both, acknowledging three orders of ministers; of whom the messengers correspond to bishops, the elders to priests, and ministering brethren to deacons. Their churches are congregational, and in respect to the election of their own ministers independent. Each denomination has, however, its general assembly, possessing some kind of authority over the whole community. The Baptists are numerous in Holland, where they are known by the title of Mennonites; and in England they form one of the principal Dissenting bodies.

BAR. A shoal often found lying across the mouth of rivers, and also of harbours; thence called bar harbours. As the sea breaks on these places, in bad weather the passage of a bar is generally dangerous.

BAR, CONFEDERATION OF. In Politics, was an association of a few influential Polish nobles, formed at Bar, a small town of Podolia, in the year 1767, for the purpose of freeing their country from foreign influence. Their efforts, however, were eminently unsuccessful: the small bands of the patriots were annihilated one by one; and their defeat gave rise to an event almost unprecedented in history, — the partition of Poland by the three neighbouring powers.

BAR. The bar or place in the courts of law where barristers or advocates plead: also where prisoners accused of felony are stationed for arraignment and trial.

BAR. In Heraldry, a kind of ordinary, resembling the *fess*, but containing only the fifth part of the field. Where two bars are borne in an escutcheon, they are so arranged that the whole field appears divided into five parts. A field divided by horizontal lines into four, six, eight, ten, or twelve equal parts, with alternate tinctures, is termed *barry* of four, six, eight, &c.

BAR. (Sax. Beorgan, *to bar.*) In Music, a line drawn vertically across the lines of the staff, including a certain quantity or measure of time, varying as the music is either triple or common.

BAR, ELOQUENCE OF. *See* ELOQUENCE.

BA'RBA. (Lat barba, *a beard.*) In Mammalogy, signifies the long tuft of hair dependent from the under jaw. In Ornithology, the same term is applied to the setiform or simple feathers, which in some species of birds depend from the skin covering the gullet or crop. In Ichthyology, a kind of spine, with the teeth pointing backwards.

BARBA. A beard; a term used in Botany to denote any collection of long loose hairs into a tuft or crest, as on the petals of the iris.

BARBA'DOES LEG. A disease indigenous to Barbadoes, in which the limb becomes tumid, hard, and misshapen.

BA'RBARISM. (Gr.) In Rhetoric, an offence against purity of style or language, which consists in employing uncouth or antiquated expressions, or in assigning to terms a different signification from that which usage has conferred on them.

BA'RBASTELLE. A small indigenous bat; *Plecotus barbastellus*, Lisson.

BA'RBEL. An indigenous fresh-water fish (*Cyprinus barbus*, Linn.) which takes its name from the processes termed Barbels.

BA'RBELLATE. (Lat. barba.) When the pappus of composite plants is bearded by short, stiff, straight bristles, as in Centaurea. Barbellulate is used when the roughness of the pappus is caused by extremely short points, as in Aster.

BA'RBELS. Small cylindrical vermiform processes appended to the mouth of certain fishes, and subservient to the sense of touch.

BA'RBER. (Lat. barba.) A person who makes a trade of shaving and dressing the hair of other people for money. It would seem that it is only where a state has made considerable progress in civilisation that this art begins to flourish. If we believe Varro, for instance (*Plin.* 7. 56.), it was not until the 454th year of the city that Ticinius Mena first imported barbers into Rome from Sicily. Their shops (Tonstrinæ) soon became the resort of fashionable loungers and idlers, and Horace, to indicate the extreme notoriety of a story, says that it was "omnibus et lippis notum et tonsoribus." Even the poorest citizens, according to the same author, sought refuge from their ennui in making a round of the barbers' shops.—

Mutat cœnacula, lectos,
Balnea, tonsores.

That the Romans paid great attention to this department of the toilet, is obvious from the ridicule that was excited against any citizen whose hair bore marks of being cut "inæquali tonsore" (by a bungling barber).

But besides shaving the beard, to the barbers of the Romans was assigned the delicate task of trimming the nails. Hence Plautus, *Aulul.* ii 4 33 —"Quin ipsi pridem tonsor ungues dempserat," and Tibullus, 1. 9. 11. —

Quid ungues
Artificis doctâ subsecuisse manu.

As early as the time of Hippocrates, some surgical operations were considered as degrading to physicians, and consequently fell to be performed by barbers. In France the council of Tours, in the year 1163, prohibited the clergy, who then shared with the Jews the practice of medicine in Christian Europe, from performing any bloody operation; and from that time the barbers remained for some centuries in uninterrupted possession of the practice of surgery. In England also, early in the 16th century, the barbers were incorporated with the surgeons of London (32 Hen. 8. c. 42.); but at the commencement of last century, when a new impulse was given to the science of surgery by the attainments and ability of many practitioners throughout Europe, the

barbers were degraded from their honourable association with surgeons. (18 Geo. 2. c. 15 ) In Holland and Germany to this day the barbers are wont to wield the lancet and the razor alternately. Nowhere, however, in these countries is the business of haircutting carried on by the barbers, but by a distinct and superior class, the friseurs. The barber's pole has given rise to many speculations and ingenious absurdities. The fact is, that the pole was the distinguishing characteristic of a few only, being a mark of superior skill, and indicated on the part of him who possessed it surgical as well as tonsorial ability. (For some curious remarks on the barbers of Edinburgh, vide *Creech's Statistical Account of Edinburgh* )

BA'RBERRY. *See* BERBERRY.

BA'RBICAN. A watch tower for the purpose of observing the enemy: also the outer work or defence of a castle, or the fort at the entrance of a bridge. Apertures in the walls of a fortress for firing through upon the enemy are also called barbicans. Authors have ascribed to this word a French, Italian, Spanish, Saxon, and Arabic origin

BA'RBITON. An ancient musical instrument, somewhat resembling the lyre

BAR'BULA (Lat barba, *a beard* ) A finely-divided beard-like apex to the peristome of some mosses, as in the genus Tortula.

BA'RCAROLLE. A song sung by the Venetian gondoliers A boat song (from the Italian *barcarola*)

BARDS. The ancient poets of the Celtic tribes are so termed by the Roman writers The etymology of the word is uncertain. According to the ancients, they appear to have been the priests as well as the instructors of these tribes, and regarded with peculiar veneration. Lucan expressly mentions the doctrine of the immortality of the soul as one of their most characteristic tenets After the introduction of Christianity the importance of the bards in society diminished, but in Wales, Ireland, and other Celtic districts, they continued to be held in much honour. The most ancient compositions of Welsh bards which we possess (those of Taliessin, Aneurin, and Lywarch) are supposed to be of the sixth century

BARE POLES The masts without any sails upon them, the ship being at sea Under bare poles, in general, implies that the wind is so high that no sail can be exposed to it

BA'RGAIN. *See* CONTRACT

BARGE (Gr *βάρις, a kind of ship* ) A general name given to flat-bottomed craft of a certain size employed on rivers and canals Also one of the larger boats of a man of war, between 30 and 40 feet long Barge is also a general term for boats of state or pleasure

BARGE BOARDS (Sax **byrgan**, *to bar* ) In Architecture, the inclined projecting boards placed at the gable of a building, which hide the ends of the horizontal timbers of a roof, and are frequently carved with trefoils, quatrefoils, flowers, and other ornaments

BARGE COURSE In Architecture, that part of the tiling of a roof which projects beyond the external face of the gable of a building.

BARILLA The name given in commerce to the impure carbonate of soda, imported from Spain and the Levant It is made by burning certain plants that grow upon the sea shore, especially the salsola soda, to ashes, which are fused into grey porous masses (For an account of the places where it is produced, the quantities shipped from them, and the uses to which it is applied, see *M'Culloch's Commercial Dictionary* )

BA'RITONE (Gr *βαρυς, heavy*, and *τονος, a tone.*) In Music, a high bass, which, in the ancient church music, is written with the F clef on the third line of the staff By the French it is called basse-taille

BA'RIUM. The metallic base of baryta; it is of a grey colour, more than twice as heavy as water, and is instantly oxidized by air and by water

BARK (Ger bergen, *to cover*.) The exterior covering of the trunk of a tree. It is composed of cellular tissue, traversed by woody tissue passing down it longitudinally, and connected with the medullary processes of the wood It is increased in trees by annual layers formed on its inner face, and gradually perishes on the outside as it is distended by the growth of the interior. It seldom, however, shows any very distinct trace of concentric circles, because the latter are continually displaced and disturbed by its distention Its inner face is named liber At the commencement of the annual growth of a tree, it separates spontaneously from the wood, in order to make room for the new matter forming beneath it. It is the depositary of many of the secretions of plants, and seems to act as a living filter of a curious kind, separating certain secretions from others, and allowing a part only to pass off horizontally in the medullary processes on their way to the centre of the tree. Its use is to act as a protector to the wood, and as the channel of the sap in its descent from the leaves. Its fibre is often tenacious, and manufactured into linen or cordage. True bark only exists in Exogens and Gymnosperms ; in Endogens its place is supplied by a cortical integument, which cannot be separated from the subjacent wood without violence.

BARK, PERUVIAN. *See* CINCHONA.

BARK. Originally a general term for a vessel, is now restricted to a particular form of rig ; namely, that of a ship, but having a gaff topsail instead of the square mizen topsail.

BARK, USE OF IN TANNING. *See* TANNERS' BARK.

BA'RKING IRONS. Instruments for removing the bark of oak and other trees which is used for tanning. They consist of a blade or knife for cutting the bark, while yet on the trunk, across at regular distances, and of chisels or spatulæ, of different lengths and breadths, for separating the bark from the wood.

BARK STOVE A glazed structure for tropical plants, in which there is a bed of tanner's bark, or of some other fermentable material, which will produce a moist heat.

BA'RLEY. (Hordeum, *L.* , Triandria monogynia, *L.*; Gramineæ, *Juss.*; characterised by an imbricated-spiked inflorescence, consisting of one-flowered spikelets in twos or threes ) A bread corn of considerable importance. Its native country is unknown, some ascribing it to Tartary, others to Siberia, and a few to Scotland. In Spain and Sicily it produces two crops in the year ; but in countries as far north as Britain it produces only one, and is rather a delicate species of grain. In England it is second in importance to wheat. It is a most valuable crop in the rotation best adapted to light or turnip soils, which, from that circumstance, are sometimes called barley lands. Where its culture is best understood, as in Norfolk, it is generally preceded by turnips or other green crop. There are two leading species of this grain in cultivation, — the *Hordeum distichon*, two-rowed or common barley ; and the *Hordeum hexastichon*, or six-rowed barley One of the best known varieties of the latter, and the only one in common cultivation in Scotland, is called bear or bigg. It is not now very extensively used as a bread corn , but it is used very extensively in malting, and in the fatting of black cattle, hogs, and poultry The crops differ very widely, according to the land and the season, varying from 28 to 64 bushels an acre ; but the most usual crop is from 28 to 40 bushels. The common weight of barley is 50 or 51 lbs per Winchester bushel, but the best Norfolk barley weighs 53 or 54 lbs

BA'RNACLES *See* CIRRIPEDS.

BARO'METER. (Gr. *βαρος, weight*, and *μετρον, measure* ) A well-known instrument for measuring the weight or pressure of the atmosphere The invention of the barometer was in some degree owing to an accident. Some workmen employed by the Duke of Florence to prepare a sucking-pump for a deep well, found to their surprise that notwithstanding their utmost care in forming and fitting the valves and piston, the water would not rise higher than 18 palms, or about 32 English feet For an explanation of this unexpected difficulty they applied to the illustrious Galileo, then passing the evening of his life at his villa near Arcetri , but the philosopher was not yet prepared with the true answer. In that age the doctrine of a *plenum* was an axiom in philosophy , and the ascent of water in the barrel of the pump was universally ascribed to nature's horror of *a vacuum* Galileo, either fearing to encounter further persecutions by propounding opinions at variance with the prejudices of the times, or preoccupied by the prevailing metaphorical modes of expression, evaded the difficulty by saying that the power of nature to overcome a vacuum was limited, and did not exceed the pressure of a column of water 32 feet in height That he was himself little satisfied with this explanation, is evident from the circumstance that previously to his death, which happened soon after, in 1642, he earnestly recommended to his pupil Torricelli to undertake the investigation of the subject, which the infirmities of advanced age no longer permitted him to prosecute. Torricelli, suspecting the true cause of the suspension of the water, namely, the weight of the atmosphere, happily conceived the idea of trying the experiment with mercury He perceived that if the weight of the atmosphere forms a counterpoise to a column of water of 32 feet, it must also counterpoise a column of mercury of about 28 inches in height, the weight of mercury being about 14 times greater than that of water Having accordingly procured a glass tube of about 3 feet in length and a quarter of an inch in diameter, hermetically sealed at one end, he filled it with mercury , and covering the open end with the finger, he immerged it in an open vessel containing mercury. On bringing the tube to the vertical position, and removing the finger, the mercury instantly sunk, leaving a vacuum at the top of the tube, and, after making several oscillations, stood in the tube at the height of about 28 inches above the surface of that in the vessel. On covering the mercury in the vessel with a portion of water, and raising the tube till the lower end came into contact with the water, the mercury all ran out, and the water rushed up to the top of the tube. This experiment,

called after its author the *Torricellian experiment*, demonstrated that the mercury was sustained in the tube, and the water in the barrel of the pump, by exactly the same counterpoise, whatever the nature of it might be. Torricelli died shortly after, in the flower of his age, without completing his great discovery; but the fame of his experiment was soon carried into other countries, and the subject engaged the attention of the most eminent philosophers; among others the celebrated Pascal. After a variety of ingenious experiments on the subject, all of which tended to establish the pressure of the atmosphere, it at length occurred to Pascal that if the mercurial column was really supported by atmospheric pressure, it must be affected by the weight of the superincumbent mass of air, and consequently be diminished at considerable elevations In order to verify this conjecture, he requested his brother-in-law, Perier, to try the experiment on the *Puy de Dome*, a lofty conical mountain in the province of Auvergne, which rises to the height of 500 toises. At the foot of the mountain Perier filled two tubes, and observed the mercury in each to stand at precisely the same height, nearly 28 English inches. Leaving one of them under the care of a person to watch its rise or fall, he carried the other to the top of the mountain; and on repeating the experiment there, the mercury stood at the height of only 24 7 English inches. At two intermediate stations in his descent, the mercury was observed successively to rise, and at the foot of the mountain it stood at exactly the same height in the tube as at first. This experiment was decisive; the result of it was communicated to Pascal at Paris, who, after confirming it by similar observations made successively on the ground, and at the top of a glass-house and the belfry of a church, proposed the barometer as an instrument for measuring the height of mountains, or the relative altitudes of places above the surface of the earth.

The barometer had been but a short time invented, before it was observed that the height of the mercurial column is subject to variations connected in some way with the changes of weather But the variations are confined within a limited range, scarcely exceeding 3 inches in all, and often, for many days together, do not exceed a few hundredths of an inch It therefore was considered desirable to render these minute oscillations more apparent by increasing their range, and accordingly, of the numerous forms which the barometer has received, or which have been suggested, the greater part have been proposed with a view to this purpose The most remarkable or useful constructions are the following, the descriptions of which will be readily understood with the assistance of the diagrams —

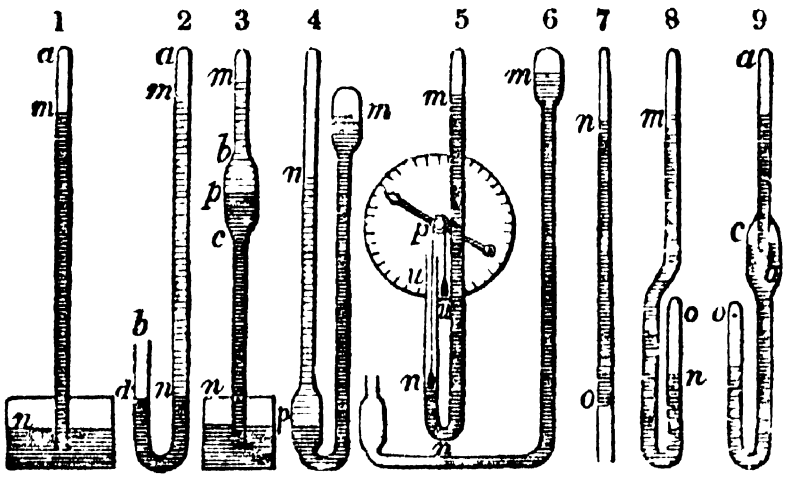



Fig 1. is the *Cistern Barometer*, and is merely the inverted tube of Torricelli already described The tube must be about 34 inches long. When placed in the cistern, the mercury sinks till the column between the two surfaces $m$ and $n$ just counterbalances the pressure of the air. The space above the mercury, $a\,m$, is or ought to be a perfect vacuum, or only filled with the vapour of mercury. In this barometer, as the diameter of the cistern is generally very much greater than that of the tube, almost the whole effect of the rise or fall is perceived in the variation of the upper surface at $m$. For supposing the section of the cistern 20 times greater than that of the tube, and that the height of the column $m\,n$ suffers a diminution of one inch; it is evident that, as all the mercury which goes out of the tube passes into the cistern, when it falls at $m$ it must rise at $n$, but less in proportion as the section of the cistern exceeds that of the tube. In the case supposed, therefore, the alteration of the level at $m$ will be 20 times greater than at $n$; that is to say, there will be a fall of $\frac{20}{21}$ of an inch at $m$, and a rise of $\frac{1}{21}$ of an inch at $n$.

Fig 2. is the *Siphon Barometer*, which was also proposed by Torricelli, as being more convenient than the former. It is merely a tube hermetically sealed at the upper end, having the lower or open end bent upwards in the form of a siphon. The variations in this are only half as great as in the cistern barometer, for the tube being of the same width throughout, a diminution of the column $m\,n$ amounting to one inch will be marked by a fall of half an inch at $m$ and a rise of half an inch at $n$. This inconvenience may, however, be remedied by having the lower branch blown into a wide bulb; but as it is very difficult to procure the bulb to be blown into a perfectly regular shape, this enlargement of the bulb is found to give rise to inaccuracies.

Fig 3. is a barometer suggested by Descartes, and executed by Huygens, in which the sensibility is greatly increased. Two tubes are cemented to the opposite ends of a pretty wide cylinder, $b\,c$. The lower tube and a portion of the cylinder, $c\,p$, are filled with mercury; above which water or spirit of wine is introduced, reaching to the top of the upper tube, which is hermetically sealed. The vacuum is made, as in the Torricellian barometer, by inverting the compound tube in a basin of mercury. The enlargement of the scale obtained by this construction is found thus: Suppose the horizontal section of the cylinder, $b\,c$, to be 10 times that of the tube, and the specific gravity of mercury 14 times that of water. Let $x$ be the fall of the mercury in the cylinder at $p$, corresponding to a fall of one inch of the common Torricellian barometer. The descent of the water $x$ inches at $p$ will be marked by a descent of $10\,x$ inches in the tube at $m$. But the diminution of the height of the column of water must correspond to a diminution of $(1-x)$ inches in the height of the column of mercury of equal weight with the water; therefore, the diminution of the column of water is $14\,(1-x)$ inches Hence $10\,x = 14\,(1-x)$, or $x = \frac{7}{12}$, and the descent of the water at $m = \frac{70}{12} = 5\frac{5}{6}$; that is to say, when the Torricellian barometer falls one inch, the barometer of Descartes falls $5\frac{5}{6}$ inches. The defect of this construction is, that the air contained in the water escapes into the vacuum above, and destroys the accuracy of the instrument.

Fig 4 is a form proposed by Huygens, to obviate the defect of the former. The siphon barometer terminates in two equal cisterns, or enlarged tubes; that at the open end communicating with a narrow tube containing water. In this case we may neglect the weight of the water between $n$ and $p$, or consider it as a small addition to the weight of the atmosphere; the variations at $n$ will be then as much greater than in the common siphon barometer as the horizontal section of the cisterns exceeds that of the tube at $n$ Thus, suppose the section of the cistern 10 times that of the tube, a variation of atmospheric pressure causing a fall of one inch in the Torricellian barometer will cause the mercury at $p$ in this barometer to rise half an inch, and the water at $n$ to rise 10 times as much, or 5 inches The defects of this barometer are these first, as the water descends at $n$, a portion of it adheres to the sides of the tube, and consequently diminishes the length of the column, secondly, the volume of the fluid in the reservoir is considerably affected by the influence of heat and cold; and, thirdly, the instrument is subject to constant derangement from the evaporation of the water.

Fig. 5 is the *Wheel Barometer*, proposed by Hooke. A small weight floats on the surface of the mercury in a siphon barometer, which is very nearly counterpoised by another weight, $w$, connected with the former by a string passing over a pulley, $p$. When the mercury rises at $n$, the weight $w$ descends, and turns the pulley An index attached to the axle of the pulley shows on a dial the quantity of revolution. This barometer, though very commonly met with, is a mere toy, and indicates neither the absolute height of the mercurial column, nor its variations, with sufficient accuracy to be of the slightest use for any philosophical purpose whatever. Even as a weather glass, it is the worst of all the common forms of the barometer.

Sir Samuel Moreland proposed to enlarge the scale, by inclining the upper part of the tube so as to form a considerable angle with the perpendicular By this contrivance the scale is increased in the proportion of radius to the cosine of the angle of inclination; but the friction on the sides of the tube is greatly increased, and it is very difficult to determine the exact plane of the top of the column which requires to be read off on a vertical scale. This construction is easily conceived without a diagram.

Fig. 6. is a form proposed by John Bernoulli. The tube terminates in a horizontal branch of considerable length and small diameter: the pressure of air on the column of mercury is exerted horizontally, and by making the vacuum in a cistern at the top, the range becomes very great; but the mercury moves along the horizontal branch with difficulty, and by starts. No reliance can be placed on its indications.

Fig. 7. represents an extremely elegant and ingenious form of the barometer proposed by Amontons. A conical tube about 4 feet long, closed at the top, is partly filled with mercury, and inverted. The diameter of the tube must be small, scarcely exceeding 3-20ths of an inch at

the wide end, and tapering away to about 1-10th near the top. The pressure of the atmosphere from beneath prevents the mercury from falling out, but it descends in the tube till it comes into such a position that the height of the vertical column forms an exact counterpoise to the atmospheric pressure. If the pressure is diminished, the mercury sinks a little at *n*; but as it there fills a tube of larger diameter, its vertical height undergoes a corresponding diminution. The height of the upper surface at *m* therefore marks the absolute height of the vertical column, supposing the tube to taper equally; but the difficulty, or rather the impossibility, of fulfilling this condition practically, prevents this kind of barometer from being used.

We shall notice only one or two other forms of the barometer, proposed with a different view from that of enlarging the scale. Fig. 8. is a modification of the siphon barometer proposed by Gay Lussac. It differs from the common form in this respect, that, after the tube has been filled, the short branch is hermetically closed at the top, and the communication with the atmosphere takes place through a small capillary hole drilled laterally through the tube at *o*, so fine that though it admits the air to pass freely, it prevents the passage of the mercury. The barometer is thus rendered very convenient for carriage, but notwithstanding the promising appearance of this barometer, it has been found, particularly in travelling, that a portion of air will frequently insinuate itself through the mercury. In order to prevent the possibility of this accident, an ingenious modification has been made by M. Bunten, a Parisian artist. It consists in causing the part of the tube *a b* to terminate in a very fine point, and to penetrate to some depth into the other part *c o*, to which it is joined at *c*, in the manner represented in fig 9 Now if an air bubble from the end *o*, which communicates with the atmosphere, should find its way through the bent capillary tube, it will pass along the sides of the bulging part, and instead of penetrating to the vacuum at *a*, will be arrested at *c*, whence it is easily expelled by reversing the barometer

None of the contrivances which have been described for increasing the range of the oscillations have been found to succeed well in practice. It is found to be decidedly better to apply minute divisions, than to attempt to enlarge the scale, accordingly, experimenters now adhere to one or other of the two ancient forms, the cistern barometer and the siphon barometer. The height of the column in the siphon barometer is conveniently measured by means of a moveable scale attached to the frame which supports the tube; by means of a tangent screw, the scale is raised or lowered till its zero coincides exactly with the surface of the mercury in the lower branch; and with the assistance of a vernier, the height can be read off to the hundredth or two-hundredth of an inch with sufficient precision. The scale of the cistern barometer is usually fixed, and the bottom of the cistern is raised or lowered by a screw till the surface of the mercury in it coincides with the zero of the scale; but the scale may be moveable, and its zero brought to coincide with the surface of the mercury in the basin, as in the former case In order to determine when this coincidence takes place, various expedients may be had recourse to. The most usual is to place on the surface of the mercury a float carrying a vertical needle, some point on which answers to a fixed point on the scale, and the coincidence obtains when the two points are brought into the same level Another contrivance to effect the same purpose was employed by Fortin, a celebrated French artist. An ivory needle is attached to the scale, pointing downwards, and having its point exactly in the same level with the zero of the scale. The image of the needle is clearly reflected from the surface of the mercury in the cistern, and the cistern is raised or lowered till the point of the needle and its image precisely coincide

In order to construct a good barometer, it is indispensably necessary that the mercury be perfectly free from impurities, and carefully purged of air, this is obtained by boiling it. The particles of air and moisture which cling obstinately to the sides of the tube must also be expelled by heat; the mercury must then be introduced slowly and continuously in a hot state, and while the tube continues hot Since the time of Deluc it has been usual to boil the mercury in the tube before inverting it and forming the vacuum; but doubts now begin to be entertained among the most skilful makers of the expediency of this very troublesome process. The mercury is partially oxydated by boiling, and a thin crust formed, which keeps the column suspended at a greater height, and obstructs the freedom of the motion. It is important that the diameter of the tube be not very small; for it is found that the mercury moves with more freedom in a tube of considerable width, the oscillations following the atmospheric changes with more promptitude than in one of smaller dimensions; besides which, there is less disturbance from capillary attraction. The interior diameter should in every case exceed one fourth of an inch.

The value of the barometer as a scientific instrument depends on the purity of the mercury, and the total exclusion of atmospheric air. By proper care in the construction, it is, perhaps, possible to expel every particle of air from the mercury and the interior of the tube when the barometer is made; but it seems doubtful if, by any means whatever, it can be preserved for a considerable length of time in this state. The most carefully constructed barometers are liable to a slow and gradual deterioration by the intrusion of air, which has been supposed to insinuate itself between the metal and the tube, and not through the mercury. To obviate this inconvenience Professor Daniell conceived the ingenious idea of fixing to the open end of the tube of the cistern barometer a substance having a greater affinity than glass for mercury. "I caused," says he, "a small thin piece of platinum tube to be made, about the third of an inch in length, and of the diameter of the glass tube; this was carefully welded to its open end, so that the barometer tube terminated in a ring of platinum. The tube was filled and boiled as usual, and the infiltration of air was completely prevented by the adhesion of the mercury both to the interior and exterior surface of the platinum guard. I have no doubt that a mere ring of wire welded, or even cemented, upon the exterior surface of the glass, which would be a much easier and less expensive operation, would be a sufficient protection, as the slightest line of perfect contact must effectually arrest the passage of the air."—*Meteorological Essays*, p. 577. He farther states, that though time alone can fully confirm the efficacy of the platinum guard, the experiments, as far as they have gone, have been completely satisfactory.

*Corrections necessary* — In all barometic observations there are, in general, two essential corrections to be made; one for the capillarity or depression of the mercury in the tube, and the other for temperature. Pure mercury in a glass tube always assumes a convex surface. The following are the corrections for tubes of different diameters, according to the theory of Mr. Ivory. (*Encyc. Brit*, art. "Capillary Action.")

| Diam. of Tube. | Depression. | Diam. of Tube. | Depression. |
|---|---|---|---|
| *Inches* | *Inches.* | *Inches.* | *Inches.* |
| ·10 | ·1403. | ·40 | 0153. |
| 15 | ·0863. | 45 | ·0112. |
| 20 | ·0581. | ·50 | 0083. |
| ·25 | ·0407. | 60 | 0044. |
| 30 | 0292. | 70 | ·0023. |
| ·35 | ·0211. | ·80 | ·0012. |

These corrections, which must always be applied to cistern barometers, show that wide tubes ought to be preferred, in fact, when the diameter of the tube exceeds half an inch, they may be safely omitted In siphon barometers having both branches of the same diameter, the depression is equal at both ends, consequently the effect is destroyed, and no correction is required. This is a considerable advantage; for notwithstanding the most elaborate calculations, some uncertainty must always remain with regard to the exact amount of the capillary repulsion

The correction for the temperature, which is the most important, depends on the expansion of the mercury, and the expansion of the scale on which the divisions are marked If we make $a =$ the height of the thermometer in degrees above the freezing-point, $x =$ the fractional part of its bulk which mercury expands for one degree of heat on Fahrenheit's scale, $y =$ the fractional part of its length by which the scale increases, $h =$ the observed height of the barometer, then the height which would have been observed had the thermometer stood at the freezing point is

$$h - h\,a\,(x - y).$$

The expansion of mercury in part of its bulk is ·0001001. The scale is generally of some mixed metal of which the expansion is not very well ascertained· supposing it to be equal to that of copper, the expansion would be ·0000096; therefore it will be sufficiently accurate to neglect the temperature of the scale, and assume that of the mercury to be 0001. Hence the following practical rule for reducing an observed height to the corresponding height at the temperature of the freezing point. "Subtract the ten-thousandth part of the observed altitude for every degree of Fahrenheit above 32" Suppose the thermometer 54° and the barometer 30 inches, the correction will be $(54-32)\times 30\times ·0001 = 066$, to be subtracted from 30 inches In order to find the value of this correction a thermometer must be attached to the barometer, and observed at the same time. A table, showing the correction for temperature for every degree of Fahrenheit from 30° to 90°, and for every difference of half an inch in the height of the mercury from 28 to 30·5 inches, was constructed by Professor Schumacher, and is given by Mr. Baily in the *Phil. Trans.* for 1837, p. 434.

*Cause of the variations of the barometer.* — Various theories have been proposed to account for those frequent

atmospherical changes which cause the rise and fall of the barometer, but none of them can be regarded as very satisfactory. Whatever tends to increase or diminish the vertical pressure will obviously cause the barometer to rise or fall; but the vertical pressure may be increased either by an influx of winds and the accumulation of air at any place, or by a diminution of the elasticity of the atmosphere. The presence of heat or of moisture augments the elasticity, and consequently reduces the weight of the vertical column. During the prevalence of northerly and easterly winds the barometer stands high, the elasticity being diminished by the cold. But the real difficulty, Professor Leslie remarks, "consists in explaining why the variations of the barometer should be greater in the high latitudes than between the tropics, and why they should exceed in all cases the quantities which calculation might assign. The only mode, perhaps, of removing the difficulty is to take into consideration the comparative slowness with which any force is propagated through the vast body of the atmosphere. An inequality may continue to accumulate in one spot before the counterbalancing influence of the distant portions of the aerial fluid can arrive to modify the result. In the higher latitudes, the narrow circle of air may be considered as in some measure insulated from the expanded ocean of atmosphere; and hence, perhaps, the variations of the barometer are concentrated there, and swelled beyond the due proportion"—*Encyc. Brit*

*Uses of the barometer*.—The barometer is an instrument of great importance in astronomy, its indications forming an essential element in determining the amount of atmospherical refraction (*See* REFRACTION). It is also, on account of its application to the measurement of altitudes, indispensable in all researches connected with climate (*See* HEIGHTS, MEASUREMENT OF). The purpose for which it is most commonly sought after is to prognosticate the state of the weather. On land this is perhaps the least important of its applications, but the case is widely different at sea. A remarkable instance of its utility to the mariner is given by Dr Arnott. "The marine barometer has not yet been in general use for many years, and the author was one of a numerous crew who probably owed their preservation to its almost miraculous warning. It was in a southern latitude, the sun had just set with placid appearance, closing a beautiful afternoon, and the usual mirth of the evening watch was proceeding, when the captain's order came to prepare with all haste for a storm, the barometer had begun to fall with appalling rapidity. As yet the oldest sailors had not perceived even a threatening in the sky, and were surprised at the extent and hurry of the preparations, but the required preparations were not completed, when a more awful hurricane burst upon them than the most experienced had ever braved. Nothing could withstand it, the sails, already furled and closely bound to the yards, were riven away in tatters, even the bare yards and masts were in great part disabled, and at one time the whole rigging had nearly fallen by the board. In that awful night, but for the little tube of mercury which had given the warning, neither the strength of the noble ship nor the skill and energies of the commander could have saved one man to tell the tale" (*Elements of Nat Phil* vol i p 353)

No certain rules can be laid down for pr[illegible] the state of the weather from the barometer [illegible]. lowing, taken from the *Saturday Magazine*, are probably of as general application as any that can be given. It is always to be remembered that what the barometer actually shows is the present pressure of the atmosphere, and that its variations correspond to atmospherical changes which have already taken place, the effects of which may follow their cause at a greater or less interval.

1. After a continuance of dry weather, if the barometer begins to fall slowly and steadily, rain will certainly ensue; but if the fine weather has been of long duration, the mercury may fall for two or three days before any perceptible change takes place, and the longer time elapses before the rain comes the longer the wet weather is likely to last.

2. Conversely, if after a great deal of wet weather, with the barometer below its mean height, the mercury begins to rise steadily and slowly, fine weather will come, though two or three wet days may first elapse; and the fine weather will be the more permanent in proportion to the length of time that passes before the perceptible change takes place.

3. On either of the two [illegible] suppositions, if the change immediately ensues on the motion of the mercury the change will not be permanent.

4. If the barometer rise slowly and steadily for two days together or more, fine weather will come, though for those two days it may rain incessantly, and the reverse; but if the barometer rise for two days or more during rain, and then on the appearance of fine weather begins to fall again, that fine weather will be very transient, and *vice versa*.

5. A sudden fall of the barometer in the spring or autumn indicates wind; in the summer, during very hot weather, a thunderstorm may be expected; in winter, a sudden fall after frost of some continuance indicates a change of wind, with thaw and rain; but in a continued frost a rise of the mercury indicates approaching snow.

6. No rapid fluctuations of the barometer are to be interpreted as indicating either dry or wet weather of any continuance; it is only the slow, steady, and continued rise or fall that is to be attended to in this respect.

7. A rise of the mercury late in the autumn, after a long continuance of wet and windy weather, generally indicates a change of wind to the northern quarters, and the approach of frost.

See also the *Phil. Trans.*, No. 187., for Dr Halley's Rules. Patrick's Rules, which have long been popularly known, were first published in *Harris's Lexicon Technicum*, art. "Barometer."

BA'ROMETZ. The hairy stem of a species of fern or Aspidium, which, from its procumbent position and shaggy surface, looks like a crouching animal; hence called *Scythian lamb*.

BA'RON. The lowest but most ancient title of British nobility. The dignity appears to have been originally territorial. The higher feudatories of England, after the Norman conquest, possessed baronies on which a certain number of knights' fees were dependent, and were bound to attend the king with a certain retinue of knights. But in process of time, many of the barons having lost by alienation great part of their lands, the distinction between *greater* and *lesser barons* began to arise, and the former alone constituted part of the great council of the sovereign, in their own right, until at some early period (supposed to have been about the reign of Henry III.) the practice of summoning individuals to parliament by the king's writ prevailed over the former usage. But this subject is involved in great uncertainty. It has, however, been very generally supposed that the dignity of baron, together with the right to sit in parliament, was at an early period annexed in many instances to the possession of certain lands or castles, which have thus been believed to confer *baronies by tenure*. But Sir Harris Nicolas, in his *Introduction to the Peerage*, gives strong reasons to show, in the first place, that it is by no means clear that persons seised of lands *per baroniam* were entitled to a summons to parliament in the reign of Edward the First; and, in the next place, that there is no positive proof of such a tenure having been legitimately established at any subsequent period. *Baronies by writ* were created by the king's writ of summons to parliament, when addressed to individuals by name. The first thus created were in 49 H 3, of which two (Despenser and Roos) exist at the present day. Whether, however, the dignity thus created was originally hereditary, admits of a doubt, no words to that effect are found in the ancient writs. But, in point of fact, the next heir was summoned by writ, after the decease of his ancestor, in a great majority of instances; and it has been long settled, that a summons to parliament by the king's writ, addressed to an individual, creates a barony descendible to heirs general. The earliest creation of a *barony by letters patent* took place in the 11th year of Richard II. (that of Beauchamp of Kidderminster), and therefore when a dignity of earlier creation than that year is claimed, it is presumed to have originated in a summons by writ, and consequently to be descendible to heirs general. On the death of a baron by writ without issue male, but with more daughters than one, the barony falls into *abeyance* until only one daughter or the sole heir of one daughter survives. The word Baron (baro, or varo, to which some give a Latin and others a German derivation) appears to have simply signified "man," and in some cases freeman or citizen, in the laws of the Franks and other early nations. In France, the title of baron originally belonged only to those who were immediate vassals of the crown: it afterwards became applied in common usage to those who had the right of executing justice on their fiefs. The title of baron ranked, as in England, after those of duke, marquis, count, and viscount; except in Dauphiné and Britanny, where the baron had precedence of the three latter. In Germany the title of Baron (Freyherr) is extremely common; but a great distinction existed, under the Empire, between the barons who were created by sovereign lords, and the barons of the Empire, the former being those immediate lords who had no voice in the Diet.

BA'RONET, KNIGHT BARONET. The lowest degree of hereditary dignity in England. This order was instituted by King James I. in 1611, as a reward for the services of those who came forward to quell the insurrection in Ireland, and especially in the province of Ulster, each person who received it furnishing a supply sufficient to maintain thirty soldiers for three years. The creation is by patent under the great seal, and generally limited to the heirs male of the body of the grantee, although sometimes otherwise entailed. Baronets rank among themselves according to creation, and come next after the younger sons of barons. By a clause in

the patent of creation, the heir male apparent to the title can claim the honour of knighthood, on attaining the age of twenty-one, in the life of his father or grandfather. Baronets bear for distinction on their paternal coats the arms of Ulster, in a sinister hand, erect, open, and couped at the wrist, gules in a field argent. This augmentation is placed sometimes in the middle chief point, sometimes on the fess point, &c. as may be most convenient, but subject to certain rules of heraldry Baronets of Ireland were instituted by James I. nine years after the creation of baronets in England, with similar privileges and badge. Baronets of Scotland, or Nova Scotia baronets, were created by Charles I. in 1625, in furtherance of a project of colonization in that part of America. Their badge is the ensign of Nova Scotia. It had long fallen into disuse; but was borne again in 1775, by way of revival of the order.

BA'RONS OF EXCHEQUER. Certain Judges in England and Scotland, to whom the administration of justice is committed in causes between the sovereign and his subjects relating to the revenue. In the former country the Court of Exchequer takes cognizance of private causes also. *See* EXCHEQUER.

BA'RONY. A territorial subdivision in Ireland, which nearly corresponds with the hundred in England Each barony is supposed to have been originally the district of a native chief. There are in all 252 baronies in Ireland.

BA'ROSCOPE. (Gr. *βαρος*, *weight*, and *σκοπεω*, *I observe*) A term which has been sometimes given to the barometer. According to its derivation it signifies *observer of weight*, and is properly applied to instruments which indicate variations in the weight of the atmosphere, without giving the means of absolutely measuring it. The wheel barometer of Hooke is properly a baroscope.

BA'RRAS The resin which exudes from wounds made in the bark of fir trees

BA'RRATRY. A name applied by our law and that of other countries to various offences. In England, a "common barreter" is defined by Lord Coke to be a common mover and maintainer of suits in disturbance of the peace, and in taking and detaining the possession of houses and lands or goods by false inventions Barratry, in this sense, is an indictable offence at common law. The obtaining benefices at Rome was also an offence of *barratry*. In maritime insurance, barratry is any act of the master or mariners of a criminal nature, or which is grossly negligent, tending to their own benefit, to the prejudice of the owner of the ship, and without his permission In Scotland, the crime of a judge who receives a bribe for a judgment is called *barratry*

BA'RREL An English measure of capacity, varying with the nature of the liquid measured. In the old measures, a barrel denoted 31½ gallons of wine, 32 gallons of ale, or 36 gallons of beer. By a statute of 1 W. & M., the ale and beer barrels were equalized for every part of England except London, and ordered to contain 34 gallons. The term Barrel was formerly in use to denote, in a rough way, other sorts of goods. Thus, a barrel of salmon, 42 gallons, a barrel of soap, 256 pounds In common language any hollow cylinder is called a barrel

BARREN FLOWERS. Are those which either have stamens and no pistil, or which have neither stamens nor pistil

BARRICA'DO. (Fr barricade) A defence either by intrenchment or raised work, made in a hasty manner, by barrels filled with earth, heaps of stones piled up, carts, trunks of trees, or any other materials which would obstruct the passage or advance of an opposing force. The famous day of the Barricades at Paris took place on the 12th of May, 1588, when the populace invested the troops of Henry III., in the Louvre, and forced him to escape from Paris The Barricades again formed an important feature in the revolutions of July, 1830, and Feb 1848.

BA'RRIER (Fr. barrière) A piece of wood work erected to defend the entrance of a passage or intrenchment, with a moveable bar in the centre, which may be removed at pleasure. It is usually erected between the citadel and town.

BARRIER TREATY. In 1713, a negotiation concluded between the Dutch and the King of France shortly before the peace of Utrecht, by which the former reserved the right to hold garrisons in certain fortresses of the Spanish Netherlands.

BA'RRIS. A large baboon of the Guinea coast.

BA'RRISTER. An advocate admitted to plead at the bar in the English courts of common law and equity Barristers were anciently styled apprentices at law, until their admission to the degree of sergeant. A student intending to be called to the bar must be admitted a member of one of the four Inns of Court (Inner and Middle Temple, Lincoln's Inn, and Gray's Inn), and reside for a certain time, during three years in some cases and five in others. The disputations or arguments termed exercises) which were formerly required of a student have been reduced to mere matters of form. A barrister has no legal mode of recovering fees for his services.

BA'RROWS, or TUMULI, says Mr. Gough, in his *Sepulchral Monuments*, are the most ancient monuments in the world. The sepulchres of the heroes of the war of Troy are still distinguished, if tradition is to be relied upon, by the mounds raised over them. In these ancient barrows the base is said to have been generally formed of stones, the upper part consisting of a mound of earth. Barrows are found scattered over the plains of the Ukraine and of Tartary, and in great numbers in the Mississippi valley of North America. The barrows of England are supposed to be almost all of British construction; although the mounds properly so called are sometimes confounded with those tumuli found in Roman camps, where they serve as land marks, or for some military purpose Of the antiquaries who have treated of these relics of ancient eras, Dr Stukely and Sir R. Colt Hoare are the most eminent. They have been distinguished, according to peculiarities of form and construction, into long barrows, bowl, bell, pond, twin, cone, broad, &c. In the most ancient barrows, the bodies found are deposited within a cist or stone receptacle, with the head towards the north: in those of later date, this direction is not observed. The bones which have been discovered within the numerous barrows that have been opened were generally accompanied by utensils, weapons, &c; and from the form and finish of these, some conjecture has been made as to the period of the interment But these barrows, although generally sepulchral, are not uniformly so. In some, bones of animals only have been found Barrow burial is said by Sir R Hoare to have lasted from a period of unknown antiquity down to about the eighth century. Barrows are chiefly found in the chalk districts of Wilts and Dorsetshire

BA'RTER A rule of Arithmetic by which the values of commodities of different kinds are compared

BARY'TA (Greek. *βαρυς*, *heavy*.) The oxide of barium, composed of 70 barium and 8 oxygen. Baryta is commonly called an alkaline earth. It is of a grey colour, difficultly fusible, and poisonous. It is soluble in about 20 parts of cold water It forms white salts with the acids, all of which are poisonous except the sulphate. The soluble salts of baryta are excellent tests of the presence of sulphuric acid, which they indicate in solution by a white precipitate, insoluble in water and in acids, and composed of 77 baryta and 40 sulphuric acid, 117 parts, therefore, of pure and dry sulphate of baryta are equivalent to 40 of sulphuric acid. There are only two abundant natural compounds of baryta. the *sulphate*, which occurs crystalline, and the *carbonate* *Native sulphate of baryta*, *heavy spar*, or *baro-selenite*, is found in this country in Cumberland and Westmoreland, a variety from Derbyshire is provincially called *cauk* Native *carbonate of baryta*, or *barolite*, was first discovered at Anglesark in Lancashire by Dr Withering, and hence called Witherite It occurs crystallised and massive. It consists of 77 baryta and 22 carbonic acid, its equivalent, therefore, is 99

BARYTO-CALCITE. A mineral found at Alston in Cumberland. it occurs both massive and crystallised in oblique rhombic prisms. It contains about 66 per cent. of carbonate of baryta, and 34 of carbonate of lime.

BA'RYTONE. (*Βαρυς*, *grave*, and *τονος*, *tone*.) The male voice, the compass of which is between tenor and base. Also a musical instrument similar to the *viol di gamba*.

BASA'LT. A common species of trap-rock; it is essentially composed of felspar and augite, of a compact texture, and dark green, grey, or black colour. It is often found in regular columns, of which the Giant's Causeway and the Island of Staffa furnish magnificent examples

BASANI'TE A variety of silicious slate, sometimes used as a touchstone to determine the purity of gold by the colour of its streak. (From *βασανος*, *the test*)

BA'SCINET, or BA'SINET A light basin-shaped helmet, worn by the infantry in the reigns of Edward II. and III., and of Richard II (See *Grose on Ancient Armour*)

BASE. In Geometry, the lowest side of any figure; as the base of a triangle, of a cone, &c. Any side of a figure may be taken as its base.

BASE. A chemical term, chiefly applied to metallic oxides, or to the leading constituent of compounds. Thus, soda is called the base of sulphate of soda, and sodium is the metallic base of soda. Hence the distinction into salifiable and metallic bases.

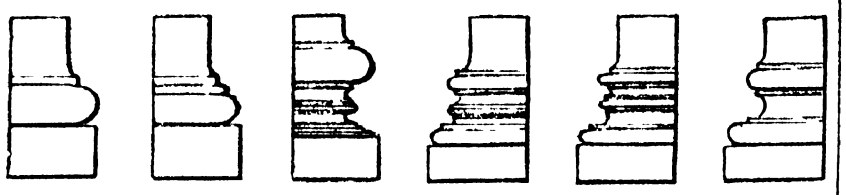
BASE. In Music (frequently written Bass), the lowest part in a concert, whether vocal or instrumental. By some it is considered the fundamental or most important part; others regard the melody, or highest part, in that light.

BASE, CLEF. *See* CLEFF.

BASE, THOROUGH. *See* THOROUGH BASS.

BASE. (Gr. *βασις*, *a foundation*.) In Architecture

generally a body which bears another. In the orders, it is the lower part of a column, moulded or plain, on which the shaft is placed. In the Grecian Doric, the columns are without bases, and stand immediately on the floor or pavement of the portico. The different bases are represented below, including the Attic base.



TUSCAN ROMAN DORIC. IONIC. CORINTHIAN. COMPOSITE. ATTIC.

BASE'LLA. (A Malabar word.) A turning succulent-leaved Chenopodiaceous plant, native of the tropical parts of Asia, and commonly cultivated instead of spinach in the East Indies.

BA'SEMENT. (From Base.) In Architecture, the lowest story of a building.

BASIGY'NIUM. (Gr. *βασις, the base, γυνη, female*.) A stalk rising above the origin of the calyx, and bearing an ovary at its apex, as in Capparis.

BA'SIL. A fragrant aromatic herbaceous plant, the *Ocymum basilicum*, a native of India, whose leaves are much used in cookery for the purpose of giving a savoury flavour to dishes.

BA'SILIC. (Gr. *βασιλικος, royal*.) A pharmaceutical term, formerly applied to certain powders, ointments, &c. of pre-eminent virtues and activity.

BASI'LICA. (Gr. *βασιλευς, king*.) In Architecture, properly the palace of a king, but it afterwards came to signify an apartment which was usually provided in the houses of persons of consequence, where assemblies were held for dispensing justice. The Gordian family in their magnificent country house in the Via Prenestina had three basilicæ, each upwards of a hundred feet long. There was usually a basilica attached to every market for summary settlement of disputes that might arise, and it was surrounded by shops and other conveniences for traders. The difference between the Roman and Grecian basilica is described by Vitruvius, to whose work the reader may refer. We have in the article ARCHITECTURE (*quod vide*) given some account of the rise of the modern basilica for religious uses from the form of the more ancient one. Its form was that of a parallelogram, with a portico at each end, being covered by a roof supported by ranks of columns. Palladio applied the term to those buildings in the cities of Italy somewhat similar in use to our town halls.

BASILI'SCUS. A basilisk. The epithet is applied in Zoology to a most harmless genus of saurian reptiles, of the Iguanoid family, having no femoral pores; but with palatal teeth, a covering of small scales, and an elevated dorsal crest, supported by the vertebral spines, and extending from the neck to the middle of the tail. One of the species (*Basiliscus mitratus*) supports a mitre-shaped crest on the head.

BA'SIN. In Physical Geography, the space of country drained by a particular river, as the Basin of the Thames, Rhine, Rhone, &c. In Geology, depressed portions of strata, forming a hollow surrounded by hills, as the "London Basin," the "Paris Basin," &c.

BA'SIS. *See* BASE.

BASI'SOLUTE. (Lat. basis and solutus, *free*.) A name sometimes applied to those leaves which are prolonged at the base below the point of origin, as in the bracts of *Fumaria*, the leaves of *Sedum reflexum*, &c.

BA'SKET. (Lat. bascauda.) In Architecture, part of the Corinthian capital. *See* CAPITAL.

BASS. *See* BASE.

BASSETTE. (Diminutive of Basso.) In Music, the smallest species of the bass violin.

BASSOO'N. (Fr. basson.) A musical wind instrument made of wood, serving as the proper bass to the oboe and clarionet. The Italians call it *fagotto*, because composed of two pieces of wood *fagotted* as it were together. It is played by means of a bent mouth-piece and reed, and its compass is shown in the synoptical view of the different instruments at the end of the article MUSIC.

BASSO RILIEVO. *See* RILIEVO.

BASSO'RINE. A modification of gum, originally discovered by Vauquelin in gum bassora.

BA'STARD. A word of which the etymology is entirely uncertain. By the ancient legal course of precedent in England, the fact of birth during the marriage of the parents, or within a certain time after the death of the husband (extended in some cases to a great length, as in that of the Countess of Gloucester, temp. E. 2., to one year and seven months), was conclusive in favour of legitimacy. But this fact is now held to amount only to strong presumptive evidence, repellable by proof of non-access. The legal incapacities of an illegitimate child, by the law of England, relate wholly to the powers of inheritance and succession, to which he is in no respect entitled either as to real or personal property. In case of a divorce "a vinculo matrimonii" in the spiritual court, children born during the marriage are bastards by the law of England. The Scottish law is less strict in favour of legitimacy than that of England. Two species of legitimation have been adopted in it from the civil law: one, "per subsequens matrimonium," by the subsequent intermarriage of the parents (but a child born in Scotland, and legitimated by subsequent intermarriage in Scotland, is not entitled to succeed to real property in England, and, if born in England, remains a bastard to all intents and purposes); and, secondly, "per rescriptum principis," by letters of legitimation from the crown.

BASTARD STUCCO. In Architecture, plastering of three coats, whereof the first is usually roughing in, or [illegible], the second floating, as in trowelled stucco, and the third or finishing coat contains a small quantity of hair besides the sand. Bastard stucco is not hand-floated, and the trowelling is done with less labour than what is called trowelled stucco.

BASTARD WING. (*Alula spuria*, Linn.) Three or five quill-like feathers, placed at a small joint rising at the middle part of the wing.

BASTI'LLE. In France, in the middle ages, towers and other outworks erected without the limits of towns were so called. The famous Bastille of Paris was an edifice of the same description, originally erected outside the city, near the modern Porte Saint Antoine. It was built by Hugues Aubriot, prevot des marchands, in 1369; and he is said to have been the first prisoner of state confined in it after it was employed for that purpose. The Bastille was taken by the people of Paris on the 14th of July, 1789, and demolished.

BASTINA'DO. (Ital. bastonnata, from bastone, *a stick*.) An ordinary mode of punishment in oriental countries, especially China, Turkey, and Persia. It is commonly inflicted upon the soles of the feet. According to the Turkish law, slaves and *rayahs* or tributaries alone are liable to it, but no such limitation is observed when the temper of a magistrate possessing summary authority is inflamed. This punishment is termed *zoob* in Turkish. It is extremely severe, although limited by law to the Jewish number of 39 blows, or 75 in some aggravated cases, but this regulation, like the other, is little observed in practice. (See generally, as to this species of infliction in penal law, the essay of Lanjuinais, *Sur la Bastonnade et la Flagellation penales*.)

BA'STION. A large projecting mass of earth or masonry at the angles of a fortified work, anciently called a bulwark. The modern bastion consists of two flanks, serving for the defence of the adjacent curtains, and two faces, making with each other an angle of 60° or upwards, which command the outworks and the ground before the fortification. The space between two bastions is called the curtain. The use of the bastions is to bring every point at the foot of the rampart as much as possible under the command of the guns, so that on whatever point a besieging army approaches it may be attacked sideways.

BAT. *See* VESPERTILIO, DERMOPTERA, CHEIROPTERA.

BATA'TAS. A species of convolvulaceous plant, *Convolvulus batatas*, a native of the East Indies, with fleshy sweet tubers. It is much cultivated for the sake of the latter in all the hotter parts of the world, where they are much esteemed as an article of food. Its name has now been popularly transferred to the potatoe, which has expelled it from cultivation in all temperate climates.

BATH. (From the Saxon baδ.) In Architecture, a place for bathing. Among the ancients, the public baths were of very considerable extent, and consisted of a great number of apartments. These prodigious monuments of Roman magnificence seem to have been borrowed in some respects from the gymnasia of the Greeks, both the one and the other being instituted with a view to the exercise and health of the people. The word *thermæ*, which the Romans called these edifices, signifies a place for the reception of hot baths, but both hot and cold were generally comprised in the same building. In later times, the Romans used the bath before they took their supper. The rich usually had hot and cold baths in their own houses, and it was not till the time of Augustus that the baths assumed an air of grandeur and magnificence. Different authors reckon nearly eight hundred baths in Rome. The most celebrated were those of Agrippa, Antoninus, Caracalla, Diocletian, Domitian, Nero, and Titus. Those of Diocletian are said to have been capable of accommodating eighteen hundred bathers. The vestiges of these stupendous buildings indicate the amazing magnificence of the age in which they were erected. Their pavements were mosaic; the ceilings vaulted, and richly gilt and painted; the walls encrusted with the rarest marbles. Many examples of ancient Greek sculpture have been restored to the world from these edifices. It was from the recesses of these buildings that Raphael took the hint for his decorations of the Vatican, and

largely from these resources drew the first restorers of the art.

BATH. In Chemistry, heated sand is often used as a medium for communicating heat, as glass and other vessels may be conveniently placed upon or immersed in it: sometimes water is used in the same way; hence *sand bath*, *water bath*, &c. The water bath is called by the old chemists Balneum Mariæ, and often abbreviated B.M.

BATH, ORDER OF THE. A British order of knighthood. On the day of his coronation, Henry IV. conferred the dignity of knighthood on forty-six esquires who had watched during the previous night, and bathed themselves, in pursuance of a very ancient custom, derived from the usages of the ancient Franks. It was usual, from this period, to make similar creations of knights on royal coronations, espousals, and similar solemnities; but the custom was discontinued after the coronation of Charles II., until George I., in the eleventh year of his reign, instituted the present order of the Bath by letters patent It consisted, exclusive of the sovereign, of a grand-master and thirty-six companions; and was a military order. In 1815, the order was greatly extended, and again in 1847, and is now composed of three classes — knights grand crosses, knights commanders, and knights companions, which classes again are each subdivided into three minor divisions — military, civil, and honorary The knights companions take precedence of esquires The badge worn by the grand crosses is a golden cross of eight points, enamelled white, with a lion of England between the four principal angles; on the centre a sceptre erect, or, having on the sides a rose, thistle, and shamrock, engrafted between three imperial crowns proper, encircled with a riband gules; thereon the motto of the order, "Tria juncta in uno" They also wear a silver star. The badge of the knights commanders is the same with that of the knights grand crosses, but smaller: their cross somewhat different. The companions have only the badge without a star.

BA'THOS. (Gr *βάθος*, *depth*) A word invented to signify a ludicrous descent, in rhetoric, from elevated to mean thoughts (*See* CLIMAX) It has been chiefly rendered popular by Pope and Arbuthnot's jeu d'esprit, the "Treatise on the Bathos, by Martinus Scriblerus"

BATIDEÆ A small division of Urticaceous plants, containing but one genus, Batis, after which it is named. It yields soda in great quantity

BA'TOLITES. A genus of fossil shells, considered by Cuvier as *hippurites*.

BA'TON. (Fr.) In Music, a term denoting a rest of four semibreves.

BATON is also the staff of a field marshal

BA'TONNI'ER (Mod. Lat. bastonarius.) In French, the elected president of an order or fraternity The *batonnier* of the order of advocates is elected by the whole body In ancient times he carried in their processions a staff (baton) with the flag of Saint Nicholas, whence the name. He is president of the council of discipline.

BATRA'CHIANS, BATRACHIA. (Gr. *βάτραχος*, *a frog*) An order of Reptilia, including the frogs and toads, and all reptiles which, like them, have naked skins and external branchiæ, in the early stage of existence, those batrachia which retain the gills or gill-apertures throughout life are called "perennibranchiate," or "amphibious."

BA'TRACHOMY'OMA'CHIA. (Gr. *βατραχομυομαχία*) *The Battle of the Frogs and Mice*, a mock heroic poem which has come down to us, and is attributed to Homer; but there is no probability that it was written by the author of the Iliad or Odyssey.

BA'TRACHOSPE'RMA. (Gr. *βάτραχος*, *a frog*, and *σπερμα*, *seed*.) A name proposed for such Algaceous genera as are articulated and live in fresh water.

BATTA'LION A division of the infantry in an army, composed of a variable number of men at present, in the English service, it is about 750. One battalion generally constitutes a regiment; but some, as those of the Guards, consists of two battalions, and a regiment of artillery of eight. Each battalion is generally divided into ten companies; it is commanded by its own colonel; and several battalions or regiments are, on service, all united under one general officer, forming a brigade.

BA'TTARDEAU. (Fr. battre, and eau.) In Architecture, the same as *Coffer-dam*, which see.

BA'TTEN (Probably from the French bâton, from its slender width) In Architecture, a name given by workmen to slips of wood, from two to four inches broad and one inch thick, the length considerable, but undefined.

BA'TTENED DOWN. Covering the hatchways in very bad weather with strong gratings, and these with painted canvass nailed under long pieces of wood (battens), to keep the water from getting below the decks.

BA'TTENING. (From batten.) In Architecture, narrow battens fixed to a wall, to which the laths for the plastering are nailed.

BA'TTER. (Probably from battre, Fr.) In Architecture, a term used by artificers to signify that a body does not stand upright, but inclines from you when you stand before it; when, on the contrary, it leans towards you, they describe its inclination by saying it overhangs.

BA'TTERING-RAM. An ancient military engine employed for beating down the walls of besieged fortresses. It consisted of a long heavy beam of timber, armed with iron at one extremity, and the effect was produced by pushing it violently with successive blows against the wall. The *ram* was worked in various ways. Sometimes it was simply supported by two files of soldiers, and the impetus given by a simultaneous thrust. More frequently it was slung from a cross beam, supported by two posts, by a rope or cable about its middle; in which case it had an oscillating motion, like a pendulum. A third sort was moved on rollers or wheels. Generally they were worked under a cover or shed (*vineæ* or *testudines*) to protect the assailants. These machines were often of immense size, and exceedingly ponderous, requiring 100 men to work them. Justus Lipsius describes a battering ram as 180 feet long, and two feet four inches in diameter, armed with an iron head weighing at least a ton and a half. The momentum of this ram, pushed forward by the united strength of 100 men, must have been equal to that of a 36-pound shot discharged point blank from a modern piece of heavy ordnance, and its efficacy in communicating a shock to the whole building very much greater.

BA'TTERY. A military term, denoting any raised place where cannon or mortars are planted. Batteries have various names, according to the different kinds of artillery employed, or the purposes they are designed to effect. *Breach batteries* are used to attack the face of a bastion, in order to make an accessible breach. *Batteries en echarpe* are those which play obliquely. *Ricochet battery*, one from which cannon are discharged with a very small quantity of powder and a little elevation, so as to carry the ball just over the parapet, where it rolls along the opposite rampart, and produces a destructive effect They are placed perpendicular to the line to be enfiladed In a ricochet battery, small mortars and howitzers are frequently used with effect in enfilading an enemy's ranks

BA'TTLE. (Fr. bataille) In the art Military, an engagement between two hostile armies for the accomplishment of some important object A battle is the most important event in war: it is the consummation to which all the previous combinations of a general necessarily tend, it is that grand act of war which may decide the fate of kingdoms and of nations as well as that of armies and campaigns. In the early ages of the world a battle was merely a fierce and bloody struggle the issue of which depended more on the physical strength of the combatants than on any scientific combinations which the general could adopt; but as the arts and sciences progressed, the military system was improved, and the battle of Marathon (the first well authenticated battle in profane history) demonstrated how far superiority in physical strength may be compensated by generalship and discipline A further illustration of this fact is afforded in the subsequent battles of Platæa, Mantinea, and Leuctra, among the Greeks; and the banks of the Ticinus, the lake of Thrasymenus, and above all the plains of Cannæ, are memorable for engagements, which for ingenuity of design and dexterity of execution have excited the admiration of soldiers in every age. But to give even a faint sketch of the various exploits which were achieved by the Grecian so called *oblique* system, the Macedonian phalanx, and the Roman legion, and of the different military principles involved in their construction, would be to furnish a history of these different nations; and we must content ourselves with referring the reader to the article "Bataille," in the *Encyclopedie des Gens du Monde*, where some concise though scientific details upon this subject will be found. Though the weapons employed in battle in modern times are widely different from those in use among the ancients, and though many circumstances have combined to give an entirely different aspect to the military systems of the two periods, still it is surprising how strong a resemblance to each other is displayed in their ground-work; and it will be found on examination that the grand principles which even in the present century were adopted by Napoleon and the Duke of Wellington were practised, though imperfectly, by Epaminondas on the field of Leuctra. Indeed, it is a circumstance worthy of note, that the changes which in every age have taken place both in the manners and the weapons of nations have had no perceptible influence on the grand leading principles of military tactics. "Les tétrarchies," says a French author, "et les manipules sont representés chez les modernes par les compagnies: les xénagies ou syntagmes et les cohortes Romaines, par les bataillons; enfin, les phalanges et les légions, par les regimens, les brigades ou les divisions." There are three combinations of which a battle is susceptible. — 1. *Defensive*, which consists in taking up a position, and

defending it against the enemy. 2. *Offensive*, in which the enemy is sought to be harassed at all points and on all occasions. The third is a medium between these two, and presupposes on the part of the general sufficient skill to know when to make an attack, and when to act on the defensive. It is impossible to state precisely the principles which should guide a general in the adoption of one or other of these three systems, from the difficulty of providing against unexpected events which often occur to perplex or overturn the most matured and ingenious plans; but making due allowance for casualities of this nature, a reference to history will prove that design and ingenuity have generally triumphed over chance and accident; and that a skilful disposition of the troops, and the seizure of the proper moment for assuming the initiative, combined with courage and adroitness in prosecuting success, will ultimately be crowned with victory. For a full and elaborate view of the principles involved in a battle, the reader may consult with advantage *Jomini's Traité des Grandes Operations Militaires* (Paris, 1824), a system which is founded on the united principle of a *concentration of the forces*, and the *commencement of hostilities*

BA'TTLE-AXE. A military weapon, which is purely offensive, and owes its origin to the Celtæ It was not employed by the Greeks and Romans, though it was found among contemporary nations At the siege of the Roman capitol by the Gauls under Brennus, the most distinguished warriors were armed with battle-axes; and Ammianus Marcellinus states, that this instrument formed part of the offensive armour of the Gauls from time immemorial. In England, Scotland, and Ireland, the battle-axe was much employed the Lochaber axe, in particular, was long a formidable implement of destruction in the hands of the Scottish Highlander, and obtained almost a universal reputation.

BA'TTLEMENTS (From battle) In Architecture, a wall or parapet on the top of a building, with embrasures or open places to look through, or discharge missiles for the annoyance of an enemy.

BATTUE. (Fr) In Sporting, a term indicating a practice of huntsmen which consists in encompassing a certain portion of the forest, and in endeavouring, by beating the bushes and with loud exclamations, to bring out wolves, foxes, or other animals of the chase

BATTU'TA. (It *a beating*) In Music, the motion of beating with the hand or foot in directing the time.

BAUERA'CEÆ (so called from Mr Bauer their discoverer), a small natural order of New Holland shrubs with pretty purple flowers, related to *Saxifragaceæ*. There is but one genus

BAULK. (From the Dutch) Sometimes called Dram Timber. In Architecture, a piece of whole fir, being the trunk of a tree of that species of wood usually squared for building purposes In the metropolis the term is only applied to small lengths from 18 to 25 feet, mostly under 10 inches square, tapering considerably, and with the angles so left that the baulk is not an exact square.

BAXTE'RIANS. In Ecclesiastical History, a name applied to those English theologians who adopted the sentiments of Richard Baxter on the subject of grace and free will, forming a sort of middle way between Calvinism and Arminianism. They never formed, strictly speaking, a sect, and the name is now disused: nevertheless, similarly modified religious opinions are common among nonconformists at this day.

BAY. (From the Dutch baye) In Architecture, a division of a barn or other building, generally from 15 to 20 feet in length or breadth. In plasterers' work it is the space between the screeds prepared for regulating and working the floating rule. *See* SCREEDS

BAY. (Fr. *baie*, Ital. *baia*, Span. *bahia*.) In Geography, a portion of the sea, inclosed between two capes or headlands, so that the opening is the widest part and the inlet gradually narrows within It is thus distinguished from *gulf*, in which the opening is comparatively narrow. The distinction, however, is not always observed in nomenclature; *e. g.* Baffin's Bay, and Chesapeake Bay in America, are both more properly gulfs.

BA'YONET. A short triangular sword or dagger fixed upon the muzzle of a musket, which is thus transformed into a thrusting weapon. The original invention and subsequent improvement of the bayonet are due to the French, who first used it in the Netherlands in 1647, and the advantages which this weapon gained to that nation soon attracted notice to its merits. In the beginning of the eighteenth century, it was every where substituted for the pike, and in some instances it has decided the issue of an engagement without a single shot being fired. Many plans have been devised at different times to augment the efficiency of the bayonet, by turning it to the purposes of tilting and fencing; but when the cumbrousness of the instrument to which it is attached is considered, it will not seem surprising that all schemes of this nature have proved abortive Cavalry are often counted by *horses*, and infantry by *bayonets*. (See *Guibert's Essai général de Tactique.*)

BAY SALT. (*See* SALT.) A large grained salt, obtained by the spontaneous evaporation of sea water in large shallow pits (bays) exposed to the full influence of sun and air; all coarse-grained salt is frequently known under the name of *bay salt*.

BAZA'AR. (From an Arabic word, signifying traffic or merchandise.) A large square or street where merchants in eastern countries have their shops or warehouses

BDE'LLIUM. An African gum resin of a bitter nauseous taste, and a dark-brown colour. It is sometimes mixed with myrrh.

BDE'LLOSTOMES, BDELLOSTOMA. (Βδαλλω, and στομα, *a mouth adapted for suction.*) A genus of Cyclostomous fishes.

BEACH. In Geography, a shelving tract of sand or shingle washed by the sea or a freshwater lake, and interposed between the water and the land on which vegetation grows. The beach of the ocean is, generally speaking, little more than the space between low and high water mark; the beach of a lake, that between the water marks of the highest and lowest ordinary level of the lake An inland sea without tide, such as the Mediterranean, has generally little beach, except on flat coasts, where the waters are apt to rise and fall considerably, according to the prevailing winds. *Raised beaches* exhibit a curious phenomenon in geology. they are tracts of shingle and gravel, indurated for the most part into the consistency of pudding-stone or breccia, found on the sides of shelving ground at a level above that of some neighbouring lake or sea, in such a position as to leave no doubt that they had in ancient times been washed by its waters They are found extending along large tracts in the vicinity of the great American lakes

BE'ACON (Sax beacn or beacen, allied to the words *beck*, *beckon*, *i. e.* to point out, in the English language.) A fire lighted by way of signal on a height, or the place where such signals are usually made Along the southern coast of England, many of the highest hills are provincially termed "beacon," from this circumstance There is a celebrated poetical description of the transmission of news by fire signals, from height to height, in the *Agamemnon of Æschylus* The English beacons were erected under the superintendence generally of the lord high admiral, they were usually pitch boxes, or fire pots, and their maintenance and watching was defrayed by a rate levied on the county. (See *Archæologia*, vols I and VIII)

BEAD (Sax beaδe) In Architecture, a moulding whose vertical section is semicircular

BEAK In Botany, a hard sharp termination of any part of the fructification It is Latinized by rostrum

BEAM (Sax beam, *a tree*) In Architecture, an horizontal piece of timber, used to resist a force or weight, as a tie beam, which acts as a string or chain by its tension, as a straining piece, where it acts by compression, as a bressummer, where it bears an insisting weight.

BEAM. In sea phrase, the width of a vessel Thus a wide vessel is said to have *more beam* than a narrow one, the beams being the strong pieces of timber stretching across the ship from side to side, for the purpose of supporting the decks and retaining the sides at their proper distance When a ship is lying entirely on her side, she is said to be *on her beam ends*. When this is the case in a hurricane or heavy gale, there is often no other resource to *right* the ship than cutting the masts away

*A-beam*. In the direction perpendicular to the ship's length, a-midships. Thus an object seen from the middle of a vessel, 90 degrees or 8 points from the head or stern, is said to be a-beam

BEA'MFILLING. In Architecture, the filling in masonry or brickwork between beams or joists, its height being equal to the depth of the timbers filled in.

BEAM-TREE A deciduous British tree of small growth, inhabiting the mountainous parts of the country, and resembling a small apple tree, with berries like those of the mountain ash Its leaves are strongly veined in a plaited manner, and white underneath, the wood is hard, compact, and tough, and is used for axletrees, naves of wheels, and cogs of machinery. The *Pyrus aria* of botanists.

BEAR. *See* URSUS

BE'ARBERRY. The *Arbutus uva ursi*. The leaves of this plant, under the name *uva ursi*, are used as an astringent and tonic in medicine.

BEARD. (*See* BARBA) When applied to corn it is used in the sense of *Awn*, which also see.

BEARD The gills or breathing organs of the oyster and other bivalves are vulgarly so called.

BE'ARER. (Sax. bapan, *to bear.*) In Architecture, any upright piece used to support another.

BE'ARING. In Geography and Navigation, the direction or point of the compass in which an object is seen, thus an object *bears* north, south, &c. when seen in these directions. When the distance of an object or point of land is specified besides the bearing, the place of the ship with respect to such object is obviously fixed; thus, the Land's

End N. 48°, E. 141 miles, determines the ship to be 141 miles in the S. 48° W. direction, or nearly south-west from the Land's End.

BEAR'S FOOT. *See* HELLEBORE.

BEASTS. As charges in Heraldry, are said to be rampant, when represented rearing; sejant, when seated; statant, when standing; couchant, when lying; salient, when springing; passant, when walking (but the words *lodged*, *springing*, and *tripping*, are used of a beast of chase in these positions); gardant, when full-faced, regardant, looking back; dormant, sleeping; nascent, rising out of the middle of an ordinary; issuant, rising from its top or bottom. Two animals represented side by side, but moving in opposite directions, are said to be counter-passant, &c.

BEAT. (Beatan, *to beat.*) In Music, a reversed shake without a turn.

To *beat*, *beat up*, or *beat to windward*, in Navigation, making progress against the wind by a zigzag course, and is the same as working to windward

BEAU IDEAL. (Fr.) In Painting, that beauty which is freed from the deformity and peculiarity found in nature in all individuals of a species All the objects which nature exhibits to us have their blemishes and defects, though every eye is not capable of perceiving them; and it is only by long habit of observing what any objects of the same kind have in common that it acquires the faculty of discerning what each wants in particular By such means the artist gains an idea of perfect nature, or what is called the *Beau Ideal* *See* IDEAL

BEAUTY (Fr beauté) In the Fine Arts, that result of all the various perfections whereof an object is susceptible, which pleases the senses, and more particularly the eye and the ear With the painter and sculptor nature, refined by selecting from the most perfect of the species, is the index and guide, but with the architect the creative power of nature herself is the model of imitation Some of the sources of beauty have been seriously considered by no less a writer than Burke as consisting in smallness, smoothness, delicacy, and the like, but such speculations are too absurd for notice here. The primary source of all beauty in the three arts is *form*, on that alone must the artist depend if he would produce a work capable of pleasing There is no doubt that in painting colour is a handmaid that decks her works with many charms, but they are all subordinate to that great effect which form, unaided by all accessaries, is capable of producing on the mind. As form is constituted by lines, it seems probable that an inquiry into their nature might lead the artist to the invention of beautiful forms, and it was doubtless this feeling which led Hogarth, in his *Analysis of Beauty*, to place so much to the account of the serpentine line. But in the arts generally the principles are infinitely more extended, for lines which, from their propriety in one art, are strikingly beautiful, become absolutely absurd as sources of beauty in others. Hence we arrive at one general conclusion, that in all of them fitness for the purpose and proportion to effect the object are the surest guide to beauty of line, and thence naturally to beauty of form. If this be so, no general laws save those dependent on fitness and proportion can be laid down; and perhaps it would not be a difficult task to trace to them all those associations which seem to be connected with the subject in its effect on the mind. Alison, in his elegant *Essays on the Nature and Principles of Taste*, appears to be much impressed with the feeling we have on this point; for he observes that "if there were any original and independent beauty in any *particular* form, the preference of this form would be early and decidedly marked both in the language of children and the opinions of mankind." We trust it may not be irreverent to close this article with a quotation which is as expressive of our notions of beauty as resulting from form as the inspired writer knew it to be true of qualities "All flesh is not the same flesh, but there is one kind of flesh of men, another flesh of beasts, another of fishes, and another of birds There are also celestial bodies, and bodies terrestrial, but the glory of the celestial is one, and the glory of the terrestrial is another."

BE'AVER. *See* CASTOR.

BE'CHICUS. (Gr. βὴξ, βηχὸς, *a cough*) A medicine for the relief of coughs.

BED. (Sax bed) In Architecture, the horizontal surface on which the stones or bricks of walls lie in courses

BED OF A STONE, BRICK, OR SLATE. In Architecture, the lower surface.

BE'DCHA'MBER, LORDS OF THE, or, as they were called before the accession of the House of Hanover, *Gentlemen of the Bedchamber*, are officers of the royal household, under the groom of the stole; their number has usually been twelve, and they wait in turn, a week each. This office is performed by *ladies* during the reign of a queen.

BED MOULDING. In Architecture, those mouldings in all the orders which are between the corona and frieze.

BED OF JUSTICE. (Fr. lit de justice.) In French History, a solemn proceeding to which the monarchs of France had recourse on particular occasions. As is well known, the parliament of that country had a right to resist any commands or decrees issued by the sovereign. If, however, the king insisted on the fulfilment of his wishes, he proceeded to hold a "lit de justice:" *i. e.* he went in person to parliament, attended by the chief officers of the court, and there, mounting the throne (called in the old French language "lit"), caused those commands or decrees which the parliament had rejected to be registered in his presence. This had the effect of intimidating the parliament into compliance, and the means which it usually adopted to intimate its dissatisfaction was to enter a protest against the whole proceeding.

BEDS. In Geology, seams of strata, thick or thin.

BEE. *See* APIS.

BEECH. One of the forest trees of the north of Europe, the *Fagus sylvatica* of botanists, belonging to the natural order *Corylaceæ*. Its fruit, or mast, consists of triangular nuts enclosed in a spiny husk or cupule, of the same nature as the cup of the acorn, only of a different shape, and covering the nuts all over. Its wood, which is hard and rather handsome, is brittle and perishable, and particularly liable to become wormeaten. It is chiefly used by turners and millwrights The purple and copper beeches seen in plantations are seedling varieties of *Fagus sylvatica*.

BEE-EATER. *See* MEROPIDANS.

BEEF-EATER. (By corruption from the French *beauffetier*, an officer appointed to watch the beauffet, buffet, or side-board) A popular appellation for the yeomen of the king's guard, partially derived from the circumstance that some of them originally were ranged at table on solemn festivals.

BEE'LZEBUB. (Heb) A god of the Philistines, who had a famous temple at Ekron. His name signifies literally the destroyer of flies, and if we consider the torment which those insignificant insects occasion in the East, it will not seem surprising that the Philistines conferred on him this appellation Besides, it is quite in conformity with the practice of other idolatrous nations to consider their gods as the destroyers of offensive vermin Take, for instance, the Apollo Σμινθεὺς (the destroyer of rats) of the Greeks. Milton in his epic poem assigns him the second rank, and in the second book, where he is represented as rising to address the fallen angels, there is an air of majesty in his demeanour nowhere surpassed.

BEER. (From the German *bier*) The wine of gram. It is usually made by fermenting an infusion of barley malt and of hops, and bears different names according to its strength and colour. It is nutritious from the sugar and mucilage which it contains, exhilarating from the spirit, and strengthening and narcotic from the hops. Mr. Brande obtained the following quantities of alcohol from 100 parts of different beers — Burton ale, between 8 and 9; Edinburgh ale, 6 to 7; Dorchester ale, 5 to 6; the average of strong ales being between 6 and 7; brown stout, 6 to 7, London porter, about 4 (average); and London brewers' small beer between 1 and 2. *See* FERMENTATION

BEET (Celt bett, *red*) The sweet succulent root of *Beta vulgaris*, a Chenopodiaceous plant of biennial duration It is used in the winter as a salad, for which purpose the red and yellow beets of Castelnaudari are the best, for the food of cattle, under the name of mangel wurzel; and for the extraction of sugar: for the last object a white-rooted variety with a purple crown is the most esteemed Sea beet, *Beta maritima*, is a well-known and excellent substitute for spinach.

BE'ETLE (Sax bȳtel) In Architecture, a large wooden hammer or mallet, with one, two, or three handles, for as many persons, with which piles, stakes, wedges, &c are driven

BEETLE. A name commonly given to the insects of the Coleopterous order, especially to such as are of a dark or obscure colour, it is also applied, but improperly, to the common pest of our kitchens, the blatta, or cock-roach, which is an insect of the Orthopterous order.

BEGHA'RDS. A German word, signifying one who begs with importunity. In this sense, it was frequently applied to the Franciscan and other mendicant orders, denoting the practice by which they gained their subsistence. The Beghards formed a sort of intermediate class between the monks and laity, and were known under various denominations; as the tertianes or half monks of the mendicant orders, the fraternity of the weavers, the brethren of St. Alexius, &c. But the term has also been affixed to a set of persons who, in the thirteenth century, became notorious for the frequency and ardour of their prayers.

The BEGUINS were a class of women throughout Germany and the Netherlands, who as early as the eleventh century, without taking vows or following the rules of any order, united themselves for devotional and charitable purposes, and were distinguished from the great body

of the laity of those times by their industrious, pious, and secluded habits, and by their attention to the education of the young. Their conduct was imitated by men, who formed a union for similar purposes, and were called Beghards (see above). The Beguins continued to exist in Germany up to the Reformation, under the name of "seelen weiber" (spiritual women), from the interest they took in the spiritual concerns of their sex; and a society of them was even seen at Louvain, in the Netherlands, towards the close of last century. There are now in some Roman Catholic countries societies or beguinages of females, who live together after the manner of nuns without taking vows; but, by their mode of life and profession, [illegible] the same intermediate state between the laity and the clergy which was first remarkable in the Beghards and Beguins of the eleventh century. The most celebrated is at Ghent.

BEGONIA'CEÆ. (Begonia the principal genus.) A natural order of Polypetalous Exogens, with showy pink or white flowers and handsome succulent leaves, which are frequently richly coloured or gaily variegated, and have one side considerably larger than the other. Their leaves have large stipules, and a subacid flavour. Much difference of opinion exists among botanists as to their affinity. They generally inhabit the dampest parts of the tropics, and are favourites with cultivators both for their beauty and the facility with which they are maintained, in health.

BEHE'MOTH. (Hebrew.) The name of an animal, of which some of the characters and attributes are described in poetical language in the 40th chapter of the Book of Job. Much pains have been taken to identify the creature here referred to; but it must be remembered that the discovery and general adoption of a mode of description which combines at once exactness with brevity, and is applicable only to the object described, are the results of a recent and highly advanced state of zoological science. Even the prosaic, and, so far as they went, scientific descriptions of animals in the writings of Aristotle, are rarely so copious and precise as to enable a modern naturalist to identify the existing species there referred to. But the aim of Job in the verses in which he sings of *Thau*, *Leviathan*, *Behemoth*, was to show forth the power and wisdom of the Deity, and lower the pride of man, by appealing to the wonderful powers assigned to some of the most remarkable and formidable objects of animated nature with which he was acquainted, and it can hardly therefore be expected that curiosity, eager to hunt out the precise species alluded to, should be gratified. Sufficient source of doubt has always been left to shake the most sagacious conjectures, and some recent inquirers into Biblical zoology, perceiving that the properties of Behemoth were not manifested to the letter in any known existing species, have endeavoured to make the scriptural allusions square with the characters of one of the gigantic extinct animals which the study of fossil remains has brought to light. the *Iguanodon*, for example, a supposed herbivorous reptile, with a horn on the nose and a long and flexible tail, has been selected as the species described by Job. The allusion, in verse 17., to a part of the generative organs, which is visible externally only in the class of mammalia, renders it very improbable that Behemoth could be one of the Reptilia. The exclamation, also, "Behold he drinketh up a river and hasteth not! He trusteth that he can draw up Jordan into his mouth," could not with any appearance of truth be applied to a species of a class of animals of which the organization requires them to drink so little and so seldom. If a mammiferous quadruped, then Behemoth was a herbivorous and ungulate species: "He eateth grass as an ox" (verse 15), but, unlike the males of the larger ruminants, he had not a divided scrotum, for "the sinews of his stones were wrapt together" (verse 17.) Thus from the few zoological characters which are brought under our consideration, we come to the conclusion that some huge pachyderm, "whose haunt was in the fens, whose place of retreat was encompassed by the willows of the brook, and overshadowed by trees, was "the chief of the ways of God," in the language and mind of the sacred poet.

As there exist differences of opinion among the best Hebrew scholars as to the exact signification of the first part of verse 17., which some have rendered "He sitteth up," and of the second part of verse 19, where allusion is made to some weapon, these become obviously unsafe elements, in the consideration of the zoological problem.

BELE'MNITES. (Gr. *βελεμνον, a dart.*) A genus of fossil Dibranchiate Cephalopods, the shells of which are chambered and perforated by a siphon, but internal. They are long, straight, and conical, and commonly called "thunder stones." These fossil remains are often found in chalk.

BEL-ESPRIT. (Fr.) A term formerly naturalized in England, applied to those individuals whose conversation or writings display an agreeable sprightliness or vivacity. (*Dict. Aca. Franç.*)

BE'LFRY. (Sax. bell, and Lat. ferre, *to carry.*) In Architecture, a tower or other place in which bells are hung. *See* CAMPANILE.

BE'LIAL. A Hebrew word, signifying wicked, worthless, and unprofitable. In Scripture, the sons of Eli are called sons of Belial, for their idolatrous and criminal conduct (1 Sam ii. 12.); and likewise the inhabitants of Gibeah, who abused the prophet's wife. (Judg xix. 22.) The apostle Paul (2 Cor. vi. 15), in order to indicate in the strongest terms the high degree of virtue after which the Christian should strive, places Christ in direct opposition to Belial. Our own epic poet has immortalized the infamy of Belial, by assigning him a prominent place in his *Paradise Lost.*

> A fairer person lost not heaven; he seemed
> For dignity composed, and high exploit.
> But all was false and hollow, though his tongue
> Dropped manna, and could make the worse appear
> The better reason, to perplex and dash
> Maturest counsels, for his thoughts were low.
> To vice industrious, but to nobler deeds
> Timorous and slothful, &c.

In the *Paradise Regained*, Milton represents even Satan as fired with indignation at the impiety of Belial, and as administering to him a sharp rebuke. (*Vide* Addison's Critique on Milton in the *Spectator*.) To these quotations may be added an allusion to Belial by Wierus. (*Pseudomonarchia Dæmonum*, p. 919.) "Sunt quidam necromantici qui asserunt ipsum Salomonem, quodam die astutiâ cujusdam mulieris seductum, orando se inclinâsse versus simulacrum Belial nomine."

BELL. A vessel or hollow body of cast metal, formed to emit sound by the act of some instrument striking against it. Bells are probably of very ancient origin, they are mentioned as worn upon the high priest's robes, in the book of Exodus (ch xxviii. ver 3.) They were used among the Greeks in camps and garrisons. Church bells are said to have been invented by Paulinus, bishop of Nola in Campania (whence the term Campana), about the year 400. They are first mentioned in England by Bede, towards the end of the seventh century.

BELLA DONNA (*Atropa bella donna*.) The deadly nightshade. it is an acro-narcotic poison. The name bella donna (*handsome lady*) is said to have been given from its having been used to improve the complexion. It contains the alkaloid *atropia*.

BELLE'ROPHON (Gr. *βελλεροφοντης*; called also Hipponous.) In the fabulous history of Argos, the son of Glaucus, and grandson of Sisyphus (*Paus* 2 4.), who was obliged to flee from Corinth for the murder of Bellerus, and seek refuge at the court of Proetus. There Antæa, the wife of Proetus, conceived a violent attachment for him, which he requited as Joseph did the advances of Potiphar's wife. Nor does the analogy between the cases end here, for Antæa forthwith accused him to her husband of attempts on her virtue. Proetus, however, unwilling to violate the laws of hospitality, sent him to Tobates, king of Lycia, his wife's father, with a letter desiring him to put Bellerophon to death, and mentioning the cause. (Hence, a letter unfavourable to the bearer was called "Literæ Bellerophontis.") With this view, Tobates sent him on various perilous expeditions: first, against the Chimæra, a dreadful monster, which continually vomited flames (*Lucr* v. 902; *Virg Æn* vi. 288. vii 785), and which at that time devastated the country of Lycia, having the head of a lion, the middle of a goat, and the tail of a serpent. (*Ovid Met* ix 646.) This monster, however, Bellerophon succeeded in destroying by the aid of a winged horse called Pegasus (*see* PEGASUS), which he had caught while drinking at the fountain Pirene in Corinth. In his next expeditions against the Solymi and the Amazons, he was equally successful (*Hom Il* vi. 155.), and consequently obtained the forgiveness of Tobates. Elated by his success, Bellerophon tried to fly to heaven on Pegasus, but Jupiter, enraged at his presumption, frustrated his attempts by sending an insect (œstrum) which stung the horse so violently that he became restive and threw his rider. Though maimed and shattered by the fall, Bellerophon was not killed, but he never perfectly recovered, and continued during the rest of his life to wander up and down in sorrow and dejection. (*Hom. Il* vi 201.) Bellerophon, we may add, was celebrated for his skill in horsemanship (*Hor* Od. iii 12. 7.), and is said to have first taught the art of riding. (*Plin.* iv. 56.)

BELLE'ROPHON. A fossil shell, the animal of which was probably allied to that of *argonauta*. The genus belongs to the carboniferous and older strata.

BELLES-LETTRES. (Fr.) Polite Literature. Almost all authors concur in censuring the vague and indefinite character of this term, as at one time every branch of knowledge has been included under this denomination, at another, excluded from it. Sometimes we are told that by the belles-lettres is meant a knowledge of the arts of oratory and poetry; sometimes that the true belles-lettres include natural philosophy,

geometry, and other essential parts of learning; and one author, in treating of the belles-lettres, introduces a discourse on the seven sacraments of the Romish church. In the division of the departments at the Lyceum of Arts, established at Paris in 1792, the belles-lettres comprehended general grammar, languages, rhetoric, geography, history, antiquities, and numismatics; whilst philosophy and the various branches of the mathematics were called, in contradistinction, sciences. Rollin and Rosenstein, who professedly treat of the belles-lettres, comprehend under the term all those instructive and pleasing branches of knowledge which chiefly occupy the memory and the understanding, and do not form part either of the superior sciences or of the mechanical professions. Belles-lettres, says Blair (after pointing out the tendencies of logical and ethical disquisitions), consider man as a being endowed with those powers of taste and imagination which were intended to embellish his mind, and to supply him with rational and useful entertainment. All that relates to beauty, harmony, grandeur, and elegance — all that can soothe the mind, gratify the fancy, or move the affections, belongs to their province. In an inquiry of this kind, reference must necessarily be made to Hume, who, both from the nature of his pursuits and the bent of his mind, was well qualified to give an opinion Paraphrasing the well-known passage of a classic author, —

> Ingenuas didicisse fideliter artes
> Emollit mores, nec sinit esse feros, —

he asserts, that the belles-lettres improve our sensibility for all the tender and agreeable passions, at the same time that they render the mind incapable of the rougher and more boisterous emotions. Still the difficulty is not removed; for while all those writers concur in awarding a distinguished place in the category of learning to the "ingenuæ artes," the "literæ humaniores," as the belles-lettres are called, they have, if not thrown a veil of obscurity over the precise definition of the term, at least not condescended to remove it If we have recourse to the Germans, we shall find that they comprehend under the denomination belles-lettres every branch of learning that is not cultivated with an ulterior view to pecuniary emolument; but their adoption of the term *belletristic*, to express all that relates to works of taste or æsthetics, does not appear to coincide with the definition above given by their professed lexicographers.

But though it would appear difficult to reduce this term within the limits of a precise and accurate definition, there can be little doubt that there are few terms which present so distinct a meaning to each individual mind The influence of the belles-lettres has been felt and acknowledged in all ages. The beautiful tribute paid to them by Cicero in his defence of Archias is familiar to all But we shall advert to the sentiments of another Roman, with whom we are more likely to sympathise, as he at least cannot be charged with special pleading In the beautiful letter to Mæcenas, who was afflicted with some mental distemper, Horace first advises his friend to have recourse to the study of polite literature in particular, —

> Sunt *verba* et *voces* quibus hunc lenire dolorem
> Possis, et magnam morbi deponere partem,

and then concludes in these general terms, —

> Invidus, iracundus, iners, vinosus, amator,
> Nemo adeo ferus est, ut non mitescere possit,
> Si modo culturæ patientem commodet aurem.

But the high importance with which the same accomplished author has invested polite literature may be still better perceived in another of his epistles, —

> Trojani belli scriptorem . . . . .
> . . . . . Præneste relegi,
> Qui, quid sit pulchrum, quid turpe, quid utile, quid non
> Planius et melius Chrysippo et Crantore dicit.

In this passage Horace pronounces Homer to be the most instructive teacher of moral and political philosophy; and indeed the tribute of respect which all the European nations pay to the Greeks in general, and to Homer in particular, as the authors of their refinement, sufficiently corroborates the opinion of the poet.

It would greatly exceed our limits to give even a cursory view of the belles-lettres in the decline and fall of the Roman empire; but we refer the reader to *Schlegel's History of Literature*, and to *Hallam's Introduction*, &c, for full information on this head. It may, however, be remarked, that during the long period of the middle ages (which has been often, though erroneously, considered as a blank in the history of the human mind) learning was almost wholly confined to the church; and though there was little original genius displayed in the province of imagination, yet here was preserved the germ of the future polite literature of Europe. As early as the 14th century, the spirit of polite literature, that had long been slumbering, was reanimated by the genius of Petrarch, and burst forth like a meteor in the Italian republics. Its genial influence was soon felt on this side the Alps; and in the year 1400, as Mr. Hallam observes, Spain, France, England, and Germany were in possession of a national literature. The traces of this spirit, however, were soon obliterated, and its effects gradually swallowed up in the wars that everywhere ensued, and in the all-absorbing taste for metaphysical and theological disquisitions that subsequently prevailed.

It is to the Reformation that may properly be ascribed the origin of polite literature in modern times; though, to use the words of Schlegel, the authors of that mighty spiritual revolution probably contemplated no other result from it than the emancipation of Europe from ecclesiastical bondage Among the first-fruits of its effects upon the interests of the belles-lettres in England, it may suffice to mention the names of Spenser, Shakspeare, Dryden, and Milton, who have embodied in their writings all the riches of the English language, and whose works are of themselves sufficient to furnish any nation with a polite literature of which it might justly be proud. In France, too, shortly afterwards, literature assumed a novel and substantial form; and in the age of Louis XIV. there arose a mighty host of literary stars, which were only equalled in brilliancy by a contemporaneous galaxy of British genius.

The close of the last and the dawn of the present century may be regarded as an era in the history of polite literature throughout Europe. Never at any former period were the true nature and object, the wide extent and dignity, of the belles-lettres so universally appreciated. While, on the Continent, Goethe and Schiller were scattering from their rich and inexhaustible stores "thoughts that breathe, and words that burn," England could at the same time boast of the brilliant productions of the Great Unknown, whose influence on polite literature has been well compared to that of the bright luminary on the terrestrial globe. The rapid strides, too, that have been made in the art of criticism, the establishment of reviews in every country on a more comprehensive plan than was ever previously adopted, and the general ability with which these are executed, have greatly contributed to the formation and confirmation of a literary taste In his admirable Essay on the Rise of the Arts and Sciences, Hume has remarked, that nothing is more favourable to the rise of politeness and l[illegible] than a number of neighbouring and independent states connected together by commerce and policy. Now, if we apply this observation to the various classes of society in the same country, and contrast the present state of society with that which existed even in the time of Hume, we may perhaps find another clue to the wide spread and cultivation of polite literature among us. At no very distant period, a broad line of demarcation was drawn between the literary and commercial classes of the community; in fact, literature and commerce stood separated like two different worlds revolving in different spheres. But the scene is changed; the framework of society has become more artificial and complicated; and we may now see the learning of the philosopher, the acuteness and promptitude of the man of business, and the earnestness and enthusiasm of the solitary artist, all brought into actual contact, and shedding each its influence upon the rest *Schlegel's History of Literature*. (*See* art. LITERATURE in this work, and the authorities there referred to)

BELL METAL. An alloy of 80 parts of copper and 20 of tin. The Indian gong metal is a similar alloy. An English bell metal analysed by Dr. Thomson was found to consist of 800 copper, 101 tin, 56 zinc, and 43 lead. Small shrill bells generally contain zinc.

BELLO'NA. (Lat. bellum) In the mythology of the ancients, was the wife or sister or the sister wife of Mars, and was especially worshipped by the Romans as the goddess of war She possessed a temple, built and dedicated to her by Appius Claudius, which stood in the Circus Flaminius, near the Porta Carmentalis. It was here that the senate granted audiences to foreign ambassadors, and received generals on their return from abroad. In front of this temple also stood the pillar against which the javelin was hurled, the usual preliminary among the Romans to a declaration of war. Bellona is generally depicted as the charioteer of Mars, with wild dishevelled hair, bloody garments, and a torch in her hand. Though the Romans were her chief worshippers, there were many temples dedicated to her service in Cappadocia and Paphlagonia. The priests of this goddess, who were termed *Bellonarii*, consecrated themselves by incisions in their bodies, and sacrificed to her honour the blood which flowed from their wounds.

BE'LLOWS. A machine contrived to propel air through a tube or orifice. It is used for blowing fires, supplying the pipes of organs, and other purposes, and is constructed according to various forms, but the principle is the same in all of them. The dimensions of a space in which air is confined are contracted; the air, being permitted to escape only at a small opening, rushes out

with a velocity proportional to the pressure and to the smallness of the opening.

BE'LLUÆ. (Lat. bellua, *any great beast.*) The term by which Linnæus designated an order of Mammalia, nearly corresponding to the Pachyderms of Cuvier.

BE'LOMANCY. (Gr. βέλος, *javelin*, and μαντεια, *prophecy.*) Divination by the flight of arrows, common to various oriental nations, and especially observed by the Arabians. It has been performed in various modes; one of the most common is, to let fly arrows, with inscriptions on labels attached to them, and take for a guide the contents of that belonging to the arrow first found.

BEL'TANE, or BE'LTIN. (Said to be the "fire of Bel" or Belus.) May-day, and the traditional Celtic customs attached to it. The month of May is thus called in the present Irish language. This day is particularly celebrated by the herdsmen in the Highlands of Scotland. The Beltane-fire, Beltane-cake, &c, are all observances of this day.

BELTS. A name given to the zones or bands which appear on the disk of the planet Jupiter. They are situated near and parallel to the equator of the planet, and are supposed to be produced by clouds in its atmosphere arranged in parallel strata, by currents of wind, which, by reason of the rapid rotation of the planet, must in the equatorial regions blow always in the same direction.

BELVEDE'RE. (It. *a fine prospect*) In Architecture, a small building at the top of a house or palace, constructed, as the name implies, to obtain a view of the country.

BELVISI'EÆ. (Belvisia, one of the genera) In Botany, a natural order of monopetalous Exogens, inhabiting Africa on the west side. Scarcely anything is known of the species, and its affinities are quite unsettled One of the species was called *Napoleona imperialis* by its discoverer, Palisot de Beauvois, after whom the genus typical of the order is now named.

BE'MBEX. A genus of Hymenopterous aculeate insects of the tribe *Fossores*, or burrowing sand-wasps, raised by Dr. Leach to the rank of a family (*Bembecidæ*), and including the genera *Bembex* proper, *Monedula*, and *Stizus*. Head transverse, with the upper lip exposed, tongue long, legs short; the brachia of the female furnished at the sides with very strong spines for burrowing in the sand For the habits of this family, *see* FOSSORES.

BEMBI'DIUM. A name applied by Latreille to a genus of Coleopterous insects, of the tribe *Carabidæ* Now raised to the rank of a family (*Bembididæ*), including the genera *Lymnæum* 1, *Cillenum* 1, *Tachys* 8, *Philochthus* 6, *Ocys* 3, *Peryphus* 16, *Notaphus* 9, *Sopha* 11, *Tachypus* 9, *Bembidium* proper 4. the figures refer to the number of indigenous species in each of the genera The common characters of the group are, cubits notched, elytra rounded at the extremity, abdomen not pedicellate, external maxillary palpi terminated by a very minute and acute joint, antennæ sub-elongate. The *Bembididæ* are generally found in low and damp situations, are of very small size, and glitter with polished metallic colours

BEND In Heraldry, an ordinary bounded by parallel lines, equally distant from the line joining the dexter base to the sinister chief. It contains the fifth part of the escutcheon if charged, and the third if not charged. The bend sinister, descending from the sinister chief to the dexter base, is the well-known difference which denotes bastardy, being borne on the paternal escutcheon of the bastard.

*To Bend.* The general sea term for fastening any thing; as to bend one rope to another, the cable to the anchor, a sail to a yard or gaff. Certain knots are called *bends*; as a carrick bend, a fisherman's bend, &c.

BENDS, called also WALES A certain number of thick planks of the ship's side, from the water upwards

BENEDI'CTINE MONKS. An order of monks that followed the rule of St. Benedict, which, as early as the 6th century, had extended itself through Italy, France, Spain, Germany, and England. The rules of Benedict, although founded no doubt on the old monastic institutions of Cassian (*Cassiani Opera*, Lips. 1733), were of a much more rational and comprehensive character Avoiding the extreme rigour of the Eastern systems, he not only exacted a promise from all who entered a convent that they would remain for life, and strictly observe its rules (*Marten Commen. in Regulas Bened* Paris, 1690), but prescribed to them a variety of suitable employments. This system soon made rapid progress, and the monks began to be useful to society in various ways: reclaiming waste lands, promoting zealously the cause of education, preserving the history of the times in their chronicles, and multiplying the treasures of antiquity by their copyists Under Charles the Great this order of monks was preferred to every other; and the spirit of inquiry which they then called into existence was perpetuated by the depth of their enthusiasm and the extent of their learning. To give even a cursory history of this order would far exceed our limits, as it embraces perhaps the palmiest days of ecclesiastical domination. (Vide *Gieseler's Kirchen-geschichte*, a work of great learning, and, as a book of reference, incomparable) As is universally known, it is to the Benedictine monks that England (A. D. 596) is indebted for its conversion from idolatry. This order has produced a vast number of ancient writers and men of learning. Among others, Placidius Maurus founded the school of Germany; Alcuinus the university of Paris; Guido invented the scale of music, Dionysius Exiguus completed the collection of papal decrees (A. D. 510); and the most learned man of his time, the admiration of the whole Western world, the Venerable Bede, belonged to this order.

BE'NEFICE. (Lat. beneficium.) A word denoting a certain class of church preferments, viz. rectories, vicarages, perpetual curacies, and chaplaincies; and distinguished from a dignity, under which title are comprehended bishoprics, deaneries, and prebends. Under the Romans, certain grants of lands made to the veteran soldiers were called beneficia, and the same term was applied at the commencement of the feudal system to estates conferred by the sovereign and held under him: which afterwards assuming a hereditary character became "fiefs" properly so called In the middle ages the popes assumed the feudal right with reference to ecclesiastical "patronage," and the term beneficium was hence applied to livings, &c, on the assumption that they were held under the pope as a superior lord. It was the assertion of this claim by Innocent III. and his successors which roused the jealousy of the European sovereigns, especially those of England and France, and from the contentions consequent upon this the first opening was made to the cause of Reformation.

BE'NEFIT OF CLERGY. In Law, originated in the immunities from municipal jurisdiction enjoyed in many states of Europe by the Roman Catholic clergy during the middle ages. When a person indicted for certain offences (most of those subjecting the offender to capital or corporeal punishment, excepting high treason) pleaded that he was a clerk or clergyman, and claimed privilege, he was demanded by his ordinary: a jury was summoned, and he was tried, and, according to their verdict, delivered to the ordinary as acquit or convict, to undergo canonical purgation, and to be discharged or punished according to the result of such purgation The proof of clergy, at first strictly required, was at last so relaxed, that it was only necessary for the offender to show that he was able to read The bishop's commissary was present, to decide whether or not he passed the test satisfactorily This loose mode of acquiring the privilege was first restricted by the stat. 4 H 7 c 13, which provided that offenders who had been allowed their clergy should be "burnt in the thumb," and if they claimed it a second time, be required to give proof of being actually in orders By 18 Eliz c 7, the second trial by compurgation before the ordinary (which had become a mere fiction) was abolished, and the judges were empowered to imprison the person who had benefit of clergy for a year, if they thought proper. By various subsequent statutes, the burning in the hand was commuted for transportation, whipping, &c, at the discretion of the judges, and the benefit was taken away altogether from a number of statutable felonies. By 5 Anne, c 6, the ceremony of reading was abolished, benefit of clergy being granted indiscriminately to all entitled to it, and finally by one of the enactments commonly called Peel's Acts (7 & 8 G. 4. c. 28. s. 6) benefit of clergy was abolished altogether

BENE'VOLENCE (Lat) In English History, a species of tax levied by the sovereign As its name implies, it was nominally a gratuity; but was, in point of fact, exacted as a forced loan, with or without the condition of repayment, under the reigns of the Plantagenet kings. By a statute of Richard III benevolences were declared illegal, but they were again exacted by Henry VII, and occasionally by means of circulars under the privy seal, by his successors By 13 C 2 stat. 1. c. 4. no voluntary aid can be raised on behalf of the king without the authority of parliament; and the general illegality of levying money for the use of the crown without such authority was declared in 1688 by the Bill of Rights.

BEN NUTS. The seeds of an Arabian plant called *Moringa aptera*; they yield an oil, called oil of ben, and have been employed in syphilitic diseases.

BEN, OIL OF. The expressed oil of the nut of the *Moringa aptera*. This oil is remarkable for not becoming rancid by age; and as it is perfectly insipid and inodorous, it is used for extracting the fragrancy of certain flowers, such as jessamin, orange, &c. The same tree furnishes the *Lignum nephriticum*, supposed to be useful in certain affections of the kidneys.

BENT GRASS. A species of Agrostis, the bent and creeping stems of which are very difficult to eradicate.

BENTS The withered stalks of grass standing in a pasture after the seeds have dropped.

BE'NZAMIDE. A compound, obtained by exposing chloride of benzule to ammoniacal gas.

BENZO'IC ACID. This acid forms a constituent of many balsams; it is generally obtained by heating benzoin, and collecting the acid vapours which are evolved and condense in brilliant acicular crystals. It is a compound of carbon, hydrogen, and oxygen; its equivalent being 120. Its combinations are called *Benzoates*.

BENZO'IN. The resinous exudation of the *Styrax benzoe*, a tree which is a native of Sumatra. Benzoin is a combination of resin and *benzoic acid*. It has a mottled or amygdaloid texture, and is composed of a mixture of brown and white parts. It has a fragrant odour.

BENZOYLE, or BENZULE. (From benzoin, and ὕλη, *principle*.) A compound of carbon, hydrogen, and oxygen, regarded as the base of benzoic acid.

BERBERA'CEÆ, or BERBERIDEÆ. A natural order of plants, named after the genus Berberis, which is in fact the most important genus it contains. It is the only one whose fruit is succulent and eatable; that of the others is dry and hard.

BE'RBERINE. A yellow bitter principle, contained in the alcoholic extract of the root of the barberry tree.

BE'RBERRY. (Lat berberis.) A spiny shrubby plant, bearing yellow flowers, and succulent one-celled fruit growing in racemes It is one of a genus in which the fruit is universally fleshy and acid, although often less so than in the common kind (*Berberis vulgaris*). Some of the species have pinnated leaves, many are evergreens, and several have a black fruit, even the common sort has a variety of this description, as well as others with pale yellow and stoneless fruit. There is an idea among people in the country that a berberry bush brings blight to a wheat field; but the parasitical fungus which attacks the berberry is altogether different from that which produces the mildew of wheat, which cannot possibly be communicated by the one to the other.

BE'RGAMOT, ESSENCE OF The essential oil of the rind of a small pear-shaped fruit, the produce of the *Citrus limetta bergamium* It is much used as a perfume, and apt to be adulterated with the oils of orange and lemon peel, and with alcohol

BERO'SUS In Entomology, a genus of Coleopterous insects of the family *Hydrophilidæ*. They inhabit ponds, in which they may often be seen swimming in an inverted position.

BE'RYL. A mineral allied to the emerald, composed of 68 silica, 15 alumina, 14 glucine, 2 lime, 1 oxide of iron It is usually transparent, pale green, and in beautiful crystals, much larger than those of the emerald. It is the *aquamarine* of the jewellers. The finest comes from Daouria, on the frontiers of China, from Siberia, and from Brazil

BESI'MEN. An obsolete term for the spores or seeds of the lowest kinds of plants, especially of Algæ.

BE'TEL. The leaf of the betel or Sirriboa pepper, which is chewed by the inhabitants of many parts of India along with a nut of the areca palm tree and lime, which substances are wrapped in the betel leaf It is acrid and narcotic, and stains the saliva red.

BETHY'LUS. In Entomology, a genus of Hymenopterous insects of the family *Proctotrupidæ*.

BETRO'THMENT A mutual compact between two parties, by which they bind themselves to marry. Betrothment was a legal contract by the Roman law, as it now is in that of various continental countries. In Germany, betrothments are either public, with the consent of relations and presence of witnesses; or private (clandestine), which in some countries are void, in others, although valid as contracts, punishable as misdemeanors. Public betrothment induces the obligation to marry But according to modern practice an action for damages is almost the only way of enforcing it, a small fine or imprisonment being the utmost criminal penalty for the violation of the engagement.

BETULA'CEÆ. (Betula, one of the genera) A small natural order of plants, containing the birch, after which it takes its name, and the common alder. The order formed part of what were formerly called *Amentaceæ*

BE'VEL. (Lat. bivium, *branching road*.) In Architecture, an instrument for taking angles One side of a solid body is said to be bevelled with respect to another when the angle contained between them two sides is greater or less than a right angle

BEVEL ANGLE. A term used among artificers to denote an angle which is neither a right angle nor half a right angle

BEVEL GEER. In Mechanics, a species of wheelwork, in which the axles of two wheels working into each other are neither parallel nor perpendicular, but inclined to one another in a certain angle Wheels of this kind are also called conical wheels because their teeth may be regarded as cut in the frustrum of a cone. *See* WHEEL.

BEY, or BEG. A Turkish and Tartar title of dignity, used with no very accurate application for lord, prince, or chief, and frequently subjoined to the proper names of persons of rank.

BEZA'NT. A gold coin struck at Byzantium (Constantinople): they varied in weight and in value. Bezants appear to have been current in England from the tenth century to the time of Edward III. Some of them weighed about twenty grains. According to Camden, a piece of gold which was anciently offered by the king on high festivals was called a *bizantine*, and valued at 15*l*. There were also white or silver bezants.

BEZANT. In Heraldry, a circle, or. The name is derived from the gold coins of the Greek empire, termed bezants, or byzantines, by the people of the West. It was probably introduced into coat armour by the Crusaders.

BE'ZOAR. A Persian word implying destructive of poison, and applied to certain intestinal concretions of animals, called bezoar stones, and supposed to possess such powers.

BI. (Lat. bis, *twice*.) Signifies, when attached to other words, two, twice, or double; as bicarbonate of potash, a compound of potash with two atoms of carbonic acid, bilocular, two cells; bivalve, two valves, &c.

BIARTI'CULATE (Lat. bis, articulus, *joint*.) Applied in entomology to the antennæ of insects when they consist but of two joints, and also to the abdomen under the same circumstances, as in the *Nycteribia biarticulata*

BIAURI'CULATE. (Lat bis, auricula, *an auricle*.) In Comparative Anatomy, signifies a heart with two auricles, as in most bivalve molluscs, and in all reptiles, birds, and mammals.

BI'BLE. (Gr. βιβλος, *a book*; from whence the word came to be applied emphatically to the volume of the Old and New Testaments)

The sixth article of the English Church enumerates the books of the Old Testament, which it considers of canonical authority, in which it follows the canon received by the Jews in the time of our Saviour. The apocryphal writings, which are accounted authentic by the Roman Catholics, are of undoubted antiquity, being comprised in the Septuagint edition of the Scriptures; but their authority has never been acknowledged by the Jews, who reckon twenty-four canonical books; nor are their originals found in the Hebrew language

The canon of the New Testament is now received without variation, we believe, in all Christian communities In the early period of the church, the authenticity of particular books was frequently disputed, and heretical sects attempted to foist other apocryphal writings into their place The general consent, however, of the orthodox church may be inferred from catalogues extant in the writings of many of the Fathers throughout the first four centuries, and the express declaration of the council of Laodicea and others Some latitude of opinion seems, however, to have been allowed in early times respecting the book of Revelations; and some of the Fathers confess that the genuineness of St. Paul's Epistle to the Hebrews, of that of James, of the second of Peter, and two last of John, was held by some to be undecided.

BIBLE SOCIETY, THE BRITISH AND FOREIGN. A society established in England in the year 1804, "with the sole object," as it is expressed in its regulations, "of encouraging a wider circulation of the Holy Scriptures without *note or comment*." The society took its rise from the circumstance of the complaints which had been made in Wales for some years previous, respecting the great deficiency of Bibles in the language of the Principality — a want which, it was urged, the Society for Promoting Christian Knowledge had very imperfectly supplied. The earliest promoters of this institution were the Rev. Mr Charles of Bala, Mr Hughes, and Mr. Stenkoff, minister of the German Lutheran Church Among its principal patrons may be mentioned Lords Teignmouth and Gambier, Messrs Wilberforce, Granville Sharp, and Charles Grant. This society has now auxiliary establishments connected with it not only in all the principal cities of the United Kingdom, but throughout Europe and North America.

The principle upon which the Bible Society acts has always been regarded with jealousy by the high church party in this country. In the first place, it is looked upon not only as a rival to the venerable Society for Promoting Christian Knowledge, which had been in action since the year 1699, but as casting some slur upon the latter as inefficient in its operation and erroneous in its principles The younger society also admits as members the adherents of every religious denomination, and in its proceedings maintains an absolute neutrality among them — which its opponents consider incompatible with the profession of true churchmanship. Accordingly many controversies have been carried on between the champions of the two institutions; in the course of which, however, it would seem that the Bible Society has gained ground in the favour of the established church, from whence a large proportion of its subscribers are now derived. Among them are the names of several bishops, and many other dignitaries.

In the report for 1840, we find the total number of

Bibles and Testaments issued by this society since its foundation to be 12,322,471. The number issued during the year ending March, 1840, was 776,360. The income of the society for that year was 111,449*l.* 13*s.* 1*d.*

BI'BLICAL HISTORY and LITERATURE. The accounts of the books of the Jewish Scriptures antecedent to the captivity are few and indistinct; but they are referred to under the titles of "the law," "the books of Moses," and "the books of the law of Moses," by Daniel (ix. 11.), Ezra (vi. 18.), and Nehemiah (viii. 1.): there are also other passages from which it may be inferred, independent of the internal evidence of the books which we possess, that there existed such from an early period.

The canon of the Old Testament appears, however, to have been settled, and the limits of inspired Scripture determined about 50 years after the return from the captivity, by the authority of Ezra and the prophets of his day; the books of Nehemiah, Malachi, and Ezra himself being subsequently added. The sacred writings which came in later times to be incorporated in the collection of the Jewish Scriptures are known by the name of Apocrypha, or secret: they were undoubtedly held in respect by the Jews, and by the Christians afterwards; but Protestants deny that they were ever held to be inspired, or their authority placed on the same footing as that of the canonical Scriptures.

At a later period we find passages in the New Testament, in Philo, and most distinctly in Josephus, to prove the fact of this collection of the Scriptures into a volume. The books themselves are first specified by Origen, who enumerates twenty two, in which number he coincides with Josephus. His list embraces all that we consider canonical, and rejects the Apocrypha.

The early versions which illustrate the question of the antiquity of the Hebrew Scriptures are the Samaritan Pentateuch, and the Septuagint or Greek translation. It is not to be supposed that the Samaritans would have adopted and translated the books of the Jews, unless they had been received prior to the separation and enmity of the two peoples, the period at latest of the return from the captivity. The Samaritan Pentateuch now extant is said to be a version from the earlier Hebrew Samaritan into the more modern Samaritan, and was made before the time of Origen. The part of the Septuagint which comprises the Pentateuch was made about the year B. C. 285; the translation of the other book into Hellenistic Greek appears to be of different and somewhat later dates.

Next in order to these may be mentioned the versions of the Old Testament in the earliest periods of Christianity, which are important, not as assisting us to ascertain the antiquity of the original, but as contributing to our knowledge of the genuine text. These may be divided into three classes.

I. The Oriental, comprising—
- The Syriac or Peschito (literal), from the Hebrew, about the end of the first century—embracing both the Old and New Testaments
- The Coptic, from the Septuagint—between centuries two and five. This embraces also the New Testament
- The Ethiopic, from the Septuagint—in the fourth century: embraces the N. T.

II. The Latin, or Western:—
- The Italic, from the Septuagint, in either the first or second century, only fragments remain: it embraced also the New Testament
- The Vulgate, made from the Hebrew by Jerome, A. D. 390. This translation is considered an ultimate authority by the church of Rome.
- The Gothic version of Ulphilas, which was made from the Greek of both the Old and New Testaments, in the fourth century, has not come down to us entire. Only a small part is in print.

III. The Greek, comprising—
- The version of Aquila.
- —— of Theodotian.
- —— of Symmachus.

All translated from the Hebrew; all of or near the second century; all exist only in the fragments of the Hexaple or combination of six versions by Origen.

The genuineness of the Hebrew text was preserved after the destruction of Jerusalem by the sedulous care of learned academies which flourished at Tiberias, Babylon, and other places, from the first to the twelfth centuries. The date of the Masora is generally fixed about the fifth century. This work consisted of a most minute enumeration of the sections, verses, words, and letters of the Scriptures; which has been so successful in fixing the genuine reading, that although there were discovered upwards of 800 discrepancies between the Oriental and Occidental Recensions, they all relate, with one single exception, to vowel points, and are of no kind of importance. For an account of the labours of the early Jewish schools of criticism in the interpretation of the Hebrew text, *see* art. TALMUD.

The integrity of the text of the New Testament has been established by the collation, wholly or in part, of 674 manuscripts, existing either entire or in fragments. These have been classified by modern critics according to recensions or families, the most simple of whose systems and that most approved, is Scholz's, who considers all the variations that exist in these MSS. to be resolvable into their having been transcribed from Constantinopolitan or Alexandrian exemplars. The former he considers to have been from the earliest times the most strict and faithful recension. It was that which was principally used in the liturgical offices of the East; and its fidelity is argued from the exact uniformity of all the MSS which can be traced historically to a Constantinopolitan origin. This may be accounted for by the authority inherent in the text received in the centre of the imperial power and of the patriarchal jurisdiction. It is also consistent with the minute care with which the rites of the Constantinopolitan church were enjoined by its missionaries upon their converts; and also with the character of the Greek fathers, who present much greater exactness and uniformity in their quotations of the New Testament than the African. On the other hand, the Alexandrian copies have been written with a considerable degree of carelessness, and do not appear to have been intended, even in their own country, for reading in public service. They are said to partake in the rash and speculative spirit of the theologians of the Alexandrian church. The former of these recensions has been adopted in the Syriac, Gothic, and Sclavonic versions. It is that also which forms the basis of our modern texts. The latter was followed by several Latin, the Coptic, and Ethiopic translations. Erasmus conceived the idea of the Greek text having been purposely corrupted to suit the Vulgate, and assigns the council of Florence in 1439 as the authority by which this transaction was effected. This opinion continued to be held under the title of the Fœdus cum Græcis, with more or less discussion till modern times, by which it seems to be very generally rejected as untenable. It is known, on the contrary, that in the compilation of his translation, which bears the name of the Vulgate, the existing Latin version was corrected by Jerome from the Greek.

BIBLIO'GRAPHY. (Gr. βιβλίον, *a book*, and γραφω, *I describe*.) The science of books. The knowledge which is required to classify books, according to the various subjects on which they treat, has been termed intellectual bibliography, that of the external peculiarities of books, their editions, &c., material bibliography. The first branch borders closely on the province of criticism, for the most valuable bibliographical works, being what are termed in French "catalogues raisonnées," are those in which the lists of books are accompanied with some remarks on the character of their contents. The second branch of bibliography has been of late years cultivated with all the ardour attached to a fashionable and somewhat eccentric pursuit. The lovers of rare editions and curious copies of works, from being, to borrow a French term, "bibliophiles," have formed of late a peculiar sect entitled "bibliomaniacs," with whom the fancy for books has become a passion, like those of Dutch speculators for tulips and pictures. Many works of novel and curious research in this department of literature have been recently produced to guide their taste, and gratify their appetite. For the purposes of the common student, *Brunet's Manuel du Libraire*, although by no means complete, is still the most useful index to general literature. Many books of a similar character exist in English, but none that can be recommended as generally valuable; although some of those devoted to particular branches of the subject, especially to the learning of early editions, display much curious research. *Watt's Bibliotheca Britannica*, although useful, from its double arrangement according to subjects and authors, is a very imperfect work.

The following list contains a selection from among the most valuable works which we possess, in different departments of bibliography. But many of them, from the critical matter which they contain, may be considered to belong to the history of literature, as well as of books and editions.

I. *Introductory Works on the Science of Bibliography.*
- *Peignot*, Manuel Bibliographique, 1800.
- *Peignot*, Dictionnaire Raisonné de Bibliologie, 3 vols. 8vo.
- *Achard*, Cours de Bibliographie, 3 vols. 8vo. Marseilles, 1807.
- *Horne, Thomas Hartwell*, Introduction to the Study of Bibliography, 2 vols. 8vo. Lond. 1814.
- *Denis*, Einleitung zur Bücherkunde, 2 vols. 4to. Vienna, 1796.
- *Boulard*, Traité Elementaire de Bibliographie.

II. *Bibliography of the Oriental and Classical Languages.*
- *Clarke, Dr. Adam*, Bibliographical Dictionary and Miscellany, 8 vols. 12mo. Lond. 1802-6.

*Le Long*, Bibliotheca Sacra, 2 vols. fol. Paris, 1723.
*Fabricius*, Bibliotheca Græca, edited by Harles, 12 tom. 4to. Hamburg, 1790. 1809.
*Fabricius*, Bibliotheca Latina. By Ernesti. 3 vols. 8vo. 1773-74.
*Fabricius*, Mediæ et Infimæ Ætatis. By Manso. 3 vols. 4to. Patav. 1759.
*Harwood's* View of the various Editions of the Greek and Roman Classics, 1775.
*Dibdin's* Introduction to the Knowledge of rare and valuable Editions of the Classics, 2 vols. 8vo. 1827 (last edition).
*Moss's* Manual of Classical Bibliography, 2 vols. 8vo. 1825
Degli Autori Classici Biblioteca Portabile (Boni and Gamba), 2 vols. 12mo. Venice, 1793.

III. *Bibliography of particular Sciences and Branches of Literature.*

*Lipenius*, Bibliothecæ (Theologica, Juridica, Philosophica, Medica), 6 vols fol. The Juridica by itself has been reprinted, with supplements, &c. in 4 vols. Leipsic, 1775-89. The whole collection passes under the title of Bibliotheca Realis.
*Meusel*, Bibliotheca Historica.
Bibliotheque Historique de la France, 5 vols. folio, 1768, 1778.
*Bridgman's* Legal Bibliography, 8vo. Lond. 1807.
*Murhard*, Bibliotheca Mathematica.
*Dryander*, Catalogus Bibliothecæ Historiæ Naturalis Josephi Banks (a general account of books on natural history).
*Lalande*, Bibliotheque Astronomique, 4to. Paris, 1803.
*Boucher de la Richardere*, Bibliotheque de Voyages. 6 vols 8vo Paris, 1808.

IV. *Bibliography of Modern Nations.*

*Watt's* Bibliotheca Britannica, 4 vols. 4to. Edin. 1819. This very laborious work contains a mere catalogue of works, arranged alphabetically, first under the head of writers, and then of subjects. A more complete, and more critical work on English Bibliography, is among the greatest desiderata of the present day. Dr Watt's work contains many foreign articles; but is chiefly devoted to English literature
*Querard*, La France Litterare; a very valuable catalogue of French works, in all departments of literature Paris, 1828.
*Mazzuchelli*, Autori d'Italia; a work containing literary history and biography, with bibliographical science 2 t fol. Brescia, 1753-63.
*Foppen*, Bibliotheca Belgica. 2 vols. 4to. 1739.

V. *Bibliographical Works on rare Books, Typographical Antiquities, early Editions, &c.*

*Vogt*, Catalogus Librorum Rariorum, 8vo 1732.
*Gerdesius*, Florilegium Librorum Rariorum, 8vo 1731
*Clement*, Bibliothèque Curieuse, ou Catalogue Raisonné des Livres Rares, 4to. 1750-60. A minutely critical work.
*Bauer*, Bibliotheca Librorum Rariorum Universalis, 7 vols 8vo. 1770-91.
*Maittaire*, Annales Typographici ab Artis inventæ Origine, 5 vols 4to. Hamb 1719-41. Several supplements have been published.
*Panzer*, Annales Typographici ab Artis inventæ Origine ad Annum 1500. (It is, however, carried down to 1536.) 11 vols. 4to. Nuremb. 1793. 1803.
*Ames's* Typographical Antiquities, first edition, 1749; republished by Mr Huhet in 3 vols. 4to. 1790; and again by Dr. Dibdin.
*Dibdin*, Bibliotheca Spenceriana (a catalogue of books in the Spencer library, printed before 1500), 4 vols. 8vo. 1814 Well known, like most of the other works of this distinguished bibliographer, for the minuteness of its research and extreme beauty of embellishment.
*La Serna Santander*, Dictionnaire Bibliographique Choisi du Quinzieme Siècle, 3 vols. 8vo 1805.
*De Bure*, Bibliographie Instructive, ou Traité de la Connaissance des Livres rares et singuliers, with supplements, in all 10 vols. 8vo. Paris, 1713, 1782. The most practically useful work on the subject.
*Osmont*, Dictionnaire des Livres rares, 2 vols. 8vo. Paris, 1768
*Raynouard*, Historie de l' Imprimeur des Aldes. *See* ALDINE EDITIONS.

VI. *General Bibliographies, and Miscellaneous Works.*

Dictionnaire Bibliographique 3 vols. 8vo. Paris, 1790.
*Brunet*, Manuel du Libraire, 3rd and enlarged edition. 4 vols. 8vo. 1820. A work of the greatest utility. Two supplementary volumes were published in 1832.
*Morhof*, Polyhistor Literarius, Philosophicus et Practicus, first edition by Fabricius, 2 vols. 4to 1747.
Saxii Onomasticon Literarium, 8 vols. 4to. 1759. 1803.





**BICA'LCARATE.** (Lat. bis, calcar, *a spur.*) When a limb or part is armed with two spurs.

**BICE.** In Painting, a light blue colour prepared from smalt. From it, by a mixture with yellow orpiment, another colour is formed of a green hue, bearing the same name.

**BI'CEPS.** (Lat. bis, *twice*, and caput, *head*) An anatomical term, applied to muscles having a double insertion, or which arise by two heads.

**BICO'LLIGATE.** (Lat. bis, *twice*, colligo, *I bind together.*) In Ornithology, a term signifying the connexion of all the anterior toes by a basal web.

**BI'COLOR.** (Lat. bis, color, *colour.*) When an animal or part is of two colours.

**BICO'RNIS.** (Lat. bis, cornu, *a horn*) In Zoology, when an animal or part has two horns, or two horn-like processes. In Anatomy, when the uterus has two divisions, like horns, as in most quadrupeds.

**BICU'SPIS** (Lat) A tooth with two points.

**BIDE'NTATE.** (Lat. bis, dens, *a tooth*) When an animal has but two teeth, as the *Delphinus bidens*; or when a part has two tooth-like processes.

**BIE'NNIAL.** (Biennis, *of two years' duration.*) A term applied to plants which grow one year and flower the next, after which they perish; they only differ from annuals in requiring a longer period to fruit in. Most biennials, if sown early in the spring, will flower in the autumn, and then perish, thus actually becoming annuals.

**BIESTINGS.** The name given to the first milk yielded by a cow after calving.

**BIFA'RIOUS.** (Lat) Arranged in two rows.

**BI'FORATE.** (Lat bis, foro, *I pierce.*) Having two perforations, as the anthers of a Rhododendron.

**BI'FORINES.** Singular bodies lately discovered in the interior of the green pulpy part of the leaves of some Araceous plants. They are minute oval sacs, tapering to each end, where they are perforated, they are apparently composed of two bags one within the other, the space between the bags being filled with a transparent fluid, and the inner bag itself with fine spiculæ. When the biforine is placed in water it discharges its spiculæ with considerable violence, first from one end, and then from another, recoiling at every discharge, and eventually emptying itself, when it becomes a flaccid motionless bag. Nothing is known of the nature, use, or origin of these bodies.

**BIFU'RCATE.** (Lat bis, furca, *a fork*) When a part has two prongs like a fork.

**BI'GAMY.** (Lat bis, *twice*, and Gr. γαμος, *marriage*) The offence of contracting a second marriage during the life of the husband or wife, which, by the law of England, is felony, punishable by transportation for seven years, or imprisonment for two Bigamy, by the canon law, signified a second marriage after the death of the first wife, or a marriage with a widow; and incapacitated the party contracting. *See* MARRIAGE, LAW OF.

**BIGHT.** Part of a rope between the ends; bight is also a shallow bay or hollow in the line of sea coast.

**BIGNONIA'CEÆ.** (So called from Bignon, a French man of letters, and the friend of Tournefort) A natural order of Didynamous plants, usually having a twining stem, large trumpet-shaped flowers, and a pod-like capsule with winged seeds. Some of them are trees of considerable size, and furnish timber valuable in the countries where it is produced; but the greater part are interesting only for the beauty of their flowers, in which respect this order yields to no other. *Bignonia venusta*, *Pandoræ*, *æquinoctialis*, *cherere*, and *grandiflora*, are probably the handsomest twining plants known.

**BI'JUGATE.** (Lat. bis and jugum, *a yoke.*) Composed of two pairs of any thing; a term applied to leaves pinnated with two pairs of leaflets.

**BIKH.** A deleterious plant inhabiting Nepal, and used by the natives of that country to poison their wells when the British troops invaded it. The *Aconitum ferox* has been ascertained to be this poison, which, like that of all other Ranunculaceous plants, is volatile; and although highly dangerous when fresh, soon loses its activity when exposed to the air.

**BILA'BIATE.** (Lat bis and labium, *a lip*) When a flower has all or any of its parts collected into two separate parcels or lips Thus a calyx having two of its sepals collected into one parcel, and the others into a second parcel, or a corolla with its five petals adhering two and three together, are bilabiate

**BILAME'LLATE** (Lat bis, lamella, *a plate.*) When a part is divided longitudinally into two lamellæ.

**BI'LBERRY.** A small bush inhabiting the northern parts of Europe in mountainous situations, and bearing small black berries, which are eaten by country people, and are a favourite food of deer. It is the *Vaccinium myrtillus* of Botanists.

**BILDSTEIN.** (German.) A mineral composed chiefly of silica and alumina, with a little oxide of iron. It is commonly seen carved into Chinese figures.

BILE. (Lat. bilis; said to be derived from bis, *twice*, and lis, *contention*, as being the supposed cause of anger and dispute.) A fluid secreted in the liver, of a yellow colour, and a nauseous taste, compounded of sweet and bitter; it sinks in water, and mixes with it in all proportions; it is slightly alkaline, and feels soapy. It contains a peculiar bitter principle, which has been called *picromel*, and a little free soda and saline matters. According to Berzelius, the solid constituents of bile amount to about one tenth of its weight.

BILGE. The lower or flat part of the bottom of a ship on which she rests when aground — Bilge of a cask, the middle part between the ends, in which the bung-hole is placed.

BILGED. Having the bottom stove in.

BILGE WATER. The water that collects in the bottom, by leakage or otherwise. It has usually a peculiar and offensive smell. When a ship is tight the bilge water when pumped up is dark; in a leaky ship, it comes up quite clear.

BI'LIARY CALCULI. Are concretions which form in the gall-bladder (gall stones) or bile-ducts They are generally composed of a peculiar crystalline fatty matter, which has been called *cholesterine*.

BILL. A legislative measure introduced into parliament is so called until it has acquired the force of law by receiving the royal assent Bills are either public or private; a distinction founded rather on usage and precedent, than on any exact definition. The immediate parliamentary consequence of the distinction is the payment of certain fees to the officers of the house, which are due by custom on private bills. According to Hatsell, this difference between private and public bills was recognised as long ago as 1607 It is a general rule of parliamentary proceeding, that the same bill or question cannot be twice offered in the same session. But at every stage of a bill, the whole of it is supposed to be before the house, and consequently if words have been inserted by way of amendment, the sense of the house may again be taken respecting them at a subsequent stage *See* PARLIAMENT.

BILL OF SALE. In Law, a contract under seal, by which a man passes his interest in goods and chattels to another, and which does not require either valuable consideration or actual transfer of the goods to support it, as between the vendor and vendee, although as between the vendee and the vendor's creditors the absence of such consideration and transfer would in general be held indicative of fraud, and invalidate the contract.

BILL OF HEALTH A certificate or instrument, signed by proper authorities, delivered to the masters of ships at the time of their clearing out from all ports or places suspected of being infested by particular disorders, certifying the state of health at the time that such ships sailed. Bills of health are of three kinds—*clean*, *foul*, and *suspected*, which are self-explanatory terms

BILL OF LADING A memorandum, subscribed by the master of a ship, acknowledging the receipt of goods intrusted to him for transportation, and binding himself (under certain exceptions) to deliver them to the person to whom they are addressed, in good condition, for a certain remuneration or freightage. Of bills of lading there are usually triplicate copies, one for the party transmitting the goods, another for the person to whom the goods are addressed, and the third for the master.

BILL OF EXCHANGE. *See* EXCHANGE.

BILL OF RIGHTS. In Law, the declaration delivered by the two houses of parliament to the Prince of Orange, February 13 1688, at the period of his succession to the British throne, in which, after a full specification of various acts of James II which were alleged to be illegal, the rights and privileges of the people were asserted

BI'LLET In Heraldry, a bearing of which the origin is very uncertain; represented of an oblong square form, sometimes showing the thickness, and always with a flat surface. Billetty, or semée of billets, signifies that the escutcheon or charge is strewed over with these bearings, without regard to particular number or station

BI'LLION. In Numeration, denotes a million of millions, and is expressed by 1,0000,0000,0000. The French use the same word to denote a thousand millions. The term is probably a contraction of *bis* and *million*, whence the English signification, a million of millions, appears more according to analogy. Thus biquadratic means the square of a square, or the product of two quadratics.

BILLS OF MORTALITY, are accounts of the number of births and burials within a certain district in every week, month, quarter, or year These were first compiled in London, after the great plague of 1593; and ten years afterwards began to be returned weekly. Several of the parishes now included within the metropolis (as Marylebone and Pancras) are not within the bills of mortality. *See* MORTALITY.

BI'LOBATE. (Lat. bis, lobus, *a lobe*.) When a part is divided into two lobes, or obtuse processes.

BILO'CULAR. (Lat. bis, locula, *a cell*) Having two cells.

BIMA'CULATE. (Lat. bis, macula, *a spot*.) When an animal, or part, is marked with two spots.

BI'MANA. (Bimana, *two-handed*.) The term applied by Cuvier to the highest order of mammalia, of which man is the type and sole genus.

BIME'DIAL. In Geometry, when two lines commensurable only in power (for example, the diagonal and side of a square) are joined together, the sum is irrational with respect to either of the two lines, and is called by Euclid a *bimedial*.

BI'NARY ARITHMETIC. (Fr. binaire, from binus, *dual*, or by *twos*) A species of arithmetic, proposed by Leibnitz, and founded on the shortest and simplest progression; namely, that which terminates with the second cipher. In the binary notation, therefore, only two characters are required, 1 and 0, the zero having the power of multiplying the number it follows by two, as in the common notation it multiplies by ten. The number *one* is represented by 1, *two*, by 10, *three*, by 11; *four*, by 100; *five*, by 101; *six*, by 110; *seven*, by 111; *eight*, by 1000; *nine*, by 1001; *ten*, by 1010, &c. This method of notation, though it may be applied with advantage in the investigation of some properties of numbers, would be inconvenient for common purposes, on account of the great number of characters required, even when the numbers to be expressed are small. We will give an example from the *Encyclopedie Methodique* of the method of expressing a number by the binary scale, and of finding the value of a number so expressed

It is convenient to begin with forming a table of the powers of 2, namely, $2^0$, $2^1$, $2^2$, $2^3$, &c They are 1, 2, 4, 8, 16, 32, 64, 128 Suppose, now, it were required to express the number 230 by the binary scale. Seek in the table the greatest power of 2 contained in 230; it is found to be 128, which is the 8th number in the table, hence the expression will contain 8 ciphers, and the first on the left hand is 1. Subtract 128 from 230, there remains 102, the highest power of 2 contained in this is 64, which is the seventh number in the table. The second cipher will therefore be also 1 Subtract 64 from 102, and there remains 38. But the sixth number in the table is 32, which is contained in 38, therefore the third cipher in the expression is still 1. Subtract 32 from 38, there remains 6, but the fifth number in the table is 16, which is not contained in 6; therefore the fourth cipher of the expression is 0. The fourth number in the table is 8, which is not contained in 6, therefore the fifth cipher must also be 0. The third number in the table is 4, which is contained in 6; therefore the sixth cipher will be 1 Subtracting 4 from 6 there remains 2, but the second number in the table is 2, therefore the seventh cipher is 1. The last difference is zero; therefore the last cipher in the expression is 0. Collecting all these results, we find the number 230 is expressed in the binary scale by 11100110

Next, suppose it were required to determine the value of the expression 110101 in the binary scale As there are here six ciphers, we look for the sixth number in the above table, and find 32, which is the value of the first cipher. The following cipher represents the fifth number, and is consequently equal to 16 The third cipher is 0, and its value nothing. The fourth cipher corresponds to the third number in the table, and represents 4. The fifth cipher is 0, and its value nothing. The last cipher corresponds to the first number of the table, which is 1. The whole expression, therefore, 110,101, is equivalent to $32 + 16 + 4 + 1 = 53$. It has been imagined, though on very slight grounds, that traces of the binary notation are discernible among the early monuments of China.

For information on the subject of arithmetical scales, see *Leslie's Philosophy of Arithmetic*.

BINARY MEASURE. (Lat. binarius, *belonging to two*) In Music, that in which the raising the hand or foot is equal to that of falling, usually called common time. The Italians are accustomed after a recitative to use the phrase *a tempo giusto*, to indicate that the measure is to be beat true and correct, which is otherwise conducted in the recitative in order to express passion, &c.

BI'NAT. (Lat. bis and natus, *born*.) When two bodies of the same nature spring from the same point, as often happens in the segments of leaves.

BIND. (Ger. binden, *to fasten together*.) In Music, the same as a ligature or tie for the purpose of grouping notes together.

BIND. The indurated clay of coal mines. Binding in agriculture is tying up sheaves of corn.

BINE'RVATE. (Lat. bis, nerva, *a nerve*.) In Entomology, when the wing of an insect is supported by only two nerves.

BI'NNACLE. The case or stand in which the steering compass is placed; it is fixed near the tiller or wheel. At night the compass is illuminated by a lamp placed over it.

BI'NOCLE, or BINOCULAR TELESCOPE. (Lat. binus, *double*, and oculus, *the eye*.) A telescope to which both eyes may be applied at once, and in which, conse-

quently, an object may be observed with both eyes at the same time.

BINO'MIAL. (Lat. bis, *twice*, and Gr. νομος, *law*.) In Algebra, signifies a quantity composed of two terms, connected together by the signs + or − ; thus, $a + b$ and $c - 5$ are binomial quantities.

BINO'MIAL THEOREM. A formula discovered by Newton, of singular use in algebra, by which a binomial quantity may be raised to any power $m$, the exponent $m$ being either a whole number or a fraction, positive or negative. The formula is this : —

$$(a+b)^m = a^m + \frac{m}{1} a^{m-1} b + \frac{m(m-1)}{1\ 2} a^{m-2} b^2 + \frac{m(m-1)(m-2)}{1\ 2\ 3} a^{m-3} b^3 + \frac{m(m-1)(m-2)(m-3)}{1\ 2\ 3\ 4} a^{m-4} b^4 + \&c.$$

And the mere inspection of the terms will give a better idea of the manner in which they are successively formed than any explanation.

When the exponent $m$ is a whole positive number, it is evident that the series has a finite number of terms ; suppose, for example, $m = 3$, then $m - 3 = 0$ ; and all the terms into which $m - 3$ enters as a co-efficient become equal to zero, or vanish. But on looking at the series, we find $m - 3$ entering the fifth term, and it will continue in all the succeeding, therefore, when $m = 3$ the series can only have four terms; and, generally, the number of terms of the series exceeds the exponent by one. When $m$ is a fractional number, or is negative, the series does not terminate, and will only express approximately the value of $(a + b)^m$ when it is convergent ; that is to say, when every individual term of the series is greater than that which succeeds it. For example, let the expression to be developed be $(xx + y)^{\frac{1}{2}}$, which stands for the square root of the binomial $(x^2 + y)$ Comparing this with the above formula, we have evidently —

$$(xx+y)^{\frac{1}{2}} = xx^{\frac{1}{2}} + \tfrac{1}{2} xx^{\frac{1}{2}-1} y + \tfrac{1}{2}(\tfrac{1}{2}-1) xx^{\frac{1}{2}-2} y^2 + \&c.$$

$$= x + \frac{y}{2x} + \frac{y^2}{8x^3} + \&c.$$

a series which goes on for ever ; but which, supposing $x$ greater than unity, approaches nearer and nearer to the true value of the root of $x^2 + y$, as the number of terms included becomes greater

In order to determine whether in any given case the series is convergent, we have only to compare two successive terms of the development of $(a + b)^m$. For example, take the fourth and fifth ; rejecting the common factors, the fourth is to the fifth as $a^{m-3} : \frac{m-3}{4} a^{m-4} b$; that is, as 1 to $\frac{m-3}{4} \frac{b}{a}$ ; therefore the fifth will be smaller than the fourth, or the series will be convergent if $(m-3)\,b$ is smaller than $4\,a$. In general, let $n$ be the order of any term in the development of $(a + b)^m$. this term will be to the succeeding in the ratio of $1 : \frac{m-n+1}{n} \cdot \frac{b}{a}$ ; and the terms will always go on decreasing, or the series will be convergent when $(m - n + 1)\ b$ is smaller than $n\,a$

The principal use of the binomial theorem is to find approximate values of the roots of quantities by expanding them into series The demonstrations which have been given of it are very numerous, and one or other of them may be found in any work on algebra. For one of the neatest and most concise we refer to the article "Algebra" in the *Encyclopædia Britannica*, 7th edition

BIO'CELLATE. (Lat bis, ocellus, *an eyelet*) In Entomology, when an insect's wing is marked with two eye-like spots

BIO'GRAPHY. (From the Greek word βίος, *life*, and γράφω, *I describe*.) The history of the life of an individual. Biography, in the progress of literature, appears to be nearly coeval with history itself It has been ingeniously described as "history teaching by example ;" and this mode of instruction was perhaps peculiarly appropriate to early and simple times, in which the relative importance of individual men to the society in which they lived was greater than it can ordinarily be in periods of more advanced civilisation. But, although we have notices of many biographical writers among the classical authors of Greece, none of their works have been preserved to us (if we except the short narrative of the exploits of Agesilaus by Xenophon, for his celebrated Memorabilia of Socrates are rather in the form of a collection of sayings and anecdotes than a memoir) of earlier date than the Roman Empire. It is to a comparatively late age that we owe all the more interesting works of this description which antiquity has bequeathed to us, some of which are among the most popular relics of the classical ages — the *Lives of Illustrious Men*, by Plutarch and Cornelius Nepos ; the *Lives of the Cæsars*, by Suetonius, a work of which the details are strictly biographical ; and the *Lives of the Philosophers*, by Diogenes Laertius. Biography may be said in strictness to differ from history not merely in the extent of the subject, but also, and perhaps more characteristically, in the mode in which that subject is treated. Thus, in classical literature, the works of Quintus Curtius and Arrian, although devoted exclusively to the actions of a single individual (Alexander), are not usually termed biographies ; not only because the individual in question was the leader and foremost character in a course of great public events, but also because those public events form the subject matter of their works, and not the more peculiar details of the personal life of their heroes. They are therefore more accurately denominated histories than biographies. On the other hand, the *Lives of the Twelve Cæsars* by Suetonius form, as has been said, a series of biographies, although the persons who furnish the subject were, like Alexander, arbiters of the destinies of a great part of mankind ; because the details which they contain are chiefly of a private and personal nature. It is the object of history, among its other lessons, to make us acquainted with the influence which the actions, the characters, and the thoughts of individual men have produced on the course of events affecting society in general conversely, it appears to be the province of the biographer to detail the effects which have been produced by external occurrences and circumstances on the character and conduct of individuals.

BIPE'CTINATE. (Lat. bis, pecten, *a comb*.) When a part has two margins toothed like a comb.

BI'PELTATE. (Lat. bis, pelta, *a buckler*.) When an animal or part has a defence like a double shield.

BIPU'PILLATE (Lat bis, pupilla, *a pupil*) In Entomology, when an eye-like spot on the wing of a butterfly has two dots or pupils within it of a different colour.

BIQUADRA'TIC. In Algebra, denotes the power immediately succeeding the cube ; that is, the square of the square, or fourth power

BIQUADRA'TIC EQUATION. Is an equation in which the unknown quantity rises to the fourth, but not to a higher power. An equation of this kind, when complete, is of the form $x^4 + Ax^3 + Bx^2 + Cx + D = o$, where A, B, C, and D, denote any known quantities whatever. Lewis Ferrari, an Italian geometer, and a pupil of the celebrated Cardan, made the discovery that the resolution of a biquadratic equation can always be reduced to that of a cubic equation. Of the various ways in which this reduction can be effected, the following, proposed by Euler, and explained at length in his *Algebra*, is perhaps the simplest The first step of the process is to transform the given equation into another in which the second term is wanting. This can always be done by assuming $y - \frac{1}{4}A = r$, and substituting it for $x$ in the proposed equation ; a new equation will result, having the form

$$y^4 + p\,y^2 + q\,y + r = o, \qquad (1)$$

and it is only to the solution of this that our attention need be confined.

Assume $y = \sqrt{a} + \sqrt{b} + \sqrt{c}$, and suppose $a$, $b$, $c$, to be three roots of the cubic equation $z^3 + Pz^2 + Qz - R = o$. By the theory of equations the co-efficient of the second term is the sum of all the roots with their signs changed ; the co-efficient of the third is the sum of the products of the roots combined by pairs ; and the last term is the product of all the roots with the signs changed. We have therefore $a + b + c = -P$, $ab + ac + bc = Q$, and $abc = R$. From the assumed equation $y = \sqrt{a} + \sqrt{b} + \sqrt{c}$, we get by squaring $y^2 = a + b + c + 2(\sqrt{ab} + \sqrt{ac} + \sqrt{bc})$, whence, substituting $-P$ for $a + b + c$, and transposing

$$y^2 + P = 2(\sqrt{ab} + \sqrt{ac} + \sqrt{bc}).$$

Squaring this equation also, we get after reduction $y^4 + 2Py^2 + P^2 = 4(ab + ac + bc) + 8\sqrt{a}\sqrt{b}\sqrt{c}(\sqrt{a} + \sqrt{b} + \sqrt{c})$, which, on substituting R and $y$ for their values given above, becomes

$$y^4 + Py^2 + P^2 = 4Q + 8y\sqrt{R},$$

and by transposing

$$y^4 + 2Py^2 - 8y\sqrt{R} + P^2 - 4Q = o. \qquad (2)$$

Now, one of the roots of this biquadratic equation is $y = \sqrt{a} + \sqrt{b} + \sqrt{c}$ ; and $a$, $b$, $c$, are the three roots of the cubic equation, $z^3 + Pz^2 + Qz - R = o$ ; consequently, by resolving the cubic we get the values of $a$, $b$, $c$ ; and thence $y$, the root of the biquadratic, becomes known.

To apply this solution to the proposed equation (1), the co-efficients P, Q, R, of the resolved equation (2), must be determined in terms of $p$, $q$, $r$. Comparing the two equations,

$$y^4 + p\,y^2 + q\,y + r = o, \qquad (1)$$

$$y^4 + 2Py^2 - 8\sqrt{R}y + P^2 - 4Q = o, \qquad (2)$$

we find $2P = p$, $-8\sqrt{R} = q$, $P^2 - 4Q = r$ ; whence $P = \frac{1}{2}p$, $Q = \frac{p^2 - 4r}{16}$, $R = \frac{q^2}{64}$. It follows, therefore,

that the roots of the proposed equation are expressed generally by $y = \sqrt{a} + \sqrt{b} + \sqrt{c}$, where $a$, $b$, $c$ denote the roots of the cubic equation

$$z^3 + \frac{p}{2} z^2 + \frac{p^2 - 4r}{16} z - \frac{q^2}{64} = o. \qquad (3)$$

All the four roots of the biquadratic are involved in the expression $y = \sqrt{a} + \sqrt{b} + \sqrt{c}$; in order to discover each of them in particular, it is necessary to consider the changes of sign of which they admit. As the square root of any quantity $a$ may be either $+\sqrt{a}$ or $-\sqrt{a}$, each of the three quantities, $\sqrt{a}$, $\sqrt{b}$, $\sqrt{c}$, may have either the sign + or − prefixed to it; whence the formula will give *eight* different expressions. But as the product of the three roots, $\sqrt{a}$, $\sqrt{b}$, $\sqrt{c}$, is equal to $\sqrt{R}$ or to $-\frac{1}{8} q$, it is obvious that when $q$ is positive, their product must be negative, and this can only be the case when either only one or all three of them are negative. When $q$ is negative the product must be positive, which can only be the case either when all three are positive, or two of them negative. There are consequently only four different expressions for $q$ positive, and four for $q$ negative, which in either case form the four roots of the biquadratic equation.

The co-efficients of the equation (3) involve fractions; but these may be removed by assuming $v = 4z$, and substituting for $z$ its value in terms of $v$. It then becomes, more simply,

$$v^3 + 2pv^2 + (p^2 - 4r)v - q^2 = o, \qquad (4)$$

the roots of which are $\frac{1}{4} a$, $\frac{1}{4} b$, $\frac{1}{4} c$.

The rule for the resolution of a biquadratic equation is therefore as follows. —

Let $y^4 + py^2 + qy + r = o$ be the proposed equation, wanting its second term. Form the cubic equation $v^3 + 2pv^2 + (p^2 - 4r)v - q^2 = o$, and find its roots, which call $a$, $b$, $c$. Then the roots of the proposed biquadratic are,

| when $q$ is negative, | when $q$ is positive, |
|---|---|
| $y = \frac{1}{2}(\sqrt{a} + \sqrt{b} + \sqrt{c})$ | $y = \frac{1}{2}(-\sqrt{a} - \sqrt{b} - \sqrt{c})$ |
| $y = \frac{1}{2}(\sqrt{a} - \sqrt{b} - \sqrt{c})$ | $y = \frac{1}{2}(-\sqrt{a} + \sqrt{b} + \sqrt{c})$ |
| $y = \frac{1}{2}(-\sqrt{a} + \sqrt{b} - \sqrt{c})$ | $y = \frac{1}{2}(\sqrt{a} - \sqrt{b} + \sqrt{c})$ |
| $y = \frac{1}{2}(-\sqrt{a} - \sqrt{b} + \sqrt{c})$ | $y = \frac{1}{2}(\sqrt{a} + \sqrt{b} - \sqrt{c})$. |

BIRA'DIATE. (Lat. bis, radius, *a ray*.) When a part has two rays.

BIRCH. A hardy tree inhabiting the north of Europe, Asia, and America. The common birch (*Betula alba*) is valuable for its capability of resisting extremes of both heat and cold; its timber is chiefly employed for fire wood. Its bark is extremely durable. The American birch (*B lenta*) produces a hard heavy timber, much used by cabinet-makers, and the bark of *B papyracea* is employed by the North American Indians for a variety of useful purposes.

BIRDLIME. A glutinous substance extracted by boiling the bark of the holly tree, a similar substance may be obtained from misletoe, from the young shoots of elder, and some other plants.

BIRD OF PARADISE. A name originally applied to the species *Paradisea apoda*, Linn.; of which the skins, deprived of the wings, the feet, and the tail, have long formed a high-priced article of export from the eastern parts of the world. The value of these mutilated specimens of natural history arises chiefly from the extraordinary development and light and beautiful structure of the plumes which grow from the scapular and lateral regions of the body, and these plumes, combined with the velvety texture and brilliant metallic reflections of the ordinary feathers, especially those covering the head, render skins of the *Paradisea* ornaments highly and justly esteemed by the fair inhabitants of the most civilised countries. The presence of the remarkable plumage just alluded to, and the constant absence of the ordinary organs of locomotion in the imported specimens, easily gave rise to strange speculations as to the nature of the rare bird of the east, and the older naturalists delighted to describe it as destitute of feet, dwelling constantly in the air, wafted about in the bright beams of the sun independently of the ordinary mechanism of wings, and nourished with dew, and the nectar and even odour of flowers. To beings thus imagined to be raised above the dull earth, to enjoy etherial food and a perpetual habitation in the air, no name could be more appropriate than Birds of Paradise or Heaven. The march of inquiry has, however, dispelled the fancied attributes and false charms of these lovely beings, and has restored to them their wings and feet. The latter, indeed, are remarkable for their robustness: they have three toes in front and one behind, as in other *Passeres* of Cuvier, with the middle toe shorter than the tarsus, the outer toe united to it at its base, and the inner one joined to it for half the length of the first phalanx. The form of the beak corresponds with that which characterises the tribe *Conirostres* of Cuv.; and their true food, which consists not only of the pulpy and farinaceous parts of fruit, but also of worms, insects, the eggs and young of smaller birds, and even carrion, causes them to be ranked with the family of *Omnivores*, Cuv. In fact, they closely resemble in their habits our magpies and jays. The principal species of the genus *Paradisea* are the Great or Common Bird of Paradise (*Par. apoda* of Linnæus); the Royal Bird of Paradise (*Par. regia*); the Red Bird of Paradise (*Par. rubra*); the Magnificent Bird of Paradise (*Par. magnifica*); the Six-threaded Bird of Paradise (*Par. sexesetacea*), which is characterized by three long and thread-like feathers, which grow from each side of the body; the Superb Bird of Paradise (*Par. superba*), which is smaller than the preceding, but perhaps the most beautiful of the genus; the Small Bird of Paradise (*Par. minor*), which measures about nine inches from the point of the bill to the end of the tail; and, lastly, the White Bird of Paradise (*Par alba*).

BIRD PEPPER. The small *Capsicum*, a species of the plant which affords Cayenne pepper.

BIRDS. In Heraldry, are said to be rising, displayed, close, volant, &c. according to the different postures in which they are represented. Birds of prey, and cocks, when beaked and legged of a different tincture from the body, are said to be *armed* of that tincture.

BIRD'S EYE VIEW. In the Fine Arts, a term used to denote a view arranged according to the laws of perspective, in which the point of sight or situation of the eye is placed at a very considerable height above the objects viewed and delineated. In architectural representations, it is used chiefly for the purpose of exhibiting the disposition of the different courts or quadrangles and roofs of a building. It is a useful method of re- [illegible] of cities, as also of giving a general notion of [illegible] of a country. As before observed, it is entirely dependent upon the same principles as those detailed in the article PERSPECTIVE, which see.

BIRD'S MOUTH. In Architecture, an interior angle or notch, cut across the grain at the extremity of a piece of timber for its reception on the edge of another piece; as a rafter, for instance, is received on a pole plate. Bird's mouth signifies also the internal angle of a polygon, its external angle being called a bull's nose.

BIRTH, EVIDENCE OF. By the French code civil it is required that a declaration shall be made of every birth to the proper officer, within three days, with production of the child. The "act of birth," setting forth the time and place of the event, sex and name of the child, and description of the father, is then immediately drawn up in the presence of two witnesses. It is entered on the register, and a copy kept by the parent. (*Code Civil*, art. 55.) In England by the 70th Canon, and statutes of 6 & 7 William 3 and 4 G. 4 c. 76, the minister of every parish is required to keep a register of births. But now, by the recent act for registering births, deaths, and marriages, 6 & 7 W. 4. c. 86., it is enacted that the parent, or occupier of a house in which a child is born, *may*, within 42 days after the birth, give notice to the district registrar, and *shall* give such information on being requested by the district registrar within the same time. After 42 days, the birth may be registered only in presence of the superintendant registrar, and on a peculiar declaration. After six months, registration of a birth cannot take place. Certified registers of births, as well as deaths, are to be forwarded after a certain time to the superintendant registrar, and copies of registers to the general register office. (Sects. 19. 21, 22, 23. 33, 34.)

BIRTH, or BERTH, OF A SHIP. The ground or space in which she is anchored, and which is said to be a *good birth*, or a *bad birth*; also, an apartment, as the midshipman's birth, also, the space allotted a seaman to sleep or hang his hammock in.

BIS. (Lat. *twice*.) In Music, a word placed over passages which have dots postfixed to one bar, and prefixed to a subsequent bar, signifying that the passage between the dots is to be twice played.

BI'SCUIT. (Fr. bis, *twice*, and cuit, *baked*.) In Sculpture, a species of porcelain, of which groups and figures in miniature are formed, which are twice passed through the furnace or oven. It is executed without glaze upon it. In Pottery, this term is applied to earthenware and porcelain, after it has been hardened in the fire, and before it receives the glaze: in this state it is permeable to water.

BISE'TOUS. (Lat. bis, seta, *a bristle*.) In Zoology, when an animal or part is furnished with two bristle-like appendages.

BISE'XUAL. (Of two sexes.) Is a term applied to flowers which contain both stamens and pistil within the same envelop: it is the same as the word hermaphrodite in botany.

BI'SHOP. (A word contracted from the Greek ἐπίσκοπος, Lat. episcopus, signifying literally an overseer.) In all denominations of Christians which admit the episcopal form of government, the bishop is the superior of the three orders, standing in rank and office distinct from the presbyter or priest. (*See* art. EPISCOPACY.) This distinct office consists in the power of ordination, confirmation, and consecration, none of which ceremonies may be performed by an inferior clergyman. The clergy of a diocese are subjected also to the ecclesiastical authority

of their bishop, who alone institutes to benefices, licenses curates, and has considerable discretionary power in requiring the residence of his clergy on their cures, and in superintending the discharge of their duties in them.

The mode of the appointment to bishoprics varies in different establishments. In early times the bishop was generally elected by his clergy. In the middle ages the pope assumed in most cases the absolute nomination, which claim has been given up in later times in many Catholic countries, where the king or clergy recommend, and the holy father only ratifies the appointment. In England the appointment is virtually in the hands of the sovereign, who upon the demise of the bishop receives from the dean and chapter intimation of the event, with a request for permission to supply the vacancy. The king accords his permission to that effect, and at the same time recommends a person to their choice — a recommendation which is equivalent to a command, as it cannot be waived without incurring the severe penalties of a præmunire.

BI'SMUTH. A brittle, yellowish-white metal, of a crystalline texture. Its specific gravity is 10·; it fuses at 476°, and at a red heat it sublimes in close vessels. It conducts heat less perfectly than most of the other metals. When strongly heated it burns with a bluish white flame, and is rapidly oxidized. Its equivalent upon the hydrogen scale is 71; and it forms only one salifiable oxide, the equivalent of which is 79. When nitrate of bismuth is dropped into water a white powder is thrown down, formerly called *magistery of bismuth* or *pearl white*: it is a subnitrate. A brown *peroxide of bismuth* is obtained by fusing the protoxide with caustic potash. Some of the alloys of bismuth are remarkable for their fusibility: a compound of 8 parts of bismuth, 5 of lead, and 3 of tin, melts in boiling water, and is commonly called *fusible metal*. The ores of bismuth are not common, but it occurs *native*, and combined with oxygen, sulphur, and arsenic. The Germans call it *wismuth*.

BI'SON. The trivial name of certain species of the Linnæan genus Bos, which differ from their congeners in having fourteen (*Bos bison*), or fifteen (*Bos Americanus*), instead of thirteen pairs of ribs. The common bison of the north of Europe (*Bos bison*), and the American bison, or bonassus (*Bos Americanus*), are the only known existing species of this group.

BISPINO'SUS. (Lat. bis, spina, *a spine*.) When an animal or part is armed with two spines.

BISSE'XTILE. (Lat. bis, *twice*, and sextilis, *sixth*.) The name given to the year which contains 366 days. The calendar used in all European countries is founded on that of the Romans, as reformed by Julius Cæsar. In the calendar of Cæsar, the length of the year was fixed at 365¼ days; and in order that the year should always begin with the beginning of a day, it was directed that every fourth year should contain 366 days, the other years having each 365. The additional day, which thus occurred every fourth year, was given to February, the shortest month, and was inserted in the calendar between the 24th and 25th days. In the peculiar method of reckoning the days of the month adopted by the Romans, namely, of reckoning backwards from the 1st of the succeeding month, it would have been very inconvenient to have interrupted the order of numeration, accordingly the 24th, which was called, *sexto Calendas Martii*, was reckoned twice, and the supernumerary or repeated day called *bis sexto Calendas*. Hence the term *bissextile*. In English, *leap year* has the same signification.

In the Julian calendar every fourth year was bissextile; but this supposes the year to be 365¼ days, which errs in excess by 11 minutes 10·35 seconds. Accordingly, in the course of a few centuries, the error will amount to days, and cause the commencement of the year to change its place with respect to the seasons. When the Julian calendar was introduced, the equinox fell on the 25th of March; in 1582, when the calendar was reformed by Pope Gregory XIII., it had fallen back to the 11th; and as it was then supposed that the error of the Julian calendar amounted to three days in 400 years, it was ordered that the intercalary day should be omitted in all the years which terminate centuries, excepting those which are multiples of 400. The Gregorian rule of intercalation is therefore as follows: — Every year of which the number is divisible by 4 is a leap year, excepting the centesimal years, which are only leap years when divisible by 4 after suppressing the two zeros. Thus 1600 was a leap year; but 1700, 1800, and 1900, which would be bissextile in the Julian calendar, are common years in the Gregorian.

This regulation, though it would for a long time preserve the commencement of the year at the same place in the seasons, is not yet quite correct. It supposes the length of the year to be 365 days 5 h. 48 m. 12 seconds, which is too great by 22·38 seconds; an error which amounts to a day in 3866 years. As this number 3866 approaches to 4000, it was proposed by Delambre to correct the Gregorian rule by making the year 4000 and all its multiples common years. Should our present calendar continue to be in use 2000 years hence, posterity may then begin to consider whether they will adopt this suggestion. *See* CALENDAR.

BI'STORT. The root of the *Polygonum bistorta*, an indigenous plant; it is used in medicine as a powerful astringent.

BI'STRE. In Painting, a dark brown colour, made from the soot of dry wood, whereof for this purpose beech is preferable.

BI'SULCATE. (Lat. bis, *twice*, sulcus, *a fissure*.) In Mammalogy, a term signifying a foot resting upon two hoofed digits.

BIT. That part of the bridle which goes into the mouth of a horse.

BI'TTER PRINCIPLE. This term has been applied to certain products of the action of nitric acid upon animal and vegetable matters of an intensely bitter taste. *See* CARBAZOTIC ACID.

BI'TTERN. *See* ARDEA.

BITTERN. The residue of sea water after the common salt has been separated by evaporation. It contains *muriate of magnesia*, which gives it a bitter taste.

BITTER SALT. Sulphate of magnesia, or Epsom salt.

BITTER SPAR. A Mineralogical term, generally applied to certain crystallized varieties of *dolomite*, or double carbonates of lime and magnesia. It occurs in rhomboidal crystals, consisting of about 55 *per cent.* of carbonate of lime and 45 of carbonate of magnesia, sometimes with traces of iron and manganese.

BITU'MEN. (From πιτυς, *the pitch tree*; because it resembles pitch.) A variety of inflammable mineral substances, which, like pitch, burn with flame in the open air, is included under this term: such as *naphtha*, *petroleum*, and *asphaltum*.

BITUMEN. Mineral pitch.

BITU'MINOUS SHALE. An argillaceous shale impregnated with bitumen. It commonly accompanies coal.

BIVA'LVES. (Lat. bis, *two*, and valva, *a valve*.) A term commonly applied to the Lamellibranchiate Acephalous Molluscs, on account of the structure of their shell, which consists of two parts or valves, joined together by an elastic ligament at the cardo, or hinge. The testaceous covering of the Palliobranchiates is also composed of two valves or shelly pieces, but these are never joined by elastic ligament.

BI'VOUAC. (Fr.) A term in the Military art, employed to denote the system by which soldiers on a march, or in expectation of an engagement, remain all night in the open air, in contradistinction to the systems of encampment and cantonment. This word is derived from the Lat. bis, *twice*, and the German wache, *a guard*, and signified originally the guard which was selected from the body of a regiment to keep watch during the night.

BIXA'CEÆ. A small natural order of plants, so called after the genus Bixa, the genus which produces the substance called arnotto, with which English cheeses are dyed of their peculiar reddish ochre colour. The species are all trees or shrubs inhabiting the tropics.

BLACK. (Sax. blac.) In Painting, the darkest colour of all, whereof the different sorts are lamp black, ivory black, Frankfort black, Spanish black, and Hart's black.

BLACK BIRD. *See* TURDUS.

BLACK CAP. This term is generally applied and understood to signify a species of frugivorous warbler (*Curruca atricapilla* of Bisson), but it is also occasionally given to the great titmouse (*Parus fringillago*), the marsh titmouse (*Parus palustris*), the black-headed bunting (*Emberiza schæniclus*), the stonechat (*Rubetra rubicola*), and even to the black-headed gull.

BLACK COCK. The name of a native species of grouse (*Tetrao*).

BLACK FLUX. A mixture of carbonate of potash and charcoal, obtained by deflagrating *tartar* with half its weight of *nitre*.

BLACK JACK. A term applied by the miners to certain sulphurets of zinc: the ore is also called *blende*.

BLACK LEAD. *See* PLUMBAGO and GRAPHITE.

BLACK LETTER. Is the name now applied to the old English or modern Gothic letter, which was introduced into England about the middle of the fourteenth century, and became the character generally used in MS. works before the art of printing was publicly practised in Europe. On the application of that art to the multiplying of books, about the middle of the fifteenth century, the block books, and subsequently those printed with moveable types, were in this character, to imitate writing, and were disposed of as manuscripts; and so perfect was the imitation, that it required great discrimination to distinguish the printed from the written. The first printed Bible, known as "the Mentz Bible without date," was an instance of this. Fust, the printer, sold copies in Paris as manuscripts; and as the demand increased on account of their beauty and correctness, he not only promptly supplied that increased demand, but even lowered the price: this

excited suspicion; and on comparing the copies they were found to be perfect facsimiles of each other, and being produced with such rapidity it was held to be totally impossible for the most expert scriptores to execute them with equal accuracy and despatch; and Fust was accused of producing them by means of magic. To avoid punishment for this crime, he was obliged to reveal the process by which they were produced.

Books printed before the year 1500 are generally in this character, and are styled black-letter books.

BLACK WASH. A lotion composed of calomel and limewater.

BLA'NCHING. In Gardening, is the whitening of the stems, stalks, or leaves of plants by tying them together, or earthing them up, so as to exclude the light, and thus to diminish the intensity of their native properties.

BLA'NK VERSE. In some modern languages, the heroic verse of five feet without rhymes. Blank verse is peculiar to the Italian, English, and German languages, having been imported into the two latter from the first. In Italian the line is of eleven syllables, and is used invariably in the drama, and frequently in serious poetry, epic or didactic. In English it was also first adopted by the dramatists, and transferred to epic poetry by Milton. The Miltonic verse is constructed with closer attention to the melody of the cadence and cæsura than the dramatic: it admits also less frequently of the eleventh syllable, which in English poetry must be regarded as a sort of license; while Shakspeare and other dramatists occasionally double the short syllable at the end, and thus extend the number to twelve.

BLAPS. A Fabrician genus of Coleopterous insects, now the type of a family (*Blapsidæ*), characterized by the absence of wings; maxillary palpi terminated by a large hatchet-shaped joint; body oblong and oval. All the species are of a dark or black colour, and have the elytra soldered together, and bent down at the sides of the abdomen so as to embrace that part. There are three British species of the genus *Blaps* proper, which are known by the trivial names of "darkling" or "church-yard beetles," and are regarded by the vulgar of this and other countries as insects of evil omen.

BLAS'PHEMY. (Gr. βλασφημια, probably from βλαπτω, *I injure*, φημη, *rumour*.) According to its supposed etymology signifies the offence of using injurious language, as calumny, reviling, &c.; and in this sense it is used in the New Testament; the word "railings," in 1 Tim. vi. 4, being in the original "blasphemies." But in the modern and restricted sense, "blasphemy" signifies the use of insulting, or derogatory, or unbelieving language, with respect to God and divine things. Under this meaning it has been considered a civil crime in most Christian countries, in imitation of the practice which prevailed among the Jews. (Levit. xxiv.) In England, by common law, it was punishable with fine, imprisonment, and other corporal punishment. By 9 W. 3. c. 35. it was first made a statutable offence, and extended so as to comprehend even the mere denial of some fundamental doctrines of Christianity; and subjected to very severe inflictions. Unitarians were relieved from the penalties of this act by 3 G. 3. c. 170. But it is almost obsolete in practice with respect to other offenders.

BLASTE'MA. In Botany, the axis of growth of an embryo; that is to say, the plumula, the radicle, and the part which connects them, the cotyledons being removed.

BLASTEMA. In Anatomy, the homogeneous gelatinous and granular basis of the ovum, in which the organic elements characteristic of the different tissues are deposited in the early stages of development.

BLA'STING. *See* MINING.

BLASTOCA'RPOUS. (Βλαστος, *a germ*, and καρπος, *fruit*.) That kind of fruit which germinates inside the pericarp, as the mangrove.

BLASTODE'RM. (Gr. βλαστος, *germ*, δερμα, *skin*.) In Anatomy, the germinal skin or membrane, or that granular membrane or stratum which lies immediately beneath the membrana vitelli of the ovum, and which is the seat of development of all parts of the body of birds.

BLA'STUS. (Βλαστανω, *I germinate*.) A name sometimes given to the plumula and radicle of grasses.

BLA'TTA. A genus of nocturnal Orthopterous insects, commonly called cock-roaches, or black beetles. In modern Entomology, it forms the type of a family, including many genera.

BLA'ZONRY. The art of deciphering coats of arms; also, that of expressing or describing a coat of arms in appropriate language. The word is supposed to be derived from the German *blasen*, to blow, and to have originated in the ceremonial of tournaments, from which so many other terms and usages in heraldry are derived; it having been customary on these solemn occasions for the herald to blow a trumpet when he called out the arms of a knight on ushering him into the lists. Blazonry requires a knowledge of, 1. The points of the shield, which are nine in number (*see* POINTS); 2. The field, that is, the tincture or tinctures forming the ground of the coat (*see* TINCTURE); 3. The charges, or devices borne on the field (*see* CHARGE); 4. The ordinaries.

BLEA'CHING. (Ger. bleichen.) This process consists in a series of operations, by which the natural colours of various substances are discharged, so as to whiten them. It is effected either by the action of various solvents, aided by exposure to light, air, and moisture, upon the bleaching ground; or by the aid of chlorine. Cotton is more easily bleached than linen, in consequence of its being originally whiter, and having a less powerful attraction for the colouring matter. In bleaching these goods upon the old principle, warm water is first liberally applied to remove the weaver's paste or dressing; they are then *bucked*, or boiled in a weak alkaline ley, and after having been well washed, are spread out upon the grass, so as to be freely exposed to the joint agencies of light, air, and moisture; the bucking and exposure are alternately repeated as often as necessary; the goods are *soured*, that is, immersed in water slightly acidulated by sulphuric acid; lastly, they are very thoroughly washed and dried. By these operations the texture of the goods is to a certain extent impaired, and much time is required to complete the process, which also cannot be carried on in the winter months. But the exposure upon the bleaching ground is now to a great extent discontinued; and the same effect is obtained, after the process of bucking, by the action of weak solutions of *chlorine*, or of *chloride* of lime, which, if skilfully used, can scarcely be said to injure the goods more than the long-continued exposure. The theory of bleaching has not been satisfactorily developed; but, from such experiments as have been made in reference to it, it appears to be a process of oxidizement, and to depend upon some peculiar influence of *nascent* oxygen upon the colouring matter.

The colour of manufactured wool depends partly upon its own oil, and partly upon the applications made to it in the loom. These are got rid of in the fulling mill by the joint action of fullers' earth and soap; the cloth is then well washed and dried, and is tolerably white, if the slight yellow tint which it retains is objectionable, it is prevented by adding a little stone-blue to the washing water, or by exposure to the fumes of burning sulphur; this latter method, however, gives it a harsh feel, and if afterwards soaped its yellowishness returns.

The colour of raw silk depends upon a natural yellow varnish, which is got rid of by boiling it in white soap and water, and by repeated rinsings. Certain articles of wove cotton, such as stockings, are bleached as usual, and finished by the action of *sulphurous acid*, or the fumes of burning sulphur. Straw is also whitened by a similar operation; and hence bleached straw hats are apt to have a disagreeable sulphurous smell. A good account of bleaching will be found in *Parkes' Chemical Essays*.

BLE'ACHING POWDER. Chloride of lime, made by exposing slaked lime to the action of chlorine.

BLENDE. Native sulphuret of zinc.

BLE'NNIUS. (Gr. βλεννα, *slime*.) In Ichthyology, a genus of Acanthopterygious fishes, of the family of Gudgeons (*Gobioidæ*), remarkable for the quantity of mucus secreted from the skin, and for the viviparous generation of some of the species, of which the *Blennius pholis*, a species common along the shores of Britain, is an example.

BLE'NNORRHŒ'A. (Gr. βλεννα, *mucus*, and ῥεω, *I flow*.) An inordinate discharge or secretion of mucus.

BLE'PHARITES. (Gr. βλεφαρον, *the eyelid*.) Inflammation of the eyelids.

BLIGHT. A term in common use for supposed atmospherical injuries received by plants. Before effects were traced to their causes with the same care that they are at present, the sudden discolouration of the leaves of plants, their death, or their being covered with minute insects or small excrescences, was called by the general name of blight; and this blight was attributed to some mysterious influence in the air, to the east wind, or to thunder, because these states of the atmosphere commonly accompanied the phenomena alluded to. It is now found that what is called blight is in some cases the effect of insects, to the progress of which the dry state of the atmosphere produced by east wind is peculiarly favourable; while in other cases, it is caused by parasitical fungi. The appearance of these fungi on corn crops is frequently designated by farmers as the fire blast; while on peach and other trees in gardens it is called mildew. The sudden death of plants, and also the withering and drying up of part of their leaves and branches, to which appearance the term blight should perhaps be restricted, are produced by the transpiration of water from the leaves taking place with greater rapidity than it can be supplied by the absorption of the roots. In very hot weather in summer, branches of fruit trees trained against walls, or of gooseberry bushes on espaliers, are sometimes withered up in a few minutes from this cause. What countrymen call the blight on standard apple or other fruit trees in orchards is commonly nothing more than the injuries done the leaves

and buds by the caterpillars of certain moths; that on thorn hedges, by the caterpillar of the saw fly, or of the ermine, or of some other moths; and that on roses, by the aphides or green fly.

BLIND WORM. An ophidian or serpent-like reptile, which is the type of the genus *Cecilia* (see that word). The term is also sometimes applied to the slow-worm. *See* ANGUIS.

BLI'NKERS. Expansions of the sides of the bridle of a horse, to prevent him from seeing on either side, but at the same time not to obstruct his vision in front.

BLIS'TER-FLY *See* CANTHARIS.

BLOCK. (Teutonic.) In Architecture, a large unworked mass of marble or other stone. It is also vulgarly used to denote a modillion in a cornice.

BLOCK. In Navigation, the case that contains the wheel or *sheeve* of the pulley (which last term is not used at sea). Two or more blocks, with the rope, constitute a *tackle* (pronounced tăcle). Blocks are also the pieces of wood and iron on which, piled up, the ship's keel is supported when she is in dock.

BLOCKA'DE. In International Law, the right to blockade the ports of an enemy in war, and to exclude neutrals, is limited by the following recognised principles. 1. The blockade must be substantial, by means of a sufficient force to prevent the entry or exit of vessels; otherwise a neutral is not bound to respect it. 2. It is essential that the neutral should have notice of the blockade; otherwise his ship cannot be justly condemned. A counter notice should also be given by the blockading power when the blockade has ceased In England, a blockade is properly declared by the king in council.

BLO'CKING COURSE. In Architecture, a finishing course of masonry above a cornice.

BLOCK TIN. Tin cast into blocks or ingots. it is generally less pure than *grain tin*.

BLOOD. The fluid which circulates in the heart and blood-vessels. When viewed under the microscope it appears to consist of very minute *red globules* or spheroids floating in a colourless fluid. The average quantity in an adult man is estimated at about 28 lbs.: it is of two distinct colours in the arterial and venous systems, florid red approaching to scarlet in the former, and dark crimson in the latter. Its specific gravity is between 1 050 and 1 070. When drawn from its vessels it gelatinises or coagulates in the course of a few minutes of common temperature, and soon separates spontaneously into *serum* and *coagulum*. The serum is a yellowish soapy-feeling fluid, of the specific gravity of about 1 030. It exhibits a slight alkaline reaction upon test papers; when heated it becomes opaque, and at 156° it coagulates. It is also coagulated by alcohol, and by most of the acids, acetic acid and ether do not coagulate it, solutions of corrosive sublimate, of subacetate of lead, and of chloride platinum occasion precipitates in it, even when considerably diluted with water. These properties of serum are dependent upon the presence of a peculiar proximate animal principle called *albumen*, the same substance, and with very nearly the same properties, constitutes the *white of egg*, the coagulability of which by heat is well known. Besides the above there is another most delicate test of albumen in solution, which consists in adding to the liquid suspected to contain it a little strong *acetic acid*, and afterwards a few drops of *ferrocyanate of potash*. If albumen be present, a white cloud is produced. This is even a more accurate test than corrosive sublimate White of egg is coagulated by ether, while serum is not According to Marcet 1000 parts of serum of human blood are composed of water 900, albumen 86 8, muriates of potassa and soda 6 6, muco-extractive 4, carbonate of soda 1 65, sulphate of potassa 0·35, earthy phosphates 0 60.

The coagulum of the blood is of a more or less firm texture, and has a greater specific gravity than the serum. It contains the colouring particles of the blood, and when carefully washed, these are carried out of it, and a tenacious whitish matter remains, which has been termed *fibrine*, but which, in all essential points, has the properties of coagulated albumen.

The colouring matter of the blood, *hæmatosine*, may be obtained by evaporating its aqueous solution at a temperature below 100°, it then appears almost black, but resumes its red colour when dissolved in water. It is soluble in acids and in alkalies. these solutions are dark-coloured; but when mixed, so as to become *neutral*, the hæmatosine falls of a bright red colour. Accordingly, when the clot of blood is put into acids it becomes brown or blackish, and is very similarly discoloured by alkalies; but most neutral salts render it florid. Dr Stevens has shown that carbonic acid in venous blood is the probable cause of its dingy hue, and that the saline matter of the serum confers the florid red upon arterial blood; and that by washing the saline matters out of the bright coagulum of arterial blood it gradually loses its brilliancy and resembles venous coagulum.

The following table shows the results of an analysis of human blood by Lecanu (*Annales de Chimie et Physique*, vol. xlviii.); considered *quantitively*, it must only be taken as a mean or approximate result.

| | |
|---|---|
| Water | 780·145 |
| Fibrine | 2·100 |
| Colouring matter | 133·000 |
| Albumen | 65·090 |
| Fat and oily matter | 3·740 |
| Extractive matter | 1·790 |
| Albumen combined with soda | 1 265 |
| Chloride of sodium, potassium; Carbonates, Phosphates, Sulphates of potassa and soda | 8 370 |
| Carbonates of lime, magnesia; Phosphate of lime, magnesia, iron | 2 100 |
| Peroxide of iron | |
| Loss | 2·400 |
| | 1000·000 |

BLOOD ROOT. The root of the *Sanguinaria canadensis*, the juice of which is of a red colour.

BLO'ODSTONE. A dark green silicious mineral, variegated by red spots (heliotrope).

BLO'WPIPE. An instrument by which a small jet of air is directed laterally into the flame of a lamp or candle, so as to divert it in a long slender cone upon a piece of charcoal or other substance so placed as to receive it. When a flame is thus urged by the blowpipe the extreme heat is just at the tip of the outer white flame, where the combustion is most perfect, and where substances are rapidly burned or oxidized; whilst the interior blue flame, in consequence of its excess of combustible matter, abstracts oxygen from, or *reduces*, substances. So that several metals, when thus heated before the blowpipe, are alternately oxidized and deoxidized by being placed in the outer and inner flame The blowpipe is of important service to the chemist in enabling him to ascertain easily and quickly the effects of intense heat upon a variety of substances, and he frequently has recourse to it in order to distinguish metallic and earthy minerals from each other, and to ascertain in a general way the nature of their component parts. it is, in fact, a most important auxiliary in all cases of qualitative analysis Several treatises have been written on the use and indications of the blowpipe: the reader is especially referred to *Faraday's Chemical Manipulation*, Sect IV. §3.

BLU'BBER. The cellular membrane in which the oil or fat of the whale is included. *See* BALÆNA.

BLUE. (Germ blau) In Painting, the colour of the sky It is one of the seven original colours, and is of many sorts, whereof the principal are ultramarine, prussian blue, blue bice, and indigo.

BLUFFS High banks presenting an abrupt form towards the sea or river.

BO'A. A genus of serpents, with the transverse scutæ of the abdomen and tail in a single row, and without a rattle or spur at the end of the tail. Some species attain an immense size; but the large serpents brought to this country, and called boa constrictors, are generally *Pythons*, and natives of Asia. The true boas are from South America.

BOARD (Equivalent to the French *bureau*.) A word applied usually to certain individuals in a collective capacity, who are intrusted with the management of some public office or department. Thus the Commissioners of Customs, the Committee of the Privy Council for the Affairs of Trade, the Commissioners of Excise, &c., when assembled to transact the business of their respective offices are styled the Board of Customs, the Board of Trade, the Board of Excise, &c But the term Board is used also in a more general sense, being applied to any individuals appointed by competent authority to deliberate on or superintend the operations of any private business or speculation.

BOARD. (Sax. bord) In Architecture, a piece of timber of undefined length, more than four inches in breadth, and not more than two inches and an half in thickness. The section of a board is, however, sometimes triangular, or rather trapezoidal, one edge being very thin. This is called a feather-edged board.

BOA'TSWAIN. The second of the three warrant officers of a man of war, he has charge of the boats, rigging, anchors, and cables It his duty to *turn the hands up*, or summon the whole crew, whenever they are required for any duty. He should from the nature of his duties be an active man, and a thorough seaman. The *boatswain's mates* assist the boatswain, summon the watches or other portions of the crew to duty, and inflict punishments.

BOAT. (Sax. bæt) A term used in a general sense to denote any small ship or vessel, whether open or decked, and which may be propelled by oars, or by

sails, or by steam. They are accordingly of very different forms and constructions, according to the different purposes they are intended to serve. Under this term are comprehended barges, cutters, pinnaces, yawls, &c. *See* SHIP; STEAM NAVIGATION.

BO'BSTAYS. Stays or strong ropes to keep down the bowsprit during the plunging of the ship, and against the upward action of the head sails (jibs, fore-staysail, &c.), and to sustain the action of the stays or ropes, which keep the foremast, fore-topmast, &c., and therefore the main-topmast, from falling aft. They are necessarily very strong; they are attached to the bowsprit by *collars* placed about $\frac{2}{3}$ of its length outside, and to the hull of the ship, by passing through holes in the *cutwater* or projecting head, and make an angle of about 30° more or less with the axis of the bowsprit. They are often made of chains.

BO'DY. In Physics, is a term applied to any portion of matter of which the existence can be perceived by any of our senses. According to the Peripatetics, body is composed of *matter*, *form*, and *privation* In modern physics, body is regarded as an agglomeration of material particles. According to the different forms in which matter exists, bodies may be *solid*, *liquid*, or *gaseous*

In Geometry, *body* is synonimous with *solid*. Thus we say the five regular *bodies*, or five regular *solids*. *See* SOLID

BOG EARTH. A soil consisting chiefly of silicious and vegetable fibre; it is often accumulated in considerable quantity where waters have deposited the mud of boggy places Many American shrubs and other plants and flowers will only thrive in such or similar soils, so that bog earth is in great request for such purposes It may, to a certain extent, be artificially imitated by mixing the cuttings of grass with the mud of ponds and a sufficient quantity of sharp sand.

BOHE'A. A species of black tea. *See* TEA.

BOI'LING POINT. The temperature at which liquids are rapidly converted into vapour with the phenomena of *ebullition*. Thus the boiling point of water is 212°; of alcohol, 176°, of ether, 96°, of oil of turpentine, 316°; and of mercury, 662°; these being the respective temperatures at which these bodies continuously pass into the state of vapour.

BO'LDNESS (Sax. bald) In the Fine Arts, that fearlessness which an artist exhibits in his designs, arising from, and grounded on, a thorough knowledge of the principles of his art. Its antagonist is tameness or insipidity.

BOLE. (Gr βωλος, *a mass*) An argillaceous earthy mineral, generally reddened by oxide of iron, as is the case in the *Armenian bole*, which is used in tooth-powder, and to give colour to the fish sauce called *essence of anchovies*

BOLE'RO. A peculiar species of dance very popular in Spain, and so called from the name of its inventor

BOLE'TIC ACID. An acid contained in the juice of the *Boletus pseudo ignarius*.

BOLE'TUS (Gr. βωλος, *a mass*) A genus of fungi, numerous large species of which spring from the sides of trees when the rind is decayed, forming firm fleshy masses, which are generally smooth on the upper side, and pierced with holes on the lower. The spawn of such plants often forms what is called dry-rot, insinuating its fine delicate filamentous ramifications between the tubes of the wood, forcing them asunder, and so destroying the cohesion and solidity of timber. *Boletus ignarius* and *fomentarius* are the fungi which, when cut into thin slices, dried, and prepared with saltpetre, form common amadou, or the German tinder of the shops. *B tuberosus* is used in Sweden, as a substitute for cork. *B. bovinus* is said to be a favourite food of oxen, deer, swine, and some other animals; it is even used for human food.

BOLOGNE'SE SCHOOL. In Painting, sometimes called the *Lombard school* of painting. It was founded by the Caracci, and its object was to unite the excellencies of the preceding schools (*see* PAINTING); hence it is occasionally called the *Eclectic school* Among the principal painters which it numbered were Domenichino, Lanfranco, Correggio, Guido, Schidone, Caravaggio, Zampieri, Primaticcio, &c.

BOLO'GNIAN STONE. A sulphate of baryta, found near Bologna, which, when heated with charcoal, becomes a powerful *solar phosphorus*.

BO'LTHEAD. A globular flask with a tubular neck, used in the chemical laboratory.

BO'LUS. (Latin, *a mass*.) A very large pill; or a medicine formed into an olive-shaped mass, not too large to be swallowed.

BOMB In Artillery, a hollow ball or shell of cast-iron, having an orifice through which it is filled with gunpowder, and into which, when filled, a fusee is inserted, so adjusted that when the bomb falls at the place intended, the fusee ignites the powder in the shell, and blows it to pieces. The havoc which is thus produced in a besieged town or the ranks of an enemy is often very great. Bombs, or shells, as they are more frequently called, are of all sizes, from about 18 inches downwards, and are in general thrown from mortars or howitzers; sometimes from cannon. They appear to have been first used as part of the regular materiel of an army about the year 1634, in the wars of the Netherlands. The principal art in throwing shells is to make them fall at or near a given point. For this purpose the distance is calculated, and the charge of powder and elevation of the mortar regulated accordingly Theoretical rules are of no great use. They must be derived from experiment and practice.

BO'MBARDIERS *See* BRACHINUS

BO'MBAX. (Βομβαξ.) A genus containing many species of very large trees, whose capsules are filled with a fine cottony substance enveloping the seeds. It gives its name to the natural order *Bombaceæ*, allied to Malvaceous plants, where it is associated with the celebrated Baobab, and many more gigantic inhabitants of tropical forests. The bombax trees are remarkable for forming on their sides next the ground huge buttresses, projecting so far from the parent trunk as to be capable of screening many men. The quantity of cotton yielded by these trees is enormous, and often covers the earth around the roots to the depth of several feet, it is unfortunately of too short a staple to be used for manufacturing purposes.

BO'MBAZINE (Βομβυξ, *a silk worm.*) A fabric of which the warp is silk and the weft (or shoot) worsted. It is chiefly made in black, and as an article of mourning for female dress The capital employed in Norwich, during the most flourishing period of the bombazine trade, amounted to 300,000*l*., but at present it is below 100,000*l*

BOMB VESSEL. A ship of war, intended for the bombardment of a town or place situated on the sea coast They are of about 350 tons burthen, and carry one 13-inch and one 10-inch mortar, together with two 6-pounder guns, one 12-pounder, and eight 24-pounder carronades, having a crew of sixty-seven men, with the usual complement of officers, and a detachment of marine artillerymen for the purpose of working the guns. See *Spaarman's British Gunner*.

BO'MBIC ACID The acid contained in the silk-worm, especially in its chrysalis state. It is supposed to resemble formic acid

BO'MBYCI'LLA A genus of omnivorous Passerine birds, of which the Bohemian wax-wing (*Bombycilla garrula*) is an example, and an occasional winter visitor of Britain.

BOMBY'LIUS A Linnæan genus of Dipterous insects, and now the type of a family (*Bombylidæ*), characterized by the great length of the oral instruments, which form a long and slender proboscis, body thick, short, hairy, thorax gibbous, wings extended horizontally; halteres exposed; antennæ short, approximate, composed of three joints, the last the longest, thickened and terminating obtusely, legs long and slender. The insects of this family have a rapid flight, and are very active; they subsist entirely on the nectar of flowers. They are of small size, and mostly exotic, affording types of many genera, of which only *Bombylius* proper and *Pthiria* afford British examples

BO'MBYX A Linnæan genus of Lepidopterous insects, now the type of a family (*Bombycidæ*), including many genera of nocturnal and post-meridian moths These have been arranged under the following sub-families — *Hepialidæ*, *Notodontidæ*, *Arctiadæ*, and *Bombycidæ* proper.

BONA DEA. In Roman Mythology, a goddess concerning whom a great diversity of opinion prevails, even among the writers of antiquity On the authority of C Labeo, she is represented by Macrobius, who treats at length upon her nature and worship, as synonimous with the Grecian Rhea or Cybele. The Bona Dea had two temples at Rome, but her rites were generally solemnised in the house of the consul or prætor. In the celebration of these rites only women participated, thereby indicating the peculiar chastity of the goddess. But a perusal of the ancient writers will convince the most sceptical that the exclusion of men from the solemnities of the Bona Dea was purely nominal, and that in the course of time the grossest licentiousness was practised during their celebration (See *Cic: pro Milone: Juv. Sat.* VI.)

BONA'SSUS. *See* BISON

BOND (Sax. bond.) In Architecture, the connection of one stone or brick with another by lapping them over each other in carrying up work, so that an inseparable mass of building may be formed, which could not be the case if every vertical joint was over that below it.

BOND. In Law, a deed whereby the obligor, or party binding himself, obliges himself, his heirs, executors, and administrators, to pay a certain sum of money, called the penalty, to another (the obligee) at a day appointed. There is a condition added, that if the obligor does some particular act the obligation shall be void, or else remain in full force. In case this condition is not performed, the bond becomes forfeited or absolute at law, and charges the obligor while living; and after

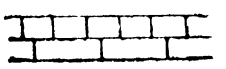
his death the obligation descends on the heir, who (in default of personal assets in the hands of the executor or administrator) is bound to discharge it, provided he have real assets by descent. The condition is usually (although not necessarily) included in the same deed, and at the foot of the obligation.

A bond without a condition is termed single (or *simplex obligatio*), and it becomes single by forfeiture, on non-performance of the condition. At law, the whole penalty mentioned in the bond was recoverable on such non-performance. But by the interposition of equity the obligee was discharged from paying more than the sum to which the obligor was reasonably entitled: viz. his principal, interest, and expenses, if the bond was for payment of a debt; or the damages accruing to him, if it was for the performance of a stipulated act. But by 4 & 5 Ann. c. 16 it was enacted that in case of a bond conditioned for payment of money, the payment of the sum due, with interest and costs, even though the bond be forfeited, and suit commenced thereon, shall be a full satisfaction and discharge; and on this footing the law now stands

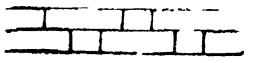
A bond on which neither principal nor interest has been demanded for twenty years will be presumed to have been satisfied; but length of time is not, strictly, a legal bar, but only a ground for the jury to presume satisfaction

In a bond where several are bound severally, the obligee may, at his election, sue all the obligors together, or all of them apart, and have several judgments and executions: but he shall have satisfaction but once; for if it be by one only, that is sufficient to discharge the debt.

BOND, ENGLISH. In Architecture, that disposition of bricks in a wall wherein the courses are alternately composed of *headers*, or bricks laid with their heads or ends towards the faces of the wall, and in the superior and inferior courses of *stretchers* or bricks, with their lengths parallel to the faces of the walls, as in the margin, in which the upper is called the heading, and the lower the stretching course



BOND, FLEMISH In Architecture, that disposition of bricks in a wall wherein each course has headers and stretchers alternately, as in the margin.



BOND OR LAP OF A SLATE. In Architecture, the distance between the nail of the under slate and the lower edge of the upper slate

BOND STONE In Architecture, a stone running through the whole thickness of a wall at right angles to its face, for the purpose of binding the wall together in the direction of its thickness

BOND TIMBER. In Architecture, timber worked in with a wall as it is carried up, for the purpose of tying it together in a longitudinal direction while the work is setting.

BONE. An important organ in the higher orders of animals (*see* ANATOMY), forming the solid support of their fabric, and protecting the vital organs, such as the brain and the heart and lungs, from external pressure and injury. In the human skeleton there are commonly enumerated 260 distinct bones They, however, admit of classification under three heads, namely, *long* or *cylindrical* bones, such as those of the extremities, *broad* and *flat* bones, such as those of the skull, and *short*, *square*, *irregular*, or *solid* bones, such as the vertebræ, and those of the wrist and instep, and the patella or knee-pan the first bones are generally filled with marrow, and are admirable specimens of strength of structure with the least possible weight. The bones are covered by a membrane called *periosteum*, by which the ramifications of blood-vessels and nerves pass into the bone In the growth of a bone, the gelatinous or cartilaginous portion, as it has sometimes been called, is first formed, and the earthy or indurating part is afterwards deposited We are indebted to Mr. Hatchett for our principal information respecting the proximate chemical components of bone. (*Phil. Trans.* 1799 and 1800) The soft parts consist of gelatine and albumen; and the hard portion is composed of phosphate of lime and carbonate of lime, with small quantities of other salts. The animal matter of bones amounts on an average to about half their weight, or, when dried, to between 30 and 40 *per cent.*; so that they contain a large relative proportion of nutritive matter. The bones, including their animal matter, are the most durable parts of the animal fabric, hence the proposal of storing them up, as occasional sources of nutriment, for not only is the cartilaginous portion unimpaired, in bones which have been kept dry for many years, but it has even been found perfect in bones of apparently antediluvian origin. The best mode of extracting the nutritious part of bone for human food consists in grinding it fine, and subjecting it with water to a heat of about 220° in a digester; or the earthy part may be removed by dilute muriatic acid When dogs and some other animals devour bones, the nutritive part is abstracted by their gastric juice, and the earthy part is voided in the excrement, forming what was formerly called *album græcum*.

When bones are submitted to destructive distillation the gelatine and albumen which they contain is abundantly productive of *ammonia*, hence a copious source of that alkali and its compounds; the residue is a mixture of the earthy part of the bone with charcoal, commonly termed *ivory* or *bone black*.

BONE DUST, or ground bones, has recently been used with the best effect as a *manure*. It is usually applied to light or turnip soils, which it has rendered in no ordinary degree productive For further details on this curious and interesting subject, see article "Agriculture" in *M'Culloch's Statistics*. The importation of bones from distant countries to be used as manure is now carried on to a great extent

BONE EARTH. The residue of bones which have been calcined so as to destroy the animal matter and carbon, and become converted into a white porous and friable substance, composed chiefly of phosphate of lime. According to Berzelius, 100 parts of human bones are composed of 51 04 phosphate of lime, 11·30 carbonate of lime, 2 fluoride of calcium, 1 20 soda and chloride of sodium, 1·16 phosphate of magnesia, and 33 30 animal matter. Albumen, gelatine, and fat constitute the animal part of bone, the greater part of which remains in the form of a tough cartilage when bones are steeped in dilute muriatic acid.

BONITO The name of a species of Scomberoid fishes (*Thynnus pelamis*, Cuv.), common in the tropical ocean, and well known to voyagers from its persecution of the flying-fish (*Exocœtus volitans*), and flying squid (*Loligo sagittata*).

BONZES The priests of the religion of Fo are so called by Europeans, especially in China, the Birman Empire, Japan, and other districts of Eastern Asia.

BOOBY. The English name of a genus of *Pelecanidæ*; they are also called gannets, noddies, and soland geese.

BOOK (Ger. buch) "The general name of almost every literary composition, but in a more limited sense applied only to such compositions as are large enough to form a volume." Short and fugitive pieces are denominated pamphlets, in contradistinction to books, which are of greater length, and embrace more general or permanent topics. To the various sizes and forms in which books appear appropriate appellations have been given, as folio, quarto, octavo, duodecimo, &c. The materials of which books have been composed have been extremely different in different nations, and in different periods of the progress of civilization. Plates of lead and copper, bricks, stone, and wood were anciently employed for this purpose. At a later period the bark of trees formed the chief material in the composition of books, as is indicated by the original signification of the term *book* itself, and its equivalent in some some other languages The materials of books were afterwards derived from the Egyptian plant papyrus, but as the demand for books increased, more durable materials were sought for, and leather, made chiefly from the skins of goats or sheep, was employed for this purpose Next followed the use of parchment, on which the ancient MSS. were chiefly written: but all these systems were swallowed up by the invention of paper (*quod vide*), which took place about the 13th century, and facilitated the circulation of knowledge to an incalculable extent. The first books were in the form of blocks and tablets; but when flexible materials came into use, it was found more convenient to roll them up in scrolls, called by the Greeks *κόντακ*, and by the Romans *volumen*

BOOK-KEEPING. In Commerce, the art of recording, in a regular, concise, and systematic manner, the transactions of merchants, traders, or other persons engaged in pursuits connected with money. It has not only the authority of experience to recommend it, but that of some of the sagest observers of human affairs; Dr. Johnson remarks, "that the counting-house of an accomplished merchant is a school of method, where the great science may be learned of ranging particulars under generals, of bringing the different parts of a transaction together, and of showing at one view a long series of dealing and exchange. Let no man (the Doctor adds) venture into large business while he is ignorant of the method of regulating books; never let him imagine that any degree of natural abilities will enable him to supply this deficiency, or preserve a multiplicity of affairs from inextricable confusion." There are two modes of keeping books of account; the one by what is termed *Single* and the other by *Double Entry*. Both are in very general use. The system of single entry is chiefly confined to the business of retail-dealers; it is much the simplest method of book-keeping, consisting only of a day-book and a ledger. In the day-book the dealer enters his sales and purchases, and in his ledger he carries the former to the debit of his customers, and the latter to the credit of the merchants who supply him with goods. By making at any time a list of the sums due to him by his customers,

and of those due by him to wholesale merchants, the retail dealer may, after adding to the debts due to him the value of his stock on hand, arrive at an approximation to the real state of his debts and assets. This, however, is but an imperfect and unsatisfactory mode of book-keeping; and, therefore, in the case of wholesale and mercantile business, where extensive and multifarious transactions have to be recorded, recourse is had to the system of *double entry*. This system possesses all the advantages of single entry, besides being so complete and comprehensive in its principles, and so certain in its results, as to admit of universal application. It may with equal advantage be adopted in the most limited as well as in the most extensive, in the most plain and simple as well as the most intricate and complicated concerns.

No very authentic accounts exist of the origin of book-keeping. The double entry system appears to have been first practised towards the latter part of the fifteenth century, in Venice and other towns in Italy, then the great emporium of the mercantile world, and from this circumstance it acquired the name of the *Italian method of book-keeping*. The advantages of the system, and the soundness of the principles on which it is based, soon became apparent; for we find it was adopted in England and France early in the sixteenth century, and has continued to be more and more practised down to the present day.

The great objects of a good method of book-keeping are to exhibit transactions as they occur, in the most minute detail, and ultimately in the most condensed form, advancing from the earliest stage to the latest by such clear and lucid steps as at all times to admit of every fact being traced in its progress, and security being obtained at every step against omission or error. For the attainment of such important objects, no mode of book-keeping has hitherto been devised at all approaching to the perfection of the Italian system by double entry. Every transaction in business is twofold, there can be no receipt without a payment, and no purchase without a sale, and consequently by presenting the same event or fact on both sides of the books, whence the name of double entry, the entries being simultaneous, become corroborative of each other. The circumstance of every transaction being entered on both sides of the ledger affords one of the most valuable results derived from the system of double entry, namely, a test of accuracy, inasmuch as the entries on the credit side must be equal to the entries on the debit side, otherwise the books will not balance.

The three principal books required under the Italian system of double entry are, a cash book, journal, and ledger. In the first of these every transaction is recorded where money forms one of its elements, and in practice these transactions are by some book-keepers carried direct from the cash book to the ledger without being passed through the journal at all. The journal, however, forms a most important part of the system. It exhibits a narrative of every transaction of which an actual transfer of money does not form one of the elements, arranging the facts in as simple and condensed a form as correctness and intelligibility will admit of, and the results of those entries in the journal are afterwards introduced into the ledger, which thereby becomes a sort of key to the detailed history of every transaction; whilst at the same time it furnishes a luminous compendium of the whole. In like manner when the cash transactions are passed through the journal they are at stated periods classed and arranged in a condensed form, and thence transferred to the ledger. This plan of introducing the cash transactions into the journal is considered much the best system, though attended with a little more trouble to the book-keeper, as it affords great facilities in balancing the books and testing the accuracy of the ledger, more particularly when the recent improvements upon the form of the journal, which were originally suggested by the late Mr. Jones, are adopted. By the plan referred to, the journal is advantageously ruled with four cash columns, two upon the left hand side for *entries debtor*, and two upon the right for *entries creditor*, and all the transactions being connected either with *personal* and *property* accounts or *nominal* accounts, such as charges, profit and loss, and so forth, they are classed accordingly in the columns on the Dr. or Cr. side of the journal respectively; and as the debit entries are at all times equal to the credit entries, the aggregate of the two columns on the Dr. side must tally with the aggregate of the two on the Cr. side of the journal. This too is found in practice to be a most useful check against posting the entries to wrong accounts in the ledger; for on balancing the books, by taking the amounts Dr. and Cr. posted to personal and property accounts, and the amounts Dr. and Cr. posted to nominal accounts in the ledger, and comparing them with the total amounts in the corresponding columns of the journal, it will be seen whether they agree. if they do not, it demonstrates that some entries must have been erroneously posted, which can then only be discovered by collating the books; but if the amounts do agree, then it affords at least strong presumptive evidence that the whole of the entries have been carried to the proper accounts. Experience and practice are occasionally suggesting minor improvements upon the forms of the cash book, journal, and ledger, to suit particular cases, as well as upon the subsidiary books required for gathering together the facts preparatory to their being transferred in a condensed form into the journal, and indeed an intelligent book-keeper may accomplish much by a judicious classification of the facts in the auxiliary books; but the fundamental principles of the Italian system of book-keeping, notwithstanding such occasional facilities and improved arrangements in the working of it, remain perfect and unchanged; and after the length of time they have successfully withstood all attempts at innovation or change, it may safely be affirmed that the system is the best hitherto discovered, and is deserving of the utmost confidence and general adoption.

We have already stated that the Italian system of book-keeping admits of universal application, and we may now observe that it is not confined to merchants' accounts, but is equally applicable to government accounts. In evidence of its being so, we may instance the East India Company, where the double entry system is used with the most perfect success in all the branches of that great and well-conducted establishment, financial as well as commercial. One great desideratum in a system of book-keeping for government accounts is centralization, which can alone be attained by a proper and well organized method of condensing the facts or elements of the accounts, and the Italian system unquestionably affords the most efficacious means of collecting and grouping the widely scattered elements of government accounts in a concise and intelligible shape, and ultimately exhibiting them in the clearest and most perfect state of centralization admitted of. Several of the ablest ministers of France from the days of Sully downwards, convinced of the necessity of a good system of book-keeping in the management of the public money, and satisfied of the efficiency and soundness of the principles of the Italian method, successively attempted to get the government accounts kept on that system. But it was not till the present century that it was successfully introduced. It has since, however, fully realized all that was anticipated of it by those great men; and has been found to answer so completely that it has been universally adopted in all the different departments of the state. Equally beneficial effects have resulted from the adaptation of the system to the public accounts in Holland, and confirmed the advantage of its application to government business. Similar laudable attempts have been more recently made in this country by some of our ablest practical statesmen (among whom Sir Henry Parnell deserves particular notice), to introduce the Italian mode of book-keeping in the government offices, and from the signal success with which the experiment has been crowned, it is to be hoped that in a few years the whole of our public accounts will be placed on one uniform plan of book-keeping by double entry, and be thereby rendered as clear and intelligible as the accounts of any merchant in London, instead of being wrapped up, as formerly, in impenetrable obscurity and useless mystery.

BOOM. (Dutch boom, *a tree*.) A nautical term, signifying a long pole run out from any part of a ship to stretch the bottoms of particular sails; whence *jib-boom*, *main-boom*, *studdingsail-boom*, &c.

BOOM. In Marine Fortification, signifies a strong chain or cable stretched across the mouth of a harbour or river, to prevent the enemy's ships from entering, and having a number of poles, bars, &c. fastened to it, whence the name.

BOOPS. A genus of fishes of the order *Acanthopterygii*: most of them occur in the Mediterranean.

BOO'TES. (Gr. *βους, an ox.*) One of the constellations.

BORA'CIC ACID. *See* BORON.

BORACI'TE. Native borate of magnesia.

BORA'GINA'CEÆ. Plants resembling the genus Borago, after which they are named. They usually have a mucilaginous sap, in which nitre exists in small quantities, wherefore they decrepitate when thrown upon the fire. It is found that liquor into which borago itself is plunged when fresh becomes cooled, and hence the *Borago officinalis* was the principal ingredient in what was called a "cool tankard." Boraginaceous plants have usually pretty, and sometimes very handsome flowers, arranged in a gyrate manner. Forget-me-not (*Myosotis*), Bugloss (*Echium*), *Anchusa*, and various species of *Lithospermum* are well-known favourites either among wild or cultivated plants. Most of them have their leaves covered with asperities, whence their old name of *Asperifoliæ*; and some, as *Anchusa tinctoria*, *Lithospermum tinctorium*, and several others, yield a deep purple dye from their roots.

BORA'SSUS. (*Βορασσος, the skin of the date.*) A genus of palm trees, usually called fan palms, because their gigantic leaves are formed of plates radiating from the

top of the petiole, and folded up after the manner of a lady's fan. *Borassus flabilliformis* is an Indian species, with a trunk from thirty to fifty feet high, and leaves with from seventy to eighty rays. The Hindoos consider it the king of trees. A most intoxicating liquor is obtained by fermenting its sap, which is also capable of yielding sugar in considerable quantity under proper management.

BORA'TES. Salts of the boracic acid.

BORAX. This salt is found native in some of the lakes of Thibet and Persia, and is imported from India under the name of *tincal*, which after purification forms the *refined borax* of commerce. Of late years borax has been obtained by combining *native boracic acid* with soda. Borax forms hexædral prisms, slightly efflorescent, and requiring 20 of cold and 6 of boiling water for solution. When heated, water of crystallization is driven off, and the residuary salt fuses into what is called *glass of borax*.

Crystallized borax consists of 68 boracic acid + 32 soda + 90 water. It has upon some tests an alkaline reaction, and has hence been called *sub-borate of soda*. Borax is chiefly used by workers in metals as a flux: it is also employed in medicine.

BO'RDER. In Gardening, a marginal space, always connected with a walk or some other object, to which it forms an accompaniment.

Border, or Bordure. In Heraldry, according to French heralds, an honourable ordinary, which should occupy a third part of the shield. In English blazonry, it has generally been considered as a mark of difference to distinguish one branch of a family from another It surrounds the field, is of equal breadth in every part, and occupies one fifth of the field. When there is a chief on the coat, the bordure is supposed to run under the chief; but it passes over other ordinaries, as a fess, &c.

BORE. A word used to express the sudden rise of the tide in certain estuaries.

BO'REAS. In Grecian Mythology, the son of Astræus and Aurora, and usually worshipped as the god of the north wind. There are few of the minor Grecian divinities of whom so strange and multifarious exploits are recorded as of Boreas, and it is interesting to trace to its source the allegory of all his adventures and achievements, and thence to elucidate the causes of his deification The assiduity, for instance, with which the worship of Boreas was cultivated at Athens proceeded from gratitude, the north wind having on one occasion destroyed the fleet of the Persians when meditating the invasion of Attica. A similar cause induced the inhabitants of Megalopolis to consider Boreas as their guardian divinity, in whose honour they instituted an annual festival. With his usual partiality for mythological allusion, Milton has given Boreas a place in his *Paradise Lost*: —

> Now from the north
> Of Norumbega, and the Samoed shore,
> Bursting their brazen dungeon, armed with ice
> And snow, and hail, and stormy gust and flaw,
> Boreas and Cæcias and Argestes loud,
> And Thrascias rend the woods and seas upturn.

Boreas was usually represented with the feet of a serpent, his wings dripping with golden dew-drops, and the train of his garment sweeping along the ground.

BO'RON The base of boracic acid, discovered by Davy in 1807. It may be procured by heating dry boracic acid with potassium. It is a dark olive-coloured substance, a nonconductor of electricity, insoluble in water, infusible, and of a specific gravity = 2. Heated to redness it burns into *boracic acid*, which consists of 20 boron + 48 oxygen.

Boracic acid is found in the hot springs, and amongst the volcanic products of the Lipari islands, and in the waters of Sasso in the Florentine territory; it also occurs in some minerals. It may be obtained by adding excess of sulphuric acid to a strong solution of borax. Its specific gravity is 1 48. In its usual state of scaly crystals it is a *hydrate*, composed of 68 dry acid + 27 water In this state it requires about 30 parts of cold and 3 of boiling water for its solution. It dissolves in alcohol, and the solution burns with a characteristic green flame. It reddens litmus; but renders turmeric brown, like an alkali. When its water is driven off by fusing it at a high heat, the anhydrous acid concretes into a glassy substance of the specific gravity of 1·8. It is a useful flux, and was formerly used in medicine under the name of *Homberg's sedative salt*.

BO'ROUGH. A town possessed of certain municipal institutions, of which the name is derived by some from the Saxon word burg, meaning an inclosed place; by others from another word of the same language — borg, meaning pledge, which was applied to some of the associations for mutual liability established by the Saxon law. Boroughs, in the sense of the definition above given, must have, in some shape, existed very early in this as well as in other countries; but the origin as well in constitution as in name of the existing municipal system in England can be traced no higher than Saxon times, and the general and connected history of English boroughs does not begin before the Conquest.

According to Doomsday Book there were in England at that time eighty-two boroughs, including cities, differing considerably in the extent of their franchises as well as in their customs and mode of government; but agreeing in this general character, that they were communities established chiefly for the purposes of trade, endowed to that effect with certain franchises, such as that of a fair or market, and possessing as boroughs a special jurisdiction exercised in the the borough court-leet, and exclusive of the jurisdiction of the hundred, with which in the political scale a borough was co-equal. Some of them then held, and all were capable of holding, lands in common; and in respect of such land they held, as did also each burgess in respect of his own tenement, of some lord, by a species of tenure called burgage tenure, which was in fact only the ancient tenure in common socage, *i. e.* tenure by rent or service certain, which continued to prevail in boroughs after the general imposition upon other lands of the feudal or military service. The lordship of the land of the borough, and of the different tenements which it contained, must have belonged in the first instance to the lord of the manor within which it was situate; but all boroughs, in contemplation of law, held their franchises of the king.

Great obscurity prevails as to what was originally the internal constitution of boroughs, and as to how far it was popular or not, and how far also it was or was not uniform. It is certain that as early as the date of Doomsday Book the proportion between the number of burgesses and that of other inhabitants was very different in different boroughs; though the fact may be reconciled with the notion of a system originally popular (which has all along prevailed in some boroughs), upon the supposition that the franchise had either been usurped on the one hand, as has frequently happened in the case of larger communities, or abandoned on the other hand as of little value, on account of the liability that attached to it of contributing to the common charges. Much perplexity also arises on this subject from the intermixture in the same place of the guild and borough franchises (*see* Guild), which prevailed to that extent that the guild-merchant, which appears to have been an incorporation, or an association by licence of all trades within the borough, is by some considered as identical in its constitution with the borough itself; and it is certain, at any rate, that the guild-merchant, though it did not in the first instance constitute the borough, yet in many places usurped its franchises and government, and finally assumed its name, so that, with the exception of burgage tenure, which still prevailed in some few places, and of birth, which was common to both institutions, the other modes of obtaining the freedom of a borough,—*i. e.* those of apprenticeship, purchase, or gift,—were introduced into the municipal system from the guild-merchant. Distinct from this in their relations and contests with the community of the borough at large were the guilds of particular trades, which succeeded in London in engrossing and parcelling among themselves, under the name of liveries, the whole of the municipal franchises.

All borough rights, being exceptive, rested either upon charter, or upon prescription, which supposes a charter. Some few of such charters were granted by Saxon kings: but they became much more frequent after the Conquest, the style and purport of these early documents being simply that of a grant to the *men* and *burgesses* of such a place of certain franchises, whether relating to trade, as that of a fair or market, or exemption from toll, or to jurisdiction, such as a commission of the peace and the right of holding sessions, which was first granted to any borough by Richard II. In the reign of Henry VI., a remarkable alteration took place in the style of these royal grants, it being then first that were granted, as it is said, charters of incorporation, strictly so called, though previous to that time boroughs, or the governing bodies that represented them, enjoyed all the privileges of a corporation, and since that time many have continued to enjoy them without any such special grant. From that time forth, however, the history of boroughs becomes identical, except as to the parliamentary franchise, with that of municipal corporations. These charters of incorporation did not, any more than did those which preceded them, pretend to regulate the internal constitution of boroughs. This very generally assumed the form of a government by a small and in great measure self-elected body, which had in most cases succeeded in engrossing not only the whole administration, and in a great degree the enjoyment also of the borough franchises and property, but the right also of granting, according to rules more or less arbitrary, admission into the subordinate body of burgesses or freemen. And even that body, where it existed, which was not always the case, was small in proportion to the whole number of inhabitants. It was the great object of the charters granted by the Tudor sovereigns to sanction and confirm the usurpations, if such they were, of these municipal oligarchies, with the view apparently of throwing the representation of boroughs (a right which had been conferred in the first

instance by Edward I., had since been extended by fresh grants, and was then becoming of considerable importance) into the hands of such as were most likely to be easily guided or controlled, either by the crown itself or by the great lords upon whose support it reckoned, and with whom it became usual about the same time to connect themselves with the boroughs in the neighbourhood of their possessions, under the honorary title of high stewards. The exclusive system of municipal government, which attained its height during the Stuart dynasty, continued unimpaired till the present time, when it was effectually put an end to by the Act for the Regulation of Municipal Corporations, passed in the year 1835 For an account of which, as well as of the other remarkable incidents in the history of our municipal institutions, which happened from the time of the Tudors to the present period, see title MUNICIPAL CORPORATIONS, and for an account of the *representation* of boroughs, and particularly of the *reform* in *their representation*, see title PARLIAMENT.

The account above given of English boroughs, both as to their origin and constitution, applies in all its general features to Scotch boroughs; with this qualification, that the government by close corporations was in the latter country more thoroughly and more generally prevalent until the reform in them, which preceded by a year the Municipal Regulation Bill applicable to this country, and resembled it in almost every thing but this, that it made the qualification for burgesship identical with that required to give a vote in the election of members, namely, the occcupancy of a house of the yearly value of 10*l*.

In Ireland the municipal system, as it now exists, is of considerably later origin than in Scotland or in England. It was transplanted, and gradually introduced from the latter country; and though with the same names and form of constitution as then existed there, had much more in it of a political character, being intended in the first instance as a support to the English against the Irish, and in later times to the Protestant against the Catholic, and was so used to the neglect of functions more properly municipal, which have therefore in many instances been intrusted to other hands by local acts of parliament. These distinctions of religion and birth aggravated also in other respects the vices of a close and exclusive system, which was there, as in Scotland, more generally and thoroughly established than it ever was in this country. A measure for the reform or abolition of the existing municipal corporations of Ireland is now pending before the legislature.

BOROUGH ENGLISH In Law, is a customary mode of descent of lands in some ancient boroughs and manors, by which estates descend to the owner's youngest son, or if he has no issue, to his younger brother. *See* DESCENT.

BOS. (Lat. bos, *an ox*) A genus of ruminating mammals, which is one of the most important in relation to the necessities and conveniences of man. To this genus belongs the domestic ox, in all its various breeds and varieties. With respect to the wild original of our numerous herds there is yet some obscurity, less, however, than hangs over the origin of other domesticated species. The wild cattle which approach nearest to the tame are those which inhabit the forests of the north-east of Europe; and the white cattle, which are still preserved in a state of purity at Craven, at Chillingham Park, and in Scotland. These are both referred to the species called *Bos taurus*, or *Bos urus*, or *Urus Scoticus*, but there is much reason for supposing this species to have been the domestic ox reverted to a state of nature Another well-marked variety of this species is the Brahminy bull, characterised by the hump on the shoulders and the pendent dewlap.

The other known wild species of ox are the Gayal of India (*Bos gavæus*); the Yak of the mountains of Central Asia (*Bos grunniens*); lastly, there are the Buffaloes, which, though anatomically less distinct than the Bisons from the typical *Boves*, yet differ from the oxen as a group in many points. They have larger horns, which sometimes form a horny covering of great thickness to the whole frontal region; and they approach the Pachydermata in the thickness of the skin and the thinly scattered coarse hair They frequent marshy grounds, and feed on a ranker and coarser herbage than the ox. The flesh of buffaloes is rank and coarse, and they are used chiefly as beasts of draught or burden The two best marked species are the Indian or Arnee buffalo (*Bos arnee*), and the South African buffalo (*Bos caffer*).

BOSSAGE. (French.) In Architecture, any projection left unwrought on the face of a stone for the purpose of afterwards sculpturing thereon, the sculpture being usually the last thing finished.

BOSTRICHUS. A genus of Coleopterous, Xylophagous, or wood-boring insects, now raised to the rank of a family (*Bostrichidæ*), including amongst its numerous genera three which contain species whose ravages have called forth the attention of the legislature both in this and other countries in consequence of the extensive destruction of valuable timber caused thereby. The species in question are the *Bostrichus ligniperda*, *Scolytus destructor*, and *Tomicus typographus;* but the two latter are the most mischievous, and astonish by the amount of damage which is produced by insects of so small a size. The elm tree is the object of attack to the *S. destructor;* while the *T. typographicus* restricts its operations to the fir. The females attack the crevices of the bark, and perforate it in diverging lateral channels, in which from sixty to eighty eggs are deposited At the end of fifteen days the larvæ are hatched, and forthwith commence the work of destruction, each gnawing a serpentine gallery between the bark and the wood, and gradually enlarging its burrow until the period when it is ready to pass into the pupa state; when, having finally become a perfect beetle, it directly bores through the portion of the tree which remains between the wood and the outer bark, and escapes through a small circular aperture in the latter. This emergence of the perfect insect takes place in the month of May; and in seasons favourable to their development they appear in swarms, and rise to a height exceeding that of the trees, and may be carried by the wind to another and distant part of the forest. The impregnation of the female takes place in the air; so that wherever they alight they are ready to recommence the work of destruction. The chief precautions and remedies which experience has suggested are to cut down the trees which are once attacked, immediately to bark them and to burn the bark, and to remove all felled timber without delay.

BOSWE'LLIA. A genus of Indian trees belonging to the natural order *Burseraceæ*, one species of which, *B. thurifera*, yields the resin called Olibanum, which seems to be a corruption of Luban, the name given by the Hindoos to this plant.

BOT The name of the larvæ of the Dipterous insects of the family *Œstridæ* (which see)

BO'TANY. (Gr *βοτανη, herb* or *grass*) That branch of natural history which relates to the vegetable kingdom; not merely including the nomenclature and classification of plants, as some have supposed, but embracing all the phenomena of vegetable life in their widest extent.

Looking only at the first principles of the science, it is generally divided into the following heads.—

*Organography or the Structure* (Organisation) *of Plants*—This is a most important department, it comprehends whatever relates to the various forms of tissue of which plants are anatomically constructed, it explains the exact organization of all those parts through which the vital functions are performed, and it also teaches the relation that one part bears to another, with the dependence of the whole upon the common system Without a perfect knowledge of Organography no systematical arrangement can be understood, for, being that part of science in which the laws of the symmetry of parts is comprehended, it must necessarily be the basis of all theory of classifications: and as to Descriptive Botany, which may be called the language of the science, it cannot have any logical precision, or be intelligible, unless the mind is distinctly impressed with the fundamental laws of this branch of study Physiology itself, the highest branch all natural science, depends so absolutely upon an exact knowledge of the structure of parts, that any attempt to investigate the important laws of vegetable life must necessarily be abortive without a strict acquaintance with the more important details of organization And by this is not meant merely a general idea of external form, or a vague notion of internal anatomy, but the most precise knowledge that the nature of the subject will admit.

Connected with this branch of study is what German botanists call Morphology, but which others think it better to consider a section of Organography The word Morphology signifies literally the "science of changes or transformations." As applied to botany, it embraces a very interesting subject of inquiry, and one which, to all those who know the importance that attaches to comparative anatomy in the animal kingdom, cannot fail to be peculiarly interesting Within the last thirty or forty years it has been clearly made out that all those parts which are familiarly known under the name of leaves, flowers, and fruit, are constructed, in all cases whatsoever, upon a simple uniform plan, out of one single organ in different states of modification and combination; and that there is no other difference between the flower of a rose and that of a nettle than what arises from modifications and combinations of this organ — which is the leaf. If it be doubted whether, considering the anomalous character of some of the lower orders of plants, all vegetables are without exception formed upon one and the same plan, it is impossible not to admit that, at least in all Phœnogamous plants, the flowers are composed of the same elements; that these elements are arranged in conformity to a few simple laws, far less variable than their appearance seems to indicate, and the study of which constitutes the basis of the theory of botany. These laws are so evident in a great number of cases, that one scarcely pays attention

to them; but curiosity is at once excited when they seem to be violated. Exact observation, however, shows that in such cases they are only masked; that is to say, an unusual application of two or three different laws produces an apparent anomaly, which is easily explained by a reference to the numerous cases of degeneracy, abortion, and cohesion with which the vegetable kingdom abounds. In such instances as this the botanist may be compared to the mineralogist, who discovers the primitive forms of crystals by means of their secondary forms. We are so accustomed to talk of plants bearing leaves and flowers and fruit, and it is so evident to our senses that extremely different organs really do exist under such names, that it seems inconceivable that parts so very dissimilar should all be only leaves in different states; that the pure white petals of the lily, the rich red flowers of the rose, the sweet-smelling blossoms of the jasmine and the orange, or the long trumpet-shaped corollas of the honeysuckle, should all be leaves; that the stamens in which the fertilizing powder is locked up, the pistils which are destined to receive the influence of the pollen, the ovula that they contain, and, finally, that the fruit which is the result of the action of the two last, are all so many parts formed out of one common organ, which in a particular and very frequent state is what we call a leaf. Botanists do not mean to say that he who eats an apple, or an orange, or a peach, is in a state of mental delusion, and that while he fancies himself to be enjoying the pleasure of gratifying his palate by the most delicious flavours he is really only chewing the leaves of these plants, but they assert that those appendages of a plant which are commonly called the leaves have a peculiar anatomical structure, and a certain relation to the stem on which they are borne, and being developed according to certain fixed laws, are always arranged upon a certain and uniform plan with respect to each other, and that all the other organs, whether calyx, corolla, stamens, pistils, or fruit, have an anatomical structure essentially the same, bear the same relation to the axis that they grow upon, are developed according to the same laws, are arranged upon the same certain and uniform plan with respect to each other, and, finally, are constantly becoming transformed into leaves of the ordinary appearance, thus losing the condition in which they are usually found, and reverting to their structural type. The admission of such propositions as these does not render our notions of the distinctions between the various organs more obscure than it was before, as some would assert, but on the contrary it enables us the better to understand the real nature of the organization of any part, and the plan upon which the most complicated arrangements of these organs have been effected. For example, who is to explain how it happens that buds occasionally spring from the axillæ of petals or sepals, that anthers are found having ovules, that branches push forth from the centre of pistils, that petals become antheriferous and stamens petaloid, unless the proposition is admitted that all those apparently different parts are formed upon a common plan, the type of which is a leaf, and are all therefore convertible into each other?

Another branch into which the science separates is *Physiology*, or the department which treats of the vital actions of plants. While organography is applicable to objects whether living or dead, physiology solely refers to them in a state of vitality. There is scarcely any part of natural history more difficult than this, if rigorous demonstration is required, nor, at the same time, one upon which there was in former days a greater degree of mere speculation. Like many other of the higher departments of natural philosophy, hypothesis preceded experiment; so that in the earlier history of botany we find scarcely a trace of those ideas which modern observation has certainly developed in a very remarkable manner.

In vegetable physiology it is not as in animal — we have not our highest order of beings endued with reason which we can study by aid of our own personal feelings and sensations, and from our knowledge of which we can proceed in a descending series to the determination of the vital functions of all other tribes. On the contrary, we are in the same position with regard to plants as a new and totally distinct race of animated beings would be to mollusca and the lowest orders of existing things, supposing such a race to have no knowledge whatever of animal economy beyond what could be learned from the study of mollusca themselves, to have a class of sensations and a structure wholly unlike our own, and finally to deduce its notions of the anatomy and vital system of mollusca, not from a comparison of them with other beings gradually and perhaps insensibly rising in perfection of organization till the relation of one part to another and the uses of all become more manifest, but wholly from the abstract consideration of the mollusca themselves. In such a case, speculation would most likely precede experimental observation, as was actually the case with plants.

It was not till after the invention of the microscope that even an imperfect knowledge of vegetable anatomy could be gained; and only when this great step was taken vegetable physiology began to establish itself upon a sure foundation. Consequent upon this discovery has been the accumulation of a considerable amount of positive knowledge of a world of organized beings having nothing in common with the race of man; with which we cannot communicate in the slightest degree; that have no volition by which we may occasionally regulate our judgment; whose texture is so frail that we cannot anatomise them without the destruction of life; whose functions are performed within an opaque dense covering that excludes everything from our view; and which finally are so exceedingly simple in their organization, have so few different organs with which to execute their functions, that we are lost in amazement at effects so complicated and forms so various being brought about by means that are seemingly so inadequate. The world has learned from the vegetable physiologist, not only that plants breathe, feed, and digest, and how the functions of breathing, feeding, and digesting are carried on; they have ascertained by what means an increase in their dimensions are brought about, how their want of locomotive power is compensated for, and by what precise means their reproduction and multiplication are so wisely ordained as to be placed beyond obstruction by any natural impediments. In short, the exact use of every part of every plant, various as their forms and uses doubtless are, has been ascertained, and we are now entitled to say of plants as of animals, that their kingdom is rendered subject to the power, not only of man's physical energy, but of his mental resources. Perhaps no part of the creation illustrates more forcibly than the vegetable world, the admirable skill and foresight with which all the phenomena of the universe have been adapted by the Great Author of our being to the accomplishment of the objects for which they have been severally intended.

Take, for example, vegetable tissue. What can be conceived more wisely prepared! The cellular, capable of great extensibility, possessing also prodigious compressibility, its particles cohering either firmly or loosely according to circumstances, its sides composed of a most delicate membrane, through which fluid and gaseous matter passes readily in every direction, is destined to form the principal mass of the vegetable, and to execute all those functions with which absorption and respiration are connected; — the fibrous tissue, composed of myriads of threads compactly combined into bundles, dispersed through the cellular substance, how admirably does it supply the place of bones and nerves in the animal economy, affording strength and solidity and elasticity to the most delicate parts! While the vascular tissue, exclusively intended for the reception and rapid transmission of gaseous matter or of highly attenuated fluid from the roots to the extremities, how wisely is it contrived by its greater size and length, and how carefully is it prepared by its spiral structure, for extending and turning, as the cellular substance develops, to those parts where the peculiar matter that it contains is most required! Here there is no confusion of offices to perform, each has its peculiar part assigned it, for which it has been especially destined, and for which it is alone adapted.

Look at the leaves. The leaves are the organs in plants that correspond with the stomach in animals; that is to say, it is in them that the fluid matter taken up by the roots and injected into them from the stem, is digested and inspissated, and separated into the nutritious and excremental portions. To the naked eye the leaves appear to be merely flat plates of cellular substance traversed by veins; but examined with a microscope they are at once seen to be constructed upon a most simple plan — of any that can be conceived the most perfectly adapted to the end in view.

Digestion takes place in leaves chiefly by the absorption of carbonic acid and the respiration of oxygen, and by the evaporation of water; if this process were to be carried on without any provision against the variations which are constantly occurring in the state of the atmosphere, it is easy to conceive that in excessively dry weather leaves would lose all their moisture and constantly become parched up, while in wet weather they would be so gorged with moisture as to burst from distension. In order to prevent the occurrence of this, nature has enclosed leaves in a cuticle scarcely pervious either to air or moisture; and in this cuticle she has placed numerous mouths, called stomata, which have the power of opening and closing, according to the state of either the atmosphere or of the leaf itself, to regulate the absorption or respiration of either water or air. And in order to expose the tissue lying beneath this cuticle to the greatest possible atmospheric influence, the leaf is not a solid mass, as it appears to be, but is traversed in all directions by passages terminating in the mouths, and opening into cavities, where the air both of absorption and exhalation can freely circulate, and pass in or out so long as the mouths permit it. Nor is this all. Many leaves are constantly submerged beneath the surface of

water, where they are never exposed to atmospheric vicissitudes, can never evaporate, and being cut off from the air, can neither absorb carbonic acid from the air, nor discharge oxygen back into it in return. It is therefore obvious that the curious provision that has been made for the regulation of the action of aerial leaves would be useless in submersed ones; and accordingly we find that the latter have neither cuticle, nor mouths, nor cavernous parenchyma, but are thin but solid plates, the whole surface of whose cellular substance is in direct contact with the water, from the air contained in which the leaves must exclusively derive their nutriment. The employment of the same kind of organ, in different forms, for the purpose of effecting the varied objects that are to be provided for in the vegetable economy, is another and a most remarkable instance of the consummate wisdom and wonderful simplicity that are discoverable in all these things. Upon the birth of a plant one or two leaves are developed, which feed the infant until it is strong enough to develop one or two more; these last, not only like the first proceed without exception from opposite sides of the stem or body, but are so placed as to alternate with the first; and this goes on with unvarying uniformity, as long as growth continues; so that view a plant in whatever way you will, whether in its earliest state, or at the most advanced period of its existence, it will always be seen to exhibit the same beautiful symmetry as the most highly developed animals: one side counterpoises the other; whatever is discoverable on one side, equally exists upon the other. If it is necessary that a protection should be formed for securing the young and tender buds against cold, the leaves surrounding the buds suddenly contract into hard scales, perhaps exude some resinous or gummy matter, or clothe themselves in a deep covering of wool, and an impenetrable living shield is thus interposed between the bud and danger. A plant is to be rendered more beautiful to the eye — its leaves again contract, the spaces that usually separate them are obliterated, new colours are assumed, and petals are created resplendent with brilliant hues or exhaling the softest perfumes. Propagation is to be effected — the petals contract into stamens, their central substance becomes disintegrated in the form of pollen, and the interior of each grain of the latter is resolved into that living matter of which in a state of cohesion all nature is composed. A few leaves are rolled together in the form of pistillum, the apex of the midrib becomes denuded, and young buds are developed at the margins. A grain of pollen, the disintegrated tissue of the flowering leaf, falls upon the denuded apex of the fructifying leaf, absorbs moisture from it, distends, and finally produces a tube of inconceivable fineness, which abstracts from the pollen its impregnating matter, some of which descends the midrib into the womb of the leaf, and thence entering the young buds that are developed at its margins, is finally hatched, and appears at last in the form of embryo plants.

Such is the simplicity of the arrangements that are observable in the most perfectly formed, the most elaborately constructed plants. In the lower orders, the mode of formation, development, and propagation is still more simple. A vesicle elongates and distends until it becomes a tube; from the end of this tube more are generated that themselves give birth to others, and thus a simple branching plant is formed. In the inside of each tube by degrees a green matter is deposited, and after a certain period has elapsed is emitted in the form of little green vesicles, like that from which the plant originally sprang, and themselves capable of developing as new plants. In certain tubes, this dissolution takes place in a much more astonishing manner; not into inert green matter, but into moving particles having all the properties of spontaneous motion and animal existence. Soon, however, the moving particles elongate, thus losing their power of motion and becoming plants, to whose laws of life they ever after submit. Turpin has seen the *Monema comoides* resolve itself into naviculæ; Desmaziéres has shown the plants called *Mycodermata*, or what we name the mothery film of fermented liquor, to consist of monads growing end to end (*Ann des Sc* x); and Treviranus (*Ann des Sc.* x) has detailed with exactness the metamorphoses in the life of the compound plant called *Batrachospermum glomeratum*. In this the filaments discharge a green matter and become colourless; the green matter consists of myriads of infusoriæ, of a round or elliptical figure; the latter collect by fives or sixes into a kind of star, become motionless, lengthen, and finally are transformed into young individuals of this undoubted plant.

These are far from being all the divisions into which Botany, or the study of the vegetable kingdom, may be subdivided; although they are no doubt among the most interesting. Besides these there is *Taxonomy*, or the principles of classification. It would be of little use that a man should know anatomy, and structure, and comparative organization, and have informed himself of all the leading principles of physiology, if he were unacquainted with the names of the objects he had been studying, and were consequently incapable of communicating his knowledge to others. At least, of whatever use it might be to himself, it could not be of advantage to any one else. But if he *is* acquainted with the names of known objects, and if he understands the rules of classification, he can then render his information available to others as well as to himself. And in like manner he can at all times determine what is known about any particular plant that he may have been studying; or if it be a kind previously unknown, he can find its place in the system, and by publishing a description of it, he can fix it there for the information of others.

But there is another way of looking at the utility of classification, which shows that what may to some appear but a dry and barren subject, is in reality one of the most important branches of the science. No man can know all things relating to such a science as this, — few men can learn many things; for this reason it is of importance that a means should be discovered of judging of what is unknown by what is known; and that by judiciously selecting a moderate number of objects for particular study, the inquirer may have a ready and by no means burthensome means of forming a clear knowledge of the whole vegetable kingdom. This is not difficult, if attention be paid to the doctrine of affinities. Every one must have seen that some species of plants are more like each other than they are like different species; without considering the matter botanically, every one must, for example, have remarked that a radish is more like a turnip than it is like a currant bush, that a pea is more like a bean than an apple, and that a cherry blossom is more like an apple blossom than a horse chesnut. These are rude instances of affinity on the one hand, and discrepancy on the other; but they are nevertheless perfectly explanatory of what is meant. Botanists find that classification may be founded upon a consideration of general resemblances and differences; and that by carefully examining the characteristic organs of plants, those species may be classed most nearly together which have the greatest degree of resemblance and the most perfect constitutional agreement. Now this being the case, it follows that a knowledge of one species is to a great extent a knowledge of many, and that a correct idea of a single individual of a group in the classification, provided that individual is well selected, amounts to a knowledge to a considerable extent of all the other species of the same group. For example, in the tribe of *Cruciferæ*, consisting of about 900 species, the study of the common radish, the mustard, or the cress, will give the student a very accurate general knowledge of the remaining 899, because they are all close modifications of the same forms. Again the common potatoe, rightly understood, represents the greater part of *Solanaceæ*, or at least of some hundred species belonging to that tribe, while the dead nettle, *Lamium album* or *rubrum*, stands as the representative of some 15 or 1600 species called *Labiatæ*. This would be of eminent importance if its advantage stopped here, but when it is considered that the properties of plants also accord in a very remarkable manner with their structure, and that those which are most closely approximated in a classification will most nearly resemble one another in their sensible properties, the advantages to be derived from a study of the laws of affinity cannot fail to be clearly perceived. For example, to use the same illustrations as before, any person acquainted with *Cruciferæ* would know that there is no instance of a poisonous or deleterious plant in the tribe, a point of great importance to be aware of, on the contrary, he would know that if they had succulent roots, they might be employed like the radish, and that their leaves are antiscorbutic, but if he met with an unknown plant, which, from its resemblance to the potatoe, he knew belonged to *Solanaceæ*, he would at once reject it as poisonous, or at least suspicious, unless it had tubers filled with fæcula, when he would except that portion, because all fæcula is wholesome, however poisonous the trees or plants may otherwise be that produce it, provided the deleterious matter that lies among it is removed by washing, or volatilized by the action of heat.

It is not, however, any kind of classification that leads to such ends. All artificial systems, as for instance that of Linnæus, are unproductive of such results. It is only the natural system of botany from which these important advantages are to be derived.

A fourth division of the science is the meaning of the terms employed in the science; or what was formerly called *Terminology*, and now more correctly *Glossology*. This is the least interesting part of the subject; but at the same time it is too important to be passed over lightly, because it is impossible either to understand the writings of botanists, or to make oneself intelligible to others, without being correctly informed of the meaning of the terms peculiar to the science. The state of Terminology at any given time may indeed be safely taken as indicative of the state of the whole science; for in propor-

tion as ideas are multiplied and knowledge rendered exact, are the terms required to express those ideas multiplied and their application rendered definite. A curious exemplification of this is to be found in the *Historia Plantarum* of Fuchs, a learned botanist of the 16th century. In the glossary prefixed to that work are comprehended only 132 terms of all kinds, many of which refer to measures, and are therefore not appertaining to botany; and of the remainder 29 belong to modifications of stems, 15 to differences of inflorescence, 6 to the fruit, but not one to any other part of the fructification. In the present state of botany, the terms that relate to the seed alone are probably as numerous as the whole that are comprehended in Fuchs' Glossology.

Another and very distinct branch of inquiry is into the rules to be observed in describing and naming plants; or what is called *Phytography*. The great object of descriptions in natural history is to enable any person to recognise a known species, after its station has been discovered by classification, and also to put those who may not have had the opportunity of examining a plant themselves into possession of all the facts necessary to acquire a just notion of its structure and affinities. It is therefore important that such descriptions should be drawn up according to certain conventional well-known rules, and not according to the caprice of individuals, and this not only for the sake of ensuring a uniformity of language, and in all cases the same order of treating the subject, but also to prevent descriptions being too general, to ensure attention to the most important points of structure, and at the same time to prevent their being more prolix than is really necessary. The rules of description are more especially intended to guard against the latter evil, for no mistake can be more common than to confound prolixity with precision.

The last branch into which the study of the science may be divided is the application of the preceding subjects to the art of discriminating species. This may be called the *Practice of Botany*, as the former belonged to its theory, and is by far the most difficult part of the subject. There is no difficulty in becoming acquainted with the fundamental principles of the science, because they naturally arise out of each other, and are dependent upon the just appreciation of a few simple laws, the various combinations of which, upon principles that it is easy to comprehend, constitute the differences that exist between organs themselves and their numerous modifications. But the practice of botany, although its study is essentially facilitated by an acquaintance with fundamental principles, and indeed cannot be usefully pursued without, yet it has peculiar difficulties of its own. It is often difficult to recognise organs in consequence of the manner in which they are masked by the modifications they have undergone; their combinations are frequently so intricate that great experience is necessary to enable an observer to judge of them correctly; their minuteness is often such as to render indispensable a use of the microscope, which requires peculiar dexterity and a good deal of practice, and finally the number of species is so great, that to bear in mind their distinctions is a heavy tax upon the memory. Difficulties of this nature are almost insurmountable by a student who is unaided by the experience of a teacher.

At what period of the world botany first began to be studied as a science, has not been satisfactorily ascertained. By some it has been referred to the highest ages of antiquity. We are assured that Moses and Solomon and other Jewish writers, especially the last, were botanists, and that traces of much knowledge of the science are to be found throughout the scriptures; but it seems difficult to assign Botany any such antiquity. That in the most remote ages man had his herbs and his roots; that he was acquainted with the properties of one plant, and the uses of another; that he gave them names, and that poets derived many of the beauties of their language from them, — was natural enough, but this had nothing to do with botany. The first dawn of that science broke from out of the deep investigations of the nature of matter and mind by the philosophers of Greece. How much they knew we have no accurate means of judging; but that they knew a great deal of vegetable physiology is obvious from their famous paradox, that plants are only inverted animals, — a sentiment which, however strangely it may sound, could only have arisen from an extensive knowledge of the vital phenomena of Vegetation. Nor could the doctrine of Aristotle, that all organic matter exhibits a series of successive degrees of development, have been conceived or promulgated, unless the philosophers of his day had possessed a practical acquaintance with vegetation much beyond that of the ages that succeeded.

Happy had it been for those ages if, instead of retrograding in the path of science, or rather stepping out of it altogether, they had only pursued the course commenced by Theophrastus 350 years before Christ. By that naturalist the beginning was made of applying particular terms to particular modifications of structure; he demonstrated the absence of all philosophical distinction between trees, shrubs, and herbs, — a distinction upon which his successors were fond of insisting; he speaks clearly of the parenchyma and woody fibre of wood, the former of which he calls the flesh; and he described accurately the difference between palm wood and that of trees with concentric layers; so that in point of fact the discovery of the difference between Dicotyledonous and Monocotyledonous wood was made by Theophrastus above 2000 years ago, although it was never applied to the purposes of systematic division till about thirty years since. Subsequently to this period, botanists almost disappeared for a long season. Those who have been dignified by historians with that title were either pharmacologists like Dioscorides; or compilers, who, like Pliny, knew little themselves, and misunderstood those they copied; or *poets*, who drew much of the beauty of their language from the charms of nature; or *geoponical* writers, who were acquainted with those parts of husbandry which relate to physiological botany.

With whom the curious arts of budding and grafting, and striking plants by layers, or propagating them by taking advantage of the divisibility which distinguishes the vegetable from the animal kingdoms originated, is now unknown, but there is reason to believe that the greater part of the modifications of those processes was in the classical ages as well understood as now. That grafting was extensively undertaken, is obvious from these lines of a well-known poet of the Augustan age: —

> Et sæpe alterius ramos impunè videmus
> Vertere alterius, mutataq. insita mala
> Ferre pyrum, et prunis lapidosa rubescere corna.

But, what is much more curious, the delicate process of budding was as scientifically performed at that period as by the most skilful gardener of the present century. Nothing can be more precise than the following elegant description of Roman budding: —

> Nec modus inserere, atque oculos imponere simplex.
> Nam quà se medio trudunt de cortice gemmæ,
> Et tenues rumpunt tunicas, angustus in ipso
> Fit nodo sinus, huc alienæ ex arbore germen
> Includunt, udoque docent molescere libro.

Again of crown grafting: —

> Aut rursum enodes trunci resecantur, et alte
> Finditur in solidum cuneis via; deinde feraces
> Plantæ immittuntur; nec longum tempus et ingens
> Exit ad cœlum ramis felicibus arbos,
> Miraturque novas frondes et non sua poma.

A cessation of all philosophical inquiry into the nature of vegetation endured about 1700 years, during the whole of which time scarcely a single addition was made to the stock of knowledge left behind him by Theophrastus. But with the revival of letters a new direction was given to researches in natural history. Men ceased to content themselves with blindly copying the writers of antiquity, and set themselves in earnest to examine the objects of nature that surrounded them. The woods, the plains, the rivers, the ocean, the valleys, and the mountains, were investigated with an ardour that soon made amends for ancient indifference. The first consequence of this was a discovery of the worthlessness of the greater part of those writers to whom the world had so long been bound in servile obedience. The spirit of inquiry once excited, men speedily learned to estimate rightly the greater value of facts than of assertions; one discovery produced another, and in a few years a new foundation was laid of that imperfect but beautiful science which constitutes modern botany. In the early part of the sixteenth century, John Manardi, a native of Ferrara, described the real nature of the anther. He was followed by a long train of writers of various merit, who at first indeed applied themselves exclusively to the collection of new species, but subsequently to an examination of the physiological characters of plants, and to the laws applied by nature to the government of the vegetable kingdom.

Up to the middle of the seventeenth century, vegetable physiology had been grounded upon observations entirely independent of anatomical investigation. But about this time the accurate inquiries of two naturalists, one an Englishman and the other an Italian, gave a new feature to the study; and what was vague or imaginary in the opinions entertained upon the vital functions of vegetables gave way to conclusions precise, and supported upon the firm basis of careful observation. The nature of cellular tissue, of spiral vessels, of ducts, of woody tissue; the composition of the internal parts of plants, and the functions of the whole — excited inquiry, and received reasonable if not accurate explanations. Collections of facts and of ideas accumulated on all hands, and the confusion that had once been caused by ignorance threatened again to overwhelm the science, in consequence of the rapid addition of new matter which

there was no means of keeping in order. Hence *systematists* sprung up; a race of inquirers to whose labours the present advanced state of botany is no doubt much to be ascribed. That the efforts of the earliest of these writers should have proved unsuccessful, will excite no surprise: with little knowledge of vegetable physiology or anatomy, for it must not be forgotten that for a long time, and even now, vegetable physiology and systematic botany were considered as distinct sciences, and with scarcely any notion of the laws of affinity and metamorphosis, they could not be expected to succeed. We should rather wonder at what they did, than at what they omitted to do. Many of them had great merit, especially John Ray, an English deprived clergyman, and Joseph Pitton de Tournefort, a professor of botany at Paris, who flourished in the end of the seventeenth century, and upon whose systems the modern arrangement according to natural orders is essentially founded. This, however, and all others, was for a time eclipsed by another, better adapted to the circumstances of the times, and emanating from a writer who, having the courage and talent to carry reformation into every branch of natural history, imparted a lustre to his peculiar system of classification which has only now, after the lapse of a century, fallen into disuse among men of science.

Charles Linné, or Linnæus, as he is usually called, was a person exactly adapted to the science of the time in which he lived. The various departments of natural history had not at that time any thing like their present extensive range, and might without difficulty be investigated by a single naturalist They were all equally in need of revision and improvement; they all wanted a settled code of laws to reconcile the fluctuating and jarring opinions which at that time prevailed, and above all things the nomenclature of natural history required to be reduced to one uniform standard. For this Linnæus was peculiarly well adapted. Nature had gifted him with a logical accuracy of reasoning, and a neatness and perspicuity of expression, which carried with them a charm that the world was not slow to appreciate; and these produced the stronger impression, because naturalists had previously been but little accustomed to them. The opinions of Linnæus were received as if oracular, and their faults were lost in the splendour which they threw over the whole of the organic world. But unfortunately Linnæus knew nothing of vegetable physiology. His opinions upon this subject are among the most worthless which are recorded in the history of science, and consequently his writings lost much of the permanent value which the originality of his ideas and the acuteness of his perception would have otherwise insured them. But notwithstanding this defect, he not only established his famous method of arrangement, which for a long time susperseded all others, but laid the foundation, although upon imaginary principles, of the curious laws of morphology, upon which modern botany founds one of its greatest claims to perfection. The notion that all the parts of plants are mere modifications of leaves, faintly shadowed forth by Linnæus in his *Species Plantarum*, became the subject of a special and most original dissertation by the German poet Göthe, in 1790. This doctrine was believed by the botanists of that day to be worthy only of the poetical fame of its illustrious author; but he lived to see his opinions received, almost without change, by every botanist of reputation.

After the artificial system of Linnæus followed the natural system of Jussieu. Vegetable anatomy became an important branch of inquiry in the hands of Kieser; the researches of Knight and others gave a new character to vegetable physiology; and the early part of the present century has seen the science by these and other means assume an entirely new appearance. Our knowledge of the vital functions of plants reposes upon the sure basis of exact observation and careful experiments; the theory of the plan upon which the organs of vegetation and fructification are severally combined into so many numerous forms is settled upon the clearest evidence; and classifications, to a great degree freed from the trammels of prejudice or narrow views, have assumed that position in science to which their importance, when rightly studied, entitles them.

The only two botanical arrangements now in use are the Linnæan and the Natural. The former is an attempt at classifying plants according to their agreement in some single characters, without reference to their resemblances or differences in any other respect, just as words are arranged in a dictionary by the accordance of their initial letters; the other is a scheme for placing next each other all those plants which have the greatest resemblance, and at the greatest distance those which are most dissimilar. To effect this, every kind of structure that plants possess is made use of; distinctions derived from great physiological peculiarities are considered fundamental, and form classes; subordinate to them are characters derived from diversities of external structure, and they are valued according to their permanence or frequency, &c. The final result being the making up of the vegetable kingdom into associations, called natural orders, which are supposed to consist of genera more closely allied to each other than to any thing else. For an explanation of the details of these two kinds of classification the reader is referred to the separate works that have been published on the subject; space can be given in this place only to a very general account of them.

The sexual system of Linnæus depends upon the number and relative position or degree of combination of the stamens and styles. It has been so often explained, and is so rapidly falling into disuse, that we shall content ourselves with the shortest possible description of the classes and orders.

| | | |
|---|---|---|
| Class I. | Stamen 1 | Monandria. |
| II. | Stamens 2 | Diandria. |
| III. | Stamens 3 | Triandria. |
| IV. | Stamens 4 | Tetrandria. |
| V. | Stamens 5 | Pentandria. |
| VI. | Stamens 6 | Hexandria. |
| VII. | Stamens 7 | Heptandria. |
| VIII. | Stamens 8 | Octandria. |
| IX. | Stamens 9 | Enneandria. |
| X. | Stamens 10 | Decandria. |
| XI. | Stamens 12—19 | Dodecandria. |
| XII. | Stamens 20 or more, inserted into the calyx | Icosandria. |
| XIII. | Stamens 20 or more, inserted into the receptacle | Polyandria. |
| XIV. | Stamens 2 long and 2 short | Didynamia. |
| XV | Stamens 4 long and 2 short | Tetradynamia |
| XVI. | Stamens united by their filaments into a tube | Monadelphia. |
| XVII. | Stamens united by their filaments into two parcels | Diadelphia. |
| XVIII. | Stamens united by their filaments into several parcels | Polyadelphia. |
| XIX. | Stamens united by their anthers into a tube | Syngenesia. |
| XX. | Stamens united with the pistil | Gynandria. |
| XXI. | Stamens and pistils in separate flowers, but both growing on the same plant | Monœcia. |
| XXII. | Stamens and pistils not only in separate flowers, but those flowers situated upon two different plants | Dioecia. |
| XXIII. | Stamens and pistils separate in some flowers, united in others, either on the same plant, or two or three different ones | Polygamia. |
| XXIV. | Stamens and pistils either not ascertained, or not to be discovered with any certainty, insomuch that the plants cannot be referred to any of the foregoing classes | Cryptogamia. |

The characters of the orders depend upon the number of the styles, or of the stigmas, if there be no style, in the first thirteen classes, such are accordingly named, —

| | |
|---|---|
| Monogynia | style 1 |
| Digynia | 2 |
| Trigynia | 3 |
| Tetragynia | 4 |
| Pentagynia | 5 |
| Hexagynia | 6 |
| Heptagynia | 7 |
| Octogynia | 8 |
| Enneagynia | 9 |
| Decagynia | 10 |
| Dodecagynia | 12 |
| Polygynia | more than 12. |

In the 14th class, Didynamia, the orders depend upon the nature of the ovary. In *Gymnosperma*, the first order, the ovary is divided into four lobes, from the base of which proceeds a single style, and within each of which is contained a single seed. In *Angiosperma*, the 2nd order, the ovary is not lobed, and is usually two-celled, and many-seeded.

In the 15th class, Tetradynamia, the orders are characterized by the form of the fruit: *Siliquosæ* have a long pod, *Siliculosæ* have a short one.

The orders of the 16th, 17th, and 18th classes, Monadelphia, Diadelphia, and Polyadelphia, depend upon the number of the stamens, and have the same nomenclature as the thirteen first classes.

The orders of Syngenesia are determined by the ar-

rangement of their flowers, and by the sex of their florets: thus—

*Polygamia* has flowers crowded together in heads.

1. *Polygamia æqualis* has each floret hermaphrodite, or furnished with perfect stamens and pistil.
2. *Polygamia superflua* has the florets of the disk hermaphrodite; those of the ray female only.
3. *Polygamia frustranea* has the florets of the disk hermaphrodite; those of the ray sterile.
4. *Polygamia necessaria* has the florets of the disk male, of the ray female.
5. *Polygamia segregata* "has several florets, either simple or compound, but with a proper calyx, included within one common calyx."

*Monogamia* has the flowers separate, not crowded in heads. This order is generally abolished by Linnæan botanists, but for no good reason.

The orders of the 20th, 21st, and 22nd classes are distinguished by the number, &c of the stamens.

The two orders of the 23rd class depend upon whether the genera are monœcious or dicœcious

The last class, *Cryptogamia*, is divided into orders according to the principles of the natural system, namely, 1. Filices; 2. Musci, 3. Hepaticæ; 4. Algæ; 5. Fungi.

With regard to the natural system of botany, that formed by Jussieu out of the views of Ray, Tournefort, and others, in combination with very numerous observations of his own, is the basis of what is at present understood by that name. It has, however, been much modified by succeeding systematists, and will undoubtedly undergo many more changes in its details. The view taken of the subject by De Candolle, the learned professor at Geneva, is thus stated by himself —"I have established in my *Theorie Elementaire*, that the proof of a classification of plants being natural is furnished when similar results are arrived at, whether from considerations drawn from the *reproductive* organs or from those of *vegetation*. Considered with reference to the organs of reproduction (or fructification), the vegetable kingdom has been divided by Linnæus into two grand series, the *Phanerogamous* and the *Cryptogamous*. These series are not merely distinguished because in the first the sexual organs are visible to the naked eye, and in the latter are microscopical. Such a difference, which might depend only upon the absolute size of the organs, could be in itself of little moment, but it is connected with a real difference of structure. Phanerogamous plants have their organs of fructification arranged upon a more or less symmetrical plan, and surrounded by integuments themselves also arranged symmetrically. Cryptogamous plants have the sexual organs disposed without order, and surrounded by integuments scarcely perceptible, and still more disorderly, or they have no sexual organs that have been proved to be so."

Phanerogamous plants have long been divided into *Dicotyledons*, or plants whose embryos present cotyledons opposite or verticillate upon the same plane, and whose minimum is consequently 2, and into *Monocotyledons*, whose cotyledons or earliest leaves are alternate, so that the minimum is 1, or that the first, when there are two, is more particularly intended to nourish the young plant.

Cryptogamous plants should in like manner be divided into two classes, the Ætheogamous and the Amphigamous. For the first I take the name of *Ætheogamous*, invented by Beauvois, but limiting its application. This term, which signifies plants with unusual fructification, suits well enough the class here indicated, and which is characterized by having sexual organs distinct and visible under the microscope, but formed upon a plan totally different from that of Phanerogamous plants; such are Equisetaceæ, Ferns, Lycopodiaceæ, Mosses, and Hepaticæ. I give the second class the name of *Amphigamæ*, to indicate the doubtful nature of their fructification; some authors have called them Agamæ but that is, I think, to assert more than is quite certain. The character of Amphigamæ is to present to view no sexual organ, even under the microscope; but we cannot affirm that the spores that they produce have not received a sort of impregnation in the very cells which generated them. It is for the sake of expressing this doubt that I employ the word Amphigamæ. Thus with respect to their organs of reproduction, plants are clearly divided into four great classes. Let us next examine them with reference to their organs of vegetation. The first division that may be established is deduced from the absence or presence of vessels; and in this view I separate plants into two series — the *vascular*, which have vessels and stomates manifest during their whole life; and *cellular*, or those which consist of nothing but cellules either throughout their life or in their first foliaceous organs. Vascular plants are divided into *Exogens*, of which the wood increases by the addition of new layers placed on the outside of the older; and *Endogens*, whose trunk increases by the addition of new fibres to the centre of the cylinder already formed. Cellular plants, in like manner, are subdivided into *semi-vascular* and *cellular*. Under the first of these names I comprehend the orders which grow with leafy cotyledons, but composed of cellular tissue only, and destitute of stomates. Eventually they assume organs in which vessels and stomates exist: this development, which gives them some resemblance to Endogens, takes place rapidly in Equisetaceæ, Ferns, and Lycopodiaceæ; and the observations of anatomists have shown that the same thing occurs, but later and less perfectly, in Mosses and Hepaticæ; so that it is a matter of some doubt whether they ought to be referred to the semi-vascular or succeeding class. *Cellular* plants have long been known to be destitute of both vessels and stomates, and to present only a homogeneous mass, where the distinction of stem, leaves, and roots can only be established analogically.

Looking back at this explanation, it is obvious that the vegetable kingdom may be represented by the following table.

| *Divisions formed by the Organs of Fructification.* | | *Divisions formed by the Organs of Nutrition.* |
|---|---|---|
| I. Phanerogamous, | *or* | Vascular. |
| Class 1. Dicotyledons, | *or* | Exogens. |
| 2. Monocotyledons, | *or* | Endogens. |
| II. Cryptogamous, | *or* | Cellular. |
| 3. Ætheogamous, | *or* | Semivascular. |
| 4. Amphigamous, | *or* | Cellular. |

Or, if it is preferred, in this other form, which is almost equally regular:—

| | | |
|---|---|---|
| I. Sexual, being furnished with sexual organs, | *or* | Having vessels and stomates at some period of their existence. |
| Class 1. Dicotyledons, | *or* | Exogens. |
| 2. Monocotyledons, | *or* | Endogens. |
| 3. Ætheogamous, | *or* | Semivascular. |
| II. Without distinct sexes, | *or* | Without either vessels or stomates at any age |
| 4 Amphigamous, | *or* | Cellular. |

But notwithstanding the apparent clearness of this system, and the importance of the arguments upon which it is founded, it is far from being unobjectionable. In the first place, the distinction drawn between the two classes of Cryptogamic plants is unfounded, both as regards the presence or absence of both vessels and sexes. Ferns and Lycopodiaceæ, in which the vascular system is most developed, have no more trace of sexes than Fungi; and on the other hand, in Mosses and Hepaticæ, in which there is the most distinct formation of something analogous to sexes, there is no trace whatever of a vascular system. The difference, then, between Amphigamæ and [illegible] falls to the ground, and in fact is analogically bad, for there are vascular and cellular orders in both the great classes of Exogens and Endogens, which ought therefore themselves to be subdivided into vascular and cellular, in order to form a consistent system; and this difference appears to be connected with a very general tendency, visible in the vegetable kingdom, to produce an impoverished or degraded condition of all great types of structure. Thus, among Exogens, Onagraceæ are merely cellular in Hippuris and Myriophyllum, Urticaceæ in Ceratophylleæ, and the orders Callitrichaceæ and Podostemaceæ are other instances of the same fact, and, in Endogens, Naiadaceæ and Pistiaceæ, or at least Lemna, are as completely cellular as Algaceæ.

In the next place, circumstances of greater importance are omitted by M De Candolle from his statement than some of those included in it. If Cryptogamic are to be separated from Phanerogamous plants by their vegetation, it is rather by their manner of growth than by any peculiarity in their vascular system. Phanerogamous plants might be called *Pleurogens*, from their growing by the sides as well as at the ends, thus increasing symmetrically both in length, density, and thickness. Cryptogamous plants grow either by simple elongation, without increasing materially in density, or they expand irregularly in all directions, and hence have been termed *Acrogens*. No circumstance can well be more important than the manner in which impregnation takes place. In common Exogens there is an ovarian covering, through the tapering apex of which, called style, impregnation takes effect by aid of a part called the stigma; but in other Exogens impregnation is effected by direct contact between the egg or ovule and the pollen; and a simple mode of veining in the leaves, together with a very small development of the vascular system, accompany this. Hence such plants, called *Gymnosperms*, ought to be regarded as a class of as much importance as Exogens themselves. Again, among plants in some respects participating in the organization of Endogens are species called *Rhizanths*, having a fungoid vegetation, a nearly total absence of the vascular system, and a most remarkable method of propagation. With the ordinary sexes of Endogens they are said to combine the spores of Cryptogamic plants, and thus

hold a sort of middle station between the two great series of plants recognised by Linnæus. Such a kind of vegetation is far too important to be omitted from consideration in determining the classes, as the fundamental divisions of the vegetable kingdom are termed.

For these reasons the writer of the present notice has proposed a material modification of De Candolle's statement, which may be expressed as follows.

| | | PLANTS, |
|---|---|---|
| *According to their Fructification.* | | *According to their Vegetation.* |
| I. Having flowers and sexes (Phanerogamous), | *or* | I. Their axis increasing symmetrically in density and breadth as well as length (Pleurogens). |
| *a.* Minimum of cotyledons 2, | *or* | *a.* Stem in concentric layers (Exogens). |
| Class 1. *Dicotyledons*, | *or* | *Veins of leaves netted.* |
| Class 2. *Gymnosperms*, | *or* | *Veins of leaves netted or forked.* |
| *b.* Minimum of cotyledons 1, | *or* | *b.* Stem a confused mass of wood and cellular tissue. |
| Class 3. *Monocotyledons*, | *or* | *Veins of leaves parallel, and not netted.* |
| *c* Acotyledons, | *or* | *c.* Vegetation fungoid. |
| Class 4. *Rhizanths.* | | Class 4. *Rhizanths.* |
| II. Having neither flowers nor sexes, | *or* | II. Their axis increasing by simple elongation or irregular expansion. |
| Class 5. *Cryptogamic plants*, | *or* | Class 5. *Acrogens.* |

For the details of this system the reader is referred to the *Natural System of Botany*, 2nd ed.

BOTA'NIC GARDEN. A garden devoted to the culture of a collection of plants, with reference to the science of botany The legitimate object of gardens of this description appears to be to collect and cultivate, at the public expence, all the species and varieties of plants that can be cultivated in the given climate, with or without the aid of glass; and then to distribute these to private individuals throughout the district by which the botanic garden is supported. The most complete system of this kind ever established appears to have been that of France soon after the revolution. All the botanical articles that could be procured from other countries were sent to the botanic garden at Paris; and after they had borne seeds or been propagated there, the progeny was distributed among the provincial botanic gardens, of which there is one or more in every department After being propagated in the provincial botanic gardens, the seeds or progeny were given out, free of expence, to whoever in the district to which the garden belonged thought fit to apply for them. As the useful species and varieties were as much attended to in these gardens as those which were cultivated only in a scientific point of view, the greatest facilities were thus given to the spread of every useful grain, pulse, culinary vegetable, and fruit, over the whole of France. Something of the same kind may be considered as taking place in Great Britain; but it is more the effect of accident than the result of design, as the giving out of plants is not considered in Britain as an essential part of the system of management of a royal or government botanic garden.

BO'TANY BAY RESIN. A yellow aromatic resin which exudes from the trunk of the *Acarois resinifera* of New Holland.

BOTRYLLA'RIANS, BOTRYLARIÆ. (Gr *βοτρυς, a bunch of grapes.*) In Zoology, a family of singular compound Tunicaries or Ascidians, in which several distinct individuals are arranged in a circle round a central aperture common to the rectum of each, while the mouths are distinct and placed at the circumference.

BOTRYO'IDAL. (Gr. *βοτρυς, a bunch of grapes; ειδος, like.*) When a part is clustered like a bunch of grapes.

BO'TRYOLI'TE. (Gr. *βοτρυς, a cluster of grapes; λιθος, stone.*) Botryoidal silicious borate of lime.

BO'TTOM HEAT. A term applied in Horticulture to the temperature communicated to certain soils by fermenting and decomposing substances placed underneath them: leaves, fresh dung, and the refuse bark of the tan-yard, are often used for this purpose; and the system is applied to pine-apples, melons, cucumbers, and other plants grown in pits or frames.

BOTTOM RAIL. (Sax. botm.) In Architecture, a term used for denoting the lowest horizontal rail of a framed door.

BO'TTOMRY. In Commercial Law, is in effect a mortgage of a ship, being an agreement entered into by an owner or his agent, whereby, in consideration of a sum of money advanced for the use of the ship, the borrower undertakes to repay the same, with interest, if the ship terminate her voyage successfully; and binds or hypothecates the ship for the performance of the contract The instrument by which this contract is effected is sometimes in the shape of a deed poll, and sometimes in that of a bond. On bottomry contracts the lender runs the risk of the voyage, and in consideration of the risk the interest he may take is unlimited. The master has authority to hypothecate a ship or its freight (*see* RESPONDENTIA) at a foreign port, in case of necessity, for the purposes of the voyage. In such case, if the loan be not repaid within the time prescribed, the agent of the lenders applies to the Court of Admiralty, with certain affidavits, and procures authority to arrest the ship, which may be sold, if necessary, under the authority of the court. Where several loans of this description have been made on the same voyage, the last lender is entitled to priority of payment out of the proceeds of the sale.

BOU'DOIR. (Fr. bouder, *to pout.*) In Architecture, a small room or cabinet, usually near the bed-chamber and dressing room, for the private retirement of the master or mistress of the house.

BOU'GET, WATER-BUDGET, or DOSSER. In Heraldry, a bearing supposed to represent a vessel for carrying water

BOU'LTIN. (Fr.) In Architecture, a name given to a moulding whose section is nearly a quadrant of a circle, whose diameter being horizontal, the contour is convex in respect of a vertical to such diameter. It is more usually called the egg or quarter round.

BOU'NTY. In Commerce and the Arts, a premium paid by government to the producers, exporters, or importers of certain articles, or to those who employ ships in certain trades, when the profits resulting from these respective branches of industry are alleged to be insufficient Bounties on *production* are usually given in the view of encouraging the establishment of some new branch of industry, or of fostering and extending a branch that is believed to be of paramount importance. Bounties on *exportation* and *importation* are granted to the exporters of certain British commodities on their taking oath, or in some cases giving bond, not to reland the same in England. Public opinion was formerly very divided as to the advantage of granting bounties; but at present the impolicy of such a practice appears to be almost universally admitted. For it will be found that in all old settled and wealthy countries, numbers of individuals are always ready to embark in every new undertaking, if it promise to be really advantageous, without any stimulus from government, and if a branch of industry already established be really important and suitable for the country, it will assuredly be prosecuted to the necessary extent without any encouragement beyond the natural demand for its produce. For further details upon this subject, see M'Culloch's *Com. Dict.*

BOU'NTY, QUEEN ANNE'S. The produce of the first fruits and tenths due to the crown (*see* art FIRST FRUITS), which were made over by Queen Anne to a corporation established in the year 1704 for the purpose of augmenting poor livings under 50*l.* a year.

BOUSTROPHE'DON. (Gr. *βους, an ox; στρεφω, I turn*) A word descriptive of a mode of writing common among the early Greeks until nearly the middle of the fifth century before Christ; *viz.* in alternate lines from right to left and from left to right, as fields are ploughed in furrows having an alternate direction, from whence the derivation. *See* ALPHABET.

BOUT. In Agriculture, is one turn or course of a plough in plou[illegible] a ridge.

BO'VEY COAL. A species of bituminous wood found at Bovey Hayfield, near Exeter.

BOW. An ancient weapon of offence, made of wood, horn, steel, or some other elastic substance, by which arrows are thrown. The force with which the arrow is propelled is proportioned to that with which the bow is bent, and to the quickness with which it recovers its former position.

BOW or BAY WINDOW. (Sax. boga, *a bow.*) In Architecture, a window projecting from the general face of a building, of a curved or polygonal form on the plan.

BO'WLDERS. Rounded masses of stone lying upon the surface, or loosely imbedded in the soil.

BO'WLINE. A rope from near the middle of the weather edge or leech of a sail, leading forward. Its use is to keep the leech forward, that the wind may get at the after side of the sail when very oblique to its direction.

BOWS. The two sides of the fore extremity of a vessel, as the starboard and larboard bows.

BO'WSPRIT. In Naval Architecture, is a kind of mast which rests slopewise on the head of the main stern, having its lower end fastened to the partners of the fore mast. It carries the sprit-sail, sprit top-sail, and jack-staff. It is exposed to violent action, especially from being struck by heavy seas, into which the ship, in plunging, dips it; and though very firmly secured by the bob-stays and side ropes called *shrouds*, is very often *carried away* or *sprung*.

BOX. (Πυξος, the Greek name of the plant.) The hard

compact wood of *Buxus sempervirens*, so much used by wood engravers, and for the turner's purposes. This evergreen bush or small tree is found all over Europe, even upon the chalk hills of England; but it acquires its largest dimensions in the south. It is from Turkey that the principal part of the wood is imported into England, formerly at a duty of 5*l.* a ton: whether or not all this is really furnished by *Buxus sempervirens* is not known. It is not improbable that *Buxus balearica*, a larger species, too tender to thrive in this country, may furnish a part at least of that which comes from the Mediterranean. It is said that the wood of this species is coarser and of a brighter yellow than that of the common species. The box plant is best known for its use in gardens as edging to borders; the kind so employed is a dwarf variety of *Buxus sempervirens*.

BOX DRAIN. An underground drain, regularly built with upright sides and a flat stone or brick cover, so that the close section has the appearance of a square box.

BOX HAULING. In Navigation, is bringing a ship when close-hauled round upon the other tack, when she refuses to tack and there is not room to wear. By throwing the head sails aback she gets sternway; the helm thereupon being put a-lee, the ship's head falls rapidly off from the wind, which she soon brings aft, she is then speedily rounded-to with but little loss of ground.

BO'XING OFF. Throwing the head sails aback to force the ship's head rapidly off the wind.

BO'XING THE COMPASS. Repeating the points in order

BO'XINGS. *See* LINING.

BRA'CCATE. (Bracca, *breeches.*) In Ornithology, when the feet are concealed by long feathers descending from the tibiæ.

BRACE. In Sea language, a rope fastened to the extremity of the yard, for the purpose of traversing the sails when it is necessary to change their position

BRACE. (Fr. embrasser, *to embrace*) In Architecture, an inclined piece of timber used in trussed partitions and in framed roofs, in order to form a triangle by which the assemblage of pieces composing the framing is stiffened. If a brace is used to support a rafter, it is called a strut. When braces are used in roofs and partitions they should be disposed in pairs, and introduced in opposite directions.

BRACE. (Fr. embrasser, *to embrace*) In Music, the line or bracket at the beginning of each set of staves which ties them together in a vertical direction.

BRACHALY'TRA. (Gr. βραχυς, *short*, ελυτρον, *sheath.*) The name of an extensive group of Coleopterous insects, including all such as have the elytra so short as not to exceed one third the length of the abdomen. To this section belongs the well-known species called the devil's coach-horse (*Staphylinus olens*).

BRA'CHIAL. (Lat brachium, *the arm.*) Belonging to the arm; as brachial nerves, vessels, &c.

BRACHI'NUS. A genus of Coleopterous insects, now the type of a family (*Brachinidæ*), including those singular beetles which from their defensive anal explosions are termed "bombardiers." Of these there are five British species, the best known of which is the *Brachinus crepitans* of Linnæus.

BRA'CHIOMIS. The name given by Muller to a genus of Rotiferous Infusorial Animalcules, now subdivided into many distinct genera.

BRA'CHIOPODS, BRACHIOPODA. (Gr. βραχιον, *an arm*; πους, *a foot.*) An order of Acephalous or headless bivalve Mollusks, characterized by having the mantle organized so as to be serviceable for respiration, and by having two long fleshy, ciliated, spiral arms, or labiate processes; whence Cuvier conceived the name, which in his system designates a distinct class of Acephala. *See* PALLIOBRANCHIATES.

BRA'CHIUM. (Lat.) In Mammalogy, is restricted to the second segment of the anterior extremity, which is articulated proximally with the scapula, and distally with the antibrachium. In Entomology, signifies the first pair of legs of Hexapods, the direction of which is usually towards the head.

BRA'CHYCATALECTIC. (Gr. βραχυς, *short*, and καταληκτικος, *deficient.*) A verse wanting two syllables to complete its length (in Greek and Latin poetry).

BRACHY'GRAPHY. (Gr βραχυς, *short*, and γραφω, *I write.*) The art of writing by abbreviations. (*See* TACHYGRAPHY.) The notæ Tironianæ, among the Romans, were a species of short-hand invented by one Tiro, a freedman of Cicero.

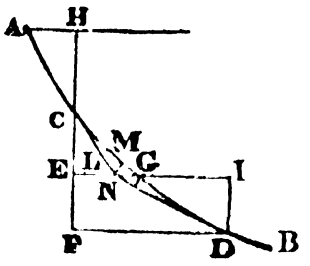
BRACHY'PTEROUS. (Gr. βραχυς, *short*; πτερον, *a wing.*) In Ornithology, when the folded wings of a bird do not reach to the base of the tail.

BRACHY'STOCHRONE. (Gr. βραχυς, *short*, and χρονος, *time.*) The name given by John Bernoulli to the curve which possesses this property, that a body setting out from a given point A, and impelled merely by the force of gravity, will arrive at another point B in a shorter time by moving in this curve, than if it followed any other direction. The problem of the *brachystochrone* is famous in the history of the new geometry It was first proposed by John Bernoulli in the Leipsic *Acta Eruditorum* for June 1696, in the following terms: —

"Two points, A and B, being given in the same vertical plane; it is required to assign the path through which a body descending by its own gravity, and beginning to move from the point A, will arrive at B in the least time possible."

According to the fashion of that age, it was proposed as a challenge to other mathematicians, *ad cujus solutionem mathematici invitantur*, with the declaration that if no one announced the nature of the curve before the end of the year, he himself would make it known. The time was subsequently extended to a year, within which solutions appeared by Newton, James Bernoulli (the celebrated brother of the proposer), and the Marquis de l'Hopital. From reflecting on this problem, James Bernoulli was led to the discovery and solution of a kindred but much more difficult class of questions; namely, those relating to isoperimetrical figures, the investigation of which required a different kind of analysis from that with which mathematicians were yet acquainted. One of these he proposed in his turn as a challenge to his brother John; and some mistakes into which the latter fell in the solution of it became the occasion of an angry quarrel between the illustrious brothers, which unfortunately was never healed. The prosecution of a similar speculation afterwards led Lagrange to one of the most important theories in the higher mathematics — the *Calculus of Variations*.

The following is the solution of the problem of the *brachystochrone* given by James Bernoulli (*Opera*, p 768) Let A be the point from which the body is to move, B that to which it is to go, and A C D B the path it follows, which by hypothesis is wholly situated in the same plane. It is not necessary, however, that the plane be vertical. Take any small portion of the curve C D, then it is obvious that if A B be the path through which the body will descend from A to B in the least time possible, it must also pass from C to D in a shorter time than if it followed any other direction. For suppose it to pass from C to D by another path, C L N D, in shorter time than by C M G D, then it must also pass from A to B in shorter time through A C L N D than through A C M G D, which is contrary to the hypothesis. This being premised, let A H be drawn horizontally through A, C H perpendicular and D F parallel to A H through the points C and D; also let C F be divided into two equal parts in E, and complete the parallelogram E F D I; the object is to find the point G in the straight line E I, or (which comes to the same thing) the inclination of the two elements of the curve C G and G D to each other, so that the time of descent through C G + time of descent through G D (which may be thus denoted, t C G + t G D) may be a minimum For this purpose assume another point L in E I, so that G L may be regarded as infinitely small in comparison of E G; and having drawn C L and D L, let L M and G N be respectively perpendicular to C G and D L. Now, variable quantities when they are infinitely near their maxima or minima, may be regarded as constant; therefore t C L + t L D = t C G + t G D, and consequently t C G − t C L = t L D − t G D. By the theory of the descent of heavy bodies,




$$CE \cdot CG = tCE : tCG,$$

and $CE : CL = tCE : tCL$;

therefore,

$$CE : CG - CL \text{ (or } MG) = tCE : tCG - tCL.$$

But by similar triangles,

$$MG : GL = EG : CG;$$

therefore, combining the two last proportions,

(1) $CE : GL = EG \times tCE : CG \times (tCG - tCL)$.

In like manner,

$$EF : GD = tEF : tGD$$

$$EF : LD = tEF : tLD;$$

therefore,

$$EF : LD - GD \text{ (or } LN) = tEF : tLD - tGD.$$

But $LN : GL = GI : GD$;

therefore,

(2) $EF$ (or $CE$) $: GL = GI \times tEF : GD \times (tLD - tGD)$.

From the two analogies (1) and (2), we have now $EG \times tCE : CG \times (tCG - tCL) = GI \times tEF : GD \times (tLD - tGD)$; or, $EG \times tCE : GI \times tEF = CG \times (tCG - tCL) : GD \times (tLD - tGD)$. But it was proved that $tCG - tCL = tLD - tGD$; and by the laws of falling bodies, t C E is reciprocally proportional to $\sqrt{HC}$, and t E F reciprocally as $\sqrt{HE}$; therefore by substitution,

$$\frac{EG}{\sqrt{HC}} : \frac{GI}{\sqrt{HE}} = CG : GD,$$

a known property of the common cycloid; which, there-

fore, is the brachystochrone, or curve of quickest descent. In the modern analysis the investigation of the brachystochrone is usually proposed as an example of the method of *Variations*.

BRA'CHYURES, BRA'CHYU'RA. (Gr. βραχυς, *short*, and ουρα, *a tail*.) A tribe of Decapodous Crustacea, in which the tail or post-abdomen is short, and folded beneath the trunk; commonly called "crabs."

BRA'CKET. (From brachetto, Ital.) In Architecture, a projecting piece for carrying a superincumbent weight. In large cornices executed in plaster the series of projecting pieces to which the laths are nailed is called bracketing.

BRA'CON. A Fabrician genus of Hymenopterous insects of the parasitic tribe of Pupivorous Ichneumons: it is now the type of a family (*Braconidæ*), distinguished from the true Ichneumons by having the maxillary palps five-jointed, and the labial ones either three or four-jointed, and by wanting the internal discoidal cell of the upper wings. The genera of this family are *Bracon* proper; *Aphidius*, the species of which prey upon the plant-lice; *Stephanus*, *Cœlinius*, *Spathius*, *Perilitus*, *Hybrizon*, *Leiophron*, *Agathis*, *Microdus*, *Hormius*, *Ichneutes*, *Microgaster*, and *Blacus*.

BRACT. An altered leaf, which is placed at the base of a flower on the outside of the calyx. It is the first attempt made by the common leaves to change into the floral organs. In general the bract is small and inconspicuous, but it occasionally acquires a considerable size and a brilliant colour, as in *Salvia comosa* and *splendens*, and the Brazilian pine-apple, and more especially in the various kinds of Arum, where it constitutes the large enveloping leaf, called spath, in which the spadix of those extraordinary plants is enveloped. This word forms the adjectives *bractiscent*, assuming the appearance of a bract, *bractial*, furnished with bracts; *bractiolate*, having little bracts. A cupule is a collection of bracts united into a cup; an involucre is the same organs arranged in a whorl. The flowers of grasses and cyperaceous plants consist of nothing but little bracts called *palæ* and *glumes*.

BRA'DYPODS, BRADY'PODA. (Gr. βραδυς, *slow*, πους, *foot; slow-footed*.) A family of Macronyhous or Edentate Mammals, including the two-toed and three-toed sloths.

BRA'HMANS. (Βραχμανος among the Greeks, *Brâhman* in the Indian dialects, and *Bramin* among the Europeans.) The first or highest of the four castes of Hindoos, said to have proceeded from the mouth of Brahm (the seat of wisdom). They form the learned or sacerdotal class; and its members have maintained a more extensive sway than the priests of any other nation. Their chief privileges consist in reading the Veda or sacred volume, in instituting sacrifices, in imparting religious instruction, in asking alms, and in exemption from capital punishment. The whole life of the Brahmans is devoted to the study of the sacred writings, and is divided into four periods. The first begins at the age of seven, when the duty of the young novitiate consists in learning to read and write, in studying the Veda, and in familiarising himself with the privileges of his order. In the second stage of a Brahman's life he is allowed to marry, and to engage in commercial speculations. In the third stage, his religious duties become more numerous, and must be rigidly performed. But in the fourth period, the Brahman is admitted to personal communication with the Deity, and this stage is reckoned so pre-eminently holy, that in a single generation it imparts a greater stock of religious importance than is attainable by any other means in a thousand years. (*Menou's Institut.*) The origin of the Brahmans is merged in obscurity. While some ancient writers regard them as a branch of the old Gymnosophists (*Str. Geo.* t. ii. p. 1038.), Diodorus Siculus maintains that they are of much earlier origin. According to the accounts of the best Jewish writers, adopted by Shorestani (an Arabian author of great repute), and sanctioned by the authority of the learned Dr. Hyde (*De Rel. Vet. Persarum*, 31, 32), the progenitor of the Brahmans was the patriarch Abraham, who in their language is styled Brachman or Brahman. But whatever may have been the origin of the Brahmans, it is certain that the whole learning of India was for ages in their hands. Many of the Grecian sages travelled into India to learn wisdom in that great storehouse of knowledge; and, among others, Pythagoras seems to have borrowed from them the greater part of his mystical philosophy, nay, it is even doubtful whether Aristotle himself did not derive both the materials and the arrangement of his system of logic from the same source. Of ancient Brahminical science the principal remains are their astronomical and trigonometrical methods, both of which have given rise to frequent and learned discussion. Among the modern Brahmans we look in vain for the deep learning that characterized the ancient members of this order; for, with the exception of metaphysical disquisitions, which have always been a favourite study among them, the learning of the present race of Brahmans is exceedingly meagre, being limited almost entirely to the construction of the almanack. Nor is it merely in point of learning that the modern Brahmans have degenerated from their ancestors. Their morals too are wofully deteriorated; and while they are the sole depositaries and ministers of a religion which in point of purity and sublimity of doctrine yields only to the Christian, their conduct is characterized by the most vile and licentious practices; a spirit of avarice, falsehood, and revenge is every where visible; and in many cases superstition and fanaticism have been exchanged for infidelity and atheism. But in spite of these grievous defects, this system maintains its ground, and neither the march of time, the inroads of the conqueror, nor any of the causes that operate in modifying or undermining other institutions, have been able to weaken or subvert the influence of the Brahmans. Whether Great Britain be destined, by the introduction and dissemination of education and Christianity, ultimately to effect what has hitherto baffled every effort, it is not for us to prognosticate; but, assuredly, whatever may be successful in eradicating the Brahminical system, and in substituting in its room a religion whose ministers will practise what they teach, will have achieved the brightest moral triumph in the annals of history. (See *Mill's British India*, *Asiatic Researches*, passim, *Coleman's Hindoo Mythology*, *Sir William Jones's History*.)

BRAIN. The chemical examination of the brain of animals was first undertaken by Vauquelin, who found in the human brain 80 water, 7 albumen, 4·53 white fatty matter, 0·70 red fatty matter, 1·12 osmazome, 1·5 phosphorus; acids, salts, and sulphur, 5·15. An elaborate dissertation upon the composition of brain has more lately been published by M. Couerbe (*Annales de Chim. et Phys.* lvi. 160.) He finds a large proportion of *cholesterine* in it; and asserts, as the result of repeated examinations, that the proportion of phosphorus in the brain of persons of sound intellect is from 2 to 2·5 per cent; in the brain of maniacs it is from 3 to 4·5, and in that of idiots only from 1 to 1·5 per cent.

BRAIN, HUMAN, ANATOMY OF. The brain, or the general mass of nervous matter which occupies the cavity of the skull, constitutes about one thirty-fifth of the weight of the body, it is divided by anatomists into the *cerebrum*, which occupies the whole of the superior part of the cavity of the cranium, the *cerebellum*, which occupies the lower back part, and the *medulla oblongata*, which is the smallest portion, lying at the base of the cranium, beneath the cerebrum and cerebellum, and, passing out of the great foramen of the occipital, becomes as it were the origin of the spinal marrow. The brain is covered by three membranes, two of which are termed *matres*, from the old idea of their giving rise to all the other membranes of the body. The external membrane, more firm than the others, is termed *dura mater*: it is very dense and fibrous, and adheres every where to the inner surface of the cranium, to which it is connected by its vessels, its inner surface is smooth, and it sends off several folds, or *processes*, as they are called, which descend between certain portions of the brain. Of these the principal is the superior longitudinal process, or *falx cerebri*, which descends from the fore to the back part of the skull, between the hemispheres of the brain, from its posterior termination it sends off a layer or expansion, which extends across the back of the skull, and is called the *tentorium*, separating the cerebrum from the cerebellum, from the middle of the tentorium another membranous expansion descends between the lobes of the cerebellum, and terminates at the edge of the great occipital hole, or *foramen magnum*, this is termed the *falx cerebelli*. There are certain spaces or *sinuses* formed in the layers of the dura mater, which perform the office of veins in regard to the blood returning from different parts of the brain, by which any venous pressure upon the substance of the brain is prevented.

When the dura mater is removed, a thin transparent membrane investing the surface and convolutions of the brain is brought to view, which from the delicacy of its texture has been called the *arachnoid* membrane, it is not apparently vascular, and does not pass into the depressions between the convolutions; and it is difficultly separable from the third membrane, or *pia mater*, which is also extremely tender and delicate, but is highly vascular, and from it the blood vessels merge into the substance of the brain, ramifying with great minuteness upon its surface; it lines all the convolutions and cavities of the brain. On removing the upper part of the cranium, and turning aside the dura mater, the brain is seen, divided longitudinally into two ovoid hemispheres, separated, as already stated, by the falx; upon the under side each hemisphere is seen to be divided into three lobes; the two anterior lobes rest upon the orbital plates of the frontal bone; the middle lobes lie upon the fossæ formed by the temporal and sphenoid bones; and the posterior lobes rest upon the tentorium. The superficial convolutions of the brain are divided by clefts of about an inch in depth. On cutting into its substance, the exterior part of the brain appears of a different colour

from the interior, and has been termed the cineritious or cortical substance; it is greyish brown, very soft, and exhibits no appearance of a fibrous texture. Some suppose that it is glandular, and constituted almost entirely of vessels and cellular membrane; it covers the whole of the brain, and is about the tenth of an inch in thickness. The inner substance, termed the white or medullary part of the brain, is of a firmer texture, highly vascular, and when minutely examined appears fibrous, the fibres decussating with each other, and occasionally combining to form commissures.

The *cerebellum*, when viewed from below, is of an elliptical shape, its longest diameter being from side to side, and is divided into two hemispheres separated by the falx cerebelli. In the centre of the upper part of the cerebellum there is a prominence, termed the *vermiform process*, and the whole surface is fissured or sulcated, the pia mater passing between the fissures and conveying vessels to the substance, whilst the arachnoid tunic is merely extended over them.

Such is an outline of the anatomy of the human brain; the details can only be fully understood by reference to illustrative plates upon an adequate scale, which would be incompatible with the plan of this work.

It has been already stated that in man the brain averages in weight 1-35th of the body; it weighs, in fact, about two pounds and a half. In quadrupeds its relative bulk is remarkably smaller, in the dog it averages 1-120th of the weight of the animal; in the horse 1-450th; in the sheep 1-75th, and in the ox 1-800th. This statement has been adduced to show the direct relation between the bulk of the brain and the quantity of mind, the above animals being ranged in the order of their docility and intelligence.

On making a vertical section of either hemisphere of the cerebellum, a central white substance becomes apparent, which ramifies in an arborescent form, and is called *arbor vitæ*; the exterior covering is grey. In front of the cerebellum is a protuberance, termed *pons Varolii* or *tuber annulare*, it is divided by a central groove into two halves, and connected with the cerebrum and cerebellum each by two thick white chords called *crura*: the former, or crura cerebri, pass from the tuber forwards and outwards, under the middle part of each hemisphere, in which they are lost, and the latter, the crura cerebelli, are continued backwards and outwards, and terminate in either hemisphere of the cerebellum. The portion of the brain between the tuber annulare and the foramen of the occipital bone is called the *medulla oblongata*, and is continued into the spinal chord, on its anterior surface are four contiguous projections; the two interior ones are called *corpora pyramidalia*, and the two exterior *corpora olivaria*. On carefully removing the membranes which cover the medulla oblongata, and gently opening its middle groove, several white bands are seen passing obliquely from one side to the other, and mutually interwoven, and are termed the *decussating bands*.

The two sides of the brain are mutually connected by commissures or medullary bands, and those of the cerebellum by the pons varolii. The principal connection of the hemispheres of the cerebrum is by a broad medullary band, called the *corpus callosum*. The occasional intervals which separate the parts of the brain are termed *ventricles*, the largest of which are the two *lateral ventricles* in the interior of each hemisphere; their figure is irregular, and they are separated by a tender layer of cerebral matter termed the *septum lucidum*, they are lined by the pia mater. The *middle* or *third ventricle* is a fissure between two convex eminences, situated at the middle and back of the lateral ventricles, and termed *thalami optici*. The *fourth ventricle*, or *ventricle of the cerebellum*, is a cavity between the cerebrum, the tuber annulare, and the medulla oblongata.

BRAIRD. In the agriculture and gardening of Scotland, the term braird is applied to the springing up of seeds, which, when they come up well, are said to have a fine braird.

BRAKE. In Agriculture, a large harrow.

BRA'MA. (Hin.) The name of a divinity in the Hindu Mythology, the fables concerning whom are so numerous, that an accurate development of his character has been hitherto unattainable. As we learn from the Sanscrit lexilogists, the epithets applied to this divinity are very numerous: some of the most usual being "*Swayambhu*, the self-existent, *Parameshti*, who abides in the most exalted places, *Pitamaha*, the great father, *Prajápati*, the lord of creatures, *Lokesa*, the ruler of the world," &c. But the most distinct account of his nature and attributes is to be found in *Coleman's Mythology of the Hindus*, where he is represented as the grandfather of the gods, and equivalent to the Saturn of the Romans. *Brahm*, the highest divinity of the Hindus, to whose name so deep reverence is attached that it is considered criminal to pronounce it, is said to have given birth to Brahma, Vishnu, and Siva, simultaneously; and to have allotted to the first the province of creating, to the second that of preserving, and to the third that of destroying. Accordingly, ever since the creation of the world Brahma has had little or nothing to do, and it will not be till the tenth avatar or incarnation that his services will be put in requisition, when this world is to undergo total annihilation. Meanwhile, however, the other deities, Vishnu and Siva, are constantly engaged in their respective duties of preservation and destruction; and the Hindoos, with that recklessness of the future which is common to them with more civilised communities, lavish all their adoration upon those divinities from whom they expect to derive immediate advantage. Hence, throughout all India, the worship of Brahma is neglected, his altars are overturned, his temples destroyed, in short, nothing has been left but his name, and even that none of the best. Brahma is usually represented with four heads and four hands, either reclining upon a lote tree (the emblem of creation among the Hindoos), or riding upon a swan.

BRAN. The husk of wheat which immediately covers the grain, and which remains in the bolting machine. It is gently laxative; an infusion of it, under the name of *bran tea*, is frequently used as a domestic remedy for coughs and hoarseness. *Calico printers* employ bran and warm water with great success to remove colouring matter from those parts of their goods which are not mordanted.

BRA'NCHIÆ. (*Βραγχια, the gills of a fish.*) The term applied to all vascular organs of an animal body which are destined to submit the circulating fluid in a state of minute subdivision, for the purpose of respiration, to the influence of air contained in water.

BRANCHI'OPODS, BRANCHIO'PODA. (Gr. *βραγχια, gills*, and *πους, a foot.*) An order of Crustaceans, in which the locomotive extremities fulfil the functions of gills.

BRANCHIO'STEGANS, BRANCHIOSTEGI. (*Βραγχια, gills, στεγω, I cover.*) A tribe of cartilaginous fishes, comprehending those in which the gills are free, and covered by a membrane, including the sturgeon and chimæra.

BRA'NDY. The spirituous liquor obtained by the distillation of wine. When pure it is perfectly colourless, and only acquires a pale brown or yellow tint from the cask. The deep colour of common brandy, intended to imitate that which it acquires from great age in the cask, is generally given by the addition of burned sugar. The average proportion of alcohol in brandy varies from 48 to 51 *per cent*. The best brandy is made in France, the preference being generally given to that shipped from Cognac. The imports of brandy for home consumption amount to about 1,100,000 gallons a year; but there can be no doubt that the quantity would be much larger, were it not for the oppressive duty of 15*s*., a gallon, reduced by Sir R. Peel from 22*s*. 6*d*., with which it is charged.

BRASS. An alloy of copper and zinc. The proportions vary according to the required colour: four parts of copper and one of zinc form an excellent brass. It is usually made by heating copper plates in a mixture of native oxide of zinc, or calamine and charcoal.

BRA'SSAGE. A sum formerly levied to defray the expense of coinage, and taken out of the intrinsic value of the coin. The term is supposed to be derived from *brachiorum labor*.

BRA'SSART. In Plate Armour, the piece which protected the upper arm, between the shoulder-piece and the elbow.

BRASSICA'CEÆ. (Brassica, one of the genera.) One of the names of Cruciferous plants, which see.

BRAZI'L NUT. A South American fruit, commonly sold in the markets of London, it is the seed of a large fruit tree, called *Bertholetia excelsa*.

BRAZIL WOOD. A valuable wood, imported from South America and the West Indies, where it is produced by certain species of *Cæsalpinia*, especially *C. echinata* and *Brazilensis*, large trees with repeatedly pinnated leaves, showy yellow flowers, and long richly coloured stamens. It is used for the preparation of a red dye, but the consumption of it in this country is inconsiderable. It fetches from 60*l*. to 80*l*. a ton in the London market, exclusive of the duty of 2*l*. a ton.

BREACH. In Fortification, a gap or opening made in any part of the walls of the besieged place by the cannon or mines of the besiegers.

BREAD. (Germ. brod.) This important article of food is made of the flour of different grains, but it is only those which contain gluten that admit of conversion into a light or porous and spongy bread, of which *wheaten bread* furnishes the best example. When flour is made into a tough paste or *dough* by the addition of a little water, rolled out into thin cakes, and more or less baked, it forms *biscuit*. For the formation of *bread* a certain degree of fermentation, not unlike vinous fermentation, is requisite, care being taken to avoid acetous fermentation, which renders the bread sour, and to most persons disagreeable. If dough be left to itself in a moderately warm place (between 80° and 120°), a degree of fermentation comes on, which, however, is sluggish, or,

if rapid, *acetous;* so that to effect that kind of fermentation requisite for the production of the best bread, a *ferment* is added, which is either *leaven* or dough which is already in a fermenting state, and which tends to accelerate the process in the mass to which it is added; or *yeast*, the peculiar matter which collects in the form of scum upon beer in the act of fermentation. Of these ferments leaven is slow and uncertain in its effect, and gives a sour and often slightly putrid flavour. Yeast is more effective; and when clean and good, it rapidly induces *panary fermentation;* but it is often bitter, and sometimes has a peculiarly disagreeable smell and taste.

All, then, that is essential to make a loaf of bread is dough to which a certain quantity of yeast has been added. This mixture is put into any convenient mould or form, or merely shaped into one mass; and after having been kept for a short time in rather a warm place, so that fermentation may have begun, it is subjected to the process of baking in a proper oven. Carbonic acid is generated; and the viscidity or texture of the dough preventing the immediate escape of that gas, the whole mass is puffed up by it, and a light porous bread is the result. Along with the carbonic acid traces of alcohol are at the same time produced, but so insignificant and impure as not to be worth notice; hence the attempts which have been made to collect it upon the large scale have entirely failed in an economical point of view. Other flour besides that of wheat will, under similar circumstances, undergo panary fermentation; but the result is a heavy, unpalatable, and often indigestible bread; so that the addition of a certain quantity of wheat flour is almost always had recourse to. It is the *gluten* in wheat which thus peculiarly fits it for the manufacture of bread, chiefly in consequence of the tough and elastic viscidity which it confers upon the dough

It is well known that *home-made bread* and *baker's bread* are two very different things. the former is usually sweeter, lighter, and more retentive of moisture. the latter, if eaten soon after it has cooled, is pleasant and spongy; but if kept for more than two or three days, it becomes harsh and unpalatable The cause of this difference may perhaps be obvious from the following details of the operations of the wholesale baker.

In making his dough he takes the water, or part of it, which he intends to use, and having slightly warmed it, dissolves in it a certain portion of salt, then he adds the yeast, and then a certain quantity of flour. This mixture is set aside in a warm place, where it soon begins to ferment This process is called *setting the sponge*, and according to the relation which the water in it bears to the whole quantity to be used in the dough, it is called whole, half, or quartern sponge The evolution of carbonic acid causes the sponge to heave and swell, and when the surface bursts it subsides, and then swells again, and so on; but the baker is careful to use it before this fermentation has communicated sourness to the mass. He then adds to the sponge the remaining quantity of flour, water, and salt which may be required to form dough of proper quality and consistence, and incorporates the whole by long and laborious kneadings till the entire mass acquires uniformity, and is so tough and elastic as to bear the pressure of the hand without adhering to it. It is then left for a few hours, during which fermentation goes on, and the inflated mass is again kneaded, so as to break down any lumps or portions which had accidentally escaped diffusion in the first operation, and to confer perfect uniformity on the whole The dough is then weighed out into loaves, which are shaped, and put aside in a warm place for an hour or two, during which they swell up to about double their original size; they are then put into the oven and baked; during which operation they again enlarge considerably in bulk, in consequence of the dilatation of the previously generated carbonic acid pent up in the dough; for, as soon as the mass is exposed to the heat of the oven, the fermentation is put an end to.

If we compare the baked loaf with the flour of which it is composed, we shall find that panary fermentation has produced a considerable change in the latter. The gluten and the starch, which (exclusive of a trace of sugar) were the components of the flour, have mutually acted upon and altered each other; the toughness and viscidity of the gluten is gone, and the starch no longer forms a gelatinous mixture with hot water; a little sugar is generally formed, as well as alcohol; but the principal cause of the change in the characters of the flour is the evolution of carbon and of oxygen in the form of carbonic acid, the production of which is independent of the presence of external oxygen (or of air) Small quantities of alum are also, it is said, invariably used by the London bakers, with the view of whitening or bleaching the bread, for it may be observed, that whatever may be the quality of the flour which is used, home-made bread is always of a comparatively dingy hue According to Mr. Accum (*On the Adulteration of Food*), the requisite quantity of alum for this purpose depends upon the quality of the flour. The mealman, he says, makes different sorts of flour from the same kind of grain. The best flour is chiefly used for biscuits and pastry, and the inferior kinds for bread. In London no fewer than six kinds of wheaten flour are brought into the market; they are called fine flour, seconds, middlings, coarse middlings, and twenty-penny. Beans and peas are also, according to the same authority, frequently ground up with London flour. The smallest quantity of alum used is from three to four ounces to the sack of flour of 240 pounds

Another article occasionally employed in bread making is carbonate of ammonia As it is wholly dissipated by the heat of the oven, none remains in the baked loaf. It renders the bread light, and perhaps neutralizes any acid that may have been formed (exclusive of carbonic acid); but it is too dear to be much employed. To some kind of biscuits it gives a peculiar shortness, and a few of the most celebrated manufacturers use it largely. The French chemists have accused the bakers of employing sulphate of copper or blue vitriol, for the purpose of improving the colour of the bread; but so dangerous and easily detected an addition can scarcely be supposed to be common. According to Mr. E. Davy, bread, especially that of indifferent flour, is materially improved by the addition of a little carbonate of magnesia, in the proportion of twenty to thirty grains to the pound of flour; it requires to be very intimately mixed with the dough. The most nefarious adulteration of bread consists, however, in the addition of certain insipid and colourless earthy substances, with a view of increasing its weight; such as pipe-clay, porcelain-clay, chalk, and plaister of Paris These, however, are probably very rarely resorted to, though in one instance the writer of this article had occasion to examine a quantity of *biscuits*, which were adulterated with gypsum to the amount of 10 *per cent*

BREAK (Teut. brache.) In Architecture, any projection from the general surface of a building.

BREA'KERS. Waves that break, or fall over, from the shallowness of the water. In a gale, the tops of the seas generally break in this way more or less, from the progressive motion of the water at the surface before the wind, which is exceedingly dangerous for open boats This is never confounded with the falling over of the whole wave, as the surf falls over on the beach

BREA'KING JOINT. In Architecture, that disposition of stones and bricks in their courses by which vertical joints are not allowed to fall over each other. *See* Diagrams to BOND, ENGLISH and FLEMISH

BREAKWA'TER. An artificial bank of stones, or the hull of a vessel, sunk to break the sea before its entrance into a roadstead or harbour. The breakwater at Plymouth is a great work of this kind. It is built across the sound, which it completely defends from a very heavy sea from the channel in south-westerly winds, and which formerly caused the loss of many ships It is composed of large stones dropt from vessels constructed for the purpose. The sea, which for a time offers serious obstacles to the construction, works the stones together, and washes up shingle and sand, which, with the growth of sea-weed, consolidate the whole. The outer mole of the harbour of Civita Vecchia, still in good repair, was formed by the Emperor Trajan exactly in the same way as the breakwater at Plymouth (*Plinii Epist* lib vi. ep. 31) The breakwater at Cherbourg, constructed by Napoleon, is one of the greatest modern works of this class

BREAM The name of a soft-finned fish, common in many of the lakes and rivers of England, and one that breeds freely and thrives in ponds, if there be sufficient depth of water. It is the type of a particular subgenus of the Carp family (*Cyprinidæ*), which Cuvier has characterized under the name of *Abramis*. *See* ABRAMIS.

BREA'MING In Nautical language, signifies cleaning the bottom of a vessel by fire When the vessel is aground, fire being applied to the bottom loosens the pitch, or composition of sulphur and tallow, with which the bottom is sometimes covered to defend it from the worms, and which is then scraped off, together with the barnacles, grass, weeds, &c that adhere to it

BREA'STING. Breasting up a hedge is cutting the face of it on one side, so as to lay bare the principal upright stems of the plants,

BREAST PLOUGH. A kind of spade or shovel, with a cross piece at the extremity of the handle, which is applied to the breast, and by which the operator skims off a thin slice of turf from a grassy surface, as if he were ploughing. Turf thus obtained is chiefly used in thatching

BREA'STSUMMER. (From Sax. breost, and summer; *quære*, trabs summaria?) In Architecture, a beam which supports an exterior wall, the beam itself being carried by wooden or iron posts.

BREAST-WORK. In Fortification, an elevation of earth thrown up round a fortified place to protect the garrison from the enemy's fire

BRE'CCIA (It.) A rock composed of an agglutination of angular fragments.

**BREECH OF A GUN.** The solid part behind the bore.

**BRE'ECHING, or BREECH BAND.** Part of the harness of a carriage horse, by means of which he is enabled to push the carriage to which he is attached backwards, or to support its pressure in going down a hill.

**BREEZE-FLIES.** *See* ŒSTRIDÆ.

**BREHON LAWS.** The ancient laws of the Irish are so termed, from an Irish word signifying *judges.* It is supposed that some of the numerous written collections of these laws which still exist are of great antiquity; as old, perhaps, as the earlier ages of the Christian era. Prior to the Anglo-Norman invasion, Ireland was entirely governed by these laws. For an account of the nature of these laws, see *Lord Lyttleton's Henry II.* vol v p 28., and the authorities there referred to.

**BRE'NTUS** A Fabrician genus of Coleopterous insects, belonging to the Weevil tribe, or *Curculionidæ*; now the type of a family, called *Brenthidæ*, including about eight genera and seventy species. These insects are peculiar to hot climates: only one species, the *Brentus Italicus*, is found in Europe, and this has been referred by Germar to a particular sub-genus, *Arrhenodes*, all the other species of which are natives of the new world.

**BRE'TTICES** In coal mines, wooden planking to prevent the falling in of the strata.

**BREVE.** (Ital) In Music, a note formed thus 𝅜 without a tail, and equivalent to two semibreves, or four minims. It is also that measure of quantity contained in two beats of the hand up and two down, but this only in common time with the mark ¢.

**BRE'VET.** In the French, signifies a royal act in writing granting some privilege or distinction; as brevet d'invention, a patent It is applied, in England, to a commission giving nominal rank higher than that for which pay is received; thus, a brevet major serves and draws pay as captain, &c

**BRE'VIARY** A book containing the offices of daily prayer according to the usage of the R C. church. The offices are seven; viz matins, lauds, first, third, sixth, and ninth vespers, and the compline. Anciently all Catholics were required to recite the breviary daily The injunction is now confined to the clergy; of whom it is still strictly exacted

**BRE'VIPENNATES,** *Brevipennes.* (Lat. brevis, *short*; penna, *quill*, *short-quilled*) An epithet applied by Cuvier to distinguish the first family of his order *Grallæ* (Echassiers), the ostrich is the type of this family. *See* CURSORES.

**BREW'ING.** *See* FERMENTATION.

**BRI'BERY.** In English Law, is a term comprehending the offences of judges, ministerial officers, &c, receiving rewards or considerations to act contrary to their respective duties, which are severally misdemeanors at common law, and also punishable under several statutes But in its most ordinary signification, it is the giving or receiving money to procure votes at parliamentary elections, or elections to public offices of trust The statutes which at present chiefly regulate the offence of bribery at parliamentary elections are 2 G. 2 c 24., and 49 G 3. c. 118 The latter statute imposes a penalty of 1000*l* on any one (if not returned, incapacity to serve in parliament for that place if returned) who "shall give or cause to be given, directly or indirectly, any sum of money, &c., upon any engagement that the person receiving shall procure, or endeavour to procure, &c, the return of any member," and imposes a fine of 800*l* on the person receiving the bribe on such a promise or agreement The former makes it an offence in any person "to procure or corrupt another to vote," and it has been recently held, that the corruption is complete, as far as the corrupter is concerned, by the act of giving the money, whether the voter intend or not to act according to the wish of the briber

**BRICK.** (Dutch bricke.) In Architecture, a mass of clay earth, sometimes mixed with coal ashes, chalk, and other substances, formed in a mould, and burnt in a kiln or clamp. The earth used for this purpose is of two sorts The one a stiff clay, with little or no extraneous mixture, which produces a hard red brick; the other a yellowish-coloured fat earth, called loam, which produces a grey-coloured brick. The clay is usually tempered in a clay mill. For the sea coal ashes that are mixed with it in London, they substitute in the country a light sandy earth. In making the paste as little water should be introduced as possible. In moulding them, which is done in a wooden mould, a clever workman will mould about five thousand in fifteen hours The kiln in which they are burnt is a large building, about 13 feet long, 10 feet 6 inches wide, and 12 feet high, furnished with a proper furnace. When otherwise burnt, the *clamp*, as it is called, is formed of the bricks themselves, generally oblong on the plan, and the foundations made with place bricks. Each course of bricks is laid on a layer of *breeze* or cinders; and flues are formed, filled with coals, breeze, and wood. The burning continues from twenty to thirty days. The size of bricks, when burnt, is required by the statute to be 8½ inches long, 2½ inches thick, and 4 inches wide. The different varieties of bricks are, *malms*, which are of a yellowish uniform colour and texture; *seconds*, not quite so uniform in colour and texture as malms; *red* and *grey stocks*, the former being burnt in kilns, both of a quality rather inferior to seconds; *place bricks* or *peckings*, sometimes called sandel or samel bricks, which are those furthest from the fire, and rarely well burnt, — these should never be used in a building where durability is required; *burrs* or *clinkers*, which are masses of several bricks run together in the clamp or kiln from the violent action of the fire; *fire bricks*, of a red colour, about 9 inches long, 4½ inches broad, and an inch and a half thick, — they are made for use in furnaces to resist the action of the fire, and from having been formerly manufactured in the neighbourhood of Windsor, they are sometimes called Windsor bricks; *paving bricks*, made for the purpose their name implies; *compass bricks* are circular on the plan, chiefly used in walling wells, and the like, *Dutch clinkers* or *Flemish bricks*, chiefly used in stables, the Dutch clinker is 6 inches long, 3 inches broad, and 1 inch thick.

**BRICKLA'YING.** In Architecture, the art of building with bricks, which is of very great antiquity. Pausanias mentions many structures in Greece which were built of bricks; and in Rome such buildings were very common. The walls of Babylon, attributed by Herodotus to Semiramis, were also of brick

**BRICKNO'GGING.** In Architecture, brickwork carried up and filled in between timber framing.

**BRICK TRIMMER.** (Sax. ꞇꞃımman, *to build*) In Architecture, a brick arch abutting against the wooden trimmer in front of a fireplace, to guard against accidents by fire.

**BRI'DEWELL.** A house of correction for offenders is commonly so called in England The name is derived from the locality of the ancient London house of correction, which was an hospital, founded by Edward VI. on the site of St. Bride's well, in Black Friars, a well-known object of pilgrimage in Roman Catholic times. The original Bridewell is under the control of the lord mayor, and used as a receptacle for vagrants, place of punishment for apprentices, &c, within the jurisdiction of the city.

**BRIDGE.** (Sax bꞃıᵹᵹe.) In Architecture, a structure for the purpose of connecting the opposite banks of a river, gorge, valley, &c. &c, by means of certain materials, forming a roadway from one side to the other It may be of stone, brick, iron, timber, suspended chains or ropes, or the roadway may be formed by means of boats. Long previous to the introduction of bridges constructed upon geometrical principles, the modes of crossing rivers by throwing the trunks of trees across them, or by suspension of ropes, or twisting together the branches of trees from bank to bank, were so obvious that they must have been resorted to at an early period. The former method, however, could only have been practised over narrow streams, whilst the latter might have been carried to almost any required extent. Mungo Park found this mode employed in Africa, and in South America rope bridges of bujuco, or thongs made from the hides of oxen, are in use at the present day. Don Antonio de Ulloa tells us, that over some of the rivers of Peru the bujuco bridges are of such dimensions that loaded mules in droves pass over them, and especially on the river Apurimac, forming the high road for the trade carried on between Lima, Cuzco, and other places to the southward Though such bridges are the contrivance of man in a less civilised state, they are the only means by which many streams whose currents are deep and rapid can be crossed; and the stupendous suspension bridges of the present day are but improvements on the simple scheme of the untutored architect of a savage tribe. When a stream is neither deep nor rapid, its breadth seems to present no obstacle to forming a roadway over it. Large stones placed across at intervals, on which other stones or beams of timber may be laid horizontally, would be the first step. Of this species appears to have been the bridge which, according to Herodotus, Nitocris constructed at Babylon over the Euphrates, and which is said by Diodorus Siculus to have been five furlongs in length. Of this sort also are many of the bridges in China. The bridges of the Chinese, however, appear to have been rather too highly extolled in the accounts of Du Halde and the missionaries, as may be gathered from the information obtained of the Foo-chow-foo bridge, during the voyage of the ship Amherst in 1832. It appears, from the testimony of Captain Parish, that the use of the arch with wedge-shaped stones converging towards the centre of the curve must have been known to the Chinese at a very early period.

In tracing the history of bridges among different nations, we shall see that local causes had great influence on the species of construction adopted by them

A nation may have reached the highest point of art in its other public monuments, and have nevertheless done nothing worthy of our admiration in the construction of a bridge. In Egypt, for example, intersected as it is by a large and wide river subject to periodic inundations, the construction of bridges would have been as difficult as it would have been useless. All the intercourse which commerce required was easily carried on by the assistance of boats; and as respects the passage over the canals which abounded in the country, their depth and breadth were so small as to require none but the most simple expedients for connecting their opposite banks, nor any which involved the employment of science. In Greece, no vestige of a bridge occurs whose date is anterior to its occupation by the Romans; but this, had they even been acquainted with the use of the arch, might be accounted for on reasons directly the reverse of those which operated in Egypt. Greece is intersected by no river of any magnitude; and even those which seem to have some title to the name, are rather mountain torrents than those immense sheets of water, swelled in their course by innumerable tributary streams, that are to be found in other parts of the world. Here scarcely more could be wanted than a single arch, whose abutments would be found in the solid rocks which the stream separated.

Following up the history of bridges into Italy, we find a country much watered by large rivers, where the architecture of bridges became a necessary study, not only for the accommodation of the cities with which it abounded, but also for the service of the frequent military expeditions of the restless conquerors who occupied its lands. Rome, from its earliest foundation, must have put in requisition considerable skill in bridge architecture over the Tiber, rapid and subject as it is to sudden floods. The earliest bridges here were of timber; such was that which joined the Janiculum to the Mons Aventinus, and was called the Pons Sublicius, from the *sublicæ* (stakes) of which it was formed. (*Liv.* i. 33.) Without enumerating the bridges of Rome, some of which are still standing to attest the science of their architects, we must mention the Pons Narniensis, on the Flaminian way, near Narni, and about sixty miles from Rome. It was built by Augustus, and vestiges of it remain to the present day, one arch above 150 feet span and 100 feet high being still entire. But of works of art, perhaps the most wonderful ever raised was the bridge built by Trajan over the Danube. It consisted of twenty piers, whose height from their foundation was 150 feet, and 170 feet apart, its breadth being sixty feet. This stupendous work was demolished by Hadrian the successor of Trajan, under the pretence that it might serve as a passage for the barbarians, if they became masters of it, but some writers have said it was through envy of the fame that attached to its founder. Over the Tagus in Spain an ancient Roman bridge, near Alcantara, is still partly standing. It consisted of six arches of eighty feet span, extending altogether 600 feet in length, and some of the arches 200 feet high above the water. Of the temporary bridges of the Romans, the most famous was that of timber thrown by Cæsar over the Rhine.

From the fall of the Roman Empire to the revival of the arts, the history of bridge architecture is, with the exception of the Moorish works in Spain, of no interest. It appears from Gautier, who uses the authority of Mag. Agricola of Aix, that when the arts began to revive in Europe an order was founded by St Benezet, under the title of Brethren of the Bridge, and that under them was begun, in 1176, the bridge at Avignon, consisting of eighteen arches, and about 3000 feet in length. During the contentions of the Popes in 1385 some of its arches were destroyed, and in 1602 three others fell. In 1670 the ice destroyed all but the third pier, which, with the Chapel of St. Nicholas upon it, still remains. In 1354 a bridge of three arches was constructed at Verona, the roadway sloping from the city. the largest of its arches, which are segmental, is 160 feet span; but a still larger arch was built at Vielle-Brioude in France, over the Allier, in 1451, of nearly 181 feet span, which is the largest stone arch upon record. Among the most celebrated bridges of Italy, is that of the Rialto at Venice, whose span is 98½ feet. It was begun in 1588, and finished in 1591, from the designs of Antonio dal Ponte (*Sansovino's Venice*), though by most authors absurdly attributed to M. A. Buonarroti. In this city alone there are no less than 339 bridges; but they are mostly of small spans. We must not omit in this place the bridge Della Santissima Trinità at Florence, by Ammanati, which, as Milizia truly observes, has not been surpassed since the revival of architecture. It is of three arches, the middle one of 96 and the two side ones of 86 feet span, the width of the piers being 26 feet 9 inches; the breadth of the carriage and footways between the parapets is 33 feet. It has been usual for writers to call the form of the arches of this bridge cycloidal; but from our own measurements and most particular investigation, we can assert that they are not of that form. They are very slightly pointed, after the fashion of what is called the Tudor arch of this country; the point at the summit, which is extremely obtuse, being hidden by the ram's head sculptured on the key-stones. During the two last centuries, the French have advanced their bridge architecture to very great perfection; but more particularly in the latter part of the last century, in which appeared Perronet, the father of the modern system of the art, whose elegant designs have not since been improved upon either in France or any other country. His is the beautiful bridge of Neuilly over the Seine. It consists of five arches, each about 128 feet span and 32 feet rise. it was finished in 1774, and remains a splendid monument of the powers of its architect. Some of the more modern specimens of their bridges do great honour to the French school, in which beauty of form is united with sound engineering.

In England, the progress of bridge architecture has kept pace with that of the Continent; and if our bridges cannot boast the elegance in design of our lively neighbours, we are fully equal to them in boldness of conception and execution of the work. Indeed, if the designs of the late Messrs. Telford and Rennie had been equal to their engineering skill, no country in the world would have been able to compete with what we should have been able to exhibit. And here must not be forgotten the bridge over the river Taaf, near Llantrissart, in Glamorganshire, celebrated for its great span; the work of William Edwards, a country mason, in 1755. The chord line is 140 feet, and the versed sine 35 feet. As we can allow but short space for an account of the bridges which within the last eighty years have been built in this country, we must be content with the mention of that over the Thames, called the Southwark bridge, which is a stupendous exhibition of engineering skill, and far better in design than many of the other works of the late Mr Rennie. This bridge is of cast-iron, and consists of three arches, the chord of the centre arch being 240 feet, and its versed sine 24 feet, or one tenth of its span. The frame-work of the arch at the vertex is 6 feet in height. We are not aware of any cast-iron bridge whose dimensions exceed those of this bridge, and do not think it therefore necessary to mention minor ones, of which there are many fine specimens in Great Britain.

Of timber bridges the boldest and most ingeniously constructed in Europe was that at Schaffhausen, in Switzerland, destroyed by the French in 1799. It was designed and executed by Ulric Grubenmann, a common carpenter of Tuelfen, in 1758. The total length of this bridge was 364 feet, but it was relieved by a pier in the middle of the river. In America are some extraordinary specimens of timber bridges. Such is the Trenton bridge, over the Delaware, built in 1804, by Burr: its chord line is 200 feet, and its versed sine 32 feet, the height or thickness of the timber framing at the crown being only 32 inches. The bridge called the Colossus at Philadelphia, over the Schuylkill, is 340 feet span, with a versed sine or rise of only 20 feet, and the thickness of the timber at the vertex only 7 feet. It is the work of a person named Wernwag. Besides these two, there are many other timber bridges in America worthy the notice of the reader, which we regret we have not space to notice.

We shall close this portion of our subject by a short account of the suspension bridge over the Menai Strait, by the late Mr Telford, as being the giant of its species, and rendering unnecessary any enumeration of others. It consists of one opening of 560 feet between the points of suspension, the height between high water and the under side of the roadway being 100 feet. The platform is 30 feet in breadth. The whole is suspended from four lines of strong iron cables by perpendicular rods 5 feet apart. On the tops of the pillars the cables pass over iron rollers, and are fixed under ground to iron frames, which are retained in their places by masonry. The weight of the whole bridge between the points of suspension is 489 tons. In Suspension bridges it has been found that the most trying circumstances under which they can be placed, as affecting the stability of their equilibrium, is the heavy and measured tread of a long line of infantry, whose feet drop at the same instant of time.

In the building of bridges, where piers are required in the stream for the support of the arches, it is important to place them as nearly as possible at right angles to the stream or current, and the piers should be made convex towards the stream, for their better resistance to floods. The position of a bridge moreover, should not be in a narrow part, nor one liable to swell with tides or floods, inasmuch as the contraction of the waterway increases the depth and velocity of the current, and may thus endanger the navigation as well as the bridge itself. It is usual to construct bridges with an odd number of arches, and this on several accounts; among which are, that the stream being usually most

powerful in the middle, an egress through that part is best provided for by having a central arch; and again, if the bridge be not perfectly horizontal, symmetry is gained by rising from the sides to the centre, and the whole roadway may be made one continued curve. When a bridge is equally high throughout, much saving of centering is made, because the arches being all equal two sets of centres will be sufficient. If, however, the bridge be higher in the middle than at the extremities, the arches on each side the centre one must diminish similarly, so as to be respectively symmetrical; and by this arrangement beauty is gained, and the centering for one side equally suits the other. It is desirable to construct a bridge with as few arches as circumstances will allow, that there may be a free passage for the water, as well as for the vessels that have to pass up and down, not to mention the saving of materials and labour where there are fewer piers and centres. When a single arch can be compassed, no more should be permitted. (For the mode of estimating the equilibrium of an arch, see the article ARCH.) The piers should be of sufficient solidity to resist the thrust or push of the arch, independent of other arches, so that the centering of an arch may be struck without danger of overturning the pier left naked; and the piers should also be spread as much as possible on their bases, and diminish gradually upwards from their foundations. The method of laying the foundations in a river is now usually by means of coffer-dams, which are large enclosures, made by piling round the space to be occupied by the pier, so as to render it water-tight, and then pumping out the water, and keeping the space dry till the pier is built up to the ordinary level of the water; but if the ground about be loose, this method cannot well be practised, and recourse is had to caissons, which are a species of flat-bottomed boat, in which the pier is built up to a certain height, and then sunk over the place where it is intended to remain, the bed of the river being dredged out to receive it, or piles driven on which it may lodge when the sides of the chest or caisson are knocked away. In constructing the centres great care must be taken to make them incapable of bending or swerving while the arch is being turned, otherwise the form of the arch will be crippled. We here subjoin a table of some of the most celebrated bridges in Europe, chiefly in reference to their dimensions, and the relative spans and heights of their arches.

STONE BRIDGES.

| Name of Bridge. | River. | Place. | Widest Arch. Span | | Widest Arch. Height | | Curve. | Architect. | Date. |
|---|---|---|---|---|---|---|---|---|---|
| | | | *Ft* | *In.* | *Ft.* | *In* | | | |
| Vielle-Brioude | Allier | Brioude | 183 | 3 | 70 | 3 | Segm of circle | Grenier & Estone | 1454 |
| Ulm | Danube | Ulm | 181 | 2 | 22 | 3 | Segm of circle | Wiebeking | 1806 |
| Castle Vecchio | Adige | Verona | 159 | 10 | 53 | 3 | Segm of circle | Unknown | 1354 |
| Lavaur | Agout | Lavaur | 159 | 10 | 64 | 8 | Ellipse | Saget | 1775 |
| Claix | Drac | Grenoble | 150 | 2 | 62 | 3 | Segm of circle | Unknown | 1611 |
| Pont y prydd | Taafe | [illegible] | 140 | 0 | 35 | 0 | Segm of circle | Edwards | 1755 |
| Neuilly | Seine | Near Paris | 127 | 10 | 31 | 10 | Ellipse | Perronet | 1774 |
| Mantes | Seine | Mantes | 127 | 10 | 38 | 3 | Ellipse | Hupeau & Perronet | 1765 |
| Waterloo | Thames | London | 120 | 0 | 32 | 0 | Ellipse | Rennie | 1816 |
| Tongueland | | Kirkcudbright | 118 | 0 | 38 | 0 | Segm of circle | Telford | 1806 |
| St Esprit | Rhone | Languedoc | 108 | 7 | 26 | 6 | Segm of circle | Unknown | 1305 |
| Munich | Isar | Munich | 102 | 3 | 17 | 0 | Segm of circle | Wiebeking | 1814 |
| Orleans | Loire | Orleans | 106 | 7 | 29 | 9 | Ellipse | Hupeau | 1760 |
| Sarah | Liffey | Dublin | 106 | 0 | 22 | 0 | Ellipse | Stevens | 1791 |
| Monthon | Durance | Monthon | 102 | 0 | 25 | 6 | Ellipse | Delborgue-Cormont | 1805 |
| Vicenza | Bacchiglione | Vicenza | 101 | 2 | 29 | 9 | Segm of circle | Unknown | |
| Blackfriars | Thames | London | 100 | 0 | 41 | 6 | Ellipse | Mylne | 1771 |
| Rialto | Canal | Venice | 96 | 10 | 20 | 7 | Segm of circle | Ant. da Ponte | 1591 |
| Holy Trinity | Arno | Florence | 95 | 3 | 11 | 10 | Pointed | Ammanati | 1569 |
| Pont de la Concorde | Seine | Paris | 93 | 9 | 9 | 8 | Segm. of circle | Peronnet | 1791 |
| Jena | Seine | Paris | 91 | 6 | 10 | 9 | Segm of circle | La Mandé | 1815 |
| Sisto | Tiber | Rome | 83 | 4 | 41 | 8 | Semicircle | Unknown | 1474 |
| Ponte Molle | Tiber | Rome | 77 | 8 | 38 | 10 | Sem circle | Unknown | 100 B. C. |
| St Maxence | Oise | St Maxence | 76 | 8 | 6 | 3 | Segm of circle | Perronet | 1784 |

TIMBER BRIDGES.

| Name of Bridge | River. | Place | Widest Arch Span. | | Widest Arch Height | | Curve | Architect. | Date. |
|---|---|---|---|---|---|---|---|---|---|
| | | | *Ft* | *In* | *Ft.* | *In.* | | | |
| Colossus | Schuylkill | Philadelphia | 340 | 0 | 20 | 0 | Segm of circle | Wernwag | 1813 |
| Piscataqua | Piscataqua | N America | 250 | 0 | 27 | 4 | Segm of circle | Palmer | 1794 |
| Bamberg | Regnitz | Germany | 208 | 0 | 17 | 4 | Segm. of circle | Wiebeking | 1809 |
| Trenton | Delaware | Pennsylvania | 200 | 0 | 32 | 0 | Segm of circle | Burr | 1804 |
| Writtenghen | - - | Switzerland | 198 | 0 | 30 | 10 | Segm of circle | Grubenmann | |
| Pont Louis | Isar | Freysingen | 164 | 0 | 13 | 6 | Segm of circle | Wiebeking | 1809 |
| Freysingen | Isar | Bavaria | 153 | 0 | 11 | 6 | Segm of circle | Wiebeking | 1808 |
| Elsingen | Wertach | Elsingen | 139 | 0 | 7 | 8 | Segm of circle | Wiebeking | 1809 |
| | Lech | Near Augsburg | 114 | 0 | 8 | 9 | Segm of circle | Wiebeking | 1808 |
| Pont de la Cité | Seine | Paris | 104 | 5 | 6 | 2 | Segm of circle | Dumoutier | 1802 |

IRON BRIDGES.

| Name of Bridge | River. | Place. | Widest Arch. Span. | | Widest Arch. Height | | Curve. | Architect. | Date. |
|---|---|---|---|---|---|---|---|---|---|
| | | | *Ft.* | *In.* | *Ft* | *In* | | | |
| Southwark | Thames | London | 240 | 0 | 24 | 0 | Segm. of circle | Rennie | 1818 |
| Sunderland | Wear | Sunderland | 240 | 0 | 30 | 0 | Segm of circle | Wilson | 1796 |
| Buildwas | Severn | Buildwas | 130 | 0 | 27 | 0 | Segm of circle | Telford | |
| Austerlitz | Seine | Paris | 106 | 0 | 10 | 6 | Segm of circle | Lamandé | 1806 |
| Bristol | Avon | Bristol | 100 | 0 | 15 | 0 | Segm. of circle | Jessop | |

BRIDGING JOISTS. *See* JOISTS.

BRIEF. (Lat. brevis, *short*.) A word applied originally to a small written scroll; but it is used at present in several significations. In modern German the word brief signifies a letter.

1. In Ecclesiastical Law, letters addressed from the pope to temporal princes or communities on subjects of discipline or public affairs, are termed apostolical briefs. The name appears to have originated either in the concise formula with which they begin ("dilecto filio salutem et apostolicam benedictionem"), or in the difference that exists between this smaller kind of instrument and the ample bullæ (bulls) of the popes. Apostolical briefs are usually written upon paper, though sometimes parchment is used. They are sealed in red wax with the seal of the Fisherman (sub annulo Piscatoris), which is a symbol of St. Peter casting a net into the sea. (*Crampini, Dissertatio de Abbrev. Munere*, cap. iii.)

2. In Law, the term brief is applied to an abridged narration of the facts of a case prepared for trial, with or without a reference to points of law involved in it, drawn up for the preliminary instruction of an advocate.

3. The term brief is applied in England to king's letters, issued to the archbishops, bishops, clergy, magistrates, and parochial officers, to authorize collections of money at the doors of the several churches and chapels throughout the country, in individual cases wherein application has been made for such assistance towards the building or repair of a particular church. This custom is supposed to have commenced after the disuse of papal briefs consequent on the Reformation. Within the last few years this practice has been dropped, and a king's letter is sent round at certain intervals to collect money for the use of the Incorporated Society for the Building of Churches generally throughout the country. The last collections were made in 1829, when something more

than 40,000*l.* was received; and in 1834, when the sum collected amounted to rather more than 30,000*l.*

BRIG. The general term for a vessel having two masts, with a boom mainsail, being otherwise square-rigged; that is, having her sails brought to yards hung horizontally by the middle.

BRIGA'DE. This term either implies the union of two or more regiments or battalions in one corps, or of a certain number of men or guns in one subdivision. A brigade of infantry may consist of from one to six battalions, and a brigade of cavalry of two or three regiments. Six pieces of ordnance form a brigade of artillery; and the horse artillery consists of twelve troops, to each of which is attached one such brigade of guns. A brigade of sappers consists of eight men. The commander of a brigade is called a brigadier-general.

BRI'GANTINE. A name often applied to a small brig of a foreign nation.

BRIGHT. (Sax. beorꝛ.) In Painting, shining with light; a term applied to a picture in which the lights preponderate over the shadows

BRILLA'NTE. (Ital.) In Music, prefixed to a movement, denotes that it is to be played in a gay and lively manner.

BRI'MSTONE. *See* SULPHUR.

BRI'STOL STONES, BRISTOL DIAMONDS. These are small and brilliant crystals of quartz, found in the vicinity of Bristol, and occasionally used for ornamental purposes.

BRI'TISH GUM. When starch is exposed to a temperature of about 600° it becomes of a brownish colour, and so far altered in its chemical characters as no longer to form a blue colour with iodine; it is also soluble in cold water In this state it is used, under the above name, by calico printers.

BRO'ADCAST. Sowing seeds by casting them or scattering them abroad, so as to distribute them evenly over the entire surface of the soil, in opposition to sowing in drills or rows. The operation of sowing broadcast is generally performed by the hand, the operator carrying the seeds in a bag or sowing sheet, or in a basket. There are also machines for sowing broadcast, but they are not much in use. In general, all corns and grasses are sown broadcast; while pulse, and broad-leaved plants grown for their roots or leaves are sown in drills or rows. The term is sometimes applied to planting, but it is more generally restricted to sowing.

BRO'ADSIDE. A nautical term, signifying the discharge of the whole of the artillery on one side of a ship of war.

BRO'KEN-BACKED. A ship is said to be broken-backed when, in consequence of being loosened from age or injury, her frame droops at either end.

BRO'KEN-WINDED. A ruptured state of the air cells, chiefly on the edges of the lungs, in the horse, in consequence of which the expiration occupies more time than the inspiration of the air, and is laboriously and generally spasmodically effected. It is a disease which may admit of palliation, but not of cure, the animal becomes gradually less capable of exertion, and if urged on, he drops and dies.

BRO'KER. In Mercantile Law, a person employed about contracting for the disposal of property without being put in actual possession of it, as is the case with a factor (*See* FACTOR) But all agents answering to this definition are not brokers, nor has the term any very exact legal signification. Particular classes of brokers are, bill or exchange brokers, stock brokers, insurance brokers, pawnbrokers, and brokers who sell or appraise household furniture for rent. By 8 & 9 W 3. c 20 brokers in the city of London must be licensed by the mayor and aldermen, and grant a bond with a penalty of 500*l.* on their admission. According to mercantile usage, if goods within the city of London are sold by a broker to be paid for by a bill of exchange, the vendor, if not satisfied with the solvency of the purchaser, has a right within a reasonable time to annul the contract.

BRO'KERAGE. The per-centage paid the broker for his trouble in effecting a sale, or in negotiating any particular business.

BROME'LIA'CEÆ. (Bromelia, one of the genera.) A natural order of Endogenous plants inhabiting the tropical parts of the world, where they grow in the rich vegetable soil of forests, or upon the branches of trees, to which they cling by their twisting slender roots. They usually have hard leaves covered with a scurfiness easily rubbed off, and are so arranged as to be able to hold the water that lodges in their centre. Many of them will grow for months, and flower, when suspended in the air, after being severed from their roots. Their flowers are usually white, crimson, blue, or purple, and often exceedingly handsome. In the genus *Ananassa* the bracts and flowers are so fleshy, that they all grow together into a solid mass, and thus form the well-known fruit called the pine apple. *Tillandsia usneoides* is a curious species of this order, hanging down in long grey threads from the branches of trees in American forests, and so seldom flowering that it might be taken for some species of lichen; it is easily dried, and then used for stuffing mattresses, &c.

BROMINE. (Gr. *βρωμος, a strong odour.*) An undecompounded substance discovered in 1826 by M. Balard of Montpelier. In its general chemical habitudes it much resembles chlorine and iodine, and is generally associated with them. It exists, but in very minute quantities, in sea-water, and in the ashes of marine plants. It is usually extracted from *bittern* by the agency of chlorine. At common temperatures it is a very dark reddish liquid, of a powerful and suffocating odour, and emitting red vapour. Its specific gravity is about 3. It boils at 116°, and congeals at 4°. The density of its vapour is 5·5; 100 cubic inches at mean temperature and pressure weighing 167·25 grains. It is an electro-negative; it has bleaching powers, and it is very poisonous. Its equivalent number is about 78; it combines with hydrogen to form *hydrobromic acid gas*, 100 cubic inches of which weigh 84·7 grams. With oxygen it forms the *bromic acid*. Its combinations are termed *bromides*; they have not hitherto been applied to any use, but some of them are probably possessed of powerful medical qualities.

BRO'NCHIA. (Gr. *βρογχος, the throat.*) The smaller ramifications of the windpipe.

BRONCHI'TIS. Inflammation of the bronchia.

BRONCHOCE'LE (Gr *βρογχος, the throat*, and *κηλη, a tumour*) A tumour on the fore part of the neck, being a morbid enlargement of the thyroid gland. From its prevalence in Derbyshire it is sometimes called the *Derbyshire neck*, and it is a very common disease among the inhabitants of mountainous districts, especially of the Alps. It has been attributed to some peculiarity of the water of those districts, but upon no satisfactory evidence. Iodine has lately been administered successfully in the cure of this and other glandular enlargements, but it is a medicine requiring to be used with caution.

BRONCHO'TOMY. (Gr *βρογχος*, and *τεμνω, I cut.*) The operation of making an opening into the trachea in order to prevent suffocation.

BRONZE. (It bronzo.) In Sculpture, a material used for casting statues, groups, &c, in a mould similar in principle to that wherefrom all plaster casts are produced From the extraordinary dimensions which involve the chief differences between the operations of casting in brass and plaster, much intelligence and care on the part of the sculptor is necessary to produce the fac-simile of the work on which his labour has been expended The material employed for the purpose is a compound chiefly consisting of copper, tin, and other metals. The process of preparing the cast depends on circumstances requiring much nice arrangement; but the reader will immediately conceive that though the difficulty of making such a mixture insinuate itself into every part of the often colossal mould is great, it is no more in reality than many of the large cast-iron foundings which are every day effected; though, from the nature of the human and other animal forms, it is difficult to conduct such an operation with any thing like a degree of certain attainment of the object without extraordinary means.

BRO'NZITE. A variety of diallage of a metallic or *bronze* colour.

BROOM. The *Spartium scoparium* or *Cytisus scoparius* of botanists, is an evergreen, green-branched shrub, native of sandy soils throughout Europe. It is sown extensively in this country as a shelter for game, and among the other plants in young plantations as a screen from the wind and a protection till the more important species can establish themselves Its branches, which are tough, are made up into brooms, to which they have given their name.

BROWN. (Sax. bpun.) In Painting, a dark dusky colour inclining towards red, of various degrees of depth, of which there are many sorts.

BROWN COAL. An imperfect kind of coal, which burns with a peculiar bituminous odour resembling that of peat. Its ligneous structure is sometimes so distinct that it has been called *bituminous wood.*

BROW'NISTS. The followers of Robert Brown, who in the year 1581 seceded from the English church, and established a sect upon the principle that every congregation should form a church independent (in matters of discipline and doctrine) of all others. In matters of doctrine he did not differ from the church; to which indeed he returned, and took preferment after some years. The Brownists underwent great persecution under Elizabeth, and retired in considerable numbers to Holland. From them, however, have sprung the Congregational Brethren and Independents, a very powerful sect in England at the present day. *See* INDEPENDENTS.

BROWN SPAR. A magnesian carbonate of lime tinged by oxide of iron and manganese.

BRU'CHUS. A Linnæan genus of Coleopterous insects, of the tribe *Rhyncophora*, now the type of a family (*Bruchidæ*), with the following characters: — upper lip distinct; head produced anteriorly into a broad flattened snout; palpi filiform; antennæ filiform or serrate; eyes notched; wing-sheaths not covering the extremity of the

body. The insects of this family deposit their eggs in the young grains or seeds of leguminous plants; the time of the hatching of the eggs is when the seeds have approached to maturity, and then the larvæ begin to feed voraciously upon them. One species, the *Bruchus granarius*, infests our peas; and the ravages of this insect, and the *Bruchus pisi*, have been so extensive as to call for legislative interference: in France, for example in the year 1780, the sale of peas in the market was prohibited, in consequence of the damaged and unwholesome condition of those vegetables through the operations of the species of *Bruchidæ* above cited.

BRU'CIA. A vegeto-alkaloid, discovered by Pelletier and Caventou in the bark of the *Brucea antidysenterica;* and also associated in small relative proportion with *strychnia* in the nux vomica and St. Ignatius's bean. It is very bitter and poisonous.

BRU'NSWICK GREEN. A pigment obtained by exposing metallic copper to the action of muriate of ammonia. It is a compound of chloride and oxide of copper. Is is also generated by the action of sea water upon copper, as in the green matter which incrusts the copper sheathing of ships.

BRUSH. (Fr. brousse.) In Painting *See* PENCIL.

BRU'TA. The term by which Linnæus designated an order of Mammals, including the elephant, manatee, and walrus, with the quadrupeds now forming the order *Edentata* of Cuvier

BRYO'NIA, or BRYONINE. A bitter and poisonous principle, extracted from the root of the *Bryonia alba.*

BR'YONY. (Gr *βρυω, I grow rapidly*) A wild climbing plant belonging to the Cucurbitaceous order, with a large woody perennial root, and annual stems, which resemble those of a gourd, except that they are more slender, clinging to bushes by means of their twisting tendrils. The berries are scarlet, with a disagreeable odour when bruised. The leaves have five angular lobes, and are three or four inches broad, with many callous tubercles. The roots are violently purgative: they are now disused. It has been known to produce violent vomiting, tormina, profuse watery evacuations, and fainting. Cases are mentioned by Orfila and others where over doses have proved fatal Bryonine, an active extractive principle, is among the most dangerous of vegetable poisons.

BU'BO. (Gr *βουβων, the groin.*) A tumour very frequently occurring in the glands of the groin, and also in the arm pit. It is often the result of local absorption of irritating matter, as in venereal buboes; or is symptomatic of constitutional disease, as in the plague, scrofula, and some fevers.

BUBONO'CELE (Gr *βουβων, the groin*, and *κηλη, tumour.*) A rupture forming a tumour in the groin

BU'CCANEE'RS. (Fr. boucanier, from boucan, a word of the Caraib Indians, signifying meat preserved in a particular manner, which was adopted, together with the custom, by the French in the West Indies.) The pirates who infested the coasts of the West Indies and South America during the 17th and 18th centuries were so called. The association of these pirates is said to have commenced as early as the middle of the 16th, but in 1625 they obtained possession of St. Kitt's, and afterwards of Tobago, which thenceforward became for a long time the head quarters of the buccaneers, who formed a sort of seafaring republic, composed chiefly of English and French adventurers. Their chief object was war against the Spaniards, and plunder of their ships and settlements. After the peace of Ryswick, in 1697, they gradually disappeared from the seas The *History of the Buccaneers of America*, by James Burney, is a well known and entertaining work By French writers these pirates are commonly called *Flibustiers*, apparently a corruption of the English word *freebooters.*

BUCCINA'TOR. (Lat buccina, *a trumpet*) A muscle of the cheek called into action in various motions of the mouth, and especially in blowing a wind instrument.

BU'CCINUM (Buccinum, *a trumpet* or *shell-fish*) The name of a Linnæan genus of Vermes Testacea, characterized by having a shell with a smooth non-plicated columella, and with a fissure or short respiratory canal inflected towards the left. The mollusca with shells corresponding to this character are ranked amongst the Pectinibranchiate Gastropods by Cuvier, and have been subdivided into the following subgenera: —*Buccinum* proper, Brug., of which the whelk, *Buc undatum*, is an example; *Nassa*, Lam.; *Ebuma*, Lam.; *Ancillaria*, Lam.; *Dolium*, Lam.; *Perdix*, Mart.; *Harpa*, Lam.; *Purpura*, Brug.; *Monoceros*, Lam.; *Ricinula*, Lam.; *Concholepas*, Lam.; *Cassis*, Brug.; *Morio*, Montf.; *Tenebra*, Brug.

BU'CCO. (Lat. bucca, *cheek.*) The name of a genus of Lygodactyle birds, called barbets. The scientific term relates to the tumefaction of the sides of the base of the bill; the trivial English name is derived from the bristly feathers which surround the base of the bill, and project beneath the chin like a beard. The genus is now the type of a family, including the barbets proper (*Bucco*), the Brazilian barbets or tamatias (*Tamatia*), and the barbicans of Buffon, which are limited to the warmer parts of India and Africa.

BUCENTAU'R. (Gr. *βους, an ox; κενταυρος, a centaur.*) A mythological monster, half man and half ox, as the Greek etymology of the word imports. This was also the name of the state galley of the Venetian doges, in which they annually sailed over a portion of the Adriatic on Ascension Day, and, dropping a ring into the sea, espoused it in the name of the republic, with the words, "Desponsamus te, mare, in signum veri perpetuique dominii"

BU'CEROS. (Gr. *βους, an ox*, and *κερας, a horn.*) A genus of Syndactylous Insessorial birds, remarkable for the prodigious size of the mandibles, the superior of which in some species supports a large horn-like protuberance. The birds of this genus are commonly called horn-bills; they are peculiar to the old world, and perform the same offices in wild nature as the toucans of America.

BU'CKA, or BUCHU. A strong-smelling leaf imported from the Cape of Good Hope, and used medicinally as an anti-spasmodic. It is produced by *Diosma crenata* and some allied species.

BU'CKWHEAT. (A corruption of beechwheat.) A kind of grain, produced by the *Polygonum fagopyrum* of botanists. It has a triangular form, and is not unlike beechmast. In some countries it is cultivated as food for man, and even in this country its flour is said to enter into the composition of the thin cakes called crumpets; but its chief value is as food for pheasants, which are so fond of it that they may be decoyed from their preserves by its employment. It is said that some estates have been rapidly stocked with this description of game, at the expense of the neighbouring coverts, by the aid of a few fields of buckwheat

BUCO'LICS. The Greek term for pastoral poems, meaning literally the songs of herdsmen (*βουκολοι*). We have considerable remains of this species of poetry in the poems of Theocritus, Bion, and Moschus, and the Eclogues of Virgil. The metre universally employed is the hexameter or heroic, but in pastoral poetry an easier flow of the lines was studied than in epics, and this was generally accomplished by introducing a larger proportion of the metrical feet called dactyls in the former than in the latter; but no rules were laid down on this point. This species of poetry has been cultivated also by most modern nations, and in England, France, and especially in Germany, with great success. Indeed, the last-mentioned country can boast among others of a Gessner, whose Idyls have been pronounced by some modern critics to be models of pastoral poetry, combining the most finished harmony of numbers with a simplicity and tenderness of sentiment and expression worthy of Theocritus himself.

BU'DDHISM A religion which prevails over a great part of Asia; and, according to the estimates of some geographers, has a much greater number of worshippers than any other form of faith among mankind. China, the peninsula beyond the Ganges, Japan, and various Indian islands, are chiefly peopled by Buddhists. The founder of this religion, according to tradition, was an Indian prince, to whom the title of Buddha, or "The Sage," is assigned by his worshippers. The period to which his life is assigned is variously estimated, according to a variety of oriental traditions; but several of them coincide in referring it nearly to the tenth or eleventh century before Christ. Buddhism was expelled from India by the persecutions of the Brahmans, between the fifth and seventh centuries of our era. The doctrines of the Buddhists seem mainly to rest on the principle, that the world, and sensible objects contained in it, are manifestations of the Deity, but of a transient and delusive character, that the human soul is an emanation from Deity; that after death it will again be bound to matter, and subjected to the miseries and accidents of this life, unless the individual to whom it belongs by the attainment of wisdom through prayer and contemplation succeeds in liberating it from that necessity, and secures its absorption into that divine essence from which it sprang.

BU'DGET, in a general sense, means a condensed statement of the income and expenditure of a nation, or of any particular public department. In this country, however, the term is usually employed to designate the speech made by the chancellor of the exchequer when he gives a general view of the public revenue and expenditure, and intimates whether government intend to propose the imposition or repeal of any taxes, &c.

BU'FFALO. (Lat. bubalis.) A term originally applied to a species of antelope; but afterwards transferred, in the age of Martial, to different species of the ox. In modern zoology the Buffaloes, or the "Bubaline group" of the genus *Bos*, include those species which have the bony core of the horn excavated, with large cells or sinuses communicating with the cavity of the nose; the horns are flattened, and bend laterally with a backward direction, and are consequently less applicable for goring than in the Bisons,

or Taurine group of oxen: the head is large, with a narrow but convex forehead, and terminates in a broad muzzle. The Buffaloes are of large size, but low in proportion to their bulk; they have no hunch on the back, and only a small dewlap on the breast: the hide is generally black; the tail long and slender. The Buffaloes occupy the warm and tropical regions of the earth; they avoid hills, and prefer the coarse vegetation of the forest and swampy regions to those of open plains; they love to wallow and lie for hours sunk deep in water; they swim well, and cross the broadest rivers without hesitation; their gait is heavy, and they run almost always with the nose horizontal, being principally guided by the sense of smelling In their combats, they usually strike or butt with the forehead, and when their opponent is thrown they endeavour to crush him with their knees; they trample on the body, and their vindictive fury is so lasting, that they will return again and again to glut their vengeance upon the same inanimate corpse: they herd together in small flocks, or live in pairs, but are never strictly gregarious in a wild state. The females bear calves two years following, but remain sterile the third; they propagate at four and a half years old, and discontinue after twelve Their extreme aversion to red colours has been remarked both in India and at the Cape. The Arnee Buffalo (*Bos Arni*) is the species in which the horns attain the greatest size. there is a pair of horns in the British Museum considered by Col. Smith (from whose excellent description of the Ruminantia in the translation of the *Animal Kingdom* of Cuvier the preceding observations are chiefly derived) to be of the true or Great Arnee. each of these horns measures along the curve from base to tip, six feet three inches; circumference at the base, eighteen inches.

BUG. *See* CIMEX.

BU'GLE HORN. (From bucula, *a heifer*) A musical wind brass instrument, latterly improved by keys, so as to be capable of all the inflexions of the scale

BUHL. Ornamental furniture, in which tortoise-shell and various woods are inlaid with brass. The name is derived from its inventor.

BULB. (Gr. *βουβος*.) A collection of fleshy scales, arranged like those of a bud, of which the bulb is a slight modification, separating spontaneously from the stem to which it belongs, and emitting roots from its base. It is usually found underground, as in the hyacinth, but sometimes upon the surface of the stem in the axils of the leaves, as in the bulbiferous lily The old botanists used to distinguish two sorts of bulbs, the tunicated and the solid. the former is the only one to which the name is now applied; the latter is the cormus, as in crocus

BULBO'DIUM. A kind of underground stem, resembling a rhizoma.

BU'LBOGE'MMA. A name for those bulbs which grow on the stems of plants, as in the tiger lily and other species of that genus

BU'LBOTU'BER. That kind of stem which the old botanists called a solid bulb, and the moderns more generally a cormus. It is a round solid underground stem, clothed with the withered remains of leaves, and producing buds on its surface, as in crocus

BU'LE. (Gr. *βουλη, a council*) By this name the Athenian senate was designated, the constitution of which was as follows.—When the people were divided into four tribes, each of these, according to the regulation of Solon, elected 100 representatives, thus making in all a deliberative body of 400 members. But when Cleisthenes increased the number of tribes to ten, the complement of the senate was raised to 500, fifty of which were sent by each tribe; when the tribes were finally increased to twelve, 100 more senators were added. All free-born Athenian citizens above thirty years of age were eligible to this office, but they were obliged to undergo a strict examination of their characters and morals. The senate was originally instituted by Solon to be a check on the assembly of the whole people (*εκκλησια*), before which, according to the Athenian constitution, no measures were allowed to be brought before they had first met with its approbation. *See* PRYTANES.

BULI'MIA. (Gr. *βου*, a syllable denoting *greatness* in compound words, and *λιμος, hunger*.) A morbid appetite for food.

BULKHEAD. The sea term for any partition, as of wood, canvass, or other material.

BULL, PAPAL. (Lat. bulla) An instrument, ordinance, or decree of the pope, equivalent to the proclamations, edicts, letters patent, or ukases of secular princes. Bulls are written on parchment, to which a leaden seal is affixed, and are granted for the consecration of bishops, the promotion to benefices, and the celebration of jubilees, &c. The publication of papal bulls is termed fulmination; and it is done by one of three commissioners, to whom they are usually addressed. The bull is thus described by Matthew Paris:—Anno Dom. 1257. In bulla domini Papæ stat imago Pauli a dextris crucis in medio bullæ figurata, et Petri a sinistris.

BULL, GOLDEN. In German History, a term applied particularly to a statute or enactment of the emperor Charles IV., published A. D. 1356, in two diets held in succession at Nurimberg and Metz, for the purpose of fixing the laws in the election of the emperor, and of regulating the number and privileges of the electors. (Churfursten) The original copy of this instrument (which was long regarded as the Magna Charta of the German Empire, and continued in operation till its dissolution in 1806) is preserved at Frankfort on the Maine, and has a seal of gold appendant; whence the appellation Golden Bull is derived.

BU'LLA. (Lat) A stud or boss, but more particularly an ornament in the shape of a heart, worn round the neck by noble Roman children till they were seventeen years old; when they assumed the manly dress of the toga, and suspended the bulla as a consecrated offering to the *lares* or household gods.

BU'LLA. (Lat. bulla, *a bubble*) A genus of Acerous Gastropodous Mollusks, the shell of which is more or less globose, or inflated like a bubble; having no visible or projecting spire, which is concealed by the large external whorl, which is elevated above the rest. The columella makes a convex prominence, which gives a crescentic form to the aperture of the shell; the animal breathes by gills, but has no respiratory tube or siphon, and consequently the margin of the aperture of the shell is entire, or without a fissure or canal. All the species of bulla are remarkable for a shelly apparatus of three pieces which converts the stomach into a gizzard or triturating cavity. These gastric calcareous pieces have been described as a bivalve shell of a new genus.

BU'LLETIN. (Mod. Lat bulleta) In Diplomatics, a term equivalent to schedule, and variously applied to different sorts of public acts In modern times, this name has been applied, especially in France, to reports of a state of facts issued by authority, as bulletins of health, bulletins of military events, &c

BU'LLION. Uncoined gold and silver.

BULL'S EYE In Architecture, a small circular opening or window.

BULL'S NOSE. In Architecture, the external angle of a polygon, or of two lines which meet at an obtuse angle

BU'MBOAT A boat allowed to attend a ship regularly to supply the sailors with articles of provisions, clothing, &c.

BUOYS. Vessels formed of wood, cork, or some light substance, moored or anchored so as to float over a certain spot, in order to indicate the situation of a shoal or sand bank, and mark out the course a ship is to follow When used for this purpose, buoys are usually close vessels in the form of a cone, of large dimensions, in order that they may be seen from a distance; and generally painted of some particular colour, in order that they may be more readily distinguished from one another Public buoys in this country are placed by warrant of Queen Elizabeth under the management of the Corporation of the Trinity House, and the amount of revenue annually collected for their use is between 11,000*l*. and 12,000*l*. Private buoys are used for the purpose of indicating the situation of ships' anchors (to which they are fastened by a rope), in order that the ship may be prevented from running foul of the anchor, and that the anchor and cable may be recovered when the latter happens to be broken, or has been cut.

BU'PHAGA. (Gr *βους, ox, φαγω, I eat*.) A genus of Conirostral Passerine birds, of which the African beef-eater (*Buphaga Africana*) is the sole example. It derives its name from its habit of sedulously extracting from the backs of cattle the larvæ of æstri and other Dipterous insects which are deposited therein. The French name of this bird, "pique-bœuf," or "cattle-picker," more correctly denotes the peculiar habits of the bird than the scientific generic term

BUPRE'STIS. (Lat. buprestis, *a noxious insect*.) The name of a Linnæan genus of Coleopterous Serricorn insects, now the type of a family (*Buprestidæ*), including the most splendid and brilliant beetles Of this family upwards of a thousand species are known: by the French they are termed "Richards."

BU'RDEN. (Fr. bourdon, *a staff*.) In Music, the drone or bass in some musical instruments, and the pipe or string that plays it. The bass pipe in the bagpipe is so called. Hence, that part of a song that is repeated at the end of every stanza is called the burden of it.

BUREAU'. (Fr.) Originally a writing table; afterwards applied to the office of any public or private functionary where business is transacted.

BUREAU'CRATIE, or BUREAUCRACY, is the system by which the business of administration is carried on in departments, each under the control of a chief, in contradistinction to those systems in which the officers of government have a co-ordinate authority.

BURE'TTE. An instrument occasionally used in the chemical laboratory, and in the assay office, for the purpose of dividing a given portion of any liquid into 100

or 1000 equal parts. (*Gay Lussac, Instruction sur l'Essai des Chlorures de Chaux.*)

BU'RGAGE TENURE. In Law, an ancient tenure proper to boroughs; under which tenements are held of the king, or other person, at a rent certain. In several boroughs such holdings conferred the electoral franchise previous to the Reform Act.

BU'RG-GRAVE. (Germ. burg, *castle;* graf, *count.*) In the German Empire, a castellan or lord of a castle, having the right of private justice, imposing taxes, &c.

BU'RGHERS and ANTIBURGHERS. In Ecclesiastical History. Owing to an undue exercise of patronage, which took place under the authority of the church of Scotland, or to the induction of a clergyman into a parish (Kinross) against the declared sentiments of the congregation, a schism took place in the church, which occasioned a secession from that establishment, and ultimately led to what is called the Burgher and Antiburgher denominations. Several clergymen, after years of painful discussion, having protested against the violent procedure in question, and having thrown off subordination to the ecclesiastical authorities, were deposed (1740) from the office of the ministry and their parishes declared vacant. (*Gillan's Acts of Assembly*, sect. *Patronage*.) These clergymen, eight in number, though cut off from all connection with the church, enjoyed the unabated confidence of their respective congregations, who almost to a man adhered to them. Previously to their final separation from the establishment, namely, in 1733, four of that number had virtually proclaimed their independence, and had constituted themselves into an ecclesiastical court, called the *Associate Synod*. To the deposed ministers and their adherents the name of *Seceders* was applied; and hence the origin of the *Secession Church* in Scotland. And so rapidly did this body increase, that so early as 1745, they formed themselves into a synod, which consisted of three different presbyteries. But while their numbers were thus augmented, and while the sphere of their influence was rapidly extending, a breach took place among themselves, which was characterized by as much agitation and violence as that which had recently caused their ejection from the established church. The Secession Synod having instituted an inquiry into the lawfulness of certain oaths, not imposed by parliament, but generally practised, a question arose as to the nature of the oath imposed in royal burghs on persons when admitted to the privileges of a burgess. The great point of debate was, whether it was lawful for a Seceder to swear the following clause —"I profess and allow with my heart the true religion presently professed within this realm, and authorized by the laws thereof. I shall abide thereat, and defend the same to my life's end, renouncing the Roman religion called Papistry." The Synod was divided into two parties on this subject. The one contended, that though they had condemned the manner in which the established church was at present administered, they had not expressed and did not feel any objection to her standards, that, in seceding, they had not set up a new religion, but that, on the contrary, they had merely endeavoured to maintain in their original strictness and purity her constitutional principles both theological and ecclesiastical. The other party took a totally different view of the question, and insisted that the oath, being administered by members of the established church, must necessarily be taken in the sense in which it was understood by them, namely, as including all the corruption and inconsistencies that attached to that establishment, and as consequently incompatible with Seceding principles and the solemn testimony they had raised against her errors and backsliding. This dispute, which commenced at the meeting of the Synod in 1745, continued to be maintained with increasing acrimony for two years, or till 1747. The party that were in favour of the oath were called *Burghers*, the party that opposed it were termed *Antiburghers*. In vain did the Burghers offer to agree to a declaration discharging Seceders from swearing the oath as inexpedient under existing circumstances. The Antiburghers peremptorily refused any compromise, and insisted on an act being passed by the Synod declaring it sinful for a Seceder to adopt the oath. Nay, to such an extent was the controversy carried, and so violent were the opinions entertained on the side of the Antiburghers, that the ministers of this party had meanwhile made the oath a test of church communion, and had debarred from the Lord's Table such as maintained its lawfulness. At the spring meeting of the Synod in 1746, the party just named succeeded in carrying a vote to the effect that the oath was subversive of Secession principles. The Burghers protested against this decision. But at a meeting of the Synod in the subsequent year, the Antiburghers, being in a minority in a division on the same subject, withdrew in a body; Mr. Mair, one of their number, having previously protested that "hereby the Burghers had forfeited all their synodical powers, and that the whole power of the Synod devolved on himself and his party and such as clave to them." Next day, the Antiburghers held a synod composed exclusively of their own adherents, twenty-two in number, including ministers and elders, constituted themselves into a distinct and separate sect of Christians, and refused all connection or conference with the opposite party, except on the condition that the latter should appear as penitents at their bar. Nay, they libelled and cited them to this effect; but as the one party did not recognize themselves as responsible to the other, nothing resulted from the step; and the two bodies, followed by their respective congregations, constituted themselves into separate and independent churches. (*Brown's Hist. Acc. of the Rise and Progress of the Secession.*)

But, while the Secession was thus divided into two conflicting parties, the Burghers and Antiburghers, they both continued their separation from, and condemnation of, the established church. They adopted, it is true, her standards, namely, the Westminster Confession of Faith, the Catechism, Larger and Shorter, the Directory for Public Worship, and form of Presbyterian government; but they [illegible] patronage unconditionally, and vested the choice of a minister exclusively in the members of each separate congregation. Indeed, the chief practical difference that obtained between the church of Scotland and the Seceding bodies consisted in the one cleaving to patronage, and in the other having abolished that system, and introduced popular election in its stead. Besides, though the church has always been governed by kirk sessions, presbyteries, synods, and a general assembly, the Burghers and Antiburghers, owing to the comparative paucity of their numbers, never adopted a general assembly. With them the synod was the supreme court, whose authority was final in all religious and ecclesiastical matters. The Seceders also were stricter Calvinists, and adopted more rigid discipline as to admission to church-membership, and to *sealing ordinances* (baptism and the Lord's Supper), than the church party had perhaps ever done. (*Ib.*)

Both the Burghers and Antiburghers continued each as rapidly to increase after their separation as the Secession had done when it formed one body, and the animosity which had characterized their disjunction gradually subsided. Indeed, by the time that the generation which witnessed this unhappy schism had passed away, all traces of hostility or opposition had disappeared. The burgess oath, too, which had been the cause of their disunion, fell into desuetude or had ceased to be imposed. The views of the two parties being otherwise identical, and both coinciding in their opposition to the established church, it is not to be wondered at that a wish became general among the members of both parties for a re-union. Overtures to that effect were accordingly made by their respective synods; and after having had many conferences and much discussion on the subject, this happy result was, without any compromise on either side, effected in 1820, and the two bodies, now united, assumed the denomination of the *United Associate Synod of the Secession Church*. At that time, the Burgher persuasion comprehended 10 presbyteries, embracing 120 congregations; and the Antiburghers 11 presbyteries, consisting of 141 congregations. Since their union, their conjoint influence and extension have been considerably on the increase; so that at this date (1851) the Associate Synod comprises no fewer than 360 [illegible], with an equal number of ministers. They have not hitherto introduced a general assembly; nor do we hear that they intend to do so. But as they form a numerous, so they are a most respectable body of Christians; and their clergy are eminent not more for professional assiduity than for learning and talents. They are hostile to the establishment of a national church, and are in favour of what is now denominated voluntaryism. They nominate professors of divinity within their own body for the instruction of young men intended for the ministry, but these young men pursue their philosophical and literary studies at any of the Scottish Universities. Their curriculum of study, like that of the established church, extends to eight years. (*M'Culloch's Stat. Acc. of the British Empire*, vol. ii. pp. 425—7.)

BURGH MOTE. (Borough meeting.) A Saxon term for the borough court. *Burgh mote* is the title of a court of miners, held in Derbyshire.

BU'RGLARY. (Lat. burgi latrocinium, *robbery committed in a burg or fenced place.*) In Law, is the breaking and entering the dwelling-house of another in the night time, with intent to commit a felony. If the goods were actually stolen, it is usual to add a count for larceny in an indictment for burglary. This offence is punishable by transportation or imprisonment.

BU'RGOMASTER. (Germ. burgermeister, *chief of the citizens.*) The usual title of the chief municipal officer in German and Dutch towns. In the German free cities, the president of the executive council is styled burgermeister; but in many towns of importance, the title stadt-director (town-governor) has been recently substituted in its stead.

BURLE'SQUE. (Ital. burlare, *to jest.*) The Italian poesia burlesca signifies merely comic or sportive poetry;

but the term, in French and English, is more commonly restricted to compositions of which the humour consists in a ludicrous mixture of things high and low: as high thoughts clothed in low expressions; or, vice versâ, ordinary or base topics invested in the artificial dignity of poetic diction. The humour of parody or travestie (*see* PARODY) arises from the burlesque. *Burletta*, a slight comic musical drama, is derived from the same origin.

BU'RNET. A British plant, whose leaves have been used as a food for sheep. It grows on poor calcareous soils, where few other plants will succeed; and in this its principal value consists, together with its being perennial and remaining green all the winter. It is the *Poterium sanguisorba* of botanists.

BURNING GLASSES and BURNING MIRRORS. The name given to glasses or mirrors so formed as to collect the sun's rays which fall on them into a point or small surface, and thereby produce an intense heat, and set fire to combustible substances. The point at which the rays meet, and where the greatest heat is produced, is called the *focus* or *burning point*. The rays of light or heat may be concentrated either by refraction or reflection: in the former case they must pass through a transparent refracting substance, as glass formed into a proper shape; in the latter they fall on a concave polished surface of silvered glass or bright metal. Reflectors made of glass are usually termed mirrors, those of metal *specula*.

In preparing a burning glass, the first thing to be considered is the figure necessary to collect all the rays into the smallest possible space. Descartes, in his *Optics*, showed that a disk of glass, convex on the one side and concave on the other, the convex side being a portion of an elliptic surface, and the concave a portion of a sphere, would cause parallel rays falling on its convex side to converge in a single point; but the practical difficulties of forming a glass accurately into this shape are insuperable: both sides are therefore ground into portions of a sphere. In a refracting mirror the focal length depends on the curvature, or the radius of the sphere, and the refractive power of the substance of which the lens is formed; the focal length in a double convex lens of glass is exactly equal to the radius of curvature. The true form of the reflecting mirror is parabolic, and this form is frequently attempted in metal, which can be cast or hammered nearly into the proper shape, but, as in the case of the refractor, it is the spherical form only which is attempted in glass. The focal distance is equal to the radius of the concavity at the centre of the mirror.

Although the forms given by theory could be obtained in practice with mathematical precision, the solar rays could not even then be collected into a single point; the focus would still have a sensible magnitude. The reason of this is, that the rays which fall on the lens or mirror are not all parallel. Those which come from different parts of the sun's disk are very sensibly convergent, forming an angle of 32 minutes of a degree, equal to the apparent diameter of the sun. Hence the focal image must be of such a magnitude that lines drawn from its opposite edges to the centre of the lens or mirror must form an angle of 32′. Supposing, therefore, the glass or mirror to have a proper form, the space covered by the focus will be proportional only to the focal distance, and entirely independent of the magnitude of the lens or mirror. Hence it follows, that if a portion of the exterior edge of the lens or mirror were covered, the magnitude of the focal image would remain unaltered. The figure of the image is also always circular, independently of the shape of the lens; for example, if one half of the lens were covered, the image would be round as before, though the intensity of the light would then be reduced to one half.

In preparing telescopes or microscopes, where distinctness of vision is the most essential object, it is indispensable that the figure of the lens or mirror be perfectly true. In burning glasses perfect accuracy of figure is not so much required: it is only necessary that the rays be concentrated, the confusion of the image being of no consequence. The effect, however, depending on the number of rays that are brought within the limits of the focus, will necessarily be diminished by the aberration as well as imperfection of figure. When the lens is accurately constructed, and all the rays fall within the focus, the heating power of the solar rays is increased in the proportion of the square of the diameter of the lens to the square of the diameter of the focus. But it is found that, supposing the concentration the same, a much greater effect is produced by a focus of considerable magnitude than a very small one. A glass, for instance, of two inches diameter, with a concentrating power of 300, will produce a much feebler effect than another six inches diameter of the same power; the latter will inflame paper in two or three seconds, while the former will hardly inflame it at all. The reason is that when the heat is concentrated in a very small space it is rapidly dispersed into the surrounding mass; as the focus is increased the accumulation increases in a greater ratio than the dispersion, and the temperature rises. Hence a body in a mass of charcoal, or other substance of very slow conducting power, is fused much more readily than when exposed on all sides to the atmosphere, or imbedded in metal.

The method of exciting heat or producing fire by the concentration of the sun's rays was known from remote antiquity; but the most famous recorded achievement of this kind is that of Archimedes, who is reported to have burned by means of mirrors the Roman fleet in the harbour of Syracuse. Considerable doubts have prevailed respecting the truth of the relation, chiefly grounded on the circumstance that although the setting fire to the fleet is positively affirmed by Dion, Diodorus Siculus, Pappus, and others, no mention is made of it by Livy, Polybius, or Plutarch, who are otherwise minute in detailing the mechanical contrivances of Archimedes, and who were not likely to pass over so notable an occurrence without notice. Descartes went so far, indeed, as to treat the whole relation as fabulous, affirming the thing to be impracticable. Its practicability was, however, experimentally demonstrated by the celebrated Buffon, who, by a combination of plane reflecting mirrors, produced results which must be regarded as of still greater difficulty. With 168 mirrors, each about 6 inches square, he set fire to planks of beech 150 feet distant, and with the faint rays of the sun at Paris in the month of March. It is not necessary to suppose that Archimedes could not place his apparatus within that distance of the fleet of Marcellus, besides, by multiplying the number of mirrors, the concentration of the rays may be increased almost to any extent. All this, however, does not prove the actual fact related of Archimedes. Buffon, with all the resources afforded by the advanced state of the arts in the middle of the 18th century, and after a number of experiments, succeeded, with considerable difficulty, in constructing an apparatus by means of which he could inflame combustible substances at a considerable distance. The low state of the arts in the time of Archimedes must have rendered the undertaking considerably more difficult. The silence of those historians who have detailed his other mechanical contrivances can hardly be accounted for, supposing the relation to be true. It seems, therefore, that though something of the kind was contemplated, and to a certain extent practised, the effect has been much exaggerated.

Among those who have amused themselves, in modern times, with the effects of burning glasses or mirrors, are reckoned Baron Napier, the illustrious inventor of the logarithms, Kircher, Dr James Gregory, Sir Isaac Newton, and numerous others. The most powerful solid lens ever constructed was the work of Mr Parker, an ingenious London artist. It was made of flint glass, was 3 feet in diameter, 3¼ inches thick at the centre, its focal distance 6 feet 8 inches, the diameter of the burning focus 1 inch, and its weight 212 pounds. The rays refracted by this lens were received on a second, the diameter of which in the frame was 13 inches, and its focal length 29 inches. The diameter of the focus of the combined lenses was half an inch; consequently, by the addition of the second lens, the burning power was increased four times. With this lens some of the most refractory substances were fused in a very short space of time. for example, 10 grs. of common slate in 2 seconds; 10 grs of cast iron in 3 sec; 10 grs of lava in 7 sec., 10 grs. of jasper in 25 seconds, &c. This glass was afterwards carried to China by one of the officers who accompanied Lord Macartney, and left at Pekin. (For detailed information on this subject, the reader may consult the article BURNING GLASSES in the *Ency Brit.* 7th edition.)

BU'RSARS. (Lat. bursa) Originally clerks or treasurers in convents: in more modern times, persons enabled to prosecute their studies at a university by means of funds derived from endowments. It is a singular circumstance that the latter acceptation of this term originated among the Poles, who, even in the 14th century, were accustomed to supply young men of talent with the means of travelling to Germany, and there studying philosophy under the guidance of the monks. This practice was soon adopted by other nations; and, there is now perhaps, no civilised country in which it does not exist, under the name of bursaries, fellowships, exhibitions, scholarships, &c. These endowments are of two kinds: either furnishing the student with the means of prosecuting his studies during the academical curriculum; or enabling him to devote himself, without distraction, to literary pursuits even after the expiration of this period. The Scottish and the Continental universities have adopted the former method; but at Oxford and Cambridge both kinds prevail. The following statistical observations on this subject, in reference to the principal universities of England and Ireland, are extracted from a paper compiled by the Rev. H. L. Jones, M. A., from the most authentic private as well as public documents, and read at Newcastle in August 1838, before the British Association for the Advancement of Science: — In Oxford

there are 24 heads of colleges with a revenue of 18,350*l.*; 557 fellows with 116,560*l.*; 393 scholarships with 6,030*l.*; 199 college officers with 15,650*l.*; 885 benefices and incumbents with 136,500*l.* The revenues of Cambridge, containing 17 colleges, are for an equal number of heads 12,650*l.*; 431 fellows, whose revenue is 90,330*l.*; 793 scholarships with 13,390*l.*; 179 college officers with 17,750*l.*; 252 prizes of the value of 1,038*l.*; 591 benefices and incumbents with 93,300*l* In Dublin the head of Trinity College receives 2,000*l.*; 25 fellows, 25,400*l.*; 70 scholars, 2,100*l.*; 10 college officers, 20,000*l.*; 62 benefices and incumbents, 9,300*l.* These honours, however, are not open to general competition, being restricted in most cases, by the will of the testator, to natives of certain countries, or to the alumni of particular schools.

At Edinburgh University there are but few bursaries. George Heriot's Hospital (the most wealthy institution in Edinburgh) grants ten bursaries of 20*l.* per annum each, for four years, to individuals not connected with the hospital, who, after a comparative trial before a committee of the governors of the institution, are found duly qualified. There are, besides, a few bursaries of 7*l.* and 10*l.* each, given by the city of Edinburgh to students in the first year of their academical course; two of 10*l* each to students named Stewart in the second year, and one of 100*l.* to a student selected from those called M'Pherson in the fourth year To these may be added two ancient bursaries instituted for the benefit of Poles resident in Scotland, which, after lying dormant upwards of a century, were discovered and brought to light in 1837. At St Andrews, there are several bursaries in the gift of the university, and at Aberdeen, besides the interest of 7000*l.* devoted to the maintenance of certain students at that university, there are a few valuable exhibitions to Cambridge At Glasgow the most important endowments of this kind are a few exhibitions to Oxford, and those left by Dr. Williamson for Englishmen not connected with the established church. In France and Italy there are no bursaries allowed for the maintenance of students; but any individual, on the payment of a trifling sum, may frequent all the lecture rooms of the professors, who of course are maintained by government

But it is in Germany that the system of bursaries is in full vigour. There every faculty in the different universities, every public academy, every cloister (for cloisters are still maintained even in the Protestant parts of Germany, though not for the education of priests), every noble family of importance, have bursaries, or, as they are called, Freytische (free tables), at their disposal These vary in value from 10*l.* to 40*l.* a year, and cease at the expiration of the literary curriculum. As the different bodies or individuals in whom the presentation to these emoluments is vested may select the beneficiary at pleasure, little regard is paid to the real merit or the necessitous condition of the latter.

Whether endowments tend to the promotion of science and learning, is a question that is often discussed, but has not hitherto been solved. Those who maintain that endowments are prejudicial found their arguments on the well-known axiom of Smith, — that in no employment ought the competition to be increased beyond what it naturally demands. Now, as endowments allure into the learned professions, and particularly into the church, a host of individuals who would otherwise have adopted a different occupation, the unavoidable consequence is that the market is glutted, and the supply becomes greater than the demand. Besides, there are and ever will be sufficient numbers to work of their own accord in the accumulation of learning, and this spontaneous industry will be sufficient to keep up an adequate supply to be distributed throughout the country; for supply always equals demand, and demand is always commensurate with the real wants of the people. On the other hand, the advocates of endowments, while they admit the correctness of the above-mentioned axiom as a general rule, maintain that there are many exceptions. In every scientific occupation, they allege, the profits should be proportioned to the time and the labour bestowed in its prosecution. Now, from abstruse studies, such as the higher branches of mathematics, metaphysics, and classical literature, no adequate remuneration results; so that none but the wealthy can pursue these studies, and a reference to history will prove that this class has not been the foremost in classical or scientific attainment Hence external encouragement is necessary at once to compensate for that want of remuneration to which such studies are exposed, and to divert into this channel a mass of applicable talent which would otherwise be turned to pursuits of more immediate profit and attraction.

BU'RSCHE. (Germ.) A youth, especially a student at a university.

BU'RSCHENSCHAFT. A league or secret association of students, formed in 1815, for the purpose, as was asserted, of the political regeneration of Germany, and suppressed, at least in name, by the exertions of the governments.

BURSCHEN COMMENT. The code of laws adopted by the students for the regulation of their demeanour amongst themselves, &c.

BURSERA'CEA. A natural order of fragrant trees and shrubs inhabiting the tropical parts of the world. They all are resinous and fragrant, although related botanically to Rhamnaceous plants which have no such properties. Indian frankincense, olibanum, colophon, the balsams of Acouchi, Gilead, and Mican, gum elim, and other similar substances, are obtained from plants of this order; besides oil, pitch, and turpentine, resembling the vegetable secretions bearing those names in Europe. They all have alternate unequally pinnate dotless leaves, and racemes or panicles of small green flowers. Their fruit is usually a drupe.

BURTHEN, or BURDEN, OF A SHIP. The weight of merchandise, &c. she is intended to carry. *See* TONNAGE.

BU'SHEL. An English measure of capacity, containing 8 gallons. By act of parliament, 5 George 4. c. 74., the Imperial gallon is declared the standard measure of capacity, and is directed to be made such as to contain 10 lbs avoirdupois of distilled water, weighed in air at the temperature of 62° of Fahrenheit's thermometer, the barometer standing at 30 inches; or to contain 277 cubic inches and 274 thousandth parts of a cubic inch. Consequently the Imperial bushel contains 80 lbs. of distilled water, or 2218·192 cubic inches.

By the same act the bushel is declared the standard measure of capacity for *coals*, *culm*, *lime*, *fish*, *potatoes*, or *fruit*, and all other goods or things commonly sold by heaped measure, and is prescribed to contain 2815 cubic inches, the goods to be heaped up in the form of a cone to a height above the rim of the measure of at least three fourths of its depth.

The Winchester bushel, used in this country from the time of Henry VII. to 1826, contained 2150.42 cubic inches. The Imperial bushel is therefore to the Winchester bushel as 2218·192 to 2150 42, or as 1 to ·969417. Hence to convert Winchester bushels into Imperial, multiply by 969447. *See* MEASURES

BU'SHMEN. (Dutch, Bosjesmannen, *men of the wood*) A name given by the Dutch colonists to some roaming tribes akin to the Hottentots, in the vicinity of the Cape of Good Hope. The description given by Governor Janssens of this people is very interesting So deep are they sunk in barbarism as to be unacquainted even with the construction of huts or tents: "the burning sky being their canopy, and the scorching sand their bed." They are of a dark copper complexion, small in stature, and of a singularly malicious, wild, and intractable disposition.

BUSI'RIS. In Egyptian Mythology, a fabulous personage, of whose origin, exploits, and character Apollodorus, Herodotus, Diodorus Siculus, and other ancient writers have given a most discrepant account. His history is so intimately blended with that of Osiris, that we must refer the reader to that article for further particulars.

BU'SKIN. (Probably bootikin, or *little boot.*) A species of covering for the leg, or rather for the ancle and foot. generally used by English writers as a translation of cothurnus, caliga, and various other Greek and Latin words denoting different kinds of boots, &c. Hence *buskin*, in the sense of *cothurnus*, stands for the tragic drama, that species of dress having been worn in antiquity by tragic actors, in contradistinction to *soccus*, the boot or sock worn by comedians, and used for the comic drama.

> Great Fletcher never treads in *buskins* here,
> Nor greater Jonson dares in *socks* appear.
>
> DRYDEN.

BUST or BUSTO. (It. busto.) In Painting and Sculpture, the head, breast, and shoulders of the human figure

BU'STARD. *See* OTIS.

BU'TTER. (Gr. βουτυρον, from βους, *a cow*, and τυρος, *cheese* or *coagulum.*) The oily part of milk: 100 parts of cream contain about 4·5 of butter and 3·5 curd; they are separated by the process of churning, during which the butter aggregates. Butter soon becomes sour and rancid, unless purified by melting and straining it so as to separate adhering curd; it is generally preserved by the addition of salt. Its *claim* or oily part has been called *butyrine*. When converted into soap it is said, in addition to the usual products, to afford three odorous volatile compounds, which have been termed by Chevreul the *butyric*, *caproic*, and *caprone acids*.

BU'TTERFLY. The common English name of an extensive group of insects, as they appear in their last and fully developed state, when they constitute the most beautiful and elegant examples of their class. These insects belong to the order *Lepidoptera*, and to the section *Diurna* of Latreille, or the genus *Papilio* of Linnæus. (See those words.)

The changes of an animal form produced by the progressive expansion of the inclosed organs of the body,

and the successive shedding of the outer case or skin, are in no instances so striking or so extraordinary as in the present group of insects. These changes or metamorphoses, as they are commonly but incorrectly termed, have been a favourite theme to the divine and the poet, and a most attractive subject of research to the naturalist. The transition of the humble grub to the gorgeous imago is the subject of the following beautiful passage in the classical work (the *Introduction to Entomology*) of Kirby and Spence: — "Were a naturalist to announce to the world the discovery of an animal which for the first two years of its life existed in the form of a serpent; which then, penetrating into the earth, and weaving a shroud of pure silk of the finest texture, contracted itself within this covering into a body without external mouth or limbs, and resembling more than any thing else an Egyptian mummy; and which, lastly, after remaining in this state, without food and without motion, for three years longer, should at the end of that period burst its silken cerements, struggle through its earthy covering, and start into day a winged bird, — what, think you, would be the sensation excited by this piece of intelligence?" The subterraneous locality of the insect in its passive state, and the silken shroud, are, indeed, less applicable to the butterflies than to other insects; but the circumstances attending the transformations of these beautiful objects are not less remarkable than those of the beetles and moths.

The eggs of the butterfly are deposited on such plants as afford the nutriment most appropriate to the caterpillars that are to be excluded from them; thus the common white butterfly (*Pieris brassicæ*, Latr.) and other species oviposit upon cabbages, and hence have been termed *Brassicariæ*: the gaudy peacock-butterfly lays her eggs upon the nettle. The eggs are coated with a glutinous secretion as they are excluded from the parent, and thus provided with the means of adhesion to the leaves or stems of the plants selected.

The larvæ are long and cylindrical, and consist of thirteen segments, including the head; they have eight feet, and nine spiracles on each side. Those feet which are attached in pairs to the first three segments of the trunk inclose the parts which are developed into the permanent legs of the future butterfly, the remaining five pairs of feet are membranous, short and thick, and are finally lost with the moultings of the skin, whence they are called "pro-legs" by Kirby. The sides of the head are studded with twelve simple globular eyes, extremely minute, and very unlike the single large compound eye of the perfect insect. The mouth is provided with an apparatus characteristic of the mandibulate class of insects, having a pair of large and strong horny jaws working in a horizontal plane, and representing the "mandibulæ," beneath these a pair of smaller and softer jaws or "maxillæ," and a fleshy lower lip or "labrum" united to the latter, and which is perforated by the outlets of the ducts of the complicated apparatus for secreting the silk. Such a condition of the 'instrumenta cibaria" or mechanism of the mouth is in perfect harmony with the habits of the caterpillar, and with the part assigned to this larva or masked Lepidopterous insect in the great theatre of nature. It is there destined to crop and devour the solid succulent parts of the otherwise too luxuriant vegetation, and must have jaws and teeth to perform its task. In its subsequent and final character the butterfly luxuriates on the exquisitely elaborated juices of the flower, and has the power to raise itself above the dull earth, and to transport itself through aerial space.

> Where he arriving round about doth fly
> From bed to bed, from one to other border,
> And takes survey, with curious busy eye,
> Of every flower and herb there set in order.
> Now this, now that, he tasteth tenderly,
> Yet none of them he rudely does disorder,
> Ne with his feet their silken leaves deface,
> But pastures on the pleasure of each space.
>
> SPENSER.

But to exchange a solid for a fluid diet, the instruments of mastication must be converted into those of suction, and the mandibulate insect be transformed into the haustellate one. This is effected by an excessive elongation of the maxillæ, which are grooved each on that side which is turned towards its fellow, and, by the union of their opposed margins, these grooves are converted into a capillary canal, by which the nectar is pumped up into the mouth. When not in action, this siphon is coiled up in a series of spiral turns, and is protected by the other parts of the mouth, which retain their rudimental condition. The nymphs are almost always naked, and of an angular form; they are generally suspended by the tail, and reflect more or less of a golden lustre, whence they are termed *chrysalides* and *aureliæ*. Reaumur has given the best account of the singular operations by which the butterflies attach their aurelian cases to the points of suspension, and afterwards extricate themselves from these cases when their transformation is completed.

Some butterflies have all their six feet in the imago state well developed, and alike in both sexes; and the chrysalis, in addition to the ordinary terminal or posterior attachment, is looped up in a horizontal position by a silken band or sling passing round the body. The internal margin of the hinder lower pair of wings is concave or folded, and the tarsal hooks or spurs are well developed. These are the butterflies proper, the *Papiliones equites* of Linnæus. Those "knights" which bear red spots on the chest are the "Trojans" of Linnæus, and those without red spots on the chest bear the name of the Grecian heroes. Some of these butterfly-knights have the anterior pair of feet remarkably shorter than the others; and this arrest of development would seem to be compensated by greater powers of flight. The butterflies of the section thus characterized, or the *Nymphalidæ*, are also remarkable for the brilliancy of their colouring. Numerous other sections and subdivisions have been founded by modern entomologists upon characters afforded by modifications of the antennæ, palpi, and other parts. In the "Plebeian" butterflies of Linnæus the larvæ are oval, the chrysalides short, and the tarsal spurs of the imago are extremely small.

BU'TTER TREE. A remarkable plant found by Park in the interior of Africa, especially in Bambarra, yielding from its kernels, by pressure, a white, firm, rich butter, which, even in that climate, will keep well for a year without salt. Another species is the Phulwara tree of India (*Bassia butyracea*), whose seeds produce a firm, agreeable, buttery substance, of about the consistence and colour of hog's lard, it is used medicinally in rheumatic affections. The Illupie tree of Coromandel (*Bassia longifolia*), and the Madhuca tree of Bengal (*Bassia latifolia*), are other species having similar properties. They are large tropical trees, belonging to the natural order *Sapotaceæ*, and their timber is sometimes of excellent quality.

BU'TTERS, MINERAL. A name given by the old chemists to some of the *chlorides* on account of their soft butyraceous texture when recently prepared, such as *butter of antimony*, *of arsenic*, and *of bismuth*.

BU'TTERS, VEGETABLE. The concrete fixed oils, such as those of the cocoa and chocolate nuts, of the nutmeg, &c., which are solid at common temperatures, are often distinguished by the above term.

BU'TTON. The round mass of metal collected at the bottom of a crucible after fusion, or which remains in the cupel in the process of assaying, is called by this name.

BU'TTRESS. (Fr. *aboutir*, *to lie out*.) In Architecture, a mass of brickwork or masonry, built to resist the horizontal thrust of another mass. Buttresses are much used in Gothic architecture, to resist the thrust of the vaulting which covers the naves and aisles of cathedrals. When open they are called flying buttresses.

BUTTS. Short ridges of different lengths, which necessarily occur in the angle of a field when the direction of the ridges is not parallel to one of the sides.

BU'ZZARD. *See* FALCO.

BY'ARD. A piece of leather crossing the breast, used by the men who drag the sledges in coal mines.

BY-LAWS, or BYE-LAWS. (The first syllable from the Danish By, *town* or *hamlet*.) Orders and constitutions of corporations, courts-leet and courts-baron, commoners, or inhabitants of vills, &c., of which the effect is to impose obligations not enforced by common or statute law. The validity of by-laws rests on the authority of the parties making them, established either by immemorial custom, or by their corporate character; for the power of making by-laws is inherent in a corporation. But the superior courts of law have the power of annulling a by-law, if it be unreasonable, or in restraint of trade, or imposing a charge without any apparent benefit to the party, &c. By the Municipal Corporations Amendment Act (5 & 6 W. 4. c. 76. s. 90.) by-laws are to be made by the town council of the borough, and to be valid unless disallowed by the king in council within forty days.

BYRE. A word used in Scotland for a cow house.

BY'RRHUS. A Linnæan genus of minute Clavicorn Coleopterous insects, now the type of a family, including those pests of museums which feed in the larva state on bird-skins, preserved insects, &c. The genera in this family are *Byrrhus* proper, *Simplocaria*, *Oomorphus*, *Syncalapta*, *Nosodendron*, *Aspidiphorus*, *Trinodes*, and *Anthrenus*. Of the latter genus there are six British species, of which the *Anthrenus musæorum* may be regarded as the type.

BY'SSIFERS, *Byssifera*. (Lat. Byssus, and fero, *I carry*.) A family of Lamellibranchiate Acephalous Mollusks, comprehending those species which are attached to foreign bodies by means of a byssus.

BY'SSOLITE. (Gr. βυσσος, *flax*, and λιθος, *a stone*.) A soft fibrous mineral from the Alps.

BY'SSUS. (Gr. βυσσος, *fine flax*.) A fasciculus of shining semitransparent horny or silky filaments, secreted by a gland at the base of the foot in certain Lamellibranchiate Bivalves, and serving as an organ of adhesion to submarine rocks or other foreign bodies.

BYSSUS. A name formerly given to all those filamentous plants which inhabit cellars and other under-

ground close places, and on which no fructification is found; it was also applied to vegetation of a similar kind when found growing in the air. It is now certain that a large number of these supposed plants are merely the young state of certain kinds of fungi, or other plants of a low organization; and, although a few species are still retained in the genus, as *Byssus floccosa*, and others, it is by no means certain that they are really of a different nature.

BYZA'NTINE HISTORIANS. A series of Greek historians and authors, who lived under the Eastern Empire between the 6th and the 15th centuries. They may be divided into three classes. 1. Historians whose works form a continuous history of the Byzantine Empire from the fourth century of the Christian era down to the Turkish conquest of Constantinople. They are nearly thirty in number, with various shades of literary merit; but their works constitute the almost only authentic source of the history of that eventful period. 2. General chroniclers or historians, whose works, embracing a wider range than those of the former, treat chiefly of the chronography of the world from the oldest times. 3. Authors who confined their attention to the politics, statistics, antiquities, manners, &c. of the Romans. These two classes combined amount also to about thirty, and their writings give an excellent illustration of the times of which they treat, whether as historians, chroniclers, antiquaries, or politicians. The works of the Byzantine historians, &c. were collected and published by order of Louis XIV. in 36 vols. folio, Paris, 1645-1711. Another and more complete edition was published at Venice in 1729 and the following years. Besides these many of the Byzantine historians were published separately at different places. But all that had previously been done to evince the importance of these historians, by the publication of their works, was destined to be eclipsed in our own times. The late professor Niebuhr of Bonn, eminently fitted for the task by his attainments both natural and acquired, projected a new edition of the Byzantine Historians (*Corpus Scriptorum Historiæ Byzantinæ Editio emendatior et Copiosior*, 8vo. Bonnæ, 1828), which he superintended till his death. Upwards of 31 volumes have already appeared, and the editorial management of the work is entrusted to Becker, Dindorf, and other distinguished philologists.

# C.

C, the third letter of the English and most other European alphabets, is borrowed immediately from the Latin alphabet, in which it first appears, but is derived originally from the κ or γ of the Greeks. In English it is pronounced like *s* before *e* and *i*, and like *k* before *a*, *o*, *u*, and may consequently be considered as superfluous in the alphabet. According to orthographers there are few letters so susceptible of interchanges as this letter, and much ingenuity has been expended in exhibiting its convertibility. As an abbreviation, C is used in ancient MSS. for Caius, Cæsar, Consul, Civitas, &c., and as a numeral for a hundred. It was the symbol of condemnation in the Roman tribunals (being abbreviated for *Condemno*), and was consequently termed *litera tristis*, in contradistinction to A (used for *Absolvo*), symbolical of acquittal, and thence called *litera salutaris*.

C. In Music, the name of one of the notes in the scale. It is a character also used for the signification of the time. *See* MUSIC.

CAA'BA. The famous square stone in the temple of Mecca, the object of the adoration of the entire Mohammedan world. According to the tradition of the Arabs, it is the first spot on earth which was consecrated to the worship of the Deity, having been presented by the angel Gabriel to the patriarch Abraham on the occasion of the building of the temple. As is well known, Mohammed enjoined all his followers to visit the shrine of Mecca once in their lifetime, and to preserve continually on their minds a sense of their obligation to perform this duty, he directed that in all the multiplied acts of devotion which his religion prescribes, true believers should always turn their faces towards this holy place, called Kebla. It may be added, that the eastern authors frequently designate the temple in which the square stone is concealed, with all its appendages, as Caaba.

CA'BAL. (Fr.) In History, was applied originally to the five cabinet ministers of Charles II.—Clifford, Ashley, Buckingham, Arlington, and Lauderdale—whose initials happened to form the word; and it has since been used for a junto of individuals, who, too insignificant in point of numbers to form a party, endeavour to effect their purposes by underhand measures.

CA'BALA. A Hebrew word signifying the oral tradition which the Rabbins conceive to complete the system of scriptural interpretation. They maintain that it was delivered in the first instance to Adam, and again to Abraham and Moses, by direct revelation; but that since the time of Esdras the memories of the priests and elders have sufficed to preserve it in all its purity. As the Masora details the literal explanation of the language of scripture, so the Cabala reveals the hidden truths of which it is the symbol. Every sentence, word, and letter of the inspired volume contain, according to these interpreters, a figurative as well as a direct sense. The former is also not uncommonly manifold; and a word may be interpreted according to the arithmetical power of the letters which compose it, which species of cabala is called *gematria*; or according to the meaning of each individual letter, the entire word thus constituting a sentence, which is called *notaricon*, or finally according to certain transpositions of the letters, which is denoted by the term *themurah*. What the mysterious doctrines of the cabala which were thus discovered actually were, is not very clearly ascertained; but the system seems to have been an invention of the philosophising Jews of the latter centuries preceding our era, with the view of accommodating the speculations of the Gnostics to the religion of the Old Testament.

The Christian cabalists in later times practised a kind of magic under this name, pretending to the power of divination by certain combinations of scriptural characters.

CABA'LLUS. In Mythology. *See* PEGASUS.

CABIÄ'I. In Zoology, the name under which the Capibara or water-hog (*Hydrochorus capibara*, Erxl.) is described by Buffon. *See* CAPIBARA.

CA'BINET. In Politics, the governing council of a country: from the cabinet or apartment in which the ruler transacts public business and assembles his privy council. In England a few of the ministers only are *ex officio* members of the cabinet. The ministers who are raised to this honour are styled by way of eminence Cabinet ministers, and are more immediately responsible for the acts of the sovereign, as well as for public measures. The distinction between the king's cabinet ministers and the rest of his privy council seems not to have been established in public usage in England before the reign of William III.

CA'BIRI. In Pagan Mythology, sacred priests or deified heroes, venerated by the Phœnicians originally as the founders of religion. Various opinions have been entertained concerning the nature and origin of the Cabiri; but from the multiplicity of names applied to them, together with the profound secrecy observed in the celebration of their rites, an almost impenetrable veil of mystery has been thrown around their history. They seem to have been men who, having communicated the art of melting metals, &c., were deified by a grateful posterity. Their worship was chiefly cultivated in the island of Samothracia, whence it was afterwards transferred to Lemnos, Imbros, and certain towns of Troas. (*Strabo*, x. 473.) They were styled the offspring of Vulcan, though their name was derived from their mother Cabera, daughter of Proteus. Their number is variously given. Those who were initiated in their rites were held to be secured against all danger by sea and land. Their distinguishing badge was a purple girdle. An ingenious account of the Cabiri has been given by Professor Muller of Gottingen, in a dissertation appended to his work on Orchomenus, wherein he rejects the Phœnician or oriental origin of the Cabiri, and regards their worship as purely Pelasgic, and down to a certain point the principal religion of the Greeks.

CA'BLE. (Gr. καταλιον, *a rope*.) The rope or chain by which the anchor of a ship is held. Cables in Europe, until within a recent period, were usually made of hemp, but of late years iron chains have come much into use. A hempen cable of 12 inches girth, and length 120 fathoms, weighs 3075 lbs. Since the weights of two cables of equal lengths will be as their sections, or squares of the girths, it is easy to deduce the following rule for the weight of any hempen cable.—Multiply the square of the girth in inches by 21 3 (or 21 nearly enough), the product is the weight in lbs. Since also as the breaking strain, or resistance against the force to part the cable, will be as the section, it will be as the weight, and will be found nearly by dividing the weight in lbs. by 100; the quotient is the breaking strain in tons. This rule is of course liable to great uncertainty from the quality or wear of the cable. Chain cables possess great advantages over hempen cables, they are not liable to be destroyed by chafing on rocky grounds, nor to become rotten and insecure from alternate exposure to the air and water; and by reason of their greater weight the strain is exerted on the cable rather than on the ship. In order that the ship may be enabled to let slip her cable in case of necessity, chain cables are furnished with bolts at distances from each other of a fathom or two, which can be readily withdrawn. A chain of which the section is 1 inch in diameter breaks with 16 tons; such a chain is equivalent to a 10 inch hemp cable nearly. And the dimensions of the chain cable corresponding to any hemp cable are therefore easily found by merely dividing the circumference of the hemp

cable by 10. The strength of every part of the chain is proved before it leaves the manufactory. The first patent for a chain cable was taken out in 1808 by Mr. Slater, a surgeon in the Royal Navy.

CA'BLED. In Architecture, the filling up the lower part of the flute of a column with a cylindrical piece like a cable.

CABO'MBEÆ. (Cabomba, the name of one of the genera.) In Botany, the name given by Richard to the natural order now called *Hydropeltideæ*.

CA'CHALOT. In Ichthyology, a name for the spermaceti or sperm whale (*Physeter macrocephalus*, Linn ).

CACHE'T, LETTRES DE. In France, under the ancient government, letters signed with the private seal (cachet) of the king. As warrants for the detention of private citizens, they appear to have been rarely employed before the 17th century. In the reign of Louis XIV. their use became frightfully common. But in other respects they had been not unfrequently made use of, even in earlier times, to interfere with the course of justice; as, by way of injunction to a party not to exercise certain authority, or pursue certain legal steps, &c. Lettres de cachet were never so multiplied as under the administration of Cardinal Fleury: not less than 80,000 are said to have been issued, without any legal judgment, in the proceedings against the Jansenists Fifty-nine are said to have been issued against the family Mirabeau in the reigns of Louis XV. and XVI., of which twenty-two against the famous count himself So scandalously were they abused, that there is an instance of a countess obtaining one for the imprisonment of her maid, who had repeated some scandal against her! They were abolished Jan. 15. 1790.

CACHE'XIA. (Gr. κακος, *bad*, and ἕξις, *a habit.*) A bad state or habit of body, whence the term *cachexiæ*, or cachectic disorders.

CA'CHOLONG A milk-white chalcedony, originally found on the borders of the river Cach in Bucharia. Cholong, in the language of the Calmucks, is said to signify a stone.

CACHU'NDE. A celebrated Chinese medicine, composed chiefly of aromatic stimulants.

CA'COD E'MON. (Gr. κακοδαιμων, *an evil spirit*) *See* DÆMON.

CACO'PHONY. (Gr. κακος, *bad*, and φωνη, *a sound.*) In Rhetoric, a defect of style, consisting in a harsh or disagreeable sound produced by the meeting of two or more letters or syllables, or by the too frequent repetition of the same letters or syllables. *e g.*

And oft the ear the open vowels tire. — POPE

CACTA'CEÆ. (Cactus, one of the genera ) A small natural order of Exogens, remarkable for their gay and large flowers, and for the grotesque forms of some of the species. They are found wild in hot dry countries, in arid situations, where they are enabled to exist because of the thickness of their skin, which allows very little moisture to be lost through it. Many of the species are like succulent Euphorbias, from which they are however known by their not milking when wounded. All the species are harmless; some have eatable fruit, and one, the *Opuntia cochinillifera*, is the favourite haunt of the cochineal insect.

CA'CUS. In Fabulous History, the son of Vulcan, a robber of Italy, whose dwelling was in the Aventine wood His exploits form the subject of a fine episode in the 8th book of the *Æneid* He was represented as a frightful monster of enormous strength, who, after a long life of crime, was at length slain by Hercules, from whom he had stolen some oxen To express his gratitude for his victory, Hercules erected the *Ara Maxima;* and Evander, with his infant colony of Arcadians, performed divine honours to Hercules as their benefactor.

CA'DDICE-WORMS, or CASE-WORMS. The larvæ or grubs of the Trichopterous insects are so called, on account of being inclosed in a sheath or case. This is always composed of extraneous substances glued together by a cement excreted from the skin of the grub; and different species of the caddis-worm protect themselves by means of different materials thus joined together. Some, which pass their larva state under water and creep along the bottom, combine bits of sticks or rushes with small pebbles or shells, to make their cases heavier than water; others, which float on the top and gather their food from thence, form a slight and slender tube of a narrow slip of grass, which is rolled round the body in a spiral direction, with the edges so nicely fitting as to seem but one piece. In every case the worm adheres by a pair of hooks at its hinder extremity to the bottom of the sheath, and only protrudes the head and two following segments, the skin of which is harder than that covering the rest of the body. Those which creep at the bottom drag themselves along by means of their mandibles. At the conclusion of their existence as grubs, they moor their case to some large stone or other fixed and submerged body, and close the outlet by a net-work of silken threads, which prevents the entry of any inimical intruder, but admits the water necessary for respiration. They then cast their outer skin, and for a while remain in the usual passive condition of a pupa; and now the organizing energy is vigorously effecting the wonderful changes which lead to the full perfection of the insect. But, as it would be obviously dangerous to the air-breathing imago to be excluded in its first feeble state under water, the pupa here exhibits a locomotive power which is without a parallel in other orders of the metamorphotic insects: being provided with a pair of small and sharp hooks at the head, it cuts the threads with which in a previous state it had confined itself, and creeping out of the water casts off its pupa skin, and emerges a May-fly or *Phryganea*.

CA'DENCE. (Ital cadenza, *a falling.*) In Music, the conclusion of a song, or of some parts thereof, in certain places of the piece, dividing it as it were into so many numbers or periods. The cadence takes place when the parts fall or terminate on a note or chord naturally expected by the ear, just as a period closes the sense in the paragraph of a discourse. A cadence is either perfect or imperfect. The former when it consists of two notes sung after each other, or by degrees conjoined in each of the two parts, the harmony of the fifth preceding that of the key note; and it is called perfect, because it satisfies the ear more than the latter. The latter imperfect; that is, when the key note with its harmony precedes that of the fifth without its added seventh. A cadence is said to be broken or interrupted when the bass rises a major or minor second, instead of falling a fifth.

CADE'T. (Fr ) A pupil in a military academy, whose aim is to qualify himself, by a due course of study, to enter the service of Her Majesty or that of the East India Company as an officer of the line, artillery, or engineers. In this country there are three grand institutions for the education of cadets Sandhurst for the British line; Woolwich for the artillery and engineers, and Addiscombe for the Indian army, both line and artillery. The academy at Sandhurst was instituted by George III for the purpose of affording general and professional instruction to the sons of private or military gentlemen, with the view of their obtaining commissions in the British army without purchase Before the commission is conferred, the cadet must undergo an examination before a competent board in the classics, mathematics, military drawing, &c. The expenses of this academy were formerly defrayed by government, but a change was recently introduced, by which the sons of private gentlemen must pay an annual sum of 125*l*, and the sons of general or other officers less sums in proportion to their rank

The academy at Woolwich was established with the view of qualifying cadets for the artillery or engineers; and to this institution the master-general of the ordnance has the sole right of granting admission As the nature of the establishment at Woolwich requires the prosecution of a more strict and professional course of study than at Sandhurst, the attention of the cadets is specially directed to geography, general history, ancient and modern, modern languages, military drawing and surveying, mathematics; engineering and fortification After the lapse of four years, generally, the cadets undergo an examination in the above-mentioned branches of science; when the most distinguished are selected for the engineers, the others for the artillery And here it may be observed, that not merely the cadet academy, but the whole vast establishment at Woolwich, its arsenal, its repository, its laboratory, are component parts of one and the same great school of military science

As the college of Addiscombe is established for the education of officers of the line, artillery, and engineers for the Indian army, the plan of instruction pursued there combines the two systems adopted at Sandhurst and at Woolwich. In order to become a cadet in this institution, it is necessary to have the promise of a commission from a director of the East India Company, and after a prescribed examination, an appointment is obtained in one of the branches of the Indian army, according to the merit or pleasure of the cadet. We may here incidentally remark, that no cadet, even after being thoroughly versed in the theory of military science, is suffered to join the engineers either of the Queen's service or that of the E I. Company, before he has gone through a regular course of practical instruction in sapping, mining, and the whole processes of a siege, as well as in other departments of field engineering, pontooning, the construction of military bridges, &c, in the admirable establishment for these purposes at Chatham. (*United Service Jour* )

In France the academies for cadets which existed previously to the French Revolution have been merged in the Polytecnic schools.

The Dutch possess two institutions of this nature; one at Breda, the other at Delft.

In the United States there is one on nearly the same principle as that at Addiscombe.

In Germany every small state has a military school:

while those at Berlin, Vienna, and Munich are on so extensive a scale as to challenge a comparison with any similar institutions in Europe. In Germany, too, the word cadet has a wider signification than in this country, being applied to those persons who, without having frequented a military school, join the army in the expectation of obtaining a commission when they have gained a competent knowledge of the service.

In Russia there is a famous academy for cadets, which was instituted by Anna at St Petersburg in 1732; and since its foundation has afforded instruction in military science to upwards of 9000 pupils, many of whom have acquired celebrity in the annals of Russian literature.

CA'DI. (In Arabic, *a judge*.) Among the Turks the inferior judges are styled Cadi. The Spanish Alcayde or Alcalde is derived from the same root.

CA'DMIUM. A white metal, much like tin; it fuses and volatilizes at a temperature a little below that at which tin melts Specific gravity about 9. Its ores are associated with those of zinc. It was discovered in 1818 by Professor Stromeyer of Gottingen. Its equivalent number is 56. It forms a yellow salifiable oxide, composed of 56 cadmium + 8 oxygen = 64 oxide of cadmium Its scarcity prevents its employment in the arts, but the oxide has been used as a pigment.

CADU'CEUS. In Antiquity, a rod of laurel or olive with a representation of two snakes twisted round it. It was the symbol of peace, and formed the chief badge of the Grecian heralds, whose persons were held sacred. In Mythology, the Caduceus was the symbol of Mercury, thence called Caducifer, to whom it was said to have been presented by Apollo in return for his invention of the lyre

CADU'CIBR'ANCHIATES. (Lat caducus, *falling*, branchiæ, *gills*.) Those Batrachians which undergo a metamorphosis, and lose their branchial apparatus before arriving at the period of maturity, as the frog, toad, salamander, and newt.

CADU'COUS. (Lat. cado, *I fall*) In Botany, when a part is temporary, and soon disappears or falls off.

C.E'CA (Lat. cæcus, *blind*.) In Comparative Anatomy, the blind processes of the alimentary canal are generally so called Those in fishes occur at the beginning of the intestines, where they are often numerous and long, representing the pancreas. In birds they are found near the termination of the intestines, and are generally two in number. In mammals the cæcum is commonly single, and situated at the beginning of the large intestines, it is of enormous size in the herbivorous species with simple stomachs. In the lower animals the intestinal glands which communicate with the intestines generally retain their primitive form of cæca

C.E'CUM. (Lat. cæcus, *blind*.) In Human Anatomy, the first portion of the large intestines, in which the *ileum* terminates by a valve The cæcum is a kind of appendage to the intestinal canal, open at one end only, whence the name *blind gut*, it has a small process attached to it, called the *appendix cæci vermiformis*

C.E'SAR. This title, originally the name of a branch of the Julian family at Rome, was assumed as a mark of dignity by the emperors after Nero It became subsequently the title of the presumptive heir to the empire, and the next title of dignity after Augustus, but was superseded in the Greek empire under Alexis Commenus by that of Sebastocrator In the West, it was assumed by the emperors of Germany, and, in German "Kaiser," is now the peculiar title of the emperor of Austria, who has succeeded to several of the dignities of the former

C.ESA'REAN OPERATION The extraction of the child from the womb by an operation Julius Cæsar is said to have been thus brought into the world.

C.ESU'RA. (Lat cædo, *I cut*.) In prosody, a metrical break in the verse, occasioned by the separation of the first syllable of a foot, forming the last of a word, from the next syllable, forming the first of another In the Latin hexameter the principal cæsura, without which the line is unmusical, occurs generally after the tenth, sometimes not until after the fourteenth time (each long syllable containing two times, each short syllable one. *see* RHYTHM), thus,

> Arma virumque cano | Troiæ qui primus ab oris
> Speluncæ vivique lacus | at frigida Tempe.

The slight pause which follows the syllable at which the interruption takes place is termed the cæsural pause In English verse a line is frequently musical without any cæsura at all; *i. e.* in which the pause takes place always at the end of a foot But a cæsura in the middle of the third, and in the middle of the fourth foot of an heroic verse, are by no means uncommon, and particularly appropriate in blank verse, in which they represent the two common cæsuræ of the Latin hexameter.

> I sing the sofa | I who lately sang
> Of man's first disobedience | and the fruit.

In the first of these lines the cæsura is in the third, in the latter in the fourth foot.

CAFFE'IN. A bitter crystallizable substance contained in coffee. A portion of it volatilizes during the roasting of coffee. It has not been applied to any use.

CAHIE'R. (Fr.) Derived by some from the Lat. *codex*, by others from *quaternio*. It signifies in its proper sense a number of sheets of paper loosely tied together. In French history, it denotes the reports and proceedings of certain assemblies, as those of the clergy, the states general, the notables, &c. The famous cahiers presented by the states general to the king of France at their convocation on the 24th of June, 1789, contain the best account of the then state of France. They were systematized and condensed in a book in 3 volumes, called "L'Esprit des Cahiers," to which the reader is referred.

CAI'NCIC ACID. A peculiar acid discovered by Pelletier and Caventou in the bark of the cainca root, a Brazilian shrub employed for the cure of intermittent fever.

CAI'NITES A strange sect of heretics, who appeared about 159, A.D. They probably originated in some of the various schools of Manicheism; and, if their doctrines are truly reported to us, they are said to have asserted that the power which created heaven and earth was the evil principle; that Cain, Esau, Korah, the people of Sodom, and others whom the Old Testament represents as victims of peculiar divine judgments, were in fact children of the good principle, and enemies of the evil. Some of them are said to have published a gospel of Judas on the same principle The Quintilianists, so called from a lady named Quintilia, of whom Tertullian speaks, were an offset of this sect.

CA IRA, CA IRA. (Literally, *it* (the Revolution) *shall go on*.) The burden of a famous revolutionary song, which was composed in the year 1790 in denunciation of the French aristocracy. The tune and sentiments of this song were much inferior to those of the Marseillaise Hymn ("Allons enfans de la patrie"), the object of which was to rouse the French to defend their country against foreign aggression

CAIRN. A word of Celtic origin, used to denote the piles of stones of a conical form so frequently found on the tops of hills, &c. in various districts, erected probably, as Sir R. C. Hoare observes, in general, for the mere purpose of memorials, although some have assigned to them a peculiar character, as receptacles for the bodies of criminals burnt in the wicker images of the Druids, &c According to some antiquaries, *cairn* is distinct from *carnedd*, the Welsh name for heaps of stones on the tops of high mountains (Carnedd David, Carnedd Llewellyn, &c.), which are said to have been sacrificial. Some cairns are undoubtedly sepulchral In common language, a cairn is distinguished from a barrow, the former being a heap of stones, the latter a mound of earth, but in all probability they had for the most part the same object, and the difference of materials was merely occasioned by local circumstances. *See* BARROW.

CAIRNGO'RM STONE A yellow or brown variety of rock crystal or crystallized silica, from the mountain Cairngorm in Scotland

CA'ISSON. (Fr) In Architecture, a sunken panel in a flat or vaulted ceiling, or in the soffit of a cornice In ceilings they are of various geometrical forms, and often enriched with rosettes or other ornaments *Caisson*, in bridge building, is a large chest or vessel in which the piers of a bridge are built. This sinking as the work advances, its bottom at last comes in contact with the bed of the river, when the sides are disengaged, its construction being such as to admit of their being thus detached without injury to the floor or bottom

CA'JEPUT OIL. A volatile oil obtained by distilling the leaves of the *Melaleuca minor*, a shrub abundant in Amboyna and Borneo, whence the oil is imported. This oil is of various shades of green, highly pungent and aromatic, and powerfully stimulant and diaphoretic. It has been much extolled as a remedy in the Asiatic cholera, but other essential oils are probably as effectual

CA'LAMARY. (Calamus, *a pen*, theca calamaria, *the pen-fish*) A Cephalopod; so called because it has a horny substance shaped like a quill in its back, and contains an ink-bag in its visceral sac: it is the *Loligo vulgaris* of Cuvier.

CA'LAMINE. A native carbonate of zinc, *Lapis calaminaris*. It is a zinc ore used in the manufacture of brass.

CA'LAMUS. (Gr. καλαμος, *a reed*) A name occasionally employed in botany for such simple fistular stems, without articulations, as occur in rushes and similar plants.

CA'LAMUS AROMA'TICUS. The rhizoma of the *Acorus calamus*, common over the whole of Europe in moist situations, it is usually known under the name of *sweet flag*. An infusion of the root is a good aromatic tonic. It yields a very small portion of essential oil when distilled with water (scarcely exceeding a thousandth part of its weight), which is used by perfumers.

CALA'THIUM, or CALA'THIDIUM. (Gr καλαθος, *a cup*.) Is a botanical term, employed by some German

botanists to denote that kind of depressed contracted inflorescence which is found in composite flowers. It is in reality an umbel with all the flowers sessile.

CALATRA'VA, ORDER OF, IN SPAIN, so denominated from a castle taken from the Moors, was instituted by Sancho III. King of Castile, in 1158. The kings of Spain are perpetual grand masters of this order of knighthood.

CA'LCAR. (Lat. calcar, *a spur*.) This term is applied by botanists to all hollow prolongations downwards of leaves or the parts of a flower. The long hollow horns which hang down from one of the sepals of a Tropœlum, or from the labellum of an Orchis, or the curved bodies enclosed within the hood of an Aconite flower, are described by this name.

CALCA'REOUS SOIL. (Lat calx, *lime*.) Soil of which lime forms a principal component part. Kirwan alleges that no soil will continue long fertile that does not contain some proportion of lime, and this has been subsequently proved by what takes place in North America. See *Ruffin's Essay on Calcareous Manures*.

CALCEOLA'RIA (Calceolus, *a small slipper*.) A genus of beautiful herbaceous or shrubby plants with yellow, or orange, or purple flowers, the lower half of which is shaped something like an old-fashioned slipper. They naturally inhabit rocks, rich plains, and woods, in Chili, Peru, or New Grenada. In this country many of them are hardy enough to live in the open air in summer, and some will even endure our winters, if not very severe. They are, however, all cultivated with most success if regarded as greenhouse plants.

CALCINA'TION. The reduction of substances to cinder or ash. The term is derived from the Latin word *calx*, quicklime, which as is well known, is prepared by the action of heat upon limestone, and hence the old chemists employed the word *calcination* to express any supposed analogous change, metallic substances being apparently converted into earthy matter by calcination.

CA'LCIUM. The metallic base of lime, discovered in 1808 by Davy. This substance has hitherto been obtained in such small quantities, that its properties have not been accurately investigated. It is probably a brilliant white metal, highly inflammable and more than twice as heavy as water. Combined with oxygen it forms lime, which consists of 20 calcium + 8 oxygen = 28 lime.

CALC-SINTER (German. From kalk, *lime*, and sintern, *to drop*.) The calcareous deposit of certain springs.

CALC-SPAR. Calcareous spar, or crystallized carbonate of lime.

CA'LCULA'TION, CA'LCULUS (Lat calculus, *a small pebble*, the Romans having made use of pebbles in casting up accounts.) In modern language, the term *calculus* is employed to denote any branch, or any operation of mathematics which requires or may involve numerical calculation, and therefore may be applied to the whole of the mathematical sciences, excepting pure geometry. Thus that part of algebra which treats of exponents is called the *exponential calculus*. In like manner the phrases *calculus of definite integrals*, *calculus of functions*, *calculus of variations* &c., are used to denote certain branches of the higher mathematics. *See* DIFFERENTIAL CALCULUS, INTEGRAL CALCULUS, VARIATIONS.

CA'LCULUS (Dimin. of calx, *a limestone*.) In Physiology, the general term for inorganic concretions of various kinds, formed in various parts of the body, and bearing in shape or composition a general resemblance to stones. The term *calculus* is, however, generally confined to urinary concretions. *See* URINE.

CALDA'RIUM (Lat.) In Ancient Architecture, by some authors used in the same sense as Laconicum, was an apartment in the baths heated for the purpose of causing perspiration. Vitruvius, however, used the word to signify a hot bath.

CALEA'NTHUM. Pliny's term for copperas.

CA'LEMBOURG. A French expression for that kind of witticism which in English is denominated a pun. A certain Westphalian Count Calemberg (Kahlenberg), who visited Paris in the reign of Louis XV., and was famous for his blunders in the French language, is said to be the person immortalized by the employment of his name to designate this species of jeu de mots.

CA'LENDAR. A distribution or division of time into periods adapted to the purposes of civil life; also a table or register of such divisions, exhibiting the order in which the seasons, months, festivals, and holidays succeed each other during the year. The word is derived from the ancient Latin verb *calare*, to call. In the early ages of Rome, it was the custom for the pontiffs to call the people together on the first day of each month, to apprise them of the days that were to be kept sacred in the course of it. Hence *dies calendæ*, the calends or first days of the different months.

The calendars in use throughout Europe are borrowed from that of the Romans. Romulus is supposed to have first undertaken to divide the year in such a manner that certain epochs should return periodically after a revolution of the sun; but the knowledge of astronomy was not then sufficiently advanced to allow this to be done with much precision. He placed the commencement of the year in spring, and divided it into 10 months — March, April, May, June, Quintilis, Sextilis, September, October, November, and December. March, May, Quintilis, and October contained thirty-one days each; the other six contained only thirty. The names Quintilis and Sextilis remained in the calendar till the end of the republic, when they were changed into July and August; the former in flattery of Julius Cæsar, and the latter of Augustus.

The year of Romulus contained only 304 days. Numa added two months; January to the beginning of the year, and February to the end. About the year 452 B. C. this arrangement was changed by the Decemvirs, who placed February after January, since that time the order of the months has remained undisturbed. In Numa's year the months consisted of 29 and 30 days alternately, to correspond with the synodic revolution of the moon. The year would therefore consist of 354 days; but one day was added to make the number odd, as being more lucky. In order to produce a correspondence with the solar year, Numa ordered an intercalary month to be inserted every second year between the 23rd and 24th of February, consisting alternately of 22 and 23 days. Had this regulation been strictly adhered to, the mean length of the year would have been 365¼ days, and the months would have continued for a long time to correspond with the same seasons. But a discretionary power over the intercalary month was exercised by the pontiffs, who frequently abused it for the purpose of hastening or retarding the days of the election of magistrates, and the Roman calendar continued in a state of uncertainty and confusion till the time of Julius Cæsar, when the civil equinox differed from the astronomical by three months.

Under the advice of the astronomer Sosigenes, Cæsar abolished the lunar year, and regulated the civil year entirely by the sun. He decreed that the common year should consist of 365 days, but that every fourth year should contain 366. In distributing the days among the different months, he ordered that the odd months, that is, the first, third, fifth, seventh, ninth, and eleventh, should contain each 31 days, and the other months 30; excepting February, which in common years was to contain only 29 days, but every fourth year 30 days. This natural and convenient arrangement was interrupted to gratify the frivolous vanity of Augustus, by giving August, the month named after him, an equal number of days with July, which was named after the first Cæsar. The intercalary day, which occurred every fourth year, was inserted between the 24th and 25th of February. According to the peculiar and awkward manner of reckoning adopted by the Romans, the 24th of February was called the sixth before the calends of March, *sexto calendas*. In the intercalary year this day was repeated, and called *bis sexto calendas*, whence the term *bissextile*. The corresponding English term, *leap year*, appears less correct, as it seems to imply that a day was *leapt* over instead of being thrust in. It may be remarked, that in the ecclesiastical calendar the intercalary day is still inserted between the 24th and 25th of February.

The Julian year consisted of 365¼ days, and consequently differed in excess by 11 minutes 10·35 sec. from the true solar year, which consists of 365 d. 5 h. 48 m. 49·62 sec. In consequence of this difference the astronomical equinox, in the course of a few centuries, sensibly fell back towards the beginning of the year. In the time of Julius Cæsar it corresponded to the 25th of March, in the sixteenth century it had retrograded to the 11th. The correction of this error was one of the purposes sought to be obtained by the reformation of the calendar effected by Pope Gregory XIII. in 1582. By suppressing 10 days in the calendar, Gregory restored the equinox to the 21st of March, the day on which it fell at the time of the Council of Nice in 325; the place of Easter and the other moveable church feasts in the ecclesiastical calendar having been prescribed at that council. And in order that the same inconvenience might be prevented in future, he ordered the intercalation which took place every fourth year to be omitted in years ending centuries; that is to say, on the 100th, 200th, &c.; excepting on the 400th, and the years which are multiples of 400. The Gregorian rule of intercalation may therefore be expressed as follows. —

"Every year of which the number is divisible by 4 without a remainder is a leap year, excepting the centesimal years, which are only leap years when divisible by 4 after suppressing the two zeros." Thus 1600 was a leap year; 1700 and 1800 were common years; 1900 will be a common year, 2000 a leap year, and so on.

The Gregorian method of intercalation thus gives 97 intercalations in 400 years; consequently 400 years contain $400 \times 365 + 97 = 146097$ days, and therefore the length of one year is 365·2425 days, or 365 d. 5 h. 49m. 12 sec., which exceeds the true solar year by 22·38 sec., an error which amounts only to one day in 3866 years.

If an astronomer were required, without any reference to established usages, to give a rule of intercalation by which the commencement of the civil year, while it always coincided with the commencement of a day, should deviate the least possible from the same instant of the solar year, he would proceed as follows:—The length of the mean solar year being 365 242241 days, the excess above a whole number of days is ·242241, which converted into a continued fraction becomes

$$\cfrac{1}{4+\cfrac{1}{7+\cfrac{1}{1+\cfrac{1}{4+\cfrac{1}{7+\cfrac{1}{1+,\ \&c.}}}}}}$$

Whence the following series of approximative fractions is derived.

$$\frac{1}{4},\quad \frac{7}{29},\quad \frac{8}{33},\quad \frac{39}{161},\quad \frac{281}{1160},\quad \frac{320}{1321},\ \&c.$$

Of these the first gives an intercalation of 1 day in 4 years, which supposes the year to be 365¼ days. The second gives 7 intercalations in 29 years, and supposes the length of the year to be 365 d. 5 h 47 m 35 sec., which is somewhat too small. The third fraction, $\frac{8}{33}$, is remarkable, as giving a year which differs in excess from the true solar by 15 38 seconds, so that by intercalating 8 times in 33 years, or 7 times successively at the end of every fourth year, and once at the end of the fifth year, the difference between the civil and solar year would only accumulate to a day in about 5600 years, while in the Gregorian calendar the error amounts to a day in 3860 years Nevertheless the Gregorian rule has this advantage, that leap year is always readily distinguished

The Gregorian calendar was received immediately or shortly after its promulgation by all the Roman Catholic countries of Europe. The Protestant states of Germany, and the kingdom of Denmark, adhered to the Julian calendar till 1700; and in England the alteration was successfully opposed by popular prejudices till 1752. In that year the Julian calendar, or *old style*, as it was called, was formally abolished by act of parliament, and the date used in all public transactions rendered coincident with that followed in other European countries, by enacting that the day following the 2nd of September of the year 1752 should be called the 14th of that month. When the alteration was made by Gregory it was only necessary to drop 10 days, the year 1700 having intervened, which was a common year in the Gregorian but a leap year in the Julian calendar, it was now necessary to drop 11 days. The old style is still adhered to in Russia and the countries following the communion of the Greek church, the difference of date in the present century amounts to twelve days

*Ecclesiastical Calendar*.—The adaptation of the civil to the solar year is attended with no difficulty; but the church calendar for regulating the moveable feasts imposes conditions less easily satisfied The early Christians borrowed a portion of their ritual from the Jews The Jewish year was lunı-solar, that is to say, depended on the moon as well as on the sun Easter, the principal Christian festival, in imitation of the Jewish passover, was celebrated about the time of the full moon. Differences of opinion, and consequently disputations, soon arose as to the proper day on which the celebration should be held. In order to put an end to an unseemly contention, the Council of Nice laid down a specific rule, and ordered that Easter should always be celebrated on the Sunday which immediately follows the full moon that happens upon, or next after, the day of the vernal equinox In order to determine Easter according to this rule for any particular year, it is necessary to reconcile three periods, namely, the week, the lunar month, and the solar year To find the day of the week on which any given day of the year falls, it is necessary to know on what day of the week the year began. In the Julian calendar this was easily found by means of a short period or cycle of 28 years (*see* CYCLE), after which the year begins with the same day of the week. In the Gregorian calendar this order is interrupted by the omission of the intercalation in the last year of the century. But to render any calculation unnecessary a table is given in the prayer books, showing the correspondence of the days of the year and the week for the current century. (*See* also DOMINICAL LETTER.) The connection of the lunar month with the solar year is an ancient problem, for the resolution of which the Greeks invented cycles or periods, which remained in use with some modifications till the time of the Gregorian reformation. (*See* METONIC CYCLE, GOLDEN NUMBER.) The author of the Gregorian calendar, Luigi Lilio Ghiraldi, or, as he is frequently called, Aloysius Lilius, employed for the same purpose a set of





numbers called Epacts (for an explanation of the use of which *see* EPACT). It is to be desired that this complicated system of rules and tables were rendered unnecessary by abolishing the use of the lunar month, and causing Easter to fall invariably on the same Sunday of a calendar month; for example, on the first or second Sunday of April.

*New French Calendar*.—A new reform of the calendar was attempted to be introduced in France during the period of the Revolution. The commencement of the year was fixed at the autumnal equinox, which nearly coincided with the epoch of the foundation of the republic The names of the ancient months were abolished, and others substituted having reference to agricultural labours, or the state of nature in the different seasons of the year. But the alteration was found to be inconvenient and impracticable, and after a few years was formally abandoned. (CYCLE, ERA, HEJIRA, YEAR.)

CA'LENDER. A machine for pressing and finishing paper, cloth and other articles, which when so prepared are said to be *calendered*. It literally means *hot-pressing*; from *calor*, heat.

CA'LENDS, in the ancient Roman calendar, were the first days of each month The Roman month was divided into three periods by the *Calends*, the *Nones*, and the *Ides* The *Calends* were invariably placed at the beginning of the month; the *Ides* at the middle of the month, on the 13th or 15th, and the *Nones* (*novem*, nine) were the ninth day before the Ides, counting inclusively. From these three terms the days were counted backwards, in the following manner.—Those days comprised between the calends and the nones were denominated *days before the nones*, those between the nones and the ides, *days before the ides*; and those from the ides to the end of the month, *days before the calends*. Hence the phrases *pridie calendas*, *tertio calendas*, &c; meaning the second day before the calends, or last day of the month, the third day before the calends, or last but one of the month (the *calends* or first day of the following month being included in the reckoning), and so on. In the months of March, May, July, and October, the ides fell on the 15th day, and the nones, consequently, on the 7th In all the other months the ides fell on the 13th, and the nones, consequently, on the 7th. The number of days receiving their denomination from the calends depended on the number of days in the month and the day on which the ides fell For example, if the month had thirty-one days, and the ides fell on the 13th (as happened in January, August, and December), there would remain eighteen days after the ides, which, added to the first of the following month, made nineteen days of calends Hence the 14th day of January was styled the *nineteenth before the calends* of February, the following day, or 15th of the month, was *the eighteenth before the calends*, and so on

CALE'NDULIN. A mucilaginous substance or species of gum obtained from the *marigold*.

CA'LENTURE. (Lat caleo) A delirious fever, produced by the sun, in which it is common for the patient to imagine the sea to be green fields

CA'LIBER, or CALIPER. (Fr calibre.) The thickness or diameter of any round or cylindrical body, as of the bore of a gun or of its ball.

CA'LICO-PRINTING. The art of producing figured patterns upon calico, they are transferred to its surface by blocks, copper plates, or engraved cylinders, by which the colours are directly printed, or by which *mordants* are so applied that when the calico is immersed in a colouring bath, the colour only adheres or is produced upon the parts to which the mordant had been previously applied. *See* DYEING.

CA'LIDUCT. (Lat. calidus, *hot*, and ductus, *a conveyance*.) In Architecture, a pipe or flue for the distribution of heat in an apartment or house.

CALIGI'DÆ A family of parasitic Entomostracous Crustaceans, belonging to the order *Siphonostoma*, characterized by having the mouth organized for piercing and suction. The parasites of this family prey almost exclusively upon fish, and are commonly called fish-lice Gold-fish are sometimes infested to an almost incredible extent with a species, the *Monoculus foliaceus* of Linnæus, which is nearly a quarter of an inch long, having the body covered with a broad round transparent shield, notched behind to give free motion to the tail The first pair of legs are shaped like a cupping-glass, and for the purpose of holding on; the four last pairs are formed for swimming, and terminated each by two long and feathered filaments probably subservient to respiration

CA'LIPER COMPASSES, or simply Calipers, are compasses with curved legs, for measuring the caliber or diameter of cylinders, balls, or other round bodies. Calipers of the best sort are made with a scale having different sets of numbers engraved on it, like a sliding rule, for the purpose of exhibiting at once various relations depending on the magnitude of the diameter of the body measured. Thus, as the weights of balls of the same metal are in a constant ratio to the cubes of their diameters

the scale may be so graduated and numbered that the observer may read off either the diameter in inches, or the weight in pounds. Other numbers having a less immediate application are also frequently attached: for example, the degrees of a circle, the proportions of troy and avoirdupois weight, tables of the specific gravities and weights of bodies, &c. It is obvious that these may be varied infinitely, according to the purposes proposed to be accomplished. This word is probably derived from the Greek καλλιπω, *I leave behind.*

CA'LIPH. (Arab khalifah.) Originally a deputy or lieutenant, but afterwards applied chiefly to the successors or representatives of Mohammed, who exercised the highest spiritual and temporal jurisdiction over the "Faithful." At first there was little difficulty in determining the right of succession to the caliphat, as it devolved on the immediate descendants or relations of the prophet. but in the course of time violent disputes arose upon this point among several Mohammedan dynasties, and led to the establishment of the caliphats of Africa (Fatimide), and of Spain (Omayzade), which were contemporary with that of the Abassides of Bagdad. The splendour of the empire founded by Mohammed reached its highest pitch towards the beginning of the ninth century, under the famous Haroun al Raschid. The period of its decline may be dated from the commencement of the tenth century; and for the last 200 years the appellation of caliph has been swallowed up in *Shah*, *Sultan*, *Emir*, and other titles peculiar to the east.

CALI'PPIC PERIOD. In Ancient Chronology, is a correction of the Metonic cycle proposed by Calippus. The Metonic cycle was a period of nineteen solar years, at the end of which time the new moons return again on the same days of the year. The period contained exactly 6940 days. Now 6940 days exceeds 235 lunations by only seven hours and a half. At the end of four cycles, or 76 years, the accumulated excess of 7½ hours amounts to one whole day and six hours. Calippus therefore proposed to quadruple the period of Meton, and to deduct a day at the end of it by changing one of the months of 30 days into a month of 29 days. (*See* METONIC CYCLE.) The period of Calippus is sometimes referred to as a date by Ptolemy.

CALI'XTINES. One division of the Bohemian Reformers, who in the 15th century protested against the errors of the church of Rome, and maintained their independence by force of arms. After the death of Huss, his followers split into two principal parties, under the names of Taborites and Calixtines, of which the latter were the most moderate, and held out chiefly on the ground of the refusal of the cup (calix) to the laity, whence they derived their name. Their hostility was at length propitiated by indulgence on this point: the church of Rome declaring expressly at the same time that the giving or withholding of the sacramental wine is a matter of ecclesiastical ordinance merely, and neither the one nor the other essential to the reception of the benefits of the eucharist. The council of Basle (1431) says,—Sive sub una specie sive duplici quis communicat, secundum ordinationem seu observationem ecclesiæ, proficit dignè communicantibus ad salutem.

The same name is given to the followers of Calixtus, a German divine of the 17th century, who proposed a reconciliation between the Roman Catholics, Lutherans, and Reformed church, on the basis of the Apostles' Creed.

CALLI'GRAPHY. (Gr. καλος, *beauty*, and γραφω, *I write.*) The art of beautiful writing. The scribes who made a profession of copying manuscripts, before the invention of printing, have been termed Calligraphers. Their art consisted not merely in writing, but also in embellishing their work with ornamental devices, although illumination (which see) was also practised as a distinct employment. Among the MSS. of the early part of the middle ages which we possess, there are some sumptuous specimens of the art, written in letters of gold, vermilion, &c. and on leaves of different colours, but that fashion went early out of use, and in general it may be said, that the current writing of calligraphers diminished in beauty and in laborious minuteness, especially in Italy, during the centuries immediately preceding the invention of printing.

CALLIO'NYMUS. (Gr. καλος, *beauty*, and ονομα, *a name.*) A genus of beautiful spiny-finned fishes, with very small gill openings; ventral fins under the throat, and larger than the pectorals; head oblong, flattened; eyes placed near to each other, and directed upwards, no teeth on the palate, intermaxillaries capable of considerable protrusion. They have no air bladder. The gemmeous, or golden dragonet (*Callionymus lyra*), is a British example of this genus.

CALLI'OPE. (Gr. καλλος, *beauty*, and οψ, *the voice.*) In Mythology, one of the Muses usually associated with Homer in the statues of antiquity, and thence considered as the patroness of heroic poetry.

CALLITRICHA'CEÆ. (Callitriche, the only genus.) A small cluster of imperfectly organized water plants, the natural relation of which is unsettled. By some they are considered allies of *Urticaceæ*, by others of *Naiadaceæ*, and others Monocotyledons.

CALLORHY'NCHUS. *See* CHIMÆRA.

CA'LLUS. In Osteology, the matter which unites the divided ends of broken bones: it is a secretion of new bony matter.

CA'LOMEL. The old chemical name of *chloride of mercury.* The word is perhaps derived from καλος, *fair*, and μελας, *black.* It is prepared by rubbing mercury with corrosive sublimate, which forms a *black* mixture, which, by the application of heat, yields a *white* sublimate of calomel. It is much used in medicine, especially as a purgative. It consists of 200 mercury + 36 chlorine = 236 chloride of mercury or calomel.

CALO'RIC. (Lat. caleo, *I am warm.*) A term applied by the French chemists to designate *the matter of heat*, it being assumed that the phenomena of heat are dependent upon the presence of a highly attenuated, mobile, and imponderable form of matter. *See* HEAT.

CALORI'FIC RAYS. A term applied to the invisible heating rays which emanate from the sun, and from burning and heated bodies.

CALOR'IMETER. (Lat. calor, *heat*, and metrum, *a measure.*) An instrument for measuring the quantity of heat given out by bodies in passing from one temperature to another.

CALORIMO'TOR. (Lat. calor, *heat*, and moveo, *I put in motion.*) This term has occasionally been applied to a peculiar form of the voltaic apparatus composed of one pair of plates of great extent of surface, the electricity of which, when transmitted through good conductors, produces intense heat.

CA'LOSO'MA. (Gr. καλος, *beautiful*; σωμα, *body.*) A genus of most splendid Coleopterous insects, belonging to the family *Carabidæ*, or ground beetles. In this genus the jaws are toothless, or rather devoid of notches, the maxillary palpes terminate in a large joint, and the abdomen is broad. There are two British species: *Calosoma sycophanta*, so called because its grub insinuates itself into the nests of gregarious caterpillars, and feeds upon them, and *Calosoma inquisitor.* In speculating on the exception which the Calosomes present among the *Carabidæ*, in the brilliant colours which are developed in them, an explanation seems to be afforded by a difference in their habits: they frequent trees, and are more exposed to the light than their hole-and-corner congeners, the ground-beetles.

CA'LOYERS. Monks of the Greek church, who follow the rule of St Basil.

CALP. An argillo-ferruginous limestone.

CALU'MBA. The root of the *Cocculus palmatus.* It is dried in slices of a yellowish grey colour, and is generally worm-eaten. It has a bitter and slightly pungent taste, and is very mucilaginous. Calumba root is an excellent tonic medicine, especially in debility of stomach and intestines: about ten grains of the powder may be taken twice or thrice a day. The Mozambique name of this plant is Kalumba.

CA'LUMET. (Lat. calamus, *a reed.*) In Modern History, a large beautifully adorned pipe, used by the North American Indians as the emblem of peace. (*Harris's Voyages*, vol. ii. p. 908.) The first notice of the calumet among European writers is to be found in Ferdinand de Soto's account of his expedition through the southern provinces in 1170.

CA'LVINISTS. The followers of Calvin, the second great reformer of the 16th century, and founder of the church of Geneva. The distinguishing tenets of this celebrated theologian refer to points both of discipline and doctrine. He was the first to reject the episcopal form of church government, originally, it is said, with great reluctance, and compelled thereto by the want of regularly ordained ministers; but he afterwards maintained the exclusive divine appointment of the Presbyterian system, which has since obtained favour in Scotland, and among the Protestants of France, and has had numerous adherents in this country and America. The doctrinal opinions of Calvin, however, have not been permanently received among those who have adopted his views respecting the ministry. On the contrary, in England and Geneva, there are many Presbyterians Arminian in sentiment. It was at the Synod of Dort, in 1618, that the points in dispute between the Calvinists and Arminians were most accurately distinguished, and arranged under five heads, upon which the former party asserted the following opinions.—

1. Of predestination—that all men have sinned in Adam, and are become liable to the curse, but that God has by an eternal decree chosen some from the beginning, to whom he should impart faith of his free grace, and consequently salvation.

2. Of the death of Christ—that it is a sufficient sacrifice for the sins of the whole world; and that some only believe and are saved, whereas many perish in unbelief, arises not from any defect in this sacrifice, but from the perversity of the non-elect.

3. Of man's corruption—that all men are conceived

in sin and born the children of wrath, and are neither willing nor able to return to God without the aid of the Holy Spirit.

4. Of grace and free will—that the influence of the Spirit upon our fallen natures does not force, but only quickens and corrects them, inducing them gently to turn themselves towards God by an exercise of their free will.

5. Of perseverance—that God does not wholly take away his Spirit from his own children, even in lamentable falls; nor does he permit them to fall finally from the grace of adoption and the state of justification.

These opinions, which were laid down at the Synod of Dort, represent the sentiments of the founder of this school, and of the ancient or *strict* Calvinists. In modern times another class of *Moderate Calvinists* has arisen, who differ from these in holding lower notions concerning reprobation and the extent of Christ's sacrifice. For other subdivisions among the Calvinists, see articles SUB-LAPSARIANS and SUPRA-LAPSARIANS.

CALX. A name applied by the alchemists to all products of combustion, especially those obtained from the metals, which were supposed to be converted into a species of *earth*.

CALY'BIO (Gr. κάλυβη, *a cottage*.) A name adopted by some carpologists, for such a one-celled, inferior, one or few-seeded fruit, enclosed in a cupule, as the acorn of the oak, the mast of beech, &c.

CA'LYCANTHA'CEÆ (Calycanthus, one of the genera.) A small natural order of plants related to *Rosaceæ*. They are all shrubs with fragrant flowers, and inhabit North America or Japan. Some of them resemble the genus *Illicium* in their flowers.

CA'LYCERA'CEÆ (Calycera, one of the genera.) A natural order of plants related to *Compositæ*, from which they differ very little, excepting that their seeds are pendulous and albuminous, and their anthers half united. The species are woody herbaceous plants, inhabiting the warmer parts of South America.

CALY'CULUS. A diminutive of *Calyx*, which see.

CALY'MENE. (Gr. κατακαλυμμένη, *concealed*.) A name devised to express the obscure nature of a genus of Trilobites (fossil crustaceans), to which it is attached, and which is distinguished from all other Trilobites by the faculty which the species possesses of rolling the body up into the form of a ball, in the same manner as the recent genera *Sphæroma*, *Armadillo*, *Glomeris*, viz. by approximating the two extremes of the trunk at the under part. The anterior segment or shield of Calymene is as broad or broader than it is long, and supports two compound prominent eyes; the posterior or terminal segment forms a sort of triangular elongated tail.

CALY'PSO. (Gr.) In Fabulous History, a daughter of Atlas, according to Homer, but of Oceanus and Thetys, according to Hesiod, was the queen of the island Ogygia. On this island Ulysses suffered shipwreck; and Calypso, by the united influence of her love and spells, prevailed on him to remain and share her sceptre. After the lapse of seven years, however, his desire to revisit his native country became irrepressible, and he resolved to forego his honours in Ogygia. Calypso tried every expedient, offering him even the bribe of immortality, to induce him to remain, but all her efforts proved unavailing, and on his departure she died of grief. The island of Ogygia, placed by Pliny (III. 10) off the Lacinian promontory, between the Tarentine and Scyllæan bays, has long since been engulfed in the ocean, along with the famous islands of the Sirens.

CALYPTRE'A (Gr. καλυπτρα, *a covering*.) The name of a genus of Gastropods, having a patelliform shell, to the concavity of which adheres either a smaller conical shell, like a cup in a saucer, or a semicircular testaceous process, forming the commencement of a columella. The branchiæ consist of a single row of long and slender filaments. The foot is circular, expanded, and furnished with two anterior processes. The genus, originally established by Lamarck, is now divided into the subgenera *Calyptopsis*, *Crepipatella*, and *Calyptræa*.

CA'LYX (Gr. κάλυξ, *a cup*.) The name given by botanists to the outermost of the enveloping organs of a flower. It is usually green, and sometimes bears a great resemblance to leaves, but it is also frequently richly coloured, as in the *Mirabilis*, *Salvia splendens*, &c. This organ appears to have the office of protecting the more tender parts lying within it, and is therefore usually present in flowers, when absent, its protecting office is always performed by some modification of bracts, as in the Arum and the Willow. If it is adherent to the sides of the ovary, it is called superior; if partially adherent, half superior; and if quite free from the sides of the ovary, it is inferior. In systematical botany these differences are of great importance.

CAMARI'LLA. (Span.) The *little* or private chamber of the sovereign of Spain (equivalent to the *petits appartements* of the old French regime); but the term is generally applied to his immediate confidants, who are usually all-powerful in the government of the country. In England the term is nearly synonymous with *clique*.

CA'MBER. (Fr. cambrer, *to bend*.) In Architecture, the convexity of the upper and concavity of the under side of a beam, by which it is prevented from becoming straight or concave at top either by its own weight, or by the loading it may have to carry.

CA'MBIUM. (A low Latin word for liquid which becomes glutinous.) A viscid secretion formed between the liber and alburnum of Exogenous trees in the early spring, when vegetation recommences. It is supposed by some physiologists to be the matter out of which new wood and bark are formed; by others to be a preparation of organizable matter, out of which the horizontal growth of the cellular system, and the vertical growth of the woody system, may be nourished during their respective development. It disappears as soon as the new wood and bark have been completely formed.

CA'MBRIC. A delicate linen fabric, which was originally manufactured at *Cambray*.

CA'MEL. A machine invented by the Dutch for carrying vessels into harbours where there is not a sufficient depth of water. It consisted of two large boxes, or half ships, built in such a manner that they could be applied on each side of the hull of a large vessel. On the deck of each part of the camel a number of horizontal windlasses were placed, from which ropes proceeded, on one side, and being carried under the keel of the vessel, were attached to the windlasses on the deck of the other part. When about to be used as much water as necessary was suffered to run into them; all the ropes were then cast loose, and large beams were placed horizontally through the port-holes of the vessel, the ends resting on the camels alongside. When the ropes were made fast, and the vessel properly secured, the water was pumped out, on which the camels rose and bore up the vessel. (*Beckman's History of Inventions*, vol. iii. p. 337.)

CAME'LEON or CHAMÆLION MINERAL. Manganesate of potash, obtained by melting a mixture of potash and black oxide of manganese. When put into water the solution is first green, and passes through a variety of tints of green, purple, and red, till at length it becomes colourless.

CAME'LIDÆ. (Camelus, *a camel*.) A family of ruminant Mammalia, which deviates from the rest of the order in the presence of two incisors in the upper jaw, and the absence of cotyledons in the uterus and fœtal membranes. The camel and dromedary of the old world, and the llama, guanacho, and vicugna of the new world, are the existing species of this family.

The old world Camelidæ (*Camelus*) are especially organized for existence in the arid and barren deserts of Asia and Africa. They have a broad, expanded, elastic foot, terminated in front by two comparatively small hoofs, and well defended beneath by a felt of coarse hair. The new world Camelidæ (*Auchenia*) have narrower feet, and the hoofs are bent in the form of claws, adapted to climb the steep passes of the mountain ranges of South America, to which continent they are confined.

Besides the peculiar characters above mentioned, the camels present a modification in the structure of the stomach which is not present in any other family of Ruminantia. There are developed from the sides of the first cavity of the stomach or paunch two series of cells, into which experiment has proved that the water which the animal drinks almost exclusively passes, and where it can be kept apart from the solid contents of the paunch in a quantity of several quarts. Surely the final relation of such a modification of structure to the peculiar physical characteristic of the localities to which the animal possessing it is confined must force itself irresistibly on the mind. But besides a reservoir of water to meet the exigencies of long journeys across the desert, the dromedary and camel are provided with a storehouse of solid nutriment on which they can draw for supplies long after every digestible part has been extracted from the contents of the stomach: this storehouse consists of one or two large collections of fat stored up in ligamentous cells supported by the spines of the dorsal vertebræ, and forming what are called the humps. When the camel is in a region of fertility the hump becomes plump and expanded; but after a protracted journey in the wilderness it becomes shrivelled and reduced to its ligamentous constituent, in consequence of the absorption of the fat. Buffon carried his teleological reasoning, or the ascription of design, so far as to assert that the humps on the backs of the camel were badges of slavery, and intended to adapt them to the burthens of their task-masters; and he supported this ingenious idea by the unfounded assertion that the dorsal prominences did not belong to the camels in free nature. But the true uses of the fatty humps, as of the water-cells, relate to the exigencies of the Camelidæ of the deserts under every condition. The complete adaptation of the camel for the dreary wastes in which it is destined to exist, is further illustrated by some minor modifications in its structure. The nostrils are narrow oblique slits, defended with hair at their margins, and provided with a sphincter muscle, like the eyelids; so that the animal can close them at pleasure. This action

is of great service in excluding the fine and penetrating sand which is drifted along in clouds by the storms of the desert. The expanded sole of the foot, elastic as a cushion, prevents the leg from sinking in the loose surface: the long joints and lofty tread of the camel are equally adapted for a rapid progression along loose sandy plains. Thus to the Arab of the scorching desert the camel is as valuable, and indeed as essential, as the reindeer to the Laplander in his region of perpetual snow. The one animal, like the other, serves, while living, for all the purposes of draught and burden, and supplies his master's family with milk. When dead the flesh of the camel is eaten, though it is coarser than that of the ordinary Ruminants: its hide, which approaches that of the Pachyderms in thickness and strength, is applied to the manufacture of saddles, harness, pitchers, shields, and various other articles. The finer hair is manufactured into articles of clothing, and the coarser hair is woven into a kind of matting for the covering of tents. By day the camels transport their owner and his family, with all their property, from place to place By night the body of the recumbent beast of burden serves as a pillow for his master, or if the air be agitated, the camels are arranged to windward, so as to form a barrier against the ever-shifting sands.

The camel is the sole medium of communication between those countries which, are separated by extensive deserts; in the beautiful and expressive metaphor of eastern speech, it is "the ship of the desert," and in truth it is the only ship by which the wilderness can be navigated with certainty and safety A stout Arabian camel can travel with a load of 800 pounds at the rate of about three miles in the hour. The swifter varieties, as the light dromedary or "mahairy," are said to carry a single rider over a space of from 70 to 100 miles in 24 hours, and that for several days in succession.

CAME'LLIA. (In honour of Kamel, a Spanish Jesuit) A beautiful genus of evergreen shrubs inhabiting China and Japan Several species are known; one of which, *C oleifera*, furnishes the Chinese with abundance of oil used for various domestic purposes, others are small-flowered and unimportant, but one, *C japonica*, is among the most beautiful species in the vegetable kingdom. It is from this that the multitudes of double varieties, now common ornaments of gardens in the spring, have been obtained by sowing seeds Most of the varieties originated with the Chinese and Japanese, but many very fine ones have been raised in this country and Belgium. They are usually cultivated in pots, but are never seen in perfection unless planted in the open ground beneath a glass roof under such circumstances they only require to be guarded from severe frost by some kind of heating apparatus In some parts of England, and even near London, they are occasionally grown in the open air, but with little success.

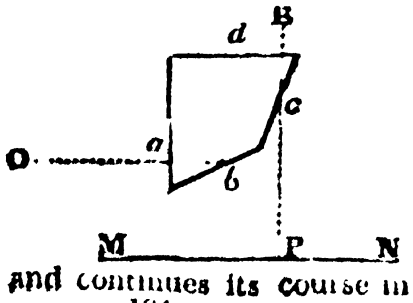
CA'MELOPARD. *See* GIRAFFE.

CAME'LOPARDA'LIS. One of the constellations formed by Hevelius in the northern hemisphere. It is situated between Cepheus, Cassiopeia, Perseus, Ursa Major, Ursa Minor, and Draco.

CA'MEO. A word of doubtful origin, applied to gems of various colours sculptured in relief. The art of engraving on gems boasts of high antiquity, having been practised with various degrees of success by the Egyptians, Greeks, and Romans It was again revived in Italy in the 15th century, and is even at the present day cultivated with great avidity and considerable success. The cameos of the ancients were usually confined to the agate, onyx, and sard, which, on account of the variety of their strata, were better accommodated to a display of the artist's talents, but they are also occasionally found executed on opal, beryl, or emerald, and even on a sort of factitious stone, the *Vitrum obsidianum* of Pliny, distinguished by the moderns as the antique paste. (*Encyc. Metr.*) One of the most famous cameos is the onyx at present in Paris, called the *apotheosis of Augustus*. It is one foot in height and ten inches in width.

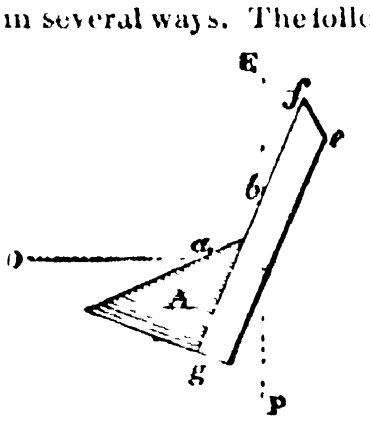
CA'MERA LU'CIDA. The name given by Dr Hooke to an instrument contrived by him for making the image of any object appear on a wall in a light room either by day or by night. It is described in the *Phil. Trans* vol. xxxviii. p. 741.

The instrument now known by the name of Camera Lucida is a very ingenious invention of the late Dr. Wollaston, for the purpose of enabling any one, without a knowledge of the rules of drawing or perspective, to delineate distant objects, or trace the outlines of landscapes



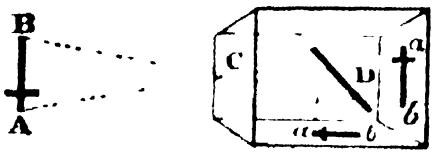

&c, with perfect accuracy. It consists of a quadrangular glass prism, *a*, *b*, *c*, *d*, by means of which rays of light are bent, by two reflections, into a path at right angles to their previous direction. A ray of light proceeding from O enters the face of the prism at *a*, and continues its course in a straight line till it meets the adjacent side of the prism at *b*, and making with it a very acute angle, is wholly reflected in the direction *b c*. At *c* it again meets the side of the prism, and is in like manner reflected in the direction *c* E. The eye being placed at E, sees the image of the object on the surface of the prism at *c*, and refers it to P, on a plane M N, which may be covered with a sheet of white paper. The point of a pencil can also be seen on the paper, and thus the accurate outline of the object may be traced. It is easy to see from this the proper form which the crystal should have. Suppose the two reflections to be equal, then the ray will be bent 45° from its original path by the first, and also 45° by the second; and the four angles which it makes with the faces of the prism at *b* and *c* are each 22½°; hence the faces *a* and *d* being perpendicular, the faces *a* and *b* must be inclined in an angle equal to three fourths of a right angle, or 67½°, *b* and *c* must make an angle of 135°, or three fourths of two right angles, and *c* and *d* make an angle of 67½°. By the laws of optics, the size of the picture will bear the same relation to the object delineated, that the distance of the eye from the paper bears to the distance of the object. Hence, in order to increase or diminish the size of the picture, the prism is mounted in a brass frame, supported by brass tubes capable of being lengthened or shortened at pleasure A thin brass plate, affixed to the upper surface of the prism, and having a small hole in it for the observer to look through, keeps the eye in its proper place, and procures steadiness of vision A convex lens may be placed over the hole in the brass plate, for the purpose of magnifying the image, or a concave lens placed before the prism at *a* will adapt it to short-sighted persons. The instrument is extremely convenient, on account of its portability.

The construction of the camera lucida may be varied in several ways. The following was proposed by professor Amici A parallel piece of plate glass, *e f g*, is connected with a reflecting speculum A. The ray of light proceeding from O is reflected from the speculum at *a* to the plate glass at *b*, and there reflected again to the eye at E The frame in which the instrument is placed has a rectangular opening at the top, through which the eye receives the image, and is prevented from receiving the rays coming directly from the metallic mirror. The image is referred to a plane below at P, where the pencil is seen through the glass




CA'MERA OBSCU'RA, or DARK CHAMBER, is an optical apparatus, by which the images of external objects are thrown on a white surface, and represented in a vivid manner in their proper colours, shapes, &c Hence the apparatus may be used for the purposes of delineation, as well as the camera lucida, but as it is from its construction less convenient, it is chiefly used as a source of amusement, or for explaining the nature of vision.

The theory of the Camera Obscura is shortly this. Through a convex lens, or small circular hole at C, the light is admitted into a darkened room or box, so that rays proceeding from an object A B, and falling on a white ground within the room, paint an image of the object on it in an inverted position, *a b*. But the image is easily restored to its natural position by causing the rays to pass through two convex lenses inserted in a draw tube placed in the opening C. Sometimes a mirror D is placed in the interior of the box, making an angle of 45° with its sides, whereby the image is thrown down on the bottom of the box at *a b*, and by means of the reflection restored to its natural position. The best ground for receiving the image is plaster of Paris, formed somewhat concave. The image is viewed through an oblong aperture cut in the box The most perfect camera obscura is formed by placing an inclined mirror in a revolving frame at the top of a building, by which the rays are thrown down on a convex lens in the roof, and the images of all the surrounding objects received on a table The images being accompanied by the motions belonging to the objects, a very pleasing picture is formed The invention of the camera obscura is usually ascribed to Baptista Porta, it was, however, known to Friar Bacon, in the 13th century.




CAMERALI'STICS. (Lat camera, *a chamber*) A word that has recently been introduced into the English language to signify the science of public finance. It is of German origin (the equivalent term in that language being *Kammeralien*), and derives its signification from certain officers (called Kammer-rathe) appointed by most of the petty princes of Germany to superintend their accounts, and disburse all payments.

CA'MERATED. (Lat. camera.) A term applied to the shells of certain Cephalopods which are divided by transverse partitions into a series of chambers which are traversed by a siphon. Most of the species are now extinct.

CAMERO'NIANS. The strictest sect of Scottish Presbyterians; so called from the Rev. Richard Cameron, one of the most eminent of their leaders. The origin of this sect is briefly told. Charles II., on his restoration in 1660, found presbytery to be the existing national church; and though he had, at one time, sworn to maintain that faith, yet thinking it incompatible with monarchical government, he lost no time in superseding it, and establishing episcopacy in its room. Thus he did in direct opposition, not merely to his own solemn obligations, but to the principles and predilections of his Scottish subjects. And the result was such as might have been anticipated. The presbyterian clergy, though driven from their parishes and deprived of their incomes, continued to preach and hold meetings, or *conventicles*, as these assemblages were contemptuously called, for the celebration of religious ordinances; and their influence with the people seemed to increase in proportion as means were taken to silence or crush them. Under these circumstances, Charles, finding that rigour failed in producing the effect at which he aimed, and the number of episcopalian ministers being insufficient to fill the vacancies that had been occasioned by his violent change of the national religion, had recourse to a plan, ostensibly liberal and mild, but which did by no means realize the views which he had anticipated from it. In 1669, he granted what he called an *indulgence*, or permission to such of the ejected ministers as had meanwhile "lived peaceably and orderly," or, in other words, who had not signalized themselves by holding conventicles, to return to their several parishes (if these were vacant), or to accept presentation to such other parishes as were vacant. A similar indulgence was issued in 1672, but both of them were marked by restrictions and conditions which were any thing but agreeable to tender consciences. (*Wodrow's Church Hist.* 8vo ed. vol. ii. p. 130-31.) This indulgence emanated solely from the king, and had not been submitted to the consideration of the church, and was, in consequence, regarded by many as tantamount to a recognition of the royal authority in matters *ecclesiastical* as well as civil, and as subversive both of the national covenants (*Acts of Assembly, apud an.* 1649), to which they had sworn, and of presbytery itself, which acknowledged no head but Jesus Christ. Some of the more moderate of the clergy, however, did not think it inconsistent either with their vows or principles to accept it; others complied with it, regarding it as an encroachment on their religious rights, but satisfying their conscience by giving an open testimony against it and the ecclesiastical authority assumed by the king, while there were some who preferred principle to expediency, and peremptorily refused compliance on any terms, and resisted every effort to procure their acquiescence. These were the persons who were afterwards denominated Cameronians. (*Wodrow*, iii. 202.)

The Cameronians were influenced in the line of conduct which they pursued solely by conscientious motives. Rather than acknowledge the authority of the king in matters ecclesiastical, or abate one iota of their indefeasible rights and privileges, they were willing to separate from their conforming brethren, and to encounter all the evils and disabilities which such a step had evidently a tendency to produce. They became at once the object not only of the disapprobation of their indulged brethren, but of the vindictive and cruel rage of a tyrannical government. On the principle that "oppression drives a wise man mad," they pushed their views to the utmost extremity; and, while they vilified the Presbyterians whose opinions, both religious and ecclesiastical, were more moderate than their own, they stigmatized the king and government as unscriptural and Erastian. In short, while they arrogated to themselves absolute liberty of conscience and of judgment, they exhibited the greatest intolerance towards others who entertained different sentiments. When persecuted and proscribed, when many of them were imprisoned, and not a few of them suffered martyrdom, they began to consider their king as a tyrant, and they publicly declared, that "by his perjury in violating his covenanted vows, by his arbitrary government, and his usurpation over their civil and religious liberties, he had dissolved their allegiance and forfeited all right and title to the crown." (*Laing's Hist. of Scot.* vol. iv. p. iii.) They also protested against the succession of his brother, on account of his popery and his breach of covenant to God and the church. To these sentiments Cameron, their leader, and a party of about twenty others, all armed, gave public utterance in a *declaration* read at Sanquhar, and affixed to the market-cross of that town. (*Wodrow*, iii. 312.) This was the signal for more prompt and decisive measures on the part of government. The party were soon after (20th July, 1680) surprised at Airsmoss, a morass on the confines of the counties of Ayr and Dumfries. Cameron and his brother fell on the field; while sixteen were taken prisoners, and soon after perished as traitors on the scaffold; the remainder of the party, with some peasants who had joined them, fled. But their spirit was not intimidated, nor was their enthusiasm abated. Cargill, who was now their leader, and who was shortly after apprehended and publicly executed, pronounced at a public meeting of the party at Torwood, near Stirling, a solemn excommunication against their persecutors, including the Duke of York and the king himself. (*Hind Let Loose, passim; Laing*, iv. 112-13.)

Meanwhile, the Cameronians had formed themselves into a more regular body; and, in 1681, agreed to hold quarterly or more frequent meetings, and took the name of *The Societies United in Correspondence*. They thus acted more in concert; and their fortitude and zeal became, if possible, more intense. They were now altogether alienated from the indulged ministers and the general public; and their meetings for religious worship and for the celebration of ordinances were, for the sake of safety, confined to the mountains, or to sequestered and remote spots. They still continued the objects of the most ruthless persecution. But while proscribed and chased like beasts of prey by the government, no respect being shown to age or sex or condition, and while numbers of them, including their most popular ministers, perished on the scaffold or at the stake, they began to disagree among themselves. Some of them having been dissatisfied with the language of the *Sanquhar Declaration*, certain portions of it had been amended or explained. A considerable number took offence at the violence of Renwick, now at the head of the party; and not only separated from them, but published testimonies against some of their proceedings. The one party were averse to unite with such as would not go to the same extreme as themselves, while the other, more moderate in their principles, were for making common cause with all who held the same general sentiments, and were exposed to the same persecutions. It was at this period (1687) that Renwick drew up their *Informatory Vindication*, which in spirit was the same as the *Sanquhar Declaration*. But the breach was never healed. It is unnecessary, however, to give a more minute account either of their proceedings or their sufferings. Renwick, who was beheaded in 1688, was the last Scottish martyr. The revolution put an end to the sufferings of the Cameronians, and to persecution for conscience' sake. (*Scotch Worthies*, § Renwick, Hackston of Rathillet, &c.; *Hind Let Loose.*)

The services of this proscribed party at this crisis were of an important kind. Suffering as they had long done at the hand of a tyrannical government, and alive as they were to the value of civil and religious liberty, they espoused the cause of the Prince of Orange with an enthusiasm and bravery worthy of their character. A regiment of 800 Cameronians was speedily raised, and their heroism as displayed at Dunkeld and other places has extorted the praise of history. A regiment bearing the name still exists. (*Laing*, iv. 191. 208. 232.)

But the Cameronians, though they occupy a prominent place in the history of the reigns of Charles, and of James II. his successor, never formed a very numerous body. After the revolution, when they were allowed to worship God according to their conscience without fear or danger, they gradually became an obscure as they were a small sect. Nor did they think of forming themselves into a regular church till 1743, when, under the direction of the Rev. M. M'Millan* and other leaders, they "formed and established a presbytery in the name of Christ, the alone king and head of the church, under the title of the Reformed Presbytery." As they became more numerous, they took the title of the Reformed Presbyterian Synod. But at this moment (1841) the synod consists only of six presbyteries, embracing thirty-five congregations, most of them being very small.

The nature of the tenets and doctrines of the Cameronians may account for their never having become a numerous sect. They denied the authority of civil rulers, unless these had sworn and subscribed the national covenants; and of course they refused to include the names of such rulers, even that of the sovereign himself, either in their public or private prayers. They contended that the civil magistrate is bound to suppress error, and to encourage the true religion; and that the covenants are binding on all posterity. These opinions, however, they have gradually modified or abandoned. They now pray for the sovereign and civil magistrates, and have virtually renounced the covenants. They are also in favour of a national church; and would have no hesitation to unite with the present established church of Scotland

* They are often called *M'Millanites*, in honour of this person. They are also known by the name of *Hills People*, from the circumstance that, till within the last fifty years, they held public worship almost exclusively in the open air on the side of some hill, in honour of their persecuted forefathers in the time of Charles II. This practice they have now laid aside, and avail themselves of stone edifices for churches like other sects. See MACMILLANITES

if patronage was abolished, and if the right of electing their own ministers were conferred on the people. They adopt the Westminster Confession of Faith, and all the standards and formulas of the church of Scotland. Their ministers are strict disciplinarians, adopt the Calvinistic creed in its most rigid sense, are peculiarly assiduous and faithful, and as a body the Cameronians now form a most unobtrusive, respectable, and exemplary sect of Christians.

CA'MISARDS. In French History, the Protestant insurgents in the Cevennes, after the revocation of the edict of Nantes, were so called, from having worn their shirts over their dress by way of disguise on the occasion of some nocturnal attacks. Their principal leader, Cavalier, succeeded so far as to effect a capitulation in their favour with the French government. He subsequently entered the English service, and at his death was governor of Jersey.

CA'MLET. A stuff or cloth, consisting of a mixture of wool and silk, or of wool and camel's hair.

CAMO'ENÆ. (Derivation unknown.) A Roman appellation of the Muses.

CAMP. In the art Military, a word of doubtful etymology, signifying the station of an army, with its artillery, baggage, and other appendages, when it has taken the field for the purposes of war. The history of camps involves that of the military art in all ages and in all countries; and in proportion to the skill displayed by any nation in the science of castrametation, may an accurate estimate be formed of its attainments in other departments of military tactics. The Lacedæmonians appear to have been the first people in profane history who directed their attention to this subject Their camps, whenever it was practicable, were of a circular form, which was said to possess the advantage that from the centre, where the general with the flower of the troops lay, help could soonest be afforded to any point menaced by the enemy. The other states of Greece, Macedonia, and Carthage borrowed the grand principles of choosing and tracing their camps from the Lacedæmonians; but accommodated the form, the arrangement, and disposition of the same to the nature and strength of the ground which they intended to occupy. It was from the Romans that the art of castrametation first acquired any systematic regularity. The form of the Roman camp was invariably quadrangular, it was surrounded by regular intrenchments, and was so admirably arranged that each cohort, legion, and individual knew exactly the point which he ought to occupy, and the part to which instant attention should be directed in the event of alarm. It would exceed our limits to give an account of the construction of the Roman camps, and of the arrangement of the troops in them. The reader will find ample details and comments upon this subject in the works of Polybius and Vegetius, and in General Roy's *Military Antiquities of the Romans in Britain*. The *Penny Cyclopædia* contains an able account of the different systems of castrametation.

CAMP. In Agriculture, a heap of turnips, potatoes, or other roots, laid up for preserving through the winter, in some places called a *pie*, and in others a *bury*.

CAMPAI'GN (Fr.) An uninterrupted series of military operations in the field. *See* WAR

CAMPANI'LE. (It campana, *a bell.*) In Architecture, properly a tower for containing a bell or bells. Though the word has been adopted in the English language, and applied to the bell towers of churches, it more properly belongs to those towers near churches, but detached from them, to be seen in many of the cities of Italy. The principal of these are the Campanile of Cremona, which is of the extraordinary height of 396 feet, that of Florence, 268 feet high, built from the design of Giotto; the Garisendi tower at Bologna, built in 1110, which is 147 feet high, and is 8 feet 8 inches out of an upright; and very near to it in the same city another tower, bearing the name of Asinelli, 327 feet in height, and leaning from the perpendicular 3 feet 8 inches, but which, seen, as it always is, in company with the first, seems to lean but little. The last we shall name is that which is commonly called the leaning tower of Pisa, and perhaps the most remarkable of all. It is 151 feet high, and overhangs 12 feet 9 inches. Its general form possesses elegance, and is that of a cylinder encircled by 8 tiers of columns over each other, and each with an entablature. The columns are all of marble, and the upper tier is recessed back.

CAMPA'NULA. (Lat. campana, *a bell.*) A very large genus of hardy herbaceous plants and annuals, inhabiting the temperate parts of both the eastern and western hemispheres, but most abundant in the latter. They have blue or white flowers, often of considerable size, on which account most of the species are favourites in gardens. In M Alphonso de Candolle's account of the genus, published in 1830, after separating from it several groups, 152 species are enumerated. The only useful plant among them is *C. rapunculus*, the radish-like sort of which is sometimes eaten under the name of Rampion.





CAMPE'ACHY WOOD. Logwood. Brought from *Campeachy*, in the bay of Honduras.

CAMPHE'NE, or CAMPHOGEN. A term applied by chemists to a hydrocarbon, composed of ten atoms of carbon = 60, and eight of hydrogen = 8; it is therefore represented by the equivalent number 68. It is identical with pure *oil of turpentine;* and camphor is its protoxide, that substance being composed of 68 camphogen + 8 oxygen; camphor is therefore represented by the equivalent number 76.

CA'MPHOR. A concrete volatile and highly odorous substance, obtained by distillation from the *Laurus camphora*, or camphor laurel, which is a native of Japan It is also found ready formed in the wood of the *Dryabalanops camphora*, a tree which flourishes in Borneo and Sumatra What is called *crude* or *rough* camphor is in small grey pieces and crystals, it is purified by sublimation, and is found in commerce in circular cakes weighing about 8 lbs. each, white, translucent, and somewhat tough and crystalline in texture. Camphor is chiefly used in medicine. it dissolves very sparingly in water, and the solution is called *camphor julep*, it dissolves abundantly in alcohol, forming *camphorated spirit of wine.*

CA'MPHORATES Compounds of camphoric acid.

CAMPHO'RIC ACID. An acid obtained by boiling camphor in nitric acid. It consists of 60 carbon, 8 hydrogen, and 5 oxygen, or of one atom of camphor and four atoms of oxygen.

CA'MPULI'TROPOUS. (Gr. καμπτω, *I curve*, and τρεπω, *I turn*) In Botany, a name given to such ovules as bend down upon themselves till their apex touches the base. They are extremely common in plants, and are more particularly those in which a *raphe* exists; the latter being a bundle of vessels, whose office is to maintain a communication between the base of the nucleus and the base of the seed.

CANA'L. (Lat.) An artificial channel filled with water, formed for the purposes of draining, of irrigation, of supplying towns with water, or of inland navigation. Illustrative of the first, may be cited the canal which extends from the Fucine Lake (now Lake Celano) into the river Liri, of the second, the canals with which ancient Egypt was intersected; of the third, the artificial aqueducts of antiquity, or in modern times the New River, by which London is in a great measure supplied with water from Hertfordshire; but it is to channels for the purpose of inland navigation that the term *canal* is usually confined.

That the importance of canals as a means of inland navigation attracted attention even in the earliest ages, is manifest from the "fossæ Philistinæ," large canals (*Pliny*, iii 16) at the south of the Eridanus in Liguria, the origin of which is ascribed by Mr. Bryant to the Canaanites, who at an early period migrated from Philistia, as well as from the grand design of the Cnidians, a people of Caria in Asia Minor, to dig a channel through the isthmus which joined their territory to the continent. (*Her* ii 78) The attempt, too, of the Egyptians at a later period to unite the Nile with the Red Sea by a canal has been often recorded, though it is difficult at the present day to discover the least traces of its existence The Greeks, who received the first principles of commerce and the arts from the Egyptians and Phœnicians, and who, improving upon the models transmitted to them, afterwards reached an unexampled pitch of civilisation, conceived the magnificent design of making a navigable passage from the Ionian Sea into the Archipelago, by cutting a canal across the isthmus of Corinth. This undertaking, however, proved abortive, and though the attempt was again renewed by several of the Roman emperors, it still remained without success In the reign of Augustus, Drusus succeeded in excavating a canal from the Rhine to the Issel, and formed, as we are told by Pliny, a new mouth from the Rhine to the sea. A canal between the Rhine and the Maese, supposed to be that now commencing at Leyden and passing Delft to its junction with the Maese at Sluys, was likewise formed by the Romans But, as has been often observed, it was by bending nations under the same yoke, and not by uniting them in commercial ties, that the Romans sought to extend international communications; hence their canals were usually formed for the purposes of draining or of warfare. There can be little doubt, however, that it was the Romans who introduced into their provinces the models of internal communication which in modern times have undergone such immense improvement, and which have been converted to a purpose nobler than conquest — the interchange of the productions of labour

There is no country in the world where the advantages of canals are more appreciated than in China. From time immemorial the rivers that intersect that vast empire have been united by innumerable canals; and the Grand Canal is said to be the most stupendous work of the kind that has ever been executed. (*Raynal, Hist. Phil* i. 102) Russia, too, exhibits a remarkable degree of enterprise in the construction of canals for the

purpose of inland navigation; and though innumerable difficulties peculiar to that country for a long period impeded the progress of works of this description, that empire is now traversed by an unbroken line of water communication from St. Petersburg to the Caspian Sea.

The canals constructed during the period of the glory of Italy are very numerous; but though many of these are navigable, their primary object has been to communicate to both banks of the Po the various productions of the country.

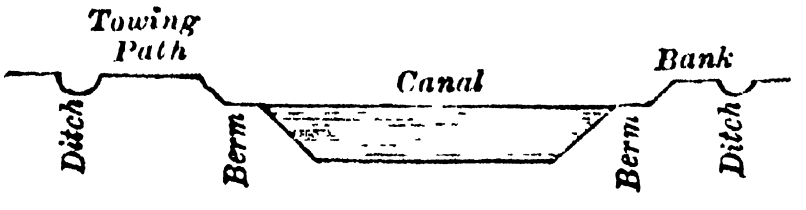
In the Netherlands, the construction of canals commenced in the 12th century, when Flanders became the commercial entrepôt of Europe; and to the large share which canals possess in its economical arrangements is to be ascribed chiefly the prosperity of Holland in the present day. From the structure of that country, canals are formed with peculiar facility; and there is not a town or a village which is not furnished with a canal of greater or smaller dimensions. France has from a distant period exercised its skill in the construction of canals for inland navigation. The first was the canal of Briare, which opens a communication between the Loire and the Seine, and then between Paris and the western provinces, and is of immense importance in inland commerce. Omitting many works of this kind, completed, in progress, or projected in that country, the canal of Languedoc may be mentioned, which was intended to unite the Mediterranean with the Atlantic, and was considered a stupendous undertaking. It is 150 miles long, is supplied by a number of rivulets, and is provided at proper intervals with 114 locks and sluices.

A reference to the earlier history of Spain, Sweden, and Denmark, and to the more recent accounts of Austria, Prussia, and above all America, will show to what extent these several states have endeavoured by the construction of canals to develop internal resources, and to distribute universally the productions of labour.

It is a singular circumstance that Great Britain, generally foremost in the race of civilisation, and possessing so many natural means for the formation of canals, from its insular position and its numerous rivers, was the last country in Europe to avail itself of its advantages. It is true that at different periods of our history the importance of inland navigation was deeply felt, and various expedients were adopted for removing obstructions in the rivers of England, with the view of facilitating internal commerce, but it was not till the middle of the last century that the construction of canals began to enter into the system of British economy. In the year 1755 an impulse was given to the progress of British industry by the project, which originated with the Duke of Bridgewater, of forming a canal between Worsley and Manchester; a project which was altered and extended by three successive acts of parliament to admit of greater comprehensiveness in its execution, and has formed the basis of every succeeding plan of canalisation in this country. The example then set by the Duke of Bridgewater was speedily followed, the large amount of capital in England, which is ever ready to be invested in undertakings that are likely to prove profitable, soon found its way into this channel, and in a short time the country became intersected with navigable canals.

The section of a canal is usually a trapezium, of which two sides are parallel and horizontal, and the other two equally inclined to the horizon. The inclination depends on the nature of the soil. It is least in tenacious earth, and greatest in loose soil; but no soil will maintain itself, unless the base of the slope exceeds its height at least in the ratio of four to three. In loose soils the base requires to be twice as great as the height.

A canal is usually confined between a bank on one side, and a towing path on the other, the breadth of whose upper surface must be sufficient for a road on which the animals employed in draught may easily pass. This requires the breadth of the upper surface to be at least 9 feet. The usual rule for the other bank is to make the breadth at top equal to the height, measured from the bottom of the canal: but in this case there should be a *berm* of a foot, or a foot and half, at the level of the water, which increases the thickness of the bank at bottom, and prevents the wash of the banks from falling into the canal. To prevent the entrance of rain-water, a *counter-ditch* is formed on the outside of each of the banks. The profile of a well-constructed canal will therefore present the following figure:—




The dimensions of navigable canals must depend on the size of the vessels intended to navigate them. In order that they may permit two vessels to pass each other with freedom, the breadth at bottom is usually made twice as great as the breadth of the beam of the vessels: the depth requires to be at least one foot more than the vessel's draught of water.

The bed of a canal must be absolutely level, or have no more slope than is necessary to convey water to replace that which has been wasted. Hence, when a canal intersects a sloping country in a series of channels at different levels, means must be provided to enable vessels to pass from one level to another. This is commonly effected by means of a *lock*.

The invention of locks as a means of carrying a canal through an undulating country has given an entirely new feature to the inland navigation of Europe. Various nations have claimed the honour of this invention; but it would appear that the controversy which has arisen on the subject is not yet settled. "A lock is a chamber, formed of masonry, occupying the whole bed of the canal where the difference of level is to be overcome. This chamber is so contrived that the level of the water which it contains may be made to coincide with either the upper or lower level of the canal. This is effected by two pairs of gates, one of which pairs is placed at each end of the chamber of the lock. By this means, while the gates at the lower end of the chamber are opened, and those at the upper end are closed, the water in the chamber will stand at the lower level of the canal, and, on the contrary, when the lower gates are closed, and the upper gates are opened, the level of the water in the lock will coincide with the level of the water in the upper part of the canal. In the first case, a boat may be floated into the lock from the lower part of the canal; and if then the gates be closed, and water is admitted into the lock from the upper level until the surface of the lock is in a line with the water above, the boat will be floated up, and on the opening of the upper gates may be passed onward. By reversing the course of procedure, boats may be as readily conveyed from the upper to the lower level." *See* Lock.

The supply of water required for maintaining a canal depends on the *lockage* or quantity wasted in passing a vessel through the locks, on the evaporation from the surface, and on the leakage. It has been found by experiment that the annual quantity of evaporation from the canal of Languedoc is 32 inches, that is to say, the body of water required to supply this waste is equal to a parallelopiped whose base is the whole surface of water in the canal, and whose altitude is 32 inches: in most calculations it has been customary to take this altitude at 36 inches. With respect to the leakage, when the soil is porous the inner surface of the banks may be lined with an earth retentive of water, or a portion of the middle of each bank may be built up with earth of this character. The operation of lining a bank with clay, or earth retentive of moisture, is called *puddling*.

The advantages derived from canals are now so generally known and acknowledged, as to render it almost superfluous to allude to the question. The beneficial effects of canals are felt in a greater or less degree by all classes of society: by their means the manufacturer is enabled to collect his materials and his fuel with less labour and expense; the farmer obtains a supply of manure at a cheap rate, and a ready conveyance of his produce to the most profitable market; and the merchant is enabled to extend his commerce by exporting greater quantities and varieties of goods from places remote from the sea, and by more easily supplying a wider extent of inland country with articles of foreign produce. In short, general arguments in favour of canals are superseded by the rapidly improving and thriving state of all the cities, towns, and villages in their neighbourhood; while the great works of every kind to which they have been conducted, and to which a large portion of them owe their rise, are their best recommendation. Some years ago, when the formation of railroads became a favourite speculation, no small degree of alarm was experienced by those interested in the prosperity of canals, lest they should diminish in importance, or in fact be entirely superseded by the introduction of railroads. Experience has, however, hitherto shown that the fears entertained on this subject were perfectly groundless; for, as railways are constructed chiefly for the expeditious transport of passengers and goods, and from the expense incurred in their construction and maintenance a higher rate of toll must be levied in order to pay the proprietors, this mode of conveyance is not likely to interfere with that description of goods which form the chief traffic of canals, and for which *cheapness*, not *expedition* of transport, is required. (For detailed information on the subject of canals, the reader is referred to *Phillips's General History of Inland Navigation*; and to *Nichols, Priestley, and Walker's Historical Account of the Navigable Rivers, Canals, &c. of Great Britain.*)

CANALI'CULATE. (Lat. canalis, *a water pipe.*)

In Zoology, is said of a surface when it has a longitudinal impressed line or channel.

CANALI'CULATE. (Lat canalis, *a water pipe*.) Is said of leaves or other parts when the edges are so much turned upwards as to produce the appearance of a channel or gutter.

CANALI'FERA. (Lat canalis, *a canal;* fero, *I bear*.) The name of a tribe of Zoophagous Univalves, or Gastropods, of which the shell is characterized by a long straight canal terminating its mouth.

CANA'RY-BIRD. Two distinct species of finch (*Carduelis*) appear to have afforded the different varieties of singing bird familiarly known by this name. The one which is best known in its wild state is the *Carduelis canaria* of Cuvier, and is very abundant in Madeira, where its characters and habits have been observed with much attention by Dr. Heineken "It builds," says this naturalist, "in thick bushy high shrubs and trees, with roots, moss, feathers, hair, &c.; pairs in February; lays from four to six pale blue eggs, and hatches five, and often six times in the season It is a delightful songster, with, beyond doubt, much of the nightingale's and sky-lark's, but none of the wood-lark's song"—"A pure wild song from an island canary, at liberty, in full throat, in a part of the country so distant from the haunts of men that it is quite unsophisticated, is unequalled, in its kind, by any thing I have ever heard in the way of bird-music." The canary-bird was brought into Europe as early as the 16th century, and is supposed to have spread from the coast of Italy, where a vessel, which was bringing to Leghorn a number of these birds besides its merchandise, was wrecked. As, however, they were males chiefly which were thus introduced, they were for some time scarce, and it is only of late years that their education and the proper mode of treating them have been known.

CANA'STER. The rush basket in which tobacco is packed in Spanish America, whence *canaster tobacco*.

CA'NCEL. (Fr. canceller.) In Printing, is the suppression of a leaf or more of a book, owing to some error of importance having escaped detection, or some fact being mis-stated, or some new discovery being made, or some change having taken place in the author's arrangements after that part of a work has been printed, and substituting for the portion cancelled a corrected leaf, &c. which is usually distinguished by one of the following signs at the bottom of the page, *, †, ‡, §, as a guide to the bookbinder.

CANCELLA'RIA (Fr canceller) A Lamarckian genus of Trachelipod Testacea, having the shell oval or turreted; base of the aperture sub-canaliculate; canal very short; columella plicate; the plaits usually transverse, varying in number; lip internally furrowed, operculum horny The reticulated Cancellaria (*Cancellaria reticulata*, Lam) is a well-known species, from the Atlantic Ocean

CA'NCELLATE. (Lat cancelli, *lattices*) Is a term applied to leaves consisting entirely of veins, without connecting parenchyma, so that the whole leaf looks like a plate of open network Instances of this kind occur in *Hydrogaton fenestralis*, but are extremely rare

CA'NCER. (Lat.) The *Crab*. The fourth sign of the zodiac, which the sun enters about the 21st of June, when he reaches his greatest northern declination. The parallel circle through this point is called the *Tropic of Cancer*.

CANCER. The Linnæan generic name for the modern Brachyurous family of Crustaceans.

CANCER. A disease chiefly attacking the glands, consisting of a schirrous tumour, terminating in an ill-conditioned and deep ulcer, generally attended by excruciating pain. When the cancerous character of a tumour is once ascertained, its extirpation, where practicable, is the only chance of effectual relief. The large blue veins which ramify round a cancer of the breast were compared by old authors to the claws of a crab, whence the name of this disease.

CANCRO'MA. A genus of *Grallatores* or wading birds, belonging to Cuvier's family of *Pressirostres*, or compressed-billed waders, including only one known species, the Boatbill, so called from the form and structure of the bill, which characterizes the genus. The bill is flattened or depressed, not compressed; and is composed of two boat-shaped or spoon-shaped mandibles, with their concavities applied towards each other, the upper one having a strong and sharp tooth near the point. The Boatbill inhabits the banks of the Orinooko, and other large rivers of South America which are subject to flooding in the rainy season.

CANDELA'BRUM. (Lat. candela, *a lamp or candle*.) A stand or support on which the ancients placed a lamp Candelabra varied in form, and were highly decorated with the stems and leaves of plants, parts of animals, flowers, and the like. There was no article of ancient furniture in which more taste and elegance were displayed than in the designs of candelabra. The etymology of the word would seem to assimilate the candelabrum to our candlestick; it is, however, quite certain that the word *candela* was nothing more than a lamp, and that the candelabrum was but a support more or less heavy in construction upon which the lamp was placed, or whose top was hollowed out for the reception of oil or some other combustible. The great variety observable in ancient candelabra was not so dependent on the caprice of the artist, as on the different uses to which they were first applied. Before the employment of oil the mode of illuminating an apartment was by means of dry wood burnt on *braziers* (basins for holding fuel) supported by tripods. The Greeks, always delighting to preserve some reminiscence of an ancient usage, thence adhered to the triangular form in this article of furniture, and their example was imitated by the Romans. Generally speaking, there are two species of candelabra. those which ending upwards in the form of a brazier, so nearly approach the form of a portable altar as to be almost confounded with it. This species must be classed with the tripod, and there seems ground for believing that it was used only in temples or in small chapels. Of this sort was that carried off by Verres; and Cicero informs us that in Sicily every house was supplied with one in silver. Of this species also are those most frequently sculptured in friezes, usually accompanied by genii and instruments of sacrifice. The other species of candelabra, whose accessaries and ornaments are of the same character as in those first described, are much higher, and of marble. Of this kind Rome furnishes an abundance of examples, but, as Winkelman observes, not one has been found in bronze

The marble candelabra exhibit as much variety in the forms of the vase or brazier, which it is their principal end to support, as in the body and base of the support itself. Sometimes they are capricious to excess, the foliage, contrivance, and design being such as to display more skill than propriety of taste Others, however, there are which are exquisite models of form, taste, ornament, and execution. The museum at the Vatican contains possibly the finest collection in Europe of this species. There is one to be seen there upwards of seven feet high, resting on griffins' or lions' paws The general form of its shaft is that of a baluster, which supports a vase-shaped basin, it is highly decorated with foliage and bassi-rilievi of bacchantes Our British museum presents some specimens, beautiful, but not of the first class For full information on this species, the reader should turn to the splendid works of Piranesi. Lachausse thinks that marble candelabra were used in temples more for the purpose of adding splendour to the service than of lighting it, but it seems probable that many with which we are acquainted, such as those that were found in the baths of Titus, where numbers of the apartments did not receive the light of day, actually held artificial light The most curious specimens of candelabra, as respects form, use, and workmanship, are those excavated at Herculaneum and Pompeii These are all of bronze, and that they were employed for domestic purposes is proved from the representation, on an Etruscan vase, of one which serves to give light to the guests assembled round a banquet table. They are slender in their proportions, and perfectly portable, rarely exceeding five feet in height. It is to be observed, that none of the candelabra hitherto found exhibit any appearance of a socket or of a spike at top, from which an inference of the use of candles could be drawn

CANDIDA'TI. (Lat candidus, *white*) In Roman Antiquities, so called from their being arrayed in white garments, were the aspirants for public offices. In this dress they canvassed the different tribes, harangued the people, extolled their own exploits, and, as the case might happen, exhibited the wounds which they had received in the service of their country. The forms of election among the Romans were remarkably strict. Every candidate for public offices was compelled to pass two years in probationary service; and even then his appointment, which could only be ratified by numerous and imposing solemnities, did not generally take place until he had spent five months as magistrate elect in familiarizing himself with the duties of his office Notwithstanding the severity of the Roman laws against corruption, the practice of bribery was constantly resorted to, and a full purse and fair promises went far to supply the want of ability and integrity.

CA'NDLEMAS. A church festival, held on the 2nd of February, to commemorate the purification of the Virgin. The name probably arose from the number of lighted candles used in the processions of the day, or perhaps from a custom of consecrating candles on that day for the rest of the year. This practice was abolished in England in the second year of the reign of Edward VI.

CA'NDLES. These are an important article of manufacture, and may be composed of a variety of materials: the principal are,—1 *Wax candles*, which are made by pouring melted wax over the wicks, which for the convenience of turning and placing them successively over the cauldron, are usually attached to the circum-

ference of a hoop; when of a proper thickness, they are rolled smooth upon a table, and the ends are cut and trimmed. It is in consequence of this method of manufacture, that when we cut a wax candle we observe it composed of successive layers or coats. Attempts have been made to cast wax candles in moulds, but those which are thus made never burn so well as those which are *poured*. 2. *Spermaceti candles*, or mixtures of wax and spermaceti. This material forms a very good and cleanly candle; but in consequence of its ready fusibility and hardness when concrete, it does not admit of being carried about without spilling the melted material. The fused portions also, which run down the candle, are apt to curl up and fall upon the table. 3. *Composition candles*. This term was originally conferred by a manufacturer who had a large stock of spermaceti candles on hand which were of a dirty hue, and which therefore were unsaleable; he advertised them under the above name, and they were soon disposed of, under the notion of their being composed of some new combination of materials. The term has since been applied to various mixtures, but what are now sold under the name of composition candles are chiefly mixtures of spermaceti, tallow, and a little resin, and occasionally wax. 4. *Tallow candles*, which are either cast upon the wick in pewter moulds, or made by dipping the wicks, attached in rows to proper frames, into melted tallow. 5 *Stearine candles*. Under this term we may include cocoa-nut oil candles, and a few others made of the stearine, or what may be compared to the *spermaceti* of the vegetable oils. The stearine, or rather the *stearic acid* of tallow, is also now extensively employed for making candles.

A candle may be considered as a portable gas apparatus, and its philosophical history involves a number of very curious points, which we can only superficially advert to here. The combustible material, in a state of fusion, is drawn up in successive portions by capillary attraction into the heated part of the wick, the texture, materials, and dimensions of which are matters of much importance. If the wick be too large, the candle flares and smokes, producing a peculiar suffocating smell in the room, and often wanting snuffing, as we constantly see in badly made mould candles, if, on the contrary, the wick be too small, the candle burns dimly and gutters, in the former case, unburned carbon soon collects in the upper part of the flame, and if not removed is apt to fall into the cup of the candle, where it forms a kind of second wick, rapidly melting away the tallow and disfiguring the candle, and occasionally, where candles are inadvertently left burning, falling upon the table and setting fire to any thing within its reach. This evil may to a great extent be prevented by inclining the candle at an angle of about 15 degrees, so as to keep the upper part of the wick out of the flame. In this way the air has access to it, and the charcoal which otherwise collects into a head is burned as soon as deposited. Where it is required to keep a common tallow candle burning during the night, the necessity for snuffing, and the risk of mischief, may be prevented by so inclining it, and candlesticks have been contrived for the purpose, which are useful and effective, but very unseemly. With good wax the wick is more easily adjusted to the wants of the flame, and the necessity of snuffing to a great extent prevented; but adulterated wax is often more troublesome than tallow. Great care is also requisite in selecting the cotton for the wicks of candles, which should be of such a nature as to leave no ash, or scarcely any, when burned. The wick is occasionally impregnated with different substances, and sometimes so platted as to curl out of the flame, but the details of these contrivances would be foreign to the object of this work. The following table contains the results of some experiments made by Dr. Ure, with a view of ascertaining the relative intensities of light and the duration of different candles —

| Number in a pound. | Duration of a candle. | Weight in grains. | Consumption per hour in grains | Proportion of light | Economy of light. | Candles equal to one Argand |
|---|---|---|---|---|---|---|
| 10 Mould | 5h 9m | 682 | 132 | 12·25 | 68·0 | 5.70 |
| 10 Dipped | 4 36 | 672 | 150 | 13·00 | 64·5 | 5 25 |
| 8 Mould | 6 31 | 856 | 132 | 10·50 | 59·5 | 6 60 |
| 6 Ditto | 7 2½ | 1160 | 163 | 11·66 | 66·0 | 5 00 |
| 4 Ditto | 9 56 | 1787 | 186 | 20·25 | 80·9 | 3 50 |
| Argand oil flame | | - - | 512 | 69·10 | 100·0 | |

In reference to the above table, it appears from Dr. Ure's experiments that one-eighth of a gallon of good oil, weighing 6010 grains, or 13 and 1-10th ounces avoirdupois, lasts in a bright argand lamp 11 hours 44 minutes. The weight of oil it consumes per hour is equal to four times the weight of tallow in candles eight to the pound, and 3 and 1-7th times the weight of tallow in candles six to the pound; but, its light being equal to that of five of the latter candles, it appears from the above table, that 21bs. weight of oil, value one shilling, in an argand lamp, are equivalent in illuminating power to 3 lbs. of tallow candles, which cost about three shillings. The larger the flame in the above candles, the greater the economy of light. (*Ure's Dictionary of Chemistry.*) In reference to the comparative cost of coal gas, oil, tallow, and wax, it appears that the cost of a lamp fed by gas, and giving the light of seven candles, will be about one penny per hour; of an argand lamp fed with spermaceti oil, about threepence; of mould candles about threepence halfpenny; and of wax candles about one shilling. Ninety cubic feet of good coal gas, value about one shilling, will produce the light of about 10 wax candles for one hour.

CANE'LLA. (Dim. of canna, *a reed.*) The bark of the *Canella alba*, imported from the West Indies in quilled pieces of a pale buff colour, and a biting aromatic flavour. It is occasionally used in medicine.

CANE'LLEÆ. (Canella, one of the genera.) A small natural order of plants, supposed to be related to *Clusiaceæ*; but very imperfectly known. They consist of South American shrubs or trees; one of which, *Canella alba*, is aromatic, and yields the wild cinnamon of the West Indies. The bark of that species is used medicinally against scurvy.

CANE'PHORÆ. (Gr. κανηφορος, *bearing a basket.*) In Architecture, figures of young persons of either sex, bearing on their heads baskets containing materials for sacrifice. They are frequently confounded with caryatides, from their resemblance in respect of attitude and the modern abuse of their application. *See* CARYATIDES.

CA'NES VENA'TICI. The *Greyhounds.* One of the constellations formed by Hevelius in the northern hemisphere. It is represented on the celestial globes and charts by the figures of two dogs, which are also distinguished by the names of *Asterion* and *Chara.*

CANI'CULAR DAYS, or DOG DAYS. The name given to certain days of the year, during which the heat is usually the greatest. They are reckoned about 40, and are set down in the almanacs as beginning on the 3rd day of July, and ending on the 11th of August. In the time of the ancient astronomers, the remarkable star Sirius, called also *Canicula*, or the *Dog Star*, rose heliacally, that is, just before the sun, about the beginning of July, and the sultry heat which usually prevails at that season, with all its disagreeable effects, among which the tendency of dogs to become mad is not one of the least disagreeable, were ascribed to the malignant rage of the star. Owing to the precession of the equinoxes, the heliacal rising of Sirius now takes place later in the year, and in a cooler season, so that the *dog days* have not now that relation to the particular position of the *Dog Star* from which they obtained their name.

CANI'CULAR YEAR. The ancient solar year of the Egyptians, so called because its commencement was determined by the heliacal rising of the Dog Star. The Egyptians chose this star for their observations, either on account of its superior brightness, or because its heliacal rising corresponded with the annual overflow of the Nile. At a very early period of history the Egyptians had perceived that the solar year contains 365¼ days; for their common years consisted of 365 days, and every fourth year of 366, as in the Julian Calendar.

CANI'NES. (Lat. canis, *a dog.*) The pointed, often long teeth, which succeed the incisors; called *dentes canini*, or *lanarii.*

CA'NIS. (Lat. canis, *a dog.*) The name of a genus of Digitigrade Mammalia, restricted in the modern systems of Zoology to the species of dog, wolf, and jackal; but by Linnæus applied in a wider sense to include the fox and hyena. With respect to the latter animal its enormously developed anal scent-glands, its brief coition, and its mane indicate it to belong to the family of the skunks and genets rather than to that of the dogs, while the prickly tongue and dentition of the hyena approximate it to the cats. The foxes are generically distinguished from the dogs by the pupils of the eye, which during the day have the form of a vertical fissure, by their less notched upper incisors, and by their longer and more bushy tail. The true characters of the genus *canis* are six incisors and two canines in each jaw, six molars on each side of the upper jaw, and seven molars on each side of the lower jaw, making in all forty-two teeth, of which there are twenty in the upper and twenty-two in the lower jaw. The first three molars in the upper, and the first four molars in the under jaw, are trenchant and pointed or lacerating teeth; the succeeding molar in the upper jaw is very large, with two sharp cutting points towards the outer edge, and a small tubercle on the inner side interiorly; the others are smaller, and all furnished with tubercles: the first of these tuberculate molars in the upper jaw is very large. In all the wild varieties of the species of canis the muzzle is elongated, and the ears are carried erect; the tongue is unprovided with cuticular spines; the fore feet have five toes, the hind foot

four only, both are armed with non-retractile claws; the cæcum is cylindrical, and coiled upon itself; the anal glands are of moderate size; the coitus is prolonged. The dog (*Canis familiaris*, L.) is distinguished from the wolf and jackal by his recurved tail; but the varieties, as to size, form, colour, and quality of the hair, are almost infinite. The dog is the most complete, singular, and useful conquest ever made by man over the brute creation: each individual is devoted to his particular master, assumes his manners, knows and defends his property, and remains attached to him till death; and all this neither from constraint nor want, but solely from the purest gratitude and truest friendship. The swiftness, strength, and scent of the dog have rendered him man's powerful ally against all other animals, and have perhaps mainly contributed to the establishment of society. Some naturalists think the dog is a reclaimed wolf, and others that he is a domesticated jackal, nevertheless, those dogs that have become wild again revert neither into the one nor the other species. The wild dogs, and those that belong to savages, as the dingo, resemble, it is true, the wolf in the shape of the head, their straight pricked ears, rough and thick hair, long bushy tail, and [illegible] gait, moreover, they never bark, but utter a sharp cry or long melancholy howl, like the jackal and wolf; yet they are plainly distinct from both. The Esquimaux dogs present the first traces of a deviation from the wild type, the figure of the legs is more determined, and their pace bolder and more rapid: still they manifest their near relationship to the wolf in their sharp nose, pricked ears, and inability to bark. The Esquimaux and the people of Kamtschatka use these dogs as beasts of draught. six or seven dogs will draw a sledge laden with eight or ten hundred weight at the rate of seven or eight miles an hour, and will easily, under these circumstances, perform a journey of fifty or sixty miles a day, when the snow is hard and smooth, and the road level. The dogs thus employed have a simple harness of deer or seal skin going round the neck by one bight, and another for each of the fore-legs, with a single thong leading over the back, and attached to the sledge as a trace. "Though they appear," says Captain Parry, "to be at first sight huddled together without regard to regularity, there is in fact considerable attention paid to their arrangement, particularly in the selection of a dog of peculiar spirit and sagacity, who is allowed by a longer trace to precede the rest as leader, and to whom, in turning to the right or left, the driver usually addresses himself."

The Newfoundland dog may be regarded as the next remove from the Esquimaux variety. These fine and sagacious animals are employed in their native island to draw sledges and carts laden with wood and fish, and to render many other useful services performed elsewhere by the horse. The readiness with which the Newfoundland dog takes the water, his aptitude to fetch and carry, and his powerful and active swimming, have been the means of preserving the lives of many human beings. Another variety of dog nearly allied to the Newfoundland breed, and belonging to the same subdivision (*Aduculatus*, Linn., or spaniel-tribe), has been trained by the benevolent monks of the convent situated near the top of the mountain of Great St Bernard, to hunt out and extricate such unfortunate travellers as may have been buried under the snow-drifts or avalanches, while attempting the neighbouring dangerous pass between Switzerland and Savoy. One of these noble animals was decorated with a medal in commemoration of his having saved the lives of twenty-two persons, who must otherwise have perished. In the museum at Berne is still preserved the stuffed skin of "Barry," another of these dogs, together with the bottle and collar which he bore in his lifetime; for the good fathers, with a provident care to afford every chance of escape to the unfortunate travellers, fasten a flask of spirits about the neck of the dog before he starts on his search. Barry having discovered a boy whose mother had been destroyed by an avalanche, unhurt and asleep in the hollow of a glacier, and almost stiff with cold, delivered to him the bottle suspended from his neck; and when he had refreshed himself, found means to induce him to mount upon his back, and thus carried him to the gate of the convent. This dog had been the means of rescuing from death upwards of forty persons before he was superannuated; when he was sent to pass the remainder of his days, on a pension, in a more genial climate at Berne.

In our own country the shepherd's dog offers the example of one of the purest races of the domesticated animal, and that which, in its straight ears, its hair, and tail, approaches nearest to the original stock. The sagacity of this variety in the peculiar department in which his services are rendered to man is well known, and has been illustrated by a hundred interesting anecdotes. The shepherd's dog, though outwardly resembling in many points the "dingo," possesses a greater cerebral development, which continues to increase together with intelligence in the spaniel and barbet. Guided by the form of the cranium, we should associate the spaniel and its immediate varieties with the shepherd's dog, the wolf dog, the Newfoundland and Mount St. Bernard's dog, and the Esquimaux dogs in one family (*Sagaces*).

A comparison of the crania indicates a closer affinity of the "dingo" with the family *Pugnaces*, including the mastiff and Danish dog, than with the *Sagaces*. After the pugnaceous mastiff and its varieties, as the bulldog, remarkable for the shortness and strength of its jaws, come the hound, the pointer, and the terrier in the order of cerebral development. The varieties of this family (*Venantes*) differ between themselves chiefly in the size and proportions of the limbs; the greyhound is longer and more lank, its frontal sinuses are smaller, and its scent weaker.

The bandy-legged turnspits, and the small pet dogs, as the pugs, poodles, Italian greyhounds, king Charles's breed, &c., are the most degenerated productions of the genus, and exhibit the most striking instances of that power to which man subjects all nature.

With some exceptions among this latter anomalous group all the domestic varieties of the genus *Canis* are easily and naturally referable to one or other of the three great tribes above mentioned, of which the mastiff, the hound, and the spaniel may be regarded as the several types, and which we have named *Pugnaces*, *Venantes*, and *Sagaces*, from their prominent aptitude respectively for the combat, the chase, and those more varied and complicated services which seem to demand for their fulfilment a greater amount of intelligence in our canine auxiliaries.

In all the varieties of the dog the following circumstances in his economy are constant.—He is born with his eyes closed; he opens them on the tenth or twelfth day; his teeth commence changing in the fourth month; and his full growth is attained at the expiration of the second year. The period of gestation is sixty-three days, and from six to twelve pups are produced at a birth. The dog is old at fifteen years, and seldom lives beyond twenty. His vigilance and bark are universally known.

CA'NIS MA'JOR. (Lat.) The *Greater Dog*. One of the 48 constellations of Ptolemy, in the southern hemisphere, and under the feet of Orion. Sirius, the brightest of all the fixed stars, belongs to this constellation.

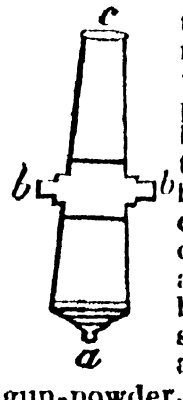
CA'NIS MINOR. The *Lesser Dog*. Is also one of Ptolemy's 48 constellations. It is in the northern hemisphere, just below Gemini. Its most conspicuous star is Procyon, of the first magnitude.

CA'NNELL COAL. (Perhaps *candle* coal, from the flame with which it burns.) A species of coal, found in most of the English collieries, especially at Wigan in Lancashire. It is difficultly frangible, and does not soil the fingers; when burning it splits and crackles, but does not cake, and leaves 3 or 4 *per cent.* of ash. It is sometimes worked into ornamental utensils, like jet.

CA'NNIBALS, or ANTHROPOPHAGI. Persons that devour human flesh. The ancient authors, but especially Herodotus, have recorded instances both of individual and national addiction to this revolting practice, as in the case of Polyphemus, the Massagetæ, and the Issedones; and though there is unquestionably a large portion of fable grafted on these traditional facts, it would be rash wholly to reject an account which the testimony of subsequent history so strongly corroborates. In the middle ages it was customary for parties engaged in hostilities to make mutual accusations of cannibalism, but there is sufficient ground for believing that such allegations originated more in a desire, natural, perhaps, to sworn enemies in those rude times, of fixing upon each other the most barbarous practices, than in any actual perpetration of this deed on either side. At the present day cannibalism is practised by some of the Indian tribes of North America, the Battas of Sumatra, and the New Zealanders, though it must be admitted, to the honour of humanity, that the most violent passions, such as revenge or hatred, or the pressure of want, must be in operation before even the wildest savage will indulge in so horrible a banquet.

CA'NNON. A military engine for projecting balls, shells, &c. by the force of gun-powder.

The principal parts of a cannon are, 1. The *breech*, which is the solid metal from the bottom of the bore or concave cylinder to the extremity of the *cascabel*, *a*. 2 The *trunnions*, *b b*, which project on each side, and serve to support the cannon in equilibrio, their axis being in the vertical plane passing through the centre of gravity, but intersecting it below that point. 3 The *bore* or cylindrical cavity. This in several sorts of cannon is made of smaller diameter towards the breech, thus assuming the shape of two cylinders united by a portion of a spherical surface. The smaller part of the bore is of such a length as to receive the maximum service charge of gun-powder, and is called the *chamber*. The entrance of the bore, *c*, is called the mouth or muzzle.




Cannon are made either of cast iron or brass, the

latter being an alloy of copper and tin in the proportion of about 10 parts of copper to 1 of tin, and called gun-metal. This has a greater tenacity than iron, but is objectionable on account of its greater density and higher price, besides being liable in rapid service to soften and droop at the muzzle, whereby it is rendered unserviceable Since the advantage of using smaller charges of gun-powder was discovered, cast iron, though possessing less tenacity than gun metal, has been substituted for ship, garrison, and [illegible] guns. But the the smaller species of cannon (field-pieces) continue to be made generally of brass; for by reason of the rapid cooling of the iron in small masses its strength is considerably impaired, so that it is difficult to be procured of the requisite quality.

Cannon were formerly cast with a cave or hollow, but they are now always cast solid; experience having shown that when cast solid they are stronger, and less liable to burst; that the metal is freer from honeycombs; and that the bore can be rendered more perfect, and its axis made to coincide more accurately with that of the piece. In boring cannon, the gun itself is made to revolve about the bit or borer, the size of which is successively increased.

In service cannon are mounted on carriages, by which they may be removed from place to place. They are supported on the carriage by the trunnions, about which they move as on an axle, and the form of the carriage is such as to admit of them being elevated or depressed a few degrees above or below the horizontal plane. *See* GUN, GUNNERY, HOWITZER, MORTAR.

CA'NNON BONE. In Farriery, signifies the single metacarpal or metatarsal bone of the horse.

CA'NNON METAL. Bronze; an alloy of copper with eight or ten *per cent.* of tin.

CANOE'. A boat made of a single trunk of a tree hollowed out. Some are made of pieces of bark fastened together, these should be properly called boats They are of various sizes, and are generally propelled by one, or if large by two or more paddles, like wooden shovels

CA'NON. (Gr. κανων, *a rule*) A word of various significations, of which we can only enumerate the principal

1 In cathedral and collegiate churches there are canons who perform some of the services, and are possessed of certain revenues connected with them. These are, strictly speaking, *residentiary* canons *foreign* canons are those to whom collegiate revenues are assigned without the exaction of any duty

2 The laws and ordinances of ecclesiastical councils are called canons

3. The canon of scripture signifies the authorized and received catalogue of the sacred books The canon of the Old Test., as received by the Romanists, differs from that of the Protestant churches in regarding as inspired those books which we reject under the term Apocrypha The catalogue received by the Jews themselves, which we adopt, was first enlarged by the Council of Carthage to the extent in which it is held by our opponents, and that decision was formally confirmed by the Council of Trent. In the canon of the New Test., however, the agreement of Christian churches may be considered unanimous There exist a series of enumerations of the sacred books of the latter covenant in the writings of the first four centuries, the general agreement of which, and the satisfactory reasons which can be assigned in most cases of omission — there are no additions — distinctly mark the universality of the judgment of the early churches in this matter.

CA'NON In Music, a perpetual fugue. The original method of writing this was on one line, with marks thereon, to show where the parts that imitate were to begin and end. This, however, was what the Italians more particularly call *canone chiuso* (shut), or *canone in corno*

CA'NONESS. A description of religious women in France and Germany Their convents were termed *colleges*. They did not live in seclusion. The college of Remiremont was the oldest establishment of this order in France Similar noble monasteries still exist in Germany, and the revenues and dignities of some belong to Protestants.

CANO'NICAL HOURS. Stated times of the day set apart, more especially by the Romish church, for devotional purposes. In England the canonical hours are from 8 to 12 in the forenoon, before or after which the ceremony of marriage cannot be legally performed in any parish church.

CA'NONIZA'TION. A ceremony in the Romish church, by which holy men deceased are enrolled in the catalogue of saints. The privilege of canonizing was originally common to all bishops, and was first confined to the Pope by Alexander III. in 1170. When it is proposed to canonize any person, a formal process is instituted, by which his merits or demerits are investigated. Hereupon the *beatification* of the person in question is pronounced by the Pope, and his canonization follows upon the production of testimony to miracles performed at his tomb or by his remains. The day of his death is generally selected to be kept in his honour, and is inserted as such in the calendar. The last instance of canonization took place in 1803.

CANO'PUS, or CANOBUS. (Gr. Κανωπος, the name of a place in Egypt.) A bright star of the first magnitude in the rudder of Argo, one of the southern constellations. As its declination is about 52½° south, it is not visible in our hemisphere beyond the 40th degree of latitude.

CA'NOPY. (Gr. κανοπειον.) In Architecture, an ornamented covering over a seat of state, and in its extended signification any covering which affords protection from above.

CANT. In sea phrase, to turn over or round; a cant is also a piece of wood laid on the deck for the support of a bulk-head.

CANTA'TA. (It. cantare, *to sing*) In Music, a song or composition intermixed with recitative, usually for a single voice with a thorough bass.

CANTHA'RIDES. (Gr. κανθαρος, *a beetle.*) Spanish flies. The *Cantharis vesicatoria*, or blistering fly. These insects are chiefly brought from Astracan and Sicily: they should be free from mould and dust, of a peculiar but not very strong or nauseous odour, and of a brilliant golden green colour. These flies furnish us with the only ready and certain means of raising an effective blister upon the skin, for which purpose they are reduced to powder, mixed with ointment or lard, and spread thinly upon a piece of leather, which is then applied to the part affected Their operation is very different in different habits and constitutions sometimes they produce much local pain and inconvenience, and great general excitement and irritation of the urinary organs, at others they are comparatively quiet in their action; and the blister being applied at bed-time, is found in the morning to have raised the cuticle with a large quantity of serous fluid underneath it, and the patient has scarcely been aware of its agency. The object of applying a blister is generally to transfer internal inflammatory action to the surface, and in deep-seated inflammations, and painful affections of the viscera and larger joints and muscles, they are often astonishingly effective. But blisters should not be incautiously applied they sometimes produce troublesome sores, and are followed by erisipelatous inflammation Care should also be taken to confine them, by a margin of adhesive plaster or other means, to the part upon which they are intended to operate, as they sometimes are displaced, and give rise to awkward accidents When cantharides are taken internally, they are violently stimulant to the urinary and generative organs

CA'NTHUS. (Lat) The corner of the eye, where the upper and under eyelids meet.

CANTILE'VER. (Probably from cantern labrum, *the lip of a gutter.*) In Architecture, a piece of wood framed into the front or side of a house, and projecting from it, to sustain the eaves and mouldings over them.

CA'NTO *See* SOPRANO.

CA'NTO-FE'RMO (Ital *firm song.*) In Music, the subject song. Every part that is the subject of counterpoint, whether plain or figured, is called by the Italians *canto fermo*

CA'NTON. In Heraldry, an ordinary formed either at the dexter or sinister chief of the escutcheon, by two lines meeting at right angles, proceeding from the top or sides of the shield. By the word canton is always understood a canton dexter, unless otherwise expressed.

CANTON (Gr. κανθος, *an angle*; or Lat. centum, *a hundred*) In Geography, originally a quarter of a city regarded as separated or detached from the rest; but applied chiefly at present to the twenty-two districts of which Switzerland is composed, and which, though forming a confederate union like the United States of America, are governed each by a separate judicature and particular laws

CANTO'NMENT. In the art Military, that distinct situation which soldiers occupy when quartered in different parts of a town, for want of barracks or caserns to contain them.

CA'NVAS. (Ital.) A very clear unbleached cloth of hemp or flax, woven regularly in little squares, chiefly used to make sails for shipping Besides serving for various domestic purposes, such as for the ground of tapestry work, canvas forms the cloth on which painters usually draw their pictures.

CANZO'NE (Latin, Provençal, and Italian, cantare, *to sing.*) A kind of lyric poem. Adopted, with some alteration, from the poetry of the Troubadours, it found its way into Italy in the thirteenth century It is divided, like the Greek strophic ode, into stanzas, in which the number and place of rhymes and metre of verses respectively correspond. The last stanza, commonly shorter than the others (the epodus of the ode), is called *congedo*, or *ripressa* (in old French *l'envoy*), and consisted, generally, of a valedictory address to the canzon itself. This form of poetry was adapted by Petrarch to the expression of

many different veins of thought — sonorous, elevated, and heroic. The Pindaric ode, somewhat more regular than the canzon, was introduced by Chiabrera. The canzonet was a sort of canzon in short verses, a favourite form with the poets of the fifteenth century.

CANZONE'TTA. (Dimin. of canzone.) In Music, a short song. The Neapolitan canzonet has two strains, each of which is, like the French vaudeville, sung twice over. The Sicilian canzonet is a species of jig-time, with six or twelve quavers in the bar. Sometimes both are rondeaus, and repeat the first strain for an ending.

CAOU'TCHOUC. This curious substance is the inspissated juice or sap of several plants: the principal supplies are from South America, and are derived from the *Siphonia elastica* (Hevea caoutchouc), and probably from other Euphorbiaceous plants. It is often termed *gum elastic* and *Indian rubber*. Its general properties and uses are well known. Among its more recent applications are those of elastic wove fabrics, formed of caoutchouc stretched into threads and covered with cotton; and various water-proof clothing, which is made by interposing a layer of caoutchouc between two folds of the cloth, and then forcibly uniting them by pressure. For this purpose the caoutchouc is dissolved by coal naphtha, and in that state brushed over the surfaces which are to be united.

Caoutchouc is a compound of carbon and hydrogen; when heated it fuses, and afterwards remains viscid; when subjected to destructive distillation at a high temperature, it yields four fifths of its weight of a highly inflammable and very light volatile oily liquid (hydrocarbon), which has been called *caoutchoucine*, and which is a good solvent of the unaltered caoutchouc. Washed sulphuric ether dissolves caoutchouc, and it is also soluble in several essential oils, but of these latter solutions the greater number leave it in a sticky state on evaporation.

CAPA'CITY FOR HEAT. Experiment shows that different quantities of heat are required to raise different bodies to the same temperature, and those substances which require the largest quantity of heat to be raised to a given temperature are said to have the greatest *capacity for heat*. *See* HEAT

CAPE. (Lat. caput, *a head*) In Geography, is the term used to indicate the extreme point of a promontory, or of that portion of land which juts out into the sea beyond the general line of the coast; as Cape Taenarus or Matapan, the most southern part of Europe; the Cape of Good Hope, the most southern part of Africa; Cape Horn, the southern extremity of America, &c. On rocky and much indented coasts capes generally terminate in acute angles, whence they are sometimes denominated *points*; and if the portion of the land which projects is small or not high, the appellation *ness* in England, and in Scotland that of *mull*, is assigned to it, as Sheerness, the Mull of Galloway.

CAPE'LLA. A star of the first magnitude in the left shoulder of Auriga

CA'PERS. The buds or unexpanded flowers of the *Capparis spinosa*, in common use as a pickle

CA'PIAS AD RESPONDENDUM. In Law, a writ for the commencement of personal actions to arrest a party who is at large or already in custody of a sheriff

CA'PIAS AD SA'TISFA'CIE'NDUM Shortly called *ca. sa.*) In Law, a judicial writ of execution which issues out on the record of a judgment, where there is a recovery in the courts of Westminster, of debt, damages, &c By this writ the sheriff is commanded to take the body of the defendant in execution This is the highest execution which can be had against a defendant, and no other can be afterwards had against his lands or goods, unless he die in custody.

CAPI'BARA. The largest known Rodent quadruped. It is of aquatic habits, and frequents the rivers of South America. It is the type of the genus *Hydrochærus*, signifying "water-hog," by which name it is sometimes known

CAPILLA'IRE Simple syrup flavoured with orange flowers, or orange flower water, generally goes under this name, which is derived from the mucilaginous syrup directed in old Pharmacopœias to be made of the *Adiantum capillus veneris*.

CAPI'LLAMENTUM. (Lat. capillus, *a hair*.) An old name of the filament of a flower *See* FILAMENT.

CAPI'LLARY. Long and slender, like a hair.

CAPI'LLARY A'CTION. (Lat capillus, *a hair*.) When a very narrow glass tube, open at both ends, is inserted in a vessel containing water, the water immediately rises in the tube, and remains suspended at some height above its level in the vessel. If the same tube is plunged into mercury, the mercury in the tube stands at a lower level than in the vessel These effects are most conspicuous when the width of the bore of the tube is so small as to resemble a hair; whence the cause of the phenomena has been termed *capillary action*, from the Latin *capillus*, which signifies a hair.

The operation of the same forces which cause the elevation of water and depression of mercury in glass tubes, gives rise to a multitude of other phenomena with which every one is familiar. If a piece of sugar, or sponge, or blotting paper, is brought into contact with water at one extremity, the fluid immediately passes through it and moistens its whole substance. A mass of wetted thread or cloth, hanging over the edge of a basin from the water within it, will empty it as a siphon would. The rise of the oil in the wick of a lamp, of the sap in trees, the functions of the excretory vascular system in plants and animals, depend on the same causes. Capillary action is, in short, only an instance of the operation of that species of attraction which is exerted among the elementary particles of matter within very small or insensible distances, which is called *molecular attraction*, and which gives rise to some of the most important phenomena of the physical world; such as the vibrations of solid bodies, the refraction of light, and chemical actions of all kinds.

The phenomenon of the elevation of water in narrow tubes began to attract the attention of experimental philosophers about the beginning of the last century; but neither the method of calculating the effects of the forces exerted among the elementary molecules of matter, nor their mode of operation, was then understood, and consequently no satisfactory theory was proposed. Two facts, however, of considerable importance were established by Hauksbee. The first is, that the ascent of the liquid is quite independent of the thickness of the tube; and the second, that if two rectangular plates of glass having their edges joined in a vertical line, and forming a very acute angle with each other, are dipped into water, the fluid which rises between them takes the form of the equilateral hyperbola On considering the phenomenon attentively, it was easy to see that as the height of the fluid between the plates at any point in the curve was inversely proportional to the distance of the plates at that point, it must follow that in capillary tubes the ascent would be inversely proportional to the diameter of the tube. The theory of the phenomenon, however, still remained unexplained.

Dr Jurin ascribed the ascent of the liquid to the attraction of the ring of the tube immediately above it. But this was merely a vague explanation, and is now known to be altogether erroneous. Clairaut, in his celebrated work on the Figure of the Earth, was the first who analyzed exactly the different forces which concur in elevating the liquid in a capillary tube, and reduced the phenomena to the ordinary laws of the equilibrium of fluids Some of his suppositions respecting the nature of the forces in action were erroneous, for example, he supposed the attraction of the internal surface of the tube on the liquid to be exerted not only at a sensible distance, but to extend even to the diameter He failed to prove from theory that the ascent must be inversely proportional to the diameter of the tube; but he showed that several hypotheses might be made with respect to the law of attraction from which that law of ascent would follow, and he demonstrated a very remarkable result, namely, that if the attraction which the particles of the tube exercise on the fluid and the attraction which the particles of the fluid exercise on each other follow the same law, and differ from each other only in intensity, the fluid will rise in the tube when the first of these attractions exceeds half the second. The error of Dr Jurin's hypothesis was first clearly pointed out by Professor Leslie, in a paper inserted in the *Philosophical Magazine*, in 1802 Mr Leslie's argument was shortly this: If the ring of the tube immediately above the liquid in a capillary tube attract it upwards, how does it happen that the ring immediately below the surface does not attract it downwards, in which case the forces would be balanced, and there would be no elevation? The fact is, that as the action of the molecules of the tube is confined within very narrow limits, its direction must be at right angles to the sides of the tube. Nor is it difficult to conceive how a lateral action may yet cause a perpendicular ascent It is a fundamental property of fluids, that any force impressed in one direction is propagated equally in every direction; the tendency of the fluid, therefore, to approach the glass will occasion it to spread over the internal cavity of the tube, and consequently to mount upwards. Mr Leslie's explanation, though correct in principle, served in no way to advance the theory, indeed little notice appears to have been taken of it till its importance was pointed out by Mr. Ivory. Another important fact was discovered by Dr. Young, who showed, in a paper on the *Cohesion of Fluids*, in the *Phil. Trans.* for 1805, that the angle made by the surface of the fluid with the sides of the tube is invariable, the fluid and the materials of the tube remaining the same, and being supposed homogeneous.

But a complete exposition of the theory of capillary phenomena was reserved for Laplace. In two Supplements to the *Mécanique Céleste*, published in 1806 and 1807, Laplace, assuming the force of molecular action to extend only to insensible or imperceptible distances, determined the separate influences of the cohesive attraction of the molecules of the fluid to each other, and the adhesive

force with which they cling to the tube. This analysis of the forces by which the capillary phenomena are produced conducted him to an equation in which the whole theory is included. It consisted of two parts: the first belonging to those points of the surface of the fluid whose distance from the sides of the tube is greater than the radius of the sphere of molecular action; and the other belonging to those points of the surface which are in immediate contact with the sides of the tube, or at least within the sphere of the action of its molecules. The first term is general, and the same for all surfaces; the other varies with the curvature in each particular case. Mr. Ivory afterwards showed that of the two quantities which enter into the formula of Laplace, the one denotes the direct pressure caused by the attraction of a fluid mass bounded by a plane; and the other the derivative force acting laterally, which is a necessary consequence of the direct pressure. (*Ency. Brit.* art. "Capillary Action.")

The latest and most important work on capillary action is by Poisson, *Nouvelle Théorie de l'Action Capillaire*, 1831. Its object was to correct the theory of Laplace by supplying an important omission in the physical data, namely, the rapid diminution of density which takes place near the free surface of the fluid, and near the sides of the tube. Now this circumstance, though it had been entirely overlooked by all former inquirers, is not only essential to the right investigation of the effects of capillary action, but it is demonstrated by Poisson that if there was no diminution of density near the superficial parts of the liquid, the surface would remain plane and horizontal, and there would neither be elevation nor depression in the capillary tube. The molecular forces, therefore, which produce the capillary phenomena, are modified not only by the curvature of the surface, according to the previous theory, but also by the particular state of liquids at their surfaces.

The power of supporting the fluid column depends entirely on the width of the tube at its upper extremity. If the tube bulge out below, the water will not rise in it spontaneously, but if plunged into a basin till the water reaches the capillary part, and then lifted up, the water will remain suspended at exactly the same height as in a tube having the same capillary bore throughout. The lower and wide part of the vessel may consist of metal, or any other substance, different from glass. It is sufficient that the cavity terminate above in a capillary glass tube.

The phenomenon of the depression of mercury in capillary tubes may be considered as the inverse of that of the elevation of water. The molecules of water have a greater attraction for glass than for each other, those of mercury, on the contrary, attract each other more powerfully than they are attracted by glass. If a drop of mercury, adhering to the edge of a plate of glass, is presented to a mass of the same fluid, it immediately leaves the glass and unites with the mass. When a plate of glass is plunged into mercury, the mercury is depressed, and forms a convex surface on both sides of the plate. In a glass tube the surface of mercury is always convex, provided the inside of the tube be perfectly clean, and the mercury free from impurities. All these phenomena clearly indicate the excess of the mutual attraction of the particles of mercury above their adhesion to the sides of the glass.

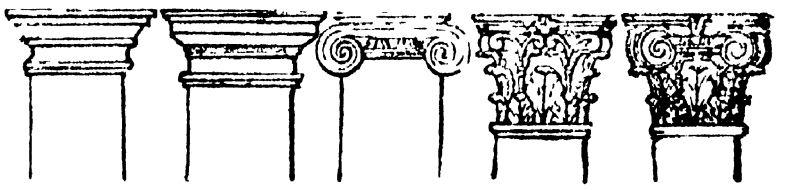
From some experiments made by *Casbois* at Metz, it appeared to result, that mercury purified with great care forms a concave surface in the interior of a glass tube, and consequently rises above the level, like an aqueous fluid. It is now generally admitted, however, that these experiments were fallacious, in consequence of the inner surface of the tube having been lined with a slight, and perhaps imperceptible, oxydation produced by the boiling of the mercury. In preparing barometers, it has been the custom to boil the mercury in the tube, when this operation is performed, great caution is requisite to prevent the oxydation from taking place.

The form of the surface of the fluid in the tube indicates the relation of the cohesive force of its particles to their attraction for the tube. The attraction of water to glass is superior to half the cohesion of the aqueous particles to one another; consequently water within a capillary tube assumes a concave surface, and rises. Mercury, on the other hand, assumes a convex surface, and is depressed; because its molecules attract one another with a force more than double that with which they adhere to glass. The radius of curvature of the bounding surface at the middle point is proportional to the width of the tube. It is stated by Professor Leslie as the result of his experiments, that the depression of mercury in capillary tubes may be estimated at unity divided by 68 times the diameter expressed in inches. Hence if the width of the bore is one fourth of an inch, the depression of the mercury is one seventeenth of an inch. On this account it is necessary, in accurate barometric observations, to apply a correction for capillary action, which is less in proportion as the diameter of the tube is greater. The best treatises on this subject have already been referred to, viz. that of Laplace, in the *Mécanique Céleste*, tome iv.; of Mr. Ivory, in the *Encyclopédia Britannica*; and of Poisson, *Nouvelle Théorie de l'Action Capillaire*.

CAPILLARY VESSELS. (Lat. capillus, *a hair*.) Anatomists give this term to the minutest ramifications of the arteries and other vessels.

CAPILLI'TUM. (Lat. capillus, *a hair*.) A kind of purse or net in which the spores of Trichia and similar fungi are retained.

CA'PITAL. (Lat. caput, *a head*.) In Architecture, the head or uppermost member of any part of a building; but it is generally applied in a restricted sense to that of a column or pilaster of the several orders, as in the figures here given, in which it will be seen that the Tuscan capital (No. 1.) consists of an abacus or square shelf at the top, and thereunder an ovolo or quarter round, and under that a neck terminated by an astragal or fillet, which latter is




always considered as part of the column itself. The Roman Doric capital (No. 2.) here given has an abacus, ovolo, and neck like the last; and also in addition three annulets under the ovolo, and a cyma or ogee with its fillet over the abacus. The Grecian Doric, however, has only a square abacus, ovolo, and small fillets. The Ionic (No. 3.) capital consists of three leading parts: an abacus, composed of an ogee and fillet; a rind, which forms the scrolls; and an ovolo and astragal at the lower part. The Corinthian and Composite capitals (Nos. 4. and 5.) consist of an abacus (*see* ABACUS) of peculiar form, and are decorated with leaves.

CA'PITAL. In Political Economy, that portion of the produce of labour saved from immediate consumption which is employed to maintain productive labourers, or to facilitate production. (*See* POLITICAL ECONOMY.) In Commerce, and as applied to individuals, capital is understood to mean the sum of money which a merchant embarks in any undertaking, or which he contributes to the common stock of a partnership.

CAPITA'TION. (Lat. caput, *head*.) A tax imposed on the population by the head; *e g* on every one, or every male, every one above a certain age, &c. (*See* POLL-TAX.) In France, the ancient capitation is now replaced by personal and other direct contributions.

CA'PITE. In Law, tenure *in capite* (Ang. *in chief*) signifies in the language of feudal law a direct holding of the king, the ultimate sovereign, without the intervention of any mesne lord. In England, tenants in capite were either by knight-service or socage; which were converted into common socage by the act 12 Ch. II. c. 24., abolishing feudal tenures.

CA'PITE CENSI. In Roman Antiquity, the lowest rank of Roman citizens; so called because they were rather counted by their *heads* than by their estates. (*Aul. Gell.* lib. vii. cap. 13.)

CAPI'TULA'TION. In its original sense, a writing drawn up in several *capitula* or heads. In the language of Military Law, the articles of surrender, when a garrison or other force surrenders to an enemy on terms, and not at discretion. In Ecclesiastical History, articles sworn by bishops and other prelates on admission to their dignities were styled capitulations. So also was the oath tendered first to Charles V., and then to the emperors of Germany who succeeded him, by the electors, termed the election capitulation (wahl capitulation).

CA'PNOMA'NCY. (Gr. καπνος, *smoke*; μαντεια, *prophecy*.) Divination by smoke was practised among the ancients, both by throwing on the fire seed of poppy and other herbs, and observing the figures which might be fancied in the smoke; and by observing the smoke of sacrifices.

CA'PNOMOR. (Gr. καπνος, *smoke*, and μοιρα, *part*.) An oily substance of a pungent and rather agreeable odour obtained from the tar of wood.

CAPONNIE'RE. In Fortification, a passage leading from one work to another, protected on each side by a wall or parapet, generally of earth, sloping to the bottom of the ditch. When a passage is thus protected on one side only, it is called a demi-caponniere.

CAPPA'RIDA'CEÆ. (Capparis, one of the genera.) A natural order of Exogenous plants, consisting of annuals, perennials, bushes, and trees, inhabiting the warmer parts of the world. They have all a powerful pungent or even acrid taste, and have been in some cases used as substitutes for the common mustard; in others they have proved severe poisons. In general their flowers are very beautiful, on account not only of their size, but of their long silken stamens, which are often gaily coloured. The common caper-bush, a native of rocky places in the North of Europe, is a species of the genus *Capparis*, and

yields the flower-buds which, pickled in vinegar, are sold in the shops as an agreeable sauce for various dishes.

CAPRE'LLA. A genus of Crustaceous animals belonging to the order *Læmodipoda*, found commonly on sea-weed. Montague, who describes a species of this genus in the seventh volume of the *Linnæan Transactions*, says the female differs in possessing several plates or valves beneath the body, situated between the two pairs of fins, the use of which is to carry and protect its eggs or young; at which time they extend very considerably, and form a kind of pouch distended with ova, fifteen or twenty of which are easily distinguished between the transparent plates. In this part a very strong pulsation is visible. While examining a female under a water-microscope, the author was surprised to observe not less than ten young ones crawl from the abdominal pouch of the parent, all perfectly formed, and moving with considerable agility over the body of the mother, holding fast by their hind claws and erecting their heads and arms. The characters of the genus, or rather family (*Caprellidæ*), are, body of narrow linear form; eyes composite, and placed behind; legs long and slender, and variable in number, the last joint of the second pair being often toothed on the under side

CAPRE'OLUS. (The tendril of a vine.) The old botanical name of the tendril of a plant; the term *cirrhus* is now preferred.

CAPRI'CCIO. (Ital. *whim, fancy.*) In Music, a term applied to certain pieces, wherein the composer gives way to his fancy, without confining himself to particular measures or keys; called also *Fantasia*

CA'PRICO'RNS. (Lat capricornus.) The name of one of the three divisions of Tetramerous beetles, including those which have the antennæ filiform or setaceous, and generally exceeding the length of the body, eyes lunate, and enclosing the base of the antennæ; jaws very robust, with short palpi; thorax often spined at the sides; the three basal joints of the tarsi dilated, and cushioned on the under surface; the third deeply cleft at the extremity, and receiving the minute ball at the base of the slender and long terminal joint. This division comprehends four great families,—*Prionidæ*, *Cerambycidæ*, *Lamiidæ*, and *Leptusidæ*; and corresponds very nearly with the Linnæan genera *Cerambyx*, *Necydalis*, and *Leptura*. The offices of the capricorn beetles in the economy of nature is to restrain the excessive multiplication of vegetable species in the warmer climates of the globe. The larvæ reside within the wood or beneath the bark of trees.

CA'PRICO'RNUS. (Lat.) *The Wild Goat.* The tenth sign of the Zodiac, which the sun enters about the 21st of December, at the winter solstice. The parallel circle passing through the first point of this sign is called the *Tropic of Capricorn*.

CA'PRIFO'LIA'CEÆ. (Caprifolium, one of the genera.) A rather large natural order of plants, consisting of twining and erect shrubs, and herbaceous or woody plants, and even of trees, with simple or pinnated leaves, and flowers of most dissimilar forms, but all monopetalous The most common plants belonging to this order are the woodbine, the St Peter's wort, the Tartarian and fly honeysuckle, the numerous species of viburnum, and the elder-tree. These all agree with the natural order *Cinchonaceæ* in most respects, except the absence of stipules at the base of the leaves

CAPRIFO'LIUM. (Lat. capra, *a goat*, and folium, *a leaf.*) Is the genus to which the wild honeysuckle (*C. periclymenum*) belongs. It consists of twining shrubs inhabiting the northern hemisphere exclusively, and in most cases having long tubular flowers of singular sweetness. Many species are known to botanists, the most interesting of which are those from the north of India, China, and Japan, the fragrance of which is superior to that of all others; of these *C. flexuosum*, now common in gardens, is the best.

CA'PROIC ACID. (Lat. capra, *a goat.*) One of the acids formed during the saponification of butter; it has a rank goat-like odour.

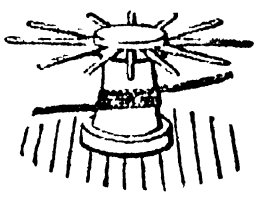
CA'PROMYS. (Gr. *καπρος*, *a boar*, and *μυς*, *a mouse.*) The name of a genus of Rodent Mammalia, exclusively confined to the island of Cuba, where they go by the name of Houtias.

They have four molars on each side of each jaw, in which the enamel is so folded as to form three angles on the outer margin and one on the inner, in the upper teeth; the reverse in the lower teeth. The liver is remarkably subdivided in the rodents of this genus.

CA'PROS. (Gr. *καπρος*, *a boar.*) A name applied by Lacipede to a subgenus of Acanthopterygious fishes, which he separated from the dories (*Zeus*), and of which the boar fish (*Zeus aper*, Linn.) may be regarded as the type. A specimen of this fish has been taken at Mount's Bay, and another near Bridgewater, but is rare as a British species.

CA'PSICUM. (Gr. *καπτω*, *I bite*; from its pungency.) The berry or seed-vessel of different species of capsicum. The larger pods of the *Capsicum annuum*, and the smaller ones of the *C. baccatum* or *bird pepper*, when powdered, form the *Kyan pepper* of commerce, so well known as a powerful condiment, and often useful as a stimulating medicine. Kyan pepper is often grossly adulterated with common salt, and occasionally red lead and earthy powders are said to be added to it: it often has a disagreeable rancid odour, owing to its being sprinkled with oil to prevent its dust affecting those who powder and sift it.

CA'PSTAN, sometimes called CAPSTERN. (Fr. cabestan.) A strong massive piece of timber, in the form of a cylinder or truncated cone, round which a rope is coiled; and being turned by means of bars or levers, it affords an advantageous mode of applying power to overcome an obstacle. The capstan is chiefly employed in ships, where it is used for weighing anchors, hoisting sails, &c. It is generally placed vertically, the lower end being let down through the deck of the ship, and the levers inserted in holes in the head or top; so that the force of the men can be exerted continuously, and that there may be no necessity for removing the levers from one hole to another, as is the case when it is placed horizontally. The power of the capstan may be greatly increased by adapting an arrangement of wheel work to it — an improvement which has been adopted for several years past in the royal navy.



CA'PSULA. (Dim. of capsa, *a box.*) This word is generally applied by botanists to all dry fruits which are dehiscent, whether they are many-seeded or few-seeded, simple or compound, and in such cases some expletive is added to indicate the particular nature of the fruit. Thus *Capsula circumscissa* is cut round by a circular line dividing it into two parts; *C. siliquiformis* is long and taper, like the pod of a mustard-plant; *C baccata* is when the pericarp is succulent; *C. tricoccea*, when a dry capsule bursts into three separate closed pieces. Sometimes, for special carpological purposes, the word capsula is limited in its application to such dry compound fruits as open by valves, and have an indefinite number of seeds, as in *Digitalis*, *Scrophularia*, the common lilac, &c.

CA'PSULE. In Chemistry, a small shallow evaporating vessel or dish.

CA'PTAIN In the Army, the commander of a troop of cavalry or of a company of infantry. The price of a captain's commission is different in the different branches of the British service. In the life guards, for instance, it is 3,500*l*, in the dragoons 3,225*l*.; in the foot guards with the rank of lieut.-colonel, 4800*l*.; in the infantry 1,800*l* The full pay of a captain in the life and foot guards is 15*s* a day, in horse regiments 14*s* 7*d*., and in the infantry 11*s* 7*d*.

CA'PTAIN. In the Royal Navy, is the title of the officer commanding a ship of a certain size. The title of post captain, which was the proper rank of captain, and answered to colonel in the army, has been for some time in disuse. The captain is next in rank above the commander: he rises by regular succession to the rank of admiral; under the condition, however, that he must at some time have commanded a ship of the line.

The heads of small parties or gangs of men in certain stations of the ship are also called captains; as of the forecastle, the tops, &c. The pay of a captain in the navy varies with the rate of the ship, from 61*l*. 7*s*. per month for a first-rate, to 20*l* 17*s* for a sixth-rate.

CA'PTION. (Lat. capio, *I take*) In Law, a certificate signed by commissioners, to testify their execution of any commission in law or equity. Also, the act of taking a man into arrest. The caption of an indictment is the designation of the style of the court before which the jurors make their presentment.

CAPTI'VITY. In Sacred History, a punishment which God inflicted upon the Jews for their vices and infidelity. The first captivity was that of Egypt, from which the Israelites were delivered by Moses; then followed six captivities during the government of the judges: but the greatest and most remarkable were those of Judah and Israel, which happened under the kings of these different kingdoms.

CA'PUCHINS. In Ecclesiastical History. *See* FRANCISCANS.

CA'PUT MO'RTUUM. The inert residue of the distillation and sublimation of different substances. When sulphate of iron, for instance, or green vitriol, is distilled at a red heat it leaves a residue of red oxide of iron, which the old chemists called *caput mortuum vitrioli* These residuary products were represented in alchemical writings by the symbol of a death's head and cross bones.

CAR. (Lat. carrus, *a cart.*) Any rude cart. The Irish car is a one-horse cart, with very low broad wheels, used for carting out manure and carting home grain in the case of soft peaty soils. The Irish jaunting car is a kind of one-horse chaise, commonly without springs, in

which the people sit back to back, and with their faces looking sideways.

CARABI'DÆ. (Lat. carabus.) A family of Pentamerous beetles, characterized by having a bilobed upper lip, smooth jaws (*maxillæ*), an entire tooth in the centre of the notch of the mentum or chin-process, and dilated tarsi in the males. The majority of the British species have the elytra soldered together. The *Carabidæ* generally defend themselves by discharging from the extremity of the body an acrid fluid, and emit a fetid odour. They are amongst the most ravenous of beetles, and prey on other insects, for which they lurk beneath stones, the bark of trees, &c.

CA'RABINE. (It. carabino.) Called also Petronel. A fire-arm used by cavalry, smaller in the bore and shorter in the barrel than a musket. The soldiers who use this species of arms are called Carabineers.

CARAGA'NA. (Carachana, the Mogul name.) A genus of pretty hardy shrubs, inhabiting the Russian dominions in Asia. *C. sibirica*, *attagana*, and *chamlagu* are common in the shrubberies of this country, where they flower in the months of June and July. *C. jubata* is a singular scrubby plant, with the branches closely covered by the leafy, spiny, ragged petioles.

CARA'NNA. A resin brought from South America, of an aromatic odour; formerly used in plasters.

CA'RANX. (Derivation unknown.) A genus of spiny-finned fishes, belonging to the *Scombridæ* or mackerel family; but differing from the true mackerel in having a series of scales, with ridges or keels in the middle, ranged along the lateral line. From this resemblance they are commonly termed "bastard mackerel."

CARA'SSÆ. The bony vault which protects the upper part of the body of the Chelonians, or tortoises and turtles, and which results from the union by suture of the dilated and flattened parts of the vertebræ and ribs. The analogous part of the body of the crab is also called carassæ; but this is not composed of corresponding parts to those of the tortoise, but of a calcified integument.

CA'RAT. "The fruit of the tree called Kuara is a red bean, which seems in the earliest times to have been used for a weight of gold. This bean is called *carat* (*Bruce's Travels.*) Morin derives the word from the Arab *kyrat*, a weight; which he thinks is from the Greek κεράτιον, a small weight" (*Todd's Johnson.*) A carat is a weight of 4 grains, used in weighing diamonds. The term carat is also used in reference to the fineness of gold, in expressing which the mass spoken of is supposed to weigh 24 carats, of 12 grains each; and the pure gold is called *fine*. Thus, if gold be said to be 22 carats fine (or standard), it is implied that 22-24ths are pure gold, and 2-24ths alloy. In the process of assaying gold, the real quantity taken is very small, generally from 6 to 12 grains, and this is termed the *assay pound*. It is subdivided into 24 carats, and each carat into 4 assay grains, and each grain into quarters, so that there are 384 separate reports for gold. When the gold assay pound is only 6 grains, the quarter assay grain only weighs 1-64th of a grain. This will give an idea of the accuracy required in the weights and scales used for such delicate operations. *See* ALLOY and ASSAY.

CA'RAVAN. (Pers. cârvân, *a trader.*) A company of merchants, travellers, or pilgrims, who associate together in many parts of Asia and Africa, that they may travel with greater security through deserts and other places infested with robbers or exposed to other dangers. The commercial intercourse of Eastern and African nations has from the remotest ages been chiefly carried on by means of caravans, as the governments that have sprung up in those continents have seldom been able, even if they had had the will, to render travelling safe or practicable for individuals. Since the establishment of the Mohammedan faith religious motives, conspiring with those of a less exalted character, have tended to augment the intercourse between different parts of the Eastern world, and to increase the number and magnitude of the caravans. Mohammed, as is well known, enjoined all his followers to visit Mecca once in their lifetime; and in obedience to a command so solemnly enjoined and sedulously inculcated, large caravans assemble for this purpose in every country where the Mohammedan faith is established. There are four regular caravans which proceed annually to Mecca; the first from Damascus, composed of pilgrims, travellers, and merchants, from Europe and Asia; the second from Cairo, for the Mohammedans of Barbary; the third from Zibith, near the mouth of the Red Sea, where those of Arabia and India meet; the fourth from Babylon, where the Persians assemble. Every caravan is under the command of a chief or aga (caravanbachi), who has frequently under him such a number of troops or forces as is deemed sufficient for its defence. When it is practicable they encamp near wells or rivulets, and observe a regular discipline. Camels are almost uniformly used as a means of conveyance, in preference to the horse or any other animal, on account of their wonderful patience of fatigue, and their peculiarity of structure, which so admirably fits them for travelling through desert wastes. (*See* CAMEL.) For further details on the subject of caravans the reader may consult *M'Culloch's Commercial Dictionary*, and the authorities there referred to.

CARAVA'NSERA. A large public building, or inn, appropriated for the reception and lodgment of caravans in the desert. Though serving in lieu of inns, there is this essential difference between them, that the traveller finds nothing in the caravansera for the use either of himself or his cattle, but must carry all his provisions and necessaries with him. Caravanseras are also numerous in cities, where they serve not only as inns, but as shops, warehouses, and even exchanges.

CA'RAWAYS. The fruit or seed of the *Carum carui*, an indigenous umbelliferous plant. English caraways are more plump and aromatic than the Dutch or foreign, which are apt to be mouldy and of little flavour. They yield about 3 per cent. of essential oil when carefully distilled with water. They are a good addition to purgative and other remedies to prevent griping and flatulency; but their chief consumption is among gingerbread bakers, confectioners, and pastrycooks.

CARBAZO'TIC ACID. A crystallizable acid and bitter substance, composed of carbon, azote, and oxygen; obtained by the action of nitric acid on indigo and some other vegetable and animal substances. It is the bitter principle of Welter.

CA'RBON. (Lat. carbo.) This term is used in chemistry to signify the pure combustible base of the varieties of charcoal and other carbonaceous matters; the diamond is pure carbon in a crystalline form. Carbon is an elementary substance, which combines with oxygen in two proportions, forming *carbonic acid* and *carbonic oxide*.

CA'RBONATES. Salts containing carbonic acid. They are recognized by the effervescence which is excited when they are put into dilute muriatic acid. *Carbonate of lime* is one of the most important of these compounds, forming the varieties of marble, limestone, calcareous spar, chalk, &c. Carbonate of lime consists of

| | | | | | |
|---|---|---|---|---|---|
| Lime - | 1 atom | = | 28 | - - | 56 |
| Carbonic acid | 1 - | = | 22 | - - | 44 |
| | 1 | | 50 | | 100 |

Carbonate of potash and carbonate of soda are also important salts (*See* POTASH, SODA.) *Carbonate of ammonia* is used in medicine; it is a white pungent salt, commonly known under the name of *smelling salt*. *Spirit of hartshorn* is a solution of impure carbonate of ammonia, obtained by distilling bone or horn.

CARBO'NIC ACID. This important compound is obtained when any form of carbon, such as the diamond or pure charcoal, is burned in oxygen gas. It consists of 6 carbon + 16 oxygen = 22 carbonic acid; or of

| | | | | | |
|---|---|---|---|---|---|
| Carbon | 1 atom - | | 6 | - - | 27·27 |
| Oxygen | 2 - - | | 16 | - - | 72·73 |
| | 1 | | 22 | | 100 00 |

100 cubical inches of carbonic acid gas weigh 47·3 grains. Under a pressure of 36 atmospheres, at the temperature of 32°, it becomes liquid; and when the pressure which retains it in the liquid state is removed, the rapidity of the evaporation, and the sudden and enormous expansion of the vapour, are such as to produce a degree of cold under which the acid solidifies, forming a white concrete substance possessed of very extraordinary properties. Mr. Faraday was the first who liquefied carbonic acid, but it was first described as a solid by M. Thilourier.

At common temperatures and pressures water absorbs its own volume of carbonic acid; under a pressure of 2 atmospheres it dissolves twice its volume, and so on. Carbonic acid imparts briskness and a slightly pungent and sour taste to water thus impregnated with it; it also confers the effervescent quality upon many mineral springs. Carbonic acid is recognized by its rendering lime-water turbid. It extinguishes flame and suffocates animals; hence the miners call it *choke damp*. Carbonic acid is contained in marble, chalk, and all the varieties of limestone, from which it is extracted by strong heat, as in the process of *burning* lime; or by the action of stronger acids, in which case the carbonic acid escapes with *effervescence*. Mountains of limestone, therefore, are great natural repositories of carbonic acid. This gas is also produced during the respiration of animals, and is evolved in the process of fermentation.

CARBO'NIC OXIDE. A gas composed of

| | | | | | |
|---|---|---|---|---|---|
| Carbon | 1 atom - | | 6 | - - | 42·8 |
| Oxygen | 1 - - | | 8 | - - | 57·2 |
| | 4 | | 14 | | 100·0 |

100 cubical inches weigh 30·2 grains. It is fatal to animals, and extinguishes flame; but it burns in contact with air, and forms carbonic acid. It is obtained by passing carbonic acid over red-hot charcoal, or by heating a

mixture of chalk or pounded marble and iron or zinc filings to redness. It is not absorbed by water.

CA'RBONI'FEROUS. (Lat. carbo, *coal*, and fero, *I bear*.) A geological term, generally applied to beds or strata containing coal.

CA'RBOY. A large globular bottle of green glass protected by basket work. Carboys are seldom used, except for containing certain acids and other highly corrosive liquids likely to act upon stone-ware. A carboy of oil of vitriol usually contains about 160 lbs. of that acid, or 12 gallons of water.

CARBU'NCLE. The ancient name of a gem, probably corresponding with our precious *garnet*.

CARBU'NCLE. A hard circumscribed inflammatory tumour, which generally arises on the neck or back, and soon forms a fetid discharge, and acquires a tendency to gangrene. It is a kind of malignant boil, spreading under the skin, and producing a morbid inflammatory action of the surrounding parts. Poultices and free incisions to let out the matter, and afterwards emollient fomentations, are the most effective remedies This disease is called *anthrax*, from the Greek, signifying a burning coal; of which *carbunculus*, from *carbo*, is the Latin diminutive.

CA'RBURETS. In Chemistry, the generic term for compounds of carbon with the simple combustibles.

CA'RBURET OF SULPHUR A liquid compound of carbon and sulphur, obtained by passing the vapour of sulphur over red-hot charcoal It was formerly termed *alcohol of sulphur*. It forms compounds, which have been termed *carbo-sulphurets*.

CA'RBURETTED HY'DROGEN. Under this term chemists describe two gaseous compounds of carbon and hydrogen, the one they call *light hydrocarbonate*, the other *oleflant gas*.

Light carburetted hydrogen is evolved abundantly in some coal mines, where it is known under the name of *fire damp*, and is the cause of those tremendous explosions which were so frequent before the invention of the safety lamp by Sir H Davy it is also evolved by the mud at the bottom of stagnant waters, where it results from the decay of vegetable matter. This gas is much lighter than atmospheric air, 100 cubical inches weighing between 17 and 18 grains. It burns with a yellow flame, is inodorous, and not absorbed by water. It consists of 6 carbon + 2 hydrogen When mixed with three volumes of oxygen, or with eight or ten of common air, it explodes with great violence when inflamed, and produces water and carbonic acid.

*Olefiant gas* received its name from its property of forming, when mixed with chlorine, a liquid of an oily appearance. It is obtained by distilling a mixture of alcohol with twice its bulk of sulphuric acid, and may be collected over water; which, however, absorbs about one eighth of its volume of the gas It has a slightly ethereal odour, it extinguishes flame; is unrespirable, burns with a dense white light, and when mixed with three or four volumes of oxygen or ten or twelve of air, it detonates on the approach of flame with great violence. It is nearly of the same specific gravity as atmospheric air; and from the quantity of oxygen required to convert its elements into carbonic acid and water, it is shown to consist of two atoms of carbon and two of hydrogen, its equivalent being 14; or of one volume of carbon vapour and two volumes of hydrogen, so condensed as to form one volume of olefiant gas.

CA'RCASS. In Artillery, a hollow case formed of ribs of iron, covered with cloth, or sometimes iron with holes in it. The carcass, being filled with combustible materials, is thrown from a mortar into a besieged place with a view to set the buildings on fire.

CA'RCERES. (Lat. carcer, *a prison*.) In Ancient Architecture, the cells at the end of a circus, in which were stationed the chariots and horses that contended for the prizes, so that they might be able to start simultaneously at the given signal.

CARCE'RULUS. (Lat. dim. of carcer, *a little prison*.) A name given by botanists to such fruits as those of the lime tree, the *Tropæolum*, &c.; which consist of a small number of dry indehiscent few-seeded cells cohering round a central axis.

CARCINO'MA. (Gr. *καρκινος, a cancer*.) A cancerous tumour.

CA'RDAMOMS. Seeds of the *Alpinia cardamomum*. These seeds are imported from Bengal: there are several varieties; but those pods which are small, short and thick, and heavy, are preferred. The seeds themselves are very pungent and aromatic; the containing capsule is quite insipid. Their chief use is in medicine, especially in combination with cathartics and bitters. They yield an essential oil by distillation, to which their virtues are to be ascribed.

CA'RDIAC. (Gr. *καρδια, the heart*.) Belonging to or connected with the heart. The superior opening of the stomach is called the *cardia*, or *cardiac end*, from its proximity to the heart.

CA'RDIA'CEANS, or CARDIACEA. (Lat. cardium, *a cockle*.) A numerous and beautiful family of Lamellibranchiate Dimiary Bivalve Mollusks, including those species in which the mantle is open anteriorly for the foot; and also has two distinct orifices, one for respiration, the other for excretion, as in the cockle (*Cardium edule*). The shell is characterized by having at the hinge irregular primary teeth, both in form and situation, and generally accompanied by one or two lateral teeth. The genera composing this family are *Isocardia, Hiatella, Cypricardia, Cardita, Cardium*.

CARDIA'LGIA. (Gr. *καρδια*, and *αλγος, pain*.) Anxiety and pain about the region of the stomach, frequently attended by a sense of gnawing and heat, and hence called *heartburn*. It is a common symptom of indigestion, and accompanied by salt and acid eructations. After excess in eating and drinking, a fit of heartburn may often be prevented by a teaspoonful of carbonate of magnesia, taken in cinnamon or in soda water, at bed time; 20 or 30 grains of bicarbonate of soda in cold chamomile tea is also an effective preventive. Where the disease is symptomatic of organic mischief, these antacid remedies must be cautiously administered.

CA'RDINAL. (Lat. cardo, *a hinge*.) An epithet implying importance, in which sense it is applied to the principal virtues, the four points of the compass, &c.; and in theological language originally to parish churches, as distinguished from chapels and oratories; from whence it was transferred to the clergy who ministered in such churches. In later times the epithet was restricted to the seven bishops of Rome, and the sees within its territory, and the clergy of the eight and twenty principal churches of that city: from whence the college of cardinals takes its origin The number of which this college consisted has varied in the course of time. It has for some centuries been limited to seventy, of whom six are bishops, fifty presbyters, and fourteen deacons; and the election of the pope, which is performed by these personages assembled in conclave, is thus concurred in by the three orders of clergy through their representatives. The period at which this election was confined to the cardinals is variously stated. Some have asserted that such was the case as early as 1058; others not before 1562 It is now understood that the pope must be chosen from among this body The cardinals are distinguished by a scarlet hat, and a short purple mantle worn over the rochet. Their rank is next to that of the pope, to whom they form a political and ecclesiastical council. For further details on the duties of cardinals, see CONSISTORIUM and CONCLAVE.

CA'RDINAL POINTS. (Lat cardo, *a hinge*) In Geography, the east, west, south, and north points of the horizon. In Astrology, the cardinal points are those of the rising and setting of the sun, and the zenith and nadir (COMPASS)

CA'RDIOID (Gr *καρδια, heart*, and *ειδος, form*.) An algebraic curve, so called from its resemblance to a heart.

CARDI'TIS. Inflammation of the heart.

CARDOO'N. A kind of artichoke. The *Cynara cardunculus*

CARDUE'LIS. (Lat carduus, *a thistle*) A genus of Conirostral Perchers (*Insessores*) or Passerine birds, of the finch tribe (*Fringillidæ*), including the goldfinch (*Carduelis elegans*), aberdevine (*Carduelis spinus*), and other British siskins, the habits of which are less arboreal than in the true finches, and which feed principally on the seeds of the thistle and other composite plants.

CAREE'NING. The laying of a ship over to get at leaks or injuries in the bottom. This is commonly called heaving down. To careen implies also to *heel* or lie over generally. Heaving down is never practised with a large ship, except where there are no docks, as the great forces which must be applied to the mast heads to get her over are liable to strain the hull.

CA'RET. (Lat. careo, *I am wanting*.) In Grammar, a character in this form ʌ, denoting that something has been omitted, and is interlined.

CARIA'MA. *See* DICHOLOPHUS.

CA'RICATU'RE. (It. caricare, *to load* or *charge*.) In Painting, an exaggerated representation of any object, in which any natural defects are overcharged, so as to make it appear ridiculous.

CARI'CHIUM. (Lat. carex, *sedge*.) A genus of land-snails, so called from their habitat among sedge, wet leaves, grass, &c. Of these sedge-shells, *Carichium minimum* is British, and may be found about Acton.

CA'RIES. A decayed bone or tooth.

CARI'LLON. A tune performed upon bells.

CARI'NA. (Lat. carina, *the keel of a boat*.) In Botanical language, is the sharp thin back of any organ; the back of a leaf folded up if thin and sharp, the winged rim that occupies the back of certain fruits, the sharp-backed part of a glume or bract, all bear this name. It is also applied to the two anterior petals of a Papilionaceous flower, which adhere by their lower edges into a body something like a boat.

CARINA'RIA. (Lat. carina, *a keel*.) A genus of

Heteropodous Mollusks, characterized by having the viscera, as the heart, liver, branchiæ, generative organs, &c., protruded from the body, and encased in an extremely fragile, beautiful, sub-transparent, symmetrical, compressed shell. The summit of the shell is slightly involuted, but never enters the aperture; the convexity of the shell is terminated by a single keel.

CA'RINATE. (Lat. carina, *a keel*) In Zoology, when a surface has a longitudinal elevated line, like the keel of a vessel.

CA'RMELITE. *See* ORDERS, MENDICANT.

CA'RMINE. A brilliant lake, made of the colouring matter of the cochineal insect combined with alumina and a little oxide of tin.

CA'RMINATIVE. (Lat. carmen, *a verse or charm.*) Medicines which allay flatulency, and pain of the stomach and bowels arising from it.

CARNA'TION. (Lat. carneus, *flesh-coloured.*) A favourite florist's plant, obtained by art from the wild *Dianthus caryophyllus*. Its flowers are deliciously fragrant, and although in the unimproved state they are a uniform deep red, they have been rendered beautifully striped and variegated by successive changes in the hands of the gardener. The most succesful cultivators of carnations are the Germans, who possess some hundred varieties, and supply the principal part of the seed used in other parts of Europe. These varieties are arranged in three classes, *flakes*, *bizarres*, and *piccotees*: the first have ten colours in their flowers, and broad stripes; the second have irregular spots and stripes, and not fewer than three colours; the last are spotted or dotted with scarlet, red, purple, &c., upon a white or yellow ground.

CARNA'TION-GRASS. (Lat. caro, *flesh*) Any coarse species of carex is so named in the north of England and Scotland.

CARNA'TIONS. (Lat. caro, *flesh.*) In Painting, the parts of a picture which represent the naked limbs, &c.

CARNE'IA (Gr. καρνεια) A festival observed in most of the cities of Greece, and especially at Sparta, in honour of Apollo, surnamed Carneus. The festival lasted nine days, and was conducted in imitation of the method of living in camps; for nine tents were erected, in each of which nine men of three different tribes lived nine days.

CARNE'LIAN. A red or flesh-coloured calcedony. The finest specimens come from India, and are in great request for seal-stones, beads, &c.

CAR'NEONS. (Lat. caro, *flesh*) A soft fleshy substance.

CA'RNIVAL. (Lat. carni vale, *farewell to meat*) A festival celebrated with much merriment and revelry in Catholic countries, and especially at Rome and Venice, during the week before the commencement of Lent, deriving its Italian name from the farewell to flesh or meat which introduces the great fast of the church.

CARNI'VORA. (Lat. caro, *flesh*, and voro, *I devour*) The second tribe of Cuvier's order *Feræ* (*Carnassiers*), including those species of which the teeth are peculiarly adapted for destroying living prey, and for tearing, dividing, or bruising flesh. They have incisors in each jaw, two long and pointed canines, and the molars are never beset with small conical points or tubercles, as in the insectivorous tribe of the same order. The carnivorous tribe is divided into those which tread on the sole of the foot (*Plantigrades*), and those which run on the last joints of the toes (*Digitigrades*).

CAROCO'LLA (Lat. caro, *flesh*, and Gr. κολλη, *glue.*) A genus of land-snails, so named from the tenacity with which their fleshy foot adheres to limestone rocks. The variegated carocolla (*Cari lapicida*, Lam.) is a native species, and has been found on Juniper Hill, Box Hill, Surrey.

CA'ROMEL. Sugar melted till it acquires a brown colour and exhales a peculiar odour.

CARO'TID. An artery of the neck. There is one on each side of the cervical vertebræ which supply the head with blood. If these vessels are tied, the animal becomes insensible; hence the term, from καρόω, *I put to sleep.*

CARP. *See* CYPRINUS.

CA'RPADE'LIUM. (Gr. καρπος, *fruit*, and δηλος, *plain.*) A little-used name, applied in botany to all indehiscent, many-celled, inferior fruits, with a single seed in each cell; as in Umbelliferous or Apiaceous plants.

CA'RPEL. (Gr. καρπος, *fruit*) A name contrived by modern botanists to denote the separate pistils out of which a fruit, consisting of more pistils than one, is composed. In its most simple state a fruit consists of a one-celled ovary, and a style and stigma, united into a pistil, as in the plum; but in most cases several such pistils are formed within the same flower, and are united in various ways into one compound body, to which the name of pistil is also applied. In the latter case the single pistils are called carpels. The pistil may nevertheless consist of one carpel only. The theory of the structure of the fruit of plants turns upon the relative position which carpels bear to each other in their united state; and upon their correspondence in this respect with leaves, of which they are undoubtedly modifications.

CA'RPENTER. The third warrant officer on board a man of war. He has the charge of the boats. It is his duty, with his mates, to attend constantly to the state of the well, in order that a leak may be immediately reported.

CA'RPENTRY. (Lat. carpentum, *carved wood:*) In Building and Architecture, an assemblage of pieces of timber connected by framing or letting them into each other, as are the pieces of a roof, floor, centre, &c. It is distinguished from *joinery* by being put together without the use of other edge tools than the axe, adze, saw, and chisel; whereas joinery requires the use of the plane. The leading points to be attended to in sound carpentry are, 1st, The quality of the timber used; 2nd, The disposition of the pieces of timber, so that each may be in such direction, considered with reference to the fibres of the wood, as to be most capable of performing its office properly; 3rd, The forms and dimensions of the pieces; 4th, The manner of framing the pieces into each other, or otherwise uniting them by means of iron or other metal.

CA'RPET. An ornamental covering for the floor. The manufacture of carpets is carried on in great perfection in this country. The principal varieties are the Brussels, Axminster, Wilton, Kidderminster, and Venetian. They are generally composed of linen and worsted. In some the pile is cut so as to give the carpet the character of velvet; as in the Wilton carpets. Kidderminster or Scotch carpets are entirely fabricated of wool.

CA'RPET WAY. Any strip or border of green sward left round the margin of a ploughed field.

CA'RPOBA'LSAMUM. (Gr. καρπος, *fruit*, and βαλσαμον, *balsam*) The exudation of the fruit of the *Amyris Gileadensis*; a variety of *balm of Gilead.*

CA'RPOLITES. (Gr. καρπος, *fruit*, and λιθος, *a stone.*) Fossil fruits and seeds.

CARPO'PHORUM. (Gr. καρπος, *fruit*, and φερω, *I bear*) The name of the central column, which, in the fruit of the Geranium, the Euphorbia, or Apiaceous plants, bears the ripe carpels, and holds them together when they attempt to separate at maturity.

CA'RREL, or QUARREL. The arrow used in cross-bows, the head of which was four-sided; a cross-bow bolt.

CA'RRONADE. A kind of short iron gun, which is attached to its carriage by a joint and bolt underneath the piece, instead of trunnions. It is only in this respect and in its dimensions that it differs from other guns or howitzers. The name is derived from Carron, a village in Stirlingshire, where this gun was first made.

CARSE LAND. Alluvial soil in a state of aration.

CART. An open box, placed upon two or more wheels, and constructed with shafts, so as to admit of being drawn by one or more horses. In agriculture, carts are used for carting or carrying from one point to another soils, manures, and produce. For this purpose there are the close cart, single or double, that is, for one or for two horses; the corn cart, single or double, constructed of open work, and used for carrying hay, and for conveying corn in the sheaf from the field to the rickyard, &c., and the stone or quarry cart, consisting of a strong bottom and low wheels, for conveying large stones. Besides these, there are the three-wheeled cart, with low wheels, for carting soil, stones, &c., to a short distance; the timber cart, which is nothing more than two pairs of wheels and axles joined by a pole, and used for conveying large trunks of trees from the place where they have been felled to the place where they are to be manufactured; and the box cart, or cart with close bottom and sides, which is used for conveying soils, manure, and small articles, commonly constructed so as to admit of discharging the load by elevating one end of the box and lowering the other; and to carts having this contrivance the term coup cart is applied in Scotland, and till cart in England.

CARTE BLANCHE (Fr.) A paper containing nothing but the signature of the party who grants it, in order that the party to whom it has been delivered may insert such conditions as he chooses to prescribe. This term is used in a general sense to express an unlimited authority delegated by one individual to another: thus a general is said to have carte blanche, when his sovereign has granted him permission to use his own discretion in conducting the operations of war.

CA'RTEL. In Military language, an agreement for the exchange of prisoners. Also, a challenge to fight a duel. A cartel ship is one commissioned, in time of war, to carry proposals of any kind between belligerent powers.

CARTE'SIAN PHILOSOPHY. The philosophical system of René des Cartes (born 1596), a native of France, perhaps the most original thinker that country has produced. Des Cartes was the contemporary of Bacon, and exercised an equally powerful influence, though in a manner widely different, on the progress of philosophy in Europe. Both equally undertook the task of demolishing the old scholastic system, and of substituting in its place a more comprehensive method and a more living

spirit of philosophising. But what Bacon strove to accomplish by calling men's attention to experiment and observation of nature, Des Cartes proposed to attain by the search for a first and self-evident ground of all knowledge. This he finds in the art of consciousness, involving necessarily the idea of self or mind. (*Cogito ergo sum.*) Consciousness is the act of thought, constitutes the essence of the soul, and is that which distinguishes it from matter. The ideas or objects of consciousness are of three kinds,—acquired, compounded, and innate. Of the last sort is the idea of God, or the Absolute Being, which, as being the ground of all reality, is itself its own demonstration. God, the Author of the universe, upholds it in its course by his perpetual co-operation, or, in Cartesian language, assistance. All physical phenomena Des Cartes endeavoured to account for by his celebrated *vortices*—motions excited by God, the source of all motion. The singular mixture of philosophical depth and extravagant hypothesis that prevails in the writings of this philosopher obtained for him, as might have been expected, a large number of warm adherents, and of equally violent opponents. Among the former may be enumerated the celebrated Pascal, Malebranche, and Spinoza. The two latter deviated indeed in many important points from the views of Des Cartes; but the main features of his philosophy are preserved alike in the religious mysticism of the one and the systematic pantheism of the other.

CA'RTHAMUS. *See* SAFFLOWER.

CARTHU'SIANS. In Ecclesiastical History, a religious order, instituted by St. Bruno in 1086: so called from their original seat, Chartreuse. They followed the rule of the Benedictines (quod vide), with the addition of various austerities, and employed themselves in the same literary and mechanical pursuits. Soon after their institution the Carthusians were introduced into England, where in the lapse of time they succeeded in establishing nine houses of their order, among which was the Charterhouse in London. (See *Histoire des Ordres Monastiques*, vol. vii.)

CA'RTILAGE, CARTILAGO. (Lat. caro, *flesh*.) A white elastic substance, intermediate between bone and ligament, and having the chemical properties of condensed albumen. It is commonly called *gristle*.

CARTILAGI'NEANS, CARTILAGINEI. A subclass of fishes, in which the endo-skeleton never passes beyond the primitive condition of gristle or cartilage. *See* CHONDROPTERYGII.

CARTOO'N. (It. cartone.) In Painting, a sketch made as a pattern for tapestry. The name is also given to large sketches on coarse or other paper for fresco subjects; in which case, when the stucco is setting the outlines are pricked through on to it so that a correct outline may be expeditiously obtained. We subjoin the following account of the cartoons of Raffaelle at Hampton Court.—These celebrated works, originally thirteen in number, are a magnificent series of coloured designs, representing the origin, sanction, economy, and progress of the Christian religion. They were made originally for the copies in tapestry, still, we believe, annually exhibited in the colonnade of the Vatican, wrought at Arras by command of Leo X. at an expense of 7000 crowns of gold. These were carried off at the plundering of Rome in 1527 by the Spanish army; but Montmorenci, the French general, found and restored them to their former station. In our own days they were again carried off when the French seized the government of Rome, and were afterwards purchased by that excellent pontiff Pius VII.

Seven of the original pictures were purchased by Charles the First, and are now preserved at the royal palace at Hampton Court. Richardson (*Theory of Painting*) gives an historical and critical description of them, and considers them better calculated to convey a true notion of the genius of Raffaelle than even the loggia of the Vatican. The object that Charles had in view when he purchased the seven cartoons above mentioned, was to supply the manufacture then at Mortlake with subjects of a higher character than Francis Cleyre, its superintendant, could himself invent; and there is evidence that some of them were actually copied there, and that they are still preserved, probably at Petworth.

In whatever light, says Fuseli, we consider their invention—as parts of *one whole* relative to each other, or independent *each of the rest* and as single subjects,—there can be scarcely named a beauty or a mystery of which the cartoons furnish not an instance or a clue. They are poised between perspicuity and pregnancy of moment: the Death of Ananias, the Sacrifice at Lystra, Paul on the Areopagus, will furnish us with conclusions for the remainder. In Paul announcing his God from the height of the Areopagus, the same sagacious critic observes that enthusiasm and curiosity make up the subject. Simplicity of attitude invests the speaker with sublimity; the parallelism of his action invigorates his energy; situation gives him command over the whole; the light in which he is placed attracts the first glance; he appears the organ of a superior power. The assembly, though selected with characteristic art for the purpose, are the natural offspring of the place and moment. The involved meditation of the Stoic, the Cynic's ironic sneer, the incredulous smile of the elegant Epicurean, the eager disputants of the academy, the elevated attention of Plato's school, the rankling malice of the Rabbi, the magician's mysterious glance, repeat in louder or in lower tones the novel doctrine; but whilst curiosity and meditation, loud debate and fixed prejudice, tell, ponder on, repeat, reject, discuss it, the animated gesture of Dionysius and Damaris announce the power of its tenets, and—what the artist chiefly aimed at—the established belief of immortality. We have selected the above as a specimen of the critical examination which the reader may apply to the remaining six of this extraordinary series of pictures, in which the power of combining the drama with pure historic fact has never been surpassed.

The cartoons have been several times engraved; first by Gribelin in the reign of Queen Anne; then by Dorigny; and afterwards by inferior artists, most probably from the engravings themselves of those that preceded them. They were likewise engraved on a small scale by Fittler, and more recently in a superior style by Holloway. The late Prince Hoare, Esq., secretary for foreign correspondence to the Royal Academy, was possessed of a very fine cartoon by Raffaelle, the subject of which was the Murder of the Innocents.

CARTOU'CH. (It. cartoccio.) In Architecture, the same as *modillion* (which see), except that this term is used almost exclusively to signify the blocks or modillions applied at the eaves of a house. Some have used the term to denote the ornament of the key-stone of an arch, which seems to represent a scroll of paper partly unrolled.

CARTOU'CHE. A Military term, signifying a strong case or box for holding balls.

CA'RTRIDGE. A case of paper or pasteboard holding the exact charge of a firearm. Those of cannon and mortars are sometimes of tin or wood, but most frequently flannel, bags of this material being found the most convenient.

CARU'NCLE. (Dim. of caro, *flesh*.) A naked soft fleshy excrescence, often ornamenting some parts of the head of birds, as, *e g* the caruncle on the cere of the king vulture (*Vultur papa*, Lin.)

CARU'NCULA. (Dim. of caro, *flesh; a little piece of flesh*.) A small protuberance found near the hilum upon the seed of *Euphorbia lathyris* and other plants.

CA'RYA. (Gr. κάρυον, *a nut*.) The genus of plants which includes the hickory nut of North America, a tree of the greatest value, for its tough elastic wood, as well as for the nuts, which resemble walnuts, except that their shell is not furrowed, and which are much eaten and pressed for their oil in their native country. There are several species of Carya; but *C. alba*, the white hickory, a hardy ornamental tree in this country, is the most valuable.

CARYA'TIDES. (Gr. κάρυα, *a nut tree*.) In Architecture, figures used instead of columns to support an entablature. The origin of them, according to Vitruvius, is as follows—"Carya, a city of Peloponnesus, took part with the Persians against the Grecian states. When the country was freed from its invaders, the Greeks turned their arms against the Caryans, and upon the capture of the city put the males to the sword, and led the women into captivity. The architects of that time, for the purpose of perpetuating the ignominy of this people, instead of columns in the porticos of their buildings substituted statues of these women, faithfully copying their ornaments, and the drapery with which they were attired; the mode of which they were not permitted to change." The writer of the articles on art in this work was the first author on architecture who endeavoured to show the want of truth in this account, and that on two grounds:—first, because the circumstance is not mentioned by any of the Greek historians; and secondly, because long previous to the time assigned by Vitruvius, figures of men, women, and animals were employed for this purpose. They appear to have acquired their name from their employment in temples to Diana, by whom the Lacedæmonians are supposed to have been made acquainted with the story of Carya, turned into a nut tree by Bacchus, who at the same time transformed her sisters into stones, and thence worshipped under the name of Caryatis. From their employment in temples dedicated to the goddess, they were used in other buildings as representations of the nymphs who assisted at the mysteries of the patron goddess. The figure No. 1 above given is a Caryatid, from the Pandroseum at Athens; No. 2. is a Canephora (see that word). When figures of the male sex are used they are called Persians.

1



2



CARYO'CAR. (Gr. κάρυον, *a hard-shelled fruit.*) A genus of trees inhabiting the forests of tropical America, especially Guayana; one of them, found in woods near Marlquita, is said to attain the height of 240 feet. The Saouari (vulgarly called Sawarrow) nuts of the shops, a delicious fruit, with a large soft buttery kernel, are the seeds of *Caryocar glabrum* and other species. Properly the name Saouari applies to *Caryocar butyrosum.*

CA'RYOPHY'LLIA. *See* MADREPORE.

CA'RYOPHYLLA'CEOUS (Lat. caryophyllus, *the garden pink*), is sometimes said of corollas consisting of petals having long claws dilating into a broad limb, as in the garden pink.

CA'RYO'PSIS. (Gr. κάρυον, *a nut*, and ὄψις, *resemblance.*) The technical name of the grain of corn. It is an indehiscent one-celled fruit, with a membranous pericarp adhering firmly to the seed.

CASCARI'LLA. (Span. dim. of cascara, *bark.*) The bark of the *Croton cleutheria*, imported for medical use from Jamaica and the Bahama Islands. It is bitter and aromatic, and when burned it diffuses an odour much resembling that of musk.

CASE. (Lat. casus; from cado, *I fall*) In Grammar, that modification of a noun which designates the relation in which a substance is conceived to exist in regard to some other substance. This end is commonly attained in language by changes in the termination of nouns. In English there are but three cases; the nominative, the genitive or possessive, and the accusative or objective case, the last only in pronouns All other varieties of relation are expressed by prepositions. *See* GRAMMAR.

CASE. (Fr casse) Is the receptacle for the types, from which the compositor gathers them separately, and arranges them in lines and pages to print from. They are always in pairs; one of which is styled the upper case, and is divided into ninety-eight boxes or recesses of equal size, in which are deposited the capitals, small capitals, accented letters, figures, &c., the other is styled the lower case, and is divided into fifty-three boxes or recesses of unequal size, containing the small letters, spaces, &c., the letters most in use having the largest boxes assigned to them. The cases are two feet nine inches long, one foot four inches and a half broad, and a full inch in depth

CA'SEIC ACID. A peculiar acid extracted from cheese.

CA'SEMATE. In Fortification, a vault or arch of stonework in the flank of a bastion, serving as a battery.

CA'SEMENT. (It casamento) In Architecture, a portion of a window sash hung on hinges. It is used also to denote the moulding called a *scotia*, which see

CASE'RNS, or CAZERNS Huts erected on the ramparts, or between the ramparts and the houses, of fortified towns, serving as temporary lodgings for the soldiers on duty.

CASE-SHOT, or CANISTER-SHOT, signifies musket balls, stones, pieces of iron, &c put into cases or tin canisters, and discharged from pieces of ordnance.

CA'SEUM. (Lat) The basis of cheese. The purified curd of milk.

CASH. In Commerce, the ready money, bills, drafts, bonds, and all immediately negotiable paper in an individual's possession.

CASSAMU'NAR. A root brought from the East Indies, and formerly used in medicine as a warm bitter

CASSA'TION, COURT OF The highest judicial institution in France; so termed from possessing the power to quash (casser) the decrees of interior courts. It is a court of appeal in criminal as well as civil cases. The tribunal of cassation was first introduced, as a court wholly independent of the king and his council, in 1790. This court has a president, and three presidents of sections; but the minister of justice, as keeper of the seals (*garde des sceaux*), has the right of presiding in cases where it sits on appeal from the cours royales The three sections are,—1. Des requêtes, which decides on the admissibility of petitions of appeal in civil cases, 2. De cassation civile; 3. De cassation criminelle. The decision of the court of cassation has the effect of sending back the case to the inferior courts. If, after a decision has been reversed, a second court decides the same case in the same way, on appeal being entered again the court of cassation must either repeat its reversal by the unanimous consent of all the three sections, or it must request an authentic explanation of the law from the government; and, after a third conflicting decision, such authentic explanation becomes absolutely necessary. The inferior judges of the three sections of the court of cassation are styled counsellors.

CASSA'VA. A species of starch obtained from the roots of the *Jatropha manihot.*

CA'SSIA. (From the Arabic.) The bark of the *Laurus cassia*; its flavour somewhat resembles that of cinnamon, and it yields an essential oil, which is pungent and stimulant.

CASSI'DEOUS. (Lat. cassis, *a helmet.*) When the upper petal of a flower is dilated into a broad helmet-shaped leaf, as in the genus *Aconitum.*

CASSI'DIDÆ. (Lat. cassis, *a helmet.*) A family of Tetramerous Coleopterans, generally known by the name of tortoise-beetles, distinguished by having straight short filiform antennæ, inserted close together in the upper surface of the head; mouth situated on the under surface of the head, with strong and broad mandibles; legs short, with the tarsi flattened, the third joint deeply cleft, receiving between its lobes the terminal joint, margins of the thorax and elytra much dilated, so as to give the insects the appearance of small tortoises The larva of the *Cassididæ* is remarkable for an apparatus, or anal fork, by which it collects and forms of its excrements a kind of parachute, or defensive covering.

The genera of *Cassididæ* are, *Alurnus*, *Hispa*, *Chalepus*, *Imatidium*, and *Cassida*; the latter is the only indigenous genus, and of this the most common example is the *Cassida equestris* of Fabricius.

CA'SSIOPE'IA. One of the constellations of the northern hemisphere.

CA'SSIS. (Lat.) A genus of Gastropodous Mollusks, separated by Lamarck from the Linnæan genus *Buccinum*, and including the species of which the shells are commonly called "helmets." The nacreous or inner layer of these shells are exquisitely sculptured by Italian artists in imitation of antique cameos; the different coloured strata resembling the onyx and other precious stones.

CA'SSIUS, PURPLE OF. So called from its inventor. A beautiful purple used in porcelain painting, and for staining glass. It is formed by immersing tin in a solution of gold. It is probably a mixture of oxide of tin and finely divided gold.

CA'SSOWARY. (Casuarius, from the Malay word cassuwaris.) A genus of Coursers or Struthious birds, inhabiting the island of Java, in which the wings are shorter than in the ostrich, and are armed with strong spines, for the purpose of combat or defence. The head is surmounted by a bony protuberance covered with horn.

CASSYTHA'CEÆ. (Cassytha, the only genus.) A most singular natural order of plants, having the fructification of *Lauraceæ*, and the manner of growth and general appearance of a *Rhipsalis*, or rather a *Cuscuta*. They inhabit the tropical parts of the world.

CAST. In Sculpture. *See* MOULDING.

CASTA'NEA. (Castana, a city of Thessaly.) A genus of trees or shrubs, related to the oak, and producing for fruit the seed-like nuts called chesnuts in this country. The common Spanish chesnuts, of which upwards of 20,000 bushels are annually imported from the south of Europe, are the fruit of *C. vesca*, a much smaller nut is obtained in North America from the *C. pumila*, or the Chinquapin chesnut. The timber of the common Spanish chesnut is good and durable, more so than that of the oak, when the latter is young, but it is a mistake to suppose that the ancient roofs and beams occasionally found in buildings of the Norman era, and which carpenters call chesnut, are the wood of this tree. Such instances all belong to the kind of oak called *Quercus sessiliflora.* The genus *Castanea* differs from *Quercus*, among other things, in having the nuts enclosed in a spiny closed-up cup, instead of a shallow open one; but in the East Indies, where both oaks and chesnuts assume very remarkable forms, the two approach each other sometimes so nearly in this particular, that it is difficult to distinguish them.

CA'STANETS (Fr castagnettes.) Small wooden or ivory musical instruments, played by being tied to the fingers, and thus rattled by dancers to the time of the music of the dance They are chiefly used in Spain.

CASTE. A term borrowed from the Portuguese settlers in India, which is used to denote the hereditary classes into which the population of Hindoostan is divided, according to the religious law of Brama. The origin of these classes is detailed in the sacred book which contains the ordinances of Menu. According to this authority, the Brahmin, the Cshatriya, the Vaisya, and the Sudra sprang respectively from the mouth, the arm, the thigh, and the foot of Brahma. 1. The class of Brahmins, or priests, whose name signifies *scripture*, are far exalted above the rest in honour and privilege, and should be devoted entirely to prayer and meditation, or at least to the most exalted concerns of life. Many Brahmins, however, do in fact engage in secular pursuits, not only as ministers of sovereign princes (an office for which, according to the ordinances above cited, they are indeed peculiarly fitted), but also, in Guzerat and other parts of Western India, as merchants, or in the lower employment of messengers and porters; while many enter the Company's service as private soldiers. These, however, are Brahmins of the first and second classes (Brachmachari and Grihast'ha), youths or married men who as yet live in the world; from which the two higher classes, Vanaprastha and Sunnyassi, are wholly divorced: from these spring the various orders of fanatics with which India swarms. 2. The Kshatriya, or soldier caste, whose name indicates *protection.* To this belong not only the high military classes, but in some parts of India whole tribes, as the Seikhs, &c. 3. The Vaisya, or commercial class (*wealth*). 4. The Sudra, or caste of tillers of the soil

(*labour*). These are deeply degraded below not only the Brahmins, but the other two castes; and even the reading of the Vedas or sacred books is forbidden to them. Besides these four grand divisions, the Hindoos have many subdivisions of caste, and no fewer than thirty-six are reckoned which are all inferior to the Sudra. These descend, according to the mythological history of the Hindoos, from the "Burren Sunker" or mixed class, proceeding from the confusion of castes which took place under the reign of a wicked and irreligious monarch. Finally, the Pariahs and some other races are considered as having no caste at all, and mere outcasts from humanity. Traces of the system of caste, which confines employments to hereditary classes, are to be found in the institutions of many countries, and in the history of many more. That the Egyptian nation was thus divided, is well known; and it is supposed that similar institutions prevailed in the ancient Assyrian empires. If Plato can be relied on as an authority, the Athenians in the first ages of their commonwealth were divided into five classes of the same description — priests, handicraftsmen, shepherds and hunters, ploughmen, soldiers. And it is said that the Cretans were divided, according to the laws of Minos, in the same manner as the Egyptians.

CA'STELLATED. (Lat. castellum, *a castle*.) In Architecture, a building in the style of a castle

CA'STING. (Dan. kaster, *to throw*.) In Architecture, a term used to denote the bending of the surfaces of a piece of wood from their original state, caused either by the gravity of the material, or by its being subject to unequal temperature, moisture, or the ununiform texture of the material. Called also Warping.

CASTING. In Foundery, the running of liquid metal into a mould prepared for that purpose. *See* FOUNDERY.

CA'STING OF DRAPERIES In Painting, the disposition of the folds of the garments wherewith the figures in a picture are clothed. Carlo Maratti thought that the disposition of drapery was a more difficult art than even that of drawing the human figure, and that a student might be more easily taught the latter than the former. Inferior painters enter into the minute discriminations of quality in drapery; but, as Sir Joshua Reynolds has well observed in his Fourth Discourse, with the historical painter "the clothing is neither woollen nor linen, nor silk, satin, nor velvet: it is drapery; it is nothing more."

CA'STING OFF COPY. In Printing, is to ascertain accurately how many pages in print a given quantity of manuscript copy will make; or how many pages a given quantity of printed copy will make when the size of the book and the type are changed; also when a given quantity of manuscript copy is delivered, with directions that it is to make a certain number of pages in print, to determine the size of the page and the size of the type This is usually done by composing a line or two of the copy, when, supposing a line and a half of it makes a line of print, it becomes a mere arithmetical question. Supposing there are 12,000 lines of copy, it will make 8,000 lines in print, which, at 24 lines to a page, will be 333 pages, and with the title, short pages, &c. equal 14 sheets in 12mo.; about the general quantity in a volume of modern novels.

CA'STLE. (Lat. castellum, or Sax cajtel) In Architecture, a building fortified for military defence; also a house with towers, usually encompassed with walls and moats, and having a donjon or keep in the centre. The principal castles of England at present are, the Tower of London, Dover, Windsor, Norwich, &c.; but at one time those of Harwood, Spofford, Kenilworth, Warwick, Arundel, and others might have vied with them in importance. The characteristics of a castle are its valla (embankments) and fossæ (ditches); from the former of which the walls rise, usually crowned by battlements, and flanked by circular or polygonal bastions at the angles formed by the walls; these latter were pierced for gates with fixed or draw bridges and towers on each side; the gates, which were of considerable strength, were further guarded by descending gratings, called portcullises; all the apertures were as small as they could be made, consistently with internal lighting. The component parts of a castle were, the foss or mote, with its bridge; the barbican, which was in advance of the castle, being a raised mound or tower, the outer walls having terraces towards the castle, with their bastions, as above mentioned; the gate-house, flanked by towers, and crowned with projections, called machicolations, through which heavy materials or molten lead were dropt on the assailants entering the gateway; the outer ballium, or area within the castle, which was separated from the inner ballium by an embattled wall with a gate-house, and in which the stables and other offices usually stood; and the inner ballium, for the residence of the owner or governor and his retinue; this, at one corner, or in the centre, had a donjon or keep tower, which was the strong hold of the place, wherein was a state apartment; a well and a chapel; the former usually, and the latter frequently, are found in ancient castles.

For further information on the subject the reader is referred to *King's Mun. Antiq.* fol. 4 vols; the *Archæologia* in several places; *Leland's Collect.* vol. ii.; *Woolnoth's Ancient Castles of England and Wales*, &c. &c.

CA'STOR. The generic name of the beaver. (*Castor fiber*, Linn.)

CA'STOR. A peculiar concrete substance, contained in oval pouches situated near the anus of the *Castor fiber* or *beaver*. There are four of these pouches; two contain a species of fat; while the two larger ones include in their membranous cells a viscid fetid substance, which is the *castor* of the Materia Medica. It is imported from Russia, Prussia, and Poland, and from Canada: the latter, known in trade under the name of *New England castor*, is very inferior. It is said to be an antispasmodic.

CA'STOR AND PO'LLUX. The name given to a meteor which sometimes appears at sea, attached to the extremities of the masts of ships under the form of balls of fire. When one ball only is seen, it is called Helena. The meteor is generally supposed to indicate the cessation of a storm, or a future calm; but Helena, or one ball only, to portend bad weather.

CA'SUA'RINA'CEÆ. (Casuarina, one of the genera.) A curious natural order of plants, inhabiting New Holland, some parts of India, and the South Sea Islands, with long slender creeping branches, resembling those of *Equisetum*, and bearing scales only in the place of leaves. The order is nearly allied to *Myricaceæ*, and belongs to the most imperfect forms of Exogenous vegetation.

CA'SUIST, CA'SUISTRY. In Theology, a casuist is a doctor charged with the decision of cases of conscience The Jesuits were distinguished for the cultivation of this mixed subject of theology and ethics; which was admirably calculated to promote the crafty policy of that order. The science of casuistry, however, has been cultivated in the Protestant as well as the Papal church, and until very recently there was a professor of casuistry at Cambridge. (See *Mayer's Bibliotheca of Casuists*)

CAT. *See* FELIS, or FELINE.

CAT. A ship employed in the coal trade.

CAT. Tackle by which the anchor is raised to the cathead. See *Falconer's Dict.*

CA'TABA'PTISTS (Gr κατα, *against*, and βαπτιζω, *I baptize*) In Ecclesiastical History, a general term to designate all the sects which have denied the necessity of baptism generally, or have opposed infant baptism *See* BAPTISTS, QUAKERS, SOCINIANS, &c.

CA'TACA'USTICS (Gr καταικαιω, *I burn*.) In Optics or Geometry, are the *caustic* curves formed by the reflection of the rays of light, and so called to distinguish them from the *diacaustic*, which are formed by refracted rays. *See* CAUSTIC.

CA'TACHRE'SIS (Gr. κατα, in the sense of *beside*, and χρησις, *use*) In Rhetoric, a figure by which a word is used in a sense analogous to its own. *See* METAPHOR.

CA'TACLE'SIUM (Gr. κατα, *against*, and κλειω, *I enclose*) A name applied sometimes to such fruit as that of *Mirabilis*, which consists of a membranous indehiscent pericarp enclosed within a hard pericarp-like tube of the calyx

CA'TACLY'SM (Gr. κατακλυσμος, *an inundation, a deluge*) Geologists apply the word to signify the various great inundations which they conceive to have occurred at different periods in the history of the globe.

CA'TACOMBS. (Gr κατα, *against*, and κυμβος, *a hollow place*) In Architecture, subterraneous places used for burying the dead. The hypogæa, crypta, and cemeteria of the ancients were used for the same purpose. In some cities those vast excavations were made use of for other purposes than those of sepulture; at Syracuse, for instance, the same cavern served for a prison as well as a public cemetery. It has been said that in the early ages of Christianity they also served as places of devotion. The most celebrated for their extent are those of Rome, Naples, Syracuse, &c; and the more modern ones of Paris, which have been formed by quarrying for the stone with which the city is built.

CA'TACOU'STICS, or CATAPHO'NICS. (Gr. κατα, *about*, ακουω, *I hear*, φωνεω, *I speak*.) The science of reflected sounds; or that part of acoustics which treats of the properties of echoes, or in general of sounds which do not come to the ear directly but after having been reflected by some substance. *See* ECHO and SOUND.

CA'TAFA'LCO. (Ital. *a scaffold*.) In Architecture, a temporary structure of carpentry, decorated with painting and sculpture, representing a tomb or cenotaph, and used in funeral ceremonies. That used at the final interment of Michael Angelo at Florence was of the most magnificent description, and perhaps unequalled as to the art employed on it by any used before or since.

CA'TALE'CTIC. (Gr. καταληκτικος, *deficient*.) In Greek and Latin poetry, a verse wanting one syllable of its proper length: *acatalectic*, a verse complete in length; *hypercatalectic*, having one syllable too many, *brachycatalectic*, wanting two syllables.

CA'TALEPSY. (Gr. καταλαμβανω, *I seize*.) A disease in which the functions of the organs of sense and

motion are suspended, whilst the heart continues to pulsate. The patients are said to be in a *trance;* and in this state they remain for some hours, or even days. Ammoniacal and etherial stimulants are the most effectual restoratives.

CA'TALOGUE RAISONNE'. In Bibliography, a catalogue of books, classed under the heads of their several subjects, and with a general abstract of the contents of works where the title does not sufficiently indicate it; thus serving as a manual, to direct the reader to the sources of information on any particular topic. The want of alphabetical arrangement is supplied by an index at the end. The catalogue of the French *Bibliotheque Royale* (10 vols. fol. 1739—53) is said to be the best work of this description, as far as it extends.

CA'TAMARA'N. A sort of raft used chiefly by the Indians on the Coromandel coast for the purposes of fishing. It is composed of three pieces of wood lashed together, the middle piece being longer and broader than the others; and it is almost the only kind of boat that can live in the surf that prevails on that coast. Catamaran was also the name given to the floating batteries with which the French at the commencement of the present century meditated the invasion of England.

CATAME'NIA. (Gr. κατα, *according to*, and μην, *a month*.) The monthly uterine evacuation.

CA'TAPE'TALOUS. (Gr. κατα, *against*, πεταλον, *a petal*.) When the petals of a flower are held together by stamens which grow to their bases, as in the mallow.

CA'TAPHRA'CTED. (Gr. καταφραχτος.) Covered with a hard callous skin, or with horny or bony plates or scales closely joined together. Among the ancients, cavalry equipped with complete defensive armour were termed *equites cataphracti*.

CA'TAPLASM. (Gr. καταπλασσω.) A poultice.

CA'TAPULT. (Gr κατα, *against*, and πελτη, *a shield*) A military engine used by the ancients for throwing stones, long darts, or javelins. The catapult is often confounded with the balista; but the latter engine seems to have been chiefly used for the purpose of propelling stones, while the former more frequently was employed with other missiles. Their size and construction were various, but the principle of action was the same in all; namely, the elastic force with which twisted rope uncoils itself.

CA'TARACT. (Gr. καταῤῥασσω, *I confound*) An opacity of the crystalline lens of the eye, producing confused or indistinct vision, or total blindness, according to the less or greater extent of the thickening it is sometimes rapid, and often very slow in its progress. It is distinguished from *gutta serena* by the visible opacity of the lens, and by the iris contracting upon exposure of the eye to light. This disease is curable either by depressing or extracting the lens, operations which are performed with wonderful dexterity by some of our oculists

CATA'RRH. (Gr καταῤῥεω, *I flow down*.) The complaint commonly called a *cold in the head*, generally attended by running from the eyes and nose, sneezing, hoarseness, and commonly ending in cough. It is produced by sudden changes of air or temperature, and by exposure to draughts of air. In its usual form domestic remedies relieve it,—diluents, mild aperients, and abstinence from wine and animal food; but when attended by fever, headache, tightness about the forehead, and difficult breathing, it often requires more serious attention, for, if neglected, it may lead to much mischief.

CA'TARRHINES, *Catarrhina* (Gr. κατα, *at*, and ρις, *nose*.) A tribe of Quadrumanes, including those which have the nostrils approximated, and the intervening septum narrow; as in the apes of the old world

CATA'STROPHE (Gr. καταστρεφω, *I overturn*.) In modern literary language, the final event of a drama or romance, to which the other events are subsidiary. The περιπετια, or revolution, indicated by Aristotle as one of the parts of the drama, was a change in the fortunes of the principal personages of the play; as, the fall of Œdipus from sovereignty into extreme misery and banishment, in the *Œdipus Tyrannus*. Some such change is generally involved in the idea of a catastrophe: thus, marriage is the ordinary catastrophe of a comedy or a novel, as some disastrous change is that of a tragedy.

CA'TCH-DRAINS. Open drains across a declivity to intercept surface water. The term is sometimes also applied to under drains across a declivity.

CA'TCHWORK-MEADOWS. Grass lands with very regular surfaces, subjected to irrigation, the water as it descends the declivities being intercepted by catchdrains.

CA'TECHISM. (Gr. κατηχεω, *I instruct*.) A form of instruction by question and answer, appropriated by general usage to instruction in religious subjects, and more especially to the set forms which most churches have authorised for the instruction of children in the elements of religion. The English church catechism is intended to be an exposition of the vow made at baptism, and till the time of James I consisted only of the *renunciation* or repetition of the baptismal vow, the creed, and the Lord's Prayer. The latter portion, explaining the nature of the sacraments, was added after the conference at Hampton Court. The catechism of the Council of Trent, or *Catechismus ad Parochos*, was set forth by the Roman Catholic divines for the use and direction of the clergy, and contains an ample account of the whole sum of the Romish doctrines. It was approved by Pius V., and published in 1566. (See *Bingham's Antiq.* b. x. ch. 1, 2.)

CA'TECHU. A Japanese word, signifying the juice of a tree. The extract of the *Acacia catechu*, an astringent substance, consisting of tan and extractive matter, imported chiefly from Bengal and Bombay. Its principal use is in medicine.

CATECHU'MEN. (Gr. κατηχουμενος.) He who learns the elements of any science: one who is undergoing a course of religious instruction with a view to his admission into the church. The Christian society in the early ages was divided into two classes, Fideles and Catechumeni; the former being those who had been admitted by baptism into the entire privileges of the church, the latter such as were preparing for that admission.

CA'TEGOREMA'TIC. (Gr. κατηγορεω, *I predicate*.) In Logic, when a word is capable of being employed by itself as a *term*, or predicate of a proposition.

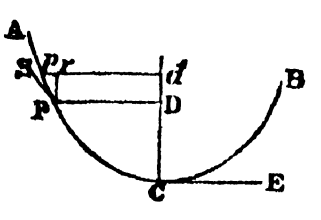
CATEGO'RICAL PROPOSITION. (Gr. κατηγορεω, *I declare something of another*) In Logic, a proposition which affirms or denies, absolutely and without any condition, that the subject does or does not agree with the predicate. (*See* PROPOSITION.) Categorical propositions are said to be pure (those which simply assert one thing of another), and modal (those which assert one thing of another under a certain mode or form). But this is a distinction arising out of the poverty of language only, and no essential difference between the two classes; *e g.* "the king reigns" is a pure categorical proposition; "the king reigns justly" is said to be modal But it is evident that if our language had a single word to express the whole idea (to reign justly), the latter would be called pure likewise. All cases of modal categoricals may probably be resolved into similar instances of the deficiency of words to express complicated notions.

CA'TEGORY. (Gr. κατηγορία) In Logic and Metaphysics, a Greek word, signifying originally that which may be said or predicated of a thing; a general term in reference to a less general one which is included under it. By Aristotle, from whom the word, and its corresponding Latin term *predicate*, was borrowed by the schoolmen, it was applied to denote the *most general* of the attributes that may be assigned to a subject. Of these he attempted an enumeration, under the names of substance, quantity, quality, relation, place, time, condition, state or habitude, action, and passion. The word has been revived in modern times by Kant, to express the most general of the modes in which a thing can be raised from an object of sense to an object of intellect; or, in other words, the forms or conditions which must pre-exist in the understanding, in order that an act of intelligence may take place. For an account of these see art. KANTIAN PHILOSOPHY. The difference between the categories of Kant and those of Aristotle is this, that the latter are mere generalizations from experience, which may consequently be multiplied indefinitely; whereas the former result from a professedly exhaustive analysis of the human understanding as it is in itself, or formally, that is, apart from all consideration of its object-matter.

CATENA'RIAN ARCH. (Lat. catena, *a chain*.) In Architecture, an arch whose form is that of a chord or chain suspended from two fixed points at its extremities.

CATE'NARY. (Lat. catena, *a chain*.) The curve into which a chord or flexible chain of uniform density and thickness forms itself when suspended or allowed to hang freely from two points. This curve was first noticed by Galileo, who proposed it as the proper figure for an arch of equilibrium, but he imagined it to be the same as the parabola. Its true nature was first demonstrated by James Bernoulli, and its various properties soon after pointed out by John Bernoulli, Huygens, and Leibnitz. It is interesting on account of the light it throws on the theory of arches, and also by reason of its application to the construction of suspension bridges.

The equation of the catenary may be found as follows: let A and B be the points of suspension, and C the lowest point in the curve. Draw C D perpendicular to the horizon, and through any two points P and *p* very near each other, draw P D and *p d* perpendicular to C D; draw also P *r* parallel to C D, and let P S be the tangent at P. Now, the chain having assumed this form, the equilibrium would not be disturbed by supposing the part C P to become rigid. In this case it would be kept at rest by three forces; namely, the tension at its two extremities, and its own weight. The tension at C is exerted in the direction C E or *p r*, that at P in the direction P S or P *p*, and the weight in the vertical P *r*. These three forces are therefore, by the principles of mechanics, proportional to *p r*, *p* P, and P *r*; that



is, making C D = $x$, D P = $y$, and C P = $z$, proportional to the differentials of these quantities, or to $dx$, $dy$, $dz$ But the tension C E (arising from the part of the chain C B) is constant; suppose it therefore equal to $a$, and the chain being uniform, the weight of C P is proportional to its length, or to $z$; therefore we have $a : z = dy : dx$, or $a\,dx = z\,dy$, which is the differential equation of the curve. On substituting $\sqrt{dz^2 - dx^2}$ for $dy$, and integrating, there results $x^2 + 2ax = z^2$, which is an equation between the arc and the abscis. The curve cannot be expressed by a simple algebraic equation between the abscis and ordinate, and is consequently of the mechanical kind. The constant quantity $a$ is called the parameter; and one of the most remarkable properties of the curve is, that the rectangle contained by the parameter and an ordinate is equal to the natural logarithm of the ratio of the parameter to the sum of the parameter, the abscis, and the arc.

CATE'NULATE. (Lat. catena, *a chain.*) When a surface presents a series of elevated ridges or oblong tubercles resembling a chain.

CA'TERPILLAR. The name of the larvæ of Lepidopterous insects.

CA'THARI. (Gr. καθαροι, *pure.*) An oriental sect of Christians. *See* PAULICIANS

CATHAR'TIC. (Gr. καθαιρω, *I purge.*) That which increases the action of the bowels. The term is commonly applied to medicines which do this with some degree of violence: among the milder cathartics, jalap, senna, calomel, and saline purges are the most used; those which are *drastic* are croton oil and elaterium.

CATHA'RTIN. The active or purgative principle of senna.

CAT-HEAD. A Nautical term, signifying a strong inclined piece of timber projecting from either bow of a ship, to which the ring of the bower anchor is secured. The block or pulley hooked to the ring is called the *cat-block*, the rope the *cat-fall.*

CATHE'DRAL. (Gr. καθεδρα, *a seat or throne.*) The principal church of a diocese, in which is the throne of the bishop. The term cathedra was originally applied to the seats in which the bishop and presbyters sate in their assemblies, which were held in the rooms in which the worship of the first Christians was also performed before they had liberty to erect temples for that purpose In after times the choir of the cathedral church was made to terminate in a semicircular or polygonal apsis; and in the recess thus formed were placed the throne of the bishop in the centre, and seats of an inferior class for presbyters. In modern cathedrals the bishop's throne is in the choir, and generally on the south side (*Bingham*, VIII. 6 10.)

CA'THETA and CATHETUS. (Gr καθετος, *let down*) In Architecture, a vertical line falling from the extremity of the underside of the cymatium of the Ionic capital through the centre of the volute

CA'THETER. (Gr. καθιημι, *I thrust into*) A tube which may be introduced by the urethra into the bladder for the purpose of drawing off the urine.

CA'THOLIC. (Gr. καθολικος, *universal*) A word which occurs in the New Test. in the titles of certain of the Epistles,—those of James, Peter, and John,—signifying that they are addressed to the whole or universal body of Christians, and not to a particular section of them. Hence the term has been used in later times to distinguish the church of Christ from all heretics and schismatics, and has been assumed by particular churches either to separate themselves from all others, as the Romish; or to include themselves as individual members of the universal body, represented under different and subordinate local names, as the English episcopal church. The Romish church appeals to the decisions of the Council of Trent for its most complete and definite rule of faith, and allows no one to be a member of the Catholic church who rejects any of the tenets therein enforced (*See* art. ROMAN CATHOLIC.) The English church considers itself a member of the Catholic, but passes no [illegible] as to what variations from its own formularies incur the guilt of heresy and incapacitate from such incorporation. *See* art. CHURCH

CATHO'LICON. (In old Pharmacy.) An universal medicine.

CA'TKIN. The English name of the inflorescence of the poplar, willow, and similar trees. A catkin is a close spike, composed of scales overlapping each other, and falls off the parent plant as soon as its office of flowering or fruiting is accomplished.

CATO'PTRICS. (Gr. κατοπτρον, *a mirror*; compounded of κατα and ὁπτομαι, *I see.*) Is that part of the science of optics which treats of the laws of reflected light, and the phenomena of vision produced by reflection. For details connected with this interesting branch of natural philosophy, see the terms MIRROR, OPTICS, REFLECTION.

The principal authors who have treated of Catoptrics are, Euclid; Alhazen and Vitellion, in the 11th and 12th centuries; James Gregory in his *Optica Promota*; Barrow, Smith, Tacquet, and all modern writers on the subject of Light or Optics.

CAT'S-EYE. A beautiful siliceous mineral (probably quartz), penetrated by fibres of asbestos, which, when polished, reflects an effulgent pearly light, much resembling the mutable reflections from the eye of a cat. Hence the Anglicised French term *chatoyant.*

CAT'S-TAIL GRASS. In Botany, a valuable meadow grass, usually forming part of all good lowland pastures. It is the *Phleum pratense*, a plant with a soft narrow cylindrical head, resembling that of the meadow foxtail.

CA'TTLE. Domesticated animals of the cow kind, which are found accompanying man in every civilized country, and in every climate. The native country of the type of British cattle is supposed by some to be Asia, and by others to be Africa; but in this case, as in all others where an animal or a plant has been long in a state of domestication, the origin of the species is involved in obscurity. When the tame cattle of any country are allowed to run wild and breed in that country, uncontrolled by man, the habits which belong to the animal in its savage state become, in the course of three or four generations, modified according to the natural supplies of food and the character of the climate. Hence, though cattle are not indigenous to Britain, South America, or the Sandwich Islands, we have in the former country a breed of wild cattle in one or two gentlemen's parks, as at Chillingham in Northumberland, which are quite different from the wild cattle of the fertile soils of South America, as these again are different from the wild cattle of the Sandwich Islands, though all undoubtedly the descendants of tame animals. Those in the Sandwich Islands, in particular, are known to be the offspring of the tame cattle that were left there by Vancouver, and which can now be only caught alive by entrapping them in disguised pits, into one of which the unfortunate botanist Douglas fell, and was gored to death by a bull who happened to be in it at the time. The domestic cattle of Britain may be divided into two races, those of large size adapted for the plains, and those of smaller size adapted for the mountains. Of each of these classes there are several breeds; such as the Highland and the Welch cattle, among the latter; and the Lancashire, the Yorkshire, and the Herefordshire cattle, among the former. There is also an intermediate breed, adapted for moderately hilly countries, such as the Galloway and Fife breeds in Scotland, and the Alderney and Guernsey cattle in England The best beef brought to the London market is that of cattle of the Highland breed fed in English pastures, or on turnips. The best milk cow for general purposes is the Ayrshire; the best for cream and butter, the Alderney; and the best for immense quantities of milk, the Lancashire. Hence the latter are generally employed in public dairies, the Ayrshire by farmers and cottagers, and the Alderney by the higher classes.

CA'TULUS (Lat catulus, *the young of any thing*) The old botanical name of the catkin of a plant, which see.

CAU'DA. (Lat.) That portion of an animal which is supported by vertebræ behind the sacrum; or which, as in fishes, have inferior spinous processes. In Entomology it signifies that part of the abdomen which becomes suddenly slender, and terminates in a long jointed tail, as in the scorpion.

CAU'DAT. (Lat. cauda, *a tail.*) When the apex of any organ in a plant is prolonged into a long slender point; this is not of rare occurrence, and is more especially common in Araceous and Aristolochiaceous plants.

CAU'DEX. (Lat. caudex, *a trunk.*) The Linnæan name of what is now more generally called the axis of vegetation; the woody centre round which the leafy and leaf-like organs are arranged The *caudex ascendens* was the stem, the *c descendens* the root of a plant.

CAUDI'CULA (Lat. dim. of caudex.) A thin, elastic, semitransparent process of the pollen masses of Orchidaceous plants, by means of which the pollen is brought in contact with the stigma or stigmatic gland. Its exact nature, use, and origin are unknown

CAUL. The trivial appellation of the *amnion* when it comes away in child-birth. It is regarded by the superstitious as a charm against shipwreck.

CAULI'COLUS. (Lat caulis, *a stalk.*) In Architecture, the small stalk under the volutes of the Corinthian capital, which it seems to support.

CAULI'CULUS. (Dim. of caulis, *a stem.*) In Botany, the slender part which connects the cotyledon of a seed with the radicle. It is usually considered a part of the radicle, but recent observations seem to show that it is rather an extension of the stem. Its office is to lengthen rapidly when germination takes place, and thus to bring the true radicle into contact with the earth upon which it has to feed.

CAU'LINE. (Lat caulis, *a stem.*) Any thing that grows to, or springs from, the stem of a plant. Cauline

leaves are those which grow upon the stem, prickles such as are borne by the same part, and so on.

CAULK, or CALK, to stuff the seams or openings between the planks of a ship with oakum, which is rope untwisted into its original state of fibre. The oakum is forced in by a caulking chisel and mallet. It has been found necessary, when a ship has worked the oakum out of the seams, to fill them with rope. Caulking affords fixedness to the whole frame, and is therefore a great support. The quantity of oakum used in a large ship is very great; in a large three-decker it is near 30 tons, or upwards of four cables.

When the seams are caulked, melted pitch is poured on the seams of the decks out of a pitch ladle; in other places it is laid on with a pitch mop: this is called *paying* the seams.

CAULOCA'RPOUS. (Gr. *καυλος*, *the stem of a plant*, and *καρπος*, *fruit*.) A name applied by De Candolle to such plants as, like trees and shrubs, annually produce flowers and fruit on their branches without perishing.

CAUSE. Four kinds of causes have been distinguished by logicians:—*the material*, *the efficient*, *the formal*, and *the final*. The *material* cause of a thing is that out of which that thing is made; in other words, that which is the ground of the possibility of a thing's coming into existence: *e g* the marble out of which a statue is made. The *efficient* cause is that in which resides the moving power requisite in order to render the possible existence actual; as the sculptor. The *final* cause of the thing is that very thing in its completeness; as the statue when made The *formal* cause is that which must supervene to the matter, in order to give the thing its precise individual existence as that thing and no other; as the shape which the sculptor communicates to the marble. This distinction is derived originally from Aristotle, with whom, however, it is rather a metaphysical than a logical determination. *See* ARISTOTELIAN PHILOSOPHY.

In popular language, the *final* cause is synonymous with the purpose to which any object is supposed to contribute, though that purpose be wholly external to the thing caused.

CAU'STIC CURVE. (Gr. *καιω*, *I burn*) In the Transcendental Geometry, is the name given to the curve to which the rays of light, reflected or refracted by another curve, are tangents. Caustics are consequently of two kinds, *catacaustics* and *diacaustics*; the former being caustics by reflection, and the latter caustics by refraction Catacaustics are generated thus. Suppose rays, as B M, B M′, &c (*fig* 1) to issue from a luminous point B, and to be reflected by the curve A M D, so that the angle of incidence equals the angle of reflection, the curve line H F F′, which touches all the reflected rays (produced, if necessary), is called the *catacaustic*, or caustic by reflection. *Diacaustics* are produced in a way entirely similar. Thus. Suppose rays, B M, B M′, &c. (*fig*. 2.), issuing from a luminous point B, to be refracted by the curve A M M′, so that the sines of incidence are to the sines of refraction in a constant given ratio; then the curve H F F′, which touches all the refracted rays, is called the *diacaustic*, or caustic by refraction

*fig.* 1.

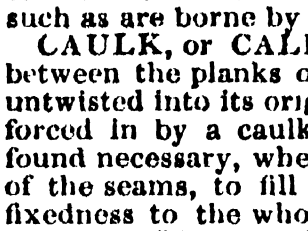
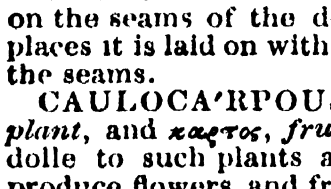



*fig.* 2.




The term *caustic* has been applied to these curves because the rays of light being collected along the curve in a greater quantity than elsewhere, heat is produced, particularly if the collection of rays is considerable In parabolic mirrors, when the luminous rays strike the mirrors in a direction parallel to the axis, the caustic merges in a single point, which is the focus of the mirror. All the conic sections have this property, that luminous rays issuing from one focus are reflected by the curve into the other focus; but in respect of all other curves, the several reflected pencils are collected, not into a single point, but into a series of brilliant points or foci, the assemblage of which forms a bright curved track, or caustic, which is mathematically defined as above.

The attention of geometers was first called to this species of curve lines by Tchirnhausen, who demonstrated some of their properties to the Academy of Sciences of Paris in 1682. One property, common to all of them, is remarkable; namely, that when the curves by which they are produced are algebraic, the caustics are rectifiable; in other words, straight lines can be found to which they are equal. In fact, any portion H F of the catacaustic (*fig*. 1.) is equal to the difference between the sums of B M and M F, and B A and A H; or H F = B M + M F − (B A + A H). In the diacaustic (*fig* 2.) we have for the length of the curve H F = A H − M F − *n* (B M − B A), where *n* is the constant ratio of the sine of incidence to refraction. If, therefore, the lengths of the radii and tangents can be expressed algebraically, the length of the caustic can also be exhibited by an algebraic expression. This circumstance having been noticed before the invention of the infinitesimal calculus, excited much interest among mathematicians, because it was then generally imagined that no curve line could be rectified.

The catacaustic may be experimentally exhibited by exposing the inside of a smooth bowl, containing any liquid not diaphanous (milk, for example, or still better, ink) to the sunbeams, or any strong light. The caustic, which in this case is an epicycloid, will appear beautifully delineated on the surface of the fluid. Another experiment, proposed by Sir David Brewster, exhibits the curves still more strikingly. Take a plate of polished metal, thin enough to be bent easily into a concave form, and place it perpendicularly on a sheet of white paper. If we expose this apparatus to the sun, holding the plane of the paper in such a manner that it may pass near the sun, without, however, intersecting it, the caustic will be exhibited on the paper as a well-defined curve of light. The interior part will be more brilliant than the exterior, and the light will diminish gradually and very rapidly at a little distance from the caustic. By varying the size of the plate, and bending it into curves of different shapes, all the different kinds of catacaustics, with their points of inflexion, &c, will be beautifully developed. (*Brewster's Optics*, *Cabinet-Cyclopedia*.)

This subject being intimately connected with the concentration and dispersion of the rays of light by reflecting and refracting surfaces, is of great importance in practical optics. (De la Hire, *Traité des Epicycloides*; *Smith's Optics*; J. Bernoulli, *Opera Omnia*, vol iii.; L'Hopital, *Analyse des Infiniments Petits*; Gergonne, *Annales des Mathematiques*; De la Rive, *Dissertation sur les Caustiques*, *Ency. Met.* art. "Light.")

CAU'STIC LUNAR. Fused nitrate of silver.

CAU'STICS. Substances which corrode and destroy the texture of the skin and of organized bodies.

CAU'TERY. The ancients divided cauteries into *actual* and *potential*. The former term is applied to red-hot iron; the latter to pure potash.

CAU'TIONARY. In Scottish Law, is the obligation by which a party becomes surety for another; answering to the English term guarantee. It is defined by Stair, "the promise or contract of a man not for himself but another" The guarantor is termed "cautioner."

CAVÆ'DIUM. (Lat.) In Ancient Architecture, an open quadrangle or court within a house. The cavædia described by Vitruvius are of five species; Tuscanicum, Corinthium, Tetrastylon (with four columns), Displuviatum (uncovered), and Testudinatum (vaulted). Though some authors make the cavædium the same as atrium and vestibulum, it was essentially different.

CA'VALIER. In Fortification, a sort of interior bastion, several feet more elevated than the principal bastion of the fortress in which it is formed. The use of the cavalier is twofold: it serves either to delade the works from the fire of an enemy on an adjacent height, or to command the trenches of the besiegers. Cavaliers are sometimes constructed in the gorges, or on the middle of the curtain, and their form is the semicircular; but when they are within the bastion they are now built with straight faces and flanks parallel to those of the work in which they are placed. French cavaliers are works raised by the besiegers on the glacis of a fortress, for the purpose of enabling them to direct a fire of musketry into the covered way.

CA'VALIER (derived probably from the Latin word caballus, *a pack-horse*), was used originally in a general sense for a horse soldier; but the term has acquired historical importance from its having been applied to the adherents of Charles I. in contradistinction to the *Roundheads* (quod vide), the supporters of the parliament.

CA'VALRY. (Fr.) A body of soldiers furnished with horses for war. This arm can boast of high antiquity, and is so peculiarly useful and necessary for a great variety of operations, that it has in all ages been held by the greatest generals in high estimation. The efficacy of cavalry arises principally from its adaptation to speedy movements, which enables a commander to avail himself immediately of a decisive moment when the enemy exposes a weak point, or when disorder appears in his ranks, for completing his defeat by disconcerting him by a sudden attack. It is singularly useful in protecting the wings and centre of an army, for furnishing detachments, for escorts, for forming blockades, for intercepting the supplies of the enemy, for foraging, for procuring intelligence, for covering a retreat, &c. The successful services which troops of this description have performed, and the number of decisive advantages which have been obtained by means of them in the most important battles of which history ancient and modern furnishes the details, prove incontestably the utility of this arm. The use of cavalry, however, is necessarily limited by the nature of the ground. Open and level countries are favourable to its operations; in forests, in

mountainous districts, on a marshy soil, &c. It is but of little avail. Among the Greeks and Romans, the cavalry was regarded as the most respectable class of troops, and its ranks were supplied especially from the *elite* of the nobility. In the middle ages a similar feeling seems to have prevailed; for, in the early French monarchy, and in the Anglo-Saxon kingdoms of Britain, the men of wealth and noble birth distinguished themselves in the field from those of inferior rank by being well armed and mounted on horses; and from the mode of warfare then practised, as well as from the peculiarities adopted in the organization of troops, cavalry constituted almost the only efficient arm of battle down to the introduction of standing armies.

The invention of gunpowder, and the subsequent employment of artillery in the field, deprived the heavy-armed cavalry of those times of all the advantages it possessed over the infantry, and rendered its movements awkward and inefficient. It was reserved, however, for Gustavus Adolphus to show the real utility of this arm by discovering the services on which it should properly be employed, and by stripping it of all unnecessary encumbrances to supersede by *rapidity of motion* the value it formerly possessed in *weight*. Since that time cavalry has often turned the scale of fortune in war: the battle of Rossbach, for instance, in 1757, one of the most brilliant victories either of ancient or modern times, was entirely decided by this arm.

Modern cavalry consists of two grand classes—*heavy* and *light* horse; which are again susceptible of further subdivisions, according to the purposes to which they are subservient. The British cavalry consists of two regiments of life guards, the royal regiment of horse guards, seven regiments of dragoon guards, and seventeen regiments of light dragoons, of which four are called hussars and four lancers. (For the history, use, accoutrements, and arms of these different branches, see the separate articles.) A regiment of cavalry is divided into four squadrons, and each of these into two troops. A troop consists of 80 men; and to each troop there is attached a captain, a lieutenant, and a cornet.

CAVATI'NA. (It. dimin. of cavata, *cut off*.) In Music, a species of air, generally short, and having neither a repeat nor second strain, often inserted in obligato recitatives. The sudden changes from recitative to a measured movement and the reverse are useful in producing expression.

CA'VEA. (Lat.) In Ancient Architecture, the subterranean cells in an amphitheatre wherein the wild beasts were confined in readiness for the fights of the arena. In the end, the amphitheatre itself, by synechdoche, was called cavea, in which sense it is employed by Ammianus Marcellinus: "Alter in amphitheatrali caveâ cum adfuturus spectaculis introiret." Lib. xxix. cap. 1.

CA'VEAT. In Law, a notice or caution given by a party interested to a judge or other officer, in order to stay proceedings by him; as, in the spiritual courts, a caveat is put in to stop the granting of probate or administration.

CAVE'TTO. (Lat. cavus, *hollow*.) In Architecture, a hollowed moulding, whose profile is a quadrant of a circle: it is principally used in cornices.

CA'VIA. The Linnæan generic name of a Cuvierian family of Rodents, including the guinea-pig,—*Agouti*, *Paca*, and *Capibara*.

CAVIA'RE. The salted roe of the sturgeon, much esteemed by the Russians as an article of food, and frequently brought as a delicacy to this country, it is an oily unwholesome article.

CA'VICORNS, *Cavicornia*. (Lat. cavus, *hollow*, and cornu, *horn*.) The name of the tribe of Ruminants comprehending those which have the horns hollowed out like a sheath and implanted on bony processes of the os frontis, as in the antelope.

CA'VITARIES, *Entozoa cavitaria*. (Lat. cavitas, *a hollow*.) Intestinal worms, or Entozoa, which have an intestinal canal floating in a distinct abdominal cavity.

CAY'MAN, or CAIMAN. A name, says Maregrave, applied to the crocodiles by the negroes of Congo. According to Bontius it was originally derived from an eastern dialect (*per totam Indiam cayman audit*). It appears, however, that Marcgrave is correct; for the negroes in the West Indies have been heard to call the crocodiles which they have seen there for the first time *caiman*, and the name has been diffused over the new continent by the negroes, and applied to most of the American species indiscriminately. It is restricted by Cuvier to the alligators. *See* ALLIGATOR.

CE'DRELA'CEÆ. (Cedrela, one of the genera.) A very important, though small, natural order of plants, allied to *Meliaceæ*, from which they differ in having winged indefinite seed. Most of the species are trees of large size. *Swietenia mahogani* yields mahogany, in the woods of the Spanish main; *Chloroxylon swietenia*, Indian satin-wood; while the yellow wood and the cedar of New Holland are the produce of others. In general their bark is powerfully astringent; that of *Soymida febrifuga* and mahogany itself is a potent febrifuge; that of *Cedrela toona* is a most valuable tonic in the Malayan archipelago; and *Khaya senegalensis* yields a similar remedy for the dangerous fevers of the Gold Coast.

CE'ILING. (Fr. ceil, *a canopy or covering*.) In Architecture, the upper horizontal or curved surface of an apartment opposite the floor, usually finished with plastered work. In executing ceiling the best mode is that in which the setting coat is composed of putty and plaster, technically called *gauge*. Common ceilings are executed with plaster without hair, the same as the finishing coat in walls left for paper.

CELASTRA'CEÆ. (Celastrus, one of the genera.) A natural order of shrubby Exogens, formerly confounded with *Rhamnaceæ*, but separated by Brown, chiefly because of the relation that the stamens bear to the petals and the different æstivation of the calyx. Allied, according to Brongniart, to *Malpighiaceæ*, through *Hippocrateæ*, a small order which scarcely differs from this order. *Celastraceæ* are natives of the warmer climates, especially of the tropics, and their general characters appear to be of a stimulating acrid nature: none of any popular interest.

CE'LERES. (Lat. celer, *swift*.) In Ancient History, the body of cavalry instituted by Romulus when he settled the constitution of Rome. They consisted of those among the citizens who were rich enough to furnish a horse. They are said to have been 300 in number, and to have been subdivided into three centuries, under the name of Ramnes, Titienses, and Luceres; but this seems to proceed on the false supposition that the three tribes known by these names were among the institutions of Romulus. The number of the centuries of the Celeres was raised to six by Tarquinius Priscus: this was the origin of the Equites or knights, who in after times formed a separate class of citizens.

CE'LIBACY. (Lat. cælebs, *unmarried*.) The legal condition of unmarried persons. This condition was subjected by the laws of the Roman emperors to a variety of penal consequences. The most remarkable of their enactments, and that on which the subsequent jurisprudence on this subject was in a great measure founded, was the *Lex Julia* or *Papia-Poppæa*, enacted under the authorization of Augustus. By these laws unmarried persons could receive nothing by will from strangers, and were subjected to many other legal disabilities (*see* LAW, ROMAN), from which, however, they were successively relieved by later laws passed in the decline of the empire, and especially after the mistaken zeal of the Christian divines of that age had invested celibacy with attributes of sanctity. It was at an early period in the history of the Christian church that ministers were exhorted to celibacy by those who laid claims to a higher degree of sanctity. At the Council of Nice, in A.D. 325, the proposition to enforce it as a general law was rejected. But at that of Arles, in 340, it was adopted; married persons being indeed held admissible into the church, but only on the terms of separating from their wives on ordination. It had become the common practice of the Latin church in the reign of Gregory the Great (end of the 6th century), and was more fully enforced, after a period of relaxation, in the 11th. It was proposed to the Council of Trent by Charles V. (in the interim), that married priests should retain their wives, but this was rejected. In the Greek church, celibacy was ordained for bishops at the council of Tralle, A.D. 695; but clergymen below the degree of episcopacy are allowed to marry. Hence the higher dignities of that church are necessarily filled by monks.

CELL. (Lat. cella.) In Ancient Architecture, the part of a temple within the walls, also called the *naos*. The part of the temple in front of the cell was called the *pronaos*, and that in the rear the *posticum*.

CE'LLAR. (Fr. cellier.) In Architecture, the lower story of a building, when wholly or partly under the level of the ground.

CE'LLEPORES, CELLEPORÆ. (Lat. cella, *a cell*; porus, *a pore*.) A genus of flexible cellular Polyps, including those in which each of the cells is pierced with a minute pore.

CE'LLULAR TISSUE. A substance consisting of little bladders or vesicles of various figures adhering together in masses. It constitutes the principal part of all plants, and may be regarded as an organic basis, into which other kinds of tissue are introduced, or from which they are created. It exists exclusively in the embryo of a plant until vitality has been excited, and new forms of tissue developed in consequence. *See* BOTANY.

CEME'NT. (Lat. cementum.) In Architecture, the medium for causing the adherence of stones or bricks to each other, formed of lime, sand, and water. The best cement is obtained from limestone, in preference to chalk; and the sand best adapted to the formation of it is that of a river, called drift sand.

CEME'NT. In Anatomy, the substance which joins together the plates of compound teeth, like those of the elephant, and which fills up the folds and cavities in the teeth of Ruminants and Pachyderms; and which also covers all that part of a simple tooth which is not coated

with enamel. The cement is characterized, like true bone, by the presence of the Purkinjian corpuscles.

CEMENT, PARKER'S. *See* SEPTARIA.

CEMENTA'TION. When a solid body is surrounded by the powder of other substances, and the whole heated to redness, the process is termed *cementation*. Iron is said to be converted into steel by cementation with charcoal.

CE'METERY. (Gr. κειμαι, *I lie dead.*) In Architecture, an edifice or area where the dead are interred. The most celebrated public cemeteries of Europe are those of Naples, one near Bologna, of Pisa, and the more modern Parisian one of Pere la Chaise. That of Pisa is particularly distinguished by the beauty of its form and architecture, which is early Italian Gothic. It is 490 feet long, 170 feet wide, and 60 feet high, cloistered round the four sides, and contains 50 ship-loads of earth, which the Pisans brought from Jerusalem. It was long matter of complaint and regret that England possessed no public cemeteries; and in the year 1832 a company was formed in London with the view of supplying this desideratum. The land selected for the first experiment contains in extent about 50 acres, and is situated at Kensal Green on the south of the Harrow road. This receptacle for the dead is denominated "All Souls Cemetery," and whether we regard the good taste or the public spirit displayed by its projectors, it is well entitled to the support of the community. (See the *British Cyclopædia*.) Since that time various cemeteries have been designed and formed in different parts of the country; and there is every ground to believe that, independently of other advantages, the benefits which cannot fail to accrue to the health of large towns, particularly, from schemes of this nature will ultimately lead to their general adoption. In the *Companion to the British Almanac* for 1839, there is an excellent description of the *Norwood* and *Highgate* cemeteries, and some of the previous numbers of the same publication contain an account of all similar works in England then in progress or completed

CE'NOBIO. A term invented by Mirbel to denote a regular fruit, divided from the base into several acephalous pericarpia; that is to say, pericarpia not marked on the summit by the stigmatic scar, the style having been inserted at their base, as in *Labiatæ*, *Boraginaceæ*.

CE'NOTAPH (Gr κενος, *empty*, and ταφος, *a sepulchre.*) In Architecture, a monument erected to the memory of a person who lies interred elsewhere

CE'NSOR In Ancient History, the title of two Roman magistrates originally created for the purpose of taking the census, or register of the number and property of citizens. But their powers were much increased subsequently, when they had the inspection of the morals of the citizens committed to them, with authority to degrade senators and knights from their respective orders, and remove other citizens from their tribes, depriving them of all their privileges except liberty; which was termed making them Ærarians. They had also the power of making contracts for public buildings and the supply of victims for sacrifices.

The office of censor was not a permanent one, but was renewed from time to time, as its functions were felt to be needed in the state It was always filled by consulars of the highest merit, and was esteemed an honour even greater than that of the consulate itself no person might be twice invested with it; and if one of the censors died, another was not substituted in his room, but his surviving colleague was obliged to resign. The office of censor was abolished under the emperors, who, however, exercised the greater part of its functions. It was attempted to be revived in the person of Valerian by Decius, but he was cut off before he could accomplish his purpose.

CE'NSUS. In Ancient History, a population return of the Roman citizens, including a valuation of each man's property, and a registration of his tribe, family, children, and servants.

The secondary senses of the word are, a tax levied according to the above-mentioned valuation; and the amount of any individual's property. A senator's census was the amount of property necessary for a member of the senate, which was equal to between 6000*l.* and 7000*l* of our money; but this was raised by Augustus to about 10,000*l.* A knight's census was something more than 3000*l.*

The term census, in modern political phraseology, signifies an enumeration of the inhabitants of a country, such as has taken place in England by act of parliament in 1801, 1811, 1821, 1831.

CE'NTAURS. In Greek Mythology, a fabulous race of beings, half man and half horse, who are said to have inhabited part of Thessaly, and waged constant war with the hostile tribe of Lapithæ.

CENTAU'RUS, the CENTAUR. One of the forty-eight ancient constellations formed by Ptolemy, situated in the southern hemisphere, and under the tail of Hydra. The Centaur is represented as half man, half horse; the human part only of the figure is visible above our horizon.

CE'NTERING. (Lat. centrum.) In Architecture, the temporary woodwork or framing on which any vaulted work is constructed; sometimes called also a centre.

CE'NTIGRADE DIVI'SION. The division into *grades* or degrees by hundredth parts. A unit of any denomination being divided into a 100 equal parts, forms a centigrade scale; but the term most frequently occurs in scientific works, in reference to the French division of the scale of the thermometer. The fixed points of the thermometric scale are the points at which water freezes on the one hand, and boils on the other; the distance between these two points being divided into a 100 degrees, the centigrade scale is formed. In Fahrenheit's scale, which is usually applied to the thermometer in this country, the same distance is divided into 180 degrees; a degree of the centigrade scale is therefore greater than a degree of Fahrenheit in the proportion of 180 to 100, or of 9 to 5. Any number of degrees, therefore, on the centigrade scale, being multiplied by 9 and divided by 5, will give the equivalent number of degrees of Fahrenheit. But in comparing temperatures expressed by the two scales, it is necessary to recollect that the zero of Fahrenheit's scale is not placed at the freezing point, but 32° below it. An example will best show how this is to be taken into account. Let it be required to express on Fahrenheit's scale the temperature corresponding to 10° centigrade. Here $10 \times 9 \div 5 = 18$; to this add 32, and we have $18 + 32 = 50$; so that 10 degrees of the centigrade scale correspond to 50 degrees of Fahrenheit's.

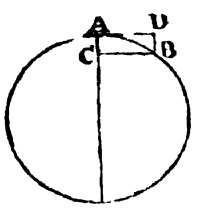
CE'NTIPEDE. (Lat. centum, *a hundred*, and pes, *foot.*) The name of the Myriapodous insects belonging to the genus *Scolopendra* of Linnæus. They are wingless; and the largest species possess, when full grown, more than fifty and less than two hundred pairs of feet.

CE'NTO. (Gr. κεντρων, *a patchwork cloak or garment.*) A word employed to designate a collection of separate verses from the works of one or more poets, arranged so as to form a distinct poem. The only classical example of a cento left to us is that of Ausonius, who composed a nuptial idyll out of Virgilian verses; in which, however, the words are also perverted into a new meaning. In his prologue to this piece Ausonius describes the cento, and gives rules for its composition.

CE'NTRAL FORCE. The power or energy in virtue of which bodies in motion tend to approach, or recede from, a centre. Hence central forces are of two kinds; *centrifugal* (Lat. fugere, *to avoid*), when the moving body tends to recede from the centre; and *centripetal* (Lat. petere, *to seek*), when the body tends to approach it.

It is a general law of matter, that all bodies tend to move in a straight line; consequently, when a body moves in a curve, there must necessarily be some force which acts upon it, and deflects it from the rectilinear direction, and constrains it to move in the curve; and if this force were removed, or its action suspended, the body would immediately fly off in a straight line, forming a tangent to the curve at the point in which it was moving when the force ceased to act A stone whirled rapidly round the hand in a sling affords a familiar illustration. The effort with which it tends to fly off is the centrifugal force, the reaction of the hand, communicated through the string, may be regarded as a centripetal force, which confines the stone to its circular path. When the string is let slip, the centrifugal force is not counteracted, and the stone flies off in the direction of the tangent.

The laws of central forces, of the greatest importance in the theory of the planetary revolutions, were first proposed by Huygens, in his celebrated work, entitled *Horologium Oscillatorium*. The case which it is most important to analyse is that of a body moving in the circumference of a circle with a uniform velocity. To find an expression for the centrifugal force of a body revolving uniformly in a circle, let $r$ = the radius of the circle, $v$ = the velocity of the body, and let A B be the arc described in the infinitely small time $t$; we have then (the space described being as the velocity and the time of description) $AB = vt$. But A B being by hypothesis a very small arc, may be considered as equal to its chord, which is a mean proportional between the diameter $2r$, and the versed sine A C. Hence, $AC \cdot 2r = AB^2 = v^2 t^2$, and consequently $AC = \frac{v^2 t^2}{2r}$. Now A C is the effect




produced by the central force, or rather the accelerating force exerted in the direction of the centre (that which prevents the body at A from flying off in the direction of the tangent A D), in the time $t$; and the accelerating force being measured by the quotient which is obtained by dividing twice the space described by the square of the time (*see* DYNAMICS, FORCE), the accelerating force in the direction of the centre becomes $\frac{2AC}{t^2}$. Calling this central force $f$, and substituting for A C its value, we find $f = \frac{v^2}{r}$; that is to say, the central force of a body describing a circle with a uniform velocity is directly

proportional to the square of the velocity, and inversely as the radius of the circle.

This expression may be put under a different form. Let $t$ = the time required to describe the whole circumference $2\pi r$, and we have $2\pi r = vt$; whence $v = \frac{2\pi r}{t}$ and consequently $f = \frac{4\pi^2}{t^2} r$; whence the central force is directly as the radius of the orbit, and inversely as the square of the periodic time.

If the law of the force be such that its intensity is reciprocally proportional to the square of the distance from the centre, then the squares of the periodic times of two bodies describing different circles about the same centre are proportional to the cubes of the distances For let F and $f$ be the two forces, V and $v$ the velocities of the two bodies, R and $r$ the radii of their circles, and T and $t$ the times respectively; then, by what has been already shown,

$$F = \frac{V^2}{R}, f = \frac{v^2}{r};$$

but by hypothesis, $F : f :: r^2 : R^2$;

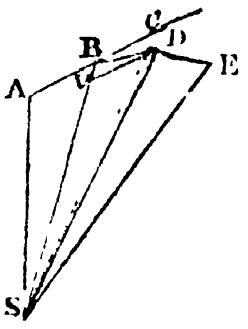
therefore, $\frac{V^2}{R} : \frac{v^2}{r} :: r^2 : R^2$;

but $V^2 : v^2 :: \frac{R^2}{T^2} : \frac{r^2}{t^2}$

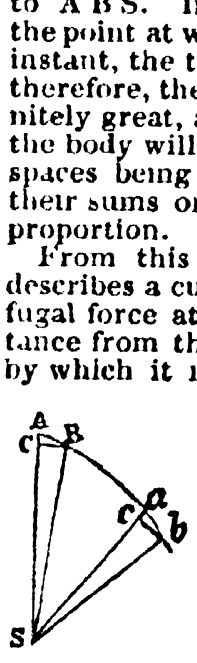
therefore, $T^2 : t^2 :: R^3 : r^3$;

or the squares of the times are as the cubes of the radii. This remarkable property was discovered by Kepler to belong to the planetary orbits. *See* KEPLER'S LAWS.

When a point is urged by one accelerating force only, constantly directed towards a fixed point, the path will be a plane curve, and the areas described around this point by the radius vector are proportional to the times employed in describing them. Suppose the time to be divided into equal portions, and that in the first portion of time the body, in virtue of the projectile force impressed on it, describes the line A B. If no other force acted upon it, in the second portion of time it would describe B C = A B; therefore, on drawing the radii A S, B S, C S, to the centre of force, the triangles A S B and B S C would be equal. But suppose the central force acting on the body while it would move from B to C to act instantaneously at B, so as to cause the body to descend through B V; draw V D parallel and equal to B C, and join B D, then at the end of the second portion of time the body will be at D. Now as the central force acts in the direction B V in the plane of A S B, the body must continue to move in that plane; and on joining C D and S D, the triangle B D S, on account of the parallel lines, is equal to B C S, and therefore equal to A B S. In like manner it may be proved that if E be the point at which the body arrives at the end of the third instant, the triangle D E S is equal to A B S. Suppose, therefore, the number of the triangles to become infinitely great, and their areas infinitely small, the path of the body will become a curve line, and the elementary spaces being proportional to the elements of the time, their sums or integrals must continue to have the same proportion. (*Newton's Principia*, Sect. II)




From this proposition it follows, that when a body describes a curve in virtue of a central force, the centrifugal force at every point varies as the cube of the distance from the centre, whatever the nature of the force by which it is attracted to the centre may be. For let A B and $ab$ be the two arcs described at different points of the curve in the infinitely small time $t$, then, by the proposition just demonstrated, A S B = $a$ S $b$. But make B C and $bc$ respectively perpendicular to S A and S $a$, then A S B = $\frac{1}{2}$ A S × B C, and $a$ S $b$ = $\frac{1}{2}$ $a$ S × $bc$; hence A S × B C = $a$ S × $bc$, and B C$^2$ : $bc^2$ :: $a$ S$^2$ : A S$^2$. Now B C$^2$ = 2 A S × A C (the square of A C being neglected as infinitely small), and $bc^2$ = 2 $a$ S × $ac$, therefore, A S × A C : $a$ S × $ac$ :: $a$ S$^2$ : A S$^2$, and consequently




$$AC : ac :: \frac{1}{AS^3} : \frac{1}{a\,S^3}$$

But A C is the measure of the centrifugal force at A, and $ac$ is its measure at $a$; therefore, denoting the distances at these points by R and $r$, we have the centrifugal force at A to the centrifugal force at $a$, as $\frac{1}{R^3} : \frac{1}{r^3}$. Hence we may perceive the reason why a body in moving round a centre of force may alternately approach to, and recede from, that centre, as the planets in describing elliptic orbits about the sun. Suppose the attractive force, like gravity, to vary inversely as the square of the distance





from the attracting point: if the planet approached 10 times nearer to the sun, the attractive force would be augmented 100 times; but the centrifugal force would become 1000 times greater, and consequently there must be some point at which this force will overcome the former, and determine the planet again to recede.

The doctrine of central forces has its principal application in astronomy. By the comparison of a great number of planetary observations, Kepler discovered that each of the planets, while its distance from the sun is variable, moves in such a manner that a straight line drawn from it to the sun describes equal areas in equal times. But this is the law by which bodies move under the influence of a central force (as is demonstrated above). It follows, therefore, that the force by which the planets describe their orbits is a central force, and directed to a point within the orbit. Newton demonstrated that the velocities of a body at different points of the curve which it describes about a centre of force, are inversely as the perpendiculars drawn from the centre to the tangents at these points. The comparison of this proposition with the elliptic motion of the planets leads directly to the conclusion that the forces by which the planetary motions are sustained are directed to the centre of the sun, and vary inversely as the squares of the distances of the planets from that body.

Mathematicians have investigated the orbits which bodies must describe under various hypotheses respecting the law of the central force, and they have found that there are only two cases in which a system of bodies like the sun and planets, mutually attracting each other, could permanently exist. One of these is an imaginary case, in which the force varies directly as the distance of the body; the other is the case presented by nature, in which the force follows the inverse ratio of the square of the distance. In all other cases the mutual action of the bodies would produce permanent derangements, which at length would of necessity subvert the system

When the force varies inversely as the square of the distance, the orbit which is described about a fixed centre must necessarily be one of the three conic sections; but it will depend upon the velocity with which it is at first projected whether the orbit be an ellipse, a parabola, or an hyperbola If the central force were supposed to vary as the inverse cube of the distance, a body would describe a circle in one particular case, namely, when the velocity of projection is equal to that which would be acquired by falling from an infinite distance, and then applied in a direction at right angles to the radius vector. In all other cases it would describe a spiral If the central force diminishes more rapidly than the inverse cube of the distance, the orbit would in all cases describe a spiral, so that if the solar force acted according to a law of this sort, every planet would at length either fall into the sun, or fly off to an infinite distance. (*Principia*, Book I. See also *Herschel's Astronomy*, *Cab Encyc*)

CE'NTRE (Lat centrum.) This term has numerous applications in Geometry and Mechanics: thus, *centre* of a *circle*, or of an *ellipse*, is the middle point of any diameter; *centre* of a *curve* is the point where two diameters intersect each other, and in mechanics we speak of centres of attraction, conversion, equilibrium, gravity, percussion, oscillation, &c

CE'NTRE OF ATTRACTION, also called *Centre of Gravitation*, is the point to which bodies tend in consequence of the action of gravity.

CE'NTRE OF CONVERSION is the point in a body about which it turns when a force is applied to any part of it, or unequal forces to its different parts. For example, suppose a rod laid on a table to be struck near one extremity in a direction perpendicular to its length; the rod will turn round, but there will be one point in it which remains at rest, or about which, as a centre, the other points turn. This point is the *centre of conversion*.

CE'NTRE OF EQUILIBRIUM of a system of bodies is a point such that if the system were suspended from it, the whole would remain in equilibrium. Thus, the fulcrum or point of support of a lever is its centre of equilibrium.

CE'NTRE OF GRAVITY. A term employed in Mechanics to denote a certain point in the interior of a body, or system of bodies connected with each other in an invariable manner, so situated that any plane whatever which passes through it divides the body into two segments of which the weights are exactly equal. Hence, if the centre of gravity of any body or system of bodies be sustained, the whole will remain at rest; for the weights on both sides of a vertical plane passing through the point of support being equal, the body can have no tendency to angular motion.

Let there be a system of bodies A, B, C, D, E, placed horizontally in the same straight line,

S A B O C D E

and connected with each other in an invariable manner; and suppose O to be the centre of gravity of the system:

by the definition of the centre of gravity, if the system is supported at O, the weights on both sides of O, or the effort which the bodies make to turn about that point on opposite sides of O, will exactly counterbalance each other, and the whole will remain at rest. But the effect of A in turning the system about O depends on the quantity of matter in A, and its distance from O, or the length of the arm of the lever at the extremity of which it acts. The whole effect of the body A is therefore proportional to the mass of A multiplied into the length of the line O A. The same reasoning obviously applies to each of the other bodies, B, C, D, and E; consequently, taking these letters to represent the masses of the bodies respectively, we have, by the definition,

$$A \cdot O\,A + B \cdot O\,B = C \cdot O\,C + D \cdot O\,D + E \cdot O\,E.$$

Now suppose it were required to determine from this property the position of the centre of gravity of the united bodies, or its distance from a given point S in the same straight line: on making $S\,A = a$, $S\,B = b$, $S\,C = c$, $S\,D = d$, $S\,E = e$, and the unknown distance $S\,O = x$, we shall have $O\,A = x - a$, $O\,B = x - b$, $O\,C = c - x$, $O\,D = d - x$, and $O\,E = e - x$. Therefore by substitution,

$$A\,(x-a) + B\,(x-b) = C\,(c-x) + D\,(d-x) + E\,(e-x);$$

and by transposition,

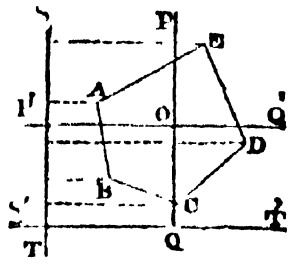
$$(A + B + C + D + E)\,x = a\,A + b\,B + c\,C + d\,D + e\,E;$$

whence $$x = \frac{a\,A + b\,B + c\,C + d\,D + e\,E}{A + B + C + D + E};$$

that is to say, the distance of the centre of gravity of the given system from a given point is equal to the sum of the products of all the masses into their distances from the point divided by the sum of the masses.

It is obvious, from the equation now given, that the effect of all the bodies to produce motion about the point S, is the same as if they were all united in their common centre of gravity O. It is also obvious that the form of the equation will be exactly the same, whatever may be the number of bodies belonging to the system, and as every body may be regarded as composed of elementary particles, the reasoning which applies to a system of particles, connected with one another in an invariable manner, also applies to solid bodies of any kind

The bodies composing the system have been supposed to be arranged in a straight line; but the centre of gravity will be found precisely in the same manner, whatever their relative situations may be. Suppose them to be situated all in the same plane, and that their centre of gravity is O, the position of which it is required to find. Let P Q be any straight line, in the same plane with the bodies, passing through O; then in order that there may be no tendency to motion about the line P Q, the sum of the products of all the bodies on one side of P Q into their respective distances from that line must be equal to the sum of the products of all the bodies on the other side of P Q into their respective distances. If, therefore, S T be a straight line parallel to P Q, and if the distances of A, B, C, &c. from S T, be denoted respectively by $a$, $b$, $c$, &c., and the distance of O from the same line by $x$, then we shall have as before,




$$x = \frac{a\,A + b\,B + c\,C + \&c.}{A + B + C + \&c.}.$$

This does not yet give us the centre of gravity; but it gives its distance from a given straight line S T, and consequently gives the position of the straight line P Q, in which the centre of gravity is situated. If then we draw another line S′ T′, and denote its distances from A, B, C, &c., by $a'$, $b'$, $c'$, &c., respectively, and put $x'$ equal to its distance O Q from O, we shall have

$$x' = \frac{a'\,A + b'\,B + c'\,C + \&c.}{A + B + C + \&c.};$$

and consequently the position of another straight line P″ Q′ passing through the centre of gravity, and parallel to S′ T′. Therefore, the centre of gravity is given by the intersection of the two straight lines P Q and P″ Q′.

Lastly, suppose the bodies composing the system not to be situated all in the same plane. In this case, the situation of each of the given bodies must be referred to three planes given in position; and it is most convenient to assume three planes which intersect each other at right angles; one of them horizontal, and consequently the other two vertical. Let the distances of the given bodies A, B, C, &c. from the given horizontal plane be respectively $a$, $b$, $c$, &c.; their distances from one of the vertical planes $a'$, $b'$, $c'$, &c.; and from the other, $a''$, $b''$, $c''$, &c.; then, if we take

$$x = \frac{a\,A + b\,B + c\,C + \&c.}{A + B + C + \&c.},$$

the centre of gravity is in a horizontal plane, at the distance $x$ from the given horizontal plane.





Take also $x' = \frac{a'\,A + b'\,B + c'\,C + \&c.}{A + B + C + \&c.}$, and the centre of gravity is in a plane parallel to the first of the two given vertical planes, and distant from it by the line $x'$.

In the intersection of these two planes, take a point distant from the second vertical plane by a quantity $x'' = \frac{a''\,A + b''\,B + c''\,C + \&c.}{A + B + C + \&c.}$: this point will be the centre of gravity of the given bodies.

In the notation of the differential calculus, these formulas are expressed as follows: — Let $dm$ be the element of the mass, the co-ordinates of which, referred to three rectangular planes, are $x$, $y$, $z$; and let the distances of the centre of gravity of the mass from the same planes be respectively X, Y, Z; then the position of that centre is determined by the three equations;

$$X = \int \frac{x\,dm}{m},\quad Y = \int \frac{y\,dm}{m},\quad Z = \int \frac{z\,dm}{m}$$

The determination of the centre of gravity of solids in general requires the application of the integral calculus, and is sometimes effected with considerable labour, there are, however, many particular cases in which it is known immediately, and requires no calculation. Thus, the centre of gravity of a sphere or ellipsoid is evidently at the centre of the figure; that of a parallelopiped is at the common intersection of its four diagonals; that of a cylinder with parallel ends at the middle of its axis. The centre of gravity of a circle or ellipse is also at the centre of the figure; and that of a parallelogram at the intersection of its diagonals. The centre of gravity of a straight line is at the middle of the line, whence we easily find that of the perimeter of any polygon. "When the body can be divided into two parts, their common centre of gravity may be found by dividing the distance between the centres of gravity of the two parts in the reciprocal proportion of their weights. This principle may be extended to bodies which are more complex. Thus the centre of gravity of two portions being determined they may be conceived to be united in that point, and connected with a third portion, and the centre of the three portions found. All these again may be supposed collected in this last point, and made to balance against a fourth portion, and their common centre of gravity computed. In this way the process may by successive steps be carried to any extent, and whatever order is followed the result will be always the same." (*Leslie's Elements of Nat Phil.*)

The centre of gravity of a triangle is in the straight line drawn from any one of its angles to bisect the opposite side, and at the distance of two thirds of the whole line from the vertex. The centre of gravity of a pyramid is in the straight line drawn from the vertex to the centre of gravity of the base, and at three fourths of the distance of this line from the vertex. The centre of gravity of a hemisphere is in the diameter, and at the distance of five eighths of the radius from the summit

The centre of gravity of irregular bodies may be found mechanically in various ways. If the body be poised in two different positions on a sharp edge, the vertical drawn from the point of intersection will pass through the centre of gravity. Or if a loose thread or string have its ends fastened to two distinct points of the body, and the body be thus suspended in two different positions from a fixed point, the verticals let fall from this will cross in the centre of gravity.

It is a remarkable property of the centre of gravity, that if a plane figure be generated by the revolution of a given line, or a solid by the revolution of a given plane figure, the area in the first case, or the volume in the second, is equal to the product of the generating quantity into the length of the line described by its centre of gravity. This property, which is frequently of use in determining the quadrature of curves and the cubature of solids, is called *Guldin's theorem;* though it is found in the *Collections of Pappus.*

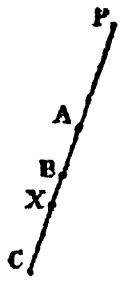
Another elegant geometrical property of the centre of gravity is, that in any given plane the sum of the squares of the distances of any number of physical points from their common centre of gravity, is less than the sum of the squares of their distances from any point in the circumference of a circle described about that centre, by the square of the radius multiplied by the number of those points. Hence it follows that the sum of the squares of the distances of any number of points from their common centre of gravity is always a *minimum.*

For a complete explanation of the method of applying the calculus to the determination of the centre of gravity of bodies, we refer to the *Traité de Mécanique* of Poisson, tom i. The subject necessarily occupies a part of every work on statics.

CE'NTRE OF GYRATION of a body, or system of bodies, is a point in which if the whole mass were collected, a force applied at any distance from the axis of suspension would communicate to the mass thus collected the same

angular velocity that it would have communicated to the system in its first condition.

It is evident from the definition that the point in question must have this property, that if the whole mass were united in it, the moment of inertia, or the power of resisting the effort of any force, will be the same as the moment of inertia of the body in its first state. Let, therefore, A, B, and C be a system of bodies, connected in an invariable manner, and turning about an axis P. Let $a$, $b$, and $c$ be the respective distances of A, B, and C from P; and conceive X to be another body placed at a distance $x$ from the axis, such that its moment of inertia is equal to the moment of inertia of A. Then, by the principles of mechanics, the moment of inertia of A is $A \cdot a^2$, and that of X is $X \cdot x^2$; therefore, by hypothesis, $X \cdot x^2 = A\, a^2$. In like manner, conceive another body Y to be placed at the distance $x$ from the axis, such that its moment of inertia is equal to that of B, or such that $Y \cdot x^2 = B \cdot b^2$; and let a third body Z be placed at the same point, such that $Z\, x^2 = C\, c^2$. Taking the sums of these equals we have $(X + Y + Z)\, x^2 = A\, a^2 + B \cdot b^2 + C \cdot c^2$. Now in this equation we are at liberty to give either to $X + Y + Z$ or to $x$ any value we please. Let us then suppose $X + Y + Z = A + B + C$ (which is evidently the same as supposing all the matter in the system united at the point whose distance is $x$), and we shall have

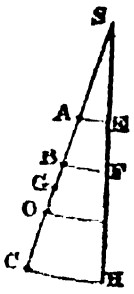



$$x = \left( \frac{A\, a^2 + B \cdot b^2 + C \cdot c^2}{A + B + C} \right)^{\frac{1}{2}}$$

to express the distance of the centre of gyration from the axis.

Centre of Oscillation is that point in a body, oscillating about a fixed axis, into which if the whole mass were collected, the body would vibrate through a given angle by the force of gravity in the same time as in its first condition.

In order to find the point having this property, conceive the weights A, B, and C fixed to a slender inflexible rod, vibrating about the point S, the centre of oscillation being at O. In every position of the system, the tangents to the arcs which the bodies respectively describe make equal angles with the horizon, consequently the bodies are all urged by the same proportion of the total force of gravity. But if the bodies had not been connected with each other, their descent through similar arcs, A E, B F, C H, in the same interval of time, would require the accelerating forces to be proportional to those arcs, or to S A, S B, S C. Let S O, therefore, represent the accelerating force at O; then A O and B O will denote the excess of the force by which A and B are respectively accelerated, and C O the excess of the force by which C is retarded. But the effects of these forces on the motion of the system must be proportional to the weights of the bodies; and by the principles of the lever, they must also be proportional to the respective distances of the bodies from the point of suspension. They are consequently represented by $A \cdot S A - A O$, $B \cdot S B - B O$, and $C \cdot S C - C O$. But the accelerating action at the centre O must necessarily be equal to that of retardation; consequently $A \cdot S A - A O + B \cdot S B - B O = C \cdot S C - C O$. Now let $S A = a$, $S B = b$, $S C = c$, and $S O = f$, and the equation becomes by substitution $A \cdot a\,(f - a) + B\, b\,(f - b) = C \cdot c\,(c - f)$, or $(A \cdot a + B \cdot b + C \cdot c)\, f = A \cdot a^2 + B \cdot b^2 + C \cdot c^2$; whence




$$f = \frac{A \cdot a^2 + B \cdot b^2 + C \cdot c^2}{A \cdot a + B \cdot b + C \cdot c};$$

that is to say, the distance of the centre of oscillation from the point of suspension, or the length of the simple pendulum which vibrates in the same time with the compound body, is found by taking the sum of the products of the weights into the squares of their distances from the axis of the pendulum, and dividing this sum by the sum of the products of the weights into their distances simply.

Though the system has here been supposed to be formed of separate bodies, the principle is universal, and applies to bodies of any form. Let $d\,m$ represent an element of the body, and $x$ its distances from the point of suspension, then $f = \frac{\int x^2\, d\,m}{\int x\ \ d\,m}$.

It may be remarked, that the denominator $A \cdot a + B \cdot b + C \cdot c$ is equal to $(A + B + C) \cdot S G$, the point G being the centre of gravity of the bodies. Now if we denote the distances of A, B, and C from the centre of gravity G by $\alpha$, $\beta$, $\gamma$ respectively, and make $S G = h$, we shall have $a = h - \alpha$, $b = h - \beta$, and $c = h + \gamma$; whence by involution and substituting in the numerator, and observing that $A\,\alpha + B\,\beta - C\,\gamma = 0$, we shall find $A \cdot a^2 + B \cdot b^2 + C \cdot c^2 = h^2 (A + B + C) + A \cdot \alpha^2 + B \cdot \beta^2 + C \cdot \gamma^2$; therefore, since $O G = S O - S G = f - h$,





$$O G = \frac{A \cdot \alpha^2 + B \cdot \beta^2 + C \cdot \gamma^2}{(A + B + C)\, S G},$$

an equation which gives the distance of the centre of oscillation from the centre of gravity.

This last equation indicates a very remarkable property of the centre of oscillation. As the two quantities O G and S G may change places without disturbing the equality, it follows that the centre of oscillation and the point of suspension are interchangeable; in other words, if the system were suspended from O, it would vibrate exactly in the same time as when suspended from S. This property was noticed by Huygens, and was first practically applied to the purpose of finding the length of the seconds' pendulum by Captain Kater. The application is made as follows: — Let a bar of iron, for example, about four feet long, be suspended from a point A, at the distance of four or five inches from one of its extremities, and observe the number of vibrations it makes in a given time. Then suspend it from another point B, near its other extremity, and let the point of suspension B be moved backwards or forwards till it makes exactly the same number of vibrations in a given time as when suspended from A. Then the distance between A and B is the length of the isochronous simple pendulum.

On comparing the three expressions for the centre of gravity, the centre of gyration, and the centre of oscillation, it will be seen that the distance of the centre of gyration from the axis is a mean proportional between the distances of the centres of gravity and oscillation.

The method of determining the centre of oscillation of compound pendulums was first given by Huygens in his celebrated work *Horologium Oscillatorium*. His demonstration, however, was founded on an indirect principle, which was rather assumed than proved. It consists in this, that if several weights attached in any manner to an inflexible rod or pendulum descend by the action of gravity, and if at any instant they were detached or disengaged from each other, each of them, in virtue of the velocity it had acquired during its descent, would mount to such a height that the common centre of gravity of all of them would reach exactly the same height as that from which it descended. The first direct demonstration on the principle of the lever was given by James Bernoulli, in the *Memoirs of the Academy of Sciences of Paris* for 1703. An interesting history of this problem may be found in the first volume of *Lagrange's Mécanique Analytique*.

Centre of Percussion. The point in a solid body, or system of bodies, into which, if the whole matter were supposed to be collected, the effect produced by striking against another body would be the greatest possible; or it may be defined to be the point in the axis of a moving body at which, if stopped by an immoveable obstacle, the body would rest in equilibrio, without inclining to either side, or acting on the centre of suspension.

When the percutient body revolves about a fixed axis, the centre of percussion is at the same point with the centre of oscillation, but when it moves with a parallel motion, the centre of percussion is the same as the centre of gravity.

Centre of Pressure, of a fluid against a surface, is that point at which if a force were applied equal to the pressure, and acting in an opposite direction, the surface would remain at rest.

Centre of Rotation. The point about which a body circulates. It is the same as the centre of motion.

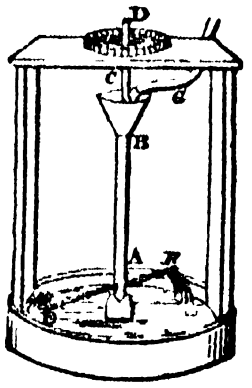
Centre of Spontaneous Rotation. The name first applied by John Bernoulli to the point about which a body, all whose parts are at liberty to move, and which has been struck in a direction not passing through the centre of gravity, begins to turn.

CENTRI'FUGAL (Lat. centrum, and fugio, *I retreat.*) A term employed in describing the inflorescence of plants, when, in a head of flowers, the central one opens first, and those of the circumference last. It is also used by carpologists in describing seeds when the apex of an embryo is turned away from the centre of a fruit.

CENTRI'FUGAL FORCE. The force by which a body in rotation tends to recede from the centre of motion: Centripetal Force, that by which a body in motion is urged towards a centre, and compelled to describe a curve instead of a straight line. *See* Central Force.

CENTRI'FUGAL MACHI'NE. A machine moved by the centrifugal force of water; frequently called, from its inventor, *Barker's Mill*. It consists of a hollow metal cylinder or pipe of metal placed upright, and resting on a pointed steel pivot at A. The pipe is widened or extended into a funnel shape at the top B, and is kept in its position by a vertical steel axis C D, passing through a frame at the top. Towards the lower extremity, two or more small pipes A E, A F, with closed external ends, are inserted at right angles to the axis. In the side of

each of these an orifice is made as near as possible to the end, and on opposite sides, so that water from them may spout horizontally in opposite directions. Water is conveyed into the funnel at the top, through the pipe G, in such quantities that the tube is kept constantly full, while the discharge is going on at the orifice near the extremities of the horizontal pipes In this state of things the resistance or reaction generated by the water issuing from the side holes is such as to throw the vertical pipe, with its arms and axis, into rapid rotatory motion; and this axis may communicate its motion or power to wheelwork or machinery, or to a mill-stone connected with its upper end (See *Library of Useful Knowledge*, "Treatise on Hydraulics;" also *Ferguson's Lectures*, by Brewster; or *Lardner's Cabinet Cyclopedia*, "Hydrostatics and Pneumatics") A machine of the same construction, but having the arms at the upper end, and turned rapidly by means of a wheel and pinion, was invented by a Mr. Erskine for raising water. Centrifugal Machine is also used synonymously with *Whirling Machine*.




CE'NTRING *See* CENTERING.

CENTRI'PETAL. (Lat centrum, and peto, *I seek*) A term employed in describing the inflorescence of plants, when, in the unfolding of a head of flowers, those at the circumference open first, and those in the centre last It is also used by carpologists in describing seeds when the apex of an embryo is directed towards the centre of a fruit.

CENTRI'SCUS (Gr. κεντρις, *a spine.*) A genus of Acanthopterygious fishes, having the foremost dorsal placed far backwards, and with its first spine remarkable for its length and strength, the mouth is slender and elongated, whence they have obtained the name of "sea-snipes."

CE'NTRUM. (Gr κεντρον, *centre*) A term applied by Fries technically to designate the typical division of the groups of species and genera, in his circular arrangement of *Fungi* Many generic names are compounded, having this word for their root, as *Centrogaster*, *Centrolophus*, *Centropristis*, and *Centronotus*, all genera of spiny-finned fishes, *Centropus*, a genus of birds, allied to the Cuckoos &c

CENTU'MVIRI. In Ancient History, Roman judges chosen three from each of the thirty-five tribes, so that properly there were 105, but they were called *centumviri*, or the hundred, from the round number The principal causes that came under them were those concerning testaments and inheritances. In the time of Augustus they formed the council of the prætor, but afterwards their number was increased to 180, and they were divided into four councils, which, however, were sometimes combined into two courts, or even into one Ten persons (*decemviri*) were appointed, five senators and five equites, to assemble these councils and preside in them in the absence of the prætor.

CE'NTURIES (Lat. centuriæ) In Ancient History, the divisions in which the Roman people voted at the Comitia Centuriata. They were instituted by Servius Tullius for the purpose of throwing political power into the hands of the plebeians The patricians were represented by six centuries of knights, and twelve centuries of knights were added to these from the plebeians. The rest of the plebeians and clients were divided into five classes, according to the amount of their property, the lower limits of each being respectively 100,000, 75,000, 50 000, 25,000, 12,500 asses The first of these classes was subdivided into eighty centuries, the next three into twenty each, and the last into thirty The centuries of each class were again separated into two equal numbers of old and young By this distribution the preponderance was given to property, though the rich classes were of course outnumbered by the poorer. Besides these centuries there were divisions in other bodies that went by the same name, as in the army half a maniple was called a century.

CE'NTURION. In Ancient History, an officer in the Roman army, who had the command of half a maniple, or one sixtieth part of a legion The word centurion signifies the commander of 100 men, but this number was in fact seldom complete, as the legion generally fell far short of its full complement. One of the two centurions of each maniple had a precedence before the other, and the centurion of the first century of the first maniple of the Triarians presided over all the others, and had the charge of the eagle or chief standard of the legion, which gave him the privilege of ranking with the knights. The badge of a centurion was a vine rod

CEPHALA'NTHIUM (Gr. κεφαλη, *the head*, and ανθος, *a flower*) A term invented by Richard to express the head or capitate inflorescence of a composite plant.

CEPHA'LIC. (Gr. κεφαλη, *the head*) Medicines used for the relief of diseases of the head are frequently termed *cephalic remedies.*

CEPHALI'TIS. Inflammation of the brain.

CEPHALO'DIUM. (Gr κεφαλη, *a head.*) In Botany, a term used by systematic writers on lichens, and signifying the figure of a convex shield without an elevated rim: it is called also a tuberculum.

CE'PHALO'PHORA. (Gr. κεφαλη, *the head*, and φερω, *I bear.*) A name substituted by De Blainville in his system of Malacology for the "Cephalopoda" of Cuvier.

CEPHA'LOPODS, *Cephalopoda* (Gr. κεφαλη, *the head*, and πους, *the foot.*) A class of Molluscous animals having the head situated between the body and the feet, these latter organs consist of a number of fleshy processes, which project forwards from the circumference of the head, and more or less conceal the mouth. The Cephalopods are the first class of *Mollusca* in the system of Cuvier, and the most highly organized of invertebrate animals. They alone present indubitable rudiments of an internal skeleton, developed for the purpose of protecting a brain and lodging organs of sight, and, in most of the existing species, organs of hearing. In these also there are distinct hearts both for the systemic and pulmonary circulations, and highly complicated digestive, secretory, respiratory, and generative organs. The sexes are in distinct individuals. All the species are marine. The principal features of the organization of this class of Invertebrata are described by Aristotle, and their habits were better understood by that ancient author than by modern naturalists of the present day. The Cephalopods are described and grouped together in the *Historia Animalium*, under the name of "Malakia"

CE'PHALOTA'CEÆ. (Cephalotus, the only genus A small natural order of Exogens, allied, according to Labillardiere, to *Rosaceæ*, according to Brown to *Francoaceæ* and *Crassulaceæ*. Its affinity appears, however, to be greater with *Droseræ* than with the previous orders It consists of a single species, with pitcher-like bodies mixed with its leaves; it is a marsh plant inhabiting New Holland

CE'PHALO-THO'RAX (Gr. κεφαλη, *the head*, and θωραξ, *the chest*) The first segment of Arachnidans and Crustaceans, which includes the head and thorax of insects

CE'POLA. (Der. unknown) The name of a genus of spiny-finned fishes, including the common riband-fish (*Cepola rubescens*) of our coasts

CERA'CEUS. (Lat cera, *wax*) In Botany, waxy. Applied to the substance of such bodies as have the texture and colour of new wax, as the pollen masses of particular kinds of Orchis.

CE'RAMBY'CIDÆ. A family of Capricorn beetles, characterized by antennæ generally exceeding the length of the body, a large and distinct labium, strong horny mandibles, maxillæ terminated by two distinct hairy lobes, eyes kidney-shaped, with the antennæ situated in the concavity, body generally long and narrow. The numerous insects of this vegetable-feeding family are arranged in many subgenera, of which the following are indigenous. *Acanthocinus*, *Aphelocnemia*, *Callidium*, *Cerambyx*, *Clytus*, *Lamia*, *Molorchus*, *Monochamus*, *Obrium*, *Pogonocherus*, *Saperda*, and *Stenopterus* One of the most remarkable species of our country is the musk-beetle (*Cerambyx moschatus* of Linnæus, *Callichroma* of Latreille), which, when alive, disseminates an odour resembling sometimes that of the otto of roses.

CE'RASIN. Cherry-tree gum A generic name given to those kinds of gum which swell and soften, but do not readily dissolve in water.

CERA'STES (Gr. κερας, *a horn.*) The name of a genus of poisonous serpents, characterized by having a pointed recurved horny process standing up over each eye: the horned vipers, as they are termed, are peculiar to Africa.

CE'RATE. (Gr. κηρος, or Lat cera, *wax.*) An ointment generally compounded of wax and oil or spermaceti

CERA'TIUM (Gr κερας, *a horn.*) A one-celled, many-seeded, superior linear fruit, dehiscent by two valves separating from the replum; the seeds attached to two spongy placentæ adhering to the replum, and alternate with the lobes of the stigma It differs from the Siliqua in the lobes of the stigma being alternate with the placenta, not opposite

CE'RATOPHYLLA'CEÆ (Ceratophyllum, the only genus) A small natural order of Exogens, allied, according to Richard, to *Coniferæ*, but to which it seems to have no kind of affinity. According to De Candolle it should be placed near *Hippuris* and *Myriophyllum*, from which it differs in its superior ovary; according to Agarh it belongs to *Fluviales*: its affinity, however, appears to be greatest with *Urticaceæ*, of which it may be regarded as a degeneration The order consists but of one genus, which is found in the ditches of Europe, being constantly submerged, and floating with its long green leaves after the manner of a Conferva. The

embryo appears to be decidedly Polycotyledonous; otherwise the plant would certainly be referred to *Naiadaceæ*.

CERATO'PHYTES, *Ceratophyta*. (Gr. κέρας, *a horn*, and φυτον, *a plant*.) A name applied by Cuvier to a family of Corticiferous Polyps, comprehending those in which the internal axis resembles horn or wood.

CE'RATRIN. The bitter principle of Iceland moss.

CE'RBERUS. In Mythology, a monster usually represented as the guardian of the entrance to the infernal regions, and described by the ancient authors as possessing three, fifty, or even a hundred heads.

CERCA'RIÆ. (Gr. κέρκος, *a tail*.) A family of Infusoria, having an enlarged body with a slender tail-like appendage. The body of the true *Cercariæ* of vegetable Infusiores is rounded, that of the Zoosperms or animalcules of the seminal secretion is flattened. *See* Zoospermes.

CERCO'PIDÆ *See* Cicadellans.

CE'RCOPITHE'CUS (Gr. κέρκος, *a tail*, and πίθηκος, *an ape*.) The name of the genus of Quadrumanes, including those which have long tails, but not prehensile, or the "monkeys" of the old world

CERE. (Lat cera, *wax*) In Ornithology, the naked and generally coloured skin which covers the base of the bill in some birds, as in those of the hawk tribe (*Falconidæ*).

CE'REAL GRASSES. (Lat ceres, *corn*) Grasses which produce the bread corns; such as wheat, rye, barley, oats, maize, rice, and millet

CEREBE'LLUM (Lat dim. of cerebrum, *the brain*.) The little brain; the posterior of the medullary masses which compose the brain of vertebrate animals. It is a single organ. *See* Brain

CERE'BRUM. (Lat.) The third medullary mass of the brain, counting from behind forwards it is divided in the mesial line into two lateral lobes or hemispheres, and is the only part of the cerebral organ whose development bears relation to the intelligence of the species

CEREMO'NIAL OF EUROPEAN POWERS, comprises — 1. The particular titles due to sovereigns in different states, the imperial title being considered as expressing some sort of superiority over the royal, and having been in consequence assumed by various kings in their public acts (as the King of England since the union of the crowns). 2. The acknowledgment of sovereign titles, the right to confer which was formerly claimed by the Popes as their own prerogative, but they are now assumed by princes, and confirmed by the acknowledgment of other sovereigns. 3. The respective prerogatives of different sovereigns; which species of precedence is that which has occasioned the greatest amount of discussion and dispute when sovereigns, or their representatives, have been brought together. In 1504, Pope Julius II arranged the rank of European powers in the following order 1 The Roman Emperor; 2 The King of Rome; 3 France; 4. Castile, 5. Aragon; 6 Portugal, 7 England, 8. Sicily; 9 Scotland, 10 Hungary; 11 Navarre, 12 Cyprus, 13. Bohemia; 14 Poland; 15 Denmark, 16. Republic of Venice; 17 Duke of Britanny, 18 Burgundy; 19. Elector of Bavaria; 20. Saxony; 21 Brandenburg; 22. Archduke of Austria; 23 Duke of Savoy, 24 Grand Duke of Florence, 25 Duke of Milan; 26 Bavaria, 27 Lorraine This arrangement, however, gave birth to repeated contests. At present, where precedence is not considered as established between rulers of equal dignity, each concedes to the other precedence at home; and when they meet on the territory of a third party, they take precedence alternately until some arrangement is effected

CE'REMONIES, MASTER OF THE. An officer of the king's household instituted by James I. for the more honourable reception of ambassadors and strangers of quality. it is his duty to attend and regulate all matters of etiquette in the drawing room and the levee, and on all occasions where the state of a court is to be maintained.

CEREO'PSIS. The generic name of an Australian goose, characterized by a green cere-like naked membrane covering the upper parts of the base of the bill. It has bred frequently in this country, and there is every probability that it will ultimately become naturalized.

CE'RES. One of the four new or telescopic planets which revolve between the orbits of Mars and Jupiter. It was discovered by Piazzi on the 1st of January, 1801. Ceres is a very small planet, its apparent diameter, according to Schroeter, being only 3·48″, which at its mean distance corresponds to about 1600 miles; but according to Sir W. Herschel its apparent diameter is only 0·35″, or 160 miles. The difficulty of distinguishing its real disk, on account of the nebulosity by which it is surrounded, accounts for the discrepancy. Its mean distance from the sun is rather more than three times the distance of the sun from the earth. *See* Planet.

Ce'res. In Mythology, the Latin goddess corresponding to the Grecian Demeter (Δημήτηρ), was the patroness of tillage. She was the daughter of Saturn and Rhea, and, by Jupiter, mother of Proserpine. The most remarkable thing connected with this goddess was the celebration of the Eleusinian mysteries, over which she presided.

CE'REUS. (Lat. cera, *wax*.) In Botany, a colour, surface, or texture which resembles that of wax.

CE'RIN. The portion of wax which dissolves in boiling alcohol. Also a peculiar waxy substance obtained by boiling grated cork in alcohol.

CERI'NTHIANS. Followers of Cerinthus, a heretic of the first or second century, who embraced certain gnostical views respecting the natures and relations of God the Father and Son. He conceived the supreme God to be the father or originator both of the Deity from whom proceeded the O. Test. and of Christ, that the God of the Jews was also the creator of this world; and that his dominion over it was superseded by the mission of Christ, who was a son of the supreme Deity residing in a human body. *See* Gnostics

CE'RIO. A term invented by Murleel to denote the fruit called a Caryopsis, which see.

CE'RITE. A silicious oxide of cerium.

CE'RIUM. A metal named after the planet Ceres, and discovered in 1803 by Hisinger and Berzelius in a Swedish mineral termed *cerite*, and since found by Dr. Thomson in *Allanite*, a mineral from Greenland. It is said to be a white brittle metal, very difficult of fusion, and volatile when intensely heated; but we are scarcely acquainted with it in its metallic state. Its equivalent number appears to be 48, on the hydrogen scale.

CE'RINUS. (Lat. cera, *wax*.) In Botany, waxy yellow; a term used in describing colour, to denote a dull yellow with a slight mixture of reddish brown.

CERO'MA (Gr. κήρωμα) In Ancient Architecture, the apartment in a bath or gymnasium in which persons anointed themselves with a composition of oil and wax.

CEROPLA'STIC. (Gr κηρος, *wax*, and πλαστικη τεχνη, *the art of the modeller or carver*.) The art of modelling in wax, one of very high antiquity. From the testimony of Pliny we learn that Lysistratus, the brother of Lysippus, was the first that used wax for modelling the human figure He lived in the time of Alexander the Great, and was a native of Sicyon

CEROSTRO'TUM, or CESTRO'TUM. (Gr. κηρος, *wax*, and στρωτος, *spread*.) A species of encaustic painting, executed chiefly on horn or ivory with a particular sort of stylum called a cestrum, which was pointed at one end and flat on the other. The cestrum was heated, and with it the lines of the subject were burnt in, and wax introduced into the furrows made by the heated instrument (See *Pliny*, lib xi cap 37, also lib xvi. cap 48; also *Salmas ad Solin*. p 231.) Doors were sometimes ornamented with this species of painting. *Ausonius*, Epigr. 26 v 10 —

Ceris murens janu arum limina,
Et atriorum pegmata.

CE'RTHIA. (Gr κερθις, part. of κειρω, *I clip or shear*) A genus of Amisodactyle or uneven-toed Tenuirostral or slender-billed Passerine birds, commonly known by the name of Creepers The common tree-creeper (*Certhia familiaris*, Linn) is a well-known native species

CE'RTIORA'RI. In Law, is an original writ issuing out of Chancery or the King's Bench, directed to the judges or officers of inferior courts, commanding them to *certify* or return the records of a cause depending before them By this writ indictments and many other proceedings may be removed from any inferior court of jurisdiction into the King's Bench. It lies generally in all judicial proceedings in which a writ of error does not lie, but not, in common cases, to remove a cause out of an inferior court after verdict.

CE'RULIN. Indigo which has been dissolved in sulphuric acid.

CERU'MEN (Lat. cera, *wax*) The secretion which lines the external auditory canal. It consists of albumen, an oily matter, a colouring matter, soda, and phosphate of lime.

CE'RUSE. (Lat cerussa) Carbonate of lead, the basis of white oil-paint. It is commonly called *white lead*.

CERVI'NUS. (Lat. cervus, *a stag*.) In Botany, fawn-coloured

CE'RVIX (Literally the lower part of the neck) An obsolete botanical term, superseded by that of *Rhizoma*, which see.

CE'SSIO BONO'RUM In the Civil Law (and in the modern jurisprudence of France, Spain, Holland, and Scotland), a yielding up on the part of an insolvent trader of his estate and effects to creditors, under the authority of the competent court; analogous to the assignment of estate and effects under a flat in bankruptcy in England. See as to the several regulations respecting the *cessio bonorum* in these different countries, *Burge's Commentaries on Colonial and Foreign Laws*, iii. 890. &c.

CE'STOI'DEANS, Cestoidea. (Gr κεστος, *embroidered*, and ειδος, *likeness; ribband-like*.) The name of an order of Sterelmintha, or Parenchymatous Entozoa, including those which are commonly called tape-worms.

CESTRA'CEÆ. (Cestrum, one of the genera.) In Botany, a very small group of plants, most usually combined with *Solanaceæ*, but by some botanists separated on account of their straight embryo, foliaceous cotyledons, and valvate corolla. Some of the species have fragrant flowers, especially at night; others emit an unpleasant odour. Some are astringent, others are said to be poisonous.

CESTRA'CION. (Gr. κεστρακιος, *the name of a fish.*) In Ichthyology, a genus of sharks, characterized by having two kinds of teeth, disposed in oblique subspiral rows; those at the anterior part of the jaws are pointed, and adapted for seizing or grappling shell-fish, &c.; those at the middle and back part of the jaws are flattened for crushing the same. the fishes of this genus are also remarkable for the large spine placed in front of the first dorsal fin. Only two existing species of this genus are known, one of which is called "the Port Jackson shark;" the fossil remains of Cestracions are numerous.

CE'STRUM. (Lat.) In Painting, a tool used by the ancients in executing the species of pictures called *cerostroti*. *See* CEROSTROTUM.

CETA'CEANS, *Cetacea* (Gr. κητος, *a whale.*) An order of Mammals living in the sea or large rivers, and shaped like fishes for moving habitually in the watery element, having the posterior part of the spine disencumbered of a sacrum and hinder extremities to allow the tail to have a due freedom and extent of motion. They breathe air, have warm blood, and a double circulation, like the rest of the class to which they belong, they are consequently compelled to resort to the surface for the purpose of respiration; and the tail-fin is accordingly horizontal, and not vertical, as in true fishes.

CE'TE. (Gr. κητος, *a whale.*) The name of the sixth order of Mammalia in the *Systema Naturæ* of Linnæus, containing those marine species which are devoid of hinder extremities. The group corresponds with the carnivorous group of the modern *Cetacea*, the manatee being associated in the Linnæan system with the elephant.

CE'TIC ACID. The result of the action of alkalis upon *cetine*.

CE'TINE. Pure spermaceti.

CE'TUS. (Gr. κητος, *the whale.*) One of Ptolemy's forty-eight constellations, in the southern hemisphere.

CEVA'DIC ACID. An acid contained in the seed of the *Veratrum sabadilla*.

CEVADI'LLA. *See* SABADILLA.

CE'YLANITE. A mineral found in rounded grains or small crystals, nearly opaque, and of a dark blue or black colour; it was first observed in the sand of the rivers of Ceylon.

CHABA'SIE. A variety of zeolite. (From a Greek word signifying a particular kind of stone.)

CHACO'NE, or CIACONE. (Spanish.) In Music, a kind of dance resembling a saraband, of Moorish origin. The bass of it consists of four notes, which proceed in conjoint degrees, whereon the harmonies are made with the same burden. Some have derived this dance from *cicco*, a blind man, its supposed inventor.

CHAFF. The husk or withered calyx of grasses, and more especially of the bread corns. The term is also applied to straw or hay cut into very short lengths, and used for mixing with corn, roots, or other food for horses or cattle. This kind of chaff, in greater lengths, is also used for mixing with mortar on some parts of the Continent, more particularly in Germany and Russia; and it is used as a substitute for hair in making plaster for rooms. Both stubble and cut hay were used by the ancient Egyptians in making bricks.

CHAFF OF THE RECEPTACLE. A term used by some botanists to denote the bracts which are stationed upon the receptacle of Composite flowers, between the florets; they have generally a membranous texture, and no colour, and are usually called Paleæ.

CHA'FFY, PALÆACEOUS. When a surface is covered with small, weak, erect membranous scales, resembling the chaff of corn, as the receptacle of many Composite plants.

CHAI'LLETIA'CEÆ. (Chailletia, one of the genera.) A natural order of shrubby arborescent Exogens, placed by De Candolle between *Homaliaceæ* and *Aquilariaceæ*; agreeing with the former in the presence of glands round the ovary, but differing in its superior ovary, with the placenta in the axis, and in many other characters. Its affinity, however, appears to be greatest with *Rhamnaceæ*, with which it agrees in habit. It inhabits the hotter parts of the world, and some species are said to be poisonous.

CHALA'ZA. (Gr. χαλαζα, in the sense of *a knob.*) In Botany, the vascular disk caused by the expansion of the vessels of the raphe, upon reaching the base of the nucleus of an ovule, after passing up the side of the latter.

CHALA'ZÆ. (Gr. χαλαζα, *hail.*) A name applied to the two membranous twisted chords attached to near the poles of the yolk of an egg, and serving to maintain it in such a position that the cicatricula shall always be uppermost, and consequently nearest the source of heat during the process of incubation.

CHALCE'DONY. A semitransparent silicious mineral, apparently formed by the infiltration of silicious matters originally in a state of solution. It is of various colours, and often banded. The finest specimens are said to have been originally found at Chalcedon in Asia.

CHALCI'DICUM. (Lat.) In Ancient Architecture, according to Festus so named from Chalcis, a city in Eubœa. A term used by Vitruvius to denote a large building appropriated to the purpose of [illegible] justice, or according to others the tribunal itself.

CHALCO'GRAPHY. (Gr. χαλκος, *brass*, and γραφω, *I write.*) The art of engraving on copper or brass.

CHA'LDRON. (Lat. chaldarium; Fr. chaudron, whence also cauldron.) A measure containing 36 bushels heaped measure.

CHALK. (Germ. kalk.) Earthy carbonate of lime. It forms an important geological feature of this country, the chalk hills which form the white cliffs of our shores having conferred the name of ALBION upon the island. Geologically considered, it is an important feature among the secondary rocks. The cretaceous formation is characterized by peculiar fossils, and especially by containing *flints*. The ranges of chalk hills in the south of England are very extensive, and the landscape which they constitute peculiar for the smooth and rounded outline of its hills, their monotony of surface, and the singular cup-shaped concavities and deep hollows in which their sides abound. Between Dunstable and Shaftesbury the chalk hills attain an elevation of nearly 1000 feet above the level of the sea. Between Lewes in Sussex and Alton in Hampshire there are several similar elevations.

CHALK STONES. The concretions formed in the joints of persons who have long suffered from gout were once supposed of a chalky nature, and acquired the above name. They are chiefly composed of uric acid in combination with soda.

CHA'LLENGE. In Law, an exception to jurors who are returned to serve on a trial. *See* JURY.

CHALY'BEATE. (Gr. χαλυψ.) The Chalybes were a Scythian people who dug iron. Medicines and mineral waters containing iron are called *chalybeates*.

CHA'MA. (Gr. χαω, *I gape.*) The cockle.

CHAMA'CEANS. (Lat. chamacea.) In Conchology, the family of Acephalous Lamellibranchiate Mollusks, of which the genus *Chama*, or clam-shells, is the type. The group is characterized among bivalves by having the mantle perforated by three apertures; one for the passage of the foot, another for the respiratory currents, and a third for the escape of the excrements.

CHAME'LEON, *Chamæleo* (Gr. χαμαιλεων, *a lizard.*) A genus of Saurian reptiles with small tubercular scales, and the tail and feet organized for climbing to the branches of trees. The chameleons subsist not on air, as poets feign and the uninformed believe, but on flies and other insects, which are caught by means of a remarkably long and extensible tongue, terminated by a finger-shaped process like the elephant's proboscis, and which the chameleon can dart upon its prey with great rapidity. The rete mucosum or coloured layer of the skin contains two kinds of pigment, situated in different layers. the deeper seated layer is of a deep green or violet red colour, the superficial pigment is of a greyish colour, the deep-seated pigment is contained in branched cavities, and is moveable, producing by its partial accumulation and varying proportions with the superficial layer the changes of colour for which the chameleon has in all ages been remarkable.

CHAMÆ'LEON MINERAL. A compound of manganesic acid and potash, which presents a variety of tints when dissolved in water.

CHA'MBER. (Fr. chambre.) In Architecture, properly a room vaulted or arched; but now generally used in a more restricted sense to mean an apartment appropriated to lodging. With the French the word has a much more extensive meaning; but with us the almost only use of it, beyond what is above stated, is as applied in a palace to the room in which the sovereign receives the subject, which is called the Presence Chamber.

CHA'MBERLAIN. (Fr. chambellan; Germ. kammerherr.) A high officer in all European courts. Originally the chamberlain was the keeper of the treasure-chamber (camera, in the 10th century), and this meaning of the word is still preserved, in the usages of corporations of London and other places, where the chamberlain is the officer who keeps the money belonging to the municipal body. But, in modern times, the court officer styled chamberlain has the charge of the private apartments of the sovereign or noble to whom he is attached. In England, the lord great chamberlain, or king's chamberlain, is one of the three great officers of the king's household. He has the control of all the officers above stairs, except the precinct of the king's bedchamber, which is under the government of the groom of the stole.

Under him are the vice-chamberlain, lord of the bedchamber, &c.; the chaplains, officers of the wardrobe, physicians, tradesmen, artizans, and others retained in his majesty's service are in his department, and sworn into office by him. He is commonly one of the highest nobility of the country; in virtue of his situation he precedes dukes. The emblem of office appropriated to the chamberlain in European courts is a gold key, generally suspended from two gold buttons.

The LORD GREAT CHAMBERLAIN OF ENGLAND (not of the household) is the sixth great officer of state. This office belonged for many centuries to the noble family of De Vere, Earls of Oxford, afterward to that of Bertie, Lords Willoughby de Eresby and Dukes of Ancaster. In that line it became vested in coheiresses, by whom the present deputy chamberlain (Lord Gwydir) is appointed

CHA'MBRE ARDENTE. In French History, a name given to the tribunal which was instituted by Francis I for the purpose of trying and burning heretics, and also the extraordinary commissions established under Louis XIV for the examination of prisoners, and under the regent Duke of Orleans against public officers charged with certain offences against the revenues, and those guilty of fraud in the matter of Law's bank.

CHA'MBRE DES COMPTES (Chamber of Accounts.) In French History, a great court established for various purposes; as for the registration of edicts, ordinances, letters patent, treaties of peace, &c. The sovereign chambre des comptes was at Paris: there were also inferior courts in ten provincial cities.

CHA'MFER. (Fr. chamfrein.) In Architecture, the edge of anything originally right-angled cut aslope or bevel, so that the plane it then forms is inclined less than a right angle to the other planes with which it intersects.

CHA'MOMILE FLOWERS. The flower-heads of the *Anthemis nobilis*, or common chamomile. They are used in medicine in consequence of their bitter extract, which is strengthening, and of their essential oil, which is aromatic and stimulant.

CHAMP DE MARS. In French History, the public assemblies of the Franks, which were held in the open air, and annually in the month of March, from whence the name. Under Pepin and some of his successors they were termed Champs de Mai. An extensive open space in Paris, appropriated to various public solemnities, is termed the Champ de Mars, a name which seems also intended to recall the ancient Campus Martius, or public field of Rome.

CHA'MPERTY. In Law, is a species of maintenance, being a bargain with the plaintiff or defendant in a suit for the "campi partitio," or division of the land or thing in dispute between the party, if he prevails at law, and the champerter, on the latter's bearing the expense of the suit. It is a punishable offence both by common law and by statute.

CHA'MPION. (From the Italian campione, derived from campo, *field*, or from the ancient German and Gothic kempe, kiempe, *a warrior*, whence some have derived also the Spanish campeador, a title of the *Cid*.) One who fights a public combat, or engages to do so, in his own or another man's quarrel. On the issue in a writ of right trial by battle might formerly be demanded, and in this case (*see* WAGER OF BATTLE), each party appeared in the field by his champion. The judicial combat in criminal cases might in some countries, although not in England, be fought by a champion for either of the parties, if an ecclesiastic, woman, or child. The office of champion of the crown of England is of great antiquity, the manor of Scrivelsby in Lincolnshire having been held from time immemorial in grand serjeantcy, on condition that the lord thereof shall be the king's champion. This manor was long held by the family of Marmion; it passed, in the 20th year of Edward I., to the family of Dymocke, in which it has since continued. The champion appears in Westminster Hall at the coronation, between the courses of the royal banquet, in complete armour; his challenge is proclaimed by the herald, waging battle with any person who shall deny or gainsay the title of the king, three times; and the champion throws down his gauntlet. In 1821, at the coronation of George IV., it was decided that this office could be performed by deputy; and W. Dymocke being in orders, his place was supplied by his eldest son.

CHANCE. A term applied to events that are supposed to happen without any known or necessary cause, or rather, of which the cause is such that they may happen in one way as well as another. Thus, when a piece of money is tossed up into the air, as no reason can be given why it should fall on one side rather than on the other, it is said to be an even chance which of the sides shall turn up. For an account of this branch of mathematics, sometimes called the *Doctrine of Chances*, see PROBABILITY.

CHA'NCEL. (Lat. cancellus.) In Architecture, the part of the choir of a church between the altar and the lattices (cancelli) or balustrades that enclose it. This is the strict meaning; but in many cases the chancel extends much further into the church, the original divisions having been removed for the greater accommodation of the congregation.

CHA'NCELLOR. (Lat. cancellarius.) A high officer in many European states. The cancellarius under the Roman emperors is supposed to have been a notary or scribe, and his title to have been derived from the cancelli or railing behind which he sate. In ecclesiastical matters, every bishop had (and continues to have) his chancellor, the principal judge of his consistory. The chancellor of France began to be an officer of importance under the Frankish kings, especially after the office of referendary had become merged in his, about the ninth century. In 1223 he was made the first minister of the crown, and rank next after the princes of the blood was assigned to him. The offices of chancellor and keeper of the seals were frequently united.

CHANCELLOR, ARCH, OF THE EMPIRE. This office, under the elective empire of Germany, belonged to the archbishop elector of Mentz. The archbishop of Cologne was titular arch-chancellor of Italy, the archbishop of Treves of Gaul and Arles.

CHANCELLOR OF A DIOCESE. The keeper of the seals of an archbishop or bishop. This office now includes those of official principal, whose duty is to hear and decide matters of temporal cognizance determinable in the bishop's court; and vicar-general, who exercises the jurisdiction properly spiritual.

CHANCELLOR OF THE EXCHEQUER. The highest finance minister of the British government. This office is from its nature necessarily entrusted to a commoner, and is commonly united to that of first lord of the treasury when the premier happens to be below the peerage. The chancellor, as an officer of the Court of Exchequer, has precedence above the barons of that court.

CHANCELLOR OF A UNIVERSITY. The head of the corporate bodies by whom he is elected. He exercises exclusive jurisdiction in all civil actions and suits where a member of the university or privileged person is one of the parties, except in cases where the right to freehold is concerned. The duties of the respective chancellors of Oxford and Cambridge are in nearly all cases discharged by a vice-chancellor.

CHANCELLOR, CHANCERY. The office of chancellor is the most ancient as well as the highest of all judicial offices in the kingdom, for though the superior antiquity of his jurisdiction has been questioned, the establishment of the office itself was certainly prior to the institution of any existing court of justice, the name as well as some of the functions, which were borrowed from the "cancellarii" of the later Roman emperors, having been introduced into this country within the first three centuries that followed the dissolution of the Western Empire.

In addition to his judicial functions, which are various and extensive, the chancellor is now by virtue of his office privy councillor, and when a peer speaker of the House of Lords, over all the members of which, with the exception of the archbishop of Canterbury, he then has precedence in rank. As chief conservator of the peace, he has the nomination of all magistrates throughout the kingdom, and he is the patron of all livings of the crown under the value of twenty marks in the king's books. He has also the right of appointment to almost all the offices in the Court of Chancery, particularly to the office of master, and has very great influence over the appointment of any of the other judges both of common law and equity. He still retains also the title of keeper of the king's conscience, a duty originally incident to his situation in the king's chapel, over the service of which he presided, and this office may perhaps have afforded a ground for that part of his jurisdiction which professes to remedy what is contrary to equity and good conscience. It is further his duty to issue the writs for the convocation of parliament, and all acts there passed, as well as many records and documents affecting the rights of individuals, — as to the latter in order to their validity, — are enrolled and kept in chancery, under the immediate care and custody of the master of the rolls, himself an officer of that court. The custody of the great seal is the peculiar and essential mark of the chancellor's dignity; and by delivery of that and the proper oaths taken the office is created, with all such of its rights as can be exercised by a chancellor not being a peer.

The jurisdiction of the chancellor is of various sorts. And, first, as to his common law jurisdiction. By this is meant that part of the chancellor's jurisdiction which is regulated by the same principles, and exercised according to similar forms, as the jurisdiction of the other courts of common law. This is by far the most ancient branch of the chancery judicature, and seems to have been originally incident to the nature of the chancellor's office, whose chief business it was to advise the sovereign on the subject of grants, charters, and letters patent, and to

authenticate them by affixing the great seal after the introduction of that symbol Out of this naturally arose a jurisdiction in all matters between the crown and its grantees, and the right to repeal or cancel all grants, charters, and letters patent, which should afterwards appear to be contrary to law, or in other respects improperly obtained. In like manner the chancellor had jurisdiction in other matters arising out of commissions under the great seal, such as returns made in pursuance of inquiries under such commissions as to the right of the crown to goods or lands of the subject either by escheat, forfeiture, or any other cause, these were legally called offices

To the same court also belonged originally, in the time of feudal tenures, jurisdiction in the case of wardship, and some other matters arising out of such tenures between the crown and its tenants in capite, but it should be observed, that as this court has not the power of summoning a jury, it can in no case try an issue of fact. It is called the Court of the Petty Bag, literally from the size of the bag in which its writs are deposited To the common law department of chancery belongs also the issuing of original writs, that is to say, precepts addressed to the party complained of, stating the nature of the complaint made against him, requiring him to do justice to it, or show cause to the contrary, such writs being originally the first and a necessary step in all causes which were tried before either of the three great courts, or in the "aula regia," before its division into separate courts

In this department of his office the chancellor was assisted by officers named cursitors, whom he was empowered to nominate for that purpose, and upon whom the whole business of devising writs soon devolved The chancery has hence been called Officina Brevium, or workshop of writs, and is, or was, in respect of the necessity of such writs, the foundation or fountain head of all justice, but this necessity, which had in practice long been satisfied by a fiction, has been in terms dispensed with by the 2d W IV c 39 The receptacle in which these writs were kept was called the Hanaper, literally a basket, and hence the office from which they issued was called the Hanaper Office

But by far the most extensive as well as most important branch of the chancellor's jurisdiction is the equitable, indeed, it is that branch alone which is commonly meant by the term chancery In this department of his office the chancellor is assisted by the master of the rolls and the vice-chancellor, the first of which is a very ancient office, and the second was established by act of parliament in the 53rd year of George III, who, though they each sit in separate courts, and exercise their jurisdiction severally, yet together with the lord chancellor constitute one court of chancery, in which all orders and decrees, though most commonly made either by the master of the rolls or the vice-chancellor, require the signature of the chancellor himself, to whom an appeal also lies from the decisions of either of the two inferior judges, but such appeals are in strictness of speech rehearings, the chancellor being by legal fiction supposed to be present in every department of the Court of Chancery The hearing of such appeals, and of incidental applications, called motions, in original causes, constitutes the ordinary business of the lord chancellor, it not being the usual practice to bring causes in the first instance before him

The general object and character of this equitable jurisdiction is to supply, in civil matters, the deficiencies of the other courts of justice, whether those deficiencies consist in the imperfections of the machinery of those courts, or in their too rigid adherence to peculiar forms, whereby certain classes of rights become excluded from the benefit of their protection The origin of this equitable jurisdiction is generally sought for in that remnant of judicial power which is alleged to have been left in that part of the "aula regia" which was not included in either of its subdivisions (*see* KING'S BENCH, COMMON PLEAS), and of which residuary part the chancellor was certainly, since the suppression of the office of justiciary, the principal member, and was thus easily enabled to assume whatever judicial power was left undelegated to the other courts. That such remnant of power was adequate to all purposes to which it was moulded, is inferred from the supreme and comprehensive nature of the "aula regia" itself, which must be supposed to have been invested originally with full power to do complete and perfect justice, and of which the remnant therefore still retained an undefined measure of authority sufficient to supply what should prove, on experience, to be wanting in the other courts. This view of the subject is strengthened by the fact that the Court of Exchequer, which was not a part of the aula regia, but a collateral and equal court, or rather perhaps the aula regia in a different shape, has also its equitable jurisdiction, as if that were a necessary part of all complete systems of judicature. Possibly also the idea of paramount and universal authority annexed to the right of framing writs in all actions, or, in other words, of devising remedies for every species of wrong, may have laid the foundation in theory for this supplemental code, as it was certainly the discovery of a new writ, or a new application of an old one, which practically enabled the chancellors to carry their equitable views into effect.

This was the writ of subpœna: a writ returnable in chancery, and calling upon the person to whom it was directed to appear there, and answer upon oath the complaint that was made against him. The invention of this writ is attributed to John Waltham, Bishop of Salisbury, who was chancellor in the reign of Richard II.; and it is upon the power thereby acquired that rests even now the equitable jurisdiction of the chancery.

Similar in principle to this is the equitable jurisdiction of the Court of Exchequer, which is concurrent with that of the Court of Chancery in all matters of equitable relief, though it can only be called into action by a fiction stated in the pleadings, and which it is not allowable to deny — that the plaintiff is a debtor of the crown, and will by deprivation of the right for which the suit is brought be less able to satisfy such debt Wherever, therefore, in the course of this or other articles the words *equity* or *courts of equity* occur, they must be taken as applying to the principles and jurisdiction as well of the Exchequer as of the Chancery.

The usual division of the objects of equitable jurisdiction is into Trust, Fraud, Accident, Agreement, and Account

As courts of equity take into their consideration a far greater variety of circumstances than do courts of law, and as evidence of no fact not suggested by the pleadings is admissible, the written pleadings are necessarily more copious and important than they are at law; and there is further this most essential difference, that the pleadings on the part of the defendant, *i e* his answer, are upon oath With regard to evidence the same general rules prevail in equity as in law, as to the admissibility of proofs, the relevancy of facts, and the competency of witnesses, and even the propriety of the questions that may be put, but the manner of taking evidence is different, for with few exceptions, and those as to very simple facts, evidence in equity is taken either under a commission to examine, or by the official examiners in London, and is produced before the court in a written shape Where special applications are made during a cause for something to be done in that cause, or, as may sometimes be done, when applications for an order of the court are made without instituting a suit, the evidence adduced is by affidavit The hearing of such applications, which is either upon written *petition* or by motion upon written notice, constitutes a great part of the business of the court Evidence of facts not essential in the first instance to the interposition of the court, is usually taken in the master's office upon a reference made to him The Court of Chancery has also jurisdiction in the guardianship of infants and the management of charities, and the lord chancellor personally has, by special delegation from the crown, jurisdiction in the case of lunatics, which is exercised according to the forms of the old common law jurisdiction of the court upon commission issued

The appellate jurisdiction of the chancellor in bankruptcy is stated under that title

CHANCE-MEDLEY (A corruption of the French *chaude mêlée*) In Law, signified originally a casual affray or riot, accompanied with violence, but without deliberation or preconceived malice, but is applied at present to a particular kind of homicide, — viz the killing of another in self defence in a sudden encounter, without *malice prépense*

CHANGE OF SEED. In Agriculture, the practice of procuring seed produced in a different soil and climate from that in which it is to be grown as a crop, and which is found to be sometimes beneficial, and sometimes injurious, according as the new seed may have been matured in a better or worse climate and soil than those in which it is to be grown.

CHA'NNELS OF A SHIP. Strong narrow platforms of thick plank, projecting from the outside of the ship, abreast each mast, to extend the shrouds, and thereby increase the support of the rigging.

CHANT (Fr. chanter, *to sing.*) In Music, an ecclesiastical song usually adapted to the psalms and litanies. There have been several sorts, of which the first was the Ambrosian, invented by St Ambrose, bishop of Milan The Gregorian chant, which was introduced by Pope Gregory, is still in use in the Roman church, and is the foundation of all that is grand and elevated in music.

CHA'NTRY. (Lat. cantaria.) A little chapel or altar, commonly in some church, endowed (before the Reformation) with revenues for the maintenance of a priest to perform prayers for the soul of the founder and others. Chantries were dissolved in England by 1 Ed. 6. c. 14.

CHA'PEL. (Lat. capella.) In Architecture, a building for religious worship, erected separately from a

church, and served by a chaplain. In Catholic churches and Protestant cathedrals, chapels are usually annexed in the recesses on the sides of the aisles; these are also called chantries.

CHAPEL. (Fr. chapelle.) In Printing, is the junction of the workmen in an office for the purpose of promoting and enforcing order and regularity in the business, the preservation of the materials, the arrangement of the price of any doubtful work, and the care of the lights. These objects are accomplished by fines.

Moxon, who published his work on printing in 1683, says, "every *Printing-house* is, by the custom of time out of mind, called a *chappel*." It is supposed that the term originated from the circumstance of Caxton, on the introduction of the art into England, practising it in a chapel attached to Westminster Abbey.

The president is termed "the father of the chapel," and is elected; the workmen are styled "members of the chapel;" and this association takes cognizance of all offences, real or imaginary, committed within the office, and punishes the offender by inflicting a fine in proportion to the offence. The process of calling a chapel is by giving the father a halfpenny and desiring him to summon a chapel, stating to him the object, the father then directs the youngest journeyman to announce to all the members the time when it will be held, when the subject is discussed, and the decision taken by vote.

It is an axiom that the chapel is always right, consequently there is no appeal from its decision, and to dispute this would subject the party to its displeasure. It has various ways of enforcing obedience to its dictates

CHAPEL. A place of divine worship, either connected with a private establishment, as a nobleman's house, a college, &c.; or subsidiary to a parish church for the sake of additional accommodation (in which case it is called a chapel of ease); or a meeting-house belonging to a Dissenting congregation

CHA'PLAIN. (Lat capellanus) Properly the minister of a chapel. The privilege which the king and nobility enjoy of appointing private chaplains arises from the ancient custom of using domestic chapels for family worship. The limitations under which this privilege may be exercised are set forth in certain statutes of Henry VIII. Under the existing law a nobleman's chaplain may hold two benefices, but the chaplain of a judge, &c. only one: on which, however, he is not obliged to reside

CHA'PLET. (Ital ciappelletto) A string of beads used by Roman Catholics to count the number of their prayers, these prayers consist for the most part of Ave Marias, Paternosters, and Credos Another name for the chaplet is Rosary. The invention of the practice is generally attributed to St Dominic.

CHAPLET (Fr chapelet) In Architecture, a moulding carved into beads, olives, and the like

CHA'PTER (Lat capitulus, from caput, *head*) The society of canons in a cathedral or collegiate church, of which the dean is the head, which forms the council of the bishop, and in which his election rested before Henry VIII.; since whom the power of the chapter in this particular (in the English church) has become merely nominal. *See* art BISHOP.

CHA'PTER-HOUSE. (Lat capitulum) In Architecture, the apartment (usually attached) of a cathedral or collegiate church in which the heads of the church or the chapter meet to transact business.

CHARA'CEÆ. (Chara, one of the genera) A natural order of Acrogens entirely destitute of a vascular system, and composed almost exclusively of tubes; placed by Linnæus near to Lichens and to Phænogamous plants; by Jussieu and De Candolle, with *Naiadaceæ*, by Brown, at the end of *Hydrocharaceæ*; by Leman, to *Halorageæ*, by Von Martius, Agardh, and Wallroth, to *Confervæ*; and finally admitted as a distinct order by Richard, Kunth, De Candolle, Adolphe Brogniart, Greville Hooker, and others. consists of but two genera, which inhabit the fresh and salt waters of most countries. They are remarkable for the distinctness with which the rotation of their fluids may be seen under the microscope. In the opinion of some Italian writers, the insalubrity of the neighbourhood of Rome is owing to the great quantity of chara which inhabits all the pools, and renders them intolerably offensive.

CHA'RACTER. (Gr. χαρακτης.) In the Fine Arts, a distinctive property or mark by which any object is separated from another. In physics as in morals, and also in the fine arts, there are three species of character; Essential, Distinctive or Accidental, and Relative. *Essential character* is that type stamped by nature on all her works; that great indication observable in the general divisions of the three kingdoms of nature; those distinctions of different classes of beings, of sexes and ages; in short, of all those great external marks which prevent the confusion of one species with another. *Distinctive* or *accidental character* is that dependent on particular circumstances; on all those varieties of development which a vast number of visible or invisible causes stamp on the same species, according to the difference of their position; as on individuals of the same species, according to the difference of the elements which modify their forms and the influences which some actions may have upon them. *Relative character* is a more particular indication of certain faculties relative to the different properties with which nature has endowed certain species or individuals, in which may be recognized the purposes to which they are more especially destined. In morals *essential character* consists in that uniformity of general habits which forms the peculiar instinct of each species of beings, and which indicates uniformly their inclinations, their predominating tastes, and those propensities which can never be changed by accidental causes. *Distinctive character* is that which peculiar habits of organization, circumstances, social institutions, and all those exceptions which in the very order of nature become suitable to an individual or one of the same species, being in fact but a modification of essential character. *Relative character* is the impression or development in a particular manner of certain qualities suited to a certain end, or to a certain mode of existence, indicating to what purposes the beings in question are suited, and manifesting a co-relation between what the species appears and that for which it is adapted.

The arts are and indeed can be but the result of nature in all countries, of the nations that inhabit them, and of the individuals of which a nation is composed. Nature influences nations, nations men, and men the arts. These are governed either mediately or immediately by an influence more or less dependent on the great natural causes of climate, government, and education, which constitute the essential character of every country, on secondary and political causes in which nations differ, and on particular causes, which modify individuals. The arts do but imitate this process according to the particular spot in which they spring up, their imitation embraces either nature in general or parts of nature; either material forms and the sensible images of things, or the moral affections and intellectual ideas of things, but of whatever kind the imitation be, to whatever object it may be directed, the arts are but the faithful mirrors which reflect in every country the physical and moral qualities of nature of nations, and of the individuals of which the latter are composed Before judging, therefore, of the imitation, it becomes necessary to judge of the model, and before we can ascertain in what the character of the arts consists, we must know on what its character depends in nature We have been thus particular in giving some general notions of character, which must be felt before we can be qualified to judge of the character of the arts in any country The character peculiar to himself which an artist imparts to his work is but a modification of the foregoing principles more easily, perhaps, may be understood that distinctive character which a work of art requires that it may seem proper and suitable to its end That character which marks species was well understood by the ancients, and if we may trust Martial, Phidias excelled in catching it. Of his fishes the poet says, "Adde aquam, natabunt"

CHARACTERISTIC OF A LOGARITHM The same as index or exponent, meaning the figure prefixed to the logarithm, or preceding the point, and which indicates the integer places or figures in the number to which the logarithm corresponds

CHA'RACTERS. (Gr χαρακτης, *a mark*) In Music, the conventional forms in musical writing and printing used for the signs of clefs, notes, rests &c

CHARA'DE (Fr) A species of riddle, the subject of which is a name or a word that is proposed for solution from an enigmatical description of its several syllables taken separately as so many individual words, and then from a similar description of the whole name or word. A charade can only be called complete if the different enigmas which it contains are brought into a proper relation to each other, and as a whole unite in an epigrammatic point The following charade, which we borrow from the *Dictionnaire de l'Academie Française*, may be regarded as a good specimen of this species of riddle: — "My first makes use of my second to eat my whole;" the solution being *chien-dent* or dog's grass. The word *charade*, like the term *calembourg* (quod vide) has been applied to this sort of amusement, from the name of its inventor.

CHARA'DRIUS. (Lat.) A bird mentioned by Pliny. The name of a very interesting genus of wading birds, or *Grallatores*, including the British plover and allied species In modern Ornithology, the Linnæan genus which included the long-legged plover (*Himantopus*), the stone curlew (*Œdicnemus*), and other species is raised to the rank of a family called *Charadriadæ*.

CHA'RCOAL. A form of carbon, obtained by burning wood with the imperfect access of air, or by heating or distilling it in iron cylinders so constructed as to allow of the collection of the volatile products; among which are *tar*, and *pyroligneous acid*, which is impure vinegar. Charcoal, exclusive of its important use as a fuel, is

possessed of some curious and valuable properties. It is a very bad conductor of heat; and hence powdered charcoal is used to surround tubes and vessels which are required to retain their heat. It is not injured by air and moisture; hence stakes and piles are superficially charred to preserve them. It is infusible; and provided air be carefully excluded, it undergoes no change in most intense heats. It absorbs air and moisture, and also the colouring and odoriferous parts of many animal and vegetable substances Tainted flesh and putrid water are thus sweetened by the action of powdered charcoal, especially by what is called *animal charcoal*, obtained by burning bone, or the clippings of hides, leather, &c. Coloured vegetable solutions filtered through well burned charcoal are materially decoloured by it: when burned in oxygen or air, it is converted into *carbonic acid* (*See* DIAMOND and CARBON.) Common charcoal intended merely for fuel is prepared by cutting pieces of wood from 1 in. to 3 in. in diameter into lengths of from 1 ft to 3 ft, forming them into a conical pile, and covering them with turf or clay, leaving two or three small holes, close to the ground, for lighting the wood and boring through the turf in the upper part of the cone, a few other small holes for the escape of the smoke. The pile being lighted at the several holes along the bottom, continues burning with a slow smouldering flame for a week or two, and is allowed to cool before the turf is removed In the case of very high winds, the holes to the windward are stopped, to prevent combustion from going on with too great rapidity Charcoal obtained by distilling beech-wood, log-wood, willow, and other woods which are free from resin, is called *cylinder charcoal* The charcoal employed in the manufacture of gunpowder is now always so prepared

CHARDS The footstalks and midrib of artichokes, cardoons, and the white beet are so called In the case of the artichoke and cardoon, the leaves are tied up, and the light excluded by straw ropes or by soil, in order to blanch the chard, and deprive it of its natural bitterness, after which, when dressed, it becomes an agreeable vegetable The leaves of the white beet, not being naturally bitter, do not require blanching to render them fit for use

CHA'RFRON, or CHAMP-FREIN In Plate armour, plates of steel or pieces of leather, to protect the face of a horse.

CHARGE In Gunnery, is the quantity of powder and weight of ball with which guns are loaded For proving cannon, the charge of powder is equal to the weight of the ball, but for service it is about one half, or more frequently about one third the weight of the ball Dr. Hutton in his Mathematical Dictionary states that different charges of powder, with the same weight of ball, produce different velocities in the ball, which are in the sub duplicate ratios of the weight of powder, and when the weight of powder is the same, and the ball varied, the velocity produced is in the reciprocal sub-duplicate ratio of the weight of the ball, which is agreeable both to theory and practice He states also, that from many experiments made by him on this subject, he found the length of the charge producing the greatest velocity in guns of various lengths of bore, from 15 to 40 calibers, to be as follows —

| Length of bore in calibers. | Length of charge for greatest velocity. |
|---|---|
| 15 | 3-16ths. |
| 20 | 3-12ths |
| 30 | 3-16ths. |
| 40 | 3-20ths. |

CHARGE In Heraldry, signifies the various bearings, *i.e* ordinaries and figures, depicted on the escutcheon A shield is said to be *charged* with the bearings depicted on it; and so is an ordinary or other charge, when it bears another device upon it.

CHARGE and OVERCHARGE. In Painting, a term applied to any exaggeration of character, expression from colour, &c

CHARGE' D'AFFAIRES. The third or lowest class of foreign ministers, according to the regulations adopted at the congress of Vienna.

CHA'RITY, SISTERS OF. The name by which an institution of females is known in France, whose office is to attend the sick, and who form a similar society to that of the Beguins in Flanders. *See* BEGUINS.

CHA'RLES'S WAIN A name sometimes given by astronomical writers to the constellation Ursa Major, or Great Bear. It has sometimes also been applied to the Little Bear.

CHA'RLOCK. A common name in the northern counties for one of the most common weeds, *Raphanus raphanistrum*. The plants when young are remarkably like those of the common turnip; but they are easily distinguished by the taste, which is hot and bitter; while that of the turnip is mild. Cold wet lands are more subject to the charlock than warm calcareous soils. As sheep are remarkably fond of the plant, they are frequently turned into corn fields where it abounds, in which case it is found that they do not touch the corn while any of the charlock remains. That excellent husbandman Mr. Lisle, having sown charlock seed and turnip seed at the same time, found that the latter came up in three days, while the charlock required ten. The seed, when buried in the soil to a certain depth, will retain its vital properties for an unknown length of time; grass lands that have not been ploughed within the memory of man having, when broken up, produced abundance of this plant.

CHA'RON. (Gr. χάρων.) In Mythology, the ferryman of hell, who conducted the souls of the departed in a boat across the Stygian lake to receive judgment from Æacus, Rhadamanthus, and Minos, the judges of the infernal regions. He received an obolus from every passenger, for which reason the ancients used to put that piece of money in the mouths of the dead. He was said to be the son of Erebus and Night.

CHA'RRED WOOD. Wood, the outer surface of which has been carbonized by burning, in order to preserve it from decay when it is buried in the soil.

CHA'RRING OF POSTS. The practice of carbonizing by burning that portion of the surface of wooden posts which is to be inserted in the ground. The object is to prevent the posts from decaying, more especially at the surface of the ground, or, as the common phrase is, between wind and water. The practice is common in most parts of Europe, and even in Russia and Sweden, though timber is there so abundant.

CHART. A hydrographic map for the use of navigators, being a projection of some part of a coast on a plane surface. Charts as well as ordinary maps may be constructed on any of the principles by which a spherical surface is represented on a plane; but they are generally laid down according to Mercator's projection, in which the meridians, and consequently also the parallels of latitude, are represented by parallel straight lines, the degrees of longitude on all the parallels being equal to those of the equator, and the degrees of latitude being increased from the equator towards the pole, so as to bear always the same ratio to the degrees of longitude which they do on the sphere itself. *See* MAP and PROJECTION

CHARTA'CEUS (Lat charta, *paper*) Papery, indicating the paper-like texture and substance of most leaves

CHA'RTA, MA'GNA, in English History. The "Great Charter of the Realm" was signed by King John in 1215, and confirmed by his successor Henry III It is reported to have been chiefly drawn up by the Earl of Pembroke and Stephen Langton, Archbishop of Canterbury. Its most important articles are those which provide that no freeman shall be taken or imprisoned or proceeded against, "except by the lawful judgment of his peers or by the law of the land," and that no scutage or aid should be imposed in the kingdom (except certain feudal dues from tenants of the crown) unless by the common council of the kingdom. The remaining and greater part of it is directed against abuses of the king's power as feudal superior.

CHARTE. (Lat charta, *paper*.) In French History, originally used to indicate the rights and privileges granted by the French kings to various towns and communities, but applied at present to the fundamental law of the French monarchy, as established on the restoration of Louis XVIII in 1814. The *Charte* consists of 69 articles, and is founded on principles analogous to those of the British constitution, as embodied originally in the Magna Charta, and subsequently extended in the Bill of Rights As is well known, it was the violation of an article of the *Charte* by the Ministers of Charles X that led to the revolution of 1830, the expulsion of that monarch from the throne, and the establishment of Louis Philippe's dynasty, which, after 18 years' sway, was itself expelled, February 24th, 1848, and therewith the charte which it was called in to support fell to the ground.

CHA'RTER-PARTY. (Fr. parti, *divided*) In Mercantile Law, is defined to be a contract, by which the owner or master of a ship hires or lets the whole or a principal part of it to a freighter for the conveyance of goods, under certain specified conditions, on a determined voyage to one or more places. A charter-party is generally under seal; but a printed or written instrument signed by the parties, called a memorandum of a charter-party, is binding if no charter-party be executed. A voyage may be performed in part under a charter-party, and in part under a parol agreement; but the terms of a charter-party cannot be altered by parol evidence, although they may be explained by mercantile usage. The instrument expresses the freight to be paid, and generally, but not necessarily, the burden of the ship, together with some usual covenants, and others at the discretion of the parties.

CHA'RTULARY. In Diplomatics, a collection of the charters belonging to a church or religious house.

CHASE. (Fr. chassis.) In Printing, an iron frame six tenths of an inch in thickness, in which pages are wedged up to secure the letters from separating or dropping out in the process of printing. Chases are of

different dimensions, according to the number of pages in a sheet, and the size of the paper: in the printing of books there are two bars fixed across at right angles, called crosses, so as to divide the chase into quarters for greater security. The thickness is always the same, however large the chase, being lower than the types, for the purpose of keeping the margin of the paper clean.

CHAST. A row or rank of plants or trees, and more especially of hedge plants; also an extent of waste or forest land.

CHAST. In Nautical language, pursuit; also the vessel pursued.

CHA'SER. The vessel pursuing Also guns at the head and stern for firing when in chase

CHA'SING, or ENCHASING In Sculpture, the art of embossing or making bassi rilievi in metals The work is punched out from the back, and then cut on steel blocks or puncheons, and cleared with small chisels and gravers

CHAT-POTA'TOES Small potatoes, only fit for giving to pigs or boiling for poultry.

CHAT-WOOD. Small sticks and spray, only fit for fuel

CHAU'NTRY. *See* CHAPEL.

CHAYA ROOT. The root of the *Oldenlandia umbellata*, cultivated upon the Coromandel coast as a red dye stuff

CHEESE. The curd of milk compressed into solid masses of different sizes and shapes, and, when intended for keeping, salted and dried, and sometimes coloured and flavoured. It is almost always made from the milk of cows, but occasionally from that of ewes, and sometimes though very rarely, from the milk of goats The following are the principal British cheeses. — *Buckbat*, formed of new milk and cream, chiefly in Wiltshire, in the autumn, and sold in little square pieces about the size of brickbats *Cheddar*, round thick cheeses, weighing about 150 or 200 pounds, with a spongy appearance, and the eyes or vesicles filled with a rich oil. *Cheshire*, large round thick cheeses, commonly weighing from 100 to 200 pounds each, solid, homogeneous, and dry and friable rather than viscid. They are made from the whole of the milk and cream, the morning's milk being mixed with that of the preceding evening previously warmed *Derbyshire* is a small white rich cheese *Dunlop*, originally made in Ayrshire, but now general throughout Scotland, is large, round, white, buttery, and weighs from 30 to 60 pounds This and the Derbyshire cheese are very much alike in form, colour, and flavour *Gloucester*, large, round and mild, buttery rather than friable There are two kinds, the single and double Gloucester, the single is made of the milk deprived of about half the cream, and the double of the milk with the whole of the cream. *Green* or *Sage* cheese may be made of any of the other kinds, by mixing the milk before it has curdled with a decoction of sage leaves, among which some put a few flowers of marigold and leaves of parsley In the Highlands of Scotland the leaves or seeds of lovage are added to the sage, which communicate a very strong flavour *Lincolnshire* is made of new milk and cream, it is quite soft, not above 2 inches thick, and will not keep more than two or three months *Norfolk*, the weight is generally from 30 to 50 pounds, the curd is dyed yellow with arnotto or saffron, and though not a rich cheese, it is considered a good keeper *Soft* or *Slip coat* is a small soft rich cheese, which might almost be mistaken for butter, if it were not white, and which must be eaten in a week or two after making *Stilton*, so named from the town in Huntingdonshire where it was first brought into notice, but which is made principally in Leicestershire. It is solid, rich, buttery and white, and, unlike all the other cheeses which have been mentioned, it is twice as high as it is broad It is much improved by keeping, and is seldom used before it is two years old. It is the dearest of all English cheeses, the price being generally to that of Chester as 2 to 1, or 2 to 1¼. In order to induce premature decay and the consequent appearance of age in these cheeses, it is said the makers sometimes bury them in masses of fermenting straw. *Cottenham*, so named from a town in Cambridgeshire; it differs chiefly from the cream cheese of Stilton in being flat, broader, and superiorly flavoured The flavour is said to be owing to the rich grasses which grow on the fens. *Suffolk*, or *skim-milk*, is round and thin, weighing from 25 to 30 pounds each, and is the best keeping cheese made in England. *Wiltshire* resembles the Cheshire; but is poorer, and of inferior flavour. It is apt to become scurfy, to prevent which it is generally coated over with red paint. *Yorkshire*, or *cream cheese*, is the same as the slip-coat cheese, already mentioned.

*Foreign Cheeses* — The most remarkable of these are the following — *Parmesan* is chiefly made at Parma and other places in Lombardy, of the curd of skimmed milk hardened by heat. Its flavour is said to be owing to the rich pastures of that part of Italy, where all plants, from the greater quantity of bright sunshine than in Britain, have doubtless their aromatic properties greatly increased. *Swiss cheese* is of various kinds; but the chief sorts are the Gruyere or Jura cheese, and Schabzieger or green cheese; the last is flavoured with the seeds and leaves of the melilot (*Melilotus officinalis*). *German cheeses* are of different kinds; but none are celebrated, unless we except that of Westphalia, which is made up into round balls or short cylinders, under a pound weight each The peculiar flavour which this cheese acquires arises from the curd being allowed to become putrid before it is compressed. In Holland very good cheese is made, particularly the Edam and Gouda cheeses, the former is very salt, and keeps well at sea In many parts of the Continent, and even in the interior of Poland and Russia, there are imitations of English cheese made; but what may be called the indigenous cheese of the Russian empire is nothing more than salted curd put into a bag and powerfully pressed, and taken to market as soon as it is made, in the same manner as butter is. In some places, instead of a press, the whey is forced out of the curd by putting it into a long cloth midway between the two ends, while a person at each end twists the cloth in an opposite direction, and thus wrings out the whey In some miserable Russian villages the curd is exposed for sale in small lumps, retaining the marks of the fingers, which shows that no other pressure has been employed than what can be given with the hand

In France the Roquefort cheese is the most esteemed, and next that of Neufchatel. The former somewhat resembles Stilton, but is much inferior, and the latter is a cream cheese, seldom exceeding a quarter of a pound in weight.

CHEESE-MITE *See* PIOPHILA.

CHI'TAH, or CHEETA A Mahratta vernacular name, applied both to the *Felis jubata* and the *Felis leopardus*. It is to the former species, or hunting leopard, that the term is confined in this country

CHIRONE'CTES (Gr χειρ, *hand*, and νηχω, *I swim*) A genus of spine-finned fishes, having the pectoral fins supported, like short feet, upon pedunicles. By means of this organization the cheironects can creep over the mud or sand when left dry by the receding tide, they also propel themselves along by short leaps, and in this way seize upon insects which may be hovering about, whence they have obtained the name of frog-fishes. The gill cavity is large, but the outlet very small and the quantity of water which can thus be retained enables the cheironects to remain out of water longer than fishes in general can do. The term *Cheironectes* is applied by Illiger to a genus of opossum having the hinder hands webbed Some naturalists adopt this application of the term, and apply to the genus of fishes so called by Cuvier the name *Lutenarius*, originally given to the cheironects by Commerson

CHIROPTERA. (Gr χειρ, *a hand*, and πτερον, *a wing*) An order of Mammalia characterized by having the anterior extremities and especially the hands, so modified as to serve the office of wings, the fingers being extremely lengthened, and connected together by a thin membrane. Of this order the common bat (*Vespertilio murinus*) may be regarded as the type The order includes very numerous and diversified species, which have been grouped by De Blainville, who has devoted an especial study to them, into three principal divisions Of these the *first* includes the largest species, called "flying-foxes" they are, however, vegetable-feeders, and are characterized by having the ears and nose of a simple form, the two innermost fingers of the hand armed with claws, and of the ordinary structure; the tail, and the web of skin connecting the hind-legs, and called the "interfemoral" web, very short, or wanting, and lastly, by having the molar teeth separated by intervals, and of simple structure. These bats are distributed over the warmer latitudes of the old continent, and extend to the islands of the Pacific ocean The *second* division has the nose complicated by variously shaped and grotesque membranous foliations; the first or innermost digit alone retains its ordinary structure and armature; the molar teeth are beset with sharp tubercles, and the food of these species consists of insects, or the blood of higher organized and larger animals. The vampire-bats of South America belong to this group, which also includes the horse-shoe bats (*Rhinolophi*), and other genera distributed over all parts of the old world The *third* division of *Cheiroptera* has the nose constantly simple; the other characters as in the second. It includes the bats properly so called, which are uniformly insectivorous, and of small size.

CHE'LA (Gr χηλη, *pincers*) The first pair of forcipated extremities of the crab, lobster, and other crustaceans.

CHE'LICERES. (Gr χηλη, *pincers*, and κερας, *a horn*.) The term applied by Latreille to two appendages of the head of the Arachnidans, or spiders and scorpions, which appendages he considers as representing the mesial antennæ of the *Decapod Crustacea*, here converted into manducatory organs.

CHELO'NIANS, *Chelonia*. (Gr. χελωνη, *a tortoise*) The order of Reptiles, including the tortoises, terrapenes,

and turtles; characterized by the body being inclosed between a double shield or shell, out of which extend the head, tail, and four extremities. The land tortoises have the power of retracting all these parts within the shell.

CHEMISTRY. (The word is probably derived from the Coptic root *chems* or *khems*, signifying *obscure* or *secret*. The German word *geheim* is apparently of the same origin.)

Chemistry is a department of science, the objects of which are to investigate the nature and properties of the elements of matter, and their mutual actions and combinations; to ascertain the proportions in which they unite, and the modes of separating them when united, and to inquire into the laws and powers which preside over and effect these agencies. As an *art*, chemistry may be traced to a very remote period, but it can scarcely be said to have existed as a *science* previous to the commencement of the seventeenth century; and in tracing its early history we shall find the principal materials upon which it is founded in the works of Bacon, Boyle, Hooke, Mayow, and Newton.

As *induction from experiment* is the exclusive basis of chemical science, little progress could be made in it till the futility of the ancient philosophical systems had been exposed, and their influence annihilated, and till the necessity of that form of severe experimental inquiry had been established which "first procures the light, and then shows the way by its means." Upon such foundations, laid by Bacon, the other philosophers whose names have been mentioned proceeded to bring together and arrange the materials which had been furnished by their predecessors, and were thence led into that train of true philosophical reasoning and research which served as an emulatory example to their immediate successors, and which has led in our times to the gigantic results of modern discovery.

It is well known that the alchemists had accumulated a number of valuable but isolated chemical facts, and that they had explored with considerable diligence the abstract properties and mutual agencies and relations of the greater number of natural products, but, with few exceptions, they neglected their useful and obvious applications, and wasted their labours upon unattainable and chimerical projects. Their discoveries and inventions, as Lord Bacon justly and forcibly observes, "are well represented in the fable of the old man who left an estate to his children, buried, as he said, in his vineyard, which therefore they fell to dig and search for with great diligence, whereby, though they found no gold in substance, yet they received an abundant vintage for their labour. So assuredly has the search and stir to make gold produced a great number of fruitful experiments."

Alchemical speculations, including the attempts at the conversion of mercury into gold, and the search after antidotes and universal remedies, were vigorously carried on during the sixteenth and seventeenth centuries, and many amusing accounts of the professors and adepts of those periods have been handed down to us by the chemical historians of the time. Those who are curious upon these subjects may consult Mangetus, *Bibliotheca Chemica*, and the *Theatrum Chemicum* of Elias Ashmole: the latter contains "several poeticall peices of our famous English philosophers, who have written the hermetique mysteries in their owne ancient language," but their perusal is labour lost; not so, however, with Basil Valentine, Paracelsus, Van Helmont, and Glauber, in whose writings we not only find the materials so happily worked upon by Hooke and Mayow, but which also abound in announcements of important practical discoveries, and in hints to which many of the improvements of modern times may be plausibly traced.

Basil Valentine of Erfurt was born about the year 1400, his writings, although tinctured with the follies of alchemy, are full of shrewd and intelligent remarks: he was the discoverer, apparently, of nitric and of sulphuric acid, and of many antimonial preparations, which are fully described in his *Triumphal Chariot*. Philip Hochener, more commonly known under the name of Paracelsus, and who died in 1541 at Saltzburgh, in the forty-third year of his age, is chiefly celebrated for the boldness and assiduity with which he introduced chemical preparations into the practice of medicine; he did little, however, as a discoverer. Van Helmont, one of the soundest writers of his period, was the first who seems to have paid attention to the nature of gaseous bodies, and to the distinction between permanent gases and vapours. the word *gas* first occurs in his works; and under the term *gas silvestre*, he seems to allude to what was afterwards termed *fixed air*. None, however, of these early practical chemists come into competition with Glauber. He was an active experimentalist, and an acute reasoner, and in reference to his discoveries we may enumerate among them the distillation of muriatic acid from a mixture of sulphuric acid and common salt, the purification of the residuary sulphate of soda, which he termed *sal mirabile*, and which still bears his name; the production of ammonia by the distillation of bone, and its conversion into *sal ammoniac* by the addition of *spirit of salt*; the preparation of sulphate of ammonia, which he terms *secret sal ammoniac*; the formation of blue vitriol by the action of sulphuric acid upon the green rust of copper, the composition of numerous earthy, alkaline, and metallic salts, and lastly, the evolution of vinegar during the destructive distillation of wood, for which he describes and delineates the distillatory apparatus, under the name of "a press for extracting the juice of wood," and the uses of which, together with those of the oil of tar and other products, he describes at length, closing his discourse with a statement of his apprehension that he shall be by many disbelieved; but "it contented me," he says, "that I have written the truth, and lighted a candle to my neighbours." Glauber also published a pamphlet, entitled "*The Consolation of Navigators, in which is taught how they who travel by sea may preserve themselves from hunger and thirst, and also from those diseases which are wont to happen in long voyages: written for the health, comfort, and solace of all those who travel by water for the good of their country.*" The sensible plan of employing extract of malt as a portable vegetable diet, and diluted muriatic acid to quench thirst, is here recommended, and many of the medicinal uses of that acid are dwelt upon, among which are some that have been claimed as recent discoveries. On the whole, there is no author, contemporary with Glauber, who has written so much to the purpose, and who, as it were, anticipated so many of our modern scientific improvements.

Reverting to the names of Boyle and his eminent associates, we are reminded of the origin of the *Royal Society of London for the Improvement of Natural Knowledge*, which was incorporated by Charles II. in the year 1662, and of which Boyle and Hooke were active and distinguished members. Boyle died in 1691. His station in life, his mild and prepossessing disposition, his strict honour and integrity, and the unaffected earnestness with which he promoted experimental inquiry, tended to shed a lustre on his pursuits, to elevate their character with the world, and to draw into their precincts many who without such an example would have passed their lives in that listless inactivity then too common with those upon whom fortune smiled. among these Mr. Boyle made many converts.

Boyle's Essays on the successfulness and unsuccessfulness of Experiments, and the Preface to his Philosophical Writings, are in the genuine spirit of experimental research, but the new and important aspect assumed about this time by such pursuits is perhaps chiefly due to Dr. Robert Hooke (born in the Isle of Wight in 1635, and died in London in 1702). Among his views and discoveries which bear upon the progress of chemical philosophy, the most important are those relating to the phenomena of combustion, and to the part which the air performs in that process, his notions upon these subjects are remarkable for their boldness as differing from the prevailing theories of the day, and for their correctness as superseding the objections to which those theories were liable. From the hints contained in the writings of the alchemists, it appears that the phenomena of combustion were referred to a subtile and highly volatile principle, which, agitated and expanded by heat, produced *flame* and *fire*. When metals were exposed to the action of heat the greater number of them were observed to alter their appearance, and, losing their brilliancy, became converted into an earth-like powder or *calx*. It was generally admitted that in this process the particles of the combustible were thrown into violent vibrations, and in that way transformed into heat and light. But it had been also remarked that in certain cases of combustion, and especially as regards the metals, the phenomenon was attended by an actual increase of weight in the burning body, and that this result was incompatible with the theory which assumed the conversion of the combustible into heat and light, or the evolution of that principle of inflammability which by Becher and Stahl and the chemists of that school was termed *phlogiston*. About the year 1630 a remarkable tract appeared in France relating to this subject, by Jean Rey, a physician of Perigord. Le Brun had melted two pounds six ounces of lead, and found that in six hours the whole had been converted into calx, but that instead of having lost *phlogiston*, or any other ponderable matter, it had actually increased in weight to the extent of many ounces. Puzzled by this result he consulted Rey as to its cause, who immediately undertook an experimental inquiry, which led him to refer the increase in weight in this and similar cases to the *fixation of air*. This inference was amply supported by the researches of Boyle and of Hooke: the former found that no combustible would burn under the exhausted receiver of the *air-pump*, and consequently that the presence of air was requisite; and Hooke, finding that however intensely charcoal was heated, it would not *burn* when air was excluded, infers "that air is the universal dissolvent of inflammable bodies, and that this dissolution generates heat, which we call *fire*." But he went a step beyond this, and

attributes the power of supporting combustion to a principle in the atmosphere, "like unto, or the very same as, that which is fixed in saltpetre;" for he had observed the power of that salt as a supporter of combustion. His words are as follow:—"The dissolving parts of the air are but few, and hence the atmosphere is like those spirits which have much phlegm mixed with them, and become soon glutted; whereas saltpetre abounds more in those solvent particles, and hence a little will dissolve a great sulphurous body quickly and violently; and as other solvents, though but weak, quickly consume the dissoluble body if the supply be renovated, so air applied to a shining body by a bellows will dissolve it as rapidly as saltpetre." From all which he concludes that there is no element of fire, but that flame results from the mutual chemical action of the combustible upon a part of the atmosphere. (*Hooke's Micrographia*) Hooke also alludes to the part performed by *air* in the process of respiration; and in his *Lampas*, published in 1677, has given a beautiful explanation of the burning of a candle. He attributes the light and heat to the action of the air upon the combustible matter of the flame, and shows that the interior of the flame is not luminous, by the simple expedient of viewing its section through a thin piece of glass or of mica.

These doctrines of Hooke were further illustrated by John Mayow (born in Cornwall 1645, died in London 1679), who not only experimentally corroborated them, but pointed out the connection between combustion and respiration, and showed that that part of the air concerned in the support of flame was also essential to the life of animals. He placed a candle under a bell-glass, and when it would no longer burn, he found that on rekindling it it was immediately extinguished by the same air; he then placed a mouse in a confined portion of air, and it soon manifested the want of its renewal, he then put the mouse under the same bell-glass with the candle, and found that it only lived half the time that it had survived without the candle; he then reversed the experiment, and endeavoured to burn a candle in air which had been breathed, and finding that it went out, he concluded that the "nitro-aerial particles" of the air were as essential to respiration as to combustion, and that they were in both cases *absorbed*, and he even refers *animal heat* to the influence of the air upon the blood.

But Mayow's claim to a distinguished place in the history of chemistry is not merely founded upon the sagacity with which he followed up these views, he was the first who distinctly expounded the nature of *chemical affinity*, and who taught its independence of those mechanical forms of the particles of matter to which it had been referred, and showed, contrary to the prevailing tenets, that in cases of combination the particles of the acting bodies were not annihilated, but that they still existed in the compound, and might again be elicited from it with all their former powers and properties. These notions he illustrates by a series of extremely apposite experiments, and proceeds to explain *decomposition* upon the principle of inequality in the respective attractive forces of the acting bodies, a doctrine which was afterwards verified and further explained by Newton, whose masterly sketch of a theory of chemical attraction, given in the queries to the third book of Optics, is nearly in the language and entirely in the spirit of his predecessor. The theory of combustion and of affinity, thus established upon the basis of experiment by Hooke and Mayow, constitute the foundation upon which most of the superstructure of modern chemistry rests, the former was extended and embellished by Lavoisier, and the latter has gradually risen into the atomic and equivalent doctrine. There are three principal points connected with the vast extension and importance of chemical science as we now find it, to which it becomes necessary therefore to allude; namely, the investigations relating to the philosophy of *heat*, those connected with *pneumatic chemistry*, and those establishing the connection of *electrical* with *chemical* phenomena.

It was not till towards the middle of the seventeenth century that such perfection was given to the construction of the *thermometer* as to enable it to be used as an accurate and comparative measure of temperature. Dr. Halley seems to have been the first who applied the uniform temperature of boiling water to obtain one fixed point for its graduation; the constant temperature of water in the act of freezing seems also to have been noticed about the same time by the Florentine academicians, and by Newton; and these two points being thus determined and ascertained, together with the causes of their occasional discrepancies, the graduation of the thermometer became easy, especially when the advantages of mercury had been pointed out by Halley, together with the mode of sealing it in the thermometer tube. (*See* THERMOMETER.) But the great and important step in the philosophy of heat was the consequence of Dr. Black's discovery of the state in which heat exists in liquids and vapours, and upon which he founded his beautiful theory of *latent heat*. This theory gave a satisfactory solution of a multitude of natural and artificial phenomena previously unexplained or unobserved, and laid the foundation of those wonderful improvements in the theoretical and practical construction of the steam engine which were soon afterwards carried into effect by Watt.

Dr. Black was born in 1728 on the banks of the Garonne, and educated at Belfast, and afterwards at Glasgow: in 1766 he was appointed to the chemical chair in the university of Edinburgh, where he died in 1799. He not only made the grand discovery of the latency of heat, but he enriched chemistry with other discoveries; among which that of the presence of carbonic acid in the mild earths and alkalies, and the cause of their causticity, was especially perfect and important. These facts, including also the discovery of carbonic acid, or, as it was then called, *fixed air*, were first published in 1756, his ideas respecting the combinations of heat with ponderable matter were perfected in 1764.

Another and distinct series of inquiries, having important bearings upon the philosophy of heat, had its origin with the Florentine academicians towards the end of the seventeenth century, and was afterwards sagaciously followed up by Scheele, Leslie, and others, it relates to the *phenomena of radiation*, to the manner in which heat is propagated through space, and to those of its emanation from luminous and incandescent bodies, and to its connection with light.

*Pneumatic Chemistry* had its origin in the experiments of Hooke and Mayow, and was subsequently extended by Hales, and more especially by Priestley. Mayow obtained hydrogen gas by the action of iron on dilute sulphuric acid, and observed the formation of nitrous gas during the action of aquafortis upon the same metal; but it was not till the commencement of the last century that the distinctive characters of the gases and their importance as chemical agents began to be duly appreciated. Connected also with this subject is the rise and progress of the chemical physiology of vegetation. Dr Stephen Hales was born in Kent in 1677, and died at Teddington in 1761. He began the communication of his researches to the Royal Society in 1717, and in 1727 published his "*Statical Essays, containing an essay towards a natural history of vegetation, of use to those who are curious in the culture and improvement of gardening, also a specimen of an attempt to analyse the air by a great variety of chemico-statical experiments, which were read at several meetings before the Royal Society*." In 1733 a second volume of these Essays was published, containing "*Hæmastatics, and experiments on the stone of the kidney and bladder*." In his various experimental researches detailed in these essays, Dr. Hales describes many curious facts, and shows much ingenuity in the contrivance of apparatus, but he furnishes a striking instance of the facility with which the mind is led away from the true path of discovery by preconceived opinions, for having predetermined that the various gaseous products which he obtained were mere modifications and contaminations of common air, he missed much that was fairly within his grasp. He observed for instance, that air was absorbed during the combustion of phosphorus in close vessels, but he examined none of the products; he collected the air evolved during the destructive distillation of wood, and found it fatal to animals, from Newcastle coal he obtained one third of its weight of gas, and from nitre, 180 times its bulk; but he did not leisurely examine any of these products. He found that iron filings and oil of vitriol would not evolve gas unless water was present; but instead of stopping to examine the properties of the hydrogen gas which he thus obtained, he hastens on to irrelevant observations, being more eager to multiply experiments than to examine their results. In the same way he details with minute accuracy the quantity of air generated during the distillation of blood, tallow, sal ammoniac, and many other substances, without drawing a single useful inference. In his experiments on respiration too, he obtained results of extreme interest, and is often upon the verge of most important discoveries; but instead of being incited by the novelty of his results, and the extent of the field of investigation opened by his researches, he drops them upon the occurrence of the slightest difficulty. His examination, however, of the motion of the sap in vegetables was pursued upon a more regular and satisfactory plan; he ascertained the quantity of matter imbibed and perspired by several plants and trees, the proportion daily lost by the leaves, and their influence upon the absorptive powers of the root; and the relation of various states of the atmosphere as to temperature and moisture upon these functions. He endeavoured to confer different flavours upon fruits by impregnating the soil with perfumed waters, and he found that the odorous particles were rejected by the living vessels, but that they affected the dead parts of the tree; he compares the functions of the leaves of evergreens with those of deciduous shrubs and trees; he notices the effect of cutting a ring of bark off the branch of a tree in promoting the growth of its leaves and fruit; and, lastly, shows that air is some-

times absorbed or inspired by plants, and gives some interesting views relative to the germination of seeds.

When it is recollected that Hales wrote at the commencement of the last century, that few models of good scientific composition were then extant, and that a pompous and obscure style was prevalent among most of his contemporaries, we must admire the perspicuous and unadorned manner in which he details his facts and observations. He has in this respect all the merit which belongs to Boyle without his diffusiveness; and a pleasing vein of sound and unaffected morality accompanies his arguments, and leads him, whilst endeavouring to unveil the mysteries of nature, to direct our attention with becoming modesty to the extreme penury of man's wisdom, when compared with the admirable adjustments of causes and effects discoverable in the lowliest works of the Creator.

But although Mayow, Hooke, and Hales had done much towards establishing the interest and importance of gaseous chemistry, it is to Dr Joseph Priestley (born at Fieldhead, near Leeds, 1733, died in Pennsylvania, 1804) that we owe the principal progress in this branch of our science. He directed his attention to it with a degree of activity and skill then peculiarly his own, and in the number of his discoveries left his contemporaries far behind, while he certainly rivalled them in their interest and importance, which is the more surprising when we reflect that he generally seems to have considered his philosophical studies as subordinate to his more severe and serious occupations. He first turned his attention to chemistry about the year 1768. He used to amuse himself with experiments on fixed air and on artificial mineral waters; and one experiment, as he says, leading to another, he soon collected those materials which he laid before the Royal Society in 1772, under the title of *Observations on different Kinds of Air*. It was on the 1st of August, 1774, that he made the great discovery upon which so much of the subsequent progress of chemical science has depended, namely, that of *oxygen gas*. He obtained it by exposing a quantity of *red precipitate of mercury* to the action of the sun's rays concentrated upon it by a lens; the red precipitate was contained in a flask filled up with mercury, and inverted in a basin containing the same metal. "I presently found," he says, "that by means of this lens air was expelled from it very readily. Having got several times as much as the bulk of my materials, I admitted water to it, and found that it was not imbibed by it, but what surprised me more than I can well express was, that a candle burned in this air with a remarkably vigorous flame, very much like that enlarged flame with which a candle burns in nitrous air exposed to iron or liver of sulphur, but, as I got nothing like this remarkable appearance from any kind of air besides this particular modification of nitrous air, and I knew no nitrous acid was used in the preparation of the *mercurius calcinatus*, I was utterly at a loss how to account for it." He then goes on to show that *red lead* and *nitre* also afford oxygen at a red heat, and calls it, consistently with the theory of combustion which was then prevalent, *dephlogisticated air*, regarding it as common air deprived of phlogiston, and consequently possessed of a powerful affinity for that imaginary principle.

Shortly after the discovery of oxygen, Priestley ascertained that plants had the power of purifying air which had been vitiated by the respiration of animals, and that oxygen was evolved by aquatic plants in water containing carbonic acid. Nitrous and nitric oxide, muriatic acid, and ammonia were also amongst his gaseous discoveries. In 1772 Dr Rutherford had demonstrated that a large portion of the atmosphere consisted of a peculiar gas differing from fixed air, yet, like it, extinguishing flame and unfit for respiration; to this component part of the atmosphere Dr Priestley gave the name of *phlogisticated air*, and pointed out the means of ascertaining its relative proportion to the oxygen of the air by the agency of nitrous gas.

Another celebrated name connected with the progress of this department of chemical science is that of Cavendish. In 1776 he presented the Royal Society with a dissertation on inflammable, fixed, and nitrous air. The two latter gases had been well described by his contemporaries; but nothing very precise was known respecting inflammable air, till its sources and properties were described in Cavendish's masterly paper. He found that it was the lightest known substance, and in conjunction with Watt he showed that by combustion with oxygen *water* was the only result; hence the term *hydrogen* subsequently applied to this gas. Cavendish also discovered the composition of nitric acid; and by passing a succession of electric sparks through common air, and through artificial mixtures of oxygen and nitrogen, he succeeded in effecting their combination, and in producing that acid.

Two capital and extremely important steps were thus made in chemical science, chiefly by the joint labours of Priestley and of Cavendish; namely, the composition of the atmosphere and of water; and about the same time Scheele (born at Stralsund in 1742, and died at Köping near Stockholm in 1786), in his dissertation on Manganese, made known the existence of chlorine, or, as he then termed it, of dephlogisticated muriatic acid gas. His "Observations and Experiments on Air and Fire," and on "Heat and Light," are also masterly productions, and contributed, in conjunction with the labours of his eminent contemporaries, to invest chemistry with a degree of interest and importance which gave it an entirely new and distinct aspect, and an elevated rank in physical science.

It was at this period that Lavoisier and his associates in Paris undertook that celebrated reform of chemical nomenclature which ended in the banishment of phlogiston, and introduced a logical precision before unknown into the precincts of chemistry. Lavoisier experimented upon a magnificent scale, and with a degree of statical accuracy which stamped his researches with a new and valuable character. By a series of beautiful experiments he determined the relative proportions of the elements of the atmosphere and of those of water; he rejected all supporters of combustion except oxygen, and regarded it as the sole source of the heat and light evolved during that process; he endeavoured to prove that gases were constituted by the union of ponderable bases with *caloric*, or the *matter of heat*, and examined, upon a splendid scale and with princely apparatus, the results of the combustion of sulphur, phosphorus, carbon, and the metals; he inferred that oxygen was the universal *acidifying* principle; and by a series of well conceived researches he demonstrated the identity of charcoal and the diamond, and showed that when burned in oxygen they yielded carbonic acid gas. Lavoisier was also the first who examined with requisite accuracy the products of the distillation of animal and vegetable substances; he also inquired with more success than any of his predecessors into the phenomena of fermentation, and, by examining the contents of certain vegetable juices, previous to and after that process, he drew some curious and important conclusions respecting the changes that take place. he also extended and corroborated Scheele's views as to the importance of the chemical agencies of light.

These, and a variety of other details, are embodied in Lavoisier's *Elemens de Chimie*, which appeared at Paris in 1789, a work which eminently displays the extent and perspicuity of his views as a theoretical and experimental philosopher, and which contains a masterly refutation of the phlogistic doctrines. The abstract facts, however, upon which this refutation rests may be traced to Mayow, Hooke, Priestley, and Scheele. It has been stated that the prominent features of the French theory were its explanation of the phenomena of combustion and of acidification, the presence of oxygen being deemed essential in both cases. That air is the food of fire was known at a very remote period; that it causes the increase of weight sustained by metals during their calcination was shown by Rey early in the seventeenth century; that a part only of the atmosphere, identical with a matter contained in saltpetre, is concerned in the support of flame, was explained by Hooke in 1667; and that the vital, or igneous spirit, as he terms it, contributes to the formation of acids was asserted by Mayow in 1674. Here, therefore, without even infringing upon the eighteenth century, we have, in explicit detail, the principal facts and arguments requisite for the construction of the French theory; and if to these we add the discovery of oxygen by Priestley, and of the composition of water and of nitric acid by Watt and Cavendish, what then becomes of its title to originality?

The influence of the researches connected with the philosophy of heat, and of those relating to the production, properties, and constitution of the gases, upon the improvement and extension of chemistry, will now be apparent; but one of the most fertile sources of its recent progress is of a distinct and remarkable origin, namely, the discovery of *the chemical influences of electricity*.

In 1790 Galvani of Bologna ascertained that certain spasmodic or convulsive contractions might be produced by the action of electricity upon the nerves of a recently killed animal, and that if the sciatic nerve of a frog be laid bare and touched with a piece of zinc, whilst at the same time the muscle is touched with gold, similar effects to those of electricity are produced whenever the metals were brought into contact, or connected together by conductors of electricity; if nonconductors were used, no spasm ensued. He accounted for these and similar effects by assuming that the nerves and muscles were in opposite electrical states, and that the spasms were the consequence of their annihilation or discharge.

Volta, on the other hand, finding that two different metals were essential, referred the phenomena to the electromotive power of the metals; and following up this idea, he soon succeeded in producing that extraordinary form of electro-generative apparatus which is now known under the name of the Voltaic pile or battery, consisting of al-

fernations of two metals with an intervening fluid: zinc, copper, and diluted acids are the substances now generally resorted to. It has lately been shown by Faraday that *chemical action* is the exclusive source of the electricity of these Voltaic arrangements; but their history and the theory of their phenomena will be given elsewhere.

In the year 1800 the *chemical powers* of the Voltaic pile were first observed in regard to the decomposition of water and certain saline solutions, by Messrs. Nicholson and Carlisle, these were more accurately investigated in 1803 by Hisinger and Berzelius, and in 1806 Sir H. Davy communicated his celebrated lecture "On some Chemical Agencies of Electricity" to the Royal Society. He had previously (1801) given a paper to the Society containing an account of some galvanic combinations formed by the arrangement of single metallic plates and fluids, analogous to the galvanic apparatus of Volta, but it was not till the publication of the Bakerian Lecture above alluded to that the importance of *electro-chemical science* could be appreciated. It contains a masterly outline of the subject, and its details present a fine specimen of experimental inquiry, especially in reference to the manner in which he traces out the decomposing powers of an electrical current in effecting the separation of the elements of water, the skill with which the conflicting results of other experimentalists are examined and explained, the caution with which he proceeds from experiment to theory, and the sagacity with which he employs theoretical views as the source of new experimental inquiries. Following the path which he had thus opened for himself, it led him on to the most important and extraordinary results, among which were the decomposition of the alkalis and earths, and the discovery of an entirely new class of metals.

But the eradication of established errors is perhaps a more difficult task than the promulgation of new theories, and in this Davy rendered a memorable service to chemistry by his several papers on "Oxymuriatic Acid," in which he successfully establishes the views of Scheele regarding its nature, and refutes and subverts those of the French school, and which had been sanctioned by the chemists of Europe. He demonstrates the existence of acids without oxygen, and lays the foundation of the theory of the *hydracids*.

To these masterly researches Davy added a third series, of equal if not superior importance, those relating to the *safety lamp*. His first paper upon this subject is printed in the *Philosophical Transactions* for 1815, and was followed by four others. Finding that flame would not recede through tubes of very small diameter, the idea occurred to him of constructing a lamp which should have no connection with the surrounding air except by capillary tubes, and he inferred from previous experiments that such a lamp might safely be employed in coal mines infested by fire-damp. He then endeavoured to ascertain the extent to which the tubes might be *shortened* without interfering with this principle of safety, and was thus led to cut them down, till their transverse section resembled a series of meshes. This approached so closely to *wire-gauze* that he was induced to try how far that tissue would prevent the passage of flame, and finding it effectual, he employed it in the construction of his lamp, and ultimately adopted the simple and efficient arrangement now in general and successful use. During the experimental investigations upon which the discovery of the safety lamp was founded, Davy ascertained a number of curious facts respecting the constitution and temperature of flame, which, with other parts of his general inquiry, are not less ingenious than original. In November, 1820, Sir H. Davy became president of the Royal Society, and continued to contribute papers as heretofore, some of them upon subjects of much interest, ably and philosophically discussed; among them the essays on the modes of protecting the copper sheathing of ships deserve especial notice, they have furnished hints for the preservation of iron and other corrodible metals from the influence of air and water, and promise to lead to results of great practical importance. In the course of the year 1827 his health became seriously impaired, he passed the greater part of the year 1828 in Italy, and terminated his memorable existence at Geneva in May, 1829, in the fifty-second year of his age.

We have now briefly sketched the principal circumstances in the history of chemistry bearing upon its origin and progress as a science, without however, adverting to the labours of contemporaries, it remains to add a short notice respecting the art of *Analysis*, and the important consequences of which the prosecution of that branch of the science has been productive.

*Analysis* was first scientifically pursued by Bergman of Sweden. He was born in 1735, and died in 1784, in consequence, as is said, of too intense application to his studies. The use of *tests* for the discovery of certain substances held in aqueous and other solutions, is first particularly dwelt upon by Boyle. He used vegetable colours for the detection of acids and alkalis, and noticed the cloudiness produced by nitrate of silver in solution of common salt. In 1667 Du Clos undertook an examination of the mineral waters of France, and in 1686 Hierne published some clever experiments upon the same subject in Sweden. In 1726 Boulduc used spirit of wine to precipitate the salts insoluble in that menstruum; in 1755 Venel pointed out the existence of fixed air in the waters of Selters, Spa, and Pyrmont; Lane, in 1760, showed the method of imitating chalybeate springs; and in 1772 Priestley published directions for saturating water with fixed air. The above and other tests were particularly examined, their accuracy compared, and the best modes of applying them pointed out by Bergman, his dissertations on the waters of Upsal, on sea-water, and on the artificial preparation of medicated waters, each exhibit proofs of his skill as an analyst, and accuracy as an experimenter. He also turned his attention to the analysis of minerals; his essay, entitled *De Minerarum Docimasia Humidâ*, must be considered as the parent source of that branch of analytic chemistry so successfully followed up, though upon a limited scale, by Scheele, and in the improvement and extension of which Klaproth passed his long and laborious life. Klaproth was born at Wernigerode in Prussia in 1743, and died at Berlin in 1817. He published 207 essays in his 'Contributions towards the Chemical Knowledge of Mineral Substances." Another eminent name among chemical analysts is that of Vauquelin, who died at an advanced age in Paris in 1829. He was originally a peasant boy in Normandy, and afterwards was employed in Fourcroy's laboratory, where he not only acquired great dexterity in the ordinary duties of his situation, but became an expert and original analyst. He afterwards rose to high eminence in his profession, and his numerous and important contributions and discoveries are lasting monuments of his skill and industry.

Among the improvers of analytical chemistry in this country Chenevix, Howard, and Tennant deserve particular mention, but to none is this part of the science more deeply indebted than to Dr. Wollaston. With him and Davy all that is practically useful in the theory of definite proportionals or, as it is often called, the *Atomic Theory*, may be said to have originated, though the facts upon which it is founded were chiefly furnished by the German analysts, and by Higgins of Dublin.

We have in another place given some account of this important subject, and have endeavoured to explain the facts upon which it is founded, and the results to which it leads. Its promulgation with us is mainly attributable to Wollaston's suggestions contained in his paper "On a Synoptic Scale of Chemical Equivalents," brought before the Royal Society in November, 1813. Many years previously he had established the important doctrine of multiple proportions in a paper "On Superacid and Subacid Salts." He now showed the practical applications of which the theory was susceptible; and, by connecting the scale of equivalents with Gunter's sliding rule, has put into the hands of the chemist an instrument infinite in its uses, and equally essential to the student, the adept, and the manufacturer.

There remains to be noticed a distinct branch of chemistry of extreme interest and importance, but beset with peculiar difficulties, namely, that relating to *organic substances*. Some progress was made in it by Scheele, but it has chiefly been enriched by the labours of modern and contemporary philosophers, and in their hands has assumed an entirely new aspect. The composition of organic bodies may be viewed in two ways, either as relates to their ultimate elements, or to their proximate groups. The former are remarkably few in number, and are almost exclusively confined to four, namely, carbon, hydrogen, oxygen, and nitrogen. These, by their varied and extraordinary union, give rise to innumerable secondary products or proximate principles. That the same elementary forms of matter should give rise to such infinitely varied products, merely in consequence of the varying proportions in which they are combined and the circumstances under which they have been presented to each other, that food and poisons, alkalis and acids, sweets and bitters, and, in short, the most opposite and dissimilar qualities, should arise out of such causes—is extremely remarkable; and although every day is adding to our information, and clearing difficulties from this department of chemistry, it is but in its infant state.

In looking at the present state of chemistry, it must be allowed that it exhibits a most promising aspect, the study of its abstract principles is calculated to keep the curiosity constantly on the alert, and awaken an intense and peculiar interest; and it is quite impossible to glance at its recent progress, and at the extraordinary discoveries which are daily rewarding the labours of its skilful cultivators, without anticipating most important consequences. Should its progress during the ensuing century only equal that of the past, it must lead to results deeply affecting the interests and welfare of mankind, but as it has hitherto acquired strength with its progress, its wonders may be expected to accumulate in a much higher ratio. We already seem to be on the brink of some great discovery connected with those powers and

properties of matter which we call *electrical*. Their association with, and convertibility as it were into, heat, light, and magnetism, and their identity with the cause of chemical affinity, have already been turned to great account, and it is only necessary to assume the possession of a more unlimited command that we at present enjoy over the production or evolution of this extraordinary agent, less dependent and scanty means of summoning it into existence or activity, and a more intimate acquaintance with its forms and qualities, to confer the highest interest upon our speculations. Its chemical powers would then be perpetually called into action as a substitute for the more sluggish or circuitous and difficult methods of ordinary decomposition. Its single application to the evolution of oxygen and hydrogen from water would alone work wonders, whilst the facility of its conveyance and transmission, its ubiquity, and its varied attributes in those different states which for want of more explicit knowledge of their cause have been termed *quantity* and *tension*, seem to point it out as of unlimited application to human uses. Through its instrumentality telegraphic communication has not only been accelerated, but rendered independent of weather, and equally facile by night as by day; and even in the present state of this invention there seems no reason against such conveyance of our thoughts, wants, and wishes, so as to transmit them over the globe with a rapidity as much beyond all previous experience, as the travelling on a rail-road exceeds that of a common carriage.

Connected, therefore, with the progress of the higher departments of chemical science, and indeed intimately interwoven with it, is the advancement of its application to all the arts of life. It is often supposed that the successful applications of chemistry to the arts have been rather the results of accident or chance than the consequence of those apparently abstract studies, and curious rather than useful discoveries, as they are called, in which the truly philosophical chemist is engaged, and in which his labours terminate, but experience justifies no such conclusion. There can be no doubt that Black's researches into those effects of heat which are connected with changes in the state and form of bodies and especially with the constitution of vapour, led Watt into that train of reasoning by which his improvements in the steam engine were ultimately effected. Most of the wonders of modern chemistry must be referred to Galvani's experiments on a dead frog. They led Volta to the construction of the electric pile, and, in the hands of Davy and his successors, what important conquests have been attained, and what extraordinary consequences are daily flowing from a source so apparently unpromising and irrelevant! Independent of the new agents which have been placed in the hands of the experimentalist, and of the new and important theoretical considerations which arise out of them, the whole aspect and character of a great department of physical science has been wonderfully changed, extended, and improved, the cause of magnetism has been developed, and a power no less extraordinary and applicable to human uses than light and heat, perhaps indeed the parent of both, is gradually showing us its mysterious relations. Of two great practical consequences have these inquiries already been productive, namely, the electrical telegraph, and the preservation of metals from corrosion. That others are upon the eve of their development cannot be doubted, and in proportion as our knowledge of this agent and consequent power over it is extended, those ends must certainly be attained which we have above ventured to anticipate.

From other departments of this science we are constantly acquiring similar benefits: the progress of gas illumination, the great improvements in metallurgic operations, in the arts of dyeing and calico-printing, in the manufacture of cements, in the preservation of timber from dry-rot, in gilding and silvering the metals, are only a few of the cases in point, even the difficult and apparently isolated researches into the relative proportions of the ultimate elements of the proximate organic products, and the application of the atomic theory to those researches, have not been fruitless, considered in reference to what are termed their practical results and popular and useful applications. The brewer and the distiller are reaping the benefits of such inquiries, the conversion of starch, and even of wood, into sugar, are the practical consequences of theoretical inferences, from the destructive distillation of ligneous matter we are already furnished with our chief supply of vinegar, and with a liquid which, as a combustible and a solvent, has to a great extent superseded the use of alcohol, and may possibly take its place at no very remote period as an intoxicating stimulant: the saw-dust of certain woods has been shown susceptible of conversion into nutriment; and the analysis of bone points it out, when properly prepared, as almost equal to its weight of flesh as an article of human food. In short, of the arts of life the greater number are dependent upon chemical principles; many of them, and perhaps the most important, are exclusively so; others, though apparently mechanical, involve chemical principles. Hence the great and growing importance of chemical science as a branch of general education, and upon political economy, and upon the prosperity of the arts and manufactures.

Having given this outline of the rise, progress, uses, and applications of chemical science, we must refer to other articles for more explicit information upon the different heads that have been alluded to. In reference to further details respecting the history of this department of knowledge, especially as relates to alchemy and to the history of chemical inventions, we may refer to Dr. Thomson's *History of Chemistry*, and to the prefatory chapter of Mr. Brande's *Manual*.

The extent necessarily occupied by chemistry in a map of human knowledge will be evident from the brief definition of the science given at the outset of this article, for it not only leads us to inquire into the composition of every product of nature and of art, but to examine the elements of all the forms of matter, and the laws which govern their mutual actions and reactions. The questions which a chemist propounds to himself, in examining any newly discovered substance, involve therefore a long train of inquiries, which can only be answered and worked out by multiplied *experiments*; for it is impossible to move onwards in this science except upon the basis of experimental research. Accordingly, when a body of unknown nature is presented to us, we endeavour, first to ascertain whether it be a *simple* or a *compound* substance. If simple, to what class of elementary bodies does it belong, is it combustible or incombustible; is it electro-negative or electro-positive, how is it affected by heat, what are its relations to other forms of matter; what its powers of combination, what are the proportions in which it unites with other substances, what are its characters and those of its combinations as a chemical and physiological agent; what are its uses in the arts and in medicine? If it be a compound substance, we inquire into the nature and number of its component parts: are they new, or are they known elements; in what proportions are they combined? We also, as before, examine its thermal and electrical relations, and its useful applications. These, and many other questions which arise in the course of chemical investigation, involve as it were several distinct branches of inquiry, and lead us to contemplate chemistry under two points of view; namely, as an independent science, which embraces the whole field of chemical knowledge, and investigates the chemical relations of bodies without reference to any extraneous considerations—this is *pure, theoretical*, or *philosophical chemistry*, and secondly, as a science having certain objects in common with others, as with mineralogy, medicine, physiology, and the arts — this being *applied chemistry*.

In a subject then so extensive and complicated as chemistry, *systematic arrangement* is of the utmost importance to the teacher and student. In the broad principles of arrangement most writers agree, but in minor details each generally pursues a path of his own. It would be useless, even if it were possible, to enumerate the details of these arrangements as adopted by the leading didactic writers on chemistry, but the basis upon which they are founded deserves a few words of explanation.

The objects of chemistry are all included under one or other of the following heads; namely, —

1. The general powers and properties of matter.
2. The chemistry of elementary substances.
3. The chemistry of compounds.

And each of these require several subdivisions. Thus, under the first head, we include *attraction* and *affinity*, *heat*, *light*, and *electricity*, under the second head are included the chemical history and properties of the ponderable *elementary substances*, and their mutual *reactions*, which of course leads on to the third head; namely, to the chemical history and properties of *compound bodies*. To render the systematic arrangements of the elements and their compounds intelligible, it will be necessary to enumerate the former, and point out such of their characters as are connected with their classification.

Every substance upon our globe contains one or more of the following *fifty-four* elementary or simple bodies. some of them are of extremely rare occurrence, others abundant and always with and about us. It will be observed that by far the greater number of them come under the denomination of *metals*, of the others, oxygen, hydrogen, carbon, and nitrogen, are by far of most frequent occurrence, as will be obvious when it is recollected that air and water and all vegetable and animal products include two or more of the last-mentioned substances.

The equivalent or [illegible] proportions of these elements, although mentioned under individual substances in this work, are here subjoined (*see* the articles AFFINITY, ATOMIC THEORY, and EQUIVALENTS), and also the *symbols* by which they are represented.

**Table of the Simple Substances, with their Symbols and Equivalent or Combining Weights.**

| | Equivalents, Hydrogen = 1. | Symbol. (Brande.) | Symbol. (Berzelius) | Equivalents, Oxygen = 1. |
|---|---|---|---|---|
| 1 Aluminum | 10 | *al.* | Al. | 1·25 |
| 2 Antimony | 65 | *ant.* | Sb. | 8·125 |
| 3 Arsenic | 38 | *ar.* | As. | 4·75 |
| 4 Barium | 69 | *ba.* | Ba. | 8·625 |
| 5 Bismuth | 72 | *bi.* | Bi. | 9· |
| 6 Boron | 20 | *bo.* | B. | 2·5 |
| 7 Bromine | 78 | *b.* | Br | 9·75 |
| 8 Cadmium | 56 | *cad.* | Cd. | 7· |
| 9 Calcium | 20 | *cal.* | Ca. | 2·5 |
| 10 Carbon | 6 | *car.* | C. | 0·75 |
| 11 Cerium | 48 | *ce.* | Ce. | 6· |
| 12 Chlorine | 36 | *c.* | Cl. | 4·5 |
| 13 Chromium | 28 | *chr.* | Cr. | 3·5 |
| 14 Cobalt | 30 | *cob.* | Co. | 3·75 |
| 15 Columbium | 185 | *col.* | Ta. | 23·125 |
| 16 Copper | 32 | *cu.* | Cu. | 4 |
| 17 Fluorine | 18 | *f.* | F. | 2·28 |
| 18 Glucium | 18 | *gl.* | G. | 2·25 |
| 19 Gold | 200 | *au.* | Au. | 25 |
| 20 Hydrogen | 1 | *h.* | H. | 0·125 |
| 21 Iodine | 125 | *i.* | I. | 15·625 |
| 22 Iridium | 96 | *ir.* | Ir. | 12 |
| 23 Iron | 28 | *fe.* | Fe. | 3·5 |
| 24 Lead | 104 | *pl.* | Pb. | 13 |
| 25 Lithium | 10 | *li.* | L. | 1·25 |
| 26 Magnesium | 12 | *mag.* | Mg. | 1·5 |
| 27 Manganese | 28 | *man.* | Mn. | 3·5 |
| 28 Mercury | 200 | *hg* | Hg. | 25· |
| 29 Molybdenum | 48 | *mol.* | Mo. | 6 |
| 30 Nickel | 28 | *nic.* | Ni. | 3·5 |
| 31 Nitrogen | 14 | *n.* | N. | 1·75 |
| 32 Osmium | 100 | *os.* | Os. | 12·5 |
| 33 Oxygen | 8 | *o* | O. | 1 |
| 34 Palladium | 54 | *pal.* | Pd. | 6·75 |
| 35 Phosphorus | 16 | *p.* | P. | 2 |
| 36 Platinum | 96 | *pla* | Pl. | 12· |
| 37 Potassium | 40 | *po.* | K. | 5 |
| 38 Rhodium | 45 | *rh* | R. | 5·625 |
| 39 Selenium | 40 | *se.* | Se. | 5 |
| 40 Silicium | 8 | *si.* | Si | 1 |
| 41 Silver | 110 | *ag.* | Aq. | 13·75 |
| 42 Sodium | 24 | *so.* | Na. | 3 |
| 43 Strontium | 44 | *str.* | Sr. | 5·5 |
| 44 Sulphur | 16 | *s* | S. | 2 |
| 45 Tellurium | 32 | *tel.* | Te | 4· |
| 46 Thorium | 60 | *th.* | Th. | 7·5 |
| 47 Tin | 58 | *sta.* | Sn. | 7·25 |
| 48 Titanium | 24 | *ti.* | Ti | 3 |
| 49 Tungsten | 100 | *tu.* | W | 12·5 |
| 50 Vanadium | 68 | *va.* | V | 8·5 |
| 51 Uranium | 217 | *ur* | U | 27·12 |
| 52 Yttrium | 32 | *yt.* | Y | 4 |
| 53 Zinc | 32 | *zn.* | Zn. | 4 |
| 54 Zirconium | 30 | *zir.* | Zr | 3·75 |

The examination of the physical and chemical properties of the preceding elements of matter leads us to classify them according to their analogies. The greater number of them possess the characters of *metals*. Several resemble the metals in certain respects, but are in others widely different; these therefore have been termed *metalloids*. A few are distinguished by entering into peculiar and distinct saline combinations, of which common salt may be taken as the type, these therefore have been termed *halogens*. And lastly, three of the elements are only known in the gaseous form, they have neither been liquified nor solidified, but whenever they are isolated they present themselves as permanent gases, hence they have been designated *gazolytes*. This is the classification of the elementary bodies suggested by Berzelius, and it represents them as follows. —

| I. | II. | III. | IV. |
|---|---|---|---|
| *Gazolytes.* | *Halogens.* | *Metalloids.* | *Metals.* |
| Oxygen. | Chlorine. | Sulphur. | |
| Hydrogen. | Iodine. | Phosphorus. | |
| Nitrogen. | Bromine. | Carbon. | |
| | Fluorine. | Boron. | |

The metals, by far the most numerous of the elementary bodies, are themselves the subjects of various classifications, among which the following is perhaps the most convenient, they are arranged nearly in the order of their respective attractions for oxygen: —

| I. | II. | III. |
|---|---|---|
| Potassium. | Manganese. | Copper. |
| Sodium. | Iron. | Lead. |
| Lithium. | Zinc. | Antimony. |
| Calcium. | Tin. | Bismuth. |
| Barium. | Cadmium. | Uranium. |
| Strontium. | Cobalt. | Titanium. |
| Magnesium. | Nickel. | Cerium. |
| | | Tellurium. |

| IV. | V. | VI. |
|---|---|---|
| Arsenic. | Mercury. | Glucium. |
| Molybdenum. | Silver. | Zirconium. |
| Chromium. | Gold. | Yttrium. |
| Vanadium. | Platinum. | Thorium. |
| Tungsten. | Palladium. | Aluminum. |
| Columbium. | Rhodium. | Silicium. |
| | Osmium. | |
| | Iridium. | |

The substances in the last division have been but imperfectly examined, and silicium should perhaps rather be regarded as a metalloid than a metal.

In one or other, then, of these classes each elementary body will find a place, but the arrangement only relates to the simple substances; the classification of their *combinations*, which are almost indefinite, is a much more intricate and difficult subject, and it would be impossible here to give even an outline of the different plans which have been pursued or suggested. As far, however, as the teacher of chemistry is concerned, none of the systematic arrangements of compounds can be conveniently adopted; his best plan, therefore, is to develope their history and properties as he proceeds. Having, for instance, discussed the abstract properties of *oxygen* and *hydrogen*, he proceeds to the *compound* which they form, and which is *water*; then he proceeds to the third element, *nitrogen*, and its *combinations* with those previously described; thus, nitrogen and oxygen form five distinct compounds, namely, *protoxide* and *binoxide* of nitrogen, and *hyponitrous*, *nitrous*, and *nitric* acids. Nitrogen also combines with hydrogen to form *ammonia*, and ammonia combines with nitric acid to form the salt called *nitrate of ammonia*. In a state of *mixture*, nitrogen and oxygen constitute the great bulk of the *atmosphere*.

From this brief notice of the mode of dealing with the three elementary bodies of the first class, the reader will readily understand the method of applying the same principle to the entire list; the student will thus be conducted, step by step, from the simplest to the most complicated chemical combinations. It is always convenient, however, in adopting this plan, to exclude the products of organization, and to consider them apart, under a separate head, entitled *organic chemistry*, which is of course subdivided into the *chemistry of vegetable* and of *animal products*.

If, having studied chemistry upon this plan, we look back upon the path which has been traversed, we shall immediately see that the *compounds* may be grouped into classes, related to each other by certain analogies both of properties and composition. Thus we have the class of *oxides*, or combinations of oxygen which are not acid; of *chlorides*, *iodides*, &c., and of *acids*, and these again subdivided into *oxyacids*, and *hydracids*, and lastly, the numerous class of *salts*, or compounds of the acids with salifiable bases.

When compound bodies are susceptible of electro-chemical decomposition (or *electrolytes*) the elements always tend to one or other pole; in other words, they are either separated at the point or surface at which the (presumed) electrical current enters, or at the surface at which it leaves the electrolyte; hence the arrangement of the elements into *electro-negative* bodies, or those which tend to the *anode*, and *electro-positive* bodies, or those which tend to the *cathode* (using the terms anode and cathode in reference to the ingress and egress of the electric influence), oxygen, the halogens, and sulphur are *anions*, or electro-negatives; hydrogen, and probably all the metals, are *cathions*, or electro-positives. A good arrangement of the elementary bodies is founded upon such properties, and although there are several whose electrical relations have not hitherto been accurately determined, the *electro-chemical arrangement* is that which will probably be most generally adopted.

CHE'NOPODIA'CEÆ. (Chenopodium, one of the genera.) A natural order of herbaceous Exogens, distinguished with difficulty from *Amarantaceæ* by their herbaceous calyx, from *Phytolaccaceæ* by their solitary carpel, and the stamens never exceeding the number of the segments of the calyx, to which they are opposite. They consist of weeds inhabiting most parts of the world, abounding least within the tropics; and they possess few sensible properties. *Chenopodium anthelminticum* produces the *worm-seed oil* of the shops; but in consequence of their insipidity the species are often used for food, as in the case of spinach, &c. Chevalier has remarked the curious fact of *Chenopodium vulvaria* exhaling pure ammonia during its whole existence.

CHE'QUY, CHE'CKY, or CHE'QUERED. In Heraldry, a term used when a field or charge is divided by transverse lines, paleways and fessways, into equal parts or squares of different tinctures.

CHERT. A silicious mineral approaching the characters of flint.

CHE'RUBIM. *See* SERAPHIM.

CHEVA'L DE FRISE. A large and strong piece of timber, traversed with wooden spikes, pointed with iron. It is laid in a breach to impede the advance of cavalry.

CHEVALIE'R (Fr. cheval, *a horse*), is used synonymously with the Eng. knight, Lat. eques, and Germ. ritter.

CHEVRE'TTE. In Artillery, an engine used for raising guns or mortars into their carriages.

CHE'VRON. In Heraldry, one of the nine honourable ordinaries. It may be defined as consisting of the lower half of a saltire (*see* SALTIRE), brought to a point on the upper side; and the object from which its name is derived accurately resembles it in shape. chevron, in

old French, meaning the support of a roof formed by two rafters leaning against one another. A chevron standing on one side of the escutcheon is said to be tourny, dexter, or sinister.

CHE'VRONEL. In Heraldry, an ordinary of the same shape with the chevron, but containing only half its dimensions.

CHI'AN TURPENTINE. A species of turpentine brought originally from the island of Chios. It is the produce of the *Pistacia terebinthus*

CHIA'RO SCURO (It. *clear obscure.*) In Painting, the art of so disposing the lights, both positive and reflected, and the shadows of a picture in such a manner, that the objects may stand out and be naturally relieved from one another. Its name, however, seems more naturally to point to those parts of represented objects which, though in shadow, have the intensity of such shadow lessened by the reflection of a light body against them. It is a branch of the doctrine of Sciography.

CHI'CA. A red colouring matter used by some tribes of American Indians to stain the skin: it is extracted from a species of *Bignonia*.

CHI'CKEN POX. (*Varicella* of medical writers.) An eruptive disease, which, though frequently very mild in its attack, is often also violent and attended by much fever. The eruption consists of smooth vesicles of various sizes, which afterwards become whitish and straw-coloured, about the fourth day they break and scab off, seldom leaving marks, or at least not more than a few, upon the most delicate parts of the face, or where they happen to have been large or accidentally scratched or irritated. In very warm weather the fluid in the vesicles becomes yellow, and apparently purulent, so as closely to resemble small-pox in appearance; and under some circumstances the eruptive fever has not only been considerable, but preceded by delirium. The distinctive or diagnostic characters by which we distinguish chicken-pox from small-pox are,—1st, the comparative mildness of the preliminary fever, which indeed is often unobserved in strong and merry children, and nothing known of the complaint till spots are observed about the face and breast. 2d, the rapidity with which the eruption attains maturity and proceeds through its stages, the scabs forming crusts about the fourth or fifth day, which does not happen in the small-pox till the tenth or eleventh 3d, the fluid in the vesicles is usually transparent, or only milky, whereas in small-pox it has a purulent appearance from the commencement Like the small-pox, it very rarely attacks the same individual more than once. In the treatment of this disease little else is in most cases requisite than to keep the patient cool, to abstain from meat, to give diluents and mild aperients, and occasionally, at the commencement, a dose of calomel and rhubarb In bad cases, the whole body is covered with eruption, in mild ones there shall only be a very few vesicles, and it not uncommonly happens that where several children have it in succession, one or two will escape with little else than slight restlessness and very trivial febrile symptoms. It is, however, by no means so trifling a disease as many writers have represented it, and if not closely watched over, may be mistaken for small-pox

CHIEF. (Fr chef, *head*) In Heraldry, the upper part of the escutcheon, divided into three points, dexter, middle, and sinister A chief, as an ordinary, is a less removed to the upper part of the escutcheon. Charges, in the situation of the chief, are described as "in chief"

CHI'LBLAIN An inflammatory swelling, of a purplish colour, produced by exposure of the extremities to cold: it is generally attended with itching, and often with shooting pains. Children, especially those of a scrofulous habit, and old persons, suffer most from chilblains; but they are not unfrequently produced at all times by holding the hands or feet to the fire after they have been exposed to great cold; in which case, the difference of temperature is such as actually to burn the part, for few persons are aware of the high temperature excited by the radiant heat of a common fire upon substances held near it. Warm socks and gloves are the best preventives against this affection, and the itching and pain are generally relieved by moderately stimulating applications, such as equal parts of solution of acetate of ammonia or of vinegar and spirit of wine, or of oil of turpentine and soap liniment. If the part should break or ulcerate, stimulating dressings, such as the resin or chlem ointment, are most serviceable, or in some cases mild escharotics

CHI'LIAD. (Gr. χιλιας, *a thousand*) An assemblage of things grouped or ranged by thousands. The word is chiefly used by the early computers of logarithmic tables, who expressed the extent of the table by saying it contained the logarithms of so many *chiliads* of absolute numbers.

CHI'LIASTS. In Ecclesiastical History, believers in the second advent of Christ to reign a thousand years on earth. *See* MILLENNIUM.

CHILOGNA'THES, *Chilognatha.* (Gr. χειλος, *a lip*, and γναθος, *a jaw.*) An order of the class *Myriapoda* or *Centipedes*, in which the two mandibles and the tongue are united together to form a large lower lip.

CHILO'MA. In Zoology, the upper lip or muzzle of a quadruped is so called when it is tumid, and continued uninterruptedly from the nostril, as in the camel.

CHI'LOPODS, *Chilopoda.* (Gr. χειλος, *a lip*, and πους, *a foot.*) An order of the class *Myriapoda* or *Centipedes*, in which the lower lip is formed by a pair of feet.

CHI'LTERN HUNDREDS, in Politics. The tract anciently called the Chiltern Hundreds extends through part of Buckingham and Oxford shires. The steward of these hundreds was an officer appointed by the crown to keep the peace there. As members of parliament, strictly speaking, cannot resign their seats, the mode of abandoning them is by accepting a nominal office (such as this stewardship) under the crown, which vacates the seat of the party taking it.

CHIMÆ'RA. In Mythology, a fabulous monster, slain by Bellerophon in Lycia According to the lines in the *Iliad*, vi 181. (which, however, are suspected of spuriousness), it had the head of a lion, the body of a goat, and tail of a serpent. (See Heyne's observations on this passage) Many other forms were assigned to the Chimæra, the poets having vied with each other in representing it as the personification of all that is horrible and terrific. It has usually been depicted as vomiting forth flames: —

—— Tremendæ
Flammæ chimæræ —HOR Od. IV. 2. 15.

From this fabulous story is probably derived the application of the term *chimera*, in nearly all the modern languages of Europe, to any wild or incongruous fancy arising in the mind.

CHIMÆRA. In Ichthyology, the name of a genus of Branchiostegous cartilaginous fishes; the best known species, which inhabits the northern seas, and has occasionally been taken on our own coast, is sometimes called "king of the herrings."

CHI'MNEY. (Fr. cheminée.) The place in a room where the fire is burnt, and from which the smoke is carried away by means of a conduit called a flue. Chimneys are usually made by projection from a wall, and recess in the same from the floor, ascending within the limits of the projection and recess. That part of the opening which faces the room is properly the *fire-place*, the stone or marble under which is called the *hearth*. That on a level with, and in front of it, is called the *slab*. The vertical sides of the opening are called *jambs*. The head of the fireplate resting on the jambs is called the *mantle*; and the cavity or hollow from the fire-place to the top of the room is called the *funnel*. The part of the funnel which contracts as it ascends is termed the *gathering*, or by some the *gathering of the wings*. The tube or cavity of a parallelogrammatic form on the plan, from where the gathering ceases up to the top of the chimney, is called the *flue* The part between the gathering and the flue is called the *throat*. The part of the wall facing the room and forming one side of the funnel parallel thereto, or the part of the wall forming the sides of the funnels, where there are more than one, is the *breast* In external walls that side of the funnel opposite the breast is called the *back*. When there is more than one chimney in the same wall, the solid parts that divide them are called *withs*. And when several chimneys are collected into one mass, it is called a *stack of chimneys*. The part which rises above the roof for discharging the smoke into the air is called a *chimney shaft*, whose horizontal upper surface is termed the *chimney top*.

The *covings* were formerly placed at right angles to the face of the wall, and the chimney was finished in that manner, but Count Rumford showed that more heat is obtained from the fire by reflexion when the covings are placed in an oblique position. He likewise directed that the fire itself should be kept as near to the hearth as possible, and that the throat of the chimney should be constructed much narrower than had been practised, with a view to prevent the escape of so much heated air as happened with wide throats. If the throat be too near the fire, the draught will be too strong, and the fuel will be wasted, and if it be too high up, the draught will be too languid, and there will be a danger of the smoke being occasionally beat back into the room Before Count Rumford directed his attention to this subject, smoky chimneys were very common; but by studying his principles, these at present seldom occur. *See* FIREPLACE, GRATE, STOVE.

CHIMPANZEE, CHIMPANSE, or QUIMPESE'. Native names of the African orang (*Simia troglodytes*, Blum). It is of a black colour, and attains the height of between four and five feet, measured in a straight line from the vertex to the heel. This species, which of all the brute creation approaches nearest to man, has been hitherto brought alive to this country only in a young state, and a knowledge of the osteological structure of the adult has been but very recently acquired.

It differs from the Asiatic or red Orang not only in colour, but in the greater size of the external ears, the

more prominent ridge above the eyes, the relative shortness of the arms, and the greater development of the thumb of the hind foot, which has constantly two phalanges and a nail.

The principal osteological differences are the following: — The cranium is flatter and broader in proportion to the face. The supraciliary ridges are more developed; and the great interparietal and lambdoidal crests, which render so remarkable the skull of the adult orang, are wanting. The interorbital space is broader. The occipital foramen has a more central position. The anterior condyloid foramen is single on each side, while in the orang it is double. The intermaxillary sutures are obliterated before the deciduous incisors are shed. The incisive and canine teeth are of smaller proportional size. There are thirteen pairs of ribs instead of twelve pairs, as in the orang; and consequently there are thirteen dorsal vertebræ. The sternal bones form a single row. The chimpanzee further differs from the orang-utan in the non-division of the pisiform bone of the wrist; and in the depression at the head of the femur, corresponding to the interarticular ligament of the hip-joint, which is wanting in the orang.

The habits and deportment of the chimpanzee, as observed in those young specimens which have been brought alive to this country, are of peculiar interest, from the high degree in which inquisitiveness, perception, memory, and docility are manifested, and by the gravity and consideration with which many even of its ludicrous and playful actions are performed. It is probable, however, that in the adult much of this intelligence gives way to the fiercer traits of the brute nature. The negroes which inhabit the forests in the interior of Africa have a general, and doubtless well-founded dread of the great black ape. Vague accounts are repeated in succeeding systems of natural history of the gregarious habits of the chimpanzee, its policy, as shown in the construction of rude huts, and other but much less probable feats. The truth is, however, that we have much more certain knowledge of the habits of the duck-billed platypus of Australia than of the adult chimpanzee, which is the most interesting of all the Mammalia, from the close approach which it makes to the human species.

CHI'NA ROOT. The root of the *Smilax China*, so called because imported from China. It was formerly used in the same cases in which sarsaparilla is now given.

CHINCHI'LLA. The generic appellation founded on the South American or local name "chinchille," or "little chinche," and applied to a genus of gnawing Mammalia or Rodents, peculiar to the South American continent. It is from a species of this genus (*Chinchilla lanigera*) that the grey fur is obtained, which has been so much prized in Europe for many years, but the exact nature of the animal itself has been only very recently ascertained, by the examination of specimens which have been procured for the menagerie of the Zoological Society.

CHI'NCOUGH. *See* WHOOPING COUGH.

CHINE'SE ARCHITECTURE. *See* ARCHITECTURE.

CHINTZ. A peculiar pattern upon printed calicos, in which flowers and other devices are printed in five or six different colours, upon white and coloured grounds. A good chintz pattern in fast colours is one of the most surprising and difficult efforts of the art.

CHIRA'GRA (Gr. χειρ, *the hand*, and αγρα, *a seizure*.) Gout in the hands.

CHI'ROGRAPH (Gr. χειρ, and γραφω *I write*.) In Diplomatics, a species of instrument contrived for the purpose for which indentures were devised, viz. the enabling different parties to retain authenticated counterparts of the deed. Some word (commonly the word *chirographum*, whence the name) was written between the two copies on the same sheet, and cut through lengthwise when they were divided.

CHIRO'LOGY (Gr. χειρ, and λόγος, *discourse*.) The language of the fingers, sometimes called *dactylology*, from δάκτυλος, *the finger*.

CHI'ROMANCY, or PALMISTRY (Gr. χειρ, and μάντικ, *divination*.) The imaginary art of divination by the lines of the hand. According to the science of Chiromancy, the lines on the palm of the hand are divided into principal and inferior. the former are five — the line of life, the line of the liver, or natural mean, the line of the brain; the thoral line, or line of fortune; the dragon's tail, or discriminal line, between the hand and the arm. Various other modes of divination were practised by observation of the hand and its parts, onychomancy (from onyx, a nail), dactylomancy (from the fingers), &c. The practice of chiromancy, once defended and explained by grave and learned authors, is now chiefly left to be exercised by the gipsies.

CHIRO'NOMY. (Gr. χειρ, and νόμος, *law*.) The science which treats of the rules of gesticulation, or pantomime, and oratorical action.

CHI'TON. (Gr. χιτων, *a garment*.) The name of a genus of Gastropodous Mollusks, which have a series of testaceous symmetrical pieces implanted in the back part of the mantle.

CHI'VALRY. (From the French chevalier, *knight*.) The usages and customs pertaining to the order of knighthood. The general system of manners and tone of sentiments which the institution of knighthood, strictly pursued, was calculated to produce, and did in part produce, during the middle ages in Europe, is comprehended in ordinary language under the term of chivalry. This imaginary institution of chivalry, such as it is represented in the old romances, had assuredly no full existence at any period in the usages of actual life. It was the ideal perfection of a code of morals and pursuits which was in truth only partially adopted; and bore the same relation to the real life of the middle ages, which the philosophical excellence aimed at by the various sects of antiquity bore to the real conduct of their professors. But, in both instances, a system of abstract perfection was propounded in theory, which, although the defect of human nature prevented it from being reduced into practice, yet exercised a very important influence in modelling the minds, and even controlling the actions, of those who adopted it. The vivifying principle of ancient philosophy was ideal virtue; that of chivalry, the ideal point of honour.

The origin of chivalry has often been traced to the German tribes, nor has its spirit ever penetrated very deeply into the usages of any country in which these tribes have not either produced the ancestors of the great body of the nation, or at least the conquering and governing class, which transfused its habits and sentiments into that body. Thus Germany and France, and England, whose gentry derive their origin from both, have been the countries most distinguished for the prevalence of this institution. The martial spirit of the Spaniards was indeed partly animated by it, but in their country it always bore something of the character of a foreign importation, modified by the circumstances of their juxtaposition with the Arab race. In Italy, it existed only among those classes which imitated the manners of France and Germany, and never entered into the general character of the natives, notwithstanding the popularity of the poetical romances of chivalry. Among the Sclavonic nations it has never prevailed extensively, although the feudal constitution of Polish society derived a certain tincture from it, it never penetrated into Russia. It has been often remarked, that it is only within the last two or three generations that the nobility of that country, by their intercourse with the nations of Western Europe, have derived something of the spirit of the chivalrous code, so far as it still subsists among ourselves. the point of honour, and its peculiar concomitant the usage of the duel, were scarcely known in Russia before the present century.

Chivalry originated in the feudal attachment of warriors to the person of their king or chief, which has been so often described as characteristic of the ancient Germans. Hence the English word knight, which, when the Norman "chevaliers" were first known among us, was spontaneously used as the translation of their title, signifies in its origin one "knit," or attached to another, — a servant or attendant. At what precise time the devotional character was added to the original martial impress of national usages, and the compound system of chivalry were thus produced, it is not easy to ascertain. It has been said that the investiture of the knight was purely military until the reign of Charlemagne, and it may be supposed that the wars of the Franks against the Saracens first blended the ardour of war and religion together, and that the Crusades completed the union. At the latter period were instituted the two celebrated military orders of monks, the Templars and Hospitallers (see those articles), the code of whose government combined monastic and knightly usages. After valour and devotion, the third characteristic feature of chivalry was gallantry to the fair sex; and the source of this sentiment also has been traced to the habits and feelings of the Northern tribes, among whom woman was looked on with a much more exalted sense of her dignity than in the most civilized countries of antiquity. It is needless to add, that this romantic feeling, however high its precepts may have sounded in theory, degenerated into licentiousness in actual life. M. de Sainte Palaye, the learned French historian of the usages of chivalry, has brought instances enough to prove the extreme depravation of manners which prevailed, even in those courts and at those periods in which the spirit of chivalry was most prevalent. If the Crusades communicated to chivalry its devotional character, it is in the poetry of the Troubadours about the same period, in the 12th and 13th centuries, that we find its peculiarity of devotion to the female sex first developed. But in their verses it does not appear clothed with the romantic purity with which it was afterwards invested by the writers of the heroic tales of chivalry; and still less in those of the contemporary French writers of the *Fabliaux*, from whose compositions we draw the most authentic monuments which we possess in this curious branch of antiquarian research. The knight, or even the esquire, was bound to follow a single lady and dedicate himself to her service; but little delicacy is either

intimated or enjoined in the relations which subsisted between them, and his devotion to her was considered as entitling him to every recompence love could bestow.

The 14th century was the brilliant period of chivalry; when its usages, originally formed in the manners of the people, had become fixed and embellished by the fictions of the writers of romances; and when princes and chieftains, forming their idea of the institution rather from the descriptions contained in them than from real life, sought to bring back their courts and camps to the likeness of those ideal models of perfection. It may be more truly said that the romances of chivalry were the prototypes of that state of courtly society which existed in the reigns of our Edward III. and Richard II., and of which Froissart has left us such accurate and lively representations, than that existing manners and sentiments furnished the subject-matter of those romances. These fictions, of which the heroes were taken from among a long list of fanciful personages, in whose history a little tradition of past events was blended with a much larger proportion of fable, represented the knight not only as devoted to the service of his religion, his lord, and his mistress, but also as consecrated to the general service of the oppressed and maintenance of right all over the world. There can be little doubt that the peculiar ceremonies which, in the 14th and 15th centuries, accompanied the creation of a knight,—the vow of chivalry, the watching, prayer, and fasting, &c.—were borrowed by romantic imaginations from such fabulous recitals, which were read and related in every courtly company. In the reign of Edward III., the romantic part of chivalry, as we have said, was more closely transfused into real manners than at any period either preceding or subsequent. Before that period, the manners of the knights and dames had exhibited but little of that polish and refinement, their sentiments but little of that generosity, which were the subjects of so much imaginary description, and, in later times, chivalry gradually decayed. Its usages were maintained with even more of magnificence than before, its various rites, titles, and distinctions subsisted for a long period in most European countries, and partly remain to this day, but the spirit of feudal devotedness was quenched by the multiplication of mercenary troops, adherence to a feudal lord was superseded by the more general feelings of national patriotism (which, singularly enough, was almost wholly omitted in the chivalric codes), and the extravagances into which the imaginary point of honour had led its votaries fell into discredit and ridicule.

It is, therefore, to the 14th century, and especially to that part of its chronicles preserved by the true annalist of chivalry, Froissart, that we must look for the period when the line between real society and that represented in romances was most nearly broken down. When the usages of chivalry were most flourishing all men of noble birth (except the highest) were supposed to pass through three orders or gradations. They first lived as pages in the train of nobles and chiefs of high rank, next, as esquires, they attached themselves to the person of some individual knight, to whom they were bound by a strict law of obedience, and for whom they were bound to incur every danger, and, if necessary, sacrifice their lives, and, thirdly, they were promoted to the rank of knighthood. (For the different orders of knighthood see KNIGHT.) It is sufficient to observe here, that however great the distinction might be between knights in point of rank and wealth, custom established a species of equality among all of the same order, which may be said to subsist among gentlemen of the present day. They formed, all over Europe, a common corporation, as it were, possessing certain rights and owing each other certain mutual duties and forbearances. They were united, not by the ties of country, but by those of feudal obedience, which attached every knight to the banner of his liege lord, from whom he held his fee; but little or rather no dishonour attached to knights who were under no such feudal tie, if they chose their own chieftain wherever they thought fit. they were free adventurers, whose order was a passport in every service, and, in the actual conflict, the hostility of knights was moderated by usage. Thus, it was dishonourable in any knight to take a knight's life if disarmed, and not to set him free when a prisoner on receiving a fitting ransom. Manny and Chandos, the two most celebrated of Edward III.'s knights, were attached wholly to the banner of their sovereign, and not to that of their country; and although the French constable Duguesclin, the third among these mirrors of chivalry, appears to have been devoted to the cause of France as well as that of his master, this double loyalty found few imitators. In peace, also, knights of all countries were welcome visitors at the courts of chivalric sovereigns, and all enjoyed the privilege of presenting themselves at the tournament, and contending there for the prize.

With regard to the point of honour, which forms the most important feature in the usages of chivalry, see some details under the article DUEL. The principal objects to which it related were, religious belief, fealty to the feudal superior; devotion to some one selected lady; and, finally, the general character for honour and courtesy which it was incumbent on a knight to maintain; for although his imaginary duties, as a knight errant, to avenge wrong and succour the oppressed on every occasion, were not of course very strictly put in practice, yet his vow to perform those duties attached to his character a certain degree of sacredness which it was necessary to maintain. Chivalrous honour was chiefly supported in two ways: first, by the single combat or duel, whether on account of serious provocation or by way of trial of strength, secondly, by the performance of vows, often of the most frivolous and extravagant nature. These latter were generally undertaken for the honour of the ladies. Many historical instances of these absurd yet daring follies are preserved by Froissart. They, with other usages of knighthood were long preserved among those who aimed at the reputation of chivalry, after these usages had ceased to form a part of the ordinary customs of society. Thus, the instances which Froissart relates of knights riding alone up to the barriers of fenced cities, &c., were imitated in after times, and at no less personal hazard, by such romantic personages as Lord Herbert of Cherbury, whose feats performed in rivalry with the French champion Balagny are mentioned in his Memoirs. But the vows did not only relate to martial achievements, but to others of a more extravagant and grotesque character. We need only refer to Monstrelet's narrative of the company called "Galois" of knights and ladies, who bound themselves, for love of each other, to follow a particular code of usages, of which a part consisted in wearing thick clothes in summer and thin in winter, to show that the power of their love rendered them insensible to the difference of seasons, a vow which was maintained with such perseverance, that the greater part of the devoted company actually died of cold. (See also the *History of the Vow of the Heron Sainte Palaye*, vol. iii.) The commencement of such extravagances, however, was rather a sign of the decline of the true spirit of chivalry. It decayed with the progress of mercenary armies and the decline of feudal institutions through the 15th century, in the 16th, it was little more than a lively recollection of past ages, which knights such as Bayard and sovereigns such as Francis I. and Henry VIII. strove to revive, and, finally, it became extinguished amid religious discords, leaving as its only relic the code of honour, which is still considered as governing the conduct of the gentleman.

CHLAMYPHORE, *Chlamyphorus*. (Gr. χλαμυς, *a cloak*, and φερω, *I carry*.) A name given to a small species of Armadillo, which is covered by its coat of mail as by a cloak. The animal is not above 6 inches long, and, like the rest of its genus, inhabits exclusively the continent of South America. It is interesting from the analogy of its skeleton and coat of mail to those of the gigantic extinct megatherium.

CHLENA'CEÆ. (Gr. χλαινα, *a cloak*. All the names belonging to this order are compounded of this word, used in a figurative sense for an involucrum.) A natural order of shrubby or arborescent Exogens, allied to *Malvaceæ*, on account of their monadelphous stamens and involucrated flowers, but referred by Jussieu to the vicinity of *Ebenaceæ*, it, however, appears, from their imbricated calyx, regular flowers, and albumen that they have the greatest affinity with *Ostaceæ*. They are all natives of Madagascar, beautiful in their flowers, but of no known use, and are, in fact, but little known even to botanists.

CHLO'RAL. (From the first syllables of *chlorine* and *alcohol*.) A liquid composed of chlorine, carbon, and oxygen, obtained by the action of chlorine upon alcohol.

CHLORANTHA'CEÆ. (Chloranthus, one of the genera.) A small natural order of apetalous Exogens, nearly allied to *Saururaceæ* and *Piperaceæ*, from both of which it differs in wanting a sac to the embryo, and in having a pendulous ovule and opposite leaves with intermediate stipules. Blume places these plants near to *Operculariæ*. They are natives of the hotter parts of the world, and appear to possess stimulating properties of great importance. *Chloranthus officinalis* and *brachystachys*, although not official in Europe, are believed to be among the most powerful of stimulating agents.

CHLO'RATES. Combinations of chloric acid with salifiable bases. Of these salts the *chlorate of potash* is best known; it was formerly called *oxymuriate of potash*. When mixed with combustibles, such as sulphur or charcoal, and some of the metals, it forms highly explosive compounds, which ignite by a blow or by friction, or upon the contact of sulphuric acid. A mixture of this salt with sugar, or with sulphuret of antimony, is used for tipping the *matches* which inflame when dipped into sulphuric acid, or when briskly drawn through a piece of emery paper. Chlorate of potash consists of 76 chlorine acid + 48 potassa = 124 of the chlorate.

CHLO'RIDES. Combinations of chlorine, corresponding with the oxides. Common salt is a *chloride of sodium*, that is, a binary compound of chlorine and sodium. Where there are two chlorides of the same

base, the relative proportions of chlorine in them are almost invariably as 1 to 2; hence the terms *protochloride* and *bichloride*. Calomel and corrosive sublimate are the protochloride and bichloride of mercury. The latter is frequently termed *perchloride*. In calomel 200 of mercury are combined with 86 of chlorine, and in corrosive sublimate with twice 36 or 72.

CHLO'RINE. (Gr. χλωρος, *green*.) This gas was discovered in 1774 by Scheele, who called it *dephlogisticated muriatic acid*; the French nomenclaturists afterwards termed it *oxygenated muriatic acid*, conceiving it to be a compound of oxygen and muriatic acid. This erroneous view of its nature was corrected in 1809 by Sir H. Davy, who gave it the present name, indicative of its colour. Chlorine is a simple substance, existing at common temperatures and pressures in the gaseous state; but when subjected to a pressure of about four atmospheres it becomes condensed into a yellow transparent liquid, which is a non-conductor of electricity. 100 cubical inches of chlorine, at mean temperature and pressure, weigh between 76 and 77 grains: water absorbs twice its volume, and acquires a yellow colour, and the peculiar suffocating odour of the gas. When humid chlorine is exposed to a temperature of 32°, it assumes a crystalline form, this *hydrate of chlorine* consists of 1 equivalent of chlorine = 36 + 10 of water = 9 × 10 or 90. Chlorine is not only unrespirable, but very injurious when breathed, even if largely diluted: a taper burns in it with a red smoky flame, and is soon extinguished. Some of the metals, when finely divided, spontaneously take fire in chlorine, such as brass leaf, or powdered antimony. A remarkable property of chlorine is its power of destroying almost all vegetable and animal colours, hence the important application of this gas and of some of its combinations to the *art of bleaching*. It also destroys the putrid odour of decomposing vegetable and animal substances, and infectious effluvia of all kinds, whence its use in fumigation, and in preventing the spread of infectious and contagious matter, and purifying noxious atmospheres.

The great natural source of chlorine is *common salt*, which contains it in the proportion of about 60 *per cent*. It is procured by decomposing common salt by the joint agency of sulphuric acid and peroxide of manganese. The best proportions are 3 parts of salt and 1 of oxide of manganese; these are well mixed, and put into a retort with 2 parts of sulphuric acid previously diluted with 2 of water. Chlorine is evolved, and its extrication is quickened by the application of a gentle heat. Chlorine may also be obtained from a mixture of muriatic acid with half its weight of black oxide of manganese. The gas may be collected over water, and should be preserved in bottles with glass stoppers, if left in the contact of water, it is soon absorbed. *See* MURIATIC ACID.

CHLORI'ODINE, or CHLORIO'DIC ACID. A compound of chlorine and iodine.

CHLO'RITE. (Gr. χλωρος.) An earthy mineral of a *green* colour, often found in the cavities and veins of slate rocks.

CHLO'RO. (Gr. χλωρος.) A term used in the composition of botanical and other scientific words formed from the Greek, to indicate a clear lively green colour without any mixture.

CHLO'ROCARBO'NIC ACID. A compound formed by exposing a mixture of chlorine and carbonic oxide to the action of light.

CHLO'ROCYA'NIC ACID. A compound of chlorine and cyanogen.

CHLORO'METER. (Gr. χλωρος, and μετρον, *a measure*.) An instrument for the purpose of testing the decolouring or bleaching powers of *chloride of lime*, by which the relative values of different samples of that important bleaching and disinfecting compound may be ascertained.

CHLO'ROPHAITE. (Gr. χλωρος, and φαιος, *black*.) A mineral, which when recently broken is green, but afterwards becomes black.

CHLO'ROPHANE. (Gr. χλωρος, and φαινω, *I shine*.) A species of fluor spar, which, when heated, shines with a beautiful pale green light.

CHLOROPHYLL. (Gr. χλωρος, and φυλλον, *a leaf*.) The green colouring matter of the leaves of plants.

CHLORO'SIS (Gr. χλωρος), or ETIOLATION. In Botany, is a species of constitutional debility, the affected individual being pale, and destitute of a healthy green: the stems are weak, long, and slender; no flowers are produced; and the plant is readily killed. It is believed that this malady is exclusively produced in plants by want of sufficient light.

CHLOROSIS. (Gr. χλωρος.) In Medicine, a disease giving a peculiar sallowness to the countenance, hence called the *green sickness*. It chiefly affects young females; its symptoms are extremely various, but generally referable to imperfect or suppressed menstrual evacuation. Tonics, chalybeates, aloetics, sea and cold bathing, and slight electric shocks passed through the pelvis, together with due amusement and exercise, are among the principal remedial agents.

CHLO'ROXA'LIC ACID. A compound obtained by exposing acetic acid and chlorine to bright sunshine. Its elements are in such proportion, that it may be regarded as a compound of 1 equivalent of hydrochloric acid and 1 of oxalic acid.

CHLO'RURETS. Compounds of chlorine. *See* CHLORIDES.

CHO'ANITES. (Gr. χοανη, *a funnel*.) A genus of extinct Zoophytes, so called on account of their fossil skeleton or polypary presenting in general a funnel-shaped figure, though sometimes they are globular or subcylindrical. This genus holds an intermediate place between *Alcyonium* and *Ventriculites*. It is distinguished from the former by having a central cavity at the upper part, and from the latter by not having an outer reticulate surface. One species, the *Choanites konigii*, is found in abundance in the loose flints beneath the turf near the race course at Lewes in Sussex, and appears to have been common in the upper beds of the chalk.

CHO'COLATE. A term said to be compounded of two Indian words, choco, *sound*, and alta, *water*, from the noise made in its preparation. Chocolate is made by triturating the roasted cacaa nut into a paste in a heated mortar, sugar and some aromatics being occasionally added, the oily matter of the nut gives it whilst hot a due consistence, so that it is cast in tin moulds, in which it concretes, on cooling, into cakes. It is a rich article of diet, and apt to disagree with weak stomachs.

CHOIR (Gr. χορος.) In Architecture, the part of a church in which the choristers sing divine service. In former times it was raised separate from the altar, with a pulpit on each side, in which the epistles and gospels were sung, as is still the case in several churches on the Continent. It was separated from the nave in the time of Constantine. In nunneries, the choir is a large apartment, separated by a grate from the body of the church, where the nuns chant the service. This term is used also in music to signify a band of singers in different parts.

CHOKE Ddamp. A term applied by well-diggers and miners to *carbonic acid gas*.

CHO'LAGOGUE (Gr. χολη, *bile*, and αγω, *I evacuate*.) A term applied by ancient medical writers to certain purgative remedies which produce bilious evacuations.

CHOLE'DOCHUS. (Gr. χολη, and δεχομαι, *I receive*.) One of the ducts of the liver is called the *ductus communis choledochus*.

CHO'LERA (Gr. χολη, and ῥεω, *I flow*.) A disease accompanied by vomiting and purging, with great pain and debility, and apparently arising from excess or acrimony of bile. It is most common at the close of summer and beginning of autumn, and seems to be produced by cold, suppressed perspiration, indigestible fruits, &c. It generally commences with a sense of pain about the bowels, fever, thirst, an irregular pulse, and severe vomiting and purging of bilious matter: in favourable cases these symptoms subside in a few days with the aid of opiates, mucilaginous diluents, and mild aperients followed by tonics, but in severe cases great exhaustion ensues, attended by depression of spirits, anxiety, hurried respiration, cold sweats, hiccup, low and fluttering pulse, and the patients rapidly sink, and are sometimes carried off within twenty-four hours. In such cases warm fomentations sometimes relieve the pain, and effervescent saline draughts check the sickness, and enable the stomach to bear large doses of opium.

CHO'LERA, ASIA'TIC. The term *Asiatic* or *Spasmodic Cholera* has been applied to a new and most appalling form of pestilential disease, which seems to have been but indistinctly known prior to the year 1817. It made its appearance in August that year at Jessore, after having previously raged to a formidable extent in the south of Bengal, and thence it spread over a great part of Asia, carrying off millions of human beings. In 1823 it broke out at Astracan, but did not at that time extend further into Russia, in 1828, however, it appeared at Orenburg, and during the autumn of that year and the spring of 1829 it spread over a considerable part of the Russian dominions. It raged at Moscow in September, 1830; and having been apparently carried by the Russian army into Poland, it propagated itself through different parts of Europe, and reached this country. The symptoms of this, as of other disorders, vary considerably at different times and in different individuals; but as our object here is briefly to describe the characteristic features of the disease in their unalloyed form, we shall omit all unnecessary details, and place before our readers a short account of its effects in its worst and by no means uncommon form.

The first circumstance that strikes us in regard to the attacks of this disease is their suddenness. A person in apparent health feels slightly giddy, chilly, or sick, and in the course of two or three hours sinks into a state of extraordinary and alarming debility; the countenance assumes a deadly paleness, and the skin feels and looks like that of a corpse; the pulse falls, flutters, and is al-

most imperceptible; a livid circle surrounds the sunken eyes; the tongue is slightly furred, and the breath cold. Under this excessive and extraordinary prostration the patients sometimes die in the course of a very few hours; otherwise it is succeeded by vomiting and purging the voided matters resembling turbid whey, and being in fact a serous fluid with floating shreds or flocculi of coagulated albumen; and now cramp assails the extremities, and afterwards the abdomen, producing spasms of varying but sometimes of extreme violence, great pain and heat about the region of the stomach, and intolerable weight and anguish round the heart are complained of, with much thirst and anxiety; the voice faulters, and the unfortunate sufferer asks frequently, in plaintive and broken whispers, for cold water; the secretions of urine, bile, and saliva appear, in this state of things, as if entirely suspended; the evacuations have a singular fœtor, and the breath and perspiration have that peculiar odour which announces the rapid approach of death. Towards the close of this horrid scene, the respiration becomes very slow, the tendons of the extremities quiver, the sufferer is unable to swallow, insensibility succeeds, and after one or two long and convulsive sobs he dies. The mind, even at last, is scarcely ever much disturbed; but towards the close the patient sinks into a state of apathy, and appears desirous of being left to his fate. Attacks of this kind generally prove fatal in from four to eight hours.

If from this extreme case we turn to what may be termed milder forms of the disease, the same general train of symptoms are observed; but they are less rapid in their succession, and there is more time and opportunity to resort to the resources of art. The attack begins with sickness or purging, succeeded by uneasiness and heat about the pit of the stomach; the matters which are thrown off from the stomach and bowels gradually assume the appearance of rice water; the countenance shrinks; the constriction of the thorax and cramps and spasms follow; and in the course of twenty-four to thirty-six hours the patient dies, in many instances delirious or comatose.

Those who survive seventy-two hours generally recover, as far as the primary symptoms are concerned, the spasms and difficulty of breathing give way, the natural warmth of the body is restored, and the pulse returns to something like its natural standard. The most favourable symptoms are sleep, perspiration, return of the secretion of urine and of bile, accompanied by proportionate improvement in the pulse and aspect of the features, but, even under these apparently and really favourable symptoms, fever of a low or continued character may ensue,—it indeed sometimes immediately follows the blue stage or collapse, and if not relieved by a critical perspiration on the second or third day, the pulse quickens, the face is flushed, there is drowsiness and suffusion of the eyes, stupor, a foul mouth, and other symptoms of mixed or typhus fever, which terminate fatally from the fourth to the eighth day, or even later, in those very individuals who had been saved in the first or cold stage.

The appearances observed on dissection of those who died within eight or ten hours were, a relaxed and pale state of the stomach and intestines; absence of bile and of fæces in the intestines; an empty and contracted bladder; congestion in the venous circulation of the large vessels; the gall-bladder full of bile, but not passing into the intestine. In more protracted cases other appearances occasionally occurred, more especially serous effusion upon and in the brain, with congestion of the vessels, and other usual appearances of febrile disease. In all cases the blood presents a more or less morbid appearance, and is often of a very dark colour and increased consistence, so as to have been compared to tar.

The pathology of cholera is as yet most imperfectly understood; nor has it been satisfactorily ascertained whether it is or is not contagious; the general opinion, however, is in favour of its contagious nature, and there cannot be the least doubt of the propriety of enforcing the most rigid precautionary measures founded upon such an opinion.

Details respecting the *medical treatment* of cholera would be out of place in this work; and the plans to be pursued vary so much with circumstances, as to render it impossible to condense into small limits a general view of this important subject.

*Emetics* are among the earliest measures which should be put in practice; they should be such as act certainly and rapidly, and conjoined with stimulants, such as essential oils and capsicum. *Blood-letting* has been adopted by many practitioners in the early stages of the disease. Its favourable effect is to cause the pulse to rise; if it produce faintness, it must be immediately put a stop to, and should be followed by the application of warm air, and other dry warmth. Large doses of calomel, with or without opium, are resorted to to remove local congestion, and especially to stimulate the liver; and these means are assisted and the general powers of the system kept up by ether, ammonia, brandy, and volatile oils, in such quantities and forms as the particular circumstances of the respective cases may point out. If the irritability of stomach continues, flannels soaked in very hot water, and then sprinkled with oil of turpentine, should be applied to the region of the stomach and abdomen.

The great object of all those remedies applicable to the first stage of the disease is to enable the system to rally from its depressing effects, to bring about re-action, and to stimulate the nervous and vascular systems; but then the utmost circumspection is required in reference to the injurious effects which this plan will induce, if carried too far. Here, however, the symptoms are usually those of typhoid or continued fever, and are to be treated accordingly, great attention being always paid to the state of the biliary and urinary secretions, and to the evacuations from the bowels.

Besides the treatment founded upon the above outline, other and very dissimilar plans have been adopted, founded upon the change which the blood appears to suffer in this disease. It has been by some presumed that in all cases of cholera, the saline matters of the blood, along with a large quantity of its water, are thrown off by the intestines, [illegible] the characteristic serous discharge above adverted to; and that the residuary blood becomes thick and black, in consequence of the deficiency of its salts. Dr Stevens therefore proposed the administration of large doses of common salt, occasionally mixed with nitre and chlorate of potash; and from this plan the best effects have, according to some, resulted, while in the hands of others it has entirely failed. The truth is, that in the worst attacks of the disease the approach of death is so quick that there is scarcely time for any thing to take effect; and where it is less rapid, the symptoms must guide the treatment: amongst these it must be confessed that there are seldom any which would justify the prudent practitioner in drenching the bowels with salt and water.

But the bolder advocates of what has been termed the *saline treatment* of cholera have gone a step further, and have dared to inject saline solutions into the veins how far such extraordinary means are justifiable, will appear from the following statement. (*Pereira, Elements of Materia Medica*, part i. 313.) "This plan was, I believe, first practised by Dr Latta. (*Med. Gaz.* x. 257.) The quantity of saline solution which has been in some cases injected is enormous, and almost incredible. In one case 120 ounces were injected at once, and repeated to the amount of 330 ounces in twelve hours. In another, 376 ounces were thrown into the veins, between Sunday at eleven o'clock A.M. and Tuesday at four P.M.; that is, in the course of fifty-three hours, upwards of 31 pounds. The solution used consisted of two drachms of muriate and two scruples of carbonate of soda to 60 ounces of water. It was at the temperature of 108° or 110° Fahr. In another series of cases 40 pounds were injected in twenty hours; 132 ounces in the first two hours; 8 pounds in half an hour! The *immediate* effects of these injections, in a large majority of cases, were most astonishing;—restoration of pulse, improvement in the respiration, voice, and general appearance, return of consciousness, and a feeling of comfort. In many instances, however, these effects were only temporary, and were followed by collapse and death."

The reports as to the ultimate benefit of this treatment in cholera are so contradictory, that it is difficult to form a correct estimate of it. "That it failed in a large proportion of cases after an extensive trial, and greatly disappointed some of its stanchest supporters, cannot be doubted. Dr Griffin states that all the published cases of injection which he can find recorded amount to 282, of which 221 died, while 61 only recovered; but he thinks that the average recoveries from collapse by this method of treatment far exceeded the amount of any other treatment in the same district and under the same circumstances" (*Med. Gaz.* xxii. 319.)

A vast quantity of matter has been published in reference to the history, symptoms, and treatment of pestilential cholera. Among those works upon the subject, the general reader may consult the following with advantage, namely, the Reports published by order of Government under the superintendence of the Medical Board; *History of the Epidemic Cholera, by B. Hawkins, M.D., &c; Mr. Bell's Letter to Sir H. Halford; the Report of Drs. Russell and Barry; Dr. James Copland on Pestilential Cholera;* and a paper in the Ninety-first Number of the *Quarterly Review* for November, 1831.

CHOLE'STERINE. (Gr. χολη, and στιεος, *solid.*) The matter which forms the basis of most gall stones.

CHONDRO'LOGY. (Gr. χονδρος, *a cartilage*, and λογος, *a discourse.*) The history of cartilages.

CHO'NDROPTERY'GIANS, *Chondropterygii.* (Gr. χονδρος, *a cartilage*, and πτερυξ, *a fin; gristly-finned.*) The name of Cuvier's last order of fishes, characterized by the gristly nature of all the spines which support the fins. The whole internal skeleton in this order is cartilaginous.

CHORA'GIC MONUMENT. (Gr. χορος.) In

Grecian Architecture, a monument erected in honour of the Choragus who gained the prize by the exhibition of the best musical or theatrical entertainment at the festivals of Bacchus. The Choragi were the heads of the ten tribes at Athens, who overlooked and arranged the games at their own expense. The prize was usually a tripod, which the victor was bound publicly to exhibit, for which purpose a building or column was usually erected. The remains of two very fine monuments of this sort, viz. those of Lysicrates and Thrasyllus, are still to be seen at Athens.

CHORD (Gr. χορδη, *the string of a lyre*) In Music, a combination of two or more sounds heard contemporaneously, forming a concord or a discord between them

CHORD. In Geometry, is the straight line which joins the two extremities of the arc of a curve, so called from the resemblance which the arc and chord together have to a bow and its string, the chord representing the string. The chord of a circular arc is twice the sine of half the arc, hence to find the length of the chord of any given arc, multiply the diameter by the sine of half the arc. Tables of chords are given in some of the older works on trigonometry, but they have been superseded by the tables of sines, which are much more convenient for trigonometrical calculations.

CHOREA. (Gr χορος, *a chorus*; the ancient accompaniment to dancing) The disease commonly called *St. Vitus's dance*. It shows itself by convulsive motions of the limbs, face, head, and trunk, varying extremely in extent and violence, the speech is often more or less affected, and frequently the mental energies become grievously impaired. It is most common in early life, as from the age of ten or twelve to puberty, and makes its approach gradually in persons chiefly of debilitated constitutions: the appetite is generally ravenous at first, and the bowels costive, various convulsive motions then ensue, and only cease during sleep, which, however, is seldom sound This is one of those diseases which require especial attention in its early stages, and which even in its lightest forms, when once habitual, is very difficult to manage. The leading treatment consists in the judicious administration of aperients and brisk purges, so as to clear the stomach and bowels thoroughly of all irritating matters; the constitution may at the same time be strengthened by tonics and chalybeates, with occasional stimulants; and some of the more urgent spasmodic symptoms may be sometimes cautiously encountered by opium, camphor, henbane, and ether. Cold bathing also has its advantages when circumspectly resorted to, and the mind must be diverted by change of air and scene The diet should be very regular, nutritive, and never in excess. In this complaint much will depend upon the exertions of the patient himself, who, though relieved of the more urgent symptoms, will often retain relics of his disorder through a long life.

CHOREPISCOPI (Gr. χωρα, *a country place*, and επισκοπος, *a bishop*) Country bishops; persons appointed by the bishops in the early periods of Christianity to superintend the rural districts which appertained to their dioceses, but which were at an inconvenient distance from the city in which they abode themselves The class of chorepiscopi is represented as holding a middle rank between the bishops and the presbyters.

CHORION. (Gr χωρα, *a receptacle*) The external membrane which envelopes the *fœtus in utero*, between which and the amnion there is a gelatinous fluid Its interior surface is smooth, but exteriorly it is shaggy and vascular

CHOROGRAPHY. (Gr. χωρα, *district*, and γραφω, *describe*.) The description of a district, in contradistinction to geography (the description of the earth or of countries) and topography (the description of particular spots)

CHOROID MEMBRANE OF THE EYE. The second tunic of the eye lying under the sclerotic, with which it has a vascular connection. it commences at the optic nerve, and passes forward with the sclerotic to the beginning of the transparent cornea, where it firmly adheres to the sclerotic by a cellular membrane, forming a white fringe called the *ciliary circle*; it then recedes from the sclerotic and cornea, forming a round coloured disc called the *iris*, and its posterior surface is termed *uvea*. The choroid membrane is very vascular, and its external stellated vessels are called *vasa vorticosa*. Its internal surface is covered by a *black pigment*.

CHOROID PLEXUS. A plexus of blood-vessels situated in the lateral ventricles of the brain.

CHORUS. Gr. χορος.) A band of singers and dancers who performed odes in honour of the gods, particularly Bacchus. The chorus formed an important part of the Greek tragedies and early comedies, which were interspersed with odes. There were likewise several other choruses besides these, as the Dithyrambic; and the exhibition of these was one of the public burthens imposed on the richest private citizens of Athens. It was called the choregia (χορηγια). *See* DRAMA, and HORAGIC MONUMENT.

CHORUS. In Music, the joint performance of music by the whole of the members of the orchestra

CHOUANS. In French History, the royalist insurgents on the right bank of the Loire during the revolution when the Vendeans rose on the left, were thus popularly named; according to some, from the cry of the screech-owl (*chat-huant*), an imitation of which was a signal during their nightly meetings. They were for the most part brigands, and their object rapine rather than civil war. After the revolution of 1830, they made a transient reappearance in the neighbourhood of Nantes and Le Mans

CHREMATISTICS. (Gr χρηματα, *wealth*) The science of wealth, a name given by Continental writers to the science of political economy, or rather to what in their view constitutes a portion of the science. They consider political economy as a term more properly applicable to the whole range of subjects which comprise the material welfare of states and citizens, and chrematistics (by which they mean nearly the same science which M'Culloch and most other English writers describe as political economy) as merely a branch of it See especially M. de Sismondi, *Etudes sur l'Economie Politique* See also CHRYSOLOGY

CHRESTOMATHY. (Gr χρηστος, *useful*, and μανθανω, *I learn*) According to the etymology, that which it is useful to learn The Greeks frequently formed commonplace books by collecting the various passages to which, in the course of reading, they had affixed the mark χ (χρηστος) Hence books of extracts chosen with a view to utility have received this name

CHRISM (Gr χρισμα from χριω, *I anoint*) The oil which is used both in the Greek and the Roman churches in the administration of baptism, confirmation, ordination, and extreme unction

CHRISTENDOM A word sometimes employed in such a sense as to comprehend all nations in which Christianity prevails more commonly, all realms governed under Christian sovereigns and institutions Thus European Turkey, although three fourths of its inhabitants are Christians, is not in ordinary language included within the term Christendom The history of the fortunes of Christianity, in respect of its geographical extension, presents remarkable periods of advance and decline After the conversion of Constantine, and the gradual decay of Paganism Christianity continued to spread, but chiefly in the direction of east and south, for more than three centuries, the barbarian conquerors of the Roman provinces soon adopting it About the middle of the seventh century, Christendom comprehended Europe south and west of the Rhine and Danube, Africa north of the Great Desert, Abyssinia, parts of Nubia, Asia to the Euphrates, Armenia, and part of Arabia, and that small colony in southern India which subsists to this day The Saracen power rose by conquest from this extensive empire In little more than a century, Christendom was deprived of nearly all its Asiatic provinces, of which the faithful inhabitants were reduced to a tributary condition, of the whole of northern Africa, in which they were exterminated or converted and of Spain Sicily, the latest conquest of the Saracens, was occupied by them about 830. But just at the same epoch, or that of lowest decline, Charlemagne began to extend the limits of Christendom in the north, and the second period of advance extends through the 9th, 10th, and 11th centuries, in which "the reign of the gospel and the church was extended over the north Bulgaria, Hungary, Bohemia, Saxony, Denmark, Norway, Sweden, and Russia" (*Gibbon*, chap 55) From that time to the 16th century, Christianity gradually reconquered Spain on the one hand, while, on the other, the newly arisen power of the Turks wrested from it the remainder of its Asiatic territories and the European provinces of the Greek empire Since that period no important changes have taken place in the relative extent of Christendom and Islamism; but the vast continent of America, as far as it has been colonized, has been added to the former, and the rapid increase of its communities in numbers and civilization has greatly enhanced their comparative importance The number of Christians inhabiting Europe and America, and scattered in the other parts of the globe, may perhaps be estimated conjecturally as follows —

| | |
|---|---|
| Roman Catholic church - - | 141,000,000 |
| Reformed churches - - | 60,000,000 |
| Greek and other Oriental churches - | 66,000,000 |
| | 270,000,000 |

CHRISTIANITY. The religion of Jesus Christ. From the period when the disciples "were called Christians first in Antioch" (Acts, xi 26.) down to the present day, the main doctrines of the gospel, and the great moral principles which it reveals and confirms, have been preserved without interruption in the church. But notwithstanding this substantial unity, it cannot be denied that the character of the religion has been very materially coloured throughout all its history by the circum-

stances and genius of different nations and ages. The first marked forms of opinion which acquired consistency among the general body of Christians tended in two very different directions. The *Judaizing* Christians clung to the ordinances of the elder religion, and strove to teach the separation from it as slightly as possible; under the names of Nazareans, &c., they existed as late as the 4th century, but ceased after the first to exercise any very extensive influence on the church. The *speculative* Christians placed figurative interpretations both on the external facts and mysteries of the religion, or sought to connect it with the philosophical and theurgical systems of the ancient world. Apollos of Alexandria was the first teacher, it is commonly said, who introduced this speculative tendency into Christianity, and St Paul, while he does not condemn Apollos, dwells on the evils produced by those who from his teaching deduced as it were a separate body of doctrine (1 Cor iii). In this way arose,—1 The early heretics the Nicolaitanes and followers of Cerinthus, and the Gnostics, professors of the "knowledge falsely so called" (ψευδώνυμος γνῶσις) of St Paul. 2. At a later period, the Manichæans, who imported into Christianity the notion of the rival principles of good and evil, which continued for many ages to possess adherents. 3 Within the church itself, the *Alexandrian school of theology*, which has exercised a more permanent influence. This school, in the second and third centuries, became partially tinged with the sentiments of Platonic philosophy, and was characterized by the acute and refining spirit of the East. Like the Gnostics, its chief doctors encouraged the notion of a mystical or second meaning in the revelations of the faith, of which the key was in the possession of the learned only (Clemens, Origen, &c.). In the meantime, the main body of believers, comparatively unaffected by the influence of science and speculation, was gradually acquiring new views of a different and more positive character. During the first three centuries after the apostolical times, the opinions respecting the authority of the priesthood, attachment to forms and ordinances, the honour paid to individual purity of life (and especially to constancy under persecution), gradually and steadily increased and strengthened. In the West, and particularly in Africa, these tendencies became peculiarly strong. The Montanists, Donatists, and Novatians separated successively from the church, on the score of its defection from an imaginary standard of personal purity; and when Africa began to have a school of theology of her own (Tertullian, Cyprian, and others, to Augustine), this was the direction of its labours. In that theology all is dogmatical, nothing speculative. Every thing is taken in its most literal and naked sense. God himself is not personal only, but invested almost with the attributes of a human agent. Both doctrines and ordinances are as definite as possible, and the utmost rigour of practice enjoined. The history of the African church affords a momentous commentary on their strainings after imaginary perfection. After two centuries of discord and decay from the time of Augustine, it was not only subdued but obliterated by the first assault of the Mohammedans. The early heretics had entertained theoretical notions respecting the inferiority of Christ to the Father, but the Arians, in the last half of the 3d century, were the first to preach it as the doctrine of the church, and seek to confirm it by appeal to antiquity. The council of Nice (A. D. 325) condemned this opinion, and by the concurring declarations of bishops from all parts of Christendom afforded the strongest testimony to the fact, that the Catholic sentiment of the church had always been opposed to it. But the Arians, and other sects differing from the church by various shades of opinion on the same subject, continued to subsist until the 6th century, during which these controversies partly died away in the West, amidst the misery and barbarism of the age, and partly were extinguished by the authority of the church. It was thus that the governors of the church were first driven to protect its fundamental doctrines by reducing them to formal propositions embodied in creeds and the canons of councils (especially the six Œcumenical or general, which were held from A. D. 381 to 680). Thus, in the West, speculation was effectually subdued. In the East, it still lingered in vain but refined distinction respecting the nature and relations of the persons of the Trinity (the Nestorian, Monophysite, and Monothelite heresies). Meantime a new and most important feature of Christianity was developing itself. A solitary believer, who left the world and retired into the deserts of Egypt (Antonius, A. D. 311), set an example which was followed by innumerable Christians with a fervour alike contagious and irresistible. The calamities of the empire, and the wretched state of society, seem to have aided the mistaken tendencies of devotion in producing this carelessness of life and its duties. It is scarcely possible to exaggerate the evils produced by the spirit of monachism in the 4th and 5th centuries: the contempt for all the social habits and social virtues; the ferocious zeal, sometimes venting itself against Paganism and sometimes against brethren; the unregulated, wandering, untameable disposition which it engendered, and which the spirit of the age dignified with the title of celestial piety. Whatever Christianity may owe to the great fathers of the church, Augustine, Ambrose, Jerome, Basil, Chrysostom, we must not forget the encouragement which they all administered to this destructive error, far more mischievous than any of the heresies which they combated. At length, when the evils of this anarchical system had become almost intolerable, arose the lawgivers of monachism in the West. Benedict (A. D. 529), and still more Cassiodorus, strove to bring religious persons under a temperate and liberal rule of government. their attention was called to what they had hitherto despised as secular pursuits, especially agriculture and literature, together with a more regulated piety; and thus monachism, which in a time of declining civilization had powerfully accelerated decay, became, in a time of barbarism, an agent of preservation and improvement. In A. D. 716, the separation between the Greek and Western churches, which had long been provoked by the gradual usurpations of the Roman bishop over the latter, became really complete through the controversy respecting images, although not formally acknowledged until the middle of the 11th century. This era is important, as those corruptions of Christianity which, according to Protestants, disfigure both the Greek and Roman Catholic churches are evidently anterior to it,—those peculiar to the latter posterior. Thus, the honour paid to saints, relics, &c., the adoration of the Virgin Mary (which seems to have been partly a result of the Nestorian controversy), monachism, &c., are common to both, and therefore ancient. the exclusively Roman tenets, transubstantiation, papal infallibility, purgatory, &c., are accounted by Protestants comparatively modern doctrines, to which the whole church has never agreed, while celibacy, which the Roman pontiffs with great difficulty succeeded in imposing on the whole clergy in the 11th century, is observed in the Greek church only by the higher dignitaries. For several centuries after this separation, the external history of Christianity in the West presents us with little more than the vicissitudes and disputes of monastic orders, the strife of ecclesiastical dignitaries with each other and with temporal sovereigns, the growth of superstitious observances among the laity, the union of the religious with the military spirit, and the increasing power of the pope, yet, under all these disadvantages, the impartial observer may discern the great principles of religion still preserved, and still working beneath the surface of society for its gradual purification. The 12th century was a period of revival in the West, both in point of learning and religion. The military spirit of devotion found ample employment in the crusades. The rise of the scholastic philosophy (A. D. 1100) gave a new and peculiar character to the study of theology. Among the lower classes a powerful spirit of religious reform began rapidly to extend itself, especially in Italy and the south of France. A strictness of life amounting almost to asceticism, a revolt rather against the wealth and temporal supremacy of the clergy than their doctrines, were the first characteristics of the reforming sects, but to these was soon added an addiction to mystical tenets and observances. The Cathari, Waldenses, Albigenses, &c. all partook more or less of these common peculiarities; but how far they had really adopted, if at all, those Manichæan opinions (derived through the medium of the Paulicians, a sect which long subsisted in the East) with which they were charged by their opponents, will probably never be ascertained. These sectaries, in their hostility to the Catholic priesthood, had to a great extent usurped their province as religious advisers of the poor and unlearned with prayer, preaching, and even auricular confession. It was this peculiar form of the impending danger which induced the church (after it had openly condemned the new doctrines) to give ample encouragement to the institution of the *Mendicant orders* (in the beginning of the 13th century), one of the most important events in the history of Christianity. These bodies met the sectaries on their own ground, by the assumption of asceticism, poverty, and the popular practices which had availed the former. They were also employed by the church in the sterner task of putting down by force heretical opposition, and completed the extirpation of the Albigenses begun by the sword of the Crusaders. But they extended their hostility to learning and science, and to all the established institutions of the time, and became as much hated by the secular priesthood (or parish clergy, so called in distinction to those who have renounced the world and are bound by monastic rule, called regulars), and by the old and wealthy orders, as by the heretics themselves. Under the influence of persecution the development of the age was checked. From the middle of the 13th century to the end of the 14th the church of Rome met with little opposition from sectaries, and underwent little change in respect of doctrine and discipline; but during the same

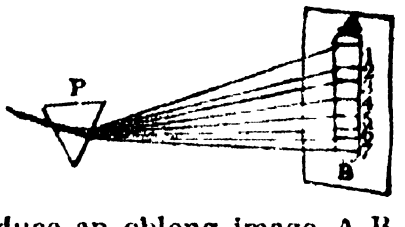
period the increasing power of princes, the long removal of the seat of papal power from Rome, and various other causes, sensibly diminished its temporal authority. In the next century, the same causes continued to act, while the revived energy of reforming sects (Lollards, Hussites, &c.) and the rapid spread of literature and learning proved still more hostile to its spiritual power. Thus the way was prepared for the great events of the Reformation. To trace the history of Christianity from that period onwards, would be impossible within our present limits. It may be sufficient to direct the reader to the general outline of the most marked events, omitting those of a nature merely political or ecclesiastical. *In the Roman Catholic church*, the definite establishment of her doctrines by the council of Trent, which met A D 1546, the foundation of the order of Jesuits, its rapid increase in power and influence, and the gradual decline of the other monastic orders; the rise, progress, and condemnation of Jansenism in France, in the 17th and 18th centuries; the suppression of the Jesuits, in 1773, and overthrow of other monastic orders in France at the revolution,—an example since followed in other countries; the revival of the Jesuits, 1814. *In Reformed countries*, the early division of Protestants into Lutheran and Calvinist, besides many subordinate sects; the foundation of the church of England under Edward VI, partaking in some degree the character of the two; the rapid advance of Calvinism and kindred opinions in the 17th century in England, Holland, and Scotland; their decline in the first of these countries by the re-establishment of the church in 1660, and the prevalence of Arminian sentiments within it, and on the Continent by a gradual tendency to a more liberal system of theology; the establishment of the three confessions (Roman Catholic, Lutheran, and Reformed or Calvinist) on an equal footing in Germany by the peace of Westphalia, 1648; the gradual approach of Protestant, especially Lutheran, divines towards what has been called the rationalist system of religion in the last part of the 18th century; the rise of Methodism in England, and of cognate systems on the Continent; the union effected by the present king of Prussia and other German sovereigns between the Lutheran and Calvinistic bodies in their respective dominions

CHRISTIAN KNOWLEDGE, SOCIETY FOR PROMOTING. This society was founded in the year 1699 for the objects which the name imports. It promotes these objects principally by the diffusion of religious and moral tracts. It has also circulated vast numbers of copies of the Bible and Testament, and of the Book of Common Prayer and other authorized expositions of faith. It is entirely supported by the established church, and is a powerful engine for the instruction of the people in the principles of that body.

CHROMA'TIC. (Gr χρωμα, *colour*.) In Music, the introduction of semitones between each of the tones in the diatonic scale.

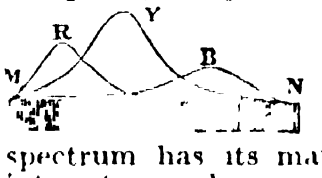
CHROMA'TICS. (Gr. χρωμα.) That part of optics which treats of the colours of light and of natural bodies. This is a very important branch of physical science, and one which of late years has been prosecuted with great assiduity. Until Newton undertook his memorable experiments on the refraction of light, the cause of the different colours of bodies had never received any satisfactory explanation. such, indeed, was the difficulty which the ancients attached to this subject, that Plato considered it to be an usurpation of the rights of the Deity to attempt the investigation of this mystery of nature. The discovery of the difference of refrangibility in the coloured rays of the solar spectrum afforded a clue to the solution of the problem, and Newton demonstrated, by a series of decisive experiments, that colour depends not on any modification of light acquired by reflection or refraction, but is inherent in the light itself; the solar beam being composed of rays of all the colours contained in the spectrum, which are differently affected in passing through refracting media This hypothesis of the existence of different species of luminous molecules is founded on the other hypothesis, that light is a substance emitted from the sun or luminous body, and is indeed a necessary consequence of that theory; for if colour depended merely on a difference of the masses, or of the initial velocities of the particles, it would follow that the dispersion of the rays, in passing through a prism, would always be proportional to the refraction, which, as is well known, is contrary to experience.

*Colours of the Solar Spectrum.*—Let a beam of solar light be admitted through a small aperture in the window shutter of a darkened room, and it will form on the opposite wall, or on a screen, a circular image of the sun. But if a prism, P, be interposed, the refracted beam, instead of forming a bright white spot, will produce an oblong image, A B, called the solar spectrum,



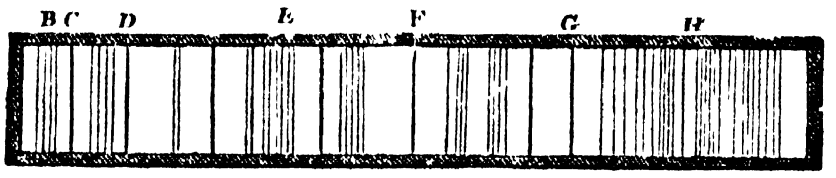

the sides of which are terminated by two vertical straight lines, and the ends by semicircles. This lengthened image consists of *seven* principal colours, which melt into each other by insensible gradations; namely, *red*, *orange*, *yellow*, *green*, *blue*, *indigo*, and *violet*, arranged in the order now written, the red being at the lower end B. Newton, by whom this experiment was first performed, conceived these to be produced by so many distinct species of homogeneous light co-existing in the solar beam, and that all other shades of colour are produced by blending them together in certain proportions. As it is impossible to define the limit at which one colour ends and another begins, and as the spectrum is in fact composed of an infinite number of different shades, the above division is entirely arbitrary. Another observer of the phenomenon for the first time would probably have fixed on a greater or smaller number. Newton, it appears, was influenced by a fanciful idea that an analogy, or rather identity of ratios, subsists between the divisions of the spectrum formed by the seven colours which he assigned to it, and those of the musical scale. But the resemblance which suggested this analogy to Newton was purely accidental, and depended, as has since been found, on the nature of the substance of which his prism was formed; for though the colours are invariably arranged in the same order, they expand very differently, according to the nature of the refracting substance; and, consequently, the relative magnitudes of the spaces which they occupy in the spectrum are entirely altered Tobias Mayer, in an essay, *De Affinitate Colorum* (Opera medita, 1775), regards all colours as arising from three primitive colours, *red*, *yellow*, *blue* But a mixture of red and green in certain proportions produces a colour which, so far as the eye can judge, is perfectly identical with the yellow of the spectrum; and a mixture of green and violet also produces a perfect blue. hence it was suggested by Dr Young that the innumerable shades of the spectrum are all compounded of *red*, *green*, and *violet*. Sir David Brewster, however, inferred from experiments on the absorption of light in passing through coloured media, that green and violet are both compound colours, separable by prisms of coloured glass, and he adopts the hypothesis of Mayer, that the three simple homogeneous colours are red, yellow, and blue He supposes the solar spectrum to consist of three spectra of equal lengths, a *red* spectrum, a *yellow* spectrum, and a *blue* spectrum The primary red spectrum has its maximum of intensity about the middle of the red space in the solar spectrum, the primary yellow, about the middle of the yellow space, and the primary blue has its maximum between the blue and the indigo space; the two minima of each of the three spectra coinciding at the two extremities of the solar spectrum. From this view of the subject it follows that *red*, *yellow*, and *blue* light exist at every point of the solar spectrum, and that as a certain portion of red, yellow, and blue constitutes white light, the colour of every point of the spectrum may be considered as consisting of the predominating colour at any point mixed with white light.

The existence of three primary colours in the spectrum, and the mode in which they produce by their combination the seven secondary or compound colours which are developed by the prism, are illustrated by Sir D Brewster as follows—Let M N be the prismatic spectrum consisting of three primary spectra of the same lengths, M N, viz. a red, a yellow, and a blue spectrum. The red spectrum has its maximum intensity at R, and this intensity may be represented by the distance of the point R from M N. The intensity declines rapidly to M and slowly to N, at both of which points it vanishes The yellow spectrum has its maximum intensity at Y, the intensity declining to zero at M and N; and the blue has its maximum intensity at B, declining to nothing at M and N. The general curve which represents the total illumination at any point will be outside these three curves, and its ordinate at any point will be equal to the sum of the three ordinates at the same point Thus the ordinate of the general curve at the point Y will be equal to the ordinate of the yellow curve, which we may suppose to be 10; added to that of the red curve, which may be 2; and that of the blue, which may be 1 Hence the general ordinate will be 13. Now, if we suppose that 3 parts of yellow, 2 of red, and 1 of blue make white, we shall have the colour at Y equal to 3+2+1, equal to 6 parts of white mixed with 7 parts of yellow; that is, the compound tint at Y will be a bright yellow, without any trace of red or blue. As these colours all occupy the same space in the spectrum, they cannot be separated by the prism; and if we could find a coloured glass which would absorb 7 parts of the yellow, we should obtain at the point Y a white light, which the prism would not decompose. (*Brewster's Optics*, in *Lardner's Cyclopædia*, p. 74)




*Dark Lines in the Spectrum.*—One of the most curious, and, with reference to the theory of light, one of the most important optical discoveries of modern times, is the

existence of a great number of dark lines, or fixed rays, in the solar spectrum, parallel to one another, and perpendicular to its length. These dark lines were first perceived by Dr. Wollaston; but it was Fraunhofer, a celebrated optician of Munich, who first accurately described the phenomenon, and pointed out the uses to which it could be applied In order to perceive these lines, considerable magnifying power is necessary. The prism employed must be perfectly free from veins, and the light must enter and emerge from it at equal angles; it is necessary also to employ a telescope. They are distributed very unequally through the spectrum, and the whole number amounts nearly to 600. Seven groups, which are more




easily perceived than the others, and which are distributed over the principal colours of the spectrum, have been designated by Fraunhofer by the letters B, C, D, E, F, G, H. Of these B is in the red space, near its outer end. C, which is a single line, and blacker than others contiguous to it, is near the limit of the red next the orange. D is in the orange, and near the yellow; it is composed of two lines of equal darkness very close to each other, and is easily distinguished. E is in the green, and consists of seven or eight rays F is in the blue, G in the indigo, and H in the violet. Besides these there are several other very remarkable groups, particularly one in the green, between E and F, which is composed of three strong lines. The circumstance which renders the discovery of these lines extremely important is, that they always preserve the same relative positions in respect of the boundaries of the coloured spaces; and though their distances vary with the nature of the prism by which they are produced, their number and order remain absolutely invariable, so long as the light proceeds from the same source For an account of the spectra formed by different lights, see *Brewster's Optics*, p 87

*Colours of Natural Bodies* — The separation of light into different colours by refraction having been established as an optical fact, a different task remained, viz that of showing in what manner refraction could take place so as to produce the permanent colours of natural bodies Newton proved that the colour of any body is not the result of any quality inherent in that body, or in the particles by which it may be tinged, but is merely a property of the light in which they happen to be placed The peculiar colours of bodies are only exhibited in a white light. If they are viewed by simple and homogeneous light of any colour, they appear of the colour of that light and no other. Thus, the leaf of a plant, for example, which in the white light of day appears green, if illuminated by homogeneous *red* light, appears *red*, if by homogeneous *yellow* light, *yellow*, and so on Hence we conclude that one body is red, and another violet, because the one is *disposed* to reflect the red or least refrangible rays, and the other the violet or most refrangible. But the difficulty consists in explaining the cause of this *disposition* or transient condition of the body, which renders it fit to reflect rays of one colour and absorb those of another. Newton has attempted, in his *Treatise of Optics*, to refer it to the constitution or elementary structure of bodies. The principles or propositions on which his theory are founded are the following.— 1. Bodies that have the greatest refractive powers reflect the greatest quantity of light, and at the confines of equally refracting media there is no reflexion. 2. The least parts of almost all natural bodies are in some measure transparent 3 Between the particles of bodies are many pores or spaces, either empty or filled with media of less density than the particles 4 The particles of bodies, and their pores or spaces between the particles, have some definite size

Upon these principles, Newton thus explains the origin of *transparency*, *opacity*, and *colour*. Transparency he considers as arising from the particles and their intervals or pores being too small to cause reflexion at their common surfaces, so that all the light which enters transparent bodies passes through them without any portion of it being turned from its path by reflexion. Opacity in bodies arises, he thinks, from an opposite cause, viz. when the parts of bodies are of such a size as to be capable of reflecting the light which falls on them, in which case the light is stopped or stifled by the multitude of reflexions The colours of natural bodies have the same origin as the colours of thin plates or soap bubbles; their transparent particles, according to their several sizes, reflecting rays of one colour and transmitting those of another. For if a thinned or plated body, which, being of an uneven thickness, appears all over of one uniform colour, should be slit into threads, or broken into fragments of the same thickness with the plate or film, every thread or fragment should keep its colour; and, consequently, a heap of such threads or fragments should constitute a mass or powder of the same colour which the plate exhibited before it was broken; and the parts of all natural bodies being like so many fragments of a plate, must, on the same grounds, exhibit the same colour. (See *Newton's Optics*, book ii.; or *Brewster's Life of Newton*, p. 81.)

Such are the general principles of the Newtonian theory of colours; but there are numerous classes of phenomena, some of which were known in the time of Newton, but many more which have been discovered since, of which they fail to afford any explanation, and to which, indeed, they are wholly inapplicable The ingenuity of its warmest supporters has not yet been able to explain by this theory the total absence of all reflected light from the particles of transparent coloured media, such as coloured gems, coloured glasses or fluids, &c. For these reasons, and many others depending on optical phenomena not connected with colours, philosophers have of late years manifested a disposition to abandon the theory of the emission of light, and to return to that of Huygens, who supposed light to be produced by the vibrations or undulations of an ethereal fluid of great elasticity, which pervades all space and penetrates all substances. *See* LIGHT.

Without entering into the subject of the propagation of light, it may be sufficient to remark, that the ordinary phenomena of colours may be explained on the principle of absorption. Every substance, how opake soever it may be, transmits light, at least through a very small thickness; thus gold when reduced into thin leaf is translucent. From this fact it is assumed as a principle, that every particle of ponderable matter has the faculty of absorbing or extinguishing a determinate fraction of the luminous rays which fall on it or pass very near it, the remainder being reflected or transmitted. This fraction varies with the colour or species of colour of the incident luminous rays, and with the nature of the particle For light of the same colour we may suppose it constant, whatever be the number of incident rays: so that the intensity of a homogeneous light, which has traversed a diaphanous plate composed of equidistant particles of the same nature, will diminish in a geometrical, when the thickness of the plate increases in an arithmetical, progression White light falling on the surface of an opake body is not totally reflected at the surface, for, as has been just remarked, no substance is perfectly opake. a portion of the incident light therefore penetrates the superficies of every body on which it falls, and is reflected by particles beneath the surface, and, in consequence of this interior reflection, is again emitted from the medium. But whilst the ray is thus penetrating and escaping from the body, the different colours of which it is composed suffer unequal absorptions, and on the totality of these absorptions depends the compound colour of the reflected ray, or the natural colour of the body In this manner are explained the effects produced by coloured glasses, the blue colour of the sky, and the various tints of great masses of water.

The phenomena of the colours of thin lamina, as soap bubbles, plates of mica, and of striated and grooved surfaces, are among the most difficult of explanation; and it is here that the undulating theory, which accounts for them by the *interference* of the light reflected from the second surface of the plate with that reflected from the second, possesses its greatest advantage For further information on this subject, see the terms INTERFERENCE, LIGHT, REFRACTION.

CHROMIUM (Gr. $\chi\rho\omega\mu\alpha$, *colour*) A metal discovered by Vauquelin in 1797. It exists chiefly in two native compounds, the one formerly called *red lead* of Siberia, which is a *chromate of lead*, the other, a compound of the oxides of chromium and iron Chromium is a whitish, brittle, and very infusible metal; sp gr. 5 5. When heated with nitre it is converted into *chromic acid*. Its equivalent number is 28. It forms two compounds with oxygen,—a green oxide, and a red peroxide; the latter being sour, and combining with salifiable bases, is called *chromic acid*. The oxide consists of 28 chromium +12 oxygen; and chromic acid of 28 chromium+24 oxygen. Chromic acid is of a red colour, and forms a variety of *coloured* compounds, some of which are much used in the arts; such as the *chromate* and *bichromate of potash*, largely manufactured for the use of calico printers, and the *chromates of lead*, employed as yellow and red dyes and paints. The oxide of chroma is green, and furnishes a valuable colour for porcelain and in enamel. Chromic acid gives colour to the ruby, and the green of the emerald is due to oxide of chroma.

CHRO'NIC. (Gr. $\chi\rho\sigma\nu\sigma\varsigma$, *time*.) Diseases of long duration are termed *chronic*, in opposition to those of more rapid progress, which are called *acute*.

CHRO'NICLE. In Literature, an historical register of events in the order of time. Most of the historians of the middle ages were chroniclers who set down the

events which happened within the range of their information, according to the succession of years.

CHRO'NICLES. The name of two books in the canon of scripture. They consist of an abridgment of sacred history from its commencement down to the return of the Jews from the Babylonish captivity, and are called by the Septuagint παραλειπομενα (lit. things omitted), because they contain many supplemental relations omitted in the other historical books. It has been generally supposed that the Chronicles were compiled by Ezra, though circumstances are not wanting to diminish the probability of this conjecture. Eichhorn (*Einleitung*, vol. ii.) gives as his reasons for attributing them to Ezra their similarity in point of style, idiom, and orthography to the books of Kings and Ezra; while the opponents of this view base their opinion on the discrepancies that occur throughout Chronicles and Kings, in regard to facts, dates, numbers, names, and genealogies. (For a learned exposition of this subject, see the *Penny Cyclopædia*, and the authorities there referred to.)

CHRO'NOGRAM. (Gr. χρονος, *time*, and γραφω, *I describe*.) An inscription comprehending a date, which may be read by selecting all or some of the numeral letters, which are frequently written in these curious trifles in larger characters than the rest; as,

"ChrIstVs DVX ergo trIVMphVs"

(A medal of Gustavus Adolphus.) Sometimes united with an anagram, as one in honour of General Monk,

"GeorgIVs MonCe DVx de AumarLe;"

which may be read,

"Ego Regem reduxi, Ano. Sa. MDCLVV"

CHRONO'LOGY. (Gr. χρονος, and λογος *discourse*.) Literally, the doctrine of time: is the science which treats of the various divisions of time, and of the order and succession of events.

In order to ascertain and register the intervals of time between different events, two things must necessarily be assumed. — 1st, An epoch or fixed point in time to which all events, whether preceding or succeeding, may be referred, and 2nd, A measure or definite portion of time, by which the intervals between the fixed epoch and other events may be estimated. Of these the first is entirely arbitrary, and the second arbitrary to a certain extent; for though certain periods are marked out by the recurrence of natural phenomena, a choice of these phenomena must be made. It is on account of the arbitrary nature of these two elements, on which all chronological reckoning depends, that so much confusion and uncertainty exist respecting the dates of historical events.

The diversity of epochs which have been assumed as the origin of chronological reckoning is a natural consequence of the manner in which science and civilization have spread over the world. In the early ages the different communities or tribes into which mankind were divided began to date their years each from some event remarkable only in reference to its own individual history, but of which other tribes were either ignorant, or regarded with indifference. Hence not only different nations, but almost every individual historian or compiler of annals, adopted an epoch of his own. Events of local or temporary interest were also constantly occurring in every community which would appear of greater importance than those which were long past, and consequently be adopted as new historical dates. The foundation of a monarchy or a city, or the accession of a king, were events of this class, and accordingly are epochs of frequent occurrence in the ancient annals. Religion also came in to increase the confusion caused by political changes. Soon after the introduction of Christianity, the various sects began to establish eras, commencing with events connected with the appearance of Christ; but no regard was given to uniformity. In like manner, the Mohammedans employ dates having reference to the origin of their faith. All these circumstances have conspired to render it a task of extreme difficulty for modern historians to ascertain the order of the political occurrences of ancient times.

But it is not merely the number of chronological epochs and the various origins of eras that have caused the perplexity; the measure by which long intervals were compared varied in different countries, and in different ages, and hence arises another source of confusion in arranging the order of time. In the scripture history, the lapse of time is frequently estimated by generations or reigns of kings. Some of the historians of early Greece reckoned by the succession of the priestesses of Juno; others by that of the ephori of Sparta, and others again by the archons of Athens. Even when the length of the solar year began to be used as the measure of time, uniformity was not obtained. The length of the solar year is a fixed element in nature, and liable to no variation. But neither the commencement or termination of the year is marked by any conspicuous sign. Its precise length can only be ascertained by a long-continued series of astronomical observations. Rude nations were therefore unacquainted with it; and even when it had become known with considerable accuracy, it was still necessary to form a civil year, and adapt it to the seasons, the solar year not being composed of an exact number of days. Most nations had recourse to intercalations (*see* CALENDAR) for this purpose. The ancient Egyptians followed a purely solar year, which consisted of exactly 365 days. Its commencement, therefore, fell one day earlier with respect to the seasons every four years, and in the period of about 1460 years would successively fall on every day in the year, and a whole year be gained in the reckoning. The civil year of the Jews, the Greeks, and many other nations, was regulated partly by the sun and partly by the moon, which rendered its adjustment still more complicated and difficult. The Mohammedan year is purely lunar; and we can only pass from their calendar to the *Gregorian*, which is used in Christian countries, by first finding the number of days from the commencement of their era to any given event, and then turning them back into Gregorian years (*See* HEGIRA.) The Chinese, Hindoos, and some other Asiatic nations, have epochs and methods of reckoning peculiar to themselves.

For these reasons, and numerous others that might easily be adduced, it is very seldom that the precise interval between the events mentioned in ancient history and modern dates can be determined with any degree of certainty, and great discrepancies exist among the computations of different chronologers. A remarkable instance of this occurs with regard to the computations made to determine the epoch of the creation of the world from the scripture history. Desvignoles, in the preface to his *Chronology of Sacred History*, mentions that he had collected upwards of two hundred different calculations, the shortest of which reckons only 3483 years between the creation and commencement of the common era, and the longest 6984, the difference being no less than thirty-five centuries. The most important works on chronology are, *Usher's Annales Veteris et Novi Testamenti*, *Newton's Chronology*, *Blair's Chronology and History of the World*, *Playfair's Chronology*, *Tables Chronologiques de l'Histoire Ancienne et Moderne*, by Thouret, and above all others, *L'Art de Verifier les Dates*.

CHRONO'METER. (Gr. χρονος, *time*, and μετρον, *measure*.) A watch of peculiar construction, and great perfection of workmanship, used for determining geographical longitudes, or other purposes where time must be measured with extreme accuracy. The chronometer differs from the ordinary watch in the principle of its escapement, which is so constructed that the balance is entirely free from the wheels during the greater part of its vibration, and also in having the balance compensated for variations of temperature. Marine chronometers generally beat half seconds, and are hung in gimbals, in boxes about six or eight inches square. The pocket chronometer does not differ in appearance from the ordinary watch except in that it is generally a little larger. Chronometers are of immense utility in navigation, and ships going on distant voyages are usually furnished with several, for the purpose of checking one another, and also to guard against the effects of accidental derangement in any single one. The accuracy with which some of the better sort of chronometers have been found to perform is truly astonishing, the error in a two months' voyage not exceeding two or three seconds.

CHRY'SALIS (Gr. χρυσος *gold*.) The second state of a Metabolian or changeable insect, in which it becomes inactive, takes no food, and is inclosed in a transparent covering, which in many instances reflects a metallic lustre, whence the name.

CHRY'SOBA'LANA'CEÆ. (Chrysobalanus, one of the genera.) A natural order of shrubby or arborescent Exogens, chiefly inhabiting the hotter parts of the world. They are very nearly related to *Rosaceæ*, from which they differ in having a style proceeding from the very base of the ovary, and irregular stamens and petals. The species are of little importance. The fruit of *Chrysobalanus icaco* is eaten in the West Indies under the name of the cocoa plum, and that of some others is used in other countries in a similar way.

CHRYSO'BERIL. This mineral occurs in small rounded masses, and in crystals, it is very hard, transparent or translucent, and of different shades of greenish yellow. It is employed in jewellery. It has been brought from Brazil, and is associated in the sand of the Ceylonese rivers with rubies and sapphires. The *cymophane* of Hauy, which is a species of chrysoberil, consists of alumina 76·7, glucina 17·8, oxide of iron 5·5.

CHRYSOCHLORE. (Gr. χρυσος, *gold*, and χλωρος, *green*.) A species of mole, *Chrysochloris capensis*, inhabiting the Cape of Good Hope, the fur of which reflects most brilliant metallic hues of green and gold.

CHRYSOCO'LLA. The Greek name for borax.

CHRYSO'GRAPHY. (Gr. χρυσος, *gold*, and γραφω,

*I write.*) The art of writing in letters of gold: a sumptuous fashion, practised by the writers of manuscripts, chiefly in the early part of the middle ages, when the leaves of parchment which contained the writing were also dyed with purple and other colours.

CHRY'SOLITE. (Gr. χρυσος, and λιθος, *a stone.*) A crystallized mineral, often of a golden yellow colour. It is a ferriferous *silicate of magnesia*, and is sometimes used in jewellery.

CHRYSO'LOGY. (Gr. χρυσος, *gold*, and λογος, *discourse*) A name by which some Continental writers distinguish that branch of political economy which relates to the production of wealth.

CHRYSO'MELA. (Gr. χρυσος, *gold*, and μελας, *black.*) The name of a Linnæan genus of Coleopterous insects, now the type of an extensive group, divisible into three families; viz. the *Chrysomelidæ* proper, characterized by having the antennæ remote from each other at the base; *Cassididæ*, having the antennæ arising close together, but concealed at the base by the thorax, and *Galerucidæ*, having the antennæ close together at the base, but not concealed by the thorax. The characters which these three families possess in common are, a small body of an oval or rounded form; antennæ seldom so long as the body; legs of a moderate length, but rather thickened, and tarsi with the three basal joints dilated and spongy beneath, forming a kind of cushion. The insects of the present tribe are of sluggish habits, and feed upon the leaves of various vegetables, both in the larva and imago state, being characterized in the latter period by their brilliant metallic tints, whence their name. The larva of one of the British species (*Eumolpus vitis*, Fabr.) preys upon the young buds and leaves of the vine, and by its attacks upon the footstalk of the grape bunch so injures the nutrient vessels, as to cause the destruction or deterioration of the fruit. In the wine countries of Europe the ravages of this insect are often very serious, and much dreaded.

CHRY'SOPRASE. (Gr. χρυσοπρασος.) A pale green silicious mineral, generally semitransparent. It is tinged by oxide of nickel, and much esteemed for ornamental purposes.

CHURCH (Gr. κυριακον, from κυριος, *Lord.*) A building dedicated to the Lord. The word *church*, however, is not confined to this signification but answers to all the senses in which εκκλησια (l'eglise) is used in the New Testament, which, from its original meaning of a *convened assembly*, is employed, 1st, to denote the whole body of true believers, or the visible church, 2nd, in addition to these, the spirits of the just made perfect, or the invisible church, 3rd, any congregation of Christians met together in a single place, or the body of believers resident in a town or district, and 4th, the edifice in which they meet for divine worship. To these we may add a fifth sense of the modern term church, when it is applied to a distinct religious community, as the Romish, the English, the Lutheran, &c. The true definition of the visible church has been a matter of much controversy. The English church, in her 19th article, explains it to be "a congregation of faithful men, in which the pure word of God is preached, and the sacraments duly administered, according to Christ's ordinance, in all those things that of necessity are requisite to the same." What these necessary requisites are is not dogmatically laid down, whence many communities come to be comprehended in the visible church by English divines which the Romish and other authorities exclude. Many sects, however, extend the pale still further, not considering the reception of the sacraments as any test of churchmanship, but referring it solely to the earnest belief and moral conduct of individuals.

CHURCH. In Architecture, a building dedicated to the performance of Christian worship. Under the art ARCHITECTURE an account is given of the Basilicæ which were first used for the assembly of the early Christians, to which the reader is referred. Among the first of the churches was that of St. Peter's at Rome, about the year 326, nearly on the site of the present church, and it is supposed that the first church of St. Sophia at Constantinople was built somewhat on its model. That which was afterwards erected by Justinian seems in its turn to have afforded the model of St. Mark's at Venice, which was the first in Italy constructed with pendentives and a dome, the former affording the means of covering a square plan with an hemispherical vault. The four most celebrated churches in Europe erected since the revival of the arts are, St. Peter's at Rome, which stands on an area of 227,069 feet superficial, Sta. Maria del Fiore at Florence, standing on 84,802 feet, St. Paul's, London, which stands on 84,025 feet, and St. Genevieve at Paris, 60,287 feet. The churches on the Continent are usually ranged under seven classes: *Pontifical*, as St. Peter's, where the pope occasionally officiates; *Patriarchal*, where the government is in a patriarch; *Metropolitan*, where an archbishop is the head; *Cathedral*, where a bishop presides, *Collegiate*, when attached to a college; *Parochial*, attached to a parish; and *Conventual*, when belonging to a convent.

CHU'SITE. (Gr. χυω, *I pour.*) A very fusible mineral found near Limbourg.

CHYA'ZIC ACID. From the initials of *carbon*, *hydrogen*, and *azote*. A term applied to the compounds of hydrocyanic acid.

CHYLE. (Gr. χυλος.) The nutritious fluid prepared from the chyme, and imbibed by the lacteals to be conveyed to the thoracic duct and venous system. It contains about 10 per cent. of solid matter. In most mammals it is white, in birds transparent, except in some that live on ants and insects, as the wood-pecker, which has been observed to be opake, it is white in the crocodile, but colourless and transparent in other reptiles and in fishes.

CHY'LOPOIE'TIC. (Gr. χυλος, and ποιεω, *I make.*) Organs concerned in the formation of chyle, hence the stomach, duodenum, and liver are termed chylopoietic viscera.

CHYME. (Gr. χυμος, *juice*) The pulpy layer of nutritious digested matter which adheres to the inner surface of the intestine, and yields the chyle by admixture with the biliary secretion.

CIBO'RIUM. (Gr. κιβωριον.) In Architecture, an insulated erection open on each side, with arches, and having a dome of ogee form carried on supported by four columns. It is also used to denote the coffer or case which contains the Host.

CICA'DA. (Lat. *a grass-hopper*) The name of a Linnæan genus of insects, celebrated in all ages for their powers of song or shrill chirp.

> Et cantu querulæ rumpent arbusta cicadæ,
> (*Georgics*, iii.)

sings Virgil, which Dryden renders,

> When creaking *grass hoppers* on shrubs complain

although it is evident that Virgil alluded to the insects of the present genus, which habitually frequent shrubs and trees, and feed on their juices, having a peculiar apparatus for piercing the bark and sucking out the juice. They are therefore more accurately described by Lord Byron, as

> The shrill Cicadæ, people of the pine.

The *manna* of the shops is the inspissated juice of the *Fraxinus ornus*, poured out from the wounds inflicted by the *Cicada orni*. The organ of sound is peculiar to the male, and is situated on each side of the under and anterior part of the abdomen. The insects referable to the Linnæan genus *Cicada* are now separated into three families — *Cicadida*, *Fulgorida*, and *Cercopidæ*.

CICA'TRIX. (Lat.) The scar which remains after the skinning over of a wound.

CICERO'NE. (Ital.) A name originally given by the Italians to those persons who pointed out to travellers the interesting objects with which Italy abounds, but applied universally at present to any individual who acts as *a guide*. This application of the term Cicerone has probably its origin in the ironical exclamation, "E un Cicerone" (he is a Cicero), being elicited from the traveller by the well-known garrulity of the Italian guides.

CICHORA'CEÆ. (Gr. κιχωρη, name of the herb *Chicory*.) One of the four divisions of *Compositæ*, a very extensive order of herbaceous or shrubby Exogens. The plants belonging to this division have a milky juice, and form a connecting link between *Compositæ* and *Campanulaceæ*. They inhabit the whole world and are characterized by all the florets of the flower-heads being alike and ligulate. Lettuce, succory, and endive are familiar examples of *Cichoraceæ*, which are generally bitter, with a soporific quality resembling that of opium.

CICI'NDELA. (Lat. cicendela, *a glow-worm*.) A name applied by Linnæus to a genus of beetles, which is placed at the head of the order *Coleoptera*, from the circumstance of the outer lobe of the maxillæ being converted into an additional pair of feelers, called internal maxillary palpi. The mandibles are very strong, and armed with strong teeth, the maxillæ are terminated by a moveable spur; the eyes are large and prominent; and the wings generally well developed. Endowed with such powers of perception, locomotion, and destruction, it may be readily inferred that these insects are a cruel and predatory race. Like the carnivora of a higher class, they are remarkable for the beauty of their colours, and were termed by Linnæus the tigers of the insect world. The species referable to the Linnæan *Cicindela* are extremely numerous, and are divided into twenty subgenera, of which one only is British, and to this the term *Cicindela* is restricted.

CICISBE'O. (Ital.) A word synonymous with *cavaliere servente*, and applied to a class of persons in Italy who attend on married ladies with all the respect and devotion of lovers. Formerly the establishment of a fashionable lady was not considered complete without a cicisbeo, whose duty it was to accompany her to private parties and public amusements, to escort her in her walks, and in short to be always at her side ready for her commands. This practice is now, however, on the decline. Though

the office of a cicisbeo has been the subject of frequent invective, it has not been without its advocates and admirers. Among others, Baretti has taken great pains to vindicate this custom in his *Account of the Manners, &c. of Italy*, vol. i. c. 8. He ascribes it to a spirit of gallantry derived from the ages of chivalry, and much heightened and refined by the revival of the Platonic philosophy in Italy about the 13th century, and by the verses of Petrarch and his numerous imitators.

CICO'NIA (Lat. *a stork*) A genus of wading birds of the tribe *Cultrirostres* of Cuvier; including the white stork (*Ciconia alba*), the black stork (*Ciconia nigra*), and the American stork (*Ciconia magnari*).

CID. (Arab. seid, *lord*) The name given to an epic poem of the Spaniards which celebrates the exploits of their national hero, Roderigo Diaz, Count of Bivar. It is supposed to have been written in the 13th century, about 150 years after the hero's death, but unfortunately the author's name has not been transmitted to posterity. (See *Southey's Chronicle of the Cid.*)

CI'DER. A fermented liquor made from the juice of apples. Cider is made in all the temperate climates of the world which are not sufficiently warm for maturing the grape, and where the cold is not so great as to reduce the inhabitants to only the beer produced by a fermented decoction of grain. Cider is formed by grinding or crushing the apples when ripe, either in a circular stone trough by a stone roller turned by a horse (which is the common practice in Worcestershire, Herefordshire, &c.), or between fluted or spiky, and afterwards between smooth rollers of wood or iron, driven by men (as practised in Devonshire, and in most places where cider is made on a small scale) The apples, including the core and the seeds, being reduced to a pulp by crushing or grinding, the mass is put into a haircloth and powerfully pressed; and the liquor which runs from it is put into casks, where it is allowed to ferment, the casks being freely exposed to the air in the shade, the progress of the fermentation is then carefully watched, and as the sediment has subsided the liquor is racked off; on the proper time being chosen for doing this depends the excellence of the cider The best cider, other circumstances being the same, is that in which the fermentation has gone on slowly, and where the vinous fermentation has not gone so far as to become acetous. The check to fermentation consists in racking off from one cask to another. Before winter the casks are removed to a cellar, and by the following spring the liquor is fit for use, or for bottling. The principal cider counties in England are Worcestershire, Herefordshire, and Devonshire. The Worcestershire and Herefordshire cider will keep from twenty to thirty years, while the best Devonshire cider will rarely keep more than five or six years.

CI'LIA. (Lat cilium, *an eyelash*) The hairs which grow from the margin of the eyelids; the term is also applied to microscopic filaments or plates which project from animal membranes and are endowed with quick vibratile motion. In most of the lower animals the respiratory function is effected by means of the vibratile cilia; many animalcules and the gemmules of the Acrites move by a similar mechanism, and it has recently been ascertained that vibratile cilia have a share in the performance of some important functions in the highest classes of the animal kingdom, where they have been detected on the membrane lining the female generative and respiratory passages, and the ventricles of the brain.

CILIA. In Botany, long hairs situated upon the margin of a vegetable body, as on the leaves of the *Sempervivum tectorum*.

CI'LIARY. (Lat cilium) The *ciliary ligament* of the eye is the circular portion that divides the choroid membrane from the iris, and which adheres to the sclerotic coat. The *ciliary processes* are the white folds at the margin of the *uvea* in the eye, which proceed from it to the crystalline lens.

CI'LIATED. (Lat. cilium.) A term used in describing the surface of an organ, to denote the presence at the margin of fine hairs resembling the eyelash, as in the leaves of *Luzula pilosa*

CI'LIOGRADE, *Ciliograda*. (Lat cilium and gradior, *I proceed.*) The name of a tribe of Acalephans or seanettles, comprehending those which swim by means of cilia.

CI'MEX. (Lat. cimex, *a bug.*) A Linnæan genus of Hemipterous insects, now subdivided into the following families,—*Pantatomidæ, Coroidæ, Lygoidæ, Cypridæ, Cimicidæ, Reduviidæ, Acanthidæ, Hydrometridæ*. Each of these families includes several genera, and each genus comprises many species; in all the mouth consists of one lengthened and jointed proboscis, including several fine sharp bristle-like processes, which are employed in wounding the vegetable or animal substances on the juices of which these insects feed. The bed-bug (*Cimex lectularius*) may be regarded as a type of this extensive tribe of insects.

CI'MOLITE. A mineral found in the island of Cimola in amorphous earthy masses: it is a hydrated silicate of alumina.

CINCHO'NA. The generic name of certain trees yielding a bitter febrifuge bark, the virtues of which are to be ascribed to the presence of the vegetable alkaloids called *cinchonia* and *quinia*.

Three species of cinchona bark are directed in the London Pharmacopœia to be kept for medical use; namely, the *pale*, *yellow*, and *red barks*. The first of these is furnished by *C. condaminea*, and contains cinchonia; the second, yielded by *C. lanceolata*, produces quinia; and the third, whose origin is not ascertained, possesses a mixture of the two.

CINCHONA'CEÆ (Cinchona, one of the genera.) A natural order of shrubby or arborescent Exogens, almost exclusively inhabiting the tropics and the hotter parts of the world They are in some respects allied to *Compositæ*, from which their distinct stamens, bilocular or plurilocular ovary, and inflorescence distinguish them. They are divided from *Apocynaceæ* by the æstivation of the corolla, the presence of stipules, and the inferior ovary, although, according to Brown, there exists a genus in equinoctial Africa which has the interpetiolary stipules and seeds of *Cinchonaceæ*, and the superior ovary of *Apocynaceæ*, thus connecting the two orders. They are most nearly related to *Caprifoliaceæ*, being only separated from them by their interpetiolary stipules. Brown describes a tribe called *Operculariaceæ* as having but one seed, and the number of stamens unequal to the lobes of the corolla; thus occupying, as it would seem, an intermediate position between *Cinchonaceæ* and *Dipsaceæ*. Powerful febrifugal properties in their bark or emetic in the roots are the great features of this order, the most efficient products of which are *cinchona* and *ipecacuanha*. Many of the plants of the order are fragrant and of great beauty, but, with the exception of the *Gardenia*, *Lucula*, and a few others, the handsome kinds are hardly known to cultivators

CI'NCTURE (Lat cingo, *I surround.*) In Architecture, the ring, list, or fillet at the top and bottom of a column, which divides the shaft of the column from its capital and base

CINE'REOUS. (Lat. cinis, *ashes*) Grey; the colour of wood-ashes

CI'NGULUM. (Lat cingulum, *a girdle.*) In Zoology, is technically applied to the neck of a tooth, or to that more or less distinct constriction which separates the crown from the fang The term *cingula* is also given to the transverse series of bony pieces connected together by tegumentary flexile joints, as in the middle part of the armour of the armadillo.

CI'NNABAR An Indian name, given, according to Pliny, to a mixture of the blood of the dragon and elephant, and other substances of similar colour. It is now exclusively applied to the red pigment called *vermilion*. It is a *bisulphuret of mercury*, composed of 200 mercury + 32 sulphur

CI'NNAMON The bark of the *Cinnamomum zeylanicum* This tree is a native of Ceylon, whence the finest cinnamon is obtained, it is of an astringent and highly aromatic and warm flavour, and yields by distillation an extremely fragrant and pungent volatile oil, kept for pharmaceutical use under the name of *oil of cinnamon*. An inferior kind of cinnamon is often met with in commerce, which is remarkably deficient in flavour.

CI'NNAMON STONE (So called from its colour.) A silicate of lime, alumine, and oxide of iron, from Ceylon. It occurs massive and in rounded pieces in the sand of rivers; some of these are occasionally cut and polished for jewellery

CINQUE PORTS, or FIVE PORTS. The seaport towns of Dover, Sandwich, Hastings, Hithe, and Romney, to which three others were afterwards added, viz Winchilsea, Rye, and Seaford. These towns are incorporated, with peculiar privileges, are under the government of a lord warden, to whom writs for the return of members to parliament from them are directed; and the members so returned are termed Barons of the Cinque Ports.

CI'PHER. (Heb saphar, *to number.*) The character 0 in numeral notation, which, standing by itself, signifies *nothing*, or the privation of value When combined with other numeral characters, its use is to determine their position with regard to the unit's place, and consequently the power of ten, by which their absolute values must be severally multiplied to produce the number they are intended to represent.

*Cipher* is sometimes used in common language to signify any arithmetical character; hence the verb *to cipher*, which signifies to perform an arithmetical operation. This term, which is found in all European languages, was no doubt introduced into Spain by the Saracens, along with the Arabic figures, which appear to have come into use among astronomers in the thirteenth or early in the fourteenth century (for the time of their first introduction is not certainly known), and to have been gradually circulated over Europe in the almanacs.

**CI'POLIN.** A green marble with white zones, somewhat like the section of an onion.

**CI'RCINNATE.** (Lat. circino, *I make a circle.*) A term used in describing the æstivation of flowers, and the direction of plants in general, to denote those which are rolled spirally downwards, so that they are bent like the head of a crosier; as the shoots of young ferns, the inflorescence of Boraginaceous plants, the leaves of the Sundew.

**CI'RCLE.** (Lat. circulus.) In Geometry, a plane figure contained by one line, which is called the circumference, and such that all straight lines drawn from a certain point within the figure to the circumference are equal to one another. The point which possesses this property is called the centre of the circle. The straight line and the circle are the only figures admitted into plane or elementary geometry, all questions in that branch of mathematics depending on the intersections of straight lines with straight lines, of straight lines with circles, or of circles with circles. This distinction was established by the ancient geometricians, who regarded the other geometrical figures as formed by the intersections of planes with solids, and thence denominated problems, for the solution of which the properties of other figures than the straight line and the circle were required,—*solid problems*. The algebraic analysis points to a different distinction. An equation between two indeterminate quantities, neither of which rises above the first degree, represents a straight line. When either or both of the interminate quantities rise to the second degree, the equation may represent a circle, an ellipse, an hyperbola, or a parabola. The circle thus belongs to the same class of curve lines as those which have been termed conic sections; and in fact a cone may be cut by a plane so that the section shall be a circle, as well as any one of the other three curves.

The circle derives its chief importance from its application to trigonometry, or the measurement of angles. Instead of directly comparing angles with one another, it is more convenient to compare the arcs (described with the same radius) contained between the sides of the angle. The numerical relations of different angles, or the corresponding arcs, are expressed as follows:—The circle is divided into four equal parts, and the four portions of the circumference thus formed serve as the measure of four right angles, which comprehend the whole space about the centre. Each of these *quarters* of the circumference is divided into 90 equal parts, called *degrees*. The whole circumference, therefore, contains four times 90, or 360 degrees. This division, adopted in the most ancient times, appears sufficiently capricious; nevertheless it is very convenient, inasmuch as the number 360 contains many primes, and consequently permits many subdivisions into parts expressible by whole numbers. Thus, the half contains 180 degrees, the third, 120, the fourth, 90, the fifth, 72, the sixth, 60, the eighth, 45; the tenth, 36; the twelfth, 30, the fifteenth, 24, &c. In order to measure smaller parts of an angle than a degree, the degree is subdivided into 60 minutes or *primes*, and the minute into 60 seconds. Since the decimal arithmetic came into general use, the sexagesimal division is not carried farther than seconds in expressing angular magnitude, the parts of a second being now always represented by decimals. The whole circumference of the circle contains 21,600 minutes or 1,296,000 seconds.

The rectification of the circle, or the determination of the ratio of the circumference to the diameter, is a problem which has exercised the ingenuity of mathematicians in all ages. It cannot be expressed in finite numbers, but numerous series have been invented from which it may be computed to any required degree of precision. Archimedes, in his treatise *De Dimensione Circuli*, proved that if the diameter is expressed by 7, the circumference is very nearly 22. A nearer ratio, which is generally used in ordinary measurements, is 113 to 355; and it has the advantage of being easily remembered, the numbers being formed of the three first odd numbers, each repeated. Vieta carried the approximation to 10 places of figures, and Van Ceulen to 36. Mr. Abraham Sharp computed the ratio to 72 places of figures; De Lagny, in the *Memoirs of the Academy of Sciences of Paris*, to 128, and lastly Dr. Clausen, in Schumacher's *Astronomische Nachrichten* (No 589.), to 250 places. Supposing the diameter 1, the first 36 figures by which the circumference is expressed (the ratio found by Van Ceulen) are

3·14159,26535,89793,23846,26433,83279,50288.

Of the series by which the circumference is expressed in terms of the diameter, one of the simplest is

$$c = 4 \times (1 - \tfrac{1}{3} + \tfrac{1}{5} - \tfrac{1}{7} + \tfrac{1}{9} - \tfrac{1}{11} + \tfrac{1}{13} - \tfrac{1}{15} +, \&c.);$$

but the following is better adapted for calculation,

$$c = 4 \times (1 - \frac{1}{2 \cdot 3} - \frac{1}{2 \cdot 4 \cdot 5} - \frac{1 \cdot 3}{2 \cdot 4 \cdot 6 \cdot 7} - \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6 \cdot 8 \cdot 9}, \&c.)$$

The areas of circles, as of plane similar figures, are to one another in the ratio of the squares of their diameters. If the diameter is unit, the area is one fourth of the circumference, and is expressed by the decimal ·7853981633974483, &c. to sixteen places. This is nearly in the proportion of 14 to 11, which was the approximation given by Archimedes. Some of the series by which the ratio of the area of a circle to the square of its diameter is expressed are curious. The following was given by Dr. Wallis in his *Arithmetic of Infinities*:—

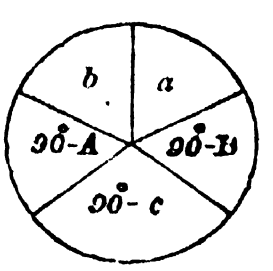
$$\frac{2 \times 4 \times 4 \times 6 \times 6 \times 8 \times, \&c.}{3 \times 3 \times 5 \times 5 \times 7 \times 7 \times, \&c.}$$

This is the same as $\frac{8}{9} \times \frac{24}{25} \times \frac{48}{49} \times$, &c, the denominators being the squares of the odd numbers, and the numerators differing from the denominators by unity. Since the invention of the infinitesimal calculus the discovery of series for the rectification and quadrature of the circle is a matter of comparative facility. A number of them may be seen in *Euler's Introductio in Analysin Infinitorum*.

**CI'RCUITS.** (Lat. circumeo, *I go round.*) In England, Scotland, and Ireland, divisions of the kingdom appointed for the judges of assize, two of whom go each circuit twice a year, to deliver the gaols and try issues at nisi prius. England is divided into six circuits—Home, Midland, Oxford, Norfolk, Western, Northern; Wales into the North and South Welsh circuits. A single judge travels each of the Welsh circuits, and these two meet at Chester to transact the business of that county. The judges choose their own circuits, the three chiefs, and the puisne judges, in order of seniority, making their election. The circuits are after Hilary and Trinity Terms, and vary in their duration from three to seven or eight weeks. (*See* COURTS, SUPERIOR; and ASSIZE.) The circuit or assize towns in most counties have been fixed by immemorial usage, but some changes have recently been made by the authority of the privy council. Barristers at the common law bar choose their circuits on first embarking in their profession, and etiquette allows of only one subsequent change. The insolvent commissioners also make circuits thrice a year through the kingdom for the discharge of debtors.

**CI'RCULAR INSTRUMENTS.** The name given to any astronomical or nautical instrument for measuring angles, in which the graduation extends round the whole circumference, or to 360°. Formerly it was thought sufficient to carry the divisions over a portion of a circle only, whence the quadrants, sextants, and octants, once so common; but experience has shown that entire circles (especially where the instruments are of considerable size) have a great advantage over graduated segments; and hence, excepting the sea-sextant, the latter are now seldom used. The principal circular instruments used in astronomy are *altitude* and *azimuth circles*, *mural circles*, *reflecting circles*, and *repeating circles*. The altitude and azimuth circle, as its name implies, is used for measuring the altitudes and azimuths of stars; it is consequently composed of two graduated circles, one vertical and the other horizontal. This is a sort of universal instrument, being applicable to almost all the purposes of astronomy. The *mural circle* is so called because it is supported by means of a long axis passing into a *wall*, the plane of the circle being parallel to the wall. The instrument is placed in the meridian, and is used for determining the polar or zenith distances of celestial objects. (*See* MURAL CIRCLE.) The *reflecting circle* carries a mirror, by means of which an object is seen by reflected vision, another object is viewed directly; the two are brought to coincide, and the angular distance between them is measured by the inclination of the mirror to the axis of the telescope. (*See* SEXTANT.) The *repeating circle*, or *multiplying circle*, is so contrived that the observer is enabled to repeat or multiply the observation, by reading it off successively on different parts of the graduated limb. A number of values being thus found, the mean of the whole is taken as the correct result. This instrument is sometimes called Borda's circle, from the name of its improver. *See* REPEATING CIRCLE.

**CI'RCULAR PARTS.** In Trigonometry, the name given to a proposition invented by Lord Napier, and demonstrated in his *Mirifici Logarithmorum Canonis Descriptio*, which gives all the relations between the parts of a right-angled spherical triangle in two formulæ. It is this:—In any right-angled spherical triangle, let *a* and *b* denote the sides, *c* the hypothenuse, and A and B the angles opposite to *a* and *b* respectively. Take the two sides, and the complements of the hypothenuse and of the two angles, and write them in order round a circle, as in the annexed diagram; then, if any one part be called the *middle* part, the two next to it are the *adjacent* parts, and the other two the *opposite* parts; and the two following rules will hold good:—



1 The sine of the *middle* part is equal to the product of the tangents of the *adjacent* parts. 2. The sine of the middle part is equal to the product of the cosines of the *opposite* parts. Thus,

Sin. $a$ = tan. $b$, tan. (90 — B).
Sin. $a$ = cos. (90° — A) cos. (90° — $c$).

CI'RCULATING DECIMALS. Are decimals in which two or more figures are constantly repeated in the same order; thus, ·09, ·09,09, &c; ·231,234,234, &c.; ·142857, ·142857, 1, &c. A decimal of this sort is equal to a vulgar fraction of which the numerator is the *period* or circulating figures, and the denominator as many *nines* as there are figures in the numerator.

CIRCUMCI'SION The initiatory rite of the Jewish covenant; which, as is recorded, was first enjoined to Abraham by God, and after his posterity had neglected it during their wanderings through the desert, was solemnly renewed upon the passage of the Jordan. (Josh. v. 1—10)

This custom of cutting off the foreskin has been long prevalent among Eastern nations. Herodotus refers to it as the practice of the Egyptians and Ethiopians, and as borrowed from them by the Phœnicians and Syrians. It does not appear, however, to have been considered by these nations in the light of a religious ceremony. It is enforced by the Koran upon all the disciples of Mahomet, whether from an idea of salubrity vulgarly attributed to it in the East, or merely as a distinguishing rite.

CIRCU'MFERENTOR. An instrument used by surveyors for taking angles. It consists of a graduated brass circle and an index all of one piece, and carrying a magnetic needle suspended above the centre of the circle. The index being directed to an object, the angle which it makes with the magnetic meridian is noted. The index is then directed to the second object, and the angle it makes with the same meridian observed in like manner. The difference (or sum, as the case may be) of the two observed angles gives the angle between the two objects. It is evident that only a very rough approximation can be obtained in this manner. For the purposes of surveying, a pocket sextant is a far preferable instrument.

CI'RCUMFLE'XUS. A muscle of the palate: the term is also applied to arteries which wind round bones or joints.

CI'RCUMPO'LAR STARS. Are those stars which at any given place move round the pole, or complete their diurnal circles, without setting. The number of stars so circumstanced increases with the latitude of the place or the elevation of the pole above the horizon.

CIR'CUMSCI'SSILE. (Lat. circumscindo, *I cut round*.) A mode of dehiscence observed in the fruit of some plants; it occurs by a transverse circular separation of the sides of the ovary, as in *Anagallis*, *Hyoscyamus*, and is analogous to the transverse articulations found in the leaf of the orange or the pod of ornithopus.

CI'RCUMSCRI'PTION. (Lat. circumscriptio, *a boundary*.) The line representing the two edges of a leaf, *i. e.* its margin: it is also used to denote the figure represented by the margin of any other body.

CI'RCUMVALLA'TION. (Lat. circum, *about*, and vallum, *a rampart*.) In Fortification, a trench or bulwark thrown up about a camp or besieged city, composed of the earth dug up from the ditch and of sharp stakes planted in it.

CI'RCUS. A straight long narrow building, whose length to its breadth was generally as five to one. It was divided down the centre by an ornamented barrier called the spina, and was used by the Romans for the exhibition of public spectacles and chariot races. There were several of these at Rome, of which the most celebrated was the Circus Maximus.

Julius Cæsar improved and altered the Circus Maximus, and that it might serve for the purpose of a naumachia, supplied it with water. Augustus added to it the celebrated obelisk now standing in the Piazza del Popolo. No vestiges of this circus remain. Besides these were at Rome the Circi of Flaminius, near the Pantheon; Agonalis, occupying the site of what is now the Piazza Navona; of Nero, on a portion whereof St Peter's stands; Florus, Antoninus, and Aurelian, no longer even in ruins; and that of Caracalla, which was 738 feet in length, and is sufficiently perfect in the present day to exhibit its plan and distribution in the most satisfactory manner.

The spectacles exhibited in the circus were called the Circensian Games, and consisted chiefly of chariot and horse races. The Romans were passionately fond of them, and more particularly of the chariot races, which excited so great an interest in the times of the emperors as to divide the whole population of the city into factions, known by the names of the colours worn by the different charioteers. The disputes of these factions sometimes led to serious disturbances, and even bloodshed.

CI'RRHOUS. (Lat. cirrus, *a tendril*.) A term used in describing the apices of bodies, to indicate those that are terminated by a spiral or flexuose filiform appendage, arising from an elongation of the costa, as in the leaf of *Gloriosa superba*. It is also applied to modifications of branches, inflorescence, the petiole, &c. when such parts assume the state of a twisting body, which enables the plant [illegible] to it to raise itself upon neighbouring objects.

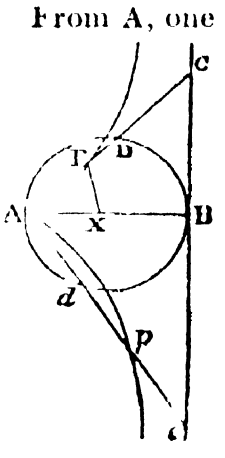
CI'RRIPEDS, *Cirripedia*. (Lat. cirrus, and pes, *a foot; curly-footed*.) A class of fixed homogangliate animals, characterized by having a number of long, curled, articulated, setigerous processes, analogous to the feet of the Crustaceans, which project from the central aperture of the multivalve shell protecting the body. These animals are commonly called barnacles and acorn-shells. *See* LEPADIDES and BALANIDES.

CI'RROUS. Furnished with tendril-like appendages.

CI'RSOCE'LE. (Gr. κιρσος, *a dilated vein*, and κηλη, *a tumour*.) A morbid enlargement of the spermatic veins in the groin.

CI'SSOID. In Geometry, a curve line of the second order, invented by Diocles, with a view to the solution of the famous problem of the *duplication of the cube*, or the insertion of two mean proportionals between two given straight lines. Its name is derived from κισσος, *ivy*; because the curve appears to mount along its asymptote as ivy climbs on the tall trunk of a tree. The curve is described as follows:—

From A, one of the extremities of the diameter of a circle, draw a straight line, A C (or $ac$), to meet the tangent through the other extremity, and make C P equal to the intercepted chord A D, the point P will trace the cissoid. The line A C may be conceived to turn on both sides of the diameter A B till it falls into the position of a tangent to the circle at A. The curve, therefore, consists of two infinite branches, which approach always nearer to the tangent C B $c$ without ever meeting it, whence this line is an asymptote to the cissoid. The point A being taken for the origin of the co-ordinates, and the diameter A B as the axis of the abscissæ, the equation of the curve is $x^3 = (a-x)\,y^2$, $a$ being the diameter of the generating circle. One of the most remarkable properties of the cissoid is, that the whole space lying between the double branches and the asymptote is equal to triple the area of the generating circle. A method of describing the cissoid mechanically by the motion of a rectangular rule, is given in *Newton's Universal Arithmetic*.




CIST. (Gr. κιστη, *a chest*.) In Architecture and Sculpture, a chest or basket. It is a term usually applied to the mystic baskets employed in processions connected with the Eleusinian mysteries. They were originally of wicker work, and when afterwards made of metal the form and texture were preserved in imitation of the original material. When sculptured on antique monuments it indicates some connection with the mysteries of Ceres and Bacchus.

CISTA'CEÆ. (Cistus, one of the genera.) A natural order of shrubby or herbaceous Exogens inhabiting chiefly the countries of the south of Europe and North America. They are distinguished from *Violaceæ* by their indefinite stamens and inverted embryo, from *Bixaceæ* by the last character, by their mealy albumen, habit, and not having the leaves ever dotted, from *Hypericaceæ* by the latter character, and the structure of the fruit. They are allied to *Papaveraceæ* by the genus *Dendromecon*, but their true station appears to be in the vicinity of *Tiliaceæ*, to which they approach by the genus *Lechea*. They are often plants of great beauty, but possess no sensible properties, excepting the *Cistus creticus* and a few others, which yield the resinous balsamic substance called gum labdanum.

CI'STERN. (Lat. cisterna, from Gr. κιστη.) In Architecture, a reservoir or receptacle of water for public or domestic use. When made of brick or stone it is commonly called a tank.

CI'STVAEN. A species of stone receptacle, often found in barrows (generally at the east end), containing the bones of the persons interred there. Cistvaens are commonly three stones placed on edge, like the three sides of a box, with a stone cover. Some which are styled cistvaens by Sir R. Hoare and other antiquaries are, however, not sepulchral.

CITA'TION. (Lat. cito, *I call*.) In Ecclesiastical Law, an act whereby the defendant, on the application of the plaintiff, is commanded to appear in court on a certain day in order to enter into a suit. In the Civil Law, reference to an authority or precedent in the course of a pleading is termed a citation, and hence the common use of the word in the same sense with quotation, allegation of instances, &c.

CI'TRATES. The salts of citric acid.

CITRE'NE. A crystalline compound of hydrogen and carbon, obtained from the essential oil of lemons.

CI'TRIC ACID. (Lat. citrus, *the lemon*.) The pure

acid part of lemon and lime juice; it is also found in other fruits. Crystallized citric acid is largely prepared for domestic use.

CI'TY. (Lat. civitas.) A borough or town corporate, which is or has been the seat of a bishop, or the capital of his see; and it differs in no respect but that of superior dignity from another borough Some cities and a few boroughs are counties in themselves

CI'VET. A brown semifluid matter contained in a gland near the anus of the *Viverra civetta* or *civet cat:* its odour is offensive unless extremely diluted, and then in combination with other perfumes it adds to their energy. The term *Civet* is Arabic. When genuine, this matter is worth from 25*s* to 35*s*. per oz.

CIVI'LIAN. One learned in the Civil or Roman Law; particularly a member of the "College of Doctors of Law exercent in the Ecclesiastical and Admiralty Courts" in England and Wales, in which courts the civil law is recognized. (*See* LAW, CIVIL) Practice as an advocate in those courts is confined to members of this college, who must have taken the degree of Doctor of Law in the university of Oxford or Cambridge.

CI'VIL LIST. The term formerly applied to the list of all the expenses of the government, or "of all the heads of public expenditure, excepting those of the army, the navy, and the other military departments," but confined at present by the act 1 W. 4 c 25 to expenses proper for the maintenance of her majesty's household. In England the civil list is fixed in the first session of parliament after the accession of the sovereign, and is then understood to be granted for the whole period of his reign

CLAMP. (From the French) In Architecture, a piece of wood fixed to another with a mortise and tenon, or a groove and tongue, so that the fibres of the piece thus fixed cross those of the other, and thereby prevent it from casting or warping

CLAMP. In Brickmaking, a large mass of bricks, generally quadrangular on the plan, and 6, 7, or 8 feet high, arranged in the brick field for burning, which is effected by flues prepared in stacking the clamp, and breeze or cinders layed between each course of bricks

CLAN (Said to be derived from the Gaelic clann, *descendants or issue*) The clans of the Scottish Highlands are tribes consisting of many families all bearing the same surname, which according to tradition descend from a common ancestor. But it is more probable that most clans were formed of an aggregate of different families, the inferior standing to the superior in the same sort of relation as the Roman clients to their patrons, and by degrees assuming the same name Some clans, however, are divided into branches, each possessing a distinct surname The chieftainship of every clan descends regularly through heirs male, but in the earliest times of their history the rights of primogeniture were not very distinctly defined The Gaelic clans occupy the northern and western with part of the central shires of the country. A Gaelic manuscript lately discovered containing genealogies of the Highland clans, and supposed to have been written about the year 1410, should seem to carry back the antiquity of the singular institution of clanship even to a remoter period than was previously believed

CLA'RET This term is applied to several of the Bourdeaux wines, it is derived from the Latin claretum, from clarere, *to be clear* *See* WINE

CLA'RINET (It clarino) A wooden musical wind instrument, whose mouth partakes of the trumpet form, and is played by holes and keys said to have been invented about the year 1600 by John Christopher Denner of Leipsic. Like the oboe it is played with a reed mouthpiece, though it is of somewhat different form.

CLA'SSES. In Ancient History, this term is particularly applied to the division of the Roman people made by Servius Tullius for the purpose of distributing them into centuries. *See* CENTURIES.

CLA'SSIC. (Lat. classis, *a class.*) In the Fine Arts, a term denoting such an arrangement of a subject that all the accessories or parts are suitable to the general design, and such that nothing be introduced which does not strictly belong to the particular class under which it is placed.

CLASSIC. In Antiquity, the Roman people were divided into classes, and the highest order were by pre-eminence termed *classici* Hence the name came to signify the highest and purest class of writers in any language; although down to a comparatively recent period, the term was used merely to denote the most esteemed Greek and Latin authors. Nothing marks more strongly the increased attention to, and appreciation of, modern literature, than the now universal application of the term to modern languages also, and the establishment in this manner of a line between those authors whom we regard as models and authorities in point of style, and those who are not so highly esteemed. An author is said to be *classical* if public opinion has placed him in the former order: language, or an expression, to be *classical*, if it be such as has been used in a similar sense and under similar rules of construction by those authors. The epithet classical, as applied to ancient authors, is determined less by the purity of their style than by the period at which they wrote. Thus we speak of the classical age of Greek or Latin writing. With respect to the former, the classical age begins with Homer, the earliest Greek writer with whom we are acquainted. The purest age of Greek classical literature may be said to end about the time of the Macedonian conquest, or about 300 B.C; but, in a wider sense, it extends to the time of the Antonines, and embraces a much larger catalogue of authors; while the centuries subsequent to that time produced a few, who by the purity of their style deserve to be ranked with earlier classics. The Latin classical period is shorter: its earliest writer is Plautus, and the language may be said to have lost its classical character about the same time with the Greek, *i.e* the reigns of the Antonines; although this limit is arbitrary, and some later writers (even down to Claudian) are generally included among classics. Within the Latin classical era there is a more restricted period of the purest Latinity, comprising the age of Cicero and that of Augustus.

CLA'SSIFICA'TION (Lat classis, *a class*) In the Fine Arts, an arrangement by which objects of the fine arts are distributed in classes, as, for instance, in galleries of paintings, the works should be arranged in schools, each school being subject to a chronological order of the masters In Numismatology, the coins should be arranged by countries, and these again in chronological order of the monarchs, and the like of other branches of the arts

CLASSIFICATION, in Natural History, denotes the arrangement or assortment of various objects into those several classes denoted by appellatives which are called genera and species For classification in Botany, Zoology, Medicine, Chemistry, &c, see the separate articles.

CLAU'SA. (Lat clausus, *shut*) A name given by Cuvier to a family of Acephalous bivalves, comprehending those which have the mantle open at one end, or near the middle, for the passage of the foot, and prolonged at the opposite end into a double tube for respiration and excretion.

CLAUSI'LIA. (Lat clausus) A genus of land-snails, so named because the aperture of the shell is closed internally by a spiral lid. Many species of this genus are natives of Great Britain The rugose or dark close-shell (*Clausilia rugosa*, Drap) is not uncommon at Charlton, where it may be found under stones. *Clausilia biplicata*, Leach, is found at Battersea

CLA'VATE (Lat clava, *a club*) Club-shaped; as when a body is linear at the base, but towards the apex growing gradually broader

CLA'VICLE (Lat clavicula, from clavis, *a key*) The bone situated between the sternum or breast-bone and the acromion process of the scapula or blade-bone. The megatherium is the largest mammal which possesses this bone

CLA'VUS. (Lat. clavus, *a nail*) In Agriculture, an excrescence from the grains of rye, of a brown or blackish colour It is a parasitical fungus, called *Spermoedia clavus*, and is a valuable agent in exciting uterine action during labour. A severe pain in the forehead compared to the driving of a nail into the skull has been called *clavus* by medical writers.

CLAW, or UNGUIS The narrow part at the base of a petal which takes the place of the footstalk of a leaf, of which it is a modification.

CLAY In Chemistry, a term generally applied to a variety of *plastic* earthy compounds of different colours, and having much attraction for water. They are essential in the manufacture of pottery, and consist of silica, with variable quantities of alumina, and generally some oxide of iron.

CLAY. In Agriculture, one of the most common ingredients that enter into the composition of soils Indeed, it may be asserted that no soil whatever will maintain its fertility for any length of time without a due proportion of clay in its composition. The most fertile soils in the world are the alluvial deposits on the banks of rivers; and these, in an agricultural sense, all belong to clayey soil. In many cases the clays of agriculture are intimately united with calcareous earths, and in others with sand; but in both cases these earths are in a state of such minute division, that the mixture has all the appearance and the mechanical properties of a strong clay, and they are treated by cultivators accordingly. Among the most tenacious clays of Britain are those of Middlesex; and these, when examined, are found in many cases to contain a considerable proportion of lime, and in others of sand. The best wheats are everywhere, both in Britain and on the Continent, grown on calcareous clays; and also the best fruits and flowers of the Rosaceous kind, such as apples, pears, plums, cherries, roses, &c.; but it is remarkable that the grape, when grown on clayey soil, produces neither high-flavoured fruit, nor good wine.

CLAYEY SOIL. Soil in which clay is the principal earthy ingredient. Soils of this description when first subjected to cultivation are expensive to labour, and uncertain in their produce; but after they have been drained, cultivated, limed, and manured for two or three generations, they become the most fertile of all soils, producing immense crops of wheat, beans, clover, rye-grass, &c.

CLEA'RING OF LAND. Removing such objects as impede the progress of the plough; such as stones, bushes, hillocks, and other obstructions.

CLEF. (Fr.) In Music, a mark prefixed to a staff, showing the tone or key in which a piece of music begins; or it is a letter or other sign marked on a line, which determines the name of all those of the degree whereon it is placed. A clef is always placed on a line, never on a space.

CLE'FT-GRAFTING. A mode of grafting, in which the scion is inserted in a cleft made in the stock. *See* GRAFTING.

CLEPSY'DRA. (Gr. κλεψύδρα, from κλεπτω, *I conceal*, and ὑδωρ, *water*.) Water clock; an ancient instrument for measuring time by the gradual emptying of a large vessel of water through an orifice of a determinate magnitude. Clepsydras were first brought into use in Egypt under the reign of the Ptolemys, and seem to have been common in Rome, though they were employed chiefly in winter; in summer sun-dials were used. Though clepsydras are attended with several inconveniences, the principal of which is the unequal rapidity of the flow caused either by a variation in the depth of the water in the containing vessel, or of temperature, or barometric pressure, they are nevertheless susceptible of considerable accuracy; and before the invention of clocks and watches, astronomers had no other dependence than on them for measuring small portions of time. At present they are abandoned, because pendulum clocks and watches are much more convenient, as well as infinitely more exact. In one case has the revival of their use been proposed; namely, for the accurate measurement of very small intervals of time by the flowing of mercury from a small orifice in the bottom of a vessel kept constantly filled to a fixed height. The stream is intercepted at the moment of noting any event, and diverted aside into a receiver, into which it continues to run till the moment of noting any other event, when the intercepting cause is suddenly removed. The stream then flows in its original course, and ceases to run into the receiver. The weight of mercury received, compared with the weight of that which passes through the orifice in a given time, observed by the clock, gives the interval between the events. This ingenious application of the principle of the clepsydra is due to the late Captain Kater.

CLE'RGY. The ecclesiastical body as distinguished from the laity. The word clergy seems to be derived from Gr. κληρος, *a lot or inheritance*, Lat clerus, whence clericus, *a clerk or clergyman*; plur. clerici, whence *clergé*, *clergy*; and is supposed to allude to a custom, which, however, was never general, of choosing the clergy by lot; or, as St. Jerome says, to signify that the clergy are the lot and portion of the Lord, or the Lord is their lot. Perhaps the true derivation is rather to be traced from the lots (κληροι) by which the apostles chose Matthias to be one of their number. (Acts, II. 26.)

*Clerk* (Lat. clericus) is still the legal appellation of a clergyman. The clergy being exclusively the learned part of the community in the middle ages, the word hence came to signify an educated person; and thus acquired the sense of a scribe or writer in France and England.

CLI'ENTS. (Lat. cliens, from the old word cluo, *I hear or obey*.) In Ancient History, a numerous body of the Roman citizens, so termed relatively to their patrons or protectors. This relation was in many respects similar to that of a serf to his feudal lord, but bore a much milder form. It was the duty of the patron to watch over the interests of his clients and protect them from aggression, and appear for them in lawsuits. He also frequently made them grants of land on lease. In return the client was bound to defend his patron, and contribute towards any extraordinary expences he might be subject to; as the portioning his daughters, the payment of a fine imposed by the state, &c. He might not appear as accuser or witness against him in judicial proceedings, a prohibition which was reciprocal. If he committed any offence against his patron, he was obliged to submit to him as his judge; and in ancient times it appears that the power of life and death was held by the latter. On the other hand, his security against oppression at the hands of his patron lay in the injunctions and authority of religion, which rendered the bond of union inviolably sacred, as that between father and son. The origin of this relation cannot now be traced; but it seems to have existed, with various modifications, throughout Italy and Greece. In Rome it appears at the foundation of the city by Romulus, when every family not included among the patricians was obliged to find itself a patron from their number. The body of clients was afterwards increased by the institution by which foreigners, who, as allies of Rome, had a share in its franchise, might choose themselves patrons on their coming to settle in the city. The obligations of clients were hereditary, and could not be shaken off unless through the decay of the family of the patron. This body alone in earlier times furnished artizans and shopkeepers; they had votes in the Comitia Centuriata; and though generally confounded with the plebeians, were undoubtedly perfectly distinct from them, as we continually meet in history with instances of their joining the patricians in opposition to the former; and when some of the plebeian houses became powerful, they themselves attached bodies of clients.

It has been seen that among the other duties of a Roman patron towards his client was that of maintaining his cause gratuitously in legal proceedings. Hence the term "client" has become appropriated in modern times to one whose cause is prosecuted or defended and his person represented by an advocate. The custom of practising gratuitously as advocates long prevailed among the Roman patricians; and from it the usage was derived, which still obtains among ourselves, of considering the fee of a counsel as "quiddam honorarium," a gratuity, which cannot be legally claimed. At present, the etiquette of the English bar appears to be this — that a barrister cannot refuse, without strong grounds for such refusal, to undertake any cause which is offered him; that he cannot refuse, without reasonable excuse, to plead gratuitously the cause of a client who sues regularly "in formâ pauperis," or to defend a prisoner, if called on to do so by the court, and that he can receive no instructions with a fee except through the medium of a regularly authorized agent of his client (attorney or solicitor). An application to a barrister, with the customary fee, to undertake a cause in which he is not yet instructed, is called a "retainer," and secures his services for the client. An application to undertake all causes for a particular client is a *general* retainer.

CLIMACTE'RICAL YEAR. (Gr. κλιμακτηρ, from κλιμαξ, *ladder, scale*.) Certain years in the life of man have been from great antiquity supposed to have a peculiar importance, and to be liable to singular vicissitudes in his health and fortunes. This superstitious belief is said to have originated in the doctrines of Pythagoras. The well-known notice of the climacterical year sixty-three, supposed to be particularly dangerous to old men, in a letter of Augustus Cæsar preserved by Aulus Gellius, evinces its prevalence among the Romans. This year has been called by some astrological writers "heroicus," as having been peculiarly fatal to great men. The virtue of this year seems to consist in its being a multiple of the two mystical numbers, seven and nine. It is certainly singular that usage should have attached in all countries peculiar distinctions to those years which are denoted by compounds of the number seven. Thus fourteen has been fixed for various purposes as the epoch of puberty, twenty-one of full age, thirty-five is selected by Aristotle as the period when the body is in its highest physical vigour. The same author supposes the vigour of the mind to be perfected at forty-nine. sixty-three is the grand climacterical year, seventy the limit of the ordinary age of man. Bodinus says that seven is the climacterical number in men and six in women. The term *climacteric disease* has more lately been applied to that declension of bodily and vital powers which is frequently observed to come on in the latter period of life, and from which many persons again rally so as to attain extreme old age.

CLI'MATE. (Gr. κλιμα, from κλινω, *I incline*.) Among the ancient geographers, was applied to denote that obliquity of the sphere with respect to the horizon which gives rise to the inequality of day and night. They divided the space comprehended between the equator and the pole into thirty parts, which they denominated *Climates* or *Inclinations*; viz twenty-four between the equator and polar circle, and six between the polar circle and the pole. The first are called *half-hour* climates, because from one to another the longest day receives an augmentation of half an hour; the second are called *month* climates, because at the two parallels between which any one of them is comprehended the difference of the time of perpetual sunshine is one month. The first half-hour climate reaches from the equator to that parallel of latitude where the length of the longest day is twelve hours and a half; the second ends at the parallel where the longest day is thirteen hours, and so on. If, therefore, from the number of hours in the longest day at any particular place we subtract twelve, the number of half hours remaining will indicate the climate in which that place is situated. Thus, the longest day at London being a little more than sixteen hours and a half, London is situated in the tenth climate.

The first month climate extends from the polar circle to the parallel under which the sun continues above the horizon during a month; the second reaches from the

first to the parallel where the sun continues visible during two months; and so on to the poles, at which the sun is alternately visible and invisible during half the year.

Instead of the divisions which we have now described, Ptolemy adopted climates corresponding to the increase of a quarter of an hour in the length of the longest day. The space from the equator to the polar circle would thus be divided into forty-eight instead of twenty-four zones; but as these in the higher latitudes became very narrow, he carried the quarter-hour climates only to the twenty-fourth, that is, to the parallel at which the longest day is eighteen hours. From eighteen to twenty hours he proceeds by half-hour climates; from twenty to twenty-four hours the breadth of the climate is estimated by the difference of a whole hour in the length of the day. The determination of the parallels at which the different climates begin and end is equivalent to this problem: — Having given the length of the longest day to find the latitude of the place? The tangent of the latitude is equal to the sine of the excess of the semidiurnal arc above a quadrant multiplied into the cotangent of the obliquity.

*Climate*, in its most ordinary and general acceptation, embraces all those modifications of the atmosphere by which our organs are sensibly affected; such as temperature, humidity, variations of barometric pressure, the tranquillity of the atmosphere or the effects of winds, the intensity of electric pressure, the purity of the air or its mixture with gaseous emanations more or less salubrious, and lastly, the habitual diaphaneity of the atmosphere, — that serenity of the sky so important on account of the influence which it exercises not only on the radiation of the ground, on the development of organic tissues in vegetables and the ripening of fruits, but also on the *ensemble* of moral sensations which mankind experience in the different zones. There are two general causes on which the climate peculiar to any country principally depends — 1st, its distance from the equator, and 2nd, its altitude above the level of the sea; but their effect is generally modified by many circumstances exerting a partial influence. Among these may be enumerated the configuration and extent of the country, its inclination and local exposure, the direction of the chains of mountains by which it is intersected, or which are in its vicinity, the nature of the soil as it is more or less favourable to radiation and evaporation, the proximity to, or distance from, seas, the action of winds blending the temperatures of different latitudes; and even the changes produced by cultivation. The appreciation of all these causes, which modify the results deduced from the consideration of latitude and elevation alone, and the effect produced by their combined operation, constitutes the science of *climatology*.

*Effect of Geographical Position* — The principal part of the temperature enjoyed by any country depends on the heat which it receives directly from the sun. In estimating the amount of solar heat received by any given space on the surface of the earth in the course of a whole year, we may suppose the sun to remain constantly in the equator, because the excess of heat above the mean in summer is exactly balanced by its defect in winter. Now, the effect produced on any given portion of the surface will depend on the number of rays that fall on that surface, and on the obliquity of their direction with respect to it. But the number of rays falling on a zone of any given breadth, a degree for example, is proportional to the cosine of its latitude; and the effect of a single ray in consequence of its oblique impact is diminished also in proportion to the cosine of the latitude, the diminution of the mean temperature, therefore, in going from the equator to the poles, must be proportional to the square of the cosine of the latitude. It hence follows that the variations of the mean temperature must be most rapid about the middle latitude of 45°; and this result of theory agrees perfectly with observation. Within the temperate zone the character of the climate changes rapidly. Thus in the south of France, and in Italy, nearly under the 45th parallel, the region of the vine is found contiguous to that of the olive and fig-tree. On the other hand, very little increase of heat is observed from the tropic to the equator, and at the other extremity of the arc, from the arctic circle to the highest latitude that has been reached, the intensity of cold is not greatly augmented. The law of the square of the cosine gives a variation of only about eight degrees of Fahrenheit's scale from the polar circle to the pole. In the system of climates of western Europe, the mean temperature at the latitude of 45° is about 13° or 13·5° of the centigrade scale (55° to 56° of Fahrenheit). The mean temperature under the equator ought therefore to be, by the theory, 26° or 27° (centigrade); and at any other place it will be found by multiplying the constant number 27 into the square of the cosine of the latitude.

*Effect of Altitude.* — That a greater degree of cold prevails in the upper regions of the atmosphere than at low levels would be manifest by the snowy covering of the summits of very elevated mountains in all latitudes, even if no direct experiments had been made on the temperature that prevails there. These, however, have been made in great number; and the constant and regular decrease of the temperature in ascending above the surface of the earth, to such altitude at least as can be reached, has not only been fully established, but the law according to which the decrease takes place determined with considerable certainty. According to theory the decrements of heat in ascending the higher regions should follow the same proportion as the decrements of the density; but this law is greatly disturbed by local peculiarities. The variation of temperature at different altitudes is the simultaneous effect of three general causes, — 1st, the absorption of rays of light in their passage through the atmosphere, which is much greater in the dense strata near the surface of the earth than in the upper regions; 2d, the radiation from the surface; and 3d, the ascending current; the two last also producing a greater effect on the strata near the surface. Any circumstance, therefore, which modifies these causes, must also modify the law which connects the decrease of heat with the elevation. It will be slower above the surface of the sea or a country covered with snow than above a desert destitute of vegetables, or a surface of sand; and it will be more rapid above the sloping sides of a conical mountain than over a cordillera which presents plains of great magnitude elevated in stages above one another. Nevertheless at great altitudes the disturbing influences of these causes becomes insensible, and a very considerable degree of uniformity in the temperature constantly prevails. In the torrid zone, Humboldt, from a mean of many observations, found that between the altitudes of 3000 and 5800 metres (9840 and 19,000 feet) an increase of elevation, amounting to 191·4 metres, produced a diminution of 1° of the centigrade thermometer. This corresponds to 349 English feet for 1° of Fahrenheit. Professor Leslie (*Ency. Brit.* art. "Climate") estimates that the diminution of temperature of 1° of Fahrenheit's scale corresponds to an ascent of 300 feet. But this will hold true only of moderate elevations. At the altitudes of 1 mile, 2 miles, 3 miles, 4 miles, and 5 miles, the increase of elevation corresponding to 1° Fah. will be respectively 295, 277, 252, 223, and 192 feet. The allowance of 1° of Fah. for every 100 yards of ascent is, however, a rule of easy recollection, and in ordinary cases may be taken as a sufficient approximation.

*Configuration* — The form of the limits of any large mass of land as determined by its contact with the ocean, that is to say, the greater or less extent of coast it possesses in proportion to its area, exercises a considerable influence on the climate. The small amount of variation in the temperature of the ocean tends to equalize the periodic distribution of heat among the different seasons of the year, and the proximity of a great mass of water moderates by its action on the winds the heat of summer and the cold of winter. Hence the great contrast between the climate of islands and coasts, and the climate of the interior of vast continents. Europe presents a remarkable example of this contrast. From Orleans and Paris to London, Dublin, Edinburgh, and even farther north, the mean temperature of the year decreases very little, notwithstanding the increase of latitude; while in the eastern part of the Continent each degree of latitude, according to Humboldt, produces a variation of 1·1° Fah. in the mean temperature. A small island, a tongue of land, or an indented coast, in contact with a great mass of water, which preserves in winter a considerable portion of the heat acquired during the summer, possesses a more moderate climate, milder winters, and fresher summers, and in the higher latitudes a somewhat higher mean temperature, than the interior of great continuous masses of land under the same latitude. The diminution of the mean annual temperature from the western shores of Europe to beyond the meridian of the Caspian is remarkable. Amsterdam and Warsaw are situated very nearly under the same parallel of latitude, that of the first being 52° 22′, and that of the second 52° 14′; but the mean annual temperature of Amsterdam is 53·4° Fah., while that of Warsaw is only 46 18°. The latitude of Copenhagen is 55° 41′, and that of Kasan 55° 48′; but the mean annual temperature of Copenhagen is 45·7°, that of Kasan 37 6°. The climate of a country is influenced not only by its horizontal configuration, but also by its *relief*, or vertical configuration. Mountains affect the climate of the adjacent plains in various ways — by the reverberation of heat from naked rocks; by affording shelter from certain predominating winds; and by giving rise to descending currents of cold air from the higher regions of the atmosphere, in consequence of the disturbance of the equilibrium of heat produced by the radiation from their sides and summits. The local exposure of a country also, or its inclination to or from the equator, which may be included under the title configuration, has a powerful influence on its mean annual temperature. Generally speaking, the local exposure is connected with

and depends upon the position of the mountain chains, and both conspire to increase or diminish the mean temperature at the same time. For example, when the general inclination of an extensive tract of country is towards the south, the northern side is bounded by ranges of mountains; so that while the sun's rays fall upon it at a less oblique angle, it is sheltered from the cold winds blowing from a higher latitude.

*Climate of Europe.* — In a general view, Europe may be regarded as a peninsular prolongation of the ancient continent, broken and intersected by numerous arms of the ocean, and by inland seas. The predominating winds are from the west; and these, for the whole of the western portion, are sea winds, greatly softened by blowing over a mass of water, of which the superficial temperature, even in the month of January, at the parallels of 45° and 50°, does not fall below 48° and 51° of Fahrenheit. It is placed directly north of an immense tract of tropical land (Africa and Arabia), which by its diurnal radiation contributes powerfully to elevate the temperature. On the northern side the cold belonging to the latitude is mitigated by numerous favourable circumstances. A very small portion of land lies within the polar circle, and the whole of the northern extremity is separated from the polar ice by a zone of open sea, the temperature of which is maintained at a considerable elevation in consequence of its communication with the Atlantic ocean, and of the existence of the gulf stream, which conveys a portion of the temperature of the gulf of Mexico into the polar seas.

*Climate of Asia.* —The circumstances which contribute to render the climate of Europe mild and temperate are nearly all reversed in respect of Asia. Its northern boundary extends beyond the parallel of 70°, and in some places reaches to 75°. In every part it extends to the winter limit of the polar ice, and only a very narrow zone of water is interposed between the ice and the land during the short summer of these high latitudes. The north winds, not obstructed by any chain of mountains, blow with unmitigated severity over an icy plain, extending northward to the pole, and eastward to the point of maximum cold, which appears to be situated near the meridian of Behring's straits. The refrigerating influence of these winds is not counteracted by arid deserts on the southern side of the continent. From the meridian of the Ourals to that of Cape Tchoukotski, through 140 degrees of longitude, there is no land under the equator, excepting the inconsiderable portion formed by the islands of Sumatra, Borneo, Celebes, and Gilolo; consequently the Asiatic countries situated in the temperate zone are not warmed by ascending currents of heated air, such as those which rise from the deserts of Africa and are so beneficial to Europe. The position of the great mountain chains and the general elevation of the country also powerfully contribute to diminish the temperature. The Himalaya and Kuen-lun, through a great extent of the continent, present an effectual barrier to the warm winds which come from the equator. Elevated plains and groups of lofty mountains accumulate, and preserve the snow till late in the summer, and give rise to descending currents of air which cool down the temperature of the circumjacent countries. Lastly, Asia being bounded on the western side by Europe, the west or predominating winds are land winds for the greater part of the continent, and their severity is increased by the great enlargement of the land towards the north. (*Humboldt, Fragmens Asiatiques; Daniell's Meteorological Essays, Murray's Ency. of Geography.*)

CLI'MAX. (Gr. κλίμαξ, *gradation*.) In Rhetoric, a figure by which several propositions, or several objects, are placed before the mind of the hearer or reader in such an order that the proposition or object calculated to produce the least impression shall strike it first, and that the rest shall follow in regular gradation. Anti-climax is the converse figure, in which the ideas sink in succession. This forms a principal cause of that vice of composition of which so many ludicrous illustrations have been given under the name of Bathos.

CLINAN'THIUM. (Gr. κλινη, *a bed*, and ανθος, *a flower*.) A term used to express the receptacle of a composite plant. It is the dilated apex of a flowering branch covered over by small flowers enclosed within an involucre.

CLI'NICAL. (Gr. κλινη.) This term is generally used medically; a *clinical lecture*, for instance, is the instruction which the teacher gives his pupil at the bedside of the patient.

CLI'NIUM. (Gr. κλινη.) A term occasionally used in botany to denote the summit of a floral branch, of which the carpella are the termination. It is the same as the *torus* of the modern French school, and one of the parts called receptacle by Linnæus, as in the strawberry.

CLI'NKERS. See BRICKS.

CLI'NOID. (Gr. κλινη, and ειδος, *likeness*.) This term has been improperly applied to certain processes of the *sphenoid bone*.

CLINO'METER. (Gr. κλινω, *I bend*, and μετρον, *a measure*.) An instrument for measuring the *dip* o mineral strata. (*Geol. Trans.* vol. iii.)

CLI'O. (Gr. κλεω, *I celebrate*.) In Mythology, the muse who was usually supposed to preside over history though she sometimes invaded the province of her sister Calliope, the goddess of epic poetry. In his [illegible] ode (Book I. Ode 12.) addressed to Augustus, Horace invokes Clio as the patroness of the flute or the lyre, or in other words of lyric poetry:—

Quem virum aut heroa lyra vel acri
Tibia sumes celebrare, Clio, &c.

CLIO. In Zoology, applied by Linnæus to a genus of *Vermes*, and by Cuvier to a genus of Pteropodous Mollusks; one species of which, the *Clio borealis*, abounds in the northern seas, and although not exceeding an inch in length, it forms a great proportion of the food of the whalebone whale, *Balæna mysticetus*.

CLOA'CA (Lat.) The excrementory cavity in which, in birds, reptiles, many fishes, and some mammals the intestinal canal, urinary ducts, and genital passages terminate.

CLOCK. *See* HOROLOGY.

CLOI'STER (Lat. claustrum.) In Architecture, an arcade or colonnade round an open court.

CLOSE. In Music. *See* CADENCE.

CLOSE. A small field, enclosed or hedged about.

CLO'SE-HAULED, that is, the tacks close down, the sheets aft, the yards braced sharp up, and the bowlines hauled, the ship making her progress as near the direction of the wind as she can.

CLO'SERS. In Architecture, the pieces (or bats) less or greater than half a brick, that are used to close in the end of a course of brickwork. In English as well as Flemish bond (*see* BOND), the length of a brick being but nine inches, and its width four inches and a half, in order that the vertical joint may be broken at the end of the first stretcher, a quarter brick (or bat) must be interposed to preserve the continuity of the bond, this is called a *queen closer*. A similar preservation of the bond may be obtained by inserting a three-quarter bat at the angle in the stretching course, this is called a *king closer*. In both cases a horizontal lap of two inches and a half is left for the next header.

CLOUD. A visible mass or collection of minute particles of water suspended in the atmosphere. Clouds differ from fogs or mists only in occupying a more elevated position, in all cases the origin is the same, namely the vapours which rise from collections of water, and indeed from the whole surface of the earth. These aqueous vapours are condensed in the higher and colder regions of the atmosphere, and thus lose their transparency and become visible. Clouds differ very greatly in respect of form, magnitude, density, &c. These differences depend on the quantity of vapour of which they are composed, and the situations which they take as they unite with one another, and are determined in a great measure by the direction and velocity of the motion communicated to them by the wind. The height at which they float in the atmosphere is determined by their specific gravity, and consequently varies with their density. Thin light clouds are observed higher than the summits of the loftiest mountains, while those which are dense and thick rise only to a small distance above the surface of the earth. It is very difficult to determine their average elevation: it is supposed to be between two and three miles, but it varies at different times of the year.

Clouds were distributed by Mr Luke Howard into three primary formations,—the *Cirrus*, the *Cumulus*, and the *Stratus*. But besides these he admitted four other varieties,—the *Cirro-cumulus*, the *Cirro-stratus*, the *Cumulo-stratus*, and the *Cumulo-cirrostratus* or *Nimbus*. The *Cirrus* consists of fibres or curling streaks, which diverge in all directions. It occupies the highest region, and is frequently the first cloud which is seen after a continuance of clear weather. The *Cumulus* is a convex aggregate of watery particles, increasing upwards from a horizontal base, and assuming more or less of a conical figure. The *Stratus* consists of horizontal layers, and comprehends fogs and mists. It is the lowest of the clouds, its under surface usually resting on the earth or water. The *Cirro-cumulus* is intermediate between the cirrus and cumulus, and is composed of small well-defined masses closely arranged. The *Cirro-stratus*, intermediate between the cirrus and stratus, consists of horizontal masses separated into groups, with which the sky is sometimes so mottled as to suggest the idea of resemblance to the back of the mackarel. The prevalence of the cirro-stratus is usually followed by bad weather. The *Cumulo-stratus*, or *twain cloud*, partakes of the appearance of the cumulus and stratus or cirro-stratus. The *Nimbus*, or *rain cloud*, is that into which the others resolve themselves when rain falls.

The above nomenclature is sufficiently fanciful; nevertheless it enables the meteorologist to convey more precise ideas in describing the diversified forms under which masses of clouds present themselves and their connection with the changes of the weather. These

forms are, however, frequently so indefinite and shapeless, that it is difficult, if not impossible, to refer them to any one of the preceding modifications. A tendency, however, to one or other of them may in general be traced. (*Howard's Arrangement and Nomenclature of Clouds*, in the 16th and 17th vols. of the *Philosophical Magazine*; *Foster on Atmospheric Phenomena*, *Murray's Encyclopædia of Geography*, p. 168.; *Companion to the British Almanac* for 1840 &c. See also *Dalton's Meteorological Essays*, 1793.)

CLOU'TED or CLO'TTED CREAM. The cream produced on the surface of milk by setting a pan of new milk on a hot hearth is so named. It is chiefly used as a kind of entremet, and, when mixed with new milk, is eaten along with fruit pies, strawberries, raspberries, &c. It is also eaten without milk, spread on bread.

CLOVES. (Lat. clavus, *a nail*.) The smaller bulbs formed in the axillæ of the scales of a mother bulb, as in garlic.

CLOVES. The unexpanded flower-buds of the *Caryophyllus aromaticus*, a low branching tree cultivated in the Dutch settlements in India. The finest cloves are from Amboyna, they are of a bright brown colour, extremely fragrant, and hot and acrid upon the tongue, they abound in essential oil, which may be pressed out of their pores by the nail, and which is generally obtained by distillation with water, to the amount of from 15 to 20 *per cent*. It is sold in commerce under the name of *oil of cloves*, and chiefly used in medicine, and occasionally in perfumery. The fruit of the clove tree was employed in old pharmacy under the name of *anthophylli*.

CLUBS. *See* SOCIETIES.

CLUB MOSS. (*Lycopodium clavatum*.) The seeds of this moss, which are very minute, and resemble an impalpable yellow powder, are used in theatres to imitate lightning; when thrown across a flame, they produce a sudden flare. They contain a peculiar oil.

CLUMP. A mass of trees or shrubs, or both, generally roundish and compact in its outline, and always small as compared with extensive plantations. The word appears to have been first used in planting and gardening in the time of the celebrated landscape gardener Brown, about the middle of the 18th century. Brown distributed his clumps at irregular distances over the entire surface of any piece of ground that was intended to be made a park, [illegible] the park at the same time with a belt of plantation. The intention of Brown in planting these clumps was to nurse up a few trees in each clump, which should remain as groups or single objects after all the other trees of the clump were removed, but as thinning and the removal of the boundary fence of these clumps very seldom took place, they have grown up in most cases deformities rather than beauties. The term clump as applied to a plantation has long since become one of reproach.

CLUMP. The compressed clay of coal strata.

CLYPEA'STER. (Lat. clypeus, *a buckler*, and astrum, *astar*.) A genus of sea-urchins (*Echinidæ*) of a flattened, shield-like form, with a submarginal vent. This genus is termed *Echinanthus* by Klein.

CLY'PEATE. (Lat. clypeus.) Shield-like; it is the same as scutate.

CLY'SSUS. An alchemical name for the water obtained by deflagrating nitre with charcoal; the vessels were generally burst in the operation, but when it succeeded the few drops of water obtained were highly prized for medical use.

COACE'RVATE. (Lat. con, *together*, and acervus, *a heap*.) Accumulated. A term applied by older physiologists to certain secretions or excretions long retained.

COADJU'TOR. In Ecclesiastical matters, the assistant of a bishop or other prelate (in some instances even of a canon or prebendary, but the latter usage was irregular). These assistants, in France and other countries, were instituted by the pope. A coadjutor was equal in rank to the dignitary whose functions he might on occasion supply, hence the coadjutor of a bishop was himself consecrated a bishop *in partibus infidelium*. The celebrated Cardinal de Retz was known by the title of the Coadjutor of Paris during the most active period of his career, having the administration of the temporalities of that see, which belonged to his uncle the Archbishop de Retz. Coadjutors usually succeeded their principals in their dignities, and hence arose an abuse which tended towards making ecclesiastical dignities hereditary, nephews and other relatives of bishops being named their coadjutors. The institution of coadjutors to bishoprics is preserved by the French concordat of 1801.

COA'DUNATE. (Lat. con. ad, and una, *together*.) Two or more parts joined together.

COAL. (Germ. kohle.) This highly important substance is found in beds or strata in that group of the secondary rocks which includes the red sandstone and mountain limestone formations, and which is commonly called the *carboniferous group*, or *coal measures*. From the peculiarities of their deposition they are often spoken of under the names of *coal basins*, and *coal fields*. There are two or three points, and those of much theoretical importance, respecting the origin of coal, on which geological authorities are nearly unanimous. The one is, that our present coal is exclusively of vegetable origin, formed apparently from the destruction of vast forests; and the prodigious quantities of timber drifted by some of the great rivers of the world into the present ocean render it not improbable that a similar formation may now be carrying on in the depths of certain parts of the sea. Secondly, from the nature of the preserved vegetables it appears probable that the climate of these parts was not merely tropical, but ultratropical. It may also be inferred that the coal strata were deposited in the neighbourhood and often probably upon the verge, of extensive tracts of dry land; for the trees that are found in coal strata are often like those of *our* submarine forests, as far as position goes. And, finally, the deposits of coal appear afterwards to have been elevated, and often singularly dislocated and contorted by forces acting from below, and probably of a volcanic nature.

In some coal fields there are appearances which justify the term *coal basin*. they are of limited extent, frequently dip as it were to a common centre, and consist of various beds of sandstone, shale, and coal, irregularly stratified, and sometimes mixed with conglomerates, showing a mechanical origin.

That these deposits have taken place, and that the change of wood into coal has often been effected under great pressure, and often under pressure and heat, seems evident from the appearance of some of the vegetable masses, and also from the manner in which the carburetted hydrogen escapes in the form of *blowers* and eructations from the strata, as if pent up in their cavities under vast condensation, and even sometimes, perhaps, in a liquid form.

Though there are often many beds and seams of coal in one field it is seldom that many of them are worked. They are generally of uniform thickness through a great extent, but are sometimes subject to irregularities. When less than two feet thick they are seldom worked to any great extent. The nature of the upper stratum, or stony matter of the *roof*, is very important. If compact, it is secure from falling, and keeps out water; if loose, the expense incurred in supporting it absorbs the profits of the coal.

The deepest coal mines in England are those of Northumberland and Durham, which are worked nearly 1000 feet below the surface. The thickest bed of coal is said to be at Wood Mill Hill colliery in Staffordshire, and to exceed 40 feet. From 6 to 9 feet is the average thickness of the most productive seams. The coal generally most esteemed is that of the northern districts, — Northumberland, Durham, and Yorkshire. It abounds in bitumen, softens and swells in the fire, and throws out jets of flame, it coheres, and therefore burns hollow and requires poking, it furnishes cinders, and but little ash. Most of the coal from the west of England blazes and burns briskly, being much more easily kindled than the other, it requires no poking, because it has no tendency to cake, it affords no cinders, and leaves a dusty white ash. *Culm* contains scarcely any bitumen, it abounds in earthy matter, and somewhat resembles bad coke.

Coal is the most valuable of all the mineral substances from which Britain derives her prosperity, and, indeed, may be regarded as the main support of the whole system of British production. It fuses the metals, produces the steam which sets the machinery in motion, and, in short, may be said to render all the resources of this country available for use. The annual consumption of coal, throughout the British Empire, is estimated at 28,575,000 tons. The coal trade gives occupation to nearly 200,000 persons. France, the Netherlands, Germany, Denmark, British America and the United States, are the principal foreign markets for British coal. In 1850 the coal exported amounted to nearly 3,000,000 tons. All coal exported to countries having reciprocal treaties with Great Britain is duty free. The imports into London in 1850 amounted to nearly 3,000,000 tons.

CO'BALT. (Germ. kobold, *a devil*.) A term applied to this metal by the German miners, who considered it unfavourable to the presence of the more important metals.

Cobalt is a brittle metal of a reddish grey colour, its specific gravity is 7·8. It fuses at a temperature a little below that required for the fusion of iron. It is magnetic. When heated red hot, and freely exposed to air, cobalt absorbs oxygen. Its equivalent number is 30, and the salifiable, or protoxide of cobalt, consists of 30 cobalt + 8 oxygen = 38 oxide of cobalt. The oxide of cobalt is nearly black, but when in the state of hydrate, or when largely diluted by fusion with glass or borax, it produces its characteristic blue colour; and as this colour is permanent at very high temperatures, it is an invaluable article in the manufacture of porcelain and pottery, all the blue colours of which are derived from oxide of cobalt. When fused with glass it communicates a blue tint without impairing its transparency. A very deep blue

glass of this kind when finely powdered acquires a pale and brilliant colour, and is called *smalt*. Impure oxide of cobalt is known in commerce under the name of *zaffre*. Cobalt is said by Stromeyer to exist in all meteoric iron, although in very small quantity. In its ores it is always associated with arsenic, and zaffre is prepared by roasting these native arseniurets of cobalt.

CO'BBLES. Lumps of coal from the size of an egg to that of a football

COBI'TIS. (Lat cobio, *a gudgeon*.) A genus of soft-finned fishes, belonging to the *Cyprinidæ* or carp family, and characterized by a small head; an elongated body; the skin covered with small scales, ventral fins placed far backwards, with one small dorsal fin above them, mouth small and toothless; gill-openings very small, and with three rays. Of this genus the loche (*Cobitis barbatula*) inhabits the clear running streams of Britain The pond loche (*Cobitis fossilis*) is a larger species. It is remarkably sensitive to atmospheric changes, and when confined in a glass-globe may be observed to sink to the bottom in a state of quiescence when the weather is cold and gloomy, but in boisterous weather it comes to the surface and swims about with great rapidity It also swallows air, which it discharges from the vent, partly converted into carbonic acid gas.

CO'BLE. A small boat or canoe, used chiefly on the rivers and lakes of Wales, and the borders.

CO'B-WALLS Walls formed of mud mixed with straw; not uncommon in some districts of England. The best cob-walls are in Somersetshire

COCCINE'LLA (Dim. of Lat coccinus, *crimson*) A genus of Trimerous Coleopterous insects, including many small species, usually ornamented with scarlet spots, and familiarly known as lady-birds, lady-cows, &c In France these small beetles are dedicated to the Virgin, and called Betes de la Vièrge They are, in fact, of great service to the agriculturist, and especially to the hop-grower, for they destroy the *Aphides*, or plant-lice, in vast numbers, feeding on them both in the larva and perfect state

CO'CCOLITE (Gr *κοκκος*, *a grain*, and *λιθος*, *stone*.) A mineral of a concretional or granular texture

COCCOO'N. The silken case which the larvæ of certain insects spin for the purpose of a covering during the period of their metamorphosis, and which some spiders prepare as a protection to their ova during the development of the young The cod or cocoon of the silk-worm is a well known example of the most valuable of these productions.

CO'CCULUS INDICUS. The fruit of the *Menispermum cocculus*, imported from the East Indies. It contains a poisonous principle, which has been termed *picrotoxia* It is often used to poison fishes a few handfuls of it ground into coarse powder, and thrown into a pond, bring the fish, in the course of a few hours, to the surface in an intoxicated or poisoned state, but if quickly removed into fresh water, they recover. It is sometimes added to ale to increase its stupefying quality

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CO'CCUS. (Lat. coccus, *scarlet cloth*) A name given by Linnæus to a genus of Hemipterous insects, including the Mexican species, the cochineal insect (*Coccus cacti*, L), which feeds on *Cacteæ*, and which affords the well-known fine red dye.

CO'CHINEAL. The *Coccus cacti*. This valuable insect was first introduced into Europe about the year 1523. It is imported from Mexico and New Spain It feeds on several species of cactus It is small, rugose, and of a deep mulberry colour They are scraped from the plants into bags, killed by boiling water, and dried in the sun. Those are preferred which are plump, of a peculiar silvery appearance, and which yield a brilliant crimson when rubbed to powder. Cochineal is sometimes adulterated by the admixture of a manufactured article composed of coloured dough. This is detected by the action of boiling water, which dissolves and disintegrates the imitation, but has little effect upon the real insect. The principal component of cochineal is a peculiar colouring matter, which has been called *carminium* and *cochinelia*. It is obtained by digesting the powder of cochineal first in ether, which takes up fat, and then in alcohol, which dissolves the cochinelia Acids change its colour from crimson to an orange red, and alkalies turn it violet. When mixed with recently precipitated aluminous earth, it forms a beautiful lake. Cochineal yields a brilliant scarlet dye, which is produced by fixing the colouring matter of the insect by a mordant of alumina and oxide of tin, and exalting the colour by the action of supertartrate of potash.

CO'CHLEAN (Lat. cochlear, *a spoon*.) A term used in describing the æstivation of a flower, to express one piece being larger than the others, and hollowed like a helmet or bowl, covering all the others, as in Aconitum, &c.

COCHLEARE. A spoon; the bowls of spoons being formerly made of the shape of a cockle-shell, and often fluted.

COCHLEA'TE. (Lat. cochlea, *a shell, a cockle*.) A term used in describing the general form of bodies, to denote any that are twisted in a short spire, so as to resemble the convolutions of a snail-shell; as the pod of *Medicago cochleata*. It also means a concave body like that of one of the valves of a cockle-shell, as in *Epidendrum cochleatum*.

CO'CKET. In Commerce, a scroll of parchment, signed and delivered by the officers of the custom-house to merchants upon entering their goods, to certify that their merchandise is customed and may be discharged

CO'CKLE-OAST. That part of a hop-kiln or oast where the fire is made.

CO'CK-LOFT. The highest loft, or garret, in any building.

CO'CKNEY A contemptuous appellation of a citizen of London Various derivations have been assigned to this word, all of which are more distinguished for ingenuity than probability But whatever may be the origin of the term, its antiquity cannot be disputed, as it is mentioned in some verses generally attributed to Hugh Bagot, Earl of Nortolk, in the reign of Henry II.:—

> Were I in my castle at Bungey,
> Upon the river of Waverney,
> I would ne care for the king of Cockeney (*i. e* of London).

CO'CK-PIT The after part of the orlop deck, or deck below the lower deck, and altogether below the water Here, in line-of-battle ships, are the cabins of several of the officers. The cock-pit is appropriated to the use of the wounded in time of action. There is also a fore cock-pit in the fore part of the ship, and sometimes an after cock-pit

Cock-Pit is the name given to the place where game cocks fight their battles The room in Westminster in which her Majesty's privy council hold their sittings is called the *cock-pit*, from its having been the site of what was formerly the cock-pit belonging to the palace at Whitehall

COCY'TUS (Gr *κωκυτος*, *lamentation*, from *κωκυω*, *I bewail*) In Mythology, the river of Lamentations, which was one of the streams that washed the shores of the mythological hell, and prevented the imprisoned souls from returning to the earth. Milton alludes to it thus (*Par. Lost*, book ii).—

> Cocytus named of lamentations loud
> Heard on the rueful stream

CO'DA (It coda, *a tail*) In Music, the passage at the end of a movement which follows a lengthened perfect cadence In some cases it consists of merely one phrase, in others it is carried to a great extent At the conclusion of a canon or fugue, it often serves to end the piece which might otherwise be carried on to infinity

CODE (from the Latin codex, *a manuscript*), signifies, in the language of jurisprudence, any collection of laws digested and reduced into an orderly arrangement, whether by public authority or by the private labour of learned men But, in the ordinary sense, the word Code is only used to signify a compilation of laws by authority Five collections of Roman law are designated by the title of *codes*:—that of Sextus Papirius, which only exists in fragments discovered by various authors, but which contained the laws of the Roman kings, the Gregorian, the compilation of an unknown author, about the reign of Constantine, the Hermogenian, of which the author is also doubtful, and the date nearly the same; the Theodosian, framed under the order of the emperor Theodosius the younger, and containing the constitutions of the emperors from the time of Constantine to his own (from which, until the greater works of Justinian became publicly known in modern Europe, the jurisconsults of the dark ages drew the greater part of their knowledge of Roman law), and, lastly, that of Justinian, A D 529. Of the codes of law now recognised in modern states the most remarkable are, in order of time—the code of Frederic the Great of Prussia, that of Catherine of Russia, confined to criminal jurisprudence, that of Joseph II of Austria; and the Code Napoleon in France. This title, though sometimes given in general language to all the digests of law made under that emperor, is appropriated by French lawyers to the greatest of his works, the Code Civil The project for this code was drawn up, in 1801, by five commissioners, by them reported to the Court of Cassation, and thence carried to the Conseil d'Etat: in that body it was fully discussed, clause by clause Besides the Code Civil, the written French law comprises five other codes, viz. the Code Pénal, the two Codes of Procedure, civil and criminal; the Code de Commerce; and, finally, the Code Forestier, or collection of laws relative to the administration of the woods, published in 1827 under Charles X.

CODE'INE, or CODEIA. (Gr. *κωδια*, *the poppy head*.) An alkaline substance, discovered in 1832 by Robiquet in opium. It was at first confounded with morphia.

CODE'TTA. (Dimin. of coda.) In Music, a short

passage which connects one section with another, and not composing part of a regular section.

CO'DEX. A manuscript: in its original sense (Latin) the inner bark of a tree, which was used for the purposes of writing. The word was thence transferred by the Romans to signify a piece of writing, on whatever material; *e. g.* with the stylus on tablets lined with wax, or on a roll of parchment or paper. In modern Latin, a manuscript volume. *Codex rescriptus* or *palimpsestus* is a manuscript consisting of leaves, from which some earlier writing has been erased in order to afford room for the insertion of more recent. Many such codices exist; and from the imperfect nature of the erasing process, the earlier writing has in some instances been restored. Considerable fragments of classical works, previously considered as lost, have been thus recovered by the Abate Mai from among the contents of the Ambrosian Library at Milan.

CO'DICIL. (Lat. codicillus, diminutive of codex, *a manuscript*.) In Law, an addition or supplement to a will, for the purpose of altering, explaining, or adding to its contents. Of codicils, as of wills, the latter prevails where it contains provisions contradictory to those of a former. By the recent Wills Act (1 Vict. c. 26), every codicil must be executed in the same manner as is thereby made requisite in the case of a will; viz. signed by the testator in the presence of two witnesses at one time. *See* WILL.

COEFFI'CIENT. In Algebra, a number or known quantity prefixed as a multiplier to a variable or an unknown quantity. Thus, in the equation $a x^m + 6 b x^n = o$, $a$ is the multiplier or *coefficient* of $x^m$, and $6b$ is the *coefficient* of $x^n$. When no number or coefficient is prefixed, unity or 1 is understood. *See* EQUATION.

COELACA'NTHIDÆ. (Gr. κοιλος, *hollow*, and ακανθος, *a spine*.) A family of Ganoid fishes in the system of Agassiz, so called on account of the species composing it being armed with hollow spines. The following interesting fossil genera, *Holoptychius* and *Cœlacanthus* proper, belong to this family.

COE'LELMI'NTHA. (Gr. κοιλος, and ἑλμινς, *a worm*.) The name of a class of Entozoa, including part of the cavitary intestinal worms of Cuvier, or those which are characterized by having an alimentary canal contained in a distinct abdominal cavity.

COELE'STINE. A mineralogical name of *sulphate of strontia* (from its blue tint).

COE'LIAC. (Gr. κοιλια, *the belly*.) A painful species of diarrhœa has been by some medical writers called the *cœliac passion*. The cœliac artery is the first branch of the aorta in the abdomen.

COENA'CULUM. (Lat.) In ancient Architecture, the eating or supper room of the Romans. In the early periods of the Roman history, the upper story of their houses, which rarely consisted of more than two, seems to have been called by this name.

COENA'TIO. (Lat.) In ancient Architecture, an apartment for taking refreshment in the lower part of the Roman houses.

COENO'BIO. (Gr. κοινος, *common*, and βιος, *life*.) A name invented by the French botanists, to distinguish that class of fruits which consists of two or more carpels separate at the apex and united at the base, from the middle of which a single style arises. It occurs in Lamiaceæ, &c.

COE'NOBITE. (Gr. κοινος, and βιος, *life*.) One who lives under a rule in a religious community, as distinguished from an anchoret or hermit, who lives in solitude. *See* ANCHORET.

COE'NURE, *Cœnurus*. (Gr. κοινος, and ουρα, *a tail*.) The hydatid which infests the brain of sheep is so called, because the dilated cyst is the common termination or basis of attachment of many heads and bodies. The disease called "staggers" is produced by this parasite.

CO'FFEE. The berries of the *Coffea arabica*. These, when roasted, powdered, and infused in boiling water, yield the well-known beverage called coffee. It is exhilarating, and operates upon many persons as an aperient. *See* CAFFEIN.

CO'FFER. (Sax. coppe.) In Architecture, a sunk panel in vaults and domes, and also in the soffit or underside of the Corinthian cornice, usually decorated in the centre with a flower.

CO'FFER-DAM. In Architecture, and Bridge-building, a case of piling, water-tight, fixed in the bed of a river for the purpose of laying the bottom dry for a space large enough to build the pier on. Coffer-dams are formed in various ways, either by a single inclosure or a double one, with clay or chalk rammed in between the two to prevent the water from coming through the sides. They are also made either with piles only, driven close together, and sometimes notched or dovetailed into one another, or, if the water is not very deep, by piles driven at a distance of five or six feet from each other, and grooved in the sides with boards let down between them in the grooves. In order to build in coffer-dams a very good natural bottom of solid earth or clay is required; for though the sides be made water-tight, if the bed of the river be of a loose consistence, the water will ooze up through it in too great a quantity to permit the operations to be carried on. It is almost needless to remark that the sides must be very strong, and well braced in the inside to resist the pressure of the ambient water. (*Hutton's Tracts* vol. i.)

CO'GNIZANCE, *Conusance*. In Law, an acknowledgment of a fine, of taking a distress, &c. It also signifies the power which a court has to hear and determine a particular species of suit.

COGNO'MEN. In Antiquities, the last of the three names by which all Romans, at least those of good family, were designated. It served to mark the house (*see* FAMILIA) to which they belonged, as the other two names, viz. the *prænomen* and *nomen*, served respectively to denote the individual and the class (*see* GENS) to which his family belonged.

COGNO'VIT. (Lat.) In Law, is a confession whereby a defendant admits that the plaintiff's cause of action against him is just (cognovit actionem), and suffers judgment to be entered against him without trial.

COHE'SION. (Lat. cohæreo, *I hold together*.) In Natural Philosophy, is the force or attraction with which the particles of homogeneous bodies are kept attached to each other, or with which they resist separation. Cohesion is thus distinguished from *adhesion*, the latter term denoting the attractive force existing between two different bodies brought into contact, as a drop of water on a plate of glass, or between two bodies of the same matter, as two lumps of lead, when their smooth surfaces have been pressed together. The three different forms which matter assumes, — solid, liquid, and gaseous, — are determined by the degree of cohesive force existing among the elementary particles. In solids this force is great, and, in fact, is that which causes solidity; in liquids it is less powerful, but still sufficiently manifest in the *drops* or globular form assumed by small quantities of water or mercury poured on a table. In the case of aeriform fluids it may be regarded as negative, the particles having a tendency to repel each other. The cohesive force of the elementary particles of matter depends on the distances of the particles from each other, but of the law according to which its intensity increases or diminishes nothing is known, excepting that the force decreases rapidly as the distance increases, and vanishes altogether when the distance becomes so great as to be appreciable to the senses.

It is a problem of very great importance to determine the cohesive power of the materials employed in mechanical structures. Numerous experiments have been made for this purpose; and their results have not only a practical utility, but throw much light on the constitution of bodies. When a bar of metal, a beam of wood, or a rope is stretched lengthwise, the tension which it bears, or the cohesive power evolved, is equal to the accumulated attraction of all the particles in any transverse section. The longitudinal distension which takes place before disrupture is at first proportional to this attraction, but afterwards increases in a more rapid progression. "A bar of soft iron will stretch uniformly by continuing to append to it equal weights till it be loaded with half as much as it can bear; beyond that limit, however, its extension will become doubled by each addition of the eighth part of the disruptive force. Suppose the bar to be an inch square, and 1000 inches in length; 36,000 lbs. avoirdupois will draw it out one inch, but 45,000 lbs. will stretch it 2 inches, 54,000 lbs. 4 inches, 63,000 lbs. 8 inches, and 72,000 lbs. 16 inches, where it would finally break." (*Leslie's Nat. Philosophy*.)

The following is a tabular view of the absolute cohesion of the principal kinds of timber employed in building and carpentry, showing the load which would rend a prism of an inch square, and the length of the prism which, if suspended, would be torn asunder by its own weight: —

| | | | |
|---|---|---|---|
| Teak | 12,915 lbs. | — | 36,049 feet. |
| Oak | 11,880 | — | 32,900 |
| Sycamore | 9,630 | — | 35,800 |
| Beech | 12,225 | — | 38,940 |
| Ash | 14,130 | — | 42,080 |
| Elm | 9,720 | — | 39,050 |
| Memel fir | 9,540 | — | 40,500 |
| Christiana deal | 12,346 | — | 55,500 |
| Larch | 12,240 | — | 42,160 |

The above numbers must be regarded as only approximative, and representing the average cohesive force of the different kinds of wood specified; for the force differs greatly in different specimens of the same sort, and even in different parts of the same timber. Thus in the tables given by Professor Barlow of experiments on the direct cohesion of different woods, we find the weight required to tear asunder a prism of an inch square varying as under: — Fir, from 11,000 to 13,448 lbs.; ash, from

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> Upon the river of Waverney,
> I would ne care for the king of Cockeney (*i. e* of London).

CO'CK-PIT. The after part of the orlop deck, or deck below the lower deck, and altogether below the water Here, in line-of-battle ships, are the cabins of several of the officers The cock-pit is appropriated to the use of the wounded in time of action. There is also a fore cock-pit in the fore part of the ship, and sometimes an after cock-pit

COCK-PIT is the name given to the place where game cocks fight their battles. The room in Westminster in which her Majesty's privy council hold their sittings is called the *cock-pit*, from its having been the site of what was formerly the cock-pit [illegible] to the palace at Whitehall

COCY'TUS (Gr. *κωκυτός*, *lamentation*, from *κωκύω*, *I bewail*) In Mythology, the river of Lamentations, which was one of the streams that washed the shores of the mythological hell, and prevented the imprisoned souls from returning to the earth. Milton alludes to it thus (*Par. Lost*, book II). —

> Cocytus named of lamentations loud
> Heard on the rueful stream

CO'DA (It coda, *a tail*) In Music, the passage at the end of a movement which follows a lengthened perfect cadence In some cases it consists of merely one phrase, in others it is carried to a great extent At the conclusion of a canon or fugue, it often serves to end the piece which might otherwise be carried on to infinity.

CODE (from the Latin codex, *a manuscript*), signifies, in the language of jurisprudence, any collection of laws digested and reduced into an orderly arrangement, whether by public authority or by the private labour of learned men But, in the ordinary sense, the word Code is only used to signify a compilation of laws by authority Five collections of Roman law are designated by the title of *codes*: — that of Sextus Papirius, which only exists in fragments discovered by various authors, but which contained the laws of the Roman kings; the Gregorian, the compilation of an unknown author, about the reign of Constantine; the Hermogenian, of which the author is also doubtful, and the date nearly the same; the Theodosian, framed under the order of the emperor Theodosius the younger, and containing the constitutions of the emperors from the time of Constantine to his own (from which, until the greater works of Justinian became publicly known in modern Europe, the jurisconsults of the dark ages drew the greater part of their knowledge of Roman law); and, lastly, that of Justinian, A. D. 529. Of the codes of law now recognised in modern states the most remarkable are, in order of time — the code of Frederic the Great of Prussia, that of Catherine of Russia, confined to criminal jurisprudence; that of Joseph II of Austria; and the Code Napoleon in France. This title, though sometimes given in general language to all the digests of law made under that emperor, is appropriated by French lawyers to the greatest of his works, the Code Civil. The project for this code was drawn up, in 1801, by five commissioners, by them reported to the Court of Cassation, and thence carried to the Conseil d'Etat: in that body it was fully discussed, clause by clause Besides the Code Civil, the written French law comprises five other codes; viz. the Code Pénal; the two Codes of Procedure, civil and criminal; the Code de Commerce; and, finally, the Code Forestier, or collection of laws relative to the administration of the woods, published in 1827 under Charles X.

CODE'INE, or CODEIA. (Gr. *κωδια*, *the poppy head*.) An alkaline substance, discovered in 1832 by Robiquet in opium. It was at first confounded with morphia.

CODE'TTA. (Dimin. of coda.) In Music, a short

passage which connects one section with another, and not composing part of a regular section.

CO'DEX. A manuscript: in its original sense (Latin) the inner bark of a tree, which was used for the purposes of writing. The word was thence transferred by the Romans to signify a piece of writing, on whatever material; *e. g.* with the stylus on tablets lined with wax, or on a roll of parchment or paper. In modern Latin, a manuscript volume. *Codex rescriptus* or *palimpsestus* is a manuscript consisting of leaves, from which some earlier writing has been erased in order to afford room for the insertion of more recent. Many such codices exist; and from the imperfect nature of the erasing process, the earlier writing has in some instances been restored. Considerable fragments of classical works, previously considered as lost, have been thus recovered by the Abate Mai from among the contents of the Ambrosian Library at Milan.

CO'DICIL. (Lat. codicillus, diminutive of codex, *a manuscript*) In Law, an addition or supplement to a will, for the purpose of altering, explaining, or adding to its contents. Of codicils, as of wills, the latter prevails where it contains provisions contradictory to those of a former. By the recent Wills Act (1 Vict. c. 26.), every codicil must be executed in the same manner as is thereby made requisite in the case of a will, viz. signed by the testator in the presence of two witnesses at one time. *See* WILL.

COEFFI'CIENT. In Algebra, a number or known quantity prefixed as a multiplier to a variable or an unknown quantity. Thus, in the equation $ax^m + 6bx^n = o$, $a$ is the multiplier or *coefficient* of $x^m$, and $6b$ is the *coefficient* of $x^n$. When no number or coefficient is prefixed, unity or 1 is understood. *See* EQUATION.

CŒLACA'NTHIDÆ. (Gr. κοιλος, *hollow*, and ακανθος, *a spine*.) A family of Ganoid fishes in the system of Agassiz, so called on account of the species composing it being armed with hollow spines. The following interesting fossil genera, *Holoptychius* and *Cœlacanthus* proper, belong to this family.

CŒLELMI'NTHA (Gr. κοιλος, and ἑλμινς, *a worm*) The name of a class of Entozoa, including part of the cavitary intestinal worms of Cuvier, or those which are characterized by having an alimentary canal contained in a distinct abdominal cavity.

CŒLE'STINE. A mineralogical name of *sulphate of strontia* (from its blue tint).

CŒ'LIAC (Gr. κοιλια, *the belly*) A painful species of diarrhœa has been by some medical writers called the *cœliac passion*. The cœliac artery is the first branch of the aorta in the abdomen.

CŒNA'CULUM. (Lat.) In ancient Architecture, the eating or supper room of the Romans. In the early periods of the Roman history, the upper story of their houses, which rarely consisted of more than two, seems to have been called by this name.

CŒNA'TIO. (Lat.) In ancient Architecture, an apartment for taking refreshment in the lower part of the Roman houses.

CŒNO'BIO (Gr. κοινος, *common*, and βιος, *life*) A name invented by the French botanists, to distinguish that class of fruits which consists of two or more carpels separate at the apex and united at the base, from the middle of which a single style arises. It occurs in Lamiaceæ, &c.

CŒ'NOBITE. (Gr. κοινος, and βιος, *life*.) One who lives under a rule in a religious community, as distinguished from an anchoret or hermit, who lives in solitude. *See* ANCHORET.

CŒ'NURE, *Cœnurus*. (Gr. κοινος, and ουρα, *a tail*) The hydatid which infests the brain of sheep is so called, because the dilated cyst is the common termination or basis of attachment of many heads and bodies. The disease called "staggers" is produced by this parasite.

CO'FFEE. The berries of the *Coffea arabica*. These, when roasted, powdered, and infused in boiling water, yield the well-known beverage called coffee. It is exhilarating, and operates upon many persons as an aperient. *See* CAFFIN.

CO'FFER. (Sax. coppe) In Architecture, a sunk panel in vaults and domes, and also in the soffit or under side of the Corinthian cornice, usually decorated in the centre with a flower.

CO'FFER-DAM. In Architecture, and Bridge-building, a case of piling, water-tight, fixed in the bed of a river for the purpose of laying the bottom dry for a space large enough to build the pier on. Coffer-dams are formed in various ways, either by a single inclosure or a double one, with clay or chalk rammed in between the two to prevent the water from coming through the sides. They are also made either with piles only, driven close together, and sometimes notched or dovetailed into one another; or, if the water is not very deep, by piles driven at a distance of five or six feet from each other, and grooved in the sides with boards let down between them in the grooves. In order to build in coffer-dams a very good natural bottom of solid earth or clay is required, [illegible]h the sides be made water-tight, if the bed of the river be of a loose consistence, the water will ooze up through it in too great a quantity to permit the operations to be carried on. It is almost needless to remark that the sides must be very strong, and well braced in the inside to resist the pressure of the ambient water. (*Hutton's Tracts* vol. i.)

CO'GNIZANCE, *Conusance*. In Law, an acknowledgment of a fine, of taking a distress, &c. It also signifies the power which a court has to hear and determine a particular species of suit.

COGNO'MEN. In Antiquities, the last of the three names by which all Romans, at least those of good family, were designated. It served to mark the house (*see* FAMILIA) to which they belonged, as the other two names, viz. the *prænomen* and *nomen*, served respectively to denote the individual and the class (*see* GENS) to which his family belonged.

COGNO'VIT (Lat.) In Law, is a confession whereby a defendant admits that the plaintiff's cause of action against him is just (cognovit actionem), and suffers judgment to be entered against him without trial.

COHE'SION. (Lat. cohæreo, *I hold together*.) In Natural Philosophy, is the force or attraction with which the particles of homogeneous bodies are kept attached to each other, or with which they resist separation. Cohesion is thus distinguished from *adhesion*; the latter term denoting the attractive force existing between two different bodies brought into contact, as a drop of water on a plate of glass; or between two bodies of the same matter, as two lumps of lead, when their smooth surfaces have been pressed together. The three different forms which matter assumes, — solid, liquid, and gaseous, — are determined by the degree of cohesive force existing among the elementary particles. In solids this force is great, and, in fact, is that which causes solidity; in liquids it is less powerful, but still sufficiently manifest in the *drops* or globular form assumed by small quantities of water or mercury poured on a table. In the case of aeriform fluids it may be regarded as negative, the particles having a tendency to repel each other. The cohesive force of the elementary particles of matter depends on the distances of the particles from each other; but of the law according to which its intensity increases or diminishes nothing is known, excepting that the force decreases rapidly as the distance increases, and vanishes altogether when the distance becomes so great as to be appreciable to the senses.

It is a problem of very great importance to determine the cohesive power of the materials employed in mechanical structures. Numerous experiments have been made for this purpose; and their results have not only a practical utility, but throw much light on the constitution of bodies. When a bar of metal, a beam of wood, or a rope is stretched lengthwise, the tension which it bears, or the cohesive power evolved, is equal to the accumulated attraction of all the particles in any transverse section. The longitudinal distension which takes place before disrupture is at first proportional to this attraction, but afterwards increases in a more rapid progression. "A bar of soft iron will stretch uniformly by continuing to append to it equal weights till it be loaded with half as much as it can bear; beyond that limit, however, its extension will become doubled by each addition of the eighth part of the disruptive force. Suppose the bar to be an inch square, and 1000 inches in length; 36,000 lbs. avoirdupois will draw it out one inch, but 45,000 lbs. will stretch it 2 inches, 54,000 lbs. 4 inches, 63,000 lbs. 8 inches, and 72,000 lbs. 16 inches, where it would finally break." (*Leslie's Nat. Philosophy*)

The following is a tabular view of the absolute cohesion of the principal kinds of timber employed in building and carpentry, showing the load which would rend a prism of an inch square, and the length of the prism which, if suspended, would be torn asunder by its own weight: —

| | | | |
|---|---|---|---|
| Teak | 12,915 lbs. | — | 36,049 feet. |
| Oak | 11,880 | — | 32,900 |
| Sycamore | 9,630 | — | 35,800 |
| Beech | 12,225 | — | 38,940 |
| Ash | 14,130 | — | 42,080 |
| Elm | 9,720 | — | 39,050 |
| Memel fir | 9,540 | — | 40,500 |
| Christiana deal | 12,346 | — | 55,500 |
| Larch | 12,240 | — | 42,160 |

The above numbers must be regarded as only approximative, and representing the average cohesive force of the different kinds of wood specified; for the force differs greatly in different specimens of the same sort, and even in different parts of the same timber. Thus in the tables given by Professor Barlow of experiments on the direct cohesion of different woods, we find the weight required to tear asunder a prism of an inch square varying as under: — Fir, from 11,000 to 13,448 lbs.; ash, from

15,784 to 17,850 lbs.; oak, from 8,889 to 12008 lbs.; teak, from 14,662 to 15,405 lbs.; pear, from 8,834 to 11,537 lbs., &c. (*Barlow on the Strength of Materials*, 1837.)

The metals differ more widely from each other in their cohesive strength than the several species of wood or vegetable fibres. According to the experiments of Mr George Rennie in 1817, the cohesive power of a rod an inch square of different metals, in pounds avoirdupois, with the corresponding length in feet, is as follows. —

| | | |
|---|---|---|
| Cast steel - - | 134,256 lbs. — | 39,455 feet. |
| Swedish malleable iron | 72,064 — | 19,710 |
| English ditto - - | 55,872 — | 16,938 |
| Cast iron - - - | 19,096 — | 6,110 |
| Cast copper - - | 19,072 — | 5,003 |
| Yellow brass - - | 17,958 — | 5,180 |
| Cast tin - - - | 4,736 — | 1,196 |
| Cast lead - - - | 1,824 — | 348 |

It is difficult to measure directly the cohesion of fluids (and it is very considerably affected by the temperature), but an approximation may be derived from the magnitude of drops, and the thickness of liquid sheets, heaped upon a horizontal surface. In this view, says Professor Leslie, let us trace the formation of a drop of water as it slowly collects at the end of a capillary siphon. The mutual attraction of the particles always rounds the under part of the pendant fluid, which continues to lengthen till its accumulating weight begins to overcome the cohesion of the particles. But this force being 75 grains for each horizontal square inch, while a cubical inch of water weighs 252½ grains, must correspond to the pull of a cylinder of ⅓ inch high, which will influence also the breadth of the pendant liquid. Beyond this limit a separation will ensue, when the cylinder merges into a sphere a little wider, or about 2-10ths of an inch diameter.

The cohesion among the particles of alcohol and of sulphuric acid being respectively the fifth part of 215 and 460 grains, the weight of a cubic inch of each of these fluids, a drop of them should measure ⅓ of an inch in diameter. The cohesive force of quicksilver at the ordinary temperature amounts to 312 grains on each horizontal inch, while a cubic inch of it weighs 3421 grains, the drop must separate when its mean depth approaches to the 9-100th part of an inch. (*Elements of Nat Philosophy*, p 369.)

With respect to the ultimate agent by which the effects of cohesion are produced, it is remarked by Dr T Young, that if it is allowable to seek for any other agent than a fundamental property of matter, appearances extremely similar might be derived from the pressure of a universal medium of great elasticity. But all suppositions founded on such analogies must be considered as merely conjectural; and our knowledge of every thing which relates to the intimate constitution of matter, partly from the intricacy of the subject, and partly for want of sufficient experiments, is at present in a state of great uncertainty and imperfection. (*Young's Lectures on Nat Philosophy*, vol. i. p. 630.) *See* STRENGTH OF MATERIALS.

COHOBA'TION. The repeated distillation of the same liquid from the same materials. The term was invented by Paracelsus.

CO'HORT. The tenth part of a Roman legion. (*See* LEGION.) The *Prætorian cohort* was a body of picked troops who attended the general, and was first instituted by Scipio Africanus.

COI'NAGE. Under this term we shall give a brief outline of the proceedings in reference to the manufacture of coin, as carried on in the Royal Mint of London.

When a parcel of gold is brought to the mint in ingots, they are deposited with the master's assay-master, who makes an assay of each ingot, and when he is ready to deliver his reports upon them, the importers are required to attend at the mint, where the weigher and teller reads over the said reports to them. They are then recorded in the journals of the master, comptroller, and master's first clerk and melter; and a mint bill is given to the importer, certifying the weight, fineness, and value of the ingots, and signed by the deputy master, comptroller, and king's (or queen's) clerk, which bill is returned upon the delivery of the bullion to the importers in the state of coin. The bullion is then delivered to the melter, who, guided by the assayer's report, adds either alloy or fine gold (when either are required), so as to reduce the mass to *standard fineness* (that is, 22 parts of pure gold and 2 of alloy), and melts and casts the metal into bars of convenient form for rolling, each bar, when intended for coinage in sovereigns, being an inch and a half by one inch square, and about two feet in length, and weighing about 26 pounds. A piece is then taken from each extremity of each bar and delivered to the king's assay-master, whose duty it is to ascertain that the said bars are of standard fineness before he allows them to be delivered to the moneyers, who next receive them for the purpose of coinage.

These preliminary operations are nearly the same as regards silver bullion.

When the moneyers, or responsible manufacturers of the coin, receive bars from the melter, they are rolled and drawn into plates of proper thickness, which require to be most nicely adjusted, so that a piece of proper size punched out of any part of the plate may have the exact weight of the intended coin; the *blanks* are then cut out of these plates, which are thus reduced to the state of *scissel*, and remelted (under due checks and precautions), to be again cast into bars. The blanks (amounting to about two thirds, and the scissel to one third of the weight of the original plate of metal) are next annealed, and passed through the *marking machine*, by which the edge of each piece is made smooth and a little raised; they are then cleaned or *blanched* by being put for a few minutes into a hot and very dilute sulphuric acid, after which they are thoroughly washed and dried, and are ready to be *stamped* or coined. This operation is performed in presses moved by mechanical power, and consists in placing the blanks between two steel dies, upon one of which is engraved the obverse and upon the other the reverse of the coin, so as to give an impression in relief; while the spreading of the piece in a lateral direction is prevented by the rising of a collar at the moment the blow is struck, in which collar is engraved the *milling*, which is thus transferred to the edge of the piece at the same moment that the impressions of the dies are taken upon its two surfaces. The coining presses at the mint are attended by boys, who only have to fill a tube or species of hopper with the blanks, the operation of laying the blank upon the dies, and again throwing it off when stamped, being effected by the machinery connected with the press, thus preventing the risk of crushing the fingers of the persons who used to be employed in this department before these *layers on*, as they are technically called, were adopted. In the coining room at the mint there are eight presses, each adapted for every species of coin, each press strikes upon an average 60 pieces per minute, or 3600 per hour, so that in the day's work of 10 hours each press produces 36,000 pieces, and the eight presses (supposing, which is rarely the case, that they are all in use) stamp 288,000 pieces daily. The money when thus completed is weighed up in what are called *journey weights* for delivery to the importers of the bullion, the gold in 15 lbs. and the silver in 60 lbs. troy. But, before any coin is suffered to pass out of the mint, it is inspected as to its workmanship; and if any journeys are faulty or imperfect in this respect, they may be cut and returned to the moneyers for recoinage. The weight and fineness of the money are also ultimately examined and insured by the process of *pixing*, which consists in taking promiscuously from every journey weight of coin a pound in tale, which is delivered by the weigher and teller to the king's assay-master, who carefully weighs it, and declares aloud the *minus* or *plus* upon each pound (if it be not *standard* or exact), which is recorded by the king's assayer, by the comptroller, and by the king's clerk. This determines whether the moneyers have made the money within the *remedy* allowed upon the pound troy, but, as the remedy upon the pound is divided among the number of pieces in it, the comptroller weighs several of the pieces individually, and if they are not within the allowed limits, can, in conjunction with the other check officers assembled on this duty, return the coin to the moneyers to be remelted and recoined at their expense. From the same pound weight of gold or silver the comptroller also takes two pieces, one of which is handed to the king's assay-master to assay, in order to prove that the metal has undergone no deterioration in any of the processes of its manufacture, the other piece is sealed up in a packet and consigned to the *pix box*, which is locked by the separate keys of the check officers, where it remains until the *trial of the pix* by jury before the king or certain of his council, which usually takes place once every three or four years in the Court of Exchequer at Westminster.

The term journey weight is applied at the mint to the weight of certain parcels of coin, which were probably considered formerly as a day's work. The journey of gold is 15 troy pounds, which is coined into 701 sovereigns, or 1402 half sovereigns. A journey of silver weighs 60 lbs. troy, and is coined into 792 crowns, or 1584 half crowns, or 3960 shillings, or 7920 sixpences.

COINS. *See* NUMISMATICS. MONEY.

COKE. The charcoal obtained by heating coal with the imperfect access of air, or by its distillation. The former is usually called *oven coke*; the latter *gas coke*, being abundantly produced in gas-works. The weight of coke usually amounts to between 60 and 70 *per cent.* of the coal employed. Coke is a valuable fuel for many purposes in the arts.

COL'CHICUM. (From Colchis in Armenia, where the plant is said to have abounded.) This term is generally applied to the cormus or bulb of the *Colchicum autumnale*, or *meadow saffron*, a plant common in this country, and largely collected for medical use. It was much employed formerly as a diuretic in dropsy, then fell into disuse; and more recently again largely prescribed for the cure of gout, it having been ascertained that the celebrated French remedy for gout called *Eau*

*medicinale d'Husson* was a tincture of colchicum. Its efficacy may probably be ascribed to the presence of a peculiar alkaloid, which has been termed *colchicia*. When the cormi are intended for medical use, they should be dug up in summer (July), and immediately cut into thin transverse slices, placed separately upon paper, and dried by a very gentle heat. The best preparation is the *wine of colchicum*, made by infusing an ounce and a half of the bulb prepared and dried as above, and coarsely powdered, in 12 ounces of sherry, for six or seven days, shaking it daily: then filter it for use. The dose is from 20 drops to 1 drachm, taken at bed-time in a little water.

COLCO'THAR. A red oxide of iron, being the residue of the distillation of green vitriol or sulphate of iron.

COLD. In Natural Philosophy. *See* HEAT.

COLD. In Medicine *See* CATARRH.

CO'LEOPHY'LLUM (Gr. κολεος, *a sheath*, and φυλλον, *a leaf*.) A term introduced into botany, to indicate a monocotyledonous structure, the young leaves being evolved from within a sheath, while those of Dicotyledons are always naked

COLEO'PTERANS, *Coleoptera*. (Gr. κολεος, and πτερον, [illegible]) The name of the order of insects comprehending those in which the first pair of wings have the consistence of horn, and serve as defensive coverings to the second pair, or true wings, which are of large size, and are folded transversely when not in use

By means of this mechanism the *Coleoptera* are enabled to burrow in the soil, or bore the trunks of trees, without injury to their delicate organs of flight, which are the true or second pair of wings, these being of ample size are peculiarly folded, being bent at nearly right angles, so as to pack up in small compass beneath the elytra or wing-covers when the beetle is at rest In some species the membranous wings are wanting, but the elytra are always present, although in this case, as they are never required to be expanded for flight, they are generally soldered together by a straight suture at the middle line. In ordinary cases the inner straight margins of the wing-covers are simply but accurately applied to each other

The *Coleopterans* are of all the orders of insects the most numerous, and the best known Their singular forms, the brilliant and agreeable colours which many of them present, the large size of some of the species, the solid consistence of their teguments, which renders their preservation easy, and the regular series of affinities traceable through several of the groups, all combine to render them objects of particular interest and attention

The head supports two antennæ of various forms, but almost always consisting of eleven joints They have two compound eyes, but no ocelli The mouth is composed of six principal pieces, of which four, called the mandibulæ and maxillæ, move transversely in pairs, while the remaining two are fixed, and close the mouth vertically. The uppermost of the two vertical pieces is called the *labrum*; the lowermost is termed the *labium*, and is itself subdivided into the *mentum* and *lingua*, and together with the maxillæ, or the lowest of the vertical pieces, supports a pair of articulated processes, called *palpi* or *feelers*

The anterior segment of the thorax, or manitrunk, supports the first pair of feet, and greatly surpasses in extent the two other segments which form the alitrunk The abdomen is sessile, and united to the trunk by a great part of its breadth. It is externally composed of six or seven wings.

The *tarsi* vary as to the number of their joints, in some *Coleoptera* having but three, in others four, in others five, modifications upon which Latreille founds his primary division of the order *See* PENTAMERA, TETRAMERA, TRIMERA.

The *Coleoptera* undergo a complete metamorphosis. The larva resembles a worm, the head is encased in a firm horny substance, the mouth is analogous in the number and functions of its parts to that of the perfect insects; it has also generally six feet, but some species have instead only simple tubercles. When perfect the larva generally burrows in the earth, and excavates an oval cell, within which it undergoes its change into an inactive pupa, this is generally of a whitish colour, with the wings and legs folded upon the breast. The habitation and manner of life of these insects varies much, both in their immature and perfect stages. The affinities of the *Coleoptera* to the *Orthoptera* are of a closer and more manifest nature than can be traced between the *Coleoptera* and any other order of the mandibulate insects. The genus *Forficula* forms the intervening link. It was formerly placed by Linnæus at the end of the *Coleoptera*, and was subsequently referred by Latreille to the order *Orthoptera*; but now constitutes the type of an order apart and intermediate to these two. The absence in some ants of the wings, sting, and ocelli, has led Mr. Macleay to suspect that these *Hymenoptera* make an approach to the *Coleoptera*. Mr. Kirby would place the *Strepsiptera* in juxtaposition with the *Coleoptera*, observing that the metamorphosis in the former "being different from that of *Orthoptera* and *Hemiptera*, and nearer to that of the *Coleoptera*, this seems its most natural station, considered as an Elytrophorous order"

COLEO'PTILUM. (Gr. κολεος, *a sheath*, and πτιλον, *a feather*.) A term sometimes applied to the young leaves of Monocotyledons, from the circumstance of their always being developed within a sheath, while those of Dicotyledons are always naked. This is, however, a mistake both in fact and theory.

CO'LEORHI'ZA. (Gr. κολεος, *a sheath*, and ριζα, *a root*.) A term invented by Mirbel to denote the sheath within which the radicle of monocotyledonous plants is enclosed.

CO'LIC. (Gr. κωλον, *the colon*; one of the large intestines, to the seat of which the principal pain is generally referred.) There are many varieties of this complaint, and it arises from various causes, and exhibits different symptoms The general indications of cure are to evacuate the bowels by the least irritating means, and, when the lower intestines are loaded, by the use of glysters; opiates and etherial remedies may be resorted to to allay spasms, and warm bath and fomentations are often necessary. There is a peculiar disease called the *painters' colic* or *dry bellyache*, which appears to arise from the absorption of lead into the system, and which therefore commonly attacks plumbers, painters, and makers of white paint and other colours and preparations in which lead is used, the persons employed also in the lead mines and furnaces are subject to it It is often named from certain places in which it is peculiarly prevalent; as Poictou, Devonshire colic, &c It begins with restlessness and uneasiness about the stomach, nausea, and obstinate costiveness There is general spasm of the bowels, often accompanied by great pain, which is somewhat relieved by pressure; and this circumstance enables us to distinguish the complaint in question from inflammation of the bowels, into which, however, it runs, if not timely relieved by opiates, emollient glysters, warm bath, and gentle aperients, especially castor oil when it will remain on the stomach, by which the spasm is allayed and the bowels evacuated of their hardened and irritating feces. This is the *acute* state of the disease, but it often occurs in a *chronic* form, in which case pains and constipation of the bowels are followed by occasional delirium, epilepsy, paralysis, especially of the hands, and wasting away of the muscles This disease terminates fatally if not timely relieved, and above all the patient should be cautiously removed from all contact with lead, and allowed fresh air and a nutritious but not stimulating diet.

COLLA'PSE (Lat. collabor, *I shrink down*.) A wasting of the body, or a sudden and extreme depression of its strength and energies

CO'LLAR (Lat. collæ.) In Architecture, an horizontal piece of timber connecting two rafters

COLLAR In Ornithology, the coloured ring round the neck of birds In Malacology, the thickened secreting margin of the mantle in the testaceous Gastropods.

COLLAR, signifies a peculiar badge worn round the neck by knights of different orders It consists of a gold chain, enamelled, &c., to which is attached the badge of the order of knighthood, and it is worn at court chiefly on state occasions, which are thence called *collar days*

COLLARI'NO (Fr. collarin.) In Architecture, that part of the Tuscan and Roman Doric columns on the upper part of the shaft encircling them like a small collar. The more proper name is an astragal.

CO'LLECT (Lat. con, *together*, and lego, *I read*), signifies, as the derivation of the word implies, a prayer *read together with* other parts of the Church of England service, either usually or on a particular occasion.

COLLECTA'NEA, is applied, in Literature, to a selection of passages made from various authors, usually for the purpose of instruction

COLLE'CTORS In Botany, dense hairs covering the styles of some species of *Compositæ*, &c: and acting as brushes to clear the pollen out of the cells of the anthers.

CO'LLEGE. (Lat. collegium.) According to the primary meaning of the word, any society or number of persons bound together by the same laws or customs (*Collegæ*, *colleagues*). Among the Romans not only societies invested with a character resembling that of modern corporations, enjoying certain political rights in common (as the colleges of augurs, pontifices, &c.), were termed Collegia; but bodies of men who appear to have had no bond of union except common employment (as the collegia opificum, or colleges of the different trades) were also thus designated. Hence has originated the erroneous notion that the guilds of modern Europe were derived from similar institutions among the ancients, by attributing to the last-mentioned collegia a corporate character, which it is not sufficiently proved that they possessed; although some of these bodies, as we learn from the fragments of the lawyer Gaius, did in effect hold common property, and had their affairs administered by by-laws of their own. In England many corporate bodies are termed Colleges; *e.g.* the colleges of phy-

sicians and surgeons, of heralds, &c. &c. A college, in the academical meaning of the word, signifies a society established for academic purposes under royal or private foundation, endowed with revenues, and subject to a private code of laws. Where such a society possesses within itself all the means of instruction and the rights and faculties which are incident to a university, the terms University and College are in effect convertible, and indiscriminately used. Thus, Trinity College, Dublin, affords a specimen of an institution called indiscriminately by either title. On the other hand, the universities of Oxford and Cambridge are composed of a number of colleges united together under the same discipline and government, and in which those powers peculiarly belonging to a university are wielded by one class of authorities, the functions of the colleges superintended by another. The Scottish universities, not being in the strict sense of the words endowed societies (*i. e.* not possessing a regular body of fellows and scholars receiving stipends), cannot be properly termed collegiate bodies.

The early history of colleges is somewhat obscure, although there can be no doubt that they were originally founded, in the various universities of the middle ages, with similar objects and from the same charitable motives. The first students at these universities assembled together under no common bond of union, except that of academic study and discipline, and lodged as suited their own convenience. Next, hostels or boarding houses were established (in the first instance, it is said, by the religious orders for students of their own fraternities), in which the scholars lodged together under certain superintendence. Charitable individuals afterwards endowed these hostels, for the purpose of providing poor scholars with free lodgings. Finally, to these endowments were added (by gifts or bequests) stipends for all or a certain number of the scholars frequenting these inns or hostels; and thus the foundation of a college was completed. The distinction of language arising from ancient usages is still preserved at Oxford, where societies endowed for the maintenance of fellows and scholars are termed Colleges,—societies unprovided with such endowments, Halls. But at Cambridge there is no distinction between Colleges and Halls. At the university of Paris fifteen colleges, or more, are said to have been founded in the 13th century; and the whole number, in the course of time, amounted to eighteen greater and about eighty lesser. But these institutions assumed a different shape from that which they took in England. The greater colleges became appropriated to particular faculties, or departments of a faculty. Thus, for example, the Sorbonne was the college of the theological faculty, and, in process of time, the lectures and disputations of most of the faculties became confined to the walls of those colleges which were exclusively devoted to them. Hence the university became, in fact, a collection of academies for instruction in particular subjects, and its corporate character for purposes of education vanished altogether as early as the 15th century. (See *Malden on the Origin of Universities*, and the authorities there cited.)

The name and institution of colleges were derived by the English universities, together with most of their other peculiarities, from Paris; but their history is very different. The colleges now subsisting in both these universities were constituted by royal or private munificence; either as original foundations, or (more commonly) by the endowment of formerly subsisting halls or hostels with stipends for students. They were all formed on the same principle, consisting of a head (variously termed master, principal, provost, &c.); of a body of higher graduates (generally termed fellows), and another of inferior graduates (scholars), who, according to the terms of the several foundations, were or were not eligible as a matter of right to the fellowships. The colleges were thus founded simply for the purpose of assisting scholars in their progress through the university, not for that of conferring instruction. All those of Catholic foundation, it must be added, were intended to supply the church with ministers, hence the still subsisting regulations prohibiting the marriages of fellows. In the course of time independent members, *i. e.* members not upon the foundation nor sharing in the endowments, were admitted to reside within the walls of the colleges; and the task of superintending, and finally of instructing them, was gradually transferred from the university authorities to those appointed by and resident within the colleges. And, by the present constitution of our national universities, the only powers retained by the university as such are of a general character, as of conferring degrees and other honours, &c. &c.; while the function of education for the purpose of qualifying for those degrees has entirely passed into the hands of the colleges of which that university is composed, every member of the university being now, by usage which has acquired the force of law, also member of some college or hall. And, with respect to discipline and government, the power is shared between the university, which through its vice-chancellor and proctors exercises a general superintendence; and the colleges, which by their own officers maintain order within their own walls. A college, therefore, in the sense in which the term is applied at Oxford and Cambridge, has a double character,—1. as an endowed society; 2. as a house of education. In the first sense, the college is composed of the head, fellows, and scholars. It is under the government of the original laws framed by its founder, with such variations as in some cases time has introduced; but alteration is always jealously watched. According to the tenure of these statutes, the head is either chosen by the fellows from among themselves, or in some instances appointed by the crown or other authority. The fellows, again (who are mostly, but not universally, graduates who have passed the lowest degree, that of Bachelor of Arts), and the scholars, who are admitted when under graduates are either chosen from particular localities, schools, &c. &c., according to the will of the founder, or elected according to merit after free competition between members of the college or of the university at large. Every college is finally under the superintendence of a visitor, generally some high ecclesiastical functionary. 2 As a place of education, the college receives within its walls not only fellows and scholars, but also (in the great majority of instances) independent members, limited in number only by the extent of the lodging which it can afford; it being usual at Oxford (although not at Cambridge) that every student on entering the university should not only belong to a college or hall, but reside within its walls. The undergraduate members of the college are under the superintendence of the tutors. These are, in general, resident fellows, appointed by the head to perform this office. In some colleges each tutor has under his special control a certain number of under-graduates; in others the tutors divide among them, not the students, but the different branches of instruction which are to be communicated. Such is a very general outline of the system of English colleges, but each of these foundations is exclusively governed by its own laws and usages, and no comprehensive description will apply without exception to all. Oxford has nineteen colleges and five halls; Cambridge seventeen colleges or halls. In both universities the oldest are supposed to have existed from the middle of the 13th century; the greater part were founded between that period and the Reformation, but a few are of Protestant foundation.

CO'LLEGE OF JUSTICE. In Scottish Law, a term applied to the supreme civil courts, composed of the lords of council and session; together with the advocates, clerks of session, clerks of the bills, writers to the signet, &c. *See* SESSION.

CO'LLET. *See* COLLUM.

COLLIMA'TION. (Lat. collimo, *I aim at.*) The *line* of collimation, in a telescope, is the line of sight, or the straight line which passes through the centre of the object glass and the intersection of the wires placed in its focus. The *error* of collimation is the difference between the actual line of sight and the position which that line ought to have in reference to the instrument.

COLLIMA'TOR. Captain Kater gave the name of *floating collimator* to an apparatus contrived by him for ascertaining the error of collimation. It consists of a small telescope, furnished with cross-wires in its focus, and fastened horizontally on a flat iron float, which is made to swim on mercury, and which of course, when left to itself, will always assume one and the same invariable inclination to the horizon. If the cross-wires of the collimator be illuminated by a lamp placed in the focus of its object glass, the rays from them will issue parallel, and consequently be in a fit state to be brought to a focus by the object glass of any other telescope, in which they will form an image as if they came from a celestial object in their direction, *i. e.* at an altitude equal to their inclination. By transferring, then, the collimator still floating on a vessel of mercury from one side of a circular instrument to the other, we are furnished with two *quasi celestial* objects, at precisely equal altitudes, on opposite sides of the centre; and if these be observed in succession with the telescope of a circle, bringing its cross to bisect the image of the cross of the collimator, the difference of the two readings on the limb will be twice the zenith distance of either; whence the reading of the horizontal or zenith point is immediately determined. Another form of the collimator has the telescope placed vertically. (*Phil. Trans.* 1828; *Pearson's Practical Astronomy*, vol. ii.)

COLLI'QUATIVE. (Lat. colliqueo, *I melt.*) Excessive evacuations are so termed, which appear to melt down the strength and substance of the body.

COLLI'SION. (Lat. collisio, from collido, *I strike against.*) In Mechanics, the action of one body impinging against or striking another with a certain degree of force. In order to explain the phenomena which take place when two bodies in motion impinge against each other, we suppose the bodies either perfectly non-elastic, or perfectly elastic, and that they move in a medium which offers no resistance. As none of these suppositions have place

exactly in nature, the results deduced from them must in practice undergo certain modifications.

In the case of non-elastic bodies, let us suppose, first, that the body A strikes against another body B, which is either at rest or is moving in the same direction with A toward C, but with a less velocity.




The body B presents an obstacle to the motion of A; part of the force of A must therefore be expended in overcoming the obstacle, that is to say, in causing B to move with a velocity equal to its own. But when the quantity of motion necessary for this purpose has been communicated, B no longer opposes the motion of A; so that both bodies have the same velocity after the shock. Now, since a body cannot impart force to another without losing precisely an equal quantity itself, the sum of the forces, or *moments*, must remain the same after as before collision, but it has just been shown that the velocities of both bodies are the same after the shock; therefore (this momentum being measured by the product of the mass into the velocity) the sum of the moments is distributed between the two bodies in the proportion of their masses, and the common velocity is found by dividing the sum of the moments before the impact by the sum of their masses.

Let us next consider the shock of two bodies moving in opposite directions. If the forces by which they are animated are equal, they will destroy each other at the instant of collision; if they are not equal, the greater will destroy the smaller, and the two bodies will then move in the direction of that whose moment was the greater, and the two moments will be equal to the difference of the moments before the impact. In this case also the velocity after the impact is the same for both bodies, and equal to the difference of the moments divided by the sum of the masses, and the remaining force is distributed between the two bodies in proportion to their respective masses.

In the case of elastic bodies, the results are modified by a new force being brought into action. Let an ivory ball A strike against another B advancing in the same direction but with a less velocity. The first effect of the collision is to produce a momentary union of the two balls, and to compress or flatten the impinging surfaces, the next is the effort of the bodies to recover their figure, and when the elasticity is perfect (as it is here supposed to be) the compressed surfaces are restored with a force exactly equal to that by which they were displaced. This restoring force, produced by the elasticity, is called the *recoil*, and its effect is to double precisely the effect that would be produced if the bodies were non-elastic. When the balls A and B come into closest union, they take a common velocity, A losing exactly as much as B gains. But in recovering their figure, the loss of A's velocity and the gain of B's velocity are each doubled. In order, therefore, to obtain the actual velocities after the impact, we may estimate the velocities that would be gained or lost by each if non-elastic, and add or subtract this to or from the common velocity they would have upon the same hypothesis.

If the masses of the two bodies are equal, their velocities are interchanged. If only one of the equal bodies be in motion, it will come to rest after the impact, and the other will move forward in the direction in which the first was moving, and with the same velocity, if they move in opposite directions, each will return in the contrary direction with the velocity the other had. Whether the bodies be equal or unequal, the difference of their velocities, or their relative velocity, will be the same in amount both before and after the impact.

A result of this theory, which at first sight appears paradoxical, is, that when several elastic bodies increasing in magnitude are arranged in the same straight line, touching each other, and one smaller than the least of them strikes against the least, each will in turn be reflected, and communicate to the succeeding one a greater quantity of motion than it has itself. This increase of momentum is greatest when the masses of the bodies increase in geometrical progression.

In all cases of collision the state of the centre of gravity, whether at rest or in motion, remains the same after the impact as before. If it was at rest, it remains in that state; and if it was in motion, it continues to move in the same direction and with the same velocity, notwithstanding the impact. This is the case both in respect of non-elastic and elastic bodies; and it is a constant law in whatever manner the bodies act on each other, and whatever be their respective natures. (For a full and elementary explanation of this subject, see *Maclaurin's Account of Newton's Principia*.)

CO'LLUM. (Lat. collum, *the neck*.) That part of the axis of a plant whence the stem and root diverge. In the beginning it is a space which there is no difficulty in distinguishing, so long as the embryo or young plant has not undergone any considerable change; but in the process of time it is externally obliterated, so as to become a mere matter of theory.

COLLUTORIUM. (Lat. colluo, *I wash*, and os, *the mouth*.) A lotion for rinsing the mouth.

COLLY'RIUM. (Gr. κωλυω, *I check*, and ῥευς, *a defluxion*.) Lotions intended to check inordinate discharges. The term is now exclusively applied to *eyewaters*.

CO'LOBUS. (Gr κολοβος, *mutilated*.) A genus of long-tailed Quadrumanes, or monkeys; so called, because the fore hands are deficient in, and, as it were, mutilated of, a thumb. In this respect the *Colobi*, which are exclusively limited to the African continent, resemble the spider-monkeys (*Ateles*) of South America: but they have not a prehensile tail to compensate for the imperfection of the hands; their long caudal appendage is, on the contrary, terminated by a tuft of hairs. The *Colobi* differ also from the *Ateles* in having five molar teeth instead of six on each side of each jaw, and in having cheek-pouches.

CO'LOCYNTH. (Gr. κωλον, *the colon*, and κινεω, *I move*.) This term is applied in the Materia Medica to the pith of bitter apple, the fruit of the *Cucumis colocynthis*, which is violently purgative. It is imported dried, and generally peeled, from Turkey. it is rarely used alone; but one of the most valuable purgatives is the *compound extract of colocynth*, which is a combination of this drug with aloes, scammony, cardamum seeds, and soap.

COLOCY'NTIN. The bitter purging principle of the *colocynth*.

CO'LON. (Gr.) This name is given to the greater part of the large intestines. the colon passes upwards towards the liver, forming the *transverse arch* which descends upon the left side, forming its *sigmoid flexure*; entering the pelvis, it passes into the *rectum*.

COLON. In Grammar. *See* PUNCTUATION.

COLONNA'DE. (Lat. columna.) In Architecture, a series of columns placed at certain intervals, called intercolumniations, from each other, varying according to the rules of art and the order employed.

COLONEL. The commander of a regiment or battalion of troops. he is the highest in rank of *field officers*, and immediately subordinate to a general of division. The word is of uncertain origin. The *lieutenant-colonel* is immediately under the colonel, assisting in his duties, and being his substitute when required.

COLONY. (Gr αποικια, Lat colonia.) Colonies are establishments formed in foreign countries by bodies of men who voluntarily emigrate from, or are forcibly sent abroad by, their mother country. Various motives have, at different periods, led to the formation of colonies. Sometimes, as in the case of most of the Greek colonies of antiquity, they were formed by citizens driven from their native country by the violence of political factions: sometimes, as in the case of the Roman colonies, they were formed for the purpose of bridling subjugated provinces. the latter, indeed, were a species of camps or military stations, forming, as it were, the advanced posts of that mighty army which had its head-quarters at Rome. and sometimes, again, as in the case of the Phœnician colonies, and of most of those established in modern times, they have been formed for commercial purposes, or in the view of enriching the mother country, by opening new markets from which she might, if she chose, exclude foreigners.

The nature of the connection that has existed between colonies and their mother countries has been exceedingly various. Most of the Greek colonies being founded by private adventurers, who received no assistance from the government of the parent state, were really independent; the duty which they owed to their metropolis being such only as is due to kinsmen and friends, and not that due by subjects to their rulers. The Roman colonies, on the other hand, being founded by the state for an important political purpose, always maintained an intimate connection with, and dependence upon, Rome. They formed the great bulwarks of the empire; nor was the conquest of any province ever supposed to be completed till colonies had been established in it, and roads had rendered it accessible to the legions. The colonies established for commercial purposes have generally been subjected to such regulations as were deemed most for the advantage of the parent state. Their growth has thus in many instances been retarded; and they have been rendered less serviceable to their founders than they would have been had they been treated with greater liberality.

The very narrow limits within which this article must be compressed make it necessary that we should limit our statements to a few remarks, having more particular reference to those questions of colonial policy most interesting to the English reader.

The advantages supposed to result from that monopoly of the colony trade which all modern countries possessed of colonies have endeavoured to enforce, seem to be altogether imaginary. The ties of kindred, and the identity of language, customs, and manners, give the merchants of the mother country great advantages, and enable them, provided their goods be about as cheap as those of

others, to supply the colonial markets in preference to every one else But all attempts to establish a monopoly in favour of the mother country, by prohibiting the importation of the produce of other nations into the colony, are necessarily either useless or prejudicial, not merely to its interests, but even to those of the mother country. If the latter can produce the articles required by the colony as cheap or cheaper than others, she will command the supply of the colonial markets, without any interference whatever; and if she cannot do this, unless by excluding the cheaper products of others, then it is plain the goods sent to the colony can only be produced by diverting a portion of the capital and industry of the mother country into comparatively disadvantageous channels, or into businesses in which she is excelled by others: it is plain, too, that no artificial monopolies can be maintained, except in the case of small and easily guarded colonies. The British merchants have at present the supply of by far the greater part of the manufactured goods required by our North American possessions; because the goods they send to them are generally cheaper than those sent there by other parties. But were competitors capable of underselling our merchants to appear in the field, they would have very little difficulty indeed in depriving them of these markets. Cheap goods are sure to make their way through every barrier, and the frontier of our North American colonies is so very extensive, and the impossibility of guarding it so obvious, that the smallest saving in point of expence would occasion the clandestine introduction of prohibited goods in unlimited quantities. In such a case custom-house enactments are good for nothing. All the tyrannical regulations and sanguinary punishments of Spain and Portugal were unable to prevent their transatlantic possessions being deluged with the prohibited commodities of Britain France, and Germany The ability to supply it with comparatively cheap goods is the only means by which it is possible to preserve any market. It is this that secures for us at this moment the same superiority in the markets of the United States that we possessed in them when they were our dependencies; and the moment we lose this advantage we shall not merely lose their market, but, with it, the markets of *all* our colonies Nothing, therefore, can in reality be more futile than to found colonies, or to retain them in a state of unwilling dependency, in the view of monopolising their trade. If we can undersell others, we shall command their markets without any sort of interference, and if we cannot do this, the attempt to force upon them comparatively dear goods is sure to be defeated, or if, unhappily, it should have a partial success, it would be injurious alike to the mother country and the colony

A colony might be advantageous, and might contribute to increase the wealth of the mother country, if it yielded a greater revenue than was required for its government and defence: but this is rarely the case Most colonies require a heavy outlay on their first foundation, and when they attain to any considerable importance, all attempts to make them contribute directly to increase the income of the mother country are very apt to excite discontent, and probably even rebellion. an unfortunate attempt of this sort led, in fact, to the American war To obviate all chance of any such disastrous event occurring in future, we have distinctly renounced all pretensions to make our colonies contribute any thing, unless it be towards defraying the expense of their local government and militia. All the troops and squadrons required for their protection and security are furnished gratuitously by England, and, instead of deriving any revenue from our colonial possessions, they cost us *annually*, in time of peace, a direct outlay of about 2,500,000*l*. (*Official Account*, 18th of August, 1836) In time of war, or when dissatisfaction prevails in any important colony, the direct outlay may be twice or three times as great

A colony may, however, be advantageous in a pecuniary point of view, even when it costs the mother country a considerable direct outlay, provided it afford great facilities to individuals for making fortunes, with which to return to the mother country. A large sum is annually brought in this way into England from India; but our colonial possessions are, in this respect, of little advantage. Few, comparatively, of those individuals who acquire property in the N. American colonies return to England; and but few situations under the colonial government give the means of acquiring fortunes.

If a colony enjoy a natural monopoly of any product or article in extensive demand, it is supposed that, by laying a heavy duty on its exportation, a considerable advantage may be made to accrue to the mother country: but this does not really appear to be the case. Ceylon possesses a monopoly of the trade in cinnamon; but the enormously high duty (3*s*. per lb.) laid on the article when exported has restricted the demand for it to the narrowest limits, and reduced its culture, and the revenue derived from it, to a comparatively trifling amount Most of our readers have no doubt heard of the immense profits made by the Dutch on spices, of which the possession of the Moluccas gave them the monopoly. But these high profits were wholly a consequence of the limitation of the quantity sold; and to prevent a fall of price by an increase of the supply brought to market, the Dutch occasionally destroyed a portion of the produce! There is no longer, however, so much even as the shadow of a doubt that they were heavy losers by this oppressive and short-sighted policy. The sales were confined to an amount hardly sufficient to employ the capital even of a single merchant; and the total sum realized by the government is not supposed to have amounted to the tenth part of what it would have risen to had the trade been left free, under a moderate duty.

When a nation derives the whole or any considerable portion of any important article from abroad, it is necessarily exposed, especially when the supply comes from one or a few foreign countries, to the risk of more or less inconvenience, from an interruption of the friendly intercourse subsisting with such countries When such important articles are furnished by a colony, their supply is comparatively secure, and, in such cases, colonial possessions may be very valuable At this moment any interruption of the trade with the United States would most probably, by interfering with the supply of raw cotton, be productive of the most calamitous results, and there can be no doubt that if the whole, or any considerable part of the supply of cotton, were derived from a colony, it would be an important advantage. This, however, is not the case It is not improbable but that, at some future period, India may yield abundant supplies of cotton; but at present the cotton she sends to Europe is neither considerable in amount nor of good quality

It was long supposed that our colonies in the West Indies were peculiarly valuable from their furnishing us with a secure and abundant supply of sugar, an article now become a necessary of life, and yielding a very large revenue We doubt, however, whether there were ever any good foundation for such an opinion, but, whatever may have been the case formerly, there is none now. Sugar is not produced in one or a few countries only; but is a staple product of almost all intertropical regions; and it is now largely produced even in the northern parts of Europe (*See* SUGAR) So far, indeed, is it from being true that we are indebted to our West Indian colonies for abundant supplies of sugar, that the fact is nearly the reverse Foreign sugar is, and has long been, excluded from our markets by oppressive discriminating duties, and were these repealed, and the duties on all sugars placed on the same level, it is exceedingly doubtful whether we should continue to derive any considerable portion of our supplies of sugar from our sugar colonies in the west

Great stress is frequently laid on the advantage of colonies established in unoccupied countries, in affording a field for the ready and beneficial employment of the surplus or unemployed population that occasionally abounds in old settled and densely peopled countries; neither can there be a doubt that this is of very material importance But it is pretty obvious that, having founded a colony, it is unnecessary to retain it in a state of dependence if it wish to become free, to realize the advantage referred to Labour, in such colonies, is always in great demand, and a regard for their own interests always disposes the colonists to give every fair facility to the immigration of labourers. Notwithstanding the advantages occasionally held out by the British government to encourage emigration to our North American colonies, the great current of emigration has always been directed to the United States, and, even of the emigrants that sail from this country for Canada, scarcely a fourth part remain in the province, but immediately leave it for the contiguous states of the Union It is idle, therefore, to attempt to excuse the policy of attempting to retain colonies in a state of reluctant dependence on the mother country, on pretence of their affording a profitable outlet for poor or unemployed persons. The interest of the settlers will keep this outlet open, and will secure every real advantage that could, in this respect, be derived from the most complete colonial domination.

We beg, however, that it may not be supposed, from any thing now stated, that we regard the foundation of colonies as inexpedient; on the contrary, their establishment has been highly advantageous to this as it has been to most old settled countries in all ages. It is not to their foundation, provided they be placed in proper situations and judiciously managed, but to the needless interference with their government, the trammels imposed on their industry, the prevention of their free intercourse with other people, and the attempt to govern them after they are able and determined to govern themselves, that we object. A nation that founds a colony in an unoccupied country, or in a country occupied only by savages, extends by so doing the empire of civilization to, it may be, an indefinite degree. Such colony not only forms a desirable outlet for the redundant or unemployed population of the mother country, but it forms a new and rapidly increasing market for its products and those of other

countries. No one can doubt that Europe has been signally benefited by the discovery and civilization of America; but the advantages thence arising, however great soever, would have been incomparably greater, but for the various impolitic regulations imposed by the mother states on their colonies. The British colonies, though fettered in various ways, enjoyed a much greater degree of freedom than those of any other country; and, in consequence their progress, both before and since the æra of their independence, has been proportionally rapid. The colonies of Spain, on the other hand, though occupying the finest provinces, had their progress thwarted by the blind jealousy and short-sighted rapacity of the mother country, and were kept as much as possible in a state of pupilage. The government was entirely administered by natives of Old Spain; the colonists were carefully excluded from every office of power and emolument; one colony was prohibited from trading with another; and had foreigners presumed to settle amongst them, they would have been liable to capital punishment. In consequence their progress was very slow; and when at length they succeeded in throwing off the galling yoke of the mother country, they became, from their inexperience in self-government, a prey to all sorts of disorders. It is very questionable whether her South American colonies were of the least service to Spain, and it is, at all events, certain that they have not conferred either on her or on other countries a tenth part of the benefit they would have done had they been treated with greater liberality, and permitted freely to avail themselves of all the advantages of their situation.

The American war seems to have decided, in so far as experience can decide any thing, the question as to the policy of retaining colonies in a state of dependency that are determined to govern themselves. No colonies were ever reckoned half so valuable as those which now form the republic of the United States; and it was generally supposed that their emancipation would be decisive of the fate of Britain,—that her sun would then set, and for ever! But have we really lost any thing by that event? Has our trade, our wealth, or our power been in any degree impaired by the independence of the United States? The reverse is distinctly and completely the fact. The notion that we could have continued for any length of time to retain such rapidly growing countries in a state of dependence, or that we could have been advantageously united in a federal union with vast regions situated in another hemisphere, is too wild and extravagant to require examination. But notwithstanding its independence we have continued, and will necessarily continue in all time to come, to reap all the advantage we can reasonably claim as founders of this mighty empire in the wilderness. Englishmen will necessarily always command a preference in the American markets. And while we are disencumbered of the impossible task and enormous expense attending the government and defence of all but boundless countries 3,000 miles distant, our intercourse with them grows with their growth; and we are as much benefited and enriched by them as we should have been had they continued in the same state of dependency as Australia or the Cape of Good Hope.

The previous remarks are not, of course, meant to apply to such dependencies as Malta or Gibraltar. These are not colonies, but naval stations necessary for the accommodation of our ships of war and merchantmen, and serving also as secure depôts for our produce. Every commercial and maritime nation that takes a just view of its real interests will always take care to possess itself of some such strong-holds.

Neither are the previous remarks meant to apply to the conquest and occupation of foreign countries, in the view of increasing national opulence and power. Such policy may be either good or bad, according to the peculiar circumstances affecting each particular case. Our remarks apply only to colonies strictly so called, that is, to the case of foreign territories, peopled principally or wholly by emigrants, or by the descendants of emigrants from the mother country, and not held as a mere military station.

Sometimes, in order to carry on a trade with a colony, it is necessary to give its products peculiar advantages in the markets of the mother country; and consequently at the expense and to the prejudice of the consumers in the latter. We rather incline to think that no small portion of our trade with the West Indies is forced in this way; and that were the discriminating duties on foreign sugar abolished, we should derive a considerable part of our supplies from other quarters. But whatever may be the case with the West India trade, this, at all events, is the case with the Canada trade. It employs a large number of ships and seamen, and seems, to a superficial observer, highly valuable. In truth and reality, however, it is very much the reverse. Two thirds and more of this trade is forced and factitious; originating in the oppressive discriminating duty of 45*s.* a load imposed on timber from the north of Europe, over and above what is imposed on that brought from a British settlement in North America! This obliges us to resort to Canada, whence we import an inferior article at a comparatively high price. The disadvantages of this impolitic system are numerous and glaring. To a manufacturing country, having a great mercantile and warlike navy, timber is indispensable; and yet, instead of supplying ourselves with it where it may be found best and cheapest, we load the superior and cheaper article with an exorbitant duty, and thus do the most we can to make our houses and ships be built and our machinery constructed of what is inferior and dear! But the mischief does not stop here. By refusing to import the timber of the north of Europe, we proportionally limit the power of the Russians, Prussians, Swedes, and Norwegians to buy our manufactured goods; while, by forcing the importation of timber from Canada, we withdraw the attention of its inhabitants from the most profitable employment they can carry on,—that is, from the cultivation of the soil,—and make them waste their energies in comparatively disadvantageous pursuits! Such, either in a less or a greater degree, is the uniform result of all attempts to interfere with the natural order of things, and to force a trade, whether with a colony or a foreign country matters not, that would not otherwise be carried on.

But the existing state of our relations with Canada affords other matter for serious, and not very pleasant reflection. That colony is not, and never has been, of advantage to England. Were the duties on Canada timber reduced to the same level as those on Baltic timber, we question whether it would be found to possess a single article that could be advantageously exported to this country, or that we might not buy cheaper and better elsewhere. It no doubt affords an outlet for emigrants, and is in so far useful, but in all other respects its occupation has always been, and will most probably continue to be, productive of little except loss. And even as respects emigration, it is, as already explained, by no means clear that the field would be at all narrowed by Canada becoming independent, or connected with the United States.

But useless as Canada has been to England in time past, the connection with it will, in all probability, become much more onerous in time to come. We shall not stop to inquire whether the Canadians have good grounds for the dissatisfaction that prevails so generally amongst them. It is enough to know that it exists; and that nothing but the presence of a large British army is able to maintain our nominal ascendency in that province. While this state of things continues, the prosperity of the colony must be at a stand, emigration to it will cease or be greatly narrowed, and the distresses in which the settlers will be involved will give additional strength to the party wishing to break off the connection with the mother country. The people of Britain would do well to reflect dispassionately on the state of the Canadian question. There are not, perhaps, a dozen men of sense in the empire who are not ready to admit that in some ten or twenty years Canada will be independent, or be incorporated with the United States. But if so, what should be our policy in the mean time? Are we resolved to maintain an army of 10,000 or 15,000 men in Canada?—to expend, directly and indirectly, some three or four millions a year in preserving a mere nominal ascendency in a colony our connection with which is really a loss? If such be our determination, it may be doubted whether we have profited much by the dear-bought experience afforded by the American war. National pride may prevent our relinquishing this costly and barren dominion; but good sense, and the most obvious views of expediency, would seem to suggest the policy of voluntarily anticipating what there is every reason to think must in the end necessarily happen, and of providing for the independence of Canada under a system of friendly and mutually beneficial relations.

The explanation given by Dr Smith in the *Wealth of Nations* (book iv. cap 7.) of the causes of the rapid growth and prosperity of colonies founded in advantageous situations, though impugned by Sismondi (*Etudes sur l'Economie Politique*, ii cap. "Colonies") and others, seems to be consistent alike with principle and historical evidence. When a colony is founded in an uninhabited or but thinly peopled district, each colonist gets a large extent of the best land; he has no rent, and but few if any taxes to pay; and being able to procure supplies of manufactured articles from the mother country, or one equally advanced, he applies all his energies to agriculture, which under the circumstances is most productive. The demand for labour in such colonies is very great; for the high rate of wages, combined with the cheapness of the land, speedily changes the labourers into landlords, who in their turn become the employers of fresh labourers. In consequence population and wealth advance with unusual rapidity; and in some instances, as in that of the United States, they have continued for a lengthened period to go on doubling every twenty or five and twenty years!

But in stating that the facility of obtaining supplies of fertile and unoccupied land is the principal cause of the rapid progress of new colonies, it is not meant to affirm that it is the only cause. An advantageous situation for the prosecution of commercial pursuits, and great superiority in navigation, may enable a colony to advance at its outset, though without any considerable extent of territory, with even more rapidity than if it enjoyed an unlimited command of fertile land. This seems to have been the principal cause of the speedy extension of the Greek colonies in antiquity. The most famous of these, as Syracuse and Agrigentum in Sicily, Tarentum and Locri in Italy, and Ephesus and Miletus in Asia Minor, were amongst the principal emporia of the ancient world. They were all sea-port towns; were founded in the most advantageous situations for carrying on an extensive commerce, and owed, in fact, their wealth and greatness mainly to trade and navigation. Owing, however, to the limited extent of their territorial acquisitions, a consequence partly of the difficulty of subduing the indigenous population, and partly of the neighbourhood of other colonies founded by rival states, their power rested on no very broad or solid foundation; so that the fall of the capital city and the annihilation of the state were all but synonymous.

The colonies founded in modern times have been placed under very different circumstances. The countries in which they were planted were either so very thinly inhabited as to be almost deserts, or they were occupied by a feeble and inferior race unable to oppose any effectual obstacle to the diffusion of the colonists; so that the latter easily spread themselves over a large extent of country, and have had in general more of an agricultural than of a commercial character. But while this has given them greater strength, it has not, after the difficulties attendant on their first establishment were got over, in any degree impeded their progress, but the contrary. The most flourishing of the colonies of antiquity will not bear to be compared in respect of rapidity of growth, magnitude and power, with the United States, and the slower progress of the Spanish and Portuguese colonies is not owing to the colonists having distributed themselves over a wide extent of country, but to the oppressive interference of the mother country with their domestic arrangements, and the vexatious restrictions laid on their intercourse with foreigners.

A very great degree of equality prevailed among the free settlers in Greek colonies, and in consequence the lands acquired by the colonists were distributed amongst them in nearly equal portions. But in modern times it is very different. Owing to the vast extent and almost desert state of the countries in which they have been principally planted, the poorest individuals have generally succeeded in acquiring slips of land; while the superior class of colonists, or those who had influence with the colonial government, or with that of the mother country, frequently succeeded in getting grants of vast tracts of land, not in the view of cultivating, but of holding them till in consequence of the increase of population in the vicinity they had acquired a considerable value. These large reserves, by interrupting the communications between different parts of the colony, and increasing the difficulty and cost of conveyance, have frequently proved not a little injurious to its interests. But there are various ways in which an abuse of this sort might be obviated, and perhaps the best would be to apportion the land according to the available capital of the settlers, it being stipulated that no individual should receive above a certain number of acres, and that it should revert back to the public unless certain improvements were effected upon it within a specified time after the grant was made.

But not satisfied with attempting to put down an abuse of this sort, we are now told that all the difficulties incident to colonization have originated in the too great dispersion of the colonists; and that to obviate them, and to ensure to all new colonies the acme of prosperity, we have merely to compel the colonists to keep close together by exacting a high price for the surrounding waste or unoccupied land, in other words, by making the colony as like an old settled country as possible! Perhaps such a crude project was hardly worth notice. If, on the one hand, the price set on the waste land were inconsiderable, it would not prevent the purchase of large tracts of land on speculation, and the entailing on the colony all the disadvantages that have resulted from the making of injudicious grants; and if, on the other hand, the price demanded for the land were pretty high, it would go far to oppose an insuperable obstacle to the progress of the colony. Rich men do not leave their native country to expose themselves to the inconveniences and hardships attending the establishment of new settlements in the wilderness. This, if it be done at all, must be done in time to come as in time past, by individuals in straitened circumstances, and anxious to improve their fortunes. But to exact a high or considerable price for land from such persons would, by sweeping away the whole or a considerable portion of their capital, deprive them of the means of clearing and cultivating the land, and proportionally retard their progress and that of the colony. The plan of letting lands by fine is admitted by every one who knows any thing of agriculture to be one of the worst that can be devised; and this colonization project is bottomed on the same principle, and will no doubt be as pernicious.

It is said that in consequence of the exaction of a price for the land, and the concentration of the colonists, their employments, being more combined and divided, will be prosecuted with a great deal more success than at present. All this, however, proceeds on the false and exploded assumption that the colonists are not, like other individuals, the best judges of what is for their own advantage. Dr. Smith says truly that it is the highest impertinence for kings and ministers to attempt to direct private people *how* they should employ their capitals. But it is, if possible, a still greater impertinence to attempt to direct them *where* they shall employ them. A regard to their own interest will draw people sufficiently together; and to enact regulations in the view of concentrating them still more, is in every respect as contradictory and absurd as it would be to set about increasing the public wealth by regulating the sort of employments to be carried on, and the countries with which, and the commodities in which, to deal.

We have already sufficiently explained the principal cause of the rapid progress made by some of the Greek colonies. It should, however, be borne in mind that these colonies had great numbers of slaves, who carried on most part of the more common employments. Hence, in Syracuse or Tarentum, every rich individual might have as many obsequious servants as he pleased, and all sorts of luxurious accommodations were to be had in the greatest profusion. But in those modern colonies where slavery is abolished, the different ranks and orders of men are more nearly assimilated, less by the depression of the rich than by the elevation of the poor. What is wanted in refinement and attention is far more than compensated by the wellbeing and comfort of the lower classes.

It is a part of this new project, on the supposed excellence of which much stress is laid, that the sums got by the sale of lands in the colony are to be expended in defraying the expense attending the conveyance thither of labourers. This is a species of bait held out to tempt capitalists to buy land, by making them believe that though land be artificially dear, labour will be artificially cheap, and that on the whole they will be very well off! This, however, is merely attempting to repair an injury done the capitalists, by inflicting a still more serious injury on the labourers. In a colony where a large portion of the capital is swallowed up in the purchase of land, the demand for labour must be comparatively limited; and this limited market is to be glutted by throwing upon it crowds of paupers transported gratis from England! We say crowds of paupers, for few labourers aware of the facts of the case, who can afford to pay for a passage to the United States, will voluntarily go to a colony where land is to be artificially raised to a high price, and labour artificially reduced. The whole scheme seems, in fact, to be little else than a tissue of delusions and contradictions, and it says little for the discernment of the public that it should have attracted any notice.

It is true that the Americans sell their unoccupied lands: but they sell the richest and finest lands in the valley of the Mississippi at less than a dollar an acre, whereas we exact 5*s* an acre for the worst land at the antipodes, or in that *terra incognita* called Southern Australia! If these regulations be intended to divert the current of voluntary emigration from our own colonies to the United States, they do honour to the sagacity of those by whom they were contrived, and there is not a word to be said against them; but in all other respects they seem to be as impolitic and absurd as can well be imagined. (For further information on this important subject, see *St. Croix, de l'Etat et du Sort des Anciennes Colonies*; the art. "Colony" in the *Encyclopædia Britannica*; and *M'Culloch's Commercial Dictionary*, and Edition of the *Wealth of Nations*.)

CO'LOPHON. In Bibliography, the postcript contained in the last sheet of an early printed work (before the introduction of title-pages), containing the printer's name, date, &c., is so termed; from a fanciful allusion to a Greek satirical proverb, in which the people of Colophon, in Asia Minor, are reproached with being always the hindmost.

COLO'PHONITE. A variety of garnet of a *resinous* fracture.

COLO'PHONY. (Gr. Κολυφωνια, the city whence it was first brought.) The dark-coloured resin which remains after the distillation of oil of turpentine.

COLO'SSAL. (From Colossus, a very large statue at Rhodes.) In the Fine Arts, a term applied to any work of art remarkable for its extraordinary dimensions. It is, however, more applied to works in sculpture than in the other arts. It seems probable that colossal statues had their origin from the attempt to astonish by size at a period when the science of proportion and that of imi-

tation were in their infancy. Colossal statues of the divinities were common both in Asia and Egypt. By the description of the palace or temple attributed to Semiramis it abounded with colossal statues, among which was one of Jupiter forty feet in height. In Babylon we learn from Daniel that the palaces were filled with statues of an enormous size, and in the present day the ruins of India present us with statues of extraordinary dimensions. The Egyptians surpassed the Asiatics in these gigantic monuments, considering the beautiful finish they gave to such a hard material as granite. Sesostris, according to history, appears to have been the first who raised these colossal masses, the statues of himself and his wife, which he placed before the temple of Vulcan, having been thirty cubits in height. This example was imitated by his successors, as the ruins of Thebes sufficiently testify. The taste for colossal statues prevailed also among the Greeks. The statue of Apollo at Rhodes, executed by Chares, a disciple of Lysippus, has indeed given this species of art the name it bears; and the great Phidias contributed several works of this order. The colossus at Tarentum by Lysippe was no less than forty cubits in height; and the difficulty of removing it, rather than the moderation of the conqueror, prevented Fabius carrying it off with the Hercules from the same city. But the proposition made to Alexander of cutting Mount Athos into a statue, in one of whose hands a city was to be placed capable of holding ten thousand inhabitants, whilst in the other he was to hold a vessel pouring out the torrents from the mountain, exceeds all others in history. Before the time of the Romans colossal statues were frequently executed in Italy. The first monument of this nature set up in Rome was one placed in the capitol by Sp. Carvilius after his victory over the Samnites. This was succeeded in after times by many others, of which those now on Monte Cavallo, said to be of Castor and Pollux, are well known to most persons. In modern times the largest that has been erected is that of S. Carlo Boromeo at Arona near Milan. This gigantic statue is upwards of sixty feet in height.

COLOSSE'UM. *See* AMPHITHEATRE.

COLO'STRUM. The first milk after delivery. A mixture of turpentine with the yolk of egg.

CO'LOUR. (Lat. color.) In Painting, that quality of a body which affects our sensation in regard to its hue. *Local colours* are those which are natural to a particular object in a picture, and by which it is distinguished from other objects. *Neutral colours* are those in which the hue is broken by partaking of the reflected colours of the objects which surround them. *Positive colours* are those unbroken by such accidents as affect neutral colours.

CO'LUBER. A Linnæan genus of serpents, including all those in which the subcaudal scale-plates or scutæ are arranged in pairs. This extensive group is now subdivided into numerous subgenera.

CO'LUM. A term, now obsolete, denoting that part of the ovarium from which the ovula arise, commonly called the Placenta.

COLU'MBA. (Lat. columba, *a pigeon*.) A genus of birds which form the transition from the Passerine to the Gallinaceous orders. They fly well; live in a state of monogamy; build their nests in trees or in the crevices and fissures of rocks; and lay but few eggs at a time, generally two, their tail is composed of twelve quill-feathers so far the Columbæ resemble the Passerine birds. But their beak is vaulted; the nostrils perforated in a broad membranous space, and covered with a cartilaginous scale, which even forms a bulge at the base of the bill; the sternum is deeply and doubly notched; a dilated crop is developed from both sides of the œsophagus; the stomach is a true gizzard, and the lower larynx has only a single pair of muscles: all these important modifications of structure indicate the close affinity of the Dove tribe to the Gallinaceous birds. And it may be further remarked, that although the pigeons lay but few eggs at each brood, they breed frequently, and at short intervals. The male assists his mate in the business of incubation and rearing of the young, which are at first supported by a milky secretion prepared from the glandular coat of the crop, and regurgitated, together with the macerated grain. The Linnæan genus is subdivided into numerous but unimportant subgenera, characterized by the greater or less length of the bill, and the proportions of the feet and tail.

COLU'MBA NOACHI. (Noah's Dove.) A small constellation in the southern hemisphere, near the hinder feet of Canis Major, formed by Halley.

COLUMBA'RIUM. (Lat.) In Architecture, a pigeon-house or dovecote. From the similarity the arched and square-headed recesses in the walls of cemeteries, which were made to receive the cinerary urns, were also called Columbaria.

COLU'MBIA. A bitter crystalline principle, obtained from colomba root.

COLU'MBIUM. A metal discovered by Mr. Hatchett in 1801, in a mineral from Massachusets in North America. It has since been found in a Swedish mineral called tantalite, but its ores are extremely rare. It is acidifiable, and hence the peroxide has been termed *columbic acid*.

COLUMELLIA'CEÆ. (Columellia, one of the genera.) An obscure natural order of shrubby or arborescent Exogens, inhabiting Mexico and Peru; distinguished from *Jasminaceæ*, to which order they have been referred, by having an adherent ovary, a perigynous disk, undivided stigma, and inferior capsule with polyspermous cells. Of its true affinity little is known.

CO'LUMN. (Lat. columna.) In Architecture, a member of an order whose section through the axis is usually a frustum of an elongated parabola. It is circular on every height of its plan, and consists of a base, shaft or body, and a capital. It differs from a pilaster, which is square on the plan. The use of the column is to support the entablature. *See* ORDER.

CO'LURES. In Astronomy, two imaginary great circles of the celestial sphere intersecting in the poles of the world, one passing through the equinoctial points of Aries and Libra, and the other through the solstitial points of Cancer and Capricorn. For this reason the first is called the *equinoctial*, and the second the *solstitial* colure. The name Colure, derived from Gr. κολουρος (cauda truncus, *imperfect*), is supposed to have been given to those circles because a portion of them is always concealed from view under the horizon. But this is the case with every other meridional circle as well as the colures.

CO'LZA, OIL OF. The oil expressed from the seed of the *Brassica oleracea*, a species of cabbage. Colza oil is much used in France and Belgium for burning in lamps and other purposes.

CO'MA. (Gr. κομη, *hair*.) The assemblage of branches forming the head of a forest tree. Also used to denote bracts that are empty and terminate an inflorescence, as in *Salvia horminum*.

COMA. (Gr. κωμα, *a swoon*.) Lethargy, or unnatural drowsiness; whence the term *comatose*.

CO'MA BERENI'CES. (Literally *Berenice's hair*.) A constellation of the northern hemisphere, between the tail of the Lion and Bootes. *See* CONSTELLATION.

COMB, or COOMB. A measure of corn, commonly four Winchester bushels.

COMB, or COMBE, in the western counties of England, signifies a small valley. The same ancient word of Celtic derivation is used in Wales (cwm), and in the Alps between France and Piedmont (combe), in the same sense.

COMBINA'TION. (Lat. con, and binus, *double*.) In Algebra, signifies the disposition or arrangement of any number of objects or symbols in all possible ways. The two principal problems that occur in the theory of combination are the following: — 1st, Any number of things with the number in each combination being given, to find the number of combinations. 2d, To find the number of alterations which any number of quantities can undergo when combined in every possible variety of ways. In the solution of the first problem we have to consider that in combining things by pairs, two things, *a*, *b*, admit of one combination only, viz. *a b*, three things, *a*, *b*, *c*, admit of three, viz *ab*, *ac*, *bc*, four admit of six, viz. *ab*, *ac*, *ad*, *bc*, *bd* *cd*, five admit of ten, viz. *ab*, *ac*, *ad*, *ae*, *bc*, *bd*, *be*, *cd*, *ce*, *de*. Generally, if $n$ denote the number of things, the formula which expresses the number of all their combinations by pairs is $\frac{n(n-1)}{1\cdot 2}$. Thus, if $n=5$, then $\frac{5\cdot 4}{1\cdot 2}=10$; if $n=6$, then $\frac{6\cdot 5}{1\cdot 2}=15$ is the number of combinations.

When the things are combined by *threes*, the number of combinations that can be made out of a given number $n$, is $\frac{n}{1}\times\frac{n-1}{2}\times\frac{n-2}{3}$. If combined by *fours*, the number of combinations is $\frac{n}{1}\times\frac{n-1}{2}\times\frac{n-2}{3}\times\frac{n-3}{4}$, and so on.

The number of combinations of all sorts that can be made of $n$ things (that is, by first taking the things one at a time, then taking them by twos, then by threes, and so on) is $2^n-1$. Thus, all the possible combinations or selections that can be made of three things are $2^3-1=7$, viz. *abc*, *ab*, *ac*, *bc*, *a*, *b*, *c*.

The second problem requires us to take into account not only the different combinations of the things themselves, but also the order of their arrangement. Admitting this element of variation,

Two things may be varied by pairs in four ways: thus, *aa*, *ab*, *ba*, *bb*.

Three quantities, taken by pairs, may be varied nine ways; thus, *aa*, *ab*, *ac*, *ba*, *ca*, *bb*, *bc*, *cb*, *cc*.

Generally the number of variations by pairs which can be made of $n$ things is equal to $n^2$; when taken by threes, the number of variations is $n^3$; when by fours, the number of changes is $n^4$, and so on. Hence the whole number of changes in $n$ things, taken by *twos*, by *threes*, by *fours*,

and so on to $n$, is the sum of the geometrical series $n + n^2 + n^3 + n^4 \ldots\ldots + n^n = \frac{n^n - 1}{n-1} \times n$. Thus, if $n=5$, the number of possible changes is $\frac{5^5-1}{4} \times 5 = 3905$; and if $n = 24$ (the number of letters in the alphabet), the theorem gives 13917.1288887252861251284913022880, a number consisting of 34 digits. *See* PERMUTATION.

COMBINA'TION. In Law, may take place for the performance of any unlawful act, and is punishable before such act is executed. But the word has been commonly used in a particular sense; viz that of a combination among workmen to demand wages at a particular rate; which was an unlawful act prior to the 6 G 4 c. 129. repealing former statutes. Workmen are now at perfect liberty to form such combinations; but penalties are enacted by the statute against such as use threats or violence towards those who refuse to join in them. And the offence of administering unlawful oaths (whether preparatory to a combination among workmen, or for any other purpose) remains unaffected by the statute.

Combinations to raise wages, or "strikes," have formed for the last fifty years the most embarrassing difficulties with which British manufacturers, and the labouring classes themselves, have had to contend, and it can scarcely be said that the repeal of the combination laws in 1824 has produced much effect either to encourage or diminish them. On this subject we shall make an extract from a note, or rather a dissertation on "wages of labour," in Mr M'Culloch's Edition of *Smith's Wealth of Nations*, in which the tendency of combinations to fetter commercial operations is set forth with a brevity and perspicuity no where surpassed.

"The repeal of the act against voluntary combinations in 1824 was a just and a wise measure. If any number of persons choose to combine to refuse to work, except for a certain amount of wages or for certain hours per day, or week, to forbid them would seem to be a most oppressive interference with one of the distinguishing privileges of free labourers It was found too that practically the laws against such combinations were good for nothing, and that, instead of putting them down, they gave them a secret character, and made them be easily perverted to other and more objectionable objects. But when workmen have power to refuse to employ themselves on terms of which they disapprove, they have got *all*, in this respect, to which they are entitled None of them have any right to dictate to their fellows, or to say that because they object to certain stipulations in the terms offered by such and such employers, no one else shall be allowed to accept them. A pretension of this sort strikes at the very foundations of society, and if tolerated might enable juntos of designing individuals to inflict irreparable injury, not only on the employers of labour, but on the manufactures of the country, and consequently on the lasting interests of the labouring class. We need not, however, be surprised to learn that this is what numbers of workmen in various places have attempted to do, and that combinations have been formed, not for the legitimate purpose of refusing to work except on certain conditions, but for preventing other workpeople who may disapprove of, or not choose to insist on, these conditions, accepting the terms offered by their employers The measures taken to enforce this most unjustifiable pretension have in some instances been of a very obnoxious description, and have evinced the existence of a very dangerous spirit. Nothing should be omitted that may serve to root out and suppress combinations for such illegal ends. They are completely subversive of that security essential to the prosecution of all industrious undertakings, and are, at bottom, as hostile to the interests of those that enter into them as they are to the interests of every one else." (For further details on this subject, see *A. Smith*, Book i. chap. 8; *the Parliamentary Debates of the Year* 1824; *Torrens on Wages and Combinations*, London, 1834; *Edinb. Review*, vol. 39 59.)

CO'MBRETA'CEÆ (Combretum, one of the genera) A natural order of shrubby or arborescent Exogens, all living within the tropics, and placed indifferently in the vicinity of *Santalaceæ* and *Elæagnaceæ*, or of *Onagraceæ* and *Myrtaceæ*. They all possess an astringency, and some are employed in dyeing. Some are polypetalous, some apetalous. They are especially distinguished by their convolute embryo.

COMBU'STION. This term is generally applied to the phenomena exhibited by burning bodies, and which depend upon the rapid union of the *combustible* with the oxygen of the air. The evolution of heat and light which attends this process announces intense chemical action; and we consequently find that combustion is always attended by the production of new compounds. *See* HEAT.

CO'MEDY. (From the Greek words *κώμη, a village*, and *ᾠδη, a song;* because the original rude dialogues, intermixed with singing and dancing, out of which the early Greek comedy arose, were sung by rustic actors at village festivals.) A species of drama, of which the characteristics in modern usage are, that its incidents and language approach nearly to those of ordinary life; that the termination of its intrigue is happy; and that it is distinguished by greater length and greater complexity of plot from the lighter theatrical piece entitled a farce. The original Attic comedy was a burlesque tragedy in form, in substance a satire on individuals, and founded on political or other matters of public interest. The modern comedy is derived from the new comedy of the Greeks, of which Menander and Philemon were the principal authors, and which has been preserved to us through the Latin imitations of Plautus and Terence *See* DRAMA.

CO'MET. (Gr. *κομητης*, from *κομη, hair.*) The name given to a numerous class of celestial bodies belonging to the solar system The luminous point which shines with greater or less brilliancy at the centre of a comet is called its nucleus. The nucleus is generally surrounded by a *nebulosity*, or luminous aurora The train of light, of greater or less extent, with which most comets are accompanied, is called the *tail*. Formerly this name was only applied to the luminous train when it fell behind the comet in its diurnal motion, if it preceded the comet, it was called the *beard*, but this distinction has disappeared in modern works on Astronomy

The ancients gave the name of comet to every nebulous star or meteor which was observed to pass successively through different constellations Modern astronomers apply the name, notwithstanding the etymology, to stars which have neither nebulosity nor tail According to them, the distinctive characters of a comet are, 1st, that it possesses a proper motion; 2d, that it traverses space in a curve so elongated that in the distant parts of its orbit it ceases to be visible. The proper motion distinguishes comets from those new stars which occasionally appear, and become extinguished without changing their place in the sky. The elongated form of the orbit establishes a distinction equally marked between the comets and the planets

*Orbits of Comets* — Some of the ancient philosophers regarded comets as simple meteors, engendered in the atmosphere In order, however, to be convinced that they occupy a far more remote situation, it is only necessary to compare simultaneous observations at very distant places on the earth Tycho Brahe was the first who showed that their true place is in the planetary regions: since the time of Tycho, it has been discovered that they revolve about the sun according to regular laws similar to those which govern the planetary motions; and that their orbits are very elongated ellipses, having the sun in one of their foci

Comets are only visible during the short time they are near the perihelia of their orbits. But an elongated ellipse, and a parabola having the same summit and focus, only begin to diverge sensibly at a considerable distance from the common summit. In order, therefore, to represent the different positions of a comet during the short time it is visible, we may in general without any inconvenience substitute a parabola for an ellipse. If it happens that the orbit cannot be represented by a parabola, we conclude that the ellipse is not very elongated. Now, by means of three positions of a comet seen from the earth, all the elements of its parabolic orbit may be determined These elements are, 1st, the line of the nodes, 2d, the inclination of the orbit to the plane of the ecliptic, 3d, the perihelion distance, or least distance of the comet from the sun, expressed in parts of the earth's semidiameter, 4th, the instant of the passage through the perihelion; 5th, the longitude of the perihelion. When these elements are known, the path of the comet is completely determined; and it is only necessary, in addition, to indicate the direction of the motion, that is to say, whether it is in the order of the signs, or the contrary.

The proper motion of all the planets is performed from west to east in the order of the signs; comets, on the other hand, appear to traverse the heavens in all directions indifferently. Of 129 comets whose orbits have been determined, there are 68 whose motion is direct, and 61 whose motion is retrograde, and their orbits intersect the ecliptic at all possible angles. Out of the whole number there are only three whose returns to the sun in successive revolutions have been verified by observation. These are, 1st, Halley's comet, of which the period is about seventy-five and a half years; 2d, Encke's, whose period is about three and one third years; and 3d, Biela's, which performs its revolution in six years and about eight months.

*Halley's Comet.* — Newton was the first who submitted the motion of a comet to calculation, and pointed out a method of determining its orbit from three of its observed positions. Halley applied Newton's method to a great number of comets, of which the positions had been observed; and on comparing the resulting elements, per-

ceived that the comet which appeared in 1682 moved nearly in the same orbit as one which had been observed in 1607, and another which had been observed by Apian in 1531. As the interval between these successive apparitions was nearly the same, namely, about seventy-six years, the identity of the three comets appeared to Halley to be established, and he accordingly predicted its return in 1759. Clairaut, a celebrated French mathematician, computed the time at which it would arrive at its perihelion; and his results were confirmed by observation, the comet actually passing its perihelion within about a month of the time predicted.

The computation of the comet's return to its perihelion is a work of great difficulty and labour, for in consequence of the attractions of the larger planets, the path of the comet is considerably changed at each revolution, and all these changes or *perturbations*, as they are called, must be computed from the theory of gravitation.

The reappearance of this comet in 1835 was expected with great interest Its perturbations in the previous revolution were calculated by Damoiseau and Pontecoulant in France, and by Rosenberger in Germany, and the time of its perihelion passage fixed for the month of November in that year. Damoiseau's calculation gave the 4th, Pontecoulant's the 7th, and Rosenberger's the 3d of the month. The comet, true to its appointed laws, became visible about the end of August, in the part of the heavens predicted, and it appears from the comparison of the numerous observations that were made of it, to have actually passed its perihelion on the 16th of November. The position of its orbit was such that it could scarcely be seen in Europe after the passage, on account of its proximity to the horizon, but it was then caught by the astronomers of the southern hemisphere, and continued to be observed by Sir John Herschel at the Cape of Good Hope till the end of March, 1836, when its increasing distance from the earth rendered it invisible. For some weeks it continued visible to the naked eye, but its splendour was not very remarkable

*Encke's Comet* —Two other comets have more recently been identified as having been seen in preceding revolutions about the sun One of these is called Encke's comet, from Professor Encke of Berlin, who first computed its elliptic elements Its orbit is very elongated, the eccentricity being nearly = 845, and inclined to the ecliptic in an angle of about 13° 22½′. The period of its revolution is 1207 days, or about 3 and 1 3d years. Though this comet was not recognized as periodic till 1819, it had frequently been observed in previous revolutions — in 1789, 1795, 1801, and 1805 From the ellipse calculated by Encke, its return was predicted in 1822 On this occasion it was invisible in Europe, but was observed at Paramatta in New South Wales. In the subsequent returns of 1825, 1828, and 1832, it was observed in the principal observatories both in the northern and southern hemispheres. In comparing the intervals between the successive returns to its perihelion, it is found that the period of this comet is continually diminishing This is exactly the effect that would be produced if it moved through a resisting medium, for the resistance, by diminishing the actual velocity, diminishes the centrifugal force, in consequence of which the solar attraction preponderates, and the comet is drawn nearer to the sun, and completes its revolution in a shorter time Accordingly, as there appears no other way of accounting for the observed acceleration, it seems now to be the general opinion of astronomers that an ethereal medium pervades the regions of space, of sufficient density to affect the motions of comets though so rare as to offer no sensible resistance to the denser masses of the planets, whose periods of revolution have continued exactly the same since the epoch of the first astronomical observations. If this medium really exists, the comet must ultimately fall into the sun, unless it is dissipated altogether; an event which seems not improbable, from the observed fact of its having been less conspicuous at each reappearance.

*Biela's Comet* —The third periodic comet at present known was discovered by Biela, an Austrian officer then residing at Prague, in February, 1826, and by M. Gambart of Marseilles in April of the same year It has been identified with comets observed in 1772, 1789, 1795, 1805, &c. It performs its revolution in 2410 days, in an ellipse inclined to the ecliptic, in an angle of 12° 33′ 15″, having an eccentricity of 0 74701, its greater semi-axis being 3 56705. Since its discovery in 1826 it has been regularly observed at each succeeding return to its perihelion. It is a small comet, having no tail, and presenting no appearance of a solid nucleus, but only a slight increasing density towards the centre; and small stars were seen through it. Its orbit, by a singular coincidence, nearly intersects that of the earth; and had the earth, at the time of the comet's passage in 1832, been a month in advance of its actual place, it would have passed through or very near the comet.

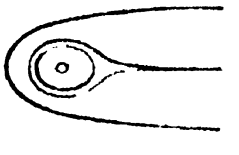
*Effects of the Action of the Planets on the Orbits of Comets.* —Comets in passing near the larger planets are drawn aside from their paths, and have their orbits sometimes entirely changed. In June, 1770, a comet was discovered by Messier; and as soon as three observations had been obtained, the elements of its parabolic orbit were determined. The comet continued visible for a long time, and it was found that the parabolic elements could not be made by any combination to represent the observations. It followed, therefore, that the orbit could not be a parabola. Lexell undertook the computation of an elliptic orbit, and found, in fact, that the comet was describing an ellipse, of which the greater axis was only equal to three times the diameter of the terrestrial orbit, and would consequently complete its revolution in about five years and a half. He accordingly predicted its return at the end of that period; nevertheless, the comet did not appear at the expected time, and, though very conspicuous in 1770, has never been seen since. On examining the catalogues, no trace was found of a comet describing the same orbit having been seen before. The question, therefore, occurred, in what manner was this mysterious appearance and disappearance to be explained? The solution was found in the disturbing influence of Jupiter. On submitting to calculation the action of this planet on the comet, it was found, in the first place, that in the year 1767, before the comet had approached Jupiter, the elliptic orbit which it described corresponded to a revolution, not of five, but of fifty years, and in the second place, it was found that in 1779, when getting beyond the sphere of attraction of the same planet, the orbit in which it then moved could only be described in twenty years Previously to 1767 it moved in so wide an orbit that it could not be seen from the earth: the attraction of Jupiter threw it into the orbit in which it was observed by Messier. On a second approach to Jupiter, it was again deflected from its path, and thrown into an orbit in which it was invisible as at first

*Physical Nature of Comets* —Notwithstanding the attention which has been given to the observation of comets whenever they make their appearance, nothing whatever is known of their physical constitution; nor has any rational or even plausible explanation been offered of the voluminous appendage denominated the tail. The following remarks of Sir John Herschel on this subject are extremely interesting.

"The smaller comets, such as are visible only in telescopes, or with difficulty by the naked eye, and which are by far the most numerous, offer very frequently no appearance of a tail, and appear only as round or somewhat oval vaporous masses, more dense towards the centre; where, however, they appear to have no distinct nucleus, or any thing which seems entitled to be considered as a solid body. Stars of the smallest magnitudes remain distinctly visible, though covered by what appears to be the densest portion of their substance, although the same stars would be completely obliterated by a moderate fog, extending only a few yards from the surface of the earth Whenever powerful telescopes have been turned on these bodies, they have not failed to dispel the illusion which attributes solidity to that more condensed part of the head which appears to the naked eye as a nucleus; though it is true that in some a very minute stellar point *has* been seen, indicating the existence of a solid body.

"It is in all probability to the feeble coercion of the elastic power of their gaseous parts by the gravitation of so small a central mass, that we must attribute this extraordinary development of the atmosphere of comets. If the earth, retaining its present size, were reduced by any internal change (as by hollowing out its central parts) to one thousandth part of its actual mass, its coercive power over the atmosphere would be reduced in the same proportion, and in consequence the latter would expand to a thousand times its actual bulk; and indeed much more, owing to the still further diminution of gravity by the recess of the upper parts from the centre.

"That the luminous part of a comet is something in the nature of a smoke, fog, or cloud, suspended in a transparent atmosphere, is evident from a fact which has been often noticed, viz. that the portion of the tail, where it comes up to and surrounds the head, is yet separated from it by an interval less luminous, as if sustained and kept off from contact by a transparent stratum, as we often see one layer of clouds laid over another, with a considerable space between These, and most of the other facts observed in the history of comets, appear to indicate that the structure of a comet, as seen in section in the direction of its length, must be that of a hollow envelope, of a parabolic form, enclosing near its vertex the nucleus and head, something as is represented in the annexed figure. This would account for the apparent division of the tail into two lateral branches, the envelope being oblique to the line of sight at its borders, and therefore a greater depth of illuminated matter being there exposed to the eye. In all probability, however, they admit great varieties of structure, and among them may very possibly be



bodies of widely different physical constitution." (*Astronomy; Cabinet Cyclopædia*, p. 304.)

From the same authority we extract the following statement respecting the actual dimensions of some of the most conspicuous comets:—"The tail of the great comet of 1680, immediately after its perihelion passage, was found by Newton to have been no less than 20,000,000 of leagues in length, and to have occupied only two days in its emission from the comet's body!—a decisive proof this of its being darted forth by some active force, the origin of which, to judge from the direction of the tail, must be sought in the sun itself. Its greatest length amounted to 41,000,000 leagues, a length much exceeding the whole interval between the sun and the earth. The tail of the comet of 1769 extended 16,000,000 leagues, and that of the great comet of 1811, 36,000,000. The portion of the head of this last comprised within the transparent atmospheric envelope which separated it from the tail was 180,000 leagues in diameter. It is hardly conceivable that matter once projected to such enormous distances should ever be collected again by the feeble attraction of such a body as a comet—a consideration which accounts for the rapid progressive diminution of the tails of such as have been frequently observed." (Ibid. p. 311.)

It is extremely probable that the comets are merely collections of gaseous matter, of which a part may be dissipated in space at every revolution, but further observations are wanted to make this hypothesis certain. In 1682 Halley's comet appeared as round and clear as Jupiter; in 1759 it was not visible to the naked eye, in 1836 it was again sufficiently visible, but it was then in a much more favourable position than in 1759.

In former times comets were regarded as preternatural appearances, betokening the displeasure of the superior powers, and accordingly viewed with the terror and apprehension naturally excited by harbingers of indefinite and unavoidable calamity. Since they have been discovered to be component parts of the solar system, their appearance excites no other interest than that which astronomers feel to determine their orbits, and to deduce from their physical aspects such conclusions as they are calculated to afford relative to the constitution of the universe.

COMETA'RIUM. An astronomical toy, intended to represent the motion of a comet about the sun. Any instrument capable of describing an elongated ellipse may be called a *cometarium*. *See* ELLIPTIC COMPASSES.

COMI'TIA. In Ancient History, the assemblies of the Roman people, which were of three kinds, distinguished by the epithets *Curiata*, *Centuriata*, and *Tributa*.

1. The Comitia Curiata were the assemblies of the patrician houses or *populus*, and in these, before the plebeians attained political importance, was vested the supreme power of the state. The name *Curiata* was given because the people voted *in curiæ*, each curia giving a single vote representing the sentiments of the majority of the members composing it; which was the manner in which the tribes and centuries also gave their suffrages in their respective comitia. After the institution of the Comitia Centuriata, the functions of the curiata were nearly confined to the election of certain priests, and passing a law to confirm the dignities imposed by the people.

2. The Comitia Centuriata were the assemblies of the whole Roman people, including patricians, clients, and plebeians, in which they voted by centuries. By the constitution of the centuries, these comitia were chiefly in the hands of the plebeians, and so served originally as a counterpoise to the powers of the comitia curiata, for which purpose they were first instituted by the lawgiver king Servius Tullius. These comitia quickly obtained the chief importance, and public matters of the greatest moment were transacted in them; as the elections of consuls, prætors, and censors, and the passing laws and trials for high treason.

3. The Comitia Tributa were the assemblies of the plebeian tribes. They were first instituted after the expulsion of the kings; and in them were transacted matters pertaining to the plebeians alone, as the election of their tribunes and ædiles.

CO'MMA. (Gr.) In Music, the smallest of all the subdivisions, being about the ninth part of a tone.

COMMA. In Grammar. *See* PUNCTUATION.

COMMA'NDER. In the Navy, otherwise called master, an officer next in rank above lieutenant, corresponding with major in the army.

COMMANDER-IN-CHIEF. The officer in whom is vested the supreme command of all the land forces of the British Empire. This officer is appointed by the ministry of the day, whose confidence he is supposed to enjoy, and he is assisted in the discharge of his duties by several subordinate officers, such as the adjutant-general, the quartermaster-general, &c. (see these terms), who are each at the head of a particular department.

COMMA'NDERY, or PRECEPTORY. According to the usages of some orders of Knights, a district attached to a manor or chief messuage under the control of a member of the order, who receives the income of that district arising from the estates of the order, taking out of it his own pension, and accounting for the rest.

COMMELINA'CEÆ. (Commelina, one of the genera.) A natural order of herbaceous Endogens, chiefly inhabiting the East and West Indies. Brown remarks that the order greatly differs from *Juncaceæ* both in habit and structure, and agrees better with *Restiaceæ*, having but little affinity with Palms; and Agardh adds, that it agrees with *Orchidaceæ* in the structure of the stamens and seeds, but in what respect he does not state. The species are very often mere weeds, but occasionally are beautiful flowering plants. A common example is the *Tradescantia virginica*.

COMME'NDAM (Lat.) A term of the Canon Law. A person to whom custody of a void ecclesiastical benefice is committed by the superior, without the profits appertaining to it, was said to hold the benefice *in commendam*, i. e. *entrusted to his care;* but by various devices the restriction on the receipt of profits was evaded, and the holding benefices in commendam became a mode of enjoying pluralities. By the English law, no one can hold in commendam without license from the crown. An ordinary case is where clergymen promoted to bishoprics with insufficient revenues are allowed in this manner to retain the profits of livings.

COMME'NSURABLE. Quantities, in Geometry, are said to be commensurable when they have some common measure or divisor which divides each of them without leaving a remainder. Thus a yard and a furlong are commensurable magnitudes, because a foot is a measure or aliquot part of each of them, being contained in the yard three times, and in the furlong 660 times. Fractional numbers and surds are also said to be commensurable when they have a common measure of the same kind as themselves. Thus $\frac{2}{3}$ and $\frac{3}{4}$ are commensurable, being each divisible by $\frac{1}{6}$, and so are $2\sqrt{2}$ and $3\sqrt{2}$, being each measured by $\sqrt{2}$.

CO'MMENTARY (Derived from the Latin verb comminiscor, *I call to mind*.) In Literature, a word used in different significations:—1. In the same sense with memoirs, as a short narrative of particular events and occurrences, composed by an actor or spectator of those events with the professed object of calling back the circumstances to his own mind, *e. g.* the Commentaries of Cæsar. 2. Critical observations on the text or contents of a book. These are either in the form of detached notes, containing remarks on particular passages; or they are embodied in what is termed a running commentary, or series of remarks written and printed in a connected form.

CO'MMERCE (from *commutatio mercium*), is the exchange of one sort of produce or service for some other sort of produce or service.

Exchanges of this description have their rise in the nature of man and the circumstances under which he is placed, and their origin is coeval with the formation of society. The varying powers and dispositions of different individuals dispose them to engage in preference in particular occupations; and in the end every one finds it for his advantage to confine himself wholly or principally to some one employment, and to barter or exchange such portions of his produce as exceed his own demand, for such portions of the peculiar produce of others as he is desirous to obtain and they are disposed to part with. The division and combination of employments is carried to some extent in the rudest societies, and it is carried to a very great extent in those that are most improved, but to whatever extent it may be carried, commerce must be equally advanced. The division of employments could not exist without commerce, nor commerce without the division of employments: they mutually act and react upon each other. Every new subdivision of employments occasions a greater extension of commerce, and the latter cannot be extended without contributing to the better division and combination of the former.

In rude societies, the principal business of commerce, or the exchange of one sort of commodities for some other sort, is carried on by those who produce them. Individuals having more of any article than is required for their own use endeavour to find out others in want of it, and who at the same time possess something that they would like to have. But the difficulties and inconveniences inseparable from a commercial intercourse carried on in this way are so obvious as hardly to require being pointed out. Were there no merchants or dealers, a farmer, for example, who had a quantity of wheat or wool to dispose of, would be obliged to seek out those who wanted these commodities, and to sell them in such portions as might suit them; and having done this, he would next be forced to send to, perhaps, twenty different and distant places, before he succeeded in supplying himself with the various articles he had to buy. His attention would thus be perpetually diverted from the business of his farm; and while the difficulty of exchanging his own produce for that of others would prevent him from acquiring a

taste for improved accommodations, it would tempt him to endeavour to supply most things that were essential by his own labour and that of his family; so that the division of employments would be confined within the narrowest limits. The wish to obviate such inconveniences has given rise to a distinct mercantile class. Without employing themselves in any sort of production, merchants or dealers render the greatest assistance to the producers: they collect and distribute all sorts of commodities; they buy of the farmers and manufacturers the things they have to sell; and bringing together every variety of useful and desirable articles in shops and warehouses, individuals are able, without difficulty or loss of time, to supply themselves with whatever they want. Continuity is in consequence given to all the operations of industry; for, as every one knows beforehand where he may dispose to the best advantage of all that he has to sell, and obtain all that he wishes to buy, an uninterrupted motion is given to the plough and the loom. Satisfied that they will have no difficulty about finding merchants for their produce, agriculturists and manufacturers think only how they may improve and perfect their respective businesses. Their attention, no longer dissipated upon a variety of objects, is fixed upon one only. It becomes the object of every individual to find out machines and processes for facilitating the separate task in which he is engaged; and while the progress of invention is thus immeasurably accelerated, those who carry on particular businesses acquire that peculiar dexterity and *sleight of hand* so astonishing to those who live in places where the division of labour is but imperfectly established. Facility of exchange is, in truth, the vivifying principle, the very soul of industry, and no interruption is ever given to it without producing the most ruinous consequences.

The merchants, or dealers, collect their goods in different places in the least expensive manner, and by carrying them in large quantities at a time they can afford to supply their customers at a cheaper rate than the latter could supply themselves. Not only, therefore, do they, by enabling every employment to be carried on without interruption, and the divisions of labour to be perfected, add prodigiously to the powers of industry, and, by consequence, to the wealth of the community, but they also promote the convenience of every one, and reduce the cost of merchandising to the lowest limit. According as commerce is extended, each particular business becomes better understood, better cultivated, and carried on in the best and cheapest method. Where it is far advanced, the whole society is firmly linked together, every man is indebted to every other man for a portion of his necessaries conveniences, and enjoyments, every thing is mutual, and reciprocal, and a large country becomes in effect, from the intimate correspondence kept up through the medium of the mercantile class, like a large city.

The annihilation of the class of traders would deprive society of all these advantages. The difficulties that would then be experienced in selling and buying would oblige every one to attempt, in so far as possible, directly to supply his own wants, the division of employments would be contracted on all sides, and Great Britain would gradually relapse into a state little, if at all, superior to its state at the Norman conquest.

The celebrated Italian economist, the Count di Verri, has defined commerce to be the conveyance of commodities from place to place (*trasporto delle mercanzie da un luogo a luogo*). This definition has been adopted by M. Say, who contends that commerce does not consist in exchanges, but in bringing commodities within reach of the consumers (*il consiste essentiellement à placer un produit à la portée de ses consommateurs*). But this is plainly to confound the means with the end, the preparations for an exchange with the exchange itself. The conveyance of commodities from place to place is necessary to enable commerce to be carried on; but unless they be conveyed in the view of being sold or exchanged for other commodities, and unless that exchange actually take place, there is no room or ground for considering the conveyance in the light of a commercial operation. It is obvious, too, that though the Count di Verri's definition were not erroneous in this respect, it is not sufficiently comprehensive. Suppose that a hat manufactory is established in Regent Street, and that a shop is attached to it, where the hats are sold; no one doubts that those employed in this shop are engaged in a commercial undertaking, and yet they have nothing to do with the carriage of commodities. Whatever, therefore, may be the particular sort of commerce carried on, whether the commodities have been brought from a distance or produced on the spot, its object and end is an exchange; when this end is not attained, no act of commerce can be said to have taken place.

The erroneous definition of commerce which M. Say has adopted has hindered him from rightly appreciating its influence. "In commerce," says he, "there is a genuine production, because there is a modification productive of utility and value. The merchant, after buying a commodity at its current price, sells it again at its current price; but the last price is greater than the former, because the merchant has brought the commodity into a situation which has really augmented its price, and the society is enriched by this augmentation." (*Cours d'Economie Politique*, t. ii. p. 213.) But though this be true, it is not the whole truth, nor even the greater part of it. Suppose that a hat-maker and a shoe-maker live in contiguous houses; if the one exchange his hats for the other's shoes society will not certainly gain much by the change in the locality of the commodities, but it will notwithstanding be materially benefited by the transaction; for, in consequence of the exchange, each tradesman will be able to confine himself to his own business: the hat-maker will not be obliged to waste his time in clumsy attempts to make his own shoes, nor will the shoe-maker be compelled to make his own hat. It is in this that the *peculiar* advantage of commerce consists. What an individual gives for anything is, speaking generally, the fair equivalent of what he gets. But the facility of exchanging allows every one, as has been already seen, to apply his entire time and energies to some one department; and in this way occasions the production of an incomparably greater quantity of all sorts of wealth than it would otherwise be possible to produce.

The mercantile class has been divided into two leading classes, — the wholesale dealers and the retail dealers. This division, like the divisions in other employments, has grown out of a sense of its utility. The wholesale merchants buy the goods at first hand of the producers; but instead of disposing of them to the consumers, they generally sell them to the retailers or shopkeepers, by whom they are retailed or distributed to the public in such quantities and in such a way as is most suitable for them. The interest of all parties is consulted by this division. Had the wholesale dealers attempted also to retail their goods, they could not have given that undivided attention to any part of their business so necessary to ensure its success. A retailer should be constantly at his shop, not merely that he may attend to the orders daily sent to him, but that he may learn all that transpires with respect to the situation of his customers, their wants, and their circumstances. But wholesale dealers being obliged to attend to what is going on in different and distant quarters, cannot give this minute attention to what happens in their immediate vicinity; and though they could, the capital required to carry on a wholesale business would not be sufficient for that purpose, were the business of retailing joined to it. Were there only one class of merchants, the capital and the number of individuals employed in commercial undertakings would not probably be less than at present; but the merchant, being obliged to apply himself principally to one department, would have to leave the chief share of the other to servants; a change which, as every one knows, would be productive of the most mischievous consequences.

There can, therefore, be no doubt that the separation in question has been highly advantageous. The classes of merchants, like those of artificers, are mutually serviceable to each other and to the public. Without this subdivision, commerce would have been impeded in its operations, particular branches of it would have been comparatively neglected; nor would any branch have been carried on with the same economy and attention with which all are now conducted.

In a highly civilized country like Great Britain, the trade in every commodity in considerable demand, as corn, sugar, tea, timber, &c., affords employment for a separate class of traders. But for all purposes of general inquiry, it is sufficient to consider commerce under three heads, viz. —1. The Home trade, or that carried on between individuals of the same country; 2. Foreign trade, or that carried on between individuals of different countries, and, 3. The Colony trade, or that carried on between the inhabitants of any particular country and its colonists. We subjoin a few remarks upon each of these heads.

1. *Home Trade.* — It has been already seen that the varying capacities and dispositions of different individuals occasion the introduction of a division of employments, and the practice of exchange or barter. But the external circumstances under which different individuals are placed vary still more than their natural powers or tastes. One set inhabit a rich fertile plain, suitable for the growth of corn and other culmiferous crops. Another set inhabit a mountainous district, the soil of which is comparatively sterile, but which is well fitted for rearing cattle; another set are planted upon the margin of a river, or arm of the sea, abounding in every facility for carrying on the business of fishing, and so on. Now it is so obvious, that though the individuals belonging to any particular district had not established a division of labour amongst themselves, it would be highly for their advantage to establish one with those occupying other districts, the productions of which are materially different. When the inhabitants of Newcastle apply themselves principally to the coal trade, those of Essex to the raising of wheat, and those of the highlands of Scotland to the

raising of cattle and wool, each set avail themselves, in carrying on their employments, of the peculiar powers of production conferred by Providence on the districts they occupy; and by exchanging such portions of their produce as exceed their own consumption, for the surplus articles raised by others, their wealth and that of every one else, is immeasurably increased. It is in this *territorial division of labour*, as it has been happily designated by Colonel Torrens, that the main advantage of commerce consists. In commercial countries, each individual may not only enter at pleasure, on such pursuits as he deems most advantageous, but the entire population of districts and provinces are enabled to turn their energies into those channels in which they are sure to receive the greatest assistance from natural powers. Suppose England were divided into separate parishes, or even counties, surrounded respectively by Bishop Berkeley's wall of brass, and having no intercourse with each other, in what a miserable situation would we be! Instead of 1,500,000, London could not under such circumstances contain 15,000 inhabitants; and these would be exposed to numberless privations of which we have not the slightest idea. Unless the territorial division of labour were carried to some extent, the division of employments amongst individuals occupying the same district, could be but very imperfectly established, and would be of comparatively little use. It is only when one is able both to gratify his taste and to avail himself of the varying capacities of production given to different districts that the benefits of commerce can be fully appreciated, and that it becomes the most copious source of wealth as well as the most powerful engine of civilisation.

"With the benefits of commerce," says an eloquent writer, "or a ready exchange of commodities, every individual is enabled to avail himself to the utmost of the peculiar advantage of his place; to work on the peculiar materials with which nature has furnished him; to humour his genius or disposition, and betake himself to the task in which he is peculiarly qualified to succeed The inhabitant of the mountain may betake himself to the culture of his woods, and the manufacture of his timber, the owner of pasture lands may betake himself to the care of his herds; the owner of the clay pit to the manufacture of his pottery; and the husbandman to the culture of his fields, or the rearing of his cattle, and any one commodity, however it may form but a small part in the whole accommodations of human life, may, under the facilities of commerce, find a market in which it may be exchanged for what will procure any other part, or the whole, so that the owner of the clay pit, or the industrious potter, without producing any one article immediately fit to supply his own necessities, may obtain the possession of all that he wants. And commerce in which it appears that commodities are merely exchanged, and nothing produced, is nevertheless, in its effects very productive, because it ministers an encouragement and facility to every artist in multiplying the productions of his own art, thus adding greatly to the mass of wealth in the world, in being the occasion that much is produced." — (*Ferguson's Principles of Moral and Political Science*, vol ii. p. 424.)

II. *Foreign Trade* — The trade carried on between individuals of different countries is founded on precisely the same circumstances—the differences of soil, climate, and productions, on which is founded the trade between different districts of the same country. One country, like one district, is peculiarly fitted for the growth of corn, another for the cultivation of the grape, a third abounds in minerals; a fourth has inexhaustible forests, and so forth: —

> Hic segetes, illic veniunt felicius uvæ,
> Arborei fetus alibi, atque injussa virescunt
> Gramina. Nonne vides, croceos ut Tmolus odores,
> India mittit ebur, molles sua thura Sabæi?
> At Chalybes nudi ferrum, virosque Pontus
> Castorea, Eliadum palmas Epirus equarum?
> Continuo has leges æternaque fœdera certis
> Imposuit natura locis — *Georg* lib. i. lin. 54.

Providence, by thus distributing the various articles suitable for the accommodation and comfort of man in different countries, has evidently provided for their mutual intercourse. In this respect, indeed, foreign trade is of far more importance than the home trade. There is infinitely less difference between the products of the various districts of the most extensive country, than there is between the products of different and distant countries; and the establishment of a territorial division of labour amongst the latter must therefore be proportionally advantageous.

"As the same country is rendered richer by the trade of one province with another; as its labour becomes thus infinitely more divided, and more productive than it could otherwise have been; and as the mutual interchange of all those commodities which one province has and another wants multiplies the comforts and accommodation of the whole, and the country becomes thus, in a wonderful degree, more opulent and more happy; so the same beautiful train of consequences is observable in the world at large,—that vast empire, of which the different kingdoms may be regarded as the provinces. In this magnificent empire, one province is favourable to the production of one species of produce, and another province to another. By their mutual intercourse, mankind are enabled to distribute their labour as best fits the genius of each particular country and people. The industry of the whole is thus rendered incomparably more productive; and every species of necessary, useful, and agreeable accommodation is obtained in much greater abundance, and with infinitelyless expense."—(*Mills's Commerce Defended*, p. 38.)

But to enable the advantages of foreign commerce to be rightly appreciated, it will be proper to consider it under the following heads:—viz. 1. Its influence in supplying us with useful and desirable articles, of which we should otherwise be wholly destitute; 2. Its influence in multiplying and cheapening the peculiar productions of our own country; 3. Its influence in making us acquainted with foreign discoveries and inventions, and in exciting invention by means of competition and example; and, 4 Its indirect influence upon industry, by increasing the sources of enjoyment.

1 With respect to the first of these influences, or the effect of commerce in furnishing every people with commodities not otherwise attainable, it is too obvious and striking to require any lengthened illustrations. Great Britain is as abundantly supplied with native products as most countries; and yet any one who reflects for a moment on the nature and variety of the articles we import from abroad, must be satisfied that we are indebted to trade for a very large part of our superior accommodations. Tea, sugar, coffee, wine, and spices; silk and cotton, the materials of our most extensive manufactures; gold and silver; and an endless variety of other highly important articles, are sent to us by foreigners. And were the importation put an end to, what a prodigious deduction would be made, not from our comforts and enjoyments merely, but also from our means of supporting and employing labourers! If foreign commerce did nothing more than supply us with so many new products, it would be very difficult to overrate its value and importance.

2. But such is the beneficent influence of commerce, that while it supplies an endless variety of new productions, it multiplies and cheapens those that are peculiar to every country. It does this, by enabling each separate people to employ themselves, in preference, in those departments in which they enjoy some natural or acquired advantage, and by opening the markets of the world to their productions. When the demand for a commodity is confined to a particular country, as soon as it is supplied improvement is at a stand The subdivision and combination of employments is, in fact, always dependent upon and regulated by the extent of the market Dr Smith has shown, that by making a proper distribution of labour among ten workmen, in a pin manufactory, 48,000 pins might be produced in a day, and since his time the number has been nearly doubled. But had the demand not been sufficient to take off this quantity of pins, the divisions and improvements in question could not have been made; and the price of pins would in consequence have been comparatively high. This principle holds universally The most important manufacture carried on in Great Britain — that of cotton — is entirely the result of commerce Supposing, however, that cotton wool had been a native product, we could never have made such astonishing advances in the manufacture had we been denied access to foreign markets. Notwithstanding the splendid discoveries in the machinery, and the perfection to which every department of the trade has been brought, the vast extent of the market has prevented its being glutted, and has stimulated our manufacturers and artizans to persevere with unabated ardour in the career of improvement. Our cotton mills have been constructed, not that they might supply the limited demand of Great Britain, but that they might supply the demand of the whole world And in consequence of the extraordinary subdivision of labour, and the scope given to the employment and improvement of machinery by the unlimited extent of the market, the price of cottons has been reduced to less, probably, than a fourth part of what it would have been had they met with no outlet in foreign countries The hardware, woollen, leather, and other manufactures, exhibit similar results. The access their products have had to other markets has led to important improvements in their production; so that, as was previously stated, commerce not only supplies us with a vast variety of new and desirable articles, but it also cheapens the staple productions of the country, and renders them more easily attainable by the great mass of people.

3 The influence of commerce in making the people of each country acquainted with foreign inventions and discoveries, and in stimulating ingenuity by bringing them into competition with strangers, is obvious and powerful. It distributes the gifts of science and art, as well as those of nature. It is the great engine by which the blessings of civilization are diffused [illegible] world, the intercourse to which it gives rise making every one

acquainted with the processes carried on and the inventions made in the remotest corners of the globe. Were any considerable improvement made in any important art either in China or Peru, it would be very speedily understood and practised in England. It is no longer possible to monopolize an invention. The intimate communication that now exists amongst nations renders any important discovery, wherever it may be made, a common benefit. The ingenious machine invented by Mr. Whitney, of the United States, for separating cotton wool from the pod, has been quite as advantageous to us as to the Americans, and the inventions of Watt and Arkwright have added to the comforts of the inhabitants of Siberia and Brazil, as well as of England. The genuine commercial spirit is destructive of all sorts of monopolies. It enables every separate country to profit by the peculiar natural powers and acquired skill of all the others; while, on the other hand, it communicates to them whatever advantages it may enjoy. Every nation is thus intimately associated with its neighbours. Their products, their arts, and their sciences, are reciprocally communicated; and the emulation that is thus excited and kept up forces routine to give place to invention, and inspires every people with zeal to undertake, and perseverance to overcome, the most formidable tasks. It is not possible to form any accurate notions as to what would have been our state at this moment, had we been confined within our own little world, and deprived of all intercourse with foreigners. We know, however, that the most important arts, such as printing, glass-making, paper-making, &c., have been imported from abroad. No doubt we *might* have invented some of these ourselves; but there is not the shadow of a ground for supposing that we should have invented them all; and without foreign example and competition, we could hardly have carried any of them beyond the merest rudiments.

4. The influence of commerce upon industry, by its increasing the number of desirable articles, though not quite so obvious, perhaps, as the influences already specified, is not less powerful and salutary. Industry is in no respect different from the other virtues, and it were idle to expect it should be strongly manifested where it does not bring along with it a corresponding reward. In the early stages of society, before artificial wants have been introduced, and men are satisfied if they can avert the attacks of hunger, and procure an inadequate defence against the cold, industry is confined within the narrowest limits, and provided the mildness of the climate renders clothing and lodging of little importance, and the earth spontaneously pours forth an abundant supply of fruits, the inhabitants are immersed in sloth, and seem to place their highest enjoyment in being free from occupation. Sir William Temple, Mr. Hume, and some other sagacious inquirers into the progress of society have been struck with this circumstance, and have justly remarked that those nations that have laboured under the greatest natural disadvantages have made the most rapid advances in industry.

But in civilized and commercial societies, new products and new modes of enjoyment, brought from abroad, or invented at home, stimulate the inhabitants to continued exertions. Their acquired tastes and the wants which civilization introduces, and custom and example render universal, become infinitely more numerous, and as urgent as the tastes or wants of those that are less advanced. The passion for luxuries, conveniencies, and enjoyments, when once excited, becomes quite illimitable. The gratification of one desire leads immediately to the formation of another. "The natural flights of the human mind are not from pleasure to pleasure, but from hope to hope." The happiness of a civilized nation is not placed in indolence or enjoyment, but in continued exertion, in devising new contrivances to overcome new difficulties, in extending still further the boundaries of science, and increasing their command over luxuries and enjoyments. The remark of the Abbe Mably is as true as it is forcibly expressed:—"*N'est on que riche? On veut etre grand. N'est on que grand? On veut être riche. Est on et riche et grand? On veut être-plus riche et plus grand encore.*" (*Œuvres*, t. iv. p. 76.)

Without commerce this progress would never be realized. The commodities possessed by particular nations are but few, and may be attained with comparatively little labour. Generally speaking, a man may easily supply himself with corn, cloth, and beer; and if the utmost exertions of ingenuity and the most laborious efforts of industry could only furnish additional quantities of those articles, they would very soon cease to be made. Men do not practise industry and economy for their own sakes, but for the advantages that result from them; and the more, consequently, that these advantages are multiplied, that is, the greater the variety of wants they are made to supply, and of gratifications they are made to command, the greater will be the energy displayed in their prosecution. "*Le travail de la faim*," as Raynal has well observed, "*et toujours borné comme elle; mais le travail de l'ambition croît avec ce vice (vertu?) même.*"

And hence the true way to render a people industrious is to endeavour to inspire them with a taste for the luxuries and enjoyments of civilized life; and this will be always most easily done by giving every facility to the cultivation of foreign commerce. The number of new articles, or, in other words, of new motives to stimulate, and new products with which to reward the patient hand of industry, is then prodigiously augmented. The home producers exert themselves to increase their supplies of disposable articles, that they may exchange them for those of other countries and climates; and the merchant, finding a ready demand for such articles, is stimulated to import a greater variety, to find out cheaper markets, and thus constantly to apply new incentives to the vanity and ambition, and consequently to the industry of his customers. Every power of the mind and body is thus called into action; and the passion for foreign commodities—a passion which some shallow moralists have ignorantly censured—becomes one of the most efficient causes of industry, wealth, and civilization.

IV. *Colony Trade.*—For some remarks on this head, the reader is referred to the article COLONIES.

*Principle and Influence of Restrictions on Commerce.*—The commercial intercourse carried on between the inhabitants of different districts of the same country, and those of different countries, is founded on the principle which prompts each member of the same family, or each inhabitant of the same village, to apply himself to some one business. It would therefore seem that that *freedom* of commerce which is universally admitted to be productive of the most beneficial consequences when established between the occupants of different districts of the same country must be equally beneficial when established between those of different countries. It appears to be generally believed, that to occasion a commercial intercourse, nothing more is necessary than to remove such legal or physical obstacles as may interpose to prevent it. But this is not by any means enough. A of Yorkshire does not sell to or buy from B of Kent, merely because there is nothing to hinder him from doing so; he must further believe that his interest will be promoted by the transaction: unless he do this, the utmost facility of exchanging will be offered to him in vain; nor will the finest roads or the speediest conveyances occasion the least intercourse. We neither buy nor sell for the mere pleasure of the thing. We do so only when we believe it will be a means of promoting some end, of procuring some peculiar advantage for ourselves that we could not so easily procure in any other way. If any one supposed he could better attain his object in entering upon a commercial transaction with some particular individual by entering upon a similar transaction with some one else, or by any other means, he would most certainly decline engaging in it. We may, and often do, make a false estimate of what is for our advantage; but its promotion is the mainspring of our actions, and it is it, and it only, that we have in view when we buy of a particular individual, or resort to a particular market, in preference to others.

Unless therefore it could be satisfactorily established that princes and rulers have a better understanding of what has a tendency to promote the wealth and industry of their subjects than themselves, it is difficult to see on what ground any restriction on the freedom of commerce is to be vindicated. The person who buys French wine or Polish corn, does so only that he may benefit himself: and the fair presumption is that he does what is right. Human reason is, no doubt, limited and fallible; we are often swayed by prejudice, and are apt to be deceived by appearances. Still, however, it is certain that the desire to promote our own purposes contributes far more than any thing else to render us clear-sighted and sagacious. "*Nul sentiment dans l'homme*," says M. Say, "*ne tient son intelligence eveillée autant que l'interêt personnel. Il donne de l'esprit aux plus simples.*" The principle that individuals are, speaking generally, the best judges of what is most beneficial for themselves, is universally admitted to be the only one that can be safely acted upon. No writer of authority has latterly ventured to maintain the exploded and untenable doctrine, that governments may advantageously interfere to regulate the pursuits of their subjects. It is their duty to preserve order, to prevent one from injuring another; to maintain, in short, the equal rights and privileges of all. But it is not possible for them to go one step further, without receding from the principle of non-interference, and laying themselves open to the charge of acting partially by some, and unjustly by others.

"The statesman," says Dr. Smith, "who should attempt to direct private people in what manner they ought to employ their capitals, would not only load himself with a most unnecessary attention, but assume an authority which could safely be trusted not only to no single person, but to no council or senate whatever, and which would nowhere be so dangerous as in the hands of a man who had folly and presumption enough to fancy himself fit to exercise it." (*Wealth of Nations*, p. 200.)

In every discussion as to any point of public economy,

it is essential to bear in mind that the legislature abandons its duty, or rather acts in direct opposition to it, the moment it begins to legislate in the view of promoting the interest of particular classes. The question never ought to be, whether any proposed measure or regulation has a tendency to benefit agriculturists, manufacturers, or merchants; but whether its tendency be to benefit the public. Certain individuals or classes may be benefited by what is prejudicial to others; but it would be a contradiction to contend that a system of policy which enriches A by impoverishing B can be publicly advantageous; and it is upon this latter consideration that the attention of the legislature should always be fixed. Whatever has any tendency to increase the security of property, to perfect the divisions of labour, to stimulate industry and ingenuity, and to increase the wealth and comforts of *all* classes, deserves the encouragement of government. But when it goes further, and interferes to prohibit individuals from carrying on certain branches of trade that others may be promoted, it arrogates to itself that authority the assumption of which is so justly censured by Smith. Such prohibition is, in fact, quite subversive of the right of private property, for that right is violated, not merely when a man is unjustly deprived of any part of his fortune, but also when he is prevented from disposing of it in any way, not hurtful to others, he may think fit.

It does not therefore appear, considering this question on general grounds, that there is so much as the shadow of a foundation for those commercial restrictions that make so prominent a figure in the policy of all modern nations. If it could be shown that statesmen and ministers were the best judges of the means by which those subject to their authority might improve their condition, the case would be different. But no such pretension is set up, and, if it were, it would be universally scouted. We may safely leave the conduct of individuals to be determined by their own prudence and sagacity. They act under the most serious responsibility; and we have the best attainable security, the plain and obvious interest of the parties, that they will, in the peculiar circumstances under which they are placed, follow that course which is most advantageous for themselves, or, in other words, for the community. All systems of policy that would regulate the pursuits of private persons according to the views of government must be arbitrary and violent in their nature, and any attempt to act upon them could not fail to be productive of the most mischievous consequences. A wise government will confine its efforts to the maintenance of that order of things which nature has established. It will not mix itself up with the affairs of its subjects, but will leave them to pursue their own interest in their own way; to bring their industry and capital into the freest competition with those of others; and will interpose only when they swerve from the rules of justice. Freedom and security are all that is necessary to stimulate industry, and to insure the most rapid advancement in the career of improvement.

We cannot, however, feel any surprise that these principles should have been so widely departed from, and that commerce, and indeed most sorts of industry, should be everywhere subjected to restrictions and regulations. They originated in a comparatively unenlightened age, before the genuine sources of public wealth and the limits of proper interference on the part of governments had been explored and defined. The fallacies on which most of them are founded, however obvious they may now seem, were not speedily or easily detected, and, after their hollowness has been exposed, the return to a better system is a work of extreme difficulty. Every regulation affecting the employment of capital and industry, though always injurious to the public, is, for the most part, productive of advantage to a greater or smaller number of individuals. The moment that any change is proposed, these persons lay before government the most exaggerated representations of the injury that would result from the abolition or modification of the regulation; and not satisfied with this, they most commonly enlist a portion of the press into their service, and availing themselves of all the aid that sophistry and ingenuity can supply, labour to make the public believe that the regulation complained of is a national benefit, and that they are interested in its support! This device has very often been attended with the most complete success; and it is to this circumstance, more than any thing else, that the tenacity with which erroneous theories in commerce are supported is to be ascribed, and that sophisms, that have been again and again exposed, are put forward anew with as much seeming confidence as if they had never been questioned.

All the great branches of industry carried on in every country depend on peculiarities of soil or climate, or on the genius of the people, and not on custom-house regulations. What should we have to fear from the abolition of all prohibitions? We export the produce of every one of our principal manufactures, as cotton, wool, iron, leather, &c., to every market of the world; so that the possibility of our being injured by the admission of similar articles from abroad is quite out of the question. Admitting, however, that the abandonment of the protective system might force a few thousand workmen to abandon their employments, it is material to observe that *equivalent new ones* would, in consequence, be opened to receive them, and that the aggregate demand for their services would not be in any degree diminished. Suppose that, under a system of free trade, we imported a part of the silks and linens we now manufacture at home; it is quite clear, inasmuch as neither the French nor Germans would send us their commodities gratis, that we should have to give them an equal amount of British commodities in exchange: so that such of our artificers as had been engaged in the silk and linen manufactures, and were thrown out of them, would, in future, obtain employment in the production of the articles that must be exported as equivalents to the foreigner. It is idle, therefore, to pretend that the repeal or modification of a restrictive regulation can ever be a means of diminishing the demand for labour. We may, by giving additional freedom to commerce, change the *species of labour* in demand, and make it be employed more profitably, but we cannot lessen its quantity. Should our imports this year amount to ten or twenty millions more than they did last year, we shall, it is certain, have to pay them by exporting an equally increased amount of our peculiar products. And therefore if *exportation* be desirable, and the most ardent admirers of the restrictive system admit it to be such, *importation* must also be desirable, for the two are indissolubly connected, and to separate them, even in imagination, infers a total ignorance of the most obvious principles. Commerce, whether carried on between individuals of the same or of different countries, is founded on a fair principle of reciprocity; buying and selling are in it what action and reaction are in physics, *equal and contrary*. Those who will not buy from others render it impossible for others to buy from them. Every sale implies an equal purchase, and every purchase an equal sale. Hence *to prohibit buying is exactly the same thing, in effect, as to prohibit selling*. No merchant would ever export a single bale of goods were he prevented from importing a greater value in its stead. But it is impossible he can do this if foreign commodities be excluded. In whatever degree, therefore, an unrestricted trade might lead us to receive commodities from other countries, in the same degree it would render them customers for our commodities, would promote our manufactures, and extend our trade. To suppose that commerce may be too free is to suppose that labour may be turned into too productive channels, that the objects of demand may be too much multiplied and their price too much reduced; it is like supposing that our agriculture may be too much improved, and our crops rendered too luxuriant.

It is often affirmed, though we believe without the least foundation for the statement, that had it not been for restrictions on importation, several manufactures that now furnish employment for a considerable population would most probably never have existed amongst us. But supposing this statement to be admitted, it would not form any valid objection to the principle now laid down. It is quite as much for the advantage of communities as of single families to respect the principle of the division of labour. The interests of every people will always be best promoted by addicting themselves, in preference, to those branches of industry in which they have a superiority over others, for it is by this means only they can ever fully avail themselves of their peculiar facilities of production, or employ themselves and their capital most beneficially.

When importation from abroad is restricted, that some new or incipient manufacture may be promoted, government assumes, though perhaps unconsciously, that it knows better than its subjects what is the most profitable line for them to engage in. Never was there an assumption more entirely unfounded. Individuals are always on the alert to find out what are the most advantageous businesses in which to embark; and though they sometimes, no doubt, form erroneous conclusions, the chances are ten to one in favour of their being right. Were it otherwise the number of well-advised and prosperous undertakings entered upon in all tolerably well-governed countries would not, as is the case, infinitely exceed those of a contrary description. But though it were different, the interference of government would not certainly abate the evil. However well intended, all attempts to introduce or extend some particular business cannot fail of being productive of immediate injury to others; and, should the object ever be realized, it would most probably not be found to be a national benefit, but the reverse. If, instead of directly producing linens, a manufacturer finds it more profitable to produce cottons or hardware, and to exchange these with the Germans for linen, how ridiculous would it be to attempt to promote the public interests by shutting out foreign linens, and compelling them to be produced at home! It is not disputed that the linen manufacture might be somewhat promoted by such a measure; but it admits of demonstration that other and more advanta-

geous businesses would sustain a corresponding depression. Governments may depend upon the fact, that their subjects are incomparably better informed with respect to these matters than they can ever be. It is not possible for them, do what they will, to interfere to encourage one set of producers, without at the same time, and by the same act, proportionally discouraging some other set. Their obvious duty is, therefore, to abstain from all interference with the legitimate pursuits of individuals. To the clamourers for protection they may always answer, that they would be happy to meet their wishes, provided they could do so without injuring others; but that that being impossible, they feel themselves bound not to interfere, but to allow every one to reap the profit or abide the loss of the speculations into which he may enter.

We have not entered in this article into any investigations with respect to that great class of exchanges which consist in the rendering of labour or services for money or commodities. The laws by which they are governed may be more appropriately stated under the head LABOUR. It is sufficient here to observe, that prohibitions are to the full as injurious and inconsistent when applied to this description of exchanges as to the exchange of commodities.

Our object in this article has merely been to lay before the reader a brief view of the principles that govern commercial transactions, and of the mode in which commerce contributes to increase private and public opulence. To have entered into a detail of the various ways in which commerce may be facilitated, would have engaged us in discussions that would have added too much to the length of this article and the reader is, therefore, referred for information on these points to the articles BANKS, COLONIES, EXCHANGE, MONEY, ROADS, WEIGHTS AND MEASURES, &c.

We subjoin some tables, derived from official sources, illustrative of the nature and extent of the commerce of Great Britain during the last few years: —

I. An Account of the Real or Declared Value of the principal Articles of British and Irish Produce and Manufacture exported in 1850, with the total Real Value of such Produce.

| Articles. | Declared Value, 1850 |
|---|---|
| | *L.* |
| Coals and Culm | 1,285,265 |
| Cotton Manufactures | 21,918,256 |
| Yarn | 6,383,704 |
| Earthenware | 999,363 |
| Glass | 307,662 |
| Hardwares and Cutlery | 2,641,570 |
| Linen Manufactures | 3,964,264 |
| Yarn | 881,492 |
| Metals, viz. Iron and Steel | 5,357,326 |
| Copper and Brass | 1,978,311 |
| Lead | 387,376 |
| Tin, in Bars, &c. | 124,798 |
| Tin Plates | 914,219 |
| Salt | 230,415 |
| Silk Manufactures | 1,255,717 |
| Sugar, Refined | 344,583 |
| Wool, Sheep's or Lambs' | 636,851 |
| Woollen Manufactures | 8,589,958 |
| Yarn | 1,451,642 |
| All other Articles | 11,705,900 |
| Total Value | 71,392,672 |

II. Account of the Quantities of the Principal Articles of Foreign and Colonial Merchandise imported into and retained for Consumption in the U. Kingdom, with the Gross Amount of the Customs Duties received thereon in 1849 and 1850.

| Articles. | | Quantities imported. | | Quantities (of Articles chargeable with Duty) entered for Home Consumption. | | Gross Amount of Duty received. | |
|---|---|---|---|---|---|---|---|
| | | 1849. | 1850. | 1849 | 1850. | 1849. | 1850. |
| Animals, living, viz. — | | | | | | *L.* | *L.* |
| Oxen and bulls | No. | 21,884 | 28,951 | | | | |
| Cows | — | 17,920 | 17,757 | | | | |
| Calves | — | 13,645 | 19,751 | | | | |
| Sheep | — | 126,248 | 137,616 | | | | |
| Lambs | — | 3,018 | 5,852 | | | | |
| Swine and hogs | — | 2,653 | 7,287 | | | | |
| Ashes, pearl and pot | cwt | 158,385 | 184,043 | | | | |
| Bacon | — | 384,696 | 536,321 | | | | |
| Barilla and Alkali | tons | 1,401 | 1,715 | | | | |
| Bark for tanners' or dyers' use | cwt. | 368,582 | 380,674 | | | | |
| Beef, salted, not corned | — | 114,682 | 123,662 | - - | - - | - - | (arrears) 2 |
| Beef, fresh, or slightly salted | — | 5,280 | 11,752 | | | | |
| Brimstone | — | 815,388 | 664,630 | | | | |
| Butter | — | 281,969 | 331,135 | 279,465 | 320,560 | 138,405 | 158,369 |
| Cheese | — | 390,147 | 347,773 | 390,962 | 341,583 | 97,677 | 85,366 |
| Cocoa | lb. | 7,805,355 | 4,478,328 | 3,233,135 | 3,103,926 | 16,632 | 16,060 |
| Coffee — | | | | | | | |
| Of British Possessions | lb. | 40,339,245 | 36,810,071 | 29,769,873 | 28,891,294 | 520,977 | 505,515 |
| Foreign | — | 22,976,542 | 13,999,117 | 4,661,541 | 2,335,546 | 122,241 | 61,307 |
| Total of coffee | | 63,315,787 | 50,809,521 | 34,431,414 | 31,226,840 | 643,218 | 566,822 |
| Corn — | | | | | | | |
| Wheat | qrs. | 3,845,378 | 3,751,593 | 4,507,626 | 3,778,435 | 226,681 | 189,170 |
| Barley | — | 1,381,008 | 1,013,051 | 1,551,860 | 1,012,801 | 79,888 | 52,148 |
| Oats | — | 1,267,106 | 1,165,856 | 1,368,673 | 1,167,177 | 69,165 | 58,388 |
| Rye | — | 240,556 | 91,078 | 256,308 | 91,078 | 13,083 | 4,701 |
| Pease | — | 234,366 | 181,419 | 285,187 | 182,559 | 11,540 | 9,138 |
| Beans | — | 457,933 | 443,306 | 485,430 | 449,493 | 21,776 | 22,542 |
| Indian corn or maize | — | 2,221,159 | 1,286,264 | 2,219,570 | 1,286,281 | 112,452 | 64,328 |
| Buckwheat | — | 307 | 297 | 308 | 296 | 15 | 15 |
| Wheatmeal or flour | cwt. | 3,349,839 | 3,855,059 | 3,936,511 | 3,858,332 | 73,949 | 72,362 |
| Barley meal | — | 225 | 106 | 224 | 106 | 4 | 2 |
| Oatmeal | — | 40,250 | 6,214 | 40,055 | 5,839 | 758 | 109 |
| Rye meal | — | 18,168 | 966 | 24,735 | 966 | 470 | 18 |
| Pea meal | — | 500 | 66 | 300 | 66 | 6 | 1 |
| Indian corn meal | — | 101,684 | 11,401 | 102,181 | 11,401 | 1,916 | 214 |
| Eggs | No | 97,715,849 | 105,761,995 | 97,881,551 | 105,780,540 | 35,695 | 38,577 |
| Flax and tow, or codilla of hemp and flax | cwt | 1,806,673 | 1,821,578 | | | | |
| Gloves | pairs | 3,656,752 | 3,261,061 | 2,871,777 | 2,849,275 | 41,058 | 43,638 |
| Guano | tons | 83,158 | 116,926 | | | | |
| Hams | cwt. | 11,751 | 16,268 | 9,477 | 11,657 | 3,291 | 4,004 |
| Hemp, undressed | — | 1,061,893 | 1,018,635 | | | | |
| Hides, untanned, viz. — | | | | | | | |
| dry | — | 142,897 | 150,575 | | | | |
| wet | — | 536,055 | 411,345 | | | | |
| tanned, tawed, curried or dressed (except Russia hides) | lb | 1,776,451 | 1,876,332 | | | | |
| Mahogany | tons | 29,012 | 32,778 | | | | |
| Metals, viz. — | | | | | | | |
| Copper ore and regulus | tons | 47,433 | 45,930 | 47,085 | 45,705 | 2,354 | 2,285 |
| unwrought and part wrought | cwt. | 51,808 | 97,706 | 41,155 | 84,626 | 257 | 523 |
| Iron, in bars, unwrought | tons | 29,396 | 34,066 | | | | |
| Steel, unwrought | — | 1,012 | 49 | | | | |
| Lead, pig and sheet | — | 7,216 | 11,977 | 5,581 | 7,064 | 700 | 884 |
| Spelter | — | 15,915 | 18,626 | | | | |
| Tin, in blocks, bars, or slabs | cwt. | 35,827 | 33,332 | 16,679 | 21,768 | 4,622 | 5,881 |
| Oil, viz. — | | | | | | | |
| Train, blubber, and sperm | tuns | 20,012 | 21,328 | | | | |
| Palm | cwt. | 493,331 | 448,589 | | | | |
| Cocoa nut | — | 61,152 | 98,010 | | | | |
| Olive | tuns | 16,964 | 20,783 | | | | |
| Pork, salted | cwt. | 317,350 | 210,948 | | | | |
| Quicksilver | lb. | 2,682,592 | 355,079 | | | | |

**III. Account of the real or declared Value of the various Articles of the Manufacture and Produce of the U. Kingdom exported to Foreign Countries during each of the 6 Years ending with 1847; specifying the Countries to which they were exported, and the Value of those Annually shipped for each; and showing also the Average Amount of Exports during the said 6 Years to each Country, and to each of the 5 great Divisions of the Globe; and the Average Proportion exported to each, supposing the whole Exports to be 1000.**

| Countries. | 1842. | 1843. | 1844. | 1845. | 1846. | 1847. | Average annual Amount of Exports 1842—47. | Average annual Proportion exported to each Country, supposing the whole Exports to be 1000. |
|---|---|---|---|---|---|---|---|---|
| EUROPE. | £ | £ | £ | £ | £ | £ | £ | |
| Russia | 1,885,953 | 1,895,519 | 2,128,926 | 2,153,491 | 1,725,148 | 1,811,513 | 1,938,930 | 34·729 |
| Sweden | 199,313 | 131,302 | 108,475 | 123,730 | 146,651 | 179,367 | 148,140 | 2 653 |
| Norway | 134,704 | 151,377 | 152,824 | 163,512 | 183,818 | 169,119 | 159,231 | 2·852 |
| Denmark | 194,304 | 260,176 | 286,679 | 258,558 | 340,318 | 253,701 | 265,623 | 4 758 |
| Prussia | 376,651 | 483,004 | 505,384 | 577,999 | 544,035 | 553,968 | 506,841 | 9·078 |
| Germany | 6,202,700 | 6,168,038 | 6,151,528 | 6,517,796 | 6,606,532 | 6,286,217 | 6,324,135 | 113 237 |
| Holland | 3,573,362 | 3,564,720 | 3,131,970 | 3,139,035 | 3,576,169 | 3,017,123 | 3,383,830 | 60 608 |
| Belgium | 1,099,490 | 984,650 | 1,171,251 | 1,179,058 | 1,158,034 | 1,059,156 | 1,208,657 | 21 648 |
| France | 3,193,939 | 2,531,898 | 2,656,259 | 2,791,238 | 2,715,963 | 2,554,283 | 2,741,097 | 49 096 |
| Portugal Proper | 947,855 | 1,094,134 | 1,153,847 | 980,380 | 969,757 | 889,916 | 1,005,648 | 18 012 |
| Azores | 39,862 | 43,807 | 56,539 | 50,938 | 57,146 | 42,980 | 48,595 | 870 |
| Madeira | 25,047 | 36,969 | 31,736 | 27,507 | 39,358 | 33,853 | 32,412 | ·581 |
| Spain and the Balearic Islands | 322,614 | 376,013 | 509,207 | 676,636 | 769,757 | 770,729 | 570,826 | 10·224 |
| Canary Islands | 54,554 | 41,731 | 46,323 | 42,272 | 49,816 | 30,680 | 44,229 | ·792 |
| Gibraltar | 937,719 | 1,176,737 | 1,049,567 | 768,973 | 605,693 | 466,815 | 834,255 | 14 942 |
| Italy and the Italian Islands | 2,491,197 | 2,960,965 | 2,569,240 | 2,601,911 | 2,391,022 | 2,318,707 | 2,727,673 | 48 856 |
| Malta | 289,304 | 224,546 | 200,009 | 183,065 | 255,033 | 195,836 | 224,632 | 4·024 |
| Ionian Islands | 83,600 | 127,598 | 123,928 | 209,612 | 171,731 | 143,126 | 143,315 | 2 567 |
| Turkey and Continental Greece (exclusive of the Morea) | 1,472,288 | 1,699,725 | 2,291,404 | 2,211,278 | 2,103,308 | 2,776,950 | 2,092,499 | 37·479 |
| Morea and Greek Islands | 17,538 | 30,052 | 28,201 | 35,577 | 35,000 | 33,931 | 30,047 | ·538 |
| Isles of Guernsey, Jersey, Alderney, and Man | 364,350 | 385,367 | 389,760 | 378,934 | 414,567 | 542,101 | 412,528 | 7·389 |
| Total | 23,909,344 | 24,369,526 | 25,043,357 | 25,671,500 | 25,859,159 | 24,194,172 | 24,841,143 | 444 934 |
| ASIA. | | | | | | | | |
| Syria and Palestine | 375,551 | 602,031 | 377,828 | 631,631 | 267,618 | 415,292 | 478,326 | 8 567 |
| Arabia and Persia | 5,082 | 8,924 | 11,009 | 16,067 | 25,187 | 12,417 | 13,765 | ·236 |
| East India Company's territories and Ceylon | 5,169,888 | 6,401,519 | 7,695,666 | 6,703,778 | 6,434,156 | 5,170,104 | 6,313,068 | 113 075 |
| China | 969,381 | 1,456,180 | 2,305,617 | 2,391,827 | 1,791,459 | 1,505,969 | 1,736,902 | 31 110 |
| Sumatra and Java | 306,132 | 218,615 | 376,918 | 515,173 | 367,918 | 358,177 | 355,589 | 6 368 |
| Philippine Isles | 47,019 | 152,096 | 92,517 | 115,215 | 92,806 | 104,186 | 100,739 | 1 804 |
| Total | 6,873,053 | 8,842,365 | 11,059,555 | 10,377,291 | 8,969,724 | 7,864,146 | 8,997,739 | 161 160 |
| AFRICA. | | | | | | | | |
| Egypt | 221,003 | 246,565 | 402,101 | 291,850 | 405,674 | 538,308 | 365,917 | 6 551 |
| Tripoli, Barbary, and Morocco | 41,952 | 83,494 | 17,740 | 30,360 | 48,116 | 30,809 | 42,078 | ·754 |
| Western Coast of Africa | 459,685 | 590,609 | 458,114 | 532,028 | 421,620 | 518,120 | 496,796 | 8 898 |
| Cape of Good Hope | 369,076 | 502,577 | 424,151 | 648,749 | 480,979 | 688,208 | 518,957 | 9 295 |
| Eastern Coast of Africa | - - | - - | 127 | 1,500 | 5,041 | 13,751 | 3,103 | ·061 |
| African Ports on the Red Sea | 262 | 40 | 152 | - - | 350 | 505 | 219 | ·004 |
| Ascension Islands | 1,145 | 4,976 | 2,201 | 1,124 | 1,509 | 1,378 | 2,022 | 036 |
| Cape de Verd Islands | 1,480 | 1,577 | 1,987 | 1,257 | 2,505 | 4,145 | 2,158 | ·039 |
| St Helena | 17,530 | 25,839 | 21,006 | 28,000 | 27,000 | 30,000 | 24,895 | 446 |
| Mauritius | 244,922 | 258,014 | 289,650 | 345,059 | 310,231 | 223,563 | 277,907 | 4 978 |
| Madagascar | - - | - - | 1,998 | 250 | 2,580 | - - | 805 | ·014 |
| Total | 1,357,055 | 1,713,691 | 1,615,530 | 1,880,177 | 1,795,405 | 2,049,087 | 1,735,158 | 31·079 |
| AMERICA. | | | | | | | | |
| British North American Colonies | 2,333,525 | 1,751,211 | 3,070,861 | 3,555,954 | 3,308,059 | 3,233,014 | 2,875,138 | 51 502 |
| British West Indies | 2,591,425 | 2,882,141 | 2,451,177 | 2,789,211 | 2,505,587 | 2,273,521 | 2,582,278 | 46 252 |
| Hayti | 141,896 | 99,209 | 174,457 | 215,072 | 136,113 | 192,089 | 159,806 | 2·862 |
| Cuba and other Foreign West Indies | 711,938 | 873,797 | 999,474 | 1,219,015 | 1,308,933 | 1,317,687 | 1,076,808 | 19·287 |
| United States of America | 3,555,381 | 5,018,944 | 7,941,985 | 7,147,663 | 6,898,960 | 10,974,161 | 6,919,516 | 123·937 |
| Mexico | 374,969 | 597,937 | 491,095 | 547,130 | 303,685 | 100,688 | 403,084 | 7 220 |
| Guatemala | - - | 5,103 | - - | - - | - - | 86,983 | 15,348 | 275 |
| Columbia | 231,711 | 378,521 | 264,688 | 390,149 | 472,107 | 327,885 | 344,176 | 6 164 |
| Brazil | 1,756,805 | 2,140,133 | 2,413,538 | 2,493,306 | 2,749,338 | 2,568,801 | 2,353,654 | 42 157 |
| States of the Rio de la Plata | 969,791 | 700,416 | 784,561 | 592,279 | 188,481 | 490,504 | 621,005 | 11 123 |
| Chili | 950,166 | 938,959 | 807,633 | 1,077,615 | 959,322 | 866,325 | 933,387 | 16 718 |
| Peru | 684,313 | 659,961 | 658,380 | 878,708 | 825,028 | 623,189 | 721,596 | 12 924 |
| Falkland Islands | 384 | 533 | 93 | 811 | 3,117 | 2,088 | 1,171 | ·021 |
| Foreign Settlements on the North West Coast of America | - - | - - | 12,611 | 1,077 | 9,438 | 8,193 | 5,219 | ·094 |
| Total | 14,282,604 | 16,047,165 | 20,073,856 | 20,937,993 | 19,668,168 | 23,065,134 | 19,012,486 | 340·536 |
| AUSTRALIA | | | | | | | | |
| New South Wales, Van Diemen's Land, Swan River, and New Zealand | 946,164 | 1,281,815 | 771,482 | 1,221,076 | 1,471,640 | 1,644,170 | 1,222,724 | 21·901 |
| South Sea Islands | 12,803 | 25,247 | 20,512 | 23,045 | 23,724 | 25,368 | 21,783 | ·390 |
| Total | 958,967 | 1,307,062 | 791,994 | 1,244,121 | 1,495,364 | 1,669,538 | 1,244,507 | 22 291 |
| **Recapitulation.** | | | | | | | | |
| Europe | 23,909,344 | 24,369,526 | 25,043,357 | 25,671,500 | 25,859,159 | 24,194,172 | 24,841,143 | 444 934 |
| Asia | 6,873,053 | 8,842,365 | 11,059,555 | 10,377,291 | 8,969,724 | 7,864,146 | 8,997,739 | 161·160 |
| Africa | 1,357,055 | 1,713,691 | 1,615,530 | 1,880,177 | 1,795,405 | 2,049,087 | 1,735,158 | 31·079 |
| America | 14,282,604 | 16,047,165 | 20,073,850 | 20,937,993 | 19,668,168 | 23,065,134 | 19,012,486 | 340·536 |
| Australia | 958,967 | 1,307,062 | 791,994 | 1,244,121 | 1,495,364 | 1,669,538 | 1,244,507 | 22·291 |
| Grand Total | 47,381,023 | 52,279,609 | 58,584,292 | 60,111,082 | 57,787,820 | 58,842,577 | 55,831,033 | 1000·000 |

# COMMERCE.

TABLE II — *continued.*

| Articles. | Quantities imported. | | Quantities (of Articles chargeable with Duty) entered for Home Consumption. | | Gross Amount of Duty received. | |
|---|---|---|---|---|---|---|
| | 1849. | 1850. | 1849. | 1850. | 1849. | 1850. |
| | | | | | *L.* | *L.* |
| Rice - - - - cwt. | 976,196 | 785,692 | 536,453 | 435,961 | 14,982 | 12,789 |
| In the husk - - qrs. | 31,828 | 37,154 | 30,661 | 36,430 | 1,533 | 1,820 |
| Saltpetre and cubic nitre - cwt. | 566,794 | 529,012 | | | | |
| Seeds, viz.: — | | | | | | |
| Clover - - - cwt. | 130,254 | 94,040 | 166,052 | 112,174 | 41,439 | 28,013 |
| Flaxseed and linseed - qrs. | 626,495 | 608,986 | | | | |
| Rape - - - — | 29,480 | 107,029 | | | | |
| Silk, raw - - - lb. | 4,991,472 | 4,944,417 | | | | |
| Waste, knubs, and husks - cwt. | 12,757 | 15,600 | | | | |
| Thrown - - - lb. | 614,770 | 469,526 | | | | |
| Spices, viz. — | | | | | | |
| Cassia lignea - - lb. | 472,693 | 988,017 | 83,500 | 97,539 | 1,077 | 1,258 |
| Cinnamon - - - — | 759,088 | 700,101 | 62,666 | 28,448 | 953 | 404 |
| Cloves - - - — | 274,713 | 749,625 | 134,881 | 159,955 | 3,541 | 4,199 |
| Nutmegs - - - — | 224,021 | 312,418 | 181,255 | 168,402 | 18,120 | 19,042 |
| Pepper - - - — | 4,796,042 | 8,082,518 | 3,258,515 | 3,174,425 | 85,537 | 83,326 |
| Pimento - - - cwt. | 25,037 | 20,448 | 3,421 | 3,564 | 898 | 936 |
| Spirits, viz. — | | | | | | |
| Rum - gals. (incl. overproof) | 5,306,827 | 4,188,639 | 3,040,398 | 2,902,206 | 1,142,249 | 1,100,286 |
| Brandy gals. ditto | 4,479,549 | 3,237,598 | 2,187,801 | 1,861,013 | 1,640,488 | 1,395,563 |
| Geneva gals. ditto | 171,236 | 337,042 | 26,958 | 28,273 | 20,226 | 21,215 |
| Sugar, unrefined - - cwt. | 6,937,319 | 6,256,031 | 5,922,386 | 6,112,321 | 3,855,933 | 3,773,400 |
| Molasses - - — | 1,062,857 | 905,054 | 813,058 | 918,293 | 214,699 | 230,156 |
| Tallow - - - — | 1,465,629 | 1,241,781 | 1,420,066 | 1,216,101 | 95,047 | 78,269 |
| Tar - - - lasts | 15,206 | 12,096 | | | | |
| Tea - - - lb | 53,159,469 | 50,513,003 | 50,024,917 | 51,178,215 | 5,471,668 | 5,597,707 |
| Timber of B. Poss. - - loads | 469,096 | 436,679 | 483,258 | 467,730 | 50,744 | 49,747 |
| Foreign - - - — | 340,687 | 359,129 | 336,184 | 367,315 | 335,708 | 366,911 |
| Staves - - - — | 79,917 | 82,588 | - - | - - | 30 | 30 |
| Timber not sawn or split — | | | | | | |
| Of B Poss. - - — | 579,506 | 620,308 | 586,942 | 623,000 | 30,815 | 32,792 |
| Foreign - - - — | 238,103 | 250,263 | 261,362 | 273,922 | 196,044 | 205,141 |
| Tobacco — | | | | | | |
| Unmanufactured - - lb. | 42,098,126 | 33,894,506 | 27,480,666 | 27,538,105 | 4,328,206 | 4,337,259 |
| Manufactured, and snuff - — | 1,913,174 | 1,532,829 | 205,091 | 196,681 | 96,834 | 92,875 |
| Wine, Cape - - - galls | 264,106 | 254,781 | 241,902 | 246,197 | 34,957 | 35,601 |
| French - - - — | 166,169 | 600,512 | 354,928 | 365,161 | 102,113 | 105,272 |
| Other sorts - - - — | 7,239,792 | 8,432,280 | 5,890,872 | 6,072,699 | 1,699,002 | 1,752,137 |
| Total of wine - - | 7,970,067 | 9,267,573 | 6,487,702 | 6,684,657 | 1,836,072 | 1,893,013 |
| Wool, cotton - - - cwt | 6,715,259 | 5,931,793 | - - | - - | 2 | |
| — Sheep and lambs' - lb | 75,113,317 | 72,671,483 | | | | |

See the *Commercial Dict.*, see also the *Treatise on Commerce* by the same author, from which part of the above article has been abstracted.

CO'MMISSARY (Lat committo, *I entrust*), is used in various ways as nearly synonymous with *deputy* In military affairs, the parties who provide clothing, &c for the army are styled *commissaries*, and the whole body of officers belonging to this department, the *commissariat*.

COMMI'SSION. In the Army *See* ARMY.

COMMISSION In the Navy, the title of the appointment or warrant of officers of the rank of lieutenant, and above to hold their office The commission is signed by the lords commissioners of the Admiralty.

COMMISSION, in Law, an appointment, usually by warrant or letters patent to one or more as commissioners, to perform certain duties specified in the instrument In this mode many of the highest judicial or ministerial functionaries of the realm are appointed, thus, the judges of the superior courts hold several commissions, as of oyer and terminer, gaol delivery, &c And high offices of state, when not regularly filled, are often entrusted to commissioners for the time being, and said to be put in commission, thus the custody of the great seal is put in commission in the absence of a lord chancellor and lord keeper The Treasury and Admiralty have of late times been usually entrusted to commissioners, no lord high treasurer or lord high admiral having been appointed. The Court of High Commission consisted of persons appointed under letters patent to examine into matters of ecclesiastical jurisdiction, under stat 1 Eliz. c. 1. (abolished 16 Car. 1) Magistrates or justices of the peace are appointed by means of a commission, occasionally renewed, commonly termed the commission of the peace.

CO'MMISSU'RE. A term applied in Anatomy to certain parts of the brain which cross from one of its sides to the other. *See* BRAIN. In Botany, it signifies the place of junction of two opposite carpels.

COMMI'TMENT. In Law, the sending to prison of one charged with any crime. It appears to have been the ancient usage that whoever could lawfully arrest a person for felony or treason could also send or bring him to the common gaol; but since the Habeas Corpus Act it is the uniform practice that offenders are committed by the warrant in writing of a justice of the peace. The privy council and secretary of state can also commit in cases of treason. A commitment in writing must declare the authority of him who makes it, and also the nature of the offence with which the party is charged.

COMMI'TTEE, in the language of Parliament, is either a committee of certain members, or a committee of the whole house. (*See* PARLIAMENT.) *Select committees* are bodies appointed by open nomination or by a peculiar mode of election for the transaction of business, either according to the standing orders, or by accustomed usage. All private bills are referred in the first instance to select committees *Joint committees* in former times consisted of bodies deputed by the two houses, and met for the purpose of adjusting differences, sometimes after free conferences had failed They were free from the forms observed in conferences As in the latter, the Lords deputed only half the number of members sent by the Commons. They have been long disused

CO'MMODORE A naval officer having the temporary rank of rear-admiral; the senior captain of several ships is called the commodore by courtesy

CO'MMON. (Lat communis) In Law, is the right which one person has of taking a part of the produce of land, while the whole property in the land is vested in another. Common of pasture is either, 1. *Common appendant*, which is the right of the tenant of a manor to pasture his beasts on the lord's waste; 2. *Common appurtenant*, annexed to land by grant or prescription; 3. *Common in gross*, a right severed from the land.

When a common is under pasture all those who have a right of pasturage may turn out on it a certain number of animals, according to the extent of the enclosed grounds which they cultivate. When the common consists wholly or partly of arable land, this arable land is formed into ridges, generally with a narrow riband or balk of turf between each ridge, or between each two or three ridges. The right of cultivating these ridges is distributed among the holders of the enclosed lands of the parish, according to the extent of their possessions; and in order that there may be no partiality, and that every one may have as much interest in preserving his neighbour's ridge as his own, the ridges which any individual has the right of cultivating do not lie together, but are distributed among the ridges of his neighbours.

CO'MMONABLE LANDS. A common in which the greater part of the land is arable.

CO'MMON-FIELD LANDS. When the whole of a common belonging to a parish is not in a ring fence, but lies in different places, these places are called common fields.

CO'MMON MEASURE. In Arithmetic, is a number which divides two or more other numbers without leaving a remainder.

CO'MMON PLEAS, or COMMON BENCH, COURT OF. In Law, was originally that branch or side of the *aula regia* in which civil causes between subjects were tried. It was separated and rendered stationary, while that portion of the court from which the King's Bench is derived followed the person of the king by a provision of Magna Charta. This court has concurrent jurisdiction with the other two superior common law courts (*see* COURTS, SUPERIOR) in personal actions and ejectments. But it retains exclusive jurisdiction over all other mixed, and all real actions or pleas of

land. These, however, have now nearly fallen into disuse. (*See* PLEADING.) The Court of Common Pleas has one chief and four puisné judges.

COMMON PRAYER BOOK. The name given to the collection of all the offices of regular and occasional worship according to the forms of the church of England. The basis of this book is to be found in the King's Primer, set forth in 1546 by Henry VIII., which was intended to convey instruction to the people in the most important parts of the church service, but contained little more than the Creed, Lord's Prayer, Commandments, and Litany. This Primer underwent two revisions and republications under Edward VI, whose second Liturgy approaches very near in its contents to that which exists at present. It was at that review that the Sentences, Exhortation, Confession, and Absolution were prefixed to the Daily Service, the Decalogue was introduced into the Communion Service; and certain remnants of the Romish customs were finally abolished, as the sign of the cross in confirmation and matrimony, the anointing of the sick, and the prayers for the dead

On the accession of Elizabeth, another review of the Liturgy was instituted; but the alterations effected were little more than in the selection of the lessons. At the review in the reign of James I., after the conference with the Presbyterians at Hampton Court, no change of importance was introduced, except the addition of the explanation of the Sacraments in the Catechism. Again, when on the restoration of Charles II a conference had been held with the Dissenters at the Savoy, the subject of the Common Prayer Book was reconsidered in convocation. The services for the 30th of January and 29th of May were then added, as also the Form to be used at Sea. A few trifling alterations were made also in the other services; but these were the last that have been effected. On the accession of William III another revision took place, and a considerable number of alterations were proposed and supported by many of the bishops and clergy; but they were rejected by convocation, and have never since been revived by authority The following is a [illegible] list of the revisions of the Prayer Book in which any alterations have taken place It is taken from the *Rev. T. V. Short's History of the Church of England*. —

1546 The King's Primer.
1548. The Communion Service.
1549. First Liturgy of Edward VI.
1550. First Ordination Service.
1552. Second Liturgy of Edward VI.
1552. Second Ordination Service.
1560. Liturgy of Elizabeth
1604. Alterations introduced by James I.
1633. Alterations introduced by Charles I.
1661. Last Revision; authorized Liturgy

COMMONS, HOUSE OF *See* PARLIAMENT.

CO'MMON TIME. In Music, that in which every measure or bar contains one semibreve, two minims, four crotchets, eight quavers, and so on

CO'MMONWEALTH *See* REPUBLIC.

COMMONWEALTH OF ENGLAND In History, the form of government established in England on the death of Charles I. in 1649, and which existed during the protectorate of Oliver Cromwell and his son Richard, until the abdication of the latter in 1659. The substitution of a democratical for a monarchical form of government was provided for and enjoined by two successive charters. The first charter of the commonwealth was drawn up in December, 1653, by the *council of officers*, who, on the voluntary resignation of the parliament in the early part of the same year, had declared Cromwell "Protector;" it was styled the "Instrument of Government." The second charter, called the "Petition and Advice," was framed in May, 1657, by the parliament which the protector had assembled in the previous year. Under the first charter, as has been well observed, the English government may be classed among republics with a chief magistrate at its head, under the second, it became substantially a monarchy, and Oliver Cromwell from 1657 to the period of his death was de facto King of England (*Hallam's Constit History*, 121) On the demise of Cromwell, the succession of his son Richard was at first cordially recognized, but soon afterwards discontents and cabals having sprung up in the country, his inability or disinclination to govern induced him to abandon the protectorship after a reign of eight months, and on the 29th of May, 1659, the restoration of the monarchy under the old *regime* was effected by the triumphal entry into London of Charles II. It would be out of place to give here a detailed view of the state of England during the commonwealth. Suffice it to observe, all authors have concurred in opinion, that, whatever were the defects of the home government, arising partly from the ambition of the protector, and partly from the stubbornness and opposition of his councils, the energy and decision which Cromwell maintained in every department of the state not only laid the foundation of England's maritime greatness, but raised her to a pitch of prosperity that has rarely, if ever, been equalled.

COMMU'NION, is used in various ways in the general sense of participation: — 1. A person is said to be in communion with a church, who declares his acquiescence in its doctrines and participates in its worship; and hence the term communion is used sometimes for a church. 2. Communion is confined emphatically to participation in the Eucharist. (*See* EUCHARIST) 3 The Communion of Saints, an article of the Apostles' Creed, is variously explained.

COMMUTA'TION. In Astronomy, the angle of commutation of a planet is the angle formed at the earth by a straight line drawn from the earth to the sun and the orthographical projection on the plane of the ecliptic of the straight line which joins the earth with the planet. It is measured by the difference between the sun's longitude and the geocentric longitude of the planet

CO'MMUTATION OF TITHES. *See* TITHES.

COMO'SE. Ending in a tuft or kind of brush.

COMPA'NION. The hut or covering over a ladder (or staircase) in a ship.

COMPANY (Fr. *compagnie*), in its most general sense, means any two or more individuals associated for any common object, whether of business or pleasure.

In its more limited sense, however, and that in which it is usually understood in this country, the term company means an association of individuals for the prosecution of some industrious undertaking Such associations may be of very various descriptions, inasmuch as the terms of the association or partnership may be varied in an infinity of ways. Generally, however, they may be said to be either *private* or *public* companies, that is, according to the law of England, companies with not more than six partners and with more than six, and public companies may farther be divided into *joint stock* and *regulated* companies, and these again into *incorporated* and *unincorporated* companies

I. The principle on which associations for industrious purposes are established is too obvious to require much illustration All great results are brought about by co-operation, and could not be effected otherwise Isolated man is comparatively feeble and helpless, the capacity of associating for a common purpose is, in fact, the main source of his power, and the principal distinction between him and the lower animals — *Quo alio fortes sumus quam quod natuus juvamur officus?* One man has capital without skill, and another skill without capital If such persons act independently, they will be able to effect little or nothing, but if they combine their efforts, and the capital of the one be applied and directed by the skill of the other, the effect of their exertions will be incomparably greater But this is not all. Many of the greatest and most important works undertaken in modern times could not have been attempted by one individual, how opulent or skilful soever Some of them require a vast outlay, while the returns being frequently remote and contingent, no single individual, and, indeed, no small number of individuals, would be willing to put their fortunes to hazard by engaging in them But such undertakings are readily and advantageously carried on by large associations, for, in that case, individuals being called upon only to subscribe comparatively small sums to the common stock, they can afford to lose them without, in most instances, suffering any material inconvenience, while the aggregate amount of the subscriptions may, notwithstanding, amount to a very large sum, and be adequate to the greatest undertakings In fact, some of the most gigantic works ever entered upon either in this or any other country have been accomplished by the joint contributions of the subscribers of 100*l* shares It is true that wealthy individuals usually subscribe for a number of such shares; but this does not affect the principle of the system, which is to distribute the risk according to the ability of the individuals associated.

II In *private* companies the business is usually conducted by one or more of the partners on the principles laid down in the deed of partnership. The rights and obligations of the partners as respects each other are, of course, mainly determined by this deed as respects the public, the law regards the act of one partner as the act of the company, and each partner is bound, without any regard to the sum he has subscribed to the company's stock, to the whole extent of his fortune, for the debts and engagements of the firm. Certain formalities are necessary at the withdrawal of a partner; such as advertizing in the *Gazette*, and the sending of special information of the fact to all individuals in the habit of dealing with the company. *See* PARTNERSHIP.

III. *Public* companies may, as already stated, be either joint stock or regulated; and these again may be either incorporated or unincorporated.

1. By a joint stock company is meant a company the stock of which is subscribed by a certain number of persons in shares of a certain amount. Thus, supposing that a joint stock association is to be formed for carrying on the business of banking or insurance, for excavating

a dock or a canal, or for constructing a railway, and that its capital is to amount to 1,000,000*l.* to be subscribed in shares of 100*l.* each; any individual (unless exceptions be made in the conditions under which the company is to be formed) who can command 100*l.* may become a partner of this association, and will be registered in the company's books as the holder of a share of 100*l.* of the company's stock. It is customary, too, in the vast majority of instances, to allow individuals to transfer their stock or shares to others, who succeed to all the rights and obligations of their predecessors. The price which shares or portions of stock fetch in the market depends, of course, on the real or supposed state of the company's affairs. If it be known or supposed to be in a flourishing and prosperous condition, and paying a high interest or dividend on its stock, the latter may sell for 10, 20, 50, or 100 per cent. or upwards of advance, whereas if it be known or supposed to be in an unprosperous condition, its shares may not bring a third or a tenth part of what they originally cost.

The affairs of companies of this description are usually conducted by salaried officers, who are appointed by and act under the orders of a board of directors chosen by the company at large, according to the conditions in their deed of association. The partners in such companies are all individually liable, without regard to the magnitude of their stock or shares, for the entire debts and obligations of the company.

At common law no action can be raised by or against such companies without making all the shareholders parties to the action. But the obvious and insuperable inconveniences that would result from the enforcement of this rule have made it be enacted, by the 1st Victoria, cap 73, that the crown may at pleasure grant to joint stock associations letters patent, authorizing them to sue and be sued in the names of particular officers of their own; without, however, unless government judge proper, incorporating the company, or affecting the liability of the different partners for its debts

2 When joint stock companies are incorporated by royal charter, or by letters patent, the liability of the partners is limited to the amount of their stock, and they cease to be responsible beyond that amount This is the case with some great joint stock associations, as the banks of England, Scotland, and Ireland, the East India Company, the Royal Exchange Assurance, and a few more. But government has hitherto been, and that for the best reasons, very chary of granting charters of incorporation. It is difficult, in fact, to imagine a case in which they ought to be granted Individuals are always ready to embark, without stipulating for any restriction of their liability, in any scheme, however hazardous, that holds out any promise of even a moderate return. And this unlimited responsibility of the partners is, in all ordinary cases, the only security worth a pinch of snuff on which the public can ever rely for protection against the fraud or misconduct of the managers of joint stock companies

The grand distinction between unincorporated and incorporated joint stock companies is, that in the case of the former, the law looks only to the individuals forming the association, while, in the latter, it looks only to the corporate body, and pays no attention to the individuals of which it is made up On judgment against an incorporation, execution can only pass on the corporate property, and supposing it to become insolvent, the partners can only, as already stated, be called upon to make good the amount of the stock of the incorporation standing in their names. But it is quite otherwise with an unincorporated joint stock company should it become insolvent, the partners, to use the words of Lord Eldon, are severally liable for the whole debts and engagements of the company, even "*to their last shilling and their last acre.*"

We have already sufficiently explained (see art. BANKS) the advantages that would result from the periodical publication of the names of the partners in joint stock companies. The public are clearly entitled to know who the parties are that embark in such concerns Nothing on which it would be prudent to place much reliance can be learned from prospectuses and professions Without knowing who the partners really are, the public have no means of forming any fair estimate of the character of any association, or of the credit to which it may be justly entitled. But we doubt whether it would be prudent to carry interference with joint stock companies farther than this It is excessively difficult, and in most cases quite impossible, to enforce such regulations in regard to such companies as would serve to disclose the real state of their affairs, provided they had an interest in concealing it; and it is needless to say, that the leading of the public to depend on regulations that cannot be carried into effect, is one of the most likely means that can be resorted to for the encouragement of imposture and fraud.

3. *Regulated companies* consist of a number of unconnected individuals or associations engaged in the same business or department of trade, under condition of their conforming to regulations laid down for their common guidance. Such companies have been mostly formed for the prosecution of the trade with distant and peculiarly situated countries. Their principle is not to exclude individual competition, but merely to make the different parties engaged in the trade observe the same general rules. Companies of this description were at one time common; but they have now mostly fallen into desuetude, though it be easy to imagine circumstances in which they might be advantageously revived.

4. *Civic companies*, of which there are many in the the city of London and other large towns, are in reality *guilds* or *fraternities* Originally they consisted of the parties carrying on a peculiar trade or profession; and in most instances they gradually acquired the privilege of prescribing the conditions and limitations under which individuals not [illegible] to the fraternity might obtain leave to engage in its peculiar trade within the precincts of the city or borough to which it belonged. In more modern times, however, the injurious influence of such restrictions on the free exercise of industry became obvious; and in consequence the powers formerly exercised by civic companies or guilds over individuals not free of their society, who attempted to carry on the same trade, have been either wholly repealed or greatly modified. At present, therefore, the companies in question exist principally as charitable institutions, or as incorporated associations, having, in many instances, the management of large amounts of property appropriated for the use of their poorer brethren, or for some similar purpose

CO'MPANY. In the Army, a body of men, forming one of the chief divisions of a battalion of infantry. In the guards and artillery, a company consists of 120 men, but in all other infantry regiments of 100. A company in the infantry corresponds to *troop* in cavalry regiments; and is under the inspection of a captain, a lieutenant, and an ensign, besides the non-commissioned officers; with the exceptions of the artillery, engineers, marines, and the rifle brigade, in which *second lieutenants* are substituted for *ensigns*.

COMPARISON, or SIMILE. In Rhetoric, appears to differ from Metaphor (which see) only in form; the resemblance being stated in the first case, implied in the second. This is the sense in which the term Comparison is used and defined by Aristotle, in his *Art of Rhetoric*. Frequently the same idea furnishes at the same time both comparison and metaphor, as in the following line, "They melted from the field as snow." The word "melted" is used by transferring the property of the snow to a multitude of individuals. so far, therefore, the phrase is a metaphor, but the additional words, "as snow," transform it into a direct comparison. Perhaps, however, it might be more correctly said, in this instance, that the predicate "melted" is transferred by the figure termed Hypallage from the *snow* to the *multitude*, both words being used as subjects in the same sentence. The comparison, being as it were a metaphor resolved and rendered more flowing and less concise, is more appropriate to poetry than to prose composition In fact, the only figures of this description which are generally admissible in prose writing are illustrations; *i. e.* arguments drawn from analogy in the form of comparisons (*See* ILLUSTRATION.) It will generally be found that in every language the earliest writers, especially the poets, are the most addicted to the use of comparisons and metaphors of a highly figurative and bold character, as is especially observable with respect to the sacred poets, and to Homer, while as language advances in cultivation the metaphor comes more and more into ordinary use, and forms, as it were, the basis of composition, while at the same time it gradually loses the energetic and poetical cast which at first distinguished it.

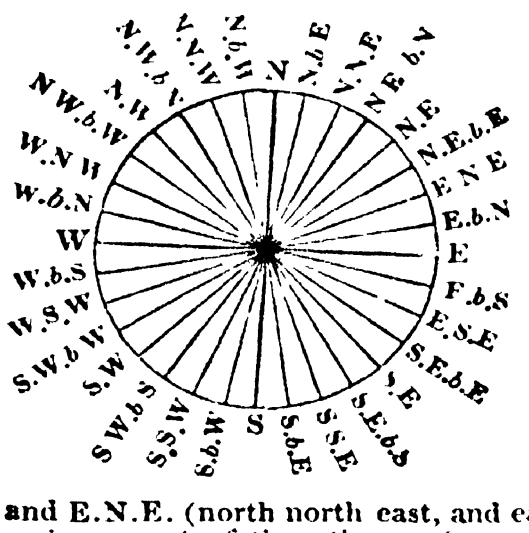
COMPARISON, DEGREES OF. Those varieties in the inflexions of adjectives which denote the degree in which a quality is possessed by a substance, either generally or in reference to one or more other substances. In English there are only two degrees of comparison, commonly named the comparative and the superlative. The first compares two conceptions only, as "John is *taller* than Charles." The second either compares one conception with a definite number of others, as "John is the *tallest* of all the four;" or expresses general superiority, as "the *fairest* of women."

COMPA'RTMENTS. (Ital compartimenti.) In Architecture, the subdivisional parts of larger divisions for ornament, to which alone this term is properly applicable.

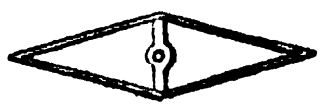
CO'MPASS. A name given to instruments contrived to indicate the magnetic meridian, or the position of objects with respect to that meridian. According to the purposes to which the instrument is chiefly applied, it becomes the *mariner's compass*, the *azimuth compass*, the *variation compass*, each particular application requiring some peculiarity of construction; but whatever modifications it may receive, the essential parts are the

same in all cases. These are a magnetized bar of steel, called the *needle*, having fitted to it at its centre a cap, which is supported on an upright pivot, made sharp at the point in order to diminish the friction as much as possible and allow the needle to turn with the slightest force. The *mariner's compass* has a circular card attached to its needle, which turns with it; and on the circumference of which are marked the degrees, and also the 32 *points* or *rhumbs*, likewise divided into half and quarter points. The pivot rises from the centre of the bottom of a circular box, called the compass box, which contains the needle and its card, and which is covered with a glass top to prevent the needle from being disturbed by the agitation of the air. The compass box is suspended within a large box, by means of two concentric brass circles or gimbals; the outer one being fixed by horizontal pivots, both to the inner circle which carries the compass box, and also to the outer box, the two sets of axes being at right angles to each other. By means of this arrangement the inner circle, with the compass box, needle, and card, always retain a horizontal position notwithstanding the rolling of the ship.

The notation of the mariner's compass is as follows.—The circumference being divided into the four quadrants by two diameters at right angles, the extremities of these diameters are the four cardinal points (cardo, *a hinge*), marked N., S., E., W (north, south, east, west) Bisecting each of the quadrants, the several points of bisection are denoted by placing the two letters at the extremities of the quadrant in juxtaposition. Thus, N.E (north-east) denotes the point which is half way between north and east; and so with N.W., S E., S W. (north-west, south-east, south-west) Let the octants next be bisected, the points of division are denoted by prefixing to each of the above combinations first the one, and then the other of the two cardinal points of which it is formed Thus N.E. gives N.N E and E.N.E. (north north east, and east north-east), and so in respect of the others. Sixteen points have thus been named. Let the distances be again bisected, then each of the points so found is expressed by that one of the preceding points already named to which it is nearest, followed by the name of the cardinal point towards which its departure from the nearest points leads it, the two being separated by the letter *b* (by) Thus, the point half way between N. and N.N E. is N. by E. (north by east), that which is half way between N.N E and N.E. is N.E by N. (north-east by north), &c The whole of the thirty-two points are thus distinguished as in the figure.




The principal requisites of a compass are intensity of directive force, and susceptibility. The first of these is obtained by constructing the needle of the material and form best suited to receive and retain the magnetic virtue. A number of experiments on this subject were made by Coulomb, and more recently by Captain Kater, an account of which is given in the *Phil Trans.* for 1821 Captain Kater found that the kind of steel capable of receiving the greatest magnetic force is shear steel, and that the best form is that of a lozenge or rhomboid (*fig* ), cut out in the middle, so as to diminish the extent of surface in proportion to the mass, it being found that the directive force of the needle, when magnetized to saturation, depends not on the extent of surface, but on the mass. Beyond a certain limit (about five inches) no additional power is gained by increasing the length of the needle; and needles exceeding a very moderate length are apt to have several consecutive poles, the effect of which is to produce a great diminution of directive force. On this account short needles, made very hard, are to be preferred.



Like many other of the most valuable arts of life, the origin of the compass is entirely unknown. By some writers it is ascribed to Flavio Gioja, who lived in the 13th century; yet Guyot de Provence, who lived a century earlier, speaks of the loadstone, to which he gives the name of *marinetti*, or mariner's stone, as useful to navigation. Others pretend that it was invented in France; but there seems to be no other reason for this supposition than the fact that from time immemorial the north point of the compass card has been distinguished and ornamented with a *fleur de lis*. For a reason of a different kind, but perhaps of the same degree of weight, Dr. Wallis and others have supposed the invention to belong to England, the name *compass*, which is given to the instrument by most European countries, being used in England to signify a circle. The term *bussola* in Italian, and *boussole* in French, has also been supposed to be derived from our term *box*, by which the compass is frequently designated. Gilbert, in his celebrated work *De Magnete*, affirms that Marco Polo brought the invention to Europe from China, about the year 1260. It appears very probable that the Chinese were acquainted with the directive property of the loadstone at an early period. Their method is to place it on a small piece of cork and set it to float on water. The art of communicating the magnetic virtue to steel, and suspending the needle on a pivot, is undoubtedly an European invention.

The *azimuth compass*, being intended to show the bearing of objects in respect of the magnetic meridian, has its circle divided merely into degrees, instead of the rhumbs used in navigation, and is provided with sights to allow the angles to be taken more accurately.

The *variation compass* is designed to exhibit the diurnal changes in the deviation of the magnetic from the true meridian; and the needle is generally made of much greater length than in the mariner's compass, in order to render minute variations more sensible. *See* MAGNETISM.

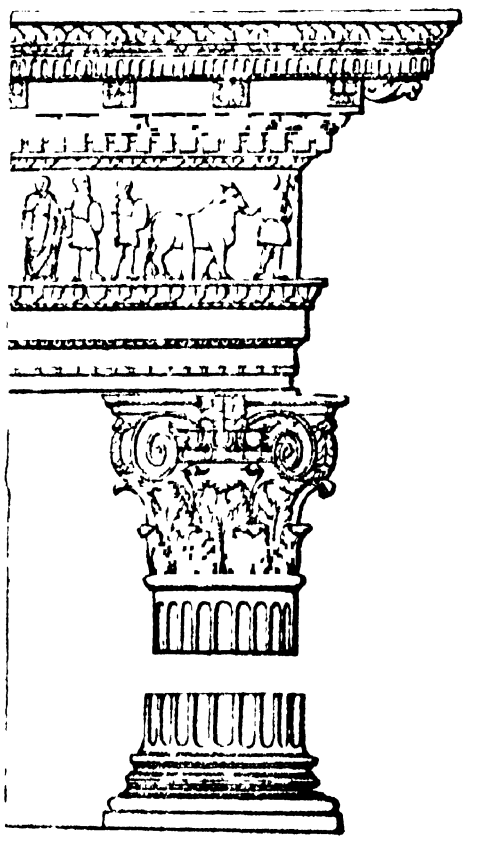
COMPITA'LIA. (Lat compitum, *a street.*) A Roman feast celebrated in honour of the Lares and Penates. Under Tarquinius Superbus, it is said that human victims were sacrificed at this solemnity. The gods invoked at it were termed Compitales, as presiding over the streets

CO'MPLEMENT. (Lat compleo, *I fill up.*) What is wanted to complete or fill up some quantity or thing. Thus, the complement of an angle is what is wanted to make the angle a quadrant or 90°. Complement of a number is what is necessary to be added in order to make the number 1, or 10, or 100, or, in general, 1 with zeros. In Geometry, the complements of a parallelogram are the two spaces which, with the parallelograms about the diagonal, make up the whole parallelogram.

COMPLU'VIUM (Lat.) In Ancient Architecture, an area in the centre of the Roman houses, so constructed that it might receive the waters from the roofs. It is also the gutter or eave of a roof

CO'MPOSITE NUMBERS, in Arithmetic, are numbers which can be divided by some other number greater than unity. They are consequently opposed to *prime numbers*, which admit of no divisor In Music, *composite numbers* are such as are composed by the multiplication of the prime integers, 2, 3, 5

CO'MPOSITE ORDER In Architecture, one of the five orders of architecture, and, as its name imports, composed of two others, the Corinthian and the Ionic Its capital is a vase with two tiers of acanthus leaves, like the Corinthian; but instead of stalks, the shoots appear small and adhere to the vase, bending round towards the middle of the face of the capital, the vase is terminated by a fillet, over which is an astragal crowned by an ovolo. The volutes roll themselves over the ovolo to meet the tops of the upper row of leaves, whereon they seem to rest The corners of the abacus are supported by an acanthus leaf bent upwards. The abacus resembles that of the Corinthian capital (*see* CAPITAL) In detail the Composite is richer than the Corinthian, but less light and delicate. Its architrave has usually only two fasciæ, and the cornice varies from the Corinthian in having double modillions. The column is ten diameters high. The principal examples of this order are the Temple of Bacchus at Rome, the arch of Septimius Severus, those of the Goldsmiths and of Titus, and that in the baths of Diocletian. The example here given is from the arch of Titus, which is considered a fine specimen of the order. *See* ORDER.



COMPO'SITÆ. In Botany, the largest of all known natural groups of plants; and so called because the old botanists who invented the name regarded the flower-heads as compound flowers. They answer to the *Syn-*

*genesia polygamia* of Linnæus, and are positively characterized by having capitate flowers, syngenesious anthers, and an inferior ovary with a single erect ovule. In the most recent account of this order, by M. De Candolle, nearly 8000 species are enumerated in about 900 genera, and the subject is not nearly exhausted; they exist all over the world where vegetation can develope, and are sometimes trees, although more generally herbaceous plants or shrubs. Among medical species, the chamomile, wormwood, southernwood, elecampane, and opium lettuce are conspicuous; of esculents, the order contains the artichoke, the Jerusalem artichoke, the lettuce, succory, and endive; and among ornamental plants, the aster, dahlia, coreopsis, sunflower, &c. But by far the greater part of this large assembly consists of species which are either weeds or of no known use. The reader who wishes to become acquainted with this order must consult *De Candolle's Prodromus Regni Vegetabilis*, vols. v., vi., and vii.

COMPOSITION. In Law, an agreement made between the owner of lands and the parson, with the consent of the ordinary and the patron, that such lands shall be discharged from the payment of tithes, by reason of some land or other real recompence given to the parson in satisfaction thereof. Such an agreement, since the 13 Eliz. c. 10., is not good for a longer term than three lives or twenty-one years. *Composition* signifies also the agreement between a bankrupt after his last examination and nine tenths of his creditors for the satisfaction of their claims, and has the effect of superseding the fiat of bankruptcy.

COMPOSITION. In the Fine Arts, that combination of the several parts, whereby a subject is agreeably presented to the mind, each part being subordinate to the whole. *See* INVENTION.

COMPOSITION. In Music, the art of disposing and arranging musical sounds into airs, songs, &c., either in one or more parts, for voices or instruments or both. Zarlino defines it to be the art of joining and combining concords and discords together, which are the matter of music.

COMPOSITION OF FORCES or MOTION. In Mechanics, signifies combining or uniting several forces or motions, and determining the result of the whole. If a body is solicited by two forces which act in the same direction, the *resulting* force, or *resultant*, is equal to the sum of both; that is to say, the effect produced is the same as would be produced by a single force acting in the same direction, and equal to their sum. If the two forces act in opposite directions, the resultant is equal to their difference, and the body will move in the direction of the greater. If the lines of direction of the two forces make an angle with each other, the resultant will be a mean force in an intermediate direction. Thus, if the two forces be represented in intensity and direction by the two sides of a parallelogram, then the resultant is represented in intensity and direction by the diagonal of the parallelogram which passes through the angle formed by those two sides.

COMPO'SITOR. (Fr. compositeur.) In Printing, the workman who arranges the types in lines and pages, and prepares them for being printed off.

COMPOSTE'LLA, ST JAMES OF, or ST JAMES OF THE SWORD. An ancient order of knighthood in Spain, the chief of the four military orders (Compostella, Calatrava, Alcantara, Mauresa), probably founded either by Alphonso IX. of Castile (1158, 1214), or Ferdinand II of Leon (1157, 1188). It originally began from the voluntary association of certain gentlemen to defend the great road leading to the celebrated shrine of St James at Compostella. Pope Alexander III. gave the order its rules of government. The order possessed at one period eighty-four commanderies, with two cities and numerous burghs and villages. The knights take the vows of poverty, obedience, and conjugal chastity; to which they add a fourth, "to defend and maintain the immaculate conception of the Holy Mother of Jesus Christ."

CO'MPOUND INTEREST, is interest charged not only on the principal, but also on the interest forborne. Thus, if money is invested so that the interest is not paid as it becomes due, but successively added to the capital, the capital is said to accumulate at compound interest. Let $r$ = the amount of 1*l.* for 1 year; that is to say, = 1*l.* with its interest added to it; then the amount of 1*l.* at the end of 2 years will be $r^2$; at the end of 3 years, $r^3$; at the end of 4 years, $r^4$; and so on. The law of this country does not allow compound interest to be charged on money lent.

COMPRE'SSIBI'LITY. The quality of bodies in virtue of which they can be reduced to small dimensions. All bodies, in consequence of the porosity of matter, are compressible, though liquids resist compression with immense force.

CO'MPTONITE. A mineral found in ejected masses on Vesuvius; named after Lord Compton, who first brought it to England in 1818.

COMPURGA'TION. An ancient mode of trial both in civil and criminal cases. In the latter, by the law of the Saxons (which William the Conqueror confirmed in this respect, at least as to its main features), the accused party was allowed to clear himself by the oath of as many of his neighbours to his innocence as amounted in collective worth, according to the legal arithmetic of the Anglo-Saxons, to one pound (*see* WEREGILD), if he could in the first instance (being a villein) obtain the testimony of his lord that he had not been previously convicted. If otherwise, he was bound to undergo ordeal, or wage his law with a greater number of compurgators. Compurgation in criminal cases was abolished in general by Henry II.'s assizes, the ordeal being enforced in lieu of it. But it was retained as a special franchise in some boroughs, to which those assizes did not extend; and the last instances of it on record are to be found in the rolls of the hundred court of Winchilsea, in the reign of Henry VI. (See *Sir F. Palgrave on the British Commonwealth.*) A singular usage of the same description long remained in the ecclesiastical courts, by which convicted clerks, allowed their clergy and delivered up to the ordinary, were admitted to purge themselves by the oaths of compurgators, which was abolished by 18 Eliz. c. 7. Wager of law, in civil cases, lay in some personal actions only, and in incidental traverses in real actions (see *Blackstone*, bb iii. c. 23.); and in these cases, although many technical difficulties prevent defendants from availing themselves of it, it is not yet abolished.

COMS, COOMS, COOMES, or CHIVES. The points of the radicles of malted grain, which after kiln-drying drop off during the process of turning. They are sold by maltsters under the name of malt dust, and are considered excellent manure.

CONCE'PTACLES (Lat. conceptaculum, *a receiver*.) The cases containing the reproductive organs of such plants as ferns, in which they are produced from the back of the leaves, growing in the form of spots at the anastomoses, margins, or extremities of the veins, and then collectively called Sori. The conceptacles are also termed Capsules, Thecæ and Sporangia.

CONCEPTA'CULUM. (Lat. *a receiver*.) A term in Botany, denoting a one-valved fruit opening longitudinally on one side, and distinct from the seeds. It is a folliculus without any attachment between the placenta and the ventral suture, as in Asclepias.

CONCE'PTION. (Lat. concipere, *to conceive*.) In Mental Philosophy, that faculty or act of the mind by which we combine a number of individuals together by means of some mark or character common to them all. We may observe, for instance, that equilateral isosceles and scalene triangles all agree in one respect, that of having three sides, and from this perceived similitude we form the conception *triangle*.

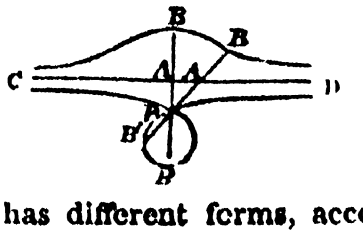
CONCERTA'NTE. (It. concentare, *to contrive*.) In Music, a term expressive of those parts of a musical composition that sing or play throughout the piece, as distinguished from those that play only occasionally in particular places.

CONCE'RTO. (It.) In Music, a piece composed for a particular instrument, which bears the greatest part in it, or in which the performance is partly alone and partly accompanied by other parts.

CONCE'TTI. (It., rendered by English writers on rhetoric *conceits*.) Ingenious thoughts or turns of expression, points, jeux d'esprit, &c. in serious composition. In the 16th century, the taste for this species of brilliancy, often false and always dangerous, spread rapidly in the poetical composition of European nations, especially in Spain and Italy; where the name of *concetti* was applied rather in a good than a bad sense, the critical taste being much perverted. Tasso is not free from *concetti*. After his time they became offensively prominent in Italian poetry for a century afterwards. Marino and Filicaia offer strong examples. In France, the mode of concetti was equally prevalent in the 17th century, and was peculiarly in vogue with the fair critics of the Hotel Rambouillet, so well known by Molière's "Precieuses Ridicules." In England, Donne and Cowley are instances of a style full of *concetti*.

CO'NCHIFERS. (Lat. concha, *a shell*, and fero, *I carry*.) A name applied by Lamarck, Schweigger, and Latreille to all mollusks which are protected by a bivalve shell.

CO'NCHOID. (Gr. κογχη, *a shell*, and εἶδος, *form*.) The name given to a curve invented by Nichomedes for the solution of the two famous geometrical problems of antiquity, — the *duplication of the cube*, and the *trisection of an angle*. It is constructed as follows: —




Let P be a given point through which any straight line is drawn to cut or meet another straight line C D given in position; if a segment AB (or AB') of a given length be taken on either side of C D, the point B (or B') will trace the conchoid. The curve has different forms, according to the different relative

positions of the point B with respect to the pole P and the given straight line C D. The conchoid is a curve of the fourth order, the equation between the rectangular co-ordinates (the origin being placed at A in the straight line perpendicular to C D) being $x^2 y^2 = (a^2 - y^2)(b + y^2)$, in which A B $= a$, and A P (perpendicular to C D) $= b$.

CONCHO'LOGY. (Gr. κογχη, *a shell*, and λογος, *a discourse*.) The science of shells. that department of Malacology which treats of the nature, formation, physiological relations, and classification of the hard parts or skeletons of the molluscous animals.

As Osteology, inasmuch as it relates to the nature, development, and physiological subserviencies of the skeletons of the vertebrate animals, is a science in the strict acceptation of the term, so also is Conchology under the like applications; but as no naturalist has yet conceived a classification of vertebrate skeletons independently of the softer organs of the body which they support and protect, and as, notwithstanding that the complex internal skeletons of the Vertebrates are closely related to their general structure and habits, the classification of these parts would not in all cases tally with the natural arrangement of the animals to which they belonged, therefore still less scientific must be a classification of shells merely, apart from a consideration of the molluscous animals by which they are secreted. For shells, instead of consisting, like bones, of living organized substance permeated by blood-vessels, absorbents, and nerves, are mere inorganic laminated, concretionary, or crystalline deposits of calcareous earth, more or less combined with albuminous matter: they are also formed in the skin, and are appendages to the dermal system, which in all classes of animals is the principal seat of variety. In many cases, therefore, there exists very little correspondence between the structure or even the presence of a shell and the general character of the organization of a mollusk; and the absence of uniformity between the condition of the shell in closely allied species is exemplified in the highest as well as the lowest classes of the molluscous sub-kingdom. The argonaut, the poulp (*Octopus*), the calamary, the cuttle-fish, and the spirula, all possess the same peculiar and highly developed organization; and in a classification founded on general structure, and expressive of the true affinities of its objects, they must rank in the same order of their class. But the shells of these mollusks present respectively the following conditions.—the first, a simple, external, light, elastic, subtransparent, but calcareous discoidal univalve; the second, two internal, friable, subtransparent styles, composed of hardened albumen, the third, an elongated, feather-shaped, horny plate, the fourth, an internal, compressed, oval, laminated, friable, calcareous mass, the fifth, an elongated, cylindrical, conical shell, twisted spirally in the same plane, divided into chambers by calcareous partitions, perforated by a siphon, and partly internal, partly external, in its situation. Now, in a system of Conchology, understood as the classification of shells in the abstract, these productions would necessarily be dispersed into five widely different groups, and in like manner, the small, thin, and flat plate, which is buried in the substance of the mantle of the slug, would be far removed from the large external spiral shell of the snail.

But no conchologist groups together his shells strictly and exclusively, according to their resemblances, all the testaceous productions of the Cephalopods, now that the real affinities of these mollusks are known, are arranged in the same group, notwithstanding their striking discrepancies of texture and form, and in their relative size and position to the bodies of their fabricators. so likewise with the shells or their rudiments of the air-breathing Gastropods, or of the Pteropodous Mollusca. In short, every purely conchological system must undergo modifications corresponding with the progress which is made in the knowledge of the true natural affinities of the molluscous animals; and the progress of Conchology is therefore essentially connected with that of *Malacology*, under which term an outline of the most approved classification of the Mollusca and their shells will be found.

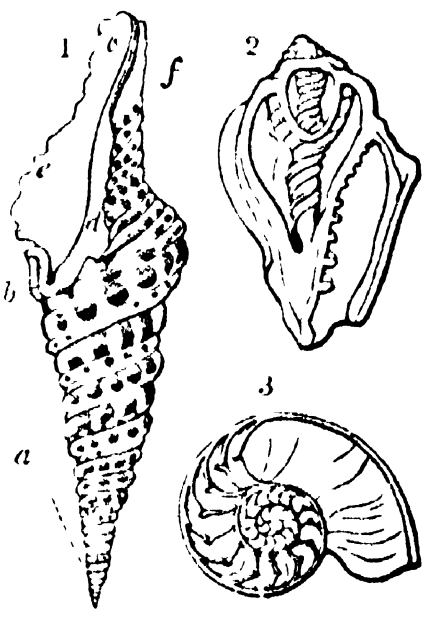
Under the present head will be briefly treated those points which relate to Conchology as a science; viz the development, structure, configuration, and physiological subserviencies of shells.

The formation of a shell commences with the exudation of layers of albumen from the outer surface of the mantle or skin of the embryo mollusk, which is generally followed by the admixture of rhombic or prismatic crystalline particles of the carbonate of lime: and this first-formed shell of the embryo constitutes the nucleus of the shell of the mature mollusk. The nucleus is developed in most cases before the embryo quits the egg-coverings, but it is never "coeval with the first formation of the animal," it is preceded by several distinct stages in the development of the embryo. The subsequent growth of the shell depends upon the deposition of fresh layers to the inner surface of the circumference of those previously formed; beyond which the new-formed layers extend in proportions which determine the figure of the future shell.

Sometimes the calcifying margin of the mantle extends outwards at an obtuse or right angle to the last-formed margin of the shell; and after having deposited a calcareous plate in this position, is retracted and absorbed, to be again similarly produced and extended after ordinary growth has proceeded to a certain extent. It is to this periodical growth of the mantle and plethoric condition of the calcifying vessels that the ridges on the exterior of the shell in the *Venus plicata* among Bivalves, and in the *Scalaria pretiosa* among Univalves, are due. Should the mantle, instead of being uniformly extended, send outwards a number of detached tentaculiform calcifying processes, these will form a row of spines corresponding in length and thickness to the soft parts on which they are moulded; and as the calcifying processes continue to deposit shelly material during the progress of their absorption, the spines, which were at first hollow, thus become solidified, and are soldered to the margin of the shell. This development of calcifying processes or filaments of the mantle and spines may likewise alternate with periods of the ordinary formation of the shell; and thus the exterior of the shell may become bristled with rows of spines, as in some species of *Spondylus*, and in the *Murex crassispina*.

The most simple form of shell is the cone, which may be much depressed, as in the genus *Umbrella*; or extremely elevated and contracted, as in the *Dentalium*; or of more ordinary proportions, as in the limpets (*Patella*). The apex of the cone is oblique and excentric, directed, in the limpets, the argonaut, and the nautilus, towards the head, but in most other mollusks towards the opposite extremity of the body. A shell may consist of one piece, as in the Inoperculat Univalves; or of two pieces, as in the Opercular Univalves and most Bivalves; or of three pieces, as in *Terebratula*, or of four or more pieces, as in some of the *Pholades* and the Multivalves proper, or Chitons. With respect to the operculum, this part is sometimes calcareous, but it consists frequently of albuminous membrane only, or is *horny*, thus presenting the condition which the univalve shell itself presents in certain genera, as *Aplysia*, *Loligo*, &c.

The conical univalve shell is generally spirally convoluted; sometimes, as in the *Nautilus* (*fig* 3), in the same plane, more usually in an oblique direction, as in *fig* 1 and 2. As a general rule, the spiral univalve, if viewed in the position in which its inhabitant would carry it if it were moving forwards from the observer, is twisted from the apex downwards, from left to right, the spire being directed obliquely towards the right (*a*, fig 1, indicates the spiral turns of *Pleurotoma*). In certain genera, as *Clausilia*, *Physa*, the shell is twisted in the opposite direction: such shells are called "perverse," or sinistral. Some species of *Bulimus*, *Partula*, and *Pupa* are sinistral; and a few marine shells, as *Fusus simstrorsus*, also exhibit the reverse of the ordinary disposition of the spire. The part around which the spiral cone is wound is termed the "columella." This is sometimes simple, sometimes plicated, as in the *Voluta musica* (fig. 2); it is also sometimes solid, sometimes hollow: when the latter, its aperture is termed the *umbilicus*. (*f*, fig. 1.)




The opening forming the base of the spiral univalve is bounded by an inner lip *d*, and an outer lip *e*: the inner lip offers a smooth convex surface, over which the foot or locomotive disk of the mollusk glides to reach the ground.

In many Univalves, the aperture of the shell is entire; in others, it is broken by a notch, or perforated by one or more holes; or a portion of it is produced into a canal or siphon (*c*, fig.1); or it may present a pallial notch (*b*, fig 1.) opposite to the siphon). These modifications are important, on account of the constancy of their relation to certain conditions of the respiratory organs: thus the conchologist, in grouping together all the spiral univalve shells of which a part of the margin was either notched or produced into a grooved siphon, would really indicate a very natural tribe of Mollusca, every species of which he might be assured was aquatic and marine, and breathed by means of two gills having a pectinated structure, to which the water is conducted by a fleshy tube. Were a like correlation between the shell and its inhabitant to hold good in other families of Mollusca, the classification of shells

would then be a subject of much importance, and worthy the attention of the scientific naturalist: unfortunately, the reverse of this is frequently the case.

The part called the *operculum*, which is present in certain univalve mollusks, is a plate consisting of layers of sometimes calcified, sometimes uncalcified, albumen, attached to a disk at the back part of the foot, and forming, when this is retracted, a more or less perfect defence to the outlet of the shell.

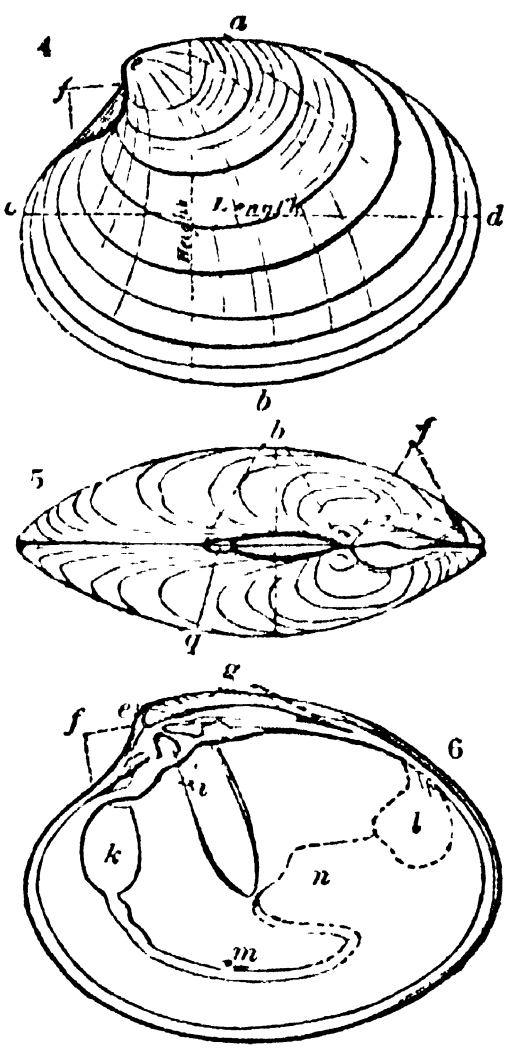
Some opercula increase by the addition of matter to their entire circumference; and these are either concentric, as in *Bithynia* and *Paludina*, or excentric, as in *Ampullaria* and most of the Pectinibranchiate mollusks: other opercula grow by the addition of matter to part of their circumference; and these are either spiral or imbricated. In the latter, the layers of growth succeed each other in a linear series. No operculum presents an annular form. As the operculum sometimes varies in structure in species of the same genus, as, *e.g.*, of *Vermetus*,—since, moreover, this part is inconstant even as to its presence in species of the same genus, as in the Volutes, Cones, Mitres, and Olives, and as some genera in a natural family, as *Harpa* and *Dolium*, among the Buccinoids, are without an operculum, while the other genera of the same family possess that appendage, it obviously affords characters of very secondary importance in a scientific classification of the Univalve Mollusca. Much confusion indeed might have been introduced into the science of Malacology if the opinions of those conchologists who have proposed to classify shells from the modifications of the operculum had been much respected by naturalists.

True bivalve shells are peculiar to the Acephalous Mollusca; and their presence is constant, although they are in a few instances too small to cover the whole of the body, and in the ship-borers (*Teredo*) exist only as small instruments, limited to the function of excavating the burrows inhabited by these mollusks. But all the species in which the bivalve shell is inadequate to the protection of the whole of the body derive extrinsic defence by burrowing in sand, or stone, or wood, and they also commonly line their burrows with a layer of smooth and compact calcareous matter, forming a tube. This calcareous tube, in some cases, is of considerable size and thickness, as in the *Teredo gigantea* or *Septaria* of Lamarck. In the *Clavagella* one valve, and in the *Aspergillum* both valves, are soldered to this tube, which, in the latter, presents a peculiar modification of its exposed extremity, which resembles the end of the spout of a watering-pot. No two shells can present a greater contrast than do those of the *Placuna* and *Aspergillum*, yet the organization of their respective constructors is essentially the same. In a classification of shells, the calcareous tubes of the *Dentalium*, *Scapula*, *Aspergillum*, *Vermetus*, &c., would be associated in the same general group, but it needs only to observe how these products of animals, belonging not only to different classes, but to distinct primary divisions of the animal kingdom, are arranged in the cabinets of collectors, to be convinced that Conchology, as a classificatory science, apart from Malacology, no longer exists.

With regard to the structure and physiological relations of bivalve shells, it may be observed, first, that in all Acephalous Mollusca which breathe by distinctly developed lamellated gills (*Lamellibranchiata*), one valve corresponds to the left, the other to the right side of the animal, but in the Brachiopodous Bivalves, one valve is applied to the ventral and the other to the dorsal aspect of the animal.

In all the Lamellibranchiate Bivalves which are free, the two valves are symmetrical, and the shell is termed *equivalve*, in all those which adhere by one of their valves to foreign bodies, this valve is deeper and larger than the unattached valve, such shells are termed *inequivalve*. Of those Acephalans which are attached to foreign bodies by means of a byssus, some, as *Tridacna*, *Saxicava*, and *Byssoarca*, are equivalve, and both valves are notched, to form the hole for the passage of the byssus, while others, as the *Pectines*, *Aviculæ*, and *Pedæ*, are inequivalve, the byssus passing through a groove in the right valve.

Linnæus, who first introduced precision into the description of shells, defined several points requisite to be noticed in the outer and inner surface of a bivalve shell, but the prurient epithets, which his comparison of the bivalve selected for illustration induced him to attach to those parts, have been abandoned and changed. If the shell of the common cockle (*Cardium edule*) be examined, each valve will be seen to be produced into a conical prominence, bent towards, and nearly meeting at, that part by which the valves are joined together. These prominences are termed the *umbones*. The apex, or beak of the umbo, corresponds to the apex of the univalve shell, and is the point at which the development of the bivalve commences. When the apex is directed in the transverse plane of the shell, and so placed that a bisection of the shell in that plane through the apices shall divide the valve into two equal parts, the shell is termed *equilateral*: of this form the common scallop (*Pecten*) is an example. When, upon a similar division, a slight difference is observed in the two valves, the shell is termed *sub-equilateral;* but where the difference is well marked, it is an *inequilateral* bivalve. When the apex is bent, as is commonly the case, out of the transverse plane, it is always directed more or less towards the anterior part of the shell; if such a Bivalve shell as a *Cytherea* or *Isocardia* be held before the observer, with the umbones directed forwards and the hinge above,—in the position, in fact, in which the living animal would place itself if it were creeping forwards from the observer,—the right valve will of course correspond with the right hand of the observer, and the left with the left. (*Fig.* 4. is the left valve of a *Cytherea*, *a* is the upper or dorsal margin, *b* the lower or ventral margin, *c* the anterior, *d* the posterior margin, *e* the apex of the umbo, *f* the lunule.) Now, if a Bivalve in which the apices have a spiral twist, as an *Isocardia* or *Diceras*, be placed in the above position, and compared with the univalve shell of a *Concholepas* or *Purpura*, it will be seen that the left valve corresponds with the ordinary or dextral spiral Univalve, and the right valve to the perverse or sinistral Univalve. Instances, however, have been met with where the characters of the valves of the Bivalve were reversed, like the occasional exceptions in the "perverse" sinistral Univalves before mentioned.




When the circumference or margin of one valve fits exactly at every part to that of its fellow, it is said to be "regular," or entire; but if it be notched at any part, so as not to come into contact with the corresponding part of the opposite valve, it is "irregular," or emarginate.

With respect to the outer surface of a Bivalve, the parts called *umbones* and *apices* have already been defined, and the upper or dorsal and anterior margins of the valve determined, if we continue our examination of the exterior surface of the Bivalve, we shall find, in most cases, anterior to the apices, a depression of variable extent and depth. This is the "lunule" (*f*, fig. 5.): it may be cordiform, or crescentic, lanceolate, oval, oblong, deep, superficial, &c. Behind the apices is another depression, longer and narrower than the lunule, and which is called the "fissure" (*g*, fig. 5.), and its margins lips. Behind the fissure there is sometimes a small depression, called the "suture" (*h*, fig. 5.). The general more or less convex surface of each valve is called the "venter," or belly, which terminates in the *limb*, circumference, or margin.

The most important part of the margin is that which is modified to form the joint or hinge upon which the two valves open and shut. This part is called the "cardinal edge," and generally presents certain prominences and depressions, the projections of one valve interlocking with the depressions of the other. The projections or "teeth," together with the cavities or "cardinal pits," are very regular in their formation in each genus and species of Bivalve. What is of more importance is, that every modification in the structure of the hinge is generally found to coincide with some recognizable and more or less important difference in the organization of the soft parts; so that conchologists have justly attached great value to the characters derivable from the hinge, especially for the purpose of generic distinctions. When the teeth are situate beneath the apex or centre of the hinge, they are called *cardinal;* when they are removed from the centre of the hinge, they are named *lateral teeth* (*i*, fig. 6.); when two only are present, one is called anterior, the other posterior; when there are three, they are distinguished respectively as the anterior, median, and posterior teeth; but when the hinge is composed of a great number of teeth, it is said to be "serial," as in *Arca*. The direct medium of union of the two valves is a dense fasciculus of elastic

albuminous fibres, generally of a brown colour, called the "ligament," or "elastic ligament." The fibres of this part are attached by their extremities to the two valves, which, in most cases, present a particular depression for their reception. The ligament is always so long as to prevent the actual closing of the valves, except when its elasticity is overcome by a certain force, as by that of the contraction of the adductor muscle or muscles: thus the inorganic power of elasticity is made the direct antagonist of a vital and muscular contraction; and as the patent condition of the bivalve shell is that which the exigencies of the animal most constantly require, it is assigned to a force which can act without ever causing fatigue, while the occasional or protective action of forcibly closing the valves is due to an action under the immediate control of the will or instinctive sensation. The modifications of the internal surface of a bivalve shell are, perhaps, the most interesting and important; as they relate immediately to the structure of the soft parts, and bespeak the general nature of the organization of the animal. Hence they afford the characters by which the habits and structure of an extinct genus may be to a great extent determined.

The adductor muscles leave well-marked impressions on the inner surface. If there be but one muscular impression on a valve, then it belongs to a "*monomyary*" or "unimuscular" Bivalve; and if neither valve of a fossil shell presenting this character have been immediately attached to foreign bodies, then the laws of co-existence warrant the inference that the constructor of such a Bivalve possessed a byssus, and the muscular organ called the foot; but that the foot was developed only to the extent adapted to serve as an instrument for moulding the soft fibres, and regulating the attachment of the byssus.

If each valve of a bivalve shell exhibit two muscular impressions, it proves the species to be "dimyary" or "bimuscular" (*k* is the anterior, and *l* the posterior muscular impression in the *Cytherea*, fig 6), if, moreover, there be a thin small muscular depression beneath the cardinal hinge, we have then an indication that the animal possessed a large foot, organized to serve as a locomotive or burrowing fleshy organ, the retractive muscle of which was inserted in the above depression The line continued between the impressions of the two adductors indicates, by its depth and breadth, the development of the muscular margin of the mantle, and is called the *pallial impression* (*m*, fig 6) If this line be continued uninterruptedly, parallel with the margin of the valve, we may be assured that the animal was either without siphons, or had them of very small size, but if the pallial line be broken by an angular notch (*n*, fig 6) continued inwards before its junction with the posterior muscular impression, then it may be certainly inferred that the animal had well developed muscular tubes or siphons for respiration, with all the concomitant powers and habits. Thus the general organization of the soft and perishable fabricator of a bivalve shell may be as certainly determined by the evidence of its fossilized enduring case, as that of a vertebrate species by the structure of its skeleton. The more immediate affinities of the Bivalve are revealed by the modifications of the hinge

It sometimes happens, however, that the whole of the internal or nacreous stratum of a fossil bivalve shell is destroyed, especially if it have been imbedded in porous chalk; and as the muscular impressions and the articular structure of the hinge are composed exclusively of the inner stratum of the shell, the means of determining the nature and affinities of the animal in that case are lost, and, unless the observer were acquainted with the texture and structure of the bivalve shell, he would run the risk of mistaking the part of a decomposed Bivalve for the whole of some nondescript "Acardian" species, as those Bivalves are termed in which the hinge is naturally wanting.

Each valve of a bivalve shell consists of two strata, distinct in texture and in their organs of formation. the internal stratum is deposited in nearly parallel layers, by the central and posterior parts of the mantle: it forms the smooth iridescent lining of the shell called "mother of pearl;" the outer stratum is secreted by the thick glandular margin of the mantle, and consists of conical fibres, resting obliquely by their apices, or narrower ends, upon the nacreous laminæ. The thickness of the two strata of the shell always preserves an inverse ratio, the outer one being thinnest at the *umbo*, and thickest at the margin; the inner one the reverse.

One hundred parts of oyster shell give—

| | |
|---|---|
| Of carbonate of lime - | - 98·3 |
| Phosphate of lime - | - 1·2 |
| Insoluble animal matter | - 0 5 |
| | 100·0 |

Most univalve shells are composed of three strata, which consist of layers of rhombic or prismatic crystals, differently arranged in the adjoining strata. The chief difference of structure depends on the relative quantity of the animal to the earthy constituents of the shell.

Hunter discovered that the molluscous inhabitants of shells had the power of absorbing a part of the shell previously formed; a fact which has been confirmed by subsequent observers, and which gives rise, in several species, to singular modifications in the form and structure of the shell in the progress of growth. Another change of form is due to the physical decomposition or destruction of a part of a shell: this occurs to the apex of certain Univalves, after they have been evacuated by their original occupant, in the widening and lengthening the shell to accommodate it to an increase of bulk. Such shells are said to be "decollated," as in *Cerithium decollatum*, *Helix decollata*, &c. An analogous partial decomposition always obtains in many *Unones* and *Anodontæ*, of which the "umbones" are then said to be "decorticated," the external coloured layer or bark of the shell being worn away. There is no general law or uniformity in the mode in which the inhabitants of either univalve or bivalve shells dispose of that part of their calcareous abode which they evacuate in the progress of their growth. In the decollated shells, the vacated spire is partitioned off by the formation of a thin nacreous plate; and its walls being thin and fragile, it is then broken away, as above described. In *Vermetus gigas*, the vacated portions of the tube are successively partitioned off, and a series of concave plates or septa developed, but the part of the shell thus divided into chambers, or "camerated," is retained. The *Spondylus varius*, among Bivalves, offers an analogous structure In the pearly nautilus, the vacated portion of the shell is converted into a series of chambers by the development of calcareous septa in greater number and regularity than in any Gastropodous Univalves; and the partitions are perforated by a membranous tube or siphon, and the deserted chambers are converted, by the superaddition of this part, into a hydraulic machine, perfectly adapted to the habits and exigencies of the animal The like structure, with various modifications, obtains in the extensive, but mostly extinct, race of "Siphoniferous" Cephalopods In the argonaut, the vacated spire of the shell is not partitioned off, but is retained in full communication with the inhabited part, and made subservient to the reproductive economy of the species In the *Magilus antiquus*, the posterior part of the shell, as it is deserted, is progressively filled up with a dense, solid, subtransparent crystalline deposit of carbonate of lime. A deposit of similar calcareous material, in a less degree, fills up the deserted spire of the shell in some species of *Cassis*, *Mitra*, *Triton*, &c; and in the long "turreted" shells of the *Terebræ*, *Cerithiæ*, &c the deposition of this dense material in the vacated apex is the preventative, instead of the cause, of decollation.

CO'NCLAVE. (Lat con, *together*, and Gr κλειω, *I shut up*.) The assembly of cardinals for the election of a pope It begins the day following the funeral of the deceased pontiff The cardinals are locked up in separate apartments, and meet once a day in the chapel of the Vatican (or other pontifical palace), where their votes, given on a slip of paper, are examined This continues until two thirds of the votes are found to be in favour of a particular candidate The ambassadors of France, Austria, and Spain have each the right to put in a veto against the election of one cardinal, who may be unacceptable to their respective courts.

CONCLU'SION In Logic, that proposition which is inferred from certain former propositions, termed the premisses of the argument.

CO'NCORD. (Lat. concordia) In Music, the relation of two sounds agreeable to the ear either in succession or consonance.

CONCO'RDANCE (Lat) A biblical index, in which all the leading words used in scripture are arranged alphabetically, and a reference made to the various places in which they occur, for the purpose of enabling the student to collate with facility one passage with another in the view of determining its meaning The importance of this class of works was early appreciated, and a vast deal of labour has been expended in compiling them Concordances have been made of the Greek Septuagint, the Greek Testament, the Latin Vulgate, and the English Old and New Testaments, a full list of which will be found in *Watt's Bibliotheca Britannica*, and in *Orme's Bibliotheca Biblica*. The first Concordance was compiled by Cardinal Hugues de St. Cher, who died in 1262. The best English Concordance is that of Cruden, which appeared in 1737, and still maintains its ground as an authority.

CONCO'RDAT. An agreement or convention upon ecclesiastical matters made between the Pope and some temporal sovereign, as that between Pius VII. and Bonaparte in 1802, by which the Roman Catholic religion was re-established in France; on which occasion the Pope recognized the new division of France into 60 sees, instead of the much greater number which had existed before the revolution, the payment of the clergy from the national revenues, and the appointment of the bishops by the

civil authority. Origiually the term was applied to agreements regulating mutual rights between bishops, abbots, priors, &c. The liberties of the French church were first established by the pragmatic sanctions of Saint Louis (1268), and Charles VII. (1439). In 1516 a concordat between Francis I. and Pope Leo X. divided the privileges of the church between them, and the king assumed the nomination of bishops. The states of Orleans restored their election to the chapters in 1560. The pragmatic sanctions were still considered as forming the base of ecclesiastical law in France down to the revolution.

CO'NCRETE. (Lat. concrescere, *to coalesce in one mass*.) In Architecture and Engineering, a mass composed of stone chippings or ballast cemented together through the medium of lime and sand, usually employed in making foundations where the soil is of itself too light or boggy, or otherwise insufficient for the reception of the walls. The employment of concrete in this country owes perhaps its introduction to Mr. George Semple, the engineer who erected the Essex bridge at Dublin, and who in 1776 published a Treatise on Building in Water; but there is no doubt it was well known at least to the Italian architects, if not to those of higher antiquity. The *riempita* of Palladio, and the instructions in Alberti's 3rd Book, chap. viii., clearly point to what is now called concrete. The essential quality of concrete seems to be that the materials used should be of small dimensions, so that the cementing medium may act in every direction round them, and that the latter should on no account be more in quantity than is necessary for that purpose. Architects and engineers have much varied the proportions of lime and sand used. If the lime, which should be fresh and ground to powder, be good stone lime, such as that from Dorking, used in the neighbourhood of London, it will bear three or four times its measure by bulk of sand. These, and the ballast or gallots, as the stone chippings are called, should be thoroughly turned over and mixed together. If the foundations be wet, the mixture will want very little if any water; indeed sometimes the ballast only is wetted, and then covered over with the lime and sand. It is then filled into the barrows, and run on to be dropped from a stage into the foundations. This latter operation should be performed at as great a height as possible above the level of the trench, in order that the whole of the different particles of the composition may be compressed together so as to occupy the least possible space. The stones employed should not exceed the size of a common hen's egg. The mass very quickly sets and becomes extremely hard. On the top of it, which is kept as level as possible, a tier of what is called Yorkshire stone landings is laid, and very often throughout the lengths a cham of timber is buried in the footings, whose durability is requisite only while the work is setting; over the landings and timber thus laid, the latter, it is to be observed, occupying but a very small portion of the thickness of the footings, and quite buried in them, the walls are carried up.

CONCRETE TERM, in Logic, is so called when the notion derived from the view taken of any object is expressed with a reference to, or as in conjunction with, the object that furnished the notion, as "foolish," or "fool." When the notion is expressed without any such reference, it is called an abstract term; as "folly." (See *Whately's Logic*, p. 124.)

CONCU'SSION. (Lat. concutio, *I shake*.) A term generally applied to injuries sustained by the brain, independent of fracture of the skull, as from blows and falls. More or less insensibility, sickness, impeded respiration, and irregular pulse are the first symptoms, but these subside, and the sufferer often becomes more easy and collected; yet, although the symptoms apparently abate, dangerous inflammation may be going on, and a fatal termination ensue. In all accidents of this kind, where, as is commonly said, persons are *stunned*, the most cautious treatment should be adopted, and no time lost in obtaining skilful professional aid.

CONDENSA'TION. The rendering a body more dense, compact, or of greater specific gravity, by bringing its particles into closer union. The term is commonly applied to the conversion of vapour into fluid by distillation or otherwise. *See* GAS.

CONDE'NSER. An instrument for reducing an elastic fluid of a given mass into a smaller volume. The pneumatic condenser is a syringe by which a large quantity of air may be forced into a given space. It is constructed on the same principle as the air-pump; only the valves are disposed in the contrary order, that is, to open inward instead of outward.

CONDI'TION. In Law, has been defined in the most general sense, "A restraint annexed to a thing, so that by the non-performance the party shall receive loss, and by the performance advantage." It is most commonly used to signify a term whereon a grant is made: *e. g.* grant of an estate to A., on condition that the grantee shall pay such a sum on such a day, or else his estate shall cease. Conditions of this description may be implied by law: as, where tenant for life enfeoffs a stranger in fee simple, he forfeits his estate for the breach, as it is said, of the implied condition not to grant a greater estate than his own. Conditions are *precedent*, when an estate is gained on the performance of them; *subsequent*, when the condition is to be performed after the acquisition of the estate which is lost by its non-performance. But the distinctions between these two classes are numerous and minute. In general, where a condition is of such a nature that compensation can be made for its non-performance, equity will relieve the party breaking it from the consequences of the breach on making such compensation.

CONDI'TIONAL PROPOSITION, in Logic, is one which asserts the dependence of one categorical proposition on another: *e. g.* "If the wind changes, it will rain." The proposition from which the other results is termed the Antecedent; the resulting proposition the Consequent. A conditional syllogism is one in which the reasoning depends on a conditional proposition. It is of two sorts, constructive and destructive; as, 1. If A=B, then C=D; but A = B, therefore C = D. 2. If A=B, then C=D; but C is not equal to D, therefore A is not equal to B. The connection between the antecedent and consequent of a conditional proposition is termed the Consequence.

CONDOTTIE'RI. (It. *leaders*.) In Italian History, a class of mercenary adventurers in the 14th and 15th centuries, who commanded military bands, amounting to armies, on their own account, and sold their services for temporary engagements to sovereign princes and states. One of the earliest and most famous among those leaders was the Englishman Sir John Hawkwood, who commanded in various Italian wars about the time of our Edward III. The bands under command of the Condottieri were well armed and equipped. Their leaders had in many instances considerable military skill; but, as they took no interest in national contests, except to receive pecuniary advantages, the wars between them became a sort of bloodless contests, in which the only object of each party was to take as many prisoners as possible for the sake of the ransom. This singular system of warfare was only put an end to by the more serious military operations of the French, who invaded Italy under Charles VIII. Although many Condottieri acquired much honour as well as emolument, one only attained to high rank and independent power, this was Francesco Sforza, originally a peasant, who in 1451 made himself duke of Milan, and transmitted that sovereignty to his descendants.

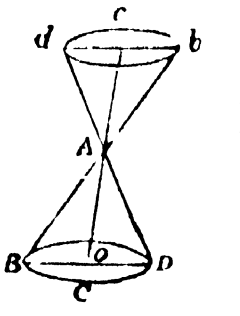
CONDU'CTOR. In Electricity. *See* ELECTRICITY.

CO'NDUIT. (Fr.) In Architecture, a passage of very narrow dimensions, usually subterranean, for the purpose of secret communication between apartments, many of which exist in ancient buildings. Also a pipe for the supply of water to any place.

CO'NDYLE. (Gr. κονδυλος, *a knuckle*.) The rounded head of a bone.

CONDY'LOPEDS, *Condylopoda*. (Gr. κονδυλος, and πους, *a foot*.) A name applied by Latreille to that subdivision of Encephalous articulate animals which have jointed feet: the Acephalous Cirripeds are excluded from this group, which consequently includes the Myriapods, Insects, Arachnidans, and Crustaceans.

CONE. In Geometry, a solid body, having a circle for its base, and terminating in a point, which is called its vertex. The cone may be described as follows:—Suppose a fixed point A without the plane of the circle B C D, and through the point A let a straight line A B indefinitely produced on both sides be drawn, and carried round the circumference of the circle B C D, the two surfaces A B C D and A *b c d* generated by this motion are the surfaces of two opposite or vertical cones. The circle B C D is called the *base* of the cone, and the straight line A O drawn from its vertex to the centre of the base is called its *axis*. If the axis is perpendicular to the plane of the base, the cone is said to be *right*, if the axis is inclined to the plane of the base, the cone is *oblique*. Some of the principal properties of the cone are the following:—The area or surface of a right cone, exclusive of its base, is equal to a triangle of which the base is equal to the periphery of the base of the cone, and altitude equal to the slant side of the cone; or equal to the sector of a circle whose radius is the side of the cone, and its arc equal to the circumference of the base of that solid. It is much more difficult to determine the surface of an oblique cone, which cannot be reduced to the measure of the sector of a circle. The solid contents of a cone, whether right or oblique, are equal to one third of a cylinder having the same base and altitude. The centre of gravity of a right cone is distant from the vertex ¾ of the axis. Sometimes the name cone is given to other solids than those whose surfaces are produced by the motion of a straight line about the circumference of a circle. It is applied generally to all bodies which can be formed in the same manner, assuming any curve whatever for the circumference of the base. The beautiful relation which connects the cone,



the sphere, and the cylinder, namely, that they are to each other in the proportion of 1, 2, and 3, was discovered by Archimedes.

CONE OF RAYS. In Optics, includes all the rays which fall from a luminous point, or from a single point of a luminous object, upon a given surface; for example, the object glass of a telescope.

CONFE'DERACY. (Lat. con, *together*, fœdus, *a league*.) In Politics, an alliance of independent states for a common object: sometimes also, but less properly, of individuals.

CONFEDERA'TION, THE GERMANIC, was formed at the congress of Vienna: the instrument by which it is constituted bears date June 8.1815. This union was framed to supply the want of the ancient imperial government, dissolved in 1806. The constituent members are thirty-four monarchical states and four free cities, which enter the confederation as equal and independent. The diet of plenipotentiaries, which forms the representative body of the league, is permanent, and sits at Frankfort-on-the-Maine. When this diet meets as a *general* assembly (plenum) six states, viz. Austria, Prussia, Bavaria, Saxony, Hanover, Wurtemberg, have four votes each; five other states three each; four two; the rest one; making seventy in all. But in the making of fundamental laws, admission of new members into the confederacy, and on religious questions, unanimity is required. In the *ordinary* assembly of the diet, the votes are so apportioned as to make only seventeen in all: this is the assembly in which propositions are discussed, which are decided without discussion in the plenum. This ordinary diet manages the general affairs of the confederation. Austria presides in both diets. The principal objects of the confederation are, the examination of disputes between its members; mutual protection; reciprocal assistance towards securing internal tranquillity; the establishment of constitutions of estates in all the states; the establishment of certain central courts of appeal; legal equality of Christian sects; an international community of civil rights in some points; and finally, the regulation of the condition of mediatized princes and states. *See* MEDIATIZATION.

CO'NFERENCE. In English Parliamentary usage, a meeting of certain delegated members of the two houses to discuss the provisions of a bill respecting which there is a disagreement between them, usually on the subject of amendments introduced by one and rejected by the other. The principal rules relating to conferences are, 1. That a conference must be demanded by that house which is in possession of the bill. 2. It is the privilege of the House of Lords to name the time and place at which the conference shall be holden. 3. The house which asks the conference must in its message clearly express the subject matter respecting which it is to be holden. 4. It is usual for the house desiring the conference to appoint a committee to draw up reasons to be offered in support of the measure which the house has adopted. These reasons are communicated by its managers (*i. e.* delegates) to those of the other house, and it is irregular for any member to go beyond these reasons, or to speak anything except by way of introduction to their delivery. 5. If the reasons alleged on both sides fail in producing agreement between the houses, what is termed a free conference is demanded, usually after two conferences have been holden without effect. In a free conference the managers are not tied down to follow a particular line of instructions (although they may have received such instructions from their house), but may discuss the provisions of the measure in a more liberal manner.

*Conference* has also been the frequent denomination of meetings of divines for ecclesiastical purposes. The conferences of Hampton Court (1601) and the Savoy (1660), between clergy of the church of England and Puritans and Presbyterians, are well known in English history. The annual meetings of Wesleyan preachers are styled conferences.

CONFE'SSION, AURI'CULAR (Lat. auricula, *ear*), is accounted by the church of Rome part of the sacrament of penance. It must be made to a priest, who is under solemn obligation not to reveal it; and must be of every mortal sin. The Roman Catholics cite several passages of scripture, particularly Matt. iii. 6., Acts xix. 18., and James v. 16., as indirectly establishing this usage; which, however, as an authorized practice of the church, does not appear to be older than about A.D. 1215. Confession is also prescribed by the Greek church. Among Protestants, the Lutherans for some time retained it; but confession to God alone is recognized in our church as preparatory to absolution. (See especially *Bingham, Orig Eccl.* book xviii c 4.)

CONFESSION OF FAITH. A formulary setting forth the opinions held by a religious community. The most important documents of this nature published prior to the Reformation are the Apostles', the Nicene, and the Athanasian creeds. (See these arts.) Since that period the Romanists refer, 1. To the decrees and catechism of the council of Trent, as containing a complete exposition, accompanied by an elaborate defence, of their opinions; 2. To the Creed of Pius IV., published in 1564, which begins with a statement of the Nicene creed, and proceeds to declare briefly and explicitly the additional tenets of the Romish church; 3. The exposition of the Catholic faith by Bossuet, as having been sanctioned by the Pope, is considered of secondary authority.

The most authentic symbol of the Greek church is that which was drawn up in 1642 by Mogila, the metropolitan of Kiow. It was approved with great solemnity by the patriarchs and principal clergy of that communion.

The reformed churches have in almost all cases drawn up summaries of their peculiar tenets, and require their ministers to express their assent to them. The church of England requires subscription upon ordination to the Thirty-nine Articles, and the three articles of the 36th Canon which relate to the supremacy of the King, &c. The Book of Common Prayer and the Homilies are also authorized statements of the doctrine of this community.

The symbolic books of the Lutheran church are numerous. the principal are, the Confession of Augsburgh, drawn up by Melanchthon in 1530; the articles of Smalcald by Luther (1538); the Great and Little Catechisms of Luther (1529); and the Form of Concord (1579). The original symbol of the Scotch church is called the General Confession of the true Christian Faith, which was adopted by the king and nation, together with the Solemn League and Covenant, in 1581. A second was drawn up in 1660 by some of the principal ministers, in consequence of an order in parliament for that purpose. The Confession of the Westminster Assembly (in 1643) was declared in 1690 by an act of parliament to be the national standard of faith in Scotland.

In this country the imposition of formularies for subscription which are conceived in other than the words of scripture has frequently been made a ground of dissent and separation from the English church. The Presbyterians also and Independents have suffered many secessions upon this ground, which is maintained as a clear deduction from the Protestant principle of the right of private interpretation. It may be answered, that a church, like the Romish, which forbids private interpretation, might reasonably enough express its belief in the words of scripture, the meaning of which in its mouth would be sufficiently intelligible, but that a Protestant church, on the contrary, must paraphrase the language of the Bible to make itself understood, and that its alternative must be between a confession of this nature and none at all; and the impracticability of the latter course has been shown by the experience of several minor sects in this country and elsewhere.

CO'NFESSOR (In Greek, *διολογητης*.) In Ecclesiastical History, the title given to those who have undergone persecution for Christianity short of death. They were peculiarly honoured in the primitive church, together with the memory of those who had actually suffered (martyrs). *Cyprian*, Epist. 37. (See *Gieseler's Eccl Hist* 1st Period, 2nd Division, ch. 3.)

CONFI'GURATION. In Astronomy, denotes the position which the planets occupy relatively to each other.

CONFIRMA'TION. The laying on of hands by the bishop, for the conferring of the grace of the Holy Spirit; a rite by which a person arrived at years of discretion takes upon himself the performance of the baptismal vow made for him by his sponsors. This ceremony is derived from the practice of the Apostles, of whom we read (Acts, viii. 16 xix. 16) that after certain disciples at Samaria and Ephesus had been baptized, they laid their hands upon them, and the Holy Ghost came upon them. The descent of the Holy Ghost upon the Apostles themselves on the day of Pentecost is considered also as an example of confirmation succeeding baptism. In the early ages this ceremony seems to have been accompanied very generally with the unction of the forehead. This ceremony is retained by the Roman Catholics, who consider confirmation a sacrament.

CO'NFLICT OF LAWS. The opposition between the municipal laws of different countries, in the case of an individual who may have acquired rights or become subject to duties within the limits of more than one state. In the language of Mr. Burge (*Colonial and Foreign Law*, 1. 5.), "the right or claim which is in contestation before a judicial tribunal may present a conflict between the laws of the country in which he was born, or had a domicile, or had taken up a temporary residence, or in which his property, the subject of the claim, was situated, or in which the act, instrument, or testament on which the claim is founded was executed, or in which the contestation takes place. In this conflict of laws it becomes an important branch of jurisprudence to ascertain which should be selected, and the principles on which the selection is to be made." The following are among the principal works on this subject: — *Rodenburg on the Conflict of Statutes*, an Essay appended to his treatise *De Jure Conjugum; Hortius, De Collisione Legum; Boullenois, De la Personnalité et de la Réalité des Lois*; the

American judge Story's treatise on the *Conflict of Laws*; and the above cited work of Mr. Burge, *Commentaries on Colonial and Foreign Laws generally, in their Conflict with each other and with the Law of England*, 4 vols.8vo. Lond. 1837.

CO'NFLUENT. (Lat. confluens, *flowing together*.) Running together. Applied to eruptive diseases in which the pimples or pustules are not detached, but so numerous as to form confluent patches, or even to cover the whole surface of the body; hence the term *confluent small-pox*.

CONFO'RMITY, OCCASIONAL. The participation of one in any of the observances (more particularly sacraments) of a church from which he dissents. Much controversy existed among the English Dissenters, especially in the reign of Queen Anne, with respect to the lawfulness of occasional conformity.

CONGE'. (Fr.) In Architecture the same sort of moulding as the echinus or quarter-round; also a term used for the cavetto; the former being called the swelling congé, the latter the hollow congé.

CONGE' D'ELIRE. (Fr. *leave to choose*.) The king's writ or license to the dean and chapter to choose a bishop in the time of vacancy of the see; a mere formal proceeding.

CO'NGENERS. Species belonging to the same genus.

CONGE'STION. When there is an unnatural accumulation of blood in the capillary vessels of any part of the sanguiferous system, the organ in which it takes place, and the functions of which are disturbed, is said to suffer under *congestion*: it induces a morbid condition of the vessels of the part affected, which when once established is difficult of removal. Congestion of the brain, liver, or lungs is a frequent effect of fevers, though generally consequent upon a previous morbid condition of the organs.

CONGLO'MERATE. (Lat. conglomero, *I keep together*.) In Anatomy, glands which are made up of many small glands, the ducts of which unite into one, as the salivary glands, are so called. In Botany, the term is applied to flowers closely compacted upon one footstalk.

CONGLOMERATE. In Geology, a rock composed of pebbles cemented together by another mineral substance, either calcareous, silicious, or argillaceous.

CONGREGA'TION. (Lat. congrego, from con, *together*, and grex, *a flock*.) At Oxford and Cambridge the assembly of masters and doctors is so called, in which the ordinary business of giving degrees, &c. is transacted.

CONGREGATION. In Ecclesiastical language, properly an assembly of the people for the purpose of divine worship. Companies of religious persons, forming subdivisions of monastic orders, are styled in the church of Rome congregations. For an account of the congregations of cardinals at Rome, a species of committees for the transaction of business of the see of Rome, see *Enc. Metropol.* art. "Congregation." The "Congregation of the Lord" was an appellation assumed by the first Scotch Presbyterian Dissenters, in contradistinction to the Church of England, which they styled the "Congregation of Satan." They first came into notice in 1557, under the Duke of Argyle, and were at a later period led by John Knox.

CO'NGREGA'TIONALI'STS. A sect of Protestant Dissenters, who arose in this country as early as the reign of Queen Elizabeth, when Robert Brown maintained that every society of Christians meeting in one place for religious worship under its own laws and ministers formed a legitimate and independent congregation. The Congregationalists have been called from their founder Brownists, and in later times Independents. They form a powerful body in England, and are very numerous in America. Each congregation appoints its own ministers by vote, and can remove them at pleasure, and reduce them to the rank of laymen. They believe in the Trinity, predestination, total depravity, particular redemption, effectual grace and final perseverance; and maintain that every congregation of visible saints furnished with a pastor is under no other ecclesiastical jurisdiction whatever. (See *Neal's Hist. Puritans.*) The number of Independent congregations in England and Wales amounts to about 1800. (*M'Culloch's Statistical Account of the Br. Empire.*)

CO'NGRESS. (Lat. congredior, *I go together*.) In Politics, a meeting of the sovereigns of states, or their representatives, for the purpose of arranging international matters. The first general European congress was after the conclusion of the thirty years' war in Germany, at Munster and Osnabrück, 1648, which was followed by the peace of Westphalia. Remarkable general congresses have been — 1. of the Pyrenees, 1659; 2. of Aix-la-Chapelle, 1668; 3. Nimeguen, 1676; 4. Ryswick, 1697; 5. Utrecht, 1713; 6. Aix-la-Chapelle, 1748; 7. Teschen, 1779; 8. Paris, 1782; 9. Versailles, 1785; 10. the Hague, 1790; 11. Rastadt, 1797; 12. Erfurt, 1808; 13. Vienna, 1814, concluded at Paris, 1815; 14. Aix-la-Chapelle, 1818; 15. Troppau, 1820; 16. Laybach, 1821, 17. Verona, 1822.

CONGRESS is also the title of the national legislature of the United States of America. It consists of a house of representatives, and of a senate. The former is composed of members chosen every second year. The qualification of electors is the same with that required in their respective states for electors to the lower house in the state legislature. The number of representatives is apportioned according to the population of each state, and is altered every ten years, when the census is taken by authority. In making this estimate, the slave population is reckoned only at three fifths of its amount. There cannot be more than one representative for 30,000 free persons. The senate is composed of two members from each state: the senators are chosen for six years by the legislature of the state. The house of representatives chooses its own speaker: the vice-president of the United States is, ex officio, president of the senate. Bills for revenue purposes must originate in the house of representatives; but are liable to the proposal of amendments by the senate. The senate has the sole power of trying impeachments; but can only convict by a majority of two thirds of the members present, and its sentence extends only to removal from office and incapacitation for holding it. The regular meeting of congress is on the first Monday in December annually. Every bill which passes the two houses is sent to the president for approval or disapproval; in the latter case, he returns it, with his reasons, to the house in which it originated: if, on reconsideration, it is passed again by a majority of two thirds in each house, it becomes law. The powers of congress are strictly limited, and separated from those of the various state legislatures, by the constitution.

CO'NIC SE'CTIONS. In Geometry, lines formed by the intersections of a plane with the surface of a cone, which assume different forms, and acquire different properties, according to the different positions of the plane in respect of the axis of the cone. There are five species: —

1. If the cone be cut by a plane passing through its vertex, the common intersection of the conical superficies and the plane will be two straight lines meeting in the vertex.

2. If the intersecting plane be parallel to the base, or, in the case of the oblique or scalene cone, if it be so situated as to cut off from the vertex a cone similar to the original cone, the section will be a circle.

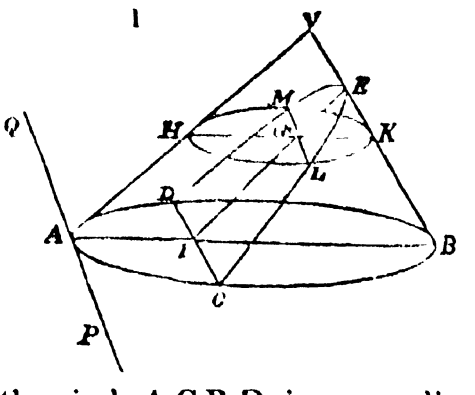
3. If the intersecting plane be parallel to a plane which touches the cone, the section will be a parabola.

4. If the intersecting plane pass through both sides of the cone, and is neither parallel to the base nor to the plane of a subcontrary section, the section will be an ellipse.

5. If the intersecting plane have such a position that, when produced, it meets the opposite cone, the section is a hyperbola.

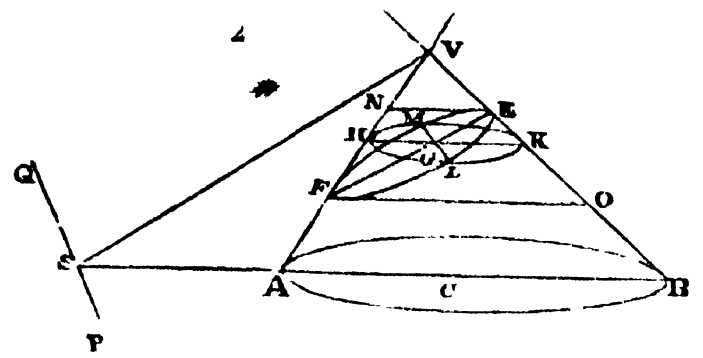
These five are the only lines which can be formed by the common intersection of a plane and the surface of a cone, and they all equally arise from that intersection; but as the straight line and the circle form the peculiar subject of elementary geometry, their properties are usually treated apart, and the three last, namely, the parabola, the ellipse, and the hyperbola, considered as the curves especially designated by the term *Conic Sections*.

Some of the principal and distinctive properties of the curves are easily deduced from this mode of generation.

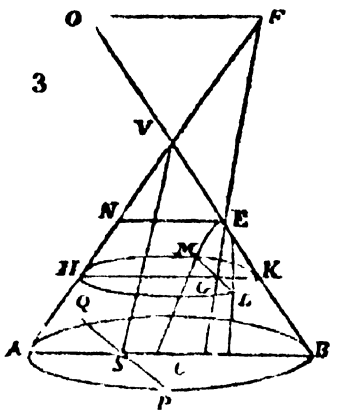



Let V A C B be the cone, and C D E the section made by a plane parallel to the plane which touches the cone in the line V A; then, by the definition, C E D is a parabola. Now let P Q be the intersection of the plane which touches the cone in V A with the plane of the base A C B; then P Q being a tangent to the circle A C B D, is perpendicular to A B, the diameter of that circle, and consequently C D, which is parallel to P Q, is also perpendicular to A B, therefore C F is equal to F D. In F E take any point G, through which let there pass a plane H L K, parallel to the base A C B, intersecting the plane C E D in the straight line L G M; then L M will be parallel to C D, and perpendicular to H K, and L G equal to G M. We have therefore, from the property of the circle, $C F^2 = A F \cdot F B$, and $L G^2 = H G \cdot G K$; therefore since by reason of the parallels V A and E F the line A F is equal H G, $C F^2 : L G^2 :: F B : G K$. But $F B \cdot G K$ $E F \cdot E G$; therefore $C F^2 : L G^2 : \cdot E F \cdot E G$, consequently, since C F and E F are constant quantities, the ratio of $L G^2$ to E G (or of $L M^2$ to E G) is constant; whence we infer that in the parabola the square of any ordinate L G is equal to the rectangle of the corresponding abscis E G into a constant quantity. From this all the other properties of the curve may be deduced. It is in fact the common equation of the parabola. *See* PARABOLA.

For the ellipse and hyperbola, let E M F L be the section; through V draw a plane parallel to E M F L, and




let P Q be its intersection with the plane of the base. Through C, the centre of the base, draw C S perpendicular to P Q, meeting the base in A and B. Let E F be the intersection of the plane E L M with the plane A V B, which passes through the axis of the cone; and in E F take any point G, through which let a plane H M K L be drawn parallel to the plane of the base, the line L M being its intersection with the plane E L M. Lastly, through the points E and F let E N and F O be drawn, meeting the opposite sides of the cone in N and O. Because of the similar triangles, we




have E G : G K :: E F : F O,
and F G : G H :: F E : E N,
therefore E G · G F : G K · G H :: E F² : F O · E N

Now E F² and the rectangle F O · E N are constant quantities, independent of the position of the point G, and G K · G H = G L² (L M being parallel to P Q, and therefore perpendicular to H K); consequently the rectangle E G · G F is to the square of G L in a constant ratio. This property furnishes an equation to the ellipse and hyperbola, from which all the properties of those curves may be deduced. *See* ELLIPSE and HYPERBOLA.

The mutual relations of all the curves to each other may be rendered sensible by supposing the plane V P Q to revolve about an axis passing through V parallel to P Q, and the intersecting plane E M L to accompany it in its revolution, always maintaining its parallelism. Suppose the revolution to commence when the plane V P Q is parallel to the base; in this position the intersection of the cone with E M L is a circle. When V P Q changes its position, and becomes inclined to the plane of the base, the section E M F L (*fig.* 2.) becomes an ellipse. As the plane V P Q continues to revolve, the ellipse becomes more and more elongated, till at length P Q touches the plane of the base (*fig.* 1), when the curve, instead of returning into itself, exhibits two infinite branches, and passes into the parabola. The revolution continuing, the line P Q falls within the base of the cone (*fig.* 3); the section E M L still presents infinite branches, but its axis E G now meets the opposite one in F, the vertex of another section entirely similar and equal to E M L, whence the hyperbola has two pairs of branches, which, from the opposite cones, are called opposite hyperbolas. Suppose that in this position (while P Q falls within the base) the distance between the two planes V P Q and E M L is diminished; as the distance diminishes the curvature of the hyperbolic branches will also diminish; and when the distance vanishes the curvature vanishes, and the two branches pass to a system of two straight lines intersecting each other in the apex of the cone.

The sections of the cone were first studied by the geometricians of the school of Plato. They admitted, however, only the right cone into their geometry; and they supposed the section to be formed by a plane perpendicular to its side. Consequently the three sections were formed from three different cones, the angles at the vertex being right, acute, or obtuse. The parabola was produced from a right-angled cone, the ellipse from an acute-angled cone, and the hyperbola from an obtuse cone. Apollonius of Perga, according to Eutocius, was the first who showed that the three sections may be obtained from every cone, whether right or oblique, and whatever the base angle of its apex, the species of the curve depending on the different inclinations of the plane of the section to the cone itself. It has, however, been established that Archimedes, who flourished about forty years prior to Apollonius, was acquainted with the fact that the three sections may be derived from the same cone. Pappus, in his Mathematical Collections, ascribes to Apollonius the names by which the three sections are designated: the term *Parabola*, however, occurs in the writings of Archimedes.

Although the three curves were first noticed as resulting from the sections of the cone, they still decidedly belong to plane geometry; and their genesis may be defined, and all their properties investigated, without having any reference whatever to the solid. Accordingly many geometers, in modern times, have treated the curves as generated by the motion of points on a plane; and this method has undoubtedly the advantage of relieving the student from the difficulty of conceiving the positions and intersections of different planes, and following out the relations of the lines drawn on them, which become so complicated when represented on the same surface. Dr. Wallis of Oxford, and the celebrated De Witt, seem to have been the first who adopted this method, which has been followed by Dechales, De La Hire, Boscovich, Dr. Simson, and many others. The ancient mode of defining them from the sections of the cone is seldom adopted in the recent treatises.

Various definitions of the curves *in plano* have been proposed. The parabola is usually defined from this property, that the distance of any point in the curve from the focus is the same as its distance from the directrix. For the ellipse and hyperbola the property which has been most generally assumed as the definition is, that if any point be taken in the curve, and straight lines be drawn from it to the two foci, the sum of those lines in the case of the ellipse, and their difference in the case of the hyperbola, is a constant quantity. This property seems to have been chosen rather from considerations respecting the facility of the description of the curves by mechanical means, than from any peculiar advantage which it affords for the investigation of their other properties. It does not indicate the relationship of the three curves, and is in fact not applicable to the parabola, which has only one focus. On this account Boscovich selected a property which gives a definition applicable alike to all the three sections, and from which the general properties common to all of them are established by the same demonstration. It is this — a point and a straight line being given by position on a plane, another point which moves in such a manner in the same plane that its distance from the given point has to its distance from the given straight line a constant ratio, describes a conic section. When the constant ratio is a ratio of equality, the curve traced out by the moving point is a parabola; when a ratio of minority the curve is an ellipse, and when a ratio of majority an hyperbola. This general definition of the conic sections has also been adopted by Thomas Newton, Walker of Nottingham, and Professor Leslie, in their respective treatises.

The different properties of the conic sections may also be investigated by the modern algebraic analysis; and as all the curves are derived from the same cone, so all their equations are included in one general equation, of the second degree, between two variables. The equation of the second degree between the two variables $x$ and $y$, in its most general form, is

$$A y^2 + B x y + C x^2 + D y + E x + F = 0,$$

which, by assigning certain values to the constant coefficients A, B, C, D, E, F, or assuming certain relations to exist among them, becomes the equation of an ellipse, an hyperbola, a parabola, a circle, or that of a system of two straight lines; and it may be demonstrated that whatever be the values of the coefficients, it can only express one or other of those curves. See *Biot's Essai de Géometrie Analytique*, *Hamilton's Analytical System of the Conic Sections*, or the *Traité Analytique des Sections Coniques*, &c. by the Marquis de l'Hopital.

The conic sections have acquired a remarkable interest in modern times on account of their use in natural philosophy and astronomy. A body projected in space, and urged by a central force which varies inversely as the square of the distance, must describe a conic section; and all the planets move in ellipses about the sun. The knowledge of the properties of the ellipse doubtlessly facilitated the discovery of the true nature of the planetary orbits; and hence it has been said, with some appearance of truth, that to the seemingly barren speculations of the Greeks relative to the sections of the cone we are indebted for the sublime theories of Kepler and Newton. A considerable number of the most interesting properties of the curves are demonstrated in the first Book of the *Principia*, where Newton has considered the method of solving this problem — Straight lines and points being given by position on a plane, to describe a conic section which shall pass through the given points and touch the given straight lines.

Treatises on the conic sections are exceedingly numerous; in fact there is no part of the mathematics which has been more studied by geometricians, both ancient and modern, than the properties of these curves. To the ancients they furnished an excellent field for the exercise of their elegant geometrical analysis; and the more difficult investigations of series for their quadrature and rectification have given occasion to some of the most elegant applications of the modern calculus. The following are some of the principal geometrical treatises — *Apollonii Pergæi Conicorum Libri Octo*, &c., Oxford,

1710, by Dr. Halley; Viviani's two works—1. *De Maximis et Minimis Geometrica Divinatio*, 2. *De Locis Solidis Secunda Divinatio Geometrica; De La Hire's Sectiones Conicæ*, Paris, 1685; *Hamilton, De Sectionibus Conicis Tractatus Geometricus*, Dublin. 1758; *Simson's Treatise*, in Latin and English; *Robertson's* ditto; *A short Treatise on the Conic Sections*, by the Rev. T. Newton, Cambridge, 1794; *Walker's Treatise*, London, 1794; *Leslie's Treatise on Lines of the Second Order; A Geometrical Treatise on the Conic Sections* by Professor Wallace, Edinburgh, 1837, &c. &c.

CONI'DIA. (Gr. κονις, *dust.*) A term sometimes used in describing lichens, to denote the bodies which constitute the powdery matter called *soredia*, lying upon the surface of the thalli. By others they are called the *propagula*.

CONI'FERÆ. (Lat.) In Botany, a natural order of arborescent or shrubby Gymnosperms, inhabiting most parts of the world, and usually both resinous and evergreen. Their real organization was, for a long period, but little understood, until Brown discovered that the ovules of the entire order are naked. No other race of plants can be named of more importance to mankind than this,—first, for their resinous secretions, as turpentine, pitch, Canada balsam, &c.; and secondly, for their timber, which is used under the names of fir, pine, deal, cedar, sandarach, and many others. All the kinds of fir, cedar, juniper, pine, savin, cypress, and arbor vitæ, are species of genera belonging to this order, which appears from geological evidence to have existed in great abundance among the earliest vegetation that clothed the surface of our planet.

CONIRO'STERS, *Conirostres*. (Lat. conus, *a cone*, and rostrum, *a beak.*) A tribe of Insessorial birds or perchers, including those which have a thick robust conical beak, as the crows and finches.

CONISTE'RIUM. (Gr κονιστηριον.) In Ancient Architecture, a room in the gymnasium and palæstra, wherein the wrestlers, having been anointed with oil, were sprinkled over with dust, that they might lay firmer hold of their antagonists

CO'NITE. (Gr. κονις, *powder*) A silicious carbonate of lime, found associated with certain zeolites, in the form of a white powder.

CONJOINT DEGREES. In Music, a term used of two or more notes which immediately follow each other in the order of the scale.

CONJOINT TETRACHORDS. In Music, two tetrachords or fourths, in which the same note is the highest of one and the lowest of the other.

CONJUGA'TION. (Lat.) In Grammar, is to verbs what *declension* is to substantives—the sum total of the inflexions which they admit, corresponding to the various circumstances of time or mood under which an action is conceived to take place.

CONJU'NCTION In Grammar, that part of speech which expresses the relation of propositions or judgments to each other *See* GRAMMAR

CONJU'NCTIVE MOOD. That modification of the verb which expresses the dependence of the event intended on certain conditions. *See* GRAMMAR.

CONNARA'CEÆ. (Connarus, one of the genera.) In Botany, a natural order of shrubby or arborescent Exogens inhabiting the tropics, and only distinguished with certainty from *Leguminosæ* by the radicle being remote from the hilum. they approximate very closely to the Cæsalpineous section of *Leguminosæ*, but their want of stipules and regular flowers will usually be sufficient to distinguish them from the great mass of the Papilionaceous section.

CONNI'VENT. (Lat. conniveo, *I wink.*) A term used figuratively by botanists in describing the direction of organs, to denote a gradual inward direction, as in many petals. It is the same as converging

In Anatomy, the term is applied to those valvular folds of the lining membrane of canals which are so disposed as to retard, while at the same time they permit, and, as it were, connive at, the passage of the contents of such canals as the "valvulæ conniventes" in the human intestine.

CO'NNOISSEU'R. (Fr. connoître, *to know.*) In the Fine Arts, one who is versed in a knowledge of the fine arts His qualifications are so numerous, that very few sound connoisseurs have appeared, and in nine cases out of ten these come under the description of a well-known Italian author of being "conoscitori senza cognizione."

CONOBE'LIX. A genus of shells, intermediate between the *Cones* and *Volutes*.

CO'NOPS. (Gr. κωνωψ, *a gnat.*) A Linnæan genus of Dipterous insects, characterized by having an elongated, slender, pointed proboscis. It is at present subdivided into the genera *Bucentes*, *Prosena* and *Stomorys*, *Myopa*, *Zodion*, and *Conops* proper: the larvæ of the latter subgenus are developed within the abdominal cavity of the humble bees, and other Hymenoptera.

CONSCIENCE, COURTS of, and of REQUESTS, were courts for the recovery of small debts. The jurisdiction of these courts arose out of various statutes, beginning with 1 J. I. c. 14., their original appointment having been by order in council under Henry VIII. But these courts have been recently abolished, and have been replaced by the county courts, whose jurisdiction extends to the recovery of debts under 50*l.*, and ten of which are situated within and around the metropolis.

CO'NSCRIPT. (Lat. conscribo, *I enroll together with others.*) *Patres Conscripti*, or *Fathers Conscript*, A title of the Roman senators; properly of those who were added to the senate subsequently to the expulsion of the kings.

CONSCRI'PTION. The compulsory enrolment of individuals for military or maritime service, taken from the population at large. The conscription, in the Roman commonwealth, was made not by lot, but by arbitrary selection by the consuls from among the bulk of the citizens when a levy was required. In France the conscription was established during the revolution, before which period the armies of that country had been recruited by voluntary enlistment. The word is first used in a law of 1798. According to the law as at present established, all citizens are liable to the conscription at the age of twenty. Each arrondissement has its contingent allotted to it out of the total number required for the service, and this number is filled up by lot from the youths liable to the conscription. There are, however, various claims for exemption recognised by the law. The legal duration of the service is seven years.

CONSECRA'TION. (Lat. sacer, *holy.*) The act of setting apart a person or thing to the service or worship of God: thus a newly built church is consecrated with certain ceremonies, varying in different communities. The admission of a bishop to his office is called his consecration.

CONSE'NTIAN GODS. A term by which the Latins distinguished their twelve chief deities—Juno, Vesta, Minerva, Ceres, Diana, Venus, Mars, Mercury, Jupiter, Neptune, Vulcan, and Apollo. The origin of these deities was Italian, and distinct from those of the Greeks; but as the literature of Rome took its tone and colour from Greece, so its mythology was mixed up with that of the latter country, those deities whose functions most resembled each other being confounded, till the above names became regarded as nothing more than the Latin appellations of the Greek divinities.

CONSE'RVATORY In Horticulture, is a glazed structure, in which exotic trees and shrubs are grown in a bed or floor of soil It is distinguished from an orangery by its having a glazed roof, while that of the latter is opaque, and from a greenhouse by the plants being planted in the free soil, and thus growing up from the floor, while in the greenhouse the plants are grown in pots placed on shelves, or on a stage or series of shelves, rising one above another Above a century ago, for example, in the time of Evelyn, the term conservatory was applied to those garden buildings now called orangeries, and in modern horticulture employed only for the preservation of exotic plants, such as orange trees, &c., which are in a dormant state during winter. The greenhouse and the modern conservatory were then not in existence. They are exclusively employed for the preservation of plants which are in a growing state during winter. The largest conservatory in the world, at the present time (1841), is that erected at Chatsworth in Derbyshire, for palms and other tropical plants, which covers above an acre of ground, and is sixty feet high. There are very handsome conservatories for Cape and Australian plants at Alton Towers, and other places.

CONSIDERA'TION. In Law, is the material cause of a contract, without which it is not binding on the party Consideration is said to be either expressed or implied. An express consideration is where the motive or inducement of the parties to the contract is distinctly declared by its terms; as where a man bargains to sell his land for 100*l.* It is implied, where an act is done, or a legal demand forborne, at the request of another, without an express stipulation: in which case, the law presumes an adequate compensation for the act or forbearance to have been the inducement of the one party, and the offer of the other; as where a person comes to an inn and makes use of it, intention to pay for the accommodation is presumed. Consideration is also either "valuable," that is, for money or an equivalent; or it is "of natural affection," certain degrees of relationship affording in some cases sufficient consideration for a gift.

CONSI'STORY. (Lat. consistorium, said to have been the private councillors of the Roman emperors.) An assembly of ecclesiastical persons; also certain spiritual courts are so called which are holden by the bishops in each diocese. At Rome the consistory denotes the judicial court constituted by the college of cardinals The representative body of the reformed church in France is styled Consistory; a title and assembly originated by Calvin. There is now, or should be, according to law, a consistory for every 6000 Protestant souls, consisting of the pastor or pastors, and from 6 to 12 elders. The consistory names the pastor. There are now 88 reformed

consistories in France (not including the Lutheran churches).

CONSI'STORY COURT. The chancellor of every archbishop and bishop is the judge of this court in England, and a commissary is appointed for places remote from the consistory. *See* ECCLESIASTICAL COURTS.

CO'NSOLE. (Ital.) *See* ANCONES.

CONSO'LIDATED FUND. Down to 1816, the exchequers of Great Britain and Ireland were kept separate, certain portions of the public revenue arising in each kingdom being especially appropriated to the discharge of the interest on its own debts, and other peculiar purposes. But on January 5th, 1816, the separate exchequers were consolidated into one; and an act was at the same time passed consolidating certain portions of the joint revenue of Great Britain and Ireland into one fund, hence called the Consolidated Fund, and providing for its indiscriminate application to the payment of the public debts, civil lists, and other specified expenses of both kingdoms. Some portions of revenue are not included in this fund; but it embraces by far the largest part of the public income. Thus, in 1838, of a total nett income of 47,333,460*l*., the consolidated fund included no less than 44,144,438*l*.: the expenditure on account of the peculiar charges to be defrayed by the fund during the same year amounted to 31,742,918*l*., leaving a surplus of 12,401,570*l*. applicable to other objects. (*Farman on the Funds*, 7th ed. p. 196.; *Parl. Paper*, No. 149. Sess. 1839, &c.)

CO'NSONANCE. (Lat. consonans, *sounding together*) In Music, the agreement of two sounds simultaneously produced, the one grave and the other acute.

CONSONANT. *See* LETTER, VOWEL.

CO'N SORDI'NI. (Ital.) In Music, a direction to perform the passage, if on a pianoforte, with the dampers down, or on a violin with the mute on, it is usually written short, C. S.

CONSPIRACY. (Lat conspiratio, *agreement*) In Law, is in the strictest sense an agreement of two or more persons falsely to indict one, or procure him to be indicted, for felony; who, after acquittal, may have his writ of conspiracy. In a more general sense, many species of combinations to injure another are termed conspiracies; as to procure one to be arrested, to defraud under certain circumstances, &c. Conspiracy is an indictable offence, and two at least of the persons indicted must be found guilty to produce a conviction, as otherwise the offence is not proved against any one. Combinations of workmen to regulate the rate of wages, prior to the 6 G. 4. c. 129, were commmonly termed conspiracies.

CO'NSTABLE. A high officer in the monarchical establishments of the middle ages. (Lat. comes stabuli, *count of the stable*.) In France, the first dignitary under the crown, commander-in-chief and supreme military judge. In that country the office was abolished in 1627, as conferring powers too dangerous in the hands of a subject. In England the last permanent lord high constable was Edward Stafford, Duke of Buckingham, whose office was forfeited to the crown by his attainder in 1522, since which time it has only been occasionally conferred on particular emergencies. The title is supposed to have originated in the Lower Empire. (*Ducange*, *Gloss.*)

CONSTABLE. A constable is an officer particularly charged with the preservation of the peace, either within the hundred, where he is called high constable, or within the parish or tything, where he is called petty constable, and where he has generally superseded the tything-man. The duties of the high constable respecting the preservation of the peace are now merely nominal; but he is still of use to represent the hundred in certain legal actions, and to perform certain ministerial offices connected with the administration of justice, as, for instance, the return of jurors, which originally devolved upon the bailiff of the hundred. The functions of petty constable are still of great and daily importance. It is his business, in the first place, to interfere upon his own authority, and if necessary by apprehension of the offender, whenever a breach of the peace or other more serious offence is committed in his presence, or whenever he has sufficient information of a felony; and, in the next place, to execute all such warrants apparently and upon the face of them legal as shall be committed to his hands by competent authorities. He has a right, when impeded in the execution of his duty, to call upon bystanders for assistance, and has the power in case of sickness or disability to appoint a deputy to execute warrants in his stead. Constables were anciently appointed, and still might legally be so, by the jury of the leet; but high constables are now appointed either at quarter sessions or by the justices of the hundred out of sessions, and petty constables are annually sworn in to the office at quarter sessions for each parish upon presentment of the vestry; and the person so presented is compellable under the penalty of fine and imprisonment, except in recognized cases of disability or exemption, to serve the office. A *special* constable is a person appointed to act as constable upon a particular occasion; and any two magistrates have, in case either of actual or apprehended riot, the power of calling upon all persons who would be liable to serve as petty constables to act as special constables, and their refusal is punishable in the same manner as in the case of the former office. Constables are frequently appointed in pursuance of particular acts of parliament, as the police constables in London. (*Burn's Justice*, tit. "Constable;" *Viner's Abridgment*.)

CONSTELLA'TION. (Lat. con, *together*; stella, *a star*.) In order to distinguish with greater facility the different stars, it has been the practice of observers, from time immemorial, to separate them into groups or clusters, which have received the name of *constellations*, and been represented by the figures of men or animals, or other sensible objects to which they were fancied to have some resemblance. Hipparchus called them *Asterisms*, Aristotle and Hyginus, *Bodies*, Proclus, *Animals*, others, *Meteors*; but the term Constellation has been long established by general usage. The origin of these figures and names is involved in impenetrable obscurity. By most authors the twelve constellations of the zodiac are supposed to have been established about 1700 years before our era, either by the Egyptians or the Chaldeans. Dupuis supposes them to have had an incomparably more ancient origin, and that their names are significative of the climate of Egypt at the epoch when the solstice was in Capricorn; that is, about 15,000 before Christ. But even on this hypothesis, namely, that the names of the zodiacal constellations, or *signs*, as they are frequently called, are significative of the seasons, it may be supposed that reference was made to the sign opposite to the sun, instead of that which the sun occupied; in which case the origin of the names would be referable to an epoch preceding our era by about 2000 or 3000 years. This arises from the motion of the equinoctial points, which regress or go backward annually among the stars, accomplishing half a revolution in about 12,500 years.

Hipparchus was the first who constructed a catalogue of the stars from exact observations. It has been preserved to our own times in the *Almagest* of Ptolemy, and contains 1022 stars, distributed among 48 constellations; namely, 12 in the zodiac, 21 to the north of the zodiac, and 15 to the south. Stars which were not comprehended in any of the constellations (and it is evident that there must be many such) were called by a Greek term signifying *unformed*, that is, not entering into the *forms* of the constellations. Several have been added in modern times, as the stars of the southern heavens became better known. A much better idea may be formed of the figures and relative positions of the constellations by [illegible] a common celestial globe, than from any description, however detailed.

The 48 constellations of Hipparchus are as follows:—

In the zodiac 12 — *Aries*, *Taurus*, *Gemini*, *Cancer*, *Leo*, *Virgo*, *Libra*, *Scorpio*, *Sagittarius*, *Capricornus*, *Aquarius*, *Pisces*.

In the northern hemisphere 21 — *Ursa Minor* (the Little Bear), *Ursa Major* (the Great Bear), *Draco* (the Dragon), *Cepheus*, *Bootes*, *Corona Borealis*, *Hercules*, *Lyra*, *Cygnus* (the Swan), *Cassiopeia*, *Perseus*, *Auriga* (the Waggoner), *Ophiucus* or *Serpentarius*, *Serpens*, *Sagitta* (the Arrow), *Aquila* (the Eagle), *Delphinus* (the Dolphin), *Equuleus* (the Horse's Head), *Pegasus*, *Andromeda*, *Triangulum* (the Triangle).

In the southern hemisphere 15 — *Cetus* (the Whale), *Orion*, *Eridanus*, *Lepus* (the Hare), *Canis Major* (the Great Dog), *Canis Minor* (the Little Dog), *Argo* (the Ship), *Hydra*, *Crater* (the Cup), *Corvus* (the Crow), *Centaurus*, *Lupus* (the Wolf), *Ara* (the Altar), *Corona Australis* (the Southern Crown), *Pisces Australis* (the Southern Fish).

To the above 48 constellations of Hipparchus, 12 near the south pole were added by Bayer, and represented in his *Uranometria*, the first edition of which appeared in 1603. These were, *Indus* (the Indian, or Indian Triangle), *Grus* (the Crane), *Phœnix*, *Apis* or *Musca* (the Bee), *Triangulum* (the Southern Triangle), *Avis Indica* (the Bird of Paradise), *Pavo* (the Peacock), *Pica Indica* (the Toucan), *Hydrus* (the Hydra), *Dorado*, *Piscis Volans* (the Flying Fish), *Chamelcon*. The two constellations, *Coma Berenices* (Berenice's Hair) and *Antinous*, were formed by Tycho Brahé; the first comprehending some of Ptolemy's unformed stars near *Leo*, and the second of others near *Aquila*. They are given in the catalogue of Riccioli, published in his *Astronomy Reformed* in 1665.

In the *Planisphærium Stellatum* of Bartschius, published in 1624, the eight following constellations are found, and said to have been formed by the moderns in that part of the heavens which is visible in Europe — *Camelopardalis* (the Giraffe), *Tigris*, *Jordanus*, *Vespa* (the Wasp), *Columba Noachi* (Noah's Dove), *Monoceros* (the Unicorn), *Rhombus* (the Rhombus or Rhomboid), *Gallus* (the Cock). The same constellations are met with in the Celestial Charts of Royer, published in 1679, with the exception of *Gallus*. *Vespa* is also changed into *Lis* (the Flower-de-luce), and *Crux* (the Cross) added.

In the Charts of Hevelius, entitled *Firmamentum Sobiescianum*, and published in 1690, we find 10 new constellations — *Canes Venatici* (the Greyhounds, Asterion, and Chara), *Lacerta* (the Lizard), *Leo Minor* (the Little Lion, in place of *Jordanus*, mentioned above), *Lynx* (instead of *Tigris*), *Sextans* (the Sextant of Urania), *Scutum Sobiescianum* (Sobieski's Shield), *Triangulum* (the Little Triangle), *Vulpecula et Anser* (the Fox and Goose), *Cerberus*, and *Mons Mœnalus*.

To the above *Cor Caroli* (the Heart of Charles II.) was added by Flamsteed, and *Robur Carolinum* (the Oak of Charles) by Halley.

Notwithstanding the additions already made to the constellations in the southern hemisphere since the time of Ptolemy, Lacaille found so many clusters of unformed stars, while observing at the Cape of Good Hope, that he added to the list no fewer than 14 new constellations, to which he gave the following names — *Officina Sculptoria* (the Sculptor's Workshop), *Fornax Chymica* (the Chemical Furnace), *Horologium* (the Clock), *Reticulus Rhomboidalis* (the Rhomboidal Net), *Cælum Scalptorium* (the Graver), *Equuleus Pictoris* (the Painter's Easel), *Pyxis Nautica* (the Mariner's Compass), *Octans Hadleianus* (Hadley's Octant), *Machina Pneumatica* (the Air Pump), *Circinus* (the Compass), *Quadra* (the Square), the *Telescope*, the *Microscope*, and *Table Mountain*. Some still more recent additions have been proposed, particularly by Bode; among which are the *Honours of Frederic*, the *Sceptre of Brandenburg*, *Herschel's Telescope*, &c.; but they do not seem to be generally used in astronomical catalogues.

If the question were to be asked, What good purpose can be served by this multiplication of arbitrary divisions and fantastic names? we apprehend that no very satisfactory answer could be given. Astronomers doubtless find it convenient to classify the stars under certain divisions, but when the number of divisions becomes so great as to be remembered with difficulty, the advantage disappears. The arbitrary nature of the divisions also leads to great inconvenience, inasmuch as they are liable to much uncertainty, and frequent change of boundary. Not only have the names in several instances been changed, but it seems to have been a common practice with astronomers and chart-makers to take stars from one constellation and give them to another, without any other rule than that of pleasing their own fancies. On this account it is frequently extremely difficult to identify stars (particularly in the southern hemisphere) in the different catalogues. It is to be wished that the whole of the constellations (excepting perhaps the 48 of Hipparchus and Ptolemy) were obliterated from our celestial charts and globes, and that observers in describing the places of the stars would confine themselves to a simple statement of their right ascensions and declinations, at least until some better arrangement and nomenclature shall have been devised and agreed upon.

CONSTITUENT ASSEMBLY. In French History, the first of the national assemblies of the revolution; elected in 1788 as the states-general, dissolved in 1791 after proclaiming the constitution of that year.

CONSTITU'TION. The collective body of the fundamental laws of a state, either contained in written documents, or established by prescriptive usage. Constitutions have been divided into three kinds by political writers. — 1. Those granted (octroyees) by monarchs to their subjects, 2. Those springing out of rights enjoyed independently by the people, or classes of the people, which in monarchical countries are recognised by the sovereign in his contract with the people; 3. Those founded on compact between sovereign powers, *i.e.* federal constitutions. In a certain sense, all states in which the power of a sovereign over his people, or classes of his people, is limited by law or legal usage in any particular, may be said to possess pro tanto a constitution; but, in ordinary language, only a government in which the power of legislation, or that of granting and withholding supplies to the sovereign, is vested in the people, or a body of representatives elected by them or by a class of them, is termed constitutional. Constitutions have again been divided into — 1. Those in which legislative power is exercised directly by the people (as in some small modern commonwealths, and in all the free states of antiquity); and, 2. Representative constitutions. The last again, as prevailing in modern Europe and America, has been divided historically into — 1. Those which have originated from compact between several independent interests, as the sovereign, clergy, nobles, and commons, in feudal kingdoms; 2. Those formed artificially, in modern times, on the model of the British constitution; which, although arising out of the same causes which produced the feudal constitutions, assumed in the course of time a different and more comprehensive character.

CONSTITU'TIONS. In Roman Law, decrees of regular authorities, as prætors, &c.; more particularly decrees of the emperors, whether by decree, edict, or letter.

CONSTITUTIONS, APOSTOLICAL. An ancient code of regulations respecting the doctrine and discipline of the church, said by some to have been promulgated by the Apostles, and collected by Clemens Romanus. They appear to have been at one time admitted into the canon of Scripture. Their authenticity has been a subject of much dispute. They have been printed together with the so-called Canons of the Apostles. (See *Cotelerii Patres Apostolici*, vol. i.; *Krabbe's Dissertations on the Apostol. Constitutions and Canons*, Hamb. and Gotting. 1829; *Gieseler, Eccl. Hist.* 1 Period, 3 Div. § 66.)

CONSTRI'CTOR. (Lat. constringo, *I squeeze*.) A name applied to the larger serpents, which overcome and destroy a struggling prey by throwing themselves round it in overlapping folds, and crushing it by their muscular force. The *Boa Constrictor*, properly so called, is a native of South America, having anal hooks, and a single row of subcaudal scutæ.

CONSTRU'CTION. (Lat. con, *with*, and struo, *I pile up*.) In Architecture, literally the building up from the architect's designs; but amongst architects it is more particularly used to denote the art of distributing the different forces and strains of the parts and materials of a building in so scientific a manner as to avoid failure and ensure durability.

CONSTRU'CTION OF EQUATIONS, in Algebra, is the representing of the roots of equations by means of the intersections of geometrical lines. The roots of any algebraic equation may be represented by the intersection of a straight line with a curve of the same dimensions as the proposed equation, the roots of the equation being the ordinates of the points of intersection. An equation of any degree may also be constructed by means of two curves, whose dimensions, multiplied together, produce the dimensions of the given equation. Thus, a quadratic equation may be constructed by the intersection of a straight line with a circle, or with any conic section; a cubic equation by the intersection of a straight line with a line of the third order, a biquadratic by the intersection of a straight line with a line of the fourth order, or by means of two conic sections.

CO'NSUBSTA'NTIA'TION. The term by which Luther expressed the opinion which he held upon the nature of the elements in the Eucharist, as distinguished from Transubstantiation, the doctrine of the Romanists. The latter assert, as the word they use implies, that the bread and wine are changed into the body and blood, and lose their former substance, although they retain its appearance miraculously to the senses. The Lutherans deny this change, but affirm that while the bread and wine do still remain in their natural substance, the body and blood are at the same time transfused into them, and thus that both are actually partaken of together. Calvin says, "I assert that the body of Christ is really (as the usual expression is) that is, truly given to us in the sacrament, to be the saving food of our souls — the Son of God offers daily to us in the holy sacrament the same body that he once offered in sacrifice to his Father, that it may be our spiritual food. If any one ask me concerning the manner, I will not be ashamed to confess that it is a secret too high for my reason to comprehend, or my tongue to express." A reformer of the English church would have said probably that the Romanist is decidedly in error, for the mystery that he maintains exceeds even the literal interpretation of the scripture language. Upon the truth of the Lutheran hypothesis he would decline to express an opinion, not denying the possibility of consubstantiation, but neither presuming to define the manner of Christ's presence in the elements; and he would rather recognize in the language of Calvin a right appreciation of the verity of our Saviour's expressions, and a just perception of the nature of a mystery.

CO'NSUL. In Politics, a public officer whose functions partake of the diplomatic and commercial characters. Such officers appear to have been first employed by the Italian republics, to protect their merchants engaged in trade in the cities of the Levant. The consuls of European states in that region, and in Africa, are at the present time officers of more importance than those established in the cities of Christendom; as they exercise, according to treaties, civil jurisdiction over the citizens of their respective states. In general, the consul is not regarded as a minister or diplomatic functionary, and is subject to the civil authorities of the place where he resides. A resident English merchant, acting here as consul of a foreign country, is not exempt from arrest on mesne process. English consuls are now under the regulations of stat. 6 G. 4., by which they are made salaried officers, and the fees which they are still allowed to take are specified. (See *M'Culloch's Com. Dic.*)

CO'NSULARS. The title given to Roman citizens who had been dignified with the office of consul, and consequently were honoured with a certain precedence in the senate.

CO'NSULS. The supreme magistrates of Rome after the expulsion of the kings. Their number was two, and the period of their office one year; but there was no re-

striction as to the number of times the same individual might be elected. The power of the consuls was nearly the same as that of the kings; *i. e.* they were the supreme executive officers, but had no legislative authority. In time of war it was highest, they then levied the armies, and led them in person against the enemy. The consuls were originally chosen only from the Patricians, but afterwards from the Plebeians also. The age required by law was 43 years; but besides this it was requisite to have passed through the inferior offices of quæstor, ædile, and prætor. They were elected at the Comitia Centuriata, some months before their entrance into office, which took place at different periods of the year at different times, but finally in January, during which interval they were termed *consules designati*, or appointed consuls Soon after their entrance into office they cast lots about the provinces to fall to the share of each, the superintendence of which was conferred on them by the senate. Under the emperors the nominal office of the consulate was preserved, but its substantial power destroyed; the elections also became merely forms, the emperor appointing whom he pleased. Then too the custom was introduced of having several sets of consuls in one year, those admitted on the first day, however, gave their name to the year, and were distinguished from the others, who were termed *suffecti* (*i. e.* substituted), by the title *ordinarii* (*i. e.* regular) Persons also were sometimes dignified merely with the title without enjoying the office, and were then styled honorary consuls. Under Justinian (A U 1294) the year ceased to be denominated by the name of the consul

CONSULS, in French History, were the persons (Bonaparte, Sieyes, and Ducos) to whom, after the dissolution of the Directory in November 1799, was entrusted the provisional government of the country, and at whose suggestion it was agreed that France should be permanently subjected to consular authority. According to the constitution framed on this suggestion, Bonaparte, Cambaceres, and Lebrun, called first, second, and third consuls, were elected by the conservative senate each for ten years, and invested with different degrees of authority. But the senate having passed various decrees curtailing the powers of the second and third consuls and augmenting those of the first, by which the government was gradually assimilated to a monarchy, after the lapse of four years and a half an easy transition was made from the consular to the imperial form, the title of emperor was substituted for that of consul; and the exercise of the sovereign authority, which indeed had been only nominally shared with his colleagues, delegated exclusively to Napoleon Bonaparte

CO'NSULTA'TION (Lat), in ordinary Legal language, is a meeting of the counsel engaged by a party to a suit, for the purpose of deliberating on the best mode of proceeding in the case.

CONSULTATION, WRIT OF. In Law, a writ granted by the king's court, whereby a cause which had been removed into such court by prohibition out of the ecclesiastical court is returned thither again. It is so called because it issues in consequence of the judges, on consultation, having found that the suggestion on which the prohibition was granted is false or not proved. *See* PROHIBITION.

CONSU'MPTION. (Lat. consumo, *I waste away*) This term is commonly applied to a diseased state of the lungs, attended by emaciation, debility, cough, hectic fever, and purulent expectoration. It may be produced by a variety of causes, but hereditary disposition and scrophulous habit are leading causes which predispose to its most alarming form, namely, that which arises from tubercles in the lungs. Its first symptoms are cough; at first dry, but afterwards attended by mucous expectoration, difficult breathing, lassitude, and impaired appetite. These are succeeded by more copious expectoration of viscid or purulent matter, sometimes streaked with more or less blood; greater difficulty of breathing, pain in the side, especially on coughing or taking a full inspiration; and inability to lie with equal comfort upon both sides; the emaciation becomes more perceptible, and the pulse, at first not much affected, becomes full, hard, and quick; frequent flushings and fever of a remittent character ensue, attended by chills and red sediment in the urine, but the tongue is not much altered, and the mouth is usually moist; the bowels, at first irregular, become habitually relaxed; profuse perspirations, attended by extreme debility and rapid emaciation, follow; the legs swell; and the patient sinks, generally retaining the senses, and even in hope and spirits to the last. In the early treatment of this disease the tendency to inflammatory action must be most cautiously encountered by bleeding, cupping, or blisters; the bowels gently opened by saline aperients; and the cough and irritability quieted by opium, henbane, or hemlock, and by small doses of expectorants. Tonics and acids require to be given with the utmost prudence; and after all little except palliation can be effected. The diet must from the beginning be scrupulously attended to, and should be mild and nutritive, but not stimulant; and sometimes a temporary benefit results from change of air; but where the disease is once established its effect is uncertain, and it is in many cases worse than injudicious to advise change of climate. The inhalation of vapours of chlorine and iodine, in very minute quantity, has appeared to give in some cases a little temporary relief; in others it has proved decidedly mischievous; in none permanently useful; and we must with regret assume that there has been some mistake in the supposed cures of established and constitutional consumption. In its very early periods, change of country, diet, habit, and occupation will sometimes seem to suspend its progress; it has also been checked by other diseases, and not unfrequently it lies dormant in females who breed quickly; but at a later period it again shows itself, and proceeds to its fatal end.

CO'NTACT, ANGLE OF. In Geometry, the angle made by a curve line with its tangent. Euclid has demonstrated that the angle made by the circle with its tangent is smaller than any rectilinear angle, and that no straight line can be drawn between the circle and tangent without cutting the circle. Innumerable circles may, however, be made to pass between them. Formerly the angle of contact afforded geometers a fruitful source of metaphysical controversy. See an excellent account of the writings of Wallis, Peletarius, Clavius, Vieta, and others, on this subject, in the notes to *Camerer's Euclid*, Berlin, 1824

CONTA'GION. (Lat contagies.) The propagation of specific diseases from person to person. *Contagious poisons* communicate the property of producing similar poisons; the *small-pox* is a characteristically contagious disease. By some writers the term has been limited to diseases requiring *actual contact* for their communication; but contagious matter appears often transmissible by the air, hence the terms *immediate* and *mediate contagion*. Where diseases are propagated through the medium of the air, they are generally called *infectious*.

CONTE'MPT In Law, disobedience to the rules, orders, or process of a court of competent authority. Contempt in court is punishable by fine or imprisonment: for contempt out of court an attachment may be granted. Contempt of the king's prerogative, by refusing to assist him in the exercise of his lawful authority, &c, is a high misprision or misdemeanor.

CO'NTEXT. (Lat contextus) The general series of a discourse, when we cite a particular passage, we mean by its *context* the parts immediately preceding and following it, which determine or affect its sense

CONTINE'NTAL SYSTEM. In Modern History, the celebrated plan of the Emperor Napoleon for excluding the merchandise of England from all parts of the Continent It was commenced by the decree of Berlin, issued 21st Nov 1806, which declared the British islands in a state of blockade, and made prisoners of war all Englishmen found in the territories occupied by France and her allies. The blockade thus instituted was far from complete; and in the course of events licenses were expressly granted by the government for its evasion, and became a source of revenue Some writers have affirmed that British commerce lost by this decree and those which followed it more than 60 millions sterling in 18 months, but this is an enormous exaggeration.

CONTI'NGENT (Lat.) In Politics, the proportion (generally of troops) furnished by one of several contracting powers in pursuance of an agreement The Germanic diet has fixed the *contingents* of the several states forming that confederacy to its army by the stipulations of 1814.

CONTI'NUAL PROPO'RTIONALS. Quantities are said to be continual proportionals, or in continued proportion, when the first is to the second as the second to the third, as the third to the fourth, and so on

CONTI'NUED BASS. In Music, the same as thorough bass. It receives the name from its continuation through the whole of a composition.

CONTI'NUED FRA'CTIONS. In Arithmetic, a species of fractions first proposed about the year 1670 by Lord Brounker, President of the Royal Society, and improved by Dr Wallis; but which have acquired their greatest value by their application, in the hands of the Continental mathematicians, to the solution of numerical equations, and of problems in the indeterminate analysis. Their nature will be most easily understood from a numerical example.

Let it be required to convert the fraction $\frac{108}{149}$ into a continued fraction. The value will not be altered by dividing both terms by the same number. Assume 27, which is contained in the numerator 108, and on dividing the denominator by it there will result the compound quotient $5\frac{14}{27}$. The given fraction therefore becomes $\frac{4}{5\frac{14}{27}}$, or $\frac{4}{5+\frac{14}{27}}$. Again, dividing the fraction $\frac{14}{27}$ by the greatest measure of its numerator, namely 7, it will be changed into $\frac{2}{3\frac{6}{7}}$, or $\frac{2}{3+\frac{6}{7}}$. Wherefore the original fraction is now transformed into $\frac{4}{5+\frac{2}{3+\frac{6}{7}}}$. It is, however,

more convenient to divide by such numbers as will render the numerators all units. Thus, let the fraction be $\frac{287}{992}$. Divide both terms by 287, and there results $\frac{1}{3\frac{131}{287}}$. Dividing again the terms of the last fraction by its numerator 131, there arises $\frac{1}{2\frac{25}{131}}$. Dividing again by 25, the fraction $\frac{25}{131}$ is converted into $\frac{1}{5\frac{6}{25}}$. Lastly, $\frac{6}{25} = \frac{1}{4\frac{1}{6}}$. Collecting all the fragments, we now get $\frac{287}{992} = \frac{1}{3+\frac{1}{2+\frac{1}{5+\frac{1}{4+\frac{1}{6}}}}}$.

It is easy to see how the continued fraction is reconstructed into its equivalent simple fraction, by following the reverse process.

By decomposing a fraction in this manner a series of derivative fractions is obtained, which constantly approach to the true expression, and exhibit the successive approximate values in the lowest terms. Taking the last example, $\frac{287}{992}$: if we stop with the first term of the expansion, we find for the approximate value $\frac{1}{3}$, which is considerably too small; if we take in two terms, we find $\frac{1}{3+\frac{1}{2}} = \frac{2}{7}$, which is a little too large. Admitting three terms, we get $\frac{1}{3+\frac{1}{2+\frac{1}{5}}} = \frac{11}{38}$, which is again too little, but nearer the true value than the last In this manner we approach nearer and nearer at every successive step, and it may be remarked, that the errors are alternately in excess and defect. (See *Leslie's Philosophy of Arithmetic; Euclid's Analysis Infinitorum*, and the *Additions* to the French translation of *Euler's Algebra*.)

CONTINU'ITY, LAW OF A principle of considerable use in investigating the laws of motion, and of change in general, and which may be thus enunciated — *Nothing passes from one state to another without passing through all the intermediate states* Leibnitz claims the merit of having first made known this law, but in so far as motion at least is concerned, it is distinctly laid down by Galileo, and ascribed by him to Plato But though a perception of its truth seems to have been felt long before, Leibnitz was certainly the first who applied the principle to test the consistency of theories, or supposed laws of nature The argument on which he attempted to establish it *à priori* is, that if any change were to happen without the intervention of time, the thing changed must be in two different conditions at one and the same instant, which is obviously impossible A remarkable application of the law of continuity was made by John Bernoulli in an Essay on the Laws and Communication of Motion, which gained the prize of the Academy of Sciences of Paris in 1724, to prove that perfectly hard bodies cannot exist; because, in the collision of such bodies, a finite change of motion must take place in an instant, an event which, by the law now explained, is impossible This conclusion was objected to by D'Alembert and Maclaurin, who on account of it were disposed to reject the law of continuity altogether, but the difficulty is got over by supposing (which on various grounds is extremely probable) that there is no real contact, and that bodies begin to act on each other when their surfaces, or what seem to be their surfaces, are yet at a distance

CONTO'RNIATI In Numismatics, medals supposed to have been struck about the period of Constantine the Great and his immediate successors, they are of bronze, with a flat impression, and marked with peculiar furrows. (Ital contorni, whence their name) They bear the figures of famous emperors or celebrated men Their object is uncertain; but they have been supposed to be tickets of admission to the public games of the circus in Rome and Constantinople.

CONTOUR. (It. contorno) In the Fine Arts, the external lines which bound and terminate a figure The beauty of contour consists in those lines being flowing, lightly drawn, and sinuous. They must be carefully and scientifically drawn, which cannot be effected without a thorough knowledge of anatomy

CO'NTRABA'ND. (Ital. contra, *against*; bando, *an edict* or *proclamation*.) In Commercial language, goods exported from or imported into a country against its laws. *Contraband of war*, such articles as a belligerent has, by the law of nations, the right of preventing a neutral from furnishing to his enemy. Articles contraband of war are, in general, arms and munitions of war, and those out of which munitions of war are made; all these are liable to be seized: but very arbitrary interpretations have been affixed to the term by powerful states, when able to enforce them by arms. Thus provisions are held contraband of war when it is the object to reduce the enemy to famine. But with respect to these and other articles not in their nature contraband, it seems to be the practice that the belligerent should purchase them from the neutral for a reasonable equivalent, instead of confiscating.

CONTRABA'SSO. (It.) The largest of the violin species of string and bowed instruments, whereof it forms the lowest bass, usually called the double bass.

CO'NTRACT. In Civil Law, the term usually applied to such agreements, whether express or implied, as create, or are intended to create, a legal right, and corresponding liability; such right not attaching to the possession of the subject matter of the contract, except in equity, and that indirectly, but subsisting both in equity and law against the contracting party.

The conditions essential to the legal validity of a contract relate either to the competency of the parties, the sufficiency of the consideration or inducement, the nature of the thing contracted for, the fairness of the transaction, or, lastly, to the form of the agreement.

And, first, as to the competency of the parties. The party to be sued must have been at the time of the contract of sound mind, and, unless it was for the supply of necessaries, of full age, and if a woman, she must have been unmarried, subject as to the latter condition to some exceptions established either by local custom or by the doctrines of equity.

Secondly, as to the sufficiency of the consideration on the part of the person suing,—it must have been either future marriage since performed, or money, or something capable of being estimated in money; or some act, whether of performance or abstinence, whereby some undoubted advantage, though not capable of being exactly valued, accrues to the party sued.

Thirdly, the act contracted for must be neither contrary to written law, nor to public policy; and it must be beneficial to the party seeking either performance or compensation, or to some one on whose behalf he gave the consideration.

Fourthly, there must have been neither fraud (either by concealment or misstatement) nor compulsion on the part of the plaintiff in obtaining the agreement; and fraudulent acts subsequent to the agreement having reference to it are also sufficient to deprive the guilty party of all right under it. Some circumstances are in equity considered either as conclusive evidence of fraud, or as substantive acts of coercion, which are not strictly of such a nature, and are not so deemed at law.

Lastly, as to the form of the agreement. Where it relates to an interest in land of three years' duration or more, or to goods of the value of 10*l* or upwards, unless there be earnest or delivery, or where it is an agreement as surety, or where it is upon marriage as a consideration, it must be in writing; though the want of a written instrument may be supplied in equity by partial performance, that is, by acts evidently done in pursuance of the alleged contract

Contracts are sometimes implied either in the whole from the acts of the parties, as from the ordering of goods a contract to pay for them, or in part, and as incidental to the principal agreement, as, in the case of a lease, a contract by the tenant to use fairly and take due care of the thing leased And at law some obligations not arising in any manner from contract are, as regards the mode of enforcing them, placed on the same footing as those which do arise from contract, the remedy, and not the right, being assimilated by statute

Such are the general requisites to the validity of agreements, but at law the extent of the right and liability arising under them varies according to their form; agreements being there divided into those under seal, which are called agreements by specialty, and those not under seal, which are called simple contract or parol agreements, including not only such as are merely verbal, but such as are written and unsealed The first sort alone are binding upon the land, and that only when the heir is named; and they possess this farther advantage over agreements by simple contract, that being executed as the *deed* of the [illegible] party, a sufficient consideration will always be [illegible] in their favour, unless an insufficient one be actually stated on the face of them. Again, agreements both by specialty and simple contract are either to pay a sum certain actually stated in the agreement, or a sum uncertain to depend upon the value of the thing received, or they are agreements to perform certain acts. In the first case, the remedy is by action of debt either on bond or covenant, or upon simple contract, as the case may be. In either of the latter cases the remedy is by action for breach of covenant where the agreement is under seal, or by action of assumpsit where it is by simple contract; the relief given in each of the two last-mentioned sorts of action being compensation in damages for the injury accrued from non-performance of the agreement. *See* ACTION.

The remedy in equity, where there is any, is in all cases alike,—specific performance of the act agreed to be done; and such relief will be given to the same extent and against the same parties, whether the contracting party himself or his real or personal representatives,

without any distinction between agreements under seal and those which are not so.

But though courts of equity have jurisdiction in all cases of agreements, at least in all such as do not constitute an actual debt at law, yet the exercise of that jurisdiction is, subject to certain rules, a matter of discretion; for the reason that the denial of the equitable relief will not leave the party without some remedy, namely, that of damages at law: and on this account specific performance can only be obtained in equity in those cases where pecuniary damages would not afford to the disappointed party an adequate compensation. Thus such relief will not be granted in any of those cases where the inducement to the bargain or agreement was merely the expectation of profit, as it is in agreements for the sale or purchase of personal chattels; and other circumstances also are a bar to equitable relief, which are no defence to an action at law, as, for instance, the want of mutual liability, apparent laches, and indifference in following up the agreement; or particular consequences of collateral hardships arising to one party from actual performance; or the impropriety in equity of the agreement, as where performance would be a breach of trust. And on the other hand, though the equitable jurisdiction is founded upon a supposed legal right, there are cases in which the right having been lost at law, as by default in literal compliance with the terms of the agreement, will yet be enforced in equity.

CONTRACT, ORIGINAL OR SOCIAL. In Politics, that which is supposed to exist ab initio, according to some theories of government, between the sovereign power and the subject. So prevalent was this doctrine at the period of the revolution of 1688, that the Convention Parliament pronounced James II to have broken the "original contract between the king and the people." The original contract, with the reciprocity of rights and duties which it engenders, is clearly a supposition having no historical foundation in the annals of any people, but it is, nevertheless, the only hypothesis in which men can consistently proceed in framing a theory of government which shall satisfy at once the moral and economical wants of society.

CONTRADI'CTORY PROPOSITIONS. In Logic, are those which having the same terms differ in quantity and in quality. *Contrary Propositions* are two universals with the same terms, the one negative and the other affirmative. *See* PROPOSITION.

CONTRA'LTO. (It.) In Music, the part immediately below the treble, called also the counter tenor.

CO'NTRAST. (Fr. contraste.) In the Fine Arts, an opposition of lines or colours to each other, so contrived that the one gives greater effect to the other. By means of contrast energy and expression are given to a subject, even when employed on inanimate forms. All art is indeed a system of contrast. Lights should contrast with shadows, figures with figures, members with members, and groups with groups. It is this which gives life, soul, and motion to a composition.

CO'NTRATENO'RE. In Music, the same as *Contralto*, which see.

CO'NTRAVALLA'TION. (Lat. vallum, *trench*.) In Fortification, a trench guarded by a parapet, formed by the besiegers between their camp and the place besieged, to secure themselves and check the sallies of the garrison. The line of *contravallation* is thus, as the name implies, a sort of *counter* fortification.

CONTRO'L, BOARD OF, or BOARD OF COMMISSIONERS FOR THE AFFAIRS OF INDIA, is constituted under the authority of Mr. Pitt's celebrated Act, passed in 1783. It consists of such members of the privy council as his Majesty is pleased to appoint, of whom the two principal secretaries of state and chancellor of the exchequer always form three. The president is usually a cabinet minister. The controlling functions of the board consist in revising all despatches prepared by the court of directors and addressed to the governments in India. It also has the power of requiring the court to prepare despatches on a given subject, and revising and altering them. The board is divided into six departments,—accounts, revenue, judicial, military, secret political, and foreign and public. The names of the first four indicate their duties: the third has three subdivisions,—the secret departments, respecting confidential communications addressed (as the act prescribes) by the local governments to the secret committee of the court of directors, and vice versâ; the political, comprising general correspondence respecting native chiefs and states, the foreign, respecting foreign Europeans and Americans resorting to India. The public department takes charge of commercial, ecclesiastical, and other miscellaneous affairs. The salary of the president of the board is 3500*l*., that of a paid commissioner 1200*l*, of the secretary 1500*l*.

CONTRO'LLER. (Fr. controleur.) An officer appointed to control or oversee the accounts of other officers, and to certify whether the matters confided to his care have been controlled or examined. In England, there are several public functionaries of this title, as the controller of the mint, customs, stationery, &c.

CO'NTUMACY. (Fr. contumace, *stubborn*.) In Scotch Ecclesiastical Law, a wilful disobedience to any lawful summons or judicial order. It is punished by imprisonment.

CO'NUS. (Gr. κωνος, *a cone*.) A term in Botany, denoting that form of inflorescence called a strobilus or cone, which is a spike, the carpels of which are scale-like, spread open, and bear naked seeds. Sometimes the scales are thin, with little cohesion; but they often are woody, and cohere into a single tuberculated mass.

CONUS. The name of a Linnæan genus of *Vermes Testacea*, characterized by the conical form of the shell, the base of which is formed by the spire, which is accordingly flat, or very slightly projecting; the aperture is narrow and rectilineal, or nearly so, without any enlargement or plication. The genus is retained without subdivision, and forms part of the *Buccinoid* family of the Pectinibranchiate order of Gastropods in the system of Cuvier.

CO'NVENT. (Lat. conventus, from convenio, *I come together*.) A religious house, inhabited by a society of monks or nuns. *See* MONACHISM.

CONVE'NTICLE. (Lat., diminutive of conventus.) An assembly for the purpose of divine worship; first used in a contemptuous sense for the meetings of the followers of Wicliffe (stat. 2 H. 4. c 15.), and since applied to the places of meeting of petty sects and of Dissenters in general in the Conventicle Act, 16 Car 2, repealed by 52 G 3 c 155. Originally the word had no such peculiar application, but was used by the fathers and ancient writers for a church.

CONVE'NTION. In Political language, this name has been applied to assemblies of national representatives meeting on extraordinary occasions without being convoked by the legal authority. Two parliaments have been so called in English history. The first, that which met in April, 1660, and restored Charles II. to the throne—the Lords assembling by their own authority; and the Commons, by virtue of writs issued in the name of the keepers of the liberties of England, by the authority of parliament. The second, that which met in 1688, each house by its own authority, and on the summons of the Prince of Orange, which declared King James II. to have abdicated the crown, and transferred it to William and Mary. In French History, the name Convention is applied to that assembly which met after the legislative assembly had pronounced the suspension of the royal functions, in September, 1792, and proclaimed the republic at its first sitting. This body dissolved itself on the establishment of the Directory, in October, 1796. The Scottish assembly which met on the flight of James II was entitled the Convention of Estates. In the United States, meetings of the people of separate states, by specially chosen representatives, to review and amend the state constitutions, have been termed Conventions.

CONVE'NTION, MILITARY. A treaty between military commanders concerning terms for a temporary cessation of hostilities, generally between a victor and a defeated general, for the evacuation of a district or position by the latter. Such, at least, were the two most celebrated conventions of modern times—that of Closter-Seven (1757), between the Dukes of Cumberland and Richelieu, that of Cintra (1808), between Junot and the English generals.

CONVE'RGENT-NERVED. A term used in describing the venation of leaves, to denote cases where the ribs form a curve and meet at the point, as in *Plantago lanceolata*.

CONVE'RGING SERIES. In Analysis, are series of which every succeeding term is smaller than the preceding, and which, consequently, tend to a certain limit. It is only converging series which admit of summation.

CO'NVERSE. In Geometry, a proposition is said to be the converse of another when the conclusion of the first being used as the supposition in the second, the conclusion of the second agrees with the supposition of the first. Thus, the fifth proposition of the first book of *Euclid* affirms that if the two sides of a triangle be equal, the angles at the base are equal, and the sixth affirms that if the angles at the base be equal, the two sides are equal. The sixth is therefore the *converse* of the fifth.

CONVE'RSION. In Logic, a proposition is said to be *converted* when the terms are so transposed that the subject is made the predicate, and vice versâ. All logical conversion is illative; *i.e.* the truth of the converse follows from that of the original. Conversion is either "simple" or "per accidens." Universal negatives (denoted by the sign E) and particular affirmatives (I) can be converted simply, retaining both quantity and quality: thus, "No virtuous man is a rebel;" "No rebel is a virtuous man." Conversion per accidens changes either quantity or quality. Universal affirmatives (A) are converted by changing the quantity; as. "All oaks are trees;" "Some trees are oaks." Particular negatives (O) by changing the quality, considering the negative as attached to the predicate instead of the copula: the proposition is

thus changed into I,—" Some poets are not learned ; " " Some not learned (unlearned) men are poets." *See* PROPOSITION.

CO'NVERT. (Lat.) A person who changes his religion. Individuals, of what faith soever, who abandon their own creed and embrace Christianity are called *converts*, in contradistinction to *apostates*, applied generally to *Christians* who adopt another religion. History, both sacred and profane, has transmitted to us many instances of sudden conversion, in which the hand of a miraculous providence may clearly be traced. Among the most remarkable may be mentioned the conversion of 3000 Jews on the day of the Feast of Tabernacles, and that of Paul the apostle, the emperor Constantine, and Clovis, king of France.

CONVEY'ANCE. (From *convey.*) In Law, a deed which passes land from one to another. (*See* REAL PROPERTY, LAW OF.) *A conveyancer* is a lawyer, whose business consists in advising and preparing such deeds. It is not necessary to be called to the bar to practise as a conveyancer ; but most conveyancers take that step soon after beginning their business, and frequently combine it with that of equity draftsmen.

CONVI'CTION. At Common Law, is the finding of one guilty of an offence by the verdict of a jury ; and may take place where one is outlawed, or appears and confesses, or is found guilty on the inquest. (*See* JURY, VERDICT.) By various statutes summary proceedings, without the intervention of a jury, are authorized for the trial and conviction of minor offenders. Such are those before commissioners of excise, &c for breaches of the revenue laws, and before justices of the peace for various disorderly offences. The party charged must be summoned to attend, and a conviction by a magistrate must be in writing, and should state the whole of the evidence for and against the defendant

CONVOCA'TION. (Lat. convoco, *I call together*.) In English Ecclesiastical Law, the council of the church, derived, first, from the custom of the bishops assembling their diocesan clergy for the sake of considering spiritual matters ; and, secondly, of the archbishops holding convocations of the clergy of a whole province. Convocations were first assembled in England under the king's authority by Edward I., who summoned them by their provinces, for the sake of obtaining subsidies from the clerical body. They met in each province in two houses — one of the suffragan bishops, the other of deans, archdeacons, and representatives of the inferior clergy. The taxation of their own body was withdrawn from convocation in 1664, and, on the other hand, the privilege of voting for knights of the shire was then conceded to ecclesiastics. As the power of enacting canons had been already virtually abolished by statutes of Henry VIII., Elizabeth, and Charles II., there now remained no business for convocation to transact ; and it was only in the reigns of William III. and Anne, when attempts were made by the high church party to impart fresh activity to it as an ecclesiastical tribunal, that its meetings were attended with any historical importance. Since that period it has become customary to prorogue convocation every year immediately upon its assembling. The rights and history of the convocation are treated of at length in several writings of the learned Bishop Gibson, especially his *Synodus Anglicana*, Lond. 1702.

CONVOCA'TION, HOUSE OF, in the University of Oxford, is the assembly which enacts, amends, &c laws and statutes ; elects burgesses, many professors, and other officers, &c. It is composed of all members of the university who have at any time been Regents (*see* REGENTS), and who, if independent members, have retained their names on the books of their respective colleges. The power of convocation at Oxford to make statutes is limited : in the first place, the royal statutes cannot be explained or amended without royal license ; and, in the next place, with respect to all other laws and statutes, no proposition can be entertained in convocation unless it has been first submitted to the hebdomadal meeting of heads of houses, by whom it must be in the first instance sanctioned or rejected.

CONVO'LVULA'CEÆ (Convolvulus, one of the genera.) A natural order of herbaceous or shrubby Exogens, twining and producing a milky juice when wounded. They are very abundant in the tropics, and possess purgative qualities in their roots, depending upon a peculiar resin, of which scammony and jalap, yielded by the *Convolvulus Scammonia* and *Ipomœa purga*, may be taken as examples. Many of these plants are objects of striking beauty ; some, which unfold their pure, white, magnificent flowers at night only, are called in tropical countries *Belle de Nuit ;* others expand only beneath a warm and brilliant sunshine. The *Lignum Rhodium* of the old pharmacologists is produced by an upright bushy species, called *Brewcria scoparia*.

CO'NVOY. (Fr. convoyer, *to conduct*.) In Navigation, the term applied to designate a ship or ships of war, appointed by government, or by the commander in chief on a particular station, to escort or protect the merchant ships proceeding to certain ports. Convoys are mostly appointed during war ; but they are sometimes also appointed during peace, for the security of ships navigating seas infested with pirates. For an account of the various regulations and conditions relative to convoys, see *M'Culloch's Com. Dict.*

CONVOY, in the Military service, signifies a detachment of troops appointed to guard supplies of provisions, ammunition, or money, in their progress to a distant part of any country, or to an army in the field, against an attack which might be made upon them either by the peasantry or by parties of the enemy.

CONVU'LSION. (Lat. convello, *I pull together*.) A writhing and agitation of the limbs, and involuntary action of the muscles in general. The fits vary much in extent and violence, sometimes attacking the whole body, and at others confined to particular parts ; in the former case the mind is affected, but it often remains in the latter undisturbed : they also vary in duration, lasting from a few minutes to some hours. They are sometimes preceded with dizziness, double or disturbed vision, and coldness, and are followed by great languor ; but at others they come and go without much disturbance. Teething, worms, and overloaded bowels are common causes of convulsive attacks in children ; and these are relieved by freely and timely lancing the gums, and by the administration of proper purges. In *puerperal convulsions* bleeding and opiates are the usual remedies ; and in cases where convulsive attacks arise from violent affections of the mind, the exciting causes must be studiously avoided. Warm baths, bleeding, and nervine stimulants are the usual medical aids ; and where there is difficulty of swallowing, a glyster, composed of half a pint of gruel with a drachm of tincture of opium and two drachms of tincture of assafœtida, has, in adults, proved eminently useful. Cold affusions often do harm. The after-treatment consists in the judicious use of tonics and nervous stimulants, and in avoiding all obvious exciting causes.

COO'LER. An apparatus used by brewers and distillers for cooling worts. The coolers generally consist of very shallow vessels exposing great surface, and placed in the high and airy parts of the brewery : the cooling is sometimes assisted by fans, which agitate the air over their surfaces. Worts are also occasionally cooled by causing them to traverse metal pipes, which are surrounded by a counter-current of cold water.

CO-O'RDINATES. (Lat. con, *together*, and ordino, *I arrange*.) In Analytical Geometry, the system of lines to which points under consideration are referred, and by means of which their position is determined. The position of a point on a plane is absolutely determined if we know its distances, measured in a given direction, from two straight lines given by position in the same plane. In like manner, the position of a point in space is determined by its distances from three straight lines given by position, provided any one of them be not in the same plane with the other two. The use of co-ordinates was introduced into geometry by Descartes, for the purpose of facilitating the investigation of the properties of curve lines. For the sake of convenience, they are generally chosen at right angles to each other, and are then called rectangular co-ordinates. In plane geometry, one of them is the *abscss*, and the other the *ordinate*. The geometry of three dimensions requires one abscss and two ordinates, the first horizontal, and the second vertical. The point from which they all proceed is the *origin of the co-ordinates*.

COPAI'BA or COPIVI BALSAM. An exudation from the *Copaifera officinalis*, a South American tree ; it is a liquid resin, and yields by distillation a considerable quantity of a pungent volatile oil. A small teaspoonful taken twice a day in a glass of water proves diuretic, and is of use in the cure of gleet and the latter stages of *gonorrhœa*. A larger dose is aperient, and has been of service in the treatment of *hæmorrhoids*.

CO'PAL. (An American name applied to clear gums ?) This substance is often improperly called *gum copal*. It is a peculiar resin, very difficultly soluble in alcohol ; hard, brittle, and inodorous : its specific gravity varies from 1·04 to 1·13. It is the produce of the *Rhus copallinum* and of the *Elæocarpus copaliferus* of the East Indies. a third kind of copal is also brought from the Coast of Guinea. It is used in varnishes.

COPA'RCENARY. (Lat. con, and particeps.) In Law, an estate is said to be held in coparcenary, and the tenants termed coparceners, where it descends from an ancestor to two or more persons. Sisters are coparceners at common law, tenants in gavelkin by custom. No right of survivorship exists between coparceners. They may agree, or any one may force the rest to make partition.

CO'PING. (Sax cop, *the head*.) In Architecture, the upper covering or top course of a wall, usually of stone, and wider than the wall itself, in order to let the rain water fall clear from the wall.

CO'PPER. (*Cuprum*, a corruption of *Cyprium*, from the island of Cyprus, whence it was formerly brought.)

This metal was known at a very remote period; and in the early ages of the world, before iron was in use, copper was the chief ingredient in domestic utensils and instruments of war. It is an abundant metal, and is found native, and in many ores; of these the most important are the varieties of *pyrites*, which are sulphurets of copper and iron. The richest mines are those of Cornwall. It occurs in veins, traversing the primary rocks of that county; it is chiefly transported to Swansea to be smelted, in consequence of the deficiency of coal in Cornwall. The ores are repeatedly roasted and fused to drive off the sulphur, and the oxide of copper is ultimately reduced by the joint agency of heat and carbon. Copper is distinguished by its colour. Its specific gravity is 8·6. It is ductile and malleable, and requires a temperature equal to about 2000° of Fahrenheit's scale for its fusion; that is, nearly a white heat. Exposed to air and moisture, copper gradually becomes covered by a green rust; heated red hot it absorbs oxygen, and is superficially converted into a black oxide, which is the basis of the principal salts of copper: it consists of 32 copper and 8 oxygen. It forms blue or green salts with the acids; of these the *sulphate of copper*, or blue vitriol, is a good example. The salts of copper are poisonous; and in consequence of the use of copper vessels for culinary purposes, food is sometimes contaminated by them. It is detected when in very minute quantities by the bright blue colour produced by the addition of liquid ammonia, and by a brown precipitate with ferrocyanate of potash. A clean plate of iron dipped into a solution containing copper becomes covered with the latter metal in a metallic state.

COPPERAS. Green vitriol, or sulphate of iron.

CO'PPERPLATE. In Engraving, a plate of copper highly polished on which an engraving is made.

CO'PPICE. Woods which are cut down at stated periods to be manufactured into poles, rods, stakes, faggots for fuel, bark for the tanner, or charcoal. When wood of this kind has no standard trees, it is called simply a coppice, or copse wood; but when it has standard trees interspersed through it, it is called a wood When coppices are cut down for hoops, rods, and small stakes for manufacturing into crates, hoops, wicker hurdles, &c., the period at which they are cut varies from six to ten years, according to the soil. When they are cut down for poles for hops and similar purposes, the periodical cuttings are commonly between twelve and fourteen years apart; and when they are cut down chiefly for the sake of the bark, they are seldom cut oftener than from fourteen to twenty-one years. A country abounding in coppice wood generally abounds also in singing birds, which are comparatively rare in countries where all the woods are of the pine and fir tribe.

COPRO'PHAGANS, *Coprophaga*. (Gr. κοπρος, *dung*, and φαγω, *I eat*) A section of Lamellicorn beetles which live in and upon the dung of animals.

CO'PULA. (Lat. *a bond or tie*.) In Logic, that part of the proposition which affirms or denies the predicate of the subject. The only true logical copula is the present tense of the verb *to be*, with or without the negative sign, "is" or "is not."

CO'PY. (Fr. copie.) In the Fine Arts, a transcript from an original work of art. When an artist copies his own work, it is called a *duplicate* or *double*.

COPY. In Printing, is the subject matter to be printed, whether it be an original work in manuscript or a reprint: in the first case it is termed manuscript copy, or written copy; in the second printed copy.

CO'PYHOLD. In Law, is a species of *customary estate*, said to be held by copy of court roll; *i.e.* where the tenant's title is evidenced by a copy of the rolls of a manor made by the steward of a lord's court. Customary estates are those which exist in real property subject to the custom of manors; and their peculiar characteristic is, that all alienations of them must be transacted, in part at least, in the lord's court, the ordinary mode of alienations being by surrender to the lord and admittance of the new tenant. The peculiar tenure called copyhold is derived from the tenure in *villain socage*, as it was termed, held formerly under a manor. This was in its origin a mere permissive tenure by serfs attached to the soil; and copyhold estates are still expressed in legal phraseology to be held "at the will of the lord by the custom of the manor." With respect to the incidents of dower, and other characteristics, they are frequently governed by the custom of the manor; but where this is not the case, they are under the same rules which govern the transmission and alienation of freehold property. By the Reform Act, copyholders for life, or a greater estate to the amount of 10*l.* per annum, are admitted to the exercise of the electoral franchise in counties. The best treatises on the law of copyholds are those of *Watkins* and *Scriven*.

CO'PYRIGHT. In Law, the right of property in a literary composition vested in the author. By 54 G. 3. c. 156. s. 4. the term of copyright in an author and his assignee extended to twenty-eight years absolutely, and for the life of the author if he survived that period. But by the 5 & 6 V. c. 45. the duration of all copyrights, whether the author be dead or alive, was extended to *forty-two* years; and it further provided, that if the author be alive at the expiration of this period of forty-two years from the publication of his works, he shall enjoy the copyright to his death, and that his heirs or assignees shall enjoy it for seven years after that event. A book of registry is kept at Stationers' Hall. The author or assignee of a pirated work has his remedy by action. The act requires that five copies of every work should be delivered at the expense of authors and publishers, on demand in writing, for the use of a few favoured public and private libraries in the United Kingdom. In France, copyrights continue for twenty years after the death of the author. In most of the German States, they are perpetual; and a copyright secured in one state is good in all. Both in England and on the Continent, various other compositions, such as engravings, etchings, prints, maps, charts, and sculpture of all kinds, receive from statute a protection analogous to that of literature

CO'RACLE. A boat made of wicker-work covered with leather, used chiefly by the ancient Egyptians.

CO'RACOID. (Gr. κορακ, *a crow*, and ειδος, *form*.) A name first applied to a small process of the blade-bone of apes and man, on account of its resemblance to the beak of a crow; and now extended to a large flattened bone passing from the shoulder-joint to the sternum in birds, reptiles, and monotremes, and of which the process above mentioned is the rudimental representative.

CORALLI'NA. A name applied by Linnæus to a genus or group of marine organized bodies of arborescent habit, with jointed stems, supported on a kind of root, divided into branches, which are likewise jointed. Neither pores nor polypes are distinguishable on the surface of these beings; their chief purpose in the economy of nature is to prepare during life, and precipitate by their decay, fine particles of carbonate of lime or chalk: they thus lend their aid to the Lithophytous corals in covering submerged land with the elements of a fertile soil, which the expansive subterranean forces may afterwards convert into dry land.

CORALLI'NES The name commonly applied to the tubular or nudibrachiate order of Polyps which have an external jointed calcareous or horny covering: the true nature of these plant-like animals was discovered by our countryman Ellis. *See* TUBULIFERA.

CO'RBEILS. In Fortification, little baskets filled with earth, about a foot and a half high, and from eight inches to a foot in diameter, which are set on a parapet or elsewhere to afford cover from the fire of an enemy.

CO'RBEL. (From the Fr. corbeille, *a basket*.) In Architecture, a projecting bracket, often sculptured like a modillion, sometimes in the form of a basket, for the purpose of supporting a superincumbent object, also for receiving the springing of an arch. A *corbel table* is a projecting battlement, parapet, or cornice, resting on corbels

CO'RCULUM. (Lat cor, *the heart*) An old name for what botanists now call the embryo of a plant. It was not, however, applied with much precision, for the plumula and radicle alone of such seeds as the bean and almond were called the corculum, while the term should have included the cotyledons also.

CO'RDATE (Lat. cor, *the heart*; literally *heart-shaped*) A term used in describing the general form of organs, to denote any thing having two round lobes at its base, the whole resembling the heart in a pack of cards; as the leaf of *Alnus cordifolia*.

COR'DIA'CEÆ (Cordia, one of the genera.) A natural order of arborescent Exogens, inhabiting the tropics of both hemispheres. They are nearly allied to *Convolvulaceæ*, from which they are separated by their inverted embryo and drupaceous fruit. They were formerly associated with *Boraginaceæ*; but their plaited cotyledons and dichotomous style caused them to be removed. The flesh of the fruit is succulent, as seen in the Sebesten plums, the produce of the *Cordia myxa* and *Sebestena*, but otherwise they are of no value. It has been asserted that the wood from which the mummy cases of the Egyptians were made was that of *Cordia myxa*; but there is no doubt that it was really produced by *Ficus sycomorus*.

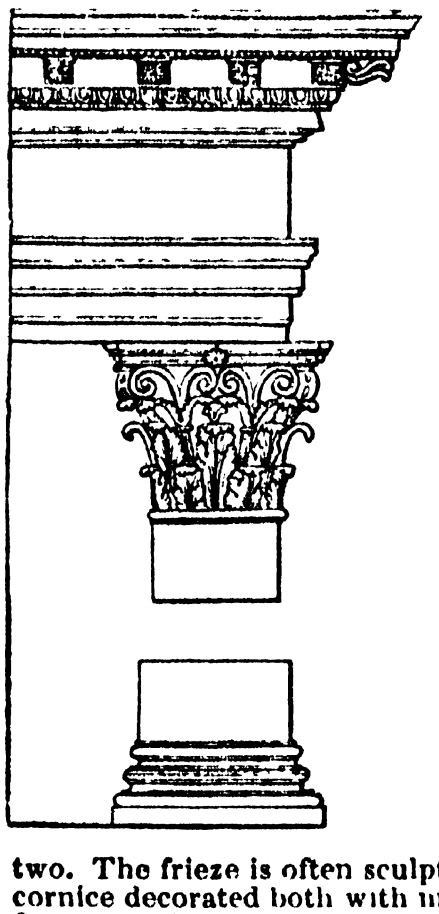
CO'RDON. In Fortification, a row of stones jutting out between the rampart and base of the parapet. A line of troops drawn round a town or tract of country, so as to prevent ingress or egress, is also called a cordon.

CO'RIA'RIA'CEÆ. (Coriaria, one of the genera) A natural order of shrubby Exogens, inhabiting Chile, Peru, the south of Europe, and a few other places. Placed by De Candolle directly after *Ochnaceæ*; an order with which they no doubt agree in some respects, but they differ from them very essentially in being apocarpous. Some botanists consider them apetalous, and allied to *Phytolaccaceæ*; the question of their affinity is still unsettled. Their sensible properties are of a poisonous nature.

CORIA'NDER. The seed of the *Coriandrum sativum*. (Gr. κορις, *a bug*, the odour of the fresh plant resembling

that of the bug.) It is a native of Europe, cultivated on account of its seeds, which are occasionally used in medicine; they have a peculiar perfumed flavour, with some bitterness, and form one of the ingredients of *curry powder*.

CORI'NTHIAN ORDER. In Architecture, one of the five orders of architecture. The capital (*see* ARCHITECTURE) is a vase elegantly covered with an abacus, and surrounded by two tiers of leaves, one above the other; from among which stalks spring out, terminating at their summits in small volutes at the external angles and centres of the abacus. The capitals of the Tuscan, Doric, and Ionic orders appear added to the tops of the shafts; but the Corinthian capital seems to grow out of the column, varying in height from a diameter and one sixth of the lower part of the shaft to one diameter only; such last being the height of the capitals of the temple at Tivoli. The entablature of this order is variously decorated. The architrave is usually profiled, with three fasciæ of unequal height, though in some specimens there are only two. The frieze is often sculptured with foliage, and the cornice decorated both with modillions and dentils; the former having a sort of baluster front with a leaf under them; and the latter, which are cut into the body of the band, being occasionally omitted, as are sometimes even the modillions. The principal remaining ancient examples of the order at Rome are in the Temple of Mars Ultor, Portico of Severus, the Forum of Nerva, Temple of Vesta, Basilica of Antoninus, the Pantheon, &c &c.



CORK. (Corrupted from Lat cortex; Germ kork) The bark of the *Quercus suber*, a species of oak growing in the southern provinces of Spain, France, and Italy. When rasped cork is digested in water and alcohol, it leaves from 70 to 80 *per cent* of insoluble matter, which has been called *suberine*, and which, by the continued action of nitric acid, is converted into *suberic acid*.

CO'RMUS. (Gr. *κορμος, a stem.*) In Botany, a short roundish rhizoma.

CORN. The seeds of certain grasses which have been immemorially used as food, for man or animals, are called corn; and those which are used exclusively or principally by man are called bread corns. The term corn is also sometimes applied to the seeds of other plants which may be ground into meal and used as food, such as the seeds of the buckwheat, the quinoa, and of certain leguminous plants, which, however, are more properly denominated pulse. The principal bread corns of temperate climates are wheat, rye, oats, and barley; those of warm climates are maize, rice, and millet; and those of cold climates oats and barley.

*Value of the Produce of Corn.* — In agricultural countries, not in a very high state of civilization, the culture of corn is the principal employment of the great bulk of the community; and in all considerable countries, how far soever they may be advanced in arts and refinement, its culture is always by far the most extensive as well as the most important branch of national industry. No great country, perhaps, ever existed, the population of which was so extensively engaged in manufactures and commerce as that of Great Britain. Still, however, we employ about a *third part* of our inhabitants in agriculture; and of these, fully three fourths are directly or indirectly engaged in the raising of corn. Unfortunately, there are no accounts, on which it would be safe wholly to rely, of the ordinary produce of corn, either in this or any other great country. But, without pretending to peculiar accuracy, we are inclined to think that the present (1850) average growth of all sorts of corn in the United Kingdom may be safely estimated at about 50,000,000 quarters, of which about 51,000,000 may be consumed by man and the lower animals. (See *post.*) Now supposing this estimate to be nearly accurate, and taking the average price of the different descriptions of corn at 30*s.* a quarter, the total value of the corn annually produced will amount to the sum of 90,000,000*l.* sterling, or to nearly or quite three times the total annual value of the cotton manufacture! This is sufficient to evince the paramount importance of agriculture as a source of wealth as well as a means of subsistence.





*Corn Laws.* — This superior importance of corn as an article of culture, and the dependence so generally placed upon it as an article of food, are the causes why the trade in it has been so very generally subjected to regulation. It is long even before the most enlightened portion of an instructed community become satisfied of the advantage of permitting the supply of corn or any indispensable article to be adjusted, like that of other less important things, by the unfettered competition of private individuals. It seems, at first sight, reasonable to suppose that the most likely way to secure plenty at home is to impose restrictions on exportation. But in truth and reality, this is very far from being the case. How fertile soever, no country that imposes restrictions on exportation need hope to escape perpetually-recurring scarcities; for wherever free exportation is prevented, the excess of supply that occurs in plentiful years being thrown wholly upon the home market depresses prices to such an extent as to be ruinous to the farmer: and thus, by injuring agriculture and lessening the quantity of land in corn, never fails to occasion a scarcity on the occurrence of a deficient harvest. In Great Britain, however, the policy has long been to give every facility to exportation, and even to lay restrictions on importation. This has arisen from our legislature being principally composed of individuals dependent on and connected with the land; and whose interest consequently has led them to endeavour to secure as high a price as possible for its produce. But it is needless to add that this policy is, if possible, even more objectionable than the other. Instead of being publicly advantageous, high prices are, in every instance, distinctly and completely the reverse. The less the sacrifice of money or of labour for which corn or any other article can be procured so much the better. But to make sure that the price of corn, or of any thing else, will be fixed at the lowest limit at which the required supply can be obtained, all that is necessary is to abolish all restrictions, whether on exportation or importation. Freedom is the parent of abundance, cheapness, and equality of price; restriction, of scarcity, dearness, and uncertainty. Any interference with the trade in corn, or with any other great department of trade, that has not the removal of natural or artificial restraints for its object, is not only inconsistent with the best established principles, but is sure to be pernicious. In this, as in all other things connected with national industry, the short and only safe rule is to leave individuals to pursue their own interest in their own way.

Our limits forbid our attempting to make any enumeration of the various statutes that have been passed at different periods for regulating the trade in corn. Down to the Revolution, the policy was to restrict exportation; but from that period the contrary policy has been pursued, and the legislature has pretty uniformly endeavoured to facilitate exportation, and to prohibit or fetter importation It was not, however, till about 1770 that the restrictions on importation began to have much practical influence. But about that time, population having begun rapidly to advance, in consequence of the extraordinary impulse given to manufacturing industry by the inventions and discoveries of Watt, Arkwright, Wedgwood, and others, the price of corn in England began to rise above its price on the Continent; and from being an exporting we became an occasionally, or rather a pretty constantly, importing country. Had there been no restrictions on importation, our prices, it is plain, could not have exceeded those of the adjoining Continental states by a greater sum than might have been required to defray the cost of importing into this country. The restrictions, however, overturned this natural principle; and in deficient years added materially to the difference between our prices and those of the Continent. This difference attained to its greatest height during the late war, owing to the formidable difficulties it threw in the way of importation. During the last six years of that contest, prices in England (after allowing for the depreciation of the currency) were fully double their amount in the principal continental markets.

At the close of the war, in 1814 and 1815, the renewed intercourse with the Continent led to a great importation of corn, which occasioned such a sudden and heavy fall of prices as was productive of much severe distress amongst the farmers. Parliament endeavoured to obviate this by increasing the restrictions on importation, a device which had, in part, the anticipated effect. But since 1820, the influence of improved communications and of ameliorations in agriculture has been so very great, that, notwithstanding the vast increase of population, prices have been progressively falling, and were, in 1835, lower than in any previous year since 1787. Practically, therefore, the influence of the restrictions was materially diminished, and a much greater effect was usually ascribed to them in ordinary years than they really exerted. No doubt, however, they tended materially to aggravate the scarcity and suffering originating in a deficient harvest, and were, therefore, highly objectionable.

But despite these defects the corn laws might have

maintained their place on the statute book for some time longer, had not the unsatisfactory corn harvest of 1845 and the failure of the potato crop of that year made it necessary to adopt extraordinary measures for making good the deficiency in the supply of food. Under the circumstances the suspension of the corn laws could hardly have been avoided. But if once suspended their re-enactment would have been all but impossible; and it was better, by at once providing for their repeal, to make an end of the system, and of the dissatisfaction and agitation to which it had given birth, than to endeavour to continue it in any modified shape. Such was the view of the matter taken by Sir Robert Peel, and he fortunately succeeded, notwithstanding the most formidable opposition, in carrying the act 9 & 10 Vict. c. 22., which provided for the immediate modification of the corn laws, and for their final abolition on the 1st of February, 1849 From that period all varieties of corn, with meal, flour, &c., have been admitted to consumption under the all but nominal duties, the former of 1*s.* a quarter, and the latter of 4½*d.* a cwt.

At the same time, we are ready to admit that, had it been practicable, we should have preferred seeing this great question settled by the adoption of a measure for opening the ports, under a fixed duty of 5*s.* or 7*s.* a quarter on wheat, accompanied with a corresponding drawback. We make this statement on general grounds, and without any reference to the peculiar burdens that affect the agriculturists, though these should neither be forgotten nor overlooked. It would be easy to show that in scarce years a duty of this amount would fall wholly on the foreigner, without affecting prices or narrowing importation; while, in years of unusual plenty, the drawback would facilitate exportation, and would, consequently, tend to hinder prices from falling so low as to injure the farmer and obstruct improvement. And in a matter of such immense importance it is the part of a wise government to be cautious how they take any step, of the consequences of which they are not fully assured, or which may expose any great interest to serious vicissitudes. But even if our limits permitted, it would be to little purpose to insist on these or any similar considerations. The pertinacity with which the agriculturists opposed every approach to a more liberal system roused a spirit which would not be satisfied with any thing short of a complete abandonment of restrictions. The time for compromise and arrangement was, unhappily, allowed to go by, and government had to deal with an unreasoning necessity: *Cum ventre humano tibi negotium est, nec rationem patitur, nec æquitate mitigatur, nec ulla prece flectitur populus* — (*Seneca, de Brev. Vitæ*, c. 18.) What was practicable became of more consequence than what was either just or proper; and even had it been possible to effect an arrangement of the question in the way now stated, the pernicious trade of agitation would most likely have continued to flourish; the object and influence of the duty would have been misrepresented; and neither landlords nor farmers would have felt any confidence in the permanence of the new arrangements. Under these circumstances, their unconditional repeal was, if not really, at all events practically, the best, or rather the only safe, course that could be adopted in dealing with the corn laws.

Those who may wish for further information as to the interesting topics now merely glanced at, and others we have not been able to notice, are referred to the article "Corn Laws," in the new edition of the *Encyclopedia Britannica*, and the art. "Corn Laws" in the *Commercial Dictionary*.

We subjoin an estimate of the quantity of corn used as food for man, of the total quantity consumed and produced in the United Kingdom, deduced from the data given in *M'Culloch's Statistics of the British Empire*, and the census of 1841.

| | Quarters. |
|---|---|
| I. Consumed by man: — | |
| Wheat | 15,000,000 |
| Oats, rye, and maslin | 13,700,000 |
| Barley for malting, &c. | 6,000,000 |
| Beans and peas as meal | 700,000 |
| Total consumed by man | 35,400,000 |
| II. Consumed by the lower animals: — | |
| Corn (principally oats), used in the feeding of horses and other animals, in distillation, &c. | 18,000,000 |
| Total consumed by man and the lower animals, &c. | 53,400,000 |

Of this quantity the imports in ordinary years amount to about 2,300,000 quarters, leaving 51,100,000 for the supply produced at home; and adding to this latter quantity 1-6th part for seed, we have 59,600,000 or 60,000,000 quarters for the total average growth of the U. Kingdom. (*See next col.*)

CO'RNEA. (Lat. cornu, *a horn.*) The transparent membrane of a horny texture which forms the anterior part of the eyeball. In vertebrates it is simple: in insects it is subdivided into numerous hexagonal segments.

CO'RNET. (It. cornetta, *a small flag.*) A commissioned officer in a troop of horse, corresponding in rank with the ensign of a battalion of infantry. His duty is to carry the standard near the centre of the front rank of the squadron.

## CORNS.

Account showing the Quantities of the different Varieties of Foreign and Colonial Grain entered for Consumption in the U. Kingdom in each of the 18 Years ending with 1847, with the Total Quantities so entered, and the Annual Entries at an Average of the above Period, with a similar Account for Indian Corn and Meal for the 5 Years ending with 1847.—(Compiled from various *Parl. Papers.*)

| Years. | Wheat and Flour. | Barley. | Oats and Oatmeal. | Rye. |
|---|---|---|---|---|
| | Qrs. | Qrs. | Qrs. | Qrs. |
| 1830 | 1,727,847 | 48,505 | 904,172 | 19,189 |
| 1831 | 1,506,740 | 514,610 | 355,492 | 56,203 |
| 1832 | 376,755 | 77,988 | 3,082 | 60 |
| 1833 | 81,036 | 1,226 | 975 | 1 |
| 1834 | 64,974 | 11,071 | 55,620 | 22 |
| 1835 | 28,554 | 136,853 | 176,142 | 3 |
| 1836 | 30,107 | 110,021 | 97,197 | 18 |
| 1837 | 244,272 | 47,475 | 334,024 | 19,576 |
| 1838 | 1,848,475 | 8,192 | 11,072 | 2,517 |
| 1839 | 2,711,723 | 591,301 | 862,789 | 152,182 |
| 1840 | 2,401,436 | 619,801 | 517,052 | 1,857 |
| 1841 | 2,647,808 | 222,837 | 27,918 | 518 |
| 1842 | 2,989,645 | 49,969 | 295,137 | 28,516 |
| 1843 | 990,523 | 223,543 | 45,254 | 2,724 |
| 1844 | 988,515 | 1,020,766 | 258,235 | 28,779 |
| 1845 | 315,615 | 299 130 | 587,434 | 23 |
| 1846 | 2,962,928 | 404,644 | 779,442 | 1,710 |
| 1847 | 4,612,110 | 782,686 | 1,788,057 | 253,510 |
| Totals | 26,532,063 | 5,173,918 | 7,099,694 | 567,808 |
| Average anuual entries for consumption. | 1,474,003½ | 287,439 8/9 | 391,427 4/9 | 31,544 8/9 |

| Years. | Peas. | Beans. | Total entered. | Indian Corn and Meal. |
|---|---|---|---|---|
| | Qrs. | Qrs | Qrs. | Qrs |
| 1830 | 44,507 | 18,697 | 2,763,417 | |
| 1831 | 57,977 | 17,678 | 2,508,700 | |
| 1832 | 16,595 | 7,439 | 481,919 | |
| 1833 | 18,092 | 6,028 | 110,358 | |
| 1834 | 57,702 | 41,566 | 233,955 | |
| 1835 | 25,184 | 69,824 | 436,560 | |
| 1836 | 80,928 | 87,796 | 406,067 | |
| 1837 | 87,615 | 109,076 | 842,038 | |
| 1838 | 11,618 | 54,240 | 1,936,114 | |
| 1839 | 170,470 | 123,597 | 4,615,262 | |
| 1840 | 159,157 | 129,517 | 3,829,120 | |
| 1841 | 132,857 | 267,697 | 3,299,635 | |
| 1842 | 80,450 | 43,279 | 3,487,296 | |
| 1843 | 45,383 | 45,702 | 1,353,129 | 10,225 |
| 1844 | 106,375 | 225,680 | 2,628,350 | 38,711 |
| 1845 | 81,735 | 197,919 | 1,492,156 | 42,295 |
| 1846 | 181,801 | 209,874 | 4,540,309 | 757,609 |
| 1847 | 193,078 | 476,253 | 8,105,694 | 4,023,118 |
| Totals | 1,551,624 | 2,134,862 | 43,059,969 | 1,872,758 |
| Average annual entries for consumption | 86,201⅛ | 118,603 4/9 | 2,392,220½ | 974,551 3/5 |

Account of the Average Prices of British Wheat per Quarter, in England and Wales, since 1771, as ascertained by the Receiver of Corn Returns

| Years. | Wheat. £ | s. | d. | Years | Wheat. £ | s. | d | Years. | Wheat. £ | s. | d. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1771 | 2 | 7 | 2 | 1798 | 2 | 10 | 3 | 1825 | 3 | 8 | 7 |
| 1772 | 2 | 10 | 8 | 1799 | 3 | 7 | 6 | 1826 | 2 | 18 | 9 |
| 1773 | 2 | 11 | 0 | 1800 | 5 | 13 | 7 | 1827 | 2 | 16 | 9 |
| 1774 | 2 | 12 | 8 | 1801 | 5 | 18 | 3 | 1828 | 3 | 0 | 5 |
| 1775 | 2 | 8 | 4 | 1802 | 3 | 7 | 5 | 1829 | 3 | 6 | 3 |
| 1776 | 1 | 18 | 2 | 1803 | 2 | 16 | 6 | 1830 | 3 | 4 | 3 |
| 1777 | 2 | 5 | 6 | 1804 | 3 | 0 | 1 | 1831 | 3 | 6 | 4 |
| 1778 | 2 | 2 | 0 | 1805 | 4 | 7 | 10 | 1832 | 2 | 18 | 8 |
| 1779 | 1 | 13 | 8 | 1806 | 3 | 19 | 0 | 1833 | 2 | 12 | 11 |
| 1780 | 1 | 15 | 8 | 1807 | 3 | 13 | 3 | 1834 | 2 | 6 | 2 |
| 1781 | 2 | 4 | 8 | 1808 | 3 | 19 | 0 | 1835 | 1 | 19 | 4 |
| 1782 | 2 | 7 | 10 | 1809 | 4 | 15 | 7 | 1836 | 2 | 8 | 6 |
| 1783 | 2 | 12 | 8 | 1810 | 5 | 6 | 2 | 1837 | 2 | 15 | 10 |
| 1781 | 2 | 8 | 10 | 1811 | 4 | 14 | 6 | 1838 | 3 | 4 | 7 |
| 1785 | 2 | 11 | 10 | 1812 | 6 | 5 | 5 | 1839 | 3 | 10 | 8 |
| 1786 | 1 | 18 | 10 | 1813 | 5 | 8 | 9 | 1840 | 3 | 6 | 4 |
| 1787 | 2 | 1 | 2 | 1814 | 3 | 14 | 0 | 1841 | 3 | 4 | 4 |
| 1788 | 2 | 5 | 0 | 1815 | 3 | 4 | 4 | 1842 | 2 | 17 | 3 |
| 1789 | 2 | 11 | 2 | 1816 | 3 | 15 | 10 | 1843 | 2 | 10 | 1 |
| 1790 | 2 | 13 | 2 | 1817 | 4 | 14 | 9 | 1844 | 2 | 11 | 3 |
| 1791 | 2 | 7 | 2 | 1818 | 4 | 4 | 1 | 1845 | 2 | 10 | 10 |
| 1792 | 2 | 2 | 11 | 1819 | 3 | 13 | 0 | 1846 | 2 | 14 | 8 |
| 1793 | 2 | 8 | 11 | 1820 | 3 | 7 | 11 | 1847 | 3 | 9 | 9 |
| 1794 | 2 | 11 | 8 | 1821 | 2 | 16 | 2 | 1848 | 2 | 10 | 6 |
| 1795 | 3 | 14 | 2 | 1822 | 2 | 4 | 7 | 1849 | 2 | 4 | 3 |
| 1796 | 3 | 17 | 1 | 1823 | 2 | 13 | 5 | 1850 | 2 | 0 | 3 |
| 1797 | 2 | 13 | 1 | 1824 | 3 | 4 | 0 | | | | |

CORNET. In Music, a shrill wind instrument formed of wood, which appears to have been in use in the earliest times, and remained so till about the commencement of the 18th century, when it was displaced by the oboe.

CO'RNET-A-PISTONS. (Fr.) A brass wind musical instrument, of the French horn species, but capable of much greater inflection from the valves and stoppers (pistons) with which it is furnished, and whence it derives its name.

CO'RNICE. (Fr. corniche.) In Architecture, the upper great division of an entablature (*see* ENTABLATURE), consisting of several members.

CORNS. Thickenings of the cuticle of the toes, of a

horny texture, arising from continued pressure over a projection of bone. One of the best and simplest remedies for this painful disorder is to wear upon the toe or part affected a piece of leather, spread with diachylon or other emollient plaster, and having a hole in it corresponding with the size of the corn. By this means all pressure upon the corn is avoided. (See *Sir B. Brodie's Lecture on Corns and Bunions*, *Medical Gazette*, 13th Feb. 1836.)

CO'RNSTONE. A provincial name for a species of red limestone.

CO'RNU AMMONIS. A name sometimes applied to the fossil shells called Ammonites.

CO'RNUA. (Lat. cornu, *a horn*.) In Zoology, hard and more or less elongated processes projecting from the head. The term is usually applied to such processes in the class Mammalia, in which they serve as weapons of offence and defence. These weapons consist either of bone, when they are called "antlers;" or of horn, or of bone and horn, or lastly of bone and hairy skin. The first kind of horns are peculiar to the deer tribe; the second to the rhinoceros; the third to the sheep, ox, and antelope tribes; and the fourth to the giraffe. The bony horns, antlers, cerata, or *cornua solida*, as they are technically termed, during the whole period of their formation resemble the horns of the giraffe, inasmuch as they are covered with a hairy and highly vascular integument: the bony material of these processes is in fact secreted by the vessels of that integument, so that their co-existence is essential as long as growth proceeds. When their growth is completed, and the antlers have arrived at their characteristic size and figure (which in the elk and Wapiti deer are truly remarkable), the determination of blood to the parts gradually lessens; the vessels shrink; the circulation in the formative membrane is at length suppressed; and the tegument then shrivels, dries, cracks, and is rubbed off by the instinctive actions which the deer now almost ceaselessly performs with his newly acquired and consolidated antlers. The skin and periosteum of the head, once continuous with those of the antler, now terminate at an abrupt line at the base of the antler, from which a ridge of bone, or "burr," as it is termed, is developed, apparently for the purpose of defending the margin of the persistent integument, for when this is continued, as in the Munt-jac deer, half way up the antlers, the burr is developed immediately above its termination, or at the middle, and not at the base of the antlers. Some physiologists have conjectured that the use of the "burr" was to compress the vessels of the periosteum of the antler, and that its formation was deferred to near the completion of the antler; but observation shows that it commences at an earlier period of growth, and sound physiology teaches that the cessation, like the commencement of the growth of the horn, must be the result of deeper and more constitutional operations. The most remarkable fact in the economy of antlers is that they are shed and renewed annually, the fall of the horns being concomitant with the shedding of the hair. The attempts to assign the final cause of this phenomenon have not been very successful. In the axis deer, *e g.* the bucks do not all shed their horns at the same time, but at different periods of the year. In the rein-deer the branches which project forwards from the base of the horn, or the brow antlers, are habitually used to scrape away the snow which conceals the lichens on which they principally feed. The female, therefore, needs antlers as much as the male, and she has them; but this is a rare and singular exception, for the females of other species of deer are destitute of these ornamental weapons. True horns, or those which consist either partly or entirely of horny material, are never shed. In the antelopes they are in almost all cases confined to the male, and their bony basis is generally solid; in sheep and oxen the horns are commonly present in both sexes, and the bony basis is hollow. The term *cornua cava* is, however, usually applied to all horns consisting of bone and horn, and reciprocally the ruminants having such horns are termed "hollow-horned." But this extension of the term seems to have arisen from a consideration of the external horny sheath alone, which is but a part, and that not the most essential, of the horn. The horn or horns of the rhinoceros consist of an agglutination of horny fibres, which are attached only to the integument; the integument adhering with more than usual firmness at this part to the roughened surface of the bone beneath. The horn of the rhinoceros differs from that of other mammalia in being situated upon the median line of the forehead; so that when there are two they are placed one behind the other, and not laterally and symmetrically, as in the ruminants.

A few ruminants have naturally two pairs of horns; and this was the case with a great extinct species, *Sivatherium*, whose remains have been discovered in the Himalayan mountainous regions, where the small *Antilope quadricornis* still exists. Horns are characterized in zoological descriptions according to their position, as *Cornua nasalia*, *frontalia*, *parietalia*, &c.: or according to their direction, as *Cornua prona*, turned forwards; *reclinata*, turned back; *incurva*, bent inwards; *vara*, bent outwards; *reduncа*, with the apices curved forwards; *lyrata*, when they represent the horns of the ancient lyre; *gyrata*, when spirally twisted: or according to their period of existence, as *cornua perennia*, when they last the life-time of the animal; or *cornua decidua*, or *annua*, when annually shed: lastly, horns are termed *cornua ossea*, *cornua solida*, *cava*, according to their structure, as above described. For the peculiarities of the giraffe's horns, see GIRAFFE.

Certain species of many other classes have parts projecting from the head, analogous in form or structure to the cornua of the mammalia. The frontal protuberance of the emeu, hornbill, and helmeted curassow consists of bone covered with a sheath of horn; the kamichi or horned screamer is a still more remarkable example of a bird so armed. In reptiles we find horned toads, vipers, and iguanas. Fishes present divers simulations of true horns. In mollusca retractile feelers or eye-stalks are commonly called "horns," as in the snail; but the appendages which would come under the general definition of our present term arrive at their maximum relative size, variety, and singularity of form in the class of insects.

CO'RNUCO'PIA. (Lat. cornu, *a horn*, and copia, *plenty*.) In the Fine Arts, an ornament representing a horn, from which issue flowers, fruits, leaves, and the like. The origin of the cornucopia has been variously given. Some authors have traced it to the infant days of Jupiter, whose nurse, Amalthea, when one of her goats had broken off a horn against a tree, presented it to the god wreathed with flowers and filled with fruit. Hence it became the emblem of Plenty among the ancients, in which light it is regarded also by many modern nations. The cornucopia is found very frequently in the types of ancient coins, particularly upon those of Sicily. (See the medal of Arsinoe.)

CORO'LLA. (Lat. corolla, *a garland*.) That envelope of a flower which is placed next within the calyx. It is usually more richly coloured and larger than the latter, but is extremely variable in this respect. Owing to its being in many plants one of the most striking parts of the flower, it is much employed by botanists in their systematical arrangements, and by the French school has been taken as the means of forming fundamental characters of the subclasses in the great Dicotyledonous division; but there is no doubt that its importance for this purpose has been much overrated. Theoretically considered, the corolla is composed of modified leaves, with the ordinary organization of which its parts or petals correspond as much as can be expected of rudimentary organs; its physiological action is to absorb oxygen, without decomposing carbonic acid, in which respect it agrees with leaves in their morbid state in the autumn. The corolla has been described by Lamarck as a diseased state of the foliage.

CO'ROLLARY. (Lat. corollarium, signifying originally a gratuity or donation presented to a person over and above what was strictly his due.) In its mathematical sense, this word is used to designate a consequence drawn from some proposition already demonstrated without the aid of any other proposition. Thus, supposing it demonstrated that if a triangle have two equal sides, it has also two equal angles; it would then follow, as a corollary, that if the three sides of a triangle are equal, its three angles are also equal.

CORO'NA. (Lat.) In Architecture, the flat, square, massy member of a cornice, very frequently called the drip or larmier. Its situation is between the cymatium above and the bed moulding below, and its use to carry the water drop by drop from the building.

CORO'NA AUSTRALIS and CORONA BOREALIS. (The *southern crown* and *northern crown*.) Two of the old constellations of Ptolemy; the first in the southern, and the second in the northern hemisphere.

CORO'NA DENTIS. In Zoology, the exposed part of a tooth, which projects beyond the alveolus and gum.

CORONA'MEN. In Zoology, the superior margin of a hoof, called in veterinary surgery the coronet.

CO'RONARY. (Lat. corona, *a crown*.) Coronary vessels and ligaments are those which spread round certain viscera, bones, &c.

CORONA'TION. *See* KING.

CO'RONER (Lat. coronator), is the title of an office established in Saxon times, of which the holder was, as his name indicates, in a peculiar manner the officer of the crown, whose private rights of property, whether arising by escheat, wardship, or consisting in demesne, it was his business to maintain and superintend in the county for which he acted. Connected in some degree with this character is the more important if not the sole function which he now exercises: that of holding inquests on the bodies of such as either die or are supposed to die a violent death. (4 Edw. 1. st. 2.) For which purpose he is empowered to summon jurymen out of the neighbourhood, and witnesses. Should violent death be occasioned by any personal chattel, it is forfeited as a deodand to the crown; but juries are now in the habit of assessing a small sum of money in lieu of the

chattel or its full value. (*See* DEODAND.) The coroner was originally in some sort the colleague and assistant of the sheriff, and in his default might still act as sheriff in the execution of writs, which in such case would be directed to him. The coroner is still, as the sheriff was formerly, elected by the freeholders of the county; but the office, which was once strictly honorary, has lost much of the dignity which belonged to it, and is now held by persons, usually either surgeons or attorneys, whose object in accepting it is the profit to be derived from fees. There are generally several coroners in the same county. (*Jervis on Coroners.*)

CO'RONET, or CORO'NA. This word is employed by botanists to express certain appendages of the corolla, which are arranged within it in a circle, and which not unfrequently give a very peculiar appearance to the flower in which it is found. In the Narcissus it is a cup; in Symphytum it consists of five glandular narrow processes; in Asclepias it is a thick fleshy ring extended into bonded lobes. In all cases the coronet is a modification of sterile stamens.

CO'RONET. In Heraldry, an inferior crown belonging to the British nobility. The figure of John of Eltham, second son of Edward II., who died in 1334, affords the earliest representation of this ornament. Barons do not appear to have borne them earlier than the reign of Charles II. The time at which the coronets of the present orders of nobility were respectively distinguished in the existing fashion cannot be ascertained.

CO'RONET-BONE. The second of the consolidated phalanges of the horse's foot.

CO'RPORAL. (Fr. caporal, from capo, *a head.*) A non-commissioned officer in a battalion of infantry immediately under the serjeant; his business is to place and relieve the sentinels, and at drill he has charge of a squad. In the ranks he does the duties of a private, but his pay is somewhat higher.

CORPORA'TION. (Lat. corpus, *body.*) A body politic or incorporate; consisting of a person or persons having power to take and grant, &c. to himself or themselves and their successors. Corporations, in English Law, are divided,—1. Into sole and aggregate. Sole corporations are such as consist of a single person who is constituted a corporation by law. for the purpose of enjoying certain advantages and incurring certain duties, transmissible to his successors. Such is the parson of a living in respect of his benefice; a bishop, in respect of the ecclesiastical rights and property of his see; the king, &c. Corporations aggregate are such as consist of more individuals than one, and are kept up by a perpetual succession of members 2. Into ecclesiastical and lay. Parsons, bishops, deans and chapters, are instances of the former. The latter are again subdivided into civil and eleemosynary. Among the first are trading companies and municipal corporations; among the latter, hospitals, colleges in the universities, and similar establishments (which, however, were anciently esteemed eccelsiastical).

By the law of England, corporations are erected only with the king's consent, express or implied; and may exist by prescription, by letters patent, or by act of parliament. Bishops, parsons, &c., may indeed be said to exist as corporations by force of the common law; but some ancient municipal bodies, such as the corporation of London, are in a stricter sense corporations by prescription. Corporations by act of parliament may be created either expressly, or by implication; as, where a body is to take lands by succession, this constitutes them a corporation But the ordinary mode by which they are erected is by the king's letters patent or charter of incorporation; persons exercising the power of founding corporations by a grant of their own (as the chancellor of the university of Oxford) being for this purpose only delegates of the king.

The chief incident of a corporation is the power of taking by succession. This power is, however, confined in the case of sole corporations to estates of freehold; corporations aggregate only can take goods and chattels by succession. Grants by a corporation aggregate must be by deed under their common seal, which is necessary to give validity to most of their acts. A corporation has essentially the power of making by-laws to bind its own members, which are valid so far as they are not contrary to the laws of the kingdom. Corporations ecclesiastical and eleemosynary may, moreover, be subject to rules or statutes imposed by the king or the founder; civil corporations only to the common law and their own by-laws. In aggregate corporations, the act of the majority is the act of the whole.

The common law capacity of corporations to take lands has been, however, materially narrowed by statute. Thus a devise of lands to a corporation by will is bad, except for charitable purposes. And, in consequence of the Statutes of Mortmain (*see* MORTMAIN), a corporation, whether lay or ecclesiastical, must now have a license from the king in order to purchase.

All corporations are said to be subject to visitation. The visitor of ecclesiastical corporations is the ordinary (*see* ORDINARY); the visitor of lay corporations is the founder. In eleemosynary corporations this right, therefore, is in the founder and his heirs, or in such person as he has appointed: in civil corporations, the king is visitor, and exercises that jurisdiction in the King's Bench; where alone misbehaviour of such corporations or their officers can be inquired into, chiefly by means of the processes termed *mandamus* and *quo warranto* (which see). A corporation is dissoluble, 1. By act of parliament; 2. In the case of an aggregate corporation, by the death of all its members; 3. By surrender of its franchises into the hand of the king; 4. By forfeiture of its charter through negligence or abuse of the franchise.

CORPORA'TIONS, MUNI'CIPAL. These bodies, which have acted so important a part in the history of modern Europe, originated in the Italian and provincial towns subject to the Roman sway. Under that empire the government of the towns was in many respects independent of the central authority, or only controlled by it in the last resort; and as the municipal institutions of the Romans remained undestroyed through the long period of the dark ages, the free cities which arose in the eleventh and twelfth centuries in Italy, France, and elsewhere, did in fact only preserve their ancient systems of internal policy in the new character of republican constitutions. (See especially *Savigny on Roman Jurisprudence in the Middle Ages.*)

In England we have no record of the internal constitution of our towns prior to the Saxon times, and during those times our information is extremely scanty and imperfect. The magistracy in Saxon towns appears to have been elective; that in Danish, hereditary. In Domesday Book we find in every town (eighty-two in all, in those parts of the record which remain to us) a certain number of persons mentioned as "burgesses;" a number sometimes equalling, sometimes falling far short of the houses enumerated. It has been supposed that at this early period all free inhabitants paying scot and lot were burgesses; a supposition which can neither be easily proved nor controverted Boroughs at this period were exempt from the immediate jurisdiction of the sheriffs of the counties in which they were situate: they possessed their own hundred courts, leets, and view of frankpledge; but they were liable for various duties to the king, who was usually lord of the leet, and exercised jurisdiction in the borough; and to the lord of the soil also, if there were any It became usual after the Conquest for the king to let the fees and revenues thus due, together with the right of appointing the officers of justice, to the burgesses in general; and by this species of enfranchisement the borough became an independent municipality. But a free borough was constituted by having, in addition to those powers, exemption from the king's tolls, granted to its burgesses by royal charter. Such continued to be, in substance, the condition of English boroughs for several centuries. Burgess-ship was gained, either by residence simply, with payment of scot and lot, or, in some cases, by apprenticeship, constituting a title of admission to the guild merchant or trading community of the borough, which by degrees became identified with the borough itself; or, as in London, by admission into the guilds of the several trades, an alteration which appears to have taken place in that city as early as the thirteenth century.

During all this period no one seems to have doubted the capability inherent in the burgesses of a town, as a community, to take and enjoy lands, tolls, or other hereditaments, to themselves and their successors. But about the period of the reigns of Henry V. and VI, the increasing subtlety of our legal system, and more particularly the notions introduced by the study of the civil law, appear to have occasioned the custom of granting charters in a new form It appears to have been thought that the power of holding lands in succession, and the right of suing and being sued by a common name, could not in strictness be enjoyed, except by a body constituted for those very purposes by the king's grant. Hence originated charters or letters of incorporation. These seem to have been first granted to eleemosynary foundations; afterwards, and first in the reigns before mentioned, they were granted to the men or burgesses of towns jointly with the mayor, bailiff, or other chief officer; and thus municipal corporations in the strict legal sense were first constituted.

But previously to this time it is probable that a great change had taken place, in most towns, in the character of the class of "men" or "burgesses" to whom these charters were granted. As the privileges of burgess-ship became more valuable, additional difficulties were thrown by the governing body in the borough in the way of its acquisition. While the old household right remained in some places, it was lost in others: in its stead, or by its side, arose the rights of freemen of a guild or trade; those of the holders of particular tenements, which alone were recognized as conferring on their occupant the title of burgess; those of freeholders in cities, counties of themselves, &c. And hence the variety of the old parliamentary franchise (*see* PARLIAMENT), as members of parliament were elected by the burgesses. Hence the

corporations, which were constituted by the charters of Henry VI. and Edward IV., were already very different bodies from the general mass of dwellers in a town. But close corporations, properly so called, were not established until the reigns of the Tudors, when the first "governing charters" were granted; that is to say, charters which, disregarding the old common law system, by which every burgess had a share in corporate rights, and the power of electing his magistrates, established special rules for the internal regulation of a borough. By these new charters the powers of municipal government were usually vested in a mayor and common council: the latter consisting of councillors and aldermen; the former of whom were selected in various ways, by the whole of the council or the aldermen; the aldermen mostly nominated by and out of the rest of the council. In these bodies the control over the town funds, the civil and criminal jurisdiction of the town, and police authority within its limits, became vested. The freemen, as well as the commonalty, thus ceased to be members of the governing body; but the former retained the extensive pecuniary advantages which in many places belonged to them.

The causes of this revolution, and of the gradual change by which the municipal bodies became more and more exclusive in their character, are chiefly to be found in the parliamentary franchise enjoyed by most of the corporate boroughs. When the House of Commons became an important body in the empire, the crown, as well as the noblemen and the powerful individuals to whose estates the boroughs were contiguous, had a strong and direct interest in controlling the nomination of members. This was much more easily effected by the agency of select bodies, such as the corporations, than by influencing the votes of an independent community. Hence, while in the larger places the corporation, usually devoted to the interest of its patron, exercised a decisive or a strong authority in controlling elections, in many smaller boroughs the elective franchise became in effect confined to the corporation itself, by means of the freemen who were closely associated with it. Thus the system of close corporations, established under the Tudors, acquired continually more strength and more exclusiveness: although the committee of privileges presided over by Mr. Serjeant Glanville, in the reign of James I., resolved that charters of the crown were inoperative so far as they assumed to alter the parliamentary franchise of a borough. The governing bodies in the previous reign seem also to have assumed in many places the power, which has been since so liberally exercised, of admitting to the rights of freemen, or burgesses, whom they pleased, either by free gift or purchase. The great bulk of the property of corporations, both that enjoyed by them to their own use, and that of which they were trustees for charitable purposes, seems to have been acquired after the first charters of incorporation were granted, and previously to the Revolution.

In the reign of Charles the Second, when the corporate bodies in the larger towns had become for the most part attached to the Whig interest, and hostile to the court, they were attacked by the crown through the famous writs of quo warranto. These were writs issued out of the King's Bench to the municipal bodies, to inquire by what right they exercised their jurisdictions and enjoyed their franchises; and the object was to contest the validity of the ancient charters, or at least to terrify them into surrendering them into the king's hands, and receiving new ones from him. Many such surrenders were actually made, and new charters granted: these, however, were recalled by a proclamation of James II., and the old ones regranted or revived; and this proclamation was allowed, after the Revolution, to have the force of law. A few boroughs, however, did not accept the restoration of their charters, and remained without a corporation. From the period of the Revolution little or no change of importance took place in the constitution of the towns or their governing bodies, until the passing of the Municipal Reform Act in 1835. By this act (5 & 6 W. 4. c. 76.) the municipal franchise is made uniform all over the kingdom. In order to enjoy it, an individual must have occupied a house, warehouse, counting-house, or shop, within the borough, for three years; and must have been rated to all poor rates in respect of such premises during the whole of such time; and must be enrolled on the burgess list, which is framed by the overseers of the parishes and revised every year by the mayor and assessors. He must also have resided within seven miles of the borough during that time. There are also provisions for the cases of successive occupancy and change of residence. These burgesses form the electoral body. They choose,—1. The councillors; of whom the number is limited by the act, according to the number of wards of which each borough consists (this number being also specified by enactment, and varying from one to sixteen). No person can be qualified as a councillor, or alderman, unless he is a burgess possessing a certain amount of property (1000*l.*), or a rating at 30*l.* per annum, in boroughs having four wards and upwards; 500*l.*, or 15*l.* per annum, in boroughs not having that number. One third part of the councillors go annually out of office. 2. The council, *i. e.* the mayor, existing aldermen, and councillors, jointly elect every year the aldermen from among the qualified burgesses; half of whom go out of office every third year. 3. The councillors and aldermen together elect out of their own united body the mayor, whose office is annual. The mayor, aldermen, and councillors together form the council. The town-clerk, treasurer, &c. are appointed by the council during pleasure.

With regard to existing rights, freemen are retained, so as to enjoy their rights of property and parliamentary franchise; but they can no longer be made by gift or purchase; and they must be inhabitants of the borough. The income arising out of the corporation property is to form a borough fund; which is to be applied, subject to existing claims, to the payment of salaries and other municipal expenses, prosecutions, maintenance of the gaol, &c. &c.; and if the fund be insufficient for these purposes, the council can impose a rate to supply the deficiency. Wherever a municipal corporate body, either sole or in conjunction with other persons, had lands, &c. in trust to charitable uses, the trusts are gradually transferred by this act to the new councils; but every corporation possessed of advowsons, or rights of nomination to benefices in the church, is required to sell such advowsons, &c. under the direction of the ecclesiastical commissioners. Where the watching of the town was regulated by local acts, these acts are repealed, and the corporation is directed in all places to appoint a committee for the purpose of superintending that duty; and wherever the lighting is not regulated by local acts, that also is placed under the management of the corporation.

With respect to jurisdiction, the council of every borough now having a separate court of quarter sessions, or desiring to attain one, may apply to the king to retain or to acquire it; on which the king may, if he pleases, appoint a recorder to be paid by the town, being a barrister of five years' standing. This officer is to hold the court of quarter sessions of the peace, in which he is to be sole judge. Borough courts of record are to be retained as heretofore, and those in which a barrister of five years' standing acts as judge have power to try personal actions to the amount of 20*l.* The king is empowered to grant a commission of the peace to all boroughs named in Schedule A of the act, and to such boroughs named in Schedule B as he shall see fit, on petition of their council. The mayor and recorder to be justices of the peace ex officio; the others named by the crown. The council also are directed, if they think fit, to petition for the appointment of salaried police magistrates in their borough, stating the salary which they are willing to pay; on which the crown will appoint such officer or officers, being barristers of not less than five years' standing. The history of municipal corporations has been often written, and generally with much party spirit and unfairness. Those who wish to study it in the only authentic records, viz. charters and other documents, will find the most abundant collection of them, chronologically arranged, in *Messrs. Merewether and Stephen's History of Boroughs*, 1836.

CORPU'SCULA VERMIFO'RMIA. (Lat. corpusculum, diminutive of corpus, *body*, and vermiformis, *worm-shaped*.) In Vegetable Anatomy, are synonymous with strangulated or necklace-shaped ducts, a kind of spiral vessel found chiefly in the knots and contracted parts of stems.

CORPU'SCULAR A'CTION. The power or influence which the minute particles, or atoms, or *corpuscles* of matter, exercise on each other, and which is the cause of all chemical changes.

CORPU'SCULAR PHILO'SOPHY. A system of physics in which all the phenomena of the material world are explained by the arrangement and physical properties of the corpuscles or minute atoms of matter. A doctrine of this sort was anciently taught in Greece by Leucippus and Democritus, and is described in the beautiful poem of Lucretius.

CO'RPUS JURIS. (Lat. *body of law*.) *Corpus Juris Romani*, the collection of the authentic works containing the Roman law as compiled under Justinian. The Corpus Juris comprehends the Pandects, the Institutes, the Code, and the Novels or Authentics, *i. e.* the later constitutions of Justinian; to which, in some editions, are added a few issued by his successors. M. Beck has lately published at Leipzig the most complete edition. There are likewise publications styled *Corpus Juris Canonici*, *Germanici*, *Feudalis*, &c.

CORRE'CTION. (Lat. corrigo, *I correct*.) In the Fine Arts. With the Italians the word, *correzione*, is used to denote an exact acquaintance with the different proportions of the parts of a body or design generally; but with us the term is applied to those emendations of inaccuracies or alterations of first thoughts, which they call *pentimenti*, to be seen under the surface of the finished picture, and which are accounted indications of its originality.

**CORRECTING**, in Printing, in the first instance, is to amend and put right the errors in the types that the compositor may have made, and any defects in his workmanship; in the next, it is the correcting of the proof sheets of a work by the author or editor, in the orthography, the punctuation, the language, and in making such alterations as may appear to him necessary. The following explanation of the marks which are in general use by printers for this purpose, with the annexed specimen, will enable a gentleman who has to superintend a work through the press to correct the proof sheets in a way that will be clearly understood by the printer, and will tend to promote correctness by preventing those mistakes that occasionally occur, owing to his not clearly comprehending the marks on the proof.

1. Where a word is to be changed from small letters to capitals draw three lines under it, and write *caps.* in the margin.
2. Where there is a wrong letter draw the pen through that letter, and make the right one opposite in the margin.
3. A letter turned upside down.
4. The substitution of a comma for another point, or for a letter put in by mistake.
5. The insertion of a hyphen.
6. To draw the letters of a word close together that stand apart.
7. To take away a superfluous letter or word the pen is struck through it and a round top *d* made opposite, being the contraction of *deleatur*, to expunge.
8. Where a word has to be changed to Italic draw a line under it, and write *Ital.* in the margin; and where a word has to be changed from Italic to Roman, write *Rom.* opposite.
9. When words are to be transposed three ways of marking them are shown; but they are not usually numbered except more than three words have their order changed.
10. The transposition of letters in a word.
11. To change one word for another
12. The substitution of a period or a colon for any other point. It is customary to encircle these two points with a line.
13. The substitution of a capital for a small letter.
14. The insertion of a word, or a letter
15. When a paragraph commences where it is not intended, connect the matter by a line, and write in the margin opposite *run on.*
16. Where a space or a quadrat stands up and appears, draw a line under it and make a strong perpendicular line in the margin.
17. When a letter of a different size to that used, or of a different face, appears in a word, draw a line either through it or under it, and write opposite *w f.*, for wrong fount.
18. The marks for a paragraph, when its commencement has been omitted.
19. When one or more words have been struck out, and it is subsequently decided that they shall remain, make dots under them, and write the word *stet* in the margin.
20. The mark for a space where it has been omitted between two words
21. To change a word from small letters to small capitals make two lines under the word, and write *sm. caps.* opposite. To change a word from small capitals to small letters make one line under the word, and write in the margin *lo ca.* for lower case.
22. The mark for the apostrophe; and also the marks for turned commas, which designate extracts
23. The manner of marking an omission, or an insertion, when it is too long to be written in the side margin. When this occurs it may be written either at the top or the bottom of the page.
24. Marks when lines or words do not appear straight.

The subjoined specimen when corrected would be as follows:—

ANTIQUITY, like every other quality that attracts the notice of mankind, has undoubtedly votaries that *reverence* it, not from reason, but from prejudice. Some seem to admire indiscriminately whatever has been long preserved, without considering that time has sometimes co-operated with chance: all perhaps are more willing to honour past than present excellence; and the mind contemplates genius through the shades of age, as the eye surveys the sun through artificial opacity. The great contention of criticism is to find the faults of the moderns, and the beauties of the ancients. While an author is yet living, we estimate his powers by his worst performances; and when he is dead, we rate them by his best.

To works, however, of which the excellence is not absolute and definite, but gradual and comparative; to works, not raised upon principles demonstrative and scientifick, but appealing wholly to observation and experience, no other test can be applied than LENGTH of duration and continuance of esteem.



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CORRESPO'NDENCE. (Lat. con, *with*, and respondeo, *I answer*.) In the Fine Arts, the fitting or proportioning the parts of a design to each other, so that they may be correlative, and that the same feeling may pervade the whole composition.

CO'RRIDOR. (Ital. corridoro.) In Architecture, a gallery or open communication to the different apartments of a house.

CORRO'SIVE SUBLIMATE. The bichloride of mercury, composed of 200 mercury + 72 chlorine. It is an acrid poison of great virulence: the stomach-pump and emetics are the surest preventives of its deleterious effects when accidentally swallowed; white of egg has also been found serviceable in allaying its poisonous influence upon the stomach. Its specific gravity is 52. It requires 20 parts of cold water, but only 2 of boiling water, for its solution. *See* MERCURY.

CO'RRUGATE. (Lat. ruga, *wrinkle*.) In Zoology, the surface of an animal is so called when it rises and falls in parallel angles more or less acute.

CO'RSAIR. (Ital. corsaro.) A term used in the south of Europe and some other parts for a pirate or his ship. The corsairs of Barbary were commissioned by their princes to attack the merchant ships of hostile countries.

CO'RTES. (*See* STATES.) The old assembly of the estates in Leon, Castile, Arragon, and Portugal. These estates were framed, as elsewhere, of nobility, dignified clergy, and representatives of the towns. In Arragon they were presided over by a high officer, termed Justiza, with powers in some respects sufficient to control the monarch. The origin of popular representation in the cortes of the several kingdoms out of which that of Spain was finally formed is assigned to a date as early as the 12th century, but the deputies sent by the towns were irregularly summoned, frequently did not attend, and the numbers which appeared for each town frequently bore no proportion to the relative size of the different places. In the 14th century the power of the cortes seems to have been at its height, after which it gradually decayed, and under the government of Ferdinand and Isabella was reduced almost to a nullity (See *Prescott's Ferdinand and Isabella*, vol. i., *Hallam's Middle Ages*.) After the time of Philip II., the cortes of Spain were only occasionally convoked on the accession of kings, and their sittings were a mere form. In 1811, during the French invasion, they were convoked at Cadiz, and conducted the affairs of that kingdom during the war of independence. In 1814, Ferdinand VII. dissolved them, and declared all their decrees null. In 1820, the cortes met again, and adopted a new constitution; in 1821, the people of Portugal followed the same example: both constitutions were overthrown in 1823; the first by the French invasion, the latter by a counter revolution. The later events of Spanish and Portuguese history have again called these national assemblies into existence.

CORTI'CIFERS, *Corticifera*. (Lat. cortex, *bark*, fero, *I carry*.) Those Polyps whose uniting fleshy substance is spread, like the bark of a tree, over a central calcareous or corneous axis.

CO'RTILE. (Ital.) In Architecture, an open quadrangular or curved area in a dwelling-house, surrounded by the buildings of the house itself.

CO'RTINA. (Lat. cortina, *a kind of table*.) A term used in describing Fungi, to denote that portion of the velum which adheres to the margin of the pileus in fragments.

CORU'NDUM. A crystallized or massive mineral of extreme hardness, and composed of nearly pure alumina, it is usually almost opaque, and of a reddish colour. It is allied to the sapphire.

CORVE'E. (French.) In Feudal Law, the obligation of the inhabitants of a district to do certain services, as the repair of roads, &c. for the sovereign or the feudal lord. Some species of corvée were performed gratis, others for a fixed pay, but generally below the value of the labour performed.

CO'RVUS. (Lat. *the raven*.) A Linnæan genus of birds, now the type of a family (*Corvidæ*), belonging to the Conirostral division of the *Passeres* of Cuvier, and including, with the Crows proper, the Rollers (*Coracias*) and Birds of Paradise (*Paradisea*).

CO'RVUS. In Astronomy, one of Ptolemy's constellations, in the southern hemisphere.

CORYBA'NTES (Gr.) in Grecian Mythology, were the priests of Cybele; so called either from Corybas, the son of that goddess, or from the frantic gestures with which their devotions were accompanied; the term Corybantes signifying literally "shaking the head violently." They used to beat brazen cymbals in their sacred rites;

——— Acuta
Si geminant Corybantes æra. HOR. *Od.* I. 16. 8.

and their whole religious proceedings were characterized by such extravagant fanaticism as to have enriched the Greek language with several terms expressive of *madness* or *frenzy*.

CORYCE'UM. (Gr. κόρυκος.) In Ancient Architecture, an apartment in a gymnasium whose exact destination is not known.

CORYDA'LEA. An alcaline principle, from the *Corydalis tuberosa* and *Fumaria cava*.

CO'RYMBI'FERÆ. (Lat. corymbus, *a flat-headed kind of inflorescence*, and fero, *I bear*.) One of the divisions of the great group of *Compositæ* admitted by Jussieu. It comprehends those plants which, like the Chrysanthemum and the Aster, have the capitula furnished with a ray; and those others which, like Artemisia, although destitute of a ray, are similar to such plants in the majority of their characters.

CORY'MBUS. (Lat.) In Ancient Sculpture, the cluster of ivy leaves, berries, garlands, &c. with which vases were encircled.

CORY'MBUS. In Botany, a form of inflorescence consisting of a central axis, developing lateral pedicels, the lower ones of which are so long that their flowers are elevated to the same level as that of the uppermost.

CORYPHE'NA. (Gr. κορυς, *a helmet*, and φαινω, *I show*.) A genus of spiny-finned fishes, so called from the head being crested like a helmet. It belongs to the Mackerel family (*Scomberoids*); and includes the true dolphin, or changeable coryphene (*Coryphæna hippuris*). The genus is now raised to the rank of a family, including, with *Coryphæna* proper, the subgenera *Centrolopus* and *Leptopodes*.

CO'RYPHE'US. (Gr. κορυφη, *summit*.) The leader of the chorus in ancient dramas; by whom the dialogue between the chorus and the other actors of the drama was carried on, and who *led* in the choric song.

CORY'ZA. (Gr. κορυζα.) A copious running from the nose.

CO'SECANT and COSINE. The secant and sine of the complement of an angle or arc; the prefix *co* being merely the abbreviation of *complement*, first introduced by Gunter.

COSME'TIC. (Gr. κοσμεω, *I adorn*.) Remedies to remove freckles and pimples from the face and to improve the complexion.

CO'SMICAL. (Gr. κοσμος, *the world*.) This word occurs frequently in the ancient astronomy, in which it is used to denote a particular position of a planet or star, at its rising or setting, in respect of the sun. A star is said to rise *cosmically* when it rises at the same instant that the sun rises, and to set cosmically, when it sets with the sun. Cosmical is opposed to *achronycal*, which signifies that a star rises at the instant the sun sets, and vice versâ. The cosmical and achronycal risings of a star are invisible to the naked eye, because the light of the sun in the horizon effaces that of the star.

COSMO'GONY. (Gr. κοσμος, *world*, and γονος, *birth*.) The science which treats of the origin of the universe. If we except the cosmogony of the Indians, the earliest extant is that of Hesiod, which is delivered in hexameter verse. The first prose cosmogonies were those of the early Ionic philosophers, of whom Thales, Anaximenes, Anaximander, and Anaxagoras are the most celebrated. In modern times, a Theory of the World has been produced by Burnet. We do not include in this list of cosmogonies the researches of modern geologists, or the systems to which they have led. They may be said to hold the same place in relation to the old cosmogoners, which the astronomer or the chemist occupies in reference to the astrologers and alchemists of ancient times.

The different theories which have been formed to account for the origin of the world may be comprehended under three classes: — 1st, Those which suppose the world to have existed from eternity under its actual form. Aristotle embraced this doctrine; and conceiving the existing universe to be the eternal effect of an eternal cause, maintained that not only the heavens and the earth, but all animate and inanimate beings are without beginning. 2d, Those which consider the matter of the universe eternal, but not its form. This was the philosophical system of Leucippus, Democritus, Epicurus, and indeed most of the ancient philosophers and poets, who feigned the world either to be produced by the fortuitous concourse of atoms existing from all eternity, or to have sprung out of the chaotic form which preceded its present state. 3d, Those which ascribe both matter and its form to the direct agency of a spiritual cause.

COSMO'GRAPHY. (Gr. κοσμος, and γραφω, *I write*.) The science which treats of the construction, figure, and arrangement of all the parts of the world; and therefore comprehends astronomy, geography, and geology.

COSMO'LOGY. (Gr. κοσμος, and λογος, *a discourse*.) *See* COSMOGONY.

COSMO'POLITE. (Gr. κοσμος, and πολις, *a city*.) A citizen of the world: one who makes the world his country.

COSMORA'MA. (Gr. κοσμος, and ὁραω, *I see*.) A species of picturesque exhibition, consisting of a number of drawings, generally about eight or ten, which are laid horizontally round a semicircular table, and reflected by

mirrors placed opposite to them diagonally. The spectator views them through a convex lens placed immediately in front of each mirror. The pictures are illuminated by lamp light; but the lamps are so placed that they cannot be reflected by the mirrors, and are therefore invisible to the spectator.

COSS. When algebra was first introduced into Europe, it was called the *Rule of Coss;* probably from the Italian *Regola di Cosa*, the *Rule of the Thing;* the unknown quantity being termed *cosa*, the thing. Hence *Cossic Art, Cossic Numbers*, &c., found in some of the old authors.

COSSA'CKS. A people inhabiting those parts of the Russian empire which border on the northern dominions of Turkey, Poland, and the southern confines of Siberia. Both the name and origin of this people are involved in great uncertainty. They seem to have nothing Russian in their origin and character, and are probably a mixed Caucasian and Tartar race. They form a sort of independent republic, paying no taxes to Russia, but cheerfully contributing their numerous and valuable contingent of troops; and are well known as the most harassing light troops that ever exercised a predatory warfare in the train of any army.

Their dress is a short vest in the Polish style, large trowsers of a deep blue colour, and a black sheepskin cap. Their arms consist of a sabre, long spear, musket, a pair of pistols, and a long whip, which they apply to their enemy as well as their charger's back They are mostly members of the Russian Greek Church, and are described as a hospitable, generous, and disinterested people. Their numbers have not been estimated for nearly a century, when they amounted to 955,228 males.

CO'STA. (Lat. costa, *a rib*) A term formerly confined to that bundle of vessels which passes directly from the base to the apex of a leaf; but which is better extended to all the main veins which proceed directly from the base to the apex, or to the points of the lobes

CO'STAL. (Lat costa.) Belonging to the ribs.

CO'STARDMO'NGER. (From costard, *a large apple.*) An itinerant dealer in apples. The word is often written *costermonger*, and applied to hawkers and pedlars who sell fruit.

CO'STATE. (Lat. costa, *a rib*) In Botany, a term applied in two ways, in describing the venation of leaves: either to indicate the presence of but one rib, as in most leaves; or in speaking of cases where three or more ribs proceed from the base to the apex of a leaf, and are connected by cross veins The latter are frequently called nerves, or nervures If a leaf has its ribs all distinct from the very base, it is called tricostate, quinquecostate, and so on; but if the ribs are united at the base in a distinct manner, the term becomes triplicostate, quintuplicostate, &c

COSTATE In Zoology, the surface of the whole or part of an animal is so termed when it has several broad elevated lines.

COSTS. In Law, the expenses to which parties are put in the prosecution and defending of actions Costs are to be considered either as between attorney and client, *i. e.* the expenses and fees which the attorney is entitled to recover from his client, or as between party and party, *i.e.* that portion of the expenses to which a successful party has been put in his suit, which he is entitled in certain cases to recover from the unsuccessful one Costs in the latter sense are not given by the common law. The statute of Gloucester (6 E 1. c 1. s 2) first enacted, that the demandant should recover from the tenant the cost of his writ, if successful; and that this provision should extend to all cases where a man recovers damages. By a liberal construction of this statute the costs of the writ are understood as the costs of the action, and its benefit is extended to plaintiffs in most cases where they would have been entitled to damages before that statute In other cases, the plaintiff is not entitled to costs, unless they are expressly given by statute. In assumpsit, covenant, and debt, if the plaintiff have a verdict, but the damages or debt and damages be under 40*s*, the judge may deprive him of any more costs than damages by certifying to that effect on the record, under 43 Eliz. c. 6. s. 2. In actions for assault and battery, and trespass, wherever the damages given by a jury do not amount to 40*s*., the plaintiff (by several statutes) is allowed no more costs than damages, unless the judge shall certify that assault and *battery* was sufficiently proved; or, in trespass, that the title to land came in question. The certificate may be granted at the trial, or within a reasonable time afterwards. Where, out of several issues, some are found for the plaintiff and others for the defendant, the plaintiff is now only entitled to costs on those issues on which he may succeed, and the costs of the defendant's issues will be deducted from his. The defendant's right to costs rests also on several statutes, principally 23 H. 8. c. 15. Double and treble costs are given by some statutes in particular cases; and they follow by implication where double and treble damages are given. Double costs, in practice, mean single costs and one half their amount in addition: treble, the same, with one half of these last. Costs are *taxed* as between party and party by officers of the court; and recoverable by action, execution, or attachment. As between attorney and client, the attorney has a right of action for costs; but his bill is liable to taxation by officers of the court, under certain restrictions. Costs in equity are within the discretion of the court, except in certain cases; as where no answer is made to a bill exhibited, or an insufficient answer, &c.

COSTU'ME. (It.) In Painting and Sculpture, this word has become used chiefly as a term denoting the particular sort of dress suitable to the subject, according to the time in which the action is supposed to have taken place; but the word has a more general signification, inasmuch as it includes the keeping of all the accessories, ornaments, utensils, &c. of such forms and colours as historical knowledge proves them really to have possessed.

COTE' DROIT, COTE' GAUCHE. *See* DEPUTIES, CHAMBER OF.

COTERIE. An old French word, supposed to be derived from the Lat. quot, *how many*, signifying literally a society or company. In the 13th or 14th century, when merchants were about to embark in any commercial enterprise, they formed a coterie or company, each contributing his *quota* of goods or money, and deriving his *quota* of profit But the term soon acquired a more extended signification, in which, however, the original meaning is still perceptible, being applied to any exclusive society in which interesting subjects (chiefly literary and political) are discussed, each member being supposed to contribute his *quota* or share of information for the general edification or amusement.

COTI'SE (Fr coté, *side*) In Heraldry, a diminutive of the bend, being one half the width of the bendlet: generally borne in couples, with a bend or charges between them A bend, less, &c. between two cotises, is termed *cotised*

CO'TTABUS (Gr κοτταβος) A celebrated Greek game. It consisted in throwing wine from cups into little basins of metal suspended in a particular manner, or floating in a large vessel of water, so that dexterity might be shown in throwing it without spilling in producing a particular sound, &c The cottabus was so favourite a sport, that rooms were built expressly for its performance, styled *cottabea*

CO'TTAGE ALLO'TMENTS, are those portions of ground which are allotted to the dwellings of country labourers for the purpose of being cultivated by them as gardens Sometimes these allotments are placed adjoining the dwellings, in which case they are more commonly called cottage gardens; but at other times they are placed at a distance from the cottage, and form small portions of a large enclosure, and to this kind of cottage garden the term allotment is more properly applied than to the other. The object in both cases is to afford resources to the cottager; and to enable him, by growing vegetables and roots of various kinds, not only to supply his own family, but to keep pigs, rabbits, poultry, &c. Such being the uses of cottage allotments, the advantage of each cottage having its garden surrounding it, instead of at a distance, is sufficiently obvious In the latter case, the cottager must necessarily lose much time in travelling backwards and forwards from his house to his garden, and his wife and children will often be prevented from employing themselves in it. In such a garden he cannot grow fruits, because they would be comparatively unprotected, nor can it be worth his while to grow flowers in a place where they would not prove an ornament to his dwelling. On the supposition that the cottager has his pigstye close to his dwelling, the food for the pigs must be brought home from the allotment; and the manure made by them, which is one of the advantages of keeping pigs, must be carried out again. It is well known to all persons of any experience on this subject, that by far the most valuable part of the manure made by the cottager, such as soapsuds, &c., may be included under the term liquid manure; and this, when the allotment is at a distance, may be considered as entirely lost, the cottager being without either conveniences or time for carrying it out. In point of usefulness, therefore, a cottage allotment in a field, at the distance of a furlong or less from the cottage, is not worth half what it would be if adjoining the dwelling; while in point of enjoyment to the cottager, and of ornament to the roadside, it is hardly worth anything. A cottage allotment is therefore a miserable substitute for a cottage garden. On the other hand, the labourer who has a lease of a comfortable cottage surrounded by a garden, even if the latter should not be larger than the eighth part of an acre, has within his reach all the essentials of happiness possessed by the richest landed proprietor. He can grow good and wholesome vegetables and fruits; he may have his live stock of pigs, poultry, rabbits, and bees; he may ornament his house front, and the borders of his walk with shrubs and flowers; and he has the wages of his labour

for the purchase of those comforts and luxuries which his garden does not afford. In the culture and management of this spot, he has constant occupation of the most agreeable and useful kind for his leisure hours throughout the year; and, in short, whatever the farmer or country gentleman has on a large scale, he has on a small one. In quiet possession of this little garden, which he regards as his own, he learns to respect himself, acquiring at the same time a taste for accumulating property. The time, it is to be hoped, is not far distant when the humblest country labourer will possess such a cottage and garden; but it is necessary that the country labourer should acquire previously a taste for these comforts by seeing them possessed by others of his class; and for this we must look partly to the country labourers themselves, partly to the government for the establishment of a system of universal education which shall raise the taste of the humblest part of society, and partly to the humanity and sympathetic feeling of the landed proprietors; because it is to them we must look, in the first instance, for building the cottage and accompanying it with garden ground.

COTTON. (*Gossypium*, Lin.) A species of vegetable wool, the produce of the *Gossypium herbaceum*, of which there are many varieties. The kinds of cotton met with in the market are usually designated by the names of the places from which they are brought; but practically, they are all divided into the two great classes of *long and short stapled* Its goodness depends on its colour, and the length, strength, and fineness of its fibre Its price varies, according to quality, from 2*s*. to 4*d* per lb The general chemical characters of cotton are those of *lignin*. It is peculiarly susceptible of combination with certain metallic oxides or bases; whence the facility with which it is locally dyed, as in the process of *calico printing*.

COTTON MANUFACTURE. In modern times cotton has attained to an importance among vegetables second only to that of corn, and which could not have been so much as dreamed of in former ages. The manufacture of cotton wool into articles of use and ornament appears, indeed, to have been carried on in India from the remotest antiquity; but it has not made any very great progress in the East, and obtained no footing worth mentioning, in Europe, till last century.

The truth is, that this manufacture, though it now affords employment and subsistence to many hundreds of thousands of persons in this and other countries, is almost wholly a consequence of discoveries and inventions made in Great Britain and the United States, since the middle of last century. Previously to that period the manufacture was everywhere confined within the narrowest limits. Owing to the difficulty of separating the wool from the seed, its price, so long as this operation had to be performed by the hand, was naturally high, while the cost of its spinning and weaving by the wheels and looms in use previously to 1760 added so much to its price, that cotton articles were suited only to the use and demand of the better classes of society; and it seems unreasonable to suppose that the manufacture should have been materially extended without a greatly increased facility of production But in this respect the most signal and extraordinary improvements have been made The *Jenny* invented by Hargreaves in 1767 enabled one individual to spin 80 or 120 threads with about the same facility that a single thread had been previously spun. The jenny, however, was fitted only to spin the softer descriptions of yarn or that used as *weft*, being unable to give the thread the firmness and hardness required in that used as *warp*. But this deficiency was soon supplied. the genius of Arkwright completed what Hargreaves had begun, by inventing the spinning frame,—that wonderful piece of machinery which spins any number of threads of any degree of fineness and hardness, leaving to man merely to feed the machine with cotton, and to join the threads when they break! Nearly at the same time that the spinning department was thus wonderfully improved, Dr Cartwright, a clergyman of Kent, invented the power-loom, a machine which has already gone far to supersede weaving by the hand, and which will, no doubt, in the end bring about this desirable result. While these extraordinary inventions were being made, Watt was perfecting the steam-engine, endowing it with capacity to engrave a seal, to give motion to the most ponderous machinery, or to lift a ship like a bauble in the air, and was thus not only [illegible] the manufacturers with a new power applicable to every purpose, and easy of controul, but with one that might be placed in the most convenient situations, and amid a population trained to industrious habits.

Still, however, something more was necessary to complete this astonishing career of discovery. Without a vastly increased supply of the raw material at a lower price than it had previously brought, the inventions of Hargreaves, Arkwright, and Watt would have been of comparatively little value. Luckily, however, what they did for the manufacturers, Mr. Eli Whitney did for the cotton growers. This extraordinary person, a native of the southern states of America, invented a machine by which cotton wool is separated from the seed with the utmost facility and expedition. Previously to 1790 the United States did not export a single pound weight of raw cotton. In 1792 they exported the trifling quantity of 138,328 lbs Whitney's invention came into operation in 1793; and in 1794, 1,601,760 lbs., and in 1795, 5,276,306 lbs. were exported! And so astonishing has been the growth of cotton in the interval, occasioned by this discovery and the discoveries made in England, that in 1849 the exports from the United States amounted to the prodigious quantity of 1,026,602,269 lbs.!

A cotton mill is probably, all things considered, th most astonishing triumph of skill and ingenuity. All the various operations, from the carding of the wool to its conversion into a texture as fine almost as that of the gossamer, is performed by machinery. Each of the workmen at present employed in a cotton mill superintends as much work as could have been executed by 200 or 300 workmen 60 or 70 years ago, and yet, instead of being diminished, the numbers employed have increased even in a still greater proportion! It would be curious to investigate how many persons in the old and new worlds directly depend for subsistence on the inventions and discoveries of Hargreaves, Arkwright, Watt, Whitney, and the other founders and improvers of this great manufacture. They certainly amount to several millions; at the same time that there is hardly an individual in any country, how remote or barbarous soever, who is not indebted to them for an increase of comfort and enjoyment.

"It is impossible to estimate the advantage to the bulk of the people, from the wonderful cheapness of cotton goods The wife of a labouring man may buy, at a retail shop, a neat and good print as low as 4*d*. a yard; so that allowing 7 yards for the dress, the whole material shall only cost 2*s* 4*d*. Common plain calico may be bought for 2½*d* a yard; elegant cotton prints for ladies' dresses sell at from 10*d*. to 1*s*. 4*d*. per yard, and printed muslins at from 1*s*. to 4*s*., the higher priced having beautiful patterns, in brilliant and permanent colours. Thus the humblest classes have now the means of as great neatness, and even gaiety of dress, as the middle and upper classes of the last age. A country wake in the 19th century may display as much finery as a drawing room of the 17th, and the peasant's cottage may, at this day, with good management, have as handsome furniture for beds, windows, and tables, as the house of a substantial tradesman 60 years since" (*Baines's Hist. Cotton Manufacture*, p. 358.)

Owing partly to our having had the start in the career of discovery, but more to our command of all but inexhaustible supplies of coal, so indispensable to the cheap and advantageous supply of steam as a moving power, and to the enterprise and invention of our capitalists, engineers, and workmen, we have continued to keep that lead in the manufacture we early acquired. At this moment it affords employment to not fewer than 1,500,000 individuals in this country; and constitutes, in fact, the grand source of our manufacturing prosperity, and the principal element of our commerce.

The following statements give a view of the progress of the manufacture in Great Britain: —

Account of the Imports of Cotton Wool, and of the official Value of the Cotton Goods exported from Great Britain in the following Years, from 1697 to 1764, both inclusive.

| Years. | Raw Cotton imported. | Official Value of British Cotton Goods exported. | Years. | Raw Cotton imported. | Official Value of British Cotton Goods exported. |
|---|---|---|---|---|---|
| | *lbs* | *L.* | | *lbs.* | *L.* |
| 1697 | 1,976,359 | 5,915 | 1730 | 1,545,472 | 13,524 |
| 1701 | 1,985,868 | 23,253 | 1741 | 1,645,031 | 20,709 |
| 1710 | 715,008 | 5,698 | 1751 | 2,976,610 | 45,986 |
| 1720 | 1,972,805 | 16,200 | 1764 | 3,870,392 | 200,354 |

The spinning jenny was invented in 1767, and Arkwright took out his first patent for spinning by rollers in 1769. The influence of these and numberless other inventions on the trade is exhibited in the following table: —

| Years. | Cotton imported. | Cotton exported. | Years. | Cotton imported. | Cotton exported. |
|---|---|---|---|---|---|
| | *lbs.* | *lbs.* | | *lbs.* | *lbs.* |
| 1781 | 5,198,778 | 96,788 | 1810 | 132,488,935 | 8,787,109 |
| 1785 | 18,100,384 | 407,496 | 1811 | 91,576,535 | 1,266,867 |
| 1790 | 31,447,605 | 844,154 | 1812 | 63,025,936 | 1,440,912 |
| 1795 | 26,401,340 | 1,193,757 | 1813 | 50,966,000 | |
| 1800 | 56,010,732 | 4,416,610 | 1814 | 60,060,239 | 6,282,437 |
| 1805 | 59,682,406 | 804,243 | 1815 | 99,306,343 | 6,780,392 |

The subjoined statement, taken from the circular of Messrs. George Holt and Co., cotton brokers at Liverpool, dated the 31st December, 1850, gives a very complete view of all the more important particulars respecting the British cotton manufacture in the undermentioned years, from 1816 to 1850, both inclusive.

# COTTON MANUFACTURE.

**Statement of the Imports into, the Exports from, and of the Consumption, Prices, &c. of Cotton Wool in, Great Britain, in different Years, from 1816 to 1850, both inclusive.**

| Average Weekly Consumption. | 1816. | 1820. | 1825. | 1830. | 1835. | 1840. | 1845. | 1848. | 1849. | 1850. |
|---|---|---|---|---|---|---|---|---|---|---|
| Upland | - | 2,918 | 3,713 | 5,452 | 5,896 | 5,346 | 7,243 | 6,519 | 5,644 | 4,450 |
| Orleans and Alabama | 990 | 1,192 | 2,442 | 4,756 | 7,823 | 13,854 | 17,169 | 15,929 | 18,467 | 15,788 |
| Sea Island | - | 409 | 360 | 460 | 354 | 392 | 392 | 427 | 577 | 529 |
| Total United States | 4,036 | 4,519 | 6,515 | 10,668 | 14,073 | 19,592 | 24,804 | 22,875 | 24,688 | 20,767 |
| Brazil | 1,589 | 2,408 | 2,502 | 3,602 | 2,339 | 1,444 | 2,192 | 1,419 | 2,260 | 3,310 |
| Egypt | - | - | 891 | 508 | 446 | 540 | 1,062 | 725 | 969 | 1,542 |
| East India | 207 | 1,518 | 1,096 | 940 | 1,069 | 2,227 | 1,888 | 2,977 | 2,442 | 3,385 |
| Demerara, West India, &c. | 656 | 534 | 527 | 284 | 421 | 260 | 331 | 150 | 187 | 121 |
| Total | 6,488 | 8,979 | 11,531 | 16,002 | 18,318 | 24,063 | 30,277 | 28,146 | 30,546 | 29,125 |
| Packages annually consumed | 337,400 | 466,900 | 599,600 | 832,100 | 954,100 | 1,251,300 | 1,574,400 | 1,463,600 | 1,590,400 | 1,514,500 |
| Average weight of packages consumed, in lbs. | 263 | 258 | 278 | 298 | 333 | 367 | 385 | 394 | 396 | 388 |
| Weekly consumption in packages, average 396 lbs | 5,892 | 8,188 | 10,521 | 14,341 | 16,118 | 22,759 | 30,044 | 28,581 | 31,176 | 29,125 |
| Average weight of packages imported, in lbs. | 256 | 249 | 270 | 300 | 331 | 365 | 386 | 395 | 396 | 392 |
| Packages exported | 29,300 | 23,400 | 72,800 | 33,400 | 102,800 | 119,700 | 122,800 | 189,600 | 254,200 | 271,800 |
| Lbs weight annually imported in millions and tenths | 93·9 | 143 9 | 222·1 | 261·2 | 561·7 | 583·1 | 716·3 | 686·4 | 754·3 | 685 6 |
| Lbs weight consumed, ditto | 88 7 | 120·3 | 166·8 | 247 6 | 318·1 | 458 9 | 606·6 | 576·6 | 629 9 | 588 2 |
| Lbs. weight in ports, 31st Dec., ditto | 19 2 | 110 5 | 107 0 | 91·4 | 73·3 | 162·9 | 400·8 | 182·6 | 202·9 | 194 1 |
| Lbs weight in Great Britain, ditto | - | 127 0 | 115 5 | 118 8 | 89 6 | 207·0 | 453 5 | 220·1 | 210·3 | 231·6 |
| Average price per lb of Uplands in Liverpool | 18¼*d.* | 11½*d.* | 11 6*d.* | 6·9*d.* | 10½*d* | 6*d.* | 4·375*d* | 4¼*d.* | 5⅛*d.* | 7¼*d.* |
| Ditto, ditto, Pernams | 26*d* | 15½*d.* | 15 1*d.* | 8¼*d.* | 14 1*d.* | 9½*d* | 6 375*d.* | 6*d* | 5⅞*d.* | 7⅞*d* |
| Ditto, ditto, Surats | 15⅜*d* | 8⅝*d* | 8 9*d* | 5*d* | 7½*d* | 4 625*d* | 3*d.* | 3¼*d.* | 3⅜*d* | 5⅛*d* |

*N. B.*—Messrs. Holt and Co. estimate the average weight of the packages imported in 1850 at 390 lbs per bag Upland; 455 lbs. Orleans and Alabama; 333 lbs. Sea Island; 182 lbs. Brazil; 245 lbs. Egyptian; 383 lbs. East Indian; and 210 lbs. West Indian.

We subjoin, from *Burns's Glance*, — a tabular statement, annually published at Manchester, and admitted to be drawn up with great care, — an account of the cotton spun in England and Scotland in 1845, and how that spun in England was disposed of, with several other interesting particulars.

**Statement of the Cotton spun in England and Scotland in 1845, and of the Quantity of Yarn produced; showing, also, how the Quantity spun in England was disposed of.**

| Description of Cotton. | Number of Bags consumed. | Average Weight of Bags in Pounds | Total Weight in Pounds. | Weekly Consumption of Bags, describing each sort |
|---|---|---|---|---|
| American cotton | 1,287,374 | 373 | 480,190,502 | 25,242 32 |
| Brazil | 124,019 | 171 | 21,207,249 | 2,431 38 |
| Egyptian | 44,227 | 284 | 15,100,468 | 1,063·14 |
| East Indian | 98,896 | 363 | 35,899,218 | 1,939 7 |
| West Indian | 13,101 | 216 | 2,829,816 | 256·45 |
| Total number of bags consumed | 1,577,617 | | 555,527,283 | 30,933·31 |
| Allowed for loss in spinning, 1¼ oz per lb. | | | 60,760,796 | |
| | | | | *Lbs.* |
| Total quantity spun in England and Scotland in 1845 | | | | 494,766,487 |
| Deduct spun in Scotland in 1845 | | | | 27,737,022 |
| Total quantity spun in England in 1845 | | | | 467,029,465 |
| *Disposal of Cotton spun in England.* | | | *Lbs.* | |
| Exported in yarn during the year | | | 131,937,935 | |
| Ditto in thread | | | 2,567,705 | |
| Ditto in manufactured cotton goods | | | 202,360,687 | |
| Estimated quantity of yarn sent to Scotland and Ireland | | | 10,734,859 | |
| Exported in mixed manufactures, not stated in the above-named articles, consumed in cotton banding, healds, candle and lamp wick, waddings, socks, calender bowls, paper, umbrellas, hats, and loss in manufacturing goods | | | 31,655,230 | |
| Balance left for home consumption and stock, 1st January, 1846 | | | 87,773,049 | 467,029,465 |
| Ditto ditto | 1845 | | 57,872,049 | |
| Ditto ditto | 1844 | | 50,636,545 | |
| Ditto ditto | 1843 | | 48,749,505 | |
| Ditto ditto | 1842 | | 52,760,274 | |
| Ditto ditto | 1841 | | 114,818,919 | |
| Ditto ditto | 1840 | | 60,813,674 | |
| Ditto ditto | 1839 | | 84,133,283 | |
| Ditto ditto | 1838 | | 63,657,902 | |
| Ditto ditto | 1837 | | 43,486,686 | |
| Ditto ditto | 1836 | | 49,932,800 | |

**The consumption of flour in the manufacture is much greater than any one not pretty well acquainted with it would readily suppose. The average quantity required for each loom is estimated at 4 lbs. per week; making the total annual consumption in England and Wales from 250,000 to 300,000 barrels of 196 lbs. each!**

**The places whence the supply of raw cotton is derived, and the quantity furnished by each, are seen in the following table:—**

# COTTON MANUFACTURE.

**Account specifying the Quantities of Cotton Wool imported from different Countries into the United Kingdom during the 3 Years ending with 1850, and the Total Quantities imported.**

| Years. | United States of America. | Brazil. | The Mediterranean. | British Possessions in the E. Indies. | British W. Indies and British Guiana. | Other Parts. | All Parts. |
|---|---|---|---|---|---|---|---|
| | *Lbs.* | *Lbs.* | *Lbs.* | *Lbs* | *Lbs.* | *Lbs.* | *Lbs.* |
| 1848 - - | 600,247,488 | 19,971,378 | 7,231,861 | 84,101,961 | 640,437 | 827,036 | 713,020,161 |
| 1849 - - | 634,504,050 | 30,738,133 | 17,369,843 | 70,838,515 | 944,307 | 1,074,164 | 755,469,012 |
| 1850 - - | 493,153,112 | 30,299,982 | 18,931,414 | 118,872,742 | 228,913 | 2,090,698 | 663,576,861 |

**An Account of the Export of Cotton from the U. States, in each Year, from 1843 to 1850, both incl.; showing, also, its Average Price per lb., and its Gross Value.**

| Years. | Exports in lbs. | Average Price per lb. | Total Value. | Years. | Exports in lbs. | Average Price per lb. | Total Value. |
|---|---|---|---|---|---|---|---|
| | | *Cents.* | *Dolls.* | | | *Cents* | *Dolls.* |
| 1843 | 792,297,106 | 6 2 | 49,119,806 | 1847 | 527,219,958 | 10 34 | 53,415,848 |
| 1844 | 663,633,455 | 8·1 | 54,063,501 | 1848 | 814,271,431 | 7 613 | 61,998,294 |
| 1845 | 872,905,996 | 5·92 | 51,739,643 | 1849 | 1,026,602,269 | 6·4 | 66,396,967 |
| 1846 | 547,558,055 | 7 81 | 42,767,341 | 1850 | 635,381,604 | 11·3 | 71,984,616 |

**An Account of the Quantities and Declared Value of British Cotton manufactured Goods exported from the United Kingdom, distinguishing the Description of Goods, and the various Countries whereto the same were exported, in the Year 1845.**

| Countries to which exported. | White or Plain Cottons. | | Printed or Dyed Cottons. | | Hosiery, Lace, and Small Wares. | Twist and Yarn. | | Total Declared Value. |
|---|---|---|---|---|---|---|---|---|
| | Quantity. | Declared Value. | Quantity. | Declared Value. | Declared Value. | Quantity. | Declared Value. | |
| | *Yards.* | *L.* | *Yards* | *L.* | *L.* | *Lbs* | *L.* | *L.* |
| Russia - - - | 984,775 | 21,330 | 336,000 | 5,854 | 9,927 | 18,243,624 | 1,033,488 | 1,073,599 |
| Sweden - - - | 60,562 | 1,668 | 119,886 | 3,121 | 1,328 | 1,269,670 | 43,136 | 49,253 |
| Norway - - - | 1,040,073 | 15,026 | 498,319 | 8,900 | 1,731 | 911,178 | 31,475 | 57,132 |
| Denmark - - - | 478,285 | 5,921 | 295,392 | 5,237 | 95 | 707,209 | 24,857 | 36,110 |
| Prussia - - - | 1,218 | 20 | 3,911 | 97 | 124 | 284,862 | 11,173 | 11,414 |
| Hanover - - - | 27,454 | 556 | 88,141 | 2,359 | 120 | 3,132,598 | 143,054 | 146,089 |
| Hanseatic Towns - - | 15,801,805 | 227,832 | 27,700,463 | 521,082 | 175,384 | 40,210,185 | 2,176,536 | 3,100,834 |
| Holland - - - | 15,737,792 | 217,762 | 12,413,743 | 256,456 | 73,924 | 21,818,927 | 1,294,121 | 1,842,266 |
| Belgium - - - | 2,255,673 | 44,289 | 1,285,370 | 41,373 | 90,801 | 3,486,061 | 180,116 | 356,579 |
| France - - - | 910,852 | 18,630 | 1,595,589 | 34,951 | 95,499 | 69,283 | 28,606 | 177,686 |
| Portugal, Proper - - | 23,977,729 | 292,819 | 15,858,797 | 279,414 | 12,809 | 755,167 | 29,810 | 614,882 |
| Azores - - | 1,182,667 | 15,497 | 771,528 | 15,170 | 308 | 40,260 | 1,674 | 32,649 |
| Madeira - - | 413,189 | 6,005 | 369,936 | 6,921 | 387 | 886 | 49 | 13,362 |
| Spain and the Balearic Islands - | 142,017 | 7,368 | 157,715 | 3,565 | 739 | 714 | 115 | 11,787 |
| Canaries - - | 709,818 | 10,785 | 563,366 | 10,519 | 955 | 2,981 | 78 | 22,367 |
| Gibraltar - - - | 18,516,193 | 273,169 | 11,851,259 | 227,112 | 25,371 | 70,297 | 3,905 | 529,857 |
| Italy and the Italian Islands - | 29,747,902 | 411,438 | 22,675,618 | 453,117 | 36,502 | 12,989,651 | 531,379 | 1,435,536 |
| Malta - - - | 2,308,931 | 35,024 | 797,109 | 15,252 | 6,000 | 320,426 | 11,664 | 65,940 |
| Ionian Islands - - - | 5,627,947 | 80,120 | 2,589,652 | 49,388 | 2,638 | 838,630 | 37,391 | 169,537 |
| Morea and Greek Islands - | 78,961 | 1,971 | - - | - - | 127 | - - | - - | 1,398 |
| Turkey - - - | 47,000,423 | 657,906 | 47,302,137 | 925,296 | 8,163 | 5,830,328 | 229,917 | 1,821,282 |
| Syria and Palestine - - | 20,394,912 | 281,733 | 8,956,580 | 191,277 | 1,495 | 2,856,981 | 135,413 | 609,918 |
| Egypt - - - | 6,687,380 | 87,169 | 1,738,112 | 33,525 | 7,517 | 227,196 | 8,821 | 137,032 |
| Algiers and Morocco - - | 277,600 | 3,013 | 95,500 | 2,762 | 55 | - - | - - | 5,830 |
| Western Coast of Africa - | 1,178,528 | 19,891 | 10,175,875 | 202,441 | 1,180 | 2,054 | 415 | 223,930 |
| Cape of Good Hope - - | 4,230,977 | 56,534 | 5,144,141 | 101,141 | 12,982 | 17,580 | 869 | 174,526 |
| Eastern Coast of Africa - | 1,600 | 23 | - - | - - | - - | - - | - - | 23 |
| Cape Verde Islands - - | 41,871 | 517 | 15,051 | 308 | - - | - - | - - | 825 |
| St. Helena and Ascension Islands | 92,599 | 1,355 | 40,620 | 789 | 576 | 53 | 7 | 2,727 |
| Mauritius - - - | 4,000,246 | 61,461 | 3,926,753 | 66,479 | 5,095 | 370 | 30 | 133,065 |
| British Territories in the East Indies - - - | 195,971,821 | 2,601,537 | 33,285,861 | 745,023 | 21,617 | 16,823,846 | 839,216 | 4,210,123 |
| Sumatra, Java, and other Islands of the Indian Seas - - | 11,915,891 | 180,122 | 8,381,091 | 209,174 | 5,717 | 296,740 | 13,911 | 409,224 |
| Philippine Islands - - | 4,413,215 | 65,373 | 1,193,618 | 27,810 | 810 | 7,280 | 880 | 91,903 |
| China - - - | 105,911,835 | 1,571,319 | 2,503,251 | 61,750 | 2,114 | 2,609,850 | 99,958 | 1,735,141 |
| British Settlements in Australia - | 4,193,557 | 86,623 | 5,185,841 | 103,916 | 31,539 | 67,361 | 2,666 | 224,771 |
| South Sea Islands - - | 132,649 | 9,791 | 375,265 | 12,882 | 84 | 466 | 17 | 22,774 |
| British North American Colonies | 13,900,057 | 256,391 | 19,116,279 | 381,996 | 73,563 | 996,510 | 30,472 | 742,225 |
| British West Indies - - | 19,008,542 | 278,068 | 27,317,916 | 455,291 | 42,222 | 77,700 | 4,715 | 780,296 |
| Hayti - - - | 2,125,722 | 37,813 | 3,998,123 | 72,536 | 2,809 | 440 | 37 | 113,195 |
| Cuba and other Foreign West Indian Colonies - - | 14,264,155 | 190,186 | 22,092,275 | 375,418 | 35,321 | 1,100 | 95 | 601,023 |
| United States of America - - | 14,696,808 | 314,701 | 16,510,756 | 523,578 | 209,915 | 91,560 | 8,013 | 1,056,240 |
| Mexico - - - | 2,031,157 | 48,552 | 6,602,653 | 186,325 | 8,862 | 31,080 | 1,106 | 244,845 |
| New Granada, Venezuela, and Ecuador - - | 6,124,783 | 79,012 | 8,749,887 | 116,047 | 10,091 | 10,296 | 444 | 235,594 |
| Brazil - - - | 47,911,839 | 618,135 | 39,131,380 | 774,878 | 36,048 | 1,900 | 148 | 1,429,509 |
| States of the Rio de la Plata - | 7,157,739 | 112,027 | 7,560,075 | 157,664 | 17,611 | 3,489 | 94 | 287,396 |
| Chili - - - | 16,220,982 | 205,168 | 19,351,183 | 371,871 | 25,235 | 411 | 9 | 602,283 |
| Peru and Bolivia - - | 8,193,217 | 125,600 | 13,558,742 | 272,258 | 21,918 | - - | - - | 419,776 |
| The Channel Islands - - | 731,169 | 22,855 | 618,474 | 22,811 | 6,317 | 7,332 | 292 | 52,275 |
| Total - - - | 678,415,780 | 9,661,014 | 413,270,289 | 8,368,791 | 1,126,288 | 135,114,865 | 6,963,235 | 26,119,331 |

Manchester, or rather Lancashire, is the grand seat of the English cotton manufacture; and next to it Cheshire, Nottinghamshire, the West Riding of Yorkshire, and Cumberland are its principal seats. Glasgow and the surrounding district is the seat of the manufacture in Scotland In Ireland it is principally confined to Belfast; but there it is of very limited dimensions, and is said to be rather on the decline.

With the exception of those employed in hand-loom weaving, the condition of the labourers employed in the cotton trade is eminently satisfactory. It has not only made a vast addition to the field of employment, but it has increased the comforts of those engaged in it. The stories once so current as to the cruelties practised upon and the hardships endured by the children and young persons employed in cotton factories were, though not wholly without foundation, grossly exaggerated;—they never, indeed, existed in the first-class mills; and since the system began of excluding children under 9 years of age, limiting the hours of employment, and appointing inspectors, abuses have been wholly put an end to.

The value of the cotton manufacture of Great Britain is greater than that of all Europe besides. And provided tranquillity be maintained at home, and we continue to be exempted from that political agitation that is the bane of industry and the curse of every country in which it prevails, we have nothing to fear from foreign competition. Our natural and acquired advantages for the prosecution of manufactures and trade are vastly superior to those of every other country; and though foreigners do excel us in a few departments, and may come to excel us in others, so that the character and species of

the manufacture may in consequence be partially changed, there is not so much as the shadow of a foundation for supposing that its amount will be at all affected. On the contrary, it is all but certain it will continue to augment with the augmenting wealth and population of the innumerable nations with which we have commercial relations.

It is impossible to frame any accurate estimate of the total value of the cotton goods and yarn annually produced in Great Britain. In the *Commercial Dictionary* they are estimated at about 34,000,000*l*., and we are inclined to think that this is not far from the mark. Mr. Baines, in his elaborate work on the History of the Cotton Manufacture, gives the following estimate of the number of people employed, and the value of the manufacture.

Estimated Yearly Value of the British Cotton Manufacture.

| Wages of | £ |
|---|---|
| 237,000 * operatives engaged in spinning and power-loom weaving - - | 6,044,000 |
| 250,000 † hand-loom weavers, at 7*s*. per week each - - - - | 4,375,000 |
| 45,000 calico printers, at 10*s*. per week each - | 1,170,000 |
| 159,300 ‡ lace workers (including 100,000 employed in embroidery, and 30,000 in mending, pearling, drawing, and finishing) - - - - | 1,000,000 |
| 33,000 makers of cotton hosiery - - | 505,000 |
| Bleachers, dyers, calenderers, fustian-cutters, machine-makers; makers of steam-engines, cards, rollers, spindles, shuttles, looms, and reeds; smiths, joiners, builders of all classes, millwrights, carriers, carters, warehousemen, &c. &c.; say - - - | 4,000,000 |
| Raw material (spun in 1833) 283,675,200 lbs. ¶ at 7*d*. per lb. - - - - | 8,214,693 |
| Profits of capital, sums paid for materials of machinery, coals, flour for dressing, and other outgoings ‖ - - - - | 6,000,000 |
| | £ 31,338,693 |

In the *Commercial Dictionary* the capital employed in the manufacture is estimated at 34,000,000*l*.; which Mr. Baines thinks is very moderate.

CO'TTUS. (Gr. κοττη, *a head*.) A genus of spiny-finned fishes; so called on account of the large size of the head. It includes two British species, viz. the Father-lasher (*Cottus bubalis*), and the Sea Scorpion (*Cottus scorpio*); both of which are dreaded by fishermen on account of the painful and dangerous wounds which they inflict by means of the spines with which the gill-covers are armed.

COTYLE'DON (Gr. κοτυλη, *a hollow*.) In Botany, the seminal leaf of a plant. This organ forms a part of the embryo, and is what nourishes the plumula and radicle at their first period of development, before they are able to subsist upon the organizable matter absorbed by the latter from the earth. Exogenous plants have generally two cotyledons, Endogenous as generally one only; but there are exceptions in both cases. The latter class of plants seldom elevate their cotyledon above ground, and never convert it into a green leaf-like body, but usually leave it behind them within the integuments of the seed; the former frequently raise their cotyledons above the soil in the form of small green leaves, as in the garden radish; but there are very numerous exceptions to this, as in the pea, the oak, the chesnut, &c.

COTYLE'DONS. (Applied by Aristotle to designate the sucking-cups of the arms of the Dibranchiate Cephalopods.) In Comparative Anatomy, the cup-shaped vascular productions of the chorion in Ruminants, serving the office of a placenta, are so called.

COTY'LIFORM. (Gr. κοτυλη, *a cup*.) A term used in describing the general form of organs to denote a rotate figure with an erect limb.

COUCH. A layer or heap of barley, moistened and prepared for malting; also the name of that part of the malting floor on which the barley is spread out.

COUCHANT. (Fr.) In Heraldry, a term applied to a beast when represented as lying on the ground.

COU'CHING. In Agriculture, clearing land from couch grass (*Triticum repens*), which is effected by first pulverizing it, and then, in very dry weather, collecting the couch by harrows, or by a horse rake, such as that used for collecting stubble, and which so applied is called a couch rake.

COU'CHING. One of the operations to restore vision in cases of *cataract*: it consists in depressing the opaque lens, so as to remove it out of the axis of vision.

COUGH. This term is applied to a spasmodic action of the respiratory organs, occasioning a sonorous expulsion of air from the lungs: it is very commonly symptomatic of other affections; and some nosologists have considered that it is always so, and never idiopathic. Many cases of cough depend upon the extension of *catarrh* to the trachea and bronchiæ, which become loaded with mucus or phlegm, the efforts to expel which constitute coughing. Others are perhaps referable to a vitiated secretion; and others to imperfect action of the absorbents, by which the natural mucous secretion remains and accumulates in the air vessels, and by evaporation becomes inspissated and irritating; this appears to be one of the causes of the dry cough to which old people are subject. The treatment of catarrhal cough consists in allaying irritation by demulcents, such as mucilaginous drinks and lozenges, which, acting upon the glottis, sympathetically affect the trachea and its ramifications: amongst these extract of liquorice, and lozenges made of it and equal parts of gum tragacanth, are very effectual. Stimulants and full diet are to be avoided, and inflammatory symptoms carefully guarded against; for these are not unfrequently brought on by the violence of a cough. It is not unfrequently necessary to call in the aid of sedatives, expectorants, and aperients. Amongst the former small doses of Dover's powder, or of equal parts of it and extract of henbane, are very serviceable; and it is not uncommon to observe a troublesome cough disappear after a brisk dose of physic. An emetic will also sometimes effect its cure; so that coughs have been by some considered as symptomatic of a vitiated state of stomach and bowels. Where a cough periodically returns at night, and is not inflammatory, a dose of laudanum sufficient to induce sound sleep will often, as it were, break the habit and relieve it. Sedatives, conjoined with stimulating expectorants, such as squills, ammoniacum, benzoic acid, &c., are often effectual in relieving the coughs of old age, and in these, and what are called nervous coughs, much relief is experienced by administering mild opiates in the form of lozenges, so that they may pass gradually over the neighbourhood of the affected part, in consequence of the slowness with which they are dissolved in the mouth and swallowed: lozenges of sugar, liquorice, or tragacanth, with about two grains of extract of poppies in each, are useful in such cases. Where coughs are symptomatic of inflammatory action, of asthma, &c., they often require modes of treatment which have more particular reference to their exciting causes.

COU'LTER. (Lat. culter, *the coulter of a plough*.) In Agriculture, an iron blade or knife inserted into the beam of a plough, for the purpose of cutting the ground and facilitating the separation of the furrow-slice by the ploughshare. *See* PLOUGH.

COU'MARIN. A crystalline odoriferous principle extracted from the tonka bean, which is the seed of the *Coumarouna odorata*.

COU'NCIL. In Church History, an assembly of prelates and other spiritual persons for the regulation of ecclesiastical matters. Such councils are either national, or œcumenical; the latter being those in which the whole body of the clergy throughout the world is represented, and are convened for the settling of points of universal interest.

The Roman Catholics hold that the decision of œcumenic or general councils are infallible, and for the most part allow their superiority to the popes themselves. This superiority was first asserted at the Council of Pisa, in which the two reigning anti-popes were deposed; and confirmed by the proceedings of those of Constance and Basil. Since that time the popes have been very unwilling to convene a general council, and that of Trent is the only one that has assembled in later times.

The Protestants allow the authority of general councils in matters which do not contradict Scripture, and attach great importance to the four first councils; viz. of Nice, Constantinople I., Ephesus, and Chalcedon. But they maintain that a general council can only be called by a

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* Mr. Stanway, from the Returns of the mill-owners, ascertained that 67,819 mill operatives in England received 141,635*l* 5*s*. 7½*d*. as wages for a month of four weeks at the same rate, 237,000 mill operatives, the number in the United Kingdom, would earn 6,434,453*l*. per year. But, as wages in Scotland are 10 per cent. and in Ireland 15 or 20 per cent lower than in England, and as two weeks' wages in the year ought to be deducted for holidays, the amount of wages paid will be about 6,044,000*l*.

† In my estimate of the *number* of weavers I have not reckoned the winders, draw boys, &c. who assist them, and who must amount to a great many thousands; but, in the supposed average of their *wages*, I include those earned by the assistants of the weavers as well as by the weavers themselves. The sum of 7*s*. per week for the *gross* wages of all the hand-loom weavers is, I am convinced, a fair estimate. The calculation is for 50 weeks in the year.

‡ The wages paid to the women and children employed in embroidery, mending, &c. the lace, must be extremely low. Mr. Felkin estimates the whole value of the lace manufactured in England at 1,850,650*l*; deduct the cost of the yarn, 635,000*l*., and there remains the sum of 1,215,650*l*.; of which, probably, 1,000,000*l*. consists of wages to the work-people.

¶ The quantity stated by Burns in the *Commercial Glance*.

‖ "I adopt this sum from Mr. M'Culloch, thinking it a moderate estimate."

temporal prince, which prerogative is assigned by the Romanists to the pope.

Their infallibility they strongly deny, and appear to reduce that assumption to an absurdity by asking —

1. What is the proof of infallibility existing in the church at all?

2. Supposing it to exist, how can it be shown that the church has been truly represented in any council? Or,

3 How can it be shown that the infallibility resides in a bare majority rather than the minority, when a difference of opinion prevails?

COU'NCIL, PRI'VY. The principal council belonging to the king of England. In its origin it appears as a small permanent committee, or minor council, consisting of members selected by the king himself out of the great council of the kingdom. The latter body is supposed to have been originally composed of all the immediate tenants of the crown; and it was occasionally summoned as late as the reign of Ric II., and seems then to have comprised nearly all the prelates, nobles, and bannerets of the kingdom, "*et autres sages*." When the privy council was formed out of it has not been ascertained. It appears in early rolls of parliament as the permanent or continual council; and as its powers under the Plantagenet kings were very extensive, so parliament exercised considerable influence in controlling the appointment of its members, although always vested in the crown as an essential prerogative. The privy council under these sovereigns usually consisted of the five great officers of state, the two archbishops, and from ten to fifteen other individuals, spiritual or temporal It sat continually as a court, both to expedite the executive part of the administration, and to provide equitable relief in cases submitted to it, thus controlling the courts of common law (See *Sir F Palgrave's Essay on the Original Authority of the King's Council*, 1834; and the Preface to the *Records of the P. C*, edited by Sir H. Nicolas) There were also under the Tudors councils, portions of the privy council, exercising like powers in various parts of England. The increasing power of parliament on the one hand, and the extended equitable jurisdiction of the lord chancellor on the other gradually encroached upon the ancient dignity and importance of both the councils. The decline in power of the privy council was, however, extremely gradual. The Star Chamber and Court of Requests, dissolved in the reign of Charles I, were both committees of the privy council. By stat 16 C. I its direct jurisdiction in England in civil cases was taken away

Privy councillors are made by the king's nomination, without patent or grant. Their number, having greatly increased under the Tudor princes, was restricted by Charles II. to thirty; but soon became indefinite again, and has so continued But no privy councillors attend except such as are specially summoned The privy council continues in office six months after the demise of the crown, unless sooner dissolved by the successor The separation of the functions of the privy council from the more important political duties of the cabinet council seems to have been chiefly effected in the reign of W. III.

The jurisdiction of the privy council is of several sorts. 1 The king in council may issue proclamations binding on the subject, if consonant to the laws of the land. He issues also orders in council for the temporary regulation of various matters relating to trade and international intercourse. 2. The privy council has power to inquire into offences against government, and commit offenders to take their trial according to law. 3 Appellate jurisdiction in the last resort from all his Majesty's dominions, except Great Britain and Ireland, is vested in the privy council. By 3 & 4 W. 4. c 41. a judicial committee of the privy council is constituted, to which are entrusted appeals from the prize and admiralty courts, and courts in the plantations abroad, and all other appeals which might before have come before the king in council The judicial committee may direct feigned issues to be tried at common law. The lord president of the council is the fourth great officer of state. The office must probably have been cotemporaneous with the origin of the council itself; but the title is comparatively recent. It was created by Hen VIII., and revived by Charles II. in favour of the Earl of Shaftesbury.

COU'NCIL OF STATE. A political and judicial body of very indefinite powers in the French monarchy, both before and since the Revolution.

COU'NSELLOR. (Lat. consiliarius.) In Law, a person retained by a client to plead his cause, who is also said to be of counsel for him. For the regulations by which the admission to practise as a counsellor is restricted in England, see BARRISTER.

COUNT. (Lat. comes, *a companion;* or according to a fanciful conjecture of some etymologists, from comedere, *to eat with*, because the holders of this dignity had the privilege of dining with the emperor.) A title of dignity in most of the continental states of Europe, equivalent in rank to the British earl and the German *graf*. This title has been in existence since the time of Augustus, who is said by Dion Cassius to have thus designated all the officers of his household. Under the Lower Empire and the first two races of the Frank kings, this title of count was given to officers of various degrees, and was at first attached to the office, and not to the person; but in the progress of time, when feudalism had introduced inheritance instead of election as a fixed rule in succession, it became subject to the same law as the higher titles of kings and dukes, and conferred hereditary privileges on its possessor. (*See* FEUDALISM.) The term count has in most of the states where it is in use degenerated into a mere title, to which no political importance is attached. "In the Papal states it may be bought for no considerable sum, and in most of the German states the sovereign may confer it as a mark of honour or esteem." Though the title count has never been introduced into Britain, the wives of earls have from the earliest period of its history been designated as *countesses*. (For further information on this subject, see *Dutillet's Recueil des Rois de France*.)

COUNT. In Law. *See* DECLARATION.

COU'NTERFORT. (Fr contre, *against*, and fort, *strong*.) In Architecture, a buttress or pier built against and at right angles to a wall to strengthen it.

COU'NTERGUARDS, in Fortification, are small ramparts with parapets and ditches, to cover some part of the body of a place They are generally made before the bastions, sometimes before the ravelins.

COU'NTERMARK. In Numismatics, a stamp frequently seen on ancient coins, often obliterating a large part of the impression. The countermark is generally a figure or inscription; and some antiquaries have considered that their use was to augment the value of the money; others, that it was only struck on money taken from an enemy

COU'NTERPART. In Law, when the parts of an indenture are interchangeably executed by the several parties, that part which is executed by the grantor is termed the original, and the rest are counterparts. If each part is signed by all parties, they are duplicate originals.

COU'NTERPOINT. (It. contrapunto.) In Music, a composition of several parts. The name originated in the circumstance of the notes being formerly placed one against or over the other, and without any stems.

COU'NTERPROOF. In Engraving, an impression obtained from another impression while it is yet wet from a copper plate, in which the design is in the same direction as in the plate itself. They are made chiefly for investigating the state of a plate; and of some prints the counterproofs are more valuable than the prints, where the drawing from the picture has not been reversed on the copper.

COU'NTERSCARP. In Fortification, the slope or *talus* of the exterior side of the ditch, towards the country. The interior slope is called *escarpe*. Sometimes the whole covert way, with its parapet and glacis, are termed *counterscarp*.

COU'NTERSIGN. In Diplomatics, the signature of a public officer to the charter of a king, prelate, &c. by way of certificate. "Obtulit," "recognovit," "relegit et subscripsit," are common additions, in charters of the middle ages, to the name of the countersigner.

COU'NTER-TE'NOR. In Music. *See* TENOR.

COU'NTY. A county is in England that district of territory which was anciently subject to the government of an earl or ealdorman, from whose Latin title *comes* the term is derived. The Saxon word corresponding to county was shire, meaning division, which is therefore not applied to such counties as were originally distinct sovereignties; such as Kent, Essex, Sussex, Middlesex, Suffolk, Norfolk.

The division of the kingdom into counties, which, in common with many other of our earlier institutions, is commonly attributed to Alfred, though it was probably of a date far anterior, was in ancient times chiefly of use in marking the limits of different jurisdictions. To each county belonged a county court, which it was the duty of the thanes and other freeholders to attend and do suits at, though it seems the thanes only took part in the administration of justice. Such court was originally held by the earl and bishop, the latter assisting in respect of the ecclesiastical jurisdiction belonging to the court; or in their absence by the sheriff, upon whom the right to preside in the county court, either in person or by deputy, as well as the other civil functions of the earl, have long since devolved. Considered in its judicial character, the county court was the great court baron or civil court of the county, and was originally competent to the trial of almost all civil actions arising within such county. The criminal jurisdiction belonging to the county, which is now vested in the magistrates at quarter sessions, was anciently exercised by the sheriff in his tourn (*see* title TOURN). The boundaries of a county serve also to mark the limits of the jurisdiction, both civil and criminal, which other courts or judges exercise within each county severally by commission from the crown (*see* VENUE); and within which limits also are

confined the ministerial functions of the sheriff as executor of the writs awarded by either of the great courts.

The division into counties is also for some purposes, particularly that of representation in parliament, political; and it is in the county court that the election of members of parliament takes place, and that other political acts of the men of the county are done; for county meetings convened and presided over by the sheriff are, properly speaking, holdings of the county court. What has been said of counties in England applies without qualification, save as to the time of the institution, to Wales, and, with very little qualification, to Ireland and Scotland; the most important point of difference being the greater extent of the jurisdiction and power of the sheriff in the latter country. There are in England 40 counties, in Wales 12, in Scotland 32, and in Ireland 32.

A County Palatine, of which description there are now two in England, viz. Durham and Lancaster, is a county in which all jura regalia, *i. e.* the whole rights of sovereignty in judicial matters, belonged to the earl of such county; but these privileges are now reduced to the possession of courts of their own, corresponding in number and jurisdiction to the Queen's courts at Westminster, whose jurisdiction is not excluded by theirs, and whose writs may be so framed as to run within the limits of the county palatine.

COU'NTY COURT. The County Court properly so called is a court baron, not of record, for civil causes, held by the sheriff in each county This court could formerly hold pleas where the debt or damage was under 40*s.*, except by virtue of the writ called of *justicies*, which was a special precept to the sheriff to do justice between parties in the same manner as it might be done in the courts of Westminster. But by the 9 & 10 V. c 95. a great extension of jurisdiction was given to the county courts, and they are now completely remodelled, with jurisdiction in all actions for debt or damage not exceeding 50*l.*

COUNTY RATE. *See* RATE.

COU'PLED COLUMNS. In Architecture, columns half a diameter apart. *See* ARÆOSYSTYLOS.

COU'PLING BOX. A strong iron cylinder, by which the shafts of machinery are connected.

COURIERS. (Fr. courir, *to run.*) A name given in ordinary language to the bearers of public despatches or private intelligence by express. The institution of persons to convey intelligence with celerity and regularity is coeval with the earliest history of civilized nations By the Persians they were styled ἀγγαροι, by the Greeks ἡμεροδρομαι, and by the Romans *cursores;* and the duties of the ancient couriers seem to have been wholly analogous to those of the moderns, and were performed chiefly on horseback; though the original derivation of the name would lead to an opposite supposition. In the middle ages couriers were known by the appellation trottarii, or *trotters;* and hence perhaps originated the English term *running footmen*, of whom history makes mention in the 17th and 18th centuries.

COURSE. (Lat. cursus) In Architecture, a continued level range of stones or bricks of the same height throughout the face or faces of a building. *See* BOND.

COURSE OF CROPS. The rotation or succession in which crops follow one another, in a prescribed course of cropping. The rule is to follow a crop grown for its seeds or roots by one grown for its leaves or stems.

COU'RSERS, *Cursores.* (Lat. curro, *I run*) An order of birds, including those which are disabled from flight by the restricted development of the wings, but which possess superior powers of running from the compensating size and strength of the legs. the ostrich, rhea, casowary, emeu, and apteryx are examples of this order.

COU'RSES. The lower square sails, as the foresail and mainsail.

COU'RTESY. (Fr. courtoisie, Ital. cortesia.) It was at the courts of princes and great feudatories that the minstrels and troubadours of the middle ages especially delighted to exercise their art; and it was there, also, that the peculiarities of chivalrous life and manners were chiefly exhibited. Hence courtesy was a general term, expressive of all the elegance and refinement which the society of those times had attained; in fact, it was synonymous with all the gentler parts of chivalry itself: and it is in this sense that it is used both by the early trouvères and romancers, and also by poets of a later age, when affecting the use of chivalrous language, as in the first lines of the great poem of Ariosto:—

> Le donne, i cavalier, l' arme, gli amori,
> Le *cortesie*, l' audaci imprese io canto.

The transition from this wider meaning to that in which it is now employed is obvious enough. It may be sufficient to refer to the very ingenious theories of Signor Rossetti respecting the secret meaning attached to this (among other) words of frequent occurrence in the poems of the Italian canzonieri of the thirteenth and fourteenth centuries. (*Inferno di Dante*, 1827, vol. ii. p. 430, &c.)

COURT PLASTER. Black silk varnished over with a solution of isinglass, which is often perfumed with benzoin.

COURTS OF JUSTICE, are divided by the rules of English law into courts *of record* and *not of record.* The former have power to make up their acts and judicial proceedings in the form technically called a *record*, as evidence of their judgment. All courts having power to fine or imprison are said to be impliedly courts of record; but this seems questionable.

The courts termed Superior are divided into those of Law, Equity, Ecclesiastical, Maritime, Prize or International, and Courts of Appeal and Error. They are,—

Three Superior Courts of Common Law (*see* COURTS, SUPERIOR), being—

1. The Court of Queen's Bench. *See* QUEEN'S BENCH.
2. The Court of Common Pleas. *See* COMMON PLEAS.
3. The Court of Exchequer. *See* EXCHEQUER.

Four Superior Courts of Equity (*see* CHANCERY), being—

4. The High Court of Chancery.
5. The Rolls Court.
6. The Vice-Chancellor's Court.
7. The Equity side of the Court of Exchequer.
8. The Ecclesiastical Courts. *See* ECCLESIASTICAL COURTS.
9. The Court of Admiralty. *See* ADMIRALTY.
10. The Prize Court. *See* ADMIRALTY.
11. The Courts of Bankruptcy. *See* BANKRUPTCY.

The Courts of Error and Appeal are—

12. The Exchequer Chamber, from the Superior Common Law Courts. *See* EXCHEQUER CHAMBER
13. The Privy Council, and Judicial Committee of the Privy Council, which are Courts of Appeal from the Ecclesiastical Courts, Admiralty, and also from the decisions of various Colonial Judicatures.
14. The High Court of Parliament. *See* PARLIAMENT

Inferior Courts are numerous, both of record and not of record, being for the most part local jurisdictions of very various extent and authority. To these belong the Courts of Conscience and Requests, Courts Baron, Hundred Courts, Borough Courts, and County Courts, in which the sheriff presides

COURTS, SUPERIOR The three superior common law courts of England are the Court of Queen's Bench, of Common Pleas, and of the Exchequer. For the origin and history of each court, and its peculiar jurisdiction, see those separate heads.

For several centuries, by means of various admitted fictions, these three courts have exercised a concurrent jurisdiction in all personal actions (*see* ACTIONS), and the practice of all three is, in material points, the same They sit, during term, at Westminster. The different branches of jurisdiction of the three superior courts are, 1. That of the full court in *banc*, during term only, when four judges sit together in each, 2 Of the Practice or Bail Court (created by the 1 W. 4 c 70. s. 1., which as yet has been brought into operation in the King's Bench only, in which a single judge disposes of some less important matters of business); 3. Of a single judge at chambers, where also points of minor importance in the conduct of a cause are decided and directions given; 4. Of the master or prothonotaries, officers to whom various matters of fact, as computations, &c., are referred, 5. Of the judge at Nisi Prius and on the circuit, for the trial of issues in fact; 6 Of the sheriff in each county, who may be considered as an officer of the superior courts for the purpose of trying issues directed to him under 3 & 4 W. 4. c. 42.

The course of proceeding in the superior courts is either formal or summary. Formal proceeding, in personal actions, is the regular course of a trial, whether the issue, or question tried, be one of fact or law. The party complaining, or plaintiff, having brought the defendant into court in person, or constructively, by preliminary *process*, entitles his *declaration*, or the form of statement of his grievance (*see* PLEADING), as of one of the three courts, the same in which the writ for commencement of the action is said to be *returnable*. The defendant then pleads; and all the subsequent pleadings, or preparatory statements in writing, are entitled of the same court: in which also the record, or parchment roll containing the authentic entry of the whole proceeding, is made up. The question eventually raised between the parties will turn out to be either of law, or of fact. The former, being raised on what is termed a *demurrer* (*see* PLEADING), is argued at Westminster before the full court, and the judgment in law is conclusive of the issue. If the question be of fact, it must be tried by a jury. If the pleadings are dated at London or in Middlesex, as in *local* actions they must be if the question arise in those districts, and as in *transitory* actions they

may be in all cases (*see* PLEADING), the jury will be summoned accordingly, and the case tried before a judge of the court in which the action is brought, at *nisi prius* (see that head), either during term or in the sittings after term. If, on the other hand, the date, or *venue*, as it is termed, be in any other county, the parties proceed to trial at the assizes (the plaintiff bringing down the record from Westminster, by which means it is in his option to proceed to trial or not). In this case a jury is summoned in like manner before the judges of assize, by virtue of their commission of oyer and terminer. In some special cases, trial at bar is granted on application; in which case the cause is tried by a jury before the full court, at such time as the court may fix for convenience. If a party imagines himself to have grounds for being dissatisfied with the result of a trial, as, that the judge has summed up the evidence improperly to the jury, or that material testimony has been illegally rejected, he may move the court at Westminster for a new trial, or to set aside the verdict, according to the circumstances of the case; and such motion is made before the full court in term. On the issue of the trial judgment is awarded, declaring that the plaintiff either has, or has not, entitled himself to the remedy prayed; and costs are given with the judgment; after which the successful party may sue out execution, unless there be an appeal by writ of error, which only lies on matter of law arising on the face of the proceedings.

Summary proceedings are of very miscellaneous character; and are by affidavit, motion, rule *nisi* (*i. e.* unless cause is shown against the rule on a certain day; when, if no cause, or insufficient cause, is shown, the rule is made absolute, and it made absolute, followed by demand of performance, and this performance enforced by means of attachment for contempt of court) By these means the courts have extensive authority to give directions and enforce conditions during the progress of a suit. Among summary proceedings may also be enumerated the leave given, on motion, to amend various formal defects in pleadings

COURT BARON. A Court Baron, so called either from the lord or baron who presided over it, or from the freemen, in ancient times also called barons, who were its suitors and judges, was a court, having its origin apparently in notions of a patriarchal jurisdiction, properly and in the first instance incident to every manor, in which it was held by the lord of the manor or his steward who, assisted by the freeholders of the manor, there decided on the purely civil controversies which arose between them. A court baron also belonged to every hundred and county (see those titles); and in many cases also to particular franchises or lordships, which might include several manors. Courts baron, from the inferiority of their judges, and from the defects of their jurisdiction, which a party might defeat by removal of the cause to a higher tribunal, have long fallen into disuse, except in manors of ancient demesne, where the jurisdiction was, and in some respect still is, in the first instance exclusive, the lord of such manors having once been the king; and except in manors containing land of copyhold or customary tenure. *See* COPYHOLD.

COURT-MARTIAL A court for trying and punishing the military offences of officers and soldiers. Courts-martial, in our law, are bound by the same rules and principles of evidence as courts of law. Their jurisdiction is conferred by the Mutiny Act (1 W. & M.), which is annually renewed. The crimes cognizable by them are designated by the Mutiny Act and Articles of War. The persons liable to martial law are officers, soldiers, and persons serving with the army in the field; and receiving pay as a soldier subjects the receiver to it, but officers on half-pay are not liable. The judgments of courts-martial are open to the disapprobation of the king or his commanders-in-chief; and are likewise liable to reversal by the Court of King's Bench. The acts of a court-martial, like those of other courts instituted by statute with particular powers, may become the subject of application to the courts at Westminster for a prohibition *Naval courts-martial* have their jurisdiction defined by the thirty-six articles of war, embodied in 22 G. 2 c. 23. and 19 G. 3. c. 17., and are composed of admirals, captains, and commanders. (See *M'Arthur on Courts Martial; Kennedy on C. M.; James, Collection of Proceedings of C. M.* 1820; *Tytler on Military Law.*)

COUSSINET. (Fr. *a cushion.*) In Architecture, the crowning stone of a pier, or that which lies on the capital of the impost and under the sweep. Its bed is level below and inclined above, receiving the first rise or spring of the arch or vault. This word is also used for the ornament in the Ionic capital, between the abacus and echinus or quarter round, which serves to form the volute, and is thus called because its appearance is that of a cushion or pillow seemingly collapsed by the weight over it, and bound with a strap or girdle called the baltheus.

COVE. An inlet on a rocky coast. It is a term nearly synonymous with *harbour;* the word cove being generally, though not always, used when the indentation on the coast is too shallow or narrow to admit first-class vessels.

CO'VENANT. In History, the famous bond of association adopted by the Scottish Presbyterians in 1638. It was framed on the model of a similar declaration, which had been twice solemnly subscribed in the early period of the Reformation: but in more violent language, and with more specific obligation to support the kirk, together with a prohibition and abjuration of the Anglican liturgy and articles. The founders of the Solemn League and Covenant were Alexander Henderson, leader of the clergy, and Archibald Johnston of Wariston, an advocate. (See *Laing's History of Scotland*, vol. iii.) A new religious covenant between the two kingdoms was framed in 1643, and taken by the English House of Commons and assembly of divines at Westminster. Charles II. subscribed the Scottish covenant on his coronation in 1651; but on his restoration it was declared null by act of parliament, and burned by the common hangman It formed, however, the watch-word and bond of union of the discontented party, or Covenanters, as they were called, in the rebellions of his reign.

COVENANT. In a theological sense, a promise made by God to man upon certain conditions: the two grand distinctions of which are emphatically designated the Old and New Covenant or Testament; in each of which certain temporal or spiritual benefits are promised to man upon the performance of duties therein pointed out.

COVENANT. In Law, is an engagement under seal to do or to omit a direct act. Covenants are of many different species, as, in fact and in law, implied and express, &c; and, according to their subject matter, or express stipulation, they are binding respectively on the heirs, executors, and assigns, or executors and assigns only, of the covenantor.

COVENANT is also a form of action, which lies where a party claims damages for breach of a covenant or contract under seal.

COVENA'NTERS. The great body of the Scottish people, at the era of the Reformation, adopted the presbyterian faith and polity as established by Calvin at Geneva, and as introduced into Scotland by Knox, and recommended and enforced by his eloquence As presbyterianism was thus closely associated in their minds with their deliverance from what they regarded as the degrading authority of popery, the people of Scotland have ever been distinguished for their cordial and unflinching adherence to this new faith But though it was the object of public veneration, it never succeeded in gaining permanently either the affection or countenance of the court. On the contrary, the successive monarchs by whom Scotland was governed from the Reformation in 1560 till the final establishment of presbytery as the national church in 1690, regarded it with disfavour, and did all in their power, either by open persecution, or by private intrigue, to undermine and destroy it They regarded it, being a republican hierarchy, as incompatible with royal authority; and James VI. declared that "presbytery and monarchy could no more agree than God and the devil." But though, owing to royal favour, episcopacy, or "black prelacy," as it was contemptuously called by the presbyterians, occasionally predominated, it was as often superseded by presbytery The latter, after having been for some time displaced by prelacy, gained the superiority in 1592; from which time till 1606 it was established as the national religion At this latter period, however, episcopacy obtained the mastery, which it enjoyed for upwards of thirty years. But though this polity, being favoured by the influence of the court, so long maintained the ascendency, it continued as obnoxious as ever to the great body of the Scottish people. Indeed, so obnoxious was it known to be, that, though episcopacy legally prevailed, it was thought prudent for some time nominally and formally to rule the church by means of the ecclesiastical judicatories peculiar to presbytery. But the people were not so easily deceived; nor could any consideration induce them either to forego the ecclesiastical polity which was so dear to them, or look on its rival with the least degree of toleration or favour. Matters at length came to a crisis on this subject. Charles I. having introduced that arbitrary judicatory in matters religious and ecclesiastical, the High Commission Court, and having attempted to introduce the Book of Canons and the Liturgy or Service Book, the public voice was aroused, and public indignation was generally and unequivocally expressed, particularly in Edinburgh, where a very serious tumult took place (July, 1637) on a Sunday, on occasion of an attempt being made (according to royal proclamation) to read the liturgy in the church of St. Giles. Supplications against the liturgy issued from almost every quarter of the country, from all classes of the people, and from the great majority of municipal corporations, and were carried by the principal men of the kingdom to be presented to the privy council. These supplications were not attended with the success which it was hoped they would have experienced. But the

supplicants or the public were not to be driven from their purpose. The supplicants, who had flocked to Edinburgh in great numbers, could not long remain there. But the most effectual means were adopted to keep up an organized opposition to the royal procedure in this matter. Four *tables*, as they were called, were formed. One table consisted of nobility, another of gentry, a third of clergymen, a fourth of burgesses; thus representing all ranks and classes of the people. There was also a general table, composed of representatives from the four subordinate tables, which received suggestions from these, and decided on what steps it was necessary to adopt. One of the first acts they passed was the production of the *Covenant;* and hence all those who either then or afterwards subscribed it or gave in their adherence to it, were denominated *Covenanters*. (*Baillie's Letters*, i. *passim; Laing's Hist. of Scotland*, iii.; *Cook's Hist. of the Church*, iii.; *Acts of General Assembly*.)

The origin of the Covenant in Scotland may be traced to the Reformation, during the progress of which it was renewed several times; and it evidently had a reference to the covenants so frequently adopted by the children of Israel, and by which they bound themselves to adhere to that religion which the Almighty had established among them.

The Covenant to which we at present more immediately refer, is in many respects a renewal of the Covenant which was subscribed in the year 1580, 1581, and 1590, but so modified and enlarged as to embrace the circumstances under which the church was placed at the interesting crisis under review. It inveighed not merely against popery, as the former Covenant had done, but "against the danger of the true reformed religion (that is, the presbyterian faith and polity as established in 1592), of the king's honour, and of the public peace of the kingdom, by the manifold innovations and evils" so generally prevalent. The subscribers also protess, and "before God, his angels, and the world, solemnly declare, that, with their whole heart, they agree and resolve all the days of their life constantly to adhere unto and to defend the foresaid true religion." "We promise and swear," to use their own words, "by the great name of the Lord our God, to continue in the profession and obedience of the foresaid religion; and that we shall defend the same, and resist all these contrary errors and corruptions, according to our vocation, and to the uttermost of that power that God hath put in our hands, all the days of our life." (*Vide* the *National Covenant* appended to the *Westminster Confession of Faith*, p 483 edit 1815.)

These expressions, however unequivocal or strong, are not more energetic than others in the same document They showed that the persons by whom they were uttered were in earnest, and that nothing could satisfy them but the abolition of the High Commission Court, and the revocation of the canons and liturgy, in other words, the total and unconditional abrogation of prelacy. They insisted on the questions that existed between them and the king being immediately submitted to a free General Assembly of the Kirk, and to parliament.

Meanwhile the tables invited all the supplicants to repair from the country to attend a solemn meeting, which was to be held in Edinburgh in honour of the Covenant The supplicants having obeyed the summons, the Covenant (1st March, 1638) was solemnly subscribed and sworn, amid prayers and with uplifted hands, by the nobility, gentry, clergy, and burgesses; by thousands of all classes, of both sexes, and of every age. Nor was this all. Commissioners were immediately despatched with copies of it throughout Scotland; and in a few weeks every district of the country, with some partial exceptions, submitted to the Covenant.*

The nation was now divided into two parties,—the *Covenanters*, a name originally imposed by their adversaries, and the *Non-Covenanters*, the latter being a small, feeble, and scattered body. (*Baillie's Letters; Livingstone's MS. Life.*)

Charles, seeing the formidable position assumed by the Covenanters, and the influence which they possessed, was at length willing to recal the liturgy and the canons, and to make considerable concessions for the sake of peace. But it was too late: no compromise could now be accepted; nothing would satisfy the Covenanters but the extirpation of prelacy: nothing that fell short of this would be at all listened to. Nay, so far did they carry their condemnation of the bishops, that they had not only preferred an accusation against them as the authors of the innovations, but had, meanwhile, applied for an interdict, prohibiting them from having a seat in the privy council. The prelates, indeed, finding that they were the object of public odium, and that their influence was nearly gone, voluntarily withdrew from the council. The king, after much temporizing and intrigue, found himself obliged, however reluctantly, to agree to the meeting of the General Assembly on the terms which the Covenanters had proposed,—namely, that lay-elders should, as in the best days of presbytery, be recognized as constituent members of the inferior ecclesiastical courts, and eligible as members of assembly; that not only should the bishops, the former official moderators (presidents) of presbyteries, not be replaced, but that these dignitaries might be legally prosecuted by the Assembly, and their usurpations restrained, if not their order entirely suppressed. (*Ib.*)

The Assembly accordingly met at Glasgow in November, and continued its sittings (for thirty days) as its inalienable right, even though the royal commissioner, the Marquis of Hamilton, had meanwhile declared the meetings dissolved. It embraced in the list of its members the most eminent of the nobility and gentry as lay-elders. It not only annulled the canons, liturgy, the High Commission Court, and other innovations, but it abolished episcopacy itself, and declared it as having been from the first both illegal and unscriptural. Of the prelates, fourteen in number, of whom the Scottish hierarchy had consisted, eight were excommunicated, four deposed, and the remaining two merely suspended from their ecclesiastical functions. Nor did the Assembly stop here; for, while it abolished prelacy, it re-established presbytery as it had existed previously to the late innovations, with all the privileges, liberties, powers, and jurisdictions which it had formerly enjoyed. (*Acts of Assembly*, 1638.)

The proceedings of this Assembly, particularly its contemptuous and summary mode of dealing with the favourite hierarchy of the king, could not be agreeable to Charles These proceedings were, on the contrary, so obnoxious to him that, on the Supplication voted at the conclusion of its meetings being presented to him, he expressed himself as deeply offended, and declined to return any answer to it "When the Covenanters," says he, "have broken my head, they will put on my cowl." This injudicious conduct on the part of the king brought matters to a crisis Both parties prepared for war; a step, however, which the Covenanters, who always professed the greatest loyalty, adopted with reluctance So devoted, however, were the people to what they regarded as a righteous cause, that the expense on the side of the Covenanters, who included in the list of their adherents almost every individual in Scotland, was defrayed by a general voluntary assessment In raising both men and money the clergy took an active part; and contributions for carrying on the war were levied by them from their respective flocks to an extent scarcely credible "We sent from Stranraer," says John Livingstone then minister of that parish, "our fourth fencible man, viz 15 men. The town was but little and poor; all the yearly rent was estimated at 2000 merks Scots * * *. I propounded to my flock the condition of the army, and desired they would prepare their contribution to be given after sermon; at which time we got 15*l.* sterling," or nearly the half of the whole income of the place (*MS. Life*, p 34.) Nor was the spirit which pervaded the army less interesting or enthusiastic than that which characterized the whole body of the Covenanters "Every company," says an eye-witness, "had fleeing at the captain's tent door a brave new colour, stamped with the Scottish arms, and the motto, *For Christ's Crown and Covenant*, in golden letters." (*Baillie*, i 174.) Every regiment was attended by a chaplain. "I carried myself," says Dr Baillie, who attended the army in the capacity of a chaplain, "as the custom was, a sword and a couple of Dutch pistols at my saddle" "Our soldiers grew in experience of arms, in courage, and favour daily. Every one encouraged another: the sight of the nobles and their beloved pastors daily raised their hearts. The good sermons and prayers, morning and evening, under the roof of heaven, to which their drums did call them for bells, the remonstrances very frequent of the goodness of their cause, of their conduct hitherto by a divine hand, made them as resolute for battle as could be wished." "Had you lent your ear, in the morning, or especially at even, and heard in the tents the sound of some singing psalms, some praying, and some reading scripture, ye would have been refreshed." (*Ib.*)

Such was the spirit under the influence of which the Covenanters waged and carried on the war with their sovereign. Of the hostilities that ensued it is unnecessary here to give a farther account than to say, that the Covenanters, though they gained the only battle that was fought, lost no time in making proposals of peace. These proposals were accepted by the king; and a treaty was concluded (June, 1639) four months after the commencement of the war. Of this treaty the most important clause was,

* So pertinaciously was subscription of the Covenant insisted on, that no student could enter college, or take a degree there, and no person could be admitted to the Lord's Supper, without having first subscribed this obligation. Not only were such persons as professors and teachers, but every human being of whatever rank, bound to subscribe under the risk of "all ecclesiastical censure." Those "suspected of papistry" were summoned before the church courts, with a view of inducing them to sign the Covenant; and if they refused, they were ordered to be proceeded against and tried as disaffected persons. Every university, synod, presbytery, and parish were obliged to have each a copy of the Covenant in 4to., "with some blank paper, whereupon every body may be obliged to sign." Subscription of the *Solemn League and Covenant*, afterwards to be spoken of, was prosecuted with almost equal zeal. (*Acts of Assembly, apud annos* 1639-48.)

that, as the king would not ratify the enactments of the Assembly of Glasgow, and as the Covenanters would not annul them, a free General Assembly should be held in the ensuing month of August, and a parliament immediately afterwards; to the decision of which courts every dispute between the contending parties was to be referred. This Assembly met accordingly; and its proceedings, as might have been expected, were exactly of the same character as those of the former: and yet, such was the progress of public opinion, that the Earl of Traquair, the royal commissioner, not only did not refuse to ratify them, but consented to subscribe that obnoxious bond, the Covenant, which was ordained, under the penalty of ecclesiastical censure, to be subscribed by all ranks. The members of the privy council, besides, gave to the Covenant the sanction of their authority, and attached their signatures to it. (Ib.)

The proceedings of this Assembly were, if possible, more obnoxious to Charles than those of its predecessor; and afraid lest the parliament, which had already met, should exhibit a similar spirit, he lost no time in proroguing it. But nothing could now arrest the march of public sentiment; and in the parliament, which met in June 1640, in direct opposition to the wishes of the king, who had determined to prorogue it, every enactment of the General Assembly respecting the Covenant and the presbyterian faith obtained the sanction of that supreme court, and became the law of the land.

Thus the Covenanters, after an arduous struggle of three years, saw their object fully gained; namely, their favourite ecclesiastical polity established, and the validity and authority of the Covenant recognised by the legislature. Their history from this date (which will be found more at length under the article PRESBYTERIANS) becomes that of the presbyterian church in Scotland, and is interwoven with the annals of their country. Charles, offended with the triumph of the Covenanters, again declared war against them; but after a short campaign, unfavourable to the royalists, peace was restored (1641) The king having, meanwhile, alienated the affections of his English subjects, and a civil war having, in consequence, broken out, the Covenanters, on the repeated and urgent application of the parliament of England, made common cause with them, and took up arms for the third time against royal authority. But along with a civil league the Scots succeeded (1643) in carrying a religious covenant, known in history under the name of the *Solemn League and Covenant*, an obligation which was long revered in both divisions of the island, and the main object of which was to accomplish uniformity of religious doctrine and church government in both kingdoms. Nor was this object long in being, so far, attained: a presbytery, as it existed in Scotland, having obtained the sanction of the famous Assembly of Divines met at Westminster (1643-9), and having been afterwards ratified by the English parliament, was recognised as the national church of both portions of the empire. Presbytery, however, was introduced into England rather as an experiment than a permanent institution. Besides, it was not systematically adopted except in London and Lancashire; and it rapidly declined, having been, to a considerable extent, superseded by Independency But at the Restoration episcopacy triumphed over both these forms, and has since prevailed as the established church in England (*Solemn League and Covenant* appended to the *Westminster Confession of Faith*, edit. 1815; *Acts of General Assembly; Wodrow, Baillie, Laing*)

Though the presbyterians had, meanwhile, differed somewhat in opinion as to some public matter, and though they were not all equally zealous in favour of the Covenant, yet the importance of this obligation was never lost sight of. On the martyrdom of Charles I. the Scots refused to recognise the right of his son, Charles II., to the throne, till he consented to subscribe the Covenant, and to guarantee and uphold the presbyterian church. Cromwell, though he allowed them the free exercise of their religion, never was the object of their affections and confidence, inasmuch as he was a sectary, and a friend to toleration, which latter they had uniformly condemned. But the Protector, while he tolerated the presbyterian faith, deprived it of some of its most valuable attributes. He not merely interdicted the meetings of the General Assembly *, but prohibited the tender of the Covenant or any similar obligation, and divested some of the ecclesiastical penalties, such as excommunication, of their terrors by depriving them of their civil effects. But a worse fate yet awaited the Covenant. At the Restoration, not only was episcopacy restored and presbytery superseded as the national church; but by a sweeping act, called the *Act Rescissory*, passed in 1661, all the parliaments that had been held since 1640 were declared null and void; thus rendering invalid those acts, in confirmation both of the Covenant and of presbytery, to which the late king had assented, and which Charles II. himself had sworn to maintain. From this period the Covenant may date its decline. It continued, indeed, to be regarded as sacred by perhaps the most valuable, if not the most numerous, portion of the clergy and people, — of those who would submit to no compromise, and who, in consequence, were the objects, during the reigns of Charles and his brother James, of the most ruthless persecution. Nay, so far did some of these parties carry their opinions, that they did not regard any person entitled to homage as king unless he had "covenanted," or affixed his signature to the Covenant. The party by which such a principle was professed are known in history under the name of Cameronians; a body which, though now much reduced both in numbers and importance, and who have moderated or changed their sentiments on this subject as well as on others, still exist in Scotland as a distinct religious sect. (*See* CAMERONIANS.) At the Revolution, when presbytery was revived in Scotland and established as it now obtains, no mention was made of the Covenant either in the General Assembly or inferior courts. It seems to have been allowed to fall into desuetude, no steps having been taken with regard to it. It now exists only as a matter of history; though, as just said, the Cameronians may be regarded as the successors and descendants of the Covenanters of the 17th century. (Ib)

CO'VERTS. In Ornithology. "The lesser coverts" (*tectrices primæ*) are small feathers which lie in several rows on the bones of the wings. The "greater coverts" (*tectrices secundæ*) are the feathers that lie immediately over the quill-feathers and the secondaries. "The under coverts" are the feathers that line the inside of the wings.

CO'VERTURE. In Law, the legal condition of a married woman. *See* MARRIAGE, LAW OF.

CO'VERT WAY, or COVERED WAY. In Fortification, a road or space of ground on the outer edge of the ditch, level with the adjacent country, and ranging all round the works. It is usually about 30 feet broad, and is protected by the glacis. Sometimes it is called the corridor.

CO'VEY. An old bird with her young ones; but generally used to designate a number of partridges or other game. It also in some countries signifies a cover for game.

CO'VIN. In Law, a compact between two or more, to deceive or prejudice others in certain cases; as, if tenant for life or in tail conspire with another party, to the intent that such party may recover lands held by the tenant to the prejudice of him in reversion.

COW'HAGE, COWITCH. This term is generally applied to the hairs or spiculæ which cover the seed pods of the *Mucuna pruriens*, a climbing perennial plant, which is a native of the East and West Indies. An electuary formed by dipping the pods into treacle, syrup, or despumated honey, and then scraping them, has long been used as a vermifuge; but it is often a very troublesome remedy, from the excessive itching which it produces when it touches the unprotected skin, and there are other more effectual means of expelling worms.

COW'-KEEPER. A person whose business it is to keep a stock of cows for supplying the public with milk and cream. The principal cow-keepers of the metropolis have their establishments in the suburbs, where they are connected with pasture fields, in which the animals are turned out a portion of every day throughout the year, excepting when the ground is covered with snow, or when it rains very hard. The cows are fed in the house with grains, mangold wurzel, hay, tares, and other kinds of nourishing food; and as the animals get air and exercise, their milk may be considered wholesome. There are many cow-keepers, however in the metropolis, who keep only a few cows in confined back houses, and even in dark cellars; and, while they feed them with rich food, give them no exercise at all: hence the milk of such cows cannot be considered as wholesome.

COW POX. This disease was proposed in the year 1798 as a substitute for, and preventive of, the small pox by Dr. Jenner; and subsequent experience, as well as the extent to which the inoculation of it, or *vaccination*, as it is called, is carried throughout the civilized world, furnish well-grounded hopes of the ultimate extinction of one of the severest visitations of the human race. Small bluish vesicles, surrounded by inflammation, elevated at the edge and depressed in the centre, and containing a limpid fluid, occasionally appear upon the teats of the cow, the animal being at the same time somewhat indisposed: a similar disease is transferable under certain circumstances to the hands of the milkers; and persons who had so received it were found to be in many instances unsusceptible of small pox, both natural and inoculated. There is a disease of the horse's heel called

* The General Assembly had met annually from the year 1638 to 1649 inclusive. It sometimes met without having the sanction of the king, or without his majesty being represented in it, as is usual, by a commissioner. Not merely the Covenanters, but Presbyterians in general, laid it down as a principle, that the church courts are, in matters ecclesiastical and religious, independent of civil authority, and irresponsible to it. Accordingly, in 1638, the Assembly continued its sittings even after it had been dissolved by the royal commissioner. Cromwell in 1653 caused the General Assembly, then sitting, to be summarily dismissed, and interdicted its meeting in future. In this instance, the Assembly had implicitly to obey. This judicatory did not again meet till after the Revolution. (*Baillie's Letters*, ii. 309-70.)

*grease*, which appears to have produced similar effects upon the hands of farriers, and is perhaps the origin of the cow's disease: but it is from the latter animal that the *matter* is most certainly effective, and from which it is transferred to the human race, where it produces similar pustules; and the fluid of these may again be transferred with the same effects from one human subject to another. Whether by continuous circulation through human subjects the *virus*, as it is called, gradually loses its preventive efficacy, is an important question, and one upon which there are differences of opinion, but it would probably be more safe if more frequently derived from its original source upon the cow's teat. It seems useless here to discuss the various objections which have been raised, and the suspicions which have been thrown out against the permanent efficacy of this preventive, since the most extended and unbiassed experience of the most skilful observers seems amply to have proved that *when the pustule has gone through its regular stages*, the person is afterwards, during the whole period of life, unsusceptible of natural and of inoculated small pox, the exceptions to this statement being so few as either to be referable to imperfect vaccination, or to idiosyncracy, and though it is not pretended that cases of small pox after vaccination are as rare as of small pox after small pox, yet it is well known that the latter do occur, and, in short, that there is no rule without exceptions. In doubtful cases vaccination should always be repeated; and as no inconvenience results from a repetition of its inoculation, and the disease is not infectious by effluvia, it may be performed at certain intervals, or may even be tested as to its efficacy by *variolous* inoculation; although to the latter there are certainly serious objections, if we look to its ultimate extermination. In inoculating patients for the cow pox the matter should be taken from a healthy child, at about the 6th or the 8th day, at which time the pustule is well formed; and it should be immediately transferred upon the point of the lancet from the pustule to the arm, and inserted by a small oblique puncture under the cuticle, one place in each arm being quite sufficient If this direct mode cannot be followed, the virus intended for inoculation may be transferred between two pieces of plate glass, one of which is slightly indented for its reception, when slid over each other they are air-tight, and the edges may be secured by a strip of moist gold-beaters' skin or very thin bladder. If it is necessary to moisten the virus, this should be done with as small a portion as possible of tepid water, not exceeding the temperature of 100°. Lancet points which have been *armed*, as it is called, cannot be long depended upon, and are apt to be rusted and to irritate the arm. About the third day after inoculation the puncture generally becomes red and elevated, but the periods of its incipient progress are very uncertain; it then continues to enlarge and become vesicular; and is in full perfection about the eighth or ninth day, at which period also the surrounding circle of inflammation or *areola* is at its height About the eleventh or twelfth day this declines, and the centre of the pustule becomes brown, and gradually dries up into a dark-brown circular scab, depressed in the centre During the progress and scabbing off of the pustule great care should be taken to avoid all external injury, all irregularities in its progress should also be carefully watched, and if much inflammation comes on spontaneously two or three days after inoculation, and especially if suppuration ensues, the probability is that the operation has failed, and in all cases where there is the least doubt the inoculation should be repeated, although, if one of the pustules has gone through the above described progress, the failure or irregularity of the other is of no consequence The cow-pock is seldom attended by any symptoms requiring medical aid; but generally there is a slight drowsiness and febrile symptoms, with some restlessness, and occasionally sickness, about the second and third days; but these symptoms are immaterial to the preventive efficacy of the virus, which can only be judged of by the appearance and progress of the pustules, to which therefore it is necessary to pay close attention.

COW'RIES. (Germ. kouri.) Small shells brought from the Maldives, which pass current as coin in smaller payments in Hindostan, and throughout extensive districts in Africa: 100 are equivalent to a penny.

COY'POU. A Rodent quadruped; the *myopotamus* of geologists. *See* NUTRIA.

CRAB. *See* CANCER.

CRA'BRO. (Lat. crabro, *a hornet*.) A genus of Hymenopterous insects, belonging to the section *Aculeata* or sting-bearers, and to the subsection *Fossores* or burrowers. The hornet (*Crabro vulgaris*) is the type of this genus, which is now raised to the rank of a family (*Crabronidæ*), including two groups of subgenera. In one of these groups all the species have their fore-legs provided with strong spurs, for the purpose of excavating in decayed wood, or burrowing in sand, to form cavities in which their eggs are deposited; the insects of the other section have the fore-legs unarmed, and form no burrows, but deposit their eggs in the nests of other species. The true hornets (*Crabro*) excavate their retreat in wood, and feed their larvæ with the caterpillars of small moths found upon the oak, as well as with flies.

CRA'DLING. (Sax. cnabel.) In Architecture, the timber ribs in arched ceilings and coves to which the laths for the plaistering are nailed.

CRAG. A provincial name applied in Norfolk and Suffolk to certain accumulations of gravel and shells, belonging to the older pliocene period.

CRAMP. Spasmodic or involuntary contraction of some of the muscles, often attended with great pain; it is common in the muscles of the leg and foot, especially after any extraordinary exertion of them, and is sometimes brought on apparently by irritation in the stomach of indigestible food. When cramp seizes the calf of the leg, it usually goes off upon placing the limb in an erect posture and rubbing the affected part: those subject to it find much relief by applying opiate liniments. If it arises from indigestion, or from indulgence in acescent drinks or champagne, mild bitters with magnesia, taken at bed time, will generally prevent its recurrence

CRAMP. (Dutch kramp.) In Architecture, a piece of metal, bent or dovetailed at each end, for the purpose of holding two blocks of any material firmly together.

CRANE. (Sax. cpan) In Mechanics, a machine for raising heavy weights, and depositing them at some distance from their original place; for example, raising bales from the hold of a ship, and depositing them on the quay. A jib or transverse beam, inclined to the vertical in an angle of 40° or 50°, is constructed, which, by means of a collar, turns on a vertical arbor. The upper end of the jib carries a fixed pulley, and the lower end a cylinder, which is put in motion by a wheel and pinion, or cog wheel, or merely with a handle. The weight is made fast to a rope which passes over the pulley and is wound round the cylinder. On turning the cylinder, the weight is raised as far as necessary; the jib is then turned on its arbor till the weight is brought immediately over the spot where it is to be deposited; when, by withdrawing the moving power, it is allowed to descend by its own gravity. Cranes may be constructed of immense power They are generally turned by human force, sometimes, however, by a steam engine.

CRA'NGON (Gr κραγγη, *a cray-fish*) The name of the genus of Macrourous Crustaceans, including the common shrimp (*Crangon vulgaris*, Fabr) This species abounds most on sandy coasts, and is caught by means of a large open net fixed to the end of a long stick.

CRANIO'LOGY. *See* PHRENOLOGY.

CRA'NIUM. (Gr κρανιον, *the skull*) Sometimes applied to the entire bony compages of the head of the vertebrate animals, but, in Human Anatomy, is restricted to that portion of the skull which surrounds the brain.

CRANK. A mechanical contrivance for changing a revolving into an alternate motion. An iron axis is bent in some part of its length out of its rectilinear direction. As the axis turns the bent part describes the circumference of a circle, and gives a reciprocating motion to a piston or rod attached to it.

CRANK. (Germ krank, *sick*) In Nautical language, a ship is said to be *crank*, when by the form of its construction, or by want of a sufficient quantity of ballast or cargo, or by being loaded too much above, it is incapable of carrying sail without being exposed to the danger of oversetting.

CRAPE A species of gauze made of raw silk woven without crossing; it is stiffened with gum-water.

CRASSULA'CEÆ (Crassula, one of the genera) A natural order of herbaceous or shrubby Exogens, growing in hot, dry, and exposed situations, remarkable for the succulent nature of their stems and leaves. They have an affinity with *Penthorum* and with *Illecebraceæ*, through *Tillæa*; and possess refrigerant abstergent properties, mixed at times with a good deal of acridity.

CRA'TER. (Gr. *a large cup* or *bowl*, used in antiquity during a repast, for holding mixed wine and water.) The mouth of a volcano, which see.

CRAYO'NS. Coloured cylinders used for drawing upon paper; they are usually made of a fine pipe-clay, coloured with metallic pigments or carmine Crayons containing plumbago are styled *solid lead pencils*.

CREAM. (Fr. creme) A semifluid yellowish substance which collects on the surface of milk, and which is made into butter by the process of churning. When the milk of any animal is allowed to stand for some time it spontaneously undergoes certain changes, this substance rises to the surface, and forms a thin stratum, which is called cream, and which consists chiefly of oily particles; while the milk below, which of course is thinner than it was before the cream separated from it, is of a pale bluish colour, and consists of curd, coagulum, or the matter of which cheese is made. When cream is kept for some days it gradually becomes thicker, and partially coagulated; and if put into a linen bag and suspended from the ceiling of a cool room, it will acquire the consistence of cheese; and this is one among other modes of making cream cheeses. When cream is shaken

by churning it is resolved into its component parts, and hence we have butter and buttermilk. In order to make butter it is not always necessary that the cream should be separated from the milk; but whether separated or not, the process is facilitated by allowing the liquid to stand for some time, during which a part of the sugar contained in the serum is changed into an acid, which shortens the process of churning by facilitating the separation of the butter from the milk. When either cream or milk is churned without having previously become sour, the process is much more tedious; and sometimes, from causes not easily accounted for by the dairymaid, it is unsuccessful, and the milk is said to be bewitched. The true cause, however, is the want of acidity; because it has been found that the addition of a small portion of vinegar will dissolve the charm, and cause the almost immediate appearance of butter. Cream, when separated from milk and kept still it has become acid, is frequently mixed with milk newly drawn from the cow; and this eaten with sugar is one of the most delicious preparations of the dairy. Costorphin cream, so called from a village of that name in the neighbourhood of Edinburgh, is made by putting the milk of three or four days together with the cream into a vessel, and allowing it to remain there till it has become sour and coagulated. The whey is then drawn off and fresh cream added; and when it is brought to table it is eaten with sugar, and in the strawberry season with that fruit. Devonshire cream is simply sour curd, or sour cream eaten with fresh milk, or fresh cream, with or without the addition of sugar. Devonshire scalded or clouted cream is milk and cream heated to the boiling point, and suffered to cool, when the cream will be found to have separated from the milk, and when skimmed off may either be made into butter or eaten with fresh cream and sugar. Common clotted cream is simply milk and cream in a coagulated state, and sour. When the clotted cream is broken and stirred, and the whey drawn off, the mass may be turned into cheese by artificial pressure, by which the whey is separated instantaneously; or by suspending it in a porous bag, in a cool airy situation, when it will be separated by degrees. *See* BUTTER, CHEESE.

CREDE'NTIALS, LETTERS OF. The instrument in the form of a letter, from one monarch to another, which constitutes the evidence of the title of a minister at a foreign court to the power which he exercises. There are two sorts of credentials: the one sealed, drawn up and countersigned by the minister of foreign affairs; the other open, signed only by the king. Unless the minister be mentioned expressly in his credentials as an ambassador, he has only a right to the observances due to foreign ministers of inferior rank.

CRE'DIT, in Political Economy, is a term used to express the lending of wealth, or of the means of acquiring wealth, by one individual or set of individuals to another. The party who lends is said to give credit, and the party who borrows to obtain credit. Hence credit may be defined to be the acquisition by one party of the wealth of another in loan, according to conditions voluntarily agreed on between them.

Very exaggerated notions are commonly entertained of the influences of credit, but, in fact, all operations in which credit is given or acquired resolve themselves into a new distribution of wealth already in existence. The "magical" effect that is every now and then ascribed to credit is quite imaginary. A party who purchases goods payable at some future date obviously acquires the command of so much of the capital of the seller of the goods as their value amounts to, in the same way that a party who discounts a bill acquires the command of a corresponding portion of the capital of the discounter. Wealth is not created by the issue of bills; and all that their negotiation does is to transfer already existing property from one individual or party to another.

In the great majority of cases loans are made by individuals who wish to retire from business, or who have more capital than they can advantageously employ, to individuals entering into business, or who wish to extend their concerns and to acquire a greater command of capital. The probability is, that capital will be more likely to be efficiently employed by the latter than by the former class of persons, and the advantage of credit, in a national point of view, consists in that circumstance. Loans made to prodigals or spendthrifts, or to individuals who expend them on unprofitable undertakings, are, in so far, publicly injurious; but, speaking generally, these bear but a very small proportion to the other class of loans, or those made to individuals by whom they are advantageously expended.

Public credit is the phrase used to express the trust or confidence placed in the state by those who lend money to government.

The interest or premium paid by the borrowers to the lenders depends on a great variety of circumstances, — partly on the rate of profit that may be made by the employment of capital at the time, partly on the duration of the loan and the security for its repayment, and partly on the facilities given by the law for enforcing payment. The only way, indeed, in which a government can advantageously interfere to encourage credit is by simplifying the administration of the law, and by giving every facility for carrying the conditions of contracts into effect.

CRE'DITOR. *See* BANKRUPTCY.

CREED. Any brief summary of Christian belief; but more especially either of the three confessions commonly called the Apostles', Nicene, and Athanasian. The term is derived from the word credo, *I believe;* in like manner as paternoster, avemaria, &c., are prayers named from the first word of these formulas in the Latin tongue.

CREEK (Sax. cpecca, said to be derived from the Lat. crepido), is a shore or bank on which the water beats, running in a small channel from any part of the sea. It is also applied to any part of a large river which is resorted to as a harbour or landing place by small craft. In the United States, the term creek is used as synonymous with our English words brook or rivulet.

CREEL. A kind of basket; such, for instance, as is used by anglers.

CRE'MOCA'RPIUM. (Gr. κρεμαω, *I suspend*, and καρπος, *fruit*.) A two to five-celled inferior fruit, the cells of which are one-seeded, indehiscent, dry, perfectly close at all times, and when ripe hanging separate from a common axis, as in umbelliferous plants.

CREMO'NA. A general designation of the violins made at Cremona in Italy, during the 17th and 18th centuries, chiefly by the family Amati. (*See* VIOLIN.) Cremona is also a name erroneously given to a stop in the organ; being nothing more than a corruption of krumhorn, an ancient wind instrument, which it was originally designed to imitate.

CREO'LE. (In Spanish Criollo.) A name given to the descendants of whites born in Mexico, South America, and the West Indies; in whom the European blood has been unmixed with that of other races. The various jargons spoken in the West India islands by slaves, &c. are called Creole dialects.

CRE'OSOTE, or KREASOTE. A colourless, transparent, oily liquid, separable from wood-tar. It appears to be the principle to which the antiseptic power of wood-tar, smoke, and crude pyrolignous acid is owing. Hence its name, from κρεας, *flesh*, and σωζω, *I save*.

CRE'PITUS. (Lat.) The crackling noise which is produced upon pressing cellular membrane when it contains air.

CRESCE'NDO. (It.) In Music, a direction to the performer to increase the volume of sound from soft to loud, marked thus <.

CRE'SCENT (Lat. cresco, *I increase*), in Heraldry, is a bearing in form of a half moon. When the horns are turned towards the chief or upper part of the shield, it is called *crescent*, in contradistinction to the terms *increscent* and *decrescent*, in the former of which the horns are turned to the right, and in the latter to the left side of the shield. The crescent is frequently used to distinguish the coat armour of a second brother or junior family from that of the principal branch. As is well known, the crescent, or, as it is usually designated, the *crescent montant*, has become the symbol of the Turkish empire, which has thence been frequently styled the Empire of the Crescent. This symbol, however, did not originate with the Turks. Long before their conquest of Constantinople the crescent had been used as emblematic of sovereignty, as may be seen from the still existing medals struck in honour of Augustus, Trajan, and others, and it formed from all antiquity the symbol of Byzantium. On the overthrow of this empire by Mohammed II., the Turks, regarding the crescent which everywhere met their eye as a good omen, adopted it as their chief bearing; and it has continued ever since to decorate their minarets, their insignia, their dress, and in short every thing appertaining to their empire. Crescent has also been applied to three orders of knighthood: the first of which was instituted by Charles I., king of Naples and Sicily, in 1268; the second by René of Anjou, in 1448; and the third by the sultan Selim in 1801, two years after the battle of Aboukir. The last-mentioned order is still in existence, and is remarkable for the fact that none but Christians are eligible for admission.

CRE'ST. (Lat.) In Heraldry, the ornament affixed to the helmet, being a personal or hereditary device. Warriors bore insignia peculiar to themselves in this manner among the classical ancients. The earliest instance of the heraldic crest in England is said to be that of Edmund Crouchback, Earl of Lancaster (about 1280). The crest is, in modern blazonry, a figure placed upon a wreath, coronet, or cap of maintenance, which surmounts the coat of arms. It is not unfrequently a repetition of some bearing in the shield itself; as, the crest of Castile is a castle.

CRETA'CEOUS. (Lat. creta, *chalk*.) Composed of chalk. In Geology, the *cretaceous group* of rocks includes the upper strata of the secondary series, immediately below the tertiary deposits, and resting upon the oolitic group. (See *Fitton*, in *Geol. Trans.*, 2d Series, vol. iv.)

CRE'TINS. A name applied in the Valais and elsewhere to a class of idiots, who are also generally afflicted with *goitres*, which see.

CRIB. Sometimes applied to a rack for hay or straw for cattle, and sometimes to a manger for corn or chaff; also to a small enclosure in a cow-house or shed for calves or sheep.

CRIB-BITING. Biting the manger or crib; a bad habit among horses, brought on by uneasiness occasioned by diseases of the teeth, or by roughness in the person who currycombs them.

CRI'BBLE. A coarse sieve, or screen, for sifting sand, gravel, or corn; the term is also applied to a sort of coarse meal.

CRI'COID. (Gr. κρικος, *a ring*, and ειδος, *appearance*.) Annular or ring-shaped. A cartilage of the larynx is hence called the *cricoid cartilage*.

CRI'NO. A cuticular disease, supposed to arise from the insinuation of a *hair-worm* under the skin of infants.

CRINOI'DEANS, *Crinoidea*. (Gr. κρινον, *a lily*, and ειδος, *appearance*.) A name given by Miller to an extinct family of Echinoderms, having a radiated, lily-shaped disc, supported on a jointed stem. When this stem is cylindrical, the species are termed *Encrinites*; when it is pentagonal, *Pentacrinites*. See those words.

CRI'SIS (Gr. κρισις, *a decision*), may be defined, in its most extended signification, as a decisive point in any important affair or business; but it is used more particularly in a political sense, to denote a certain conjuncture of affairs in which, from what cause soever it may have originated, the ordinary operations of government are so fettered or deranged as to lead to some important change in the policy or institutions of a country. Like many expressions of similar import, the phrase "political crisis" admits of an almost endless variety of shades of meaning, being applicable at once to a change of ministry, the abolition of a constitution, a revolutionary insurrection, and the dethronement of a sovereign. Hence this expression will be better interpreted by the feelings, predilections, or prejudices of each individual, than by any definition of which it is susceptible. In France, a "crise politique," as it is called, is synonymous with the terms *coup d'etat*, *emeute*, *revolution*, *insurrection*, &c. In Medicine, certain symptoms which announce a favourable or an unfavourable termination of a disease are called *critical symptoms*, and the period at which they show themselves the *crisis* of the disease In the progress of fevers these symptoms have been supposed to show themselves at certain definite periods, which therefore have been called *critical days*.

CRI'TICAL PHILO'SOPHY. The metaphysical system of Kant is sometimes so termed, from his famous work, the *Kritik der Reinen Vernunft* (Criticism of Pure Reason). *See* KANTIAN PHILOSOPHY.

CRI'TICISM (Gr. κρινω, *I judge*), has been defined "the art of judging with propriety concerning any object, or combination of objects." In a somewhat more limited, but still extensive meaning, its province is confined to literature, philology, and the fine arts; and to subjects of antiquarian, scientific, or historical investigation. In this sense, every branch of literary study, as well as each of the fine arts, has its proper criticism as an appendage to it. The elements of criticism depend on the two principles of Beauty and Truth, one of which is the final end or object of study in every one of its pursuits: Beauty, in letters and the arts, Truth, in history and the sciences. The office of criticism, therefore, is, first to lay down those forms or essential ideas which answer to our conception of the beautiful or the true in each branch of study; and, next, to point out by reference to those ideas the excellences or defects of individual works, as they approach or diverge from the requisite standard in each particular. Thus, historical criticism teaches us to distinguish the true from the false, or the probable from the improbable, in historical works; scientific criticism has the same object in each respective line of science; while literary criticism, in a general sense, has for its principal employment the investigation of the merits and demerits of style or diction, according to the received standard of excellence in every language; and, in poetry and the arts, criticism develops the principles of that more refined and exquisite sense of beauty which forms the ideal model of perfection in each. Taste is the critical faculty; that perception of the beautiful in literature and the arts, for the acquisition of which, perhaps, some minds have superior natural powers than others, but which can in no instance be fully developed except by education and habit. (*See* ÆSTHETICS.) Among the classical ancients, the criticism of Beauty was carried to a high degree of perfection. Less encumbered with a multitude of facts and things to be known than ourselves, their minds were more at leisure, and more sedulously exercised in reflecting on their own notions and perceptions; hence the astonishing progress which they made in the fine arts; and hence, in literature, they valued more the beauty of the vehicle in which sentiments were conveyed, and the moral or poetical beauty of those sentiments themselves, than the objective branches of study which it is the principal purpose of literature, in our days, to convey easily and precisely to the mind. And as the criticism which antiquity has left us consists almost wholly of such as relates to literature and the arts (in history they had, as far as we know, few critical spirits, in the sciences almost none), the name is still confined, in its most popular signification, to those provinces of research. The criticism of Truth is of later growth; but as it is regulated for the most part by similar rules and principles, and as minds which possess the faculty of judgment in a high degree in the one are generally capable, if exercised, of forming right apprehensions in the other, they may be considered as nearly allied in the more essential respects. For although it is true that in scientific investigation great knowledge of the individual subject is required to constitute a critic, and in the fine arts the most gifted mind will require much education and practice to judge of beauty; yet it is equally true in both of these branches of study, however widely differing from each other, that knowledge alone (except perhaps in purely abstract science, in respect of which the name of criticism seems hardly applicable) will not make the critic, and that the habit of discriminating and judging correctly is a distinct faculty or compound of faculties in the mind. Among a host of works which may be consulted with advantage on this subject, are *Blair's Lectures on Belles Lettres*; *Campbell on Rhetoric*; *Whately on Rhetoric*, *Knight and Alison on Taste*; *Laharpe*, *Cours de la Litterature*, *La Cretelle*, *Traité de la Rhetorique*; *Horn and Menzel's History of Polite Literature*; and *Schlegel's Miscellaneous Essays*, &c. *See* BELLES LETTRES and RHETORIC.

Criticism, in a more limited sense, is a branch of belles-lettres. Essays written for the purpose of commending or discommending works in literature or the arts, and pointing out their various merits and defects, are works in the critical department. Thus the term "periodical criticism" is used to express the body of writing contained in the various works under the name of magazines, reviews, &c., which are periodically published in most literary countries.

CRO'CKETS. (Fr. crochet, *a hook*.) In Gothic Architecture, ornaments resembling curved and bent foliage running up on the edge of a gable or pinnacle. They are of two varieties: the earliest are formed by a simple curve turning downwards, as in the gables and spires of Lincoln cathedral, the later have the point of the leaf returned and pointing upwards. Sometimes animals are substituted in the place of leaves.

CRO'CODILES. (Gr κροκοδιλος.) A name first applied by Herodotus to the crocodile of Egypt, because that animal resembled a small lizard of the same name (*Stellio* of the moderns), which is now known in Greece under the name of *Koslordylus* The Egyptian and other species of crocodile were confounded by Linnæus under the name of *Lacerta crocodilus*, but the crocodiles are distinguished from all other Saurian reptiles, or *Lacertæ* of Linnæus, by the following characters:—They have a long and powerful tail, which is flattened in the vertical direction, to serve as the principal means of propelling the body through water with the swiftness required in the pursuit of fish, which form the principal prey of the crocodile. The extremities are short, and comparatively of little use in aquatic progression, except in guiding and changing the direction of the motion, for which purpose they are always webbed or half-webbed. The fleshy tongue is attached by its entire marginal circumference, as in most fishes, to the inner side of the lower jaw, and is not extensible, as is the case in all true lizards. The teeth are simple, conical, sharp-pointed, large, lodged in distinct sockets, and arranged in a single row; which structure and disposition are in relation with the carnivorous habits of the crocodile. Lastly, the intromittent organ of the male is single.

To these essential differences between the crocodiles and lizards may be added the following characters, which are common to all the crocodiles:—

1. The fore-feet have five toes; the hind-feet four toes.
2. Three toes only on each foot are armed with claws; so that there are two toes in front and one behind which have no claws.
3. The whole of the tail and the upper and under parts of the body are covered with square scutæ or plate-scales; and the greater number of those on the back are traversed longitudinally by a more or less prominent ridge.
4. The sides of the body are covered with small round scales.
5. The ridges on the scales of the tail form at its base two prominent lateral series, or dentated keel-like crests, which converge and blend into one at the posterior part of the tail.
6. The tympanum or drum of the ear is protected by two moveable flaps.
7. The eyes are provided with three eyelids.
8. Two little pouches containing a substance of a musky

odour. Their anatomy also affords some characters which are common to all the species, and very well distinguish their skeleton from that of other Saurians. The ventricles of the heart do not intercommunicate. The vertebræ in the cervical region support a series of spurious ribs, which are directed backwards, and the extremities of each overlapping the next in succession prevent the animal from turning the head to the side. This structure, it will be seen, is in admirable accordance with the aquatic habits of these large piscivorous reptiles; since, in order to displace the fluid medium through which they move, it is essential that the head should be firmly locked to the trunk. It is for this reason that the vertebræ immediately behind the head in fishes bear ribs; and the cervical vertebræ of the whale, although they accord in their number and in the absence of ribs with those of other mammalia, are modified so as to answer the same end as the costo-cervical vertebræ of crocodiles and fishes, being compressed from before backwards, and anchylosed sometimes into a single piece.

CROFT. A small field adjoining the dwelling house and kitchen garden. The term is also sometimes applied to common field lands.

CRO'MLECH, or CROMLEH. In British Antiquities, large flat stones laid across others in an upright position; very commonly found in parts of Wales, in Devonshire and Cornwall, and other exposed districts of England, as well as in some continental countries. Cromlechs are generally supposed by antiquaries to have been constructed to serve as altars. According to some (see *Fosbrooke's Encyclopædia of Antiquities*, 508) there is a difference between the cromlechs of the Britons and those of nations of Germanic descent; the former being inclined stones, perhaps for the purpose of allowing the blood shed in sacrifice to run off, the latter thick round stones, standing on small hillocks and covering caves.

CROP OUT. A mining and geological term, expressing the rising up or exposure at the surface of a stratum or series of strata.

CROPS, ROTATION OF. *See* AGRICULTURE.

CRO'SIER. The staff of an archbishop, surmounted by a cross, and thereby distinguished from the pastoral staff or crook of a bishop. This staff, according to Polydore Virgil, was given to bishops wherewith to chastise the vices of the people; and was called *baculus pastoralis*, in respect of their pastoral charge and superintendence over their flock, as well as from its resemblance to the shepherd's crook. Many authors contend that the crosier is derived from the *lituus* or augural staff of the Romans.

CROSS. (Lat. crux.) A gibbet made of two pieces of wood laid upon each other at any angle. Originally, it was nothing more than a tree; but it afterwards assumed a variety of forms, of which the following are the most usual examples, × T +. The cross was used as a very general instrument of punishment by almost all the nations of antiquity, from the earliest period of their history. Among the Syrians, Jews, Egyptians, Persians, and especially the Carthaginians, it appears to have been the usual military punishment (*Val Max.* ii. 7; *Herod.* iii 125—159.), and that it was not unknown to the Greeks, the crucifixion of 2000 Tyrians by Alexander after his capture of their city abundantly testifies (*Quin Cur* 11, *Just* 18. 3.) But in no part of the ancient world was this punishment so generally resorted to as in the Roman empire. Under the early monarchical government of Rome, it extended indiscriminately to every rank (*Liv.* i. 26); but latterly it came to be regarded as the most infamous of deaths, and, save in cases of sedition, was inflicted only on slaves or the vilest malefactors. The disgust and horror in which this punishment was held by the Romans is evident from the expressive epithets applied to it by Cicero, "crudelissimum et teterrimum" (*most foul and brutal*), as well as from the phrases used synonymously with the instrument of punishment itself; such as "arbor infelix," "infame lignum," &c. From the multiplicity of conflicting details respecting the punishment of the cross, it is clear that there was but little uniformity observed in carrying it into effect. By the Roman law the culprit, or, as he was called, the *crucarius*, was scourged previously to the crucifixion either in the prætorium, or on the way to the place of execution. On his arrival there he was stripped of his garments, and then either nailed by the hands and feet to the cross, or, as sometimes happened, only fastened to it by ropes. In order to hasten death, it was the practice to break the legs or to pierce the body of the sufferer with a spear or other sharp instrument; but this was not always done; and instances have occurred of persons, who after being suspended for some considerable time on the cross, were taken down and survived. By the Jewish law, it was ordained, that the body of the culprit should be removed from the cross on the day of his execution; but the Romans frequently allowed it to hang till it dropped piecemeal to the ground and nothing remained. "Suffixorum corpora crucibus," says Seneca, "in suam sepulturam defluunt." In general, the cross was erected near some great road or highway, in order to indicate more distinctly the ignominy of the culprit and the severity of his death.

After Jesus Christ had, by an unjust sentence, suffered on the cross, and by his death made atonement for the transgressions of mankind, the cross, from being an object of horror, became, as it were, the symbol of the Christian world, and in the end came to be regarded even with superstitious veneration. Constantine, from respect for these feelings, abolished the punishment of crucifixion throughout the Roman world.

The Apostles make use of the term cross as expressive of the sufferings to which the faithful must submit in attestation of their belief, which they liken figuratively to those of our Saviour in his death. Tertullian says that the early Christians were accustomed on every occasion of daily life, *frontem crucis signaculo terere*, to make the sign *with the fingers upon the forehead*. This extravagant profuseness in the use of a symbol naturally led to superstition; and the cross appears to have become the object of actual adoration as early as the 4th century, when that practice is made a reproach against the Christians by Julian. The allegation of the later Romanists, that it is not the wood of the cross, but Christ figuratively present, that is worshipped by them, appears to have been put forward occasionally at this time, but sometimes not without reproof from the ecclesiastical authorities. In the Romish church there are certain festivals observed to this day in memory of circumstances connected with the cross; as the Invention or Discovery and the Exaltation of the Cross: the former commemorates the supposed discovery of the true cross by the Empress Helena, the latter its restoration to Calvary by Heraclius.

CROSS. In Heraldry, an ordinary, formed by lines drawn palewise and fesswise, inclosing (if bounded by the escutcheon) one fifth of the shield, or one third if charged. A cross gules is termed the cross of St. George. A plain cross is one the extremities of which do not reach to the circumference of the escutcheon, but are "couped," or cut off in a straight line. There are many other kinds of crosses not reaching the circumference of the escutcheon known in heraldry, the following are only a few, most commonly used in bearings:—A *cross crosslet* is one crossed on each arm. Such a cross between four plain crosses is termed a Jerusalem cross. A *cross flory* has three points at each end. A *Maltese cross* has arms increasing in breadth towards the end, with double points. A *cross fitchy* has the lower limb pointed, as if to fix in the ground. A *patriarchal cross*, the insignia of patriarchs or archbishops, is plain, having two bars, the upper smaller than the lower. A *cross moline* terminates in representations of the ends of the fer-de-moulin, or milrind. It is the difference of the eighth son of a family.

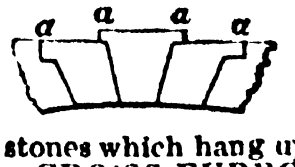
CROSS. An instrument formerly used in surveying for laying out perpendicular lines, but now seldom employed. It consists of a brass cross or circle, divided into four equal parts by two diameters at right angles to each other. At each extremity of these diameters perpendicular sights are fixed. The instrument is mounted on a staff to fix it in the ground, and its use is to find the point in a given line or direction through which a straight line drawn to an object at some distance will be perpendicular to the former line.

CRO'SS-BOW. A weapon used for shooting with, before the invention of fire-arms. All weapons having the bow attached to a stock were called cross-bows; and some of the larger sort were furnished with instruments for bending the bow.

CRO'SS-BREED. The offspring of parents of two different breeds.

CRO'SSES, STONE, in Architectural Antiquities, are of various descriptions, according to the occasion or purpose of their erection. They are said to have originated in the practice of marking the Druid stones with a cross, at the period of the conversion of the Celtic tribes to Christianity. *Preaching crosses* are generally quadrangular or hexagonal, open on one or both sides, and raised on steps. They were used for the delivery of sermons in the open air; such was the famous Paul's Cross in London. *Market crosses* are well known. *Weeping crosses* were so called because penances were finished before them. *Crosses of memorial* were raised on various occasions; sometimes where the bier of an eminent person stopped on its way to burial, in attestation of some miracle performed on the spot: such are the well-known crosses of Queen Philippa. Crosses served also as land marks; they are especially set up for this purpose on the lands of the Templars and Hospitallers.

CROSSE'TTES. (Fr.) In Architecture, the returns on the corners of door cases or window frames; called also ears, elbows, ancones, prothyrides. In architectural construction, they are the small projecting pieces in arch stones which hang upon the adjacent stones—*a*, *a*, *a*, *a*.




CRO'SS-FURROW. A furrow or open trench cut across other furrows to intercept the water which runs

along them, in order to convey it to the margin of the field where it may find its way to an open ditch or some other general drain.

CRO'SS-STONE. So called from the intersection of its crystals. It is a species of *harmotome*, found in great beauty at Andreasberg. (*See* ANDREASBERGOLITE.) It is composed of 49 *per cent.* of silica, 16 alumina, 18 baryta, and 15 water.

CRO'TALUM. (Gr. κροταλον.) An ancient kind of castanet, used by the Corybantes or priests of Cybele. This instrument must not be confounded with the modern *crotalo*, a musical instrument used chiefly by the Turks, and corresponding exactly with the ancient cymbalum.

CRO'TALUS. (Lat. crotalum, *a castanet* or *rattle.*) A genus of poisonous serpents, including those which are furnished with a rattle at the extremity of the tail.

CRO'TCHET. (Fr. crochet ) In Music, one of the notes or characters of time, equal to half a minim.

CRO'TCHETS, in Grammar, more frequently called *brackets*, are certain marks or hooks in which words or phrases are included thus [ ], by way of distinguishing them from or of illustrating the context.

CRO'TON OIL. The expressed oil of the seeds of the *Croton tiglium;* formerly called *Grana tiglia*, and *Molucca grains*. The tree is a native of Ceylon, and of Malabar and the Molucca Islands. Its seeds are very purgative; and their expressed oil so drastic, that a single drop will often prove violently operative, completely emptying the bowels and exciting a copious watery secretion from them. The most active form for its exhibition is made into a pill with bread crumb: it may also be rubbed with a little mucilage of gum arabic, and given in a liquid form; but it always requires much caution in its administration.

CROUP. An inflammation of the larynx and trachea, accompanied by difficulty of breathing and cough, and by a peculiar shrillness of voice and wheezing; there is also generally more or less expectoration of purulent and filmy matter, which is thrown out upon the affected part and continually threatens suffocation. This disease is most common in infants, and in children from three to nine years old; it is of rare occurrence, in its acute form at least, after twelve years of age In the successful treatment of this distressing and dangerous disease, everything depends upon promptitude in the application of remedies calculated to subdue the local inflammatory action This is to be done either by leeches to the region of the trachea, by cupping, or by bleeding in the jugular vein; by the cautious application of external irritants of rapid action, such as a piece of lint dipped in strong acetic acid, which, however painful, is sometimes of service; by blisters, and by the exhibition of large doses of calomel: there is a difference of opinion as to the employment of emetics. The inhalation of steam is useful where it can be resorted to, but in young children it is impracticable In *spasmodic croup* the wheezing and sense of suffocation appear to depend upon spasmodic action of the larynx or epiglottis. like the former it attacks infants and children, but comes on and goes off very suddenly, returning at intervals, during which the patient is comparatively easy In weakly and irritable children it sometimes appears a consequence of teething An emetic, calomel purges, warm bath, diaphoretics, and a blister, are the leading remedies; bleeding should be avoided There is a kind of croup which sometimes attacks children of weakly constitutions, and which appears symptomatic of irritation in the stomach and bowels, for it is relieved by purging, and disappears as the constitution improves. Another form of this disease is called *chronic croup*. It is attended by cough and the expectoration of tough mucus, sometimes apparently membranous or tubular, occasioning difficulty of breathing and suffocation. This disordered state of the trachea and bronchial membranes may occur at all periods of life. it is relieved, and often cured, by using the inhaler with warm water, by expectorants with small doses of sedatives and mercurials, and by occasional purging.

CROWN. (Lat. corona.) In Heraldry. Among the ancients, and especially in the Roman republic, crowns were presented to citizens as marks of distinction for valiant or otherwise meritorious exploits. From this usage the crown has been adopted as a bearing by modern heralds. Nine species of the crown are enumerated in heraldry; some of which, however, have not been introduced into modern arms, and are only known from the description left of them by the ancients:—1. The Eastern Crown, imitated from that which appears on coins of Greek oriental sovereigns, and borne by those who have distinguished themselves in the East: the East India Company's arms have this crown. 2. The Triumphal Crown, which, after being borne by Julius Cæsar, became the Crown Imperial. 3. The plain Circlet or Diadem. 4. The Obsidional Crown, given among the Romans to those who had performed exploits in the defence of fortified places. 5. The Civic Crown, for saving the life of a citizen. 6. The Crown Vallary, to soldiers who had first entered the enemy's trench. 7. The Mural Crown, to soldiers distinguished in besieging armies. 8. The Naval Crown, common in English coats of augmentation. 9. The Crown Celestial.

CROWN. In Architecture, the uppermost member of the cornice; called also *corona* and *larmier*.

CROWN or DEMESNE LANDS (*Terræ Dominicales*). The lands, estates, or other real property belonging to the crown or sovereign. These were anciently very extensive in this and most other European countries. The rents and other payments arising from them formed during the middle ages an important part of the revenue of our English kings; and they still form an important part of the revenue of several Continental sovereigns. These lands have been acquired by various means, such as purchase, succession, forfeiture, &c. Having been regarded for a lengthened period as the private property of the crown, and as being consequently at the free disposal of the sovereign for the time being, but little providence has been displayed in their management. A grant of crown lands was, indeed, the ordinary method in which our sovereigns used formerly to gratify their favourites; and, in consequence of the magnitude and improvidence of such grants, the crown estates in this country have been reduced within very narrow limits. Parliament frequently interposed to check this profusion, but without effect till after the Revolution, when the lavish grants of crown lands, made by William III. to the Bentinck and other families, occasioned so much dissatisfaction that the practice was put an end to. This was done by the act 1 Ann, st. 1. cap. 7., which declared that all future grants or leases of lands from the crown for a longer term than 31 years, and of houses for a longer term than 50 years, should be void.

The crown estates, forests, manorial rights, &c. not granted away, have now become, in consequence of arrangements to that effect, the property of the public; and are administered by a department specially appropriated to that purpose, called the "Woods and Forests." Their total nett revenue in 1838 amounted to 388,642*l.*, collected at an expense of 10½ per cent. Of late years a considerable extent of crown lands, consisting of old forests and chaces, have been enclosed and planted with forest trees, with a view to the supply of timber for the navy.

Certain lands, manorial rights, &c., with the sum paid as commutation for the loss of the tin duties, are the private property of the prince of Wales, as duke of Cornwall; and when there is no prince of Wales, of the crown.

CRU'CIBLE. (Lat crucio, *I torment;* because, in the language of old chemistry, the metals were tortured by fire to yield up their various virtues ) A vessel, generally made of very refractory earthenware, in constant use in the chemical laboratory for performing fusions of metals and other substances.

CRUCI'FERÆ. (Lat. crux, *a cross;* the flowers being in the form of a Maltese cross ) A natural order of Exogens, inhabiting most temperate countries They are allied to *Capparidaceæ*, but differ in their tetradynamous stamens; and also to *Papaveraceæ* and *Fumariaceæ*, but are distinguished by their seeds, and having no albumen They are characterized essentially by their deviation from the ordinary symmetry observable in the relative arrangement of the parts of fructification of other plants Linnæus divided this order into *Siliquosæ* and *Siliculosæ*, from the forms of their fruits; but more recently divisions have been founded upon the nature of the plicature of the cotyledons, and the position of the radicle with respect to them. They possess universally antiscorbutic and stimulant properties, combined with an acrid flavour; and their seeds uniformly abound in a fixed oil,—properties of which cress, mustard, and rape may be taken as representatives.

CRU'CIFIX. The figure of Christ upon a cross; also a cross with the figure of Christ upon it.

CRUDE (Lat crudus.) In Painting, a term applied to a picture when the colours are rudely laid on, and do not blend or harmonize.

CRUISE. (Germ. kreutzen, *to cross.*) A voyage within certain limits, for the purpose of meeting with enemy's ships, pirates, &c., or for mere exercise.

CRU'OR. (Lat. *gore* ) The red coagulum of the blood, which appears as the blood cools.

CRU'PPER. A roll of leather put under a horse's tail, and connected with the saddle by a strap and buckle, for the purpose of preventing the saddle from being cast forward on the horse's neck by the action of riding.

CRU'RAL. (Lat. crus, *the leg.*) Relating to the leg, or shaped like a leg or root.

CRUSA'DES. (Lat. crux, *cross.*) In the European History of the Middle Ages, wars undertaken by confederacies of chiefs and soldiers with a religious object. Those which were engaged in by great part of the nations of Europe for the recovery of Palestine from the infidels are more frequently denoted by this peculiar name. The term Crusade is derived from the sacred symbol of the cross, which was borne by the warriors engaged in it over their arms: the colour of the cross often served to designate the nation of the soldier; as, the white cross on a red ground, France; the red cross on a white

ground, England. The principal crusades for the conquest of Palestine were—1. The first, A. D. 1096, excited by the preaching of Peter the Hermit and the encouragement of Pope Urban II., in which Godfrey of Boulogne headed the Christians, who made themselves masters of Jerusalem and great part of Palestine. 2. The second, A. D. 1142, in which Conrad III. of Germany and Louis VII. of France led armies to complete the conquest of Palestine, but without success. 3. The third, A. D. 1189, was occasioned by the capture of Jerusalem by sultan Saladin; Frederic II. of Germany, Philip Augustus of France, and Richard Cœur de Lion of England were the chief among the confederate monarchs: the capture of Acre was almost the only fruit of this great expedition. 4. The fourth crusade was conducted by the King of Hungary, Andrew II., in 1217. 5. The fifth was conducted by Frederic II. of Germany (Barbarossa), who recovered Jerusalem, but for a short time. 6. The sixth, A.D. 1248, by Saint Louis king of France, against Egypt, but without success. Among other wars which have been at various times denoted by the name of Crusades, that against Raymond count of Toulouse and his heretical vassals the Albigeois, of which the first leader was the famous Simon de Montfort, is the most memorable. (*See* ALBIGENSES.) Whether the Crusades exercised a beneficial influence on the state and condition of society, is a question which has long engaged the attention of the learned; and, as is the case with every subject of a purely speculative character, different opinions have been entertained respecting it at different times. In the seventeenth century, when the question came first to be agitated, these extraordinary expeditions were generally regarded as having been in the highest degree favourable to the intellectual, commercial, and political interests of the world; but in the succeeding century there arose a host of inquirers, at the head of whom was Voltaire, less dazzled by the brilliancy which romance had thrown around these enterprises than the philosophers of the preceding age, by whom they were represented as mere ebullitions of superstition, fanaticism, and barbarism, which, how strongly soever they agitated the surface of society, in no degree contributed to its permanent improvement. And it was not until Robertson published the introduction to his *Charles V.*, in which he expressed his conviction that the Crusades had exercised a most favourable influence over the progress of freedom and the advancement of the human mind, that a check was given to these unfavourable views, and that the interest and importance formerly attached to the Crusades began to be revived. With the view of stimulating inquiry into this grand historical question, the French Institute, in the year 1806, with its usual enlightened spirit, proposed it to the learned of all countries as a subject of general competition; and the prize was awarded jointly to the essays of Heeren and Choiseul d'Aillecourt, which have since been published. These essays form the groundwork of the more elaborate researches of Michaud, and of the numerous other treatises upon this subject with which the literature of France, England, and Germany has since been inundated; and along with all the most recent discussions upon this question, which it has been our fortune to see, manifest a singular coincidence of opinion respecting the tendency of the Crusades, which, in spite of some strong drawbacks and disadvantages, they consider as having materially contributed to the revival of European learning and civilization. There are few disputed subjects of which it is more difficult to form a correct estimate than the influence of the Crusades, whether we regard the distant period when they took place, the insufficiency of contemporary history, the different phenomena and consequences by which they were accompanied in different countries, or, above all, the difficulty of assigning to these enterprises their own peculiar effects, amid the multiplicity of other causes, more powerful, perhaps, though less apparent, which were then operating on society. As our limits necessarily preclude us from entering upon this interesting inquiry, we must content ourselves with merely glancing at the chief arguments which have been adduced on both sides of the question. Some of those who maintain that the Crusades exercised a beneficial influence over the interests of society, scruple not to trace to them the origin of almost all the civilization which modern Europe at present enjoys. But those who take a more reasonable view of the matter, reckon among the advantages which resulted from these enterprises the general intercourse which they tended to establish between nations that might otherwise have long remained strangers to each other; the removal of international contentions and prejudices, which the union of nearly all the European states in pursuit of a common object tended to effect; the impulse which they gave to commercial enterprise throughout the world, more especially in Italy, and subsequently to the revival of literature and the fine arts in that country; the general diffusion of more liberal modes of thinking and acting on political and religious questions; and finally the breaking up of the feudal system, which, as is alleged, laid the foundation of the civil liberty at present enjoyed by all the communities of Europe. On the other hand, those who advocate the negative side of the question allege that the Crusades were begun in folly, prosecuted without skill, and ended in defeat. They caused, it is maintained, a waste of life and labour beyond example, without any advantageous return. For two centuries they afflicted almost every family in Europe with the most painful privations; and withdrew the attention of its inhabitants from the peaceful pursuits of industry to marauding expeditions undertaken in a spirit of religious fanaticism, and evincing in their conduct a disregard for the most obvious principles of justice. Agriculture, commerce, arts and education, were neglected by all ranks, under a general distemper of the imagination, which represented the recovery of the Holy Land from the possession of infidels as the most sacred and urgent of duties. In this Quixotic attempt, they sacrificed the flower of successive generations, and the strength and ornament of their respective countries. It is contended too by those who take this view of the matter, that the absence of the principal sovereigns from their kingdoms gave full scope to all sorts of faction and disturbance at home; and that though the power of some of the greater barons was broken by the debts and obligations they contracted during these expeditions, the anarchy inseparable from the feudal system was greatly augmented, and the progress of good government greatly retarded. Without attempting to determine the precise degree of weight that should be attached to these conflicting statements, it is abundantly clear that there has been, on both sides, a vast deal of exaggeration; and though it be obviously absurd to ascribe to the Crusades the superior wealth, civilization, and freedom of modern Europe, it is at the same time sufficiently clear that their beneficial influence, in various respects, countervailed to a considerable extent the impoverishment, anarchy, and war in which they involved the greater part of Europe and Asia. In addition to the prize essays already referred to, the reader may consult the elaborate and important work of *Michaud, l'Histoire des Croisades*, and his *Bibliographie des Croisades*; with *Wilken's Geschichte der Kreuzzuge*, *Haken's Gemalde der Kreuzzüge*; the art. "Croisades" in the *Encyclopédie des Gens du Monde*, &c. &c.

CRUSCA, ACCADEMI'A DELLA. *See* ACADEMY.

CRU'STA (Lat.) In Gem Sculpture, a gem engraved for inlaying on a vase or other object.

CRUSTA'CEANS, *Crustacea*. (Lat crusta, *a hard covering*.) A class of free articulate animals, with articulated limbs, a branchial respiration, and a dorsal ventricle or heart.

CRY'OLITE. (Gr. κρυος, *ice*, λιθος, *stone*.) A rare mineral from Greenland. It is a double fluoride of sodium and aluminum. It readily fuses in the flame of a candle, whence its name.

CRYO'PHORUS. (Gr. κρυος, and φερω, *I bear*.) The frost-bearer or carrier of cold; an instrument contrived by Dr. Wollaston for freezing water by its own evaporation. (*Philos. Trans* 1813, p. 71.)

CRYPT. (Gr. κρυπτω, *I hide*.) In Architecture, the under or hidden part of a building. It is used also to designate that part of the ancient churches and abbeys appropriated to the monuments of deceased persons. (See *Dugdale's Monasticon*.)

CRY'PTA. (Gr. κρυπτω.) In Botany, the round receptacles for secretion present in the leaves of some plants, as in the orange and myrtle.

CRY'PTÆ. (Gr. κρυπτω.) Little rounded excrescences, in which the minute ramifications of the arteries terminate in the cortical part of the kidneys.

CRYPTOGA'MIC PLANTS (Gr. κρυπτος, *concealed*, and γαμος, *marriage*), are those which never produce flowers or sexes, but which are multiplied without the aid of sexual intercourse. Linnæus gave them their name, upon the supposition that they in fact do possess sexual organs, although he was unable to discover them; and since his time Hedwig and others have endeavoured to show that sexes do exist in them, although in a concealed and anomalous state. In fact, it appears that in *Marchantiaceæ*, Mosses, *Jungermanniaceæ*, and some others, the reproductive organs are of two sorts, and it is not altogether unreasonable to call the one male and the other female; but at the same time it must be confessed that if such parts are rightly named, they are exceedingly dissimilar to the organs so called in Phanerogamic plants, and that the utmost which can be conceded to them is, that one contains a male principle and the other a female principle. From the recent observations of Agardh, Morren, Leveillé, Klotzsch, and others, it is not improbable that two such principles exist, although in a state of intimate intermixture, even in plants like *Fungi* and *Algæ*. The principal natural orders of Cryptogamic plants are *Ferns*, *Mosses*, *Equisetaceæ*, *Lycopodiaceæ*, *Characeæ*, *Hepaticæ*, *Lichens*, *Algæ*, and *Fungi*. In these orders we have the greatest variation in the organ of vegetation, some of the ferns forming trees 50 or 60

feet high, while many *Algæ* and *Fungi* are vesicular and microscopic. Among the latter, vegetable life approaches so nearly to that of animals that distinctions fail, and it is no longer possible to say that locomotion is the peculiar property of the one and fixation that of the other; for in numerous *Algæ* the seeds have an undoubted spontaneous power of motion in water until they begin their growth as young plants. Cryptogamic plants are connected with Gymnosperms through *Lycopodiaceæ* and *Equisetaceæ*, with Rhizanths through Fungi, and perhaps with Endogens by tree ferns; they do not appear to have any immediate relation to Exogens.

CRYPTO'GRAPHY. (Gr. κρυπτος, and γραφω, *I write*.) Also termed *Polygraphy* and *Steganography*. The art of writing in a manner intelligible only to those admitted into the secret of the method, either by conventional signs (cipher), or by other contrivances.

CRY'PTO PORTICUS. In Ancient Architecture, a concealed portico; also one that for coolness is enclosed on every side. Some of them were sunk some way into the ground.

CRY'STAL, *Crystallus*. (Gr. κρυσταλλος, *ice*.) This term was originally applied to those beautiful transparent varieties of silica, or quartz, known under the name of *rock crystal*. When substances pass from the fluid to the solid state, they frequently assume those regular forms which are generally termed crystals.

CRY'STALLINE LENS. The *lens* of the eye, placed in a depression upon the anterior part of the vitreous humour. *See* EYE.

CRY'STALLIZATION, *Crystallography*. (Gr. κρυσταλλος, *a crystal*, and γραφω, *I describe*.) The doctrine of the relation of crystalline forms, and of the origin and structure of crystals. Natural as well as artificial crystals occur in an infinite variety of forms; but they may generally be referred to some primary figure, of which these varieties may be regarded as modifications. The structure of crytallized bodies is most easily illustrated by reference to natural crystals, but the theory applies to all crystallized bodies; it assumes the existence of some definite primary figure, which by various truncations may be modified into its secondary forms.

The varieties of calcareous spar may be referred to as presenting one of the easiest illustrations of the mechanical texture of crystals, and of the modifications of which a definite primary figure is susceptible. Calcareous spar occurs in more than a hundred different forms, all of which, by careful mechanical division, are reducible to an *obtuse rhomboid*, whose faces are inclined to each other at angles of 105° 5′; this, therefore, is called the *primary form* of calcareous spar.

The *secondary forms* are presumed to be derived from the primary forms in consequence of *decrements* of particles taking place upon the edges, or angles, or both, of the primary form. Thus, if the primary form were a cube, it might be reduced to a secondary octahedron by decrements, or *truncations*, in the direction of the planes produced by the removal of its solid angles; and by a similar operation a primary octahedron might become a secondary cube.

The doctrine of the relations and conversions of these forms is, properly speaking, a branch of solid geometry; but its practical applications to chemistry have in fact rendered crystallography a subsidiary branch of those departments of science. By a careful examination of the forms and modifications and texture and fracture of crystals, the chemist and mineralogist are in many cases enabled to determine their nature or composition; and in some cases a strict examination of such forms may supersede analysis, or other more circuitous methods

When we attempt by cautious mechanical means to dissect a crystal, we find that it will only yield kindly and afford smooth surfaces when broken or divided in certain directions. A *cube* of fluor spar, for instance, will only give way under such circumstances in the direction of its solid angles or corners; and pursuing the division in such directions an octahedron will be the resulting figure; and each slice which is removed may be further divided into octahedra and tetrahedra. The new and smooth surfaces resulting from this division or *cleavage* of the crystal are called its *cleavage planes*, the line produced by the meeting of two planes is called the *edge* of the crystal, and the meeting of any two lines or edges forms a *plane angle*. A *solid angle* is produced by the meeting of three or more plane angles. Different crystallographers have assumed various primitive forms as the bases of their respective *systems of crystallization*. Hauy assumed six (*Traité de Mineralogie*); Mr. Brooke enumerates fifteen primary forms (*Familiar Introduction to Crystallography*); and almost each author upon this subject has adopted different views as regard the number of fundamental forms and the modes of derivation of secondary figures. In Germany the system of crystallography of Mohs is pretty generally adopted. (See Haidenger's Translation of *Mohs' Mineralogy*.) But any detailed account of these different systems and theories would be inconsistent with our present object. It may be observed, however, that the *theory* of crystallization is greatly simplified by assuming all secondary forms as resulting from the aggregation of primary spherical or spheroidical molecules. (See a paper on this subject by Dr. Wollaston, in the *Philosophical Transactions for* 1813; and Mr. Daniell's interesting confirmations of the hypothesis in the first volume of the *Quarterly Journal of Science and the Arts*.)

The process of crystallization is resorted to for many useful and important purposes in the chemical arts: it is the principal means by which various saline products are obtained in a state of purity; for, in the act of crystallization, they throw off foreign substances and acquire definite composition. It is thus, for instance, that nitre is purified for the manufacture of gunpowder; and that the common and other salts with which crude nitre is contaminated are got rid of, a *crystal* of nitre being of necessity a definite compound of 54 parts of nitric acid combined with 48 of potassa. Nitre furnishes an instance of what is termed an *anhydrous* crystal; it retains none of the water in which it had been dissolved, and from which it is deposited. There are, however, many salts, the crystals of which are *hydrous;* and in such cases the quantity of water which they contain always bears a certain definite quantitative relation to the elements of the salts. Sulphate of magnesia, for instance, or Epsom salt, forms prismatic crystals, which always contain 51·2 per cent. of *water of crystallization*: they are constituted of 20 parts of magnesia, 40 of sulphuric acid, and 63 of water.

CTE'NOBRA'NCHIATA. (Gr. κτις, *a comb*, and βραγχια, *gills*.) A name substituted by some naturalists for *Pectinibranchiata;* applied by Cuvier to that order of Gastropods which breathe by means of pectinated gills.

CTENOI'DES. (Gr. κτις, and ειδος, *form*.) A name given by Agassiz to one of his orders of fishes, characterized by scales composed of layers with pectinated or toothed posterior margins These combs overlapping one another give a rough feel to the skin: the scales are horny or bony, without enamel The Ctenoid order includes the following families.—*Chetodontes*, *Pleuronectes*, *Percoides*, *Polyacanthes*, *Scienoides*, *Sparoides*, *Scorpenoides*, *Aulastomes*.

CU'BATURE, is the measurement of the contents of a solid body, or finding a cube equal to it.

CUBE (Gr. κυβος, *a die*.) In Geometry, a solid body bounded by six equal squares. The cube is one of the five regular Platonic bodies, which, being placed beside each other, fill up the space about a point. It is also called the *hexaedron*, on account of its six sides. The *duplication* of the cube, or the finding of the side of a cube containing exactly twice as much matter as another given cube, was a celebrated problem among the geometers of antiquity, but which cannot be solved by means of the straight line and circle, the only lines which the ancients admitted into their geometrical constructions (*See* DUPLICATION OF THE CUBE.) In arithmetic, *cubes*, or *cubic numbers*, are numbers formed by the multiplication of any number into itself twice: thus 8 and 27 are cubes; the first being equal to $2 \times 2 \times 2$, and the second to $3 \times 3 \times 3$.

CU'BEBS. The berries of the *Piper cubeba*, or *Java pepper*. They have a bitter and aromatic flavour, and contain volatile oil and resin: they are stomachic, and given in a dose of from one to two drachms in powder, two or three times a day, have proved curative in certain forms of *gonorrhœa*.

CU'BIC EQUA'TION. In Algebra, is an equation which involves the *cube* or third power of the unknown quantity. Like equations of any other degree, cubic equations are either *pure* or *affected:* the pure containing only the cube of the unknown quantity; and the affected containing the square or simple power, or both, of that quantity. A pure cubic equation is of this form, $x^3 = a$, where $a$ is any number whatever, positive or negative, and the value of $x$ is found by extracting the cube root of the number $a$ by the usual arithmetical rule.

It might seem, at first sight, that the only value which $x$ can have in the equation $x^3 = a$ is $x = \sqrt[3]{a}$; but on further consideration it will be seen that there are two more values of $x$, or at least two other sets of symbols by which the value of $x$ may be represented, which equally satisfy the equation. On substituting $n^3$ for $a$, the equation becomes $x^3 = n^3$, or $x^3 - n^3 = o$; but $x^3 - n^3$ is resolvable into the two factors $(x - n) \times (x^2 + x\,n + n^2)$, therefore the equation is satisfied either by making $x - n = o$, or $x^2 + x\,n + n^2 = o$. The first gives $x = n$; and on solving the quadratic $x^2 + x\,n + n^2 = o$, the following values of $x$ result, namely, $x = \frac{1}{2}(-n + \sqrt{-3\,n^2}) = \frac{1}{2}\,n\,(-1 + \sqrt{-3})$, and $x = \frac{1}{2}\,(-n - \sqrt{-3\,n^2}) = \frac{1}{2}\,n\,(-1 - \sqrt{-3})$. The three roots of the equation $x^3 - n^3 = o$ are therefore $x = n$, $x = \frac{1}{2}\,n\,(-1 + \sqrt{-3})$, $x = \frac{1}{2}\,n\,(-1 - \sqrt{-3})$; and this conclusion is easily verified by raising each of these three expressions to the cube, or by multiplying all three together: in either case the result will be $n^3$. It may be remarked that the first expression only for $x$ is real, the two latter are imaginary,

A complete cubic equation has the form $x^3 + A\,x^2 + B\,x + C = o$, where A, B, and C denote known quantities, positive or negative. Now it is always possible, by assuming $x = y - \frac{1}{3}A$, to transform an equation of this form into another in which the second term shall be wanting, and which shall have the form $y^3 + a\,y + b = o$, the coefficients $a$ and $b$ of this last equation being also known, and depending on those of the former equation. If, therefore, we can succeed in finding the value or values of $y$ from this equation, those of $x$ will also become known in consequence of the equation $x = y - \frac{1}{3}A$.

In order to discover the roots of the equation $y^3 + a\,y + b = o$, suppose $y$ to be composed of two parts, $u$ and $v$, or assume $y = u + v$. The equation then becomes by substitution,

$$\left.\begin{array}{r} u^3 + 3\,u^2\,v + 3\,u\,v^2 + v^3 \\ + a\,u + a\,v \\ + b \end{array}\right\} = o;$$

which, as it contains two indeterminate quantities, may be divided into any two parts at pleasure. Let it be resolved into the two,

$$u^3 + v^3 + b = o,$$
$$3\,u^2\,v + 3\,u\,v^2 + a\,u + a\,v = o.$$

The last of these is the same as

$$(3\,u\,v + a)\,(u + v) = o,$$

which may be satisfied either by making $u + v = o$, or $3\,u\,v + a = o$. But the supposition that $u + v = o$ is inadmissible, since $u + v = y$, for if we suppose $y = o$, then on account of the original equation, $y^3 + a\,y + b = o$, it would be necessary to suppose also $b = o$, which is inconsistent with the hypothesis. To determine $u$ and $v$, therefore, we have only the two equations,

$$u^3 + v^3 + b = o, \quad 3\,u\,v + a = o;$$

the first of which gives $u^3 + v^3 = -b$, and the second $u\,v = \frac{1}{3}a$, whence $u^3\,v^3 = \frac{1}{27}a^3$. On substituting in the first of these two last equations the value of $v^3$ deduced from the second, we find $u^3 + \frac{a^3}{27\,u^3} = -b$, from which $u^3$ is obtained by the solution of a quadratic. The solution gives $u^3 = -\frac{1}{2}b + \sqrt{\frac{1}{27}a^3 + \frac{1}{4}b^2}$, whence, and from the equation $u^3 + v^3 = -b$, $u^3 = -\frac{1}{2}b + \sqrt{\frac{1}{27}a^3 + \frac{1}{4}b^2}$, $v^3 = -\frac{1}{2}b - \sqrt{\frac{1}{27}a^3 + \frac{1}{4}b^2}$, $u = \sqrt[3]{-\frac{1}{2}b + \sqrt{\frac{1}{27}a^3 + \frac{1}{4}b^2}}$, $v = \sqrt[3]{-\frac{1}{2}b - \sqrt{\frac{1}{27}a^3 + \frac{1}{4}b^2}}$, but $y = u + v$, therefore

$$y = \sqrt[3]{-\tfrac{1}{2}b + \sqrt{\tfrac{1}{27}a^3 + \tfrac{1}{4}b^2}} + \sqrt[3]{-\tfrac{1}{2}b - \sqrt{\tfrac{1}{27}a^3 + \tfrac{1}{4}b^2}}$$

Having obtained a value of $y$ in terms of $a$ and $b$, which satisfies the equation $y^3 + a\,y + b = o$, that equation is resolved, but, as in the case of pure cubic equations, two other values of $y$ may be found, each of which also satisfies the equation. For the sake of abridging, let $P = -\frac{1}{2}b + \sqrt{\frac{1}{27}a^3 + \frac{1}{4}b^2}$, $Q = -\frac{1}{2}b - \sqrt{\frac{1}{27}a^3 + \frac{1}{4}b^2}$, and let also $p = \frac{1}{2}(-1 + \sqrt{-3})$, $q = \frac{1}{2}(-1 - \sqrt{-3})$, then $u^3 = P$, and $v^3 = Q$, and in consequence of what was shown above $u$ and $v$ have each these three values.

$$u = \sqrt[3]{P}, \quad u = p\sqrt[3]{P}, \quad u = q\sqrt[3]{P}, \qquad (m)$$
$$v = \sqrt[3]{Q}, \quad v = p\sqrt[3]{Q}, \quad v = q\sqrt[3]{Q}. \qquad (n)$$

To determine in what manner these equations must be combined in order to give the corresponding values of $y$ $(= u + v)$, we must recollect that $u\,v = \frac{1}{3}a$, but $P\,Q = \frac{1}{27}a^3$, or $\sqrt[3]{P\,Q} = \frac{1}{3}a$, therefore $u\,v = \sqrt[3]{P\,Q}$. But it is obvious that $p\,q = 1$, in order therefore to preserve these relations, we must combine the first of the equations $(m)$ with the first of $(n)$, the second of $(m)$ with the third of $(n)$, and the third of $(m)$ with the second of $(n)$. Hence the three values of $u + v$, or $y$, are $y = \sqrt[3]{P} + \sqrt[3]{Q}$, $y = p\sqrt[3]{P} + q\sqrt[3]{Q}$, $y = q\sqrt[3]{P} + p\sqrt[3]{Q}$.

The first of these three formulæ was invented by Nicholas Tartalea and Scipio Ferreus independently about the same time; but having been first published by Cardan, is generally known by the name of *Cardan's Rule*.

In applying the above formula for the resolution of a cubic equation, it is necessary to extract the square root of the quantity $\frac{1}{27}a^3 + \frac{1}{4}b^2$. Now, as $a$ and $b$ may have any values whatever, if it happen that $a$ is negative, and such that $\frac{1}{27}a^3$ is greater than $\frac{1}{4}b^2$, the quantity $\frac{1}{27}a^3 + \frac{1}{4}b^2$ becomes negative, and the extraction of its square root impossible. This circumstance gives rise to what is termed the *irreducible case*, and long continued to puzzle algebraists, the three roots of the equation appearing all under an imaginary form. It has been found, however, from a more profound analysis of the nature of equations, that in this case (that is, when $a$ is negative, and $\frac{1}{27}a^3$ greater than $\frac{1}{4}b^2$) all the three roots are real, notwithstanding their imaginary form. In fact, every equation of the third degree must have at least *one* real root. when the irreducible case occurs, *all* the roots are real; in the other case, one root is real, and the other two imaginary.





CUBI'CULUM. (Lat.) In Ancient Architecture, strictly a bed room; but with the Romans applied in a more extended sense to the balcon or tent provided to cover the emperors at the public shows.

CU'BIT (Lat. cubitus) In Architecture and Sculpture, a linear measure of the ancients, equal to the length of the arm from the elbow to the extremity of the middle finger, usually considered about eighteen English inches. The geometrical cubit of Vitruvius was equal to six ordinary cubits.

CU'BITUS. The fore arm; the larger bone of which is called the *os cubiti*. This term is said to be derived from cubo, *I lie down*, from the ancient custom of leaning on that part of the arm when in the recumbent posture at meals.

CU'CULINÆ. A name given by Latreille to a family of bees, distinguished by the absence of the femoral plates for transporting pollen, and which are consequently compelled to resort to the combs of other bees in order to deposit their eggs. hence they may be regarded, like the cuckoo, as a kind of parasite.

CU'CULUS. (Lat cuculus, *a cuckoo*.) A most interesting genus of Passerine birds, belonging to that group which is characterized by having the toes situated two before and two behind (*Zygodactyli*); and so named from including as the typical species the common European cuckoo (*Cuculus canorus*). The cuckoo is a migratory bird, it arrives in England in the month of April for the purpose of breeding. It differs from almost every other bird in not constructing a nest, nor under any circumstances hatching its own eggs, but deposits them in the nests of other birds, as the hedge-sparrow. The unfledged young have a remarkable instinct, which impels them to increasing efforts to expel their helpless companions from the nest, which they effect by pushing them in the hollow of their back to the verge of the nest, and tilting them over, until they at length monopolize all the care and provision of the foster-parent. The young cuckoos of the year do not leave this country till the month of September.

CUCU'RBITA'CEÆ (Cucurbita, one of the genera.) A natural order of Exogens, inhabiting the hot countries of both hemispheres. They are placed by Auguste de St Hilaire and De Candolle between *Myrtaceæ*, to which they appear to have little affinity, and *Passifloraceæ*, to which they are so closely allied that they differ only in the sinuous stamens, unisexual flowers, inferior fruit, and exalbuminous seeds. St Hilaire also insists upon their affinity with *Onagraceæ*, with which, including *Combretaceæ*, they agree in some respects. The order is one of the most useful in the vegetable kingdom, comprehending the melon, the choco, and the various species of gourd; all valuable as the food of man. Colocynth is the pulp of *Cucumis colocynthis*, which is so drastic as to be classed by Orfila among his poisons. The root of *Bryonia* possesses a powerful purgative property, but is said to become wholesome if properly cooked, and the perennial roots of all the order appear to contain similar bitter drastic virtues especially of the *Momordica elaterium*, which has an active poisonous principle called *elatine*.

CUIRA'SS. (Fr cuir, *leather*.) A covering for the breast, originally, as the name denotes, of leather, also of quilted linen, cloth, &c. The cuirass of plate-armour succeeded the hauberk, hacqueton, &c. of mail, about the reign of Edward III, and from that period the surcoat, jupon, &c, which were usually worn over the coat of mail, began to be laid aside. From that period the cuirass or breast-plate continued to be worn, and was the last piece of defensive armour laid aside in actual warfare. There were cuirassiers in the English civil wars, and in the French service nearly to the end of the 17th century: after this period, the cuirass was generally laid aside, until it was again employed by some of Napoleon's regiments, and it is now, in most services, worn by some regiments of heavy cavalry.

CUISSES, CUISSOTS, CUISSARTS, &c. In Plate Armour, the pieces which protected the front of the thigh.

CULDE'ES. A religious order, whose origin is attributed to St. Columba, an Irish monk of the 6th century, who evangelized the western parts of Scotland, and founded a famed monastery in Iona. The word is probably contracted from *cultores Dei*. See *Jamieson's Hist.*

CU'LEX. (Lat. *a gnat*.) A Linnæan genus of insects, having the common gnat (*Culex pipiens*, L.) for its type, but now raised to the rank of a family (*Culicidæ*), including the genera *Megarhina*, *Sabethes*, *Œdes*, *Anopheles*, and *Culex* proper: the two latter are British.

CU'LINARY VEGETABLES. Plants cultivated in gardens, and sometimes in fields for culinary purposes. They may be classed as—leaf plants, such as the cabbage tribe, spinaceous plants, salads, pot and sweet herbs; stalk plants, such as asparagus, tart rhubarb, sea kale, &c.; roots, such as the turnip, carrot, potato, &c; seeds, such as the pea and bean; fruit, such as the cucumber, gourd, &c; and the entire plants, such as the onion, leek, mushroom, &c. They may be otherwise arranged as—the

cabbage family; the leguminous family; esculent roots; spinaceous plants; aliaceous plants; asparaginous plants; acetarious plants; pot herbs, sweet herbs, plants used in tarts and confectionary, and edible fungi.

CULI'NUS. A term introduced by Linnæus to denote the stem of *Gramınaceæ*, which has a peculiar organization. The term is now used by few writers.

CU'LLET. The term given to broken glass brought to the glass house for the purpose of being melted up with fresh materials.

CULM. A provincial synonym of *anthracite* Mineral carbon, glance coal, columnar coal, are terms also applied to this species of coal, of which Kilkenny coal furnishes an example.

Culm. In Agriculture, the stem of grasses.

CULMINA'TION. (Lat. culmen, *the top*) The passage of a celestial body over the meridian, or the highest point of its diurnal circle.

CULTIVA'TOR. An implement of the horse-hoe kind, chiefly used in working fallows. It consists of a frame, sometimes of wood and sometimes of iron, into which a number of coulters, or tines, are introduced; which, when the instrument is drawn along lands already ploughed, penetrate to the bottom of the furrow, and thoroughly pulverize the soil. One of the best of these implements for using on a large scale is Finlayson's harrow; but it requires six horses to work it properly On a small scale, and for working with two horses between rows of plants, Wilkie's grubber is an excellent implement; as is that known as Kirkwood's cultivator.

CU'LTRATE. (Lat. culter, *a ploughshare*.) Coulter-shaped, as when a body is straight on one side and curved on the other

CU'LVERT. An arched channel of masonry built beneath the bed of a canal, for the purpose of conducting water under the canal. If the water to be conveyed has nearly the same level as the canal, the culvert is built in the form of an inverted siphon, and acts on the principle of a water pipe. This word also signifies any arched channel for water under ground

CU'LVERIN. A cannon equal to an 18-pounder; a *demy-culverin* is a 9-pounder.

CU'MIN SEED The seed or fruit of the *Cuminum cyminum*. It is imported from Sicily and Malta It forms an ingredient in *curry powder*, and in some kinds of cheese, it has also been used medicinally, but is unimportant. It has a very peculiar odour, and a bitter and aromatic taste. In poultices and plaisters, it is supposed to promote the dispersion of indolent tumours Some of the Roman poets allude to its power of producing pallor and languor.

CU'NEATE. (Lat. cuneus, *a wedge*.) An animal or part is so called which has the longitudinal diameter exceeding the transverse, and narrowing gradually downwards.

CU'NEIFORM LETTERS, called *Keilschriften* by the Germans. (Lat cuneus, *a wedge*.) The name given to the inscriptions found on old Babylonian and Persian monuments, from the characters being formed like a wedge. This species of writing, as it is the simplest, so it is the most ancient of which we have any knowledge; and though it is difficult to say by whom or in what country it was invented, its use was common to the Medes, Persians, and Assyrians, at the most remote periods of their history. It should seem, however, that the peculiarity of its form caused it to be employed, like the hieratic character of the Egyptians, chiefly in monumental inscriptions, there being another mode of writing in use better calculated for ordinary purposes; and Mr. Rich conjectures that it fell into disuse soon after Alexander's conquest of Persia, when neither the Persians nor the Babylonians had any monuments to erect or events to record. The native princes, says that ingenious traveller, who wrested the throne of Persia from his feeble successors, adopted the Greek language and character in their coins and inscriptions; and all recollection of the cuneiform writing must have perished during the long period in which they held the sceptre of Iran.

About eighty years ago, a few specimens of inscriptions existing at Persepolis having found their way into Europe, the attention of the learned was directed to the subject; and many German philologists, at the head of whom was the celebrated Tychsen, applied themselves to the task of deciphering and translating these inscriptions with an unrivalled energy and enthusiasm. It was not, however, till the commencement of the present century, when Dr. Grotefend of Hanover engaged in the pursuit, that the mystery in which this species of writing had for so many centuries been involved began to be cleared up, and the foundation laid of a more satisfactory and philosophical mode of explication. As might be expected on a subject on which so much wing may be given to the imagination, the most diverse and extraordinary theories have been propounded respecting it, many of them supported by ingenious reasonings, and displaying great learning and research; but as the general opinion inclines to regard Dr. Grotefend's theory as based on the most solid foundation, and as the most likely to lead to important results, we shall limit ourselves to giving a brief summary of his views. According to him this mode of writing is formed of two radical signs,—the wedge and the angle,—susceptible, however, of about thirty different combinations; and consists of three varieties, distinguished from each other by a greater or less complication of the characters. It is of Asiatic origin; is written from right to left, like the Sanscrit; differs from the ancient Egyptian hieroglyphics, inasmuch as it is alphabetic, not ideographic; and, finally, with a few considerable modifications, forms the basis of most of the Eastern languages The views of Dr. Grotefend received striking confirmation from the researches of Mr. Rich, whose valuable Memoirs, enriched at they are with numerous inscriptions found at Babylon and Persepolis, cannot fail to give considerable impulse to the prosecution of this intricate study. A full exposition of this species of writing would prove one of the most valuable accessions to modern literature, as it would throw a flood of light upon many points of the manners, customs, and civil polity of many Eastern nations now enveloped in the most profound obscurity, and rescue their ancient history from the gross fictions by which it is disfigured in the modern literature of Persia. But apart from the collateral benefits which have flowed from the prosecution of this study, the only direct results by which it was long followed may be stated to be the translation of a few minor inscriptions, and the establishment of a canon so extremely arbitrary, that it was very problematical if the labours of others in the same field could be materially benefited by it To those who read the paper of Dr. Grotefend addressed to the university of Gottingen twelve years ago, in which all that had been done on the subject is exhibited with much perspicuity, it must have been a matter of painful regret to observe that the immense amount of labour and learning expended upon it had been attended by such incommensurate results. But within the last few years a new impetus has been given to the prosecution of this study by the numerous facts brought to light through the intrepidity of Botta, Rawlinson, and Layard on the spot, and we cordially re-echo the opinion expressed by Dr. Layard, that the materials for inquiry now collected are quite sufficient to warrant the hope of future success. (The reader will find in Dr Layard's interesting work, *Nineveh and its Remains*, vol. ii pp. 153—236, a full account of the most recent investigations into this subject, with the results thereof.)

CU'NONIA'CEÆ. (Cunonia, one of the genera) A natural order of arborescent or shrubby Exogens, inhabiting South America and the East Indies; allied so very intimately to *Saxifragaceæ*, that they are only distinguished by their arborescent habit and interpetiolar stipules. The bark of some species is used for tanning leather

CU'PEL A shallow earthen vessel, somewhat of a *cup* shape, generally made of bone earth. It is used in the assays of the precious metals, which are fused upon a cupel with lead. Cupellation means the refining of gold or silver upon a *cupel*.

CU'PID (Lat Cupido.) The Roman name of the Grecian god of love Eros ("Ερως). There were three divinities, or rather three forms of the same deity, with this appellation (*Cic de Nat. Deor*. 3. 23.); but the one usually meant when spoken of without any qualification was the son of Mercury and Venus. Like the rest of the gods, Cupid assumed different shapes; but he is generally represented as a beautiful child with wings, blind, and carrying a bow and quiver of arrows, with which he transpierced the hearts of lovers, inflaming them with desire. Among the ancients he was worshipped with the same solemnity as his mother Venus; his influence pervaded all creation, animate and inanimate; and vows and sacrifices were daily offered up at his shrine. Statues of Cupid formed among the ancients great objects of *vertu*. Praxiteles is said to have derived great honour from his statues of this divinity; and in his orations against Verres, Cicero has given celebrity to one statue of Cupid by this artist, which formed an object of peculiar veneration to the Thespians.

CU'POLA. (It.) In Architecture. *See* Dome.

CU'PPING. (From the *cup shape* of the glasses used in its performance) In this operation a cup-shaped glass is used, into which the large flame of a spirit lamp is momentarily introduced, so as to expel a great part of its air by dilatation; it is then instantly applied to some part of the body, which is forced into it by the external pressure; and on removing the glass a circular red mark is left, from the propulsion of the blood in the small vessels of the part: this is called *dry cupping*. It is generally followed up by making a number of incisions in the part by means of an instrument called a *scarificator*, from which the blood oozes, and from which a considerable portion may be drawn by again applying the cupping glass. Cupping, when well performed, is not a very painful or disagreeable operation, and is an excellent mode of local

blood-letting. When the operator is not dexterous, it is not only painful, but often dangerous in its consequences. The bleeding may generally be easily stopped by a piece of lint or soft rag; but this should be looked after, as instances have occurred of persons bleeding to death from the wounds of a scarificator.

CUPULI'FERÆ. (Lat cupa, *a cup.*) A natural order of arborescent or shrubby Exogenous plants, inhabiting all temperate and some hot climates. They are distinguished by their amentaceous flowers and peculiarly veined leaves from all European trees; and from other plants by their apetalous superior rudimentary calyx, fruit enclosed in a husk or cup; and by their nuts, which contain but one cell and one or two seeds, in consequence of the abortion of the remainder. These plants are akin to *Betulaceæ* and *Salicaceæ*, from which they are distinguished by the presence of a calyx and the veining of the leaves. They are nearly allied to *Urticaceæ;* but differ in their many-celled ovary, pendulous ovules, and superior calyx. This order comprehends the oak, hazel, beech, chestnut, and hornbeam,—well known valuable forest trees.

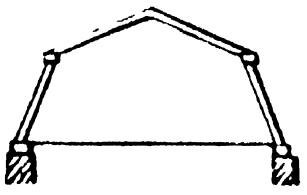
CURACO'A. A liqueur which derives its name from the island of Curacoa: it is prepared in great perfection by the Dutch. It derives its flavour from Seville orange peel, with a small quantity of cinnamon and mace.

CURASSOW. *See* CRAX.

CU'RATE. (Lat curare, *to take care.*) Properly an incumbent who has the cure of souls, now generally restricted to signify the spiritual assistant of a rector or vicar in his cure Curates form the lowest order of the clergy; and are divided into two classes, perpetual and stipendiary. "Perpetual curates are such as are appointed to the churches of those parishes in which the tithes were appropriated to some monastery before the statue 4 H. 4. making it necessary to endow a vicar, or which had from some cause or other escaped its operation," or they are such as officiate in some chapel: in either of which cases, their salary is usually paid by some fixed payment, or by a portion of the tithes appropriated for their maintenance at the foundation of the chapel Stipendiary curates are such as are appointed by the vicar or rector to officiate at their churches in their stead The salary of stipendiary curates is defrayed by the party who appoints them, and by the 57 Geo 3 c 90 it must in no case be under 90*l.*; and where the population of the parish amounts to 500, with certain restrictions, 150*l* (See *M'Culloch's Stat. Brit. Empire*, vol ii 280 2d ed)

CURA'TOR (Lat), in a general sense, signifies a person who is appointed to take care of any thing Among the ancient Romans, there were officers in every branch of the public service to whom this appellation was given. thus we read of *Curatores frumenti, viarum, operum publicorum, Tiberis*, &c. &c, *i.e.* persons who distributed corn, superintended the making of roads and the public buildings, or were conservators of the river — Curator, in the Civil Law, is the guardian of a minor who has attained the age of fourteen Before that age, minors are under a tutor The guardianship of persons under various disabilities, and of the estate of deceased or absent persons and insolvents, is also committed to a *curator*. This title is derived from the ancient Romans, by whom, as was remarked above, it was given to various officers who acted as superintendents of different departments of the public service. In learned institutions, the officer who has charge of libraries, collections of natural history, &c is frequently styled curator.

CURB ROOF. (Fr. courber, *to bend*) In Architecture, a roof in which the rafters, instead of continuing straight down from the ridge to the walls, are at a given height received on plates, which in their turn are supported by rafters less inclined to the horizon, whose bearing is, through the medium of the wall-plate, directly on the walls. It presents a bent appearance, as in the diagram, whence it derives its name.



CURCU'LIO. (Lat curculio, *a weevil.*) A Linnæan genus of Coleopterous insects, now the type of an extensive family, — *Curculionidæ*, or weevils belonging to the Tetramerous section of the order. The prolongation of the anterior part of the head, in the form of a proboscis or snout, at once distinguishes the insects of the present family from all other beetles. The number of the *Curculionidæ* may be imagined when it is stated that entomologists have found it necessary to distribute them into nearly three hundred subgenera. They are all vegetable feeders, and include some of the most dangerous enemies to the vegetable stores of mankind.

CU'RFEW. (From the French couvre-feu, in modern Latin ignitegium) The practice of tolling the church bell at eight or some other hour in the evening, to warn people to extinguish their fires, was a very common one in the middle ages. It is difficult to say on what foundation the common tradition, that William the Conqueror introduced it from Normandy to prevent the English from assembling in the evening to plan schemes of rebellion, rests. Lord Lyttleton, in his *Life of Henry II.*, discusses the question. It is more probable that the Conqueror enforced a very common police regulation. The real reason of the curfew was to prevent fires. The custom of ringing the evening or curfew bell is still retained in many places. (See *Brand's Popular Antiquities*, vol. ii. p. 136, 137.)

CU'RIA. (Lat.) In Ancient Architecture, a court, council, or senate house.

CU'RIES, *Curiæ.* A subdivision of the Roman patrician tribes, each of which were divided into ten *curiæ*. Three *curiæ* probably contained originally ten houses (*gentes*) each. These houses were similar to the Scottish clans, in which, though the bond of union was supposed to be that of common blood, yet in reality there was no consanguinity between many of the component families.

CURL. A disease in potatoes, in which the leaves on their first appearance appear curled and shrunk up; and consequently, as they do not present a sufficient surface to the light to elaborate the sap in a sufficient manner for carrying on the growth of the plant, it never acquires strength, and either dies, or produces very imperfect tubers. The cause of the disease in the first instance is generally supposed to be the unhealthy state of the set; but something also may be owing to bad management and improper soil.

CU'RRANT. The fruit of two species of *Ribes;* namely, *R. rubrum*, which furnishes the common red and white currants; and the *R. nigrum*, which produces the black currant. The currants of the grocers' shops are the dried berries of a small species of grape cultivated in Zante, Cephaloma, and Ithaca; and in the Morea in the vicinity of Patras. Notwithstanding the heavy duty of 15*s* per cwt with which this commodity is burdened, they are largely imported into the British empire. The entries of currants for home consumption amounted at an average of the two years ending 1850 to 419,846 cwt., producing an annual revenue of 330,241*l.*

CU'RRENCY. (Lat. curro, *I run.*) In Political Economy, a term sometimes used to express the collective amount of the money, and of the bills, cheques, and other substitutes for money, employed in selling or buying, or in the distribution of commodities and services among the different ranks and orders of the community.

CU'RRENT (Lat. curro.), denotes in its most general sense the progressive movement of any object; but it is applied chiefly to the progressive movement of fluids, especially of air, electricity, and water.

Currents in the ocean arise from various causes, either occasional or constant. They may be occasioned by an external impulsion, for example a gale of wind; from a difference in the temperature of different parts of the sea, from the inequality of evaporation, the melting of the polar ice, or in short any cause tending to disturb the hydrostatic equilibrium It is difficult in many cases to trace their causes, or to give any satisfactory theory of their existence; but on account of their importance to navigation they have been observed, especially of late years, with great care Among those which have a permanent or general character, there are two which are very remarkable. The first is that of the tropical waters westward round the globe, and the second that which constantly flows from each pole towards the equator. The tropical or westerly current is chiefly confined within the zone extending to about 30° on each side of the equator, and its velocity is estimated by Humboldt at about nine or ten miles a day. In the Atlantic it separates into two branches: one of which forms the *gulf stream*, and the other flows along the coast of Brazil, and passes through the Straits of Magellan. The gulf stream flows northward through the middle of the Atlantic, till it reaches the Cape Verd Islands; it then passes through the Caribbean Sea, between Cuba and the peninsula of Yucatan, sweeps round the Gulf of Mexico, and rushes out by the Bahama Channel; then, spreading out to a greater breadth, it continues its course along the shores of the United States to Newfoundland, where it is deflected eastward by a current setting in from Baffin's Bay, and, passing the Azores and Canary Islands, returns in a great measure into itself. Its breadth is 51 leagues in the Bahama Channel, and velocity from 3 to 5 miles an hour. (*Murray's Geography*, p. 186.) The polar currents flow constantly from the poles towards the equator, though it is evident that their sources must be supplied by currents in a contrary direction. Their existence is proved by the great masses of ice which are carried every year from the polar seas to tropical latitudes. Oceanic currents, by carrying with them the temperature of the regions whence they flow, contribute in no small degree to modify the temperature of the atmosphere, and give a character to the climate of the countries to which they are contiguous On the parallel of New York Humboldt found the temperature of the gulf stream 72° of Fahrenheit, while out of the current the heat of the ocean at the surface was only 63°. The current which flows

along the eastern coast of Africa, and doubles the Cape of Good Hope in a stream 130 miles broad, is from 7° to 8° warmer than the contiguous sea. The existence of *under currents* in the ocean is suspected rather than proved. For currents in the atmosphere, *see* WINDS.

CU'RRYING. (Fr. corroyer.) The art of dressing skins after they are tanned, for the purposes of the shoemaker, saddler, and harness-maker, &c.; or of giving them the necessary smoothness, lustre, colour, and suppleness. The operation of currying is performed in two ways; either upon the flesh, or on the hair, or, as it is technically called, the *grain*, and consists chiefly of four processes, which require great experience and dexterity. The reader will find in Dr. Ure's *Dictionary of Arts, &c.* a full account of this curious operation, accompanied by a wood cut illustrative of the singular tools and manipulations which it requires.

CU'RSITORS. (Lat. curro, *I run.*) Officers in the Court of Chancery, whose duty it is to make out original writs. They are called also clerks of the course (clerici de cursu); and are 24 in number, forming a peculiar corporation. Cursitor Baron is the name of an officer in the Court of Exchequer, who administers the oath to all high sheriffs, under sheriffs, bailiffs, and all the functionaries of the customs.

CURTAIL STEP. (Lat. curtus, *short*.) The lower step in a flight of stairs ending at its outer extremity in a scroll. Perhaps taking its name from the step curling round like a cur's tail.

CURTA'NA. The sword (as it is called) of Edward the Confessor, which has its edge blunted as an emblem of Mercy. It is carried between the swords of justice temporal and justice spiritual; and borne before the kings of England at their coronation.

CU'RTATE DISTANCE. A term employed in astronomy to denote a planet's distance from the sun reduced to the plane of the ecliptic. The curtate (or shortened) distance is therefore equal to the true distance multiplied by the cosine of the planet's heliocentric latitude.

CU'RTESY or COURTESY OF ENGLAND, in Law, is the right of a husband who has married a wife seised in fee simple or fee tail general, or heiress in special tail, and has issue male or female born alive, and which by possibility may inherit, to hold her lands after her death for his life. (*See* MARRIAGE LAW OF.) Thus, four things are said to be necessary to give an estate by the curtesy,—marriage, seisin of the wife, issue, and death of the wife.

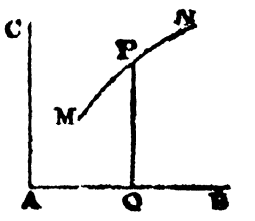
CU'RULE MAGISTRACIES, in Ancient History, were those of the greatest dignity in the Roman state, and were distinguished from all others by the privilege enjoyed by the persons who held them of sitting on ivory chairs (*sellæ curules*) when engaged in their public functions. The curule magistrates were the consuls, prætors, censors, and chief ædiles; which last, on account of this privilege, were called curule ædiles, to distinguish them from the plebeian.

CU'RVATURE. The continual flexure or bending of a line from the rectilinear direction. The curvature of a circle is greater in proportion as the radius is smaller, and the curvature of any other curve at a given point is measured by comparing it with a circle which *osculates* it, or forms with it a contact of a particular kind at that point. (*See* OSCULATING CIRCLE, and RADIUS OF CURVATURE.) The determination of the curvature of curve lines requires the aid of the differential calculus.

CURVE. In Analytical Geometry, a line of which no three consecutive points are in the same direction or straight line. The general theory of curve lines, and of the figures bounded by them, forms an extensive and important part of mathematical science, and in fact properly constitutes what is called the high or transcendent geometry. It will easily be understood, however, that the curves which form the object of geometrical speculation are those only of which the succession of points observes a regular law, capable of being expressed by a mathematical formula; not those which are formed irregularly by the hand, for example, like letters in writing.

Although the ancient geometricians had bestowed some attention on the subject of curve lines, and in addition to the conic sections had investigated some of the properties of a few other curves, as the cissoid, the conchoid, particular kinds of spirals, and perhaps others whose names may have been forgotten; yet their researches had only led them to the knowledge of a small number of particular propositions deduced from a laborious consideration of the circumstances of each individual case, and not admitting of extended application. The general methods of investigation which the modern geometer can apply with so much greater advantage are owing to the progress of algebra, and the happy invention by Descartes of the method of defining curves by algebraic equations.

Let M N be a curve, and A B, A C two straight lines in the same plane, to which all its points are referred; then A B and A C are the axes of the curve. Take a point P in the curve, and draw P Q parallel to A C; the line A Q is called the abscissa of the point P, and is denoted by $x$; and P Q the ordinate, and denoted by $y$. Now if for any given value of A Q a corresponding value of P Q can be assigned, that is, if P Q can be expressed in terms of A Q and known quantities, that expression is called the equation of the curve, and all its properties can be thence deduced by means of algebraic transformations without any reference to the diagram.




The first use of this method of defining curve lines by means of an equation between the abscissa and ordinate is to enable us to divide them into classes, of which all the individuals have some properties in common. Descartes divided them into two great classes,—*geometrical* and *mechanical*. It is now usual to indicate the same distinctions by the terms *algebraic* and *transcendental*. Algebraic curves are those in which the relation between the abscissa and the ordinate is expressed by an algebraic equation: transcendental curves are those in which the relation between $x$ and $y$ is not expressed by an algebraic, but by a differential equation; that is, by an equation between $dx$ and $dy$. There is still a class which may be regarded as intermediate between these two, namely, *exponential* curves, or those in the equation of which one or both of the unknown quantities enters as an exponent. Such, for example, is the equation $y = a^x$.

In order to form an idea of a curve of which the equation is given, it is necessary to suppose the equation resolved; that is to say, that the value of $y$ is found in terms of $x$ and given numbers. This being found, we take all the positive values of $x$ from 0 to + infinity, and also all the negative values to − infinity. The corresponding ordinates or values of $y$ will give all the points of the curve, the positive ordinates being taken on one side of the axis of the abscissa, and the negative on the opposite side.

Algebraic curves are divided into different classes or orders, according to the degree of the equation which expresses the relation between their co-ordinates. Straight lines are denominated lines of the *first order*, because the equation of a straight line being of the form $0 = A + Bx + Cy$, is only of one dimension, that is to say, it contains no powers or products of the variables $x$ and $y$. Lines of the second order are those of which the equation rises to two dimensions. The general form of this equation is,

$$0 = A + Bx + Cy + Dx^2 + Exy + Fy^2;$$

and the curves which it includes are the conic sections; that is, the circle, the ellipse, the hyperbola, and the parabola. These curve lines are the simplest of all, because lines of the first order are not curves, hence they are sometimes called *curves of the first order*. Following out the analogy, lines of the *third*, or those whose equation rises to the third degree, are *curves of the second order*, and so on.

The dimension of the equation of a curve line is not altered by changing the origin or position of its co-ordinates, or in making any transformation of its axes. It follows, therefore that a line of the $n$th order can never be intersected by a straight line in more than $n$ points, because the ordinates can never have more than $n$ real values. This follows from the general theory of equations, and in fact all the properties of any curve line being deducible from its equation, a complete theory of algebraic equations of any degree includes the theory of lines of that order. In this way it is proved that all lines of any order of which the number is uneven have necessarily at least two infinite branches, for in this case one at least of the co-ordinates is raised to an uneven power in the equation — for example, the 3d, the 5th, &c.; and therefore will have at least one real value, whatever value (which may be increased *in infinitum*, positively and negatively) may be given to the other co-ordinate.

We have mentioned that the lines of the second order include only the circle and the conic sections. Newton, in his *Enumeratio Linearum Tertii Ordinis*, reckons 72 *species* of lines of the third order, or curves of the 2d degree. As the order is more elevated the number of *genera* and species becomes more numerous. The subdivisions into genera and species are, however, founded on some arbitrary properties, and consequently are not made uniformly by different authors. Cramer, in his *Analyse des Lignes Courbes*, found fourteen different genera of curves of the third order; and Euler (*Introductio in Analysin Infinitorum*) sixteen. The whole number of curves [illegible] to this order has been supposed to amount to some thousands.

*Curves of Double Curvature.*—Hitherto we have spoken only of curves on a plane; but if they are traced on surfaces which are not plane, they will have a double curvature; that which belongs to the line itself, and that of the surface on which it is traced. In order to investigate the properties of a curve of this sort, it must be supposed to be projected on two different planes perpendicular to each other, the projections will be two ordinary curves having a common axis and different ordinates. One of these curves will be defined by an equation between $x$ and $y$, and the other by an equation between $x$ and $z$; so that the

equation of a curve of double curvature is composed of two equations, each containing two variables, of which one is common to both equations, and taken on the line of intersection of the two planes of projection.

*Curve Surfaces.* — A curve surface is represented algebraically by an equation containing three variables, for example, $x$, $y$, and $z$. It is geometrical when its equation is algebraic, and expressed in finite terms; and mechanical when the equation is differential, and not algebraic. Curve surfaces are also classed according to the dimensions of the variables in their equations. When the variables are only of the second degree, the surfaces are of the second order; when the variable co-ordinates rise to the third degree, they are surfaces of the third order, and so on.

The most complete treatise on the theory of curve lines is that of Cramer, *Introduction à l'Analyse des Lignes Courbes;* but more or less on the subject is contained in every work treating of the application of algebra to geometry. For curve surfaces, and curves of double curvature, the student may consult Lacroix's large work, *Traité du Calcul Differentiel et du Calcul Integral*, or the *Application de l'Analyse a la Géométrie* of Monge.

CUSCUTA'CEÆ (Cuscuta, one of the genera.) A very small natural order of Exogens, consisting of but one genus, inhabiting all the quarters of the globe, and related to *Convolvulaceæ;* but distinguished by the imbricate corolla, which does not fall off after flowering, the spiral embryo, and the parasitical habit. Common dodder, a curious thread-like twining plant, found on heaths, belongs to the order.

CUSP (Lat. cuspis, *point*.) In Astronomy, expresses the points or horns of the moon. In geometry the word is used to denote the point or corner formed by two parts of a curve meeting and terminating there.

CUSP. In Architecture, a term applied by Sir James Hall, in his *Origin of Gothic Architecture*, to the spear-shaped ornaments appended to the several points of trefoil, quatrefoil, &c. arches, but this term, it is to be observed, has not been generally adopted by architects.

CUSPA'RIA BARK. *See* ANGUSTURA.

CU'SPIDATE (Lat. cuspis.) In Botany, a term used in describing the apex of a body, when it gradually tapers into a rigid point. It is also used sometimes to express abruptly acuminate, as the leaf of many *hubi*.

CU'STARD APPLE. A term applied in the West Indies to the fruit of the *Anona reticulata*.

CU'STOM (Fr. coutume), in Law, signifies generally a right or law not written, but established by long usage. To render a custom valid it has been said that the following qualities are requisite: — 1. Antiquity, *i. e.* that it shall have been used as far back as time of legal memory, that is, the first year of Richard I. 2. Continuance without interruption, 3. Without dispute. 4. It must be reasonable, and 5. Certain. 6. Compulsory. 7. Customs must be consistent with each other. Customs in derogation of the common law must be construed strictly. General customs, relating to all England, are determinable by the judges, but local customs by a jury. An exception to this rule is to be found in the *Custom of the City of London*, which, if questioned, is established by certificate of the mayor and aldermen, with the exception of those customs from which the corporation itself claims a benefit. *Customs* (*coutumes*), in the law of France, were the laws relating both to moveable and immoveable property peculiar to different districts of the kingdom before the Revolution. Districts governed by customs were commonly termed *pays coutumiers*, in contradistinction to the remainder of the realm, which being under the civil law was termed *pays de droit Romain*. The pays coutumiers embraced all the north of France. The valid coutumes were estimated at 140 *general*, or comprehending districts, and 360 *local*, belonging to towns and places, but the enumeration was not exact. The *coutume de Paris* was the most important of all, and it was a generally recognized principle that when a case was unprovided for by local custom, that of Paris was to be applied in aid. Works containing the customary law of a particular district are styled *Coutumiers*.

CU'STOMARY FREEHOLD, in Law, is a superior kind of copyhold, the tenant holding as it is expressed, by copy of court roll, but not at the will of the lord. *See* COPYHOLD.

CU'STOMS (Lat. portoria.) In Finance, duties charged on the importation or exportation of certain commodities, that is, on their being brought into, or sent from, a country. Such duties were levied in antiquity, and form an important part of the revenue of this and most other modern states. Down to the æra of the Revolution, customs duties were charged indiscriminately on most commodities, whether exported or imported; but since the epoch in question they have been almost exclusively laid on imported articles; those laid on exports being, in most instances, imposed rather to check or prevent the exportation of the articles, than in the view of raising revenue.

Were this the proper place for such investigations, it might be easily shown that moderate customs duties are about the least exceptionable of all taxes. They are collected with the greatest possible facility, involving no inquiry into the circumstances of individuals, as is the case with taxes on income or property; nor any interference of any sort with the processes carried on in the arts, as is the case with certain excise duties. By allowing imported goods to be lodged in bonded warehouses, under the joint locks of the king and the importer, the revenue is protected, without its being necessary for the importer to pay the duties till the goods be withdrawn for consumption; so that but little additional capital is required to be at the command of the importing merchant because of the articles in which he deals being subject to duties, and but little addition is consequently made to the price of the goods on account of the profits accruing to the dealers on the duties.

Customs duties should not be carried to such a height as to give any overpowering stimulus to smuggling. They then contradict and defeat the very purpose for which they are intended. Our finance ministers have not, however, been sufficiently alive to this obvious consideration. There can be no articles better fitted to bear customs duties than tobacco and spirits; but the duties with which they are loaded are so extravagantly high, that they occasion a great deal of smuggling with its accompanying crime and demoralization, and would certainly be a good deal more productive, were they effectually reduced. The existing duties on brandy and geneva are, perhaps, the very worst in our tariff; but they would be about the very best, were they reduced from 15*s.* to 8*s* or 10*s* a gallon.

We subjoin an abstract of the nett produce of the customs duty collected in each of the great divisions of the United Kingdom in the years ending Oct. 10th, 1837, 1838, 1849, and 1850, respectively.

| Nett Receipt, 1837. | Nett Receipt, 1838. | Nett Receipt, 1849. | Nett Receipt, 1850. |
|---|---|---|---|
| *L.* *s* | *L* *s* | *L* *s.* | *L.* *s* |
| 20,556,559 3 | 20,751,182 15 | 18,758,805 0 | 18,657,563 0 |

CU'TICLE (Lat. cutis, *skin*.) In Anatomy the scarf skin. The exterior membranous covering of the body. In its chemical characters it resembles nail, quill, &c., and has the properties of a condensed form of albumen.

CU'TICLE. In Botany, the thin vesicular membrane that covers the external surface of vegetables, and adheres firmly to the cellular substance beneath it. It acts in plants as a means of preventing a too rapid perspiration, and is furnished with respiratory openings called stomata.

CU'TLERY. A term used to designate all kinds of sharp and cutting instruments made of iron or steel, as knives, forks, scissors, razors, &c. The principal seat of the manufacture of British cutlery is Sheffield, and the articles made there are held in the highestest imation in all parts of the world. *See* HARDWARE.

CU'TTER. A vessel with one mast and a bowsprit, of considerable breadth in proportion to her length. The distinction between a cutter and other vessels of one mast, which are called sloops, is, that in the cutter the jib, has no *stay* to support it.

CU'TTING. An excavation made through land, to conduct a road through it on a level lower than that of the surrounding land. *See* RAILROAD.

CYA'NIC ACID. A compound of 26 cyanogen + 8 oxygen = 34 cyanic acid.

CY'ANITE (Gr. κυανος, *blue*.) A massive and crystalized mineral. It has a pearly lustre, is translucent, and of various shades of blue. It is a silicate of alumina, with a trace of oxide of iron. Only found in primitive rocks.

CYA'NOGEN. (Gr. κυανος, and γιγνομαι, *I am produced*, because it is an essential ingredient of Prussian blue.) Cyanogen is a gas of a strong and peculiar odour, resembling that of rubbed peach leaves, it is obtained by heating *cyanuret of mercury*. Under a pressure of between 3 and 4 atmospheres it becomes a limpid liquid. It extinguishes a taper, is highly poisonous and unrespirable, and burns in contact of air with a rich purple flame. Water absorbs between 4 and 5 times its volume of the gas. It is composed of carbon and nitrogen in the proportions of 12 carbon + 14 nitrogen = 26 cyanogen; it is therefore a bicarburet of nitrogen. Mixed with oxygen it explodes by the electric spark, and is resolved into carbonic acid and nitrogen gas. It combines with hydrogen to produce the *hydrocyanic* or prussic acid: it forms with the metals *cyanurets* or *cyanides*.

CYANO'METER. (Gr. κυανος, and μετρον, *measure*.) An instrument contrived by Saussure for determining the deepness of the tint of the atmosphere. A circular band of thick paper or pasteboard is divided into 51 parts, each of which is painted with a different shade of blue, decreasing gradually from the deepest blue

formed by a mixture of black, to the lightest formed by a mixture of white. The coloured zone is held in the hand of the observer, who notices the particular tint which corresponds to the colour of the sky. The number of this tint, reckoned from the lightest shade, marks the intensity at the time of observation.

CYANO'SIS. (Gr.) In Medicine, the blue disease. A blueness of the body occasionally arises from malformation of the heart. The whole of the body, and especially its exposed parts, becomes a blue or lead colour, in consequence of the administration of nitrate of silver.

CY'ANU'RETS. Compounds of cyanogen When Prussian blue is boiled in water with red oxide of mercury, and the solution filtered, it yields white or pale buff crystals of *cyanuret of mercury*.

CYANU'RIC ACID. A crystallizable acid, obtained by decomposing urea by heat.

CYBE'LE (Gr. Κυβέλη), in Mythology, was originally the Phrygian goddess of the earth. When her worship was introduced among the Greeks, they confounded her with Rhea, as did the Latins with their Ops. Her rites, like those of the Asiatic deities, in general were celebrated with great excitement; her priests, who were called Galli, Corybantes, Curetes, &c., running about with howlings and clashing of cymbals.

CY'CADA'CEÆ (Cycas, one of the genera) In Botany, a very small natural order of arborescent Gymnosperms, inhabiting the tropics of Asia and America. They were formerly referred by Linnæus to the Palms; but in 1825 Brown showed the analogy between *Cycadaceæ* and *Coniferæ*, and hence their present station. Adolphe Brongniart also proved the affinity by finding the vessels contained in the wood of both orders to be, as he says, of the same structure. The only remarkable quality in the order is the production of a kind of sago by the soft centre of *Cycas circinalis*.

CY'CLANTHA'CEÆ. (Cyclanthus, one of the genera.) In Botany, a natural order of Endogens, inhabiting the tropics of the western hemisphere, and allied to *Pandanaceæ*, from which their plaited leaves and spiral flowers divide them.

CY'CLAS, SINGLETON, &c. An article of dress worn both with and without defensive armour, which came into fashion about the reigns of Edward II and III in England. It was a mantle or surcoat without sleeves, of silk, cloth, &c., reaching to the knees before and to the calves of the legs behind. It was succeeded by the japon or gyppon, a shorter kind of surcoat

CY'CLAS. (Gr. κυκλος, *a circle*) A genus of fresh-water air-breathing Gastropods or snails, so named on account of the more or less rounded circumference of the shell in all the species. Of these the following are natives of Britain: — the river cycle (*Cyclas rivicola*, Leach), the largest species of which is not uncommon in the smaller streams communicating with the Thames; the horny cycle (*C. cornea*, Lam), common in ditches near Battersea; cupped cycle (*Cyclas calyculata*, Drap); lake cycle (*Cyclas lacustris*, Drap)

CY'CLE. (Gr. κυκλος) The revolution of a certain period of time which finishes and recommences perpetually. Cycles were invented for the purposes of chronology, and for marking the intervals in which two or more periods, of unequal length, are each completed a certain number of times, so that both begin again exactly in the same circumstances as at first. The cycles used in chronology are three, the *cycle of the sun*, the *cycle of the moon* or *Metonic cycle*, and the *cycle of indiction*

The *cycle of the sun*, or solar cycle, is a period of time after which the same days of the week recur on the same days of the year. If the number of days in the year were always the same, this cycle could only contain seven years, but the order is interrupted by the intercalations In the Julian calendar the intercalary day returns every fourth year, and the cycle consequently contains $4 \times 7 = 28$ years; after which period the Dominical letters return in the same order, or the first day of the year and of every month falls again on the same day of the week. The origin of this cycle is unknown; it is supposed to have been invented about the time of the Council of Nice (325); but the first year of the first cycle is placed by chronologists nine years before the commencement of the Christian era. Hence the year of the cycle corresponding to any given year in the Julian calendar is found by the following rule: — *Add nine to the date, and divide the sum by twenty-eight; the quotient is the number of cycles elapsed, and the remainder is the year of the cycle.* Should there be no remainder, the proposed year is the 28th, or last of the cycle. In the reformed calendar this rule can only apply from century to century; for the order is interrupted by the omission of the intercalary day every hundredth year, and is not restored till the end of four hundred years. *See* DOMINICAL LETTER.

The *cycle of the moon* is a period of 19 solar years, after which the new and full moons fall on the same days of the year as they did 19 years before. This cycle was invented by Meton, a celebrated astronomer of Athens, and the chronological period which he founded on it is celebrated in history under the name of the *Metonic cycle*. The Metonic cycle contained exactly 6940 days, which exceeds the true length of 19 solar years by nine and a half hours nearly. On the other hand, it exceeds the length of 235 lunations, or synodic revolutions of the moon, by seven hours and a half only. The framers of the ecclesiastical calendar, in adopting this period, altered the distribution of the lunar months, in order to accommodate them to the Julian intercalation; and the effect of the alteration was that every three periods of 6940 days was followed by one of 6939. The mean length of the cycle was therefore 6939¾ days, which agrees exactly with 19 Julian years. A table, therefore, showing the days of the new and full moons for 19 years, would serve to show the days of these phenomena for any year whatever when its number in the cycle is known The number of the year in the cycle is called the *golden number;* either because it was so termed by the Greeks, who, on account of its utility, ordered it to be inscribed in letters of gold in their temples, or more probably because it was usual to distinguish it by red letters in the calendar. The cycle is supposed to commence with the year in which the new moon falls on the 1st of January. This happened in the year preceding the commencement of our era; hence to find the number of any year in the lunar cycle, or the golden number of that year, we have this rule. — *Add one to the date, and divide by nineteen; the quotient is the number of cycles elapsed, and the remainder is the year of the cycle* Should there be no remainder, the proposed year is the last or 19th of the cycle

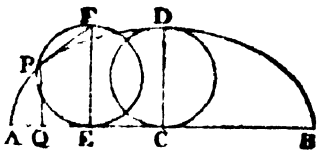
*Cycle of indiction*, or *Roman indiction*, a period of 15 years; not astronomical, like the two former, but entirely arbitrary. Its origin and the purpose for which it was established are alike uncertain, but it is conjectured that it was introduced by Constantine the Great, about the year 312 of the common era, and had reference to certain judicial acts that took place under the Greek emperors at stated intervals of 15 years. In chronological reckoning, it is considered as having commenced on the 1st of January of the year 313. By extending it backwards to the beginning of the era, it will be found that the 1st year of the era corresponded with the 4th of the cycle. In order, therefore, to find the number of any year in the cycle of indiction, we have this rule: — *Add three to the date, divide the sum by fifteen, and the remainder is the year of indiction* *See* CALENDAR.

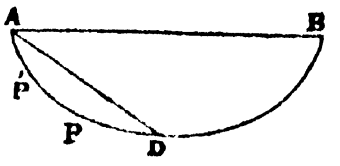
CY'CLIC CHORUS The chorus which performed the songs and dances of the Dithyrambic Odes at Athens. They derived their name from the circumstance of their dancing round the altar of Bacchus in a circle (κυκλος), and were thus distinguished from the square (τετραγωνος) choruses of tragedy

CY'CLIC POETS. (Gr κυκλος) This term was applied to a succession of Epic poets who followed Homer, and wrote merely on the Trojan war and the adventures of the heroes immediately connected with it, keeping, as it were, to one circle (κυκλος) of subjects. None of their works have come down to us

CY'CLOBRA'NCHIANS, *Cyclobranchiata*. (Gr. κυκλος, and βραγχια, *gills*) The name of an order of hermaphrodite Gastropodous Mollusks, including those in which the branchiæ consist of little tufts or pyramids attached in a circular arrangement to the inner surface of the margin of the mantle

CYCLOI'D, or TROCHOID. (Gr. κυκλος, or τροχος, *wheel;* and ειδος, *form*) In Geometry, one of the transcendental curves, described by a point P in the circumference of a circle which rolls along an extended straight line A B until it has completed a revolution. Some of the properties of the curve are obvious from this definition. The line A B, which is called the base of the cycloid, is equal to the circumference of the generating circle; and C D, which is the axis of the cycloid, is equal to the diameter. In any position E P F of the generating circle, A E is equal to the arc E P, A Q the abscis = A E − Q E = arc E P − sine E P, and P Q the ordinate = 1 − cosine of E P. It is also easy to prove that the whole length of the cycloid A D B is equal to four times C D, and the whole area or space between the curve and its base triple that of the generating circle. A portion of the curve D P, counted from its summit, is double of F P, the supplemental chord of the arc E P; and F P is also a tangent to the cycloid at P. The curve has many other remarkable properties which have been discovered by more recondite investigations. Its *involute*, or the curve formed by unfolding a thread or flexible line from its convex side, is a cycloid equal and similar to the original. If a heavy body descends by the force of gravity in an inverted cycloid, the velocity which it acquires is exactly proportional to the length of the cycloidal arc P D; so that from whatever point (P, P′) it may begin to fall, it will arrive at the lowest point D



in precisely the same time. If a body is to descend by the force of gravity from a point A to another point D not in the same vertical, it will accomplish the passage in a less time by describing the cycloid A P D than by moving in the straight line A D, or in any other path whatever. *See* BRACHYSTOCHRONE.

The cycloid may be made to assume an endless variety of forms by placing the tracing point not in the circumference of the generating circle, but without or within it, though still in the same plane. When the tracing point is without the circle, the curve has its base shortened, and is called the *curtate* or *contracted cycloid* If the point is within the circumference, the curve is called the *prolate* or *inflected cycloid*.

Few curves have afforded finer scope for the exercise of modern geometry than the cycloid. Its properties successively engaged the attention of Roberval, Fermat, Descartes, Pascal, Slusius, Wren, and Wallis. Huygens rectified the curve so early as 1657; and having afterwards discovered its isochronism, or the remarkable property that all bodies gliding along it will descend from any point in the same time, and likewise that it produces a similar cycloid by its development, he applied these discoveries to the improvement of the pendulum, and showed how a perfectly synchronous vibration could be procured, theoretically at least, by causing a flexible rod to vibrate between cycloidal cheeks. Its property of being the line of swiftest descent was discovered by John Bernoulli in 1697.

CYCLOI'DES. (Gr. κυκλος) A name given by Agassiz to one of his orders of fishes, the species composing which have scales composed of simple layers with smooth margins, but often ornamented on their exterior surface with different figures impressed upon all the layers: these are of horn or bone without enamel; the scales of the lateral line, instead of being flat, are funnel-shaped; the contracted part applied against the disk of the scale forms the tube by which the mucus exudes which covers the fish. The families included in the *Cycloid* order are, *Labroides*, *Muges*, *Atherines*, *Scomberoids*, *Gadoids*, *Gobioids*, *Murenoids*, *Lucioids*, *Salmonoids*, *Clupeoids*, and *Cyprinoids*

CY'CLOPÆ'DIA. (More correctly *Encyclopædia*, from the Greek words ἐν κύκλῳ παίδεια, *instruction in a circle*) A work containing definitions or accounts of the principal subjects in one or all departments of learning art, or science. Its arrangement may be either according to divisions into the various sciences, &c, or the subjects may be arranged and treated in alphabetical order The *Encyclopédie Française*, or *Dictionnaire Encyclopédique*, and the *Encyclopædia Britannica*, have been the most celebrated works of this species, but the earliest appears to be the *Lexicon Technicum* of Harris, published in 1706. The great French work, the *Encyclopédie Methodique*, consists, not of one, but of a series of encyclopedias or dictionaries. *See* DICTIONARY, ENCYCLOPÆDIA.

CYCLO'PEAN. An epithet applied to certain huge structures the remains of which are found in many parts of Greece, Italy, and Asia Minor, the architecture of which was totally different in style from that which prevailed during the historical ages. The epithet originated in the Grecian tradition that assigned these edifices to the gigantic strength of the Cyclops It is most probable that they were really raised by the Pelasgians, the predecessors or ancestors of the later Greeks, and a gradual progress may be traced in them from the extreme of rudeness to a degree of symmetry that indicates an approach to the elegance of Grecian architecture.

CYCLO'PES. (Gr κυκλος, *circle* and ωψ, *eye*) In Mythology, a race of gigantic beings fabled by the Greeks to dwell in Sicily, where they assisted Vulcan in forging the thunderbolts of Jupiter. They had only one eye, round, and situated in the centre of the forehead. The most celebrated among them was Polyphemus, whose exploits have formed a prolific theme for the poets of antiquity. His attachment to the nymph Galatea, is happily described in an idyl of Theocritus; and the 9th book of the *Odyssey* contains a graphic account of his savage propensities, and of the loss of his eye by the stratagem of Ulysses.

CYCLO'SIS. (Gr. κυκλος) A term applied by Schultz to that general motion of latex or the vital fluids of plants, which passes through vessels of a peculiar kind, and which are diffused through the system of plants without interruption; in distinction to *rotation*, or the movement of fluids in separate cells, as in Chara, Valisneria, &c. According to this physiologist, the phenomenon of cyclosis is confined to the highest forms of vegetation, while that of rotation is characteristic of the more imperfect orders of plants.

CY'CLOSTO'MA. (Gr. κυκλος, and στομα, *a mouth*) A genus of air-breathing Gastropods or snails; so called on account of the circular form of the aperture of the shell. *Cyclostoma elegans* and *Cycl productum* are both natives of England

CY'CLOSTO'MES, *Cyclostoma* (Gr. κυκλος, and στομα *a mouth; round-mouthed.*) A tribe of cartilaginous fishes, including those in which the mouth is surrounded by a circular lip, forming a large sucker, as in the lamprey.

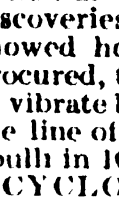
CY'GNUS. (Lat. *the swan.*) In Astronomy, one of the old constellations in the northern hemisphere.

CY'GNUS. In Ornithology. *See* SWAN.

CY'LINDER. (Gr. κυλινδω, *I roll.*) In Geometry, a solid which may be conceived to be formed by the revolution of a rectangular parallelogram about one of its sides. The surface of a cylinder, not including the two ends, is equal to the rectangle formed by multiplying the circumference of its base into its altitude; and the solid content is equal to its altitude multiplied into the area of its base. The cone, the sphere, and the cylinder have a remarkable relation to each other, first discovered by Archimedes: namely, that the cone is one third of the cylinder, having the same base and altitude; and the inscribed sphere two thirds of the cylinder; or the cone, the sphere, and the cylinder are to each other as the numbers 1, 2, and 3.

CYLI'NDROID. (Gr κυλινδρον, *cylinder*, and ειδος, *form.*) A solid which differs from a cylinder in having ellipses instead of circles for its ends or bases.

CY'MA, or CYMATIUM. (Gr. κυμα, *a wave.*) In Architecture, a moulding, taking its name from its contour resembling that of a wave, being hollow in its upper part, and swelling below. Of this moulding there are two sorts: the cyma recta, just described; and the cyma reversa, whose upper part swells, whilst the lower is hollow. By the workmen these are called ogees.



CYMA. (Gr. κυημα, *a fœtus.*) In Botany, a form of inflorescence consisting of a solitary flower seated in the axilla of dichotomous ramifications, as in *Sambucus* This term is also sometimes improperly used, in place of coma, to express the head of a forest tree

CY'MBALS. (Gr. κυμβαλον, from κυμβος, *hollow*) Brass musical instruments of percussion, played in pairs by striking one against the other. They are circular, about six or eight inches diameter, attached to leather mountings, by which they are held Cymbals are musical instruments of great antiquity, though there is considerable doubt as to who was the inventor. They were employed by the Greeks in the festivals of Cybele and Bacchus, and indeed by nearly all the nations of antiquity. The cymbals and the *crotola* (which see) were used together.

CY'MBIUM. In Natural History, a name given by many writers to a kind of sea-shell, commonly called the gondola. It belongs to the genus *concha globosa*, or *dolium*.

CYNA'PIA. A crystallizable alkaline base obtained from the *Æthusa cynapium*

CY'NARA'CEÆ. (Cynara, one of the genera) In Botany, one of the divisions of the great group of *Compositæ*, admitted by Jussieu. It contains the thistle, the artichoke, and similar plants, having their capitula surrounded by a hard spiny or lacerated involucrum, and long equal tubular florets with an inflated limb. They are also called *Cynarocephalæ*.

CYNAROCEPHALÆ. *See* CYNARACEÆ.

CYNARRHO'DIUM (Gr κυων, *a dog*, and ῥοδον, *a rose*) In Botany, a fruit with distinct ovaria, and hard indehiscent pericarpia enclosed within the fleshy tube of the calyx, as in *Rosa*

CY'NICS. A sect of philosophers among the Greeks, so called from their snarling humour, and their disregard of the conventional usages of society; the name being derived from κυων, *a dog*. It is difficult to give any satisfactory account of the tenets of this sect, as during all the period of its existence it was in a state of constant fluctuation, and, like most of the philosophical systems of antiquity, derived its character and complexion from the peculiar temperament and disposition of those who embraced it. But amid all the follies and incongruities by which it was disfigured, and which exhibited themselves chiefly in a contemptuous neglect of all science and art, and of all the comforts and charities of life, it is impossible not to admit that its grand aim was to inculcate the love of rigid virtue and a contempt of pleasure. On this point the testimony of Horace,—himself a zealous adherent of the school of Aristippus, the very opposite of the cynical sect,—even were there no other, must be held to be conclusive; and, according to his opinion, the aim of the cynical philosophy was to induce every man to become

Virtutis verae custos, rigidusque satelles.

This sect was founded by Antisthenes, a disciple of Socrates, who sought to imitate his master in carelessness of outward splendour and contempt of riches; but his indifference to these things soon degenerated unhappily into a love of ostentation, shown by a display of poverty. Thus he and many of his followers rejected not only the conveniences but the common decencies of life, and lived in rags and filthiness; while they sneered bitterly at the rest of the world, instead of endeavouring to teach it to cultivate the pure reason of which they professed themselves to be the only followers. Of this sect was the

famous Diogenes, whose meeting with Alexander the Great is too well known to require being noticed in this place.

CY'NIPS. (Gr. κυω, *I am pregnant.*) A Linnæan genus of Hymenopterous insects, belonging to that section which has not a poisonous sting. The ova of this genus are deposited in living trees, and the irritation excited by their presence gives rise to the formation of the excrescences called galls.

CY'NOMORIA'CEÆ. (Cynomorium, one of the genera.) In Botany, a natural order of Rhizanths, at present but little known. One species is a native of Malta, and was formerly supposed to possess great medicinal powers as an astringent: it figures in old officinal catalogues under the name of *Fungus melitensis*

CY'NOSA'RGES. A sort of academy in the suburbs of Athens, situated near the Lyceum, so called from the mythological story of a white dog (κυνος αργου), which, when Diomus was sacrificing to Hercules, the guardian of the place, carried off part of the victim. Besides possessing several temples erected in honour of Hercules, Alcmene, and other mythological personages, it was chiefly famed for its gymnasium, in which foreigners or citizens of half blood used to perform their exercises; and as being the place where Antisthenes instituted the sect of the cynics, and taught his opinions

CY'NOSURE. (Gr. κυων, *a dog*, and ουρα, *a tail.*) Literally the tail of a dog, applied by some philosophers to the constellation Ursa Minor, by which the ancient Phœnicians used to be guided on their voyages whence it has been borrowed by the language of poetry, in which it signifies "a point of attraction:"

> Where perhaps some beauty lies,
> The cynosure of neighbouring eyes *L'Allegro*, 79

CY'NTHIUS and CY'NTHIA In Mythology, surnames given by the ancient poets to Apollo and Diana; from Cynthus, a mountain of the island of Delos, on which they are fabled to have been born. (*Virg.*, Eclog. 6 3. *Hor.*, Od III 28.)

CYPERA'CEÆ (Cyperus, one of the genera.) A natural order of Endogens, inhabiting the marshes, ditches, streams, &c of all countries They closely resemble *Gramineæ*, but are distinguished from them by the stems being solid and angular, not round and fistular, and by there being no diaphragms at the articulations They approach *Juncaceæ* and *Restiaceæ*, but are known at once by the sheaths of their leaves not being split The entire order has lately been re-arranged by Nees Von Esenbeck and Kunth. Their sensible properties are unimportant *Carex arenaria* affords one of the European substitutes for sarsaparilla

CYPHE'LLÆ. (Gr. κυφος, *a tubercle.*) A term used in describing lichens, to denote pale tubercle-like spots on the under surface of the thallus

CY'PHER, or CIPHER In Diplomatic affairs, "an occult manner of writing, legible to those only who possess the key or secret" This art, in a variety of forms, has been more or less practised in every civilized country and has been cultivated by the moderns in particular to such a degree as to have acquired the importance of a distinct science, under the names *Cryptography*, *Polygraphy*, *Stenography*, &c. To give a general exposition of the principles of the art, it would be necessary to enter into minute details inadmissible in a work of this kind, but the reader will find in *Rees's Cyclopædia* a full and learned disquisition on the subject.

CY'PHONISM. (Gr. κυφων, *an instrument of punishment*) A species of punishment frequently resorted to by the ancients, which consisted in besmearing the criminal with honey, and then exposing him to insects. This punishment was carried into effect in various ways, but chiefly by fastening the sufferer to a stake, or extending him on the ground with his arms pintoned.

CYPRÆ'A, *Cowry.* The name of a Linnæan genus of the *Vermes Testacea*, characterized by a subovate smooth shell, with a linear aperture extending from one end of the shell to the other, and transversely furrowed or dentated in the mature state. The genus is retained without subdivision, and forms part of the *Buccinoid* family of the Pectinibranchiate order of Gastropods of the system of Cuvier.

This genus is remarkable for the difference of form which exists in the young and old states of the shell. in the former the lip is thin, and the aperture wide, but the mantle is progressively developed until its lobes extend over the columella on the one side and the lip on the opposite side of the aperture, covering them with successive layers of nacreous shell, and at length diminishing the aperture to a narrow linear form. One species of cowry (*Cypræa moneta*, L.) is commonly used by the natives of certain parts of Africa and other semi-barbarous nations as a medium of monetary exchange

CYPRI'NUS (Lat. cyprinus, *a carp.*) A Linnæan genus of abdominal fishes, now the type of a family of Malacopterygians in the system of Cuvier, and of Cyclond fishes in the system of Agassiz; including the genus *Cyprinus* proper, or carps; *Barbus*, or barbels; *Gobio*, or gudgeons; *Tenca*, tenches; *Abrama*, breams; *Leuciscus*, minnows; *Cirrhinus*; *Labes*; *Catastomus*; and *Gonorhynchus*

CY'PSELA. (Gr. κυψελη, *a bee-hive.*) In Botany, one-seeded, one-celled, indehiscent fruit, with the integuments of the seed not cohering with the endocarp: in the ovarium state evincing its compound nature by the presence of two or more stigmata; but nevertheless unilocular, and having but one ovule. Usually called an *Achenium*

CYRE'NIANS The philosophers of a school founded at Cyrene, a Grecian colony on the northern coast of Africa, by Aristippus, a disciple of Socrates. They held, with the Epicureans, that pleasure was the only good and pain the only evil, and were not at such pains as the latter to prove that the first could only attend on virtuous conduct; they also differed from them in not considering absence from pain of itself to be a pleasure of the highest order But though these philosophers held that pleasure should form the ultimate object of pursuit, and that it was only in subserviency to this that fame, friendship, and even virtue are to be desired, still there were many points in their philosophy calculated to command general sympathy. It is impossible not to admit that, with all the defects of the system, its object, as Dryden says in reference to Horace, is to render us happy in relation to ourselves, agreeable and faithful to our friends, and discreet, serviceable, and well-bred in relation to those with whom we are obliged to live and converse. Perhaps the best view of the philosophy of this sect is to be obtained from the Satires and Epistles of Horace, in which the versatility of disposition, politeness of manners, and knowledge of the world that distinguished the Cyrenians, are set forth with great clearness, and with all the ardour of an enthusiastic disciple The grand principles of Aristippus are thus happily described in the couplet —

> Omnis Aristippum decuit color et status et res,
> Tentantem majora, fere præsentibus æquum

and the poet's own partiality for this system of philosophy, and its accommodating character, are thus exhibited —

> Nunc in Aristippi furtim præcepta relabor,
> Et mihi res non me rebus subjungere conor

CY'RTANDRA'CEÆ (Gr. κυρτος, *crooked*, and ανηρ, *a male*, Cyrtandra, the name of one of the genera) A natural order of Monopetalous Dicarpous Exogens, inhabiting the tropics, and closely allied to *Gesneraceæ*, *Bignoniaceæ*, and *Pedaliaceæ*, from the former differing only in never producing an inferior ovary, their deeply lobed placentæ, their siliquose fruit, and the want of albumen, from *Bignoniaceæ*, by their habit, their minute apterous seeds, one-celled ovary, with two double parietal placentæ, from *Pedaliaceæ*, in nothing except their minute indefinite seeds and the membranous not woody texture of the fruit and placentæ

CY'STIBRA'NCHIANS (*Cystobranchia*) (Gr. κυστις, *the bladder*, and βρεγχια, *gills*) A family of Isopodous *Crustacea*, comprehending those which have the branchiæ lodged in vesicular cavities

CY'STIC OXIDE (Gr. κυστις) A species of urinary calculus composed of a peculiar animal matter.

CY'STICS *Cystica*. (Gr. κυστις) Rudolphi thus denominates the order of Entozoa in which the body is terminated by a cyst peculiar to one individual or common to many The hydatid in the brain of sheep, and the parasite which produces measly pork, are examples of this order

CYSTI'TIS. (Gr. κυστις) Inflammation of the bladder

CY'STOCE'LE (Gr. κυστις, and κηλη, *a tumour*) A hernia or rupture formed by a protrusion of the bladder.

CYSTO'TOMY (Gr. κυστις, and τεμνω, *I cut*) The operation of cutting into the bladder for the extraction of a stone or other extraneous substance

CYTHERE'A In Mythology, a name given to Venus, from the island Cythera, where she was worshipped with peculiar veneration (*Ovid Fast* iv 285)

CY'TINA'CEÆ (Cytinus, one of the genera) In Botany, a natural order of Rhizanths protruding the south of Europe, the Cape, and Guinea They are very little known, and have no sensible properties of importance. Pelletier says that Cytinus has the property of precipitating gelatin without containing tannin

CYZICE'NUS. In Ancient Architecture, a large hall decorated with sculpture; and so called from the inhabitants of Cyzicus, who were celebrated for their magnificence in [illegible]

CZAR, ZAR, or TZAR A title given to their monarch by several Sclavonic tribes. In Russia, Ivan II. adopted in 1579 the title of Czar of Moscow The eldest son of the Czar was termed Czarovicz, but after the death of Alexis, the murdered son of Peter I, this title was no more used, until revived by Paul I., in 1799, in favour of his second son, the late grand duke Constantine. The consort of the emperor of Russia is styled *Czarina*.

# D.

D. The fourth letter in the Hebrew alphabet, and those derived from it, is the medial of the order of dentals or palato-dentals; and is susceptible of various interchanges, particularly in the German and English languages As an abbreviature, D has several significations; thus, D. stands for Doctor, — M. D. Doctor of Medicine, — D. D. Doctor of Divinity, &c. Among Roman writers, D is used for Divus, Decimus, Devotus, Diebus, &c. D. M in the Roman epitaphs signifies Dis Manibus; but, on other occasions, Deo Magno, or Dus Magnis. As a Roman numeral, D signifies five hundred: in this case, it is more correct to write I,)

D. In Music, the note on the third line in the bass or F clef, on the fourth space in the tenor clef, on the third space in the counter-tenor clef, and on the fourth line in the treble or G clef.

DA CA'PO. (It) In Music, usually written short, D. C An instruction to the performer in such airs as end with the first strain, that the song must be begun again and ended with the first part.

DA'CELO. One of those generic terms which Dr. Leach framed by transposing the letters of the name of the typical or Linnæan genus from which the species so designated were dismembered; in the present case, the word is obtained from *Alcedo*, and is applied to a large Australian species of Passerine bird, nearly allied to the kingfisher.

DACRYO'MA. (Gr. δακρυω, *I weep*) A disease of the lachrymal duct of the eye, by which the tears are prevented passing into the nose, and therefore trickle over the face

DACTI'LIOGLYPH. (Gr. δακτυλιος, *a ring*, and γλυφω, *to engrave*) In ancient gem sculpture, the inscription of the name of the artist on a gem

DACTILIO'GRAPHY (Gr δακτυλιος, and γραφω, *to write*.) In gem sculpture, the science of gem engraving

DA'CTYL. (Gr δακτυλος, *the finger*) The name of a metrical foot in Greek and Latin poetry, consisting of a long and two short syllables, as in the word *carmină* In the English and German languages, where accent determines quantity, the word dactyl means an accented followed by two unaccented syllables, as in *quantity, lachrymae*.

DA'CTYLI. Priests of Cybele in Phrygia, so called, according to Sophocles, because they were five in number, thus corresponding with the number of the fingers (δακτυλοι), from which the name is derived Their functions appear to have been similar to those of the Corybantes and Curetes, other priests of the same goddess in Phrygia and Crete

DA'CTYLO'LOGY. (Gr δακτυλος, *a finger*, and λογος, *discourse*) The art of spelling words by placing the fingers in such positions as to signify the letters of the alphabet.

DACTYLO'PTEROUS (Gr δακτυλος, and πτερον, *a wing or fin, finger-finned*) A fish is said to be so when the inferior rays of its pectoral fin are partially or entirely free The term *Dactylopterus* has been applied by Lacepede to a genus of Gurnards, remarkable for the great expansion of their pectoral fins The most common and best known species of this genus inhabits the Mediterranean, and is the *Trigla volitans* of Linnæus, or the flying gurnard It is sometimes confounded with the true flying fish (*Exocœtus*)

DA'DO. (It *a die*) In Architecture, the die, or that part in the middle of the pedestal between the base and cornice. It takes its name from being a cube like a die.

DÆDALUS In Fabulous History, the great grandson of Erechtheus king of Athens, is celebrated as the most ancient statuary, architect, and mechanist of Greece. To him is ascribed the invention of the saw, the axe, the plummet, and many other tools and instruments, and to such a degree did he excel in sculpture, that his statues are fabled to have been endowed with life For the alleged murder of his nephew he was obliged to quit Athens, whence he repaired to Crete, then under the sway of Minos, by whom he was favourably received. Here he constructed the famous labyrinth, on the model of the still more famous one of Egypt; but having assisted the wife of Minos in an intrigue with Taurus (*see* MINOTAUR), he was, by a strange fatality, confined to this very labyrinth along with his son Icarus. By means, however, of wings, which he formed of linen or feathers and wax, Dædalus and his son contrived to make their escape. The former pursued his aerial journey, and arrived safely in Sicily; but the latter having soared too near the sun, in consequence of which the wax that fastened the wing was melted, dropped into and was drowned in the sea (thence called the *Icarian*) In Sicily Dædalus continued to prosecute his ingenious labours, and lived long enough to enrich that island with various works of art From the plastic powers of Dædalus, the ancient poets used to regard his name as synonymous with *ingenious*, as in the phrase *Dædaleum opus;* and in a somewhat similar sense Lucretius applies it to the earth, in order to describe its vernal vegetation, —

> ——— tibi suaves Dædala tellus
> Submittit flores.

A few years ago the name of Dædalus, which had been appropriated by various artists in the history of Grecian art, was assumed by the constructors of some ingenious automata, in memory of the grand impressions which the works of Dædalus had produced

DA'GON. (Heb. דג, dag, *a fish*) One of the principal divinities of the ancient Phœnicians and Syrians, and more especially of the Philistines. The origin, attributes, and even the sex of this divinity, are all wrapt in the most profound obscurity, but the sacred writers concur in assigning to him such a degree of authority as must place him on a level with the Jupiter of the Greeks and Romans. The reverence in which he was held by the Philistines, and the remarkable circumstances attending his downfall, will be found fully detailed in Judges, c 16., and 1 Samuel, c. v.; but we cannot refrain from transferring to our pages Milton's graphic sketch of the leading features of his history: —

> —— Next came one
> Who mourned in earnest when the captive ark
> Maim'd his brute image, head and hands lopt off
> In his own temple, on the grunsel edge,
> Where he fell flat, and shamed his worshippers:
> Dagon his name, sea monster, upward man
> And downward fish, yet had his temple high
> Reared in Azotus, dreaded through the coast
> Of Palestine, in Gath and Ascalon,
> And Accaron and Gaza's frontier bounds

The *Samson Agonistes*, as is well known, exhibits the great importance of this divinity, and the

> —— solemn feasts,
> With sacrifices, triumph, pomp, and games,

celebrated to his honour by the Philistines.

DAGUE'RROTYPE The name given to a process lately introduced by Daguerre, an ingenious French artist, by which the images from the lens of a camera obscura, as is supposed, are fixed on metal plates. It has been our good fortune to see several of the productions of this surprising discovery, and we regret that words cannot convey the impression they made on us. With the exception of local colour, they present nature herself to the spectator The qualities of objects are so clearly expressed that silk could not in the representation be mistaken for satin, nor marble for plaster. The sky is given with as different an expression of quality from stone as that substance is from the ground on which it stands. The productions we saw were nearly uniform in size, being about 10 inches by perhaps 6 or 7; and notwithstanding the small space within which the views are confined, we could by means of a lens count the strands in a rope. This extraordinary discovery must not be confounded with that of an ingenious gentleman (Mr. Talbot) of this country, in which what in nature is in light becomes a dark space in the representation, and the parts that are dark are exhibited in masses of light. In Daguerre's discovery the objects are lighted as they are in nature, with all the sparkling effects which the sun scatters on them: the intensity of tone in the [illegible] is balanced by the aerial effects in the distances; in short, the only step wanting to rival the original is to impart to these self-created pictures that which the father of colour, the sun, bestows upon all things beneath him, namely, colour. Mr Talbot's process has been made known by a paper read before the Royal Society, and some have called his specimens Photogenic pictures. *See* PHOTOGENIC.

DAI'RY. (Dey, *milk*, obsol Eng) An apartment in a house, or a separate building, for the purpose of holding milk, and manufacturing it into butter, cheese, or other dairy produce. On a small scale, where butter only is made from milk, the dairy may be a room in the north side of the dwelling-house; or it may form one of the offices connected with the kitchen court. The requisites for the room to contain the milk are — an equal temperature throughout the year, viz between 48° and 55°; sufficient ventilation to carry off all bad smells and impurities in the air; and the exclusion of flies and other insects. An equable temperature is maintained by thick or by hollow walls, and by double windows. In winter the temperature is somewhat raised by the warm milk, and in summer it is cooled to the degree required by ventilation and the evaporation of water poured on the floor. The ventilation is effected by opening the glazed sashes of the windows, and supplying their places by wire shutters; and indeed one of the best modes of arranging the windows of a dairy is to have wooden shutters outside for closing in the most severe weather in winter; next a fixed frame of wirework to exclude the flies; and within this, at three or four inches distance, the glazed sash, which should be made to open. A dairy on a large scale is most conveniently arranged as a detached building; in which case, it contains a milk-room, a churning-room, and a dairy scullery, or place for

scalding the utensils. If cheese is to be made, a room will be required for the cheese press, and another for drying the cheeses.

The quantity of milk raised in the vicinity of London for the supply of the inhabitants, and the revenue derived from the sale of it, show the importance of this article. In his valuable work on cattle, their breeds, &c. "Mr Youatt estimates the number of dairy-cows, at present kept in London and its environs, at 12,000; affording, on Mr. Middleton's hypothesis, an annual supply of 38,400,000 quarts of milk. Now, as milk is sold by the retailers at from 3*d*. to 4*d*. a quart, after the cream is separated from it, and as the cream is usually sold at from 2*s*. 6*d* to 3*s*. a quart, and there is reason to suspect that a good deal of water is intermixed with the milk, we should hardly be warranted in estimating that the milk, as obtained from the cow, is sold at less than 5*d*. a quart, which gives 800,000*l*. as the total price of the milk consumed in the city and its immediate vicinity." (*M'Culloch's Statistics*, 2d ed. vol. i. p. 490.)

DA'IS. (Fr.) In Architecture, the platform or raised floor at the upper end of a dining hall, where the high table stood; also the seat with a canopy over it for those who sat at the high table.

DALMA'TICA. A long white gown with sleeves; worn by deacons in the Roman Catholic church over the *alb* and *stole*. It was imitated from a dress originally worn in Dalmatia, and imported into Rome by the emperor Commodus, where the use of it gradually superseded the old Roman fashion of keeping the arms uncovered. A similar robe was worn by kings in the middle ages at coronations and other solemnities.

DA'MAGE-FEASANT. In Law, a beast is said to be so, when found in another person's ground without his leave or licence; in which case the tenant may distrain or impound it: but at his own peril, if the accident have happened through his own negligence in not repairing the fences of his close. Possession, without title, is sufficient to empower the tenant to distrain damage-feasant Proper notice is, however, to be given, and if the owner of the estate tender amends, it is unlawful to detain them.

DA'MAGES. (Lat damna.) In English Law, the recompence awarded by a jury to a plaintiff, in certain forms of action, for the loss or *damage* he has sustained by the injury committed by the defendant. At *common law*, damages are recoverable in personal and mixed actions. In actions upon the case, trespass, &c., a certain amount of damages, sufficient to cover all the hurt really sustained by the plaintiff, is alleged or *laid* in the declaration; and it is the duty of the jury to inquire the real amount of damages, and assess it accordingly In the action of debt, where the amount due is something certain, the damage laid is now merely nominal for the injury supposed to be done by the detention of the debt; the jury, therefore, award a nominal sum only Damages are also allowed in actions upon a variety of statutes, and sometimes double or treble damages; in which case the plaintiff is entitled to twice or three times the amount awarded by the jury.

DA'MASK. (From *Damascus*, where it was anciently made.) A woven fabric produced by a particular construction and management of the loom, in which are represented various figures of flowers, fruit, leaves, &c The chief seat of this manufacture is Dunfermline in Fifeshire, and Lisburne and Ardoyne near Belfast. The best damasks are of linen; those of cotton are cheaper, but less elegant and durable.

DAMASKEE'NING. The art of inlaying iron and steel with gold and silver, originally practised at Damascus in Syria.

DAMA'SSIN. A species of woven damask with gold and silver flowers.

DAME (probably a corruption of the Lat domina, *a mistress*), was formerly a title of honour, and is still used in the English law to denote the wife of a knight or baronet. Dame was also the designation of nuns of the Benedictine and certain other ancient orders

DA'MPER. An iron plate sliding backwards and forwards in a groove, and so arranged as to enlarge or contract, and occasionally close the chimneys of furnaces, steam-boilers, &c so as to increase or diminish the draught of air through the fire, and consequently regulate the intensity of the combustion

DAMPS. (Germ. dampf, *vapor*.) The noxious exhalations of mines and excavations. The carburetted hydrogen of coal mines is called *Fire Damp*; carbonic acid is termed *Choke Damp*.

DA'NCING (Germ. tanzen), may be defined to be a graceful movement of the figure, accompanied by gestures and attitudes indicative of certain mental emotions, and by measured steps in harmony with a piece of music arranged for the purpose. The great antiquity of dancing is attested by history, both sacred and profane. It consisted at first, probably, of nothing more than gesticulation and moving in a procession; in which sense it formed part of the celebration of the religious rites of the ancient Hebrews and Egyptians. But the Greeks, who are confessedly indebted to the Egyptians for the elements of their religion and literature, though these were afterwards refined by them to such a degree as nearly to obliterate all traces of their origin, soon polished and improved these sacred rites, and introduced them into all the festal ceremonies of which their elegant mythology was composed. In this they were, as usual, imitated by the Romans. If we believe Scaliger, the early bishops of the church were styled *præsules*, because (as the word literally implies) they led off the dance at their solemn festivals; and this practice continued in the church till the 12th century. Almost every country can boast of national dances peculiar to the inhabitants; which it is rare to see so well performed when adopted by others Of these the best known to us are the *tarantella* of the Neapolitans, the *bolero* and *fandango* of the Spaniards, the *mazourick* and *krakowiaque* of Poland, the *cosaque* of Russia, the *redowac* of Bohemia, the *quadrille* and *cotillon* of France, the *waltz* and *gallopade* of Germany, and the *reel* of Scotland.

DA'NEGELT. A tribute of twelve pence laid by the Danes upon the Anglo-Saxons upon every hide of land throughout the realm.

DA'NNEBROG. An ancient Danish order of knighthood, supposed to have been founded in 1219; revived in 1693, and re-constituted in 1808.

DANS. Small trucks or sledges used in coal mines.

DA'PHNE. (Gr. Δαφνη) In Grecian Mythology, a nymph of Diana, the daughter of the river god Peneus. She was beloved by Apollo, but she resisted all his attempts to excite in her a mutual attachment, and at last betook herself to flight On being hotly pursued by the god, she invoked the earth to swallow her up, when her prayer was granted, and she was immediately changed into a laurel tree, which was ever after sacred to Apollo, and regarded as the symbol of fame and glory. (*Ovid. Met.* i. x.)

DA'PHNIA A genus of the Entomostracous or lower-organized Crustaceans, belonging to the order *Branchiopoda*, and the section *Lophyropoda* The most common species and type of this genus, *Monoculus pulex* of Linnæus, is a favourite and interesting microscopic object. Its body is compressed, oval, and inclosed in a large bilobed carapace, the two lobes being connected together along the back and open below, resembling a bivalve shell. The head is prolonged into a snout, and provided with a single central compound eye. The chief organs of swimming are the modified antennæ, which have a long basal joint, supporting two jointed branches beset with long bristles It is by the sudden contraction of these organs that the little animalcule propels itself through the water by a series of jerks The true legs are ten pairs, very small, having a respiratory vesicular organ attached to the second joint, the first eight pairs have the terminal joint dilated and hairy The eggs are incubated in a kind of marsupial pouch, situated towards the dorsal aspect of the lower end of the body in five days the young are excluded. The *Daphnia pulex* is extremely prolific; and as it assumes a rose-red colour in summer time, the swarms which abound in stagnant water often impart to it so deep a colour as to give rise to a suspicion and popular belief that it is occasioned by blood

DA'RIC. A Persian gold coin (so called by the Greeks, from Darius, the name of several Persian sovereigns), having upon the obverse an archer crowned and kneeling upon one knee, and on the reverse a quadrata incusa, or deep cleft The weight of the daric is about 130 grains.

DAROO' TREE. The *Ficus sycamorus*, or Egyptian sycamore

DA'RTER Certain web-footed birds of the Pelican family are so called. *See* PLOTUS

DASH (Etym uncertain) In Music, a small mark, thus ', denoting that the note over which it is placed is to be performed in a short and distinct manner.

DA'SYPRO'CTA (Gr δασυς, *hairy*, and πρωκτος; Lat anus) The subgeneric name applied by Illiger to the *Agouti* and *Acouchi*, which before were included in the great genus *Cavia* of Linnæus.

DA'SYPUS (Gr δασυς, and πους, *a foot*.) A name originally and very appropriately applied by the Greeks to the hare, but transferred by Linnæus to the genus including the Armadillos. This genus is subdivided in modern systems into *Dasypus* proper, *Tatusia*, and *Prionodon*. The remains of a gigantic extinct animal of the armadillo kind has recently been discovered in South America, and called *Glyptodon*. See that word.

DA'SYURE. (Gr δασυς, and ουρα, *a tail; hairy-tailed*.) The name of a genus of Carnivorous Marsupials, comprehending those which have hairy tails combined with digitigrade feet, and a dental formula of—incisores $\frac{8}{6}$, canini $\frac{2}{2}$, molares spurii $\frac{4}{4}$, molares veri $\frac{8}{8} = 42$.

DA'TA. (Lat *things given*.) A term used in geometry to denote certain things or quantities determined by the conditions of the problem, and at the same time known or assignable. According to Simson (Preface to *Euclid's Data*), a thing is said in general to be given which is either actually exhibited or can be found out;

that is, which is either known by hypothesis or can be demonstrated to be known; so that in the analysis or investigation of a problem, from the things that are laid down to be known or given, by the help of known propositions other things are demonstrated to be given, and from these other things are again shown to be given, and so on, until that which was proposed to be found out in the problem is demonstrated to be given. When this is done the problem is solved, and its composition is made and derived from the compositions of the data which were made use of in the analysis.

In the language of the ancient mathematicians, geometrical quantities are given in *species*, *magnitude*, or *position*. Thus, a triangle is given in *species* when its three angles, or the ratios of its sides, are known. A straight line is given in *magnitude* when we know its length, or the area of a triangle of which the three sides are given. And lastly, a line is given in *position* when we know its inclination to another given line. The *Book of Data*, ascribed to Euclid, is the first in order of the ancient treatises on the geometrical analysis. There are numerous editions of this work. Those of Simson and Horsley are the best.

DATE. In Diplomatics, the notation of the time and place of the delivery or subscription of an instrument. The word is derived from the common formula at the foot of instruments, "datum" or "data," *given* at such a place and time Dates of time are distinguished into definite and indefinite. The former mark specially the year, and sometimes the month, day, &c.; the latter only contain a general reference to some period of time. Thus many instruments of the earlier part of the middle ages are dated only "*Regnante Domino nostro Jesu Christo*," and very often the date contained only mention of the reigning prince, without reference to the years of his reign. Definite dates are various in ancient charters and deeds The Christian Greeks dated generally, down to the fall of Constantinople, by the year of the world, beginning their year at the 1st of September. The date used in the oldest Latin charters is commonly that of the Indiction (*see* INDICTION), which is also frequently added in the Greek. The Christian era (under the several names of year of grace, of the incarnation, of the reign of Christ, of the nativity, &c. &c.) began to be in common usage in royal charters in France about the reign of Hugh Capet, in Spain and Portugal not until the 13th and 14th centuries. In England, the Saxon kings frequently dated by the incarnation, but deeds and charters under the Plantagenet kings generally bear the year of the reigning prince.

DA'THOLITE, or DATOLITE A mineral composed of silica, lime, and boracic acid, a borosilicate of lime. It occurs in Norway, in the Tyrol, and in the Hartz. It becomes opaque when heated

DA'TIVE CASE. (Lat dativus, from do, *I give*) That inflexion of a noun which denotes participation in the action of the verb which accompanies it *See* GRAMMAR.

DATU'RIA. The poisonous principle of the *Datura stramonium*. It belongs to the class of crystallizable alkaloids.

DAU'PHIN. The well-known title of the heir apparent to the crown of France, before the Revolution, was that of the counts or lords of Vienne in Dauphiné, from the 12th century, or an earlier period: its origin cannot be ascertained. From the last male of that ancient house the title passed to his heirs, the house of Burgundy; and from them to the family of La Tour Dupin, of whom Humbert II surrendered his principality in 1349 to Charles, grandson of Philip of Valois: from which period the principality of Dauphiné continued to be the apanage, and the title of Dauphin the appellation, of the king's eldest son. The name of the province is derived from the title of its lords.

DA'VIT. A piece of timber used in managing the anchor.

DA'VITE. A name given to a fibrous sulphate of alumina found in a warm spring near Bogota, in Columbia.

DAVY'NE. A white or brown crystallized mineral found in cavities of some of the lapideous masses ejected by Vesuvius.

DAY (Lat. dies; Germ. tag), in its most common acceptation, denotes the interval of time during which the sun remains above the horizon; and is opposed to *night*, which denotes the time the sun is below the horizon. In this sense it is sometimes called the *artificial day*. But the term day is also generally used to denote the time in which the earth makes a complete revolution with respect to the celestial bodies, and consequently expresses different intervals, according as the body with which the earth's rotation is compared is fixed or moveable.

The *Astronomical* or *Solar Day*, called also the *Apparent Day*, is the time that elapses between two consecutive returns of the same terrestrial meridian to the centre of the sun. Astronomical days are not of equal length, for two reasons: 1st, the unequal velocity of the earth in its orbit, in consequence of which the apparent daily motion of the sun is greater in winter than in summer; and 2d, the obliquity of the ecliptic, in consequence of which the sun's apparent daily motion in right ascension (that is, in the plane of the earth's equator) is less at the equinoxes than at the tropics. The astronomical day commences at noon, and is counted on, through the 24 hours, to the noon following.

The *Civil Day*, or *Mean Solar Day*, is the time employed by the earth in revolving on its axis, as compared with the sun, supposed to move at a *mean* rate in its orbit, and to make 365 2425 revolutions in a mean Gregorian year. In this mode of reckoning time, the days are all of the same length; and noon, or any given hour of the civil day, sometimes precedes and sometimes comes after apparent noon, or the corresponding hour of the astronomical day. Most nations, at least in modern times, have agreed in placing the commencement and termination of the civil day at mean midnight.

The *Sidereal Day* is the time that elapses between two successive culminations of the same star. This interval of time has always remained of the same invariable length, as is proved by the most ancient astronomical observations. It is divided into 24 sidereal hours; and these are again subdivided into sidereal minutes and seconds. This mode of reckoning time, during the day, is now universally adopted by astronomers in their observatories; although the commencement of the day is still determined by the apparent culmination of the sun.

DE'ACON (Gr. διακονος, *a minister or servant*.) A minister of religion, holding, in Protestant churches, the lowest degree in holy orders. The first appointment of deacons is mentioned in Acts vi, where the Apostles direct the congregation to look out seven men of honest report, upon whom they may lay their hands. Their office at this time seems to have been chiefly the care of the poor and the distribution of the bread and wine in the love feasts. We learn, however, from the example of Philip, Acts viii, that they also had authority to preach. In the English church it is customary to require a candidate for deacon's orders to have completed his 23d year. He is not capable of holding any benefice, and may only officiate as a curate, chaplain, or lecturer he may not read the Absolution, nor administer the sacrament alone, but in assisting the priest may offer the cup to the communicants. In Scotland, the term *deacon* is applied to a corporate officer.

DEAD BEAT. In Clock-work (called also *dead scapement*, or *scapement of repose*), a peculiar kind of scapement invented by Mr. George Graham about the year 1700, with a view to lessen the effect of the wheel work on the motion of the pendulum; and acquired its name from the circumstance that the seconds' index stands still after each drop whereas the index of a clock with a *recoiling* scapement is always in motion, hobbling backward and forward *See* HOROLOGY.

DEAD LIGHTS. Strong wooden posts or shutters put over the glass windows of the cabin in bad weather, as a defence against the sea.

DEAD RECKONING. A term used in navigation to express the estimation that is made of a ship's place without having recourse to observation of the celestial bodies. It is made by observing the way she makes by the log, and the course on which she has been steered, making allowance for drift, leeway, &c.

DEAD WATER. The water that closes in with a ship's stern.

DEA'FNESS. An imperfection of the sense of hearing, arising from a variety of causes, some of which are inexplicable and incurable, and others ascertainable and susceptible of relief or entire removal. When the organ of hearing is imperfect in its functions, either at birth or in childhood, dumbness or imperfect articulation attends it, for speech is an imitative faculty, and an infant born deaf, cannot attempt those motions of the organs of voice which gradually attain perfection by practice: he consequently becomes incapable of communicating his ideas through that medium.

The external ear, though tending by its form and situation to improve and perfect the sense of hearing, is in no way necessary; for it may be cut off without producing deafness. A common cause of deafness arises out of imperfections or obstructions in the passage leading from the external ear down to the membrane of the tympanum. This passage is partly cartilaginous and partly bony; and from its oblique direction it is difficult so to see into it as to ascertain the seat or cause of the obstruction. In some persons, however, when placed in a proper position, so that the sunshine or other strong light may be properly directed into it, a little management enables us to examine nearly its whole extent. In some cases of congenital deafness this passage is closed by a membrane, which, if near the external orifice, is easily detected, and may be divided or removed; but, if deeply seated, it may escape observation till the child attains a certain age, or should begin to talk: for till that time the deafness of infants often passes unobserved. Under these circumstances, and where the malformation exists in both ears,

the child will be dumb as well as deaf; for although the organs of speech may be perfect, if those of hearing are inert he is incapable of imitating sounds: in this case, therefore, a timely operation may effect the double benefit of giving both hearing and speech. Where the passage to the tympanum is more extensively obliterated or malformed, the cases become of course more complicated, but yet often admit of entire cure by a skilful and timely operation.

The presence of foreign bodies in the aural passage is a common cause of imperfect hearing, and sometimes it is obstructed by accumulations of hardened wax These causes of deafness may in most cases be relieved or removed by syringing the ear with warm water, which should be forcibly injected, and so directed as to reach the membrana tympani. Insects or worms in the ear may be washed out in the same way, or killed by the introduction of a few drops of olive oil, or of camphorated oil.

Another cause of deafness is deficient secretion of wax, occasioning a dryness of the tube of the ear. It is relieved by greasy applications, and by the cautious use of stimulants, such as olive oil, to which a few drops of oil of turpentine, or of compound camphor liniment, or of spirit of ammonia, have been added.

In cases of inflammation of the tympanum followed by suppuration, more or less deafness ensues, dependent upon the extent of the mischief going on, and requiring prompt, and generally antiphlogistic treatment the pain, especially at the outset of the disorder, is often intense, and the discharge purulent and often offensive.

Lastly, hardness of hearing often appears to depend upon imperfection in the functions of the auditory nerve, and from obstructions in the Eustachian tube The deafness that attends a violent cold is frequently dependent upon the latter cause, and goes off as the secretions of the part return to their natural state.

DEAL. (Sax. delan, *to divide*) In Architecture, the small thicknesses of timber into which a piece of timber of any sort is cut up, but the term is now improperly restricted in its signification to the wood of the fir tree cut up into thicknesses in the countries whence deals are imported,—viz. Christiana, Dantzic, &c Their usual thickness is three inches, and their width nine They are purchased by the hundred, which contains 120 deals, be their thickness what it may, and reduced by calculation to a standard thickness of one inch and a half, and a length of twelve feet. *Whole deal* is that which is one inch and a quarter thick, and *slit deal* is half that thickness

DEAN. (Lat decanus) An ecclesiastical dignitary in cathedral and collegiate churches, being the head of the chapter of canons or prebendaries, and forming together with them a council to advise the bishop in the affairs of his see. (*See* CHAPTER.) In England there are, properly speaking, three classes of ecclesiastical prestdencies to which the title dean belongs, deans rural, deans of cathedrals, and deans in peculiars Rural deans were originally beneficed clergymen appointed by the bishop to exercise a certain jurisdiction in districts of his diocese remote from his personal superintendence They seem to have been equivalent in many respects to the chorepiscopi of the early church, and many parts of their office are now discharged by the archdeacons. Rural deans are still occasionally employed in visitations, to examine into the state of repair of churches and performance of divine service; their functions have for many years become almost obsolete. Deans of cathedrals have already been noticed The third species of deans, or deans in peculiar, are those of "particular parishes and churches, or rural districts that have jurisdiction within themselves, and are not under the ordinary of the diocese." In Scotland, the head of the faculty of advocates is called the *dean*; and in the Scottish municipal system, the *Dean* of Guild is the second magistrate, having the care of all buildings, public and private, and discharging functions somewhat equivalent to those of the Roman ædile

DEATH WATCH. *See* ANOBIUM.

DE'BACLE. (Fr. debacler, *to unbar*) A rush of waters, breaking down all opposing barriers, and carrying away and dispersing the broken fragments of rocks

DEBE'NTURE. A custom-house certificate entitling the exporter of goods to a drawback or bounty Also, an instrument in use in some government departments, by which government is charged to pay to a creditor or his assigns the sum found due on auditing his accounts

DEBRI'S. (Fr.) In Geology, the fragments of rocks, &c.

DEBT, in Law, is a species of contract, whereby a *chose in action*, or right to a certain sum of money, is mutually acquired and lost: usually divided into debts of record, debts by special contract, and debts by simple contract. A debt of record is a sum which appears to be due by the evidence of a court of record; such as debt on judgment or recognizance. Debt by specialty is where a sum is acknowledged to be due, or becomes due, by instrument under seal; such as a covenant, bond, &c. Both these species of debts, being contracted by a man or himself and his heirs, attach on his lands and tenements, and bind them in the hands of his heir or devisee. Debt by simple contract is either by parole or by written obligation unsealed; within which class fall bills of exchange and promissory notes.

DEBT is also a personal action of contract, in which the plaintiff seeks the recovery of a debt; *i. e.* a *liquidated* or certain sum of money alleged to be due to him. *See* ACTION.

DEBT, NATIONAL. *See* NATIONAL DEBT.

DEBUT (Fr), in its most general acceptation, is applied to the commencement of any undertaking, or to the first step made in a public career; but it is confined more particularly to the language of the theatre, in which it signifies the first appearance of an actor, or his first appearance on any particular stage.

DE'CADE (Lat. decas, from Gr. δεκα, *ten.*) A word used by some old writers in a general sense for the number ten, or an enumeration by tens; but more peculiarly appropriated to the number of books into which the history of the Roman Empire by Livy is divided, each division consisting of ten books or *decades* It was also the name given to the space of ten days, which in the French republican calendar was substituted for the ordinary week The tenth or last day was termed *decadi*. Thus, except in bissextile years, the whole number of decades was thirty-six and a half: the days of the half decades, falling at the close of the year, were at one time called *sansculottides*, and afterwards *complementary*, and dedicated respectively to Virtue, Genius, Labour, Opinion, and Recompence.

DE'CAGON (Gr. δεκα, *ten*, and γωνια, *an angle*) A geometrical figure, having ten sides and ten angles. If the sides and angles are all equal, the figure is a regular decagon, and inscribable in a circle. Euclid, in the Fourth Book of his *Elements*, shows that the side of a regular decagon is equal to the greater segment of the radius of the circumscribing circle divided by a medial section, or so that the rectangle contained by the whole radius and one of the parts is equal to the square of the other part, consequently, if we denote the radius by $r$, and the side of the decagon by $s$, we shall have the proportion $r : s :: s : r - s$, whence $s^2 + r s = r^2$, and by solving the quadratic $s = \frac{1}{2} r (\sqrt{5} - 1)$. If the radius is unit $s = \frac{1}{2}(\sqrt{5} - 1) = .618034$; and the area $= 7.694209 \times s^2$, or 7.694209 of the square of the side

DE'CALOGUE (Gr δεκα, *ten*, and λογος, *discourse* or *catalogue*) The commandments which were delivered by God to Moses upon Mount Sinai (Exod xx) That their number was understood by the Jews to be ten appears from Exod xxxiv 28, but they differed from us in the manner of dividing them, considering our two first as one, and separating the last into two The same method is adopted by the Romish church, professing to follow the authority of St Augustine (See *Catechism. ad Parochos*)

DE'CA'MERON (Gr δεκα, *ten*, and ἡμερα, *day*) The name given by Boccaccio to his celebrated collection of tales they are supposed to be narrated in turn, during ten days by a party of guests assembled at a villa in the country to escape from the plague which raged at Florence in 1348

DECA'NDROUS. (Gr δεκα, and ανηρ, *a male*) A plant having ten stamens

DECANTA'TION The pouring off a clear liquid from its subsidence or residue, it is often resorted to in the chemical laboratory instead of filtration, the clear supernatant liquor being poured or syphoned off from precipitates, which may thus be repeatedly washed or edulcorated, so, as to free them from all soluble matters.

DECAPITA'TION (Lat decapitare, *to behead*) A mode of punishment of great antiquity, having been practised by the Jews, Greeks, and Romans, and some other ancient nations Among the Continental nations of modern times, it has long been the ordinary punishment inflicted on all capitally convicted criminals During the early period of English history, it was the usual mode of punishing felons, but it afterwards became a punishment appropriated only to criminals of the highest rank, and even to this day it is considered as the most honourable death which a capital offender can undergo. The last instance of the infliction of this punishment in England occurred in 1745, soon after the rebellion in Scotland had been quelled

DE'CAPOD, *Decapoda* (Gr. δεκα, and πους, *a foot; ten-footed*) A name applied by Dr. Leach to a tribe of Cephalopods, including those which have ten locomotive and prehensile appendages proceeding from the head, two of which are always longer than the rest, and are called tentacles. Also applied by Cuvier to designate an order of Crustaceans, comprehending those which have ten thoracic feet.

DECA'PTERY'GIANS, *Decapterygia.* (Gr. δεκα, *ten*, and πτερυξ, *pinion.*) A name given by Schneider to an artificial division of fishes, including those which have ten fins.

DE'CARBONIZATION OF CAST IRON. This process is resorted to in order to convert cast iron into

steel, or by a further decarbonization to reduce it to the state of malleable iron; hence, many articles which were formerly exclusively manufactured of wrought iron are now cast, and afterwards decarbonized, such as horse-shoes, &c.; and in other cases various cutting instruments are cast, and afterwards brought to a proper hardness by a similar process. The articles to be decarbonized are packed in finely powdered hæmatite, or native oxide of iron, and exposed for a sufficient time to a high red heat. It is often necessary to mix iron filings or turnings with the hæmatite: these substances, thus applied, gradually abstract the excess of carbon in cast iron, and reduce it to a state analogous to that of steel; or, by a longer continuance of heat, to that of soft iron. In some cases, however, the process seems rather to affect the texture and mechanical properties than the composition of the iron, and is therefore more analogous to annealing.

DE'CASTYLE. (Gr. δεκα, *ten*, and στυλος, *a column*.) In Architecture, a building having ten columns on a front or flank.

DE'CASYLLA'BIC, having ten syllables. In the German and English languages the ordinary heroic verse is decasyllabic; but a short syllable is sometimes added at the end by way of variety, and this, in consequence of the structure of those languages, takes place more frequently in the former than the latter. In the Italian heroic verse the eleventh syllable is almost uniformly added, and hence it is more properly to be termed an *hendecasyllabic*. In French versification the decasyllabic line is appropriated to light compositions, especially tales.

DECE'MBER (Lat. decem, *ten*), was the tenth month in the calendar of the ancient Romans, who began the year with March.

DECE'MVIRI. (Lat. *ten men*.) Properly any body of ten men appointed for particular purposes. But that which is especially known by this name was the commission elected from the Roman patricians in the 302d year after the foundation of the city, and invested with all the supreme powers of the state, for the purpose of drawing up a body of laws founded, according to Roman tradition, on the most approved institutions of Greece. They presented to the people a number of laws engraved on ten tables, containing a summary of the privileges to be enjoyed by the people, and the crimes to be punished, &c. At the same time they informed the people that their plan was incomplete, and accordingly a new commission, to which the plebeians were admitted, was appointed for the next year, with the same powers, the result of which was the addition of two more tables to the former ten, thus making up the famous twelve tables, which were the foundation of all Roman law in subsequent times. The second decemvirate did not demean itself with the same moderation as the first, but sought to prolong its power, and at the same time proceeded to some violent acts of despotism, which so exasperated the people as to make its dissolution necessary.

Besides these extraordinary commissions, there was a body of decemviri chosen for judicial purposes, to preside over and summon the centumviri, and to judge certain causes by themselves. There were likewise decemviri appointed from time to time to divide lands among the military.

DECE'PTIVE CA'DENCE. In Music, a cadence in which the final close is avoided by varying the final chord.

DECI'DUOUS. (Lat. decido, *I fall off*.) In Zoology, a term applied to parts which have but a temporary existence, and are shed during the life-time of the animal, as certain kinds of hair, horns, and teeth.

DECI'DUOUS is applied, in Botany, to plants whose leaves fall off in the autumn, in contradistinction to evergreens.

DE'CIMAL ARI'THMETIC, is the common system of arithmetic, in which the scale of numbers proceeds by tens. *See* ARITHMETIC.

DE'CIMAL FRACTIONS, are fractions which have for their denominator 10, 100, 1000, &c., or in general some power of 10. The use of decimal fractions is merely an extension of the ordinary scale of arithmetical notation. Setting out from the unit's place, the first figure to the left (in the expression of any whole number) denotes so many tens, the second to the left so many hundreds, the third so many thousands, and so on; so that in the number 765, for example, each unit of the 6 is the tenth part of each unit of the 7, and each unit of the 5 a tenth of each unit of the 6. In like manner, in the expression of a decimal fraction, setting out from the unit's place, the first figure to the right expresses so many tenth parts, the second to the right so many hundredth parts, the third so many thousandths, and so on; so that each figure, as before, expresses parts, which are each ten times smaller than those expressed by the figure immediately preceding. By expressing fractions in this manner, the operations of addition, subtraction, multiplication, and division are exactly the same as in integer numbers.

In order to distinguish the integral from the fractional part of a numerical expression, a point or comma is placed between them. Various marks have been used for this purpose at different times; but the point is now most commonly employed, and, according to the practice of Sir Isaac Newton, it should always be placed near the top of the figure, thus 2·46, which prevents it from being confounded with the ordinary marks of punctuation.

Decimal fractions appear to have been introduced by Regiomontanus, about the year 1464; but Stevinus was the first who wrote an express treatise on the subject in his *Practique d'Arithmetique*, published in 1582. They are now universally employed in all arithmetical calculations, and it is much to be regretted that a decimal division of weights, measures, money, &c. has not been adopted in all civilized countries, by which the reduction of fractional parts from one scale to another would be obviated, and all the applications of arithmetic to the ordinary purposes of life greatly simplified. A subdivision of weights and measures on this principle was adopted in France at the time of the Revolution, but has not been imitated by other countries.

DECIMA'TION. (Lat.) In Roman History, the selection by lot of one man out of every ten, who was put to death as an example to, or satisfaction for, the rest. If an army, legion, or century, as the case might happen, had quitted its post, raised a mutiny in the camp, or otherwise failed in its duty, it was assembled before the general; the lots were cast into an urn, as many were drawn as formed the tenth part of the number of the offenders, and the unlucky drawers were put to the sword. This practice has been occasionally recurred to in modern times, as by the Spanish general Cuesta, after the battle of Talavera.

DECLAMA'TION (Lat. declamatio), signified, among the ancients, the art of speaking indifferently upon both sides of a question; a species of intellectual exercise resorted to by the rhetoricians of Greece and Rome, as the best means of acquiring facility in public speaking. In modern times the meaning of *declamation* is different in different countries. In Germany, and in most parts of the Continent, it is often used in a sense nearly synonymous with *recitative*. In France and England, especially the latter, it is sometimes applied to any grand oratorical display, either in the pulpit, at the bar, in the senate, or on the stage, in which the voice, gesticulation, and the whole delivery of the speaker are in perfect keeping with the subject matter of his address. But it is employed most usually in a disparaging sense, to indicate the use of forced emphasis, inflated language, and violent gestures to withdraw the attention of the auditors from the weakness or fallacy of the reasoning. *See* ELOQUENCE.

The Romans employed the term *declamare* only in the sense of *to plead* or *practise at the bar*, as in the verse of Horace (*Epis.* 2. 2),—

> Dum tu declamas Romæ;

but that they at the same time assiduously cultivated the art of declamation in the sense of recitation, is evident from the following couplet, in which Martial has happily illustrated the great importance of a good delivery: —

> Quem recitas meus est, O Fidentine, libellus,
> Sed male quum recitas, incipit esse tuus.

DECLARA'TION. In Law, a legal specification, on record, of the cause of action, by a plaintiff against a defendant. *See* PLEADING.

DECLE'NSION. (Lat. declinatio, from declino, *I deflect*.) In Grammar, the changes of termination in nouns, corresponding to the various relations in which substances are conceived to stand. *See* CASE and GRAMMAR.

DECLINA'TION CI'RCLES, are small circles of the sphere, parallel to the equator, in which the stars perform their apparent diurnal revolutions.

DECLINA'TION OF A CELESTIAL BODY, is the angular distance of the body north or south from the equator, and is measured on the great circle which passes through the centre of the body and the two poles, and is consequently perpendicular to the equator. The place of a star in the heavens is determined by means of its *right ascension* and *declination*, the *right ascension* being the angular distance, measured on the equator, between the first point of Aries and the point in which the meridian of the star intersects the equator. Right ascension and declination thus correspond to longitude and latitude on the surface of the earth. In the analytical theory of the planets it is often necessary to define the place of a planet or comet with reference to the ecliptic, or plane of the earth's annual motion; and the early astronomers unfortunately adopted for this purpose the terms *longitude* and *latitude*, which, as the same terms are appropriated to terrestrial objects in a different sense, is the cause of considerable embarrassment to beginners. The student of astronomy must therefore remember that in speaking of celestial objects, declination and right ascension have

reference to the *equinoctial*, or plane of the earth's diurnal rotation; while *latitude* and *longitude* refer to the *ecliptic*.

The declination of a star is said to be *north* when the star is north of the equator, and *south* when the star is south of the equator.

DECLINA'TION OF THE MAGNETIC NEEDLE. The axis of a magnetic needle, that is, the straight line which joins its poles, does not coincide with the astronomical meridian, but deviates from it more or less, sometimes towards the west, and sometimes towards the east. This deviation is called the *Declination of the Needle*.

It was formerly imagined that the magnetic needle, when freely suspended, took a direction exactly north and south at all places on the earth; and Columbus is said to have been greatly astonished when he observed, in his memorable voyage for the discovery of the New World, in 1492, that the needle of his compass did not point to the true north. The same fact was observed by Sebastian Cabot about the year 1500; but notwithstanding its great importance to mariners, the first tables showing the amount of the declination at various places were only prepared in 1599 by the Dutch navigators at the orders of the Prince of Nassau. In 1622, Gunter, professor of geometry at Gresham College, made the important discovery that the declination is not constant. He found it to be 6° 13′ to the east at London in that year; whereas in 1580 it had been observed by Robert Norman to be 11° 15′ also to the east.

The following table of observations, made at Paris, will be sufficient to give an idea of the changes which the declination of the needle has undergone at different epochs: —

| Years. | Declination. | Years. | Declination. |
|---|---|---|---|
| 1580 | 11° 30′ East. | 1805 | 22° 5′ West. |
| 1618 | 8 0 | 1813 | 22 28 |
| 1663 | 0 0 | 1814 | 22 34 |
| 1678 | 1 30 West. | 1817 | 22 19 |
| 1700 | 8 10 | 1819 | 22 29 |
| 1767 | 19 16 | 1822 | 22 11 |
| 1780 | 19 55 | 1824 | 22 23 |
| 1785 | 22 0 | 1825 | 22 22 |

From this table it appears that since 1580 the declination has varied more than thirty degrees. In 1663 it vanished From the date of the first observations till 1820, it has advanced progressively westward; but since that time it appears to have assumed a retrograde movement towards the east. (*Pouillet, Elemens de Physique*, t. i. p. 462.)

DECOLLA'TION. (Lat. de, *off*, and collum, *the neck*) A word synonymous with *beheading*, used chiefly in reference to the decapitation of John the Baptist, to the festival instituted by the Romish church in his honour, and to the celebrated picture of Mabuse (*Walpole's Anecdotes of Painting*, vol. i. p. 82), which represents this subject. This word is used by Fabyan so far back as the year 1350.

DECOMPOSITION, CHEMICAL When compounds are resolved into their elements, or when the chemical constitution of substances is altered, they are said to be decomposed; and when, in this operation, new products are formed, such products are called the *results of decomposition*. Thus, *ammonia* is the result of the decomposition of most animal substances; *carburetted hydrogen gas* is the result of the decomposition of pit-coal, &c.

Chemists use the terms *simple* and *compound*, or *single* and *double* decomposition, to distinguish between the less and more complicated cases. When a compound of two substances is decomposed by the intervention of a third, which is itself simple, or which acts as such, the case is one of simple decomposition: water, for instance, is a compound of oxygen and hydrogen. When the metal potassium, which is a simple body, is thrown into it, it is decomposed; the hydrogen is liberated in the form of gas, and the oxygen combines with the potassium to form potassa. Such a case is often tabularly represented as follows; and the annexed numbers are the *equivalents* of the acting bodies, or the respective weights which are required for perfect decomposition.

Water 9. { Hydrogen 1. / Oxygen 8 + potassium 40. } Potassa 48.

This shows that when 9 parts by weight of water are decomposed by 40 parts of potassium, 48 parts of potassa (or oxide of potassium) are formed, and 1 part of hydrogen liberated.

When two new compounds are produced, the result is called *double* or *complex* decomposition. Thus, when potassa (composed of potassium and oxygen) and hydrochloric acid (composed of hydrogen and chlorine) react upon each other, chloride of potassium (composed of chlorine and potassium) and water (composed of hydrogen and oxygen) are the results. These, with their respective *equivalents*, are shown in the following diagram.

Water 9.

Hydrochloric acid 37. { Hydrogen 1 + oxygen 8. / Chlorine 36 + potassium 40. } Potassa 48.

Chloride of potassium 76.

This table, therefore, shows that 37 parts by weight of hydrochloric acid and 48 of potassa produce, by mutual decomposition, 76 parts of chloride of potassium and 9 of water.

A knowledge of the mutual decomposing powers of different substances, or, in other words, of their relative affinities, constitutes the skill of the practical chemist. See in reference to this subject the articles AFFINITY, EQUIVALENTS, and the general article on CHEMISTRY.

DECO'MPOSI'TION OF FORCES. In Mechanics, signifies the same thing as the *Revolution of Forces*. Any force whatever may always be decomposed or resolved into several others, the resultant of which is equal to the given force. For example, a force represented in intensity and direction by the diagonal of a parallelogram, may be resolved into two others of which the intensities and directions are respectively represented by the sides of the same parallelogram. *See* COMPOSITION OF FORCES.

DECO'MPOSI'TION OF LIGHT. The separation of a beam of light into the different rays which exhibit the prismatic colours. *See* LIGHT.

DE'CORATION. (Lat. decorare, *to adorn*.) In the Fine Arts, adornment, ornament, embellishment. It is a combination of ornamental objects, which a desire for variety brings together in all sorts of forms for embellishing those subjects which are the objects of art. The decoration of any work should be confined strictly to the development of impressions which the mass itself is intended to create, its object being merely to multiply the relations it has, by presenting new images which spring from the original bare design. Decoration in all the arts, except on particular occasions, should be used with a sparing hand. Once commenced it becomes difficult to know when to cease.

DECOY A device by which aquatic birds, chiefly ducks, are enticed from a river or lake, up a narrow winding canal or ditch, which, gradually becoming narrower, at last terminates under a cover of net work of several yards in length The birds are enticed by the smoothness of the turf on the margin of the canal, which tempts them to leave the water, and begin to dress their plumage. When so engaged at some distance up the canal, they are suddenly surprised by the decoy man and his dogs, who have been concealed behind a fence of reeds, and having again taken the water, they are driven up by the dogs till they enter within the net work which terminates the decoy, and are then readily caught.

DECRE'E, *Decretals* (Lat decerno, *I decide*) Decreta or decrees, in the Civil Law, are the decisions of emperors on cases submitted to them, forming a part of their constitutions Decretals were the decrees of popes, having the same authority in canon law as decrees in civil. They retained this authority in most Catholic countries until the 11th century Several compilations of them are in existence The false decretals of Isidore, a spurious collection framed with a view to extend the papal power, profess to contain the decrees of popes during the first three centuries: they were forged in the 9th.

DECREE. In Law, the judgment of a court of equity on any bill preferred Either party may petition the court for a re-hearing, before it is signed and enrolled. After that form has been gone through, a bill of review may be had upon apparent error in judgment on the face of the decree. It may also be appealed against in the House of Lords. In Scottish law, various legal judgments and sentences are styled *decrees*

DE'CREMENT. (Lat. decresco, *I decrease*.) The small part by which a variable quantity becomes less and less. It is opposed to *increment*; but these terms are now seldom used by mathematicians.

DECRE'PITATION. (Lat. decrepito, *I crackle*) The crackling noise which common salt and many other substances make when thrown into the fire.

DECU'RION. The Latin name for the commander of ten men. A military decurion was a cavalry officer, who originally commanded ten soldiers, or one third of a turma; but afterwards the same name was preserved, though the command was extended to the whole turma. Municipal decurions were magistrates in the municipal towns, answering to senators at Rome. In later times also certain officers of the imperial household used this title; as decurions of the chamberlains, &c.

DECUSSA'TUS, *Decussate*. Applied to the arrangement of bodies in pairs that alternately cross each other; as the leaves of many plants.

DEDICA'TION. (Lat.) In Literature, a complimentary address to a particular person, prefixed by an author to his work. Dedications arose out of the dependent situation in which authors have too frequently been placed in reference to their powerful or wealthy patrons; and, at no very distant time, were often rewarded by pecuniary presents. The custom of dedicating works was in use at a very early period The brightest ornaments of Roman literature, Horace, Virgil, Cicero, and Lucretius, were among the number of those who practised it. At the period of the revival of letters in Europe, few works were published without dedications; many of which are remarkable for their elegance and purity of style, and from the interesting matter which they contain are of far more value than the treatises to which they are prefixed. But the practice became gradually perverted; and many of the authors of the succeeding generations employed them chiefly with the view of securing the patronage of the great. Dedications were most abused in France under Louis XIV., and in England from 1670 to the accession of George III. Dryden was a great dedicator, and Johnson wrote dedications for money. Corneille got 1000 louis d'ors for the dedication of *Cinna*. Some of the most beautiful dedications with which we are acquainted are those prefixed to the different volumes of the *Spectator*, by Addison; and in more recent times the poetical dedications with which each canto of Sir Walter Scott's *Marmion* is prefaced. A complete history of dedications would prove a valuable accession to modern literature, as they would throw a flood of light upon the history, character, and attainments of many distinguished persons which are now involved in obscurity. A few such works are in existence, but they are only accessible to the learned. See *De Dedica Lib. vet Lat.* by Walch (Leip 1715) *Commenta de Dedica. Lib* by Tacke. (Wolfenbuttel, 1733)

DE'DIMUS POTESTA'TEM. In Law, a writ or commission given to one or more private persons, for the speeding an act appertaining to a judge or some court. When the commission of the peace is renewed, a writ of dedimus potestatem is issued out of chancery, directed to some ancient justice, to swear in a justice newly inserted

DEED. A deed, in Law, is a writing sealed and delivered by the parties. If made by one party only, it is termed a deed poll; if by several, an indenture The formal parts of a deed of conveyance are, first, the date and names of the parties; secondly, the recitals, in which the intention of the parties and former transactions with reference to the same property are recounted, so far as necessary; then the operative part. This expresses, first, the consideration for which the deed is made (which for many sorts of deeds is now merely nominal); then the conveyance by and to the several parties; then the parcels, or description of the tenements and their legal adjuncts; then what is termed the habendum, beginning with the words "to have and to hold," expressing the quantity of estate conveyed; then the declaration of uses, which limits or modifies the enjoyment to one or more parties, according to the stipulations previously made; then the declarations of trusts, if any, that is, of equitable interests created in the property; and lastly, the covenants for title. These covenants stand in the place of the ancient warranty, a clause by which the grantor warranted and secured to the grantee the thing granted; arising out of the feudal custom, whereby if a lord had thus warranted a fief, and the tenant was afterwards evicted, the lord was bound to recompense him with another fief of equal value. The covenants relating to the title secure to the grantee a pecuniary compensation for any damage he may suffer contrary to their stipulations. Besides the covenants for title, such as may be demanded by the peculiar circumstances of the case, — as in a lease the covenants for repairing, payment of rent, &c, — covenants in general, when broken, give the covenantee an action for damages against the covenantor; or if he be dead, against his executor or administrators to the extent of his personal property in their hands; or if the covenant be with him, his heirs and assigns, the remedy extends to the heir or grantee of the covenantee

Lastly, the conclusion of a deed contains its execution and date. It must be signed and sealed by the grantor; and also by the grantee, if any engagement or covenant is entered into by him. It is usual for witnesses to attest the deed, but this is not necessary, unless where a power having been given to be executed by deed the terms of the power require such attestation. There are several species of deeds; some having effect at common law, others under the Statute of Uses; some creating an estate termed original or primary; some enlarging, restraining, transferring, or extinguishing estates already created, which are called secondary or derivative.

DEER. The English generic name for the ruminating quadrupeds with deciduous horns, or antlers; which appendages form, in fact, the essential character of the genus *Cervus* of Linnæus. (*See* CORNUA.) Deer are anatomically distinguished from other ruminants by the absence of a gall bladder

The species of deer may be primarily divided into two groups, of which one includes those with antlers more or less flattened, the other those with rounded antlers. The elk (*Cervus alces, L.*) is the most characteristic species of the first group, and forms the type of the subgenus *Alces* of modern systems. It equals or exceeds the horse in bulk; has a short body, with a still shorter neck, raised on long stilt-like legs. The muzzle is long, broad, and overhangs the mouth like a square-shaped lapel: it is very muscular, and is of essential service to the animal in detaching the lichens and mosses from the trunks of trees and other places within its easy reach. The long legs of the elk particularly adapt it to the marshy and swampy forests which it chiefly frequents, in the northern parts of both the European and American continents. The antlers of the elk appear first in the form of *dags* or unbranched pointed stems; these are succeeded by a stem or *beam* supporting a few short branches. At five years he puts up antlers in the form of a triangular plate, supported on a pedicle, and notched along the outer margin. Afterwards the bony plate increases in its expanse, and the points between the notches are developed into long branches or *snags*, of which a single antler sometimes sends off as many as fourteen; and the pair will then weigh about fifty pounds. The female elk goes with young rather longer than eight months.

The rein-deer (*Cervus tarandus*) differs from the rest of the genus in the presence of antlers in both sexes, and in the great development of the *brow-antlers*, or branches which extend forwards over the forehead from the base of the beam. The antlers are retained through the winter, and, as it is understood that the brow-antlers are used to detach the frozen snow, which at that season covers the *lichen rangiferinus*, and other species on which the rein-deer feeds, the necessity of the singular exception in favour of the female rein-deer becomes obvious. Her antlers are, however, always smaller than those of the male. The rut takes place in mid-winter, and the period of gestation is about six months, as in most other species of deer, one fawn is produced at a birth. The rein-deer is a native of the most northern parts of Europe and America. To the Laplander it serves all the ordinary offices of the beast of draught, and supplies him with the rich variety of nutriment, clothing, and useful implements, which man in more favoured climes obtains from other species of the valuable order of Ruminantia.

The third species of deer referable to the flat-horned group is that which the ancients termed *platiceros*, and which now forms the ornament of the English park; the fallow deer (*Cervus damas*, Linn.). In the technical language of the hunter, the male fallow deer is called a "buck," the female a "doe," and the young a "fawn." The buck-fawn of the second year, which is characterized by having simple dags, is a "pricket." In the third year a brow-antler is put forth, and the young buck is termed a "sorel." In the fourth year he is a "sore," and the summit of the beam presents a bifid expansion. At the fifth year the expanded summit of the beam is formed, and begins to develop snags, and the fallow deer is then a "buck of the first head." At each subsequent year the branches of the expanded beam increase in length to a certain period, after which they lose their size and regularity. The period of gestation in the fallow doe is eight months.

Of the species of deer of which the beam of the antler gives a rounded form in section, the red deer (*Cervus elaphus*) and the roe-buck (*Cervus caprcolus*) are indigenous species.

The male red deer, in the language of "the noble art of venerie," is called a "hart," and the female a "hind." She goes with young about a week longer than the fallow doe; and brings forth in May a single fawn, rarely two. The young of both sexes are at first styled "calves." The male differs from that of the fallow deer in putting up at six months a pair of rudimental antlers, in the form of cylindrical knobs, called "bossets." In the second year they assume the condition of "dags," and the wearer is called a "brocket." In the third year two or three branches or "tynes" are developed, and the young deer becomes a "spayad." In the fourth year the summit of the beam expands into the crown or "surroyal," and the deer is now distinguished by the name of "staggard." In the fifth year the term "stag" is applied to him in a limited and technical sense. At the sixth year he is a "hart," and his designation is not afterwards changed; but at this period he is particularly distinguished as a "hart of ten," and is not considered fair game till his seventh year, when the hart is said to be "palmed" or "crowned," in reference to the full development of his antlers. The antlers or "attire" are shed very soon after pairing; at this period, when the hart has "lost his attire," he retreats to the shadiest or most unfrequented part of his range. New antlers begin to grow very soon after the old ones are shed, and they are completed in the month of August. The skin, or "velvet," which protected the vascular periosteum during their growth now dries, and is rubbed off against trees or any resisting body;

this act is technically called "burnishing." The narts during this period form a peculiar and distinct association. The hinds form another group, and go also into retirement with their calves, to which they attend with a high degree of instinctive maternal solicitude. The "brockets," and the "brockets' sisters," constitute a third association.

The roebuck is the smallest species of European deer; the male is monogamous, and the female brings forth two fawns. In our own island they are now confined to the Scottish mountains.

The largest species of round-antlered deer in America is the *Wapiti* (*Cervus strongyloceros*); that of Asia is the great *Rusa* (*Cervus hippelaphus*), which is noticed in the writings of Aristotle. In South America there is a singular group of small deer, called prickets or brockets, on account of the antlers never being developed beyond the simple condition of "dags," such as characterize the brocket age of the red deer.

DEFÆCA'TION. (Lat. de, and fæx, *dregs*.) The separation of the dregs and impurities of liquors.

DEFAMATION. *See* LIBEL.

DEFAU'LT. (Fr défaut.) In Law, is in a general sense the omission of any act which a party ought to do in order to entitle himself to a legal remedy. Such is, for example, non-appearance in court on a day assigned. If a plaintiff in an action make default in appearance, he is non-suited; if a defendant, judgment by default passes against him. Suffering judgment by default is taken for an admission of the contract alleged by the plaintiff.

DEFEA'SANCE. In Law—1. A collateral deed, made at the same time with a deed of conveyance, containing conditions on the performance of which the estate created by the deed of conveyance may be defeated. 2. A defeasance on a bond, recognizance, or judgment recovered, is a condition which when performed defeats a bond, &c. (*see* BOND), contained in or indorsed on the instrument itself.

DEFE'CTIVE FIFTH. In Music, an interval containing a semitone less than the perfect fifth. It is also called semidiapente, and flat, lesser, or diminished fifth.

DEFE'NDER OF THE FAITH. (Fidei Defensor.) A title bestowed on Henry VIII. of England by Pope Leo X. on the occasion of that monarch's publishing his writing against Luther. When at the Reformation Henry suppressed all the monasteries and convents in England, the pope deprived him of this title, but in the thirty-fifth year of his reign, it was confirmed by parliament, and it has been since constantly assumed by the sovereigns of England.

DE'FERENT. (Lat. defero, *I carry away*.) In the Ptolemaic system of the universe the planets move in circular orbits, the centres of which are carried round in the circumferences of other circles. These secondary circles are called the *deferents*, as carrying the orbits, those in which the planets move being the epicycles. The system of epicycles and deferents was invented by Hipparchus for the purpose of explaining the eccentricities, perigees, and apogees of the planets. *See* EPICYCLE.

DEFI'CIENT NUMBERS, in Arithmetic, are numbers such that the sum of their aliquot parts is less than the numbers themselves. Thus, 8 is a deficient number; because its aliquot parts, 1, 2, 4, when added together, make only 7. In like manner the number 16 is deficient, its parts being 1, 2, 4, 8, the sum of which is 15.

DEFILADING. *See* FORTIFICATION.

DEFI'LE. In Fortification, a narrow way, through which troops can pass only in *file*, or a small number abreast.

DE'FINITE PROPORTIONALS. In Chemistry. *See* ATOMIC THEORY and EQUIVALENTS.

DEFINI'TION. (Lat.), literally laying down a boundary, signifies, in Logic, an expression which explains any term so as to separate it from every thing else, as a boundary separates fields. By the schoolmen definitions are divided into *nominal* and *real*, according to the *object accomplished* by them, whether to explain merely the meaning of the word or the nature of the thing; and, on the other hand, they are divided into accidental, physical, and logical, according to the *means employed* by each for accomplishing their respective objects, whether it be the enumeration of attributes, or of the physical or the metaphysical parts of the essence. (*Whately's Logic*, pp. 141-2.)

DEFLAGRA'TION. (Lat. deflagro, *I burn*.) A chemical term applied to sudden and rapid combustion: when a mixture of charcoal and nitre is thrown into a red hot crucible it burns with a kind of explosion, or *deflagrates*.

DEFLE'CTION OF THE RAYS OF LIGHT. When a luminous ray passes very near an opaque body it is *deflected*, or bent from its rectilinear course, towards the surface of the body, and the deflection is greater in proportion as the distance of the ray from the body is less. This phenomenon was first observed by Grimaldi, and was carefully examined by Newton, who gave it the name of *diffraction*.

DE'FTER-DAR, literally *Book-keeper*. The title given by the Turks to the chancellor of the exchequer and his two coadjutors or deputies in the finance department.

DEGLUTI'TION. (Lat. de, and glutio, *I swallow*.) In Physiology, the act of swallowing food. This operation is performed by mechanism of the most extraordinary and complicated kind, in which the consentaneous actions of the various muscles of the tongue, the soft palate, the pharynx, the larynx, and the œsophagus or gullet, are concerned, partly by voluntary and partly by involuntary impulse.

There are, as it were, four openings at the back part of the mouth, three of which, during deglutition, must be perfectly but temporarily closed; whilst the fourth, namely, that through which the food is to pass towards the stomach, must be open and without impediment. The openings which are to be closed are those which communicate with the nose, with the ears, and with the lungs; but, as far as the latter is concerned, it follows of course that respiration can only be suspended for a very short time, and that therefore the moment the morsel is swallowed, or has passed over the larynx, the communication between it and the nose must again be free.

When food is properly masticated, a sufficient quantity is collected upon the tongue, which is then so pressed against the palate by a muscular action proceeding from the tip of the tongue backwards as to propel it towards the pharynx, or upper end of the gullet, at this moment the soft palate, previously hanging like a pendulous veil at the back of the mouth, is drawn into a horizontal position, so as to form a continuation, as it were, of the bony part of the palate, and at the same time to close the nasal canals. No sooner does the portion to be swallowed reach the pharynx, than it is embraced, as it were; while the base of the tongue, the os hyoides, and the larynx are raised forward to meet it, and hurry it over the opening of the glottis towards the œsophagus. The instant the larynx is raised the glottis is firmly closed; and as soon as the morsel has passed over it the larynx descends, the epiglottis is raised, and the glottis opens again to allow air to enter the lungs. Thus it is, therefore, that the food is limited to the direction of the œsophagus, and neither passes into the nasal canals, nor into the Eustachian tubes, nor into the larynx, all the concurrent actions in this period of the act of deglutition being simultaneously and involuntarily performed. By the contraction of the pharynx the morsel is delivered into the œsophagus, and propelled by the muscular structure of that tube towards the stomach. In the upper part of the œsophagus, the fibres relax immediately after the passing of the food, but the inferior portion remains contracted for some moments after the food has entered the stomach.

The due admixture of saliva with the food, and the lubrication of the various and complicated parts over and through which the food passes, by mucous secretion, tend materially to facilitate the progress of the alimentary pellet.

DEGRE'E. A distinction of rank in universities: in its proper use denoting a certain amount of proficiency in the faculty or science of which it is entitled; but, by modern usage, frequently conferred either of right to members of the university of sufficient standing, or merely as an honorary distinction. The origin of degrees at the universities of Paris and Bologna, the two most ancient in Europe, appears to have been only the necessary distinction between those who taught and those who learnt. The former were styled (such was at least the case at Paris) doctors or teachers, and masters, as a token of respect, indiscriminately. At what time the distinction between these two degrees arose we cannot ascertain, but about the middle of the 13th century we find, at Paris, doctors and masters simply as graduates, and not necessarily connected with the business of teaching; those who were so being called regent masters, or simply regents. (*See* REGENT.) The degree of bachelor, the lowest in the several faculties, is certainly of French origin; from whence it has been argued that the whole system of academical titles is so likewise. Degrees still continue to bear the same names, and, with some variation, the same relative academical rank, in most European countries; but the mode of granting them, and their value at different universities as tokens of proficiency, vary greatly. At Oxford and Cambridge degrees are given in arts, divinity, law, medicine, and music; but among all these the lowest degree in arts, viz. that of bachelor (B. A.), is the only one conferred on a substantial examination, and the only one which is attained by proceeding through a regular academical course of study. The higher degrees in arts, and those in the other faculties, are attained simply by residence and the performance of a few unimportant exercises. Honorary degrees, in the English universities, are generally conferred in civil law.

A considerable difference of opinion exists upon the question how far the possession of degrees forms a valid test of ability to exercise any of the learned professions; and though at first sight nothing might appear more preposterous than to question the necessity of some such test being exacted from those to whom the lives and fortunes of millions of human beings are in a peculiar manner

intrusted,—physicians and lawyers, — still there are many who maintain that "degrees have always been, and must continue to be, utterly worthless." Among those who entertained this opinion may be mentioned Dr. Smith; whose sentiments on this subject, though pretty distinctly indicated in the *Wealth of Nations*, are fully detailed in a letter to Dr. Cullen, which the reader will find in Mr. M'Culloch's edition of that work, 1 vol. 8vo. But those who wish to see this question fully examined in all its bearings, should consult a note, or rather dissertation, "On the Value and proper Mode of conferring Literary and Scientific Degrees," in the same edition of the work now referred to, in which the author contends that it is not against the principle of degrees, so much as the mode of conferring them, that the chief objections may be urged. The value of a degree, it is there contended, must always depend on the disinterested character of the parties who confer it. Now, when it is remembered that, till very recently, in every university, those in whom was vested the privilege of granting degrees are the identical parties engaged in preparing the candidate for receiving them, who are thus, as it were, called upon to form an estimate of their own handiwork, it will be sufficiently obvious that the system hitherto pursued in awarding academical distinctions must be wholly inadequate as a test of literary or scientific merit. This being the case, it might seem almost unaccountable that so little success should have attended the many efforts that have been made to place the granting of degrees on a sounder and more satisfactory footing, were it not matter of notoriety that to divert into a new channel the current of popular feelings or prejudices which has been flowing for ages in a particular direction is almost impracticable, even after the benefits of the change have been clearly and unequivocally demonstrated. Some such ideas as to the inadequacy of degrees appear to have been entertained a few years ago in many of the German states. There the bare possession of a degree was formerly sufficient to authorize members of the legal or medical profession to engage in the exercise of their several duties; but a change has been since effected, which has at once infused new life into the educational establishments of the country, and has been attended with great advantage to all classes of the people. This change consists in the establishment of boards composed of gentlemen eminent for their attainments, and wholly unconnected with the business of education, whose duty it is to ascertain by a rigid examination the qualifications of those who have already obtained degrees in the faculties of law and medicine, and thus to determine whether the degree has been properly conferred; and unless the diploma obtained at the university be stamped with the authority of these different boards, the possessor of it is prohibited from engaging in the exercise of his profession. In this way the degree, which was formerly regarded as the *aim* or *end* of the student's ambition, is now looked upon simply as a *means* of attaining it, inasmuch as it confers no direct privileges, and does not necessarily secure professional honour or emolument, though it form the sole passport to both. A somewhat similar course relative to the granting of degrees was adopted in this country on the establishment of the London University; with this peculiarity, that while in Germany the different faculties of the universities retain the privilege of conferring degrees, which, however, are of little value, unless confirmed by the authority of the boards alluded to, in the London University this right is vested in the board to the entire exclusion of the professors. Whether this system will work well remains yet to be seen; but, to use the words of Mr. M'Culloch, "if we mistake not, its formation will mark the commencement of a new era in the history of education."

DEGREE. In Algebra, a term applied to equations to denote the highest power of the unknown quantity. Thus, if the index of the highest power of the unknown quantity is 4, the equation is said to be of the fourth degree.

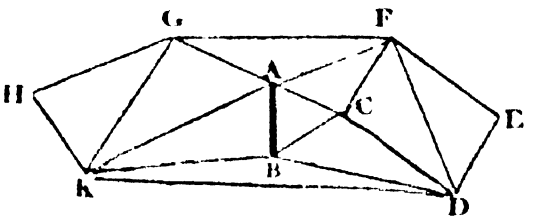
DEGREE, in Geometry and Trigonometry, is the 360th part of a circumference, or of four right angles. Every circle, whether great or small, is considered as divided into 360 parts or *degrees*, each degree being subdivided into 60 minutes, and each minute into 60 seconds. This division of the circle has been employed since the most remote ages. It is not certainly known what gave occasion to the adoption of the arbitrary number 360; but it most probably had reference to the space described by the sun in one day in performing his annual revolution in the ecliptic, the number 360 being taken instead of 365, as being more convenient for arithmetical operations on account of its containing a great number of divisors. The Chinese divide the circle into 365¼ equal parts; so that the sun describes daily an arc of one Chinese degree. An attempt was made by the French philosophers, at the period of the Revolution, to introduce into works of science a division of the circle better adapted to our decimal arithmetic (the quadrant or right angle being divided into 100 degrees, the degrees into 100 minutes, and so on); but

though the system was adopted by some writers of first order of merit (for example, Laplace in the *Mécaniq Céleste*), and extensive tables were computed for purposes of astronomical calculation, it never came i general use, and now appears to be entirely abandon It may be remarked, that a division of this sort was commended long ago by some of the most eminent mat maticians, Stevinus, Wallis, Briggs, Gellibrand, Newt and others.

DEGREE. In Grammar. *See* COMPARISON.

DEGREE OF LATITUDE, on the surface of earth, is the distance an observer must advance along meridian, to the north or south, in order to produc variation of one degree in the altitude of the pole. E since it was discovered that the earth is round, the ex measurement of a degree of the terrestrial meridian been a problem of extraordinary interest, inasmuch a leads directly to a knowledge of the earth's dimensio In modern times the problem has acquired a still grea importance, in consequence of the discovery of the eart ellipticity; for it is by the comparison of the lengths meridional degrees at different latitudes that we are abled to ascertain accurately the true figure of the ear which enters as an element into many of the most in resting inquiries of physical astronomy.

When we consider the great irregularities of the act surface of the earth, and that the length of a degree pends on the radius of the circle on which it is measur it will readily appear that terrestrial degrees at differ places, if measured on the external surface, must be ceedingly unequal. In order to obviate the effects superficial irregularities, and to reduce all the degrees the same radius, the surface of the sea is supposed to continued all round under the continents, and it is to t surface or level that all the measurements must be referr This being understood, the general principle on wh the measurement of degrees of the terrestrial merid must be accomplished are readily perceived. Two stati being assumed on the same, or nearly the same meridi the distance between them must be found with gr exactness in feet, yards, or some known linear measu Having ascertained the itinerary distance, the latitude each of the stations must be determined; the differe of the two latitudes is the length of the celestial arc tercepted between the two stations; and by compar this with the terrestrial measure, the number of ya or feet corresponding to a degree becomes known. I evident that, in order to obtain a result of any value, these operations must be executed with the greatest c and precision. An error of a single second in the celes arc corresponds to about 100 feet on the ground, an long series of astronomical observations must be mad obtain the latitude of any place true to a second. On t account it is necessary to measure an arc of considera length, two or three degrees at least; because the erro the determination of the latitudes is the same, whet the arc be long or short, and in the case of a long arc influence becomes less sensible. But the exact measu ment of a line extending two or three degrees on surface of the earth, by the direct application of rods chains, is perhaps altogether impracticable, on accoun the irregularities of the ground and many other circu stances which render an operation of this sort, when carr on even for a few miles, an affair of great difficulty. He it becomes necessary to have recourse to other meth A level piece of ground is selected near the meridional proposed to be measured. On this a straight line A




traced in any dir tion, and its len accurately found the application rods of metal, sometimes of w or of glass. T ground adjoin the arc to be m sured is then formed into triangles by means of sign C, D, E, F, G, H, K, erected at convenient distances, on remarkable points of the country; and the angles wh the signals make with each other determined by a theo lite or other appropriate instrument. The sides A C B C are then deduced from the measured base A B, thence successively the sides of the other triangles; an this manner the whole distance between the stati which form the terminal points of the arc is determined a series of trigonometrical calculations. The reductio for differences in the levels of the signals must next applied, and also for their altitude above the level of sea; and it is obvious that these reductions cannot made without having at least an approximate knowled of the dimensions of the earth, and without making so hypothesis respecting its figure, though the dimensi and figure of the earth are elements that can only be duced from the measurement and comparison of degre

From this general description it will be readily infe that the measurement of terrestrial degrees depends astronomical operations of very great nicety, and that

attempts made in ancient times could lead only to rude approximations with respect to the dimensions of the earth, supposing its figure to be spherical. Eratosthenes, who lived in the 3d century before Christ, is the first with the detail of whose operations we are acquainted who undertook to determine the length of a meridional arc on correct principles. Having observed the difference of the sun's altitude at the summer solstice at Alexandria and Syene in Upper Egypt, and having found, by means with which we are unacquainted, the itinerary distance between the two places, he inferred the circumference of the earth to be 250,000 stadia, and consequently the length of a degree 694⅓ stadia. Posidonius, some time after, measured in a similar manner the arc between Alexandria and Rhodes, and inferred the length of the degree to be 666⅔ stadia. Ptolemy, in his Geography, assigns 500 stadia as the length of a degree of the meridian; but as we are unacquainted with the precise value of the stadium, we cannot form any correct idea of the approximation attained in these ancient measures. In the 9th century, the Arabian caliph Almamoun ordered a degree to be measured on the plains of Mesopotamia. His mathematicians arrived at the exact value given by Ptolemy; a circumstance which, as it could scarcely have happened if they had operated independently, has led to the suspicion that they merely adopted the conclusion of the Greek astronomers. In modern times the measurement of terrestrial degrees has been justly regarded as of the greatest scientific importance. About the middle of the 16th century, Fernel made a rough measurement of the distance between Paris and Amiens by counting the revolutions made by his coach wheel, and concluded the length of the meridional degree to be 364,960 English feet. Norwood, in 1635, measured the distance between London and York, and found the length of the degree to be 367,176 feet. But the first who employed the method of triangulation for obtaining the length of a terrestrial arc was Snell, a native of Holland. The application of the telescope to instruments for measuring angles, by Picard, was an invention which gave a far greater accuracy and certainty to operations of this kind than could before be attained; and the discovery by Richer of the flattened form of the earth at the poles, and the consequent inequality of the meridional degrees, invested the subject with a new and unexpected interest. In the year 1735, the Academy of Sciences of Paris, to decide the important question of the spheroidal form of the earth, resolved that two arcs of meridian, the one at the equator and the other as near the pole as possible, should be measured with all the accuracy which the improved state of astronomy admitted of. Accordingly, Bouguer, Godin, and Condamine were despatched to Peru; Maupertuis, Clairaut, Lemonnier, and some other associates, to Lapland,—for the execution of this purpose. The latter party accomplished their mission, and returned to Paris within 16 months, Bouguer and his companions had to contend with great difficulties and hardships, and were detained not less than ten years. The result was, that the length of the degree of the meridian at the equator, reduced to the level of the sea, was found to be 56,753 toises, or 362,912 English feet; and in Lapland, under the parallel of 65½°, to be 57,437 toises, or 367,286 feet, exceeding the former by 684 toises.

Since these memorable expeditions several arcs of meridian have been measured in different countries, and all the results concur in proving that the degrees increase in length as we proceed from the equator to the pole, agreeably to the theory of hydrostatic equilibrium, which requires an accumulation of matter in the equatorial regions of the earth, in order to counterbalance, by its attraction, the effect of the centrifugal force of rotation. Lacaille, in 1751, measured a degree at the Cape of Good Hope; and the result is interesting on account of the locality, as no other operation of the kind has yet been undertaken in the southern hemisphere. In the same year an arc was measured in the Roman states by Maire and Boscovich; another by Liesganig in Hungary in 1762; one in North America by Mason and Dixon in 1764; and one by Beccaria in Piedmont in 1777; but the results cannot be regarded as entitled to much confidence in comparison of those obtained from the more extensive and accurate operations that have been since executed in France and England, and also in India. The French philosophers, in 1792, having chosen for the unit of their new system of weights and measures a fractional part of the terrestrial meridian, it was resolved to measure the arc extending through the whole of France from Dunkirk to Barcelona. This splendid undertaking was confided to two astronomers of the highest eminence, Mechain and Delambre, by whose spirited exertions it was carried through in the face of obstacles of the most formidable kind, arising from the political state of the country at that time. Every precaution that profound theory or eminent practical skill could suggest was adopted to secure the accuracy of the results. In 1806 the triangulation was extended from Barcelona through Spain to the coasts of the Mediterranean; and subsequently, after the death of Mechain, who fell a victim to his exertions, by Biot and Arago to the Balearic Isles. The whole, thus extended from Dunkirk on the north to Formentera on the south, comprehends 12° 22′. The English arc, connected with the trigonometrical survey of the kingdom, which has been carried on since 1790 under the direction of the Board of Ordnance, reaches from Dunnose in the Isle of Wight to Burleigh Moor in Yorkshire; nearly 4 degrees. Though no doubt is entertained that the result of this measurement is of a high degree of accuracy, it must be confessed that our confidence arises rather from the great excellence of the instruments employed than the science or skill of those to whom the operations were entrusted. It is deserving of remark that both the French and English arcs present this anomaly, that when portions of them taken at particular places are considered separately, the length of the degrees appears to increase on going southward. Two arcs of meridian have been measured in India. The first extends only a degree and a half; but the second is the longest which has been measured in any country, and includes about 16 degrees. It was begun, and about 10° executed, by Colonel Lambton; and the remainder was conducted by Captain Everest. The details of Colonel Lambton's operations are given in the *Asiatic Researches* (vols. viii. to xiii.); those of Captain Everest, in his *Account of the Measurement of an Arc of the Meridian between the Parallels of* 18° 3′ *and* 21° 7′. London, 1830.

Some portions of meridional arcs have more recently been measured in Europe, but as our limits will not permit us to enter into further details, we shall content ourselves with giving the following table of the results of those which appear to be deserving of confidence: —

| No. | Meridional Arcs. | Amplitude or length of Arc. | Latitude of middle point. | Length of Degree in English feet. |
|---|---|---|---|---|
| 1 | Arc measured by Bouguer, recomputed by Delambre | 3° 7′ 3″ | 1° 31′ 0″ S | 362,809 |
| 2. | First Arc measured in India by Col Lambton, from Trivandeporum to Paudree | 1 34 56 | 12 32 21 N. | 362,988 |
| 3 | Second Indian Arc by Col Lambton and Captain Everest, from Punnae to Kulliampoor | 15 57 39 | 16 8 22 | 363,040 |
| 4. | French Arc from Dunkirk to Formentera by Mechain and Delambre | 12 22 12 | 41 51 | 364,644 |
| 5 | English Arc from Dunnose to Burleigh Moor | 3 57 13 | 52 35 45 | 365,032 |
| 6 | Arc measured in Hanover by Gauss, from Gottingen to Altona | 2 0 57 | 52 32 17 | 365,301 |
| 7 | Arc measured in Lithuania by Struve, from Jacobstadt to Heckland | 3 35 5 | 58 17 37 | 365,577 |
| 8. | Arc measured in Sweden by Svanberg, from Maltorn to Pahtawara | 1 37 20 | 66 20 11 | 365,697 |

In the above table the numbers are exhibited as if the whole arcs had been measured at once, and the latitudes only observed at each extremity; but in fact, in the three long arcs, latitudes were observed at several intermediate stations, and consequently so many more independent measures obtained. Thus the second Indian arc consisted of five partial arcs, the French of six, the English of three, and Struve's of two; so that there are in the whole *twenty* independent determinations of the meridional degree. Combining the results of these twenty measurements by methods well known to mathematicians so as to deduce the most probable mean values, the dimensions and ellipticity of the earth are found to be as follows. —

| | English feet. | Miles |
|---|---|---|
| Equatorial diameter | 41,843,330 = | 7924·87 |
| Polar diameter | 41,704,788 = | 7898 63 |
| Difference of diameters | 138,542 = | 26 24 |
| Ellipticity, or difference of diameters divided by greater | 1 / 302·026 | |

Assuming these as the true elements of the earth's magnitude and figure, the following table is calculated, showing the length of a degree of the meridian at every 10th degree of latitude. The formula from which the calculation is made is the following: — Let $a$ be the equatorial semidiameter of the earth, $e$ the ellipticity, $l$ the latitude of the place, and $d$ the length of a degree at the latitude $l$; then $d = a\,(1 - e + 3\,e \sin^2 l)\ 3600 \sin. 1''$.

| Latitude. | Length of Degree in English feet. | Latitude. | Length of Degree in English feet. |
|---|---|---|---|
| 0 | 362,734 | 50 | 364,862 |
| 10 | 362,843 | 60 | 365,454 |
| 20 | 363,158 | 70 | 365,937 |
| 30 | 363,641 | 80 | 366,252 |
| 40 | 364,233 | 90 | 366,361 |

DEGREE OF LONGITUDE, on the earth, is a degree of the equator, or of any of its parallel circles. If the earth is a regular spheroid of revolution, the circles parallel to the equator, and consequently the degrees of those circles, must diminish regularly as their distance from the equator increases, according to a law derived from the nature of the ellipse. Hence, if we know the measured lengths of a degree of two or more small circles in different latitudes, we are in possession of data sufficient to determine the diameters and ellipticity of the earth. The measurement of degrees of longitude, therefore, in reference to the determination of the earth's figure, is of equal importance with the measurement of degrees of the meridian, and has accordingly been executed in various instances. The geodetical operations required in the one case are the same as in the other; but on account of the great difficulty of determining the astronomical longitudes with the necessary accuracy, the results have never been regarded as equally satisfactory. Supposing the equatorial diameter of the earth, as indicated by the meridional degrees, to be 41,843,330 English feet, and the ellipticity $= \frac{1}{302{\cdot}026}$, the following table shows the length of a degree of longitude at every tenth degree of latitude.

| Latitude. | Degree of Longitude in English feet. | Latitude. | Degree of Longitude in English feet. |
|---|---|---|---|
| 0 | 365,152 | 50 | 235,171 |
| 10 | 359,640 | 60 | 183,029 |
| 20 | 343,263 | 70 | 125,254 |
| 30 | 316,493 | 80 | 63,612 |
| 40 | 280,106 | 90 | 0 |

DEGRE'ES. In Music, the small intervals of which the concords or harmonical intervals are composed

DEHI'SCENT. (Lat. dehisco, *I gape.*) A term applied to those fruits which separate regularly round their axes, either wholly or partially, into several pieces.

DEIFICATION. *See* APOTHEOSIS.

DEI GRATIA (*by the grace of God*). A Latin formula, usually inserted in the ceremonial description of the title of a sovereign. It was used originally by the clergy.

DEILE'PHILA. (Gr δειλη, *evening*, and φιλεω, *I love.*) A subgenus of hawk-moths (*Sphingidæ*) belonging to the crepuscular or evening tribe of Lepidopterous insects. They are characterized by wings entire and acute; antlia rather elongated; antennæ short, and clubbed in the male. One species, *Deil celerio*, feeds upon the vine

DEINOTHE'RIUM. (Gr δεινος, *terrible*, θηριον, *wild beast.*) The name of a fossil genus of gigantic Pachyderms, chiefly remarkable on account of its enormous tusks, which projected downwards from the lower jaw instead of the upper, as in the elephant and walrus.

DE'ISM, or THEISM (Lat. Deus; Gr Θεος, *God*) Belief in the existence and attributes of God, coupled with disbelief in any express revelation of his will. There exist various shades of opinion among Deists, which the reader will find pointed out in Clarke's learned work on the *Attributes*, but general usage has assigned this word a meaning synonymous with *sceptic* or *freethinker*: hence it is regarded as a term of reproach. In its original acceptation, *theist* was directly opposed in meaning to *atheist*; but these terms are now frequently, though very incorrectly, employed without distinction to designate an *unbeliever in Christianity*.

DEJEUNER. (Fr. *breakfast.*) A term wholly naturalized in almost all the languages of modern Europe, not excepting the English, signifying the morning meal. The materials of which it is composed vary of course with the climate and usages of different countries; but it is worthy of remark that in France itself this term is rapidly losing, if indeed it has not already lost, its original acceptation, being used, particularly by the fashionable world, as synonymous with the English *luncheon*

DEL CREDERE COMMISSION In Mercantile Law, a term derived from the Italian (credere, *to trust*), which denotes a commission granted by a merchant to a factor to dispose of goods; the factor, for the consideration of an additional per-centage, agreeing to guarantee the solvency of the purchaser. *See* FACTOR

DE'LEGATES, COURT OF. Formerly the highest ecclesiastical court of appeal in England: in ordinary cases composed of three common law judges and three civilians; in special cases a fuller commission is sometimes issued. In case of a division of opinion, or where no common law judge is in the majority, a commission of adjuncts was issued. Appeal lay to it from the archiepiscopal courts. Its powers are transferred by 2 & 3 W. 4. c. 92. to the privy council.

DELEGA'TION. In the Civil Law, the act by which a debtor transfers to another person the duty to pay, or a creditor makes over to a third party the right to receive payment.

DELFT WARE. A coarse species of porcelain, originally manufactured at Delft in Holland, whence its name.





DE'LIAN PROBLEM. *See* DUPLICATION OF THE CUBE.

DE'LICACY. (Lat. deliciæ.) In the Fine Arts, minute accuracy as opposed to strength or force: slenderness of proportion, great finish, and softness are its characteristics.

DELIQUE'SCENCE. (Lat. deliquesco, *to melt down.*) When certain saline substances are exposed to air, they absorb so large a quantity of moisture as to run down into a liquid state, or *deliquesce*.

DELI'RIUM TRE'MENS. A disease of the brain, resulting from the excessive and protracted use of spirituous liquors; it is therefore almost peculiar to drunkards. It begins with excessive irritability, loss of sleep, frightful dreams and visions, and a multiplicity of the ordinary delusions of insane persons, ending in furious madness. The hands are usually, but not always, tremulous. By careful treatment, and more especially by the judicious use of opium, patients have recovered from this disease; but, for obvious reasons, it is difficult to manage, and subject to relapses. Bleeding should in almost all cases be, if possible, avoided.

DE'LITE'SCENCE. (Lat. delitescere, *to lie hid.*) In Surgery, when a tumour very suddenly and unexpectedly subsides, it is said to terminate in *delitescence*.

DE'LPHI, ORACLE OF; so called from Delphi, the capital of Phocis, the most famous of all the oracles of antiquity, sacred to Apollo. The origin of the oracle at Delphi is wrapt in obscurity. By some authors it is ascribed to chance; but many incline to believe that it owed its origin to certain exhalations, which, issuing from a cavern on which it was situated, threw all who approached it into convulsions, and during their continuance communicated the power of predicting the future. Be this as it may, these exhalations were soon invested with a sacred character; and as their reputation extended, the town of Delphi insensibly arose around the cavity from which they issued. The responses were delivered by a priestess, called Pythia, who sat upon a tripod placed over the mouth of the cavern; and after having inhaled the vapour, by which she was thrown into violent convulsions, gave utterance to the wished-for predictions, either in verse or prose, which were then interpreted by the priests. Originally the consultation of the oracle was a matter of great simplicity, but in process of time, when the accuracy of the predictions became known, a series of temples, each more magnificent than its predecessor, was erected on the spot. Immense multitudes of priests and domestics were connected with the oracle; and to such a height of celebrity did it attain, that it wholly eclipsed all the other oracles of Greece.

The position of the oracle was the most favourable that could well be imagined. Delphi formed at once the seat of the Amphictyonic Council and the centre of Greece, and, as was universally believed, of the earth. Hence, in every case of emergency, if a new form of government was to be instituted, war to be proclaimed, peace concluded, or laws enacted, it came to be consulted, not only by the Greeks, but even by the neighbouring nations; and thus the temple was enriched by an incredible number of the most valuable presents and the most splendid monuments, and the town of Delphi rose to be one of the most wealthy and important of the cities of Greece

As it was well known that the riches of all Greece were concentrated in the temple at Delphi, this sacred repository became frequently an object of plunder. But in spite of all the rapacity to which it was exposed, the oracle continued to utter its responses long after the seat of empire had been transferred from Greece to Rome; and it was only when Constantine the Great removed the sacred tripods to adorn the hippodrome of his new city, that the responses of the oracle ceased to be delivered. For a view of the characteristics of oracles in general, and the influence which they exercised over the nations of antiquity, see the article ORACLE.

DE'LPHIN. In Literary History, a name given to the edition of the Latin classics, prepared and commented upon by thirty-nine of the most famous scholars of the day, at the suggestion of Louis XIV., for the benefit of the young prince (in usum Delphini) under the superintendence of Montausier his governor, and his preceptors Bossuet and Huet.

DELPHI'NIA. A vegetable alkaline base, obtained from the seeds of the *Delphinium staphisagria*, or staves-acre.

DELPHI'NUS. (Lat. *a dolphin.*) The *Dolphin*, one of the ancient constellations of the northern hemisphere.

DELPHINUS. This term is restricted in modern Zoology to those species of Cetacea which have teeth in both jaws, all simple, and almost all conical. They are the most carnivorous in proportion to their size. The Linnæan genus *Delphinus* is now subdivided into *Hyperoodon*, of which the great bottle-nose dolphin is the type; *Delphinapterus*, represented by the beluga; *Phocæna*, represented by the common porpesse; and *Delphinus* proper.

DE'LTA. The Greek letter Δ; and, in antiquity, the lower portion of Egypt, comprised between the E. and W. branches of the Nile and the sea, was from its resemblance to the above letter called the Delta. And hence if any large river, before it enters the sea, diverges and forms two sides of a triangle, the sea being the base, the strand or alluvial land included by the three lines is called a *delta;* as the delta of the Rhone, the Danube, Ganges, &c.

DELTO'ID. Of the shape of the Greek letter delta, Δ. The term is used in anatomy and botany.

DE'LUGE. (Lat. diluvium.) In the 1656th year after the creation (according to ordinary chronology), in the 600th year of the life of Noah, and on the 17th day of the second month (November, according to some commentators), the waters began to rise upon the earth. They appear to be represented as swelling upwards by some upheaving force (the fountains of the great deep were broken up), and descending also in continual rain for forty days and nights. All the mountains "that were under the whole heaven" were covered; "all flesh perished that moved on the earth," with the exception of Noah and his family, and the animals which entered with him into the Ark. The waters remained 150 days; and then "returned from off the earth continually:" and the Ark rested on Ararat on the seventeenth day of the seventh month; and on the first day of the first month of the following year "the face of the ground was dry," but not completely drained of the water for nearly two months longer. Such is a very concise abridgment of the account of this great catastrophe contained in the 7th and 8th chapters of Genesis. Two subjects connected with it require a brief discussion:—the parallel traditions of ancient mythology; and the confirmation which the Mosaic account has been supposed by some to receive from the discoveries of modern geological science, which others have represented as directly opposed to it.

As to the first, the belief in the destruction of mankind by a deluge in the earliest times, and of the escape of one individual and family under circumstances resembling those recorded in sacred history respecting Noah, is a remarkable feature in the traditions of a great variety of nations The Fo-ki of the Chinese, the Satyavrata of the Indians, Xisuthrus or Seisithrus among the Assyrians, Deucalion and Ogyges among the Greeks,—all present striking features of analogy to the patriarch of scripture. even the Mexicans had their traditional deluge These fragments of early belief are collected very copiously in the third volume of *Bryant's Ancient Mythology*. (See also *Russell's Connexion of Sacred and Profane History*, vol ii ) It is undoubtedly true that some of these deluges may have been local inundations only; as, for example, the natural features of the Thessalian plain seem to account conclusively for the tale of Deucalion. Still the universality of these traditions, and their general agreement as to circumstances, seem to point to some common source of information.

With regard to geological theories of the deluge, it is perhaps the safest and wisest course to acquiesce in the general principle, that as scripture was given for a very different purpose than that of conveying physical knowledge, so the endeavour to torture its brief language into exact accordance with our discoveries, real or imaginary, in that branch of inquiry, is both vain and unreasonable But since much controversy has been expended on the subject, it may be worth while to observe, that in the instance of the deluge, the chief difficulties have arisen not from any endeavour of infidel writers to confute scripture by the aid of geology, but through the over eagerness of the advocates of religion to seize on each hasty generalization made in the progress of an advancing science, in order to press it into the service of their own opinions Thus the cause of revelation has been defended by physical arguments where no defence was called for; and these arguments have been necessarily abandoned afterwards by those who advanced them. We need not here speak of the notions which have been propounded by speculative geologists respecting the proximate causes of the deluge; such as Burnet (*Telluris Theoria Sacra*), Newton, &c.; and Dr. Geddes, whose ingenious theory is, that it was produced by a sudden increase of the central heat expanding the volumes of water supposed to be contained in cavities of the globe, breaking up its surface from within, and then submerging it under an inundation of *hot* water. More general interest has been excited by the imaginary proofs which from time to time geology has been supposed to furnish of the *fact* of a universal deluge. Thus the discovery of fossil shells in inland strata, and near the summits of the highest mountains, was at one time offered as conclusive evidence; and some infidel writers were reduced to the absurd shift of representing them as *lusus naturæ*, or accounting, like Voltaire, for those found on the Alps by supposing them to have been thrown away by pilgrims on their journey! But when, in the course of discovery, it was known that these fossil relics are to be found scattered through an infinite variety of solid strata formed apparently by partial deposition, one reposing beneath another, so as to form the whole superficial crust of the globe, the impossibility of considering them as the results of any great convulsion became evident, and the argument founded on them fell to the ground. A similar instance of over hasty conclusion has been exhibited in more recent times. Some geologists imagined themselves to have discovered proofs of a general convulsion, attended by a rapid passage of water over the surface of the whole earth, at a period subsequent to the deposition of the last tertiary strata. This notion is to a certain extent countenanced by Cuvier (*Theory of the Earth*, Dr. Jameson's translation, pp. 11. 13. &c.), and by Dr. Buckland (*Reliquiæ Diluvianæ*, 1823.); and it is unfortunate that Dr. Sumner (*Records of the Creation*) should have adopted it as the foundation of an argument in favour of revelation. For more recent investigations have shown that it is impossible to distinguish these supposed traces from those of local disturbance.

On the whole, the question may perhaps be summed up thus: many writers (Cramer, Von Hoff, &c.) have contended that the scriptural deluge was local only, extending over the then inhabited portion of the earth; but if it is to be regarded as universal, and the expressions of the Bible taken in their literal sense, geology (in its present very imperfect state) affords us no insight into the possible *causes* of such a convulsion. But on the supposition of its having been produced by a sudden miraculous interference with the order of nature, no such information was to be expected from science. Neither does geology afford any distinct *evidence* of a universal deluge; but, looking at the manner in which that deluge is recorded to have taken place, and the short period of its duration, it is difficult to see how any permanent results which it may have produced *could* be distinguished from those of the innumerable local inundations of which the surface of the earth furnishes such manifest testimony. The points of contact between natural science and revelation are in reality few or none, it is the jealousy of believers on the one hand, and the cavils of scepticism on the other, which have given rise to the very unmeaning controversies which exist upon the subject.

DE'MAGOGUE (Gr. δημος, *people*, and αγωγος, *leader*) One who directs or leads the people in political matters In its original acceptation it was considered as a most honourable designation, having been applied to Solon Demosthenes, and in fact to many of the most illustrious characters of antiquity; but it is now almost invariably used in a bad sense The oldest and most satirical of all portraits of the demagogue is traced by Aristophanes in his play of the *Knights*, in the character of Cleon

DEMA'ND. In Political Economy. *See* POLITICAL ECONOMY.

DEMARCA'TION. (Fr.) A term used to designate the line or boundary by which one object is separated from another. The word was first introduced in 1493, when Pope Alexander VI., in order to put an end to the disputes which prevailed between the crowns of Spain and Portugal relative to their Indian discoveries and conquests by virtue of his pontifical authority drew through the ocean an imaginary line, by which the dominions of both parties were defined; and thus originated the expression *line of demarcation*. It is only in this phrase that the word is employed to this day in all the languages of Europe

DEMES'NE. (Lat. terra dominicalis) In Law, originally that portion of the lands belonging to a lord which was held in his own occupation. Hence it is sometimes used to distinguish those parts of a manor which the lord has in his own hands, or those of lessees at rack-rent, from those which are in the hands of freeholders and copyholders. *See* ANCIENT DEMESNE.

DEME'TER (Doric Gr. δα, *the earth*, and μητηρ, *a mother*) The Greek appellation for Ceres (quod vide).

DE'MI. (Fr.) A word signifying *half*, frequently used in the composition of English words, being equivalent to the Latin *semi*.

DE'MIDITO'NE. (Gr. διτονος.) In Music, a minor third. *See* THIRD

DE'MIGODS. A general appellation of the inferior divinities of Greece and Rome, more particularly of such of the mixed offspring of divinities and mortals as were afterwards deified. Of these the number was almost incredible; and though their worship was not cultivated with such veneration or solemnity as that of the superior gods, it prevailed to a greater or less extent in every quarter of the ancient world, and formed a large part of the heathen mythology.

DE'MILUNE, in Fortification, is a work placed before the curtain.

DE'MIQUAVER. In Music, a note equal in duration to half a quaver.

DE'MITINT. In Painting, a tint representing the mean or medium between light and shade; by some called a *half tint*.

DEMIU'RGUS, *Demiurge*. (Gr. δημιουργος, from δημος, *people*, εργον, *work*) In the original sense of the word, as used by classical authors, an artificer employed

in ordinary handicraft. In the language of Platonist writers, it denotes an exalted and mysterious agent, by whose means God is supposed to have created the universe. Hence the Demiurgus, or Logos, as the same imaginary agent is termed in the *Timæus* of Plato, is identified by the Platonizing Christians with the second person in the Trinity.

DEMO'CRACY. (Gr. δημος, *people*, and κρατεω, *I govern*.) A government is usually termed a democracy in which the whole of the people, or a large proportion of it, exercises sovereignty either directly or by representatives. According to some political writers, the term is strictly appropriate only where "a majority of the adult males" share in the government. In Aristotle's view of governments, democracy is a perversion of the imaginary system, which he terms Politeia, or commonwealth par excellence; in which the majority are supposed to govern for the good of the whole, while in democracy they govern for their own. *See* REPUBLIC.

DE'MOGO'RGON. (Gr. δαιμων, *a demon*, and γοργος, *terrible*.) In Mythology, a mysterious divinity of antiquity, of whose origin, attributes, and history no satisfactory account can be given, in consequence of the obscurity in which they are enveloped By some writers he is regarded as the author of creation; others consider him to have been a famous magician, to whose spell all the inhabitants of Hades were subjected; but all concur in viewing him as an object rather of terror than of worship. hence in the *Paradise Lost* (Book 2.), Milton speaks of

——— the dreaded name
Of Demogorgon

For further information the reader is referred to one of the most learned works of any age or country, the *Dictionnaire de Trevoux*

DE'MOISELLE. In Zoology *See* GRINDAE

DE'MON. (Gr. δαιμων, *a spirit*) The existence of invisible beings of superior powers and intelligence to mankind, though inferior to the Deity, has been an article of belief among all heathen nations They have varied, however, in the dispositions they have assigned to them. The Greeks, from whom we derive the term in Scriptural language, applied it originally to the deified spirits of departed heroes, whom they supposed to have some influence in promoting the good of mankind, and considered therefore as objects of adoration. The manner, however, in which demons are represented in Scripture as evil spirits inflicting injury on men at the suggestion of the Father of Evil, is conformable to the oriental notion upon such points, except, indeed, that in the Scriptures the general supremacy of God, who suffers evil to exist, is maintained, in opposition to the eastern dogma of the eternal and equal conflict of the good and the evil principles. The early fathers indulged in much speculation upon these subjects, but in modern times the literal interpretation of the agency of demons as referred to in Scripture has been frequently called in question. The demons, like the fairies and goblins of other mythologies, are represented with various characters of beneficence, malice, and wanton mischief They were sometimes distinguished by the names Cacodemon and Agathodemon (from κακος, *bad*, and αγαθος, *good*), according as their influence was evil or beneficent.

DEMO'NIACS. Persons possessed by or under the influence of demons or devils, of whom mention is made in some passages in the New Testament. Some divines have supposed that such influence was permitted to the powers of evil at one particular time for the greater manifestation of our Lord's authority in rebuking them: but it is certain that the idea of demoniacal possession was very ancient among the oriental nations; and those to whom it seems incredible that it should have been grounded on fact, must be content with interpreting such passages of Scripture as a concession to the opinions and feelings of the Jewish people.

DEMONO'LOGY. (Gr δαιμων, *deity* or *dæmon*, and λογος, *discourse*.) The belief in an intermediate race of beings, between deity and humanity, has been a prevalent feature in almost every popular creed; and all tradition or speculation respecting it may be said to fall under the general term of Demonology. Among the early oriental nations, especially the Persians and Egyptians, the science of astronomy appears to have been essentially connected with this branch of superstition; the heavenly bodies were honoured as dæmons or celestial intelligences. This ancient belief appears to have had much influence on the Jewish rabbinical writers; and out of it, connected with what is revealed to us in the Old Testament of the existence and attributes of angels, they framed their peculiar mythology.

The Greek word δαιμων, *dæmon*, is said to be derived from δαημων, *knowing* or *intelligent*. In the earliest monuments of the language, its signification is vague and uncertain. In Homer it generally signifies a deity: δαιμονιον is anything godlike, wonderful, which may have been communicated or inspired by a deity; but, in the *Odyssey*, some traces are to be found of the meaning "fortunate" or "unfortunate" attached to the word. In Hesiod, however, we have an express mythological account of the dæmons,—as spirits, in a state between mortality and divinity, peaceful and favourable to man: he describes them as of different orders. The mortals who lived in the golden age have become dæmons of the first rank; those of the silver age have inferior honours, and are mortal, although their life is prolonged to a length of many hundreds of human generations. The heroes form a still inferior class of intermediate spirits. In popular language, when hero-worship became widely spread in Greece, the word hero and dæmon were used without much distinction; but the more recondite difference appears to have been this,—the hero was the departed worthy himself, such as he had once lived on earth; the dæmon was his immaterial part, converted into a sort of abstract principle,—a spiritual agent of good or evil, favourable or unfriendly to mankind. It is in this sense also that the inferior deities themselves are designated as dæmons. Thales is said to have defined more accurately the difference between gods, heroes as the souls of deceased mortals, and dæmons properly so called; and in Plato's theology the dæmons occupy an important place —as intermediate spirits, closely watching over, directing, and recording the actions of mortals. By later writers they were divided into many classes: some ministers of punishment and revenge, some freeing from evils already befallen (λυσιοι), some warding off their approach (αλεξικακοι), &c It was in Egypt and Syria, under the Ptolemies and Seleucidæ, that the Grecian philosophy and mythology came in contact with those of the Rabbis; and from that union a new mixed system of dæmonology took its origin. Hence, in the Greek of the New Testament, the word δαιμονιον is taken, without addition or qualification, as an evil spirit, and rendered by our translators "devil."

Analogous to the dæmons of the Greeks were the genii of the Romans, but there were peculiar and characteristic features about the belief in the latter which show it to be of a different origin, probably derived from the Etruscans, who, as some antiquarians believe, drew their mythology from the ancient source of Samothrace. The genii of the Romans were an innumerable host of spirits: every man, house, or city had an attendant genius. The genius of every mortal is mortal as himself; accompanies him into life, and conducts him in all its vicissitudes In this sense, the genius was a favourable companion to enjoy the good things of life is represented as "indulging" or gratifying the genius; abstaining from them, as "defrauding" him. Wine and flowers are appropriate offerings to him. But he is also "vultu mutabilis, albus et ater." he is the companion of the mischances as well as the pleasures of life, unless, as the difficulty appears sometimes to have been solved, the individual had his *pair* of genii, good and bad. And this latter should appear to have been the popular belief among the Etruscans, as far as we can collect it, in a subject where all is vague and indistinct, and it is impossible accurately to separate the abstract creations of philosophers and poets from the substantive objects of general belief. The Etruscans represented the evil genius as a dark and frightful figure, attending a mortal on one side, who is protected or followed on the other by a child or youth — the usual emblem of the good genius. The genius is often represented on vases and in ancient paintings as a winged figure; and a genius holding a torch downwards is the emblem of death.

The dæmons of the middle ages were simply fallen angels or devils, according to the sense of the word in the New Testament; and hence demonology, in the language of modern writers, generally signifies the history of the supposed nature and properties of such evil spirits, and of the modern superstition respecting compacts between them and mankind. *See* MAGIC, WITCHCRAFT.

DEMONSTRA'TION (Lat. demonstro, *I show*), was used by the old writers to signify "any manner of showing either the connection of a conclusion with its premises, or that of a phenomenon with the asserted cause; but it now means, in philosophical language, only that process by which a result is shown to be a necessary consequence of the premises from which it is asserted to follow, on the supposition that those premises are admitted, either as matter of fact, or of intuitive evidence, or of previous demonstration." Demonstration is also used in ordinary language as synonymous with *proof*: thus it is often said that "evidence amounts to demonstration."

DEMONSTRATIONS, in a Military sense, are manœuvres practised for the purpose of misleading the enemy.

DE'MOS. (Gr. δημος.) In Ancient History, a borough or ward; an Attic word, denoting one of the districts into which Attica was divided, and which in early times were bound together by the ties of common blood, but were not united closely into one nation till the time of Theseus, who fixed on Athens as the nucleus of the state.

DEMU'RRAGE. In Mercantile Law, the delay which a merchant makes in loading or unloading a ship, beyond the time specified in his charter-party, or other agreement with the owners; in which it is usually stipulated that

he shall pay at a certain rate per diem for such extra time, which payment is also termed demurrage.

DEMU'LCENTS. (Lat. demulceo, *I soothe.*) Medicines which sheathe and defend sensible parts from the action of irritating matters; they are chiefly mucilaginous substances, such as gum, starch, &c.

DEMU'RRER. (From the Lat. demoror, *I delay.*) In Law, an issue between plaintiff and defendant on matter of law. It confesses that the facts are true as stated by the opposite party, but denies the legal consequences inferred by the opposite party from these facts. Demurrers are either general or special. (*See* PLEADING.) Demurrers in equity are of the same nature with those at law. Demurrer may be also to an indictment in criminal cases.

DEMY. *See* PAPER.

DENA'RIUS. A Roman silver coin worth ten asses originally, and afterwards considered equal to eighteen asses, when the weight of the latter coin was reduced to one ounce.

Originally the denarius was $\frac{1}{100}$ of a pound of silver, but its weight varied. Its value is considered equal to $7\frac{3}{4}d.$ of English money.

There was also a gold denarius equal in value to wenty-five silver ones.

DENDRO'DOA. (Gr. δενδρον, *a tree*, and ωον, *an egg*) The name of a subgenus of Ascidians, or fixed tunicated Mollusks, suggested by the ramified form of the ovarium, but this structure is not peculiar to the species included in the genus so designated.

DE'NDROMYS. (Gr. δενδρον, and μυς, *a mouse*) A South African genus of Rodentia, nearly allied to the true mice, but differing in the habits of the species, which frequent the branches of trees, in which they construct their nest and bring forth their young.

DE'NDROPHIS. (Gr. δενδρον, and οφις, *a serpent*) A genus of harmless serpents of the great family of Colubers, remarkable for their long and slender body

DE'NIZEN. (Welsh dinassdyn, *man of the city*) In Law, an alien born, who has received ex donatione regis letters patent to make him an English subject He may take lands by purchase and devise; but cannot enjoy offices and trusts, &c., or receive a grant of lands from the crown.

DENOMINA'TOR. A term used in Arithmetic, in speaking of fractions, to denote the number of parts into which the unit or whole is divided. Thus, for example, in the fraction $\frac{7}{12}$ (seven twelfths) of a foot, 12 is the denominator, and indicates that the unit or one foot is divided into 12 equal parts; and 7, the numerator, shows how many of these parts are to be taken. The denominator always indicates unity, for the whole is equal to all its parts. A fraction may always be regarded as a whole number, whose unit is a part of the primitive unit, which part is expressed by the denominator. Thus, in the fraction $\frac{7}{12}$ of a foot, the foot is supposed to be divided into *twelfths* or inches; and $\frac{7}{12}$ expresses the same thing as 7 inches, or the particular unit, an inch, taken seven times.

DENOU'EMENT. (Fr.) A term completely naturalized in England; used to designate the development of the plot or story in a novel or play, and in short in every department of literature.

DE'NSITY (Lat. densus, *thick*), is used in Physics to denote the quantity of matter which a body contains under a given or determinate surface, for example, a cubic foot. The quantity of matter in any body is called its mass, and is measured by the weight of the body, to which it is always proportional. Hence the density of any body is great in proportion as its weight is great and its volume small; or, the density of bodies are directly as their masses, and inversely as their volumes. It follows also from the definition, that if two bodies have the same volume, their densities are directly as their masses or weights; and that if two bodies have the same mass or weight, their densities are respectively in the inverse ratio of their volumes. The density of a body is also proportional to its specific gravity.

DE'NTAL FO'RMULA. (Lat. dens, *a tooth.*) A notation used to signify the number and kind of teeth of a mammiferous animal, and usually forming the main element in its generic character. Thus the cats, or genus *Felis*, are characterized by incis. $\frac{6}{6}$; canin. $\frac{1}{1}, \frac{1}{1}$; præmol. $\frac{2}{2}, \frac{2}{2}$; mol. $\frac{1}{1}, \frac{1}{1} = 30$; which signifies that they have six incisores in both the upper and the lower jaw; one canine tooth on each side of both jaws; two præmolares, or false molares, on each side of each jaw; two true molares on each side of the upper, and two on each side of the lower jaw. The dental formula of man is — incis. $\frac{4}{4}$; canin. $\frac{1}{1}$, præmol. $\frac{2}{2}, \frac{2}{2}$; molares, $\frac{3}{3}, \frac{3}{3} = 32$.

DENTA'LIUM. A genus of Mollusks inhabiting elongated univalve shells, resembling an elephant's tusk in miniature, whence the name.

DE'NTATE. (Lat. dens.) In Zoology, the margin of a part of an animal is so termed when it is cut into teeth whose sides are equal, or nearly so.

DENTA'TUS. (Lat. dens.) Toothed; applied to the margins of bodies furnished with sharp teeth with concave edges.

DE'NTES (Lat. *the teeth*), properly so called, are parts peculiar to the vertebrate animals, composed of gelatin, hardened principally by the phosphate of lime, and are fixed to the bones of the mouth. They serve to catch, kill, hold, pierce, cut, or crush the objects of food, and are variously shaped accordingly. Substances composed of softer material, generally horn, perform the analogous offices in the invertebrate animals, and are generally called teeth; horny material is substituted for teeth in a few fishes, in chelonians, birds, whales, and the *Ornithorhynchus paradoxus*.

In fishes the teeth may be situated on the intermaxillary, maxillary, mandibular, palatine, vomerine, pterygoid, hyoid, or pharyngeal bones; in a few instances they are implanted in sockets or "alveoli," or they may be fixed to an osseous base which is attached by ligamentous substance to the oral bones, but most commonly they are immediately anchylosed, or joined by a direct continuation of bony substance, to the bones themselves which encompass the mouth.

In reptiles the teeth may be found on the palatine, pterygoid, or vomerine, as well as on the maxillary and intermaxillary bones They are generally anchylosed, or confluent with the substance of the jaws, but in the plesiosaurs and crocodiles are implanted in sockets.

In mammals the teeth are confined to the maxillary and intermaxillary bones, are always implanted in sockets, and in this class only may be so fixed by more than one fang or root

Teeth generally consist of three distinct substances, viz. ivory, enamel, and bone, or cæmentum, also called crusta petrosa

The texture of the ivory is minutely tubular, that of the cæmentum of combined tubules and cells, and the earthy material is arranged principally in these cavities, which have definite arrangement and proportions in each species of animal The enamel consits of hexagonal filamentary crystals

In the human subject the teeth are called, according to their figure, "incisors," "canines," "bicuspids," and "molars," the same terms have been transferred to the teeth of the mammalia generally, except that those which are analogous to the bicuspids in man are called "præmolars," or spurious molars A tooth is divided into a crown, a neck, and a fang or fangs.

The vascular bodies concerned in their development are called "pulp" and "capsule" the ivory or body of the tooth is formed by the former, the enamel and cement are due to the latter organ.

In most cases when the pulp has secreted as much ivory as forms the full-sized crown of the tooth, it begins to diminish in size, and as it continues to exercise its function during the progress of its absorption, a gradually decreasing fang is the result: when the absorption of the pulp, instead of being general, proceeds from two or three parts, a corresponding number of fangs are extended from the crown But sometimes the pulp retains its full size and activity during the lifetime of the animal, in which case the part of the tooth lodged in the socket presents the same size and form as the protruded crown, of which it is a direct continuation. The fore teeth of the rat, beaver, and other rodents are familiar examples of these constantly growing teeth. But this is not the only mode in which excessive wear and tear of the teeth is provided for. In the elephant when one grinder is worn down it is pushed out, and replaced by a second of subsequent formation; these successional teeth, or "dents de remplacement," as they are termed by the French anatomists, are formed in the elephant, each in a cavity at the back part of the jaw, behind the tooth which they are destined to succeed. In other animals again, the teeth which suit the size of the jaws when young are pushed out by others which are proportioned to the size of the full-grown jaws; these, which are termed "permanent teeth," succeed the "deciduous teeth" in the vertical direction, being developed in the substance of the jaws above the deciduous teeth in the upper, and below the deciduous teeth in the lower jaw. As the deciduous series of teeth are generally developed in the mammalia at the period when the young animal is suckling, they are commonly called "milk" teeth; but as in some rodents deciduous teeth are formed and shed before birth, they might be termed "uterine" teeth. Thus teeth may succeed each other in the horizontal or vertical direction. In the human subject all the deciduous teeth are succeeded vertically; but the additional teeth follow each other from behind forwards. In mammalia a tooth has not more than one successor in the vertical direction, but in reptiles and fishes there may be many such.

It is a singular but constant fact, that in mammalia the permanent molar always presents a more simple crown

than the deciduous one which it has replaced; thus, in man, the quadricuspid milk grinders are succeeded by the permanent bicuspides.

DE'NTILS. (Lat. dentes, *teeth*.) In Architecture, small square blocks or projections in the bed mouldings of the cornices in the Ionic, Corinthian, Composite, and occasionally Doric orders. Their breadth should be half their height; and, according to Vitruvius, the intervals between them should be two thirds of their breadth. In the Grecian orders they are not used under modillions

DE'NTIRO'STRES. (Lat. dens, and rostrum, *a beak*.) The name of a tribe of Insessorial birds, characterized by having a notch and tooth-like process on each side of the margin of the upper mandible. In connection with this organization the Dentirostral birds manifest rapacious habits, and prey on smaller and weaker birds. The butcher-birds belong to this tribe

DENTI'TION. (Lat. dens) The cutting of the teeth. At birth the teeth consist of pulpy rudiments buried in the gum; and it is not till the third or fourth month that they begin to assume shape and hardness At this period children generally become fretful; the saliva flows copiously, and they are fond of biting upon any thing hard and cold; the gums become turgid; there is more or less fever, frequently a cough; and a rash appears, commonly called the *red gum*. These symptoms generally subside in the course of a fortnight or three weeks, and the child remains tolerably free from uneasiness till the seventh or eighth month, when the gums become tender, and often so much so, at some particular spot, that the slightest touch or pressure produces extreme pain. the gums become more red and swollen, but paler at the upper part, which, just before the tooth appears, becomes blistered. During these periods an increased flow of saliva and a lax state of bowels are favourable symptoms; but where the local irritation is considerable, the gums should be freely lanced, and any excessive diarrhœa should be very cautiously checked: small doses of magnesia or of chalk julap with dill water, and occasionally with a little powdered rhubarb, will generally be sufficient for this purpose When involuntary motions of the jaws and face, or more general convulsions ensue, and are not relieved by the loss of blood which generally follows proper lancing of the gums, or where there is drowsiness and oppressed respiration, a leech or two to the temples, and a small blister to the back of the neck, or behind the ear, must be promptly resorted to; and any sluggishness of bowels prevented, or even anticipated, by a little calomel and rhubarb, or some other active purge. Very mild opiates, very cautiously administered, may afterwards prove necessary, but the administration of these in any form to young children requires the utmost caution, and syrup of poppies and other soothing remedies should never be entrusted to the nurse The period of teething in children cannot be too scrupulously watched over, as the irritation which then ensues seems not unfrequently to lay the foundation of water in the head, especially where there is a predisposition to that disease.

DENUDA'TION. (Lat. denudo, *I lay bare*) In Geology, the removal of part of the land, so as to lay bare inferior strata

DENUDA'TUS. (Lat.) Naked In Botany, applied to the polish or texture of bodies, and denoting the reverse of hairy, downy, or any similar term.

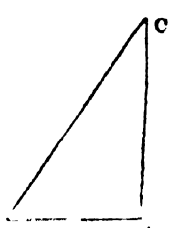
DEO'BSTRUENTS. Medicines which remove obstructions. The term is often used in reference to the removal of glandular complaints.

DE'ODAND. (Lat. Deo dandum, *to be given to God*) At Common Law, every personal chattel which had been the immediate occasion of the death of a human being is forfeited to the king on the finding of a coroner's inquest; to be applied as alms by his almoner Where a thing not in motion was the cause of death, it was held that the part only which was the immediate cause was forfeited, as the wheel of a cart, where a man met his death by climbing on the wheel at rest and falling from it: if in motion, the whole; as, the whole cart, where the wheel went over him. However, juries for a long time past took on themselves to assess a sum of money, as the value of the thing forfeited; and in this way to a certain extent usurped a power which the principle of the law by no means entrusted to them; viz. of imposing a fine where they believed negligence to have caused death. But this evil was remedied by the 9 & 10 V. c. 62., which abolished all forfeiture of chattels in respect of homicide from Sept. 1, 1846, and all inquiry by any coroners' inquest relative to Deodands.

DEONTO'LOGY. (Gr. δέον *due*, and λόγος *discourse*.) The science of duty; a term assigned by the followers of Jeremy Bentham to their own doctrine of ethics, which is founded on the tendency of actions to promote happiness. (See *Bentham's Deontology, init.*; also Mr. Whewell's Preface to *Sir James Mackintosh's Dissertation on Ethics*, Edinb. 1836; and art. ETHICS in this work)

DEPA'RTMENT. (Fr. departir, *to divide*.) In Geography, a territorial division of the kingdom of France. Before the first revolution, France was divided into 37 generalities, or governments, each of which was subdivided according to local custom into districts, bearing various names; and the laws regulating property in each were subject to extremely complicated varieties. The plan of a new division into more convenient portions was first conceived by the Constituent Assembly in 1787, and carried into effect in 1790. Mirabeau proposed the formation of 120 departments; but the actual number formed was 80, afterwards increased by subdivision to 83. M. Belleyme, geographical engineer, was the chief agent in the work. In tracing the limits of the departments, the subsisting divisions of provinces and generalities were maintained to a certain extent; but the chief object was to render them nearly equal on an average repartition of size and population, so that the more populous departments are in general smaller; but the division is by no means uniform. The names of the departments are chiefly taken from rivers, mountains, or other well-known geographical objects. In 1808, the number was increased by conquest to 127, including 12 for the colonies These last were subsequently retrenched; but in 1811, when the empire extended from Rome to Hamburg, the total number was 130. At present France has 86 departments. Each is administered by an officer named by the government with the title of Prefect, and subdivided into *arrondissements* and *cantons*.

DEPA'RTURE. A nautical term, used to denote the distance a ship has gone to the east or west of the meridian from which she departed. The difference of meridians being first found in degrees, the departure must be estimated by the number of miles in a degree of the parallel of latitude where the ship is. In *Mercator's Sailing*, the departure is represented by the base A B of a right-angled plane triangle, A B C; of which the angle at C opposite the base is called the *course*, and the hypothenuse B C is the *distance sailed*. Hence the theorem for finding the departure. — As radius is to the sine of the course, so is the distance run to the departure.




DEPHLEGMA'TION. The operation of freeing spirit of wine and certain other fluids from the water which they usually contain A very strong and pure spirit is often said to be highly *dephlegmated*.

DEPHLOGISTICA'TION. (Lat. de, *down*; and Gr. φλογιστος, lit *burned up*) A term applied by the older chemists to certain processes by which they imagined that phlogiston was separated from bodies. They regarded oxygen as common air deprived of phlogiston, and hence called it *dephlogisticated air*.

DEPI'LATORY (Lat de, *from*, and pilus, *hair*) Any application which removes hair from any part of the body The celebrated Turkish Depilatory is a mixture of 7 parts of quicklime and 1 of orpiment. The latter ingredient is probably useless, for when powdered quicklime is made into a thin paste with water, and applied by a camel-hair pencil to any part till it produces a tingling or burning sensation, on wiping it off with a wet sponge the hair, especially if it be soft and delicate, is removed with it

DEPLOY. (Fr deployer, *to expand*.) In the art Military, the expansion of a body of troops previously compacted in column, so as to present a larger front; generally for the purpose of performing some evolution, or of forming into line, or of directing an attack in some quarter least expected by the enemy.

DEPORTA'TION In French law, a punishment equivalent to transportation in English. It is ranked as third in degree, after capital punishment, and condemnation to the galleys or public labour (travaux forcés) for life. Deportation for political offences was a common punishment at one period during the French revolution; especially after the fall of Robespierre and his party It was then usually executed by conveying the criminals to Cayenne in South America.

DEPOSI TION. In Law, the testimony of a witness, put down in writing, in answer to interrogatories legally exhibited for that purpose. In the court of chancery such depositions form the established medium of proof; and the interrogatories are exhibited, in London by the examiners, in the country by commissioners appointed for that purpose. Depositions in civil actions, in the courts of common law, are regulated by the stat. 1 W. 4. c. 22. By 7 G. 4. c. 64 the examination of the prisoner and witnesses before a magistrate on a charge of felony must be taken down in writing, and returned to the court. If duly taken, these depositions are evidence at the trial under certain restrictions.

DEPO'T (Fr.), is used to designate a place where all sorts of military stores and provisions are kept, or where recruits are received and trained. It is also applied to that portion of a regiment which remains at home when the rest is ordered upon foreign service.

DEPRE'SSED. (Lat. deprimo, *I depress*.) In Zoology, the whole or part of an animal body is so called when its vertical section is shorter than the transverse.

DEPRE'SSION OF EQUATIONS, in Algebra, is the reduction of equations to a lower degree, by dividing them by one or more of their component factors. It is only in a few cases that equations, whose roots are unknown, can be thus depressed. 1st, When some particular relation subsists between two (or more) of the roots; for example, if an equation contain equal roots these may be found, and the equation reduced as many dimensions lower as there are equal roots. 2d, If two roots of an equation be of the form $+a$, $-a$, differing only in their signs, they may be found, and the equation depressed. 3d, If the equation is reciprocal, that is to say, such that its form is not changed by changing $x$ into $\frac{1}{x}$, then it is susceptible of depression. The methods by which these classes of equations are depressed are to a certain point to be regarded as a branch of the transformation of equations, since the general object of the theory is to make the solution of an equation depend on the solution of another more simple. (See *Bourdon's Algebra*.)

DEPRE'SSION OF THE HORIZON, or DIP OF THE HORIZON, in Nautical Astronomy, denotes the depression or dipping of the visible horizon below the true horizontal plane, and which arises from the circumstance that the eye of the observer is not placed on the same level with the surface of the sea, but at some distance above it. Hence in observing the altitude of the sun or a star above the horizon with the sextant, the altitude appears greater than it really is. Let $a$ = the radius of the earth, and $x$ = the height of the eye above the horizon; then the cosine of the angle of depression $= \frac{a}{a+x}$. At the height of 10 feet this amounts to about three minutes of a degree.

DEPUTA'TION (Lat.), is applied to a certain number of persons selected from a company or body, and appointed to lay before a sovereign, an assembly, a minister, or other public functionary, a statement of the views of the selecting party relative to any question, or to prosecute any affair in their name.

DE'PUTIES, CHAMBER OF. The lower of the two legislative chambers in France under the monarchy. The right of election was in persons of 25 years of age, paying 200 francs of direct contributions; *i. e.* the land tax, personal tax, door and window tax, and a few others. officers in the army and navy, and members and correspondents of the Institute, were only required to pay 100 francs. The list of electors was made out by the mayors of the communes annually, and revised by the prefect; subsequent claims were judged by the prefect in council, and, in the last resort, by the Cour Royale. There were 459 members of the chamber, each elected by a separate electoral college: the election was by ballot. To be eligible to the chamber, the candidate must be thirty years of age, and pay 500 francs of direct taxes. The total number of electors in 1846-7 amounted to 200,000. The duration of the chamber was triennial.

The Chamber of Deputies was divided into nine bureaux; which were renewed every month. To these bureaux questions were referred by the chamber; as well laws proposed by the king or the house of peers as propositions of individual members. The bureaux reported on the question, after separate discussion in each, before the general discussion in the chamber began. Except in case of dissolution, measures commenced in one section passed on to the next in the same stage in which they had been left. The vote on a proposed law was secret, on any other proposition open.

The "coté droit," "coté gauche," and the "centres," formed the three grand divisions of which the Chamber of Deputies was composed. When the three chambers of the States-General of 1789 were consolidated into one by the designation of the National Assembly, the most distinguished members of the aristocratic and republican parties were in the habit of sitting together, for the purpose of communicating more easily with one another: the former occupied the benches to the right, the latter those to the left of the president's chair; while the centre benches, or those fronting the president's chair, were filled by those who held various intermediate shades and modifications of opinion. This custom remained in force down to the fall of the monarchy, and nothing could exceed the nicety with which each variety of political opinion was grouped in the French representative assembly. The coté droit, or the side to the right of the president's chair, was occupied by those members who inclined to favour the royal prerogative; the coté gauche, on the other hand, was set apart for those who were more in favour of popular ascendency; while those members who, with considerable difference of opinion among themselves, generally supported the ministers, occupied the "centres" (centre droit et centre gauche), which might thus be termed the ministerial benches. But, it has been judiciously remarked, "as in every great political party there are shades of opinion, some being more warm and violent, and others more moderate, discriminating, or cautious, so both the coté droit and the coté gauche were generally subdivided into three sections each. The more zealous royalists took their seats at the outer extremity of their side of the house towards the president, and were styled the "extrême droit;" the ultra liberals sat on the corresponding seats on the opposite or left side, and were styled the "extrême gauche." (For further information see the *Encyclopédie des Gens du Monde*, and the *Penny Cyclop.* art. "Coté Droit.")

DE'RBYSHIRE SPAR, *Fluor Spar*. It is of various colours; and the large nodules, which are peculiar to Derbyshire, are often beautifully veined, and admit of being turned in the lathe into vases and small columns. A fine variety of this spar occurs in Cumberland, in cubic crystals of a pale sea-green colour. The cube is the most common form of the crystals of fluor; but it also occurs in octohedra, some fine specimens of which have been found associated with galena in the mine of Beer Alston upon the Tamar. It consists of fluorine and calcium.

DERM. (Gr. δερμα, *skin*.) The true or organized layer of the tegumentary covering of animals. It is composed of a close and irregular network of whitish fibres, consisting of condensed cellular tissue, whence it is also termed "corium," and is every where traversed by capillary arteries and veins, absorbents and nerves; and, in the mammalia, with the roots of the hairs and the ducts of the sudoriferous follicles: it is covered with the "rete mucosum" and "epiderm." The derm is of considerable thickness in the rhinoceros, hippopotamus, elephant, &c.; whence the name "Pachyderma," applied to the order containing these and allied quadrupeds.

DERMA'PTERANS, *Dermaptera*. (Gr. δερμα, and πτερον, *a wing, skin-winged*.) An order of insects dismembered from the *Orthoptera* of Latreille, and including those which have the elytra wholly coriaceous, and always horizontal, the two membranous wings are folded longitudinally, and the tail is armed with a forceps. This order is represented by a single Linnæan genus,—viz. *Forficula*, or earwig; insects which are common in damp places, and often found in numbers under stones, and beneath the bark of trees. they do much damage in gardens by preying upon the fruit. The English common name, and also the French, "pierce-oreille," relate to a habit absurdly attributed to these insects of penetrating the ears.

DE'RMATOBRA'NCHUS. (Gr δερμα, and βραγχια, *gills*.) A genus of Gastropods, or snails, in which the branchiæ consist, as in *Scyllæa*, of ramified productions of skin.

DERMATO'LOGY. (Gr δερμα, and λογος, *a discourse*.) A treatise or history of the skin and its diseases.

DERME'STES. (Gr. δερμα, and εσθιω, *I eat, skin-devourers*.) The name of a Linnæan genus of Clavicorn Coleopterous insects, noted for their ravages on dead animal substances, especially the preserved skins of animals, and which are consequently the pests of a museum. The old genus *Dermestes* is subdivided in modern entomology into several subgenera. The "bacon-beetle" (*Dermestes lardarius*) is the type of that to which the term *Dermestes* is now confined.

DE'RMOBRA'NCHIATES, *Dermobranchiata*. (Gr. δερμα, and βραγχια, *gills on the skin*.) The name of a family of Gastropods, comprehending those which respire by means of external branchiæ or gills, having the form of membranous plates, filaments, or tufts.

DE'RMOSKE'LETON. (Gr. δερμα, and σκελετον, *the dried remains of a body, or the skeleton; skin-skeleton*.) A term applied to the coriaceous, crustaceous, testaceous, or osseous integument, such as covers most invertebrate and some vertebrate animals; it serves more or less completely the offices of protecting the soft parts of the body, and as a fixed point of attachment to the moving powers.

DE'RRICK, in Nautical language, used in a variety of meanings, but chiefly for a tackle used at the outer quarters of a mizen-yard, consisting of a double and single block connected by a fall.

DE'RVISE. (From a Persian word signifying *poor*.) The name of certain classes of religious persons among the Mohammedans of Turkey and Asia. They live partly in monasteries, partly alone, either stationary or wandering; and belong to a great variety of orders, of which there are thirty-two (it is said) within the Turkish empire only. It is impossible to determine the period to which the origin of the dervises is to be referred. As in most other countries, there has existed in Persia from time immemorial a class of enthusiasts, who, impressed with the conviction that poverty is the only passport to virtue, and that the privations of this world will be commensurately compensated in the world to come, have voluntarily renounced all the comforts, luxuries, and charities of this life, and devoted themselves entirely to religious exercises. In most instances, however, such enthusiasts have been more famed for the theory than the practice of sanctity; and the dervises do not appear to form an exception to the rule. Their public religious

exercises are disfigured by the grossest fanaticism and buffoonery; and their private life is said to be marked by great hypocrisy and licentiousness. (*D'Herbelot, Bibl. Crit.*)

DESCANT. (It. descanto.) In Music, composition in several parts. It is either *plain*, which consists in the orderly placing of many concords answering to simple counterpoint; *figurate* or *florid*, wherein discords are employed; or *double*, where the parts are so contrived that the treble or any high part may be made the bass, and the contrary.

DESCE'NT. In Law, if a person die seised in fee-simple, otherwise than as a joint tenant (see *post*), of lands or tenements which he has not disposed of by will, they will descend to his heir. Such seisin is either actual possession or virtual; as, possession by the tenant of a chattel interest, whose possession is always held to be the same with that of the remainderman, or reversioner, who is to succeed him. If a person have become possessed by purchase of lands or tenements in fee-simple, of which, from the nature of the estate, he cannot obtain seisin (as a remainder expectant on a particular estate of freehold), these likewise descend to the heir in case of his intestacy. It is well known that by the common law of England the rules of descent were different from those obtaining in other countries; that a direct lineal ancestor could in no case inherit from his descendant; that brothers and sisters of the half blood, *i. e.* sprung from another mother, or from another father, were also excluded from the succession. These rules have now (by 3 & 4 W 4 c. 106.) been wholly removed or modified; so that the law of descent recognizes in succession the following heirs:— 1. The eldest or only son, or his issue. 2. The younger son, or his issue. 3. The daughter, or, if more than one, all the daughters as *coparceners* (see *post*) and their issue; such issue claiming *per stirpes*, not *per capita*, *i. e.* claiming only the share of their respective mothers. 4. In default of lineal descendants, the nearest lineal ancestor now succeeds, in preference to any person who would have been entitled to inherit either by tracing his descent through such lineal ancestor, or in consequence of there being no descendant of such lineal ancestor; *e. g.* a father inherits before a brother, a grandfather before an uncle, &c. 5. In default of father, brothers, or sisters of the whole blood and their issue, then the inheritance devolves on the eldest brother or sister of the half blood by a different mother, the half blood following the same rule where the inheritance devolves on the descendant of any other ancestor. 7 On failure of male ancestors on the paternal side and their descendants, female paternal ancestors and their descendants. 8 On failure of these, the mother, her ancestors,—first male, then female,—and their respective descendants. 9. The half blood follow always next after any relation in the same degree of the whole blood and his issue, if the common ancestor be a male; next after the common ancestor, if a female: so that the brother by the half blood on the part of the mother inherits next after the mother Descent is always traced from the first purchaser; but the last owner is presumed to be the first purchaser unless the contrary can be proved. In some particular localities the custom of gavelkind prevails, by which all the sons inherit equally from the father. By the custom of borough English, the youngest son is heir Bastards cannot inherit, nor can an alien; but a natural-born subject may derive his title (under certain restrictions) through alien ancestors.

DESCENT, in Mechanics, is the motion of a body towards the centre of the earth caused by the attraction of gravity. The following are the laws of *descent* of bodies:—

1st. Heavy bodies, in an unresisting medium, fall with a uniformly accelerated velocity.

2d. When the action of gravity is uniform, the space passed over in a given time is exactly half that which would be passed over in the same time by the velocity acquired at the end of the time if continued uniformly.

3d. The spaces passed over in different times are proportional to the squares of the velocities, or the squares of the times.

4th. The time of the oblique descent of a body down any chord of a circle, drawn from the uppermost or lowermost point of the circle, is equal to the time of descent through the diameter of the circle.

5th. The times of descent through all arcs of the same cycloid are equal.

6th. It is found by experiment that a heavy body near the surface of the earth, when allowed to descend by its own gravity, falls through 16½ feet in the first second of time; consequently, by the 2d law, it acquires a velocity in that time which would carry it through 32 feet in a second, if gravity ceased to act. *See* ATTRACTION, ACCELERATION.

DESCRI'PTION (Lat. descriptio), in Rhetoric, is used to designate such a strong and lively representation of any object as places it before the reader in a clear and satisfactory light. The execution of this task, as is universally admitted, is attended with great difficulty, and requires no ordinary powers. Indeed, such is the importance which some critics of eminence attach to the possession of this quality, that they have erected it into a standard whereby to estimate the productions of genius in every department of literature; and though such a test may seem somewhat arbitrary, yet when we consider the powers indispensably requisite to form a good description, we shall not be surprised to find that amid the galaxy of brilliant productions in other departments with which our literature is adorned, there are so few authors who have attained eminence in this. A good description, according to Dr. Blair, is simple and concise; it sets before us such features of an object as on the first view strike and warm the fancy; it gives us ideas which a statuary or a painter could lay hold of and work after them — one of the strongest and most decisive trials of the real merits of description. Hence among the qualities essentially necessary, and without which, indeed, even mediocrity is unattainable in this walk of literature, are an eye conversant with nature in all her aspects, a strong imagination wherewith to catch her grand and prominent features, and great simplicity and clearness of style to transmit the impression unimpaired to the imagination of others.

There is no species of composition, prose or poetical, into which description does not enter in some shape; but the term has been borrowed from literature generally, and applied more particularly to those poetical productions which are devoted exclusively to the description of nature, such as Milton's *Allegro* and Thomson's *Seasons*. Hence, although Shakespeare may with great justice be styled a descriptive poet, from the exquisite descriptions of nature with which his unrivalled plays are interspersed; yet as his chief excellence lies in pourtraying the character and passions of man, he does not fall, properly speaking, within this category. By no writer, either of antiquity or modern times, was the faculty of description possessed in a more eminent degree than by Sir Walter Scott. All his delineations of natural scenery are executed with an unrivalled fervour of imagination; while at the same time they are marked by such traits of character and truth that every object is brought distinctly before the mind, and might without difficulty be transferred to canvass by the artist's pencil. Under the head "Descriptive Poetry," in *Blair's Lectures on the Belles Lettres*, the reader will find an admirable account of the characteristics of this species of composition, with a critical notice of the most celebrated descriptive poets of all ages and countries.

DESCRI'PTIVE GEO'METRY. A term first employed by Monge, and subsequently by other French geometers, to express that part of science which consists in the application of geometrical rules to the representation of the figures, and the various relations of the forms of bodies, according to certain conventional methods It differs from ordinary perspective, inasmuch as the design or representation is made in such a manner that the exact distance between the different points of the body represented can always be found, and consequently all the mathematical relations resulting from the form and position of the body may be deduced from the representation.

In the descriptive geometry, the situation of points in space is represented by their orthographical projections on two planes, at right angles to each other, called the *planes of projection*. It is usual to suppose one of the planes of projection to be horizontal, in which case the other is vertical; and the projections are called horizontal or vertical, according as they are on the one or the other of these planes.

According to this system, any point whatever in space is represented by drawing a perpendicular from it to each of the planes of projection. the point on which the perpendicular falls is the projection of the proposed point. As contiguous points in space form a line, so the projections of those points, which are also contiguous, form a line in the same manner, which is the projection of the given line. Hence as two projections only are required for the determination of a point in space, they are also sufficient for the determination of any curve whatever, whether of single or double curvature.

The same mode of representation cannot be employed with regard to surfaces; for as the projections of the contiguous points of a surface cover a continuous area on both planes of projection, there is nothing to indicate that any particular point on one of the planes of projection corresponds to one point more than another on the second plane, and consequently that it belongs to one point more than another in space. But if we conceive the surface which is to be represented to be covered with a system of lines succeeding one another according to a determinate law, then, by projecting these lines on each of the two planes, and marking the correspondence of the one projection with the other, the projections of all the different points of the surface will have an evident dependence on

each other, and the surface will be rigorously and completely determined.

Some elemenatry surfaces may, however, be represented in a much more simple way. The plane, for example, is completely defined by the straight lines in which it intersects the two planes of projection. These lines are denominated the *traces* of the plane. A sphere is also completely defined by the two projections of its centre, and the great circle which limits the projections of its points. A cylinder is defined by its intersection (or trace) with one of the planes of projection, and by the two projections of one of its ends. A cone is represented by its intersection with one of the planes of projection and the two projections of its summit.

The most immediate application of descriptive geometry is the representation of bodies, of which the forms are susceptible of a rigorous geometrical definition. Sculpture, architecture, painting, and all the mechanical arts, the object of which is to give to matter certain determinate forms, borrow from descriptive geometry their graphical procedures, by the aid of which all the parts of an object are faithfully represented in relief before the object itself is executed. But it was chiefly in consequence of its application to civil and military engineering, and to fortification, that this branch of geometry received a distinctive appellation, and was considered of so much importance as to form one of the principal departments of study in the Polytechnic school of France. The best systematic works written on the subject are those of Monge, Hachette, Vallée, and Leroi. A good general idea of the methods of procedure may be obtained from the small work of Lacroix, *Complément des Elemens de Géométrie*.

DE'SERT. (Lat. desertum.) A term generally used to designate an uninhabited place or solitude, in which sense, as has been judiciously remarked, it is equally applicable to the fertile plains watered by the Maranon, and the sandy wastes of Lybia, but applied more particularly to the vast sandy and stony plains of Africa and Asia. In every region of the globe plains are to be found of greater or less extent, which, though marked by strong features of resemblance in their grand outlines, exhibit with the different latitudes in which they are placed a corresponding variety of character, and according to the distinguishing peculiarities of each are known by different appellations. Thus we have the *steppes* of Europe, the *deserts* of Asia and Africa, the *savannahs* of the Mississippi and the Missouri, and the *pampas* and *llanos* of South America. (See these different articles.)

The most striking feature of Africa consists of its immense deserts, which have in all ages presented to the speculations of the geographer objects highly worthy of attention. Of these the chief is the *Sahara*, or *the Desert*, so called by way of eminence. This prodigious zone of sand stretches, with few interruptions, from the shores of the Atlantic to the confines of Egypt, and comprehends in its length and breadth a superficies of about 2,200,000 square miles. The sand raised by the burning wind called the simoom is frequently in a state of motion, and as it sweeps along in its career of desolation bears a strong resemblance to the waves of a tempestuous sea. This immense expanse, however, is by no means a uniform surface of loose sand. In many parts the dreary waste is broken by low hills of naked sandstone, or by tracts of arid clay, and occasionally it is enlivened by verdant isles or *oases*, which serve as resting places for the caravans that traverse these dismal regions. (*Traill's Physical Geog.*) But for these *oases*, indeed, the Sahara would be wholly impassable. It presents, says Malte Brun, no traces of a beaten path; and the caravans that traverse it, directing their way by the polar star, describe a tortuous road in order to profit by the oases, which are represented as brilliant with vegetation, but which probably owe a great part of their reputation to the contrast they form with the absolute barrenness of the desert.

As we have elsewhere remarked (*see* CAMEL and CARAVAN), the camel is the sole medium of the communication between those countries which are separated by extensive deserts. In the beautiful and expressive metaphor of eastern speech, it is "the ship of the desert;" and in truth it is the only ship by which the wilderness can be navigated with certainty and safety.

The great deserts of Africa are only separated from those of Asia by the valley of the river Nile and the Red Sea. But upon this subject we cannot refrain from transferring to our columns the remarks of Dr. Traill, who has sketched with a masterly hand the grand outlines of the Asiatic deserts. "Soon after quitting the Nile, the traveller by the route of Suez encounters sand, which is continued into the centre of Arabia, where it forms the desert of Nedsjed, extending to the valley of the Euphrates. The sandy zone then inclines northward, enters Persia, and forms the saline deserts of Adjemi, Kerman, and Mekran; it is turned north-east by the valley of the Indus, passes through Caubul and Little Bukharia, till it joins the vast deserts of Cobi and Shamoo, which occupy so large a portion of Central Asia between the Altaian and Mustag chains, and reach to the confines of China. The sandy zone, thus traced throughout the breadth of the ancient continent from Western Africa to the 120° of east longitude, has been computed to cover an area of 6,500,000 square miles; but the Asiatic portion of this tract includes many chains of mountains and fertile valleys. It is characterized by the occurrence of arid wastes of sand or clay, sometimes with saline incrustations on the surface, and is remarkably deficient in considerable rivers: except the Nile, the Euphrates, the Indus, and the Oxus, there are no large rivers in a region which embraces almost a fourth part of both Africa and Asia. This portion of Central Asia forms a series of elevated plains 6000 miles in length from east to west. Some of these plains, says Humboldt, are covered with herbage; others produce only evergreen saliferous plants, with fleshy and jointed stems; but a great number glitter from afar with a saline efflorescence that crystallizes in the semblance of lichens, and covers the clayey soil with scattered patches like new-fallen snow." (*Physical Geog.* pp. 21, 22.) Under the head MIRAGE will be found some account of the so called singular optical illusion so often seen in the desert.

In Scripture, the term desert bears a wholly different interpretation from that usually attached to it in profane writings. It has been fully shown by Reland (*Palest.* l. i. p. 375.) that the Hebrew מדבר (midbar), the ἔρημος of the Greeks, and the *desertum* or *solitudo* of the Latins bear no analogy to each other, the first being appropriated almost exclusively to those thinly peopled districts of the Holy Land which yielded pasturage for cattle, and were remarkable at once for their beauty and the luxuriance of their vegetation.

DESE'RTER (Lat.) An officer, soldier, or sailor, who absents himself from his post without permission, and with the intention not to return. The crime of desertion has in all ages and countries been regarded with peculiar detestation. In Greece and Rome, the deserter, during war, suffered death, during peace, was deprived only of civil rights, a sound and enlightened distinction. The military code of Great Britain inflicts "death or such other punishments as may be adjudged by a general court-martial" on deserters, thus leaving a proper discretionary power for the exercise of lenity in cases where the motives to the crime may bear the most favourable construction.

DESICCA'TIVES (Lat. de, and siccus, *dry*.) In Materia Medica, applications which dry up the secretion of membranes, ulcers, &c.

DESIDERA'TUM (Lat. *wished for*), is used to signify something wanted to improve or perfect any art or science, or to promote the advancement of any object or study whatsoever.

DESI'GN (Fr. dessin.) In all the Arts, the idea formed in the mind of an artist on any particular subject, which he endeavours to transfer to some medium for the purpose of making it known to others. It is sometimes loosely and improperly used synonymously with drawing.

Every work of design is to be considered either in relation to the art that produced it, to the nature of its adaptation to the end sought, or to the nature of the end it is destined to serve, thus its beauty is dependent on the wisdom or excellence displayed in the design, on the fitness or propriety of the adaptation, and upon the utility of the end. The considerations of design, fitness, and utility, have become the three great sources of beauty of form. This beauty frequently arises from the combined power of these expressions.

Every work of art supposes unity of design, or some particular end proposed by the artist in its structure or composition. In forms considered simply as expressive of design, the only possible sign of unity of design is uniformity or regularity, by which the productions of chance are distinguished from those of design; and without the appearance of this, variety becomes confusion. In every beautiful work of art, we are not satisfied with mere design, — we must have elegant design, of which the grand feature is variety, it is this which in general distinguishes beautiful from plain forms, and without it uniformity is dull and insipid.

The arts of design are usually considered those of Painting, Sculpture, and Architecture; to which, under their several heads, the reader is referred for further information.

DESI'GNA'TOR. (Lat.) In Roman Antiquities, a species of master of the ceremonies, whose duty it was to assign to each person his proper place in the theatres and at the other public spectacles. Officers with this appellation were employed among the Romans on every occasion of public display, and in all domestic solemnities whether of a joyful or mournful character. But the chief occupation of the *designator* consisted in arranging and marshalling the funerals of distinguished persons; and in this capacity he was attended by a troop of inferior officers, all arrayed in black, whose part it was, among other duties, to keep off the crowd, like the lictors of the magistrates. In his brief and elegant description of the

insalubrity of Rome during the autumnal season (*Epis.* 1. 7.), Horace thus graphically introduces the designator and his attendants: —

——dum ficus prima calorque
Designatorem decorat lictoribus atris.

DE'SPOT. (Gr. δεσπότης, *master*.) A name applied to sovereign princes possessing absolute authority. The well-known address of the slave to Hippolytus, in *Euripides* — "O king, for it is fitting to call only the gods despots" (*masters*) — shows the distinction which the republican spirit of the Greeks took between the two titles. The later Greek emperors took the title of despot: which was afterwards, about the eleventh century, given to the son or nearest relation of the reigning prince.

DE'SPOTISM. In Politics, absolute and irresponsible government by a single individual or despot. In popular language, all governments are called despotical that are administered by one individual whose decisions are not controlled by any representative assembly or recognized subordinate authorities. Thus, we are in the habit of saying that the emperors of Austria and Russia and the king of Prussia are despotical or absolute sovereigns; meaning by this, that all legislative and executive measures seem to proceed from their free will. But the abstract idea of despotism goes farther than this; and means a government by a single individual with unlimited power over the lives and fortunes of his subjects. The prophet Daniel, in his description of the Babylonian monarch Nebuchadnezzar, has given what is perhaps the best account of this species of government. "All people, nations, and languages, trembled and feared before him whom he would he slew, and whom he would he kept alive: whom he would he set up, and whom he would he put down." (Chap. v 19.)

But though this gives a vivid idea of what is understood by a pure depotism, it can be regarded only as a popular, or rather poetical account, of a government where the sovereign is possessed of great power. The truth is, that a purely despotical government never had, and never can have, any existence in fact. How absolute or despotical soever, all sovereigns must conduct their government so as to procure the concurrence and support of a large, or, at all events, a powerful portion of their subjects. A despot is, after all, merely an individual, and becomes quite powerless when those masses of individuals, in whom the ability to coerce others really resides, disapprove of his proceedings. The prætorian bands in antiquity, the janissaries of Constantinople, and the grenadiers of Petersburg, must, at least, be led by opinion. But though the sanction of the instruments employed in his government be indispensable to the existence of a despot, it is but seldom that he dares trust to it only. The most absolute and tyrannical of the Roman emperors, when they wished to get rid of any obnoxious individual, dared not to order him to be executed, but were obliged to suborn false evidence, and to proceed against him according to legal forms: and so it is in all countries. Were the most absolute sovereign of whom we have any certain accounts openly to seize on the property of any individual in his dominions, or to put him to death without being able to assign some apparently satisfactory grounds for doing so, the foundations of his power would be shaken to the very centre; and the repetition of such conduct would most likely occasion his deposition. The strength of absolute governments, when they embark in oppressive courses, depends on their being able to conceal or pervert the real facts of the case, so that the victims of their tyranny may be made to appear to be the victims of their justice. We may be assured that no ruler of any country emerged from the merest barbarism ever could, for any considerable period, openly commit on his own responsibility any gross injustice towards any considerable portion of his subjects. Those who have done so have rarely, if ever, failed to expiate their folly and tyranny by some signal punishment.

Neither the government of Prussia nor Austria, nor even that of Russia, can be justly called despotical. Their rulers are controlled to a very great extent by the force of public opinion; and are influenced by a much more lively feeling of responsibility than the sovereigns of limited monarchies, or of countries in which the legislative functions are divided. It is this fear of their subjects that makes them so anxious, by laying restrictions on the freedom of the press, to conceal their conduct, or to obtain a favourable judgment upon it. There can be no despotism, nor any considerable approach towards despotical government, where the press is free and the people instructed; and it is to their influence in securing the freedom of the press, and consequently in enlightening public opinion, and making the bulk of the people acquainted with their *real* interests, that the advantage of representative assemblies and of a popular form of government is mainly to be found.

DESQUAMA'TION. (Lat. squama, *scale*.) The separation of layers or scales from the skin or bones.

DESSE'RT. A word of doubtful etymology, signifying the last service at dinner, consisting of fruits and confections, &c. The modern dessert is probably equivalent to the *mensæ secundæ* of the Romans. If we believe Congreve, the term came into use among the French about the commencement of the 17th century, and was soon adopted into and naturalized in most of the European languages. In all the countries of Europe the splendour of the dessert has ever since the period of its introduction kept pace with the progress of refinement and civilization, and by many *gastronomes* the qualities and arrangement of a dessert are looked upon as the most valid test of all that is Attic in taste and refined in elegance.

DESTE'MPER. (Fr. détrempe.) In Painting, a preparation of opaque colour ground up with size and water, used in scene painting. This species of painting is also called, when practised on a small scale, *body colour painting*. Destemper painting differs from fresco painting in that the latter is performed while the walls are still wet, whilst the former requires that they should be dry.

DE'STINY. (Lat. destinare, *to appoint*.) An inevitable necessity depending upon a superior cause. This doctrine has, under a variety of names, been embodied in almost all the religious systems of antiquity; and even in modern times, with a few modifications, it has been largely adopted by many sects of the Christian church. (*See* PREDESTINATION, NECESSITY.) Destiny was called by the Romans *Fatum* (*see* FATES), and by the Greeks Ανάγκη, *Necessity*, or Μοῖρα, *a Part*, as if it were a chain or necessary series of things indissolubly linked together. According to many of the heathen philosophers, destiny was a secret and invisible power or virtue, which with incomprehensible wisdom regulated all the occurrences of this world which to human eyes appear irregular and fortuitous. The Stoics, on the other hand, understood by destiny a certain concatenation of things, which from all eternity follow each other of absolute necessity, there being no power able to interrupt their connection (*Rees's Cyclo.*). To this invisible power even the gods were compelled to succumb. Jupiter and Venus are represented by the poets as vainly attempting to withdraw Cæsar from his impending fate; but, as Seneca observes, it is thus that the Ruler of all things, in writing the book of destiny, has prescribed the limitation of his own power. "Scripsit fata; sed sequitur, semper paret."

DESTRU'CTIVE DISTILLA'TION. A term applied to the distillation of organic products at high temperatures, by which the ultimate elements are separated or evolved in new combinations. The destructive distillation of coal is resorted to for the production of gas, and that of bone for the production of ammonia, and of wood for the formation of vinegar.

DETA'CHED. (Fr. detache.) In Painting, a term applied to all objects in a picture which appear to stand out from those by which they are surrounded. It arises from a due knowledge of aerial and linear perspective.

DETA'CHMENT. (Fr. detachement), in Military language, is a certain number of squadrons of cavalry and battalions of infantry, selected from the main body of an army for the purpose of being employed in some particular duty, such as in *foraging*, *escorting*, &c.

DETA'ILS. (Fr. detail.) In the Fine Arts, the parts of a work as distinguished from the whole as a mass. They must always be so kept under as not to interfere with the general effect of the work; neither must they be overlaboured, lest, instead of aiding, they embarrass the work of which they form parts.

DETE'NTS, in Clock-work, are the stops which lock and unlock the machinery in striking.

DETE'RGENTS. (Lat. detergo, *I wipe away*.) Medicines which remove viscidity, and cleanse sores.

DETE'RMINATE PRO'BLEM. In Geometry, is a problem which admits of one solution only, or a limited number of solutions; and is opposed to an *indeterminate problem*, which admits of an indefinite number of solutions.

DETERMINA'TION OF BLOOD. In Medicine and Surgery, when there is apparently a more copious and rapid flow of blood to any part, it is said to suffer under a determination of blood; as to the brain, liver, &c.

DE'TINUE, in Law, is a personal action of contract, and lies where a party seeks to recover goods and chattels, or deeds and writings, detained from him.

DE'TONATING TUBE. A stout glass tube used in the chemical laboratory for the detonation of gaseous bodies. It is generally, as represented in the annexed cut, graduated into centesimal parts, and perforated by two opposed wires, for the purpose of passing an electric spark through the gases which are introduced into it, and which are confined within it over water or mercury. When a detonating tube is used over either of these fluids, the smallest possible quantity of explosive gas should be introduced into it, as in consequence of the expansion which ensues, a portion is apt to be forced out at the moment of the explosion. The tube, when used, should be firmly held; a spring is sometimes substituted for the grasp of the hand, but it is inconvenient.



DETONA'TING POWDER. A term applied in

Chemistry to fulminating mercury and silver, and to other compounds which suddenly explode when struck or heated. Some of these compounds have lately been much used for the ignition of gunpowder in percussion locks.

DETONA'TION. When chemical combination or decomposition is sudden and attended by flame and explosion, it is often said to be effected by *detonation*. If a mixture of hydrogen gas and oxygen be inflamed by the electric spark or by a taper, it burns rapidly and with explosion, and is said to *detonate*. When a grain or two of phosphorus is mixed with chlorate of potassa and struck with a hammer, the mixture detonates.

DETRI'TUS. A geological term applied to deposits composed of various substances which have been comminuted by attrition. The larger fragments are usually termed *debris*; those which are pulverized, as it were, constitute *detritus*. Sand is the detritus of siliceous rocks.

DEUCA'LION. One of the most famous personages of antiquity, the son of Prometheus, and king of Thessaly. The story of the deluge with which Thessaly was inundated during his reign, the preservation of Deucalion with his wife Pyrrha, and the mode by which, in compliance with the injunction of the oracle, they repeopled the world, are too well known to require being dwelt upon in this place. The grand features of the flood of Deucalion, which, as recorded by Ovid and other writers of antiquity, bear so striking a resemblance to the scriptural account of the deluge, are common to the history or the traditions of almost all nations, how remote or barbarous soever. The great Indian poem, *Mahabarada*, for instance, contains a graphic description of a flood, by which, with two exceptions, the whole human race was overwhelmed; and M. Humboldt found on the banks of the Orinooko a similar tradition, which had prevailed among the barbarous natives from time immemorial. In that beautiful ode dedicated to Augustus (Book 1, 2.), in which richness of imagery and elegance of language vie with the loftiest tone of morality, Horace thus alludes to the flood of Deucalion: —

> Terruit gentes, grave ne rediret
> Sæculum Pyrrhæ nova monstra quæstæ,
> Omne cum Proteus pecus egit altos
> Visere montes, &c.

The date assigned to Deucalion by Eusebius is 1541 B C., by the Parian marbles seven years earlier; but many of the statements concerning him are so obscure, while others are so manifestly mythological, as to leave considerable doubts of his having ever existed. *See* DILUGE

DEUS EX MACHINA. A scholastic expression, borrowed from the stage In conformity with the mythological belief of the age, the tragic poets of Greece, and especially Euripides, instead of bringing about their catastrophe by natural means, often resorted to a more convenient expedient — the intervention of a divinity. But when any such intervention, contrary to the maxim of Horace,

> Nec deus intersit nisi dignus vindice nodus,

took place without an adequate cause, it was injurious to scenic effect; and hence the expression *deus ex machina* originated, the divinity in such a case being nothing more than a *machine*. This expression has also been applied by analogy to those philosophers who, unable to solve a difficulty by ordinary means, have immediate recourse to the aid of a supernatural power.

DEU'TERONOMY. The name given to the last book of the Pentateuch The term is composed of two Greek words, *δευτερος*, *second*, and *νομος*, *law*; and is equivalent to the *Mischna* of the Hebrews, who thus designated the book of Deuteronomy, from its containing a recapitulation of the laws and ordinances scattered over the other books of Moses. *See* PENTATEUCH.

DEUTEROPA'THIA. (Gr. *δευτερον*, *second*, and *παθος*, *disease*.) A sympathetic affection of any part; as a headache from an overloaded stomach, or sickness from an injury of the head.

DEU'TOXIDE. A term applied in Chemistry to certain compounds containing *one* atom or prime equivalent of base in combination with *two* of oxygen; in this sense the word is synonymous with *binoxide*. It is sometimes indiscriminately applied to the second degree of oxidizement of which bases are susceptible.

DE'VIL. (Gr. *διάβολος*, *an accuser*), lit. one "who accuseth us before God day and night." (Rev. xii. 10.) The word bears the same sense as Satan, and is applied in the New Test. to the evil principle, the adversary of man referred to throughout the books of the Old and New Test. under various names and titles, as Satan, Lucifer, Belial, Apollyon, Abaddon, the Man of Sin, the Tempter; and described as an angel who fell from heaven with many inferior spirits, being cast down from thence by God for his pride and rebellious spirit. From that time he is said to have had permission to try and tempt mankind, in which he succeeded in the persons of our first parents, thereby introducing sin and sorrow into the world. He is represented in Job and Zechariah as standing in the presence of the Lord, seeking permission to tempt men. It is manifest that the character herein attributed to the Devil is identical with that of the Evil Principle in the Gnostic and Manichean philosophy, and in the oriental system of religion generally; excepting, indeed, that the scriptures always maintain the inferiority of the evil to the good; but it may also be reasonably inferred that it was held by the Jews anterior to their captivity in Babylon, and the contact into which they then came with the Magian superstitions. Although the serpent who tempted Eve in Paradise is not expressly said to be this Satan or Devil, nor is he at all mentioned by name by Moses, yet the character of the Evil Principle is there vividly delineated; he is also characteristically mentioned in the Psalms, the Book of Job, and the Chronicles.

DEVI'SE, or DEVICE. (Fr. deviser, *to invent, will*, or *imagine*.) In Heraldry, the term Devise is popularly used in the same sense as armorial bearings (which see); but it is more strictly employed to signify a symbol, consisting of a representation of some visible object, and in many instances a motto appropriate to it, used, not by way of heraldic bearing, but according to the fancy of the inventor: sometimes for the motto alone. Monograms are also a species of device From the word *deviser*, in its ancient signification of *to will*, is derived the Norman French *devise*, a bequest of real property by testament, which is still retained in our law.

DEVISE, in Law, is a gift of lands by a last will and testament. Lands held in fee-simple became devisable, where not so by special custom, by the statute 34 & 35 H. 8 c. 5. By 3 & 4 W. & M. c. 14. devises were made void against specialty creditors. Estates pur auter vie are devisable by stat. 29 C. 2. c 3. A will of lands formerly only operated on those lands of which the testator was possessed at the time of publishing it. (*See* WILL) In a devise, the words are, in general, more liberally construed than in alienation by deed. But by the recent Statute of Wills (1 Vic. c. 26) every will is held to speak, both as to real and personal property, as if executed immediately before the death of the testator.

DEW (Germ. thau, *moisture*.) The deposition of water from the atmosphere, occasioned by cold. The phenomena of dew have been considered by all writers on meteorology, from Aristotle downwards, but they were first successfully investigated by the late Dr Wells, who gave the true theory of the meteor in an admirable essay on the subject, first published in 1814.

The circumstances which influence the production of dew are the following — Dew is never abundant except during calm and serene nights. It is, however, frequently observed in small quantities both on windy nights, if the sky is clear, and on cloudy nights, if there is no wind; but it is never seen on nights both cloudy and windy at the same time. If, in the course of the night, the weather, from being calm and serene, should happen to become windy and cloudy, not only will no more dew be formed, but that which has been already formed will disappear, or at least diminish considerably. In calm weather, if the sky be partially covered with clouds, more dew will appear than if it were entirely covered, but less than if it were entirely clear A slight motion of the air is rather favourable than otherwise to the formation of dew On two nights equally calm and serene, the quantities of dew deposited may be very unequal. If rain has fallen recently, it will be formed in abundance; on the contrary, very little will be formed in nights otherwise favourable, if the weather has been dry for some time previously. In general, whatever tends to increase the quantity of moisture in the atmosphere will contribute to render the deposition of dew more abundant. Dew is commonly more plentiful in spring and autumn than in summer; the reason is, that the differences of the temperatures of the day and night are greater in the former seasons of the year than in the latter. It is always most copious on those clear and calm nights which are followed by misty or foggy mornings; the formation of the fog showing that the atmosphere had previously contained much moisture. Dew has been observed to be unusually plentiful on a clear morning succeeding a cloudy night. The notion that dew is only formed in the morning and evening is incorrect; bodies are covered with dew at all hours of the night, provided the sky be serene. In this country dew probably begins to appear upon grass, in places shaded from the sun during clear and calm weather, soon after the heat of the atmosphere has declined; that is, three or four hours after midday. Grass is frequently felt to be moist, in dry weather, several hours before sunset; but, on the other hand, dew is scarcely ever known to be present in such quantity upon grass as to exhibit visible drops before the sun is very near the horizon, or to be very copious till some time after sunset. Other circumstances being equal, less dew is formed during the first half of the night than during the second, although the air at midnight has already lost a certain portion of its moisture.

Polished metals are, of all bodies, those which attract the least quantity of dew. This property of metals is sufficiently remarkable to have led some respectable philosophers to affirm that they are never wetted by dew.

Dr.Wells, however, observed it to form on gold, silver, copper, tin, platina, iron, steel, zinc, and lead; but when dew does form on these metals, it commonly only sullies the lustre of their surfaces; and even when it is sufficiently abundant to gather into drops, these are almost always small and indistinct. Dew which has been formed upon a metal will often disappear, while other substances in the neighbourhood remain wet; and a metal which has been purposely wetted will often become dry, though similarly exposed with bodies that are contracting dew. This inaptitude of the metals to attract dew is communicated to bodies of a very different nature which touch or are near them: for example, wool laid upon a metal will acquire much less dew than an equal quantity laid upon grass in the immediate vicinity; and, conversely, bodies on which the metals are laid have an influence on the quantity of dew which the latter will attract. The metals do not all resist the formation of dew with the same force. Dr.Wells one night saw platina distinctly dewed, while gold, silver, copper, and tin, though similarly situated, were entirely dry; and he several times saw these four metals free from dew, while iron, steel, zinc, and lead were covered with it.

Difference in the mechanical state of bodies, though the other circumstances be similar, has an effect on the quantity of dew which they attract. Thus, more dew is formed upon fine shavings of wood, than upon a thick piece of the same substance. It is chiefly for a similar reason that fine raw silk, fine unwrought cotton and flax, were found by Dr.Wells to attract somewhat more dew than the wool he employed, the fibres of which were thicker than those of the other substances just mentioned.

The quantity of dew which is precipitated on bodies does not depend solely on their nature and constitution, but also on the situation in which they are placed with regard to surrounding objects. As a general principle, it may be affirmed that whatever tends to diminish the portion of the sky which can be seen from the place which the body occupies, diminishes the quantity of dew with which the body will be covered.

*Of the Cold connected with the Formation of Dew.*—The temperature of grass covered with dew is always lower than that of the surrounding air. On calm and clear nights, Dr.Wells very frequently found the grass 7, 8, or 9 degrees, and on one occasion 14 degrees, colder than the air about 4 feet above the ground. He also observed that in places sheltered from the afternoon sun, but still open to a considerable portion of the sky, the difference between the temperature of the grass and the air begins to be sensible as soon as the heat of the atmosphere begins to diminish. In analogous circumstances, a similar coldness continues on grass, in still and serene mornings, for some time after the rising of the sun. In cloudy nights, particularly if there was wind, the grass was never much colder than the air; sometimes it was even warmer: but in calm weather, very high clouds, though sufficiently extensive and dense to conceal the sky, would yet frequently allow of the grass being several degrees colder than the air. If the night became cloudy, after being very clear, the temperature of the grass immediately became higher. The temperature of metals sometimes falls from 2 to 4 degrees below that of the surrounding air; when this takes place, other bodies, such as wool, swan-down, the leaves of plants, &c., are considerably colder than the atmosphere. The substances which are most easily covered with dew are those which are cooled down the quickest when exposed to a clear sky. Of all substances tried by Dr.Wells, swan-down exhibited the greatest cold; in general, the most productive of cold are the filamentous and downy. Snow, also, is one of those bodies which acquires a temperature very considerably lower than the atmosphere.

*Theory of Dew.*—Dr. Wells's experiments show that the most perfect analogy subsists between the faculty which bodies possess of attracting moisture from the atmosphere, and the other property which they have of acquiring, in calm and clear nights, a temperature much below that of the surrounding air. But is the cold which is observed on bodies covered with dew the cause or the consequence of the precipitation of the fluid? The latter opinion was maintained by Dr. Wilson of Glasgow, in a paper on hoar-frost inserted in the first volume of the *Transactions of the Royal Society of Edinburgh*. But it has been clearly established by Dr.Wells that the cold is the cause of the dew; for he found, 1st, that in certain circumstances bodies would become colder than the air without being dewed, whence it is obvious that the cold could not be the effect of the dew; and, 2d, that when dew was formed, its quantity and the degree of cold that appeared with it, at different times, were very far from being always in the same proportion to each other. He also invariably found that bodies became colder before dew began to appear on them. The formation of dew is therefore a phenomenon precisely of the same kind as the precipitation of moisture which takes place on the outside of a vase into which a liquid colder than the air is poured. But this is a phenomenon of which the most complete and satisfactory explanation has been given. It is well known that atmospheric air, at every different degree of temperature, can contain only a determinate quantity of water, and that the quantity is greater as the temperature is higher. Conceive then a stratum of air coming into contact with a solid body colder than itself: the contact cools it down to a lower temperature, and immediately a portion of its water is precipitated. A second stratum of air succeeds the first, is cooled down in its turn, and abandons that portion of its moisture which its decreased temperature does not permit it to retain. The phenomenon is repeated with great rapidity, and in a short time the *cooling* body is covered with small drops, or even a continuous sheet of moisture. As soon as it was proved that bodies exposed to the clear sky acquire a temperature lower than that of the atmosphere, the origin of the moisture with which their surfaces become covered could not be mistaken.

In order to render this theory complete, it only remains to explain the cause why bodies, when exposed to the sky in clear and calm nights, become colder than the surrounding atmosphere. Since the laws of the radiation of heat were established by the experiments of Sir John Leslie and Count Rumford, the rationale of this phenomenon has been well understood. During calm and serene nights, the upper parts of the grass radiate their heat into the regions of empty space, from which they receive back no heat in return; its lower parts, from the smallness of their conducting power, transmit little of the earth's heat to the upper parts, which at the same time receiving only a small quantity from the atmosphere, and none from any other lateral body, must remain colder than the air, and condense into dew its watery vapour, if this be sufficiently abundant, in respect of the decreased temperature of the grass.

This explanation is grounded on the hypothesis of M. Prevost of Geneva respecting the constant radiation of heat by bodies in contact with the atmosphere, even at the time when they are exposed to the influence of bodies warmer than themselves: but the hypothesis has not been universally admitted; and Sir J. Leslie, on the contrary, ascribes the effect to the descent of cold air from the upper regions of the atmosphere. "The application of the æthrioscope," he remarks, "has not only ascertained the existence, but measured the intensity, of the cold pulses which are at all times darted downwards from the successive strata of air, though often partially intercepted by clouds, or more completely obstructed by low fogs. It may be computed that in fine bright evenings those cold pulses, rained from the sky, are sufficient alone to depress the temperature of the ground, according to the seasons, sometimes eight degrees, but generally about three degrees of Fahrenheit's scale. The blades of grass, thus chilled from exposure, cool in their turn the damp air which touches them, and cause it to drop its moisture." (*Ency. Brit.*, art "Dew") The theory of Dr. Wells has also been examined by Mr. Blackadder, in the *Edinburgh Philos. Journal*, Nos. XXI., XXVII., and XXVIII.; and more recently by Van Roosbroek of Leyden in his *Théorie de la Rosée*, Rotterdam, 1836.

It may be added, that among all the phenomena connected with the formation of dew, there is not one which does not admit of a satisfactory explanation on the principle established by Dr.Wells; namely, that dew is never deposited on the surface of bodies till they have been previously cooled down by their radiation towards space.

DEW'BERRY. The fruit of the *Rubus cæsius*, so termed from the resemblance of the bloom or waxy secretion upon it to dew.

DEW POINT. The degree indicated by the thermometer when dew begins to be deposited. It varies with the degree of the humidity of the atmosphere.

DEXIA'RIÆ. A family of Dipterous insects, which subsist chiefly on the juices of flowers. The typical genus is *Dexia*, Mirgen; the other genera included in the family are *Zeuxia*, *Dinera*, *Scoliptera*, *Rutila Gymnostyla*, *Omalogaster*, and *Prosena*.

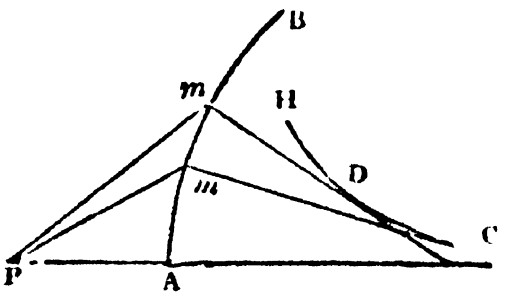
DE'XTRINE, in Chemistry, means the soluble or gummy matter into which the interior substance of starch globules is convertible by *diastase*, or by certain acids. It is remarkable for the extent to which it turns the plane of polarization to the *right* hand, whence its name. The term is also applied to starch which by exposure to heat has been rendered soluble in cold water.

DEY. (Derived by some from the Turkish daï, *a maternal uncle*.) A Turkish title of dignity, given to the governors of Algiers (before the French conquest), Tunis, and Tripoli. The dey is chosen for life from among the chief authorities of the place, with the approbation of the Turkish soldiery. At Tunis the equivalent title of *bey* is more usually substituted for *dey*. This term is admitted by all philologists to be of very great antiquity; though it is impossible to assign any precise date to its introduction. The reader will find in *Ersch and Gruber's Encyclop* much valuable information respecting this title, and the regencies in which it is in use.

DIABE'TES. (Gr. *δια*, *through*, and *βαινω*, *I pass*.)

An immoderate flow of urine. There are two varieties of this disorder: the one is merely a superabundant discharge of ordinary urine, and is termed *diabetes insipidus;* in the other the urine has a sweet taste, and contains abundance of a peculiar saccharine matter: it is called *diabetes mellitus*. This disease usually attacks persons of a debilitated constitution towards the decline of life, and generally without any obvious cause. Thirst and a voracious appetite are its first symptoms; the urine gradually increases in quantity; and then there is a sense of weight and uneasiness in the loins, emaciation, œdematous legs, and hectic fever. The quantity of urine which is voided sometimes far exceeds that of liquid and solid food taken together; so that it has been supposed that the solids of the body are, as it were, melted down, and flow off in the form of water and sugar. In diabetes mellitus the quantity of saccharine matter is generally such, especially where the disorder has been of long standing, as materially to increase the specific gravity of the urine; and this accordingly forms a useful criterion of the state of the disease, for whatever tends to diminish the specific gravity of the urine is at the same time diminishing its saccharine contents: an hydrometer therefore is useful in determining this point. The specific gravity of healthy urine does not exceed 1020, and contains about 380 grains of solid matter in the pint; that of diabetic urine sometimes attains a specific gravity of 1040 to 1050; in which case, as appears from Dr. Henry's table (*Medico-Chirurgical Transactions*, vol ii.), it contains from 766 to 960 grains of solid matter in the pint The cause of this disease is unknown; but it has been shown that there are no traces of sugar in the blood of persons who are voiding it abundantly by urine; so that the idea of its formation in the stomach, and subsequent separation in the kidneys, is untenable. Nor has dissection thrown much light upon the subject, for in some cases no morbid state of the viscera is observed; in others, however, the kidneys are flabby, pale, and enlarged, or more vascular than they should be: the lacteals are also sometimes thickened, and the mesenteric glands enlarged There are very few cases on record of the cure, or even of the relief, of confirmed diabetes. Where it is symptomatic of hysteria, dyspepsia, or hypochondriasis, the usual remedies for those affections are useful, but where it is *idiopathic*, and saccharine, nothing has proved decidedly serviceable. Strict abstinence from vegetable food of every kind, and the free exhibition of opium, are the only plans which have held out hopes of success; but there are very few cases upon record in which these seem to have been permanently successful.

DIACAU'STIC CURVE (Gr *διὰ*, *through*, and *καίω*, *I burn*), in the higher Geometry, is the *caustic by refraction*. It is generated as follows:—If rays P *m* issuing from a luminous point P be refracted by the curve A *m* B, so that the sines of incidence are to the sines of refraction in a given ratio, the curve C D H, which touches all the refracted rays, is called the *diacaustic*, or caustic by refraction. *See* CAUSTIC.




DIA'CHYLUM, or DIACHYLON. (Gr *διὰ*, and *χυλὸς*, *juice*.) A celebrated plaister of former days made of the juices of several plants; the term is still retained, and applied to common plaister, made by boiling hydrated oxide of lead with olive oil

DIACO'DIUM. (Gr. *διὰ*, and *κώδια*, *a poppy*) A preparation of the poppy. Syrup of white poppies was formerly called *syrup of diacodium*.

DIA'COPE. (Gr. *διὰ*, and *κόπτω*, *I cut*) A genus of spiny-finned fishes of the perch tribe, allied to *Serranus*, but distinguished by a notch at the lower part of the preoperculum, to which a projecting tubercle is adapted.

DIACOU'STICS. (Gr. *διὰ*, and *ἀκούω*, *I hear*) That branch of physics which treats of the properties of sound refracted in passing through media of different densities. *See* SOUND

DIACRI'TIC MARKS. (Gr. *διακρίνω*, *I distinguish*) In Palæography, marks used to distinguish letters between the forms of which much similarity exists Thus *n* and *u* are distinguished in German running hand by the mark ⌣ over the latter letter.

DIADE'LPHOUS. (Gr. *διὰ*, and *δελφὺς*, *a womb*.) A term applied to stamens the filaments of which have coalesced into two masses, as in Fumaria and many leguminous plants.

DI'ADEM. (Gr. *διάδημα*, from *δέω*, *I bind*.) Originally a fillet wound round the temples, probably imported into Greek costume from the East. It was the symbol of royalty among various oriental nations. The diadem of Bacchus, from the representation in ancient statues, &c., was a broad band, which might be unfolded so as to form a veil. Constantine the Great was the first Roman emperor who used the diadem; after his time, it was set with rows of pearls or precious stones.

DIÆ'RESIS. (Gr. *διαίρεω*, *I divide*.) In Grammar, the resolution of a diphthong, or a contracted syllable, into two syllables: as, in Latin, aurai for auræ, &c.; and, in English, the resolution of the last syllable of participles by giving a sound to the final *e:* belovëd, cursëd, &c. *See* METAPLASM.

DIAGNO'SIS. (Gr. *διαγιγνώσκω*, *I distinguish*.) The art of distinguishing one disease from another. The characteristic symptoms of diseases, by which they are recognized, are termed their diagnostic symptoms.

DIA'GONAL. (Gr. *διὰ*, *through*, and *γωνία*, *angle*.) A straight line drawn through a figure, joining two opposite angles. The term is chiefly used in geometry, in speaking of four-sided figures; but it is also properly applied with reference to all polygons of which the number of sides is not less than four. Euclid uses the term *diameter* in the same sense; but modern geometers use *diameter* only when speaking of curve lines, and *diagonal* when speaking of angular figures.

DI'AGRAM. (Gr. *διάγραμμα;* from *διὰ*, through, and *γράφω*, *I write*) The figure or scheme drawn for the illustration of a mathematical proposition, or the demonstration of any of its properties. It is also used in other branches of science, and in the fine arts, for the general purposes of illustration.

DI'AGRAPH. (Gr. *διὰ*, and *γράφω*, *I describe*.) A name given by the French artists to a recently invented instrument used in perspective. For a minute description of its properties we beg to refer the reader to the *Encyclopédie des Gens du Monde*, and to the paper of M. Gavard, the inventor, recently published at Paris.

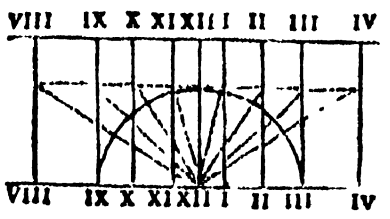
DI'AL, or SUN-DIAL. (Lat. dies, *day*.) An instrument for showing the hour of the day by means of the sun's shadow. The invention and use of sun-dials are of the highest antiquity. According to Herodotus, the Greeks learned the use of them from the Chaldeans; and the first of which history makes mention is the hemisphere of Berosus, who is supposed to have lived about 540 years before Christ. The sun-dial and the clepsydra were the only instruments known to the ancients for the measurement of time

In constructing a sun-dial, the object is to find, by means of his shadow, the sun's distance at any time from the meridian. When this distance is known, the hour is also known, provided we suppose the sun's apparent motion to be uniform, and that during the whole course of a day he moves in a circle parallel to the equator. Neither of these conditions is, in fact, accurately fulfilled, but the error which this gives rise to is of small amount; and it is, moreover, sufficiently obvious that the use of a dial is not to indicate the hour with astronomical precision, but merely to give such an approximation as is necessary for the purposes of civil life.

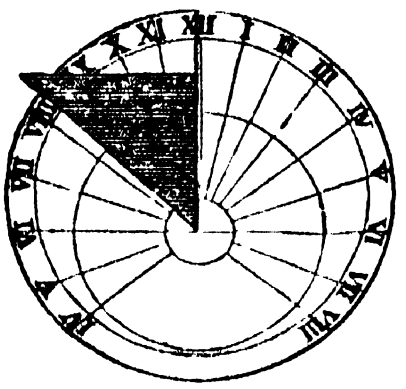
Dials are usually constructed on an immoveable surface, and admit of an infinite number of different constructions, all depending on the nature of the surface and its position with regard to the equator of the earth. The general principles, however, are the same in all, and depend on the simplest elements of geometry and astronomy. The first part that claims attention is the *style* or *gnomon*, or axis of the dial, which is usually a cylindrical rod, or the edge of a thin plate of metal. The style must be directed perpendicularly to the terrestrial equator; in which direction it may be considered, on account of the smallness of the earth's diameter in comparison of the distance of the sun, as coinciding with the axis of the diurnal rotation, consequently the plane which passes through the style and its shadow on the surrounding surfaces, and which always passes through the centre of the sun, will be an hour plane, and turn with the sun as the sun turns round the style by the effect of the diurnal motion. All that remains to be done, in addition, is to discover, and describe, for the different hours of the day, the intersections of this variable hour plane with the surface on which the dial is to be constructed. On these intersections the shadow of the style will be projected every day at the same hour; because at the same hour the sun must have returned to the same hour-plane, although his distance from the equator may be different.

From these considerations it is manifest that the whole theory of dialling is comprehended in the solution of this general problem.—"Twelve planes all intersecting each other in the same straight line, and making with each other equal angles of 15°, being given in position; to find the intersections of those planes with any surface whatever, also given in form and position." The surface which intersects the hour planes may be of any kind whatever, but for obvious reasons it is generally a plane; and when its position with respect to the common intersection of the hour planes (which is the style of the dial) and to any one of those planes is given, the *traces* or intersections, which are in this case all straight lines, are the hour lines on the dial, and easily calculated by the ordinary rules of trigonometry or geometry.

According to the position of the plane of the dial with respect to the horizon of the place, the dial is *horizontal*, *vertical*, or *inclined*. The simplest case of all is that in which the plane of the dial is parallel to the axis of the earth (or passes through the poles) and perpendicular to the meridian of the place. In this case the style is also parallel to the plane of the dial, and the hour lines are parallel straight lines, whose distances from the meridian, or twelve hour line, are respectively proportional to the tangents of the angles which the hour planes make with the plane of the meridian. Let $d$ be the shortest distance of the style from the plane of the dial; then the distance of the hour line of XI and I from the hour line of XII is equal to $d \times \tan. 15^\circ$. The distance of the hour line of X and II from XII is $d \times \tan. 30^\circ$; the distance of IX and III is $d \times \tan. 45^\circ$; and so on, the hour line of XII being the intersection of the plane of the meridian in which the style is with the plane of the dial. This is called a *Polar Dial*.

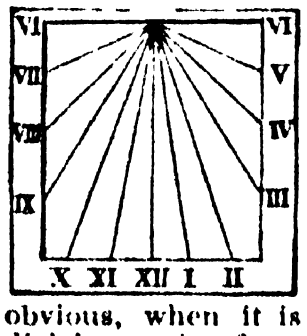



The most common construction is the *Horizontal Dial*, or that in which the plane of the dial is parallel to the horizon, and consequently makes with the style an angle equal to the latitude of the place. At the equator, this is the same as the polar dial, which has just been described; but at all other places, the hour lines intersect each other in the point in which the style intersects the plane of the dial, which point is called the centre, and the angles they make with one another, or with the XII hour line, depend on the latitude. Their respective positions are computed from this theorem —As is the radius to the sine of the latitude, so is the tangent of the hour from noon (reckoning 15° to the hour) to the tangent of the hour angle at the centre Or, putting $h$ = the hour from noon, $l$ = latitude of the place, and $x$ = the hour angle at the centre of the dial, then the formula for computing the hour lines is $\tan. x = \tan. h \sin. l$, the radius being unit From this formula the following table is computed, showing the angles which the different hour lines of a horizontal dial make with the meridional line, at the latitude of London, or 51½°.



| MORNING | AFTERNOON. | | |
|---|---|---|---|
| XI | I. | 11° | 51′ |
| X. | II. | 24 | 19 |
| IX. | III | 38 | 3 |
| VIII. | IV. | 53 | 35 |
| VII. | V | 71 | 6 |
| VI | VI. | 90 | 0 |

After the horizontal dials, the construction most frequently employed is that in which the plane of the dial is vertical; for example, when fixed on the wall of a house In this case, the positions of the different hour lines depend on the latitude of the place and on the aspect of the dial; that is to say, its position with respect to the meridian. If the dial is perpendicular to the meridian, it is a *south dial*, or *north dial*, according as it faces the south or north. (The vertical south dial is represented in the annexed figure.) When not perpendicular to the meridian, the vertical dial is said to be *declined*. The formula for the hour lines of a south vertical dial differs from that for a horizontal dial in no respect excepting that the sine of the latitude is changed into the cosine, the cause of which will be obvious, when it is considered that the plane of the dial in passing from the horizontal to the south vertical direction preserves its inclination to the different hour planes unaltered; while the angle which it makes with the style, or the axis of the earth, is the complement of the angle it made with the same line in its former position. Let $y$, therefore, be the hour angle at the centre of the dial; and putting, as before, $h$ = the hour from noon, and $l$ = the latitude, the formula for the south vertical dial is $\tan. y = \tan. h \cos. l$, whence it follows that a horizontal dial constructed for any given latitude will be a south vertical dial for any place of which the latitude is the complement of the latitude of the former place, —a property which was discovered by the Arabians. The hour lines of the vertical north dial are found exactly in the same way as those of the south dial.




When the face of the vertical dial is exactly east or exactly west, its plane is in the meridian, and consequently parallel to the vertical plane in which the style is. The hour lines, therefore, as in the polar dial, are all parallel to each other. Let $d$ be the height of the style above the plane of the dial, $h'$ the hour from 6 o'clock, and $x$ the distance of that hour line from the hour line of VI, which is the intersection of the prime vertical with the plane of the dial; then $x = d \tan. h'$: the same formula as was given for the polar dial.

When the vertical dial does not face directly one of the four cardinal points, it is called a declining vertical dial, and the investigation of the hour lines is somewhat more complicated.

Let $l$ denote the latitude of the place,
$d$ the declination of the dial, reckoned from the east towards the south,
$h$ the hour angle from noon,
$y$ the hour line angle on the dial.

Find these two auxiliary quantities, viz. an angle P, and the tangent of an angle Q (of which only the logarithm is required), such that

$$\tan. P = \frac{\sin. l \tan. d}{\text{rad.}}; \quad \tan. Q = \frac{\cot. l \sin. P}{\sin. d};$$

then, the forenoon hours on the west declining dial, and the afternoon hours on the east, will be found from the formula

$$\tan. y = \frac{\tan. Q \sin. h}{\cos. (x + P)};$$

and the morning hours on the east declining dial, and the afternoon hours on the west, by the formula

$$\tan. y = \frac{\tan. Q \sin. h}{\cos. (x - P)}.$$

The formulæ which have now been given are sufficient to enable any one who has a slight knowledge of logarithmic computation to trace the hour lines of any one of the dials which has been described with great facility. It is therefore unnecessary to explain the *geometrical* methods of construction by the rule and compasses, which are besides less accurate, and more liable to be misunderstood. Of the mechanical operations necessary to be executed, such as fixing the style and placing the plane of the dial in the true vertical or horizontal position, it is unnecessary to speak, as they will readily suggest themselves to any one who has a clear conception of what is required to be done. The only thing that requires explanation is the method of finding the meridian line without having recourse to any of the more delicate operations of astronomy The method generally practised is as follows.—Assume a point in the plane of the dial through which it is intended the meridian line shall pass. With this point as a centre, describe several concentric circles, then fix a pin or wire in the same point, perpendicular to the plane, and of such a length that the extremity of the shadow shall fall within the circles (or some of them) at midday. Observe the time when the extremity of the shadow reaches some one of the circles in the forenoon, and mark the point where it crosses the circle In the afternoon mark the point where it again crosses the same circle, and divide the arc between the two points thus marked into two equal parts; the straight line which joins the point of bisection with the centre is the meridian line required. For greater security, the passage of the shadow over several circles may be marked; and if the points of bisection of the different arcs do not lie in the same straight line with the centre, a point must be chosen which occupies a mean position among all the others, and the straight line passing through it may be regarded as the true meridian This method is sufficiently accurate for the purposes of a dial. Two plummets suspended over the meridian line will indicate the plane of the meridian in space. Its intersection with any vertical plane may be found by the eye.

It will be observed that the time indicated by a dial is *solar* time or *true* time, and agrees with *mean* time, or that which is shown by a well-regulated clock, only on four different days of the year. In order to find the mean time from the dial, it is necessary to apply a correction called the *Equation of Time*. (See the term.)

It has been supposed that the style is formed by a wire, or the straight edge of a thin plate; but a slit in a plate properly placed, allowing a line of light to pass, will evidently answer the purpose. Sometimes a small hole is preferred; and the hour lines, instead of being described on a plane surface, are sometimes described on the surface of a sphere, or a cylinder or a cone. The reader may find a description of some curious dials in Brewster's edition of *Ferguson's Lectures*. For the history of dialling, see *Delambre, Astronomie Ancienne*, tome ii.; *Montucla, Histoire des Mathematiques*, tome i. The writers on the subject are very numerous. For a concise and perspicuous treatise we may refer to the article in the *Encyclopedia Britannica*.

DI'ALECT. (Gr. διαλεκτος, from διὰ, signifying *division*, and λέγω, *I speak*.) In the philosophical sense of the word, any variety of a common language. Hence German, English, Swedish, &c. are all strictly said to be dialects, as coming all of them from the same original

stock. Commonly, however, we limit the application of the term dialect to the varieties of a national language; and speak of the dialects of English, French, &c. In Greek the four dialects (Doric, Ionic, Æolic, Attic) were the four written varieties of the language, each possessing a literature of its own. In this respect no modern tongue presents a parallel to the Greek; inasmuch as, in all, one dialect has been arbitrarily adopted as the standard of polite writing and conversation, and the written works which are extant in the other dialects are regarded merely as exceptions to the general rule.

DIALE'CTICS. (Gr. διαλέγομαι, *I converse or debate.*) This name was originally used by Plato as synonymous with metaphysics, or the highest philosophy. Strictly speaking, it can only be regarded as a preparatory discipline for such investigations, or at most as a scientific method of prosecuting them. The most splendid examples of dialectical subtilty that exist are to be found in the *Dialogues* of Plato, especially in those entitled *Parmenides*, *the Statesman and Sophist*. Aristotle expresses himself with some contempt of dialectics. It is certain, however, that its own logic owes its existence to the dialectical exercises of the Platonic schools; and that it may, in one point of view, be regarded as a body of canons and directions for their legitimate use. (*See* PLATONIC PHILOSOPHY.) In modern times various systems of dialectics have been propounded in different countries; but by no philosophers, either ancient or modern, has this science been more successfully cultivated than by the Germans, who, among a host of other names more or less distinguished, can boast of a Fichte, Kant, Leibnitz, Hegel, Schelling, and Schlegel, as the propounders each of a peculiar dialectical system.

DIA'LLAGE. (Gr. διαλλαγη, *difference.*) A mineral of a foliated structure easily divisible in *one* direction, its natural joints and fractures exhibiting a very *different* lustre and appearance.

DI'ALLING LINES, or SCALES. Graduated lines on rules or circles to facilitate the construction of dials. They usually consist of two lines of tangents and a line of latitudes. Such contrivances are of no great use; the readiest and best method is to compute the angles of the hour lines from the trigonometrical formulæ: when the angles are known, they can be set off by means of a scale of chords, or by any of the other methods employed in practical geometry.

DIA'LOGISM. (Gr. διαλογος, from δια, *through*, and λογος, *speech.*) In Rhetoric, a mode of writing which consists in the narration of a dialogue; *i. e.* in which the conversation of two or more persons is reported, without their being actually introduced as personages speaking; in which, therefore, the sentence is framed or governed by the third person instead of the first. A speech by a single person, or the species of conversation held by a person with himself (thinking aloud), when reduced into the narrative form, is also, although somewhat incorrectly, termed by French literary writers dialogism.

DI'ALOGUE. (Gr. διάλογος.) In Literature, a composition or part of a composition in the form of a conversation between two or more persons. The dialogue was the form most generally adopted by the ancients for the conveyance of instruction, and was considered equally applicable to the most grave and philosophical, and to the most ludicrous and comical subjects. Thus it was adopted by Plato, Cicero, and Lucian, with equal success. Plato chose this form for the conveyance of his philosophical sentiments; because real conversation had been the mode by which his master, Socrates (who left no writing), gave instruction to the Athenians. In the *Dialogues* of Plato, Socrates is himself introduced as the chief interlocutor. Among modern writers the philosophical dialogue has been frequently employed for the same purpose, more especially by the French, to whose language and mode of thought it should seem to be peculiarly suited. Among other eminent persons of that country who have enriched its literature with this species of composition are, Fenelon; Paschal, in his *Provincial Letters;* Bouhours, in his *Entretiens d'Ariste et d'Eugène*, Fontenelle, in his *Dialogues of the Dead*, and *Plurality of Worlds;* Galiani, *Sur le Commerce des Grains*, &c. In England this method of composition has been less frequently practised; and, perhaps, with the exception of Berkeley and Hurd, has rarely succeeded in the hands of those who attempted it. Both the Germans and Italians have attempted to impart a knowledge of their different philosophical systems in this manner. Among the latter may be mentioned Machiavelli and Algarotti; and among the former Lessing, Mendelssohn, Schelling, and Herder; though the labours of none of these distinguished persons in this department of literature are so important as to require any particular notice in this place. It has long been a question of dispute as to the class of subjects for the discussion of which this mode of writing is chiefly adapted, and upon this point various opinions have been entertained. Upon this question it is not our intention to enter; but we cannot refrain from citing here the opinion of a gentleman as to its peculiar fitness for conveying philosophical instruction, whom few will venture to gainsay on such subjects. "There are some subjects," says Mr. Hume, "to which dialogue writing is peculiarly adapted, and where it is preferable to the direct and simple method of composition. Any point of doctrine which is so *obvious* that it scarcely admits of dispute, but at the same time so *important* that it cannot be too often inculcated, seems to require some such method of handling it; where the novelty of the manner may compensate the triteness of the subject, where the vivacity of conversation may enforce the precept, and where the variety of lights presented by various personages and characters may appear neither tedious nor redundant. Any question of philosophy, on the other hand, which is so *obscure* and *uncertain* that human reason can reach no fixed determination with regard to it, if it should be treated at all, seems to lead us naturally into the style of dialogue and conversation. Reasonable men may be allowed to differ where no one can reasonably be positive; opposite sentiments, even without any decision, afford an agreeable amusement; and if the subject be curious and interesting, the book carries us in a manner into company, and unites the two greatest and purest pleasures of human life, study and society."

The dramatic dialogue differs from the philosophical, inasmuch as its subject is one of action. The whole of modern dramas is dialogue, with the exception of occasional monologue or soliloquy. (For a learned account of the *dialogue*, see the *Encyclo. des Gens du Monde.*)

DIA'METER. (Gr. δια, *through*, and μετρον, *a measure.*) A straight line passing through the centre of a geometrical figure, as that of a circle, ellipse, or hyperbola. Many figures have diameters, though they have, properly speaking, no centres, in this case, the diameter is the straight line which bisects all the parallel chords. Some geometers extend this definition, and apply the term diameter to the curve lines which pass through the points of bisection of all the parallel chords of other curves. In this sense every curve has a diameter. In astronomy the *apparent diameters* of the celestial bodies are estimated by the number of seconds in the angles they subtend at the eye. The apparent diameter (which is measured by the micrometer), compared with the distance of the body, gives its *real* diameter; for the distance of the sun or a planet is to its real diameter, as radius to the sine of the angle subtended by the apparent diameter of the body.

DIAMETER. In Architecture, the measure across the lower part of the shaft of a column, which is usually divided into sixty parts, called minutes, and forms a scale for the measurement of all the parts of an order.

DI'AMOND. (A corruption of *adamant*, from Gr. α priv., and δαμαω, *I conquer*, from its extreme hardness and difficulty of fracture.) The most valuable of the precious stones. Diamonds were originally discovered in Bengal, and in the Island of Borneo. About the year 1720 they were found in Brazil. They always occur in a detached state in alluvial soil. The primitive crystalline form of the diamond is a regular octahedron, of which there are numerous modifications. Diamonds are found of all colours: those which are colourless, or which have some very decided tint, are most esteemed; the latter, however, are rare. Those which are slightly discoloured are the least valuable. The diamond is the hardest known substance, and can only be polished by its own dust or powder. The art of splitting or cutting and polishing this gem, though probably of remote antiquity in Asia, was first introduced into Europe in 1186 by Louis Berghem of Bruges, who accidentally discovered that by rubbing two diamonds together their surfaces might be abraded. They are cut chiefly into two forms, *rose* and *brilliant:* the latter have the finest effect, but require the sacrifice of a larger portion of the gem; so that the weight of an ordinary polished diamond often does not exceed half that of the rough gem. The largest known diamond is probably that mentioned by Tavernier, in possession of the great mogul: it was found in Golconda in 1550; is of the size of half a hen's egg, and said to weigh 900 carats. Among the crown jewels of Russia is a magnificent diamond, weighing 195 carats. It is of the size of a pigeon's egg, and was purloined from a brahminical idol by a French soldier; it passed through several hands, and was ultimately purchased by the Empress Catherine for the sum of 90,000*l.* and an annuity of 4000*l.* Perhaps the most perfect and beautiful diamond hitherto found is a brilliant brought from India by a gentleman of the name of Pitt, who sold it to the regent Duke of Orleans for the sum of 100,000*l.* It weighs about 136 carats, or 544 grains.

That the diamond is combustible, was first proved by the Florentine academicians in 1694, who found that when exposed to the heat of the sun concentrated in the focus of a large lens, it burned away with a blue lambent flame. The *products* of its combustion were first examined by Lavoisier in 1772, who showed that when it was burned in air or oxygen it produced carbonic acid: subsequent experiments have shown that nothing but carbonic acid is thus formed; and hence it is proved that the diamond is charcoal or carbon in a pure and crystalline form.

DIA'NA. In Mythology, the Latin name of the goddess known to the Greeks by the name of Artemis (Ἄρτεμις), the daughter of Jupiter and Latona, and sister of Apollo. She was the virgin goddess of the chase, and also presided over health. The sudden deaths of women were attributed to her darts, as those of men were to the arrows of Apollo. In later times she was confounded with various other goddesses, as Hecate, Lucina, Proserpina, and Luna. In the two last of these characters she was said to appear in the nether world and in heaven respectively, while on earth she assumed the character of Artemis; whence she was called the three-formed goddess. Her power and functions in these characters have been happily expressed in the couplet —

> Terret, lustrat, agit, Proserpina, Luna, Diana
> Ima, suprema, feras, sceptro, fulgore, sagitta.

She was generally represented as a healthy active maiden in a huntress's dress, with a handsome but ungentle expression of countenance. The homage rendered to Diana was so extensive that the silversmith who remarked that she was worshipped in all Asia and the world, can scarcely be accused of exaggeration. A catalogue of the various places where temples were erected in her honour would comprise every city of note in the ancient world. Among others may be mentioned Ephesus, Abydos, Heraclea, Aulis, Eretria, Samos, Bubastus in Egypt, Delos (whence she was termed Delia), and Mount Aventine at Rome. But of all her temples, that at Ephesus was the most celebrated. It was erected at the joint expense of all the states of Asia; and according to the accounts of ancient authors, it must have surpassed in splendour all the structures of antiquity, and fully deserved to be regarded as one of the wonders of the world A small statue of the goddess, or, as she was termed by her votaries, the "Great Diana of the Ephesians," which was commonly supposed to have been sent from heaven, was here enshrined and adorned with all that wealth and genius could contribute. The fate of this temple is well known. On the day that Alexander the Great was born, it was set on fire by Eratostratus (*Val. Max* 8 14), from a morbid desire to transmit his name even with infamy to posterity. This edifice was afterwards rebuilt on a plan of similar magnificence; and it remained in full possession of its wealth and reputation till the year 260 A. D, when it was completely destroyed during an invasion of the Goths.

DIA'NA, TREE OF. A name given by the old chemists to the crystallized silver which is separated when mercury is put into a solution of nitrate of silver.

DIA'NDROUS. (Gr δις, *double*, and ανηρ, *a man*.) A term applied to any plant having but two stamens

DIAPA'SON. (Gr. δια, *through*, and τας, *all*) In Music, an interval used by most authors to express the octave of the Greeks By one of the boldest metaphors with which we are acquainted, Dryden has beautifully availed himself of this expression in the well-known stanza of his first Ode to St. Cecilia's Day: —

> From harmony, from heavenly harmony
> This universal frame began,
> From harmony to harmony
> Through all the compass of the notes it ran,
> The diapason closing full in man.

For an account of the diapason in the organ pipes, see ORGAN.

DIAPE'NTE. (Gr. δια, and πεντε, *five*) In Music, an ancient term signifying a fifth.

DI'APER A woven linen ornamented with patterns, and used for towels and table linen; it sometimes resembles an inferior kind of damask. It is said to have been originally manufactured at Ypres in Flanders; whence the term d'Ypres, corrupted into diaper.

DIA'PHANOUS. (Gr. δια, and φαινω, *I shine*.) A term applied to bodies which permit the light to pass through their substances. It is the synonyme of translucent. A body which allows the forms of objects to be seen through it is transparent.

DIAPHO'NICS. (Gr. δια, and φωνη, *sound*.) The doctrine of refracted sound. *See* SOUND.

DIAPHORE'SIS. (Gr. διαφορεω, *I carry through*) A perspiration; hence also *diaphoretics*, medicines which promote perspiration.

DI'APHRAGM. (Gr. δια, and φρασσω, *I divide*.) This term is applied to the straight calcareous plate which divides the cavity of certain shells into two parts only; its more common signification relates to the muscular and tendinous partition which separates the chest from the abdomen in mammalia.

DI'APHRAGMATI'TIS. Inflammation of the diaphragm, or of its peritonæal coats. The treatment is the same as that of pleurisy and peritonitis.

DIARRHŒ'A. (Gr. διαβρεω, *I flow through*.) A purging or looseness of the bowels. There are several varieties of diarrhœa, depending upon different causes, and consequently requiring in many instances distinct modes of treatment. In general it is necessary first to remove offending and irritating matters from the bowels by means of aperients; rhubarb, from its astringent tendency, is the purgative usually employed; afterwards astringents with warm aromatics, and the occasional addition of some form of opium, are prescribed and continued till the inordinate laxity of the bowels is quelled. Where diarrhœa is connected, as it often is, with excess of acidity in the stomach, magnesia, chalk, or carbonated alkalis are united to the other remedies.

DIARTHRO'SIS. (Gr. *articulation*.) The moveable connection of bones.

DI'ARY. (Lat. diarium, literally *a daily allowance*; from dies, *a day*), signifies properly a note-book or register of daily occurrences, in which the writer has a principal share, or which have come under his own observation, or have happened in his own time. The term *diary* is equivalent to the French *journal*, the Italian *diario* and *giornale*, and the German *Tagebuch*.

DIASCHI'SMA. (Gr. διασχιζω, *I cleave*.) In Music, an interval consisting of two commas.

DI'ASPORE. A laminated mineral, composed of 80 alumina, 18 water, 3 oxide of iron. A small fragment decrepitates when heated, and is dispersed in numerous fragments; hence its name, from the Gr. διασπειρω, *I scatter*.

DI'ASTASE. (Gr. δια, and ιστημι, *I set*.) A peculiar substance generated during the germination of barley, wheat, &c, which tends to accelerate the formation of sugar during the fermentation of worts. It is precipitated from infusions of bruised malt by alcohol. It is the principle which by its reaction on starch tends to develop sugar in the processes of germination and malting.

DI'ASTEM. (Gr. διαστημμα.) In Ancient Music, a simple interval as distinguished from a compound one; to which latter was given the name of a *system*.

DIASTE'MA. (Gr.) In Zoology, the vacant space occurring in the dental series by the absence of the canine or laniary teeth.

DIA'STOLE. (Gr. δια, and στελλω, *I stretch*.) The dilatation of the heart and arteries.

DI'ASTYLE. (Gr δια, and στυλος, *a column*.) In Architecture, that mode of arranging columns in which the intercolumniation or space between the columns consists of three diameters, or according to some of four diameters.

DIATE'SSARON. (Gr δια, and τεσσαρες, *four*.) In Ancient Music, the interval of a fourth.

DI'ATHE'RMAL, or DIATHERMANOUS. (Gr. δια, and θερμη, *warmth*) A term applied to certain substances, such as transparent pieces of rock salt, &c., which suffer radiant heat to pass through them, much in the same way as transparent or *diaphanous* bodies allow of the passage of light.

DIA'THESIS (Gr. διατιθημι, *I dispose*.) A particular state of constitution predisposing to certain diseases: such as inflammatory, nervous, and putrid diathesis; uric diathesis, in which there is excess of uric acid thrown off by the kidneys; gouty diathesis, &c.

DIA'TONI (Gr δια, and τονος, *an extension*) In Ancient Architecture, the angle stones of a wall, which were wrought on two faces, and which, from stretching beyond the stones above and below them, made a good bond or tye to the work.

DIATO'NIC. (Gr δια, and τονος, *a tone*.) In Music, a term denoting the natural scale of music, which proceeding by degrees includes both tones and semitones. It includes the intervals formed by the natural notes, as well as those produced in transposing the natural.

DIAZENE'TIC (Gr. διαζευγνυμι, *I separate*.) In the Ancient Greek Music, a term applied to the tone disjoining two fourths, one on each side of it, and which joined to either made a fifth.

DIAZO'MA (Gr. δια, *through*, and ζωμα, *a cincture*.) In Ancient Architecture, the landings or resting places which encircled the amphitheatre at different heights, like so many bands or cinctures; whence the name.

DI'BBLE. In Agr. and Hort., a cylindrical piece of wood from one to two inches in diameter, and from 1 ft. to 2 ft. in length, having a cross handle at one end, and brought to a conical point at the other, for the purpose of making holes in the ground to receive plants or seeds. Dibbles which are used for planting potatoes or beans are commonly from two to two and a half feet in length, with a peg inserted near the ground in order that the operator may press it in with his foot.

DIBO'THRIANS, *Dibothri*. (Gr. δις, *twice*, βοθριον, *a pit; two-pitted*.) The name of a division of tape-worms, including those *Bothriocephalans* which have not more than two pits or fossæ on the head.

DIBRA'NCHIATES, *Dibranchiata*. (Gr. δις, and βραγχια, *gills; two-gilled*.) The name of the order of Cephalopods which includes those with two gills, and which are also characterized by having three distinct hearts; an apparatus for secreting and emitting an inky fluid; cephalic arms, never exceeding ten in number, solid, and supporting acetabulæ; and in short all the chief characteristics which are usually ascribed to the entire class of Cephalopods. The same term (*Dibranches*) is applied

by Latreille to an order of the class *Cirripedia*, comprehending those species which are similarly characterized by having two gills.

DICASTE'RIUM. (Gr. δικη, *justice*.) In Ancient Architecture, the name of a tribunal or hall of justice in Athens.

DICE COAL. A species of coal easily splitting into cubical fragments.

DICERA'TES, *Dicerata*. (Gr. δις, *double*, and κερας, *horn; two-horned*.) A name applied by De Blainville to a family of the order *Paracephalophora Polybranchiata*, comprehending all such Gastropodous Mollusks as have two tentacles on the head. The term *Diceras* was previously applied by Lamarck to a fossil genus of Bivalves.

DICHO'TOMOUS, *Dichotomus*. (Gr. διχοτομος.) Signifies the division of an object by repeated bifurcation, so that the branches are always in pairs.

DICHO'TOMY. An artificial system, in which natural objects are arranged according to the above mode of division.

DI'CHROISM. (Gr. δις, *double*, and χρωμα, *colour*.) A term in Optics, used to designate a property possessed by several crystallized bodies of appearing under two distinct colours according to the direction in which light is transmitted through them. Thus the muriate of palladium appears of a deep red colour along the axis, and of a vivid green when viewed in a transverse direction. Sir D. Brewster states (*Optics*, *Cab. Cyclopedia*) that in examining this class of phenomena, he found them to depend on the absorption of light, being regulated by the inclination of the incident ray to the axis of double refraction, and on a difference of colour in the two pencils formed by double refraction.

DICO'LOPHUS. (Gr διχα, *separately*, and λοφος, *a crest*.) The name of the genus of wading birds (*Grallatores*), including the *cariama*, which is characterized by a tuft of feathers projecting from the crown of the head in two directions.

DICOTYLE'DONS. (Gr. δις, *double*, and κοτυληδων, *a seed-leaf*.) One of the primary classes of the vegetable world, consisting of all those plants that have their embryo furnished with two cotyledons, or with a greater number arranged on the same plane. These plants are also called Exogens.

DICTA'TOR. In Ancient History, a Roman magistrate appointed on special occasions to supersede the consuls. The first dictator was elected some years after the expulsion of the kings, on the occasion of a war with the Latins, while a dangerous sedition was feared at home; but the period is very uncertain. Dictators were appointed also for mere ceremonial objects, as for holding comitia. But the purposes for which the dictator was appointed differed so materially at different times, and the opinions of later historians respecting the extent of his authority are so conflicting and unsatisfactory, that more obscurity still exists upon this subject than almost any other within the compass of Roman antiquities. According to Niebuhr, the object aimed at in the institution of the dictatorship was to evade the Valerian laws, and to re-establish the unlimited authority of the patricians over the plebeians; for the appeal to the commonalty granted by these laws was from the sentence of the consuls, and not from that of this new magistrate. But this unlimited power did not extend over the patricians. The form of their election was precisely similar to that of the kings, who were appointed by the senate, while their authority was confirmed by a decree of the curies. Originally the dictator continued in office only six months, but at a later period this salutary rule was neglected. Sylla and Julius Cæsar, the last dictators, were nominated perpetual dictators; the former in the year 81 B. C., the latter after the battle of Pharsalia. The title was subsequently offered to Augustus by the people, but declined, and it was never afterwards assumed by the Roman emperors. An officer called magister equitum, appointed sometimes by the dictator, sometimes by the senate, and sometimes by the people, was always in attendance on the dictator. (See *Niebuhr's Rom. History*, and *Ersch and Gruber's Encyclo.*)

DI'CTIONARY (Mod. Lat. dictionarium), either signifies a collection of words in one or more languages, with their peculiar significations, arranged in alphabetical order; or it may be applied in a more extended sense to any work which professes to communicate information on an entire subject, or an entire branch of a subject, under words or heads digested in order of the alphabet. Hence dictionaries may be said to be of two sorts, — of *words*, and of *facts* or *things*; in the former sense the term *dictionary* being equivalent to *lexicon*, in the latter to *encyclopædia*.

*Dictionary of words.* — The ancients have left us no monuments of this species of literature; and, with a few brilliant exceptions, all the attempts that took place at the early period of the Christian era, and during the middle ages, are comparatively incomplete. It was not till after the invention of printing, when a taste for the classic literature of antiquity became general, that some laborious men, in the view of elucidating the Greek and Roman authors, and of facilitating the investigations of others, undertook the task of compiling dictionaries, or Lexica, as they were called; for the term *Lexicon* is generally restricted to such works. The history of ancient, and, with a few modifications, of modern lexicography, presents the singular phenomenon, that it is only when the language of a country is on the decline, or at all events has attained such a degree of perfection as to be apparently unsusceptible of further improvement, that dictionaries begin to be compiled. "No one," says an able writer, "thinks of writing a dictionary till the language he intends to illustrate has become a study;" and this is seldom the case till the age of its purity and vigour has gone by, till the phraseology of its original authors has become in some degree obsolete, and the caprice or ignorance of later writers has diversified or corrupted the significations of words. In modern times the honour of possessing the best dictionaries belongs to Italy, France, and England. These are the *Vocabulario degli Academici della Crusca*, extended in the latest editions to 6 vols fol.; the *Dictionnaire de l'Académie Française*, 2 vols. 4to, to which a supplementary volume has been recently added; and *Johnson's Dictionary*, 2 vols. fol. 1755; — to which must be added the Dictionaries of Dr. Richardson and Dr. Webster, which, though differing in plan and execution, are models of sound criticism and philological skill. The Spaniards also possess a dictionary of considerable reputation, entitled *Diccionario de la Lengua Castellana, compuesto por la Real Academia Espanola*, 6 vols fol. 1726, but the Germans, perhaps from the cause above adverted to, that the resources of their language have, as is universally admitted, not yet been adequately developed, do not possess any dictionary of universally acknowledged authority.

*Dictionaries of facts or things* are of two species, being either devoted to separate or single branches of science, art, or literature, or embracing the whole circle of the arts and sciences. Of the former, the *Historical and Critical Dictionary* of Bayle, and the *Dictionnaire de la Bible*, by Dom Calmet, may serve as specimens; and of the latter, the *Encyclopédie Française*, and the *Encyclopædia Britannica*. That the idea of comprising all the sciences in a single work was not unknown in antiquity is evident from the expression εγκυκλιος παιδεια, which was used to signify such a course of instruction as should embrace all the sciences. The earliest approximation to this species of literature is to be found in the work of Varro, *Rerum Hum. et Divin Antiquitates*, of which nothing remains but the title; and in the *Historia Naturalis* of Pliny, who has embodied in that work all the results of his multifarious studies and vast erudition. But the term *Encyclopædia* is said to have been first applied to works of this description by some of the Arabian writers of the middle ages, and particularly by Alfarabius, whose general treatise on the sciences is still preserved under this designation. Towards the close of the 16th and the commencement of the 17th centuries, there appeared in Europe several similar treatises with the same title, of which the most celebrated was that of Alstedius, in 2 vols. fol., but none of these productions can be properly termed dictionaries or encyclopædias, being merely collections of treatises resembling rather such works as *Kett's Elements of General Knowledge*, &c., than corresponding to the modern notion of an encyclopædia. The strongest resemblance to the works in question is presented by the *Lexicon Universale Historicum Sacrum et Profanum* of Hofmann, 1677, in 2 vols. fol., and followed in 1683 by a supplement of equal extent; the form of which, at least, has served for a model to nearly all succeeding dictionaries or encyclopædias. (*Penny Cyc.*) It might perhaps be preposterous to assert that Hofmann borrowed the notion of his *Lexicon* from Bacon's theory of the *Encyclopædian Tree*, as set forth in the *Novum Organon* (Leyden, 1650), but, as M. Guizot has observed, there can be little doubt that the great abundance of dictionaries and encyclopædias which the whole of Europe has since witnessed is in some degree owing to that eminent philosopher's *Classification Complete et Raisonnée* of human knowledge.

The subjoined list contains a selection of the most valuable productions in this department of literature which have appeared since that time, arranged according to the place and date of their publication.

*Great Britain.*

1. Lexicon Technicum, or Universal Dictionary of the Arts and Sciences, 2 vols. fol; the first published 1704, the second in 1710. A supplementary vol. was afterwards added.
2. Chambers's Cyclopædia, 2 vols. fol. 1728. This work was extended in a 7th edit. to 4 vols. fol. 1778-86, by Dr. Rees, who afterwards re-edited the work in 45 vols. 4to. (See *infrà*.)
3. An Univ. History of Arts and Sciences, &c., by Dr. De Coetlogon, 2 vols. fol. 1745.

4. Barrow's New and Universal Dictionary of Arts and Sciences, 1 vol. fol. 1751; with a suppl. vol. 1754.
5. A New and Complete Dict. of Arts and Sciences, by a Society of Gentlemen (commonly called Owen's Dictionary, from the name of the publisher), 4 vols. 8vo. 1754.
6. The Complete Dict. of Arts and Sciences, 3 vols. fol. 1766, by the Rev. Ben. Croker, Dr. Thos. Williams, and Sam. Clark.
7. Encyclopædia Britannica, 3 vols. 4to. 1771. The fifth edition of this work, completed in 1814, was extended to 20 vols.; and a supplement in 6 vols., under the editorship of Mr. Napier, added in 1824. A seventh edition of this work, in which the supplement is incorporated, was completed in 1840, under the care of the same indefatigable editor.
8. The English Encyclopædia, 10 vols. 4to. 1795-1803
9. The Cyclopædia, commonly known by the name of Rees's Cyclopædia, 1802-19. 45 vols. 4to
10. British Encyclopædia, 6 vols 8vo. 1807-9.
11. Encyclopædia Londinensis, 24 vols. 4to. 1810-29, by John Wilkes
12. Brewster's Edin. Encyclop, 18 vols. 4to 1810-30
13. Pantologia, or New Dict. of Arts and Sciences, 12 vols 8vo. 1813-16. By Mason Good, Gregory, and Bosworth.
14. Burrowe's Modern Encyclopædia, 10 vols. 4to. 1816.
15. Encyclopædia Edinensis, 6 vols 4to. 1816.
16. Encyclopædia Perthensis, 23 vols. roy. 8vo.; completed in 1816
17. Encyclopædia Metropolitana, 1818. Not yet completed.
18. Oxford Encyclopædia, 6 vols. 4to 1824; to which a supplement in 1 vol. was added in 1831.
19. The London Encyclopædia, 24 vols 8vo 1826
20. Partington's British Cyclopædia, 10 vols 8vo 1833-36.
21. Penny Cyclopædia, large 8vo begun in 1833, completed in 1843, in 27 vols, with a supplement of 2 vols

*France.*

1. Dictionnaire Universel Français et Latin, known by the name Dictionnaire de Trévoux, 1704 3 vols fol. The fifth and last edition, Paris, 1771, was augmented to 8 vols fol
2. Encyclopédie ou Dictionnaire raisonnée des Sciences, des Arts, et des Métiers, par Diderot et d'Alembert, 35 vols fol 1751-80. The original series consisted of 28 vols, of which 11 were plates A supplement of 5 vols was afterwards added, one of which consisted of plates, besides a "Table Analytique" of the whole work, compiled by M Monchon, in 2 vols. A variety of encyclopædias of more or less reputation was published in France immediately after the "Encyclopedie" of Diderot and D'Alembert, but as they are all, to a greater or less extent, mere abridgments of, or compilations from, this great work, we do not think them worthy of notice in this catalogue.
3. Encyclopédie, ou Dictionnaire Universel raisonnée des Connaissances humaines, par le Professeur de Felici. Yverdun, 1770-75. 42 vols 4to., besides a sup. of 6 vols 4to.
4. Encyclopédie Méthodique, &c., 1782-1832, 201 vols 4to., including 47 vols of plates. In this work every art or science is treated of in a separate volume or series of volumes, so that it forms in fact a collection of dictionaries
5. Dictionnaire des Sciences et des Arts, par Lumier, 3 vols 8vo. 1805.
6. Encyclopédie Moderne, &c., par M. Courtin, 1823, &c 24 vols 8vo.
7. Encyclopedie des Dames, par une Société des Dames, Paris, 1821, &c.
8. Dictionnaire de la Conversation et de la Lecture Paris, 1834-9, 52 vols 8vo. or 104 livraisons.
9. Encyclopédie des Gens du Monde Paris, 1833, &c This valuable and popular work, consisting of 22 vols. 8vo., was completed in 1845.

*Germany*

1. Grosse vollständige Universal Lexicon, von Zedler, 1732-50, 64 vols 8vo.; with a sup Another edition was published 1751-54 in 4 vols. fol Halle and Leipsig.
2. Deutsche Encyclopedie, &c., 1778-1804, by Koester and Roos. Of this work 23 vols. 4to. appeared, bringing it down to letter K.
3. Economische Encyclopedie, by Krunitz, Floerke, and Korte, 1774-1828. 148 vols. 8vo. Berlin.
4. Conversations Lexicon, 1796-1809, 6 vols. 8vo.; besides a sup. of 2 vols. The 6th edition was completed at Leipsig, 1824, in 10 vols., with 2 of a sup.; since that time there have appeared several editions of this work materially augmented. An English translation of it, with the addition of much valuable information, was completed at Philadelphia, in 13 vols. 8vo. 1820-33, under the superintendence of Dr. Liebner; and a re-publication of this American work, with considerable improvements, has been completed at Glasgow in 6 vols.
5. Allgemeine Encyclopedie der Wissenschaften und Künste, von Ersch und Gruber, 1818, &c. Leipsig, 96 vols. 4to. of this work have already appeared. It is divided into sections, of each of which A, H, and O are the commencement.
6. Gehler's Physicalisches Wörterbuch, neu bearbeitet von Brandes, Gmelin, Horner, Muncke, Pfaff, 9 vols. 8vo. Leipsig, 1825-40. As the title implies, it is confined to general physics, and physical astronomy; but its great value renders it worthy of a place in this catalogue.
7. Haus-Lexicon, or Vollständiges Handbuch praktischer Lebens-kentnisse fur alle Stände, 8 vols. 8vo. Leipsig, 1835-37.
8. Damen Conversations Lexicon, 10 vols. small 8vo. Adorf, 1835-38.

Besides these, there have been no fewer than 20 Encyclopædias of greater or less extent published in Germany, but, with the exception of the Conversations Lexicon der Gegenwart, which forms a species of supplement to the Conversations Lexicon above specified, they are not of such general importance as to be noticed here.

*Italy.*

1. Dizionario Scientifico ex Curiosa, Sacra, Profana, by G. P. Pinati. 10 vols. fol. Venice, 1746-51.
2. Encyclopedia Italiana. Naples, 1788.
3. Encyclopedia, Methodica, Critica, Ragionnata delle belle Arti, by Pietro Zani. Parma, 1818-20.

But another branch of the same encyclopædian tree, which, as already remarked, yielded such brilliant fruits in the hands of Ducange, Bayle, and Calmet, has taken deep root in Europe, and more especially in this country, and has greatly contributed to the diffusion of knowledge, viz the compilation of Dictionaries appropriated to separate branches of literature, science, or art. A mere catalogue of these would swell this notice to a size wholly incompatible with our limits, as there is scarcely a department of human knowledge in which works of this class have not been published within the last fifty years. It is not our intention to enter upon a discussion of the positive or comparative merits of the works referred to, though there exist perhaps few more fertile fields for criticism, but, if we take into consideration the extreme difficulty of compiling a good dictionary, and the acquirements essential to the individual who undertakes it, we shall not be surprised if but a few only of the vast number of dictionaries with which the literature of this and other countries is inundated be respectably executed. It may be true that the qualities of brevity, precision, and distinctness, without which no work of this class is even tolerable, do not belong to the highest order of intellect, though they are, perhaps, quite as rarely to be met with as its more showy attributes, but it is easy to see that to give interest to a work of this nature, and to present the reader with satisfactory information in a perspicuous and compendious form, a more than ordinary share of ability is indispensable. Montesquieu said of Tacitus that he abridged all, because he knew all. But though a thorough knowledge of the subject be indispensable, that is not enough to enable an individual to make a good dictionary. He must be able to split it into its elements; to treat each part as if it were separate and independent, and the reader wished to study it only; and at the same time to preserve all the parts in due subordination to each other and to the plan of the work. The judgment, tact, and variety of research and learning, to say nothing of the labour, necessary to give permanent interest and real value to a work of this sort in any of the great departments of human knowledge, may be more easily imagined than described; and hence the extreme fewness of such works. But even the inferior class of dictionaries have many recommendations, and though mostly compiled at second hand from other works, and with but little unity of plan or execution, still, if they be *tolerably accurate and precise*, they cannot fail to be of great utility. We are aware, indeed, that this position has been denied, and that it has been contended that the general prevalence of dictionaries has exercised a baneful influence upon the literature of the age, inasmuch as, by making people satisfied with the information which they contain, they tend to generate a taste for superficial learning, and thus by discouraging all reference to more elaborate treatises, strike at the root of original thought and profound erudition. Those, however, who adopt this line of argument, quite overlook the main objects which dictionaries are calculated to serve. Such arguments would have some weight had it been ever contemplated that the mathematician should study mathematics, the philosopher philosophy, the divine theology, or any professional man the subjects that form the basis of his profession, in a dictionary only. But this is by no means the case. The grand object aimed at in such works, is to place within the reach of persons engaged in the business of active life a mass of well-digested, accurate, and readily accessible information upon subjects not connected

with their own immediate pursuits, such as it might be exceedingly difficult for them to procure elsewhere; while even to the learned, or to those who have access and leisure to refer to more extensive depositories of human knowledge, they serve as convenient manuals or reference books. But upon this subject we cannot do better than transfer to our columns an eloquent passage from the elaborate paper of M. Guizot on *encyclopædias* (Paris, 1826), to which we beg to refer the reader for a clear and learned exposition of the merits of this species of literature. "Parlerai-je enfin de leur utilité commune et pratique, de l'abondante instruction, des innombrables enseignemens qu'elles fournissent, et qui s'appliquent à tant de circonstances, à tant de besoins de la vie? Dans les grandes villes, au milieu de toutes les facilités, de toutes les richesses de la société humaine, on oublie trop qu'une multitude de familles independantes, aisées, dont le travail n'absorbe point le temps ni les facultés, vivent dans une situation toute différente, celles-ci à la campagne, celles-là dans de petites villes, éloignées de toutes ces ressources de la science et de l'industrie qui se pressent autour de nous. C'est là qu'on apprend à connaître le prix de cette science domestique qui se transporte en quelques volumes dans la solitude la plus profonde Sans doute elle est incomplete et fautive; on se trompe souvent dans l'application qu'on en fait; mais, à tout prendre, elle éclaire et dirige plus souvent encore; elle diminue les embarras, les ennuis de l'isolement; elle rassure les imaginations; elle établit enfin, entre des milliers d'individus dispersés et les grands foyers de la science, une sorte de lien intellectuel dont l'importance et les effets se laissent difficilement apprecier." Such, then, being the purposes contemplated by works of this class, and such the acknowledged benefits that accrue from them, so far from the number and variety of works which have been published in the course of the last and present century under the title of dictionaries and encyclopædias, occasioning any surprise, we are almost warranted in anticipating that, owing to the gradual progress of human knowledge, the progressive augmentations to the stock of polite literature, and the number and rapidity of the inventions and discoveries which are constantly enriching the arts and sciences, this species of publication will continue to increase, and that, in a word, the literature of every country will gradually assume more and more of the dictionary form.

DI'CTUM. (Lat *something said*) A word used in common parlance to signify the arbitrament or award of a judge.

DI'CTYOTHE'TON (Gr. *δικτυον, a net*, and *τιθημι, I place*.) In Ancient Architecture, masonry worked in courses like the meshes of a net. Also open lattice work for admitting light and air.

DIDA'CTIC (Gr. *διδασκω, I teach*), in the schools, signifies every species of writing, whether in verse or prose, whose object is to teach or explain the rules or principles of any art or science Thus to this class of literature belong the writings of Aristotle on grammar, poetry, and rhetoric; Longinus's Treatise on the Sublime, and the *Institutiones* of Quintilian, &c But the term has been borrowed from scholastic phraseology, and appropriated more exclusively to all poetical writings devoted to the communication of instruction on a particular subject, or of a reflective or ethical character, thence called *didactic poetry*. Were this the place for such investigations, it might be easily shown that the *didactic* must have been among the first species of poetical composition; and that the writings of the earliest poets of whom profane history makes mention, such as Orpheus and Linus, might with propriety be classed under this category. But be this as it may, this species of poetry has been in use from a very remote period, and there is scarcely any nation in which it has not taken root. Among the most celebrated poems of this species may be reckoned in ancient times that of Lucretius, *De Rerum Naturâ*, in which the Epicurean system of philosophy is explained; Virgil's *Georgics*, which has almost always served as a model to the didactic poets of succeeding ages, and Horace's *Art of Poetry*; and in more recent times, Pope's *Essays on Criticism* and *Man*; Du Fresnoy's *Art of Painting* (see Mason's translation in the Literary Works of Sir J. Reynolds); Vida and Boileau's *Art of Poetry*; Akenside's *Pleasures of the Imagination*; Armstrong's *Art of Preserving Health*; Somerville's *Chace*; Dyer's *Fleece*; Young's *Universal Passion*, &c. The reader will find in Blair's *Lectures*, vol. iii., a full exposition of the nature and characteristics of this species of poetry, and a critical notice of the most famed didactic poems of all ages and countries.

DIDA'CTYLE. (Gr. *δις, double*, and *δακτυλος, the finger; two-fingered, or two-toed.*) This epithet is applied to various animals, as to the ruminants among quadrupeds (by Klein), to the ostrich among birds; to the amphiuma, an amphibious reptile with two digits on each extremity; and to certain insects, as the *Pterophorus didactylus* and *Gryllotalpa didactyla*.

DIDASCA'LIA. (Gr.) A term in use among the Greek writers of antiquity, and till within the last century among almost all the nations of modern Europe, applied to the representation of dramatic pieces, or to critical notices of the stage, and of every thing appertaining thereto. The only paper with this designation, now in existence, is, as far as we know, that published at Frankfort, which enjoys a large circulation.

DI'DORON. (Gr. *διδωρον.*) In Ancient Architecture, a brick whose length was one foot, and its breadth one half its length.

DIDE'LPHYS. (Gr. *δις, double*, and *δελφυς, womb.*) A generic name originally applied to the opossum, and all other quadrupeds which like it have a duplicature of the integument of the abdomen forming a pouch, in which the prematurely born young are received, protected, and nourished, as in a second womb, until their growth is advanced to a stage corresponding to that of the new-born young in the ordinary mammalia. In modern systems the term is, singularly enough, restricted to that group of Marsupials in which there are certain species deficient in the abdominal pouch. The genus *Didelphys*, or true opossums, are characterized by the following dental formula — incisores $\frac{8}{8}$, canini $\frac{2}{2}$, molares spurii $\frac{6}{6}$, molares veri $\frac{8}{8}$, = 50; and by having the hinder foot provided with a thumb, and a prehensile tail.

DI'DUS. The generic name for the dodo or dronte. Birds of this kind were discovered by the Portuguese in 1499 on the island now called Mauritius, where they were afterwards observed by the Dutch in 1598, and in the early part of the following century. Original figures of the bird are given in *De Bry* (*Quinta pars Indiæ Orientalis, &c*, MDCI.); by Clusius, in his *Exotica*, 1605; by Herbert, in his *Travels*, 1634, by Bontius (Piso's edition, 1658); and by Savery, in his celebrated picture of "Orpheus charming the Beasts," now in the museum at the Hague. The last figure is the best; it was painted, as were the other figures of exotic species in the same picture, from studies of the living animals preserved at that time in the celebrated menagerie of Prince Maurice of Nassau. It is highly probable that the same dodo was the subject of the painting of which the one now in the British Museum is a copy

Besides this pictorial evidence there exist a head and a foot of the dodo in the Ashmolean Museum at Oxford, and a foot of the dodo in the British Museum The following is Willoughby's translation of the original description of this extinct bird by Clusius. — "The dodo is called by Clusius *Gallus gallinaceus peregrinus*, by Nieremberg *Cygnus cucullatus*, by Bontius *Dronte*. This exotic bird, found by the Hollanders in the island called by the Portuguese *Cygnæa* or *Cerne*, that is the Swan Island, and Mauritius Island by the low Dutch, of thirty miles compass, famous especially for black ebony, did not exceed a swan in bigness, but was of a far different shape, for its head was great, covered as it were with a certain membrane resembling a hood; besides, its bill was not flat and broad, but thick and long, of a yellowish colour next the head, the point being black. The upper chap was hooked, the nether had a bluish spot in the middle, between the yellow and black part. They reported that it is covered with thin and short feathers, and wants wings, instead whereof it hath only four or five long black feathers, that the hinder part of the body is very fat and fleshy, wherein for the tail were four or five small curled feathers, twirled up together, of an ash colour. Its legs are thick rather than long, whose upper part, as far as the knee, is covered with black feathers; the lower part, together with the feet, of a yellowish colour; its feet divided into four toes, three (and those the longer) standing forward, the fourth and shortest backward, all furnished with black claws. After I had composed and writ down the history of this bird, with as much diligence and faithfulness as I could, I happened to see in the house of Peter Pauwius, primary professor of physic in the university of Leyden, a leg thereof cut off at the knee, lately brought over out of Mauritius his island. It was not very long from the knee to the bending of the foot, being but little more than four inches, but of a great thickness; so that it was almost four inches in compass, and covered with thick set scales; on the upper side broader, and of a yellowish colour; on the under (or back side of the leg) lesser and dusky. The upper side of the toes was also covered with broad scales, the under side wholly callous. The toes were short for so thick a leg; for the length of the greatest or middlemost toe to the nail did not much exceed two inches, that of the other toe next to it scarce came up to two inches; the back toe fell something short of an inch and a half; but the claws of all were thick, hard, black, less than an inch long; but that of the back toe longer than the rest, exceeding an inch. The mariners in their dialect give this bird the name *Walgh-vogel*, that is, a nauseous or yellow bird; partly because after long boiling the flesh became not tender, but continued hard and of difficult concoction (excepting the breast and gizzard, which they found to be of no bad relish), partly because they could get many

turtle-doves, which were much more delicate and pleasant to the palate. Wherefore it was no wonder that in comparison of those they despised this, and said they could be well content without it. Moreover they said that they found certain stones in its gizzard; and no wonder, for all other birds as well as these swallow stones to assist them in grinding their meat." Thus far Clusius.

Now, with respect to the parts of the bird which still remain to us, we infer that the head, from the sudden rising of the cranium above the face, and the form of the anterior extremity of the lower jaw, as also from the nostrils being covered with an arched scale, did not belong to a vulture or any other Accipitrine bird; while in the presence of the cere at the base, and the forward position of the nostrils, it resembles the rhea and apteryx among the Struthious birds. The apteryx, however, deviates more from the typical *Struthionidæ* in the shape of the bill and position of the nostrils than does the dodo. With respect to the foot in the British Museum, this differs from that of the vultures in the form and disposition of the tarsal scales, in the shortness of the middle toe, and the bluntness and straighter figure of the claws; while in all these respects it agrees with the foot of the apteryx and the Gallinaceous order. So that even those naturalists who, like Mr. Gray of the British Museum, still reject the evidence in proof of the Struthious nature of the dodo, and deny its existence at any period, are compelled to imagine that the bird represented in the original figures above quoted was made up by joining the head of a bird of prey to the legs of a Gallinaceous bird. The analogies of ornithology, however, by no means sanction the rejection of the multiplied, and, if we except Leguat's narrations, consistent evidence, of the actual existence of the Struthious dodo. Whoever inspects the painting by Savery, above mentioned (which seems hitherto to have escaped the attention of the naturalists who have written on the dodo), must feel a conviction that its original was no factitious or artificial specimen. Neither the head nor the feet still preserved in our museums can be referred to an albatross, a penguin, a vulture, or any other known existing species, while they closely correspond (allowance for the absence of the horny sheath of the bill) with the original figures of the dodo. We have therefore no hesitation in concluding that in other respects those figures are equally faithful representations of the extinct Struthious form in question. Such also appears to be the conclusion to which the learned writer of the article "Dodo" in the *Penny Cyclopedia* arrived; in whose words we shall conclude the present notice:—"If the picture in the British Museum and the cut in Bontius be faithful representations of a creature then living, to make such a bird a bird of prey, a vulture in the ordinary acceptation of the term, would be to set all the usual laws of adaptation at defiance. A vulture without wings! How was it to be fed? And not only without wings, but necessarily slow and heavy in progression on its clumsy feet. The *Vulturidæ* are, as we know, among the most active agents in removing the rapidly decomposing animal remains in tropical and intertropical climates, and they are provided with a prodigal development of wing to waft them speedily to the spot tainted by the corrupt incumbrance. But no such powers of wing would be required by a bird appointed to clear away the decaying and decomposing masses of luxuriant tropical vegetation—a kind of vulture for vegetable impurities, so to speak, and such an office would not be by any means inconsistent with comparative slowness of pedestrian motion."

DIDY'NAMOUS (Gr. δις, *twice*, and δυναμις, *power*) A term applied to flowers having four stamens, of which two are short and two are long.

DIE (Fr. dé), in Coinage, is the instrument by which the impressions are given upon the various denominations of coin. The following is an outline of the *die manufacture*, as conducted in her Majesty's mint:—The engraver selects a forged plug of the best cast steel of proper dimensions for his intended work; and having carefully annealed it, and turned its surfaces smooth in the lathe, proceeds to engrave upon it the intended device for the coin, the Queen's head, for instance. When this is perfect the letters are put in, and the circularity and size duly adjusted; it is then hardened, and is termed a *matrix*. Another plug of soft steel is now selected; and the matrix being carefully adjusted upon it, they are placed under a very powerful fly-press, and two or three blows so directed as to commence an impression of the matrix upon the plug; this is then annealed, and the operation repeated till the plug receives a perfect impression of the work upon the matrix. This impression is of course in *relief*, the original work upon the matrix being indented, and produces what is termed the *punch*. This, being duly shaped in the lathe, is hardened, and is employed in the production of impressions in soft steel or *dies*, which being properly turned and hardened, are exact *fac-similes* of the original matrix, and are used in the process of *coinage*. When a pair of dies are made of good steel duly hardened and tempered, and are carefully used, they will sometimes yield from two to three hundred thousand impressions before they become so far worn or injured as to require to be removed from the coining presses.

DI'ERESI'LIS. A term invented by Mirbel to denote a many-celled superior fruit; the cells being dry, indehiscent, few-seeded, and cohering by a common style round a common axis—Ex. *Malva*.

DIE'SIS. (Gr.) In Music, an interval less than a comma. The harmonical diesis is the difference between a greater and a less semitone.

DI'ET. (Lat. dies, *a day;* Germ. Reichstag.) A name given to the principal national assembly in many countries of modern Europe.

By the usage of the *German Empire*, two diets were summoned every year by the emperor, besides such as were convoked on extraordinary occasions. There were three chambers—1. That of the electors (*see* ELECTORS) 2. That of the sovereign princes, divided into two spiritual and four temporal benches. The counts of the empire voted collectively in four benches or divisions, and not as individuals; the prelates and the abbots in two. 3. The chamber of the imperial cities, divided into the Rhenish and the Swabian benches. The diets, together with the emperor, exercised the prerogatives of sovereignty. A decree of the diet was termed a recess of the empire. The diet of the modern Germanic Confederation is a meeting of plenipotentiaries, permanently assembled in the city of Frankfort-on-the-Maine. There are two diets: one termed *plenum*, in which the thirty-eight sovereign members of the confederacy have seventy votes divided between them, the other the lesser or ordinary, in which their votes amount together only to seventeen. In the latter assembly propositions are brought forward and discussed, which are decided in the other without discussion. On some fundamental questions unanimity is required, in order that any proposition may be adopted; in other cases a majority of two thirds is necessary. Austria presides in both diets, and has the casting voice in the lesser.

The diet of Hungary is composed of the king (Emperor of Austria) and the estates. The latter consist of the higher clergy, the magnates, the two courts of appeal, and two representatives from each chapter, county, city, and privileged district. They are divided into two chambers, called tabulæ.

The diet of Switzerland is composed of the representatives of the cantons, and manages such affairs as by the federal constitution are exempted from the jurisdiction of those several independent states. It is held every two years, alternately at Zurich, Berne, and Lucerne, which are termed the presiding cantons (vorort). The schultheiss or governor (chief executive magistrate) of the presiding canton is landamman of Switzerland for the time being. Each canton has one vote in the diet.

From a very remote period, down to 1832, Poland enjoyed a national assembly, or *diets*, which were of two sorts, *ordinary* and *extraordinary*. The ordinary diet was held every two years, and usually at Warsaw; though it was expressly enacted that every third meeting should be convened at Grodno, in Lithuania. The duration of its sitting was restricted to six weeks, and could not, under any pretext, be protracted beyond this period. The diet was composed of a selection from the nobility, who formed what was called the senate, and of the deputies returned by each of the palatinates and districts of the country. The number amounted to about 100. The period of its meeting was fixed by the king, who presided over its deliberations; except during an interregnum, when the business of summoning the diet devolved on the archbishop of Guesna. The *extraordinary* diets differed from the *ordinary* chiefly in this, that there was no stated period for the former being summoned together, that they were convoked only to listen to propositions from the throne, and lasted only four days.

As is well known, the throne of Poland was not hereditary, but elective; and, on the occasion of choosing the sovereign, the Polish diets were held in the open country, and were attended by all the nobility on horseback, armed and equipped as if for battle. On this subject the reader is referred to a work of great ability, by De la Birardière, entitled *Histoires des Dietes de Pologne, pour les Elections des Rois, depuis* 1572 *jusqu'en* 1674 (8vo. Paris, 1679). *Dietines* was the name given to the particular assemblies of the Polish nobility in which deputies were elected to serve in the ordinary diets, and to represent the wishes and interests of their constituents. In these dietines every gentleman possessing an estate of three acres had the right of voting, and every deputy was chosen by the majority of suffrages. (See *Dunham's History of Poland.*)

DIET DRINK. Alterative decoctions taken in considerable quantities; such as decoction of sarsaparilla, sassafras, dandelion, &c. *Lisbon diet drink* nearly resembles the compound decoction of sarsaparilla of the London Pharmacopœia.

DIETE'TICS. (Gr. διαιτασιν, *to nourish.*) That part of medical science which relates to the diet or ordinary food. *See* DIGESTION and FOOD.

DIEU ET MON DROIT. (Fr. *God and my right.*) The motto of the royal family of England. It was first assumed by Richard I., to intimate that he held his sovereignty from God alone, and not in vassalage to man; and it should seem that it fell into desuetude among the immediate successors of that prince, and remained so till the reign of Edward III., by whom it was revived when he first claimed the crown of France. Since that period, if we except the reigns of Elizabeth, William III., and Anne, the first and last of whom used the motto "Semper eadem," and the second, though only in his private capacity, "Je maintiendray," *Dieu et mon droit* has always formed the royal motto of England.

DI'FFERENCE. In Logic, one of the predicables. It is that particular quality which distinguishes the subject from all others, when contemplated from that point of view in which we are then regarding it; and is said, logically, to be part of the essence of the subject. The genus, together with the difference, is said logically to make up the species; the species, with the difference, to make up the lower species, or the individual: — *e. g.* To the genus metal add the difference "susceptible of magnetic attraction," and we obtain the species iron, which is distinguished from all other metals by the existence of that peculiarity. *See* LOGIC.

DI'FFERENCE, in Arithmetic and Algebra, is the excess of one quantity over another, or that which remains when one quantity is taken from another quantity of the same kind. In the higher mathematics the theory of *Finite Differences* forms an extensive branch of analysis, which is usually explained in treatises on the Differential and Integral Calculus. (See the treatises of Euler, Bossut, Lacroix, &c.; or the Appendix by Sir J. Herschel to the English translation of Lacroix's smaller work.)

DI'FFERENCES. In Heraldry, devices borne on the escutcheon to indicate the part of a family to which the bearer belongs. This has been effected by various methods, — at present by what are termed brisures, marks of filiation, or of cadency; being small charges placed conspicuously in the shield. The eldest son bears a label of three points; the second, a crescent; the third, a mullet; the fourth, a martlet, the fifth, an annulet or small ring; the sixth, a fleur-de-lys, the seventh, a rose, the eighth, a cross moline; the ninth, a double quatrefoil. The family of the second son repeat these differences on their own paternal mark of filiation — *e. g.* the second son's first son bears a crescent ensigned with a label, and so on of the rest. Females do not bear differences.

DIFFERE'NTIAL (diminutive of Difference), in the higher Mathematics, denotes a quantity infinitely small, or less than any assignable magnitude. *See* DIFFERENTIAL CALCULUS.

DIFFERE'NTIAL CALCULUS. The name by which one of the most important branches of the higher mathematics is usually designated.

In confining ourselves to a very general view of the subject, it may be said that the object of the differential calculus is to find the ratios of the differences of variable magnitudes, on the supposition that these differences become *infinitely small*, an hypothesis which gives rise to considerable abbreviations in the general calculation of differences. But it is here necessary to attend to the particular signification in which the terms *infinite*, *infinitely small*, are used in the language of the calculus. Every magnitude which forms the subject of mathematical reasoning is susceptible of augmentation or of diminution without limit. We may therefore always conceive a quantity to become so great as to exceed any finite assignable quantity of the same nature as itself, or so small as to be less than any finite assignable quantity also of the same nature as itself: in the former case the quantity is said to be infinite, in the latter, infinitely small. In this sense it is obviously not necessary to attribute a real and physical existence to an infinitely great or infinitely small quantity. It is sufficient to imagine that if we attribute to any quantity which enters into a question a value as great or as small as we please, there always exists, beyond this limit, a quantity of the same kind still greater or still smaller, and which in this sense is infinitely great or infinitely small in comparison of any other finite quantity of the same kind. So that a finite magnitude may be regarded as nothing, or zero, in comparison of one infinitely great; and an infinitely small magnitude as nothing, or zero, in comparison of a finite magnitude.

The infinitely small quantities which come under consideration in the differential calculus are called *differentials*. The differential of a magnitude or variable function is expressed by writing the letter $d$ before the magnitude or function: thus $dx$ signifies the differential of the variable magnitude $x$, $d(xy)$ the differential of the product of the two variables $x$ and $y$, and so on. Instead of using the letter $d$, the English mathematicians formerly indicated the *fluxion* of a quantity (which is equivalent to the differential) by placing a dot over it; thus $\dot{x}$ represented the fluxion of $x$, and $\dot{xy}$ that of the product $xy$; but this notation was found in the progress of the calculus to be inconvenient, and has been disused by all the modern writers. The letter $d$ was introduced by Leibnitz, and it has been adopted by all the Continental writers since the origin of the calculus as the symbol of differentiation.

The principles upon which the doctrine of infinitesimal quantities can be best established have been the subject of much dispute among mathematicians, and various methods of deducing the fundamental theorems have been proposed, of which the principal are — the *differential method* of Leibnitz, the Newtonian *method of fluxions*, Newton's *method of prime and ultimate ratios* followed in the *Principia*, D'Alembert's *method of limits*, Lagrange's *method of derivation*, and Landen's *residual analysis*. The principles and general procedure of Leibnitz's method (which, properly speaking, is the differential calculus) may be explained as follows: —

The differential of a variable quantity may be defined to be the infinitely small difference between two successive states of the same variable, and the object of the calculus is to find this differential for all possible cases; that is to say, for all the possible functions of the proposed variables, such as $x$, $y$, $z$, &c., of which the particular differentials are expressed by $dx$, $dy$, $dz$, &c. Before explaining how this is done, it is necessary to examine into the distinction that must be made between the operation by which an ordinary or finite difference is found, and that to which we must confine ourselves when the difference is infinitely small, or a differential. If we consider the proposed system or function in any two determinate states different from each other, the difference of the two values of the same quantity taken in the two states will be determinate, and consequently cannot be supposed as small as we please, so that no part of its expression can be omitted; but if the two states of the function approach indefinitely near each other, the difference of the two values of the same variable may be rendered as small as we please. It then becomes a differential, and is in fact nothing more than the ordinary difference simplified by the suppression of the quantities which in its expression may be regarded as infinitely small in comparison of the other quantities of which it is composed. Such is the general principle of differentiation. (Carnot, *Reflections sur la Metaphysique du Calcul Infinitésimal*, Paris, 1813.)

From this general principle it follows evidently that in order to differentiate a quantity, or any function whatever of a quantity, or of several combined quantities, which function we shall represent by $\varphi(x, y, z, \&c.)$, it is only necessary to consider it in its second state, that is to say, when $x$, $y$, $z$, &c. having become respectively $x + dx$, $y + dy$, $z + dz$ &c., the function itself becomes $\varphi(x + dx, y + dy, z + dz, \&c.)$, to subtract the primitive value of the function from its value thus increased, which will give for the finite difference of the proposed function

$$\varphi(x + dx, y + dy, z + dz, \&c.) - \varphi(x, y, z, \&c.);$$

and, lastly, to pass from this difference to the differential by neglecting those quantities which in the development are infinitely small in comparison of those to which they are to be added, or from which they are to be taken away. This general rule will be better understood by showing its application to some particular examples.

1. Let it be proposed to differentiate the sum $a + b + x + y$, composed of constant and variable quantities. According to the general formula, the constants $a$ and $b$ have no differential, and those of $x$ and $y$ are $dx$ and $dy$ respectively, therefore the differential of the proposed sum, that is, $d(a + b + x + y)$ is $a + b + (x + dx) + (y + dy) - (a + b + x + y)$, which becomes on reduction $dx + dy$. Hence, *the differential of any sum whatever of constants and variables is equal to the sum of the differentials of the variables alone.*

2. Let it be required to differentiate $x - y$. Here we have $d(x - y) = (x + dx) - (y + dy) - (x - y)$, or after reduction, $d(x - y) = dx - dy$, whence the differential of the difference of any two variables is equal to the difference of their differentials.

3. Let it be proposed to differentiate the product $xy$. By the formula we have $d(xy) = (x + dx)(y + dy) - xy = x\,dy + y\,dx + dx\,dy$; but it is necessary to remark that the last term $dx\,dy$ is infinitely small in comparison of each of the two others, as will be evident on dividing it by either of them, for the quotient is obviously an infinitely small quantity. The third term must therefore be neglected; whence the formula becomes $d(xy) = x\,dy + y\,dz$. In like manner $d(xyz) = xy\,dz + xz\,dy + yz\,dx$, and so on for the differential of the product of any number of variable quantities.

4. Let it be proposed to differentiate the fraction $\frac{x}{y}$. By the general formula the difference will be $\frac{x + dx}{y + dy} - \frac{x}{y}$; which being reduced to a common denominator, becomes $\frac{y\,dx - x\,dy}{y^2 - y\,dy}$; and on leaving out the quantity $y\,dy$, which is infinitely small in comparison of $y^2$ with which it is joined, we have $d\frac{x}{y} = \frac{y\,dx - x\,dy}{y^2}$.

5. Let it be proposed to differentiate the function $x^m$. In this case the general formula gives $(x + dx)^m - x^m$. Expanding $(x + dx)^m$ by the binomial theorem, we get $(x^m + m\,x^{m-1}\,dx + \frac{1}{2}(m-1)\,x^{m-2}\,dx^2 + \&c.) - x^m$, or $m\,x^{m-1}\,dx + \frac{1}{2}(m-1)\,x^{m-2}\,dx^2 + \&c.$, for the difference. But $dx^2$ being infinitely small in comparison of $dx$, the term into which it enters as a factor (and all the succeeding ones which are multiplied by $dx^3$, $dx^4$, &c.) must be rejected. We have therefore simply, for the differential, $d\,x^m = m\,x^{m-1}\,dx$. It will easily be understood that $m$ may be any quantity, whole or fractional, positive or negative.

6. Let it be proposed to differentiate the expression $a^x$, in which $a$ is a constant quantity, and $x$ a variable exponent. According to the general principle the differential is $a^{x+dx} - a^x$, or $a^x \cdot a^{dx} - a^x$, or $a^x(a^{dx} - 1)$. Assume $a = 1 + b$, and we shall have $a^{dx} = (1 + b)^{dx}$; whence by the binomial theorem,

$$a^{dx} = 1 + dx\,b + dx\,b^2\,\frac{dx - 1}{2} + dx\,b^3\,\frac{(dx-1)(dx-2)}{2 \cdot 3}$$

+ &c.; and as the quantity $dx$, being infinitely small in comparison of the finite numbers 1, 2, 3, &c., must be rejected, the equation, on transposing the first term of the second member, becomes

$$a^{dx} - 1 = dx\,(b - \frac{b^2}{2} + \frac{b^3}{3} - \frac{b^4}{4} + \&c.)$$

Substituting this value of $a^{dx} - 1$ in the expression $a^x(a^{dx} - 1)$, and writing $a - 1$ instead of $b$, we have for the differential of the proposed function

$$da^x = a^x\,dx\left((a-1) - \tfrac{1}{2}(a-1)^2 + \tfrac{1}{3}(a-1)^3 - \&c.\right)$$

Or, making the constant factor (which is the Napierean logarithm of the number $a$) $= M$,

$$da^x = M\,a^x\,dx.$$

7. Let the proposed function be $\log y$. Make $x = \log y$, then $dx = d \log y$, and by the general definition of a logarithm, we have always, whatever may be the value of $a$, the base of the system, $y = a^x$. Hence $dy = da^x$, and substituting for $da^x$ its value $M\,a^x\,dx$, given in the last paragraph, we have $dy = M\,a^x\,dx$. Substituting, therefore, $y$ for $a^x$, and $d \log y$ for $dx$, we find ultimately

$$d \log y = \frac{dy}{M\,y}.$$

8. Let it be proposed to differentiate $\sin. x$, $x$ being an arc of a circle of which the radius is 1. By the general principle $d \sin. x = \sin.(x + dx) - \sin. x$, whence, by the common trigonometrical formula, $d \sin. x = \sin. x \cos. dx + \cos. x \sin. dx - \sin. x$. Now if we recollect that $dx$ is an infinitely small arc, it will be obvious that its cosine differs from unity only by an infinitely small quantity, which therefore must be rejected. The formula consequently becomes $d \sin. x = \sin. x + \cos. x \sin. dx - \sin. x = \cos. x \sin. dx$. Again, $d\,x$ being infinitely small, it differs from its sine only by an infinitely small quantity, which must therefore be rejected. Hence $\sin. dx = dx$, and we have

$$d \sin. x = \cos. x\,dx.$$

By the same process of reasoning we find $d \cos. x = -\sin. x\,dx$, and $d \tan. x = \frac{dx}{\cos. x^2}$. It is unnecessary to give more examples, the method of applying the general principle is obvious.

Hitherto we have considered the system of variable quantities in two successive states only, but it may be considered successively in two, three, four, or any number of consecutive states, all differing infinitely little from each other. This consideration gives rise to successive *orders* of differentials, derived from each other by a continued repetition of the same operation. By differentiating a function of any variable quantities we obtain a derivative function, in which the corresponding quantities differ infinitely little from their values in the original function. Another differentiation gives a second derivative function, and so on; so that we obtain as many successive orders of differentials as operations are performed. But it is to be remarked, that the infinitely small differences between the quantities in the first derivative system and the corresponding quantities in the original function, are not the same as the infinitely small differences between the quantities in the second derivative system and the corresponding quantities in the first, and those between the second and third systems are again different from those between the first and second. Hence it follows that these differentials are themselves variable, and consequently, like all other variable quantities, have their differentials. If therefore we retain the symbol $d$ as the characteristic of the differential of any species of variable, the expression $ddx$ will denote the quantity by which $dx$ is augmented in passing from the first derivative state to the second, exactly in the same manner as $dx$ represents the increase of $x$ in passing from the original to the first derivative state. In like manner $dddx$ will express the augmentation which $ddx$ receives in passing from the second system to the third, and so on.

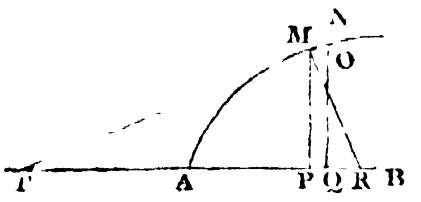
The quantities $dx$, $ddx$, $dddx$, &c. are called the first, second, third, &c. differentials of $x$. In the same manner, $dy$, $ddy$, $dddy$, &c. are the first, second, third, &c. differentials of $y$. Instead of writing $ddx$, $dddx$, &c., it is usual to write $d^2x$, $d^3x$, &c. And this notation is not merely preferred on account of the abbreviation; it is absolutely necessary in many cases for the sake of carrying on the investigation when many successive differentials of the same variable are necessary to be considered. But these symbols must be carefully distinguished from $dx^2$, $dx^3$, &c., which are likewise abbreviations, but which at the same time denote real powers of $dx$, signifying respectively $dx\,dx$, $dx\,dx\,dx$, &c.; and they must also be distinguished from the quantities $d(x)^2$, $d(x)^3$, &c., which are the differentials of the powers $x^2$, $x^3$, &c. of $x$, while $dx^2$, $dx^3$, &c. are the powers of the differentials.

From these considerations it follows that the differentials of all orders are differentiated in the same manner as any other variable, and consequently no particular rules are required for this purpose. For example, the differential of $xy$ is $x\,dy + y\,dx$; and on differentiating this differential, we find $dx\,dy + x\,d^2y + dy\,dx + y\,d^2x$. Differentiating a third time, we get, on adding the similar terms, $3\,dx\,d^2y + 3\,dy\,d^2x + x\,d^3y + y\,d^3x$, and so on.

In the application of the calculus, it is very important to observe, that when different variables are connected by equations we are always at liberty to assume the differential of one of the variables to be constant; and this constant differential then becomes a term of comparison, and serves to regulate all the others. For instance, in considering a curve line, we may suppose the successive infinitely small increments of the abscis to be all equal; in this case $dx$ is invariable, and consequently $d^2x = 0$. But the increments of the ordinate, which correspond to these equal increments of the abscis, are not equal, and consequently the differentials of $dy$ (or $d^2y$) are not zero; and the law according to which $dy$ varies in passing from one point to another, while $dx$ remains constant, is precisely that which will make known the nature of the curve. In other words, the nature of the curve will be determined by the relations between the successive differentials $dy$, $d^2y$, $d^3y$, &c. of the variable $y$.

Having now endeavoured to explain the general principles of the calculus, we shall give a few examples of its application to the theory of curve lines, the first subject to which it was applied by its inventors.

Let A M N be a curve line, which we may regard as a polygon of an infinite number of sides. Let one of these sides M N be produced till it meet the axis A B in T, and draw M P perpendicular to A B; then M T is the tangent and T P the subtangent. Through N, the other extremity of the side M N, draw N Q parallel to M P, and draw M O parallel to A B. Now, since M N is supposed to be infinitely small, M P and N Q are infinitely near each other; consequently M O is the differential of the axis A P $= x$, and N O the differential of the ordinate M P $= y$, whence M O $= dx$, and N O $= dy$. But the two triangles M N O and M T P are similar, therefore N O . O M :: M P . P T, that is, $dy : dx :: y :$ P T; whence P T $= y\,\frac{dx}{dy}$, an equation giving the value of the subtangent, and consequently the position of the tangent itself. It therefore only remains to determine the value of $y\,\frac{dx}{dy}$ from the equation of the curve. As an example, let it be required to find the subtangent of the common parabola, the equation of which is $y^2 = ax$, $a$ being the semiparameter of the axis. Differentiating the equation of the curve, we get $2\,y\,dy = a\,dx$; whence $\frac{dx}{dy} = \frac{2y}{a}$, and the subtangent $y\,\frac{dx}{dy} = \frac{2y^2}{a}$. Substitute in this expression $ax$ for $y^2$, and we have subtangent $= 2x$, a well-known property of the parabola.




The position of the normal is found in a similar manner. Draw M R through M perpendicular to M T and meeting A P in R; then M R is the normal, and P R the subnormal. Because T M R is a right angle; therefore P R : P M :: P M : P T; that is, P R : $y$ :: $y$ : $y\,\frac{dx}{dy}$, consequently the subnormal P R $= y\,\frac{dy}{dx}$. Let the curve, for example, be an ellipse, the equation of which is $b^2x^2 + a^2y^2 = a^2b^2$, the co-ordinates being referred to the centre. The differential of this equation is $2b^2x\,dx + 2a^2y\,dy = 0$, whence we find $\frac{dy}{dx} = -\frac{b^2x}{a^2y}$; and consequently the subnormal $y\,\frac{dy}{dx} = -\frac{b^2x}{a^2}$.

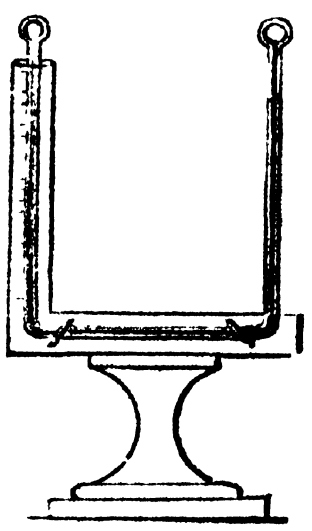
The differential calculus applies with like facility to the determination of the radii of curvature and the involutes of curve lines, to the finding of maxima and minima, in-

vestigations respecting series, and numerous other inquiries; in all of which it affords a singular facility in resolving questions, the solutions of which without its aid could only be obtained with great labour and difficulty.

The differential calculus was invented by Leibnitz; but reduced to a systematic form, and greatly extended, by the two celebrated brothers James and John Bernoulli. Some years, however, before Leibnitz fell on the discovery, the method of *fluxions*, with which the differential calculus agrees in every respect excepting its notation and the manner in which the principles are usually explained, had been invented and applied by Newton. This circumstance gave rise to a dispute, which was long carried on with great acrimony, between the mathematicians of England on the one hand, who put forward the claims of Newton for the honour of the invention, and those of France and Germany on the other, who gave the merit of it to Leibnitz. It was established beyond doubt that Newton was in possession of his method before it had been thought of by Leibnitz: the only question, therefore, was whether Leibnitz received such hints or information respecting the nature of Newton's method as were sufficient to guide him to its discovery. Of this there is no evidence, and extremely little probability; accordingly mathematicians have long agreed in recognizing the claim of Leibnitz to be regarded as an independent inventor. The notation introduced by Newton was followed generally by British mathematicians till some years after the beginning of the present century; but that of Leibnitz and the Bernoullis is now universally adopted.

DIFFERENTIAL COEFFICIENT, in Analysis, is the ratio of the differential of any function of a variable quantity to the differential of the variable. Let $x$ and $y$ denote two quantities related to each other by the equation $y = a x^2 + b x + c$, then $y$ is a function of the variable $x$; the differential coefficient is $\frac{d y}{d x}$; and we have $\frac{d y}{d x} = 2 a x + b$. It is to be observed that the differential coefficient is not to be considered as an algebraic fraction, but merely a symbol, showing (in the present instance) that the function $y$ has been differentiated with respect to $x$, and of which the two parts $d y$ and $d x$ have no independent meaning

DIFFERENTIAL THERMOMETER. An ingenious instrument, of great use in experimental philosophy, for measuring very small differences of temperature, invented and first applied by Sir John Leslie, though the idea of an instrument of the same kind seems to have long before suggested itself to Sturmius The differential thermometer is described by Leslie, in his *Experimental Inquiry into the Nature and Propagation of Heat*, nearly as follows:— Two glass tubes of unequal lengths, each terminating in a hollow ball, and having their bores somewhat widened at the other ends, a small portion of sulphuric acid tinged with carmine being introduced into the ball of the longer tube, are joined together by the flame of a blow-pipe, and afterwards bent into nearly the shape of the letter U; the one flexure being made just below the joining, where the small cavity facilitates the adjustment of the instrument, which, by a little dexterity, is performed by forcing with the heat of the hand a few minute globules of air from the one ball into the other The balls are blown as equal as the eye can judge and from four tenths to seven tenths of an inch in diameter



To one of the legs of the thermometer a scale is attached, and the liquid contained in the tube is so disposed that it stands in the graduated leg opposite the zero of the scale, when both balls are exposed to the same temperature From this construction of the instrument, it is easy to see that it is affected by the difference only of heat in the two balls. As long as both balls are of the same temperature, whatever this may be, the air contained in the one will have the same elasticity as that contained in the other, and consequently the intercluded coloured liquid, being thus pressed equally in opposite directions, must remain stationary. But if, for instance, the ball which holds a portion of the liquor be warmer than the other, the superior elasticity of the confined air will drive it forwards, and make it rise in the opposite branch above the zero, to an elevation proportional to the excess of elasticity or of heat. Sulphuric acid is chosen as the liquor best adapted to the purpose; because it is not vaporizable, and consequently does not by its vapour affect the pressure of the air above it. The carmine is used to render it more easily visible.

DIFFRA'CTION. In Optics, a species of deviation or inflexion which the rays of light undergo in passing very near the extremities of any opaque body. This phenomenon was first observed by Grimaldi, who described the principal appearances with sufficient accuracy; but it was Newton who first attempted to explain its cause by the general properties of light. His experiments are detailed in the last book of his *Optics*. In order to exhibit the phenomena of refraction, let a beam of solar light, reflected horizontally, be admitted into a dark chamber through a small round hole, and received on the white horizontal wall. If the hole has a sensible diameter, the image of the sun thrown on the wall will suffer no sensible alteration of colour; but if we place in the axis of the beam of light, and at a distance of 5 or 6 feet from the hole through which it is admitted, a metallic plate, having a puncture made in it by the point of a very fine needle, and intercepting all other light than that which passes through the puncture, the appearance on the wall will no longer be a circular spot of white light only; it will be surrounded with several concentric coloured rings, covering a space far exceeding in extent that which the solar beam would have occupied if the rays of which it was composed had followed their rectilinear direction. It is obvious therefore, both from the colours and the space occupied by the light, that the different rays have been reflected or bent in different degrees, and in a manner quite analogous to what takes place when light passes through a glass prism. By substituting a very narrow slit for the puncture in the metallic plate, or several punctures or slits very close to each other, and arranged in a certain manner, some of the most beautiful phenomena of optics are exhibited. The phenomena of diffraction have been much studied of late years, as affording a test by which to try the truth of the rival theories of light. At present the result is in favour of the theory of undulation, inasmuch as it has afforded a satisfactory explanation of all the phenomena without exception *See* LIGHT.

DIFFU'SION OF GASES When two gaseous bodies which do not act chemically upon each other are mixed together in any relative proportions they gradually diffuse themselves through each other, so that after a sufficient time has elapsed for the purpose, whatever may have been their relative densities, they are found intimately blended the heavier gas does not fall, nor does the lighter one float. Dalton, therefore, has appropriately represented gaseous bodies as acting as *vacua* to each other Professor Graham's researches have lately thrown much new light upon this subject, and he has determined the laws of *gaseous diffusion* by a series of well conceived experimental inquiry. (See *Graham's Elements of Chemistry*, vol i p 71; and *Quarterly Journal of Science*, N S, vol v)

DIGA'MMA. (Gr δις, *double*, and γαμμα (Γ), so called from its representing two gammas, one set above another, thus, F) The name given to the form of that letter in the ancient Greek alphabet which corresponds in appearance generally to the Latin F.

A mere outline of the controversies that have prevailed among the learned respecting the form and power of the digamma, the mode of its pronunciation, and the purposes which it served in the early language of Greece would occupy more space than our prescribed limits admit of, and we must content ourselves with referring the reader to the article "Digamma" in the *Encyc Metrop.*, and Ersch and Gruber's *Allgem. Encyc.*, in which the discussions on this subject display great learning and research This letter appears to have occupied the sixth place in the alphabet, and was most prevalent in the Æolic dialect, though some grammarians contend that it was common to all the dialects of Greece in their more ancient mode of pronunciation It has often been expressed by B, and sometimes by, Γ, Δ, Θ, Φ, and X; and it is now almost universally considered to have had the force of F, V, or the English W. As the Latin language approximated more nearly to the Æolic than to any of the other Grecian dialects, the use of the digamma is very prevalent in many Latin words, and the facility with which it was there interchanged for V, both at the commencement and in the middle of words; will be at once apparent from the following examples:— Gr, ιαρ, *spring*, Æol. Fιαρ, Lat ver; Gr. ισπερος, *evening*, Æol. Fισπερος, Lat. vesperus, Gr. οινος, *wine*, Æol Foινος, Lat vinum; Gr. ωον, *an egg*, Æol. ωFον, Lat. ovum, &c. (See Kidd's edition of *Dawe's Miscellanea Critica*, pp. 175—335.; and *Buttmann's Greek Grammar*.)

DIGA'STRIC MUSCLE. (Gr. δις, and γαστηρ, *belly*.) A double muscle, situated externally between the lower jaw and mastoid process; it is attached to the *os hyoides* in the human subject at the middle of its course. It pulls the lower jaw downwards and backwards; and when the jaws are shut it draws the larynx, and with it the pharynx, upwards in the act of swallowing.

DI'GEST. Several compilations of the Roman Law have been so called; but the best known is that which was made by order of the emperor Justinian. It is also

termed the Pandects, from the Greek words *παν*, *all*, and *δεχεσθαι*, *to receive*; signifying the general nature of the collection. The care of this great compilation was entrusted by the emperor to Tribonian, with seventeen associates. It was completed in three years, and published A. D. 533. It contains the best decisions and opinions of former jurists, collected, it is said, from more than two thousand volumes; and follows the same arrangement as the code of the same emperor, which had appeared in 529. The Pandects of Justinian, according to the commonly received story, were neglected in the Eastern Empire shortly after the decease of that emperor, and were wholly lost in the West until the accidental discovery of a MS. at Amalfi in 1130. But this tradition is now generally believed to rest on no solid foundation. *See* LAW, CIVIL. (See also *Gibbon*, cap. 44., *Savigny on the Roman Law*.)

DIGE'STER. A strong iron or copper vessel with a tightly adjusted lid, furnished with a safety valve, in which bodies may be subjected to the action of high-pressure steam

DIGE'STION. The general process by which food is converted into *chyme* in the stomachs of animals, and by which it is rendered fit for the production of *chyle*, and ultimately of *blood*. The term digestion is also more generally applied to the entire functions of the Intestinal canal. The phenomena of digestion, though exclusively chemical, are also under the immediate influence of vitality, and are consequently perfectly different from any changes which the food suffers out of the body; hence the unsatisfactory conclusions of the older physiologists, who considered attrition, fermentation, and similar mechanical and chemical processes as sufficient to account for the extraordinary changes that are produced It has been clearly ascertained that the influence of the nervous system is essential to the due performance of the functions of the stomach; and that when the brain, or the nerves that supply that viscus, are either injured or divided, digestion is either impaired or altogether suspended, and the food then ferments and putrefies instead of digesting It has been said that the transmission of a current of electricity through the nerves is equivalent to their connection with the brain, and that under such circumstances the stomach, notwithstanding the division of its nerves, continues its functions, but these, and other statements in which electricity is said to be equivalent to the nervous and cerebral agency, require much more extended experimental proofs than they have hitherto received, before they can be admitted as true interpretations

DIGESTION. In Surgery, this term was formerly applied to the treatment by which wounds or ulcers were brought into that state in which they form healthy pus. the remedies or applications promoting this object were termed *digestives*.

DI'GGING The operation of moving earth with a spade In gardens where the soil is loose the main object of digging is to mix the soil by burying the surface and bringing what is below to the top, and in that case a spade with a large blade may be used, but in digging firm ground spades can only be used which have narrow blades, as these may be more easily made to penetrate the ground

DI'GIT (Lat. digitus, *finger*), in Arithmetic, signifies one of the ten symbols, 0, 1, 2, 3, &c, by which all numbers are expressed By astronomers the term is used in speaking of eclipses, to denote the twelfth part of the diameter of the sun or moon Thus, the eclipse is said to be of ten digits, if ten parts out of twelve of the diameter are concealed It is convenient to employ this mode of defining the magnitude of an eclipse

DIGITA'LIA A vegetable alcaloid, procured from the leaves of the digitalis. *See* FOXGLOVE.

DI'GITIGRADES, *Digitigrada* (Lat digitus, *a digit*, gradior, *I walk*) The carnivorous quadrupeds, which walk on the extremities of their digits An artificial group of *Carnivora* is so called in the system of Cuvier.

DI'GLYPH. (Gr. *δις*, *twice*, and *γλυφω*, *I carve*) In Architecture, a projecting face with two panels sunk thereon.

DI'GNITARY, in the Canon Law, signified originally a person who held an ecclesiastical benefice or dignity, which gave him some pre-eminence above mere priests and canons. To this class exclusively belonged all bishops, deans, archdeacons, &c.; but it now includes all the prebendaries and canons of the church.

DIGRE'SSION (Lat. digredi, *to diverge*), signifies any details introduced into a work, which are either altogether foreign from the immediate subjects of which it treats, or not absolutely necessary to the progress or development of the story. It will at once be perceived from this definition that, as a general rule, digressions are to be carefully avoided, from their tendency to withdraw the attention of the reader from the chief points of the story or the question under discussion. There are, however, some departments of literature in which the use of digressions is not only admissible, but even advantageous. On this subject, however, no definite rules can be laid down for the guidance of the author; but there can be little doubt that if introduced properly and without effort, managed with good taste, and confined within reasonable limits, digressions have the effect of relieving the mind from the fatigue of a too long sustained attention, and of imparting life and interest to a subject that may be naturally dry and uninteresting. The Essays of Montaigne exhibit more clearly than any similar productions with which we are acquainted, the admirable uses to which digressions may be turned in the hands of a master. Many of the writings of Sterne, but more especially his *Tristram Shandy* (which contains an eulogium upon digressions), supply the happiest examples of their effects; and in our times *The Doctor*, *&c.*, of which five volumes have already been published, owes its principal attractions to the digressions with which the story is interlarded. *See* EPISODE.

DIGRESSION, in Astronomy, denotes the apparent distance of the inferior planets Mercury and Venus from the sun. Mercury is never seen at a greater distance than about 28° from the sun; this is called its *greatest digression*: but on account of the great eccentricity of the planet's orbit, the limit is subject to considerable variation. The greatest digression of Venus is about 47½°, and it admits of a variation only amounting to about 2° 48′ between its extreme values. When the digression of an inferior planet attains it maximum, the visual ray along which it is seen is a tangent to the orbit, and the planet appears for some days nearly stationary. The term *elongation* is also used to denote a planet's apparent distance from the sun; but *elongation* is applied indifferently to any planet, whereas *digression* is usually confined to the two inferior ones.

DILA'PIDATION, chiefly in Ecclesiastical Law, is where an incumbent of a benefice suffers the parsonage house or outhouses to fall down or be in decay for want of necessary repairs, or commits any wilful waste of the inheritance of the church. Proceedings against an incumbent for dilapidations must be in the spiritual court. Against his executors, the remedy is either by proceeding in that court, or the successor may have an action of debt or on the case for damages at common law.

DILATA'TION. *See* EXPANSION.

DILE'MMA. (Gr. *δις*, *twice*, and *λημμα*, *an assumption, a twofold assumption*) In Logic, a species of argument in the form of a complex conditional syllogism. (*See* SYLLOGISM) It has been divided by logical writers into — 1. The simple constructive dilemma, in which the major premiss contains several antecedents all with the same consequent; the minor premiss grants that some one of these antecedents is true; and the conclusion infers that the common consequent is true. *e.g.* If A is B, C is D; and if X is Y, C is D; but either A is B or X is Y, therefore C is D 2. The complex constructive dilemma, in which the several antecedents have each a distinct consequent; and it being granted that one antecedent is true, it follows that one consequent is true: *e.g.* If A is B, C is D; and if X is Y, E is F; but either A is B or X is Y, therefore either C is D or E is F. 3. The destructive dilemma, properly so called, has several antecedents with each a different consequent, and by denying the consequents disjunctively (*i. e.* denying that one or the other consequent is true) in the minor premiss, we proceed in the conclusion to deny the truth of one or the other antecedent. *e g.* If A is B, C is D; and if X is Y, E is F; but either C is not D or E is not F, therefore either A is not B or X is not Y. Every dilemma may be reduced into two or more simple conditional syllogisms.

In the ordinary sense of the word, a dilemma is an argument in which two or more propositions are pressed upon the mind in such a manner that by granting which we will we are compelled to infer the same conclusion. One of the most celebrated dilemmas is that of the philosopher Protogoras in reference to his pupil Euathlus, for an account of which we beg to refer the reader to the *Athenian Letters*, vol 1. p. 149.

DI'LETTA'NTE. (It) A term wholly naturalized in France, England, and Germany; signifying an amateur, chiefly of music, but also of the kindred sciences. There has existed in England, since the year 1760, a society called the *Dilettanti Society*, which was originally instituted by gentlemen who had travelled in Italy, simply for social purposes, and for perpetuating in each other's company the pleasure they had derived from their residence in that classic country: but its objects soon become materially extended; and it has acquired universal celebrity by the liberality with which it has devoted its funds to the purposes of science and art The society still exists, and meetings of it are occasionally held. Some of the most famous travellers in Greece and Asia Minor, among whom we may mention Chandler, have been sent out at the sole expense of the Dilettanti Society; and many works illustrative of the art and science of the classic regions of antiquity, which would otherwise in all probability never have seen the light, have under their auspices been given to the world.

DI'LIGENCE. In Scottish Law, a general term, comprehending the process of law by which persons, lands, or effects are seized in execution or in security for debt

It is divided into that against the *heritage*, that against the *moveables*, and that against the person of the debtor; of each of which there are several species. (*See* INHIBITION, ADJUDICATION, POINDING, SEQUESTRATION, HORNING.) Diligence is also the name of the warrants issued by courts for enforcing the attendance of witnesses, or the production of writings.

DILLENIA'CEÆ. (Dillenia, one of the genera.) In Botany, a natural order of chiefly arborescent Exogens inhabiting the hotter parts of the world. Allied to *Magnoliaceæ*; from which they are distinguished by their want of stipules, and the quinary arrangement of the parts of fructification. They differ from *Ranunculaceæ*, to which they are also akin, in their persistent calyx and habit, and are universally characterized by the presence of an aril. Their properties are generally astringent.

DILL SEED. The seed of the *Anethum graveolens*, or *common dill*. This plant is grown for the supply of the medical market with seeds: they are warm aromatics, with something of the caraway flavour, and yield *dill water* and an essential oil when distilled with water. Dill water is a useful remedy in flatulency and gripes of children.

DI'LUENTS. (Lat. diluo, *I wash away*.) Water and aqueous drinks, which increase the secretion of urine and the perspiration, and appear to dilute the fluids of the body, are medically spoken of as *diluents*.

DILU'VIUM. (Lat.) The accumulations of gravel, &c. supposed to have been the consequence of the deluge.

DI'MERANS, *Dimera*. (Gr. δις, *two*, μηρος, *thigh*.) The name of a section of Coleopterans, comprehending those which have apparently only two joints in each tarsus; this structure, however, does not in point of fact exist, there being always a third rudimental tarsal joint

DIMI'NISHED INTERVAL. In Music, one that is defective or short of its just quantity by a lesser semitone

DIMINUE'NDO. (It.) In Music, an instruction to the performer to lessen the volume of sound from loud to soft, usually marked thus >.

DIMINU'TION. (Lat diminutio) In Music, a division of a large note into smaller ones; as a semibreve into two minims, four crotchets, &c.

DIMINU'TION. In Architecture, the gradual decrease of the diameter of a column as it rises. *See* ENTASIS.

DIMI'NUTIVE (Lat.), in Grammar, is applied to words which, by the addition of one or more syllables to those from which they are derived, soften the meaning or diminish the force and effect thereof. Every language is in a greater or less degree susceptible of diminutives; but in this respect, as is well known, the Italian language surpasses all those both of ancient and modern times

DI'MITY. A cotton cloth of a thick texture, and generally striped or otherwise ornamented in the loom, it is chiefly used for articles of female dress, and for bed furniture or window curtains, and is very rarely dyed.

DIMYA'RIAS, *Dimyaria* (Gr. δις, *twice*, μυαν, *a muscle*.) All those bivalves or conchifers are so called which have two distinct and separate adductor muscles, and consequently two corresponding muscular impressions on each valve.

DI'OCESE. (Gr διοικησις, *a government*) The territorial extent of a bishop's jurisdiction, embracing several parœciæ or parishes. As in early times the Christian converts were most numerous or most easily collected into a congregation in large towns, so in these towns did the bishop reside and minister to the faithful in his church, assisted by his priests and deacons. When the number of believers required the accommodation of additional temples, or congregations were formed in the neighbouring villages, the bishop was wont to appoint priests for their service, and the districts inhabited by these subsidiary congregations would become the parishes of his diocese.

DI'ODON. (Gr. δις, and οδους, *a tooth; two-toothed*) The name of a genus of Plectognathic fishes with undivided jaws, each with a single and continuous dental plate.

DIONY'SIA. (Gr τὰ Διονυσια.) In Ancient History, the festivals of Dionysus or Bacchus, but more particularly those that were celebrated in Attica, which were three in number, distinguished by the following titles.—1. The Country Dionysia (τὰ κατ' ἀγρους). 2. Those in Limnæ (a part of the city of Athens, where they were held), which were also called Lenæan (τὰ ληναία, from λῆνος, *a wine-press*), or Anthesteria (Ανθεστήρια, from Anthesterion, the name of the Attic month corresponding to our January, in which they were celebrated); and 3. The Great Dionysia (τὰ μέγαλα). At all of these festivals the chief amusements consisted in the representation of stage plays; but the last was most celebrated, as then, before the face of all Greece, the great tragic contests were held, no expense being spared to render the decorations and accompaniments as splendid as art could make them: for on these exhibitions a great portion of the revenues drawn from the tributary states was expended, besides the private property of the persons appointed to superintend them, they being not only under the protection of the state, but a principal object of its care. (See *Bœckh's Public Economy of Athens*.)

DIOPHA'NTINE ANA'LYSIS. A branch of algebra, which treats of certain classes of indeterminate questions relating to square and cube numbers, rectangular triangles, &c. The name is derived from Diophantus, a mathematician of Alexandria, who is supposed to have lived in the third century of our era, and who examined and resolved a great number of questions of this nature in his celebrated treatise on arithmetic. Of this work, which exhibits the state of algebra among the Greeks, there are two editions: one by Bachet at Paris, in 1621; the other at Toulouse, in 1670, which is enriched by some valuable notes of Fermat. The following example will serve to illustrate the nature of the Diophantine problems; the object of which, in general, is to find commensurable numbers that satisfy conditions which may be satisfied by an infinity of indeterminate numbers. Suppose it were required to find three numbers, such that the sum of the squares of the two first is equal to the square of the third; that is, to find $x$, $y$, and $z$, such that $x^2 + y^2 = z^2$. The solution may be as follows:—Let $z = x + u$, then $z^2 = x^2 + 2xu + u^2$, and $x^2 + y^2 = x^2 + 2xu + u^2$, or $y^2 = 2xu + u^2$, whence $x = \frac{y^2 - u^2}{2u}$. Now we may choose for $y$ and $u$ any numbers we please, so that $y^2 - u^2$ is divisible by $2u$ (which will be the case if we make $u = 1$, and $y$ any odd number whatever). For example, if we suppose $y = 3$, and $u = 1$, we have $x = 4$, and $z = x + u = 5$; so that the three numbers are 3, 4, and 5 Since $x^2 + y^2 = z^2$, it is obvious that $x$ and $y$ may represent the two sides of a right angled triangle, of which $z$ is the hypothenuse The student of the indeterminate analysis will find this subject very fully and perspicuously treated in the second volume of *Euler's Algebra*.

DIO'PSIS. (Gr διᾳ, *through*, and ωψ, *an eye*.) The name of a genus of Dipterous insects, remarkable for having the eyes and antennæ situated at the extremity of slender horny peduncles rising from the sides of the head, and equalling in some species, the entire length of the body.

DIO'PTRICS. (Gr διοπτρον, *something transparent*; from διᾳ, *through*, and οπτομαι, *I see*.) A branch of Optics, of which the object is to investigate and explain the effects of the refraction of light when it passes through different media, as air, water, glass, &c. Its principal application is to the construction of telescopes and microscopes, and other instruments which require the use of refracting lenses The term is not much used by modern writers on optics, the phenomena to which it refers being treated under the general head of *Refraction*. *See* LENS, LIGHT, OPTICS, REFRACTION

DIORA'MA (Gr διᾳ, *through*, and ὁραω, *I see*.) A mode of painting or scenic representation, invented by two French artists, Daguerre and Bouton, and recently brought forward as a public exhibition in all the principal cities of Europe.

The peculiar and very high degree of optical illusion produced by the diorama depends upon two principles; the mode of exhibiting the painting, and the manner of preparing it With respect to the first of these, the spectator and the picture are placed in separate rooms, and the picture viewed through an aperture, the sides of which are continued towards the picture, so as to prevent any object in the picture room from being seen excepting the painting itself Into the room in which the spectator is placed no light is admitted excepting what comes through this aperture from the picture; he is thus placed in comparative darkness, and also (which contributes to the effect) at a considerable distance from the picture. The picture room is illuminated from the roof, which is glazed with ground glass, and the picture so placed that the light falls on it at a proper angle to be reflected towards the aperture. The roof, which is invisible to the spectator, is provided with an apparatus of folds or shutters, by which the intensity of the illumination may be increased or diminished at pleasure, and so modified as to represent, with great effect and accuracy, the different *accidents* of light and shade, or the changes of appearance depending on the state of the atmosphere; as bright sunshine, cloudy weather, or the obscurity of twilight.

The second principle consists in painting certain parts of the picture in transparency, and admitting a stream of light upon it from behind, which, passing through the picture, produces a brilliancy far surpassing what could be obtained by illuminating the picture in the ordinary way, and renders the relief of the objects represented much stronger and more deceptive. Hence, the diorama is peculiarly adapted for representing architectural objects, as the interiors of cathedrals, &c.

In order to render the exhibition more attractive, it is usual to present more scenes than one. This may of course be effected by removing one picture and substituting another; but with a view to prevent the illusion from being impaired by the accidents incidental to scene-shifting, a different method is sometimes resorted to. In the diorama in the Regent's Park, the room in which the spectator is seated is a rotunda about 40 feet in diameter, which turns round a vertical axis by means of machinery placed under the floor. There are two pic-

ture rooms contiguous to each other, each containing a view; and when the scene is to be changed, the rotunda is turned round until the aperture in front of the spectators, which was first opposite to the opening into one of the picture rooms, is placed directly opposite the opening into the other. This contrivance, however, it will be observed, is independent of the principles peculiar to the diorama.

DIOSCOREA'CEÆ. (Dioscorea, one of the genera.) A natural order of Endogens, inhabiting the tropics, and agreeing with *Smilacea* by the genus *Tamus*, in having an inferior fruit; but differing from it by the threefold character of inferior ovary, capsular fruit, and the albumen having a large cavity. The mealy tubers of Dioscorea, under the name of *yams*, form an important food in all tropical countries.

DIP, in Magnetism, is the angle which a magnetic needle makes with the plane of the horizon, when poised on its centre of gravity and at liberty to turn in the vertical plane. *See* DIPPING NEEDLE.

DIP. In Geology, when strata are inclined, the angle which they make with the horizon is called the angle of *dip* or inclination, and the point of the compass towards which they slope is called the *dip of the strata*.

DIP OF THE SEA HORIZON. The apparent angular depression of the visible horizon, caused by the height of the spectator above the surface To find it, multiply the square root of the height in feet by 1 063; the result is the dip in minutes (of a degree) and decimals

The actual dip observed is generally less than the true or abstract dip by $\frac{1}{14}$ on the average; but this is again affected by the temperature of the sea: when the sea is warmer than the air the horizon appears lower than its place by theory, and the contrary when the sea is the colder.

DI'PHTHONG (Gr. δις, *double*; and φθεγγομαι, *I sound*), has usually been defined to be a double vowel, or the union of two vowels pronounced together, so as only to make one syllable. If, however, this definition be more narrowly examined, it will be found to be deficient in two of the most essential qualities of a good definition —precision and accuracy. If, says Mr Walker, a diphthong be two vowel sounds in succession, they must necessarily form two syllables, and therefore by the very definition cannot be a diphthong If it be such a mixture of two vowels as to form but one simple sound, it is improperly called a diphthong, nor can any such simple mixture exist. Perhaps the best definition of a diphthong, although even that is far from embracing all the peculiarities of this class of letters, is to be found in *Smith's Scheme for a French and English Dictionary*, to which we beg to refer the reader.

DI'PHYANS, *Diphyes* (Gr δις, *two*, and φυη, *an offspring*) A family of *Acclaphans*, comprehending those singular species in which two distinct individuals are always conjoined, one being lodged in the concavity of another.

DI'PLOE. (Gr. διπλοω, *I double*) The horny or spongy substance between the tables of the skull.

DIPLO'MA. (Gr διπλωμα, from διπλος, *double*.) Every sort of ancient charter, donation, bull, &c is comprehended by writers on diplomatics under the name diploma The term is derived from the earliest charters of donation with which we are acquainted, those of the early Roman emperors having been inscribed on two tablets of copper joined together so as to fold in the form of a book. Writings of earlier date than the fifth century are generally on leaves of the papyrus, or *Biblos Ægyptiaca*; those of a later period, on parchment. The form and character of the diploma granted by the sovereigns, prelates, nobles, &c. of modern Europe, varied from age to age; and the knowledge of these variations forms an important branch of the science of diplomatics.

DIPLO'MACY, in its most restricted sense, is used to express the art of conducting negotiations or arranging treaties between nations by means of their foreign ministers, or written correspondence; but, in its most extended signification, it embraces the whole science of negotiation with foreign states as founded on public law, positive engagements, or an enlightened view of the interests of each. But, upon this subject, we cannot do better than embody in our pages some remarks from the Introduction to Marten's *Manuel Diplomatique*, in which a distinct view is exhibited of the importance and main objects of diplomacy.

Diplomacy, says that able statesman, must be placed in the foremost rank of the useful sciences. The fate of nations, in the present state of the world, depends greatly on their relations with others; and these again are materially influenced and determined by the nature of their foreign policy, that is, by the success with which they have cultivated and applied the principles of this science. Diplomacy embraces —

1. The law of nations, by which the relations of one state with another are determined both in peace and war.

2. The political principles of individual states, as deduced from a regard to their peculiar interests; and a knowledge of the way in which these interests may be reconciled with, and made subservient to, the law of nations.

3. An acquaintance with the privileges and duties of diplomatic agents.

4. The conduct of negotiations, or the course to be pursued in treating of the interests of different states.

5. The moral and physical statistics of each power.

6. The political and military history of the states having diplomatic relations; and the projects, tendency, and policy of their respective governments.

7. The various systems of government, supremacy, concession, retention, equilibrium, centralization, confederacy, &c., that may be brought into operation.

8. The art of composing diplomatic despatches.

To this multifarious information the diplomatist should unite the powers of calculation and application peculiar to strong minds,—the "tact des convenances," which may be felt, but cannot be expressed, — circumspection, address, and perfect integrity. The combination of these various qualities will procure for the diplomatist such a character for sagacity, rectitude, and straightforwardness, as will sooner or later obtain for him an ascendency over the minds of others, and give great weight to his opinions.

It must be remembered that the diplomacy of every nation is more or less within the range of casualties; being subject to the versatility inseparable from human affairs, the fickleness and passions of man, and the uncertainty of events; — an unlooked-for death, a change of ministry, treacherous designs, undue influence from any quarter, a false calculation, corruption, — each of these causes may change the policy or course of a government; and this will more or less affect every other government, in proportion to the extent of its influence. In addition to these numerous causes of variation, if ambitious projects be entertained by any great power, diplomacy becomes still more intricate and difficult. Every state desires to be protected against the storm which its rulers imagine they can prognosticate, and of whose bursting they are apprehensive. Again, we must remark that the schemes of a government, how admirably soever contrived, have often miscarried, either from subordinate persons or those intrusted with putting them in execution having misapplied or misunderstood the instructions of their superiors.

From what has been said, it will be easily understood that, in diplomacy, false estimates are frequently formed of the merits of original plans or designs from looking at their results only. The diplomatist is of course exempted from all responsibility in regard to operations mixed up with the events of war; he is answerable only for the success of his projects under the conditions on which he proposed them.

A diplomatist of moderate capacity, if favoured by circumstances, may accomplish much more than the man of genius who has to contend with adverse fortune; but this difference of success makes no change in their relative ability, and those acquainted with the circumstances readily discriminate between sagacity and accident.

Diplomacy has been practised in substance ever since mankind have been formed into independent states, though it is difficult to ascertain the precise period at which the term came into use The system, however, of the regular and uninterrupted residence of foreign ministers during peace at the European courts, as at present practised, is said to have originated with the Cardinal de Richelieu. Before that time embassies had been only sent on special occasions, but attended with much greater show and retinue than has been the fashion in modern times; while the substantial business of states at the neighbouring courts was transacted by agents of a lower stamp and character. Diplomatic agents are now ranked, in Europe, in the following order, according to the regulations of the Congress of Vienna: —1. Ambassadors; 2. Envoys extraordinary and ministers plenipotentiary; 3. Ministers resident, 4. Chargés d'affaires; 5. Secretaries of legation and attachés: the latter, however, have no precise diplomatic character, and are only considered by courtesy as attached to the legation.

Among the best works on this important subject are the *Traité complet de Diplomatie, ou Theorie generale des Relations exterieures des Puissances de l'Europe*, par M. le Comte de Garden (Paris, 1833), 3 vols. 8vo; and *De Wicquefort's Ambassadeur et ses Fonctions* (Ed. Opt.), 1746, 12 vols 4to. See also the *Manuel Diplomatique*, by Von Marten (Paris, 1825); *Flassan's Hist. Gen. et Raisonn. de la Diplom. Française*, 7 vols. (Paris, 1811); and Von Marten's (senior) *Grundriss einer Diplom. Geschichte der Europ. Staatshandel, &c.* (Hamburg, 8vo).

DIPLOMA'TICS. The science of deciphering ancient writings, assigning their date, &c. The name is derived from *diploma*, which see. Writings of earlier date than the fifth century were mostly on the leaves of the papyrus, or *Biblos Ægyptiaca*. Parchment appears to have been first generally used in that century; and the oldest documents bearing the character of diplomas which we possess do not extend to a higher antiquity. Not long after the general adoption of parchment, a variety of substances and colours began to be used in

writing, as vermilion, purple, gold and silver; but this sumptuous fashion did not long remain in use. The science of diplomatics teaches the different styles and forms adopted in ancient public documents; the titles, rank, &c., of public officers whose names are subscribed to them; the knowledge of the materials used in writing in different ages, of the different characters used in successive periods and in various countries; and the several kinds of diplomas or public instruments.

This science is said to owe its origin to a Jesuit of Antwerp, named Papelroch, who devoted himself arduously to the research and exposition of old diplomas about the year 1675; but the honour of having reduced it to a science, and established it on a sure and more satisfactory foundation, is due to Mabillon, whose learned work, *De re Diplomatica*, was given to the world in 1681. The principles laid down by Mabillon, however, were more fully developed about the middle of last century, in one of the most elaborate works of which the literature of any nation can boast, the *Nouveau Traité de Diplomatique*, and which has left little to be done by subsequent labourers in this field beyond the duty of translation, compilation, or abridgment. From the above statement of the objects of this science, it will be at once perceived that it is of immense utility. It has greatly facilitated the researches of the historian, the politician, the divine, the political economist; and has contributed to the elucidation of points in the history of nations which might otherwise have been for ever buried in obscurity. We subjoin a list of the most important works on this interesting science, arranged according to the date of their publication; from which it will be seen that the French and Germans have prosecuted this science with an energy and enthusiasm to which, considering its vast importance, our national literature presents a most humiliating contrast. Besides the work of Papelroch above referred to, entitled the *Propylæum*, there are, Mabillon, *De re Diplomatica*, 6 vols fol. (Paris, 1681), to which a supplementary vol. was added in 1704; *Historia Diplomatica*, by Maffei, 4to (Mantua, 1727: this work may be regarded as merely a supplement to Mabillon); *Chron. Walthери Lexicon Diplom* 3 vols fol. (Gotting. 1745-7); Heumann von Teutschenbrunn, *Commenta. de re Diplom. Regum*, &c., 4to (Nuremberg, 1745); *Nouveau Traité de Diplomatique*, by the Benedictine monks Toussaint and Tassin, 6 vols 4to (Paris, 1750-65.); *De Vaine's Diction. Raisonnée de Diplomatique*, 2 vols. 8vo. (Paris, 1774. this work is intended chiefly to aid beginners in the science); Gatterer, *Abriss der Diplomatik*, 8vo. (Gotting. 1798); *Schœnemann's Prolusio de finibus Artis Diplom. Pract. Regundis*; and his *Versuch eines Vollständ. Systems der Allgem. besonders ältern Diplomatik*, 8vo. (Gotting 1802).

DIPLONEU'RANS, *Diploneura*. (Gr. διπλος, *double*, and νευρον, *nerve*.) A name applied by Rudolphi to that division of the animal kingdom comprehending the species which have two nervous systems, viz the ganglionic or sympathetic, and the cerebro-spinal, the series so designated corresponds with the *Vertebrata* of Cuvier.

DIPLO'PIA. (Gr. διπλος, *double*, and οπτομαι, *I see*) Double vision. This affection occasionally is symptomatic of nervous irritability, worms, indigestion, hysteria, &c.

DIPLO'PTERA. (Gr. διπλος, *double*, and πτερον, *a wing; doubled wing*) The name of a division of Aculeate Hymenopterous insects, comprising those species of wasp which have the upper wings folded or doubled up longitudinally when at rest.

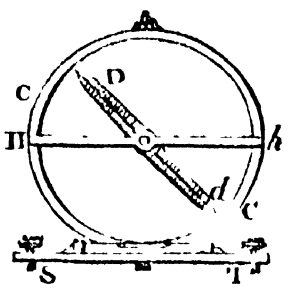
DIPLO'ZOON. (Gr. διπλος, *double*, ζωον, *an animal; double animal*.) The name of a very singular parasitic worm, which infests the gills of the bream, and which appears to be formed of two distinct bodies united in the middle, so as to present the appearance of a St. Andrew's cross, each half of the animal containing precisely the same organs; viz. an alimentary canal, a sanguiferous and a generative system.

DIPNEUMO'NEANS, *Dipneumonea*. (Gr. δις, *twice*, and πνευμων, *a lung; two-lunged*) A term applied to a section of spiders (*Araneidæ*), including those which have only two pulmonary sacs.

DI'PPEL'S OIL. An empyreumatic oil, produced during the destructive distillation of bone.

DI'PPER. A name commonly given to the water-ouzel and other species of the genus *Cinclus*.

DI'PPING NE'EDLE An instrument for showing the direction of the magnetic force of the earth. It is a magnetic needle, furnished with an axis at right angles to its length, and passing as exactly as possible through its centre of gravity, about which it moves in a vertical plane. When a needle thus mounted is placed any where not on the magnetic equator, it *dips*, or points downwards; and if the vertical plane in which it moves coincides with the magnetic meridian (which is always known by means of a variation compass), the position which it assumes shows at once the direction of the magnetic force; and the intersection of two or more directions, found by making the experiment at different places, indicates the place of the magnetic pole. Though the principles on which the dipping needle acts are abundantly simple, its practical construction is found to be exceedingly difficult. It must be accurately balanced on its axis; the axis must be placed exactly horizontal; the friction must be diminished to the utmost extent possible; and the adjustments can only be made when the needle is perfectly free from magnetism, and also secured from the effects of the magnetic influence of the earth. It must be subsequently magnetized, and during this process much care is required to guard against derangement. The simplest construction is represented in the annexed figure. The needle D *d* consists of a flat oblong piece of steel, tapering to a point at both ends, and having a slender cylindrical axis passed through its centre of gravity. The axis moves freely in circular holes made in the lateral horizontal bars H *h*, which support a vertical circle C C, graduated for the purpose of showing the inclination of the needle to the horizon. The stand S T, to which the circle is fixed, is provided with levels, and adjusted to horizontality by means of screws. But in the most improved form of construction of the dipping needle, the axis, instead of being a cylinder, is a knife edge, resting perpendicularly, like the supports of a pendulum, on two agate planes. A needle thus supported, however, must necessarily make small oscillations; consequently it must be so adjusted that when it points in the direction of the magnetic force, the knife edges may be perpendicular to the agate planes. The mean value of the angle of the dip must therefore be known previously to its construction; but it is the best adapted, on account of its delicacy, for ascertaining the minute variations of the dip at the same place. The angle of the dip, like that of the variation, changes its value even at the same place, following of course the motion of the magnetic poles, which, from the observations made by Scoresby, Parry, Ross, and others in high latitudes, appear to have a motion westward, the annual amount of which is about 11′ 4″ In the summer of 1831, Commander Ross, in an excursion from the vessel in which his party were so long detained in the polar seas, reached a spot on the continent of North America, which had been calculated to be the position of the magnetic pole There he found the dip of the needle to be 89° 59′, within one minute of the vertical, and compass-needles suspended in the most delicate manner possible exhibited no polarity whatever. The latitude of this spot is 70° 5′ 17″ north, and its longitude 96° 46′ 45″ west. (For a description of some other forms of the dipping needle, see *Brewster's Treatise on Magnetism*.)




DIPSA'CEÆ. (Dipsacus, one of the genera) In Botany, a natural order of herbaceous Exogens, chiefly inhabiting the south of Europe and a few other countries. Nearly allied to *Compositæ*, but differing in their stamens being distinct, and their ovule pendulous. They are distinguished from *Calycereaceæ* in the latter having connate anthers and alternate leaves; and from *Valerianaceæ* by their capitate flowers, and the presence of albumen. Their properties are unimportant *Dipsacus fullonum* is employed mechanically, for the sake of its hard stiff bracts, in the process of dressing woollen cloths.

DI'PSAS. (Gr *a viper*) This term has been applied by Laurenti to a genus of Colubrine serpents; and by Dr. Leech to a genus of fresh-water Bivalves, intermediate to *Unio* and *Anodonta*.

DIPTERA'CEÆ. A natural order of arborescent Exogens, only found in India and the Indian Archipelago, very near to *Elæocarpeæ*, but distinguished by the petals not being fringed, and in the want of albumen They are also allied to *Malvaceæ* in the contorted æstivation of the corolla and the crumpled cotyledons; but differ in the stamens being either distinct or partially combined, their long, narrow, 2-celled anthers, and pendulous ovules. Blume traces an affinity with *Guttiferæ* in their resinous juice, compound superior ovary, drupaceous fruit, numerous long anthers, irregular coloured calyx, and single exalbuminous seed; but from this order the stipules and the æstivation of the corolla abundantly distinguish them. The order is chiefly marked by the enlarged foliaceous unequal segments of the calyx investing the fruit. To it belongs the camphor tree (*Dryobalanops camphora*), which also yields the camphor oil of Borneo and Sumatra, and a timber called sal, the best and most extensively used in India; while other species yield pitch.

DI'PTERAL. (Gr. διπτερος, *double-winged*.) In Architecture, a temple which had a double range of columns on each of its flanks.

DI'PTERANS, *Diptera*. (Gr. διπτερος.) An order of insects having for their main and most conspicuous character two wings only corresponding to the anterior pair, and two short clubbed appendages, called *halteres* or balancers, and which seem to be the rudiments of the posterior pair in four-winged insects. The Dipterans are also distinguished by having the mouth in

the form of a sucker, composed of from two to six lancet-shaped elongated scales, inclosing a canal upon the upper surface of a fleshy tongue or proboscis. The larvæ or maggots of the Dipterous insects have frequently a membranous head; and always have the stigmata, or breathing pores, confined to the second and terminal segments of the body. In some species, as the blow-fly, the eggs are hatched within the body of the parent; in others, as the forest-fly (*Hippobosca*), the larva undergoes its metamorphosis in the parent's body, and the young are excluded in the form of *pupæ*.

DIPTERY'GIANS, *Dipterygia*. (Gr. δις, *twice*, and πτερυξ, *a fin; two-finned*.) A family of fishes comprehending those which have but two fins.

DI'PTYCH. (Gr. δίπτυχον, *twofold*.) Among the Romans, a tablet of wood, metal, or other substance, used for the purpose of writing, and folded like a book of two leaves. when the book consisted of several leaves, it was termed πολύπτυχον, or *manifold*. The diptychs of antiquity were employed especially for public registers The sacred diptycha of the Greek church were double catalogues, containing on one side names of the living, on the other those of the dead, which were rehearsed during the office.

DI'PUS. (Gr. δις, and πους, *a foot*) The general name for the Jerboas or Rodent animals, in which the hind-legs are disproportionately developed, and chiefly serve for locomotion. The numerous species referable to the Linnæan genus are now divided into the subgenera *Alactaga*, *Gerbillus*, *Dipus* proper, &c; and form the family *Dipodidæ*: the *Gerbilli*, however, are more nearly allied to the *Muridæ*.

DIPY'RE. (Gr δις, and πυρ, *fire;* i e a mineral doubly susceptible of the action of fire) This mineral was originally confounded with *picnite*. It is found in the Western Pyrenees. When heated before the blowpipe, it first becomes phosphorescent, and then fuses. characters by which it is distinguished from picnite It occurs in white or reddish white transparent or translucent crystals, of a prismatic form; its specific gravity is 2 63. It is hard enough to scratch glass. It is a silicate of alumina and lime.

DI'RECT. (Lat. dirigo) In Music, a character used at the end of a staff, to direct the performer's notice to the succeeding note at the beginning of the following staff.



DIRE'CTOR. A common surgical instrument it is generally made of silver, and resembles a grooved probe. Its use is to direct the knife, and protect the parts underneath from its edge or point

DIRECTORS. In Commerce, the name given to the individuals composing the board of management of a joint stock company, as the Bank of England, the E I Co, &c.

DIRE'CTORY. In French History, the name given by the constitution of 1795 to the executive body of the French republic. It consisted of five individuals, called directors, who were selected by the council of elders from a list of candidates presented by the council of five hundred One of these directors retired every year, and was succeeded by another elected on the same principle To the Directory was entrusted the superintendence of the home and foreign departments, the finances and the army, and the appointment of the ministers of state and other public functionaries. Its policy was at first moderate and conciliatory, but after a short interval it had recourse to measures which produced wide-spread dissatisfaction, and it was at length overthrown on the ascendency of Bonaparte after an existence of four years. (For the history of the Directory, see *Memoires de Gohier*, Paris, 1824.)

DIRECTORY, signifies also a book containing the names of the inhabitants of a town, arranged in alphabetical order, together with their places of abode, &c It is likewise applied to a book containing directions for public worship, or other religious services.

DIRE'CTRIX. In Geometry, the name given to a certain straight line perpendicular to the axis of a conic section; and it is a property of these curves that the distance of any point of the curve from the directrix is to the distance of the same point from the focus in a constant ratio. The term is also sometimes applied generally to any line, whether straight or curved, which is required for the description of any curve.

DIRGE. (A contraction of *dirige*, used in the old formula of the Catholic service for the dead—*Dirige, Domine, Deus*.) A funeral song or hymn.

DISABI'LITY, in Law, signifies a state which renders a person incapable of enjoying certain legal benefits; as, the state of an alien renders him incapable of taking lands, that of infancy of making valid contracts, and so forth. Disability, it is said, may happen in four ways; by the act of the ancestor, of the person, of God, or of the law.

DISC, or DISK. (Lat. discus.) In Astronomy, the face of the sun, moon, or a planet, such as it appears to us projected on the sky. The forms of the celestial bodies being spherical, their projections are circular planes.

DISCHA'RGE. (Fr. discharger.) In Architecture, a term used to signify the relief or distribution of a weight or load to be borne; thus *discharging arches* are those used in any wall over a lintel to discharge the lintel of the weight which would be otherwise borne by it.

DISCI'PLE. (Lat. discipulus.) Literally, one who learns the principles of any science or liberal art from another; but the term is used in a eulogistic sense, more particularly to signify the followers of any renowned teacher or philosopher, whose spirit they have imbibed along with a knowledge of his peculiar tenets.

DI'SCIPLINE (Lat.), signifies, primarily, instruction or government; but it is applied figuratively to a peculiar mode of life, in accordance with the rules of some profession or society. It is also used to designate the punishments employed in convents, and those which enthusiasts undergo or inflict upon themselves by way of mortification.

DI'SCIPLINE, BOOK OF, in the Church of Scotland, is a common order, drawn up by the General Assembly in 1650 for the reformation and uniformity to be observed in the discipline and policy of the church. In this book episcopal government is set aside, Kirk sessions are established, the observance of saints' and other holy days is condemned, and other regulations for the internal government of the church are prescribed. It is called the First Book of Discipline.

DISCIPLINE, MILITARY. The obedience to and exercise of the laws of military men and matters: bravery may gain a battle, but the final event of war is essentially dependent upon discipline. "Discipline is the right arm of a general, and *money* is his shield"

DISCIPLINE OF THE SECRET, or DISCIPLI'NA ARCA'NI. A name given by theological writers to a system supposed to have been in force in the primitive church, by which its most important and mysterious doctrines were concealed from the mass of believers, and fully developed only to a select class. When at the beginning of the Reformation the Roman Catholics were urged with the silence or ambiguity of the fathers of the first four centuries upon many principal points of their doctrine, they met the objection by declaring it to be the constant custom of the primitive church, enjoined by the apostles themselves (for which they quoted 1 Cor. iii. 1, 2.), to throw a veil of mystery, or preserve entire silence, upon all such awful and incomprehensible subjects. The opinions of Protestants upon this question have certainly been far from uniform, but all allow probably that in the 4th century the practice alluded to was prevalent: the usage of the 3d is more equivocal, and there are few who attach any weight to the defence set up by their adversaries by appealing to the two first.

The following we are disposed to consider a fair representation of the subject.

The apostles and evangelists say very little directly and systematically concerning the principal doctrines of Christianity. We may suppose that in their private teaching they were more express, and that some particulars assumed a more definite shape from their connection with apostolic tradition, than would have been the case had they been derived to us from the language of the Holy Scriptures merely. But the comparatively private and temporary occasions of the writings of most of the apostles may account for this want of precision, without supposing that they purposely concealed their ultimate conclusions. The one or two passages upon which a contrary opinion is grounded certainly refer only to the spiritual progress of a believer, and not to any advance in the knowledge of forms and results. The writings of the Fathers of the first two centuries may, we believe, be pronounced entirely clear of any passage which can fairly be appealed to by the advocates of the Disciplina. In the third Clemens of Alexandria is considered to furnish the strong-hold of the theologians of that party; but although he makes a very marked and accurate distinction between the perfect and imperfect Christian, he founds it not upon superior knowledge of the doctrines, but upon an advance in purity and spiritual conduct. This is what he denominates true gnosticism, which he is at great pains to distinguish from the spurious and heretical; and even herein he appears to be speaking only from his own individual notions, or at least from those only of the Alexandrian school of theology, and not from any recognized opinions and usages of the church.

It is to be observed that the primitive church was wont to make some trial of the candidates for baptism, causing them to pass through a course of religious instruction, in which they were led by certain steps from the elemental to the more complete knowledge of their duties preparatory to that initiatory ceremony. This is no more than would be practised even now in the case of an adult convert; but such cases in these times are extremely rare, and hardly admit of a definite formal custom. But in the first four centuries the conversion of adults was the most prominent object of Christian solicitude: it was this that most drew the attention of the church; it was this therefore which naturally became the subject of formal ceremonies and practices. Accordingly in process of time, when the clergy began to feel the strength of their position, and to cherish the ambitious views which were prompted by it, this practice was an instrument fitted to their hands.

They made a mystery of that which was before only a second step in knowledge, and excited the awe or curiosity of their hearers by checking themselves ostentatiously when hovering on the borders of a doctrinal subject, with such phrases as *ἴσασιν οἱ μεμυημένοι, the initiated understand me*, &c.; and probably, by the rhetorical flourishes with which they screened their real meaning, deceived themselves, or at least posterity, into the exaggerated notions whose shape and system were finally confirmed at the Council of Trent.

DISCLAI'MER, in Law, is a plea containing an express denial or renunciation of some claim which has been made upon or by the party pleading. It is more especially taken for the denial, by an alleged tenant, of his tenancy. Such disclaimer is punishable at common law by the forfeiture of the land, if, on writ of right *sur disclaimer* brought, the lord succeed in proving the tenancy.

DI'SCOBOLES, *Discoboli*. (Gr. *δισκος, a quoit, βάλλω, I throw*.) Those who played at quoits (*discus*) in antiquity. In Ichthyology, this word is applied to a family of pectoral or subbrachian fishes; comprehending those which have the ventral fins confluent, and forming a suctorious disc beneath the throat.

DI'SCOID. (Gr. *δισκοειδης*.) This term is applied to those univalve shells of which the whorls are disposed vertically on the same plane, so as to form a disc, as in the *pearly nautilus* and *planorbis*.

DISCONTI'NUANCE. In Law, an injury to real property, which consists in the keeping out the rightful owner of an estate by a tenant whose entry was at first lawful, but who wrongfully retains the possession afterwards: as, where tenant in tail makes a feoffment in fee-simple for life or in tail. In this case the heir in tail, remainder-man, or reversioner, is put to his writ: so alienations made by husbands seised in right of their wives, or by ecclesiastics seised in right of their church, work a species of discontinuance.

DI'SCORD. (Lat. discordia) In Music, the relation of two sounds which the ear receives with displeasure, whether used in succession or consonance

DISCO'RDIA. In Mythology, a malevolent deity, daughter of Night, and sister of Erinnys, the Parcæ, and Death. She is represented as having been banished from heaven by Jupiter, on account of the broils she perpetually occasioned. This was the goddess who, from disappointment at not being invited to the marriage of Thetis and Peleus, threw into the midst of the assembly the golden apple, with the inscription *detur pulchriori* (*let it be given to the fairest*), which, as is well known, occasioned the famed contest between the goddesses Juno, Minerva, and Venus, and ultimately led to the Trojan war, and the destruction of Troy. The ancient poets represent this divinity with a pale and ghastly look, a dagger in her hand, and her hair entwined with serpents; and Milton graphically describes her as

> Discord, with a thousand various mouths.

DI'SCOUNT. An allowance made for the payment of money before it is due, and is equivalent to the interest of the principal sum diminished by the discount during the time that must elapse before the money becomes payable The proper meaning of discount, and the rule for computing it, will be best understood from an example Suppose the rate of interest to be 4 per cent., and that A holds a bill of 104*l.* payable a year hence. Suppose, also, that B has a sum of 100*l.* in hand, which he wishes to lay out at interest for one year. At the end of the year A's bill becomes due, and he receives 104*l.* B also receives back for principal and interest 104*l* It is therefore clear that if at the commencement of the year A had given B his bill, and received from B his 100*l.*, neither party would have gained or lost by the transaction Hence a bill of 104*l*, payable a year hence, interest being 4 per cent., is equivalent to 100*l.* in hand; and the difference between the amount of the bill and its present value, viz. 4*l.*, is the discount Now the discount on 104*l* having been found, the discount on any other sum is found by simple proportion. If we observe that 4 is the rate per cent. of interest, and that 104*l.* is the present worth plus the discount, the truth of the following rule for the computation of discount will be apparent:—"As 100*l.* with the rate per cent. added is to the rate per cent, so is the principal sum to the discount." This rule supposes the time of payment to be one year; if it is less or more, the result must be diminished or increased in proportion to the time. Bankers and mercantile people, however, instead of computing discount in this correct way, reckon it in the same manner as simple interest, by which, in large transactions, they obtain a very considerable advantage. At 4 per cent. interest is 1 in 25, whereas discount is only 1 in 26.

DISCO'URSE. (Lat. discurrere, *to discuss*.) In Rhetoric, signifies in its widest acceptation a series of sentences and arguments arranged according to the rules of art, with the view of producing some impression on the mind or feelings of those to whom it is addressed. In Logic, this term is applied to the third operation of the mind, commonly called reasoning. *See* LOGIC.

DISCO'VERY. In Law, the act of revealing or disclosing any matter by a defendant in his answer to a bill in Chancery. *See* CHANCERY.

DISCRE'TE PROPO'RTION (Lat. discretus, *separated*), in Arithmetic, is a proportion in which the ratio of the antecedents to the consequents is different from the ratio of the consequent of the first pair of terms to the antecedent of the second. Thus, the proportion 2 : 3 : : 4 : 6, is a discrete proportion; for the ratio of 2 to 3, or of 4 to 6, is different from the ratio of 3 to 4 Discrete is therefore opposed to *continual*, a continual proportion being that in which the ratio of every two contiguous numbers is the same throughout; thus, 2 : 4 : : 8 . 16.

DISCRE'TE QUANTITY. A term applied to quantities of which the component parts have a separate and distinct existence. Thus, numbers are discrete quantities, being composed of separate units.

DI'SCUS. (Gr. *δισκος*) The ancient quoit, which consisted of a heavy circular mass of iron, sometimes perforated in the middle. In the ancient game, the players did not try to hit a mark, but to throw the quoit to the greatest possible distance. There is a discus preserved in the Cabinet of Antiques at Paris, in which holes are provided for the thumb and fingers. The practice of throwing discs is mentioned by Homer among the sports which occurred at the funeral of Patroclus; and Pindar celebrates Castor and Iolaus as skilful launchers of the discus.

DISCU'TIENT. (Lat. discutio, *I destroy*.) Remedies which repel or resolve tumours

DI'SDIAPA'SON (Gr. *δις, twice*, and *διαπασων, through all*) In Music, two octaves or a fifteenth.

DISEA'SE. (Dis, and ease) Any morbid state of the body generally, or of any particular organ or part of the body, is called a *disease*. By medical writers the term *disease* is defined as implying "a deviation from the natural and healthy actions of the whole system or of any individual part," and they are in the habit of designating certain forms of disease by the following terms, namely —*Acquired*, which are not congenital or hereditary, but derived from causes evidently operating after birth. *Acute*, which are severe, but of comparatively short duration *Asthenic*, attended by manifest depression of the vital powers. *Chronic*, which are of long duration *Congenital*, which are born with the individual. *Constitutional*, which more or less affect the whole system *Contagious*, this term should be confined to those diseases only which are communicable from one to another by *contact*, either personal or intermediate: it is presumed, for instance, that the plague is a truly contagious disease, and that it can only be transferred from one individual to another by actual bodily contact, or through the medium of bedclothes or articles of apparel. The term "contagious disease" is, however, often misapplied to those which are *infectious*, or communicable through the medium of the atmosphere *Endemic*, diseases which are either peculiar to particular places, or which are especially prevalent in certain districts only *Epidemic*, diseases which are generally diffused over a whole country; they may generally be traced to atmospheric causes, and are commonly of an infectious character influenza and cholera often prevail in this way *Exanthematous* are those diseases which are accompanied by an eruptive fever, such as measles, small-pox, &c. *Hereditary* diseases are such as prevail in families, and are transmitted by parents to their offspring; gout and scrofula furnish examples. *Idiopathic* or *primary* diseases are those which are not dependent upon or symptomatic of others; certain affections of the head, for instance, may arise immediately from disease of the brain, or they may be mediately connected with disordered states of the stomach. the former are idiopathic, the latter *symptomatic*. *Intercurrent* diseases are those which arise in individuals from incidental causes during the prevalence of endemic or epidemic sickness. *Intermittent* diseases are marked by a regular cessation and recurrence of symptoms; the patient, during the interval, being, to all appearance, free from disorder: the various forms of ague are characteristically intermittent. *Local* diseases are opposed to those which are constitutional; they are presumed to be limited to some particular organ: the term "chronic disease" is sometimes misapplied in this sense. *Malignant* diseases are those which are of a highly dangerous and intractable character, and the symptoms of which are generally very formidable from the first; various forms of fever, rapidly depressing the vital energies, are said to assume a malignant type: hence also the term *malignant*, as generally applied to the Asiatic cholera. Local diseases are frequently malignant, such as cancer and ill-conditioned ulcers: all these are opposed to the *mild* forms of the same maladies *Periodical*, diseases which recur at fixed periods, as in autumn, winter, &c. *Puerperal*, diseases incident to women soon after child-birth. *Specific* diseases are those which are marked by some disordered vital action not belonging to disease in general, but peculiar to the

individual case. *Sporadic* diseases are those arising from adventitious causes affecting the individual. *Sthenic* diseases are marked by the activity of the vital powers, directly opposed to those which are asthenic.

DISINFECTING LIQUOR. Solution of chloride of soda, or of chloride of lime.

DISJU'NCTIVE PROPOSI'TION, in Logic, is a proposition compounded of two or more categorical propositions, so stated as to imply that some of them must be true:—thus, "Either A = B, or C = D." A disjunctive, in which the two propositions are not naturally connected together in such a manner as to warrant their being proposed as alternatives, is nugatory and absurd in sense, although not incorrect in logical form. If one or more of the categorical antecedent propositions be denied, we infer that the remaining one, or, if there are more than one, some one of those remaining, is true: *e. g.* "Either A = B, or C = D; but A is not equal to B, therefore C = D." A poem is either good, bad, or indifferent: but it is not good; therefore, it is bad or indifferent. There are different forms of the *disjunctive syllogism*, founded on the disjunctive proposition.

DISK. In Botany, a term applied to certain bodies or projections, situated between the base of the stamens and the base of the ovarium, but forming part of neither, and taking a variety of forms. The disk is usually supposed to consist of rudimentary stamens, since an anther has been noticed to grow from that of *Pæonia moutan*, and in other cases manifest indications are observable of a tendency to assume the form of those organs.

DISLOCA'TION. (Lat. dislocare, *to put out of place*.) A surgical term, synonymous with *luxation*. "When the articular surfaces of bones are forced out of their proper situation, they are said to be dislocated or luxated. A considerable share of anatomical knowledge is required to detect the nature of these accidents, and it is much to be lamented that students neglect to inform themselves sufficiently upon the subject. (See *Sir A. Cooper's Surgical Essays*, i. p. 2.)

DISO'MUM. (Lat.) In Ancient Sculpture, a tomb made for the reception of the remains of two persons.

DI'SPART, in Gunnery, is the difference between the semidiameter of the base ring at the breech of a gun and that of the ring at the swell of the muzzle.

DISPE'NSARY. A place where medicines are made up and distributed, but used more generally for a charitable institution, where the poor are supplied with medicines and advice. Institutions of this nature are of comparatively recent origin, though they are now to be met with in every town of any importance both in this country and on the Continent. In London there are one or more dispensaries in each district, and to every dispensary there are always attached one or more physicians, surgeons, and apothecaries, whose duty it is respectively to prescribe and dispense medicines to the poor, and to visit them in their own houses in the event of their being too ill to attend personally at the institution. In most cases dispensaries are supported by voluntary contributions.

DISPENSA'TION. In Law, a licence granted by the bishop to a clergyman within his diocese to omit some particular of his duty; as, to hold two or more benefices, or to reside out of his parish. The name is peculiar to ecclesiastical law, and was formerly applied to the licences granted by the papal authority for several purposes, as, to marry within the prohibited degrees, &c.

DISPE'NSATORY. A word synonymous with Pharmacopœia (which see), signifying a book which describes the history, preparation, and composition of medicines.

DISPE'RSION. In Optics, a term used to denote the angular separation of the constituent rays of light when decomposed by the prism. In consequence of the unequal refrangibility of the different rays, a beam of light admitted through a small hole or slit in the shutter of a darkened room, and refracted by passing through a prism, forms an elongated image or spectrum; the red rays, which are the least refracted, occupying one end of the spectrum, and the violet rays, which suffer the greatest refraction, occupying the other end. The rays therefore, after refraction, are no longer parallel, so that the *index* of refraction (or the ratio of the sine of incidence to the sine of refraction) is different for each ray, and the difference of the indices for the extreme rays is called the *dispersion* of the light.

Sir Isaac Newton, who first examined the prismatic colours, was led by some imperfect experiments to suppose the dispersion proportional to the refraction; but it was soon discovered that although the colours in spectra formed by prisms of different substances are always arranged in the same order, they do not occupy the same relative lengths,—a prism of flint glass, for example, giving proportionally less red and more violet than a prism of crown glass; and that substances, for which the index of refraction of the middle ray of the spectrum is nearly the same, produce spectra of different lengths, or different amounts of dispersion. It is on this property namely, the irrationality of the refractive and dispersive powers of different substances, that the methods of forming achromatic lenses depend: had the supposition of Newton been correct, it would have been impossible to produce an image by refraction unaccompanied by the prismatic colours. *See* ACHROMATISM.

The difference between the indices of refraction of the extreme rays of the spectrum formed by a prism of any substance is called the *coefficient of dispersion* with respect to that substance, or simply the *dispersion*; and the *dispersive power* is the quotient which is obtained by dividing the coefficient of dispersion by the mean index of refraction diminished by unity. The *mean index* is that of the ray which corresponds to the middle of the spectrum. As these terms are of frequent occurrence in scientific works, we shall illustrate the definitions by an example. According to Sir D. Brewster, the index of refraction of diamond for the extreme violet ray is 2·467, and for the extreme red ray 2·411; the difference of these two indices is ·056, which, therefore, is the coefficient of dispersion for diamond. Again, the mean index, or mean of the above two numbers, is 2·439, which diminished by unity becomes 1·439; therefore the dispersive power of diamond is ·056 divided by 1·439, or ·0388.

For a table of the dispersive powers of a great number of different substances, see *Brewster's Optics*, in the *Cabinet Cyclopedia*, but we may remark, that as this table appears to have been constructed before the discovery of Fraunhofer's method of determining the indices of refraction by means of the dark rays in the spectrum, it rests on data subject to great uncertainty. *See* REFRACTION; also LIGHT, OPTICS, and SPECTRUM.

DISPLUVIA'TUM. (Lat.) In Ancient Architecture, a place in which the rain is conveyed away in two channels. A cavædium displuviatum, according to Vitruvius, was an open court exposed to the rain.

DISPOSI'TION. (Lat. dispositio.) In Architecture, one of the six essentials of the art. It is the arrangement of the whole design by means of ichnography (plan), orthography (section and elevation), and scenography (perspective view); and differs from distribution, which signifies the particular arrangements of the internal parts of a building.

DISQUISI'TION. (Lat.) An inquiry into the nature and properties of any problem, question, or subject, in the view of gaining or communicating correct information respecting it.

DISSE'CTION. (Lat. disseco, *I cut asunder*.) Signifies literally the cutting to pieces of any organized body with a view to elucidate its structure and functions. *See* ANATOMY.

DISSE'ISIN. In Law, a species of wrongful ouster or putting out of him who is seised of the freehold in lands: it is either *single disseisin*, or *disseisin by force*, more properly termed *deforcement*.

DISSE'NTERS. Persons who dissent on religious grounds from the usages and formula of the established church in England. Roman Catholics, however, are generally referred to as a distinct class, and the term Dissenters applied to Protestants only.

The first dissenters from the church of England were the Puritans, who, at the beginning of the reign of Elizabeth, complained of the use of the surplice, the sign of the cross in baptism, and some other relics, as they esteemed them, of popery. The laws of Elizabeth, however, required their attendance at church under severe penalties, and no opportunity was allowed them, even though they held episcopacy itself in abhorrence, of forming separate sects or congregations. Perhaps the first distinct sect of dissenters were the Brownists, who adopted very extreme opinions on the subject of church government, and against whom the punishment of death was enacted, as denying the queen's supremacy in ecclesiastical matters. On the accession of James an attempt was made by the puritanical party within the church to obtain a relaxation in some points of doctrine and discipline; but the conference at Hampton Court, which was convened upon that occasion, separated without effecting more than a few trifling alterations in the services. The penal laws continued in force, and Dissenters were not recognized as a distinct body by the state. They may be said to owe their origin in this sense to the assembly of divines convened by authority of parliament at Westminster in 1643, when a body of 120 clergymen and 30 laymen met and established the Presbyterian forms of doctrine and government, as set forth in the book called the *Directory*. The Independent party did not entirely accede to this settlement, and created some disturbances during the Protectorate. At the Restoration, the Presbyterian clergy were ejected on St. Bartholemew's-day, 1662, by the Act of Uniformity, which re-established the Liturgy, and was attended with some circumstances of aggravation and harshness. Two thousand non-conforming clergy were thereby ejected from their benefices. The Corporation Act, requiring attendance on the sacrament preparatory to accepting municipal offices, was also passed at the beginning of this reign; and the Test Act followed, which

excluded Dissenters in like manner from all places of trust and profit under government. These laws were repealed by 9 G. 4.; and Dissenters are now required only to make a declaration, according to the form of the act, that they will not exercise any influence they may possess by virtue of such office to injure or weaken the church by law established. The Act of Toleration (1 W. & M.) had long since abrogated the penal laws of Elizabeth against Dissenters, excepting Papists and such as deny the Trinity.

DISSE'PIMENTS. In Botany, the partitions that are formed in ovaria by the united sides of the cohering carpella, and which separate the inside into cells; also called *septa*.

DISSERTA'TION. (Lat.) An oral or written examination of any question or subject under some general or particular view. Perspicuity, simplicity, and methodical arrangement are the most essential qualities of a good dissertation.

DI'SSIDENTS. In modern European History, a term applied in Poland to those dissenters from the established religion (Catholic) who, under the old republic, were allowed the free exercise of their faith; including Lutherans, Calvinists, and Greeks, but excluding various minor sects. Their rights were fixed by the Religious Peace (pax dissidentium) of 1573, but they were infringed upon in the 18th century by various princes They were supported in demanding the repeal of these restrictions by Russia and Prussia (in 1766), and hence those powers acquired one of their favourite pretexts for interference in the affairs of the Polish nation. Their rights were restored in 1775, with some exceptions; but after the Russian conquest they were placed on the same footing with the Catholics.

DI'SSONANCE. (Lat. dissonans, *discordant*) In Music, a false consonance or concord. The same as discord.

DISTE'MPER. A disease of the dog. The distemper in dogs is commonly considered as a catarrhal disorder, and in general a running from the nose and eyes is one of the first and leading symptoms, it is usually accompanied by a short dry cough, and succeeded by wasting of the flesh and loss of strength and spirits The nasal defluxion, which is at first watery, becomes after some days, or perhaps weeks, mucous and purulent, loading the eyes and obstructing the nostrils, the cough becomes more distressing, and is attended by an effort compounded of coughing and vomiting, the listlessness, wasting, and loss of appetite also increase.

If the disease be virulent, symptoms of affection of the brain are its frequent concomitants, attended by fits, and great debility and paralysis of the extremities, or by convulsive twitchings resembling St. Vitus's dance, and such is the induced irritability of the animal at this period, that an angry menace, or the sight of another dog in a fit, will often bring one on; and fondling and encouraging a dog under these primary attacks will shorten their duration, or altogether check them. If they continue, and increase in violence and frequency, they commonly prove fatal. "When the epileptic fits," says Mr Blaine, "have gained their full hold on the dog, a partial or total mental alienation takes place, when total, the poor brute is often perfectly phrenitic; he waters and dungs unconsciously; he tears up the ground, bites every thing around him, and not unfrequently himself also. When the fit is over, he shakes himself, and looks and acts as usual, unless the attacks have been very violent and long-continued, when they leave him greatly exhausted and dispirited." In some of these attacks the dog walks round and round, unconscious of every thing about him. In such cases, the unfortunate animal is often supposed to be mad, and is frequently sacrificed accordingly; "but the suddenness of the seizure ought to inform the looker-on of the total impossibility of its being *rabies*, which is always in the worst cases marked with some recollection, some knowledge, and which never exhibits the indiscriminate fury which characterizes epilepsy."

Inflammation of the lungs is by no means an unfrequent consequence of distemper; and the bowels are always more or less affected by diarrhœa and dysenteric discharges, often indicating ulceration of the intestinal canal, and accompanied by bloody mucus and extremely offensive evacuations.

Protracted cases of distemper are sometimes attended by a pustular eruption on the abdomen and chest, accompanied sometimes by an hepatic affection, called by sportsmen, the *yellow disease*, from its giving the whole surface of the body a yellow hue: these are almost always fatal symptoms.

The danger and fatality of this disease depend upon so many causes that it is extremely difficult to prognosticate the results; young dogs and puppies seldom survive, and it is generally fatal to weakly and delicate dogs, and more so in town than in the country. Early in the disease a single fit is not alarming; but one or more fits in the advanced stages are seldom followed by recovery: impatience of light, red eyes, pneumonic attacks, and obstinate diarrhœa, are all bad symptoms; and spasmodic twitchings, a yellow tinge of the skin, and a pustular eruption, are in almost all cases the forerunners of death.

Laxatives, emetics, and occasional bleeding, are the leading remedies in the early stage of this disease; obstinate diarrhœa should be checked by astringents; and warm bathing, and anti-spasmodics must be resorted to to quell the violence of the fits.

The distemper is communicated by the contact of the diseased catarrhal secretion, and it may also be given by its inoculation; inoculation has indeed been proposed as a mitigation of the disorder, and it has been asserted that vaccination is a preventive. But it has been proved by Mr. Blaine that vaccination is quite inefficacious; and that inoculation with the matter of distemper is equally inefficient in mitigating the complaint, even when it is borrowed from the mildest forms. Many dogs, indeed, which have taken the disease by inoculation have had it with peculiar severity, and several have sunk under it. (See *Blaine's Canine Pathology*.)

DISTEMPER. In Painting. *See* DESTEMPER.

DI'STICH. (Gr. διστιχον) A couplet of verses. In the Greek, Latin, and German languages, distich is applied to pieces of poetry consisting of two lines, in hexameter and pentameter verse

DISTICHI'ASIS. (Gr. δις, *twice*, and στιχος, *a row*.) A double row of eyelashes, the innermost of which excite a constant irritation of the eye. The term *trichiasis* is generally applied to this malformation.

DI'STICHOUS. (Gr) A term applied to the arrangement of organs in two rows, the one opposite to the other, as the florets of many grasses.

DISTILLA'TION. (Lat) The evaporation and subsequent condensation of liquids by means of a *still* and *refrigeratory*, or of a *retort* and *receiver*.

The discovery of the art of distillation is generally ascribed to the alchemists; but it was doubtlessly known in more remote ages to the Arabians, and by them probably derived from nations further east

The process of distillation, though in continual use in the chemical and pharmaceutical laboratory, is carried on upon the most extensive scale for the production of ardent spirits in the *distilleries* Under the words ALCOHOL, BRANDY, FERMENTATION, WINE, &c. will be found some details bearing upon the nature, sources, and production of spirituous liquors, in the present article, therefore, we shall limit ourselves to an outline of the different processes which are more exclusively conducted in the British distillery.

There are two distinct operations in the production of ardent spirits the one is the conversion of certain vegetable principles into alcohol; and the other, the separation of the alcohol from the other substances with which it is necessarily blended during its production.

The vegetable principle which is essential to the formation of alcohol is *sugar*, and this is sometimes used *directly*, as where molasses and analogous saccharine products are subjected to immediate fermentation; or it is *indirectly* obtained by subjecting amylaceous grains to certain processes, by which the starch they contain is first converted into sugar, and then that sugar afterwards alcoholized.

In our distilleries the latter alternative is adopted; and various kinds of grain, but chiefly barley, wheat, and rye, with more or less malt, are subjected to the operation of *mashing* For this purpose the ground grain and the bruised malt are duly mixed, and infused under constant agitation in a proper quantity of hot water in the *mash-tun*, the wort is then run off, and fresh water added, till the soluble materials of the grain are extracted.

In this way the mixed worts or *wash* is obtained, which is afterwards to be subjected to fermentation; but in the distillery the operator is not, as in the brewery, left to his own judgment or convenience, but enforced to conform to the excise laws, which are of a very peremptory and often of a very unscientific character. By these laws the distiller is restricted in the density of his worts to specific gravities between 1050 and 1090; and in Scotland, between 1030 and 1075. It is presumed that at those specific gravities, which are called 50 and 90, and 30 and 75, the actual quantity of saccharine or saccharifiable matter contained in each barrel (or 36 imperial gallons) amounts respectively to from 47¼ lbs. to 85 lbs., and from 28 lbs. to 79$\frac{3}{10}$ lbs. When the wash above alluded to is adjusted as to density, it is run into the fermenting vats, where, mixed with a small quantity of yeast, it is subjected to the process of fermentation, which continues from six to ten or twelve days, the time required for its completion varying with the mass of liquid and with the temperature of the atmosphere.

During mashing, as well as during fermentation, the starch passes into sugar, and the sugar into alcohol; the consequence of which is that the wash gradually decreases in density or *attenuates*; and as soon as this attenuation has reached its maximum, which may be determined by

the hydrometer, it should be distilled, in order to prevent the access of acetous fermentation.

In all large distilleries there are two sets of stills: one for the purpose of distilling from the wash a weak spirit, technically called *low wines;* and the other for redistilling (or *rectifying*) the low wines. In these distillations there passes over along with the first and last portions of the spirits a peculiar volatile oil of a disagreeable flavour and odour, and rendering the weaker spirit milky. These portions are called *faints*, and are carefully turned into separate receivers as soon as the appearance of the runnings from the worm end indicates their presence.

The quantity of alcohol which may be obtained from a given quantity of sugar will depend upon the skill and care with which mashing, fermentation, and distillation have been respectively conducted; theoretically, 100 pounds of sugar are convertible into about 51 of alcohol and 49 of carbonic acid. The quantity of alcohol to be procured from different kinds of grain will also depend upon the same causes, and upon the quantity of sugar, and of starch and gum convertible into sugar, which each may contain. According to Hermstædt 100 pounds of starch should yield 35 pounds of real alcohol; and 100 pounds of the following grains should yield the following quantities of spirit of the specific gravity of 0·9427; that is, of spirit containing 45 per cent. of real alcohol; namely, wheat 40 to 45 pounds, rye 36 to 42, barley 40, oats 36, buckwheat 40, maize 40.

Sometimes malt only is used in the distillery, in which case the distiller calculates in obtaining two gallons of whiskey of proof strength from each bushel of malt

What is meant by the term *proof spirit* will appear obvious from the following extract from a report of a committee of the Royal Society respecting the improvement of the hydrometer. "With regard to the substance *alcohol* upon which the duty is to be levied, there appears to be no reason, either philosophical or practical, why it should be considered as *absolute* (that is, *pure*). A definite mixture of alcohol and water is as invariable in its value as absolute alcohol can be. It is also invariable in its nature; and can be more readily and with equal accuracy identified by that only quality or condition to which recourse can be had in practice, namely, *specific gravity*. A *diluted alcohol* is that, therefore, which we recommend as the only exciseable substance, and as on the one hand it will make no difference in the identification, and on the other will be a great commercial advantage, it is further recommended that the standard be very nearly that of the present proof spirit The proposition, therefore, of your committee is, that *standard spirit* be that which, consisting of alcohol and water alone, shall have a specific gravity of 0·92 at the temperature of 62° Fahrenheit. This standard is rather weaker than the old proof spirit in the proportion of nearly 1·1 gallon of the present proof spirit per cent. But this difference is trifling compared with the convenience resulting from the adoption of the specific gravity 0·92, instead of that of the present proof spirit, which is 0·91863 It may be interesting hereafter to ascertain what proportion of *absolute alcohol* enters into the composition of the recommended standard spirit, but the point possesses not the slightest practical importance in reference to the present question."

The *proof spirit* of commerce, and that of the Pharmacopœia, is generally stated to be of the specific gravity of 0·920 at 62°, and is considered as a mixture of *equal weights of absolute alcohol of the specific gravity of* 0·791 *at* 60° *and of water*. The *rectified spirit* of commerce, or rather that of the Pharmacopœia, is directed to be of the specific gravity of 0·838 at 60°, and may be regarded as a mixture of about 82 parts of absolute alcohol and 18 of water.

The inquisitorial regime, observes Dr. Ure, imposed by law upon our distilleries might lead a stranger to imagine that our legislators were desirous of repressing by every species of annoyance the fabrication of the fiery liquid which inturiates and demoralizes the lower population of these islands. But, alas! credit can be given them for no such moral or philanthropic motive. The necessity of the exchequer to raise a great revenue, created by the wasteful expenditure of the state on the one hand, and the efforts of fraudulent ingenuity on the other, to evade the payment of the high duties imposed, are the true origin of that regime. Examinations in distilleries are constantly making by the officers of excise. There is a survey at six o'clock in the morning, when the officers take their accounts and gauges, and make calculations which occupy several hours. At ten o'clock they again survey, going over the whole premises, where they continue a considerable time, frequently till the succeeding officer comes on duty; at two in the afternoon another survey takes place, but not by the same people; at six in the evening the survey is repeated; at ten there comes another survey by an officer who had not been engaged in any of the previous surveys of that day. He is not relieved till six o'clock next morning. In addition to these regular inspections, the distilleries are subject to frequent and uncertain visits of the surveyor and general surveyor. "We are never," says Mr. Smith, the eminent distiller of Millbank, "out of their hands."

There can be no doubt that all the operations of our distilleries would be susceptible of infinite improvement by an alteration in the excise laws. As these at present stand, the duty is charged from calculations — 1. On the quantity and density of the wash; 2. On the quantity and density or strength of the low wines, or first products of distillation; 3. Upon the quantity and strength of the spirit, or, in other words, of the alcohol actually produced. It is presumed, in reference to the wash, that the alcohol which it will afford by fermentation will be directly as its density (without reference to the nature of the matter which it holds in solution). In low wines, and in the spirits, the proportion of alcohol is inversely as the density, and the duty is charged in conformity with experiments upon the composition of mixtures of alcohol and water of different densities.

Nothing need be said here of the mode of judging of the value of the wort by its attenuation during fermentation, nor of the fallacies to which the different operations are liable, and we are well aware of the danger and difficulties of meddling with so important a branch of the revenue; but it is impossible for any scientific person to visit our distilleries without at once seeing much that is susceptible of safe and effectual alteration; or to peruse the multitudinous documents, and the evidence which has been brought before the commissioners of revenue inquiry and before parliamentary committees, bearing directly or indirectly upon this subject, without an anxious wish that some remedy should be found for the evils which are there set forth. In every point of view two things seem highly desirable, and apparently not unattainable; the one is that the materials employed as sources of spirit, and the mode of conducting the operations of the distillery, should be, as far as possible, entirely unshackled, the other (a necessary consequence), that the duty should be levied upon the ultimate product at the worm end, or, in other words, upon the quantity of absolute alcohol actually produced, and that the charge should be made in reference to that alone.

In reference to further details regarding the operations of the distillery and their influence upon the revenue, the reader is referred to *Dr Ure's Dictionary of Arts and Manufactures*, art "Distillation;" and to *M'Culloch's Dictionary of Commerce*, art. "Spirits," which is enriched with numerous tables. See also the article Spirits in this work.

DI'STOMA. (Gr δις, *twice*, and στομα, *mouth*) The name of a genus of Trematodous intestinal worms, including those which have two suckers or organs of adhesion, of which the anterior alone is a true mouth; and the posterior or larger disc is situated on the ventral aspect of the body, a little way behind the mouth.

DISTO'RTION. (Lat. distorqueo, *I turn awry.*) An unnatural deviation of shape or position of any part of the body, producing visible deformity.

Some distortions are exclusively dependent upon disordered actions of the muscles or nerves, or both; certain kinds of lameness, for instance, arise from a want of due sympathy between the flexor and extensor muscles, or from an unnatural contraction of one or more muscles in consequence of the inefficiency of their opponents; hence various paralytic distortions, squinting, wry neck, and some forms of what is termed club-foot.

The most common cause of distortion, however, is disease of the bones, which, being sometimes deficient in their hardening or earthy principle, are incapable of supporting the weight of parts which they are designed to bear, or of sustaining pressure or muscular action, without more or less flexure. Of this kind is the disease called *rickets* (from ῥαχις, *the spine*), in which it has been presumed, though erroneously, that the vertebræ are the chief seat of the mischief Besides rickets, there are other cases of curvature of the spine, the causes of which are by no means very obvious, more especially those of the *serpentine* or *lateral* curvature, which is not unfrequent among delicate girls in the higher and middling classes of life, though of very rare occurrence among the lower orders. This disease is usually observed about the ninth or tenth year, and the symptoms are generally traced in the following order: — 1. The child makes frequent attempts to prevent the dress falling off one shoulder; 2. One shoulder appears higher than the other; 3. One of the collar-bones, or one side of the breast-bone, appears fuller than the other; 4. One hip appears to project; 5. One leg appears shorter than the other; 6. There is a peculiarity in the manner of walking, one foot being swung round and the shoulder thrown forward. When the girl reaches the age of twelve or thirteen (for this disease is *very rare* in boys), she becomes evidently twisted, and the spine is found to have assumed a serpentine form. In reference to the treatment of this kind of distortion, it appears that very opposite methods have been successful; thus, some patients have been confined for months to the same position; another violently exercised; another

shampooed and acupuncturated; a fourth relies on artificial supports, such as stays and bandages; a fifth is leeched or blistered; and many are told to attend only to the general health. The truth is, that distortion may depend upon different causes, and different remedies may be required in its different stages of progress. The serpentine curvature of the spine generally originates in muscular debility; and therefore, at its commencement, is appropriately treated by attention to the general health, by proper exercises and tonics. As the disease, however, proceeds, the muscles and ligaments acquire a certain form, and then artificial supports may be appropriately resorted to. In a yet more advanced stage, the vertebræ themselves become altered in form; and hence the spine may require to be stretched, and kept so during a considerable part of the twenty-four hours, so as to allow the bones to resume their natural form. When the ribs and sternum have become much displaced and misshapen, methods of compressing and remodelling them must be adopted; and lastly, when what is called *anchylosis*, or permanent bony deformity, has taken place, palliations and preventives of further mischief can alone be resorted to.

In all cases where there is a tendency to distortion, its early progress should be watched with the utmost solicitude, and *preventive means* steadily and perseveringly adopted. When a girl is eight or ten years old, she should not be confined to the school room, and to a walk once or twice a day, but she should be induced by amusing and romping games to use active exercise, and especially such as brings the muscles of the trunk into play; she should not be kept long at the piano-forte, and her chair should be made so as to support her. If she has a tendency to lean to one side, she should be allowed to learn her lessons in a recumbent posture, and not constantly admonished to "hold herself up" By attention to these simple rules at a very early period of this tendency to distortion, its further progress may be possibly prevented, but if the girl becomes listless, lo[illegible] and pallid, appearing awkward in her gait, and the clothes slip off of one shoulder, the spine is probably becoming distorted; and in this case she should not be allowed to sit erect without using some artificial support, such as an arm chair, or chair crutch, and she should read always lying down; while by the help of proper stays and a belt support should be given to the loins, while the upper part of the chest is left free. No shoulder-straps, collars, or back-boards should be used to push in the projecting shoulder, unless the loins be at the same time supported, for in the majority of cases a sinking of the lumbar part is the cause of the inequality of the shoulders The child should, in this stage of the disorder, be a good deal in the open air; not walking sedately, but, if possible, skipping about; and when she comes in, should not lounge on a chair, but lie down; or if out-of-door exercise is inadmissible, she should play at battledore and shuttlecock, and use a skipping rope But whatever exercise be used, it should never be carried to fatigue The child should sleep on a firm hair mattress, with scarcely any pillow; she should have good nourishing diet, occasional warm aperients and alkaline tonics may be proper, and cold bathing or sponging By scrupulously following up the preceding plan, the general health is improved, and the tendency to distortion often diminished, but constant care for months, and even years, can alone ensure its removal Where the spine has acquired a decided twist, a variety of mechanical contrivances, and many different plans of treatment, have been proposed and used with more or less success, with a view of correcting the deformity, or preventing its increase and improving the figure For an account of these we must refer to the authors who have expressly treated upon these subjects, and especially to the sensible tract of the late Mr John Shaw, from which we have abridged the preceding remarks.

There is another kind of distortion, differing entirely from the preceding; namely, *angular curvature* of the spine. It generally proceeds from scrofulous ulceration of the bodies of the vertebræ; it is attended with paralysis of the lower extremities, and is often fatal. Similar disease often occurs in the other bones and joints of the body.

There are a variety of deformities resulting from other causes than those above adverted to; namely, from gout, rheumatism, and various chronic and local affections, which, however, do not come under the general term of *distortions*: nor can we properly refer to this head a variety of real deformities which are chiefly the consequence of dress and fashion; such as those which result from wearing stays, bandages, ill-made and tight shoes, and the like.

DISTRA'CTILE. In Botany, a term invented by Richard to denote a connective which divides into two unequal portions, one of which supports a cell and the other not, as in *Salvia*.

DISTRE'SS, in Law, is the taking of a personal chattel out of the possession of a wrongdoer into the custody of the party injured, to procure satisfaction for the wrong committed.

Distress may be had for various kinds of injuries, and as a means of enforcing process, or the performance of certain acts in various cases. But the most usual injury for which a distress may be taken is that of non-payment of rent. Distress for rent is said to be incident to the reversion; so that it may be taken for rent reserved upon a gift in tail, lease for life, years, &c., though there be no clause of distress in the deed, if the reversion is in the party distraining. Distresses are to be of things valuable, wherein some one has a property. But various species of personal chattels are exempt from distress, especially the utensils and instruments of a person's trade and profession, if in actual use, otherwise they are not privileged. All distresses for rent must be made by day, and on the premises; but if any tenant fraudulently removes goods from off the premises, the landlord may within thirty days seize such goods wheresoever found, unless they are sold for a valuable consideration before the seizure. Persons who distrain for rent may sell the distress for payment of rent in arrear, if the tenant or owner fails to replevy, with sufficient security, within five days after taking the distress and giving the tenant notice of the cause. In this case the constable is bound to assist; the goods are to be appraised by two sworn appraisers; and the overplus, if any, left in the constable's hands for the use of the owner.

DI'STRICT. A territorial division. This term was formerly used in France, and particularly in the year 1790, when by the law of 16th Feb. the whole country was divided into 555 districts, and it is still common to many of the Continental states The county of Lincoln is divided into three districts, Lindsey, Kesteven, and Holland. These divisions are of great antiquity, and in all probability owe their origin to the distinct natural features by which they are characterized.

DITHYRA'MBIC ODE. (Gr. διθυραμβος.) A species of Greek lyrical poem in honour of Bacchus, which derived its name from Dithyrambus (Διθυραμβος), one of the appellations of that deity. a word of uncertain meaning and etymology. The style of this poetry was very bold often passing into bombast; so much so indeed as to become proverbial for the latter quality. The most celebrated Dithyrambic writer was Pindar; none of whose compositions in this line, however, have come down to us, or indeed any other known poems of this class. In modern times the term is indiscriminately employed to designate odes of an impetuous and irregular character. *See* ODE.

DI'TONE (Gr διτονος) In Music, an interval consisting of two tones.

DI'TRIGLYPH (Gr δις, *twice*, τρις, *three*, and γλυφω, *I carve*) In Architecture, an arrangement of intercolumniations in the Doric order, by which two triglyphs are obtained in the frieze between the triglyphs that stand over the columns.

DI'TTO, in Book-keeping, more usually contracted into *Do*, signifies *the same* as that which precedes it. It is derived from the Italian word *ditto*, signifying *the said*.

DI'TTY. (Fr ditie) A word of great antiquity in the English language, signifying most usually a simple or pastoral song. Thus Milton says—

> Meanwhile the rural ditties were not mute,
> Tempered to the oaten flute,
> Rough satyrs danced, &c.

Shakespeare, Dryden, and many of the old classic English writers, have repeatedly given importance to this word

DIURE'SIS. (Gr. διουρησις, *a discharge of urine.*) An excessive flow of urine. *See* DIABETES.

DIURE'TIC, signifies literally any thing which increases the secretion of urine. The term is usually applied to certain medicines which act specially upon the kidneys, such as squills, turpentine, and some of the neutral salts; and it frequently happens that during an inordinate flow of urine derived from such causes watery fluids are absorbed from other parts, and, as it were, transposed to the kidneys: upon this principle is founded the use of diuretics in dropsy. There are some alteratives which operate as diuretics, especially when they are taking a favourable operation upon the system: this seems especially to be the case with sarsaparilla. Water and other diluents and liquids, when taken in excess, also operate as diuretics; as far, at least, as mere increase in the flow of urine is concerned.

DIU'RNAL (Lat. dies, *a day*), is the name given to the book containing those canonical hours of the Roman Catholic breviary which are to be said during the day. It is intended especially for the clergy of the Romish church, and consists generally of four volumes, one for each season of the year.

DIU'RNALS. (Lat. diurnus, *by day*) A tribe of Raptorial birds, including those which fly by day and have lateral eyes: also a family of Lepidopterous insects, which have a similar period of activity.

DIVA'N. A word common to many of the eastern languages, signifying in Turkish the audience-chamber of the vizier, or supreme judicial tribunal. The divan of

the caliphs was a court for the relief of petitioners, over which those monarchs presided in person. The Turkish divan, as is well known, is the great council of the empire.

It would seem that the earliest acceptation in which this word was employed is that of a muster-roll or military day-book; and we find it used, especially by the ancient Arabs, who borrowed it from the Persians, to signify a collection of poems by one and the same author, arranged in alphabetical order; thus we hear of the Divan (*i.e.* the collected poems) of Sadi, the Divan of Halfiz, &c. The word *divan* is also among the Turks a common appellation for a saloon or hall which serves for the reception of company, for the transacting of business, or for occasional repose; hence in all probability the term is employed in all modern languages to signify a sofa.

DIVA'RICATE. (Lat. divarico.) In Zoology, when the divisions of a part spread out widely.

DIVE'RGENT. (Lat. divergo.) In Zoology, when the branches form a right angle with the stem; as the snags of certain antlers, the divisions of certain Polypiaries, &c.

DIVE'RGING. In Botany, used in describing the venation of leaves, to denote the angle which is formed by the midrib and one of the primary veins, when it is between 20° and 40°

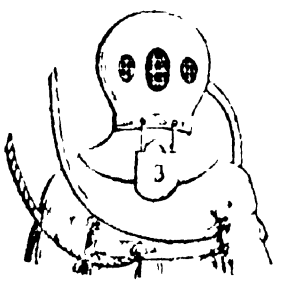
DI'VIDEND. (Lat divido, *I divide*.) In Arithmetic, the number or quantity given to be divided. Dividend, in Commerce, is the name given to the payment made to creditors out of the estate of a bankrupt, and to the annual interest payable upon the national debt and other public funds.

DIVINA'TION. (Lat.) The art of foretelling future events. A singular and ever-active feeling of curiosity has in all ages induced mankind to cast an anxious look towards futurity in the desire of penetrating its mysteries, originally either by serious reflections on the past, by a comparison of the past with the present, or by inferences more or less satisfactorily deduced from the probable occurrence of events. But mankind did not rest here: since the remotest period of antiquity, divination formed a regular science, intimately allied to religion, and furnished with peculiar rules and regulations, more or less skilful and ingenious in proportion to the state of civilization of the people by whom it was practised. But of all the nations of antiquity there were none who, notwithstanding their great learning and refinement, cultivated the science of divination with such enthusiasm as the Greeks and Romans. Independently of their credulity with regard to auguries and oracles, which may be termed the higher class of divination, the most trifling incidents supplied them with the occasion to indulge in this propensity; and there was nothing in the wide range of human affairs from which they did not derive tokens of futurity. To enumerate all, or even the chief objects of divination among the ancients, would far exceed our prescribed limits. Under the different heads, as BELOMANCY, NECROMANCY, &c., the reader will find a notice of the principal of them; and for the rest he may consult with advantage Cicero, *De Divinatione*. *See* ORACLE.

DIVINE RIGHT, THE, OF KINGS. In Politics, means the absolute and unqualified claim of sovereigns on the obedience of the people; insomuch that, although they may themselves submit to restrictions on their authority, yet subjects endeavouring to enforce those restrictions by resistance to their unlawful acts are guilty of a sin. This doctrine, so celebrated in English constitutional history, has been asserted on very different grounds. Hobbes (*De Cive*) deduced the absolute authority of kings from the supposed social contract, whereby men parted absolutely with their natural rights in exchange for protection. But the fashionable political writers and theologians of the times both of Charles I. and II. (in the latter reign, Sir Robert Filmer, author of the *Patriarcha*, may be more especially cited, on account of his having been directly answered by Leslie), maintained that government had an existence before property, and before any supposed social contract could take place; that it originated in the patriarchal sway, which was succeeded by the regal, and that no other was authorized by Scripture. See also the *Convocation Book* of 1603; Archbishop Leslie on the *Power of the Prince;* Sherlock's *Case of Resistance to Supreme Powers*, 1684; Mackenzie's *Jus Regium*, 1683. The same principles were practically adopted by the Jacobites, when they maintained the divine right of the expelled sovereign, and afterwards of his descendants, by hereditary title. As to the views of modern high church divines on the subject, see *Dr. Pusey's Sermon on the 5th of November*, 1837. *See* NON-RESISTANCE.

DI'VING. The art of descending in water. Independently of the valuable native productions which are found at the bottom of the sea, such as pearls, coral, sponges, &c., the treasure which is so frequently carried down in wrecked vessels makes it an object of importance to be able to descend to the bottom and remain there long enough to execute the operations necessary to recover it. But without the assistance of some mechanical apparatus, it is extremely little that even the most practised divers can perform. A minute and a half, or two minutes, is the longest time that a diver, in general, can remain under water. Besides, on account of the loss of weight in water, the power which a man can exert is extremely small, unless borne down by a load which would entirely prevent him from rising again to the top. For these reasons, numerous projects have been brought forward to assist the natural powers of the body, and render diving an art of more extensive utility. In all these projects, the principal object aimed at is to supply the diver with fresh air and light, and leave him the free use of his arms, and the power of walking within a moderate range at the bottom. Borelli contrived an apparatus which he called a diving bladder; the bladder being of brass or copper, about two feet in diameter, to contain the diver's head, and fastened to a goat skin covering exactly fitted to the shape of the head. An apparatus of this kind was successfully used by Mr Deane on the west coast of Scotland, at Spithead, and at Donaghadee, where he brought up an immense number of dollars and various other articles from a vessel which had been wrecked there more than thirty years before.

The principal part of Mr. Deane's apparatus consists of a helmet of thin sheet copper, which covers the head of the diver, large enough to admit of free motion, and furnished with three eye-holes, covered with glass protected by brass wires. The helmet comes pretty well down over the breast and back, and is fastened by rivets to a water-proof canvass jacket so tightly that no water can penetrate. A leather belt passes round the diver, to which are attached two weights, one before and the other behind, each about 40 lbs. The belt is supplied with a buckle in front, which, in case of any accident happening, can be instantly undone. The diver is supplied with fresh air, by means of a flexible water-proof pipe, which enters the helmet, and communicates with an air-pump, wrought above in the barge from which he descends. This pipe passes under the left arm of the diver, and enters the back of the helmet, being so contrived that the fresh air is made to impinge on the glasses, which in a great measure prevents their being dimmed by the moisture of the breath.



From the back part of the helmet there is also led an eduction pipe, to allow the escape of the breathed air. A signal line passes under the right arm to communicate with attendants at the surface. The diver descends from the side of the vessel, either by means of a rope or wooden ladder, loaded at the lower end, the weight being kept at a little height above the ground. When the diver descends to the bottom, the weight is let down, and the rope allowed to become slack, to prevent the motion of the boat from obstructing him. His motion is rendered steady by heavy weights attached to his feet; and he carries a line in his hand, that he may, when necessary, guide himself back to the rope. A waterproof dress covers his body entirely; and he is thus enabled to remain under water five or six hours at once, all the while perfectly dry. (See *Popular Encyclopædia*, art. "Diving.")

DIVING BELL. An apparatus, by means of which persons are let down and enabled to remain under water, and execute various operations; such as levelling or clearing the bottoms of harbours, preparing a foundation for buildings, bringing up sunken materials, &c. The principle of the diving bell depends on the impenetrability of atmospheric air, and may be illustrated by a very familiar experiment. Bring the edge of an inverted tumbler, or any close vessel, to the surface of water, and, keeping the mouth horizontal, press it down in the water. It will be seen that, though some portion of water ascends into the tumbler, the greater part of the spacer emains empty, or only filled with air; and any object placed in this space, though surrounded on all sides with water, would remain perfectly dry. In fact, the quantity of air remains the same, but is compressed into a smaller volume, in proportion to the depth to which it is made to descend. Now, if we conceive a vessel of wood or iron, sufficiently capacious to hold several men, to be suspended by a chain, and lowered by means of weights attached to it to any moderate depth under water, it is evident that they may remain there for a considerable time, and perform any operation that could be executed on land in the same confined space. The machine, however, as thus described, is liable to two great defects, which must be obviated by other contrivances before any great advantage can be derived from it. In the first place, as the air by its compressibility allows the water to enter the lower part of the bell, the dry space is not only diminished, but the bottom on which the bell rests, and where the operations are to be carried on, is also covered with water to a proportional depth. In the second place, the air within the bell, by repeated respiration, soon becomes mephitic, and unfit to support life; so that it is necessary to elevate the apparatus after short intervals, to admit a fresh supply.

It is not known at what period the diving bell was invented. Beckman, in his *History of Inventions*, mentions that at Toledo, in the sixteenth century, two Greeks, in the presence of the emperor Charles V. and several thousand spectators, let themselves down under water in a large inverted kettle with a burning light, and rose again without being wet. George Sinclair, the author of *Satan's Invisible World Displayed*, in his work entitled *Ars Nova et Magna Gravitatis et Levitatis*, mentions some attempts that were made, about the year 1665, to raise, by means of a diving bell, the treasure from the ships of the Invincible Armada that went to the bottom near the Isle of Mull in the Hebrides, and describes the kind of bell that was employed But, on account of the defects to which we have alluded, the diving bell continued to be of very little use till the time of Dr. Halley, who contrived a means of introducing fresh air into the bell while under water, and of allowing the mephitic or breathed air to escape. The bell he made use of he describes as having been of wood, containing about 60 cubic feet in its concavity, and of the form of a truncated cone, whose diameter at the top was three feet, and at the bottom five This was coated with lead, so heavy that it could sink empty, and the weight so distributed about its bottom that it could only descend in a perpendicular direction In the top a clear glass was fixed, to let in the light from above, and a cock to let out the air that had been breathed To supply the air to the bell he caused a couple of barrels, of about 36 gallons each, to be cased with lead so as to sink empty, each of them having a bung-hole in its lowest part, to let in the water as the air in them condensed on their descent, and to let it out again when they were drawn up full from below To a hole in the uppermost part of the barrels a trunk or hose was fixed, long enough to fall below the bung-hole, and kept down by a weight, so that no air could escape by the hose till its end was raised up. The barrels thus prepared were let down by the side of the bell A man stationed on a stage suspended from the bell was ready to take up the hose, and, as soon as their ends were brought to the surface of the water in the barrels, all the air that was included in the upper parts of them was blown with great violence into the bell, while the water entered at the bung-holes below and filled the barrels. By means of this contrivance the air was not only kept fresh, but another great advantage was gained; namely, that by admitting a sufficient quantity of it the whole of the water was expelled from the inside of the bell, and the bottom of the sea laid dry

By means of this contrivance for the admission of fresh air, it was now possible to remain for any length of time under water, but the use of the apparatus was still found to be attended with some inconveniences, and even considerable danger The divers within the bell having no power over it, its rising or sinking depends entirely upon the people at the surface of the water, and as the bell, even when in the water, has a considerable weight, there is always a possibility of the chain by which it is raised breaking, which would inevitably be attended with the destruction of the divers Another danger, still more to be apprehended, is, that if the mouth of the bell in its descent should come upon a sunken ship, or a rock projecting abruptly from the bottom, it might be overset before any signal could be given to those above. These defects were obviated by the very ingenious contrivances of Mr Spalding of Edinburgh. In order to avoid the risk of being upset when the bell descends on a rocky or uneven bottom, he suspended a considerable weight, which he called a *balance weight*, below the bell, by a rope passing over a pulley fixed in the inside; and the other weights attached to the bell being so adjusted that they could not sink it without the balance weight, as soon as the latter rested on the ground the bell remained suspended in the water. In case of the mouth of the bell being caught by any obstacle, the balance weight is immediately lowered, till it rests on the bottom; and as the bell, when thus relieved, is buoyant, the divers, having disengaged it from the rock, have it in their power either to descend by pulling in the rope, or by allowing it to run to ascend to the surface. Another contrivance of Mr Spalding deserves mention. He divided the bell into two compartments, the one above the other, and communicating by means of a stopcock. The divers are stationed in the lower one, and the weights are so adjusted that when the cavity above is empty the bell is buoyant; when it is filled with water, the bell sinks. Immediately above the partition are some slits in the sides of the bell, and at the top is an orifice, which can be opened or shut at pleasure Suppose now, this orifice being open, the bell is required to be lowered; as it descends, the water enters at the slits, and the air escapes by the orifice When the apparatus is entirely under water, and the cavity consequently completely filled, let the orifice be shut. The bell will now continue to descend; but if the stopcock communicating with the upper compartment be opened, the air will rush from the under to the upper, and displace a quantity of the water, and the apparatus will be lightened by the whole of the water so displaced. The divers have it thus in their power to regulate the descent or rise as they please. By admitting a certain quantity of air into the upper cavity, the descent of the bell is arrested; by admitting a greater quantity it becomes buoyant, and rises to the top. This method of constructing the diving bell has not, however, been adopted.

The greatest improvement on the diving bell, since that of Halley, was made by the celebrated Mr. Smeaton, and consists in forcing down a continued stream of air by means of an air pump through a flexible tube; and this plan is now always adopted In the year 1788, Mr. Smeaton constructed a diving bell to be used in the operations then contemplated at Ramsgate harbour on a new and improved plan. Instead of a bell-shaped vessel sunk by weights, his apparatus consisted of a square chest of cast iron, four and a half feet long, four and a half feet high, and three feet wide, affording sufficient room for two men under it. It was cast of such a thickness that its own weight was sufficient to sink it; and its thickness was greatest near the mouth or lower part, to prevent it from being easily overset This construction of the diving bell gave the men within it no power of raising or sinking it, but as the apparatus was made to be used at a place where the nature of the bottom was known, this advantage was not considered of great consequence, and, in fact it is found by experience that it is better to leave the bell to be entirely guided from above. On account of the facility with which water conveys sound, the strokes of a hammer on the inside of the bell can be heard at a great distance, and the sound coming through the water has a peculiar character, which cannot be mistaken By previous arrangement any directions can be given in this manner For instance, one blow may denote more air, two, stand fast, three, heave up, four, lower down, and so on With these successive improvements, the diving bell is found to be a most important machine in all great operations to be performed under water It was used with great advantage by Mr Rennie in the construction of the various harbours he projected, and it has recently been successfully employed in deepening the Clyde between Glasgow and Greenock, and improving the navigation of the river See the article "Diving Bell," in the new edition of the *Encyclopedia Britannica*.

DIV'INING ROD See RHABDOMANCY

DIVI'SIBILI'TY The property which all bodies possess of being separable into parts It was a question formerly much agitated among philosophers, whether matter is divisible *in infinitum*, or whether a certain term does not exist beyond which the particles are reduced to simple atoms incapable of further division. The question is incapable of direct solution, and fortunately is of no importance to science, but the extent to which the actual subdivision of bodies has been carried in many cases in the arts may well be considered as prodigious "In the gilding of buttons, 5 grains of gold, which is applied as an amalgam with mercury, is allowed to each gross, so that the coating left must amount to the 110,000th part of an inch in thickness It a piece of ivory, or white satin, be immersed in a nitro-muriate solution of gold, and then exposed to a current of hydrogen gas, it will become covered with a surface of gold hardly exceeding in thickness the ten-millionth part of an inch."

"The solution of certain saline bodies, and of other coloured substances, exhibits a prodigious subdivision and dissemination of matter. A single grain of the sulphate of copper, or blue vitriol, will communicate a fine azure tint to five gallons of water. In this case the copper must be attenuated at least ten million times; yet each drop of the liquid may contain so many coloured particles, distinguishable by our unassisted vision Odours are capable of a still wider diffusion A single grain of musk has been known to perfume a room for the space of twenty years Animal matter likewise exhibits in many instances a wonderful subdivision. The milt of a codfish when it begins to putrefy has been computed to contain a billion of perfect insects, so that thousands of these living creatures could be lifted on the point of a needle But the infusory animalcules display in their structure and functions the most transcendent attenuation of matter The *Vibrio undula*, found in duck weed, is computed to be ten thousand million times smaller than a hemp seed The *Vibrio lineola* occurs in vegetable infusions, every drop containing myriads of these oblong points. The *Monas gelatinosa*, discovered in ditch water, appears in the field of a microscope a mere atom endued with life, millions of them playing like sunbeams in a single drop of liquid." (*Leslie's Natural P*[illegible])

DIVI'SION. (Lat. divido, *I divide*) One of the four fundamental rules of arithmetic, the object of which is to find how often one number is contained in another. The number to be divided is the *dividend*, the number which divides is the *divisor*, and the result of the division is the *quotient*. Division is the converse of multiplication.

DIVI'SION. In Music, a dividing or separation of the interval of an octave into a number of lesser intervals.

DIVI'SION, in Logic, is the enumeration of several things [illegible] by a common name; thus, tree is said

to be divided into oak, ash, elm, &c. A common term may be divided in several ways, according to the various points of view in which it may be regarded for the purpose of qualification. Thus a bookbinder may divide books into folios, quartos, &c.; a librarian into theological, historical, &c.

DIVISION, in the art Military, signifies generally a certain proportion of an army, consisting of cavalry and infantry together or separately, that is, under the order of a brigadier or other general officer; but, in a more restricted sense, it is applied to any number of men on military duty detached from an established body, as a division of artillery, pioneers, &c. The divisions of an army are the number of the brigades and squadrons of which it consists; the divisions of a battalion are the several platoons into which a regiment or battalion is divided either in marching or firing. (*James's Mil Dict.*)

DIVO'RCE. (From the modern Latin word divortiare, *to turn or put away*.) The Jewish law of divorce is founded on the directions given in the 24th chapter of Deuteronomy, but the permission therein contained is subject to many obstacles and formalities in modern practice. In Greece, in classical times, the practice of divorce seems to have varied in different states; at Sparta it appears to have been unusual, in Athens great facilities were afforded by the law. In republican Rome great strictness in this branch of morals prevailed for a long period, although parties were less impeded in pursuing a divorce by the difficulties imposed by the law than by public opinion. But in the later period of the republic, and under the emperors, divorce became extremely common, and was obtained with equal ease by either sex. Our Saviour's declaration to the Pharisee, in the 19th chapter of St. Matthew, became the foundation of the law on this subject in Christian countries, and divorces were consequently allowed in one particular case only, but after the Roman church had erected matrimony into a sacrament, they became, as they now are in Catholic countries, wholly impossible, the only dissolution of marriage being in cases where it is void ab initio. In most Protestant countries, the facility of divorce has been so much restored in latter times as to approximate to the heathen practice. In England divorce *a vinculo matrimonii*, on the ground of adultery, can only be obtained by act of parliament; divorce *a mensa et toro*, commonly termed separation, by sentence of the spiritual court. *See* MARRIAGE, LAW OF.

DO. In Music, a syllable used by the Italians instead of *ut*, than which it is by them considered more musical and resonant.

DOCE'TÆ (Gr. δοκεω, *to seem*.) One of the earliest heretical sects, so called from the reality of our Lord's incarnation, and considering him to have acted and suffered only in appearance. Some divines have conceived that the express declarations of the nature of Christ in St. John's writings were specially directed against these opinions.

DO'CIMA'STIC ART. (Gr. δοκιμαζω, *I prove*.) The art of assaying minerals or ores, with a view of determining the quantity of metal which they contain.

DOCK. (Probably from the Gr. δεχομαι, *I receive*.) An artificial basin for the reception of ships. Docks are of two sorts, wet and dry; the former are used for the purpose of loading and unloading a ship's cargo out of the influence of the tide, and are constructed with gates which when shut keep the ship constantly afloat at low water; the latter are intended for the building, repairing, or examination of ships, which are admitted into them at flood tide, and are so called because they are either left *dry* by the ebbing of the sea, or rendered so by the use of great flood gates or of pumps. The reader will find in the *Commercial Dictionary* a full account of all the docks of Great Britain, with remarks on their utility, history, &c. A *naval dock* is a place provided with all sorts of naval stores, timber, and all the requisite machinery for ship building. The principal naval docks of Great Britain are Portsmouth, Plymouth, Chatham, Sheerness, Woolwich, and Deptford. It is in these docks, and particularly the three first, that ships of war are laid up in time of peace.

DOCKET, DOCQUET, or DOGGETT (Lat. documentum), in Law, is an abridged entry of an instrument or proceeding on a small piece of paper or parchment. Exemplifications of decrees in chancery, fiats in bankruptcy, and other instruments, are thus *docketed* for purposes of reference.

DO'CTOR, or TEACHER. This title of learned distinction was first adopted in the twelfth century. The degree of Doctorate, succeeding and superior to that of Master in European universities, was first conferred at Bologna, by the university of Paris, in 1145, on Peter Lombard; in England, it is supposed, in the reign of King John. Before this time, if the appellation of Doctor was used, it was only in its plain sense of "teacher," and as synonymous with master. The degree of Doctor is conferred, in the English universities, in each of the three faculties of divinity, law, and medicine, — but not in that of arts, — and in the science of music. The Continental degree of Doctor of Philosophy is unknown among us.

DO'CTOR. A thin plate of steel used in scraping the colour or mordant off the copper plates employed in calico printing; the term is probably a corruption of the word *abductor*.

DO'CTORS' COMMONS, is the popular name for the courts and offices occupied by the body incorporated in 1768 under the title of "The College of Doctors of Law exercent in the Ecclesiastical and Admiralty Courts," and which are situate on the southern side of St. Paul's Churchyard. The college consists of a president (the dean of the arches for the time being), and of those doctors of law who having regularly taken that degree in either of the universities of Oxford or Cambridge, and having been admitted advocates in pursuance of the rescript of the Archbishop of Canterbury, have been elected fellows of the college in the manner prescribed by the charter. *See* COURTS, ECCLESIASTICAL.

DO'CTRINAIRES. In Politics, a cant word, originally applied in France to a section of politicians who occupied a place, in the first chambers after the restoration of 1815, between the deputies of the centre, who generally supported ministers, and the extreme left, which always opposed them. The chief men of this party were systematic writers and speakers on government, who sought to establish a frame of constitution somewhat more resembling that of England than any which has hitherto subsisted in France. The nickname given to them implied that they were considered by the public as theorists; they were, in fact, the same class which Napoleon used to term Ideologists. They supported the Duc de Cazes when in office, afterwards they were generally in opposition until 1830, since which time several of their leaders have held office at different times. Royer Collard, De Broglie, the young Baron de Stael, Guizot, &c. were among the chief public men commonly called Doctrinaires, but this, like other party nicknames, has been, and is, employed in a very arbitrary manner.

DO'CTRINE (Lat. doceo, *I teach*), signifies, in its most extended sense, any thing that is taught either as a matter of faith or practice, and accordingly the term is applied more particularly to various theories that have been embraced and enforced in philosophy and religion; hence we hear of St. Augustine's *doctrine* of grace, Newton's *doctrine* of colours, &c.

DO'CUMENTS (Lat. doceo, *I teach*.) In Law, written instruments adduced for the purpose of evidence. *See* EVIDENCE.

DO'DECADA'CTYLUS (Gr. δωδεκα, *twelve*, and δακτυλος, *a finger*.) The portion of the small intestines called *duodenum*, its length being about the breadth of twelve fingers; this at least may be the case in some animals to which the dissection of the earlier anatomists, who gave this name, was limited.

DODE'CAGON. (Gr. δωδεκα, and γωνια, *an angle*.) A regular polygon of 12 equal sides. If the side of a dodecagon be represented by 1, the area is $=3\times(2+\sqrt{3})$ =11·196 nearly. In general, the area of the figure is equal to the square of its side multiplied by the constant number 11·196.

DO'DECAHE'DRON. (Gr. δωδεκα, and εδρα, *seat*.) One of the five Platonic bodies or regular solids, its surface being composed of 12 equal and regular pentagons. The surface of a dodecahedron is found by multiplying the square of its side or linear edge into the number 20·64578, and its solidity by multiplying the cube of its side by 7·66312.

DODECA'NDROUS (Gr. δωδεκα, and ανηρ, *a male*.) Any plant having twelve stamens.

DODECA'STYLE (Gr. δωδεκα, and στυλος, *a column*.) In Architecture, a building having twelve columns on a front or flank.

DODO'NA. In Antiquity, the seat of the most ancient, and one of the most celebrated oracles of Greece, sacred to Jupiter. By some writers its origin is attributed to Deucalion, who is said to have built the town of Dodona where it stood; but according to the traditions of the priestesses of the temple, it was founded by a dove, which, perching on the branch of an oak, recommended in a human voice that a temple should be erected to Jupiter in that place. The situation of the oracle was in an extensive forest, the oaks of which are said to have been endowed with the gift of prophecy; and the oracles were most frequently delivered by three priestesses, who expounded the will of the divinity. That the responses of this oracle were received with singular veneration, may be inferred from the number of votaries by whom it was frequented, and the costly presents which adorned the temple and its precincts. This oracle continued to utter responses till the time of Augustus, when it ceased. (*Strabo*, vii.) *See* ORACLE.

DO'DRANS. (Lat.) A measure equal to about nine inches, being the space between the end of the thumb and of the little finger when both are fully extended. It is about equal to the *palm*.

DOG. *See* CANIS.

DO'G BELTS. A term used in some coal mines for a strong broad piece of leather round the waist, to which a chain is attached, passing between the legs of the men drawing the dans in the low works

DOG DAYS. *See* CANICULAR DAYS.

DOGE. (Probably a corruption of the Lat. dux, *a leader*.) The title of the supreme executive magistrate in the republic of Venice. The origin of this office dates as far back as 697; when, owing partly to the dissensions and intrigues that resulted from the annual election of the seven tribunes by whom the affairs of Venice had been previously administered, and partly to so divided an authority being found inadequate to the conduct of the rapidly increasing powers of the state, the Venetians resolved to replace the tribunes by a single chief magistrate, who should hold office for life. This magistrate, whom they called *the Doge*, was clothed with almost regal authority. In him was vested the power of convoking assemblies, of declaring war or concluding treaties; of commanding the armies of the state; of appointing the military tribunes and the judges; of hearing appeals and deciding definitively on all matters at issue, of collecting the citizens in their different islands, and in the quarters or districts of Venice, for the purpose of choosing their parish priests or bishops; of judging all matters concerning the clergy in all causes, both civil and criminal, and of awarding ecclesiastical punishments, investing the bishops, and installing them in their churches (*And. Dandolo apud Gallicioli. Chron.* 1) But notwithstanding these apparently vast powers which were vested in the doge at the first institution of the office, the slightest glance at the history of Venice, which for more than eleven centuries, with a few interruptions, continued to be governed by doges, will abundantly prove that though the Venetians allowed four centuries to elapse before they attempted to fix the bounds or control the exercise of the sovereign authority by any legal enactments, they never ceased to regard with jealousy the chief magistrate of their own appointment and approval, and at last succeeded in limiting and restricting his power so as to render him a mere state pageant of the *grand* council, in which resided the supreme executive authority. The history of the doges is so incorporated with that of the Venetian republic as to be wholly inseparable from it; and a bare outline of the various phases which they exhibited during a career unrivalled for duration and brilliancy in the annals of human society, would be incompatible at once with our limits and the design of this work The reader will find ample information on this subject in *Daru's Histoire de la République de Venise* (8 vols 8vo. Paris); the *Quarterly Review*, vol 31., and *Edinburgh Review*, vol 46 (*See* BUCENTAUR) *Doge* was also the title given to the chief magistrates of Genoa, who were elected from the senatorial body The doges of Genoa held office originally for life, as at Venice, but from 1528 down to 1797, when that form of government was abolished by the French, they remained in office only two years, and their authority was exceedingly circumscribed.

DO'GMA. (Gr. δοκειν, *to seem*.) Literally a conclusion founded upon experience. In Theology, *dogma* has been defined to be a fundamental article of belief derived from acknowledged authority, and is usually applied to what are considered as the essential doctrines of Christianity, deduced either from the Scriptures or from the fathers of the church. (*See* THEOLOGY) There are, however, many other *dogmas* peculiar to the different sects into which Christianity is divided. Thus the bulls and decretals of the pope, together with all the councils both of earlier and later times, are regarded by the Roman Catholics with as much veneration as the authority of the Scriptures and the holy fathers. The Greek church, on the other hand acknowledges the authority only of the earlier councils, in addition to that of the Scriptures and the fathers, and the Lutheran and other Protestant churches have embodied their dogmas in their respective confessions of faith and other ecclesiastical standards. *Dogmatic theology*, as this branch of divinity is called, in contradistinction to moral and scholastic theology, forms an important object of study in many of the Continental universities. In the Protestant universities of Germany, there are chairs set apart for the history of *dogmas*, or, as it is termed, *Dogmatik*; in which the origin and nature of the dogmas of the various Christian sects are examined, and the merit of the arguments by which they are supported respectively canvassed. Among the ancient physicians, the *dogmatists* founded their practice upon conclusions or opinions drawn from certain theoretical inferences, which they conceived might be logically defended or proved. At present a dogmatist is one who is fond of strong assertions not always founded upon correct reasoning.

DO'G STAR. A name popularly given to *Sirius*, a star of the first magnitude, in the constellation *Canis Major* (the Greater Dog), and the brightest fixed star in the firmament.

DO'GWOOD. A name applied to two different plants: in England to any of the shrubby species of *Cornus*; in the West Indies to the *Piscidia erythrina*. The former are of little interest, except as ornamental shrubs; the latter is a powerful narcotic, the real value of which in medicine has still to be determined.

DOLA'BRIFORM. (Lat. dolabra, *a hatchet*.) In Zoology, when a whole or part is shaped like a hatchet, as the foot of certain Bivalves.

DO'LCE. (It) In Music, an instruction to the performer that the music is to be executed softly and sweetly.

DO'LERITE. A trap-rock composed of augite and felspar.

DOLICHO'TIS. (Gr. δολιχος, *long*, and ους, *an ear*.) The name applied by F Cuvier to the subgenus of Cavies, to which the Patagonian hare (*Cavia Patachon*.) belongs.

DOLLAR. *See* MONEY.

DO'LOMITE. Magnesian marble, or granular magnesian carbonate of lime. Named after Dolomieu

DO'LPHIN. This term is applied, in common language, to two inhabitants of the ocean of widely different habits and organization: by naturalists it is generally used to signify the dolphin of the ancients, which is a cetaceous mammal of the genus *Delphis* of Linnæus; by poets it is applied to the coryphene (*Coryphæna Hippurus*, Linn), a fish long celebrated for the swiftness of its swimming, and the brilliant and beautiful colours which it successively assumes in the act of death

DOM (Lat dominus, *a lord*), in the middle ages, was a title originally possessed by the pope, and at a somewhat later period by the dignitaries of the Roman Catholic church In more recent times, it formed a distinguishing title of certain monastic orders, such as the Benedictines, &c; and it appears to have been equivalent to the *don* of the Spaniards, the *von* of the Germans, and the *de* of the French Mabillon and Calmet are always spoken of as Dom Mabillon and Dom Calmet.

DOMAI'N (Lat dominicum, from dominus, *lord*; in legal language, *demesne*), signifies properly that portion of the territorial possessions of a lord which he retains in his own occupation Thus, the lands retained in possession of the crown, and not granted out to the great feudal lords, were styled domaines in France. *Ancient demesne*, in English law, is a peculiar tenure by which certain lands are held of the crown, being such as are evidenced by Domesday Book to have been in the possession of King Edward the Confessor.

DOME (Lat domus) In Architecture, the spherical or other figured concave ceiling over a circular or polygonal building A *surbased* or *diminished dome* is one that is segmental on its section; a *surmounted dome* is one that is higher than the radius of its base The forms of domes are various, both in plan and section. In the former, they are circular and polygonal; in the latter, we find them semicircular, semi-elliptical, segmental, pointed, sometimes in curves of contrary flexure, bell-shaped, &c The oldest cupola on record is that of the Pantheon at Rome, which was erected under Augustus, and is still perfect We here subjoin a list of the domes whose dimensions entitle them to notice.

| Domes. | Feet diam. | Feet high. |
|---|---|---|
| Pantheon at Rome | 142 | 143 |
| Duomo at Florence, Sta Maria del Fiore | 139 | 310 |
| St Peter's at Rome | 139 | 330 |
| St. Sophia at Constantinople | 115 | 201 |
| Baths of Caracalla (Ancient) | 112 | 116 |
| St Paul's, London | 112 | 215 |
| Dome of the Mosque of Achmet | 92 | 120 |
| Chapel of the Medici | 91 | 199 |
| Baptistery at Florence | 86 | 110 |
| Church of the Invalids at Paris | 80 | 173 |
| Minerva Medica at Rome | 78 | 97 |
| Madonna della Salute, Venice | 70 | 133 |
| St. Geneviéve at Paris (Pantheon) | 67 | 190 |
| Duomo at Sienna | 57 | 148 |
| Duomo at Milan | 57 | 254 |
| St Vitalis at Ravenna | 55 | 91 |
| Val de Grace at Paris | 55 | 133 |
| St. Mark, Venice | 44 | |

DO'MESDAY BOOK (*Liber Judiciarius*, or *Censualis Angliæ*), according to Hume, the most valuable piece of antiquity possessed by any nation, was framed by order of William the Conqueror (1031-6), and contains a general survey of most of the lands in England, their extent in each district, their proprietors, tenures, value; the quantity of meadow, pasture, wood, and arable land which they contained; and, in some counties, the number of tenants, cottagers, and slaves of all denominations who lived upon them. It consists of two volumes; one in fol., the other in 4to.: the former comprehending 31 counties, the latter those only of Essex, Norfolk, and Suffolk. The counties of Northumberland, Cumberland, Westmoreland, and Durham, were not comprehended in this survey, probably on account of their then wild uncultivated state. Nor does Lancashire appear under its proper name; but Furness and the north-

ern part of that county, as well as the south of Westmoreland and part of Cumberland, are included within the West Riding of Yorkshire. Though in several respects the information contained in Domesday Book is inaccurate and defective, still in a variety of interesting particulars it serves admirably to illustrate the ancient state of England. The publication of Domesday Book was undertaken by order of Geo. III. in 1767, and was completed, under the superintendence of Mr. Abraham Farley, in 1783. The original is deposited in the Chapter House at Westminster, where it is open to inspection. Sir H. Ellis has published a useful introduction and index to it. Two volumes of Records supplementary to Domesday Book, framed for a similar purpose, and of a nearly contemporary date, were published in 1816 by the Commissioners upon the Public Records. The term Domesday is of doubtful origin: the first syllable seems derived from doom, *judgment*.

DO'MICILE. In Law, the place where a person has his home. Personal property, on the decease of the owner, is distributable according to the law of the country in which he was domiciled at the time of his death; not according to the law of the country in which the property is situate. Residence for forty days constitutes a domicile as to jurisdiction in Scotland.

DOMI'NICAL LETTER. For the purpose of exhibiting the day of the week corresponding to any given day of the year, the framers of the ecclesiastical calendar denoted the seven days of the week by the first seven letters of the alphabet, A, B, C, D, E, F, and G; and placed these letters in a column opposite to the days of the year, in such a manner that A stood opposite the 1st of January or first day of the year, B opposite the 2d, and so on to G, which stood opposite the 7th, after which A returns to the 8th, and so on through the 365 days of the year. Now if one of the days of the week, Sunday, for example, falls opposite to E, Monday will be opposite F, Tuesday G, Wednesday A, and so on, and every Sunday through the year will be represented by the same letter E, every Monday by F, and so on. The letter which represents Sunday is called the *Dominical Letter*, or *Sunday Letter*. As the number of days in the week and the number in the year are prime to each other, two successive years cannot begin with the same day, hence the Dominical Letter changes every year. This mode of representing the days of the week has now fallen nearly into desuetude, and the initial letter of the name of the day is placed in our almanacs opposite the day of the month.

DOMI'NICANS. Friars of the order of St Dominic, instituted at the beginning of the 13th century. *See* art. ORDERS, MENDICANT.

DO'MINO. (Ital.) A long loose cloak of black silk, furnished with a hood removeable at pleasure, and worn chiefly at masquerades by persons of both sexes by way of general disguise. *See* MASQUERADE.

DON. (Lat. dominus.) A Spanish and Portuguese title, which the king, the princes of the blood, and the highest class of the nobility prefix to their names. The ladies of rank have the predicate donna. The title was originally equivalent to that of knight.

DO'NATISTS. A religious faction, which arose in Africa in the beginning of the 4th century in opposition to Cecilianus, bishop of Carthage. The Numidian bishops were indignant at a slight received from him at the time of his consecration, and declared him informally appointed, on account of their absence from the ceremony. They also accused him of unworthy conduct during the Diocletian persecution. There are two persons of the name of Donatus celebrated as leaders of this party. Their cause was heard before several councils (those of Arles, Milan, and Carthage), in all of which they were pronounced schismatics. The Donatists, however, continued to be a powerful faction for more than 100 years, and raised at various times great wars and commotions. The name of Circumcelliones was given to the numerous bands of country people of the lowest ranks who took up arms in their cause. St Augustin was most successful in bringing public opinion to bear against the Donatists.

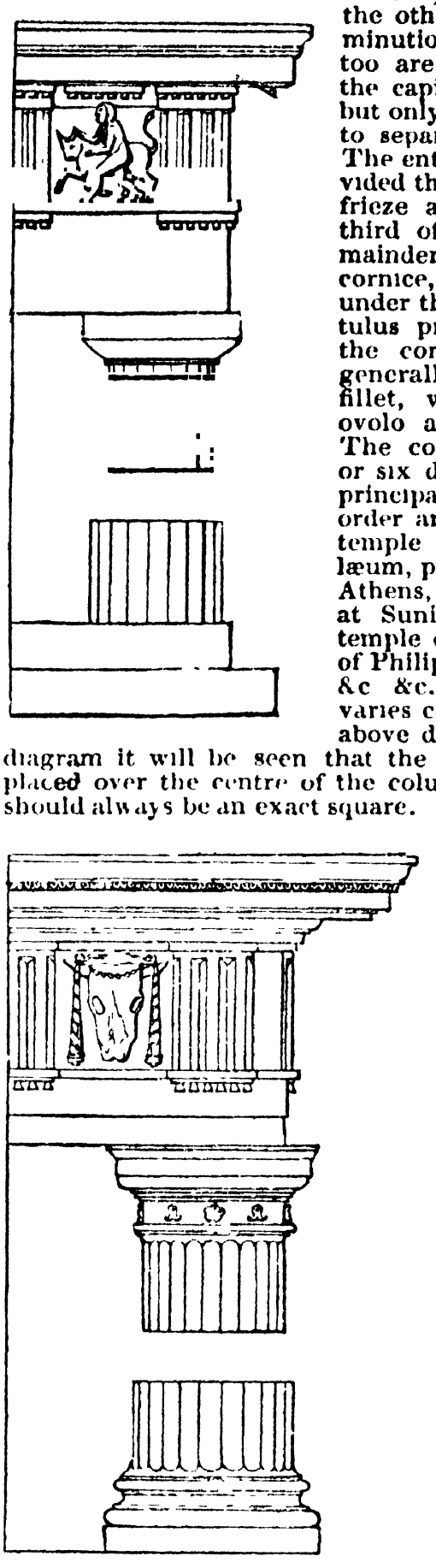
DO'NATIVE, in Law, is a benefice merely given and collated by the patron, without presentation or induction.

DO'NJON, or DUNGEON. Originally a fortress on a hill: from the Celtic dun, *height*. The central building or keep of an ancient castle; frequently raised on an artificial elevation.

DOOR (Sax. ðor, Gr. θυρα.) In Architecture, the gate or entrance of a house. The *door frame* is the surrounding case into and out whereof the door shuts and opens. It consists of two upright side pieces or posts and a head, generally fixed together by mortices and tenons, and wrought, rebated, and beaded.

DORA'DO. (Span. *gilt*.) A southern constellation, formed by Bayer; called also sometimes the Sword-fish.

DO'RIC ORDER. In Architecture, one of the five orders. The true origin and birthplace of this order is not satisfactorily known. The example here given is from the temple of Theseus at Athens. The principal points in which the Grecian differs from the Roman Doric are, that it stands at once on the pavement of the building, without socle, tori, or fillets; and that it presents a more pyramidal section than the other, from the great diminution given to it. Its flutes too are never deeply sunk; the capital has no astragal, but only some small annulets to separate it from the shaft. The entablature is so subdivided that the architrave and frieze are each more than a third of its height, the remainder being given to the cornice, which has a band under the mutulus. The mutulus projects forward under the corona, over which is generally placed an ovolo fillet, with another larger ovolo and fillet thereover. The column is usually five or six diameters high. The principal examples of the order are in the Parthenon, temple of Theseus, Propylæum, portico of the Agora at Athens, the temple of Minerva at Sunium, one at Corinth, temple of Apollo and portico of Philip in the Isle of Delos, &c. &c. The Roman Doric varies considerably from that above described. From the diagram it will be seen that the triglyphs are always placed over the centre of the column, and the metopæ should always be an exact square. It follows thence that the intercolumniations are always regulated by the triglyphs. Sometimes it is placed on a plinth, at other times on a pedestal sparingly decorated with mouldings. Though it occasionally, as in this example, has an Attic base, it is more commonly used with only a torus and astragal. The capital is formed with a neck and astragal under the ovolo, and a cyma-reversa and fillet on the abacus. The only pure ancient example of this order is that of the theatre of Marcellus at Rome. The flutes are without fillets between them, as in the Grecian Doric, and are twenty in number. Of the moderns by far the most successful in his profile of the order, which they have made what may be called Italian Doric, is Palladio, from whom the example here given is selected.



DORI'PPE. A genus of the short-tailed Decapod Crustaceans, belonging to the tribe *Notopoda*. The species of this genus exist at great depths in the sea, and it is probable that they use the small feet, which are directed towards the back, to cover themselves with foreign bodies for concealment: they have been found in the Mediterranean, Adriatic, and Indian seas.

DO'RMER. (Lat. dormio, *I sleep*.) In Architecture, a window placed on the inclined plane of the roof of a house, whose frame is placed vertically on the rafters.

DO'RMITORY. (Lat. dormio, *I sleep*.) In Architecture, a large sleeping apartment capable of containing many beds.

DO'RNOCK. A stout figured linen, named after the town in Scotland where it was originally manufactured.

DORSIBRA'NCHIATES. *Dorsibranchiata*. (Lat. dorsum, *back*; branchiæ, *gills*.) A name given by Cuvier to an order of Anellidans, or red-blooded worms, comprehending those which have the gills projecting from the middle part of the back or sides of the body. The Nereis, or sea-centipede, is an example of this order.

DORT, SYNOD OF. An assembly of Protestant divines convoked at Dort in 1618-19, by the States-general, under the influence of Maurice, Prince of Nassau, in which the tenets of the Arminians on the five points

relating to election, redemption, original sin, effectual grace, and perseverance, were condemned by the adherents of Calvinism. This national synod consisted of thirty-eight Dutch and Walloon divines, five professors from different universities, and twenty-one lay elders; but besides these there were ecclesiastical deputies present from most of the states of the United Provinces, and from the churches of the Palatinate, Hesse, Switzerland, Bremen, England, and Scotland. This synod was opened on Nov. 13. 1618, and continued till May 29th in the following year, during which period it held 180 sessions; but long before these sessions had come to a close, the Arminians were pronounced guilty of pestilential errors, and condemned as corruptors of the true religion. For minute details of the proceedings of this celebrated synod, the reader may consult *Brandt's History of the Reformation in and about the Low Countries* (London, 1720-22), and the usual authorities in ecclesiastical affairs It was at this synod that the project of obtaining a translation of the Bible into Dutch was first started The execution of this task was entrusted to some of the most learned men of the time; and after the lapse of 19 years their labours were given to the world in what has been since known as the *Dort Bible*. (See *Townley's Illustrations of Biblical Literature*)

DOSI'THEANS. The name of a religious sect which sprung up in the first century of the Christian era. Their principal tenets consisted in believing in the divine mission of their leader, Dositheus, from whom they derived their name, and in rejecting the authority of the prophets by denying their inspiration. This sect remained in existence till the 4th century; but with regard to its history, there exists but little information on which we can rely

DOU'BLE BASS. *See* CONTRABASSO.

DOU'BLE STARS. *See* STARS, DOUBLE.

DOUBLOO'N. *See* MONEY.

DOUCHE. (Fr) A jet or current of water directed upon some part of the body. An apparatus for this purpose is to be found in most bathing establishments Steam or vapour is also sometimes applied in the form of douche.

DO'VECOT. A structure for keeping tame pigeons, the only essential difference between which and a common poultry-house is, that the entrance for the birds must be raised to a considerable height from the ground, because pigeons fly higher in the atmosphere than most other birds.

DO'VER'S POWDER A compound of ipecacuanha, opium, and sulphate of potash It is the *pulvis ipecacuanhæ compositus*, or compound powder of ipecacuanha of the present Pharmacopœia. Ten grains, which is the average dose, contain one grain of opium and one of ipecacuanha. It is an excellent sedative and sudorific.

DO'VE-TAIL. (From its spreading like a pigeon's tail.) In Architecture, a joint used by carpenters in connecting two pieces of wood by letting one piece into the other, in the form of the expanded tail of a dove It is the strongest method of joining masses, because the tenon or piece of wood widens as it extends, so that it cannot be drawn out, because the tongue is larger than the cavity through which it would have to be drawn The French call this method *queue d'hirondé*, or swallow's tail

DOW'AGER (Fr douairière), seems to signify a widow who either enjoys a dower from her deceased husband, or who has property of her own brought by her to her husband on marriage (dowry), and settled on herself after his decease. In the language of etiquette the term is applied to a widow lady, to distinguish her from the wife of her husband's heir having the same title.

DOW'ER (Lat. dotarium, from dos), in Law, is defined to be the estate for life a widow acquires in a certain portion of her husband's real property after his death. Dower by the common law entitles her to a third part of all the lands and tenements of which the husband was seised in fee-simple or fee-tail at any time during the coverture. Hence this species of dower could not be affected by the husband's conveyance of the lands, unless by fine or recovery in which the wife joined, or by his devise. But the law in this respect has undergone material alterations by the provisions of the 3 & 4 W. 4. c. 105 Dower by custom varies in different districts There were other obsolete species of dower, now abolished by the statute already mentioned. A married woman may be deprived of her right to dower by attainder of her husband for treason, or herself for treason and felony, by divorce a vinculo matrimonii; by elopement from the husband and living with an adulterer, which incapacity may be removed by reconciliation with the husband. In order to prevent the inconveniences occasioned by this right, which materially impeded the conveyance of property, various modes of *barring*, i. e. defeating, the right to dower were invented by legal ingenuity. Of these the most usual in practice was and still is the limitation of a separate estate (commonly, although incorrectly, called a jointure) to the wife on marriage. This estate must be "a competent livelihood of freehold for the wife, of lands and tenements, to take effect in profit or possession presently after the death of the husband, for the life of the wife at least." This mode of barring dower derives its efficacy from the provisions of the Statute of Uses, 27 H. 8. c. 10. But now by 3 & 4 W. 4. c. 105. dower may be barred by a simple declaration in the deed by which land is conveyed to the husband, or in any deed executed by him; or by declaration in his will, or by any devise of real estate to her.

DOWLAS. A coarse kind of linen.

DOWNS, have been defined to be banks or elevations of sand which the sea gathers and forms along its shores, and which serve it as a barrier. The word is derived from the Celtic *dune*, which see The term is also applied to large tracts of poor naked hilly land which serve chiefly for the grazing of sheep, thence called Down sheep. Downs is the name given to the well-known road for shipping in the English Channel, which possesses excellent anchorage, and in time of war forms the place of rendezvous for the English navy.

DOW'RY, although often confounded with *dower*, has a different meaning; namely, the *dos mulieris* or marriage portion brought by the wife to her husband. The word, however, has no legal signification.

DOXO'LOGY. (Gr δοξα, *glory*; λογος, *discourse*.) A form of praise or glorification The greater and lesser Doxologies, as they are distinguished by the liturgical writers, are the hymn sung by the angels at the Nativity, "Glory be to God on high," &c; and the shorter form, "Glory be to the Father," &c The last clause in the Lord's Prayer, as it is recorded by St Matthew, the genuineness of which has been sometimes questioned, is also frequently called the Doxology

DRACHM There are two drachms in our system of weights; namely, the avoirdupois drachm, which is the sixteenth part of the avoirdupois ounce; and the apothecaries' drachm, which is the twelfth part of the troy ounce, and equivalent to sixty troy grains: the latter drachm is the only one which is retained in common use.

DRA'CHMA (Gr δραχμή) An Athenian silver coin of the value of six oboli, or about 7½*d* of our money. Other Greek states had *drachmæ* of different values, but the above is that generally referred to. There was also a weight of this name nearly equivalent to 2 dwt. 7 gr. troy weight

DRA'CO (Lat *the Dragon*) One of the ancient constellations in the northern hemisphere.

DRA'CO MITIGA'TUS An alchemical name of *calomel*: corrosive sublimate was probably called *draco* or the dragon

DRACO'NIN, or DRACINA. The colouring matter of the resin called *dragon's blood*

DRA'GOMANS The interpreters attached to European embassies or consulates in the Levant. The dragoman of the Sublime Porte is an important Turkish officer, who forms the medium of communication between his own government and the embassies of foreign countries.

DRA'GON (Gr δρακων.) In Fabulous History, one of the most famous mythological creations of antiquity and the middle ages The position which this being occupies in fabulous history presents one of the most singular phenomena of the human mind, as its existence was firmly accredited among the ancients of almost every nation, both in the eastern and western regions of the earth. It occurs in the sacred allegories of the Jews and in the legends of the Chinese and Japanese, and the pages of the classic poets of Greece and Rome teem with representations of the dragon Thus the dark retreats of their gods and their sacred groves were defended by dragons; the chariot of Ceres was drawn by them; and a dragon kept the garden of the Hesperides. In the Scandinavian mysteries, the dragon was the minister of vengeance under their vindictive gods (see *Grimm's Deutsche Mythologie*); and the ancient Britons, enslaved in the trammels of Druidic superstition, entertained a similar notion of its nature. (*Rees's Cyclopædia*) The allegory of the Dragon has even found a place among many nations who have embraced Christianity In the Book of Revelations (chap 20.), the angel is represented as laying "hold on the dragon, that old serpent, which is the devil;" and hence in painting and statuary the triumph of Christianity over infidelity and heathenism is sometimes represented by a dragon pierced or trampled under foot. This representation forms also the attribute of different saints in the legends of Christianity, more especially of St. Michael, St. George, and St. Margaret the Martyr. The dragon of antiquity was a species of monstrous serpent with wings and feet; and he seems to have possessed many qualities in common with the most famed terrors of ancient Greece, such as the

Gorgons and hydras and chimæras dire,

with which he was in all probability intimately allied.

DRAGON In Zoology, this term is applied to a genus of small Saurian reptiles, characterized by two lateral aliform productions of the skin supported upon the first

six pairs of ribs; which, instead of bending round the thorax, are elongated and directed outwards for that purpose.

DRA'GON BEAM. In Architecture, an horizontal piece of timber on which the hip or angle rafters of a roof pitch. It is framed into a short diagonal piece, which ties the plates at the internal angles of a roof.

DRA'GON FLY. A common name for the Neuropterous insects belonging to the genus *Agrion* or *Lobellula*.

DRAGONNA'DES. (Fr.) The name given to the persecutions instituted by Louis XIV. and his successor against the French Protestants, from the coercive measures (parce qu'on y employait les *dragons*) which were put in force to effect their conversion.

DRA'GON'S BLOOD. A deep red resin used in colouring varnishes; it is the produce of the *Pterocarpus draco*, and is imported from India.

DRAGOO'NS (Fr. dragon; probably from the Lat. draconarius, *the bearer of a standard upon which was represented the figure of a dragon*), is the name given to a species of cavalry trained and armed to act either on foot or on horseback, as emergencies may require. The origin of this species of troops has been ascribed by Pere Daniel to the Marechal de Brissac, but there can be but little doubt that a sort of soldiers answering exactly to the definition above given of dragoons was in use among the ancient Romans. At present dragoons form part of the military force of all the powers of Europe. The first regiment of dragoons in this country was raised in 1681, and called the Royal Regiment of Dragoons of North Britain, now the *Scots Greys*. In England, this species of troops is of two sorts,—*Dragoons* simply, and *Dragoon guards*; the difference between them consisting in this, that the accoutrements and horses of the latter are somewhat heavier than those of the former. *See* CAVALRY.

DRAI'NING. The art of freeing the surface of the soil from superfluous water, considered with reference to cultivated vegetables, and the health of man and animals. Water may become superfluous by being collected in the natural hollows on the surface, and thus forming bogs, by being retained in the surface stratum, in consequence of a retentive subsoil; or by oozing through a moist subsoil to the surface stratum, in consequence of supplies from subterraneous sources. Water collected in bogs, or marshy places, remains there, because it has no natural outlet, neither by an opening or hollow along the natural surface, nor by the porosity of the subsoil, in consequence of which the water might sink into it and disappear. The obvious mode of draining in the first case is by a trench or drain, so deep as to draw the water from the lowest parts of the hollow, bog, or marsh. Where water is retained in the surface soil in consequence of a retentive subsoil, as in the case of clays and many loams, the most effective mode is to cut a number of small drains parallel to and at short distances from one another, and by the tops of these drains reaching within an inch or two of the bottom of the surface soil, which in cultivation is turned over by the plough, they absorb the superfluous water that passes through this soil and carry it off. Or, should the land be in pasture, the tops of the drain should be brought within an inch or two of the grassy surface, so as to intercept the water, both oozing laterally from the surface soil, and vertically from among the leaves of the grass. It may be observed also that pasture lands on this description of retentive soil may be more readily drained when laid into ridges, and an underground drain formed under each furrow or surface drain. This, however, is not essential; and though furrows or surface drains would be no deformity in field culture, yet in lawns and parks the appearance of furrows would destroy the continuity and evenness of surface, which in lawns is one chief source of beauty. To drain the surface soil, where it is supplied by water from the subsoil, requires some knowledge of the strata of which the subsoil is composed. In general the strata composing the subsoil lie over one another in a direction more or less approaching to horizontal; and when the natural inclination of the surface is everywhere parallel to this strata beneath, the water, if it oozes out of the subsoil at all, will generally do so equally throughout the subsoil; and in such cases numerous drains at no great distance are required to carry it off, precisely as in the case of draining soils with retentive subsoils. But when the line of surface does not correspond with the line of substrata, but intersects this line, then water will generally be found oozing out at the line of intersection, technically called the cropping out of the strata. The quantity of water which will issue from these sections or croppings out of broken strata will depend on a great variety of circumstances, into which it is unnecessary here to enter; because in all cases the mode of draining is the same, viz. that of forming a drain parallel to the line of the fracture of the strata. This drain in some cases is not required to extend the whole length of the line of fracture; because if the strata have a double inclination, so as it were to conduct the water to one angle or point, a drain at that angle or point will carry off the whole of the superfluous water contained in the strata. The subsoil in some cases is composed of strata in a nearly vertical position, and in others of strata alternately depressed and elevated, so that a section through them would form a serpentine line; and sometimes the subsoil is composed of strata the layers of which have been broken up and jumbled together. All these, and other cases, are to be drained in one or more of the above described modes; that is, accumulated water, whether in the soil or above it, is to be let off by cuts or drains made at the lowest points of accumulation; and surface soil saturated with water, whether from greater atmospherical supplies than can be carried off by evaporation or can sink into the subsoil, or whether it arise from sources in the subsoil, is to be carried off by numerous drains close to one another, and the tops of which are within a few inches of the cultivated soil, or of the permanent clothing of grass or other herbage.

DRA'MA (from the Greek word δρᾶμα, *an action or thing done;* derived from the verb δρᾶω, *I act or do*), has been defined a species of poem in which the action or narrative is not related, but represented. The invention of the drama is one of those which should seem to proceed most naturally from the ordinary customs and feelings of men. There is a species of dramatic action which seems almost instinctive: we naturally imitate the tone and gestures of others in reciting their sayings or adventures, or even in adopting their sentiments. Yet some nations appear never to have taken the farther step of doing, methodically and with design, what all do involuntarily. In the accounts which we possess of the ancient Egyptians, for example, we have no trace of their having possessed dramatic representation. But among a great number of tribes, wholly independent of each other, we find something approaching to the dramatic art intermingled with their common or solemn customs, and generally connected with religious observance. This was especially the case in Greece, whence the name and substance of the drama have been chiefly derived by the modern European nations.

The history of the development of the dramatic art in Greece is well known. Its elements were found in the religious festivals celebrated from the earliest ages in that country. The feasts of Bacchus in particular had sacred choruses or odes; these were afterwards intermixed with episodic narrations of events in mythological story, recited by an actor in the festival with gesticulation. Thence again, the next step was to introduce two actors with alternate recitation; and thus were produced tragedy (τραγῳδία, *the song of the goat*, from the animal which was led about in those festive processions); and comedy (κωμῳδία, *the village song*), which differed from the former in that the dialogue of the interlocutors was satirical, and not mythological. The early Greek tragedy was a dramatic representation of some scenes or events recorded in the national traditions, the actors personating those who played a part in these events, together with a chorus or band of singers, representing such persons as might naturally be supposed to have been bystanders at the occurrence (captive women, old men, or counsellors, &c.), who sang at intervals, during the representation, hymns to the gods, or songs appropriate to the scenes passing in representation. While the Attic comedy, in its first invention, must be regarded as a parody on tragedy, in which the personages were either real characters introduced for the purpose of satire, or ludicrous personifications. Æschylus, the oldest tragic writer (with the exception of Phrynichus, his cotemporary), carried the Greek drama at once to nearly its highest state of perfection. Sophocles and Euripides introduced additional actors into the dialogue (which at first admitted only two at the same time), and turned the naked recitals of events which form the substance of the plays of Æschylus into something more nearly resembling the modern idea of a plot, with contrasted characters and incidents leading to the accomplishment of a main action. Many tragic writers, the whole of whose works have been lost, flourished after Euripides in Athens and Alexandria; but they do not seem to have altered the character of the art which they received from their predecessors. The fate of comedy was different: the old Attic comedy was a political or philosophical satire in action, which in form was a burlesque on the tragedy. Afterwards, passing through the intervening stage of the middle comedy, of which we know little, the art acquired in the new comedy of Menander and Philemon a character somewhat approaching to that in which it is at present cultivated; a narrative in representation of scenes and incidents in ordinary life of a light or ludicrous character.

The dramatic art among the Greeks aimed at producing an impression upon the spectators by three different means; which, according to modern phraseology, we may denominate poetical effect, dramatical effect, and theatrical effect. The poetry of the Greek drama was of the highest order; but it forms a topic to be considered apart. Dramatical effect is the proper subject of the dramatic art; and, in judging of the efforts of the Greek mind in this direction, we are assisted not only by the

study of the dramatic poems which we possess, but by the rules of criticism delivered to us by Greek authors, and especially by Aristotle. From these it appears that the parts or characteristics of a tragedy, essentially divided, were held to be the fable or story, the manners, the style, the sentiment, the music, and the diction: that the fable should consist of an entire action, namely, one principal event and the auxiliary events; and that the proper emotions to be excited by the action are terror and pity: that its parts of quantity, according to the division of form, were the prologue, being that part of the tragedy which precedes the parode or first entry of the chorus; the episode, being all those several parts which are included between the several choral odes; the exode, the part which follows the last choral ode; and the chorus itself, or the intervening odes, which also admit of various subdivisions. Formally considered, the arrangement of the old comedy nearly resembled that of tragedy; in the new, the chorus was altogether omitted. The unity of action was a remarkable characteristic of the Greek drama, although widely different from that peculiar quality which modern critics have characterized by the name: it should rather be termed unity of subject, inasmuch as in many of our remaining tragedies, and especially those of Æschylus, there is little or no trace of what we term a plot, *i.e.* a main incident at which we arrive through subordinate incidents tending to its accomplishment. The unity of time, —viz. that the imaginary duration of the action should not exceed twenty-four hours, and that of place,—namely, that the scene in which the events occur should be the same throughout,—are inventions of French critics, not warranted by the remains of Greek art, in which both are not unfrequently violated; but, although not rules of Grecian discovery, they are easily rendered applicable to the simple and severe form of the Greek tragedy.

In considering the theatrical effect of the Greek drama, we must remember that the tragedies were originally religious solemnities; the theatre, a vast building open at the top, calculated for the accommodation of several thousand spectators; the scene, &c. proportionally large. Dramatic representations were, at Athens, the offering of wealthy men to the people: he who contributed the expenses of the entertainment was said, ἰσταγειν, to bring in the play; the poet who produced it, διδασκειν, to teach it, *i.e.* teach the actors to perform it. A complete representation consisted of four pieces by the same author, a trilogy, or three tragedies, narrating successive events in the same series of mythological tradition; and a fourth piece, termed a satyric drama, of which the chorus consisted of satyrs, and the mythological subject was treated in a manner approaching to burlesque. The features of the actors were exaggerated by masks, their height increased by dress, their powers of voice aided by acoustic contrivances, in order to suit the colossal dimensions of the theatre. The whole vocal part was rhythmical, the choral odes were sung, and accompanied by the choric dance, in which the actors composing the chorus took part, subjected to very peculiar rules. the narrative part of the performance was spoken in a peculiar modulated voice, resembling probably the recitative of the modern opera. As to the metrical character of the ancient Greek drama, the metre used in the dialogue was the iambic trimeter, varied occasionally with the anapæstic and trochaic, chiefly where the other dramatis personæ conversed with the chorus, or the members of the chorus itself took part in the action; the choral odes were composed in a great and very artificial variety of metre.

*Latin Drama.*—The early Etruscans possessed dramatic representations, whence the Romans derived some peculiar national entertainments (*see* MIMI); but, with this slight exception, their drama consisted merely in the first instance of translations, afterwards of close imitations of the Greek. Accius and Pacuvius transferred to the Roman stage the tragedy of the three Attic poets; Plautus and Terence the new comedy of Menander. Of these writers Terence is the only one who appears to have deviated, and that slightly, into original invention: in the degeneracy of the Roman empire even this adscititious taste ceased to be cultivated, and the theatres were entirely occupied by farcical buffoonery, or shows and sports on a gigantic scale. Among an infinite variety of works which treat of the classical drama, may be cited the first volume of *Schlegel on Dramatic Art and Literature*. A catalogue of them will be found at the end of the 4th edition of the *Theatre of the Greeks*, Cambridge, 1836. See also *Edin. Rev.*, vol. 49.

*Chinese Drama.*—Before proceeding to the dramatic art of modern Europe, derived as it is from that of Greece, two oriental nations may be noticed which possess a national drama of their own. In China, theatrical entertainments form one of the most popular amusements, and theatrical writing has been cultivated from a very early period. The Chinese drama comprises pieces which we should term both tragical and historical plays, tragicomedies, and comedies both of intrigue and of manners; together with abundance of low, pantomimic, and farcical representations. In their regular drama, however, there appears to be less of what we should term connected than of successive action: many of them are, as it were, dramatized memoirs or biographies of individuals, real or fictitious; the representation of some is said to require ten days. It is remarkable that, of all national dramas, the Chinese appears to be the only one in which we can trace no original connection with religious observance. (*Morrison, Horæ Sinicæ; Abel Remusat; Memoirs of the Acad. des Inscriptions*, &c.)

*Hindoo Drama.*—The Hindoo plays which now exist are written for the most part in Sanscrit, although not a living language at the period when they were composed; mixed, however, with other dialects, which, according to Hindoo critics, are respectively appropriate to different parts of a play. They seem to have been appropriated to the entertainment of learned persons, and acted only on solemn occasions. They are few in number; about sixty only are known: some containing long mythological narratives, others much complicated incident of a domestic character, in a strain of tragedy alternating with comedy, like the romantic drama of modern Europe. The dramatic art appears to have flourished in India during a period of several ages, ending about the 14th or 15th centuries of our era. Dramatic criticism was also much cultivated; and the most minute and artificial rules are laid down by Hindoo commentators as to the conduct of a piece, the requisite ethics, the formal arrangement, and the characters which must be introduced. The Hindoo drama is so widely different from the Greek or Chinese, that it must be regarded, like them, as a spontaneous offspring of national genius. (*Wilson's Specimens of the Theatre of the Hindoos*, 2 vols 8vo. 1835.)

*Modern European Drama.*—For many centuries after the downfall of the Roman empire, the dramatic art appears to have been entirely lost. Its first revival in the middle ages was owing to the solemnities of the church, into which dramatic interludes were introduced in various countries of western Europe, representing at first events in biblical history or the lives of the saints, and afterwards intermingled with allegorical fantasies. (*See* MYSTERIES, MORALITIES.) The framers of these early pieces were monks, and the monks were the only preservers of classical learning, but whether we can infer from these facts that the idea of these rude representations was suggested or their details improved by classical associations, it is not easy to pronounce. At the period of the revival of literature, however, the dramatic art was called nearly at once into life in the four principal countries of western Europe, Italy, France, Spain, and England. In the two first of these countries it arose simply classical, and unmixed with any original conceptions, or with the sentiments and fashions of the middle ages; in the two last it partook largely of both, and was also immediately derived from the mysteries and moralities above mentioned. hence, in a historical view, arose the distinction, so elaborately explained by modern critics, between the classical and romantic drama.

*Italian Drama.*—Originated in close imitation of classical models. The *Sofonisba* of Trissino (1515) is not absolutely the oldest Italian play, but the first which served as a model for subsequent composers. Rucellai and many others followed in the same track; Bibbiena, Machiavel, Ariosto, as closely imitated the model of the Terentian comedy. The pastoral drama of the 16th century, of which Tasso and Guarini were the most celebrated writers, furnished the first novelty in this branch of literature; but these are rather poetical than dramatical compositions. The true national theatre of Italy arose in the 17th century, in the musical drama (opera), to which Metastasio, early in the 18th, communicated all the charms of poetry; but since the period of that writer, the operatic part of the dramatic art has again been wholly disconnected from the literary, and the words only serve as vehicles for the music. While the higher classes were devoted to the opera, the lower found their national amusement in the commedie dell' arte; comedies performed by masqued characters, which gradually became fixed in the well-known persons of Harlequin, Pantaloon, Brighella, &c., who improvised their parts: Goldoni, in the middle of the 18th century, succeeding in establishing a regular comic drama in possession of the stage; while his rival, Gasparo Gozzi, took up the commedie dell' arte as models, and founded upon them a series of amusing extravagances. But since the period of these two spirited writers comedy has fallen almost completely into disrepute. At the end of the 18th century Alfieri, a bold and severe genius, produced tragedies in which the ancient classical form (with the exception of the chorus) was again reverted to, instead of the French imitations of it which had long been current in Italy as well as the rest of Europe; and several dramatic poets have since appeared, who have adopted the same model. (*Ginguené, Littérature Italienne; Tiraboschi; Walker on Italian Tragedy*, 1799; *On the Revival of the Drama in Italy*, 1805; *Riccoloni, Hist of the Ital. Theatre.*)

*French Drama.*—The early French tragic writers, from the beginning of the 16th century down to Corneille in the

middle of the 17th, produced nothing but unsuccessful and somewhat barbarous imitations of the Greek tragedy. The first pieces of this kind represented on the French stage had prologues and choruses. Corneille had studied and loved the Spanish drama; and without introducing much of its varied form and incident, he transfused a portion of its boldness and romantic sentiment into the French theatre, together with a power of energetic declamation peculiarly his own. Racine, on the other hand, was a pure admirer of antiquity; but with a taste and delicacy of feeling which until his time had been very rarely found to accompany classical knowledge. The French tragedy grew up with these two great writers as models, and Boileau as its legislator. A peculiar and rigorous system of criticism was introduced, affecting both the form and the substance of dramatic writing; and this system became established in the minds of the French public, as the natural and not the conventional rule of beauty. It would be impossible to enter into an examination of the rules of the French drama, suffice it to say, that they banished from the tragic stage all except heroic characters and passion; required perfect simplicity of plot, uniformity of language, and, in addition, the observance of the before-mentioned technical unities of place and time. These rules have ever since been scrupulously followed, without deviation, on the regular French stage, and many of the greatest names in dramatic literature have voluntarily subjected themselves to their restraints The French comedy, however, is infinitely more national and characteristic than the French tragedy. it originated in that of Spain, and was carried at once to a high degree of perfection by Molière, — rejecting the extravagance of the Spanish drama, confining itself within certain definite limits governed by analogy to those established for tragedy, and retaining satire instead of adventure as its leading principle Since that period the French comic stage has been, beyond all contradiction, not only the best, but the model from which that of all other nations has been wholly derived. Of the present state of the French drama it is difficult to speak with precision; but the national or regular stage seems to be every day losing in popularity, while the attempts to establish a new one on what is termed in France the romantic model have hitherto met with very partial success. (*Laharpe, Cours de Littérature; Correspondance de Grimm*, passim; *Voltaire, Discourse on Tragedy, Schlegel.*)

*Spanish Drama.* — Spain commenced her literary career more independent of foreign aid than any other country Her dramatic art appears to have originated as early as the 14th century; which produced satirical pieces in dialogue, and one complete dramatic romance by an unknown author (*La Celestina*), in addition to the mysteries and miracle plays, which were exhibited in Spain even more plentifully than elsewhere. The early Spanish comedies of the 16th century were conversations, like eclogues, between shepherds and shepherdesses, with occasional interludes of negroes, clowns, and Biscayans, the favourite subjects of popular jest. But the Spanish drama owed to one great author, Lope de Vega, what our own owed to his contemporary, Shakspeare, — a rise at a single bound from insignificance to great richness and variety, he created, moreover, nearly all its numerous divisions, and has left examples of each. The name comedy, in the early Spanish stage, implied no ludicrous or satirical representation, but simply a play of adventure. Comedias divinas, or spiritual comedies, were subdivided into lives of saints, and pieces of the holy sacrament (autos sacramentales): the comedies of human life into heroic, answering to the tragedy of our early English dramatists, although even less regular in form, and comedies of domestic adventure (comedias de capa y espada, — of cloak and sword). Besides these, the interludes which were played between the prologue and the piece (sayneteres) possess a distinct character as literary compositions. Almost all pieces have one favourite invariable character, the gracioso or buffoon. Calderon, a greater poet than Lope, and his equal in dramatic power, is the only other great name in the Spanish drama Subsequent writers may all be classed as imitators either of their own older poets, or of the favourite dramatists of the French school. (*Bouterweck's Hist. of Sp. Literature; Quart. Rev.*, vol. 38.; *Sismondi, Lit du Midi de l'Europe; Schlegel.*)

*English Drama.* — For the semi-religious representations out of which the English drama arose, *see* MYSTERY and MORALITY. One of the latter, *The New Custom*, was printed as late as 1573; by which time several regular tragedies and comedies, tolerably approaching to the classical model, had appeared. But a third species of exhibition soon took possession of the stage, the historical drama, in which the successive events of a particular reign or portion of history were represented on the stage; and, together with it, arose the English tragedy and comedy. Our first dramatic poets (those before Shakspeare) were scholars; hence they preferred the form of the ancient drama, the division into acts, &c. But they were also writers, who strove for popularity with the general class of their countrymen; hence, instead of imitating classical simplicity, and confining themselves to a peculiar cast of diction and sentiment removed from the ordinary course of life, they invented a species of composition which intermingled poetical with ordinary life and language. Comedy, again, became in their hands a representation of adventures, differing from those of tragedy only by ending generally in a happy instead of an unhappy exit, and not materially either in the characters or language. Thus the distinctions which they established between tragedy, comedy, and tragi-comedy, are little more than adventitious; and the Shakspearian drama, properly considered, must be looked on as a miscellaneous compound, in which actors, language, and sentiments, of a character far removed from those of ordinary life, alternate with those of a low and even a burlesque character. There is no tragedy of Shakspeare in which comic scenes and characters are not introduced: there is only one comedy (*The Merry Wives of Windsor*) without some intermixture of sentiment approaching to tragic. It continued to be the chief national literature, as well as the favourite national amusement, down to the period of the civil wars, when the opinions and legislation of the prevailing party put a stop to dramatic representation altogether. During the interval thus created the old English art was unlearned altogether, and the new drama, on the model of the French, introduced almost at once on the return of Charles II. and his courtiers from the Continent. The distinction between tragedy and comedy was then first substantially recognized the former confined to heroic events and language, the latter to those of ordinary life. But tragedy, subjected to foreign rules, ceased entirely to flourish: and Otway, the last writer of the old English drama, who wrote partly on the ancient model, although after the Restoration, is also the last tragic poet of England who still occupies the stage; with the exception of Rowe, and of a few authors of that peculiar species of composition, the domestic tragedy, in which the distresses and melancholy events of common life are substituted for those of an heroic character. Comedy, on the other hand, obtained possession of the national taste and stage; and although the charm of poetry and romantic adventure, which had belonged to the old drama under either name, was denied to the modern comedy, it soon attained a high degree of excellence as well as popularity. The last comedies in verse were written shortly after the Restoration; since which time, with the exception of a few insulated attempts to revive the older form, it has been entirely framed on the French model. The main element of a modern comedy is satire, but it admits of a subdivision into comedy of intrigue and comedy of manners, — the former being chiefly directed to the development of a plot, the latter to the delineation of manners; although these qualities ought, properly speaking, to be united to constitute a good play. The most distinguished of our dramatic writers in the former line are, amongst many, Congreve, Vanbrugh Farquhar, Colman, Sheridan: in the latter, the writings of Shadwell and Foote, perhaps, afford the most remarkable instances of that less popular form of comedy which almost neglects the interest of plot, and confines itself to a satirical representation of prevailing vices and follies. (See *Edin Rev.* vol. 38.; *Prolegomena to Malone and Boswell's Shakspeare; Hazlitt's Lectures, Coleridge's Remains; Collier, Hist. of Eng. Dramatic Poetry*)

*German Drama.* — The modern German drama is founded on the old English model; and, although the last in order of time, has risen to a high degree of excellence, the stage in Germany being incomparably more national and popular at the present time than in other European countries. While France, England, and Spain have to look back two hundred years for those names which form the glory of their dramatic literature, Lessing, Schiller, and Goethe are writers only of the past generation.

DRAMATU'RGY. (Gr. δραμα, and εργον, *work.*) The science or art of dramatic poetry and representation: a word used by German writers.

DRAM TIMBER. *See* BAULK.

DRA'PERY. (Fr. draperie.) In Painting and Sculpture, the clothing applied to the human figure. *See* CASTING OF DRAPERY.

DRA'STIC MEDICINES. (Gr. δραστικος, *effective.*) A term chiefly applied to purgatives and some other remedies which are rapid and powerful in their operation.

DRAUGHT OF WATER. The depth of the lowest point of the ship: as the keel is seldom exactly horizontal, the draught of water is taken forward and aft. A ship of the largest size draws nearly 30 feet.

DRAW'BACK. In Political Economy. When a duty is laid on an article produced in a country that is suitable for the foreign market, it is usual, on its being entered for exportation, to remit or pay back the duty to the exporter; and hence the technical phrase drawback. The policy of a measure of this sort is, in most cases, obvious. It is rarely for the public advantage to impose a duty on an article about to be exported: the inevitable effect of such duty is, by proportionally increasing the price of the article, to lessen the foreign

demand for it; and its probable effect is, in most instances, entirely to exclude it from the foreign markets. Except in a few rare cases, one country has seldom so great an advantage over others in the production of commodities as would justify the imposition of a duty on their exportation, without incurring an extreme risk of making them be supplied from some other quarter. This, however, is a result to be deprecated in every point of view. And hence in every case in which the exporting country has no ascertained or decided superiority over others in the production of commodities on which duties are laid at home, there can be no question as to the expediency of drawbacks. These must not, however, exceed the amount of duty charged; for when they do this, the excess becomes, in fact, a bounty.

DRAW'ING. (Sax. ðnagan, *to draw along*.) In the Fine Arts, the art of representing any object by means of lines circumscribing its boundaries. Drawing is of course the foundation of every thing in art, including within it a knowledge of perspective, anatomy, and proportion, and when acquired giving, as Sir Joshua Reynolds observes, "a proportionable power of drawing correctly what we imagine." The human figure is the principal, perhaps the only object, upon which a student should be first employed; for he who can correctly draw that will not be at a loss in representing any thing else he may wish. Sir Joshua observes, that he who endeavours to copy nicely the figure before him, not only acquires a "habit of exactness and precision, but is continually advancing in his knowledge of the human figure, and though he seems to superficial observers to make a slower progress, he will be found at last capable of adding (without running into capricious wildness) that grace and beauty which is necessary to be given to his more finished works, and which cannot be got by the moderns as it was not acquired by the ancients, but by an attentive and well compared study of the human form."

DREAMS (Germ. Traume), may be defined to be those trains of ideas which occupy the mind, or those imaginary transactions in which it is engaged, during sleep. Dreams constitute some of the most curious phenomena of the human mind, and have in all ages presented to philosophers a subject of most interesting investigation. The theory of dreams embraces two distinct classes of phenomena, *physical* and *psychological*: the former relate to the question as to how the body is affected in a state of sleep (*see* SLEEP), how the body in that state affects the mind, and how this affection operates to the production of the phenomena of dreams, the latter comprehend an inquiry into the laws which regulate the train of ideas that occur during sleep and the mode in which these laws operate, together with an examination of certain psychological appearances peculiar to that state. To both these classes of phenomena the attention of some of the most distinguished philosophers, both of antiquity and of modern times, has been directed; and much labour and ingenuity have been expended in endeavouring to ascertain the origin and nature of dreams, and to account for the various phenomena by which they are accompanied. To give even an outline of the various theories that have been propounded on this subject, would be wholly incompatible with our limits. The system of condensation on which works of this species must be constructed is, as will be easily understood, but little suited for metaphysical disquisitions, in which, to use a remark of Horace, brevity so easily degenerates into obscurity; but in the present instance this is perhaps the less to be regretted, for of all those speculative questions which are said to lie beyond the reach of human inquiry, there is none on which the opinions of philosophers are more conflicting and unsatisfactory than the theory of dreams. Among a multitude of other *efficient* causes, dreams have been ascribed to direct impressions on the organs of sense during sleep,—to the absence of real impressions on the senses,—to a disordered state of the digestive organs,—to a less restrained action of the mental faculties,—to the suspension of volition while the powers of sensation continue,—and to the succession and unequal relaxation and cessation of the different senses at the commencement and during the time of sleep. (*Encyc. Edin.*) From the remotest period of antiquity, dreams have also been ascribed to supernatural agency. The records of history, both sacred and profane, abound in instances of dreams which it is impossible to account for on any other hypothesis than that of a supernatural interposition; and, as has been well observed, though there can be no doubt that many dreams which have been considered supernatural, as revealing facts and scientific truths, may now be explained by means within our own knowledge, it can just as little be doubted that many well authenticated dreams are utterly inexplicable by ordinary or natural means. This belief in the supernatural character of dreams is common to every nation in a greater or less degree; but it prevails more especially in the countries of the East, where, from time immemorial, there has existed a class of persons whose peculiar occupation consists in the interpretation and explanation of dreams. Those who wish for comprehensive details on this subject may consult the writings of Aristotle, Lucretius, Democritus, &c.; and, among ourselves, of Locke, Newton, Hartley, Baxter, Beattie, and Stewart; and still more recently, those of Abercrombie and Macnish, which are extremely valuable for the numerous instances of extraordinary dreams with which their theories are illustrated. The *Penny Cyclopædia*, also, contains an article upon dreams, which exhibits great metaphysical acumen. (See *The Royal Book of Dreams*.)

DRE'DGING MACHINE. A machine for clearing out or deepening the beds of navigable rivers, harbours, canals, &c., by the removal of deposited matters.

DRE'SSING. A term applied to gum, starch, and other articles used in stiffening or preparing silk, linen, and other fabrics.

DRE'SSINGS. In Architecture, mouldings round doors, windows, and the like.

DRIFT, in Navigation, is the angle which the line of a ship's motion makes with the meridian, when she is driven by the wind or waves and not governed by the helm. It also signifies the distance to which she is carried in a given time in that direction.

DRIFT (Sax. ðnipan.) In Architecture, the horizontal force which an arch exerts with a tendency to overset the piers.

DRILL. In Mechanics, a small instrument of steel for perforating metals or hard substances. Its action is produced by communicating to it a very rapid rotation by means of a *drill-bow*.

DRILL. In Agr., a machine for sowing agricultural seeds in rows, sometimes worked by the hand alone, and sometimes by the addition of a horse.

DRILL HUSBANDRY. In Agr., the cultivation of arable land, by sowing the crops in rows; the advantage of which is, that it admits of destroying the weeds, and stirring the soil in the intervals between the lines of plants. As this mode of cultivation requires some implements and machines not in use in the commoner kinds of farming, and as it is besides better adapted for some soils than for others, it is not so generally used as the obvious advantages attending it would lead us to expect.

DRIP. In Architecture, the same as Corona, which see.

DRI'PPING EAVES. (Dan. dripper, *to drop*.) In Architecture, the lower edges of a roof where from the rain drips or drops to the ground.

DRI'VING NOTES. In Music, such notes as connect the last note of one bar with the first of the following one, so as to make only one note of both. They are also used in the middle of a measure, and when a note of one part terminates in the middle of the note of another, in which case it is called *binding* or *ligature*. Driving notes are also called *syncopation*, when some shorter note at the beginning of a measure or half measure is followed by two, three, or more longer notes, before any other occurs equal to that which occasioned the driving note to make the number even, for instance, when an odd crotchet succeeds two or three minims, or an odd quaver two or more crotchets.

DROITS OF ADMIRALTY. The perquisites resulting chiefly from the seizure of the property of an enemy at the commencement of a war, and attached to the office of lord-high-admiral, or to the crown when that office is vacant. These perquisites were originally vested in the sovereign, to enable him to provide for the expense of defending the realm, and clearing the seas of pirates, and their value and importance will be at once perceived from the following brief statement. In 1798, one ship which had been captured brought 55,000*l*.; in 1800, another brought 65,000*l*., in 1804, one captured ship was worth 105,000*l*.; and in 1806, several taken at once netted 155,000*l*. During the last war, also, the Dutch ships at one seizure brought 1,030,000*l*.; the Spanish ships, 2,200,000*l*.; and so large were the sums made at one and the same moment in this rich fund, that the crown one year, after paying many hundred thousands to captors, and large sums to different branches of the royal family, gave a million out of the residue to the public service. (*Edin Rev.* vol xxxiii. p 482.) By the civil list introduced on the accession of William IV., it was arranged that all the droits of admiralty which might accrue during his reign should be paid into the exchequer for the benefit of the public service; and the civil list of her present Majesty has made no alteration in that arrangement. *See* PRIZE MONEY.

DRO'MEDARY. *See* CAMELUS.

DROPS. (Sax. ðnoppan.) In Architecture, the frusta of cones in the Doric order, used under the triglyphs in the architrave below the tænia. They are also used in the under part of the mutuli or modillions of the order. In the Greek examples they are sometimes curved a little inwards on the profile.

DROP SERENE. (Lat. gutta serena.) *See* AMAUROSIS.

DRO'PSY. (Gr. ὑδωρ, *water*.) An unnatural collection of watery fluid in any part of the body. When it

takes place in the cellular membrane, it constitutes *anasarca;* when in the cavity of the abdomen, *ascites;* in the cavity of the cranium, *hydrocephalus;* in the scrotum, *hydrocele;* in the uterus, *hydrometra;* and in the chest, *hydrothorax*. Dropsy may arise from a variety of morbid actions, either of the secerning or absorbing vessels. When the fluid which lubricates the internal surfaces and cavities of the body is secreted in excessive quantity, or is not adequately removed by the absorbents, it may so accumulate as to constitute the various forms of this disease; it may therefore arise out of excessive as well as of defective action, it may also result from a variety of other causes connected with organic lesion or derangement, both vascular and nervous. The treatment of dropsy will of course vary with the cause of the disease it sometimes requires depletion, and at others tonics; and local accumulation of fluids is often susceptible of removal by remedies which stimulate the absorbents to increased action, or which excite the excretories of the intestines or promote the flow of urine. Dropsy is a common symptom of a broken constitution and failure of the powers of life.

DRO'PSY. In Botany, a disease peculiar to succulent plants, arising from an excessive introduction of water into the system It produces rapid rottenness, and can only be stopt by destroying all the parts affected by it, and exposing the individual to a very dry atmosphere.

DROSO'METER (Gr. δροσος, *dew*, and μετρον, *measure*) Any instrument for measuring the quantity of dew that collects on the surface of a body exposed to the open air during the night. The first instrument for this purpose was proposed by Wendler It consisted of a bent balance which marked in grains the preponderance which a piece of glass of certain dimensions, laid horizontally in one of the scales, had acquired from the settling and adhesion of the globules of moisture. A simpler and more convenient drosometer would be formed on the principle of the rain gauge, and in order to facilitate the descent of the dew down the sides of the funnel into the tube, a coat of deliquesce salt of tartar may be spread over the shallow surface Dr. Wells, in making his celebrated experiments on dew, exposed a small quantity of wool to the open sky, and the difference in its weight when laid down and taken up showed the quantity of moisture it had imbibed in the interval

DROWNING When a person is submerged under water, suffocation ensues, not in consequence of the access of water to the windpipe or lungs, but merely from the exclusion of air the mechanism of the glottis, or upper portion of the windpipe, being such as to prevent, by the spasmodic closure of the epiglottis, the entrance of more than a very trifling and accidental quantity of water Under these circumstances, however, an attempt is made to inspire, which is followed by the reaction of expiration, and consequently a little air is thrown out, and the residuary quantity in the lungs still further diminished, access of oxygen to the blood is therefore effectually cut off, the aeration of the blood is prevented, and venous blood circulates in the arterial system, the right side of the heart becoming loaded with it, and the pulmonary vein returning it to the right cavities of that organ The consequences of the non-aeration of the blood thus ensuing upon the vital functions is their suspension and rapid extinction, so that in the course of four or five minutes after the access of air has been cut off death ensues, although some of the organic functions may and do continue for a much longer period When therefore a person has been perfectly submerged in water for the space of five minutes, perfect insensibility ensues, and the functions upon which life more immediately depends cannot be restored

In consequence, however, of the struggles made by a drowning person, and of their chances of occasional gasps of air, and of the varying quantity of air which the lungs may contain, we must not despair of the possibility of resuscitation, even when the body has been for fifteen or twenty minutes in the water, although it must be confessed that after four or five minutes' submersion the chances of recovery are very remote

The state of alarm and agitation into which persons falling into the water, and who cannot swim, are thrown, and their ignorance in general of the means which should be resorted to upon such an emergency, as well as want of presence of mind to adopt them, lead to neglect of those obvious measures by which immediate dangers might be averted. They should endeavour to recollect that the specific gravity of the human body when the lungs are filled with air, is less than that of water, and that consequently the body has, under such circumstances, a natural tendency to float; and that if the head can then be so placed as to keep the mouth or even the nostrils above water, respiration may be continued. They should also remember that by a forced inspiration a much larger quantity of air may be drawn into and retained in the lungs than in a common or natural inspiration; and that therefore the blood will continue longer aërated, and consequently a longer period will elapse before a second attempt at inspiration need be made, and before insensibility or the cessation of the vital functions will ensue. If, for instance, while breathing as usual, we suddenly hold our breath, we shall find ourselves forced to make an inspiration in the course of from a quarter to half a minute; but if we previously make two or three forced respirations, so as to cleanse the lungs in the first instance of foul air, and then take a forced inspiration, we shall be able to hold breath for more than a minute, and sometimes even for two minutes. It is upon this principle, that skilful divers are enabled to remain under water for a period that sometimes appears almost incredible; and if the depth of water be considerable, and the air supplied from a diving bell, its degree of condensation or diminished bulk will of course enable a given volume to oxygenate the blood more effectually than the same volume at common atmospheric pressure.

Such, then, is an outline of the physiology of drowning; it naturally leads to the important question as to the most effective means of restoring suspended animation in such cases. It of course follows from what has been said, in the first place, that not a moment is to be lost in getting the body out of the water, and removing it with the utmost speed to any place where further means can be resorted to; and now air should be thrown into the lungs, and artificial respiration should be attempted with as little loss of time as possible, for till the blood has an opportunity of being aerated, the return of the vital functions is of course impossible. The body should also be immediately stripped of the wet clothes, which should be cut off or otherwise removed with the utmost speed; and warm blankets should be at hand as wrappers, and warm towels for rubbing and drying the body. Artificial respiration, together with warmth and friction, carefully, however, and moderately employed, are the first and most essential remedies. Much has been said of the advantage in these cases of electricity; and, if possible, it should certainly be resorted to: slight shocks should be passed through the region of the diaphragm, the heart, and along the course of the spine; and various forms of the magneto-electric machine seem particularly well adapted to these purposes. The truth is, that the means to be adopted in all these cases are few and simple; but unless they are immediately at hand, and instantly available, they will fail, even under the most favourable circumstances. Yet, where even a glimmering of hope remains, they should, even under unfavourable circumstances, be as speedily and completely as possible resorted to, for there are on record extraordinary cases of resuscitation, when every thing appeared to militate against a successful issue.

But in these cases it is not only important to know what to do, but also what to avoid. Nasal stimulants, such as ammonia, aromatic vinegar, and other pungent and volatile applications, should be avoided. they can be of little use under the most favourable circumstances, and in the most judicious hands; and if unskilfully employed, may do infinite mischief. The warm-water bath is a bad substitute for warm air and friction; it interferes with the latter, and with the use of electricity, and places the body in a constrained and unfavourable position. In these days it is scarcely necessary to point out the extreme absurdity of holding the body with the head downwards, to allow the water to run out by the mouth, or the still more dangerous use of tobacco, especially of the injection of tobacco smoke,—means calculated to put the life of a healthy person in jeopardy, and every way suited to render all attempts at the restoration of suspended animation ineffectual.

DRU'GGET. A coarse and flimsy woollen texture, chiefly used for covering carpets. It was formerly extensively employed as an article of clothing by the poorer classes, more especially of females; but this and similar fabrics are now almost wholly superseded by cotton goods, which induce greater cleanliness, and are less liable to retain infectious and contagious poisons.

DRU'IDS. The priests of the Celtic inhabitants of ancient Gaul and Britain. Our classical information respecting them is chiefly derived from Julius Cæsar; Strabo, Tacitus, Pliny, Lucan, and other authors, have also left us particulars respecting them. On those slender foundations very extensive superstructures have been raised by the imagination of English and French antiquaries. The classical name of Druid was derived by the Latins from δρυς, an oak; but is more probably of Celtic origin. The doctrine of the Druids was not committed to writing, but retained by memory in the form of verses; of which the Welsh Triads are supposed, with some probability, to retain the form and vestiges. There appears to have been much of fraud and vulgar delusion mixed up in the religious rites which they practised. The gods whom they worshipped, according to classical writers, were Jupiter (Taranis), Apollo (Belenus), Mars (Hesus), and several others, whom they believed to be the same with personages of the Grecian mythology. The sacrifice of human victims is uniformly represented as a part of their worship. Their places of worship were chiefly conse-

crated groves, of one of which Lucan has given a fine description in the second book of his *Pharsalia*. The rock-altars, cromlechs, cist-vaens, and other relics of antiquity, which are scattered over the surface of parts of England and France, are attributed by antiquaries for the most part to the Druidical age. Claudius and other Roman emperors issued severe edicts against the Druids, but did not succeed in extirpating them. This was only effected by the general introduction of Christianity; and some suppose that the celebrated Culdees of Scotland and Ireland were converted Druids.

DRUM. (Dan. tromme.) In Architecture, the upright part of a cupola either above or below a dome. The same term is used to express the solid part or vase of the Corinthian and Composite capitals.

DRUM. In Music, an instrument of percussion, formed by stretching a piece of parchment over each end of a cylinder formed of thin wood, or over the top of a cauldron-shaped vessel of brass; the latter is hence called a kettle drum. The large drums which are beaten at each end are called double drums, and are used chiefly in military bands. Kettle drums are always used in pairs; one of which is tuned to the key note, the other to the fifth of the key. It is principally used for military purposes, especially for exciting the soldiers under the fatigue of march or in battle. The drum is supposed to be an eastern invention, and to have been brought into Europe by the Arabians, or perhaps the Moors. The kettle drum, the bass drum, and tambourine, are common in the East.

DRUM OF THE EAR. *See* EAR.

DRUPE. In Botany, a one-celled, one or two-seeded, superior, indehiscent fruit; the outer coat is soft and fleshy, and separable from the inner or endocarpium (stone), which is hard and bony: the whole proceeding from an ovarium, which is perfectly simple. The peach, plum, apricot, cherry, are examples of this.

DRY. (Sax. ðrig.) In Painting, a term applied to a painting wherein the outline is too strongly marked, and the colours of the objects do not unite with those by which they are surrounded. In sculpture it is used in speaking of a work wherein there is a want of luxuriousness and tenderness in the forms.

DRY'ADS. (Gr. δρυς, *an oak*.) In the Heathen Mythology, a kind of imaginary female deities whom the ancients believed to inhabit the woods and groves.

DRY DISTILLATION. This term is applied to the distillation of substances *per se*, or without the addition of water: thus if we put wood into a retort or other distillatory apparatus, and subject it to heat, it yields tar, vinegar, water, and various gaseous and other matters, which are called the products of its *dry* or destructive distillation.

DRY'ING OIL. This term is generally applied to linseed and other oils which have been heated with oxide of lead; they are the bases of many paints and varnishes

DRY ROT. A disease which attacks wood, rendering it brittle, and destroying the cohesion of its parts, is known by this name. It occurs among the timbers of ships, where it sometimes commits the most serious damage, and in damp ill-ventilated houses. It is usually ascribed to the attacks of fungi, especially to such as *Polyporus destructor* and *Merulius lachrymans*, whose filamentous spawn or thallus appears upon the surface, overspreading it like a tough thick skin of white leather, and there is no doubt of its being often connected with the appearance of such fungi. But dry rot is certainly, in some cases, to be identified with the presence of fungi of a more simple kind than those just mentioned, especially of such as belong to or resemble the genus *Sporotrichum*.

The destruction of timber by such plants is effected in part by the disintegration of the tubes of the weed, in consequence of the introduction between them of the fine filamentous spawn of the fungi, and in part by the dampness which is thus conveyed to the interior of the wood, where it soon produces decomposition. It is not, however, certain that dry rot is always caused in this manner; on the contrary, the term appears to be frequently applied to cases of spontaneous decomposition of timber without the presence of fungi, or when the appearance of the latter takes place long after the commencement of the disease.

When dry rot produced by fungi has once made its appearance, there is no means of arresting its progress without removing the whole of the diseased and neighbouring parts; and even then it will probably again break out, unless means can be taken to introduce a circulation of fresh air among the parts liable to the affection. For if timber is allowed to remain in a damp situation, and in the dark, it affords so favourable a nidus for the seeds of fungi, that they are almost certain to vegetate upon it; unless some means have been previously taken to render the timber permanently unsuited to their growth. This end appears to have been attained by Mr. Kyan, who has obtained a patent for pickling timber, as a preventive of the dry rot, and who employs for this purpose a solution of corrosive sublimate. This salt of mercury is a well-known vegetable poison: if any animal jelly, upon which fungi will quickly appear in the form of mouldiness, is mixed with a minute quantity of corrosive sublimate, no fungi will in that case be produced; so that both theory and experience are in favour of Mr. Kyan's process. It is not improbable that the progress of dry rot might even be arrested in the buildings where it occurs, if the timbers could be got at and well washed with the same solution.

Although dry rot generally fixes itself upon timber, it will also attack any form of vegetable matter. The paper hangings of rooms, chiefly composed of cotton and linen thread, are occasionally overrun in houses which have been long shut up and neglected; and the mildew which destroys the strength of canvass is only another form of dry rot, the appearance of which is altered by the special circumstances under which the fungus is developed, or by the species of the fungus itself.

DRY'SALTER. A dealer in salted or dried meats, and in the materials used in pickling, salting, and preserving various kinds of food, hence drysalters usually sell a number of saline substances and miscellaneous drugs

DRY'STOVE. A glazed structure for containing the plants of dry arid climates; such as the cactuses, mesembryanthemums, aloes, and other succulents of Africa.

DU'ALISM. A name given to those systems of philosophy which refer all existence to *two* ultimate principles. Dualism is a main feature in all the early Greek cosmogonies, and is that which distinguishes them from the eastern speculations on similar subjects, which mostly regard all things as *emanating* from a single principle. The dualistic hypothesis was, doubtless, originally suggested by the analogy of male and female in animal existence. The earliest forms under which the theory appeared are, as might be expected, rude in the extreme. The Orphic poets made the ultimate principles of all things to be Water and Night; by others Æther and Erebus, Time and Necessity, are severally deemed worthy of this distinction (*Brandis, Gesch der Phil.* i. p. 71.; *Arist Metaph* xix 3) The ancient Greek and Roman mythology was evidently constructed on this principle. (See *Varro, De Re Rustica*, i. 2) In its more philosophic form, the dualistic theory was maintained among the ancients by Pythagoras and many of the Ionian school; among the moderns, chiefly by Descartes. (*See* arts. IONIC PHILOSOPHY, CARTESIAN PHILOSOPHY.) It may be expressed generally as the assumption of the coeternity and simultaneous development of the formative with the formed, of the *natura naturans* with the *natura naturata*. So the system of philosophy which regards matter and spirit as distinct principles is a species of dualism, as opposed to materialism.

In Theology, the doctrine of the two sovereign principles of good and evil (*see* MANICHEISM) is also dualistic, and the high Calvinistic theory may be said to be a species of dualism, viz that all mankind are divided, in the eternal foreknowledge of God, and by his arbitrary decree, into two classes,—the elect and reprobate.

DU'AL NUMBER, in Grammar, is the name given to that form of the verb and substantive by which, in the ancient Greek, Sanscrit, and Gothic, and the modern Lithuanian languages, *two* persons or things are denoted, in contradistinction to *plural*, which expresses an indefinite number of persons or things. For full discussions on the nature and peculiarity of the dual number, see *Buttmann and Matthai's Greek Grammar;* see also the *Penny Cyclop.*, and the authorities there referred to.

DU'BBING OUT. A term used by plasterers to signify the bringing of an uneven surface to a plane by pieces of tiles, slate, plaster, or the like.

DUCAT, DUCATOON. *See* MONEY.

DUCK. *See* ANAS.

DUCKBILL. *See* ORNITHORHYNCHUS

DUCTI'LITY. (Lat duco, *I draw*.) A property of certain bodies, in consequence of which they can be *drawn out* at length without suffering any interruption of the continuity of their constituent particles. The term ductility is frequently confounded with malleability, or that property of bodies through which different forms can be given to them by pressure or percussion. In general ductility depends, in a greater or less degree, on the temperature. Some bodies, wax for example, are rendered ductile by a small degree of heat; while glass requires a violent heat before it acquires ductility. Some of the metals—for example, gold, silver, lead, &c.—are ductile under all known temperatures.

"The ductility of some metals far exceeds that of any other substance. The goldbeaters begin their operations with a riband an inch broad and 150 inches long, which had been reduced, by passing it through rollers, to about the 800th part of an inch in thickness. The riband is cut into squares, which are disposed between leaves of vellum, and beat by a heavy hammer till they acquire a breadth of about three inches, and are thus extended to ten times their former surface. These are again quar-

tered, and placed between the folds of goldbeaters' skin, and stretched out by the operation of a lighter hammer to the breadth of five inches. The same process is repeated, sometimes more than once, by a succession of lighter hammers; so that 376 grains of gold are thus finally extended into 2000 leaves of 3·3 inches square, making in all 80 books, containing each of them 25 leaves. The metal is consequently reduced to the thinness of the 282,000th part of an inch, and every leaf weighs rather less than the fifth part of a grain. A particle of gold, not exceeding the 500,000th part of a grain, is hence distinctly visible to the naked eye."

"It has been asserted that wires of pure gold can be drawn of only the 4000th part of an inch in diameter; but Dr. Wollaston, by an ingenious procedure, has lately advanced much farther. Taking a short cylinder of silver, about the third part of an inch in diameter, he drilled a fine hole through its axis, and inserted a wire of platinum only the 100th part of an inch thick This silver mould was now drawn through the successive holes of a steel plate, till its diameter was brought to near the 1500th part of an inch; and consequently the internal wire, being diminished in the same proportion, was reduced to between the 4000th and 5000th part of an inch The compound wire was then dipped in warm nitric acid, which dissolved the silver, and left untouched its core, or the wire of platinum. By passing the incrusted platinum through a greater number of holes wires still finer were obtained, some of them only the 30,000th part of an inch in diameter The tenacity of the metal, before reaching this limit, was even considerable, a platinum wire, of the 18,000th part of an inch in diameter, supporting the weight of a grain and a third." (*Leslie's Elements of Nat. Philosophy*)

Glass, when well softened by the fire, becomes as ductile as soft wax, and may be spun out into threads of greater fineness than any hair, and which bend and wave like hair in the wind The method of producing these threads is exceedingly easy Two workmen are employed; the first holds the glass over the flame of a lamp, the second applies a hook to the metal in fusion, which, when drawn back, brings with it a thread of glass, still adhering to the mass; the hook is then fitted on the circumference of a wheel, which, being turned round, draws out the thread, and winds it about its rim Some of these threads are scarcely larger than that of a silkworm, and are surprisingly flexible

DUCTS. Those membranous tubes in the internal anatomy of plants which have conical or rounded extremities, their sides being marked with transverse lines, or rings, bars, or dots, arranged spirally, and being incapable of unrolling.

DU'EL (Lat duellum, *a conflict between two individuals*, in the original use of the Roman word, *between two states*), signified originally a trial by battle resorted to by two persons as a means of determining the guilt or innocence of a person charged with a crime, or of adjudicating a disputed right; but in more modern times it is used to signify a hostile meeting between two persons, arising from an affront given by one to the other, and for the purpose (as is said) of affording *satisfaction* to the person affronted.

The practice of the duel, as a private mode, recognized only by custom, of deciding private differences, seems to be of comparatively recent date, and descends by no very direct transmission from the ancient appeal to the judicial combat as a final judgment in legal disputes. That it originated with the feudal system is abundantly clear, if it were only from the fact that in Russia, where that system was never known, the custom of the duel was unheard of, until introduced by foreign officers even within the memory of the present generation. But it is certain that many antiquarian writers have confused together two very different institutions, the *appeal to arms*, as an alternative for the trial by ordeal or by compurgators, appointed by traditionary usage from the earliest periods of Germanic history; and the *voluntary challenge or defiance*, resorted to for the purpose of clearing disputes involving the honour of gentlemen This last custom was first elevated to the dignity of an established institution by Philip le Bel of France, whose edict regulating the public combat between nobles bears the date of 1308: the best comment on which may be found in the spirited and accurate representation, by Shakspeare, of the quarrel between Mowbray and Bolingbroke

The duello, in this its high and palmy state, when favoured by princes and tolerated by the church, became the subject of many fantastic regulations, partly framed on the imaginary code of chivalry, and partly on the precepts of the civil law. Thus, in a curious treatise on this subject by Dario Attendoli, an officer of the Italian wars (printed in 1565), we find it laid down that not less than twenty days must elapse between the receipt of a cartel or challenge and the answer; because such was the time required to elapse, in civil suits, between the plaintiff's charge and the defendant's first pleading. Three, four, or five months must then be allowed to the champions for preparation. The combat must take place in lists, and under the eyes of the sovereign authority of the city selected by the challenger. The strictest equality of rank must be observed between the parties; a rule which appears to have been tolerably well attended to, and must have saved the shedding of much unnecessary blood. But, while every precaution was taken to render such duels not easily to be engaged in on light grounds, it was part of the same code that they should be carried through in serious earnest. In another curious Italian book of problems concerning the duel (of the same date), the question is put, "Whether a prince will do well or ill in separating two champions, when both shall be so weakened by loss of blood as to appear unable to continue the combat?" and resolved in the negative. And if the vanquished had his life spared him, he was bound to consider himself the prisoner of his conqueror, and devoted to his service, until released by death or by positive permission; although Attendoli intimates that, in his opinion, the limitation of thirty years, according to the maxims of the civil law, ought to apply to this servitude.

The particular regulations of these Italian laws of honour are of the most curious and pedantic minuteness. Attendoli has favoured us with several common precedents of challenges and answers The commencement of the cartel, "per injuria di fatti," for injury in deeds, runs as follows:—"I, M., having been by thee, N., enormously beaten with a stick (superchievolmente con un bastone percosso) at Rome, on the —— ultimo, after an evil fashion, from behind, I not being aware of thee, and in time of peace, say to thee that thou hast done basely and wickedly, and as a traitor and vile cavalier." To this cartel are appended the signatures of four witnesses, who affirm themselves to have been present at the administering of the bastinado. The cartel was to be publicly placarded in the streets; as was also the answer, or, if the adversary declined the combat, a statement of his refusal In this latter case, it was debated whether it were not allowable to hang up a likeness of the person declining to fight; but this singular species of posting, although we are told it was not uncommon, is reprobated as unbecoming a gentleman The distinctions as to persons are not less amusing. (See *e.g.* question 3d of the Book of Problems in the treatise of Attendoli above referred to.)

The fashion of the public duel seems never to have prevailed to any extent in England. Although the ancient Judicium Dei was so interwoven with our laws that, at a comparatively late era, the whole court of Common Pleas would occasionally adjourn in full term to Smithfield or Bankside, to see the long-contested intricacies of a "writ of right" brought fairly to issue in a match at singlestick; yet the stern necessity of washing out affronts in blood, whether in open or private quarrel, does not seem to have been strictly adhered to until the latter part of the reign of Queen Elizabeth. Then the the imaginations of the young nobles of the court, heated with the favourite study of chivalry, readily adopted the sanguinary practice of foreign realms. At this period appeared the famous *Treatise of Honour* of Vincentio Saviolo—a fierce and punctilious Italian, a fencing master by profession, bred in the wars of Italy, and deeply versed in the science of the public duello, then a favourite theme of reminiscence, although no longer known in practice, as will be presently shown. This little work, published in 1594,—now little known to us, save by the famous quarrel in Shakespeare's *As You Like It*, concerning the cut of the courtier's beard, which seems intended as a parody on some parts of it,—appears to have been adopted by the gallants of the time as a standard book of reference in all cases of supposed insult Saviolo resolves all quarrels into the lie,—that is, he supposes the original insult to be followed, either expressly or impliedly, by a regular series of replies and retorts, until one or the other party is reduced to give the lie direct; which, like the phrase "stupid youth" (*dummer junge*), in some German universities, was immediately followed by the appeal to arms.

> That ordinary commotioner the lie,
> The father of most quarrels in this climate,

appears to have been raised to this "bad eminence" by Francis the First, the great guide of his day in matters of chivalry, who first gave it as his opinion, that the lie could under no circumstances be brooked by a man of honour. Attendoli holds that the virtue of the insult lies mainly in the word lie; and that any circumlocution, however plain, greatly deprives it of its effect. This, however, Saviolo stoutly denies; and maintains that an imputation on the veracity of a party, in whatever words it may be couched, is equally deserving of resentment. The lie, being a matter of so great importance, became the subject of much nice distinction; insomuch that a note to *Dr. Moore's Essay on Duelling* informs us, that they enumerated thirty-two different ways of giving the

lie in the latter part of the sixteenth century. Saviolo, however, contents himself with the division into the lie direct and lie circumstantial; each of which he subdivides into general and special; besides a fifth sort, which he calls "fictitious" or "sham" lies. These, he says, seem to have originated from the custom that he who receives the lie direct, or last retort, being of necessity the challenger, has the choice of weapons; to gain which advantage it was not unusual for one who sought a quarrel to address his enemy with, "If you say I am a scoundrel, you are a liar;" by which means they supposed that the latter was put to the necessity of making a direct reply. In opposition to this notion, Vincentio shows divers honourable devices by which an ingenious duellist, when assailed in this manner, may retort on his adversary, so as to throw the burden of the last word on him. Paris de Puteo, a Neapolitan lawyer, is said to have practised chiefly in this branch of business, and to have answered cases on the point of honour put to him from all parts of Europe.

Yet, however extravagant the foolery of these early writers may seem on a matter of such serious nature, it must be confessed that, retaining as they did much of the old opinion, refined into a sentiment, respecting the immediate interposition of God in the judicial combat, the true point of honour was far safer in their hands than in the less scrupulous ones of the professed duellists of modern times. Saviolo does not hesitate earnestly to inculcate on his pupil the duty of maintaining no cause except that which he seriously believes to be just and true, and of submitting to any humiliation rather than fight in defence of a falsehood. A fine, although somewhat extravagant illustration of this chivalric principle, may be found in the old play of *A Fair Quarrel*, by Middleton and Rowley. Captain Ager, the hero of the piece, is saluted by his colonel on the occasion of some dispute with the appellation of "son of a whore." A challenge follows, and time and place are fixed; but the captain cannot satisfy his conscientious honour without repairing to his mother, and acquainting her, although indirectly, with the provocation he has received. She, suspecting his meaning, and fearing for his life, in a moment of weakness falsely intimates the imputation to be a true one. The captain's mind is instantly made up—he will not fight in a bad quarrel; but, for his mother's sake, he will not divulge the reason. His two seconds arrive, and he hears, with seeming equanimity, their expostulations, and at last their insults, declaring that although he is ready to follow them to the field, he will not fight a stroke. But, being branded on that account by his adversary with the epithet "coward," he thankfully seizes on the opportunity afforded him by this fresh insult; draws in "a fair quarrel," and overthrows his opponent.

In 1547, Henry II. of France issued an edict absolutely prohibiting the judicial or public combat. This decree was produced by the death of his favourite, La Chataigneraye, in consequence of wounds received in the lists in the presence of Henry himself. By a curious coincidence, the abolisher of one of the grand institutions of the feudal ages was destined, in his own person, to be the cause of the disuse of another: he was slain in a tournament, and that knightly exercise was no longer practised at courts after that melancholy event. The public duel survived some time longer in Italy, as may be seen by the dates of the treatises quoted above. Its abolition in France was by no means followed by the good effects which the statesmen of those days probably anticipated from it. Debarred from public conflict, the gentlemen of France were at the same time freed from its manifold restraints; and private duels, conducted with a ferocity and sanguinary spirit hitherto unheard of, became prevalent to the most astonishing degree. The wars of religion, prosecuted with a degree of bitterness perhaps unexampled in the history of any nation, added public causes of dispute to those of an hereditary and personal nature. Even the ordinary laws of honour, which seem inseparable from the practice, were neglected. We find in Brantome, that there were duellists who prided themselves on the advantages which they had taken of their antagonists, and were not esteemed the less in society for having done so. Not only had individuals and families their quarrels; we are told that there were regiments in the same service, of which the officers were bound to fight one another whenever they met. The duellist seems to have usurped, with the fair sex, the attentions usually paid to the soldier. We have the testimony of Lord Herbert of Cherbury, himself a vain and cold-blooded quarreller, for the honour in which the ladies of France held the brave Balagny—an ordinary man, in a threadbare doublet and grey breeches, with neither figure, wit, nor fortune to recommend him; but whose testimonials consisted in the fact of his having killed eight or nine of his friends in single combat.

It was about the reign of Henry III. also, that the sanguinary custom of the seconds taking part in the quarrel of their principals seems first to have become established, a custom which only gradually wore out in the beginning of the last century. When such bloody practices were rife in all parts of France, we are scarcely tempted to doubt the extraordinary assertions we find in the writers of those days,—that one hundred and twenty gentlemen were killed in duels, in a single French province, in six months; that in the reign of Henry IV. four thousand fell in two years; that this strange species of mania cost France more gentle blood than thirty years of civil war. Henry IV. issued edicts against duelling; Louis XIII. proceeded against it at one time with such severity, that we are told that wounded duellists were dragged at once from the field to the gibbet; but this unwarrantable violence, as usual in such cases, had no effect. The evil at length produced a remedy by its own excess. In the minority of Louis XIV. the Duke de Nemours, a prince of the blood, fell, with two of his four seconds, in a quarrel with another grandee of the court. After this deplorable event, many noblemen and gentlemen of undoubted courage entered into a voluntary compact to abstain from duelling. Louis XIV., when of age, approved of their resolution, and seconded it by several edicts. To the honour of this prince, it should be remembered that during the whole of his life he laboured firmly and temperately to correct this abuse, and with no ordinary success. This he effected, not merely by the force of laws, but by exhibiting in his own demeanour, and encouraging in his courtiers, that mixture of dignity with gentleness which most readily turns away wrath and repels insolent familiarity. One of his expedients, however, it must be admitted, seems to our modern ideas not very likely to attain the object proposed. This was the establishment of a court of chivalry,—the members of which were the marshals of France,—which was to decide on all questions in which a gentleman might conceive his honour to be involved. It is said that this singular sort of arbitration was at first very efficacious; although in Mercier's time (the reign of Louis XVI.) he tells us (as we might naturally suppose) that a person who should have resorted to the court to redress an insult would only have incurred ridicule, in addition to the disgrace of not personally resenting it. Various laws relating to the duel have been since made in France, but have fallen into disuse for the most part. Whether slaying in a duel be murder, is a point on which there has been a continual conflict between the courts of cassation and the royal courts since 1817, when it was raised in the case of De Poligny and Rosay. But the legal question is of comparatively small importance, from the licence assumed by juries in that country. A civil action lies on behalf of the friends of the slain man.

In England, the first attempt made to introduce legislative enactments in aid of the common law for repressing of duels is said to have taken place in 1713; when, after the celebrated duel of Duke Hamilton and Lord Mohun, a bill for that purpose was brought into the Commons, but lost on the third reading. A provocation or challenge to fight is a high misdemeanor. In Scotland, as late (we believe) as the middle of the 16th century, licences for duelling were granted by the crown, and formed a source of revenue. death in a duel without licence was murder (See *Pitcairn's Criminal Trials*.) The new codes of Bavaria and Prussia contain a number of provisions, with perhaps too much minuteness of distinction, against duels, challenges, &c. The common punishment is imprisonment for a shorter or longer term.

See as to duels, in addition to former works on the subject, *Fougeroux de Campigneulles, Histoire des Duels*, 3 vols. 8vo. 1834, in which most authorities are collected, although it is a compilation including many anecdotes, &c. of no authenticity. For modern legislation on the subject, the article "Duel," in *Ersch and Gruber's Encyclopædia*, may be consulted with advantage.

DUE'NNA. (Span. dueña.) The chief lady in waiting on the queen of Spain. In a more general sense, it is applied to a person holding a middle station between a governess and companion, and appointed to take charge of the junior female members of Spanish and Portuguese families.

DUE'T. (Lat. duo, *two*.) A piece of music composed for two performers, either vocal or instrumental.

DUGO'NG, or DUYONG. The name of a herbivorous cetaceous animal, characterized by two large permanent incisive tusks in the upper jaw, and four molar teeth above and below, the grinding surface of which exhibits a rim of cementum surrounding a slight excavated centre of ivory. The upper lip is beset with numerous strong bristles, and similar ones are found more sparingly scattered over the body. The anterior extremities are fin-like, and without nails. The caudal fin is broad, and of a crescentic figure. One species (*Halicore Indicus*, Cuv.) inhabits the seas of the Indian Archipelago. A second dugong has been recently discovered in the Red Sea (*Halicore tabernaculi*, Ruppel), but which is at most only a variety of the preceding. The fabled mermaid seems to have been founded on the dugong.

DUKE. (From the Latin dux, *leader or commander*.)

The title of Duke is said to have originated in the usages of the Lower Empire, where it was given to the military governors of provinces. From thence it was borrowed by the Franks, who adopted, in many respects, the titles and distinctions of the empire. Charlemagne is said to have suffered it to become obsolete, but the emperor Louis created a duke of Thuringia in 847. In course of time, according to the usual progress of feudal dignities, the title became hereditary. In Germany the dukes became the chief princes of the empire; this title being proper to all the secular electors, and to most of the greater feudatories. In other countries their dignity became merely titular. In Italy and France dukes form the second rank in the nobility, being inferior to princes: in England they form the first. The title was not known in the latter country until the reign of Edward III.; and the word dux is used by writers before that period as synonymous with count or earl. In the eleventh year of the latter monarch the dignity of Duke of Cornwall was bestowed on his eldest son, Edward the Black Prince. In the year 1351, his third son, John of Gaunt, Earl of Lancaster, was created Duke of Lancaster for life, furnishing the next instance of this dignity. In neither of these instances, nor in any subsequent one, according to Sir H. Nicolas (*Introduction to the Peerage*, vol. i. p. lxxvii.), was the dignity thus created a dukedom by tenure: it has always remained a personal title only, and descendible according to the limitations of the charter.

DULCAMA'RA. (Lat. dulcis, *sweet*, and amarus, *bitter*.) The common woody nightshade, the stalk of which is used in medicine to furnish a decoction which is somewhat narcotic and diuretic, and has a very peculiar bitter-sweet flavour. It has been recommended in chronic rheumatism, and as an alterative in some cutaneous cases, but is not much depended upon.

DU'LCIMER. (Etym uncertain.) A musical instrument, of what description is unknown, but probably of the wind species, in use among the Jews.

DU'MBNESS. (*Aphonia* of medical writers; from α, privative, and φωνη, *voice*.) This term is generally applied to persons who are either born deaf, or become so in early infancy; the consequence of which is that the organs of speech have never been called into due action, their functions being at first imitative in respect to sounds, and the numerous muscles of the tongue, glottis, &c. concerned in speech remain inactive; for persons who even in very early life become deaf are not rendered dumb, the organs of speech having been once called into activity, and having acquired their peculiar powers and consentaneous actions. Dumbness may also arise from injury to the lingual nerves, or from great general or local debility, in which case blisters, stimulants, tonics, and other remedies may be resorted to for the restoration of speech. It is remarkable that the loss of the tongue, and even of part of the palate, does not necessarily occasion dumbness: this has happened from disease, and among barbarous nations the tongue was occasionally extirpated; yet cases are on record showing that even under such circumstances speech was more or less perfectly retained; and there is an account in the *Memoires de l'Academie des Sciences* for 1718 of a girl who was born without a tongue, and yet acquired the faculty of speech. The case of Margaret Cutting, related in the *Philosophical Transactions* (1742) by Dr. Parsons, may also be consulted in reference to this subject.

DU'MUS. In Botany, a low and much-branched shrub.

DUNES. (Ang. Sax. *low hills*.) Hills of moveable sand, which are met with along the sea coast in various parts of Great Britain, Ireland, and the Continent. The mode of their formation and progress is exceedingly curious. In various districts the sea deposits on the beach a quantity of fine sand, which is carried forward by the wind till it meets with some obstruction in the shape of large stones, roots of trees, or other obstacles, when it gradually accumulates into mounds or hillocks, "whose general appearance, size, and distribution depend on those of the obstacles to which they owe their existence." When these mounds have attained a certain elevation they are urged forward upon the land; for, as Cuvier observes, "le même vent qui éleve le sable du rivage sur la dune jette celui du sommet de la dune à son revers opposé." The direction which they take depends chiefly on that of the wind; and their inroads upon the land are attended by the most destructive effects. One of the departments of France, the Landes, has been nearly overwhelmed by their progressive advance. The quantity of moveable sand which the sea annually deposits on that coast has been estimated at upwards of 3,000,000 square feet, and its annual progress inland at about 72 feet. In that department the dunes advance in a north-easterly direction; and it has been calculated, with apparently sufficient exactness, that unless their progress be arrested, they will have reached Bordeaux in 1500 years. During the violent hurricanes which frequently occur in these regions, the whole mass of sand of which the dunes are composed appears to be in agitation; and such is the rapidity with which they then advance, that entire villages, fields, and gardens are almost instantaneously engulphed, and the aspect of whole districts changed within four and twenty hours. The progress of the dunes, however, as already remarked, is in general slow and steady. Thus the town of Mimizan, after struggling for more than the fourth part of a century against their encroachments, is now almost buried beneath them; and such have been their destructive effects upon a village of Britanny, that nothing is visible of it except a small part of the church steeple. As will be easily imagined, the means of arresting the progress of the dunes forms a most interesting and important inquiry. For this purpose various measures have been recommended; but by far the most efficient means hitherto adopted consists in planting close together, so as to form, as it were, a line of defence against the sand, such trees and shrubs as are known to thrive in a barren soil. This process, wherever it has been tried, has been found not only to fix the dunes, but at the same time to form a simple and secure barrier against all further encroachment of the sand.

DU'NKERS. A Christian sect, which formed itself into a society under peculiar rules in Pennsylvania in the year 1724. The origin of their name is unknown. They practise abstinence and mortification, under the idea that such austerities are meritorious in the sight of God, and effective, first in procuring their own salvation, and further in contributing to that of others. They form a society strictly connected within itself, and hold love feasts in which all assemble together; but their devotions and ordinary business are carried on in private, nor do they recognize a community of goods. They also deny the eternity of future punishments; conceiving that there are periods of purgation, determined by the sabbath, sabbatical year, and year of jubilee, which are typical of them.

DU'NNAGE. Any light or loose material, as wool, &c., used as a bed in the stowage of heavy articles.

DUODE'CIMAL. (Lat. duodecim, *twelve*.) Proceeding by twelves. The term is given to a rule or operation of arithmetic, by which the contents of any surface or solid are found by multiplying together its linear dimensions, expressed in feet, inches, and lines, and is consequently much used by artificers in finding the contents of their work. The rule is also called cross multiplication, from the manner in which the operation is usually performed, and which is as follows: Suppose it were required to find the superficial content of a plank 12 feet 9¼ inches long, and 3 feet 7 inches broad. Set down the two dimensions under each other, placing feet under feet, inches under inches, &c., and for the half inch put down its equivalent 6 lines, as in the following example: —

| | | |
|---|---|---|
| 12 | 9 | 6 |
| 3 | 7 | |
| 38 | 4 | 6 |
| 7 | 5 | 6½ |
| 45 | 10 | 0½ |
| | 12 | |
| | 120½ | |

Now, since the feet are conceived to be units of measure, the inches are so many 12ths of unity, and the lines so many 12ths of a 12th, or 144th parts of unity. The units consequently form the first column, the 12ths the second, and the 144ths the third. Multiplying therefore the first line by 3 feet or 3 units, we get 38 feet, 4-12ths of a foot, and 6-144ths of a foot. Next, multiplying the upper line by 7-12ths, we get first the 6 lines or 6-144ths, multiplied by 7-12ths, equal to 42-1728ths, which is equal to 3½-144ths. Then the 9-12ths multiplied by the 7-12ths give 63-144ths, which added to the 3½ make 66½-144ths, or 5-12ths and 6½-144ths; therefore 6½ is placed in the third column, and the 5-12ths carried on. Lastly, the 12 units multiplied by the 7-12ths give 84-12ths, which added to the 5-12ths make 89-12ths, and this is equal to 7 units or feet and 5-12ths; consequently 7 is placed in the first column and 5 in the second. Adding the two products together, we get 45 feet, 10-12ths of a foot, and ½-144ths of a foot. But in square or superficial measure the 144th part of a foot is an inch; and 10-12ths = 120-144ths; consequently the result of the operation is 45 sq. feet and 120½ sq. inches.

The operation is itself much simpler than the description or explanation, which is found embarrassing to beginners; it would therefore, perhaps, be better to reject the rule altogether from elementary books of arithmetic; and, regarding the inches and lines as parts of a foot, to perform the operation by the ordinary rule of *practice*.

DUODE'CIMO. (Lat.) A book is said to be in *duodecimo* (abbreviated 12mo.), when every sheet being six times folded makes twelve leaves or twenty-four pages.

DUODE'NUM. (From duodenus, *consisting of twelve*.) The commencement of the intestinal canal, forming a division, which in some animals is about as long as the breadth of twelve fingers. This term, introduced by the older anatomists, is still applied to that portion of the intestines, though the measure is generally inapplicable.

DU'PLICATE RATIO, is the ratio of the squares of two quantities, or the square of their ratio. Thus the ratio

of $a^2$ to $b^2$ is the duplicate of the ratio of $a$ to $b$. If there be three quantities in continued proportion, the first is to the third in the duplicate ratio of the first to the second: — thus if $a$, $b$, $c$ be continual proportionals, that is, if $a : b :: b : c$, then $a$ is to $c$ in the duplicate ratio of $a$ to $b$.

DUPLICA'TION OF THE CUBE. A celebrated problem of the ancient geometry. While a plague was desolating Athens, a deputation was sent to consult the oracle of Apollo at Delos, who returned for answer that the plague would cease when they had doubled the altar of the god. The altar was cubical, consequently the problem was to find the side of another cube of twice the solid contents. As this problem requires the solution of a cubic equation, it cannot be solved by plane geometry; but Hippocrates of Chios reduced it to another; namely, the insertion of two mean proportionals between two given straight lines, a problem which several of the ancient geometers, particularly Archimedes, Eutocius, Pappus, and Nicodemes, discovered methods of constructing by means of the higher curves. Among the modern geometers who have not disdained the same inquiry, are the illustrious names of Newton and Huygens. See *Montucla, Histoire des Mathematiques*.

DU'PPER, or DUBBER. A globular short-necked vessel made of buffalo's hide, in which castor oil is imported from India. Each dupper holds about 80 lbs. of oil.

DU'RA MATER. A thick membrane enveloping the brain and adhering to the inner surface of the cranium. *See* BRAIN.

DURA'MEN. (Lat.) The fully formed central layers of the wood of Exogenous trees; what is called in common language the heart wood. It is only the sapwood solidified by the introduction of various secretions into the interior of the cells or tubes of which such wood is composed.

DU'RESS (Lat. duritas, *hardship*), in Law, is such constraint, either actual or by threats occasioning a reasonable fear, as will invalidate legal acts done by a party suffering it. Duress of imprisonment must be by illegal imprisonment. Duress per minas, by threats, is interpreted to mean such threats as occasion fear of life or limb.

DUTCH GOLD. Copper, brass, and bronze leaf is known under this name in commerce; it is largely used in Holland for ornamenting toys and paper.

DUTCH SCHOOL. In Painting, this school, generally speaking, is founded on a faithful representation of nature, without attention to selection or refinement. The ideas are usually low, and the figures local and vulgar. Its merit lies in colouring and drawing with extreme fidelity what was before the eye of the artist The pothouse, the workshop, or the drunken revels of unintellectual boors, seem to have furnished its principal subjects The great appearance of reality infused into its productions induced Hagedora to call it the School of Truth. Notwithstanding its deficiency in all that tends to raise the mind, it has gained an unspeakable lustre from its great head, Rembrandt van Rhyn, to whose name may be added those of De Leide, Heemskirk, Polemburg, Wouvermans (an exception to our general observations), Gerard Dow, Mieris, and Vandevelde, &c.

DUU'MVIRI. A general appellation, among the ancient Romans, given to any magistrates elected in pairs to perform any function or class of functions. The chief Duumviri were the Duumviri Sacrorum, to whom were entrusted the care and the interpretation of the Sibylline books. The Duumviri Municipales had almost consular power in the municipal cities. The Duumviri Navales were officers appointed to man, equip, and command the Roman navy.

DWA'RFING TREES. Dwarf trees may be produced in three different ways: by grafting on dwarf slow-growing stocks, as, for example, the pear on the quince; by planting in pots of small size filled with poor soil, by which the plant is starved and stunted; and by causing a portion of the extremity of a branch to produce roots, and then cutting it off and planting it in a pot or box of poor soil. This last is the Chinese method, and is thus performed: — The extremity of a branch two or three feet in length, in a fruit or flower-bearing state — for example, the points of the branches of a fir tree bearing cones, or of an elm bearing blossom buds — being fixed on, a ring of bark is taken off at the point where it is desired that the roots should be produced. The space thus laid bare is covered with a ball of moist clay, which is kept moist by being covered with moss, which is occasionally watered. In the course of two or three months in some trees, and of a year or two in others, roots are protruded into the ball of clay. The branch may then be cut off below the part from whence the roots have been protruded, and the branch being planted in a pot of poor soil, and kept sparingly supplied with water, it will remain nearly in its present state for many years; producing leaves, and perhaps flowers, annually, but never shoots longer than a few lines.

DWARF WALL. (Sax. ðpeopþ.) In Architecture, a low wall, not so high as the story of a building in which it is used.

DY'EING. The object of this beautiful art is to fix certain colouring matters uniformly and permanently in the fibres of wool, silk, linen, cotton, and other substances. There are a few dyeing materials which impart their colour to different stuffs without any previous preparation, and these have been technically termed *substantive colours;* by far the greater number, however, of colouring materials, only impart a fugitive tint under such circumstances, and require that the stuff to be dyed should undergo some previous preparation, in order to render the colour permanent; that is, capable of resisting the action of air, light, and water. The substance applied with this intention is called a *base* or *mordant*, and must posess an affinity for the fibre of the stuff on the one hand, and for the colouring materials on the other. The mordant often effects another important object; that of changing or exalting the colour at the same time that it fixes it. The principal mordants are aluminous earth and oxide of iron, and these are usually applied in the state of acetates. As an instance, we may mention the mode of dyeing calico red by means of *madder*, a decoction of which, if applied to the unprepared goods, would only give them a dirty red tinge, neither agreeable nor permanent. If the calico be previously passed through a weak solution of acetate of alumina, and then dried at a high temperature, and afterwards washed, a portion of the alumina is retained in chemical combination with the fibre of the calico; and when thus prepared and submitted to the action of a hot decoction of madder, and again washed, it comes out of a fine red, which is fixed in consequence of the attraction of the alumina for the peculiar principle which gives colour to the madder. If the mordant be oxide of iron instead of alumina, the colour which is then produced is purple; and various shades and colours are obtained by mixing mordants, by using more or less of them, and by applying the coloured solutions in various states of concentration. Sometimes articles are dyed by a similar precipitation of coloured metallic oxides in the fibre; thus yellow is obtained by passing cloth impregnated with acetate of lead through a solution of chromate of potash: a double decomposition ensues, and yellow chromate of lead is precipitated in and combined with the vegetable or animal fibre Blues are produced by passing the goods previously mordanted with iron through an acidulated solution of ferrocyanate of potash; these are generally called *chemical colours*, though not in fact more so than the others Scarlet is exclusively produced by the colouring matter either of the cochineal or of the lac insect, which is fixed by oxide of tin, or by alumina, and heightened by the action of tartar.

The chemical principles of the art of *calico printing* are the same as those of dyeing, but the details are more difficult and complicated; and in consequence of the combination of a great variety of colours upon the same ground, the process is sometimes extremely refined and intricate, so that a rich, varied, and pleasing pattern, thus effectively produced, may be considered as a triumph of practical skill over theoretical difficulties, which is scarcely rivalled, and certainly not excelled, in any other of the arts. It is obvious that calico printing is in the abstract a topical dyeing; and much discrimination and taste are requisite in the contrivance of the pattern, its general design, and the colours in which it is exhibited. In this art the mordants, and sometimes the colours, are applied either by *blocks*, upon which the pattern is designed in relief, or by *copper plates*, which are engraved, or by *cylinders* or rollers. If the aluminous mordant be printed by one block and the iron mordant by another, and a mixture of the two by a third, and the piece thus prepared be then passed through a madder bath, and properly cleansed and bleached, the colour will only adhere to the mordanted places, and it will be red where the aluminous earth only has been applied, purple with the mixed mordant, and black with the iron; if the same three mordants be used with a decoction of quercitron bark, the resulting colours will be yellow, olive, and brown; and in this way a great variety of colours may be produced. Sometimes copperplate and block printing are combined; a fine running pattern being printed by the plate or cylinder over the whole surface, which serves as a groundwork, and upon which other figures are printed by blocks. Sometimes the mordant and colour are both applied at once by means of a block, and rendered fixed and permanent by exposing the goods for some time to steam. Some beautiful effects are also produced by printing the pattern upon a mordanted ground with some substance which will *resist* the colour, and so produce a white pattern upon a coloured ground. The same effect is sometimes brought about by *discharging* the colour by the topical application of certain bleaching materials.

DYKE, or DIKE. When a mass of unstratified or igneous rock, such as granite, trap, or lava, appears as if injected into rents and fissures in the stratified rock, so as to intersect the strata, it is called a *dyke*. *Dyke* is also the name given to a mound of earth, stones, or other materials, intended to prevent low land from being inundated by the sea, &c.; as the dykes of Holland.

DYNA'MICS (Gr. δυναμις, *force or power*), signifies literally the doctrine of force or power; but as force or power is known to us in no other way than by its effect, that is, by the *motion* which it produces in the body on which it acts, and is measured by that motion, dynamics may be defined to be the science which treats of the motion of bodies. It is, however, usually restricted to those circumstances of motion in which the moving bodies are at liberty to obey the impulses communicated to them; the opposite cases, or those in which the bodies, whether by external circumstances, or by their connection with one another, are not at liberty to obey the impulses given, being comprehended in the science of *mechanics*. Thus, the motion of a stone falling freely to the ground, or of a celestial body in its orbit, belongs to dynamics; while that of a body descending an inclined plane would properly belong to mechanics.

The theory of varied motions, and of the accelerating forces which produce them, is founded on two general laws: 1st, That all motion impressed on a body is by its nature uniform and rectilinear; and 2nd, That different motions impressed either simultaneously or successively on the same body, are compounded in such a manner that the body is found at every instant in the same point of space in which it would have been found in consequence of the combination of the motions had they existed separately. Thus, if a body be acted on by two forces at the same instant, one of which acting alone would cause it to move uniformly over A B, and the other acting alone would cause it to move over A C at right angles to A B in the same time; the velocity of the body in the one of these directions will not be changed by the force impelling it in the other. With regard to the first of these laws, it is evident that a body in motion, not subjected to the action of any new force, will continue to move in the prolongation of the straight line in which it moves at any given instant, since there is no reason why it should deviate from its rectilinear direction rather to one side than the other; but the uniformity of its motion cannot be asserted *à priori*: it is only by induction and experience that we come to be persuaded that the velocity with which any body is impressed will not diminish of itself, nor the body finally come to rest unless it is impeded by some external causes. The second law, which involves the theory of the *composition of forces*, has been demonstrated by several mathematicians, particularly Daniel Bernoulli, D'Alembert, Laplace in the *Mecanique Céleste*, and Poisson in his excellent *Traité de Mécanique*; but all these demonstrations are too difficult to be accounted elementary.

The science of dynamics is due entirely to the moderns, and its foundations were laid by the celebrated Galileo. Before him no one had considered the forces which act on bodies, excepting in the case of equilibrium, and although the acceleration of falling bodies, and the curvilinear motion of projectiles, had been attributed to the constant action of terrestrial gravity, no one had yet succeeded in determining the laws of these common phenomena. Galileo first made this important step in advance, and thereby opened a new and boundless field for the progress of mechanics. Huygens added to Galileo's theory of the acceleration of falling bodies the theories of the motion of pendulums and of centrifugal forces, and thus prepared the way for the great discovery of universal gravitation. In the hands of Newton mechanics became a new science, and the discovery of the infinitesimal calculus at length enabled geometers to express all the laws and circumstances of the motion of bodies by analytical equations. The investigation of the forces which produce the phenomena of the material world, or of the mutual action of the different parts of matter on each other, now form indeed the principal object of mathematical studies. The best systematic treatises on Dynamics are to be found in *Lagrange's Mécanique Analytique*, and *Poisson's Traité de Mécanique*. Of late years several valuable elementary treatises have appeared in our own language. *See* FORCE, MECHANICS, MOTION.

DYNAMOMETER. (Gr. δυναμις, *power*, and μετρον, *measure*.) An instrument for measuring power of any kind, as the strength of men and animals, the force of machinery, the magnifying power of a telescope, &c. An instrument for measuring animal force was invented by Mr. Graham many years ago, and afterwards improved by Desaguliers; but as it consisted of wooden works, it was too heavy and bulky to be conveniently used for ordinary purposes. Leroy, of the Academy of Sciences of Paris, proposed a dynamometer, which consisted merely of a tube of metal of ten or twelve inches in length, placed vertically on a stand, and containing a spring in its interior, which indicated by its compression the amount of the force applied. This instrument was in fact the same in principle as the common spring balance.

The most convenient dynamometer is that of Regnier, which is described in Cahier 5 of the *Journal de l'Ecole Polytechnique*. It consists of an elliptical steel spring of about 12 inches in circumference, and the force is applied either by pressing the two vertices of the axis minor against each other, or by drawing in opposite directions the two ends of the axis major. In both cases the sides of the spring are made to approach each other; and thus they move an index which marks the degree of approximation on a semicircular scale. By means of this machine the mean force is ascertained which a man can exert with the right hand, or with the left, or with both together, and in various positions of his body. Some interesting results relating to the average strength of men at different ages, and of different weights and sizes, have been deduced by M. Quetelet of Brussels from numerous experiments with this dynamometer. *See* STRENGTH OF ANIMALS.

DYNA'STIDÆ. (Gr. δυναστης, *a master*.) A family of beetles, including the giants of the Coleopterous order. They are remarkably powerful insects, excavating burrows in the earth and in putrescent timber, upon the latter of which they principally feed.

DY'NASTY. (Gr. δυναστεια, from δυναστης, *a lord or chieftain*.) A race or family of sovereigns in succession.

DYSÆSTHE'SIA. (Gr. δυς, an adverb signifying in composition *badness* or *difficulty*, and αισθανομαι, *I feel*.) Impaired sense of touch.

DY'SENTERY. (Gr. δυς, and εντερα, *bowels*.) A disease of the bowels, endemic in many climates in the autumnal months, and frequently arising from marsh miasma, bad diet, exhaustion and fatigue: its symptoms are loss of appetite, sickness, pain about the bowels, and a frequent ineffectual desire to evacuate their contents, which when passed are mucous, fetid, and bloody, with small indurated lumps. It is often accompanied by intermittent and remittent fever, especially in hot and damp countries. In this country dysentery is generally a mild disorder, and not infectious; and is commonly cured by gentle aperients, such as castor oil, or salts and manna, to cleanse the bowels, and opiates to allay irritation. The chronic symptoms which remain are treated with mild tonics, especially vegetable bitters, such as infusion of calumba, angustura, or cascarilla. The contagious dysentery of camps, attended by remittent or typhoid fever, is an alarming and fatal disease; its treatment requires much consideration and skill, and consists in judiciously meeting the various symptoms as they arise. Aperients, diaphoretics, and nauseants, succeeded by tonics, are leading remedies; and the febrile symptoms must be treated according to their inflammatory or putrid tendency.

DYSPE'PSIA. (Gr. δυς, and πεπτω, *I digest or concoct*.) Indigestion. This is a complaint from which few entirely escape, which assumes an infinite variety of shapes and symptoms, and which arises from many causes. In the higher ranks of society, and amongst the luxurious and opulent, it is a common consequence of over eating, or of indulgence in difficultly digestible or over-stimulating food, or of want of due exercise and general bodily and mental exertion. In others it results from mental anxiety and labour associated with a sedentary life; from the fatigues of business, or the influence of debilitating passions. In the lower orders it is the constant result of indulgence in spirituous liquors, combined in many instances with want of proper food, the means which ought to be applied to procuring it being disposed of in the gin shop.

The symptoms of dyspepsia vary, therefore, in the different grades of life. The epicure loses his relish for the most refined dishes, becomes bloated, plethoric, heavy, and perhaps apoplectic; the lady of fashion suffers from headaches, flatulence, occasional giddiness, and dimness of sight; she becomes indolent, capricious, and full of fancies, or, as the old physicians used to say, she has the *vapours*; the studious man feels the intensity of his mind blunted, loses his appetite, or at least all enjoyment of meals, sleeps ill, and dreams much, gets whimsical and discontented with himself and his friends, and becomes a *hypochondriac*, the lower classes at first take their glass of gin or of rum because they find it a cheap stimulant, little thinking of the misery they are laying up for future years; this stimulant soon becomes habitual, and they not only feel miserable and heartbroken without it, but the single glass soon loses its efficacy, and the dose must be gradually increased till they degenerate into regular tipplers, the aspect and characters of whom it were needless to describe, as they may be daily and hourly studied in those hells of temptation and iniquity, the gin shops of London,—where it is curious and instructive, but humiliating and alarming, to witness the various grades of mental and bodily disease in the men, women, and even children, who there immolate to Satan.

Complicated as are the symptoms of dyspepsia, and numerous as are the remedies and modes of treatment proposed for its relief or cure, they really resolve themselves into a few simple rules. In the majority of cases, *abstinence* is the first and most essential step: the epicure must abstain from the luxuries of the table, eat and drink with moderation, rise betimes, and use due exercise; the woman of fashion must revert to regular hours, that is,

the night and the day must be employed as intended by nature, and not in inverted order; the philosopher and the scholar must occasionally, and often frequently and assiduously, divest themselves of their mental labours, and resort to amusements and occupations of a more trivial character. Those among the lower orders who have once acquired the habit of dram drinking are incurable; for such is the depression of mind and body, and such the gnawing restlessness that want of the accustomed stimulus occasions, that without it they become miserable and inconsolable, and usually fall a sacrifice to mental or bodily disease, or to both combined: here, therefore, prevention is the only cure. The medical treatment of dyspepsia generally resolves itself into that of such of its particular symptoms or consequences as are most prominent; the inactivity of the bowels is to be opposed by proper aperients properly administered; the debilitated stomach to be strengthened by mild tonics, antacids, and stimulants; the mental symptoms often yield to the same treatment, and often require local depletion, or diffusible stimulants, such as ammonia and ether; and lastly, change of air, of scene, and of occupation are often indispensable, under which head sea bathing and courses of mineral waters may be included. The above observations are of course inapplicable to all cases of dyspepsia resulting from structural disease, which, though often an effect, is also a frequent cause of symptoms of indigestion; indeed, such are the sympathies of the stomach that it is apt to be affected by any aberration from health.

DYSPHA'GIA. (Gr. δυς, and φαγω, *I eat*) Difficulty of swallowing. Paralysis, stricture of the œsophagus, enlarged tonsils, relaxed uvula, a debilitated state of the muscular coat of the pharynx and œsophagus, spasm of the organs concerned in deglutition, inflammation, are among some of the leading causes which occasion difficulty of swallowing; it is also an attendant upon hysteria, hypochondriasis, tetanus and trismus, and hydrophobia. The treatment will depend upon the prevailing cause, and is noticed under other articles.

DYSPNŒ'A. (Gr. δυς, and πνεω, *I breathe*) Difficulty of breathing. This is generally a symptomatic affection, and commonly attends upon various morbid affections of the lungs, heart, &c. It occasionally happens that persons in full health are seized with an attack of difficulty of respiration; where this occurs in nervous irritable habits it generally goes off by perfect quiet, with the help of a little ether or ammonia; if in full habits, bleeding is sometimes requisite. Persons who are subject to these attacks should keep themselves as quiet and tranquil in body and mind as possible, and should avoid excess of food and wine, and even all stimulating diet. A recumbent posture, and sudden change of air, — as going out of a warm into a cold room, or into the open air, — will often relieve an accidental attack of dyspnœa.

DYSU'RIA. (Gr. δυς, and ουρον, *urine*) Dysury. Difficulty in voiding the urine. A common symptom in cases of gravel, inflammation of the urinary organs, spasm, and stricture. The nature of the relief must depend upon the exciting cause.

# E.

**E.** The fifth letter in the Hebrew alphabet, and in those derived from it. In the Latin language it is often interchanged with *i* and *o;* and in the Greek with *a*, *o*, and occasionally *u*. In most languages *e* admits of great variety in its pronunciation, and, in French and English particularly, surpasses every other letter of the alphabet in this quality: as a Latin numeral E signifies 250 —

*E quoque ducentos et quinquaginta tenebit.*

**E.** In Music, the third note or degree of the diatonic scale, corresponding to the *mi* of the French and Italians. In the bass clef it is that on the third space of the staff, in the tenor on the first space, in the counter tenor on the fourth line, and in the treble clef that on the first line.

EA'GLE. In Ornithology. *See* AQUILA, FALCONIDÆ.

EA'GLE. In History, the symbol of royalty; as being, according to Philostratus, the king of birds. Hence, in the Scriptures, a Chaldæan and Egyptian king are styled eagles. The eagle was borne as a standard by many nations of antiquity. The first who assumed it, according to Xenophon (*Anab.* i. 10.), were the Persians, from whom (in all probability through the medium of the Greeks) it was borrowed by the Romans at an early period of their history, but first adopted as their sole ensign in the consulate of C. Marius. (*Plin.* x. 4.) Previously to that period they had used as standards wolves, leopards, eagles, and other animals, indifferently, according to the humour of their generals. The Roman eagles were gold or silver figures in rilievo, about the size of a pigeon; and were borne on the tops of spears, with their wings displayed, and frequently with a thunderbolt in their talons. When the army marched the eagle was always visible to the legions; and when it encamped the eagle was always placed before their *prætorium* or tent of the general. The eagle on the summit of an ivory staff was also the symbol of the consular dignity. In modern times Napoleon caused the tricolor flag, which at the outbreak of the first French Revolution had become the standard of France, to be surmounted with an eagle; and thus constituted it the standard of the consular and imperial armies. From this circumstance, and from the almost unprecedented career of victory so long pursued by the French under this standard, the expression *eagles of Napoleon* is often used metaphorically to designate the *armies* under his command. After the battle of Waterloo the eagle was superseded in France by the fleur de lys, the ancient emblem of the Bourbon race. Eagles are frequently found on ancient coins and medals; where, according to Spanheim, they are emblematic of divinity and providence, but according to all other antiquaries of empire. They are most usually found on the medals of the Ptolemies of Egypt and the Selucidæ of Syria. An eagle, with the word *consecratio*, indicates the apotheosis of an emperor.

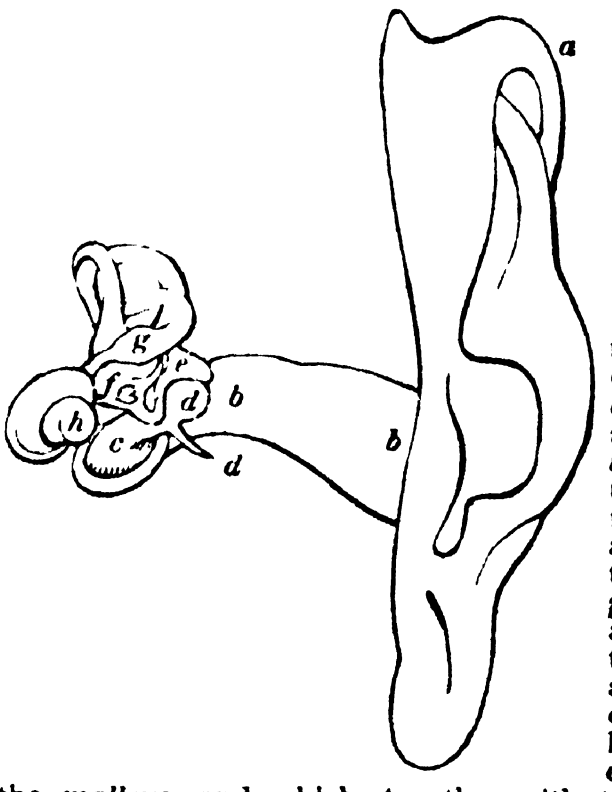
EAGLE. In Heraldry, a bearing of frequent occurrence, and particularly assumed by sovereigns as the emblem of empire, from having been borne on the legionary standard of the ancient Romans. The eagle of Russia is *or*, with two heads displayed, sable, each ducally crowned of the field; the whole imperially crowned, beaked, and membered, gules. The eagle of Austria is also displayed with two heads; the Prussian eagle has one only. The Americans have adopted an eagle of a peculiar species belonging to their continent as the device of the Union, which is impressed on their gold coins.

EA'GLE, BLACK. A Prussian order of knighthood, founded in 1701; united with the order of the Red Eagle, or order of Sincerity, instituted by the Margraves of Bayreuth.

EA'GLE STONE. A term applied by the old pharmaceutists to globular clay ironstone, which they called *lapis aetites*.

EA'GLE WOOD. A fragrant wood, used by the Asiatics for burning as incense. The Malayan name is *Agila*, whence the Portuguese name *Pao d'Agila*.

EAR. (Germ ohr) The external ear is formed of a plant cartilage covered by a thin skin, and having appropriate nerves and muscles, its various cavities and projections have received distinctive names from the anatomist. The curved and irregular passage which leads to the inner ear is called the *meatus auditorius*, and in the adult is more than an inch in length; it is lined with a peculiar secretion called *cerumen*. The *tympanum* separates the external from the internal ear; it is closed by a membrane called the *membrana tympani* or *drum of the ear*, upon the inner surface of which a nerve called the *chorda tympani* ramifies, and to the centre of which is affixed the process of a little hammer-shaped bone, called the *malleus*, and which, together with the *incus*, the *os orbiculare*, and the *stapes*, forms a chain of communication between the *tympanum* and the *fenestra ovalis:* these small bones are supplied with appropriate muscles. The *vestibule* is a small cavity in the petrous portion of the temporal bone, having a little spiral cavity called the *cochlea* connected with it, and three cylindrical cavities, or tubes, bent in a semicircular form, two of which are horizontal and one vertical. These cavities contain a liquid; and in them the auditory nerve, which proceeds from the fourth ventricle of the brain, ramifies and terminates. It is obvious that vibration of the tympanum, occasioned by undulations of the air, may be communicated through the bony chain above mentioned to the fluid in the vestibule, and thence to the acoustic nerve; but any further uses of this extraordinary and complicated mechanism are beyond our knowledge. In the annexed diagram *a* represents the external ear, *b* the external meatus, *c* the tympanum, *d* the malleus, *e* the incus, *f* the stapes, *g* the semicircular canals, and *h* the cochlea.



EA'RINGS. Small ropes fastened to cringles (loops) in the upper corners, and also to the *leeches* of sails, for the purpose of fixing the leeches of the sail to the yard. The first or head earings fix the corners of the sail permanently, the second are used only in reefing.

EARL. A title of dignity, derived from the Anglo-Saxons. It denoted at first any person of noble race (see *Palgrave's Rise of the E. Commonwealth*); and there seem to have remained in popular language traces of this ancient use of the name down to a late period. Afterwards some of the Saxon earls were hereditary, and some official governors of extensive districts. After the Conquest, the title of earl was used by the English to express the French title of count (in Latin comes); to which again the word graf (identical in origin with the English reeve) furnishes an equivalent in Germany. Hence the wife of an earl is still styled countess. In writings earlier than the age of Stephen, the Latin word consul is also used as synonymous. It has been supposed (and the explanation is supported by Mr. Cruise, *On Dignities*, p. 17.) that the dignity of an earl was originally annexed to the possession of a certain tract of land, and that there were three sorts of earldoms—one, when the dignity was annexed to the possession of a whole county with *jura regalia*, in which case the county was a county palatine, as Chester, Pembroke, and Durham; the second, where the earl had no possession of the county, and no advantage from it, but the third penny or third part of the sum arising from pleas in the county court; the third, where a tract of land was granted to hold as a county, "per servitium unius comitatus" But this is an opinion open to controversy; and it may be doubted whether there are any settled principles as to the creation or descent of earldoms earlier than the reign of Edward III, when they were granted by letters patent to the earl and the heirs of his body Earldoms, like baronies, gradually became converted from territorial to merely titular honours. These two were the only titles in the English peerage, until the creation of the duchy of Cornwall in the 11th year of Edward III (See *Nicolas's Synopsis of the Peerage of England*)

EARL MA'RSHAL OF ENGLAND. One of the great officers of state, who regulates all great ceremonies, takes cognizance of all matters relating to honour, arms, and pedigree, and superintends the proclamation of peace or war. The court of chivalry, *curia militaris* (now almost forgotten), was formerly under his jurisdiction he is still at the head of the herald's office, or college of arms. Camden, in his discourse concerning the etymology, antiquity, and office of earl marshal, alleges that it was first introduced in the reign of Richard II, who conferred it on Thomas Mowbray, Earl of Nottingham, his predecessors having been styled only *Marshals* of England Various limitations have been made in the grants of this office from time to time, but it is now hereditary in the family of Howard, and enjoyed by its head, the Duke of Norfolk.

EA'RNEST (Lat. arrhæ; Fr arrhes), in Law, is a part of the subject of a contract, as money or goods, transferred, in order by such delivery to pass the property in the whole, or in some other way to confirm the contract. By the Statute of Frauds, 29 C. 2. c. 3, no contract for sale of goods of the value of 10*l* or more is good unless in writing, or unless such earnest be given or taken.

EA'R RINGS. (Germ ohrringe) Well-known ornaments worn by women, and sometimes by men, in all ages and countries. They have assumed an endless variety of forms; but consist generally at present of a simple ring, to which are attached pendant jewels, such as pearls, diamonds, or other precious stones. In the middle ages they were termed *pendants*, to which article the reader is referred for full information.

EARS. In Architecture. *See* CROSETTES.

EAR SHELL. *See* HALIOTIDÆ.

EARTH. (Germ erde, Lat. terra) The name of the planet which we inhabit. It is the third in order from the sun, its orbit embracing the orbits of Mercury and Venus, but being within the orbits of all the other planets. The earth is endowed with a double motion: first, a motion of rotation about an axis passing through its centre; and secondly, a motion of revolution about the sun. It is the first of these motions which produces the phenomena of day and night, and the apparent diurnal revolution of the celestial bodies. The time in which the earth's rotation is performed is measured by the interval which elapses between two transits of the same fixed star over the meridian of any place; and this interval is always precisely the same, for astronomers have proved that it cannot have varied so much as three times the thousandth part of a second since the date of the first astronomical observation, that is to say, during the last two thousand years. It is called the *sidereal day*, and forms a perfectly uniform measure of time.

The revolution of the earth about the sun is performed in an elliptic orbit, which lies all in one plane, and has the sun in one of the foci. The eccentricity of the orbit, or the distance of the foci from the centre, is 0·01679 parts of the mean distance of the earth from the sun; so that if we take the mean distance for unity, the greatest distance of the sun is 1·01679, and the least 0·98321. The mean distance is nearly 95 millions of miles. The motion of the earth in its orbit is not uniform; being most rapid when it is at its *perihelion*, or point nearest the sun, and slowest at its *aphelion*, or greatest distance from the sun. This inequality of the angular motion of the earth about the sun gives rise to an inequality in the lengths of the *apparent* solar day, which is the interval of time between the successive transits of the sun over the same terrestrial meridian. If the earth moved uniformly in its orbit, accomplishing its annual revolution in the same time it does, the interval between any two consecutive transits of the sun over the same meridian would always be the same. This interval is called the *mean solar day*. The time in which the earth performs a revolution in its orbit, with respect to the fixed stars, or points in absolute space, is 365 2563612 mean solar days, or 365 days, 6 hours, 9 minutes, 9·6 seconds. This is called the *sidereal year*.

The plane which contains the earth's orbit is called the plane of the *ecliptic*. The axis of the earth's diurnal rotation is not perpendicular to the plane of the ecliptic, but makes with it an angle of 66° 32′ 4″; whence the *equator* of the earth is inclined to the ecliptic in an angle of 23° 27′ 56″. This inclination, which is called the *obliquity of the ecliptic*, gives rise to the phenomena of the seasons In fact, as the two planes intersect always at the centre of the earth, it is evident that if, while the earth is carried round its orbit its axis of rotation remains always parallel to itself, the sun must rise above the equator during one half of the revolution, and fall below it during the other. Now this is what takes place:—the earth's axis of rotation preserves its parallelism, or points always towards the same star; and the sun in consequence at one period of the year is 23° 27′ 56″ to the north of the equator, and at the opposite season of the year is precisely the same distance to the south of it The straight line formed by the intersection of the planes of the equator and ecliptic does not preserve the same position on the ecliptic; it has a slow motion *westward*, or contrary to the order of the signs, and retreats at the rate of 50·1″ annually, so that when the sun appears to return to the equator the sidereal revolution has not been quite completed: there remains an arc of 50·1″. The time in which the sun, or, to speak correctly, the earth, describes this arc is 20 minutes, 19·9 seconds; consequently the periodical return of the seasons is shorter by 20 m 19·9 sec than the true sidereal revolution of the earth round the sun But the revolution of the seasons forms what is called the *equinoctial* or *tropical* year; which, therefore, is equal to 365·2422414 mean solar days; or 365 d 5 h. 48 m. 49·7 sec.

The figure of the earth is that of an oblate spheroid of revolution, the axis of the poles being to the diameter of the equator in the ratio of 301 to 302. The equatorial diameter is nearly 7925 English miles, and the polar diameter about 7898 miles. (*See* DEGREE.) The mean radius of the earth is 3956 miles. Hence, supposing the earth to be a sphere, its whole surface would contain about 196,663,000 square miles.

The knowledge of the true figure and dimensions of the earth has been obtained by a combination of the results of mathematical theory with the actual measurement of degrees, and observations of the length of the seconds' pendulum at different places on its surface. As a great portion of the surface of the earth is covered by the sea, the general figure must be such as will satisfy the conditions of hydrostatic equilibrum. If the earth were fluid, and had no motion of rotation, its figure would be that of a sphere, but the rotation gives rise to a force which tends to cause every particle to recede from the axis, and which is proportional to the distance of the particle from the axis Hence the attraction of the whole mass on any particle is to a certain extent counteracted by the centrifugal force of rotation, and the attraction is most diminished at the equatorial parts, where the distance from the axis is the greatest. Hence, in order that equilibrium may be restored, an accumulation of matter must take place round the equator, so that the mass will bulge out in that region, and become flattened at the poles. These theoretical considerations only render the spheroidal form of the earth probable; but they are fully confirmed by experiments of different kinds. If the earth is an oblate spheroid of revolution, the force of gravity at its surface must increase on going from the equator towards the poles; and the increase must be exactly proportional to that of the square of the sine of the latitude. Now it has been found by swinging an invariable pendulum at a great number of places, that the increase of gravity from the equator to the poles does follow this law. Anomalous results, indeed, appear; but they are only such as might be expected *à priori* from local irregularities of the surface, which, however, bear a much smaller proportion to the whole mass of the earth than the protuberances on the skin of an orange to its diameter. Another method of determining the exact form of the earth is by measuring the length of degrees of the meridian. Supposing the meridian to be an ellipse, the degrees of latitude must

become longer and longer as we recede from the equator, and the augmentation must be proportioned to the square of the sine of the latitude. This has likewise been found, by numerous measurements undertaken for the purpose, to hold true; so that theory and experiment fully concur in proving the general form of the earth to be that of an oblate spheroid of revolution.

On account of the large proportion of the earth's surface which is covered with water, and the comparatively small height to which the dry land rises above the level, it is evident that the figure of the earth cannot deviate much from that which is required for the hydrostatic equilibrium. It is computed that the proportion of water to land over the whole surface is as 2 to 1; that is to say, two thirds of the whole surface is covered with water, the surface of which must be in equilibrium. The altitude of the highest mountains on the earth above the level of the sea is supposed to be about 26,000 feet, or nearly five miles. But the mean radius of the earth, as we have already stated, is nearly 4000 miles; consequently the greatest superficial inequalities do not exceed the 800th part of the radius. In general they amount to but a small part of this quantity.

The *mass* of the earth compared with that of the sun is nearly as 1 to 355,000. Its mean density, which has been ascertained by observing the effect of mountains in deflecting the plumb-line from the perpendicular (ATTRACTION OF MOUNTAINS), and by experiments on the attraction of leaden balls, is to that of water as $5\frac{1}{2}$ to 1. The centrifugal force at the equator is to that of gravity as 00346 to 1; and the force of gravity there is such that bodies fall through $16\frac{1}{12}$ feet in the first second of time. If the rotation of the earth were 17 times more rapid, the centrifugal force at the equator would be just equal to the attractive force, and bodies would have no weight.

From a knowledge of the form of the earth, and of its mean density, we are enabled to form some conjecture respecting its interior constitution. Newton demonstrated that if the earth were a homogeneous mass, or of equal density throughout, the ratio of its polar to its equatorial diameter would be that of 230 to 231, that is, the ellipticity would be $= \frac{1}{231}$. But the ellipticity found from the actual measurement of degrees is, as we have seen, considerably less than this fraction; consequently the earth is not homogeneous. Huygens, on the other hand, adopting the hypothesis that the density increases regularly from the surface to the centre, at which point it is infinite, found the ratio of the diameters to be that of 578 to 579. The true compression considerably exceeds that given by this ratio; and therefore, since it lies between the results of the two hypotheses, we infer that the density increases towards the centre, but that the density at the centre is not infinitely great.

Considering that the mean density of the whole earth is only about five and a half times that of water, and that the materials of which the crust of the earth is composed are all compressible in a greater or less degree, so that even at no very great depth the density of the different substances must be greatly increased by the mere pressure of the superincumbent materials, some philosophers have supposed that the effects of pressure must be counterbalanced by the expansive force of a great heat subsisting in the interior of the earth, and others that the earth is not solid, but merely a hollow shell of inconsiderable thickness. It has been calculated that at the depth of 35 miles, air, subjected to the pressure of a column of matter of the mean density of that at the surface of the earth, would acquire the density of water; that at the depth of 173 miles, water itself, which is eminently incompressible, would acquire the density of marble; and at the centre, marble would have a density 119 times greater than at the surface. But the comparatively small mean density of the mass proves that none of these effects take place. The hypothesis which supposes the earth to be hollow in the interior, is contrary to every analogy; and as it can be demonstrated from astronomical considerations that the density must increase in descending from the surface to a depth equal at least to one fourth of the radius, it is infinitely probable that this density continues to increase even to the centre; but that a very high temperature exists in the interior of the earth, in consequence of which the materials resist the effects of the condensation due to the pressure to which they are subjected. The principal arguments which have been brought forward to prove the high temperature of the interior parts of the earth, or the central heat, are drawn from the following circumstances:—

1. The form of the earth, nearly spherical, and flattened at the poles of rotation, together with the regular disposition of the materials about the centre in elliptic layers, proves that it must have originally existed in a fluid, if not an aeriform state; so that the constituent molecules must have had free liberty to obey the forces arising from their mutual attraction and from the rotation of the whole mass, and arrange themselves in the position of equilibrium. But there is no other agent than heat to which we can attribute the fusion of such substances as compose the greater part of the exterior crust of the earth. 2. The phenomena of volcanos, hot springs, and earthquakes, receive a very simple explanation on the hypothesis that the nucleus of the earth still remains in a state of fusion, and that the consolidation of the exterior crust still proceeds, though at an extremely slow rate. 3. The fact, which now appears to be fully established, that a sensible increase of temperature takes place as we descend from the surface (in deep mines for example), after passing the depth at which the influence of the solar heat ceases to be felt, furnishes a direct proof of a very high temperature in the interior of the earth. Much uncertainty exists as to the rate at which this increase takes place; but the mean results of a number of experiments made in the deep mines of Cornwall, and different parts of France and Germany, gives an increase of 1° of Fahrenheit's thermometer for every 15 yards of vertical descent, after passing the stratum of constant temperature. Admitting this rate of increase, and supposing it to be continued to the centre, the intensity of heat at the centre will be expressed by 3500° of Wedgewood's pyrometer. The temperature of 100° of Wedgewood, which is sufficient to fuse the lavas and the greater part of the known rocks, would be found at the depth of 125 miles; but M. Cordier, who, in the *Memoirs of the Royal Academy of Sciences of Paris* (volume for 1827), has collected a great number of facts relative to this subject, is of opinion that the phenomena warrant the conclusion that the mean thickness of the solid crust of the earth does not exceed 60 miles.

In order to explain the primitive fluidity of the earth, which it is necessary to admit in consequence of its figure and the law of the diminution of gravity from the poles to the equator, a different hypothesis has been proposed, and had numerous partisans. It consists in supposing a primitive dissolution of all the materials of the earth in a liquid, such as water. But if we consider that the fluidity of all bodies, even of liquids, is an effect of heat; that it is necessary to suppose not merely a partial fusion of the exterior crust, but of the whole mass of the earth; and that the weight of all the water on the globe does not probably amount to a 50-thousandth part of that of the solid materials, the insufficiency of this hypothesis will be apparent.

In whatever manner the earth may have taken its existing form, there are abundant proofs that its surface has been the theatre of many great revolutions. The masses of sand and gravel, and beds of limestone composed of shells and corals, which are found in the interior of continents, and even to the summits of the highest mountains, plainly show that the present land was once immersed deep under the waters of the ocean. The remains of animals and plants belonging to tropical countries, found in the highest latitudes, indicate an entirely different disposition of climates from that which now exists. The appearances of the mineral strata, twisted, and dislocated, and broken asunder, also afford undeniable evidence that the changes which have taken place on the surface of the earth have not all been brought about by the silent action of the causes which we see in daily operation, but by the operation of some violent force which has shaken the globe to its very centre. Whether these convulsions have been produced by an internal or external force, by the action of a central heat heaving up the solid crust of the earth, and raising mountains from the depths of the ocean, or by the collision of a comet, changing the axis of the earth's diurnal rotation, destroying the pre-existing equilibrium, and carrying the waters towards the new equator,—can never be any thing more than matter of speculation and conjecture. All that science makes known on the subject is, that since the time of the first recorded astronomical observations, that is to say, during the last two thousand years, the poles of the earth have been at precisely the same points on its surface as at the present day. *See* GEOGRAPHY, PLANET.

EARTH. In Agriculture, earths are distinguished from soils by their being without organized matter in their composition. Though scarcely any such earths are found on or near the ground's surface, yet the distinction is of use in speaking of soils. Thus we say a soil, the basis of which is earth, of sandstone, or of chalk, &c.

EARTH. In Chemistry this term is applied to certain insoluble metallic oxides of abundant occurrence in rocks and soils, such as silica and alumina. Lime, magnesia, baryta, and strontia have been called *alkaline* earths, their action on vegetable colours being similar to that of the alkalis.

EARTHENWARE. *See* POTTERY.

EARTH NUTS, are various subterranean substances produced by plants. In England the name is given to the nut of *Conopodium flexuosum*, an umbelliferous plant; in Egypt to the round tuber of *Cyperus rotundus*, and other species of the same genus; in China to the subterranean pods of *Arachis hypogæa*, a leguminous plant; and in other countries to similar pods produced by the genera *Voandzeia*, *Amphicarpæa*, &c.: or to the small tubers of Cyperaceous plants.

EARTHQUAKE. One of the most formidable phenomena of nature. As the name implies, it consists of a vio-

lent agitation of the earth, accompanied by various other phenomena more or less singular and destructive in their effects, but by no means uniform in character, as the following enumeration of concomitant circumstances, gleaned from the accounts of various earthquakes that have occurred in ancient and modern times, will sufficiently evince. Earthquakes are usually preceded by a general stillness in the air, and an unnatural agitation of the waters of the ocean and of lakes. The shock comes on with a deep rumbling noise, like that of a carriage over a rough pavement, or with a tremendous explosion resembling a discharge of artillery or the bursting of a thunder cloud; and sometimes heaves the ground perpendicularly upwards, and sometimes rolls it from side to side. The single shocks of an earthquake seldom last longer than a minute, but they frequently follow one another at short intervals for a considerable length of time. During these shocks large chasms are made in the ground, from which sometimes smoke and flames, but more frequently stones and torrents of water, are discharged. In violent earthquakes, these chasms are sometimes so extensive as to overwhelm whole cities at once. In consequence of these shocks, also, whole islands are frequently sunk and new ones raised; the course of rivers is changed; seas overflow the land, forming gulfs, bays, and straits; sometimes disrupting the land into islands, and sometimes joining them to the continent.

There is no portion of the earth's surface, whether it be land or water, that is not more or less subject to earthquakes; and records of their destructive effects have been transmitted to us through every age. The first earthquake particularly worthy of notice was that which, in A. D. 63, destroyed Herculaneum and Pompeii. In the fourth and fifth centuries, some of the most civilized parts of the world were almost desolated by these awful visitations. Thrace, Syria, and Asia Minor, according to contemporary historians, suffered most severely. On the 26th of January, A D. 447, subterranean thunders were heard from the Black to the Red Sea, and the earth was convulsed, without intermission, for the space of six months; and in Phrygia, many cities and large tracts of ground were swallowed up. On the 30th of May, A D. 205, the city of Antioch was overwhelmed by a dreadful earthquake, and 250,000 of its inhabitants are said to have been crushed in its ruins

In the year 1346, Asia Minor and Egypt were violently shaken; and in the following year severe earthquakes were experienced in Cyprus, Greece, and Italy

In 1692, the island of Jamaica was visited by a terrible earthquake, in which enormous masses of earth were detached from the Blue Mountains; and vast quantities of timber, hurled from their flanks, covered the adjacent sea, like floating islands It was during this earthquake that the city of Port Royal, with a large tract of adjacent land, sunk instantaneously into the sea In the following year great earthquakes occurred in Sicily, which destroyed Catania and 140 other towns and villages, with 100,000 of their inhabitants

Since the records of history, there have been no earthquakes equal in intensity to those which ravaged different parts of the world in the eighteenth century. Passing over the convulsion which in 1746 nearly laid waste Lower Peru, and those by which in 1750 the ancient town of Concepcion in Chili was totally destroyed, we come to 1755, when the city of Lisbon was almost wholly destroyed by one of the most destructive earthquakes which ever occurred in Europe It continued only six minutes, but such was the violence of the convulsion, that in that short space upwards of 60,000 persons are said to have perished The phenomena that accompanied it were no less striking The sea first retired and laid the bar dry, it then rolled in, rising fifty feet or more above its ordinary level The largest mountains in Portugal were impetuously shaken from their very foundations, and some of them opened at their summits, which were split and rent in a wonderful manner, huge masses of them being thrown down into the subjacent valleys. But the most remarkable circumstance which occurred at Lisbon during this catastrophe was the entire subsidence of the new quay, called Cays de Prada, to which an immense concourse of people had fled for safety from the falling ruins. From this hideous abyss, into which the quay sunk, not one of the dead bodies ever floated to the surface, and on the spot there is now water to the depth of 100 fathoms. This earthquake excited great attention from the incredibly great extent at which contemporary shocks were experienced. The violence of the shocks, which were accompanied by a terrific subterranean noise, like the loudest thunder, was chiefly felt in Portugal, Spain, and northern Africa; but the effects of the earthquake were perceived in almost all the countries of continental Europe, and were even experienced in the West Indies, and on the Lake Ontario in North America. Ships at sea were affected by the shocks as if they had struck on rocks; and even at some of the Scottish lakes, Loch Lomond in particular, the water, without the least apparent cause, rose to the perpendicular height of two feet four inches against its banks, and then subsided below its usual level. During the next twenty years, various earthquakes occurred in different parts of the world, attended with more or less destructive consequences. In 1759, Syria was agitated by violent earthquakes, the shocks of which were protracted for three months, throughout a space of 10,000 square leagues, and levelled to the ground Accon, Saphat, Balbeck, Damascus, Sidon, Tripoli, and many other places. In each of these places many thousands of the inhabitants perished; and in the valley of Balbeck alone, 20,000 men are said to have been victims to the convulsion. In 1766, the island of Trinidad and great part of Columbia were violently agitated by earthquakes. In 1772, the lofty volcano of Papandayang, the highest mountain in Java, disappeared, and a circumjacent area, fifteen miles by six, was swallowed up. In 1783, the north-eastern part of Sicily and the southern portion of of Calabria were convulsed by violent and oft-repeated shocks, which overthrew the town of Messina, and killed many thousands of its inhabitants, as well as many persons in Calabria. In the same year the islands of Japan, Java in 1786, Sicily and the Caraccas in 1790, Quebec in 1791, and the Antilles and Peru in 1797, were violently agitated by convulsions of this kind.

Since the commencement of the present century, various earthquakes have occurred both in the Old and New World. In 1811, violent earthquakes shook the valley of the Mississippi, by which lakes of considerable extent disappeared, and new ones were formed. In 1812, Caraccas was destroyed, and upwards of 12,000 of its inhabitants buried in the ruins. In 1815 the town of Tombora, in the island of Sumbawa, was completely destroyed by an earthquake, which extended throughout an area 100 miles in diameter, and destroyed 12,000 persons. In 1819, a violent earthquake occurred at Cutch, in the Delta of the Indus, by which, among other disastrous consequences, the principal town, Bhoog, was converted into a heap of ruins. In 1822, Aleppo was destroyed by an earthquake. In the same year Chili was visited by a most destructive earthquake, from which the coast for 100 miles is stated to have sustained an elevation of from two to four feet, while about a mile inland from Valparaiso it was raised from six to seven feet. In 1827, Popayan and Bogota suffered severely from earthquakes, during which vast fissures opened in the elevated plains around the latter city. In 1835, the town of Concepcion, in Chili, was entirely demolished by an earthquake. In 1837, the countries along the eastern extremity of the Mediterranean, especially Syria, were violently agitated by an earthquake, which caused great damage to the towns of Damascus, Acre, Tyre, and Sidon, and entirely destroyed Tiberias and Safet. Such are some of the most violent earthquakes that have occurred within the period of authentic history. The reader will find in *Poggendorf's Annalen* lists of the different earthquakes that have taken place within the last twenty years; and from these it will be observed that scarcely a month elapses without being signalized by one or many convulsions in some part of the globe. Shocks of earthquakes have at different times been felt in various parts of Britain, and more particularly in Scotland; but they have all fortunately been so insignificant, compared to those which have been experienced in other countries, that we shall refrain from entering into any details respecting them.

But though history supplies us with so large a catalogue of well-authenticated earthquakes, it is surprising that so little was done by the ancients either in investigating their causes or noticing their effects. It is only within the last century and a half, says Mr. Lyell, since Hooke first promulgated his views respecting the connection between geological phenomena and earthquakes, that the permanent changes effected by these convulsions have excited attention. Before that time the narrative of the historian was almost exclusively confined to the number of human beings who perished, the number of cities laid in ruins, the value of property destroyed, or certain atmospheric appearances which dazzled or terrified the observers. The creation of a new lake, the engulphing of a city, or the raising of a new island, are sometimes, it is true, adverted to, as being too obvious or of too much geographical interest to be passed over in silence. But no researches were made expressly with the view of ascertaining the amount of depression or elevation of the ground, or any particular alterations in the relative position of sea and land; and very little distinction was made between the raising of soil by volcanic ejections, and the upheaving of it by forces acting below. The same remark applies to a very large proportion of modern accounts; and how much reason we have to regret this deficiency of information appears from this, that in every instance where a spirit of scientific inquiry has animated the eye-witnesses of these events, facts calculated to throw light on former modifications of the earth's structure are recorded. Upon these questions, however, it is not our present intention to enter, as they will be more appropriately treated of under the heads GEOLOGY

and VOLCANO; to which articles we must refer the reader for an account of the various theories that have been maintained in regard to the origin or cause of earthquakes, as well as for a view of the grand permanent changes which these convulsions have produced on the surface and in the internal structure of the earth's crust. See *Bakewell's Introduction to Geology; Lyell's Geology; Traill's Physical Geography;* and *Phillips's Geology*.

EA'RWIG. *See* DERMAPTERA FORFICULA.

EA'SEL. (Germ. esel, *an ass*.) In Painting, a wooden frame used for supporting a picture during the progress of its execution.

EA'SEL PIECES. In Painting, pictures whose size is small enough to be painted on an easel.

EA'SEMENT. In Law, a convenience which one man has of another, his neighbour, by grant or prescription. Easements were included in the Roman law under the title servitutes; such are a way over the lands of another, or a water-course.

EAST. (Germ. Ost.) The point of the horizon at which the sun rises at the time of the equinoxes; or the point determined by a perpendicular to the meridian drawn towards the quarter of sunrise. The *east* is one of the four *cardinal points* of the compass.

EA'STER. (Germ. Ostern.) The festival which is held in commemoration of our Lord's resurrection. The term seems to be derived from a Saxon word signifying *rising*.

The Jews celebrated their passover, in conformity with the directions given them by Moses, on the 14th day of the month Nisan, being the lunar month of which the 14th day either falls on, or next follows, the day of the vernal equinox. In the year of our Lord's crucifixion this fell on a Friday: the resurrection, therefore, took place on the first day of the next week, which from thence is denominated the Lord's day. The primitive Christians in their desire to celebrate this anniversary fell into two different systems. The Western churches observed the nearest Sunday to the full moon of Nisan, taking no account of the day on which the passover would be celebrated. The Asiatics, on the other hand, following the Jewish calendar, adopted the 14th of Nisan upon which to commemorate the crucifixion, and observed the festival of Easter on the third day following, upon whatever day of the week that might fall; hence they obtained the name of Quartodecimantes the former appealed to the authority of St. Peter and St. Paul, the latter to that of St. John.

The dispute which took place upon this point in the 2d and 3d centuries of our era is remarkable, as connected with perhaps the first event which can be brought to bear upon the question of the primacy of the Roman bishop; and it is the more interesting as both parties are accustomed to claim it as a testimony in favour of their own views. Victor, bishop of Rome, wrote an imperious letter to the Asiatic bishops, requiring their conformity to the Western rule; which was answered by Polycrates, bishop of Ephesus, in the name of the rest, expressing their resolution to maintain the custom handed down to them by their ancestors. The Roman bishop thereupon broke off communion with them; but he was rebuked by Irenæus of Lyons, and it was agreed by his mediation that each party should retain its customs. Such continued to be the practice till the time of Constantine, when the Council of Nice determined the matter by the following canons —

1. Easter must be celebrated on a Sunday
2. This Sunday must *follow* the 14th day of the paschal moon; so that if the 14th day of the paschal moon falls on a Sunday, then Easter must be celebrated on the Sunday following.
3. The paschal moon is that moon of which the 14th day either falls on, or next follows, the day of the vernal equinox.
4. The 21st day of March is to be accounted the day of the vernal equinox.

The new moons, it is necessary to observe, are those of the ecclesiastical calendar, which are determined arbitrarily (by the lunar cycle in the Julian calendar, and by means of the table of epacts in the Gregorian), so that the above rules define Easter without ambiguity. The new moons of the calendar are in general one or two days, sometimes even three days, *later* than the astronomical or true new moons; and the 14th day of the moon is accounted the full moon, although the opposition takes place more frequently on the 16th day. *See* CALENDAR, EPACT.

EAST INDIA COMPANY. A famous joint stock association originally established to carry on the trade between this country and the East Indies, or rather with the countries to the eastward of the Cape of Good Hope. It was constituted by royal charter in 1600, and continued, notwithstanding repeated efforts to open the trade, to enjoy the exclusive privileges originally conceded till 1688. At that period the power of the crown to restrain the freedom of trade without the sanction of parliament having been denied, a rival association obtained an act of parliament in its favour; but after a variety of negotiations, which it is unnecessary to specify, the two corporations were joined in 1702 under the name of "The United Company of Merchants trading to the East Indies;" an appellation which has been continued to the present day. In 1708 the United Company was secured by parliament in the exclusive privilege of trading to all places eastward of the Cape of Good Hope to the Straits of Magellan; and this privilege, with some modifications, was confirmed and prolonged by successive acts of parliament down to 1814. By the act 53 Geo. 3. c. 133., passed in 1813, the East India Company's charter was renewed for twenty years; but it then received some important modifications, by which a restricted intercourse was permitted to all British merchants with the whole of the Company's Indian possessions; the monopoly of the trade between England and China being, however, retained in the hands of the East India Company. These concessions paved the way for the act of 1833, by which, though the Company's charter was prolonged till 1854, not only was the monopoly of the China trade abolished, but an end wholly put to the Company's original character of a commercial association.

But it is not as a commercial association so much as a great territorial power, that the East India Company has become so distinguished. The first establishments of the English in India, as of other European nations, arose out of the alleged necessity of providing armed factories or strongholds, where the adventurers might warehouse their goods, and reside in safety for the purpose of carrying on their intercourse with the natives; but the factories speedily degenerated into fortifications, and the garrisons into armies. For a while the power of the English and French was pretty nearly balanced in India; but the talents and victories of the famous Lord Clive gave us a decided superiority over every competitor, foreign or native, and extended our sway over some of the largest and finest portions of the Mogul empire. The policy of Clive, whether it were really approved by the succeeding governors-general of our Indian dominions, or were forced upon them by necessity, has, some few short intervals excepted, been steadily followed up; and with such signal success, that our Indian empire comprizes at present the whole of Hindostan from the Himalaya Mountains to Cape Comorin, with a population of above 120 millions!

The most exaggerated accounts have been at all times current in Europe of the extraordinary wealth of India, and of the importance of the commerce with that part of the world. After the victories of Lord Clive, the most sanguine expectations began to be entertained, not only of a vast increase of trade with India, but that we should draw from her an immense amount of surplus revenue, or tribute. Perhaps it is not going too far to say that these expectations have been entirely disappointed. Great abuses existed in the government of the Bengal provinces when conquered by Clive, the servants of the East India Company making large fortunes by the oppression of the natives and the ruin of the country. But, notwithstanding the eradication of the abuses in question, the immense additions that have since been made to our empire, and the oppressive taxes laid on the natives, it is not very clear that England has hitherto derived any direct revenue from India. The distance of the country, and the totally dissimilar language and customs of the people, are very great obstacles to our governing it with the economy necessary to make it yield any considerable amount of surplus revenue. The East India Company always contended that the profits made by their monopoly of the China trade were necessary to enable them to conduct the government of India. But, though there are strong grounds on which to impeach the accuracy of this statement, still it is abundantly clear that the surplus revenue we have derived from India, supposing there has been any such, has been comparatively inconsiderable; and quite trifling, indeed, compared with our own anticipations, and with the notions entertained by others of its magnitude.

Until 1815 and 1816, when the continued fall in the price of cotton goods, caused by the astonishing discoveries and inventions of Arkwright, and the other founders and improvers of the cotton manufacture, enabled us to export cottons to India and to undersell the natives, the trade between this country and India was of the most limited description. Previously to the opening of the trade in 1813-14 the total amount of the exports of all sorts, including the important item of military stores, by the East India Company and by private traders in the Company's ships, did not amount to 1,400,000*l.* a year; and even on this a considerable loss is believed to have been incurred! But such has been the increased demand for British cottons, that the value of those exported to India amounts, at present, to above 2,500,000*l.* a year, and the whole of our exports to her to near 4,000,000*l.* Even this, considering the vast extent of India, is but a trifling export; it is, in fact, less than half the amount of our exports to the United States.

The restricted amount of our commerce with India may, perhaps, be in some degree ascribed to its having

been so long monopolized by the East India Company. But this will not explain the small surplus of Indian revenue; for, however ill fitted to serve as a commercial engine, the East India Company has governed India with singular discretion; and has made the most praiseworthy efforts to enforce economy in all departments of the administration, and to appoint the best men to all situations of power and emolument in that country. The patronage of India has always been less jobbed and abused than that of England; and there are few governments that have made more vigorous exertions to repress abuse, and to protect the rights of their subjects.

Under the act 3 & 4 W. 4. c. 85., to which we have alluded above, for continuing the charter till 1854, the functions of the East India Company have been rendered wholly political. She is to continue to govern India, with the concurrence and under the supervision of the Board of Control (*see* CONTROL, BOARD OF) nearly on the plan laid down in Mr. Pitt's act, in 1784, by which the Board of Control was constituted All the real and personal property belonging to the company on the 22d of April, 1834, is vested in the crown, and is to be held or managed by the company in trust for the same; subject, of course, to all claims, debts, contracts, &c. already in existence, or that may hereafter be brought into existence by competent authority. The company's debts and liabilities are all charged on India. The dividend, which is to continue at 10½ per cent, is to be paid in England out of the revenues of India, and provision is made for the establishment of a *security fund* for its discharge The dividend may be redeemed by parliament, on payment of 200*l* for 100*l* stock, any time after April, 1874; but it is provided, in the event of the company being deprived of the government of India in 1854, that they may claim redemption of the dividend any time thereafter upon 3 years' notice. (3 & 4 *Will* 4 c. 85.)

*Company's Stock* — forms a capital of 6,000,000*l*, into which all persons, natives or foreigners, males or females, bodies politic or corporate (the Governor and Company of the Bank of England only excepted), are at liberty to purchase, without limitation of amount. Since 1793, the dividends have been 10½ per cent., to which they are limited by the late act

*General Courts* — The proprietors in general court assembled are empowered to enact by-laws, and in other respects are competent to the complete investigation, regulation, and control of every branch of the company's concerns, but, for the more prompt despatch of business, the executive detail is vested in a court of directors A general court is required to be held once in the months of March, June, September, and December, in each year No one can be present at a general court unless possessed of 500*l*. stock, nor can any person vote upon the determination of any question who has not been in possession of 1000*l*. stock for the preceding 12 months, unless such stock have been obtained by bequest or marriage. Persons possessed of 1000*l* stock are empowered to give a single vote. 3000*l* are a qualification for two votes, 6000*l*. for three votes; and 10,000*l* and upwards for four votes. There were 2003 proprietors on the company's books in 1825; of these, 1494 were qualified to give single votes; 392, two votes; 69, three votes, and 48, four votes. Upon any special occasion, 9 proprietors, duly qualified by the possession of 1000*l* stock, may, by a requisition in writing to the court of directors, call a general court; which the directors are required to summon within 10 days, or, in default, the proprietors may call such court by notice affixed upon the Royal Exchange. In all such courts the questions are decided by a majority of voices; in case of an equality, the determination must be by the treasurer drawing a lot. Nine proprietors may, by a requisition in writing, demand a ballot upon any question, which shall not be taken within 24 hours after the breaking up of the general court.

*Court of Directors.* — The court of directors is composed of 24 members, chosen from among the proprietors, each of whom must be possessed of 2000*l*. stock; nor can any director, after being chosen, act longer than while he continues to hold stock. Of these, 6 are chosen on the second Wednesday in April in each year, to serve for 4 years, in the room of 6 who have completed such service. After an interval of 12 months, those who had gone out by rotation are eligible to be re-elected for the ensuing 4 years. Formerly, no person who had been in the company's civil or military service in India was eligible to be elected a director until he had been a resident in England two years after quitting the service; but this condition no longer exists; and all civil or military servants of the company in India, supposing they are otherwise eligible, may be chosen directors immediately on their return to England, provided they have no unsettled accounts with the company; if so, they are ineligible for 2 years after their return, unless their accounts be sooner settled. (3 & 4 *Will.* 4. c. 85. § 28.) The directors choose annually, from amongst themselves, a chairman and a deputy-chairman. They are required by by-laws to meet once in every week at least, but they frequently meet oftener, as occasion requires. Not less than 13 can form a court. Their determinations are guided by a majority. In case of an equality, the question must be decided by the drawing of a lot by the treasurer: upon all questions of importance, the sense of the court is taken by ballot. The company's officers, both at home and abroad, receive their appointments immediately from the court, to whom they are responsible for the due and faithful discharge of the trust reposed in them. The patronage is, nevertheless, so arranged, as that each member of the court separately participates therein.

*Secret Committee* — The principal powers of the court of directors are vested in a secret committee, forming a sort of cabinet or privy council. All communications of a confidential or delicate nature between the Board of Control and the company are submitted, in the first instance at least, to the consideration of this committee; and the directions of the board, as to political affairs, may be transmitted direct to India, through the committee, without being seen by the other directors. The secret committee is appointed by the court of directors, and its members are sworn to secrecy.

The territorial possessions of the East India Company are divided into the three presidencies of Bengal, Madras, and Bombay, at each of which the executive government is administered by a governor and three councillors, the governor of the Bengal presidency being at the same time governor-general of India. In their several presidencies, the governors and their councillors possess the privilege of enacting and enforcing laws; subject, however, in some cases, to the concurrence of the supreme court of judicature, and, in all cases, to the approval of the court of directors and the board of control.

We copy the following tables of Revenue, &c. from Mr. M'Culloch's *Statistics*, vol. ii. p. 519.

AN ACCOUNT of the Total Annual Revenues and Charges of the British Possessions in India under the East India Company, from 1809-10 to 1829-30; showing also the Nett Charge of Bencoolen, Prince of Wales Island, and St. Helena, the Interest paid on account of Debts in India, and the Amount of Territorial Charges paid in England. — (*Parl. Papers*, No 22. Sess. 1830, and No. 306 Sess 1833)

| Years. | Total Gross Revenues of India. | Total Charges in India. | Nett Charge of Bencoolen, &c. | Interest on Debts. | Territorial Charges paid in England. | | | General Result. | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cost of Political Stores. | Payments, Pensions, &c. | Total. | Surplus Revenue. | Surplus Charge. |
| | *L.* | *L.* | *L.* | *L.* | *L.* | *L.* | *L.* | *L.* | *L.* |
| 1809—10 | 16,464,391 | 13,775,577 | 203,361 | 2,159,019 | 190,128 | 867,097 | 1,057,225 | - - | 730,791 |
| 1810—11 | 16,679,198 | 13,909,983 | 199,663 | 2,196,691 | 217,703 | 901,688 | 1,119,391 | - - | 736,530 |
| 1811—12 | 16,605,616 | 13,220,967 | 168,258 | 1,157,077 | 151,998 | 922,770 | 1,077,768 | 681,516 | |
| 1812—13 | 16,159,774 | 13,659,129 | 201,349 | 1,491,870 | 193,784 | 1,184,976 | 1,378,768 | - - | 271,634 |
| 1813—14 | 17,228,711 | 13,617,725 | 209,957 | 1,537,134 | 64,257 | 1,148,156 | 1,212,413 | 651,182 | |
| 1814—15 | 17,231,191 | 14,182,154 | 201,250 | 1,502,217 | 129,873 | 1,064,223 | 1,194,596 | 117,677 | |
| 1815—16 | 17,168,195 | 15,081,587 | 225,558 | 1,584,157 | 81,903 | 1,199,952 | 1 281,885 | - - | 1,004,992 |
| 1816—17 | 18,010,135 | 15,129,839 | 205,372 | 1,719,470 | 191,374 | 1,071,1 6 | 1,265,550 | - - | 310,096 |
| 1817—18 | 18,305,265 | 15,841,964 | 219,793 | 1,753,018 | 81,941 | 1,094,701 | 1,176,642 | - - | 689,152 |
| 1818—19 | 19,392,002 | 17,558,615 | 210,224 | 1,665,921 | 133,162 | 1,150,378 | 1,280,540 | - - | 1,323,305 |
| 1819 20 | 19,172,506 | 17,010,848 | 142,019 | 1,910,327 | 265,055 | 1,150,391 | 1,415,446 | - - | 1,466,164 |
| 1820—21 | 21,292,036 | 17,520,612 | 220,043 | 1,902,585 | 228,058 | 1,072,106 | 1,300,164 | 348,632 | |
| 1821—22 | 21,753,271 | 17,555,668 | 207,816 | 1,932,535 | 202,735 | 1,175,149 | 1,377,884 | 979,068 | |
| 1822—23 | 23,120,934 | 18,083,482 | 154,761 | 1,694,731 | 204,147 | 1,354,960 | 1,559,107 | 1,528,853 | |
| 1823—24 | 21,238,623 | 18,902,511 | 257,276 | 1,652,449 | 305,276 | 758,590 | 1,153,866 | - - | 727,479 |
| 1824—25 | 20,705,152 | 20,410,929 | 279,277 | 1,460,433 | 414,181 | 1,166,078 | 1,580,259 | - - | 3,025,746 |
| 1825—26 | 21,096,960 | 22,316,365 | 214,285 | 1,575,941 | 740,728 | 1,076,504 | 1,817,232 | - - | 4,856,867 |
| 1826—27 | 23,327,753 | 21,424,894 | 207,973 | 1,749,068 | 1,111,792 | 1,318,102 | 2,429,894 | - - | 2,484,076 |
| 1827—28 | 22,818,184 | 41,778,431 | 272,014 | 1,958,313 | 805,016 | 1,255,125 | 2,060,141 | - - | 3,250,715 |
| 1828—29 | 22,692,711 | 19,298,622 | 250,791 | 2,121,165 | 449,603 | 1,517,802 | 1,967,405 | - - | 945,275 |
| 1829—30 | 21,669,310 | 18,300,715 | 215,304 | 3,007,693 | 293,873 | 1,454,867 | 1,748,740 | - - | 608,142 |

# EAST INDIA COMPANY.

**Abstract View of the Revenues and Charges of India, for the Years 1847-48, 1848-49, and (by estimate) 1849-50.**

| | Revenues. | | | | Charges. | | | |
|---|---|---|---|---|---|---|---|---|
| | 1847-48. | 1848-49. | 1849-50, (partly estimated). | | 1847-48. | 1848-49. | 1849-50, (partly estimated). |
| | *Co.'s Rs.* | *Co.'s Rs.* | *Co.'s Rs.* | | *Co.'s Rs.* | *Co.'s Rs.* | *Co.'s Rs.* |
| Bengal - - | 7,73,93,036 | 7,89,12,192 | 8,72,36,862 | Bengal - - - | 10,36,86,218 | 10,22,43,492 | 10,32,33,610 |
| North-Western provinces, inc. Punjaub and Trans-Indus territory - - | 5,00,51,482 | 4,99,83,128 | 6,43,68,000 Actual. | North-Western provinces, inc. Punjaub and Trans-Indus territory - - | 88,05,406 | 1,01,44,420 | 1,75,14,000 Actual. |
| Madras - - | 3,88,11,613 | 3,91,17,169 | 3,77,92,791 | Madras - - | 3,59,83,417 | 3,43,62,612 | 3,34,76,033 |
| Bombay - - | 2,12,30,874 | 2,64,09,534 | 2,63,63,170 | Bombay - - | 2,72,35,052 | 3,12,48,216 | 3,14,42,547 |
| Total nett revenues of India, Co.'s rupees - | 18,74,87,005 | 19,44,22,023 | 21,57,00,826 | Total, including war charges, Co.'s rupees | 17,57,10,093 | 17,79,98,740 | 18,56,66,190 |
| At 2*s.* per Sicca rupee - - *L.* | 17,576,907 | 18,227,065 | 20,221,952 | At 2*s.* per Sicca rupee - - *L.* | 16,472,821 | 16,687,382 | 17,406,206 |
| Commercial assets of Bengal, at 2*s.* per Sicca rupee - *L.* | 195 | 285 | 37 | Charge on discharge of debt of Bengal, at 2*s.* per Sicca rupee *L* | - - | 175 | |
| Total nett revenues and receipts in India - *L.* | 17,577,102 | 18,227,350 | 20,221,989 | Total charges in India - *L.* | 16,472,821 | 16,687,557 | 17,406,206 |
| | | | | Charges in England on account of India *L.* | 3,016,072 | 3,012,908 | 2,750,937 |
| Deficiency, after deducting produce of commercial assets *L.* | 1,911,791 | 1,473,115 | | Total charges of India - *L.* | 19,488,893 | 19,700,465 | 20,157,143 |
| | | | | Surplus, estimated *L.* | - - | - - | 64,846 |
| *L.* | 19,488,893 | 19,700,465 | 20,221,989 | *L* | 19,488,893 | 19,700,465 | 20,221,989 |

N. B. The debts of the E. I. Company in India, on the 30th of April, 1849, amounted to 44,204,080*l*, bearing an interest of 2,101,322*l*. a year.

We subjoin the following table, exhibiting the extent and population of India, which we copy from the Parliamentary Paper, No. 219, Session 1851, on the Trigonometrical Survey of India.

| British States. | Area. | Population. | Area. | Population. |
|---|---|---|---|---|
| | *Sq Miles.* | | *Sq Miles.* | |
| Bengal - - - - - | 325,652 | 47,958,320 | | |
| North Western Provinces - - - | 85,571 | 23,800,549 | | |
| Madras - - - - - | 111,889 | 16,339,126 | | |
| Bombay - - - - - | 120,065 | 10,185,017 | | |
| Eastern Straits Settlements - - - | 1,575 | 202,540 | | |
| | | | 677,752 | 98,785,852 |
| Native States. | | | | |
| Bengal - - - - | 583,404 | 43,051,596 | | |
| Madras - - - - | 50,637 | 4,691,230 | | |
| Bombay - - - - | 56,320 | 4,613,225 | | |
| | | | 690,361 | 52,359,051* |
| Foreign States. | | | | |
| French - - - - - | 158 | 171,217 | 1,368,113 | 151,144,903 |
| Portuguese - - - - - | 800 | not known | 988 | 171,217 |
| | | Grand Total - | 1,369,101 | 151,316,120 |
| India beyond the Ganges. — *British Acquisitions in* 1824 *and* 1825. | | | | |
| Countries south of Rangoon, consisting of half the province of Martaban, and the provinces of Tavoy, Ye, Tenasserim, and the Mergui isles - - - - - | | | 12,000 | 61,000 |
| The province of Arracan - - - - - | | | 11,000 | 100,000 |
| Countries from which the Burmese have been expelled, consisting of Assam and the adjacent petty states, occupying a space of about - - - - - - | | | 54,000 | 150,000 |
| Total - - - - - - | | | 77,000 | 301,000 |

* It is proper to observe that this statement of the population of the Native States must be regarded only as an approximation to the actual amount. In a large number of cases the particulars have been derived from official sources, where no information of an official character existed, recourse was had to such publications as had reference to the subject, but some of these, it is right to mention, are not of recent date. Thus, the population of the States of Central India is given chiefly on the authority of Sir John Malcolm, and that of the Rajpoot States on that of Col. Tod. In regard to the few states where no information from any quarter was attainable, the density of the population has been calculated in the same ratio to their areas as was found to prevail in the territories by which they are respectively surrounded.

**EASY.** The sea phrase for a ship that moves over the sea without jerking or straining.

**EAU DE COLOGNE.** A perfumed spirit originally prepared at Cologne, and principally used as a perfume; though many imaginary medical virtues have also been ascribed to it. Various recipes have been published for the preparation of eau de Cologne. The following affords a good imitation of the original article: — Take of alcohol one pint; of the oils of bergamot, orange-peel, and rosemary, each one drachm; of bruised cardamom seeds one drachm; orange-flower water one pint; distil one pint from a water-bath.

**EAU DE LUCE.** A strong solution of ammonia, scented and rendered milky by the addition of a little mastic and oil of amber. It is considered an effective remedy in India against the bites of poisonous snakes.

**EAVES.** (Fr. eaux.) In Architecture, the lowest edges of the inclined sides of a roof which project beyond the face of the wall so as to throw the water off therefrom, that being their office.

**EBBING OF THE TIDE.** The reflux of the tide. *See* Tide.

**EBENA'CEÆ.** (Ebenus, one of the genera.) A natural order of shrubby or arborescent Exogens, chiefly inhabiting the tropics. They are allied to *Oleaceæ*, with which they agree in the placentation of their seeds; but are distinguished by their alternate leaves, and axillary usually unisexual flowers. They are more closely related to *Aquifoliaceæ;* but differ in the number of their stamens and in their divided sexes. Some species are remarkable for the hardness and blackness of their wood, known under the name of ebony and iron wood; others, as the *Kaki* of China, yield an eatable fruit; all are beautiful objects when growing.

**E'BIONITES.** An ancient sect (referred by Mosheim to the second century), who believed in Christ as an inspired messenger of God, but considered him to be at the same time a mere man, born of Joseph and Mary. They maintained also the universal obligation of the Mosaic law, and rejected the authority of St. Paul. The origin of their name is uncertain, some deriving it from that of their supposed founder; others deduce it from a Hebrew word signifying *poor*, and suppose the title to be given to them in reference either to the *poverty* of the class to which they mostly belonged, or the *meanness* of their doctrine. (See *Gieseler's Eccl. Hist.* b. i. c. 3.)

**E'BONY.** *See* Ebenaceæ.

**EBULLI'TION.** (Lat. ebullitio, *bubbling up*) The motion produced in a liquid by its rapid conversion into vapour.

**ECCHYMO'SIS.** (Gr. ἐκχέω, *I pour out.*) The extravasation of blood into the cellular membrane which results from blows and bruises.

**ECCLE'SIA.** (Gr. ἐκκλησια.) In Ancient History,

the great assembly of the Athenian people, at which every free citizen might attend and vote. This assembly, though nominally possessed of the supreme authority of the state from the earliest times, yet having no fixed times of meeting, was but seldom convened at all; so that the archons, who were elected from the body of nobles or eupatridæ, had virtually the whole management of the state. But the regulations of Solon, which appointed it to meet regularly four times in every period of thirty-five days, besides extraordinary occasions on which it might be convened, called it into active energy. Solon, however, restricted the subjects discussed in the Ecclesia to such as had before passed through the senate of five hundred; but when the democratic spirit of after times prevailed, this rule was not at all strictly observed. The magistrates who had the management of these assemblies were the Prytanes (*see* PRYTANES), the Probedri (*see* PROHEDRI), and Epistates (*see* EPISTATES). The first of these sometimes convened the people, and hung up in a conspicuous place a programme giving an account of the matters to be discussed. The *Probedri* proposed to the people the subjects on which they were to decide, and counted the votes. The *Epistate*, who presided over the whole, gave the liberty of voting, which might not be done before his signal was given.

The forms of their proceedings were as follow: — First, an expiatory victim was sacrificed, and his blood carried and sprinkled round the bounds of the assembly. Then the public crier demanded silence, and invited all persons above fifty years of age to speak; after that, any one who pleased. After the subject was discussed, they proceeded to vote on the crier's [illegible] of them, "whether they would consent to the decree proposed to them?" The votes were commonly given by show of hands, but on some occasions by ballot. When the suffrages had been examined and their numbers declared, the *Prytanes* dissolved the assembly. In order to incite the people to attend the Ecclesia, a small pay of one or three oboli was given for early appearance; and a rope, rubbed with vermilion, was carried through the Agora, to mark such as lagged behind, who were accordingly fined.

ECCLE'SIA'STES. One of the canonical books of the Old Testament, so called from the Greek word signifying a preacher. Solomon is generally supposed to be the author of this book, though various opinions have been entertained on the subject, and indeed the whole question of its author, date, and design is involved in such difficulty, "that the labours of critics and commentators serve rather to perplex than to assist the inquirer." (*Holden on Eccles.*)

ECCLE'SIA'STIC. Something pertaining to or set apart for the church; in contradistinction to *civil* or *secular*, which regards the world. Ecclesiastics are persons whose functions consist in performing the service or in maintaining the discipline of the church. *See* CLERGY.

ECCLESIASTICAL COURTS. The ordinary Ecclesiastical Courts in England and Wales are, beginning with the lowest, —

1. The Peculiar Courts, which are very numerous; Royal, Archiepiscopal, Episcopal, Decanal, Sub-decanal, Prebendal, Rectorial, and Vicarial, with jurisdiction frequently extending only to a single parish, and sometimes limited only to a part of the matters usually subject to ecclesiastical cognizance.

2. The Archdeacon's Court, generally subordinate, with an appeal to that of the bishop.

3. The Courts of Commissaries, especially appointed by the bishop.

4. The Diocesan Court of every bishop within his respective diocese.

5. The Provincial or Archiepiscopal Courts.

These, in the province of Canterbury, which contains twenty-two dioceses, are —

(1.) The Court of Peculiars, which takes cognizance of matters arising in some particular deaneries.

(2.) The Prerogative Court. This court has authority in the matter of all wills or administrations of property left by persons having *bona notabilia*, that is, personal estate to a certain amount, within several dioceses of the province. It grants administration to the effects of all such persons dying intestate, and probate of wills.

(3.) The Court of Arches, or Supreme Provincial Court of Appeal. It also may take original cognizance of causes, by letters of request from the inferior courts, and it has a separate jurisdiction of its own in suits for legacies.

The province of York, including four dioceses besides that of Sodor and Man, has two courts; the Prerogative Court, and the Chancery or Court of Appeal.

A suit is commenced in the Ecclesiastical Courts by a process, sued out by the party complaining, and served on the other party by an officer of the court. The party cited may appear either in person or by his proctor, who discharges duties similar to those of the attorneys in common law courts. A party disobeying citation may be pronounced contumacious, and imprisoned by an attachment out of the lord chancellor's court.

In case the party cited appear to show cause against his citation that the court has no jurisdiction, or that he is not amenable to it, this preliminary objection is heard upon petition and affidavits. If the judge decide against the defendant on the question of jurisdiction, the latter may apply to the courts of common law for a prohibition.

If the cause proceed to trial, the plaintiff's first statement of facts is termed, in criminal cases, *articles*; in testamentary causes, an *allegation*; in other civil proceedings, a *libel*. Every subsequent plea in all cases is called an allegation; and every allegation is divided into separate heads or articles; so that witnesses are produced and examined, not as to the whole allegation, but as to such special facts as may be within their knowledge. Where a plea has been admitted, a certain time, or *term probatory*, is allowed to the party making it to examine his witnesses.

The witnesses are either brought to London, or examined in the country by a commission. The depositions are taken in private, and in writing, by the examiners of the court; who, on view of the allegations, examine the witnesses by such questions as they judge most proper to elicit the truth. The cross-examination is conducted by means of interrogatories delivered by the adverse party to the examiner, and by him addressed to the witness. The examinations are kept secret until publication passes; after which either party is allowed to except, by a plea called an exceptive allegation, to the credit of an adverse witness.

When the cause is heard, the judge first peruses and carefully considers all the pleas and evidence, and then hears the case argued by counsel. Judgment is given in open court; and execution enforced by the compulsory process of *contumacy*, *significavit*, and *attachment*. Such is a very general view of the ordinary process of these courts.

If either party be condemned in costs, the other party's bill is taxed by the registrar. But the costs due by a party to his own proctor cannot be recovered in this court, and must be sued for by an action at law.

The law of the Ecclesiastical Courts is administered by men associated, as a distinct profession, for the practice of the civil and canon laws. They are incorporated as "the college of doctors of law." Every advocate must have taken that degree in the university of Oxford or Cambridge. From the college of advocates the archbishop selects the judges of the provincial courts.

The jurisdiction of these courts may be considered as threefold —1. In causes of a purely spiritual nature pertaining to the discipline of the church; 2. In mixed causes, partaking of a spiritual and civil nature; 3. In causes of a purely civil nature.

1. The first of these branches arises out of the natural power exercised by every church to correct its communicants by censures and discipline submitted to. Under this class falls the cognizance of offences committed by the clergy themselves by neglect of duty, immoral or heretical delinquencies, suffering dilapidations, &c.; also by laymen, in brawling and other indecent conduct in churches and churchyards, in neglecting to repair churches, in cases of incest, incontinence, defamation. All these, except the last, are termed "causes of correction." The punishments inflicted are monition, penance, excommunication, suspension *ab ingressu ecclesiæ*, and (in the case of clergymen) suspension from office and deprivation. In the case of laymen a great part of this jurisdiction has fallen into disuse; and the real penalty, whenever a cause is tried, consists, for the most part, in the payment of costs by the guilty party. The terrors so long attached to the process of excommunication (the only one by which ecclesiastical courts can enforce a sentence), are now matter of history. By the common law a person excommunicated was incapacitated from any legal act, and was, moreover, on certificate from the bishop, liable to imprisonment until reconciled to the church; but now, by the statute 53 George 3. chapter 127, the writ de contumace capiendo is substituted for the old writ de excommunicato capiendo in cases of contempt; and in the few cases in which excommunication is still pronounced as a sentence the court is empowered to assign a term of imprisonment, not exceeding six months. 2. Causes of a mixed description are suits for tithes, church rates, seats in churches, and faculties; which concern the temporals or external possessions of the church. The subtraction of tithes or other ecclesiastical dues may be complained of in the Ecclesiastical Courts; but if any question of law arises on the defence, as where modus or prescription is relied on against a claim of tithe, either party may apply for a *prohibition* from the King's Bench, as the Ecclesiastical Court has not authority to decide the point of law. Suits of this description are consequently of rare occurrence. The Ecclesiastical Court exercises jurisdiction to enforce the payment of church rates; but where the amount to be recovered does not exceed 10*l*., and the validity of the rate is undisputed, two justices may enforce payment by distress. 3. Exclusive property in a seat in the body of the

church can be claimed only in virtue of a faculty, that is, a grant from the ordinary (or immediate ecclesiastical superintendent); or of a prescription, that is, immemorial usage, presumed to be founded on a faculty. But the courts of common law interfere, — 1. Where the pew is claimed as annexed to a house; 2. In all cases of prescription, in which a prohibition will be granted to remove the cause from the ecclesiastical tribunal in order to have the prescription tried by a jury. Causes of a purely civil nature, although in their origin supposed to possess something of a spiritual character, are testamentary and matrimonial. And these constitute the bulk of the business transacted in our Ecclesiastical Courts. The jurisdiction of these courts over wills is of very ancient date in England; while it either ceased at an early period or was never held valid in other Christian countries. The distribution of the personal effects of persons who died intestate was entirely at the discretion of the ordinary. This is one of the rights confirmed to the prelates by Magna Charta. The absolute power of the ordinary was first limited by Edward I, in whose reign he was compelled to discharge the intestate's debts; and in the reign of Edward III he was obliged to divide them, by means of administrators, among the kindred of the deceased, in proportions which were finally determined by the Statute of Distributions. *See* ADMINISTRATION.

As a natural consequence of their power to distribute intestates' effects, the bishops acquired a jurisdiction over wills, both to determine their validity, and to decide disputes respecting bequests of personal property; hence arose the *granting probate of wills*, and suits for legacies (*See* WILL.) The courts of common law exercise exclusive jurisdiction over all testamentary devises of real estate; the ecclesiastical courts possess a similar power over bequests of personal estate; but courts of equity have no authority to determine the validity of a will of any description of property Hence, in a devise of land, a judge and jury determine on vivâ voce evidence; in a bequest of personalty, the judge of the ecclesiastical court on depositions reduced into writing; and when the will relates both to real and personal estate, there may be a double trial and conflicting determinations

Matrimonial causes form the next and most important branch of ecclesiastical jurisdiction. (*See* MARRIAGE, LAW OF.) Directly, the ecclesiastical courts have the sole cognizance of the validity of a marriage; but indirectly, the common law courts assume this jurisdiction whenever the question arises in a civil or criminal proceeding before them.

ECCLE'SIA'STICUS. An apocryphal book, composed, as is generally supposed, by Jesus the son of Sirach, and admitted by the Romish church into the canon of the Old Testament This book was originally written in Syro-Chaldaic, and consists chiefly of meditations relating to religion and the general conduct of human life. It displays but little regard for methodical arrangement; but the style is so highly poetical, and the sentiments so profound, that Addison (*Spectator*, No 60.) has pronounced it one of the most brilliant moral treatises on record.

ECCOPRO'TICS (Gr. ἐκ, *out*, and κοπρος, *excrement*) The term formerly applied to mild aperient medicines

E'CHEA. (Gr. ηχεω, *I sound*) In Ancient Architecture, sonorous vases of metal or earth in the form of a bell, used in the construction of theatres for the purpose of reverberating the sound of the performer's voice They were distributed between the seats; and are described in the fifth book of Vitruvius, who states that Mummius introduced them in Rome, after the taking of Corinth, where he found this expedient used in the theatre.

E'CHELON (Fr.), in the art Military, signifies the position of an army, when its divisions are so formed as to be behind one another in the form of steps.

ECHI'DNA. In Grecian Mythology, the daughter of Geryon and the sea-nymph Callirhoe, or of Tartarus and Gaia; a monster that devoured travellers: parent, according to Hesiod, of those well-known terrors of ancient Greece, — Cerberus, the Hydra, the Sphinx, and the Nemean lion. Hence some suppose the name to represent a sort of general type of monsters and terrific phenomena.

ECHI'DNA. In Zoology, a name proposed by Cuvier for a genus of Australian quadrupeds, having the general form of an ant-eater, but covered with spines. The *Echidna*, like the *Ornithoryhnchus*, deviates in a remarkable manner from the typical structure of the mammalia in general in the organization of the generative and osseous systems, and forms with it a family or order called *Monotrema*. (See that word.) In the male of the *Echidna*, as in the *Ornithorhynchus*, the hind foot is armed with a curved spur, perforated like the fang of a viper by the duct of a poison gland, whence probably the reason for the name. Among the colonists of Australia, the *Echidna* is generally known by the name of the porcupine. It frequents sandy localities, lives in burrows, and feeds on ants and other insects, which it entraps by means of a long and adhesive tongue.

ECHINA'TUS, in Botany, signifies bristly.

ECHI'NOCO'CCUS. (Gr. ἐχινος. *a spine*, and κοκκος, *a cyst*.) A genus of Hydatids or Cystic Entozoons, of which one species (*Echin. hommis*) is recorded by Rudolphi as infesting occasionally the human subject.

ECHI'NODERMS, *Echinoderma*. (Gr. ἐχινος, *a hedgehog*, and δερμα, *skin*.) A name applied to a class of Invertebrate animals, which have a crustaceous or coriaceous integument, most commonly armed with tubercles or spines.

ECHINO'PORA. (Gr. ἐχινος, *a spine*, and πορος, *a pore*.) A subgenus of *Madrepores*. See that word.

ECHI'NUS. (Gr. ἐχινος,.) The generic name of the sea-urchins, which constitute the type of the class *Echinoderma*. The Linnæan genus is now subdivided into many subgenera; some of which have their names compounded of Echinus and some other word, as *Echinobrissus*, *Echinocidaris*, *Echinoclypeus*, *Echinoconus*, *Echinocorys*, *Echinocyamus*, *Echinodiscus*, *Echinoampas*, *Echinometra*, *Echinoneus*, *Echinorodon*, &c.

ECHINUS. In Architecture, the same as the ovolo or quarter round, though the moulding is only properly so called when carved with eggs and anchors. (*See* ANCHORS.) It is the shell or husk of the chesnut, though the ornament does not seem to bear much resemblance to it.

E'CHO. (Gr. ηχω, *sound*.) A sound reflected from a distant surface, and repeated to the ear. When sound in its passage through the atmosphere meets an obstacle, the molecules of air in vibration are reflected in the same manner as elastic bodies, and communicate to the contiguous molecules a vibratory motion, which is propagated in the direction determined by the inclination of the opposing surface to the original direction in which the sound reaches it, the angle of incidence being equal to the angle of reflection. Though echo is a simple consequence of the reflection of sound, several conditions must be fulfilled before it can be produced. In the first place, it is necessary that the ear be situated in the line of the reflection, and in order that the person who emits the sound may himself hear the echo, this line must be perpendicular to the reflecting surface, at least if there is only one reflecting surface, but if there are several such surfaces properly disposed, the sound may be brought back by a series of successive reflections to the point from which it emanated. In the second place, it is necessary that the opposing surface be at a certain distance from the ear, for if the direct and reflected sound succeed each other with great rapidity, they are in some measure confounded, and the echo cannot be distinguished. Hence large rooms and vaulted caves have a strong *resonance*, but no echo is produced by them, the proximity of the walls rendering it impossible to distinguish the reflected sounds

Observation proves that sound passes through the atmosphere at the rate of about 1125 feet in a second; hence a person placed at half that distance, or 512 feet from the reflecting surface, would hear the echo exactly one second after the sound was emitted by him, and the echo would repeat as many distinct sounds as the ear can distinguish in a second The utmost number of sounds which any ear can distinguish in a second perhaps does not exceed ten, hence the least distance of the reflecting surface from the point whence the sound is emitted must be about 50 feet, in order that an echo may be produced.

Every thing which is capable of reflecting sonorous pulses may cause an echo; whence the wall of a house, or the rampart of a city, a wood, rocks, or mountains, produce echos. Unless, however, the surface which reflects the sound is of considerable extent, the echo will be too feeble to be heard. A certain degree of concavity in the surface, by which several diverging rays of sound are collected and concentrated at the point where the echo is audible, if not absolutely essential, is at least highly favourable to the production of echos It is a property of the ellipse that every sound proceeding from one of its foci, and impinging against the curve, is reflected into the other focus; whence two persons placed in the two foci of an elliptic chamber may converse with each other in a whisper, and their voices not be heard by those who are in the other parts of the room Hence also walls or buildings approaching to the elliptic form return sounds with great distinctness and force. In the whispering gallery of St. Paul's, the faintest sound is conveyed from one side of the dome to the other, but is not heard at any intermediate point. In Gloucester cathedral a gallery of an octagonal form conveys a whisper 75 feet across the nave. Some echos are remarkable for their frequency of repetition. An echo in Woodstock Park repeats 17 syllables by day and 20 by night. Southwell (*Phil. Trans.* 1766) describes an echo in the Simonetta palace, near Milan, which repeated the report of a pistol 60 times. In *Birch's History of the Royal Society*, an account is given of an echo at Rosneath, near Glasgow, that repeats a tune played with a trumpet three times, completely and distinctly.

ECHO, in Architecture, is a term often applied, though improperly, to certain vaults and arches, usually of an elliptic or parabolic form, made for the purpose of producing artificial echoes.

**ECHO'METER.** In Music, a sort of scale or rule, marked with lines, which serve to measure the duration of sounds, and to ascertain their intervals and ratios.

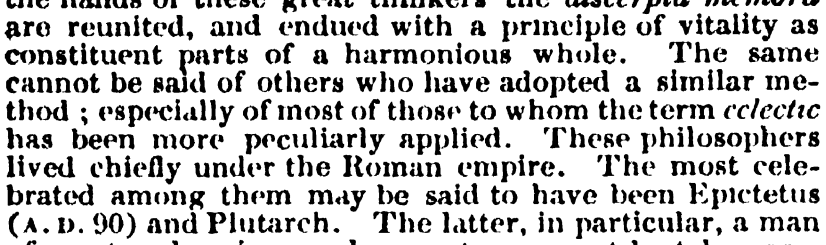
**ECLE'CTICS.** (Gr. ἐκλέγω, *I pick out.*) Those philosophers who endeavour to select from the systems of various schools those doctrines alone which are true, and to present these in the form of an entire whole. An eclectic spirit, it is evident, can only arise at a period of some maturity in philosophical speculation. Whether or not it is to be regarded as an evidence of the decay of original power in the age in which it appears, must depend on the less or greater coherence in the system when completed. In one sense of the word, Plato and Aristotle may be regarded as eclectics. They both availed themselves largely of the labours of their predecessors. Plato, in particular, comprehended in his scheme of philosophy the whole of more than one foregoing system; as the doctrine of Heraclitus of the perpetual flux of sensible objects, and the consequent uncertainty of sensible impressions. But in the hands of these great thinkers the *discerpta membra* are reunited, and endued with a principle of vitality as constituent parts of a harmonious whole. The same cannot be said of others who have adopted a similar method; especially of most of those to whom the term *eclectic* has been more peculiarly applied. These philosophers lived chiefly under the Roman empire. The most celebrated among them may be said to have been Epictetus (A. D. 90) and Plutarch. The latter, in particular, a man of great and various endowments, may yet be taken as a striking instance of a false eclecticism. His great object, in his philosophical writings, seems to have been to reconcile the profound speculations and pure morality of the philosophers with the fanciful inventions and the gross theology of the poets and priests of Greece, Italy, or Egypt.

A far more favourable specimen of the eclectic spirit has been afforded us in modern times in the person of M. Victor Cousin, without doubt the most able and ingenious thinker of modern France. See his *Lectures on the Hist of Philosophy*, in which eclecticism is presented under its fairest guise, and vindicated with the utmost vigour of style and acuteness of thought.

**ECLI'PSES** (Gr ἐκλειψις, from ἐκλειπω, *I faint away or disappear*), taken in a general sense, are those phenomena which exhibit the obscuration of astronomical luminaries, and may be divided into two kinds, in reference to the circumstances under which they are presented; viz 1. When the obscuration is caused by an interception of the light received by the luminary from the sun, as in the cases of eclipses of the moon, eclipses of Jupiter's satellites, &c. 2 When the obscuration is caused by an interception, either totally or partially, of the light transmitted from the luminary to the spectator, and this kind consists of eclipses of the sun, occultations of stars and planets by the moon, and the transits of Mercury and Venus over the disc of the sun.

The most popular and generally interesting objects are the eclipses of the sun and moon, and their causes and aspects will here deserve some explanation The earth and moon being opaque bodies are illuminated by the sun; and, just as we observe with small opaque bodies on the surface of the earth which are within the range of ocular examination, they cast their shadows in directions which are opposite to the sun. As the figures of the bodies are nearly spherical, and as the sun is the largest, it is plain that these shadows must be very nearly of a conical form. The moon is eclipsed when it becomes involved in the shadow of the earth, and so deprived of the light it is accustomed to receive from the sun; and this can take place only at the time of full moon, or when the moon is in opposition to the sun. Let S represent the

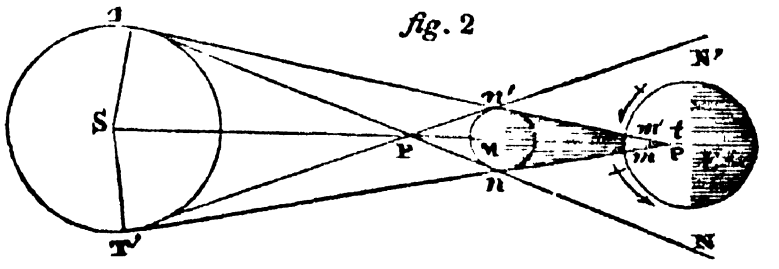
*fig.* 1.




sun, E the earth, and *n' t n* its conical shadow, into which the rays of the sun do not enter. This shadow must evidently be a portion of the larger cone T *t* T' which envelops both bodies. Suppose the plane of the paper to be the plane of the ecliptic, or the plane in which the earth moves round the sun, and let ☾ ☾' represent a portion of the path of the moon round the earth, the arrows indicating the direction of her motion. Conceive also by means of cross tangents T P ☾, T' P ☾' the two opposite and circumscribing cones T P T', ☾' P ☾ to be drawn. The latter of these cones, ☾' P ☾, is called the *penumbral cone*; and the space N *n n'* N', projected beyond the earth, is called the *earth's penumbra*. It is evident that any position within this penumbra is at least partially deprived of the light of the sun; for if we imagine a spectator to be in that position, it is obvious that the interposition of the earth would act as a partial screen and obscure a portion of the sun's disc from his view. It is also evident that a greater portion of the disc of the sun would be hidden from this supposed spectator as his position approaches nearer to the earth's shadow; and that if we suppose him to enter the shadow, he will become totally deprived of the light of the sun, the disc of the sun in this case being entirely hidden by the intervention of the earth. From this observation it follows that as the moon advances in the penumbra from ☾ to *m* her disc will receive less and less light from the sun, and its brightness will gradually diminish; also, as soon as a portion of the moon's disc enters the shadow, that portion becomes totally deprived of the light of the sun, and is, in other terms, darkened or eclipsed. If in the course of the eclipse only a part of the moon's disc enters the earth's shadow, it is called a *partial eclipse;* but if the moon is totally darkened by the whole disc entering the shadow, it is called a *total eclipse*. It is to be understood in the diagram that the orbit of the moon, or the path she describes round the earth, is not in the plane of the ecliptic or the plane of the paper, but inclined to it at an angle always greater than 4° 57′ and less than 5° 21′. This is the reason why eclipses of the moon do not happen at every full moon, for they can only take place when the moon's elevation above the ecliptic at full moon happens to be less than the semidiameter of the section of the earth's shadow through which she passes. In the course of a year there may be three eclipses of the moon, which is the greatest number that can happen; but there must always necessarily be two.

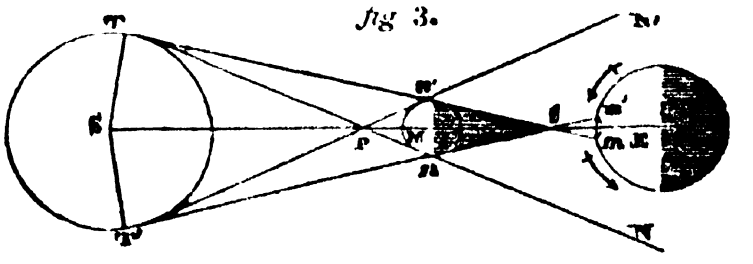
At the time of new moon, or when the moon is between the sun and the earth, her shadow or penumbra may fall on the disc of the earth at certain places, and prevent either all or part of the light of the sun from reaching those places on the earth's surface. This circumstance produces the phenomenon of a total or partial eclipse of the sun, which is limited to the portion of the earth on which the moon's shadow or penumbra happens to fall. The shadow of the moon does not always reach so far as the earth. In the two following diagrams, annexed by way of illustration, the former represents the case in which it does reach, and the latter represents the case in which it

*fig.* 2




does not reach, the surface of the earth. The shadow of the moon in the first diagram falls upon a portion of the earth's surface between *n* and *m'*; and the inhabitants, if any, of that portion, will evidently, from what has been said before, have the sun's disc wholly covered by the intervention of the dark body of the moon, and therefore

*fig* 3.




have presented to them a *total eclipse of the sun*. But in the second diagram, where the shadow of the moon does not reach the earth, if we suppose the dark conical shadow *n t n'* to be produced into the small opposite cone *m t m'* meeting the surface of the earth, it will be obvious, after a slight consideration, that any supposed spectator within this latter cone, or any inhabitant of the portion *m m'* of the earth, will perceive the dark body of the moon wholly within the disc of the sun, and intercepting only an interior part of his light; the unobscured part of the sun which circumscribes the disc of the moon will consequently present the appearance of a beautiful luminous ring or annulus, and the eclipse exhibiting this aspect is commonly called an *annular eclipse* of the sun; the cone *m t m'* may be similarly called the *annular cone*. It does not always occur, during the progress of an eclipse of the sun, that either the dark shadow of the moon or the annular cone will fall on the earth's surface, and it very rarely happens that either of them will fall on any defined spot, such as London or Edinburgh. For the occurrence of an eclipse on the earth, it is only necessary that the moon's penumbra N *n n'* N' shall be projected against a portion of the terrestrial surface, as an inhabitant of that portion will at least have a part of the disc of the sun intercepted by the moon. When neither the moon's shadow nor the annular cone meets the earth in the course of an

eclipse, and consequently only a part of the sun's disc is obscured to terrestrial vision, it is called a *partial eclipse of the sun*, and in that respect it is similar to a partial eclipse of the moon. If in the two diagrams we suppose, as before, the plane of the paper to be the plane of the ecliptic, the position of the moon must not necessarily be considered to be in that plane. The north pole of the earth will be directed upwards at an angle of about 23° 28′, and the arrows will represent the direction in which the earth revolves about its axis; the moon proceeds round the earth in the same direction, and carries her penumbra across the earth's surface with a much greater velocity than the earth's rotation. It follows, therefore, that the arrows indicate also the direction in which the phenomena of the eclipse pass geographically over the earth, viz. from west to east; and that different places will have the eclipse at a later or earlier time, according as they are more to the east or west. Eclipses of the sun occur more frequently than eclipses of the moon. In the course of each year there must be two at least in some parts of the earth; but there cannot possibly be more than four,—a number that sometimes, though very seldom, happens.

*Calculation of Eclipses of the Sun and Moon.*—It is here chiefly intended to explain methods by which the times of beginning and ending of any phase or appearance may be predicted for a particular place on the earth. For these calculations it is necessary, first, to ascertain the longitudes and latitudes of the sun and moon by means of the solar and lunar tables. Those of the sun may be determined from the revised tables of Carlini, which form the supplement to the *Milan Ephemeris* for the year 1833; and those of the moon may be calculated from the tables of Burckhardt or Damoiseau. With the help of the tables, the hourly variations of the same quantities, as well as the horizontal parallaxes and semidiameters of both bodies, are to be calculated. The results so found will be elements from which the phenomena of the eclipse may be determined for any stated place on the earth; but their computation is necessary only for eclipses that occur at remote periods, since all these calculations are accurately executed and registered in the *Nautical Almanac*, a work regularly published three or four years in advance. The positions are there likewise reduced to the plane of the equator, so as to determine the places of the bodies by their right ascensions and declinations, which are more readily applicable to the calculation of *all* the circumstances of an eclipse; besides, the right ascensions and declinations of the moon are given with the utmost precision for every hour, which adds considerably to the facility of these calculations. It will here be the more generally useful and interesting, therefore, to describe methods by which, with the use of the *Nautical Almanac*, the circumstances of an eclipse may be predicted, as it will appear from any given spot on the earth's surface.

In the diagram (*fig.* 1.) join E $m$, E ☾, S $n$, and denote

E $m$ $n$ = the moon's horizontal parallax, by P,
E S $n$ = sun's —— by $\pi$,
T $n$ S = sun's semidiameter, by $\sigma$;

then the angle M E $m$ is the semidiameter of the section of the earth's shadow traversed by the moon, as it would be seen from the centre E; and the angle M E ☾ is the similar semidiameter of the penumbra. To determine the semidiameter of the section of the shadow, we have $m\,E\,t = E\,m\,n - E\,t\,m = E\,m\,n - (S\,n\,T - n\,S\,t) = E\,m\,n + n\,S\,t - S\,n\,T$; that is, the semidiameter of the shadow $= P + \pi - \sigma$. This value, however, is affected by the atmosphere of the earth, which absorbs those rays of the sun that would pass near to the surface, and thus makes the shadow of the earth to appear sensibly larger. To take this effect into account, it is the usual practice of astronomers to increase the value given by the preceding expression by one-sixtieth, or to add as many seconds as there are minutes in the radius of the section. The actual formula employed in this calculation is therefore

$$\text{Semid. of shadow} = \frac{61}{60}(P + \pi - \sigma).$$

By adding to this the angle $m\,E\,☾ = m\,n\,☾ = T\,n\,T' = 2\sigma$, we have also,

$$\text{Semid. of penumbra} = \frac{61}{60}(P + \pi - \sigma) + 2\sigma.$$

Let the circle H H′ K represent the section of the earth's shadow through which the moon passes during the eclipse; P Q a portion of the circle of declination which passes through the centre S and the north and south poles, P being towards the north, and S towards the south; A B a portion of the parallel of declination, which also passes through S; O R, intersecting P Q in $c$, the line or orbit described by the centre of the moon in passing through the shadow; M her position when she first comes into contact with the shadow, and begins to be eclipsed at H; $m$ her position at the middle of the eclipse, or time of greatest obscuration; and M′ her position at leaving the shadow when the eclipse ceases. In the figure, for the sake of convenience, the shadow is supposed to be fixed; and hence the motion of M is not considered to be the entire motion of the moon, but the motion with which she passes through the shadow, or, as it is called, the relative motion of the moon. This relative motion is equal to the difference between the motion of the moon and that of the shadow. But as the centres of the sun and shadow must always be in opposite points of the sphere, as seen from the centre of the earth, the motion of the shadow will be just the same as that of the sun.

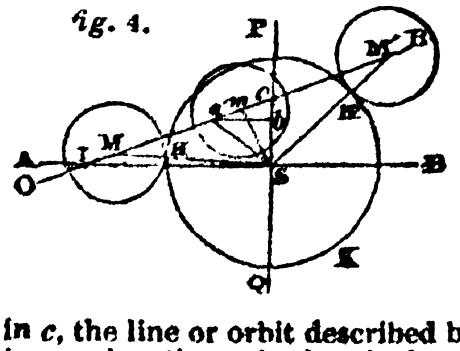


*fig.* 4.

At any assumed time T, near to the time of opposition, let $a$ be the position of M, and draw $a\,b$ parallel to A B; at this instant let $\alpha$ denote the difference between the right ascensions of the moon and shadow; also let $x = S\,b$, and $y = a\,b$. Then, from what has preceded,

Right ascension shadow = right ascension ☉ + 12$^h$.

Declination shadow = declination ☉ with a contrary name.

$\alpha$ = right ascension shadow — right ascension ☾
$x$ = declination ☾ — declination shadow
= declination ☾ + declination ☉.

But as $a\,b = y$ may be considered to be part of a parallel of declination, and as $\alpha$ is the spherical angle it subtends from the pole, it is evident that $y = \alpha \times$ cos. ☾'s declination. We must therefore first calculate the following quantities:—

Right ascen. shadow = right ascen. ☉ + 12$^h$.

$y$ = (right ascen shad. — that of ☾) × cos. ☾'s dec.
hourly mo. $y$ = (hor. mo. ☾'s right ascen. — that of ☉) × cos. ☾'s dec.
$x$ = ☾'s dec + ☉'s dec.
hourly mo. $x$ = hor. mo. ☾'s dec. + hor. mo. ☉'s dec.

It will be here observed that hourly mo. $y$ denotes the decrease of $y$, while hourly mo. $x$ denotes the increase of $x$, in one hour.

If $i$ denote the angle $c$ I S or $m$ S $c$, which is the inclination of the relative orbit O R with the parallel A B, we find also,

$$\tan.\, i = \frac{\text{hourly mo } x}{\text{hourly mo. } y}$$

$$\text{hourly motion in the orbit } o\,R = \frac{\text{hourly mo. } y}{\text{cos. } i}.$$

Again, in the right-angled triangle $a\,b$ S, knowing the sides S $b = x$, and $a\,b = y$, we calculate the angle $a$ S $b$ and the distance S $a$. The difference of the angles $a$ S $b$, $m$ S $c$, gives the angle $a$ S $m$, and in the right-angled triangle $a$ S $m$, knowing also the side $a$ S, we find the other two sides $a\,m$, S $m$, the latter of which is the nearest distance of the centres of the moon and shadow. The distance S M, at the beginning or ending of the eclipse, is found by adding the semidiameter of the moon to that of the shadow; hence, in the triangle M S $m$, knowing also the side S $m$, we find the side M $m$ = $m$ M′; and by subtracting and adding the value of $a\,m$, before found, we get the distances M $a$, $a$ M′. Knowing therefore these distances, and the hourly motion in the orbit O R, we find the times employed by the moon in traversing them: the former of these times, subtracted from the time originally assumed at which the elements were taken, will therefore give the time of the beginning of the eclipse; and, similarly, by adding the latter, we get the time at which the eclipse will terminate. The times thus found will be for the meridian of Greenwich, and will require reducing for the longitude of the place.

To those who are not familiar with algebraical operations, a rough sketch of the figure, drawn by the hand, will indicate most distinctly the way in which the several angles and lines ought to be combined in the process of the calculation.

For an eclipse of the sun the relative positions of the sun and moon are not independent of the observer's position, like those of the moon and the earth's shadow. In the calculation of an eclipse of the sun, we must first apply the effects of the relative parallax to the right ascension and declination of the moon to get her exact position with respect to the sun, as she will appear to a spectator at the place for which the calculation is proposed to be made. (See the article PARALLAX.) By subtracting and adding the hourly motions, given in the *Nautical Almanac*, we obtain the values of the quantities for an hour before and after the time of conjunction in right ascension. Then, after calculating and applying the effects of parallax to the moon, we find the quantities $x$, $y$, in the same manner as for an eclipse of the moon, only substituting the sun in place of the sections of the earth's shadow. The half differences of the quantities so computed for an interval of two hours will show their apparent hourly motions; and with these the remaining calculation, for either time, is precisely the same as has already been described for an eclipse of the moon. It is only further to be observed, that as the apparent relative motion of the moon is not

very uniform, the results will be most accurate when they are close to the times assumed. If a very accurate calculation of the beginning or ending be required, it will, for this reason, be necessary to repeat the calculation for a single assumed time close to the occurrence of the phase; and for this purpose we may adopt the hourly motions in the first calculation. In these cases, greater accuracy is to be obtained by interpolating the right ascensions and declinations from the running ephemeris than by inferring them from the list of elements.

ECLI'PTIC. In Astronomy, the great circle of the heavens which the sun appears to describe in his annual revolution. It has been called the *ecliptic*, because eclipses only happen when the moon is in the same plane, or very near it. The ecliptic, from time immemorial, has been conceived to be divided into twelve equal parts, called *signs*, — Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, Pisces. But the signs of the ecliptic are not to be confounded with the *signs of the zodiac*, which denote the places occupied by certain constellations, and consequently never alter their position in the heavens. The signs of the ecliptic denote merely arcs of 30°; and as they are reckoned from the intersection of the equator and ecliptic, which is not a fixed point, their limits are not, in all ages, determined by the same stars.

The ecliptic is the circle to which longitudes and latitudes in the heavens are referred, as right ascensions and declinations are referred to the earth's equator.

The angle which the plane of the ecliptic makes with the plane of the equator is called the *obliquity of the ecliptic*. It is to the oblique position of these two planes that we owe the vicissitudes of the seasons. If the equator coincided with the ecliptic, the days and nights would always be equal at all parts of the earth, and there would be no summer or winter.

The obliquity of the ecliptic at the present time (Jan 1 1840) is 23° 27′ 36 52″. (*Nautical Almanac*) This quantity, besides being subject to a periodic variation of about 18″, arising from the nutation of the earth's axis, is affected by a *secular* inequality, of which the period is not ascertained. By comparing the observations of the present times with those made in former ages, it is found that the obliquity has continued to undergo a slow progressive diminution, the rate of which appears to be about 45″ in a century, amounting to a fourth of a degree since the time of Hipparchus. The planes of the ecliptic and equator have consequently been approaching each other during the last 2000 years; but though mathematicians have not yet ventured to assign the limit of this approach, it cannot exceed a certain small quantity, and, after a few thousand years more, the two planes will begin again to recede. The diminution of the obliquity is caused by the action of the other planets, particularly Venus and Jupiter, on the earth; in virtue of which action the plane of the earth's orbit is drawn, as it were, nearer to the planes of these two planets. *See* NUTATION, and PRECESSION OF THE EQUINOXES.

ECLIPTIC DIGITS. *See* DIGITS.

ECLIPTIC LIMITS, are the greatest distances at which the moon can be from her nodes, in order that an eclipse of the sun or moon may happen. When the moon is within those limits at the time of the new or full moon, an eclipse certainly happens; but when the moon is beyond those limits, an eclipse cannot happen. The limits for an eclipse of the sun are about 17°, and for an eclipse of the moon about 12°.

E'CLOGUE. (Gr. ἐκλογή, *a selection*.) In the original meaning of the word, the select or choice pieces of an author; or extracts collected out of former works, such as were termed in Latin *excerpta*. It is not known how this title was originally given to the pastoral poems of Virgil; but from the circumstance of their being so named, the word eclogue in modern usage is applied to that species of poetry. The persons who are introduced conversing in eclogues, or whose adventures are recounted in them, are shepherds; that is, for the most part, imaginary personages, whose sentiments, and the external circumstances among which they live, belong rather to an ideal age of gold than to the realities of modern life; and their loves constitute the main and proper subjects of the eclogue. Nevertheless various writers (Gay, &c. among ourselves) have endeavoured, but with little success, to give an air of greater reality to pastoral poetry, and give their rustics more of the costume and diction of actual clowns; but the result has been a species of burlesque, not at all answering to our conceptions of pastoral poetry; nor can we easily imagine that the personages of Theocritus, although the earliest and therefore the simplest of pastoral poets, are correct resemblances of the Sicilian rustics among whom the writer lived. The eclogues of Virgil are of various descriptions: some of them only have the true character of pastorals; others contain occasional poems on public and private events of the day, very slightly enveloped in the pastoral costume. The characteristics of this species of poetry, as assumed by the moderns, are, first, the representation of nature in soft and quiet scenes of cultivation; secondly, a slightly dramatic turn either of action or narration; thirdly, characters whose sentiments and language are confined within certain peculiar limits: thus, any strong emotion, virtue, or vice, would be an unfit topic for a pastoral poet to dwell upon. Among ourselves, Spenser, Philips, and a few others, may be named as pastoral poets in the strict sense of the word; others, as Milton in his *Lycidas*, have assumed the pastoral costume in order to convey a very different class of ideas. It is worthy of remark, that this species of composition is among those which have wholly disappeared in the present day: we have had no pastoral poet since Gay and Collins; and Gesner, in Germany, is the latest author who has acquired any degree of celebrity in this line. *See* IDYLL, BUCOLIC.

ECO'NOMY, POLI'TICAL. *See* POLITICAL ECONOMY.

ECTHY'MA. (Gr. ἐκθύω, *I break out*.) An eruption of pimples or small pustules common in young persons after having overheated themselves, or eaten indigestible and greasy things. Analogous eruptions are seen upon infants, especially those who are ill nursed. Proper diet, mild aperients, especially small doses of rhubarb and magnesia, generally carry them off.

ECTRO'PIUM. (Gr. ἐκτρέπω, *I evert*.) An unnatural eversion of the eyelids, arising from tumefaction of the inner membrane, or from a contraction of the skin covering the eyelid.

ECZE'MA. (Gr. ἐκζέω, *I boil out*.) An eruption of the skin frequently observed in irritable habits, and sometimes mistaken for the itch: it is not pustular, but consists of small vesicles, often forming patches or blotches, and producing, as they die off, a desquamation of the cuticle. Alteratives and cooling local applications are the remedies usually resorted to for the relief of this complaint.

E'DDA. The ancient collection of Scandinavian poetry in which the national mythology is contained. There are two Eddas: the older is believed to have been reduced to writing, from oral tradition, in Iceland, between A. D. 1050 and 1133. It was recovered and published in Denmark in 1643. The new Edda, supposed to have been composed 200 years after the former, is an abridgment of it, with a new arrangement of its parts. It was translated by Resenius in 1640, and is thence called the Resenian Edda. The authenticity of these monuments of an early age has been doubted in recent times, but the latest researches of critics (the brothers Grimm and others) seem to go far towards establishing it. (See the *Penny Cyclopædia*.)

E'DDY (Sax. ed, *water*, and ea, *backwards*), is the water of a stream or tide which, in consequence of striking against some obstacle, is thrown backwards, and runs in a direction opposite to that of the general current. More frequently, however, the term is used to denote the whirling or circular motion caused by the meeting of two opposite currents; and, in this sense, it is also applied to a similar motion of the atmosphere. *See* WHIRLPOOL, WHIRLWIND.

EDE'NTALS, *Edentata*. The name of an order of Mammals, including those genera in which the dental apparatus is more or less incomplete: the incisive teeth are almost always deficient.

E'DICT. (Lat. edico, *I speak out*.) An instrument signed and sealed by a despotic prince to serve as a law to his subjects. In ancient Rome, the ordinances of the magistrates, but especially of the two prætors, *prætor urbanus* and *prætor peregrinus*, were so called. Previously to the time of Augustus, the grand principles of Roman law were exceedingly ambiguous and undefined; and to remedy this defect in some measure, the prætors used to publish, on their accession to office, *edicts* or rules for regulating the practice of their courts, as well as for their own guidance in the decision of doubtful cases. A jurisdiction, however, thus vague and arbitrary in its nature being constantly abused, it was enacted by the Cornelian Law (B. C 56), that the prætor of the year should be compelled to adhere to the spirit and letter of his first proclamation. The edicts of the preceding prætor were not binding on his successor. If the latter confirmed them, they were styled *edicta vetera* or *tralatitia;* in contradistinction to *edicta nova*, those framed by himself. (*See* PRÆTOR.) Under the emperor Hadrian, a digest of the best decisions of the prætors from the earliest times was made by Sylvius Julianus, collected into a volume called *Edictum Perpetuum*, or Perpetual Edict, ratified by the emperor and senate, and fixed as the invariable standard of civil jurisprudence.

The *Edict of Milan* was a proclamation issued by Constantine after the conquest of Italy (A.D. 313), to secure to the Christians the restitution of their civil and religious rights, of which they had long been deprived, and to establish throughout his extended dominions the principles of a wise and enlightened toleration.

The most famous edict of modern history is the Edict of Nantes, issued by Henry IV. in 1598, to secure to the Protestants the free exercise of their religion. This act, after continuing in force nearly a century, was repealed

by Louis XIV.; and, as is well known, its revocation led to a renewal of the persecutions and bloody scenes which previously to the issuing of this edict had been enacted against the Protestants. The depopulation caused by the sword was also increased by emigration. Above half a million of her most useful and industrious subjects deserted France, and exported, together with immense sums of money, those arts and manufactures which had chiefly tended to enrich the kingdom. About 50,000 refugees passed over into England; and there can be little doubt that their representations of the cruelties perpetrated by the King of France tended to excite the suspicions of the English against their own Roman Catholic sovereign, and in some degree accelerated the advent of the Revolution of 1688. *See* HUGUENOTS.

In the French law, the term *edict* has a wide signification, being applied equally to the most momentous and the most trifling proclamations of the government.

E'DINGTONITE. A mineral found near Dumbarton in small greyish-white translucent prisms, composed of silica, alumina, lime, water, and probably some alkali.

EDI'TION (from the Latin verb edere, *to give out or publish*), means simply the (indefinite) number of copies of a work printed at one time, before the types are distributed by the compositor. Any one who prepares for publication the writings of another is said to edit them, and is called the *editor*. In literary language, since the invention of printing, the *editor* of a work revises, adds notes, prepares for the press, &c. &c.: the *publisher* is the bookseller who negotiates the sale of the impression. Sometimes (but especially in classical works) the edition goes generally by the name of the printer or publisher, sometimes by that of the editor. Thus, we have the Aldine and Elzevir Classics &c., the houses of Aldus and Elzevir having been concerned both in printing and publishing, while *Bentley's Horace*, *Heyne's Homer*, &c, are so denominated from the name of the *editor*. In bibliographical works, *editio princeps* signifies the earliest printed edition of an author; *editio optima*, that which is generally regarded as the best, &c.

E'DITORS, are of different species:—1. Those who merely republish a text, or content themselves with adding notes and commentaries to it. 2. Those who superintend the publication of a work, receiving the manuscripts from one or more contributors; seeing that the object of the work is attained, that the language is correct, the illustrations appropriate, and the facts accurately stated, and that all the parts of the work are properly adjusted and made subordinate to each other.

E'DRIOPHTHA'LMA. (Gr. ἑδραιος, *fixed*, and ὀφθαλμος, *an eye*.) The name under which the Malacostracous Crustaceans with sessile eyes are grouped together.

EDUCA'TION (Lat. educare), in its most extended signification, may be defined, in reference to man, to be the art of developing and cultivating the various physical, intellectual, and moral faculties; and may thence be divided into three branches—physical, intellectual, and moral education. This definition is by no means complete, but it is used merely as indicative of the manner in which this subject has generally been discussed. Under physical education is included all that relates to the organs of sensation, and the muscular and nervous system. Intellectual education comprehends the means by which the powers of the understanding are to be developed and improved, and a view of the various *branches of knowledge* which form the objects of instruction of the three departments into which we have divided education. Moral education embraces the various methods of cultivating and regulating the affections of the heart.

The wide extent of this subject, and the infinity of collateral questions with which it is mixed up, would prevent us from entering into any details respecting it, even if the difficulty of communicating any satisfactory information upon so boundless a theme within our limits did not preclude us from the attempt. The influence which education has exercised in humanizing the world is universally acknowledged. Its importance has been recognized by philosophers and legislators in every age; and by all the nations, both of antiquity and modern times, which have become distinguished in history, it has been regarded as the chief element in the attainment and promotion of civilization. The reader will find, in the writings of Plato, Plutarch, and Quintilian, among the ancients, and in modern times of Locke, Rousseau, Basedow, Niemeyer, Rehberg, Cousin, &c., a view of the chief systems that have been proposed or adopted in reference to this subject; and for an account of the comparative merit of the different systems, and the innumerable controversies that have been maintained in regard to them, he may consult the *Edin.* and *Quar. Reviews*, passim, and the other periodical publications of England.

EDU'LCORA'TION. (Lat. edulcoro, *I purify* or *sweeten*) A chemical term applied to the cleansing of substances, especially pulverulent precipitates, by the repeated affusion of water, so as to remove all soluble matters, and render them free from taste and smell.

EFFE'CT. (Lat. efficio.) In the Fine Arts, that quality in works of art whose nature is to give particular efficacy to other qualities, so as to bring them out and to attract the eye of the spectator.

EFFECT. *See* KEEPING.

EFFE'NDI. A Turkish word signifying *lord* or *superior*; applied to legal, ecclesiastical, or other *civil* functionaries, in contradistinction to *aga*, the name by which high *military* personages are designated. *See* REIS EFFENDI.

EFFERVE'SCENCE. (Lat. effervesco.) The escape of gaseous matter from liquids, as in the act of fermentation. All liquids from which bubbles of gas rapidly escape, so as to resemble boiling, are said to effervesce.

E'FFIGY. (Lat. effigies.) In Painting and Sculpture, the representation of an individual.

EFFLORE'SCENCE. (Lat. effloresco, *I flower*.) The spontaneous crumbling down of transparent crystals in consequence of the loss of water.

EFFLU'VIUM. (Lat. effluo, *I spread abroad*.) The vapours arising from putrefying matters.

EFFU'SION. (Lat. effundo, *I pour out*.) In Surgery, the escape of a fluid from the vessel naturally containing it; thus when the chest is wounded blood may be effused into the cavity of the pleura, and in injuries of the head blood may be effused upon the brain, when death almost inevitably ensues.

E'GERAN. A variety of garnet found near Eger in Bohemia.

EGG. (Germ. ei.) The ovum of birds and oviparous animals. The changes which the hen's egg undergoes during incubation have been described by Sir E. Home in the *Philosophical Transactions* for the year 1822 (page 339.), and illustrated by a beautiful series of plates after Bauer's drawings: the same volume also contains a valuable paper by Dr Prout on the same subject, but chiefly in reference to the chemical changes of the egg during that process. The specific gravity of new-laid eggs at first rather exceeds that of water, varying from 1080 to 1090; but they soon become lighter, and swim on water, in consequence of evaporation through the pores of the shell. When an egg is boiled in water, and suffered to cool in the air, it loses about 32 hundredths of a grain of saline matter, together with a trace of animal matter and free alkali. The mean weight of a hen's egg is about 875 grains, of which the shell and its inner membrane weigh 93·7 grains, the *albumen* or white 529·8 grs, and the yolk 251·8 grs The shell contains about 2 *per cent.* of animal matter and 1 *per cent.* of the phosphates of lime and magnesia, the remainder being carbonate of lime, with a trace of carbonate of magnesia. When the yolk of a hard-boiled egg is digested in repeated portions of strong alcohol, there remains a white residue having the leading characters of albumen, but containing phosphorus in some peculiar state of combination: the alcoholic solution is yellow, and deposits a crystalline fatty matter, and when distilled leaves a yellow oil. The albumen of the egg contains sulphur. The use of the phosphorus is to yield phosphoric acid to form the bones of the chick; but the source of the lime with which it is combined is not apparent, for it has not been detected in the soft parts of the egg, and hitherto no vascular communication has been discovered between the chick and the shell.

The trade in eggs is of great value and importance; the number of eggs imported into this country from various parts of the Continent greatly exceeds one hundred millions, and there is every prospect of a steady increase.

E'GLANTINE. (Fr. eglantier.) The old English name of the sweet-briar rose. The term is improperly applied by Milton to the honeysuckle.

EGYPTIAN ARCHITECTURE. *See* ARCHITECTURE.

EGYPTIAN BEAN. The fruit of the *Nelumbium speciosum* has been so called: it has been regarded as the forbidden bean of the disciples of Pythagoras.

EGYPTIAN PEBBLE. A species of agate or jasper.

EI'DER-DUCK. The species of duck tribe so called is one of the largest and most valuable of the *Anatidæ*, and, from certain modifications of the beak and sternum, constitutes the type of a subgenus, called *Somateria*. The common eider (*Somateria mollissima*) frequents in great numbers the Orkneys, Hebrides, and Shetland isles. It is defended from the cold of the dreary northern coasts by the development of an unusual quantity of the finest down beneath the dense exterior plumage, which is equally well adapted to form an impenetrable barrier to the wet. The down of the eider constitutes its chief value, as it combines with its peculiar softness, fineness, and lightness so great a degree of elasticity that the quantity of this material which might be compressed and concealed between the two hands will serve to stuff a coverlet.

As the female plucks from her own body a quantity of her finest down to line her nest, the Orcadians avail themselves of this instinct, and take an early opportunity to rob the nest of both eggs and down. She then begins to lay afresh, and envelops her eggs with another layer of down; and if this be removed, the male is said to contribute his own down when the female can afford no

more. Lastly, when the brood of ducklings is hatched, the nest is again visited and the down removed. Thus a considerable quantity of the valuable material furnished by the eider-duck is obtained independently of that which is plucked from the slaughtered birds. Besides the down and eggs, the islanders turn the skins and flesh of the eiders to profit; while these birds cost them no expense, as they feed entirely on sea-weed and other natural productions of the ocean.

EISTE'DDFOD. (Welsh, from eistedd, *to sit*.) The assemblies or sessions of the Welsh bards were so termed (*See* BARD.) They were held, according to Pennant (*Tour in Wales*), at different places for the minstrels of their respective neighbourhoods; at Caerwys, at Aberfraw in Anglesea, and Mathravel in Powys. The judges were appointed by commissions from the Welsh princes, and after the Conquest from the English kings. The last was issued in 1568. But the Gwynnedigion and Cambrian Societies have lately revived the old custom; and annual meetings for the recitation of prize poems, and for performances on the harp, are now held under the name of Eisteddfod.

EJE'CTMENT, in Law, is a personal action in the form of trespass, in which a tenant for years claims damages for his expulsion from land demised to him; and it has become the usual form of trying questions of right to real property by a singular fiction. The party claiming land or its appurtenances not in his possession is the real plaintiff, through the means of a fictitious tenant (the celebrated John Doe), who complains of being ejected from his farm by the defendant. The defendant justifies by disputing the plaintiff's title to let the land, and if the plaintiff succeeds, he recovers not only *nominal* damages for his ejectment, but also *the land itself* for the term of Doe's supposed demise, and in fact for the term of his own right.

ELÆAGNA'CEÆ. (Elæagnus, one of the genera.) A natural order of shrubby arborescent Exogens inhabiting the entire northern hemisphere down to the equator, having leprous leaves, superior fruit, tubular calyx, and apetalous flowers. They are distinguished from *Thymelaceæ* by the ovule being erect, from *Proteaceæ* by the valvate calyx and the dehiscent fruit of the latter, and from *Santalaceæ* by the superior ovary. The berries of some species are eaten in Persia and Nipal.

ELÆOTE'RIUM. (Greek. ελαιον, *oil*.) In Ancient Architecture, an apartment in the ancient baths wherein the bathers anointed themselves after leaving the bath.

ELAI'DIN. A fatty matter produced by the action of nitric acid upon certain oils, especially upon castor oil.

ELAI'N. (Gr. ἔλαιον, *oil*.) That portion of fat or oil which retains a liquid state; it may be pressed out of hog's lard and other solid fats, and separated from oils by exposing them to cold and subsequent pressure.

ELAIO'DIC ACID. (Gr ελαιον, and ειδος, *form*.) One of the compounds produced during the saponification of castor oil.

E'LAOLITE. (Gr ελαιον, and λιθος, *stone*.) A brittle mineral, of a greasy lustre, crystalline in its texture, of various shades of grey, green, and red, and composed of silica and alumina, with about 18 *per cent* of potash. It is found in Norway, and when *chatoyant* is sometimes used for ring stones.

E'LAPS. A subgenus of vipers. *See* VIPERA.

ELA'SMOTHE'RIUM. (Gr ελασμος, *a plate*, and θηρ, *a beast*.) The name of an extinct Pachydermatous animal, which forms the type of a new genus, characterized by the laminated structure of its teeth, and intermediate between the horse and rhinoceros.

ELASTI'CITY. (Gr. ἐλαστη, *a spring*, from ελαυνω, *I draw*.) In Physics, that property which certain bodies possess of recovering their primitive form and dimensions after the external force by which they have been dilated or compressed or bent is withdrawn.

The theory of elasticity must be deduced from some hypothesis respecting the constitution of matter. The simplest and most general view which can be taken of the subject is, that all matter is composed of indefinitely small parts or *molecules* acted upon by attractive and repulsive forces. The attractive forces result from the action of the molecules on each other; the repulsive forces from the caloric with which the molecules are combined. From the combined action of these two forces, the attraction of matter and the repulsion of caloric, the different forms of matter and its varied physical properties may be explained.

This view of the constitution of bodies supposes that the molecules are not in contact, but at a certain distance from each other, which, though it is to be regarded as infinitely small in comparison of any distance appreciable by our senses, admits nevertheless of increase and diminution. When a body is in a state of rest, the opposite forces which any two of its contiguous molecules exercise on each other are in equilibrium. The energy of the forces also depends on the distance between the two molecules, or, in mathematical language, is a function of that distance. If the distance be increased within the limits of the action of the forces, both forces are diminished; and if the distance is diminished, both are increased, but not in the same proportion. If the interval at which the two forces balance each other be diminished, the repulsive force becomes stronger than the attractive force, and the two molecules are repelled from each other: on the contrary, if the distance be increased, the attractive force acquires the superiority, and the molecules are drawn towards each other.

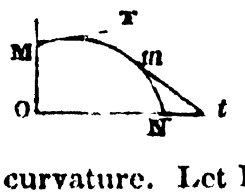
Let us now suppose a solid body, of which all the molecules are in a state of equilibrium, to receive the impression of an external force. The operation of the force is to produce a change in the distances of the molecules at the surface, in consequence of which the equilibrium is disturbed, and the molecules thrown into a state of vibration. This vibration is communicated to the interior molecules; and the body, under the action of the external force, undergoes a certain change of form. The molecules at the surface, which receive the impulse, transmit it to those in the interior of the body, and are reacted on by them with an equal force. In this manner the action is propagated through the whole mass, until it is destroyed by another exterior force, or by the resistance of an obstacle to the motion of the body itself.

From this hypothesis respecting the constitution of matter, analytical expressions may be deduced to represent the motions or the equilibrium of the molecules of a body acted upon by an external force which is not so great as to exceed the limits of its elasticity, or to produce a change in the distance of the molecules greater than the radius of the sphere of molecular action. These equations contain a numerical coefficient, which is constant for the same body, but variable for different bodies: and which has no influence on the law of elasticity, though it serves to measure its effects. It is therefore called the *modulus* of elasticity, or *coefficient* of elasticity; and is of the same nature and order of magnitude as the cohesive resistance which bodies oppose to rupture on being crushed, and may therefore be expressed as so many pounds acting on a square inch of surface. The modulus of elasticity for each particular body must be determined by experiment, and has only been ascertained in a few instances.

Elasticity is perfect when the body exactly recovers its primitive form, after the force by which it is bent or compressed or dilated has been removed, in the same time as was required for the force to produce the alteration. This perfect elasticity is, however, not found in any of the bodies of nature, the aeriform fluids or gases are those whose elasticity approaches the nearest to it. Hard bodies, even tempered steel and ivory, possess it in a less degree; in fluid substances the elastic force is greatly diminished; and in soft bodies, as butter, moist clay, it entirely disappears. In solid bodies the elastic force is, in general, diminished by use, or by a long-continued application of a straining force. A bow which has been long bent, or a spring which has been long compressed, will not entirely recover its original form. In many cases the elasticity of a body can be augmented by producing a closer aggregation of the molecules. The metals, for example, are rendered more elastic by hammering them cold, or by alloys. Iron and steel acquire a greater elasticity by *tempering*; that is, by producing a sudden contraction of their volumes when they have been expanded by heat.

The principal phenomena of elastic bodies are the following:—1. That an elastic body (the elasticity being supposed perfect) exerts the same force in endeavouring to restore itself as that with which it was compressed or bent. 2. The force of elastic bodies is exerted equally in all directions, but the effect chiefly takes place on the side on which the resistance is the least. 3. When an elastic solid body is made to vibrate by a sudden stroke, the vibrations are performed in equal times, to whatever part of the body the stroke may be communicated. Thus, sonorous bodies always emit sounds of the same pitch; and the difference of the pitch depends on the greater or less frequency of the vibrations of the sonorous body. 4. A body perfectly incompressible cannot be elastic, therefore bodies perfectly solid can have no elasticity; and hence, also, the small degree of elasticity belonging to the liquids which are eminently incompressible. *See* COLLISION, PERCUSSION, STRENGTH OF MATERIALS; also ATMOSPHERE, HYDRODYNAMICS, PNEUMATICS, and VAPOUR.

ELA'STIC CURVE. In Mechanics, the figure assumed by an elastic plate or lamina, one end of which is fixed horizontally in a vertical plane, and the other loaded with a weight which tends by its gravity to bend the plate. This was the manner in which the curve was conceived to be formed by James Bernoulli, who first investigated its properties; but a more general view may be taken of its formation. Let the lamina M N be fixed at the point M in such a manner that, however it may be bent, the direction of the tangent M T shall be constant; and let it be submitted to the action of any number of forces acting in the same plane, which will be the plane of the curvature. Let P be the resultant of all the forces acting



in the direction O M, the axis of $y$, and Q the resultant of all those acting in the direction O N, the axis of $x$; and let the distances of the directions of the forces P and Q from the axes of the co-ordinates be respectively $p$ and $q$. The curve at any point $m$, the co-ordinates of which are $x$ and $y$, is kept in equilibrio by the action of three forces, namely, P and Q, which are exerted in turning the lamina round the point $m$, and the elasticity E, which may therefore be considered as acting in the direction perpendicular to $m\,t$, the tangent at $m$. But the action of P on the point $m$ is equal to the product of that force by its distance from the ordinate of $m$ parallel to its direction, which distance is $p-x$. The action of P is therefore equal to $P\,(p-x)$; and, in the same manner, the action of Q is equal to $Q\,(q-y)$. Hence, since the elasticity is equal to the sum of these two, we have the equation

$$P\,(p-x) + Q\,(q-y) = E.$$

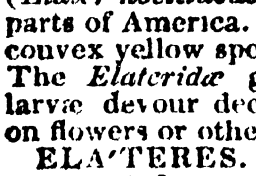
It is now necessary to make a hypothesis respecting the manner in which the elasticity E varies from point to point in the curve. The law usually assumed is, that the force of elasticity at any point is proportional to the tension, or inversely as the radius of curvature at that point, hence if $r$ denote the radius of curvature, and E be the elasticity at the point where $r = 1$, the general equation of the elastic curve becomes

$$P\,(p-x) + Q\,(q-y) = \frac{1}{r}\,E.$$

Let $f'x = \frac{dy}{dx}$, and $f''x = \frac{d^2y}{dx^2}$; then, by the known expression for the radius of curvature, we have $\frac{1}{r} = \frac{f''x}{(1+f'x^2)^{\frac{3}{2}}}$. The differential equation of the curve therefore becomes

$$P\,(p-x) + Q\,(q-x) = \frac{E\,f''x}{(1+f'x^2)^{\frac{3}{2}}}.$$

To take a simple case, let us suppose the lamina so situated that the tangent M T is parallel to the axis O N, in which situation the force Q vanishes; and also let the force P be that resulting from the gravity of a weight suspended from the extremity N of the lamina; then, if $l$ = the length of the lamina, we shall have




$$P\,(l-x) = \frac{E\,f''x}{(1+f'x^2)^{\frac{3}{2}}}$$

Let us further suppose the curvature to be very small, in which case, $f'x = \frac{dy}{dx}$ will be very small, so that its square may be neglected. We have then, on substituting for $f''x$ its value,

$$P\,(l-x) = E\,\frac{d^2y}{dx^2}.$$

The integral of this is

$$P\,(lx - \tfrac{1}{2}x^2) = E\,\frac{dy}{dx};$$

and a second integration gives

$$y - k = \frac{P}{2\cdot 3\,E}\,(3lx^2 - x^3),$$

$k$ being a constant, and equal to the distance O M.

The elastic curve is the same as that which a perfectly flexible line would form itself into, if supported at its two extremities and loaded with a fluid of uniform density filling the whole cavity of the curve; or it is the figure assumed by a spider's thread fixed at its extremities and blown by the wind.

E'LATER. (Gr. ελατης, *leaper*.) A Linnæan genus of Coleopterous insects, now the type of an extensive family of the Serricorn Coleoptera. The *Elateridæ* may be distinguished from the other Serricorn beetles by the presence of a strong, short, and often slightly curved spine, projecting from the posterior margin of the prosternum, and of a depression just above the origin of the second pair of legs adapted for the reception of the preceding spine. An *Elater* may be recognized on a distant view from the particular use to which it puts the above described sternal modifications. If a beetle be seen to fall upon its back, and instead of making the ordinary attempts to set itself upon its legs, bends its head towards its tail, raising this part, and then suddenly springing into the air, and repeating the action until it has fallen upon its feet, such a beetle may be recognized at once as a species of one or other of the numerous subgenera of the *Elateridæ*. This leap is due to the rebound occasioned by the sudden disengagement of the sternal spine from its socket. One of the species of *Elater* proper (*Elater noctilucus*) is the common fire-fly of the tropical parts of America. Its luminosity is emitted by two round convex yellow spots situated at the sides of the thorax. The *Elateridæ* generally are vegetable feeders; the larvæ devour decayed timber; the perfect insects feed on flowers or other soft and living parts of vegetables.

ELA'TERES. In Botany, the loose spiral fibres that are contained, together with the sporules, in the conceptacles of *Junger mannia* and *Marchantia*.

ELA'TERIUM. (Gr. ελαυνειν, *to stimulate*.) This substance, commonly called *extract of elaterium*, is obtained from the fruit of the *Momordica elaterium*, or *squirting cucumber*, which, if gathered a little before it ripens and the juice gently expressed, deposits a green sediment, which is collected and dried. In the dose of from one eighth of a grain to a grain, good elaterium operates as a drastic purge, bringing away from the bowels a large quantity of watery secretion; it is seldom prescribed except with a view of diminishing the collection of fluid in cases of dropsy.

ELATERIUM. In Botany, a term invented by Richard to denote that kind of fruit which is found in *Euphorbia*, consisting of three or more carpels, consolidated when young, but bursting with elasticity when ripe.

E'LBOW. The sea phrase for the half twist in the cables by which the ship is moored, caused by her swinging the wrong way. (*See* HAWSE.) Also a term for a sudden turn in a line of coast or course of a river.

ELBOWS. (Sax. elboga.) In Architecture, the upright sides which flank any panelled work, as in windows below the shutters, &c.

ELCA'JA. An Arabian tree, the fruit of which is emetic, and is employed in an ointment for the cure of the itch it is the *Trichilia emetica* of botanists.

E'LDERS. Certain laymen who, according to the constitution of the Presbyterian church, form a council of which the minister is the moderator, and discharge the functions of a spiritual court. They also assist the minister in the management of the concerns of the parish, attending to the interests of the poor, like the deacons of the primitive church. Among the Jews, elders were those persons most distinguished for age, rank, and wealth, who formed the council of the people. *See* PRESBYTERS.

EL DORA'DO (Span. *the golden region*.) The name given by the Spaniards to an imaginary country, supposed in the 16th century to be situated in the interior of South America, between the rivers Orinoco and Amazon, and, as the name implied, abounding in gold and all manner of precious stones After the Spanish conquest of Mexico and Peru, the most exaggerated accounts of the wealth and riches of the newly acquired territory were circulated and believed A new region was fabled to exist far surpassing the wealth and splendour of Peru; expeditions were fitted out for the purpose of discovering it, and though all such attempts proved abortive, the rumours of its existence continued to be believed down to the beginning of last century. The term has now passed into the language of poetry, in which it is used to express a land of boundless wealth and felicity, like the ancient Elysium or the Mohammedan Paradise. (See a learned article on "Sir Walter Raleigh" in vol. lxxii of the *Edin. Review*, which contains a *resumé* of all the speculations that have been entertained upon this subject.

ELEA'TIC PHILOSOPHY. A system owing its origin to Xenophanes, a native of Elea (in Latin *Velia*), who lived about the year B C 530. The most celebrated of his followers were Parmenides and Zeno, also natives of Elea. The dialectical character of the principal systems of antiquity may be said to owe its existence to the Eleatics The tendency of their speculations was the direct contrary of that which distinguishes the Ionic school. While the latter fixed their attention on outward nature, and strove to discover the laws which regulate its progress, Xenophanes and his disciples confined their thoughts to what they conceived to be the only objects of real knowledge — the ideas of God, or Being as it is in itself. The world of succession and change, which they designated under the title of *that which becomes* (το γιγνόμενον), they held to be utterly vain and illusory; the very conception of change itself seeming to them to involve a contradiction. Time, space, and motion they regarded as mere phantasms, generated by the deceiving senses, and incapable of scientific explanation. They were consequently led to distinguish between the pure reason, the correlative of Being, and in one sense identical with it, and opinion or common understanding, the faculty which judges according to the impressions of sense. Parmenides, in particular, was the author of a philosophical epic, the two books of which treated respectively of these two modes of thinking. For a full account of all that can be gathered from remaining fragments of this rigid system of rationalism, the reader must consult the German writers on the subject; in particular Brandis and Ritter, in their histories of philosophy. Frequent allusion is made both by Plato and Aristotle to the Eleatic doctrines, the authors of which are mentioned by both those philosophers in terms of evident respect and veneration. Plato has made their system the subject of a whole dialogue, entitled the *Parmenides*; perhaps the most striking specimen of dialectic subtlety which Grecian philosophy affords. Many valuable remarks on the nature and influence of the Eleatic doctrines are to be met with in Mr. Thirlwall's *History of Greece*, vol. ii. c. 12.

ELECA'MPANE. The vulgar name of the *Inula*

*Helenium*. It is an aromatic bitter, and was formerly regarded as expectorant; whence the monkish line,

Enula campana reddit præcordia sana.

A coarse candy, composed of little else than coloured sugar, is sold under the name of elecampane.

ELE'CT. (Lat. electus.) Some functionaries are so termed during the period between their appointment and some act which is necessary to ratify it; as, a bishop after election and before consecration.

ELE'CTION, in Law, is when a man is left to his own free choice to take or do one thing or another, which he pleases; as, where a man has two forms of action by which he may recover his right, it is within his election to choose that according to which he will proceed; or where, as in some cases, he has an election between several parties, against any of whom he may prosecute his suit. Where there are coparceners of lands, on partition the eldest sister has the election.

ELE'CTION, in Theology, is the choice made by God of certain individuals of the human race to enjoy peculiar privileges and blessings. In the Old Testament election is spoken of as national, not individual. The Jews were the chosen people of God (Deut. iv. 37., Is. lxv. 9., and in passages too numerous to be cited). And that the "elect" or chosen of God, of whom the inspired writers of the Epistles speak, and to whom they often address themselves, are in some instances only persons called to partake in the benefits of the Christian dispensation, appears to be admitted on all hands (1 Pet i 1, 2.; 1 Pet. ii. 9 ). But an opinion arose from very early times in the church, that in other passages (Rom. ix. 18. 24., Eph. 1, &c ) the election spoken of is a predetermined choice, not to the immediate blessings of the covenant, but to eternal life; that God, by arbitrary will, selects a number of persons without respect to foreseen faith or good works, and infallibly ordains to bestow upon them eternal happiness through the merits of Christ. This doctrine is of course opposed to that of universal redemption; namely, that every man is enabled (if he will) to obtain salvation through those merits It is certain that the doctrine of election — something resembling which is attributed to the Basilidians, Valentinians, and other early heretics — cannot easily be traced in the writings of any father of the church before Augustine, who embraced it with all the ardour of his eager disposition, but appears to have varied much in his opinions respecting it. It is most rigidly laid down in his treatise *De Dono Perseverantiæ*. Calvin, in modern times, was its great reassertor, and declared it in a dogmatical manner. "We were elected from eternity, before the foundation of the world, from no merit of our own, but according to the purpose of the divine pleasure." (*Inst* iii. c. 15 s 5 ) It became a fundamental article of belief in Calvinistic churches. The synod of Dort was expressly convened to vindicate the doctrines of election and predestination against Arminian tenets (1615). The language of the Church of England, on this as on other controverted points, admits of a variety of interpretations; but during the prevalence of Calvinism in the higher clergy, and especially in the university of Cambridge, under Archbishop Whitgift, an attempt was made to define her tenets more strictly. The Lambeth articles, agreed to in 1595 by a portion of the clergy, assert that "God from eternity hath predestinated certain men unto life, certain he hath reprobated." But these were never authentically received by the church. *See* CALVINISM, PREDESTINATION.

ELECTIVE AFFINITY signifies the order of preference, as it were, in which substances combine; thus, if nitric acid be added to a mixture of lime and magnesia, it will *elect* or choose to combine with the lime in preference to the magnesia. *See* AFFINITY, CHEMICAL.

ELECTIVE GOVERNMENTS are those in which all functionaries, from the highest to the lowest, are chosen by the suffrages of a greater or less number of citizens. Of these the government of Athens in antiquity, and in modern times that of the United States, will serve as examples. When the functionaries of an elective government are chosen by a very great number, it is identical with a democracy; and when by a comparatively small number, either with an aristocracy or an oligarchy.

ELE'CTORS. (Germ chur- or kur-fürsten.) Those princes of the old German empire who had a voice in the election of the emperor. These were originally (A D 1256) seven: Mentz, Treves, and Cologne, — ecclesiastical; and Bohemia, Brandenburg, Saxony, and the Elector Palatine, — lay; but to these Bavaria was added soon after their institution. In 1692 this dignity was conferred on the dukes of Brunswick-Luneburg, who were afterwards styled electors of Hanover; and, at different periods during the last century, on the princes of Salzburg, Wurtemberg, Baden, and Hesse Cassel. But on the dissolution of the German empire in 1806, the title of elector was merged in that of king, grand duke, &c. &c., by all the German states except Hesse Cassel, whose sovereign is still designated elector. The electors had various privileges, both general and special.

ELE'CTRIC FISHES. The species of the class *Pisces* are so called which have the power of discharging electric shocks; the most remarkable are the *Torpedo*, *Gymnotus*, and *Silurus*, or *Malapterurus electricus*.

ELECTRI'CITY. (Gr. ηλεκτρον, *amber*; the substance in which the property of attracting light substances after friction was first observed.)

This truly extraordinary power of matter, independent of the interest that always belonged to it, has of late years acquired much importance from its influence over chemical phenomena, and its connection with those of magnetism. When a clean glass tube is rubbed with the dry hand, or with a piece of silk, it attracts and repels any light substances, — such as feathers, bran, or little pieces of paper, — which are brought near it; a stick of sealing wax rubbed upon dry flannel exhibits the same appearances, and, to a superficial observer, seems to be exactly in the same state as the glass; and they are said to be electrically *excited*. But, on more close examination, it is found that when light bodies are *attracted* by excited glass, they are *repelled* by excited sealing wax, and *vice versâ*, so that the glass and wax are said to be in *opposite electric states*; and hence the terms *vitreous* and *resinous* or *positive* and *negative* electricity. But these two states are always coexistent: thus when glass is rubbed by silk the glass becomes positive, but the silk becomes negative, and in the case of sealing wax rubbed by flannel the wax is negative, but the flannel is positive.

A similar excitation of electricity is seen in an infinity of other cases; as when we rub a cat's back with the hand, or when a piece of silk riband is drawn briskly between the fingers, or a sheet of paper rubbed with India-rubber, or a metal rod with a silk handkerchief. These, and other extraordinary phenomena connected with them, are hypothetically referred to the presence of a peculiar form of matter called the *electric fluid*; it is supposed to appertain to all matter, but to become evident only when in redundance or deficiency. When glass is rubbed with silk the equilibrium of the electric fluid is disturbed, the silk imparts it to the glass; and hence the former, losing electricity, becomes *minus* or negative, and the latter, acquiring electricity, becomes *plus* or positive. This is commonly called "Franklin's Theory," having been proposed and defended by that celebrated electrician. Others have assumed the existence of *two fluids* as essential to the explanation of electrical phenomena; both equally subtile, elastic, and universally diffused, and each highly repulsive as to its own particles, and attractive of those of the opposite kind. Electrical quiescence is referred to the combination of these fluids, and their consequent mutual neutralization; and electrical excitation is the consequence of either being free or in excess. It is supposed that they are separated by friction, and by all those other causes which give rise to the appearance of free electricity. Either of these hypotheses may be adopted as facilitating the explanation of electrical phenomena, and as conferring meaning on terms which would otherwise be unintelligible of the two the simplest, or that which refers the phenomena to one fluid, is perhaps the most generally applicable Both are apparently equally consistent with facts; but the existence of any *fluid*, or form of matter, as the cause of electrical phenomena, is at best extremely problematical.

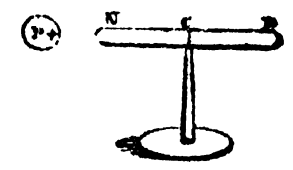
There are two series of distinct phenomena presented by electrified bodies: the one seems to result from the accumulation of electricity upon the surfaces of bodies; they are commonly included under the term *electricity of tension*, and are well exhibited by the common electrical machine and its prime conductor. It affects all neighbouring bodies, and they are thrown by it into a polar electrical state by what is termed *induction*: it has a tendency to pass off in sparks through the air, or gradually to escape from points. The thunder storm furnishes a magnificent specimen of this state of electricity. The other state of sensible electricity is that exhibited by *electricity in motion*, as when a current of electricity is passing through a wire or other conducting medium: in this case a vast *quantity* of electricity may be concerned in the phenomena without any apparent *intensity*; but, whilst the current is continuous, it produces magnetic phenomena of a most extraordinary character; and, when the perfect conductor is broken by the intervention of certain other media, they suffer in some cases chemical decomposition, and in others become heated, and even ignited. The phenomena of electricity in motion are best exhibited by the Voltaic apparatus.

In all electrical experiments remarkable differences are observed in respect to the transfer of the electric fluid through different bodies: some, such as the metals, allow its free and nearly unimpeded passage through their substance; while others receive and retain it more superficially, such as glass resin, and other substances which exhibit attractive and repulsive powers when rubbed. Hence the division of bodies into *conductors* and *non-conductors*.

Many most important electrical phenomena depend apparently upon *induction*, a subject which has been ably

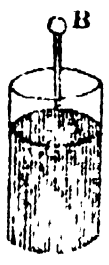
studied by Faraday. (*Phil. Trans.*) We shall here enter into such details only as are required to render some of the principal terms employed in discussing electrical phenomena intelligible.

If P + represent a metallic sphere in a highly positive electric state, and N P a metallic *conductor* in its vicinity *insulated* upon a glass stem; it will be found that the extremity N of N P is *negative*, whilst the other extremity P is *positive*, and that these opposite electricities are greatest at the extremities of the conductor, and gradually diminish towards the centre line C, which is neutral. This extraordinary state of excitation in N P is entirely dependent upon the proximity of P+; for if P+ be withdrawn, N P loses all appearance of electricity; and the degree of excitement in it is directly proportional to the extent to which P+ is excited, and (within certain limits) to its nearness to N; so that fluctuations in the electricity of N P will be observed in proportion as P+ is brought towards or removed from N, provided they are not brought into *contact*, and that no *spark* passes. These phenomena have been theoretically explained upon the supposition that the free electricity in P+ disturbs the equilibrium of the natural electricity of N P, and by repelling it from N to P leaves the former *minus* and the latter *plus*. Or, if we assume the existence of two electric fluids, then the free positive electricity of P+ *repels* the positive fluid of N P and *attracts* its negative fluid, throwing it into an *electro-polar* state. If N P, instead of being insulated, be connected by its extremity P with the ground, the accumulation at P is prevented whilst N retains its deficient or negative state; or, upon the other theory, the positive fluid at P is neutralized by a supply of negative fluid from the earth; and if, after having effected this by momentarily touching N P with the finger, we suddenly remove P+, the insulated conductor N P will be left with an excess of negative electricity.




It will be obvious from the above statement that when light bodies, especially if they be conductors, are attracted by electrified surfaces in their vicinity, they are thrown by induction into opposite electrical states, and when the hand is brought near the excited conductor of the electrical machine, it becomes negative, and remains so till the equilibrium is restored by the passage of a spark, which phenomenon is supposed to be the result of the combination of the two electric fluids.

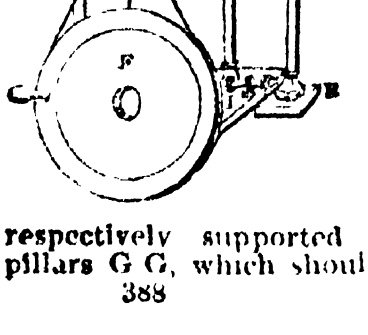
Many important phenomena of electrical accumulation are explained by reference to the principles of induction, and among them the action of the *Leyden jar* or phial. A thin glass jar or bottle, A, is coated inside and out, to within three or four inches of its mouth, with some conducting substance, tin foil, being especially convenient for the purpose, is generally used; and a metallic rod projecting a few inches from the aperture, and surmounted by a brass ball, B, communicates with the interior coating.

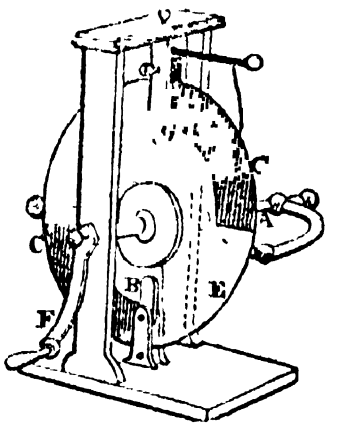



When the ball is applied to the prime conductor of the electrical machine, and the outer coating communicates with the ground, the interior acquires a positive and the exterior a negative charge, and on making a communication by means of a conductor between the inner and outer coatings, the electricities are annihilated with the production of a bright spark and explosion, and by a most disagreeable sensation, called the *electric shock*, if the body be made part of the *circuit*. When several jars are so arranged that their interior and exterior coatings are all separately connected, the assemblage constitutes the *electrical battery*.

In the common *electrical machines*, electricity is excited by the *friction* of the plate or cylinder of glass upon the cushions or rubbers. and the glass becomes positive, and communicates the same state to the opposed conductor, generally termed the *prime conductor* of the machine, the rubber becomes negative, and is sometimes connected with a second conductor.

The annexed figures represent the two common forms of the electrical machine. The first is the *cylinder* machine, commonly called Nairne's machine. B is the glass cylinder, which is made to revolve upon its axis by the multiplying wheels F, C, the necessary friction for the electric excitation being produced by the cushion and silk flap D. A A are the positive and negative conductors: the latter, bearing the cushion, is adjusted as to its requisite pressure upon the cylinder by the screw at E. The conductors are respectively supported and insulated by the glass pillars G G, which should be coated with lac varnish; and the axis of the cylinder rests upon the pillars H H, which are also of glass. The second figure represents the *plate* machine, usually termed Cuthbertson's machine, in which A is the prime conductor, borne by a stout glass stem which is attached to the frame of the machine. B B are the upper and lower pairs of cushions, by which, together with the silk flaps C C, the necessary friction is obtained. E is the disk of plate glass which is made to revolve upon its axis by the winch F. In this machine, as the cushions or rubbers are not insulated, the negative electricity cannot be separately accumulated or exhibited, as in the cylinder machine.




There are many other and highly important causes of electric excitation than those above adverted to; such as contact of different metals (*see* GALVANISM), chemical action (*see* VOLTAIC ELECTRICITY), change of temperature (*see* THERMO-ELECTRICITY), and magnetism (*see* MAGNETISM and ELECTRO-MAGNETISM).

ELE'CTRO-CHEMISTRY. That branch of chemical science describing the especial applications of electricity as a chemical agent.

ELE'CTRODE. (Gr. ηλεκτρον, and ὁδος, *a way*.) The surfaces by which electricity passes into and out of other media have been called by Mr Faraday *electrodes*. The term has also sometimes been derived from ηλεκτρον, *amber*, and ειδος, *like*, and applied to substances which, like amber, become electric by friction.

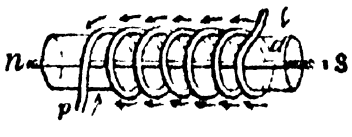
ELE'CTRO-DYNA'MICS. (Gr. ηλεκτρον, and δυναμις, *power*.) The phenomena of electricity in motion.

ELE'CTROLYTE. (Gr. ηλεκτρον, and λυω, *I set free*.) Substances susceptible of direct decomposition by the action of the electric current. hence, also, the verb *electrolyze*, i. e. to resolve compounds into their elements by the agency of electricity. Faraday has shown that in many supposed cases of electrolysis, the evolution of elements is the consequence of a secondary action; the sulphur, for instance, which is thus evolved at the negative pole from sulphuric acid, is the result of the evolution of hydrogen at that pole, in all cases of true electrolytic action sulphur appears at the anode.

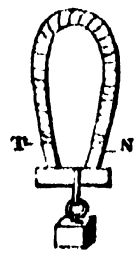
ELECTRO-MAGNETISM. When a current of electricity is traversing any substance, or when electricity is in motion, magnetism is at the same time developed. This fact was first observed by Professor Oersted of Copenhagen, and has become the source of an important series of discoveries included under the above term. The excitation of magnetism depends upon *quantity* of electricity, and is best observed in the wire which closes the voltaic circle, especially of one or more pairs of large plates. If a magnetic needle be brought near a wire through which an electric current is passing, it will immediately deviate from its usual position, and assume a new one, dependent upon the relative position of the needle and the wire. On placing the electric wire *above* and parallel to the magnet, the pole next the negative end of the battery always moves to the west, and when the wire is placed *under* the needle, the same pole turns to the east. When the electric wire is on the same horizontal plane with the needle, no declination takes place; but the magnet shows a disposition to move in a vertical direction, the pole next the negative side of the battery being depressed when the wire is to the west of it, and elevated when it is to the east.

The magnetic phenomena of a wire transmitting electricity are such as appear to depend upon the circulation of magnetism at right angles to the electric current, so that if N P represent the wire transmitting a current of electricity in the direction of the horizontal darts, a current of magnetism will be established in the direction of the vertical dart, appearing to move round the axis of the electric current; hence the term *rotatory* or rotary magnetism, applied to these phenomena, and hence the motion of the pole of the magnet round the electric wire, or of the electric wire round the pole of the magnet, when they respectively are so arranged as to be able to move freely in any direction. If a steel needle be placed in contact with the electric wire, and parallel to it, it acquires opposite magnetisms upon its two sides; but if it be placed at right angles to the connecting wire, it becomes polar, and permanently magnetic. If the electric wire be twisted into a spiral, and the steel needle placed within it (as in the cut), it is retained there, and becomes a more powerful magnet in consequence of the repetitions and direction of the electric and magnetic currents, as will be evident from the annexed figure, where *a* represents a glass tube with the

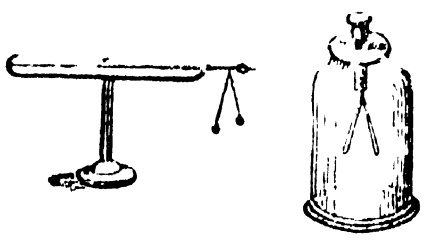


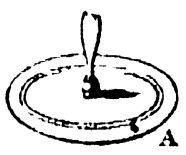
wire *n p* conveying the electric current twisted round it; the darts at the ends of which show the ingress and egress of the electricity, and the transverse darts the direction of the magnetic current. If the cylinder round which the wire conveying the electric current is twisted be of steel, it becomes a permanent magnet; if of pure soft iron, it becomes a temporary magnet, so long as the electric current is in motion, and *s* and *n* are powerfully opposed poles. If the bar be bent, as in the annexed cut, a powerful horse-shoe magnet is obtained when the ends *p n* of the copper wire twisted round it are connected with the voltaic circle; and a single pair of plates is sufficient for the purpose.




ELECTRO'METER. (Gr. ηλεκτρον, and μετρον, *a measure.*) An instrument for ascertaining the presence and intensity of electric excitation. The simplest form of electrometer consists of two very small pith balls suspended from a small conductor by very fine wire or thread; upon the principle that bodies similarly electrified repel each other, these *diverge* upon the reception of very minute quantities of electricity. Two thin slips of gold leaf are also similarly applied; and, to prevent the influence of the agitation of the air upon them, they are suspended in any convenient way under a glass shade. The other forms of electrometers generally act upon the same principle, being respectively adjusted to the varying degrees of quantity and intensity.



ELECTRO'PHORUS. (Gr. ηλεκτρον, and φερω, *I carry.*) This instrument consists of a flat smooth cake of resin A, which is rendered negatively electrical by friction, a plate of brass with a glass handle is then placed upon it, and becomes electropolar by induction. The brass plate, having been touched by the finger whilst lying upon the resin, is afterwards lifted off by its glass handle, and gives a spark of positive electricity. The same operation may be indefinitely repeated. This instrument is sometimes a convenient substitute for the electrical machine, and is elegantly applied to inflame a jet of hydrogen gas in *Volta's inflammable air lamp.*




ELE'CTROPO'LAR. A term applied to conductors, one end or surface of which is positive, and the other negative, a state which they commonly exhibit when under the influence of induction.

ELE'CTROSCOPE. (Gr. ηλεκτρον, and σκοπεω, *I see.*) An instrument for rendering electrical excitation apparent by its effects. The gold leaf electrometer, and other similar arrangements, are *electroscopes.*

ELE'CTRUM. (Gr. ηλεκτρον.) A term applied by the ancients to various substances, but especially to the substance now called amber, or to a certain metallic alloy consisting of four parts of gold and one part of silver. (See *Pliny*, lib. xxxiii. and xxxvii.)

ELE'CTUARY. (Lat. electuarium.) This term is generally applied to powders which are mixed up with syrup, so as to be of about the consistency of treacle. The *confections* of the present Pharmacopœia are substituted for the former electuaries.

ELE'DONE. (Gr. ελεδονη.) A name applied by Aristotle to a genus of Malakia or Cephalopods having a single row of suckers on each arm, and without any musky odour; it is applied in modern zoology to the same genus.

E'LEGANCE. (Lat. elegantia.) In the Fine Arts, a quality indicating grace and lightness, but especially the latter. In painting and sculpture it greatly depends on good selection and delicacy of execution, and these again upon taste. Heaviness, and leanness or extreme lightness, are the boundaries between which elegance is a mean.

ELE'GIT (Lat. *he has chosen*), in Law, is a writ of execution, which lies for one who has recovered debt or damages; or upon a recognizance in any court against one not able in his goods to satisfy the same, directed to the sheriff, commanding him to make delivery of a moiety of the party's land, and all his goods except beasts of the plough. The creditor holding the moiety of the land until satisfaction is termed tenant *by elegit.*

E'LEGY, is the name given in modern times to a species of poetical composition of a mournful character. But though this signification of the term tallies with its etymology (Gr. ε, and λεγειν, *to cry alas*), the expression *elegy* among the Greeks, with whom it originated, and among the Romans, by whom it was assiduously cultivated, had a much wider signification. Thus among the former it embraced equally the warlike verses of Tyrtæus, the melancholy effusions of Mimnermus, and the moral and political aphorisms of Theognis and Solon; and among the latter it comprehended the miscellaneous themes of Ovid, Propertius, Tibullus, and Catullus. The form of verse in which it was composed was the alternate hexameter and pentameter (*See* PENTAMETER.) In modern times almost all the nations of Europe have practised this species of composition; but if we except the *Elegies* of Hammond, Milton's *Lycidas*, and Gray's *Elegy* among ourselves, and Matthisson's *Elegie* among the Germans, it does not appear with great success.

E'LEMENTS. The old chemists applied this term to certain imaginary principles or essences of matter; such as fire, water, earth, and air. The elements of the alchemists are salt, sulphur, and mercury. The term element is now used as synonymous with *simple* or *undecompounded body;* that is, a substance which we cannot resolve into simpler forms of matter. The present list of *elements* includes all the *metals*, and the following substances — oxygen, chlorine, iodine, bromine, fluorine, hydrogen, nitrogen, sulphur, phosphorus, carbon, selenium, and boron; amounting in all to fifty-four, exclusive of the imponderable forms of matter. *See* EQUIVALENTS, CHEMICAL.

E'LEMI. The resinous exudation of the *Amyris elemifera*, brought from the West Indies: it yields a volatile oil on distillation. It is used in ointments, giving them a gently stimulating character, and adding to their viscidity. The *compound elemi ointment* of the Pharmacopœia is a good preparation of this kind, and resembles the *yellow basilicon* of old pharmacy.

ELE'NCHUS. *See* SOPHISM.

ELEPHANTI'ASIS. A disease which chiefly affects the legs and feet, which become rough, scaly, and swollen, and have been compared to the foot of the elephant: the skin gets thick, unctuous, and insensible, and the limb occasionally attains an enormous size.

E'LEPHANT, WHITE. A Danish order of knighthood of great antiquity. the number of knights is limited to thirty, besides members of the royal family.

E'LEPHAS, or ELEPHANT. (Gr. ελεφας, *an elephant.*) The generic name of the most gigantic of existing quadrupeds. They are characterized essentially by having grinders composed of alternating vertical plates of ivory, enamel, and cæmentum, and two tusks in the upper jaw: they are also the only living Mammalia which have a proboscis or trunk longer than the head. It is inferred from the structure of the skull that the extinct Mastodons, which have grinders of a more simple structure, also possessed a long proboscis, and accordingly Cuvier includes the genus *Elephas* and *Mastodon* in a particular family of Pachyderms called *Proboscidians.* Of the true genus *Elephas* there are two living and a greater number of extinct species. The Indian elephant (*Elephas Indicus*, Cuv.) differs from the African species in its greater size, in the skull being higher in proportion to its length, and with a more concave forehead. The Indian elephant has also comparatively smaller ears; the skin is of a paler brown colour, and it has four nails on the hind feet instead of three. The elephant will breed in confinement; its period of gestation is twenty months and some days. It brings forth one young at a birth, which derives its nourishment from two nipples placed on the inner side of the setting in of the fore-legs. The perpendicular height of the Indian elephant, measured from the top of the shoulder, has not been found to exceed ten feet six inches: the ordinary height is from seven to nine feet. The Indian elephant varies as to the length of the tusks; their ends only are visible externally in the females, and there is also a race (Mooknah) in which they are straight and short in the males. In other races the males have the tusks long and curved, especially in that called "Dauntelah." The anecdotes of the docility, sagacity, and tenacious memory of the elephant are numerous and generally known. The characteristics of the African elephant may be inferred from the account of those of the Indian species. It is usual to describe it as having a forehead convex instead of concave; but the projection is caused by the nasal bones, which are higher placed than in the Indian species; and the true front is in reality concave in the African species, but in a less degree than in the Indian. The chief external character of the African elephant is his huge ears. It is a remarkable fact that no African nation has ever subdued the elephant, or made it available for any useful purpose. For an account of the fossil elephants, see MAMMOTH.

ELEUSI'NIAN MYSTERIES. The secret religious rites performed every year in honour of Ceres and Proserpine at the Attic town of Eleusis. To these mysteries all Greeks of both sexes, if unpolluted by crime, were admitted; and as persons thus initiated were considered to be peculiarly under the protection of the gods and to enjoy their favour, it was a privilege much sought after. It has been thought that many passages of ancient classical writers refer in a covert manner to these mysteries, and the doctrines disclosed in them. thus, the whole sixth book of the *Æneid* has been interpreted by Warburton and others as an allegorical exposition of them, a notion controverted by Gibbon in one of his early works. *See* MYSTERIES.

ELEVA'TION. (Lat. e, *from*, and levo, *I raise.*) In Architecture, a geometrical representation of a building measured vertically in respect of the horizon; by the an

cient architects called the orthography. It is only in this sense that it is technically used by architects; in general terms it is the height of a building above the ground.

ELEVATION, in Astronomy, denotes the angular height or the altitude of a celestial object above the horizon. Thus, *elevation of the pole* denotes the arc of the meridian intercepted between the pole and the horizon.

ELEVATION, in Perspective, is sometimes used for the scenography or perspective representation of the whole object or building.

E'LEVATOR. A surgical instrument for raising depressed portions of the skull.

ELFS, or FAIRIES. Imaginary beings, honoured more particularly by the northern nations, in whose mythology they occupy a prominent place. They were divided into two classes—the good and the bad; and their exploits have given rise to a multiplicity of delightful stories. (See *Midsummer-Night's Dream*: and *Grimm's Deutsche Mythologie*, p. 259.) *See* FAIRIES.

E'LGIN MARBLES. A collection of ancient bas reliefs, statues, &c., which were chiefly decorations of the Parthenon at Athens, and are now deposited with some additions at the British Museum. Mr. Harrison, a northern architect of great abilities, suggested to Lord Elgin in 1797, at the period of his nomination to the embassy at Constantinople, the removal of these celebrated works. But it was not till some time after Lord Elgin's arrival that the ministers of the Porte were prevailed on to allow him to detach any portion of the marbles; and about eighty cases arrived in England in 1812. In 1816 the collection was purchased by government under a recommendation of a committee of the House of Commons at, if we rightly recollect, the sum of 35,000*l*. They are without question the finest productions of sculpture in the world.

EL'IMINA'TION. (Lat. elimino, *I put out*.) A term used by writers on algebra to denote that operation by which any number *n* of equations being given, containing *n* unknown quantities, a single equation is deduced from them containing only one unknown quantity; so that, by resolving this equation, we find the value of the unknown quantity it contains, and thence, by successive substitutions, the values of all the other unknown quantities. To eliminate a quantity is therefore to cause that quantity to disappear from an equation.

ELIQUA'TION. (Lat.) The separation of two metals by fusion.

ELI'SION. (Lat. elido.) In Grammar, the cutting off or suppressing of a vowel at the end of a word, for the sake of euphony or the measure of the verse. The use of the *elision* was confined chiefly to the languages of Greece and Rome.

ELI'XIR. (Arab.) A term applied in old pharmacy to certain essences or tinctures: a mixture of an aromatic tincture with sulphuric acid was called *elixir of vitriol*. The alchemists applied the term *elixir* to various solutions employed in the art of transmutation.

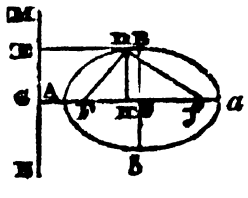
ELK. *See* DEER.

ELLA'GIC ACID. An acid obtained by Braconnot from gall nuts, and differing from the gallic acid: the term is derived from the word *galle*, reversed.

ELLI'PSE. (Gr. ἔλλειψις, *defect*.) One of the conic sections, produced by cutting a cone by a plane passing obliquely through its opposite sides. (*See* CONIC SECTIONS.) The ancient Greek geometers gave this name to the figure, because, among its other properties, one is, that the squares of the ordinates are less than the rectangles under the respective abscissa and the parameter, or differ from them in *defect*.

Though the ellipse was first suggested to geometers from considering the sections of the cone, it may be defined in various ways, and all its properties investigated without any reference to the solid. We subjoin some of these definitions, which are, in fact, so many different properties of the ellipse.

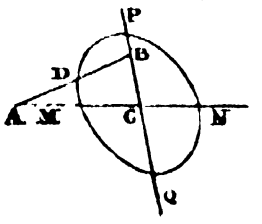
1. If two points F and *f* be given in a plane, and a point D be conceived to move around them in such a manner that the sum of the two distances D F and D *f* is always the same, the point D will describe upon the plane an ellipse A D B. The points F and *f* are the *foci* of the ellipse; and the point C, which bisects the distance between the foci, is its centre. The line A *a* is the *major* or *transverse axis*; and B *b*, which passes through the centre, and is perpendicular to A *a*, is the *minor* or *conjugate* axis. From this definition it is obvious how the curve may be described mechanically. Having fixed two pins F and *f* in the plane, let the ends of a thread be fastened to the two pins; then, moving a style or pencil within the thread, so as to keep it always stretched, the point of the style will describe the ellipse.



2. Let F be a given point, and M N a straight line given in position; if another point D move on the same plane so that its distance D F from F shall have always to the perpendicular D E, or its distance from the given line M N, the constant ratio of two given lines X and Y, of which X is less than Y, the point D will describe an ellipse. The line M N is called the *directrix*, and its distance from the centre C is such that C G is a third proportional to C F and C A. It is obvious that F A is to A G in the given ratio of X to Y.

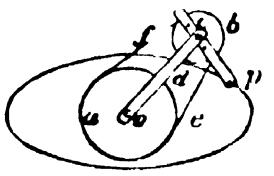
3. It is also a property of the ellipse that the rectangle under A H and H *a* is to the square of the ordinate H D in the ratio of the square of C A to the square of C B. From this property the common algebraic equation of the ellipse is derived. Let C A = *a*, C B = *b*, C H = *x*, and H D = *y*; then A H·H *a* : H D² : : *a*² : *b*², that is, (*a* − *x*) (*a* + *x*) : *y*² : : *a*² : *b*², or *a*² − *x*² : *y*² : : *a*² : *b*², whence $y^2 = \frac{b^2}{a^2}(a^2 - x^2)$. This equation may be put under the following elegant form, $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

4. Let M N, P Q be two straight lines intersecting each other in C; then if a straight line B A of a given length be carried along the two straight lines M N, P Q, any point D in A B (or in A B produced) will describe an ellipse the centre of which is at C. It is on this principle that elliptic compasses and lathes for turning ovals are constructed.



5. If a moving or generating circle roll along the concave circumference of a fixed circle in the same plane, and the radius of the former be half that of the latter, any given point in the plane of the generating circle, within or without it, will describe an ellipse. This very remarkable property of the ellipse, by which the curve is shown to be an epicycloid, was applied by Professor Wallace of Edinburgh to the invention of an ingenious instrument for describing an ellipse by continued motion. The construction of the instrument is as follows:—

"*a* and *b* are two wheels, the axes of which turn in holes *c o*, near the ends of the connecting bar *d*. One of the wheels *b* must be just half the diameter of the other *a*, which may be of any size, and a band *e f* goes round them outside; an arm *c p* is attached to the wheel *b*, and admits of being lengthened or shortened by sliding along its surface in a socket which may be anywhere on the wheel. Suppose now that the wheel *a* is fixed or kept from turning, and that the bar *d* is turned round the centre *o*, carrying at its other extremity the wheel *b*, the action of the band *e f* will then turn this wheel round its centre *c*; and while the bar makes one revolution round the centre of the fixed wheel, the other wheel will make two revolutions about its centre, and the point *p* in the sliding bar will describe the ellipse." (*Wallace's Conic Sections*.)



6. The ellipse is the curve in which the planets perform their revolutions about the sun, and its properties enter into almost every investigation connected with physical astronomy. In these investigations it is found most convenient to define the curve by means of an equation between the *radius vector*, that is, a line drawn from the focus to the curve, and the angle which it makes with the transverse axis. This is called the *polar equation* to the ellipse, and is found as follows:—Let F D the radius vector (see the first diagram) = *r*, C A = *a*, C F the eccentricity = *e*, and the angle A F D, which is called the *anomaly* = φ; then $r = \frac{a^2 - e^2}{a + e \cos. \varphi}$.

It is a property of the ellipse, that if a circle be described upon either axis, and from any point of that axis an ordinate be drawn both to the circle and ellipse, then the ordinate of the circle is to the ordinate of the ellipse as that axis to the other axis. Hence the whole area of the circle is to the whole area of the ellipse in the same proportion, and consequently the area of an ellipse is a mean proportional between the areas of the two circles described upon its transverse and conjugate axes. Hence, to find the area of an ellipse, multiply the two axes together, and multiply the product by ·7854. *See* CIRCLE.

The whole length of the periphery of an ellipse is expressed by the following series:

$$2\pi\left(1 - \frac{1}{2^2}e^2 - \frac{1^2 \cdot 3}{2^4 \cdot 4^2}e^4 - \frac{1^2 \cdot 3^2 \cdot 5}{2^6 \cdot 4^2 \cdot 6^2}e^6 - \frac{1^2 \cdot 3^2 \cdot 5^2 \cdot 7}{2^8 \cdot 4^2 \cdot 6^2 \cdot 8^2}e^8, \&c.\right)$$

where 2 π denotes the circumference of the circle described about the greater axis, and *e* is the eccentricity that is, $e^2 = 1 - b^2$, *b* being the semi-axis minor, and the semi-axis major being unit.

ELLI'PSIS. (Gr. ἐλλείπω, *I omit*.) In Grammar and Rhetoric, the omission of a word or part of a sentence, which is left to be supplied by the imagination of the hearer or reader.

ELLIPSOID. (Gr. ἔλλειψις, and εἶδος, *form*.) A geometrical solid, of such a nature that every section of it made by a plane produces an ellipse.

ELLIPSOID OF REVOLUTION, called also the *Spheroid*, is the solid generated by the revolution of an ellipse about its lesser axis.

**ELLIPTIC COMPASSES.** An instrument for describing an ellipse by continued motion. An instrument of this kind has been described under ELLIPSE. Various contrivances for effecting this purpose are described in the *Exercitationes Mathematicæ* of Schooten.

ELLIPTI'CITY of the TERRESTRIAL SPHEROID. A term used by Clairaut and other writers on the figure of the earth, to denote the deviation of the earth's form from that of a sphere. Clairaut employed the term to denote the difference of the two axes divided by the smaller: most other writers understand by it the difference of the axes divided by the greater. Thus, let $a$ = the equatorial diameter, $b$ the polar diameter, $e$ = the ellipticity; then $e = \frac{a-b}{a}$, whence $b = a\ (1-e)$.

ELM. A valuable genus of trees, confined to the colder parts of the northern hemisphere, but common to both the old and new world. Most of the species are trees of considerable size, and produce a timber useful for many common purposes in which great strength and durability are not required; but some of them are small bushes of no known value. In Great Britain there are several species in a wild state, the most valuable of which are called the Welsh, the Hertfordshire, the Huntingdon, and the smooth-leaved; in other countries of Europe and Asia many peculiar species exist, but they have been little examined by botanists. The elm is valued for the rapidity of its growth, its hardiness, and its capability of thriving in poor soil unfit for tillage. The word seems to be an alteration of ulmus, its Latin name

ELOCU'TION (Lat. eloquor, *I speak out*), signified originally, as the derivation of the word imports, the art of choosing and adapting words and sentences to the ideas to be expressed; but it is more frequently employed to denote the just and graceful management of the voice, countenance, and gesture in speaking; in which sense it is synonymous with what is termed a *good delivery* or *pronunciation*. *See* DECLAMATION, ELOQUENCE.

E'LOGE. (Gr. ευλογια, Ang *eulogy*) A term applied in France to the panegyrical orations pronounced in honour of illustrious deceased persons, and particularly of members of the Royal and other academies. Formerly the secretaries of the various French literary institutions used to compose and pronounce the *éloge*; but this duty is now performed by the new member elected in the room of the deceased This practice is no doubt open to censure; but it has been the means of giving to the world many interesting biographical sketches, which would never otherwise have appeared. *Eloge* is also applied to any species of biographical writing in which praise predominates over censure, and has been much cultivated by French and Italian authors

ELONGA'TION, in Astronomy, is the apparent distance of a planet from the sun The greatest elongation of Mercury amounts to about $28\frac{1}{3}$ degrees, and that of Venus to about 47° 48′ With regard to the superior planets, the elongation may have any value from 0 to 180°.

E'LOQUENCE. (Lat) The art of clothing the thoughts in the most suitable expressions, in order to produce conviction or persuasion. In its primary signification, eloquence (as indeed its etymology implies) had reference to public speaking alone; but as most of the rules for public speaking are applicable equally to writing, an extension of the term naturally took place; and we find even Aristotle (*Rhe* book III.), the earliest systematic writer on the subject whose works have come down to us, including in his treatise rules for such compositions as were not intended for public recitation A still wider extension of the term was contended for by the ancient rhetoricians, who included under it all kinds of literary productions (such as treatises on law, logic, &c), and whatever might be necessary to illustrate and explain them. In the following observations, we shall confine ourselves chiefly to the etymological meaning of the word, and shall give a brief sketch of the history, the objects, and the divisions of eloquence The invention of eloquence is ascribed by the Egyptians and the fables of the poets to the god Mercury; but no certain account can be given when or by whom this art first began to be cultivated. If we may judge from the eulogiums which Homer pronounced upon Ulysses and Nestor for their attainments in eloquence, it must have been very early in high esteem among the Greeks. But though, from time to time, there arose in Greece many distinguished writers upon eloquence, it does not appear that the practice of the art was combined with the theory for public purposes till the time of Pisistratus, who owed to his rhetorical acquirements his elevation to the throne. Passing from Pericles (the next in order to Pisistratus), who was distinguished at once as a general, a statesman, and an orator, we find many eminent names during the Peloponnesian war immortalized for their eloquence by the pen of Thucydides. In the succeeding age arose the school of rhetoricians, or sophists, as they are called, who endeavoured to graft upon eloquence the subtleties of logic; and among the earliest





and most eminent of this school were Gorgias, Isocrates, and Isæus, of whose publicly delivered orations there are still ten extant. It was in this age that Grecian eloquence attained its highest perfection by the genius of Demosthenes, to whom the palm has been conceded by the unanimous consent of ancient and modern times. Various are the writers that have endeavoured to point out the beauties of Demosthenes; but by none are the peculiar qualities and distinguished properties of his style more vigorously and happily (though briefly) pourtrayed than by Hume, who, throwing aside his usual calm and dispassionate manner, thus describes it: — "It is rapid harmony exactly adjusted to the sense: it is vehement reasoning without any appearance of art: it is disdain, anger, boldness, freedom, involved in a continued stream of argument: and of all human productions, the orations of Demosthenes present to us the models which approach the nearest to perfection." After this period, Grecian eloquence declined rapidly; and though in the following ages there flourished among others Hermagoras, Athenæus, Apollonius, Cæcilius, and Dionysius, their names have been almost without exception rescued from oblivion by a work, which may be regarded as the last expiring ray of Grecian eloquence — the incomparable treatise of Longinus on the Sublime.

In consequence of the all-absorbing spirit for military glory with which the ancient Romans were animated, it was long before they found leisure to appreciate the advantages of eloquence; and even so late as the year of the city 592, when, by the industry of some Greeks, the liberal arts began to flourish at Rome, the senate passed a decree banishing all rhetoricians from the country But a few years afterwards, when Carneades, Critolaus, and Diogenes were sent as ambassadors from Athens to Rome, the Roman youth were so charmed with the eloquence of their harangues, that the study of oratory formed thenceforth a branch of a liberal education. Men of the highest rank were now seen teaching and learning respectively the art of eloquence, and such was the impetus given to this study, that it made the most rapid advances, and was at last crowned by the appearance of Cicero, to whom critics have concurred in assigning a rank inferior only to that of Demosthenes That many illustrious orators existed at Rome prior to the age of Augustus, we learn from the work of Cicero, *De Claris Oratoribus*. In this treatise Cicero, in detailed notices and liberal eulogiums, has given immortality to the very men whose works were thrown into obscurity by the splendour of his own: as Quintilian says of Menander and *his* predecessors — atque ille quidem omnibus ejusdem operis auctoribus abstulit nomen, et fulgore quodam suæ claritatis tenebras obduxit. The mighty scale on which every thing was conducted at Rome, and the enormous interests so frequently at stake, were never so wonderfully exhibited as in the age of Cicero; and the unparalleled exigency found or created in him a talent for profiting by its advantages or coping with its difficulties. In the succeeding ages of the Roman empire, the despotic character of the government checked the growth of the rhetorical art; but the names of Tacitus, Quintilian, and Pliny are an earnest of what might have been achieved in this arena, had circumstances permitted the development of their talents.

During the middle ages, though the practice of eloquence may, as far as we know, be said to have lain dormant, the theory formed part of the scholastic study, as may be seen from the old doggrel hexameter, which served to fix the monastic studies in the memory—

> "Gramm. (Grammatice) loquitur; Dia. (Dialectice) vera docet;
> Rhet. (Rhetorice) verba colorat."

With regard to the early history of eloquence in England, there are found, indeed, the names of several distinguished men who in former times directed the resolutions of our parliament; but no pains were taken to preserve their speeches; and, as Hume observes, the authority which they possessed seems to have been owing to their experience, wisdom, or power, more than to their talents for oratory. It was not until the close of the last century (a period which, it may be said, Hume did not live to see), that an era arose in the history of British eloquence, which the genius of Chatham, Pitt, Burke, Fox, and Sheridan has consecrated and immortalized.

We can only allude to the history of eloquence in other countries. The little opportunity afforded for a display of forensic or senatorial eloquence by the different governments of Germany has almost entirely checked its growth in that country; and the same remark is applicable to Italy, Spain, and Portugal; all of which, however, have been rich in the eloquence of the pulpit The only two countries in the world whose orators can be put in competition with those of Britain, are France and America. To the pulpit oratory of the former, the illustrious names of Bossuet, Bourdaloue, and Massillon have given enduring celebrity, while the popular character of their respective institutions, has formed a host of forensic and senatorial speakers worthy a prominent place among the orators of antiquity, and modern times. The pulpit orators of England are too well known to be noticed here.

The elements of eloquence are usually comprised under the four following divisions — *invention*, *disposition*, *elocution*, and *delivery*. The first has reference to the character of the thoughts or ideas to be employed; the second to their arrangement (usually called the *parts* of a discourse, — consisting of the *exordium* or *introduction*, the *narration*, the *proposition* the *proof* or *refutation*, and the *peroration*: see these terms); and the third and fourth have respect to words, style, utterance, action, &c.

The Greeks divided discourses according to their contents, as relating to precept (λογους), manners (ηθη), and feelings (παθη), and as therefore calculated to instruct, to please, and to move. The Romans distinguished three kinds of eloquence: — the demonstrative, occupied with praise or blame, and addressed to the judgment; the deliberative, which acts upon the will by persuasion or dissuasion; and the judicial or forensic, which was used in defending or attacking — a division originally laid down by Aristotle, *De Rhetorica*. In our own times, a division somewhat similar has been made; and the bar, the senate, and the pulpit are the three grand theatres for the exhibition of oratory. With regard to the distinguishing characteristics of these three kinds of eloquence, the reader will find ample information on this head by consulting Blair, or *Campbell's Philosophy of Rhetoric*. The following is a summary of their views. In popular assemblies, the great object to be effected by the orator is persuasion: the speaker aims at determining his audience to adopt some line of conduct, as good, fit, or useful; and in order to accomplish this object, he must address himself to all the principles of action in human nature, — to the passions, to the heart, as well as to the understanding. At the bar, on the other hand, it is not persuasion, but conviction, that the orator aims at producing. There it is not the speaker's business to persuade the judges to what is good and useful, but to show them what is just and true. Hence it is chiefly to the understanding that his eloquence is to be addressed. Hence, also, the eloquence of the bar is considered by most rhetoricians of a more limited kind than that of popular assemblies. In many instances, however, the eloquence of the bar has a much wider scope than such writers have conceded, and the trial by jury admits of the most impassioned appeals to be found in the annals of modern eloquence. With regard to the eloquence of the pulpit, though it appears at first view to be possessed of many qualities advantageous to oratorical display, such as the dignity and sublimity of the subject, the large and mixed audience, and the leisure of the speaker for premeditation, these will be found to be counterbalanced by many disadvantages; *e. g.* the triteness of the subject, and the difficulty experienced by the speaker to excite attention. Besides, at the bar, or in the senate, the orator addresses passions which are forbidden ground to the preacher; and if at any time the latter makes an incursion into those regions, he is in danger of assuming a tone inconsistent with the dignity and the charity of his profession. The fierce invective, the terrible criminator, the bold and unexpected retort, the cutting sarcasm, the cool and dignified irony, on the one hand, — and, on the other, the skilful flattery, the exquisite artifice, with which the baser as well as the nobler passions of the audience are wrought into a subservience of the purpose of the orator, all these fall more or less within the province of the bar and the senate, but are beyond the sphere of the pulpit orator. With all these restrictions, however, the subject to which pulpit eloquence may be addressed are sufficiently extensive to admit of great oratorical display; and as to convince the intellect and force the unwilling homage of the reason, as well as to awaken the conscience and to arouse the imagination, are the objects of preaching, the pulpit orator may, by the choice of his subject, at one time be argumentative and ratiocinative at another declamatory and impassioned.

It is admitted on all sides that, in modern times, eloquence has not been invested with so much importance, or cultivated with so much care as among the ancients. For the cause of this alleged inferiority of modern as compared with ancient eloquence no satisfactory reason has been hitherto assigned, and even Hume has confessed his inability to solve the problem. Perhaps one cause of the ascendency of the ancient orators lies in the difference of the means employed in ancient and modern times to gain the consent of the audience. Among the ancients, the most violent and passionate expressions, accompanied by what Cicero calls the "supplosio pedis," and the "percussio frontis vel femoris," were not only admissible, but were even necessary, in order to produce an effect upon the audience. Among the moderns, such violence of gesture, except on the stage, would excite nothing but laughter. Those orators are now-a-days more esteemed who aim at convincing the understanding than at captivating the feelings; and this is a characteristic that pervades every species of modern eloquence. Again, if we look to the peculiarities of ancient law, the tribunals of justice, and the legislative assemblies of the Greeks and Romans, we may perceive, perhaps, the superior arena of the ancients. The great scope for eloquence in ancient times, as has been observed by an able writer in the *Quarterly Review*, arose from a circumstance that with us would be considered a vice — the blending of the legislative with the judicial powers. When the legislature is employed, as in England, in establishing, from the contemplation of a whole class of cases, a general principle for deciding on every future case that may be referable to that class; and when the judicial power is only occupied in ascertaining to what previously established legal class any particular case belongs, and what the decision of the law is regarding that class: in this state of things, there is scope, indeed, for the exercise of the most useful and respectable powers of eloquence, — the clear, strong, and elegant development of ratiocination, and of the information and the views of a comprehensive mind; and this is all. But when, as was the case in Greece and Rome, the written laws are few and vaguely expressed; when the judges exercise an undefined equitable jurisdiction, in the application of which they are not bound by any regulation of their predecessors; still more, when the tribunal is invested with a direct legislative power, the question is no longer to be decided by argument and the application to general principles alone, but the individual passions and interests of the judges are let loose; and then all the higher and more perilous faculties of the orator are called forth to rule in this war of elements, and direct the storm as may suit his purpose, — whether to sweep away falsehood and oppression, or to bear down the barriers of truth, law, and justice. (See *Whately's Rhetoric*; *Campbell's Rhetoric*, *Cicero, De Oratore*, and the works already mentioned.)

ELUTRIA'TION. (Lat. elutrio, *I cleanse*.) The separation of substances by washing them in large quantities of water, so that the heavier particles fall to the bottom, and the lighter ones, remaining some time suspended, are gradually deposited in a finely divided state.

ELYDO'RIC PAINTING. (Gr. ἐλαιον, *oil*, and ὑδωρ, *water*.) In Painting, a species of painting with a vehicle composed of oil and water, invented by M. Vincent of Montpetit. Its object is to add the fresh appearance of water colours and the extreme finish of miniature painting to the mellowness of oil colours. Not, however, having seen any specimen of it, we are unable to state from our own knowledge whether those objects have been attained.

ELY'SIUM, or the ELYSIAN FIELDS. (Gr. ηλυσια πεδια.) In Mythology, the region to which the souls of the virtuous were said by the poets to be transported after death. They are variously represented as a part of the infernal realms, or islands situated in the Western Ocean beyond the Columns of Hercules. The enjoyments of the blessed spirits in this abode were held to consist in the same pursuits that were their delight on earth, carried on in a calmer and happier climate: beautifully described in the well-known passage (*Odyss.* iv. 563) —

Αλλα σ' ες ηλυσιον πεδιον και τειρατα γαιης, &c.

Thus admirably rendered by the late A. Moore: —

> Thee to the Elysian plains, earth's farthest end,
> Where Rhadamanthus dwells, the gods shall send
> There mortals easiest pass the careless hour,
> There neither winter comes, nor snow, nor shower,
> But ocean ever, to refresh mankind,
> Breathes the shrill spirit of the western wind.

A tract on the coast of Campania was also termed the *Elysian Fields*.

E'LYTRUM. (Gr. ελυτρον, *a sheath*.) The superior or first pair of wings in four-winged insects are so called when they are of a coriaceous and hardly flexible texture, and serve as a protective covering to the second pair, as in beetles.

EMANATION, system of. In Philosophy, a synonym for *Pantheism*, which see.

EMA'NCIPATION. (Lat., from mancupo, *I sell*, or deliver over the tangible property in any thing.) By the ancient Roman law, the son stood in the relation of a slave to the father. By a fiction of that law, the son might be freed from this relation by being three times sold (mancipatus) by the father. Hence the enfranchisement of the son derived from this ceremony the name of emancipation. In course of time, various modes of emancipation, both tacit and express, became recognized by the Roman jurisprudence. The word, in countries following that law, signifies the exemption of the son from the power of the father, either by express act, or by implication of law. By the present civil law of France, majority (and with it emancipation) is attained at 21 years of age, and the marriage of a minor emancipates him (See *Code Civil*, lib. 1. ch. 3.) In ordinary language, emancipation is used in a general sense to signify the enfranchisement of a slave, or the admission of particular classes to the enjoyment of civil rights.

EMA'RGINATE. In Zoology, when the margin of a part is broken by an obtuse notch, or the segment of a circle.

EMARGI'NULA. A subgenus of Gastropodous Mollusks, dismembered from the genus *Patella* of Linnæus, and characterized by a shell of a simple conical form, but

having a narrow fissure extending from the margin to near the summit.

EMBA'LMING. (Lat. balsamum, *balm*) A process adopted by the ancient Egyptians, chiefly for the preservation of dead bodies from putrefaction. The term is derived from the use of balsamic substances in the operation; in addition to these, saline substances and tanning materials seem also to have been used. *See* MUMMY. (See *Granville*, in *Phil. Trans.*; and *Pettigrew upon Mummies.*)

EMBA'NKMENT. In territorial improvement, an embankment is a mound of earth or a wall, or a structure composed partly of a wall and partly of a bank of earth, to protect lands from being overflown by rivers or the sea. Embankments appear to have been coeval with the culture of corn crops; because these, it appears, were first grown on the alluvial soils which border large rivers, and to protect the crops from the overflowing of these rivers after heavy or long-continued rains, the cultivator would naturally throw up a bank of earth. This appears to have been done in Egypt at the most remote period of which there is any record. In modern times, embankments are employed, not merely to protect lands under cultivation, but to enclose land that is occasionally overflown by rivers or the sea, and render it fit for the purposes of husbandry. This has been done to a greater extent in Holland than in any other country. There are also immense embankments in Italy, particularly in Lombardy. In Britain, we have the embankments of the Thames near London, which have been in existence since the time of the Romans; many in Lincolnshire, formed during the time of Cromwell, and some of them many centuries before; and one of the most recent is that at Tre Madoc in Caernarvonshire, by which upwards of 4000 acres were recovered from spring tides, and in great part rendered fit for the plough. Embankments are attended with immense expense, but as the soil gained or protected is generally of the best quality, a judicious embankment is commonly considered as paying about the same rate of interest as a landed estate.

EMBA'RGO. A restraint or prohibition imposed by the public authorities of a country on merchant vessels or other ships, to prevent their leaving its ports. Embargoes are usually imposed only in time of war, or in apprehension of an invasion; in which cases the government employs the ships under embargo in armaments, expeditions, and transportation of troops, &c. When it is found necessary to stop the communication of intelligence between any two places, an embargo is laid upon all ships, both foreign and under the national flag.

E'MBASSY. *See* AMBASSADOR.

E'MBER DAYS, in the Romish calendar, are certain fasts appointed by Pope Calixtus for imploring the blessing of the Almighty on the fruits of the earth, and upon the ordinations performed in the church at these times. They occur four times a year, or once in each of the four seasons; being the Wednesday, Friday, and Saturday after the first Sunday in Lent, after the Feast of Pentecost or Whitsunday, after the festival of Holy Cross on the 14th of September, and after the festival of St. Lucia on the 13th of December. The weeks in which the ember days fall are called *ember weeks*. The word *embers* signifies ashes, which the primitive Christians strewed on their heads at these solemn fasts.

EMBERI'ZA. (Lat.) The name of a genus of Passerine birds, characterized by having the upper mandible narrower than the under one, with the edges turned inwards, and with a hard knob on the palate: the entire bill has the usual short strong conformation of the *Conirostral* tribe of Passerine birds. It is now the type of a family, subdivided into minor genera, under the name of *Emberizidæ* or Buntings.

EMBE'ZZLEMENT, in Law, is a felony, consisting of the same class of acts which would in any other case amount to larceny, when committed by one employed as a clerk or servant, and by virtue of his office, on the goods and chattels of his employer.

E'MBLEM. (Gr. εμβλημα; from εν and βαλλειν, *to throw in.*) Literally, *something inserted*. This term has various significations; but it is used most frequently in English to signify a figurative representation, which by the power of association suggests to the mind some idea not expressed to the senses. In Bibliography, books consisting of a series of plates, containing emblematic subjects, with explanations, generally in verse, in Latin or modern languages, are termed books of emblems. They were fashionable in the latter half of the sixteenth century. The best known is the *Emblemata Alciati*, by André Alciat, a French lawyer, which went through many editions.

EMBOLI'SMIC (Gr. εμβαλλω, *I insert*), in Chronology, signifies the same thing as *intercalary*, and is chiefly applied to the additional months required to fill up the lunar cycle. *See* CYCLE and EPACT.

EMBO'SSING, *Embossment.* (Fr. bosse, *a protuberance.*) In Architecture and Sculpture, the raising or forming in relievo any sort of figure, whether performed with a chisel or otherwise. It is a kind of sculpture, in which the figures rise from the plane on which they are formed; and as they are more or less prominent, they are said to be in alto, mezzo, or basso rilievo.

EMBOUCHU'RE (Fr.), signifies the mouth of a river; it is used also for the mouth-piece of a musical instrument.

EMBRA'CERY. (Norm. Fr. embraserie.) In Law, the offence of endeavouring to corrupt or influence a jury; punishable by fine and imprisonment.

E'MBRASU'RE. In Fortification, an opening made in the wall or parapet of a fortified place, or breast-work of a battery, through which the guns are fired. The embrasures are usually made about two and a half feet wide at the interior extremity, and eight or nine feet at the exterior; and the sole or lower surface is at the height of about two and a half feet above the platform on which the carriage of the gun is placed; but their forms and dimensions are of course varied, according to their position relatively to that of the point against which the fire is to be directed.

E'MBROCATION (Gr. εμβρεχω, *I moisten.*) A fluid application to any part of the body when painful or inflamed.

EMBROI'DERY. (Fr. broderie.) The name given to the art of working figures on stuffs or muslin with a needle and thread. All embroidery may be divided into two sorts, embroidery on *stuffs* and on *muslin*: the former is used chiefly in church vestments, housings, standards, articles of furniture, &c., and is executed with silk, cotton, wool, gold and silver threads, and sometimes ornamented with spangles, real or mock pearls, precious or imitation stones, &c.; the latter is employed mostly in articles of female apparel, as caps, collars, &c., and is performed only with cotton. In Germany this division is indicated by the expression *weisse* (*white* or muslin), and *bunte Stickerei* (*coloured* or cloth) *embroidery*. The embroidery of *stuffs* is performed on a kind of loom or frame; that of *muslin* by stretching it on a pattern already designed. The modes of embroidering stuffs or muslin with the common needle are extremely various; but a minute description of these processes would be as difficult as it would be uninteresting to the general reader. They consist for the most part of a combination of ordinary *stitches*; but no limit can be assigned to their number or variety. The art of embroidery was well known to the ancients. As early as the time of Moses we find it practised successfully by the Hebrews; and long before the Trojan war the women of Sidon had acquired celebrity for their skill in embroidery. At a later period, this art was introduced into Greece, probably by the Phrygians (by some considered as the inventors); and to such a degree of skill did the Grecian women attain in it, that their performances were said to rival the finest paintings. In our own times the art of embroidery has been cultivated with great success, more especially in Germany and France, and though for a long period it was practised only by the ladies of these countries as an elegant accomplishment, it is now regarded as a staple of traffic, and furnishes employment for a large portion of the population. In England also it appears to have taken deep root, as it now forms an accomplishment of which almost every lady is in possession. About seven years ago a great impetus was given to the cultivation of this art, both on the Continent and in England, by the invention of a machine which enables a female to execute the most complex patterns with 130 needles, all in motion at once, as accurately as she could formerly do with one. But as no account of this remarkable invention which we might give could be intelligible without the aid of illustrations, which would be out of place in this work, we must refer the reader to *Dr. Ure's Dictionary of Arts, &c.* for full information respecting it. One such machine with 130 needles is estimated to perform daily the work of 15 hand embroiderers employed in the ordinary way. Many of them are now mounted in Germany, France, and Switzerland; and in Manchester there is one factory where they do beautiful work. (See the *Art of Needlework*, edited by the Countess of Wilton. Lond. 1840.)

E'MBRYO. (Gr. εμβρυον, from βρυω, *I bud forth.*) In Botany, a fleshy body occupying the interior of a seed, and constituting the rudiment of a future plant. It is divided into three parts;—viz. a plumula or growing point, a radicle or root, and a cotyledon or cotyledons. It is the vegetable fœtus, and is so tenacious of life under particular circumstances, that there are well-attested instances of its having preserved its vitality much beyond 1000 years. The term is also applied to the fœtus in utero before the fifth month of pregnancy, because its growth has been compared to the budding of a plant.

EMBRYO'TOMY. (Gr. εμβρυον, *the fœtus*, and τεμνω, *I cut*.) The operation of cutting the fœtus out of the womb.

E'MERALD. (Fr. emeraude.) A mineral of a beautiful green colour, which occurs in prismatic crystals, and is much valued for ornamental jewellery. The finest are obtained from Peru. It consists of 65 silica, 16 alumina, 13 glucina, about 3 oxide of chromium (which is the colouring matter), and a trace of lime. (*Vauquelin.*) The mines from which the ancients obtained emeralds are said to have existed in Egypt, near Mount Zabarah. (*Caillaud.*)

**EME'RITI.** (Lat.) The name given to the soldiers and other public functionaries of ancient Rome, who had retired from their country's service. On these occasions the parties were entitled to some remuneration, resembling our *half-pay;* but whether it was a grant of land or of money has not been accurately ascertained.

EME'RSION. (Lat. emergo, *I rise.*) In Astronomy, the reappearance of the sun, moon, or planets, or of a star, from behind the celestial body by which it has been eclipsed. The phenomena of *immersions* and emersions are of considerable use in determining the longitudes of places.

E'MERY. (From Cape *Emeri* in the island of Naxos.) A variety of corundum; amorphous, compact, and generally opaque. It is characterized by excessive hardness; and its powder is used for cutting and polishing glass, gems, and all hard substances: it scratches and wears down nearly all minerals except the diamond.

EME'TICS. (Gr. εμεω, *I vomit*) Medicines which occasion vomiting. The only vegetable emetic in general use is *ipecacuanha*, from ten to twenty grains of which is a dose; the chief mineral emetics are the *tartrate of antimony and potash*, or *emetic tartar*, *sulphate of zinc*, and *sulphate of copper*. When it is merely wished to evacuate the contents of the stomach in cases where it is disordered by improper food, twenty grains of ipecacuanha in an ounce of water is a safe and good emetic; it generally operates in ten to twenty minutes, and its action may be assisted by chamomile tea or warm water. At the beginning of fevers or inflammatory disorders, an emetic is often advantageously administered, and then ten or fifteen grains of ipecacuanha with half a gram or a grain of emetic tartar in an ounce and a half of water is to be preferred. the perspiration which the vomit induces should be kept up by remaining in bed, and by warm drinks or other proper remedies. Where poisons have been swallowed, the stomach is often insensible to these means, especially where large doses of opium are concerned, and then half a drachm of sulphate of zinc or of sulphate of copper may be dissolved in three ounces of warm water, and a third part of the solution taken every ten minutes till it operates. In such cases, however, the stomach-pump is principally to be relied upon. When emetics are given in small doses, they produce *nausea*, and to this extent they have proved useful in restraining hæmorrhage of the lungs and stomach. Emetics should be avoided in all plethoric habits, and where there are any symptoms announcing fulness of the vessels of the head, in hernia, in the advanced stage of pregnancy, and in active inflammations. They should also be given with the utmost caution to young children; and when given, ipecacuanha should be resorted to. Old chronic pains and obstinate rheumatism are sometimes relieved by an emetic

**EME'TIC TA'RTAR.** A triple salt, composed of oxide of antimony, potassa, and tartaric acid. It is soluble in eighteen parts of cold and in three of boiling water. In the dose of from half a grain to two grains it operates as a powerful emetic and sudorific; in smaller doses, it acts upon the bowels, and is diaphoretic.

**E'METINE.** A substance discovered in 1817 by Pelletier in ipecacuanha. It is white, pulverulent, and bitter; easily soluble in hot water and alcohol, and intensely emetic. It exists in ipecacuanha to the amount of about 16 *per cent.*, and appears to be the sole cause of its emetic property.

EMIGRA'TION. (Lat.) Migration is the movement of an individual or a number of people from one place of residence to another; emigration, their abandonment of their former home; immigration (a word of modern coinage), their settlement in their new one. Emigration is, in modern times, chiefly regarded in the light of a mode of relieving a country or district labouring under excess of population. The prejudices which formerly existed against it, on account of the loss of inhabitants thus sustained by a country, have long been removed, both by severe necessity, and by the progress of economical knowledge. The power of reproduction in the human race is so great, that the vacuum occasioned by any practicable amount of emigration is speedily filled. It was long ago observed that those provinces in Spain from which the most constant emigration to America was going on (Biscay, Asturias, &c.) were among the best peopled. The subject of emigration, considered in an economical light, has been amply discussed by Sir W. Horton (1825, &c.), by Col. Torrens, and by Mr. G. Wakefield (*on Colonization*, 1830, in which there are some curious calculations as to the effect produced on the movement of population by the emigration of a comparatively small number of marriageable persons: England and America, 1837.) Emigration from our islands was for two centuries chiefly directed to North America; but of late years, Australia has begun to absorb large portions of our surplus population. In 1831, a government commission on emigration was formed, with a view to the regulation of the practice; by which officers were appointed both at home and in the North American colonies to watch over the interests of emigrants and furnish them with necessary information. With reference to Australia, they established, for the first time, the principle of disposing of the public lands by sale, in order to form a fund for emigration. The following table shows the number and destination of the emigrants who have left the United Kingdom from 1839 to 1849 inclusive: —

| Years. | North American Colonies | U. States | Australian Colonies and New Zealand. | All other Places. | Total. |
|---|---|---|---|---|---|
| 1839 | 12,658 | 33,536 | 15,786 | 227 | 62,207 |
| 1840 | 32,293 | 40,612 | 15,850 | 1,558 | 90,713 |
| 1841 | 38,161 | 45,017 | 32,625 | 2,786 | 118,592 |
| 1842 | 38,123 | 63,852 | 8,534 | 1,835 | 128,344 |
| 1843 | 23,518 | 28,335 | 3,178 | 1,881 | 57,212 |
| 1844 | 22,924 | 43,060 | 2,229 | 1,873 | 70,086 |
| 1845 | 31,803 | 58,538 | 830 | 2,330 | 93,501 |
| 1846 | 43,439 | 82,239 | 2,347 | 1,826 | 129,851 |
| 1847 | 109,680 | 142,151 | 1,949 | 1,187 | 258,270 |
| 1848 | 31,065 | 188,233 | 23,901 | 4,887 | 248,089 |
| 1849 | 41,367 | 219,150 | 32,091 | 6,590 | 299,193 |
| Total | 441,034 | 915,656 | 149,623 | 27,680 | 1,556,993 |

In 1850 the total number of emigrants from Great Britain and Ireland was 280,849.

E'MINENCE. A title of honour borne in Europe by various dignitaries at different times; but appropriated to cardinals by a papal decree of the year 1630

E'MIR. (In Arabic, *chief* or *lord*) The khalifs took the title of *Emir-al-Mumenin*, — chief or commander of the Faithful. The title is now given by prescriptive usage to those who are considered to descend from Mohammed, by his son-in-law Ali and daughter Fatima (*see* SCHERIF, a title having the same application) But when joined to another word expressive of a particular command or office, it is a common title of dignity; as, *Emir-al-Omrah*, — a title given by the Turks to viziers and pachas, &c *See* MIRZA

EMME'NAGOGUE. (Gr εμμηνιος, *monthly*, and αγω, *I move*) Medicines which promote the menstrual evacuation.

EMO'LLIENTS. (Lat. emollio, *I soften.*) Medicines which are supposed to relax the living animal fibre.

E'MPEROR (Lat imperator), was originally merely the title of a Roman general; but, on the fall of the republic, it was particularly applied to the head of the state. The authority of the Roman emperors was formed principally by the combination of the chief offices of the old republic in a single person; besides which, some extraordinary powers were conferred. Thus, Octavius held the titles of emperor, proconsul, and tribune, pontifex maximus or high priest; and was invested with perpetual consular authority, and also that of the censorship. Besides this, he was termed prince of the senate, and Augustus, which designation descended to his successors; but he was much more moderate in his use of titular dignities than his successors, contenting himself with substantial power The provinces of the empire were divided between the senate and emperor, who appointed their governors, distinguished by the respective titles of proconsul and proprætor; but this division threw all the armies into the hands of the latter, as he took for his share the frontier provinces. The emperors appointed their own successors, who were dignified with the title of Cæsar, and in later times enjoyed a share in the government. Diocletian first divided the care of the empire with a second Augustus in the person of Maximian, and each of these colleagues associated with himself a Cæsar. After the court was removed to Constantinople, the old titles and forms of the republic vanished by degrees, and the emperors assumed the style of oriental princes.

Charlemagne assumed the title of emperor after his coronation at Rome; and from his time this title (in German *kaiser*) was claimed exclusively, in western Europe, by the rulers of Germany On the dissolution of the German empire in 1805, the title passed to the emperor of Austria, and, in the same year, Napoleon assumed it in France: the czars of Russia claimed it in the reign of Alexander.

E'MPHASIS. (From the Greek preposition εν, and φημι, *I speak*) In Elocution, the stress laid on particular words or syllables in the pronunciation of a sentence, in order to express or enforce a meaning. It is divided by some writers into emphasis of force, which we lay on almost every significant word; and emphasis of sense, which we lay on particular words, to distinguish them from the rest of the sentence.

EMPHYSE'MA. (Gr. εμφυσαω, *I inflate.*) A collection of air in the cellular membrane, rendering the part tense and elastic, and crepitating when pressed.

EMPHYTE'USIS. (Gr. εμφυτευσις, from φυτον, *a plant;* a contract conveying the right of cultivation.) In the Civil Law, a contract by which houses or lands are given to be possessed for ever, or for a long term, on condition they shall be improved, and a small annual rent or pension (*canon emphyteuticus*), either in money, grain, or

any other thing, reserved and made payable to the grantor as a recognition of his paramount title. The grantor is said to retain the *dominium directum*, the grantee to acquire the *dominium utile*. The Scottish grant in feu-farm resembles the emphyteusis. From this word (pronounced in the lower age of Latinity emphytefsis) it is supposed that fief (fevodum, feodum) is derived.

E'MPIRE. (Lat. imperium.) Originally the territory or extent of land under the command and jurisdiction of an emperor. The dominions under the sway of ancient Rome were the first to which the term empire was applied: they consisted of two grand divisions,—the Empire of the East, or, as it was afterwards called, the Lower Empire; and the Empire of the West. The former admitted of various subdivisions in reference to the different dynasties to which it was subject; and the latter became, about the end of the 9th century, the German or Holy Roman Empire. In all these cases the sovereign or chief person in the empire was named the emperor. But the term empire has in several instances been employed to designate *a large extent of dominion*, without reference to the title of the ruler or sovereign of a country: thus we hear of the empire of Persia, Hindostan, &c. The dominions of the Queen of England are invariably designated the British Empire; and the epithet "imperial" is officially prefixed to the parliament of the United Kingdom. The term empire was applied from 1804 to 1814 to the dominions of France, including all the countries then incorporated with it by the conquests of Napoleon.

EMPI'RIC. (Gr. εμπειρικος.) One whose knowledge is founded on experience. The empiric school of medicine was opposed to the *dogmatic;* it appears to have originated with Serapion of Alexandria The empirics considered the foundation of medical science to rest upon experience, derived either directly from experiment or from chance and imitation. They were, however, a pretending, and generally ignorant sect, so that the term empiric is generally applied to quacks and pretenders, without reference to its strict etymology, which should have limited it to the study of medicine, in accordance with the principles of Lord Bacon's philosophy.

EMPLE'CTON. (Gr. εμπλεκω, *I entangle*) In Architecture, a method of constructing walls, in which, according to Vitruvius, the front stones were wrought fair, and the interior left rough and filled in with stones of various sizes.

EMPO'RIUM. (Gr. εμπορειον.) A Greek word wholly naturalized in England, signifying a city or place where great commercial transactions are made. This word has been in use in England upwards of three centuries.

EMPROSTHO'TONOS. (Gr. εμπροσθεν, *forwards*, and τεινω, *I draw*.) A spasmodic action of the muscles, by which the body is involuntarily drawn forwards.

EMPYE'MA. (Gr. εν, *in*, and πυον, *pus*) A collection of purulent matter in the cavity of the thorax. This is an occasional termination of pleurisy, and is attended by difficulty of breathing and inability to lie on the side opposite that which is affected; an external swelling is sometimes perceptible, and the matter has occasionally been let out by making an opening between the sixth and seventh ribs.

EMPYRE'AL AIR. Oxygen gas.

EMPYREU'MA. (Gr. εμπυρευω, *I kindle*) A burned odour. Hence, the oils obtained by distilling various organic substances at high temperatures are called *empyreumatic oils*.

EMU. A three-toed Struthious bird, peculiar to Australia, differing from the *rhea* of South America in the extreme shortness of its wings, and from the cassowary of Java in the absence of the horny projection on the head.

EMU'LGENT. The artery and vein of the kidney are so called.

EMU'LSION. (Lat. emulgeo, *I milk*) A milky liquid; as *almond emulsion*.

EMU'NCTORIES. (Lat. emungo, *I drain off*) The excretory ducts of the body.

E'MYDINES, *Emydina*. A section of Chelonian reptiles or tortoises, having the genus *Emys* as the type.

EMY'DO-SAURIANTS, *Emydo-sauria*. (Gr. εμυς, and σαυρος, *a lizard*.) The name of an order of the class *Reptilia*, including the tribe of Crocodiles (*Crocodiliens*, Cuv.), which form part of the order *Sauria* of the *Règne Animal*.

ENA'LIOSAU'RIA. (Gr. εν, *in*, ἁλς, *the sea*, and σαυρος, *a lizard*.) A name applied to the entire group of extinct Saurians, in the organization of which paddles, like those of the whale or turtle, were combined with the head and trunk of a crocodile. *See* ICHTHYOSAUR, PLESIOSAUR.

ENA'MEL. (Fr. enemail.) A semitransparent or opaque glass. Common glass fused with oxide of tin is converted into enamel. It is often variously coloured.

ENAMEL OF TEETH. *See* TEETH.

ENAMEL PAINTING. (Fr en email.) In Painting, the art of painting with vitrifiable colours on thin plates of metals which are melted on to it. This art is of extremely high antiquity; it was practised by the Egyptians to a considerable extent, and by the Etruscans from the time of Persenna. After lying dormant, or at least in little vogue, for centuries, it was renewed in Italy under the pontificate of Julius II. The various colours used are prepared from oxides of different metals, melted with some vitrescent mixture laid on with a fine brush, the medium being oil of spike or some other essential oil; and it is not difficult to conceive, says Mr. Aikin, "how much the difficulties of this nice art are increased, where the object is not merely to lay a uniform coloured glazing on a metallic surface, but also to paint that surface with figures and other designs that require extreme delicacy of outline, accuracy of shadowing, and selection of colouring. The enamel painter has to work, not with actual colours, but with mixtures which he knows from experience will produce certain colours after the operation of the fire" This work requires several firings. The outline is first burnt in, after which the parts are filled up gradually with repeated burnings to the last finishing touches.

ENARTHRO'SIS. (Gr. εν, *in*, and αρθρον, *a joint*.) The ball and socket joint.

ENCA'MPMENT, in Military affairs, signifies the position occupied for an indefinite period by an army, with all its artillery, stores, baggage, &c., either for the purposes of exercise or warfare.

ENCANTHIS. (Gr. εν, *in*, and κανθος, *the angle of the eye*.) A small tumour or excrescence growing from the inner angle of the eye.

ENCA'RPUS. (Gr εν, and καρπος, *fruit*.) In Architecture, the festoons on a frieze, consisting of fruits, flowers, leaves, &c.

ENCAU'STIC PAINTING. (Gr. εν, and καυστικος, *burning*.) In Painting, a method of painting used by the ancients, the precise mode of executing which is by no means sufficiently explained. From Pliny's account, it seems that the colours were made up into crayons through a medium of wax, and, the subject being previously traced with a metal point, were melted on the picture as they were used. The picture being finished, a varnish of melted wax was spread over all. The colours thus not only obtained considerable brilliancy, but the work was also protected from the weather. It was lastly well polished. The attempts to revive this art, which, after all, if we may draw our conclusion from Pliny's account, seems to have been but a clumsy process, have not been attended with success.

ENCE'PHALOCE'LE. (Gr. εγκεφαλος, *the brain*, and κηλη, *a tumour*) Hernia of the brain. There are two kinds of this disease. one occurs in young infants, before the skull is completely ossified; the other presents itself after the destruction of a part of the skull in consequence of disease, accident, or the operation of the trepan.

ENCE'PHALON. (Gr. εν, *in*, and κεφαλη, *the head*) The brain. The contents of the cranium.

ENCHA'NTMENT. The name given to the charms or ceremonies to which magicians have recourse in the practice of their art It is derived from the Lat. in, and cantare, *to sing;* and is so called because the formulæ used in magic were usually written in verse and designed to be sung *See* MAGIC, DEMONOLOGY.

ENCHASING *See* CHASING.

ENCHIRI'DION. (Gr. εγχειριδιον, from εν, *in*, and χειρ, *the hand*) In Literature, a brief and useful compilation; a *manual*. The ethical treatise of Epictetus is termed his *Enchiridion*.

ENCLI'TICS *See* PARTICLES.

E'NCRINITES *See* CRINOIDEANS.

ENCYCLOPÆ'DIA. *See* CYCLOPÆDIA, DICTIONARY.

ENCY'STED. A term applied to tumours which are inclosed in a sac or cyst

ENDE'CAGON, or UNDECAGON. (Gr. ενδεκα, *eleven*, and γωνια, *angle*) A plane geometrical figure bounded by eleven sides. If the sides are all equal, and the length of each be supposed = 1, the area of the figure is 9·36564.

ENDE'MIC. (Gr. εν, *amongst*, and δημος, *the people*) A disease peculiar to a certain class of persons, or to a certain district Thus agues or intermittent fevers are endemic in low countries,—the *goitre* in the Alps, the *plica Polonica* in Poland. *See* EPIDEMIC.

E'NDOCA'RPIUM (Gr. ενδον, *within*, and καρπος, *fruit*.) A term invented by Richard to denote the inner coat or shell of a fruit

E'NDOGENS. (Gr. ενδον, and γινομαι, *I grow*) One of the primary classes of plants, so called because their stems grow by successive additions to the inside. They are usually known by the veins of their leaves running parallel with each other, without branching or dividing. Grasses, lilies, the asparagus, and similar plants belong to this class, which in warm countries contains trees of large size, such as palms and screw pines.

ENDOPHY'LLOUS (Gr. ενδον, and φυλλον, *a leaf*.) A term invented by Dumortier to denote the young leaves of Monocotyledons, from their being evolved within a sheath, while those of Exogens are not so enclosed.

ENDOPLEU'RA. (Gr. ενδον, and πλευρα, *the side*.) In Botany, the internal integument of a seed.

E'NDORHI'ZÆ. (Gr. ἔνδον, and ῥίζα, *a root.*) A term invented by Richard for the embryo of Monocotyledons, in which the radicle has to rupture the integument at the base of a seed prior to entering into the earth, appearing as if it came from within the mother root.

ENDORSEMENT *See* EXCHANGE.

E'NDOSI'PHONITES. (Gr. ἔνδον, *internal;* σίφων, *a tube.*) A genus of extinct Cephalopods, with chambered convolute discoidal shells, having the siphon placed at the inner side of the turns, as in the Spirula. The *Endosiphonites* characterize the slate rocks of the Cambrian system, and have not yet been observed in the Silurian formation.

ENDOSMO'SE. (Gr ἔνδον, and ὠσμος, *impulsion.*) The transmission of gaseous bodies, or vapours or liquids, through membranes or porous substances from without inwards.

ENDOSPE'RMIUM. (Gr. ἔνδον, and σπέρμα, *seed* ) A term invented by Richard to denote the albumen of seeds

E'NDOSTOME. (Gr. ἔνδον, and στόμα, *the mouth.*) The passage through the inner integument of a seed immediately below the part called the foramen.

ENDOTHE'CIUM. The fibrous cellular tissue lining an anther.

ENDOW'MENTS *See* FOUNDATION.

ENEID. *See* ÆNEID.

ENE'MA. (Gr ἐνιέναι, *to inject.*) A medicine injected into the rectum. A clyster.

ENFEOFFMENT. *See* FEOFFMENT.

ENFILA'DE. A term used in military language to denote a fire of artillery or musketry in the direction of the enemy's line. A trench or parapet is said to be *enfiladed* when guns are so placed that the shot can be fired into it in a direction parallel to its length

ENFRA'NCHISEMENT (Fr. franchise, *freedom or right*), in Law, is the act of incorporating a person into any society or body politic; as where one is made a citizen or free burgess of a town corporate. In feudal usage, a villein was said to be enfranchised when he was made free by his lord; and hence is derived the popular signification of the term. For enfranchisement of land, see COPYHOLD

ENGA'GED COLUMNS. In Architecture, columns attached to walls, by which a portion of them is concealed; they never stand less than one half out from the walls.

ENGA'GEMENT, signifies either a battle by sea or land; but it is applied more frequently to the former, being synonymous with *action*. An engagement between two ships is called simply an *action:* between fleets a *general action*. As the object is to get possession of the enemy if possible, efforts are made either to disable him by cannonading, or, as is the practice of the English, to board him at once. The conquered vessel strikes (hauls down) her colours, which are afterwards replaced by those of the enemy hoisted over them.

E'NGINE, in Mechanics, is used to denote generally any kind of machine in which two or more of the simple mechanical powers are combined together.

ENGINE'ERING. (Fr. engine ) Strictly, the art of managing engines; but latterly applied in a more extended sense, not only to that art, but to all manufacturing and building operations in which engines are used. It is divided into two branches, Military and Civil.

Military engineering, as a science, implies a knowledge of the construction and maintenance of fortifications, and all buildings necessary in military posts, and hence includes a thorough instruction on every point relative to the attack and defence of places. The science also embraces the surveying of a country for the various operations of war, and consequently an acquaintance with mathematics and facility in drawing. When at a siege the engineer has surveyed a place, he reports to the commander the weakest places, and those in which approaches may be made with most success. He draws the lines of circumvallation and contravallation; marks out the trenches, places of arms, batteries, and lodgments; and in general directs the workmen in these operations. He should possess a practical and theoretical knowledge of gunnery. In regard to the marine branch of military engineering, it requires of course a general acquaintance with the construction of vessels, jetties, moles, and other buildings of that description.

Civil engineering, as its name imports, does not include those branches above named which specially belong to the art of war; but relates to the forming of roads and bridges, railroads, the construction of machinery for all purposes, the formation of canals, aqueducts, harbours, drainage of a country, &c. Till the year 1760, civil engineering was little cultivated in England as a distinct occupation; at that period, manufactures began to be extended by the enterprise, the capital, and science of a number of individuals eminent for their deep knowledge and persevering industry. New and more appropriate situations were chosen for carrying them on than the small towns in which they had been seated, and where combinations and corruption made the wages of the workman extravagant. Internal navigation was consequent upon this change: communication from harbours to warehouses, and the converse, as well as facility of transport from factory to factory, became absolutely necessary. Hence a system of canal navigation and aqueducts, which perhaps will not be entirely superseded even by the more modern railroad. Previous to the above period, a few jetties and piers of defence were thrown out in our seaports, affording to the mariner little better protection than nature herself: they have since become harbours of refuge; some of them are capable of holding large navies. The application of the steam engine to almost every purpose, independent of its importance in manufactures, has smoothed the difficulties formerly experienced in forming works under water, and has now made rapid strides towards superseding all animals of draught. To give the faintest outline of the science of practical engineering would be to write treatises on mathematics, mechanics, hydraulics hydrostatics, and the other branches of natural philosophy: the reader must therefore seek for information under the separate heads of science involved in it.

ENGLAND, CHURCH OF. The period at which Christianity was first preached in this country has not been settled with any certainty; but there was certainly a British church existing in the island at the time of the mission of Augustine, in the year 597, to convert the Saxons. The British church, however, at that time, had shared the fate of the general British population, and had been pent up by the pressure of the heathen invaders within narrow limits at the extremities of the island It can hardly be thought to have retained sufficient vigour to have effected the conversion of the barbarians, and would probably have died out but for the seasonable reinforcement from Rome If such be the case, we must allow that Christianity in Britain owes at least its second foundation to the Romish see; but this foundation took place at a comparatively pure age, and possibly the influence of the uncontaminated religion of the Britons may have had its effect in preserving to the Saxons a very modified form of popery. Certain it is, as has been shown from existing homilies by Anglo-Saxon prelates, that some of the principal novelties of the Romanists were unknown to or repudiated by the English church, at least up to the time of Edward the Confessor.

The intercourse with France, which began to take place in that reign, and the superstitious temper of the monarch, prepared the way for the introduction of the Roman power it was furthered by the necessities of the usurpers William and Stephen. Under Henry II royalty took the alarm, and a fierce struggle took place, in which the papal authority was eventually victorious Under John, the triumph of Romanism was completed, when the crown of England was actually given into the hands of Innocent III But at that very time the seeds of the Reformation were being sown among the lowest classes, sects of strolling fanatics were constantly appearing and passing away, misguided themselves, but drawing the attention of the people to the errors of the church; and at length, under the impulse given by the learning of Wiclif, taking a definite and lasting shape under the name of the Lollards A general reformation in opinion was almost at hand, when Henry VIII threw off the supremacy of the Pope But while he encouraged the reformers by that step, he checked them by severe enactments upon points of belief, and, as far as he is concerned, it may be doubted whether he at all assisted the development of the Reformation. The Church of England was first reformed by law on the accession of Edward VI; but many points of doctrine and discipline were left untouched; and the enactments of Elizabeth, by which its whole constitution was finally settled, followed rather than preceded the expressed convictions of the nation (For the variations that have since taken place in the services of the church, see art. COMMON PRAYER ) The government of the Church of England is episcopal, and the bishops sit in the House of Lords by virtue of the temporal baronies into which their benefices were converted by William the Conqueror. This constitution was subverted on the success of the Great Rebellion, and presbyterianism established in its stead; but the episcopal form was restored in 1660 with the return of Charles II.

ENGLISH ARCHITECTURE. We have already, under the article ARCHITECTURE, given a general view of the rise and progress of Gothic architecture. Our purpose in this place is to enter into details respecting its subdivisions in this country Without disrespect to the later writers who have differently arranged and named the styles, we think none more convenient than that used by the Rev. Geo Millers (in his description of the cathedral church of Ely) for giving the reader a succinct and satisfactory view of some of the examples which England affords. We propose, therefore, to subdivide the styles into five periods:—1*st Period*, or *Anglo-Saxon*, which may be comprised from A. D. 600 to 1066, that is, from the conversion of the Saxons to the Norman Conquest; 2*d Period*, or *Norman*, from 1066 to nearly 1200, comprising the reigns of William I., William II., Henry I., Stephen, Henry II., and Richard I.; 3*d Period*, or *Early English*, from 1200 to 1300, or during the reigns of John, Henry III, and Edward I.; 4*th Period*, or *Ornamented English*, 1300

to 1460, comprising the latter portion of the reign of Edward I., that of Edward II., Edward III., Richard II., Henry IV., Henry V., and Henry VI.; *5th and last Period*, or *Florid English*, by some called the *Tudor Style*, from 1460 to the dissolution of the religious houses in 1537, comprising the reigns of Edwards IV. and V., Richard III., Henrys VII. and VIII.

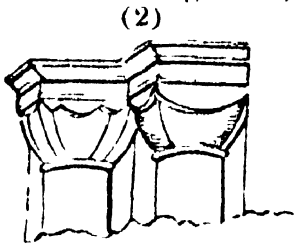
Ducarel, in his *Norman Antiquities*, enumerates the churches in England anterior to the Norman Conquest; among which appear those of Stukely in Bucks, Barfreston in Kent, and Avington in Berks. Other examples are to be found in Waltham Abbey; the transept arches of Southwell, Notts; the nave of the abbey church of St. Alban, Herts; nave of St Frideswide, Oxford, &c The principal characteristics of this the *First Period* are,

(1)



*arches* (1) of semicircular form, frequently quite plain, occasionally decorated with various sorts of mouldings, both on the face and soffit; often double, triple, or quadruple, each projecting beyond the face of the other, with a moulding on the semicircular edge or arris, and resting on columns. The *columns* are always single, and on the plan circular, hexagonal, or octagonal; placed on a square plinth, and so low in proportion to their height as to be not more than 3½ diameters high. The shafts are sometimes ornamented with spiral fluted or other work The capitals are indented, or rather engrailed,

(2)



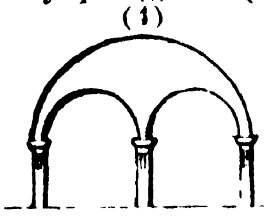
with fissures of different lengths and forms variously sloped off, or hollowed out towards the top (2) They are often decorated with rude imitations of volutes and leaves, being exceedingly varied in their composition —*Windows*, semicircular-headed, extremely narrow, being sometimes not more than six or eight inches wide to a height of little more than three feet, and splayed or levelled off on the inside through the whole thickness of the wall —*Walls* of great thickness, without external buttresses —*Ceilings* open-timbered, with a few specimens of vaulting in crypts. —*Ornaments* very sparingly used, except to capitals and shafts of columns —*Plan* rectangular and parallelogrammic, being usually divided into a body and chancel separated by an ornamented arch. The chancel occasionally as broad as the nave, and at the eastern part ending in a semicircle In large churches there is a nave and two side aisles, the latter being divided from the former by ranks of columns, but no transepts appear till the latter part of the period, that is, about 970, when they were generally adopted, with a square tower over their intersection with the nave of the church, and rising a little above the roof. At this date also towers began to appear at the west end, for the reception of bells. The churches of this period were of small dimensions, and it seems doubtful whether they were ever higher than one tier of arches with a range of windows above.

Of the *Second Period*, or *Norman Style*, many more examples remain than of those in the *First Period*, as in the nave, aisles, transept, and west front of Tewkesbury, the nave and west front of Malmsbury, Wimborn minster; Dunstable, St. Cross in Hampshire, Romsey in the same county, &c. Also in the cathedrals of Ely, western towers, and nave, choir, and round tower, called Becket's Crown, at Canterbury; nave and choir at Norwich, transept and choir at Hereford, chapterhouse at Chester; presbytery at Chichester; transept at Peterborough, &c The characteristics of this style are, *arches*, generally semicircular, as in the diagram (3) here given of the nave of Gloucester cathedral, and of much larger dimensions than those of the preceding periods, their ornaments less minute They are sometimes without ornament at all, and their soffits are always plain In the second tier two small equal arches are comprised under one larger one, with a column between, from which they spring, thus (4).

(3)



(4)



— In the third tier there are generally three together, the central one being higher and wider than those on the sides, and usually opened for a window. The three, however, only occupy a space equal in width to the lower arch. The arches, which serve for the decoration of entrance doorways, are richly ornamented with mouldings, foliage, representations of men and animals of grotesque forms fantastically put together. The pointed arch began to creep in about the end of this period, though but sparingly; and it may sometimes be seen capriciously intermixed with the semicircular arch, and alternating with it: when these appear they are usually sharp-pointed. —*Columns*. These are of large diameter compared with their intervals; the shaft is circular, hexagonal and sometimes octagonal on the plan, fluted, lozenged, reticulated, and otherwise sculptured. Sometimes they are square on the plan, and then they are accompanied by portions of columns or pilasters applied to them. Sometimes four columns are connected together, with or without angular pieces. They are much higher in proportion to their diameters than the Saxon columns above described; and though their capitals are not unfrequently quite plain, they are more commonly decorated with a species of volute, or with plants, flowers, leaves, shells, animals, &c. The bases stand on a strong plinth adapted on its plan to the shape of the combined forms. — *Windows*. These are still narrow, and semicircular-headed; but they are higher, and often in groups of two or three together. — *Ceilings* always of timber, except in crypts; in which they are vaulted with stone, with plain groins, frequently moulded, and with ornamented edges; but they are universally without tracery: the White Tower of London, however, affords an example of a centre aisle covered with vaulting.—The *walls* are of extraordinary thickness, with but few buttresses, and those of small projection, usually without ornament.—The *ornaments* employed were, the chevron or zigzag moulding (5); the embattled frette (6); the triangular frette (7); the nail head (8); the billet (9); the cable (10); the wavy (11); the nebuly (12); and some others.

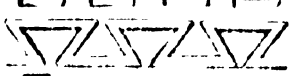
(5)



(6)



(7)



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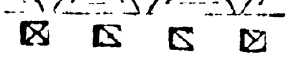

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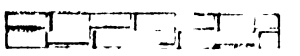

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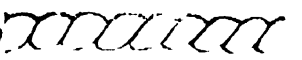
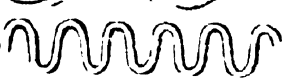


(11)

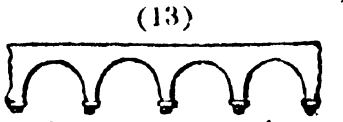


(12)



Many of these were used in the preceding period, as well as many which have received no names. Ranges of small arches also appear; these rest on brackets, sometimes with carved heads, along the upper part of a building, just below the eaves or battlement, and have received the name of a

(13)



corbel table (13) — *Plans* in this period are always with transepts and a tower at the intersection, rather loftier than before, and without spires; there are usually tiers of arches one above the other, and the eastern ends are semicircular. Though much of the Saxon style is retained, there is, from the larger dimensions of the edifices of this period, a much more impressive air of magnificence than has hitherto appeared. Indeed, the larger dimensions alone have by some been thought to be the only criterion for distinguishing the Norman and Saxon styles; but this cannot be depended on, inasmuch as many of the former buildings are of small extent.

The *Third Period*, or *Early English Style* —It was not till towards the close of the reign of Stephen, that the first transition from the Anglo-Norman style appears to have taken place As we have before hinted, it is discoverable in the arch, which, from being semicircular, became pointed, a circumstance, though often investigated by antiquaries, still in obscurity There is, however, another remarkable feature exhibited in the transition, the transformation, namely, of single massive pillars into clusters of small ones. Specimens of this style may be seen in the conventual edifices of Westminster Abbey, Tintern Abbey in Monmouthshire, Ripon and Beverley minsters in Yorkshire; and in the cathedral of Lincoln, the nave and arches beyond the transept; in York, the north and south transepts, in Wells, the tower and western front; in Ely, the presbytery; in Oxford, the chapterhouse, in Worcester, the transept and choir; and in Salisbury throughout. The characteristics of the style are, *arches* sharply pointed, and lofty in proportion to their span. In the upper tiers two or more are com-

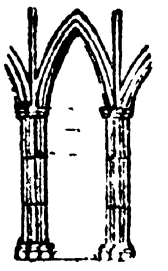
(14)



(15)



(16)

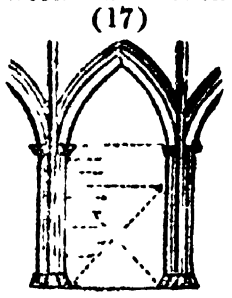


prised under one, and finished with trefoil (14), or cinquefoil (15) heads, instead of points. — The *columns* (16) on which the arches rest are extremely slender in respect of their height, and usually consist of a central shaft surrounded by several smaller ones. The base assumes the general form of the cluster, and the capital is often decorated with foliage of extremely elegant formation. —*Windows* tall, narrow, and shaped at top like the head of a lancet; hence some writers, among whom Dallaway, have called this style the *lancet* Gothic They are divided by one or at most two plain mullions, finished at their upper extremities with some simple ornament, such as a trefoil. —*Roofs* are high-pitched, and the *ceilings* vaulted, affording the first examples of arches with cross springers only, which, after a short period, diverged into many more, rising from the capitals of the columns, and almost overspreading the whole of the vaulting; the longitudinal line which reigned along the apex of the vault being decorated with bosses of flowers, figures, and other fancies.—The *walls* now lessen in thickness; but they are strengthened externally with buttresses, leaning as it were against them, for the purpose of counteracting the thrust exerted by the vaults

of the ceilings, which the walls and piers could not by their own gravity resist. The buttresses are, moreover, aided in their office by being surmounted with pinnacles, adorned with crockets at their angles, and crowned with a finial flower.—The *ornaments*, though numerous, are simple and elegant. The mouldings have not the variety found in the preceding period, being usually cut into a combination of leaves and flowers, placed commonly round the sides of arches, and especially of windows; but the columns are sometimes completely, as it were, embroidered with them. The spandrels of the arches are often covered with trefoils, quatrefoils, cinquefoils, roses, mullets, bosses, pateræ, &c. The pinnacles of shrines are high and acutely formed, often with niches under them containing statues; similar niches are also frequently used on the west and eastern fronts, their heads being extremely sharp. These ornaments, however, are not so profusely used in large as in small edifices, or in parts added to old ones.—The *plans* are generally similar to those of the *Second Period;* but the towers rise to a great height, and lanterns and lofty spires are very frequent accompaniments to the structure. In the transition from the second to the third style, it will naturally occur to the reader that the architect left one extreme for another, though it has been contended that the latter has its germ in the former. Be that as it may, the period of which we are now speaking was undoubtedly the germ of the succeeding styles by no very forced or unnatural relationship.

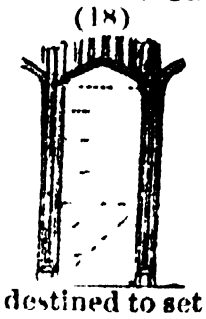
The *Fourth Period*, or *Ornamented English Style*.—Examples of this style are, the Chapel of Merton College, Oxford; New College Chapel in the same city; St. Stephen's Chapel, Westminster, so injured by the conflagration of the houses of parliament as to be now no longer in existence; St. Mary's, in York; choir of Tewkesbury, in Gloucestershire; Magdalen College, Oxford, Eton College Chapel, Bucks; and the Beauchamp Chapel at Warwick: also in the cathedrals of Exeter; nave and choir of Litchfield throughout; naves of Worcester and York; spire and tower of Norwich; spire of Salisbury; nave and choir of Bristol; the Lady Chapel and Louvre at Ely; choir of Gloucester; Bishop Beckington's additions at Wells and at Lincoln, from the upper transept to the great east window. Its *characteristics* are, that the *arches* are less acute, changing in form, and more open (17) In the *columns* the central and detached shafts are now brought into one general combination.—The *windows* are not only larger, but divided into several lights by a number of mullions, which constantly branch out at the top into leaves, flowers, wheels, fans, and numberless other forms. Though, however, these expanded considerably during the reigns of the two first Edwards, they grew narrower and sharper in proportion to their height during the reign of Edward III., when the head was often formed of lines scarcely curved above the haunches The eastern and western windows were of large dimensions, and their glass splendidly painted.—The *ceilings* were constructed with vaulting of very highly decorated parts, whose principal ribs, spreading out from their springings on the imposts, covered the whole surface with tracery, much subdivided, and ornamented with beads, bosses, and a multitude of other devices, which were elaborately painted and gilt.—The *ornaments* are not so pure in line as in the previous style; but they are more varied and studied. Niches covered with tabernacles, for the reception of statues, every where abound; tiers of ornamental arches; pinnacles, not so lofty and tapered, but adorned with leaves and crockets, with much sculpture, painted and gilt, constantly occur; as also screens, carved stalls, panelled ceilings, and other ornaments in carved and painted wood.

(17)



The *Fifth Period*, being the *Florid English* or *Tudor Style* (18), is very completely exhibited in Henry the Seventh's Chapel at Westminster, King's College Chapel at Cambridge, and St. George's Chapel at Windsor,—edifices well known to most persons in this country. Examples are to be found also in the Lady Chapel of Gloucester Cathedral, Alcocke's Chapel at Ely, the exterior of the choir at Winchester, the Lady Chapel at Peterborough, and the north porch at Hereford. In the Tudor style, it seems as though this species of architecture having culminated, was now destined to set in a blaze of uncontrolled splendour of ornament. Simplicity was superseded by the dazzle of minute decoration, which was exhausted by the caprice of its inventors. It has therefore as well received the name of *Florid*, as its other name of *Tudor;* the latter from having been introduced and carried to its utmost pitch during the power of the family of that name Its *arches* are universally flat and wide in proportion to their height.—The *windows* are much more open than in the last, flatter at the top, divided in the upper parts by transoms, which are almost constantly crowned with miniature embattled work.—The

(18)







*ceiling* spreads out into such a variety of parts that the whole surface seems covered with a web of delicate sculpture or embroidery thrown over it; and from different intersections of this ribbed work clusters of pendent ornaments hang down, as Mr. Millers observes, like "stalactites in caverns." The *flying buttresses* are equally ornamented, and the external surfaces of the walls are one mass of delicate sculpture. The *ornaments*, as may be deduced from what we have above noticed, are lavish and profuse: fretwork, figures of men and animals, niches and tabernacles, accompanied with canopies, pedestals, and tracery of the most exquisite workmanship, carried this style to the summit of splendour, and perhaps had no small share in producing the extinction it was doomed to undergo.

The beautifully timber-framed roofs, of which many examples still exist, appear to have originated, as applied to great halls, about the reign of Edward III. About 1400 they were employed in churches, wherein prior to that date stone vaulting appears to have been more common. The Norman castles had their keeps and halls vaulted with stone, as was the case in those in North Wales built by Edward I.

Our limits preclude us from adverting to many fine specimens of ecclesiastical architecture in Scotland; but the abbeys of Melrose and Kelso, founded by David I., as well as those in Dryburgh and Jedburgh, all in Roxburghshire, show that the art was carried to as great perfection north of the Tweed as in the southern parts. Roslin and Holyrood Chapels, for richness and variety of ornamental carvings (the first erected by Sir William St Clair), cannot be exceeded. Its plan is without parallel in any other specimen of the fifteenth century. The latter was finished by James, the second of that name, in 1440; and is a beautiful specimen, with flying buttresses, more ornamented than any even in England.

It would be impossible here to enumerate the palaces and private Gothic buildings of this country, of which parts still exist in the remains of the ancient palace at Westminster, Eltham, Kenilworth Castle, Hampton Court, and in many other places A desire to renew it has appeared in this country of late years; but we doubt whether such will be attended with success. The habits of the people, one of the principal stimulants in architectural style, seem to us rather out of joint for the purpose The following list exhibits the dimensions of the different cathedrals in England, as arranged from the Rev. Mr. Dallaway's *Discourses upon Architecture*.

| | Total Internal Length in Feet | Internal Breadth of Transept. | Choir. | | |
|---|---|---|---|---|---|
| | | | L | B | H |
| Old St Paul's | 500 | 218 | 165 | 42 | 88 |
| Winchester | 545 | 186 | 138 | — | 78 |
| Ely | 517 | 178 | 101 | 73 | 70 |
| Canterbury | 514 | 154 | 150 | 71 | 80 |
| York | 498 | 222 | 131 | — | 99 |
| Lincoln | 498 | 227 | — | — | — |
| Westminster | 489 | 189 | 152 | — | 101 |
| Peterborough | 480 | 203 | 138 | — | 78 |
| Salisbury | 452 | 210 | 140 | — | 84 |
| Durham | 420 | 176 | 117 | 33 | 71 |
| Gloucester | 420 | 144 | 140 | — | 86 |
| Chichester | 401 | 131 | 100 | — | — |
| Norwich | 411 | 191 | 165 | — | — |
| Litchfield | 411 | 88 | 140 | — | 67 |
| Worcester | 410 | 130 | 126 | — | 71 |
| Exeter | 390 | 140 | 131 | — | 69 |
| Wells | 371 | 135 | 106 | — | 67 |
| Hereford (ancient) | 370 | 140 | 105 | — | 64 |
| Chester | 338 | — | — | — | — |
| Rochester | 306 | 122 | 156 | — | — |
| Carlisle | 213 | — | 137 | 71 | — |
| Bath | 210 | 126 | — | — | — |
| Bristol | 175 | 108 | 100 | — | — |
| Oxford | 154 | 102 | 80 | — | 37½ |

ENGRAILMENT. The ring of dots round the edge of a medal

ENGRAVING. (Sax. ȝnaran, *to dig.*) The art of producing by incision or corrosion designs upon blocks of wood, plates of metal, or other materials, from which impressions or prints upon paper or other soft substances are obtained by pressure. Engraving as an art, seems to have nearly the same relation to design and painting as typography bears to written language; and its utility and great importance must be obvious to every one from its capability of giving a boundless circulation to representations of the most valuable examples of the arts and of objects connected with science. By some authors it is placed among the representations called monochromes (μονοχρώματοι). Xylography, or wood-engraving, was the earliest method practised, but its origin is involved in obscurity. If we might rely on Du Halde (*Description, &c. de l'Empire de la Chine*, 4to. 1736), it is possible that it was known in China 1120 years before Christ; though we think its invention is of a much later period, as the Chinese were not acquainted with the art of making paper till 95 B.C. It has been stated that this art was introduced into Europe from China, through the intercourse of the

Venetian merchants with its inhabitants; for it is proved that engraving on wood had been practised in that part of Italy which borders on the Adriatic as early as the 13th century. The first wood engravings in Europe of which any thing is known with certainty were executed in 1285, by a brother and sister of a noble family of the name of Cunio. They represent the actions of Alexander; and though doubts of their authenticity are expressed by Heinecken, Mr. William Young Ottley, the author of the elegant and learned *History of Engraving*, to which we are much indebted, thinks otherwise. But for the accidental discovery by a Venetian architect of the name of Temanza of a decree of the magistracy of Venice, in 1441, we might have been without positive proof of the practice of the art in Italy previous to 1467, and the Germans might still have continued to claim the honour of its introduction into Europe. This decree, dated 11th October, 1441, states in substance that the art and mystery of making cards and printed figures had fallen to decay, owing to their extensive importation; and in order that the native artists might find encouragement rather than foreigners, it was ordered that no work of the said art, printed and painted on cloth or paper, — viz altar-pieces or images and playing cards, and whatever other work of the said art is done with a brush and printed, — should be allowed to be brought into the city, on pain of forfeiting the works, besides a pecuniary penalty. This decree plainly indicates that wood engraving was practised in Venice as early as the commencement of the fifteenth century. In Germany and the Low Countries, the early block books seem to have existed as early as 1420, and to have given Guttenburg the hint for using moveable types. At Rome, in 1467, a work intituled *Meditationes Johannis de Turrecremata*, issued from the press of Ulric Han, embellished with wood engravings, in which the design and execution of an Italian artist are evident. The decorations of the work of Valturius by Matteo Pasti, of Verona, published five years afterwards, exhibit considerable spirit and accuracy; and before the end of the fifteenth century the art had been carried to great perfection, as may be proved by the delicacy and purity with which the designs are engraved in the celebrated Hypnerotomachia of Colonna (*See* ARCHITECTURE). At this period, however, the discovery of copper-plate engraving had been made, and to this the more ancient art yielded place. Maso Finiguerra, a goldsmith and sculptor of Florence, and pupil of Masaccio, about the middle of the fifteenth century, seems from the most authentic accounts to have been the person to whom the world is indebted for the discovery. In his time, and for a considerable period previously, it was the practice to decorate church and other plate with works in *niello*, which were designs hatched with a steel point upon gold or silver, then engraved with the burin, and run in, while hot, with a composition called niello, — a compound of silver, lead, copper, sulphur, and borax, which was more easily fusible than silver, and of a black colour. The superfluous part of this niello which remained above the surface of the plate was then rubbed off with scrapers, and cleaned away with pumice-stone, leaving the engraved design on the plate with all the effect of a print. In order to preserve copies of their designs, the artists were in the habit before filling the design with the niello to take impressions of the plates with earth, over which liquid sulphur was poured, and from which, when cold, the earth was removed. But Finiguerra carried his practice beyond this; for with a mixture of soot and oil he filled the cavities of the engraving, and by pressing damp paper upon it with a roller, obtained impressions on the paper, having, as Vasari says, all the appearance of drawings done with a pen, "venivano come disignate di penna." Bartsch, in his *Essay on the History and Discovery of the Art of taking Impressions from Engravings* prefixed to the thirteenth volume of his work *Le Peintre Graveur*, very unwillingly admits the invention to have originated with Finiguerra, though he claims for the Germans the merit of applying it to practice for the multiplication of copies of pictures, &c.; but to this the opposing arguments of Mr Ottley are so powerful that we apprehend the subject is not likely to be again mooted. Finiguerra was followed by Baccio Baldini, a goldsmith of Florence, who, according to Vasari, employed Sandro Botticelli to design for him. Mr. Ottley doubts, however, the inference that might be drawn from this passage; and indeed it does not appear likely that such an artist as Botticelli could have resigned himself to employment in such works as Baldini would be constantly requiring. Baccio's works were numerous, and are of course much sought after by collectors. Botticelli, a painter of eminence as well as an engraver, was a native of Florence, where he was born in 1437. He is spoken of with praise by Vasari, and especially for his picture at San Pietro Maggiore, of the Assumption of the Virgin: among the works he engraved from his own designs are subjects illustrative of Dante, and a number of prints of prophets and sybils. His death occurred in 1515. Contemporary with him flourished Antonio del Pollajuolo, and rather later Gherardo and Robetta, who advanced the art; though it was still dry in execution, and more to be admired for correctness of drawing and design than for any attempt at relief or effect. There can be no doubt that at this period the art was practised at Rome, though the Venetian state and other parts of the north of Italy furnished a more abundant supply of artists; — of whom Francesco Squarcione, Andrea Mantegna, Girolamo Mocetto, Marcello Fogolino, Montagna, Bramante the architect, Altobello, Gio Bat del Porto, Giovanni Maria, and Giovanni and Antonio de Brescia were among the most eminent. The works of Mantegna exhibit great marks of improvement on the Florentine school, and are characterized by a vigour and facility of execution which might naturally be expected, considering the rapid strides towards perfection made in the other arts.

In Germany and the Low Countries the art of engraving had made extraordinary progress during the fifteenth century; and the name of Martin Schoen or Schongauer must not be forgotten. This artist, who was also a painter and goldsmith, was the father of the German school of engraving. He was a native of Culmbach in Franconia, and born about 1420. He began the practice of the art when it was in its infancy, and succeeded in carrying it to a great degree of perfection. His death occurred at Colmar in 1486. Vasari relates that Michael Angelo, when young, was so pleased with a print by Schongauer representing St. Anthony tormented by devils, that he copied it in colours. Albert Durer, the most celebrated of the early engravers of Germany, was born at Nuremburg, in 1471. Skilled in many arts, and a painter of no ordinary powers, it is astonishing that, in a life not exceeding fifty-eight years, he should have succeeded so eminently in that of engraving that he has even hardly been surpassed. On copper as well as wood his works exhibit specimens of executive excellence, which the experience of centuries has not been able to surpass. Durer is supposed to have been the inventor of the art of etching, at least no etchings are known before those which are extant from his hand. Of the works he has left, which are very numerous, his wood engravings are the most free and masterly. Following Albert Durer were Aldegrever his pupil, Hans Beham and his brother Bartholomew, Altdorfer, Binck, Goerting, Penz, and Solis. Hans Holbein, who, according to some was a native of Basle, and according to others of Augsburg, besides acquiring celebrity as a painter is known as an engraver on wood, executed many pieces; the best known and most remarkable of which are the fifty-three prints called the "Dance of Death," first published about 1530. Of the Dutch and Flemish schools Lucas van Leyden must be considered the head. Born in 1494, at the place whence he derives his name, he was the contemporary and friend of Albert Durer; to whom, though inferior in design, he was superior in composition. His works, which were both on wood and copper, are few in number. The Low Countries furnished a host of engravers, among whom we think it unnecessary to name more than the Sadelers, Bloemart, who laid the foundation of the principles upon which lines become capable of expressing quality, colour, and chiaroscuro, which the French engravers afterwards improved, Goltzius and his pupils; Muller; and Lucas Kilian: the three last, though they handled the graver with great freedom and dexterity, fell into boundless absurdity and extravagance, which, however, were tempered and corrected by Mathieu and Saenredam. In the beginning of the seventeenth century the two Bolswerts appeared, whose style was much improved by the instructions of Rubens. Vosterman, Pontius, and Peter de Jode the younger were of this school, which is distinguished for the success and correctness with which it transferred the picture to the copper. Rembrandt, notwithstanding all his faults and absurdities, claims a special notice in this place as an engraver. The Descent from the Cross, and the print called the "Hundred Guilder Print," are extraordinary efforts of art. His portraits and landscapes are full of nature, expression, and character; and it is difficult to say whether he is more successful in his sunshine effects, than in the sober solemn twilight with which his varied subjects are enveloped. Vandyke has left a few specimens of etchings worthy of his name. Jegher, Lutma, and above all the family of the Vischers, exhibited great excellence in the art, which continued to advance under the hands of Waterloo, Jacob Ruysdael, and Paul Potter; the last of whom, in his etchings of animals, displayed a scientific acquaintance with drawing and anatomy till his time unpractised.

We must now return to close the brief account of the Italian school, in which the appearance of Marc Antonio Raimondi forms the most splendid era. Born at Bologna about 1488, he became the pupil of Raibolini, an artist of that city. His master in the art of engraving is, however, unknown. We first hear of him at Venice, whither Albert Durer went to institute proceedings against him for pirating his prints, which had been copied by Raimondi with such wonderful accuracy that they were sold for the originals. But the proper sphere for Marc

Antonio was Rome, whither he soon bent his steps. There his merit soon gained him the friendship and esteem of Raffaelle, then in the pleuitude of his glory, by whom he was employed to engrave from his designs. His first plate from a design by Raffaelle was the Lucretia, soon after which he executed the Judgment of Paris. His engravings after this master are very numerous; and though free from the blandishments of style, chiaroscuro, and local colour which the art has received since his time, such was his knowledge of drawing, such the beautiful character that pervades his works, that he is entitled to the highest rank in the art to which excellence has ever attained. Strutt considers him one of the most extraordinary engravers that ever lived. His school attracted to Rome artists from all parts; among whom may be enumerated Marco de Ravenna, Giulio Bonasoni, Agostino de Musis, Enea Vico, and Nicolo Beatrici. Some of the German artists whom we have named above — viz. Beham, Penz and James Buck — resorted to Rome for the benefit of his instructions. On the death of Raffaelle, he executed engravings of some of the works of Giulio Romano. His last print, the Battle of the Lapithæ, is dated 1539. Some of the principal pupils of Marc Antonio have already been named; to them may be added Georgio Grisi, commonly called Mantuanus, and others of his family. Many of the Italian painters were extremely successful in engraving, among whom Titian etched many landscapes; but none cultivated the art with more success than Agostino Caracci, who studied under Cornelius Cort, a Dutch engraver, born at Hoorn in 1536. His design and execution are equally to be admired; and had he but concentrated his lights more, and attended to local colour, he would have been exceeded by none. In the seventeenth century Della Bella, Callot (who, though born in France, belongs to the Italian school), Guercino, Salvator Rosa, and Claude continued the reputation of the art. At the latter end of this century was born Antonio Canaletti, originally a scene painter, like his father Bernardo. His etchings opened an entirely new field in architectural engraving, and may be considered almost if not quite the first in which fine sparkling effects of light are introduced, and in which the darkest shadows partake of the transparency and clearness which nature herself exhibits Piranesi, who was born in Venice, and died in 1770, appeared about the middle of that century: he was one of the most surprising architectural engravers that have ever existed, whether we consider the astonishing power or number of his works His use of the etching needle surpassed all that has been done before or since; and in our own time Volpato of Florence, who, besides his other works, engraved almost all the celebrated performances of Canova with a delicacy, grace, and correctness of the first order

The French school commenced about the middle of the sixteenth century with Noel Garnier, who was followed by many clever artists; but till the time of Louis XIV. it cannot be said to have been highly distinguished At that epoch we have Gerard Edelinck, who, though born at Antwerp, belongs properly to the French school, and Gerard Audran. The former of these, who worked entirely with the graver, carried what is called colour in engraving to a much greater degree of perfection than had ever before been practised. His facility was amazing, and portrait and history were equally the subjects of his burin. The name of Audran, not less from the circumstance of the family having produced six engravers, than for Gerard Audran, who engraved the well-known Battles of Alexander after Le Brun, is conspicuous in the history of the art; his name, however, will descend to posterity with greater lustre from his engravings after the Italian school, and particularly those of Nicolo Poussin. Gerard Audran was born at Lyons in 1640, and died in Paris in 1703. John Audran, the last of the family who exercised the art, and nephew of Girard, died in 1756 Nanteuil, the three Drevets, of whom Peter was the most eminent, Le Clerc, Chereau, Cochin, Beauvais, Simonneau Dupuis, and many other masters belong to this period; but Balechon and Wille, towards the middle of the century, outstripped all that had been done by their predecessors. Wille was a German; but his residence having been chiefly at Paris, he is always ranked among the French engravers. His extraordinary powers in imitating the qualities of objects, and particularly of satin, the smoothness of effect he produced, and his extraordinary clearness in the use of the graver, entitle him to a place of the first rank in the French school, which since the age of Louis XIV., has been more distinguished for its great mechanical skill, than for grace, correctness, and beauty in the higher departments of the art.

Till the middle of the seventeenth century England was indebted to foreign artists for the embellishment bestowed upon the typographical works she produced, as well as for such engravings, either in history, portrait, or landscape, as the taste of the nation required. Among the artists who visited England and made it their permanent or temporary residence were the Passes, Vaillant, Hondius, Vosterman, Hollar, Blooteling, Dorigny, and several others. Payne, who died about 1648, and Faithorne, who executed many historical pieces and portraits in a masterly manner, were the earliest English engravers deserving mention. William Faithorne, son of the last named, was eminent as one of the earliest mezzotinto engravers; a species of engraving of English invention, if the editor of *Wren's Parentalia* can be relied on, and discovered, according to him, by his eminent relation, Sir Christopher Wren This invention, which is usually attributed to Prince Rupert, is claimed by Heineken for Lieutenant-Colonel Siegen, who was a Hessian officer, from whom Heineken says Prince Rupert learned the secret, which he brought to England on his return with Charles II. After the two Whites, father and son, appeared Vertue, who was born in 1684. He was the scholar of Vandergucht, and from the numerous works he brought out must have been an artist of great industry and facility. The larger portion of his labours was confined to portraits. Vertue died in 1757, and left behind him a History of Painting and Painters in England, which was published by Horace Walpole in 4 quarto volumes. The works of Pond and Knapton can only be mentioned as continuing the history, though occasionally they possess some spirit; but Vivares, a Frenchman by birth, belonging, however, to the English school, and indeed the founder of it in landscape engraving, has shown in his engravings from the pictures of Claude talents, the precursors of that pre-eminence in landscape engraving which this country has not only improved upon but exclusively possessed. Woollett carried execution to a far greater extent than Vivares, uniting with that engraver's spirit all the elegance, clearness, and delicacy of the French school; and to these Woollett superadded every beauty that mechanical skill could effect John Browne was a contemporary worthy of Woollett, whose works after Salvator, Both, and others are well executed. Sir Robert Strange distinguished himself by his great mechanical skill, whence resulted beautiful execution, by the breadth he preserved in the effects he copied, and by the delicacy he imparted to flesh in a manner that has never been equalled. His principal engravings are from the Italian painters, especially Titian, Guido, and Correggio, and reflect great honour on the English school, which since his time has never been deficient in producing artists of the first class. Strange was a native of one of the Orkney Islands, where he was born in 1721, and died in 1792 Since his time the names of artists of talent might be here supplied to a very great extent we shall merely mention those of Basire, Bartolozzi, Rooker, Heath, Byrne, Bromley, Lowry, Earlom, Raphael, Smith, &c In the present day the demand of prints for the embellishment of books has produced talent which perhaps might be more nobly employed in works of a higher order. In the enumeration of masters it will be seen that the name of Hogarth does not find a place, — for which our reason is that his engravings partake more of the nature of pictures transferred at once to copper, often without proceeding through the intermediate stage.

*Engraving on Wood, or Xylography* — In this branch of the art the material used is a block of box or pear-tree wood, cut at right angles to the direction of the fibres its thickness being regulated by the size of the print to be executed The subject is drawn on the block with a black-lead pencil, or with a pen and Indian ink, taking care that the whole effect is represented in the lines so drawn. The whole of the wood is then cut away, except where the lines are drawn, which are left as raised parts, in which point it is that this mode of engraving differs so essentially from copper-plate engraving, wherein the lines are cut out or sunk in the metal, instead of being raised from it. The impressions from wood blocks are taken in the same manner as from printing types.

*Engraving on Copper* is performed by cutting lines representing the subject on a copper-plate by means of a steel instrument ending in an unequal-sided pyramidal point, such instrument being called a graver or burin, without the use of aquafortis; which mode will be seen below, under the art. ETCHING Besides the graver there are other instruments used in the process; viz. a scraper, a burnisher, an oil stone, and a cushion for supporting the plate. In cutting the lines on the copper the graver is pushed forward in the direction required, being held in the hand at a small inclination to the plane of the copper. The use of the burnisher is to soften down lines that are cut too deep, and for burnishing out scratches in the copper. it is about three inches long. The scraper, like the last, is of steel, with three sharp edges to it, and about six inches long, tapering towards the end. Its use is to scrape off the burr raised by the action of the graver. To show the appearance of the work during its progress, and to polish off the burr, engravers use a roll of woollen or felt called a rubber, which is put in action with a little olive oil. The cushion, which is a leather bag about nine inches diameter filled with sand for laying the plate on, is now rarely used except by writing engravers. For architectural subjects, or in skies, where a series of parallel

lines are wanted, an ingenious machine was invented by the late Mr. Wilson Lowry, called a ruling machine, the accuracy of whose operation is exceedingly perfect. This is made to act on an etching ground by a point or knife connected with the apparatus, and bit in with aquafortis in the ordinary way.

*Etching* is a species of engraving on copper or other metals with a sharp-pointed instrument called an etching needle. The plate is covered with a ground or varnish capable of resisting the action of aquafortis. The usual method is to draw the design on paper with a black-lead pencil; the paper being damped and laid upon the plate, prepared as above, with the drawing next the etching ground, is passed through the rolling press, and thus the design is transferred from the paper to the ground. The needle then scratches out the lines of the design; and aquafortis being poured over the plate, which is bordered round with wax, it is allowed to remain on it long enough to corrode or bite in the lines which the etching needle has made. Etching with a dry point, as it is called, is performed entirely with the point without any ground, the burr raised being taken off by the scraper. Etching with a soft ground is used to imitate chalk or black-lead drawings. For this purpose the ground is mixed with a portion of tallow or lard, according to the temperature of the air. A piece of thin paper being attached to the plate at the four corners by some turner's pitch and lying over the ground, the drawing is made on the paper and shadowed with the black-lead pencil. The action of the pencil thus detaches the ground which adheres to the paper, according to the degree to which the finishing is carried: the paper being then removed, the work is bit in in the ordinary way. *Stippling* is also executed on the etching ground by dots instead of lines made with the etching needle, which, according to the intensity of the shadow to be represented, are made thicker and closer. The work is then bit in. *Etching on Steel* is executed much in the same way as in the process on copper. The plate is bedded on common glazier's putty, and a ground of Brunswick black is laid in the usual way, through which the needle scratches. It is then bit in, in the way above described.

*Mezzotinto Engraving.* — In this species of engraving the artist, with a knife or instrument made for the purpose roughs over the whole surface of the copper in every direction, so as to make it susceptible of delivering a uniform black, smooth, or flat tint. After this process the outline is traced with an etching needle, and the lightest parts are scraped out, then the middle tints so as to leave a greater portion of the ground, and so on according to the depth required in the several parts of the work.

*Aquatinta Engraving*, whose effect somewhat resembles that of an Indian-ink drawing. The mode of effecting this is (the design being already etched) to cover the plate with a ground made of resin and Burgundy pitch or mastic dissolved in rectified spirit of wine, which is poured over the plate lying in an inclined position. The spirit of wine, from its rapid evaporation, leaves the rest of the composition with a granulated texture over the whole of the plate, by which means a grain is produced by the aquafortis on the parts left open by the evaporation of the spirit of wine. The margin of the plate is of course protected in the usual way. After the aquafortis has bitten the lighter parts they are *stopt out*, and the aquafortis is again applied, and so on as often as any parts continue to require more depth. Formerly the grain used to be produced by covering the copper with a powder or some substance which took a granulated form, instead of using the compound above mentioned; but this process was found to be both uncertain and imperfect. In the compound the grain is rendered finer or coarser, in proportion to the quantity of resin introduced. This mode of engraving was invented by a Frenchman of the name of St. Non, about 1662. He communicated it to Jean Baptiste le Prince; who died in 1781, from whom it was acquired by Paul Sandby, who introduced it through the medium of Mr. Jukes into England. It has been practised in this country with much greater success than elsewhere.

*Etching on Glass* — The glass is covered with a thin ground of beeswax: and the design being drawn with the etching needle, it is subjected to the action of sulphuric acid sprinkled over with pounded fluor or Derbyshire spar. After four or five hours this is removed, and the glass cleaned off with oil of turpentine, leaving the parts covered with the beeswax untouched. This operation may be inverted by drawing the design on the glass with a solution of beeswax and turpentine, and subjecting the ground to the action of the acid.

*Engraving on Stone*, or *Lithography* (λιθος, *a stone*, and γραφειν, *to write or draw*). A modern invention, by means whereof impressions may be taken from drawings made on stone. The merit of this discovery belongs to Aloys Senefelder, a musical performer of the theatre at Munich about the year 1800. The following are the principles on which the art of lithography depends: — First, the facility with which calcareous stones imbibe water; second, the great disposition they have to adhere to resinous and oily substances; third, the affinity between each other of oily and resinous substances, and the power they possess of repelling water or a body moistened with water. Hence, when drawings are made on a polished surface of calcareous stone with a resinous or oily medium, they are so adhesive that nothing short of mechanical means can effect their separation from it, and whilst the other parts of the stone take up the water poured upon them, the resinous or oily parts repel it. Lastly, when over a stone prepared in this manner a coloured oily or resinous substance is passed, it will adhere to the drawings made as above, and not to the watery parts of the stone. It was formerly thought that this country did not possess a sort of stone like that of Germany suitable to the purposes of lithography; this, however, is now known to be erroneous, as the neighbourhood of Bath abounds with it, being the white *lias*, which lies immediately under the blue. It is also found in Scotland. The ink and chalk used in lithography are of a saponaceous quality: the former is prepared in Germany from a compound of tallow soap, pure white wax, a small quantity of tallow, and a portion of lamp-black, all boiled together, and when cool dissolved in distilled water. The chalk for the crayons used in drawing on the stone is a composition consisting of the ingredients above mentioned, but to it is added when boiling a small quantity of potash. After the drawing on the stone has been executed and is perfectly dry, a very weak solution of vitriolic acid is poured upon the stone, which not only takes up the alkali from the chalk or ink, as the case may be, leaving an insoluble substance behind it, but it lowers in a very small degree that part of the surface of the stone not drawn upon, and prepares it for absorbing water with greater freedom. Weak gum water is then applied to the stone, to close its pores and keep it moist. The stone is now washed with water, and the daubing ink applied with balls as in printing, after which it is passed in the usual way through the press, the process of watering and daubing being applied for every impression.

There is a mode of transferring drawings made with the chemical ink on paper prepared with a solution of size or gum tragacanth, which being *laid on the stone and passed through the press* leaves the drawing on the stone, and the process above described for preparing the stone and taking the impressions is carried into effect.

In Germany many engravings are made on stone with the burin, in the same way as on copper; but the very great inferiority of these to copper engravings makes it improbable that this method will ever come into general use.

Perhaps one of the greatest advantages of the art of lithography is the extraordinary number of copies that may be taken from a block. As many as 70,000 copies or prints have been taken from one block, and the last of them nearly as good as the first. Expedition is also gained, inasmuch as a fifth more copies can be taken in the same time than from a copper-plate, and as regards economy the advantage over every other species of engraving is very great.

*Zincography* — This art, which is of very recent introduction in this country (so much so, indeed, that but few specimens are as yet to be seen), is similar in principle to lithography, the surface of the plates of zinc on which it is executed being bit away, leaving the design prominent or in relief. We have seen some beautiful examples of this art, but varying little in their appearance from those of stone engraving.

ENGRO'SSING. The writing of a deed over fair, and in proper legible characters. Among lawyers it more particularly means the copying of any writing upon parchment or stamped paper. In statute law, engrossing means the buying up of large quantities of any commodity in order to sell it again at an unusually high price. *See* FORESTALLING.

ENHARMO'NIC SCALE. In Music, a scale in which the modulation proceeds by intervals less than semitones; that is, by quarter tones, having two dieses or signs of raising or lowering the voice.

ENI'GMA. (Gr αινιγμα.) A proposition put in obscure or ambiguous terms to puzzle or exercise the ingenuity in discovering its meaning. In the present day, the enigma is only a jeu d'esprit, or a species of amusement to beguile a leisure hour; but formerly it was a matter of such importance that the eastern monarchs used to send mutual embassies for the solution of enigmas. Every one remembers the enigma which Sampson proposed to the Philistines for solution; and the still more famous enigma of the Sphinx (quod vide), the source at once of the elevation and the misfortunes of Œdipus. About the 17th century the enigma which had been for centuries neglected as a species of literary display, again came into favour; and in France particularly it was cultivated with so much zeal, that several grand treatises were dedicated to its history and characteristics. The best enigmas with which we are acquainted were written by Schiller, and have been incorporated in his works. Even in the present day the periodical literature of France and Germany does not disdain this species of writing; though, as was before observed, it is now employed gene-

rally for amusement, and rarely to convey moral instruction.

ENLI'STMENT, in Military and Naval affairs, means a voluntary engagement to serve as a private soldier or sailor, either for a fixed or unlimited period. Unlike the armies of the Continental nations, whose ranks are generally supplied by conscription, the troops of the British army in all its departments, whether of the line, artillery, or East India Company, are obtained by voluntary enlistment. About a century ago, it was usual to engage recruits for the period of three years; but the present practice is to enlist either for an unlimited period, as during the continuance of a war, or for certain defined numbers of years, which vary in the different classes of troops. For the infantry the period is ten years; for the cavalry twelve years; for the artillery twelve years, and for the East India Company for an unlimited time or twelve years, provided the recruit be upwards of eighteen years of age, otherwise the difference between his age and eighteen years is added to each period. The last acts regulating this subject were the 10 & 11 Vict. c. 37 By an act passed in 1819, called the Foreign Enlistment Act, no British subject was allowed to enter foreign service without permission from the crown; and though this act was suspended for three successive years in favour of the troops raised in this country for the service of the Queen of Spain, it is once more in full operation.

The navy of Great Britain is also manned by voluntary enlistment; though in time of war, or on other great emergencies, impressment (quod vide) is often resorted to for obtaining adequate supplies The period of engaging to serve in the navy was, by an act passed in 1835, limited to five years; after which the sailor is entitled, under certain beneficial restrictions, to his discharge, with the privilege, however, of re-enlisting for a similar period.

E'NNEAGON (Gr. *ἐννεα, nine; γωνια, angle.*) A plane geometrical figure bounded by nine sides. When the figure is regular and the side supposed = 1, the area is 6·18182.

ENNEA'NDROUS. In Botany, having nine stamens.

ENNUI', a French term wholly naturalized in England, signifies a kind of listlessness or inaptitude for mental exertion; or it may be more scientifically defined as that uneasiness or languor which prevails during the absence of mental impressions. The Italian word *noja* corresponds to the French *ennui*.

ENRO'LMENT (in legal orthography, more properly, Inrolment), signifies in law the registering or entering of any document or lawful act in the rolls of the chancery, or superior courts of common law, or in the records of the quarter sessions. Such inrolment is rendered necessary in different cases by statute; as a deed of bargain and sale in order to pass lands must be inrolled in one of the courts of record at Westminster, or by the clerk of the peace in any county, by 27 H 8 c 16 Every deed before it is inrolled is to be acknowledged to be the deed of the party before a master in chancery, or a judge of the court in which it is inrolled

ENSE'MBLE (Fr.) In the Fine Arts, a term denoting the masses and details considered with relation to each other.

E'NSIGN. The national flag carried by a ship. Men of war carry a red, a white, or a blue ensign, according to the colour of the flag of the admiral in command of the station. Ships do not display their ensigns at sea, except in meeting strangers, on which ships show their national ensign. In harbour the ensign is not shown before 8 A M, nor after sunset.

The ensign hoisted with the upper corner (or in British ships the *union* of the crosses of St. George and St. Andrew) downwards, is the signal of distress.

The English ensign is a red, white, or blue flag, having the union in the upper corner next the mast.

E'NSIGN. The lowest commissioned officer, subordinate to the lieutenants, in a regiment of infantry. An ensign is appointed to each company, and the junior ensigns carry the colours of the regiment. In the artillery and in the rifle brigade a second lieutenant takes the place of an ensign.

ENTA'BLATURE. (Fr. entablement.) In Architecture, the whole of the parts of an order above the column. The assemblage is divided into three parts: the architrave, which rests immediately on the column; the frieze next, over the architrave, being the middle member; and the cornice, which is the uppermost part. The first and last are variously subdivided in the different orders. *See* ORDER.

ENTAI'L. *See* FEE TAIL.

E'NTASIS. (Gr. *ἔντασις.*) In Architecture, a delicate and almost imperceptible swelling of the shaft of a column, to be found in almost all the Grecian examples, adopted to prevent the shafts being strictly frusta of cones. This refinement, which is alluded to in the second chapter of the third book of *Vitruvius*, was first observed in execution by Mr. Allason in 1814 in the Athenian edifices.

ENTE'LECHY. (Gr. *ἐντελέχεια*; from *ἐντελὴς, perfect*, and *ἔχω, I hold.*) A peripatetic term, invented by Aristotle in order to express an object in its complete actualization, as opposed to merely *potential* existence (*τὸ δυνάμει ὄν*). *See* ARISTOTELIAN PHILOSOPHY.

ENTELMI'NTHA. (Gr. *ἐντος, within*, and *ἕλμις, a worm.*) A name synonymous with *Entozoa*, and applied to the same heterogeneous group of invertebrate animals. *See* CŒLELMINTHA and STERELMINTHA.

ENTERI'TIS. (Gr. *ἐντερα, the intestines.*) Inflammation of the bowels. This disease is frequently occasioned by incautious exposure to cold, by acrid substances or hardened fæces in the bowels. Its symptoms are, pain over the abdomen; thirst, heat, and excessive restlessness and anxiety; sickness; obstinate constipation; and a hard, small, and quick pulse. The pain increases as the disease proceeds, especially about the navel; there is great difficulty in voiding the urine, which is small in quantity and high-coloured, and the abdomen is so tender as not to endure the slightest pressure. It often terminates in a few hours in mortification of a part of the intestinal canal; in which case the pain suddenly ceases, the belly becomes tumid, the pulse sinks rapidly, and the countenance acquires a peculiar ghastliness: it also proves fatal during the inflammatory stage. Favourable symptoms are, a gradual diminution of pain and of tenderness on pressure, natural evacuation by the bowels, moist skin, equal and firm pulse, and a copious discharge of urine depositing abundance of red sediment. This is a disease which requires prompt and decided treatment, more especially as relates to bleeding, which should be carried as far as the strength will allow upon the first accession of the inflammation. Leeches should be applied over the abdomen, and the patient should be put in a hot bath, or fomented with hot water: the lower bowels should be evacuated by a glyster of castor oil and gruel; and small doses of saline purgatives, or of calomel and cathartic extract, should be administered to clear the bowels. The stomach, however, is very apt to reject these remedies, and sickness should be avoided it must be quelled by the effervescing draught, with a very few drops of tincture of opium. In some cases pretty large doses of calomel and opium have been given with success. When the urgent symptoms give way, and the bowels have been cleared, diaphoretic saline medicines and gentle aperients may be used, and a mild nourishing diet allowed; but great care is requisite in ascertaining that all relics of the inflammatory action are got rid of, and that it is not lurking in some one spot in a chronic form

E'NTEROCE'LE. (Gr. *ἐντερα, the bowels*, and *κηλη, tumour*) A hernia or rupture, the contents of which are a portion of intestine.

ENTERODE'LA (Gr *ἐντερα*, and *δηλος, manifest*) The name given by Ehrenberg to a section of his class *Polygastrica*, comprehending those which have a complete alimentary canal terminated by a mouth and anus.

E'NTEROEPI'PLOCE'LE (Gr *ἐντερα; ἐπιπλοον, the omentum, κηλη, tumour.*) A hernia or rupture containing both intestine and omentum.

ENTERO'LOGY (Gr.) A treatise on the bowels.

ENTHYME'ME (Gr. *ἐν*, and *θυμος, mind;* something understood in the mind and not expressed), in Logic, is commonly defined to be an argument having one premiss expressed, the other understood. (*See* LOGIC, SYLLOGISM) This is the character under which the universal form of reasoning, or syllogism, generally presents itself in connected writing. For example, the following argument, if drawn out in the correct logical form, would stand thus, "All tyrants deserve death; but Cæsar is a tyrant, therefore Cæsar deserves death." But in the rapid diction of oratory, or poetry, it would probably be expressed either, "All tyrants deserve death, therefore so does Cæsar," in which case the minor premiss, "Cæsar is a tyrant," is suppressed. or, "Cæsar is a tyrant, therefore he deserves death," by suppressing the major premiss. Instances may be cited in which the enthymeme consists merely of one of the premisses expressed, while both the other premiss and the conclusion are to be supplied by a rapid exercise of thought. Thus in the well-known words, "But Brutus says he was ambitious, and Brutus is an honourable man," the last of these propositions contains a complete argument, — "what honourable men say is to be believed: Brutus is an honourable man, therefore what Brutus says is to be believed."

ENTOMO'LOGY. (Gr. *ἐντομα, insects*, and *λογος, a discourse*) The science of insects: the history of the organization, habits, properties, and classification of those articulated animals which are distinguished by the presence of antennæ and of breathing organs, composed of ramified tracheæ with or without air-sacs. The name insect, from its etymological signification of an animal insected or divided into sections, is applicable to the greater part of the Articulate sub-kingdom, but is now restricted to those species characterized as above. The presence of highly developed organs for breathing air, together with peculiar and complex organs of sensation, is associated, as might be expected, with active powers of locomotion; and most insects, besides having articulated

members for terrestrial progression, for leaping or climbing, swimming or diving, are endowed with wings, and are capable of rapid and extensive flight. The power of traversing space is given in greater fulness and perfection to the class of insects than to any other created beings on our planet. A peculiar condition of the breathing organs, and a peculiar animal tissue (chitine), which combines great strength, elasticity, and levity, coexist in insects, and in insects only. If, therefore, the highest of living created animals contain the characteristic structures of all lower forms, as some transcendental anatomists assume, then man is not the acmé or apotheosis of animal organization; for neither anastomosing tracheæ nor a particle of chitine is present in his system; nor does he possess a thousandth part of the locomotive energies of certain insects.

Those insects which have more than six articulated legs, and have the segments of the trunk free, without distinction of thorax and abdomen, which undergo no other metamorphosis than an increased number of segments after exclusion from the egg, and which lastly possess neither compound eyes nor wings, are separated by some zoologists as a distinct class, under the name *Myriapoda*, which see.

In the Hexapod insects, the body is divided into a head, thorax, and abdomen; the head supports a pair of antennæ, and contains a pair of compound, and often also simple eyes; the mouth is provided with a labium, labrum, mandibulæ, and maxillæ; the labium and maxillæ also support peculiar feeling organs, called palpi. Sometimes these parts of the mouth, which are termed collectively trophi, or oral organs, are distinct, and adapted to mastication: the insects thus characterized constitute an extensive primary division of the class termed *Mandibulata* Those insects in which the trophi are so modified as to form an instrument of suction are included in the primary division called *Haustellata*

The Hexapod insects were divided by Linnæus into the following orders: —

1. *Coleoptera* Wings four, the upper pair hard, with a straight suture. Ex.: Beetles and earwigs
2. *Hemiptera* Wings four, the upper pair moderately hard and incumbent. Ex.. Bugs, locusts, tree-hoppers, plant-lice, &c.
3. *Lepidoptera* Wings four, covered with scales Ex · Moths and butterflies.
4. *Neuroptera*. Wings four, membranaceous; anus unarmed. Ex.: Dragon-flies, May-flies, &c.
5. *Hymenoptera*. Wings four, membranaceous; anus aculeate. Ex.: Bees, ants, saw-flies, &c
6. *Diptera*. Wings two, halteres two, in place of the posterior wings. Ex.: Flies
7. *Aptera*. Wings none. In this order Linnæus included not only true Apterous insects, as fleas, but also centipedes, spiders, crabs, lobsters, &c, or the articulate animals now forming the classes *Myriapoda*, *Arachnida*, and *Crustacea*.

There is not, perhaps, any class of the animal kingdom which has been the subject of more numerous and various attempts at classification than that of insects. We have just seen that Linnæus adopted the locomotive system as the basis of his method Fabricius, his pupil, proposed a system founded on modifications of the structure of the mouth. Latreille endeavoured to form a natural classification of those most numerous animals from a consideration of their entire organization. His latest system is as follows: —

Sub-class I. *Aptera* No wings; simple eyes in most.
*A*. No metamorphosis, but simple moulting, without a season of torpidity, mouth in some a simple sucker, in others mandibulate.
Order 1. *Thysanura*.
2. *Anoploura* (or *Parasita*)
*B*. A complete metamorphosis, larvæ apodal; pupæ torpid; mouth haustellate, composed of an articulate sheath containing three setæ, with two scales at their base; body much compressed; the species saltatory and parasitic.
3. *Aphaniptera* (or *Siphonaptera*).
Sub-class II. *Ptilota*. Wings, but sometimes not developed as such; two compound eyes, to which in many are added simple eyes.
*A*. Two wings covered by two elytra, either crustaceous or coriaceous.
*a*. Mandibles and maxillæ; elytra of the same consistence.
4. *Coleoptera*.
5. *Dermaptera*.
6. *Orthoptera*.
*b*. No mandibles nor maxillæ; mouth haustellate, composed of an articulate sheath, including four setæ; elytra membranous at their extremity in most.
7. *Hemiptera*.
*B*. Wings four, or two; not covered by elytra.
*a*. Mandibulate; wings four, membranous, and generally transparent; a small scale (tegulum) at the base of the two anterior wings.
8. *Neuroptera*.
9. *Hymenoptera*.
*b*. Haustellate; wings scaly; tegula large, and thrown back.
10. *Lepidoptera*.
*c*. Two wings; haustellate.
11. *Strepsiptera* (or *Rhipiptera*).
12. *Diptera*.

For the characters of the above orders see the articles under their respective denominations.

ENTOMO'PHAGA. (Gr. εντομα, *insects*, and φαγω, *I eat*.) A tribe of Marsupial quadrupeds, characterized by having three kinds of teeth — viz. incisors, canines, and molares — in both jaws, and the intestinal canal provided with a moderate-sized cœcum. The Opossums (*Didelphys*), Bandicoots (*Perameles*), and the genera *Myrmecobius* and *Chœropus* are associated to form this group; and feed principally, though not exclusively, on insects.

E'NTOMO'STRACANS. (Gr. εντομος, *incised*, and οστρακον, *a shell*.) A division of the class *Crustacea*, including those species which are covered with a thin horny tegument in the form of a shell, and consisting of one or two pieces.

ENTOZO'A. (Gr. εντος, and ζωον, *an animal*.) A name given to an extensive series of low-organized invertebrate and generally vermiform animals, of which the greater part are parasitic on the internal organs of other animals. They have colourless blood, circulated in the higher organized species in a closed system of vessels, without an auricle or ventricle; they have no respiratory organs, no articulated members for locomotion, no organs of sense. The digestive system consists either of tubes or cavities excavated in the parenchymatous texture of the body, and without an anal outlet; or of a tube with both oral and anal orifices freely suspended in an abdominal cavity. A filamentary nervous system has been recognized in the higher organized Entozoa, occasionally complicated with a ganglion near the mouth; the generative system is unisexual, hermaphrodite, or dioecious. (For the classification of the Entozoa, see INTESTINALIA.) The species of Entozoa known to infest the human body are the following: —*Ascaris vermicularis*, *Ascaris lumbricoides*, *Tricocephalus dispar*, *Bothriocephalus latus*, *Tœnia solium*, in the alimentary canal; *Distoma hepaticum*, in the gall-bladder; *Accphalocystis endogena*, *Echinococcus hominis*, in the substance of the liver, in the omentum and cavity of the abdomen; *Filaria bronchialis*, in the bronchial glands; *Strongylus gigas*, in the kidney; *Spiroptera hominis* and *Strongylus spiniger*, in the urinary bladder; *Polystoma pinguicola*, in the ovarium; *Trichina spiralis*, in the voluntary muscles, *Cysticercus cellulosæ*, *Filaria medinensis*, and *Filaria oculi*, in the cellular tissue.

ENTREPOT. In Commerce, the name given in France and some other countries to a warehouse or other place where goods brought from abroad may be deposited, and from whence they may be withdrawn for export to another country, without payment of any tax or duty. An entrepôt is, therefore, synonymous with what is called a free port on the Continent, and in this country with a *bonded warehouse*; that is, a warehouse in which foreign products are stored under the joint locks of the king and the importer: if such products be entered for home consumption, they are free of duty till their entry; and if they be re-exported to a foreign country, they are exempted from all duty, and merely pay a small sum as warehouse rent. In popular language, however, the word entrepôt is frequently employed to designate a sea-port or commercial town which exports the produce of a considerable adjacent territory, and imports the foreign articles required for its supply. But its correct signification is that given above.

E'NTRESOL. (Fr.) In Architecture. *See* MEZZANINE.

ENTRO'PIUM. (Gr. εν, *in*, and τρεπειν, *to turn*.) A turning in of the eyelashes and eyelid, so as to irritate the ball of the eye.

E'NTRY, in Law, signifies the taking possession of lands and tenements where a man has title of entry. It is also used for a writ of possession. Entry is either actual, made by the party or his attorney; or an entry in law, by continual claim. Remedy by entry takes place in cases of abatement, intrusion, and disseisin; not on discontinuance or deforcement.

E'NVELOPE. In Fortification, a mound of earth, raised to cover some weak part of the works Envelopes are sometimes raised in the ditch of the place, sometimes beyond it; and are in the form of a single parapet, or a small parapet bordered by another

E'NVOYS, ORDINARY and EXTRAORDINARY, belong to the second order of diplomatic ministers. They are inferior in rank to ambassadors, properly so called; the chief difference between them being that the latter are held to represent the interests of their sovereign as agents, the former his person. *See* AMBASSADOR.

E'OCE'NE. (Gr. ηως, *the morning*, and καινος, *recent*.) In Geology. "This period we shall call *Eocene*, because

the extremely small proportion of living species contained in these strata indicates what may be considered the first commencement or *dawn* of the existing state of the animal creation. To this period the formations first called tertiary, of the Paris and London basins, are referable." (*Lyell, Geology.*)

E'OLIPILE. *See* ÆOLIPILE.

EPA'CRIDA'CEÆ. (Epacris, one of the genera.) A natural order of shrubby Exogens, chiefly natives of Australia; they differ from *Ericeæ* chiefly in the structure of the anther, which is one-celled and destitute of appendages. The fruit of *Lissanthe sapida*, and a few other species, is eaten under the name of the Australian cranberry; otherwise there is no plant of any known use in the order, which, however, contains many beautiful species of the genera *Epacris*, *Lysinema*, *Sphenotoma*, *Styphelia*, and *Dracophyllum*.

E'PACT (Gr. επακτος, *added or introduced*), in Chronology, denotes the moon's age at the end of the year, or the number of days by which the last new moon has preceded the beginning of the year. The common solar year consists of 365 days, and the lunar year of only 354 days: the difference is therefore 11; whence, if a new moon fall on the 1st of January in any year, the moon will be 11 days old on the 1st day of the following year, and 22 days old on the 1st of the third year. The numbers 11 and 22 are therefore the *epacts* of those years respectively. The addition of 11 to the last epact gives 33 for that of the succeeding or fourth year; but as the lunar month never exceeds 30 days, the epact cannot exceed 30; whence 30 is deducted from 33, and the epact is reduced to 3. Of the thirty days thus rejected an *embolismic* or *intercalary* month is formed, which, consequently, occurs every third year of the lunar cycle, and gives 13 lunar months to that year. In like manner the epacts of all the succeeding years of the lunar cycle are obtained; that is to say, by adding successively 11 to the epact of the former year, and rejecting 30 as often as the sum exceeds that number, the leap years being taken account of by adding one day to each lunar month which contains the 29th of February. Supposing, therefore, the epact of the first year of the cycle to be 11, the epacts of all the 19 years of which the cycle is composed will be as follows:—11, 22, 3, 14, 25, 6, 17, 28, 9, 20, 1, 12, 23, 4, 15, 26, 7, 18, 29. But the order is interrupted at the end of the cycle; for the epact of the following year, formed in the same manner, would be 29 + 11 — 30 = 10, whereas it ought obviously to be 11, to correspond with the moon's age, all the circumstances being now supposed to be the same as they were at the commencement of the previous cycle. In order to understand this, it is necessary to remember that the lunar cycle of the ecclesiastical calendar is composed in the following manner:—The lunations are supposed to consist of 29 and 30 days alternately, or the common lunar year of 354 days; and, in order to make up 19 solar years, six embolismic or intercalary months of 30 days each are inserted in the course of the cycle, and one of 29 days at the end. Hence it follows that after adding 11 to the epact of the 19th year of the cycle, we must reject 29 instead of 30, in order to have the epact of the following year, or the first year of the following cycle.

This method of forming the epacts is adapted to the Julian calendar, and might be continued indefinitely, if the Julian intercalation were followed without interruption, and the lunar cycle, defined as above, had corresponded exactly with the lunar motions. But the intercalation is subject to correction, and the cycle is not quite exact Hence the epacts must occasionally be adjusted, and, generally speaking, an alteration is made on the last year of each century. In the ordinary tables of the church calendar the epacts are therefore given only for a single century; but as the Gregorian calendar now in use defines precisely the length of the year, tables, though somewhat more complicated, have been formed, which show the epacts of every future year in all time to come. They may even be found by means of an algebraic formula of no great perplexity. (See the article "Calendar" in the *Encyclopedia Britannica*.) The epacts were invented by Luigi Lilio Ghiraldi, more frequently styled Aloysius Lilius, a physician of Naples, and author of the Gregorian Calendar, for the purpose of showing the days of the new moons, and thence the moon's age on any day of the year, and consequently of regulating the church festivals. It is only in ecclesiastical computations that the epacts are ever employed; in civil affairs the civilized portion of mankind have long since laid aside the use of the lunisolar year, and regulated time entirely by the sun. In the calendar of the Church of England, Easter and the other moveable feasts are determined in the same manner as in the old Romish calendar, excepting that the golden numbers are prefixed to the days of the *full moons*, instead of the days of the new moons. The epacts are consequently not used. It is desirable that the custom of reckoning time by the moon, which had its origin in ignorant ages, were abandoned, and the civil year adopted for every purpose. *See* CALENDAR.

The following table shows the epacts corresponding to each year of the lunar cycle during the present century. The year of the cycle is what is usually called the golden number, which is found by the following rule:—Add 1 to the date (or year), and divide the sum by 19; the quotient will be the number of cycles elapsed since the commencement of the era, and the remainder the golden number. *See* GOLDEN NUMBER.

*Table of Gregorian Epacts.*

| Golden Number. | Epact. | Golden Number. | Epact. | Golden Number. | Epact. |
|---|---|---|---|---|---|
| I. | 0 | VIII. | 17 | XV. | 4 |
| II. | 11 | IX. | 28 | XVI. | 15 |
| III. | 22 | X. | 9 | XVII. | 26 |
| IV. | 3 | XI. | 20 | XVIII. | 7 |
| V. | 14 | XII. | 1 | XIX. | 18 |
| VI. | 25 | XIII. | 12 | I. | 0 |
| VII | 6 | XIV. | 23 | | |

EPA'NALE'PSIS (From the Greek preposition επι, and αναλαμβανω, *I take up.*) In Rhetoric and Composition, a figure by which the word which begins the sentence is repeated at the end of it: "Judge not, that ye be not judged"

EPAU'LE. In Fortification, the shoulder of the bastion, or the angle made by the face and flank

EPAU'LEMENT. A side work hastily raised to cover the cannon or men. also used for a demi-bastion, consisting of a face and flank; or for the redoubts made on a right line

EPAULETTES. (Fr.) Distinguishing ornaments worn both by military and naval officers In the different armies of the German states ensigns are not allowed to wear epaulettes, and hence the phrase "to obtain epaulettes," is synonymous with "to become a lieutenant." In the British army all officers with the rank of captain upwards wear two epaulettes; all under that rank only one.

EPENE'TIC. (Gr επαινετικος, from επαινος, *an encomium.*) The laudatory or "encomiastic" species of oratory: a branch of the Epideictic, according to the division of Aristotle's *De Rhetorica*. *See* PANEGYRIC.

EPE'NTHESIS. A figure of grammar, by which one or more letters are inserted in the middle of a word; as in the Latin *vetlulit* for *vetulit* *See* METAPLASM.

EPHEBE'UM (Gr εφηβος, *a youth.*) In Ancient Architecture, the building appropriated for the wrestling and exercises of youth till they had, on their arrival at manhood, the right to enter the gymnasium

EPHE'BI. (Gr εφηβοι, signifying *arrived at the age of puberty*) Applied particularly to the Athenian youth between the ages of eighteen and twenty years.

EPHE'MERANS, *Ephemeræ*. (Gr εφημερος, *daily*) A family of Neuropterous insects, having the genus *Ephemera* as the type They are called day-flies, from the enjoyment of their last stage of existence being generally limited to twenty-four hours.

EPHE'MERIS (Gr εφημεριος; επι, *upon*, and ημερα, *day*) An astronomical table showing the places of a celestial body for every day at noon. Ephemerides (the plural) of the planets are computed and published annually for most of the principal observatories of Europe The most celebrated of these are our own *Nautical Almanac*, the French *Connaissance des Tems*, and the Berlin *Jahrbuch*.

EPHEMERIS, in Literature, is a collective name for reviews, magazines, and all kinds of periodical literature.

EPHIA'LTES. (Gr. εφαλλομαι, *I leap upon*; from the sensation of something leaping upon the breast.) The nightmare. This affection, consisting of horrid dreams, with a sensation of great pressure upon the body, and of fruitless endeavours to escape and call for help, is generally symptomatic of indigestion, or of over-distension of the stomach For its relief opening medicine, and sometimes an emetic, are often required, and careful abstinence from all that promotes dyspepsia, especially supper eating.

E'PHOD. (Heb) A species of ornament worn by the Hebrew priests. The ephod worn by the high priest, says Calmet, was richly composed of gold, blue, purple, crimson, and twisted cotton; and upon the part which came over his shoulders were two large precious stones, upon which were engraven the names of the twelve tribes of Israel, six names upon each stone. The ephods worn by the ordinary priests were of fine linen. (See *Exod.* xxxix)

E'PHORI (Gr. εφοροι.) In Ancient History, the title of a class of magistrates common to many of the Dorian states of Greece, but more particularly known in reference to the political constitution of Sparta. The Spartan ephors were five in number, and were elected annually from the body of the ruling caste, and not from any particular tribe. They originally seem to have exercised a jurisdiction over the Spartans in their civil concerns, the

limits of which it is not easy to define; but their power increased by degrees, till it became supreme in the state. Besides their judicial authority, they exercised a control over the functions of the kings and the senate, and sometimes recalled the former from their foreign expeditions, and demanded an account of their proceedings. The executive power likewise was almost wholly in their hands.

E'PIC. (Gr. ἐπος, *a verse*.) A poem of an elevated character, describing generally the exploits of heroes. This species of poetry claims a very ancient origin, and is universally allowed to be the most dignified and majestic to which the powers of the poet can be directed. There are various theories regarding the character of an epic poem, and while some critics claim this title exclusively for the *Iliad* and *Odyssey* of Homer, the *Æneid* of Virgil, and the *Paradise Lost* of Milton, others — and particularly the Germans — embrace in the catalogue of epic writers Scott, Byron, Pope, Moore, and Campbell. Epic poetry has often been compared to the drama; and the essential difference between them is, that description is the province of the former — action of the latter The emotions which epic poetry excite are not so frequent and violent as those produced by dramatic composition, but they are more prolonged, and more developed by actual occurrences, for an epic poem embraces a wider compass of time and action than is admissible in the drama. History has generally supplied the best epic writers with themes, but a close attention to historical truth in the development of the story is by no means requisite. Fiction, invention, imagination, may be indulged in to an almost unlimited extent, provided always the poet be careful to preserve what the critics call unity, *i. e.* provided his work embrace an entire action, or have a beginning, a middle, and an end This is the distinguishing characteristic of the great epic poems The object of the *Æneid*, for instance, is the establishment of Æneas in Italy, and amidst all the ramifications of the poem, the great object is kept steadily in view, and every digression from the subject is made powerfully and directly conducive to the progress and development of the tale According to Aristotle, who has been implicitly followed by Blair, the essentials of an epic poem consist in the recital of some great event in a poetical form, — the contrivance of a plot important in itself, and instructive in the reflections which it suggests, filled with suitable incidents, enlivened with a variety of characters and descriptions, and maintaining throughout propriety of character and elevation of style But besides these essential ingredients in epic poetry, there are also what may be termed *accidentals*, in which none of the great epic poems are deficient. These are a prescribed and lengthened march, formal addresses, sustained pomp, episodes, and machinery About the necessity and use of machinery (the introduction of supernatural beings) in an epic poem there are various opinions The French critics consider it as essential to the constitution of an epic poem, alleging that no poem, though possessed of every other requisite, has any pretension to be ranked in the epic class unless the main action be carried on by supernatural beings "On peut dire," says Bossu, "en un mot qu'il faut user de machines partout, puisque Homere et Virgile n'ont rien fait sans cela" To be convinced of the error of this critic, we have only to ask ourselves what it is, in the writings of Homer and Virgil, that pleases us most? Assuredly, as an ingenious writer has remarked, it is not the councils of Olympus, the wiles of Juno and Venus, or the "animis in cœlestibus iræ" (how beautifully soever these are all pourtrayed), that awake a chord of sympathy, even after a lapse of two thousand years, in the breast of every one who reads them; but it is the knowledge of human nature, and the pictures of human feeling which these poems display, that have made them a "κτημα εις αει,"—a work for all time, a possession for eternity. In a word, upon this head we may say, that while, on the one hand, the *observance* of all these rules regarding machinery *alone* will never constitute an epic poem; so, on the other, the absence or violation of them in the hands of a man of genius will never deprive it of that character.

If the epic is the highest, it is also the most difficult style of poetical composition, and that in which mediocrity is least endurable; and hence few of the writers of epics on the classical model have obtained a high reputation as national poets in any language. Virgil is the earliest imitator of Homer whose epic has been preserved, and the most successful. The other Greek and Latin epic poets contain passages of great beauty; but their poems, as wholes, are of an inferior order. In the English language we have only two epics which can be said to form part of the national literature, and those only in part framed on the classical model: the *Paradise Lost* and *Regained* of Milton. French epics, including even the *Henriade* of Voltaire, so famous in its time, have no place among the chefs-d'œuvre of the national literature. Of the great Italian poems, only one (the *Jerusalem Delivered* of Tasso) fulfils the conditions of an epic. The poem of Dante, however sublime in style, has no unity of event or action: those of Ariosto, and the other Romanzieri, form a class distinguished from the epic by the mixture of the serious and ludicrous. The *Italia Liberata* of Trissino is simply pedantic. The old German and Spanish national poems, — the *Romance of the Cid*, and the *Nebelungen-Lied*, especially the latter, which is closely confined to the conduct of one great action, — although the work of writers unskilled in classical literature, deserve the title of epic as truly as those of Homer. There is a brief but masterly exposition of the origin and distinguishing characteristics of epic poetry in the *Penny Cyclopædia*, with reference to the chief German authorities on this subject.

EPICA'RIDANS, *Epicarides*. (Gr. επι, *upon*, and καρις, *a shrimp*.) A family of Isopodous or equal-rooted Crustaceans, which are parasitic upon shrimps.

EPICE'DIUM. (Gr. επι, and κηδος, *grief*.) In Poetry, an elegiac poem on the occasion of a funeral solemnity in honour of some deceased person.

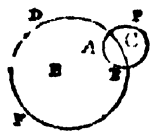
EPICRA'NITIS (Gr. ἐπικρανω, *I finish*.) In Ancient Architecture, a tile forming the cyma of the cornice. The angular stone forming the vertex of the pediment was called the angular epicranitis. The term is used in the celebrated Athenian inscription brought to this country by Dr. Chandler, and now in the British Museum.

EPICURE'ANS. Followers of the tenets of Epicurus, a philosopher who lived from B. C. 337 to B. C. 270, and taught during the latter half of his life at Athens. The name of Epicurean has become the general designation of those who, either theoretically or practically, make pleasure the chief end of life and the standard of all virtue. Of the genuine doctrines of Epicurus himself we have notices in the work of Diogenes Laertius, who has preserved to us fragments of his very voluminous writings: but for these remains we should be at a loss, amid the conflicting statements of his friends and enemies, how to judge of his character as a man and a philosopher. The private character of Epicurus has, we doubt not, been unjustly aspersed, it will be found, however, on a careful examination of his system, that his merits as a philosopher have been as undeservedly extolled. Epicurus was the first philosophical teacher who deserted the lofty idea of science which Plato and Aristotle had striven to develop. Truth is, with him, no longer an object worth pursuing for its own sake, but only in so far as it contributes to the peace of mind of its possessor Hence, though he retains the threefold division of philosophy into ethics, physics, and dialectics (in Epicurean language, canonic), he assigns the two latter a place subordinate to the first, and bestows on them a cursory and heedless mode of treatment.

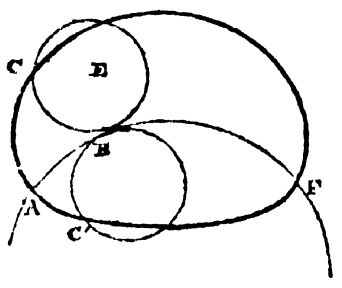
We should greatly wrong Epicurus if we represented the gratification of the sensual appetites to be the object proposed by him to the wise man The happiness which he regards as the true end of existence is rather a species of quietism, in which the philosopher, protected by his knowledge from all fear of injury from the powers of nature, and by the laws from the assaults of his fellow creatures, holds himself open to all the pleasurable sensations which the temperate indulgence of his ordinary appetites, the recollection of past enjoyments, and the anticipation of future, are sufficient abundantly to furnish. In order to support his imaginary wise man in this tranquillity, he deemed it necessary to show that the apprehensions which beset mankind, of death, of the power and anger of the gods, and the like, are wholly unfounded. For this purpose he made use of the physical doctrine of Democritus; a system of atomic materialism, which makes all existences to arise from the concourse of minute particles of matter — the soul among the number, which is consequently, at the moment of death, resolved into its constituent elements. The mental philosophy of Epicurus was of a similar stamp: all our mental powers are resolved into sensation, immediate or recollected; and sensation, under both its forms, consists in the influx of certain extremely fine films, which are perpetually, as it were, sloughed from external objects, and find their way through the organs of sense to the soul. The gods of the Epicureans bear no relation to any part of their system: they are beings sprung, like men, from the concourse of atoms, and differing from them only in their superior blessedness and tranquillity, shown in their entire aloofness from the care and government of the world. The followers of Epicurus were numerous, especially among the Romans. Little more, however, than their names are recorded; with the exception of Lucretius, who, in his well-known poem, *De Rerum Naturâ*, illustrates and defends the physical and religious tenets of his master. In modern times, Gassendi, an atomic philosopher of the 17th century, has published an able statement of the Epicurean system, under the title of *Syntagma Philosophica Epicuri*. (See also *Diogenes Laërtius, Vit. Phil.* l. x.; and Cicero's philosophical writings generally: also *Ritter, Gesch. der Philos.* b. x. And for a list of the Epicureans, *Fabricii Bibliotheca Græca*, vol. iii. ed. Harles.)

EPICY'CLE (Gr. επι, *upon*, and κυκλος, *circle*), in the Ancient Astronomy, is a circle having its centre on

the circumference of another circle. It was a favourite axiom of the Greek astronomers, that all the celestial motions must be circular and uniform. The phenomena of the stations and retrogradations of the planets were apparently inconsistent with this supposition; and in order to explain them, Apollonius of Perga imagined the ingenious apparatus of *epicycles* and *deferents*. He supposed the planet P to move uniformly in the small circle or *epicycle* P A B, the centre of which is carried uniformly forward along the circumference of the large circle or *deferent* C D F, of which the earth occupies the centre E. Hipparchus, having discovered the eccentricity of the solar orbit, supposed the motions to be performed in eccentric circles. Ptolemy, the celebrated founder of the system which astronomers followed till the days of Copernicus, adopted the hypotheses both of Apollonius and Hipparchus; that is, he supposed the earth E to be placed at a small distance from the centre of the deferent circle (which consequently was called an eccentric), and the planet to move uniformly in the epicycle, the centre of which also moves uniformly in the deferent. By means of these suppositions, and by assigning proper ratios (determined by observation) between the radius of the deferent and the radius of the epicycle, and also between the velocity of the planet in its epicycle and the velocity of the centre of the epicycle on the deferent, he was enabled to represent with considerable accuracy, indeed with all the accuracy which the observations of that time required, the apparent motions of the planets, and particularly the stations and retrogradations which formed the principal object of the researches of the ancient astronomers. As a first step towards connecting the two sciences of astronomy and geometry, the system of epicycles does infinite honour to its inventors; and it ought to be borne in mind that it was never given out by Ptolemy as any thing else than a mere hypothesis for representing the apparent celestial motions, or, as he expresses it, for *saving* the appearances.

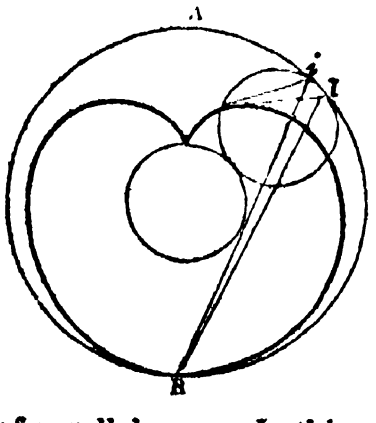



E'PICY'CLOID (Gr. επικυκλος, and ειδος, *form*), in Geometry, is a curve line which is generated by the revolution of a point in the circumference of a circle which rolls on the circumference of another circle either externally or internally. Thus, let the circle whose centre is E touch the circle A B F at the point A, and roll along the outside of the circumference, the point of original contact C, carried round till it return again to the circumference at F, will trace an epicycloid. If the circle revolve on the inside of the circumference, the curve traced out by the point C' will still be of the same kind, though somewhat different in form. This is sometimes called the *hypocycloid*.




The revolving circle is called the *generating circle*, the circle on which the revolution is performed the *fundamental circle*, and the portion of the fundamental circle on which the epicycloid rests is called its *base*. Some of the properties of the curve are easily deduced from these definitions. It is evident that the whole base A F is equal to the circumference of the generating circle; and when the radius of the generating circle is any aliquot part of that of the fundamental circle, the epicycloid, after repeated accessions to the circumference of the fundamental circle, must return into itself at the same point A.

The epycycloid assumes a variety of forms, according to the relative magnitudes of the fundamental and generating circles; when the two circles are equal, its form is that of the annexed figure. This is one of the caustic curves, for rays of light, issuing from a luminous point R in the circumference of a circle R I A, and reflected from any points I *i* in the circumference, are tangents to the curve; consequently all the reflected rays intersect in the curve which is thus traced out by the assemblage of brilliant points. When the radius of the generating circle is only half that of the fundamental circle, the exterior epicycloid forms the caustic of parallel rays. In this case the interior epicycloid becomes a straight line, the point C tracing out the diameter of the fundamental circle.




It is a remarkable property of epicycloids, that when the diameter of the generating circle is any aliquot part of the diameter of the fundamental circle, they are algebraic curves; and the whole epicycloidal circuits are capable of being expressed geometrically in terms of the diameters of those circles. Thus, let the radius of the generating circle be 1, and the radius of the fundamental circle $n$; then the length of the complete arc of the exterior epicycloid is expressed by the formula $8\left(\frac{n+1}{n}\right)$, and of the interior epicycloid by $8\left(\frac{n-1}{n}\right)$. In this case also the epicycloidal spaces, or areas, are expressible in terms of the areas of these circles; the surface of the exterior epicycloid being $\frac{3n+2}{n}$ times, and that of the interior epicycloid $\frac{3n-2}{n}$ times the area of the generating circle.

In all cases the epicycloid, as above defined, is rectifiable; but when the tracing point is not situated in the circumference of the generating circle, but any where in its plane within or without it, the curve is of a different nature, and the above properties no longer hold true. In this case the exterior curve is usually called the *epitrochoid*, and the interior the *hypotrochoid*.

The epicycloid was invented by the celebrated Danish astronomer Romer, the discoverer of the progressive motion of light, who proposed this curve, about the year 1674, as the proper form of the teeth of wheels, in order to destroy the friction. Newton, in the first edition of the *Principia*, gave its rectification; and Halley, in the *Philosophical Transactions*, No 218, showed how its quadrature depends on that of the generating circle. The other principal properties of the curve were discovered and demonstrated by John Bernoulli.

The term *epicycloid* is applied to other curves than the above, but described in an analogous manner. If the revolving circle forms a constant angle with the plane of the fundamental circle, the curve traced out is called a *spherical epicycloid*. If an ellipse is made to roll on another ellipse, the generating point traces an *elliptic* epicycloid, &c.

EPIDE'MIC. (Gr. επι, *upon*, and δημος, *people*.) An infectious or contagious disease, which attacks many people at the same period and in the same country, "rages for a certain time, and then gradually diminishes and disappears, to return again at periods more or less remote." Thus influenza, scarlet fever, measles, &c., frequently appear as *epidemics*, that is, are found to prevail in certain parts of a country, while the adjacent districts are wholly free from their ravages. It is essential to the medical notion of an *epidemic* that it be of a temporary, in contradistinction to a permanent character. It differs from *endemic*, inasmuch as the latter class of diseases are of a permanent nature, and prevail only among certain people, and in certain districts.

EPIDE'RMIS (Gr. επι, and δερμα, *the true skin*.) In Anatomy, the cuticle or scarf skin. It is an albuminous membrane.

EPIDERMIS. In Botany, the cellular integument, or the exterior cellular coating of the bark, or leaf, or stem of a plant. It is composed of cells compacted together into a stratum, varying in thickness in different species, and is often readily separable by gentle violence. It is believed to be intended by nature as a protection of the subjacent parts from the drying effects of the atmosphere.

E'PIDOTE. (Gr. επιδιδωμι, *I increase*.) A mineral which has received a great variety of names. It occurs crystallized, massive, and granular; its usual colours are various shades of green; its structure is generally fibrous. It is a triple silicate of alumina, lime, and iron. It occurs in most parts of Europe, in America, and in the East Indies. "L'épidote emprunte même des dimensions de sa molécule un caractère particulier; il consiste en ce que l'un des côtés de la base de cette molécule est plus étendu que l'autre, en sorte que cette base est un parallélogramme allongé, au lieu que dans les autres substances (actinote, amphibole, &c.) la figure de la base est d'un nombre. C'est de cette espèce *d'accroissement* que j'ai tiré le nom *d'épidote*." (*Hauy*.)

EPIGÆ'OUS. (Gr. επι, *upon*, and γη, *the earth*.) In Botany, a term used in describing the situation of bodies to denote any one growing close to the earth.

EPIGA'STRIC REGION (Gr. επι, and γαστηρ, *the stomach*), is that part of the abdomen which is over the stomach. It is also called the epigastrium.

E'PIGE'NESIS. In Physiology. *See* EVOLUTION.

EPIGLO'TTIS. (Gr. επι, and γλωττα *the tongue*.) An oval cartilage at the root of the tongue, which closes upon the superior opening of the larynx; its superior extremity is loose, and elevated by its own elasticity: it closes the aperture of the larynx when the tongue is drawn back in the act of deglutition. Its base has a ligamentous attachment to the base of the tongue, the thyroid cartilage, and the os hyoides.

EPI'GONI. (Gr. επι, in the sense of *after*, and γιγνομαι, *I am born*.) The collective appellation of the sons of the seven Greek princes who conducted the first war against Thebes without success. The war subsequently undertaken by the Epigoni to avenge the defeat of their forefathers is celebrated in history. Their capture of Thebes forms the theme of Wilkie's epic poem, the *Epi-*

*goniad*, which was published about the middle of the last century, and procured for its author great reputation.

E'PIGRAM. (Gr. *ἐπίγραμμα, an inscription.*) In Poetry, a short poem or piece in verse, which has only one subject, and finishes by a witty or ingenious turn of thought; or, to use a more general definition, an interesting thought represented happily in a few words.

The first of these definitions, although tolerably correct as to the modern epigram, differs, as it will be seen, widely from the original sense of the word in Greek. The Greek epigram was, in the first instance, a short collection of lines actually inscribed on a monument, statue, fountain, &c.; and the word was thence transferred to such short poems as might serve for inscriptions: of such the collection termed the *Greek Epigrams* is almost wholly composed. Their general characteristic is perfect simplicity, and the seemingly studied absence of that *point* which characterizes the modern epigram. They are almost wholly in one form of metre, the elegiac.

In the poetry of classical Rome, the term epigram was still somewhat indiscriminately used to designate short pieces in verse; but the works of Catullus, and still more the well-known collection of the *Epigrams of Martial*, contain a great number which present the modern epigrammatic character; and Martial has, in fact, afforded the model on which the modern epigram has been framed In this class of composition, and especially where the turn of thought is satirical, the French writers have been far more successful than those of any other nation; and the term "piquant" seems expressly invented to designate the peculiar force of those epigrammatic sallies of fancy of which their literature is full. (See Dr Johnson's learned *Essay on Epigrams*.)

E'PIGRAPH (Gr. *ἐπιγράφω, I inscribe*), also termed *Motto*. In Literature, a citation from some author, or a sentence framed for the purpose, placed at the commencement of a work or of its separate divisions.

EPI'GYNOUS (Gr. *ἐπι, upon*, and *γυνη, a female*.) A term used in botany to denote any organ growing upon the summit of the ovarium.

E'PILEPSY. (Gr. *ἐπιλαμβανω, I seize upon.*) This disease is also called the *falling sickness*, from the suddenness of its attack. It is attended by convulsive stupor and frothing at the mouth It comes on by fits, which after lasting a certain time go off, generally leaving a degree of lassitude and drowsiness Where epilepsy is symptomatic of irritation in the primæ viæ, from worms, or indigestible and noxious food or poisons, or when it arises from the suppression of long-accustomed evacuations, the treatment is sufficiently obvious, so also in cases where it results from a blow, wound, or fracture, or from diseased bone, it may be relieved by proper surgical aid. Plethoric habits require lowering and debility indicates the use of tonics The disease, however, is always indicative of something essentially wrong in the nervous system; and where it arises from hereditary disposition, or comes on about the age of puberty, where the fits are frequent, and cannot be referred to any apparent cause, an unfavourable opinion must be formed respecting its termination, which, if not in apoplexy, is commonly in mental alienation or imbecility Yet, the most unpromising cases have in a few rare instances ended well; that is, they have not recurred after violent pains, or eruptive disorders. It sometimes happens that certain symptoms precede the attack, and among them a sense of coldness proceeding from some part of the body towards the head, and called *aura epileptica*, with palpitation, flatulency, and slight stupor, are the most common In such cases a brisk emetic, a large dose of opium and ether, a cold bath where it may be ventured upon, or any thing which produces a sudden shock upon the system, has prevented the fit. The most effective remedial treatment seems to be that which is directed to the diminution of nervous irritability by sedatives and tonics. among the former opium, ether, henbane, hemlock, and more lately morphia and strichnia, have been recommended; and as tonics bark, quinia, cascarilla, valerian, and some metallic salts, such as sulphate of iron, zinc, or copper, arseniate of potash, or the arsenical solution, and especially nitrate of silver; but the chance of permanently disfiguring the patient by the leaden hue which this last salt often communicates to the skin, should induce practitioners to be most scrupulous in the selection of this remedy. It is said that a violent scald or burn, or great alarm, as from a fire, a fall, and such accidents, have sometimes relieved the system of this horrible complaint; and hence perhaps the superstitious notions which have attached to its cure by charms.

During an epileptic fit, nothing can be done for the relief of the sufferer except taking care that he does not injure himself, and relieving him of any part of his dress which may tend to compress the vessels of the head; the paroxysms, however, are most frequent in the night.

E'PILOGUE. (Gr. *ἐπιλογος.*) In Dramatic Poetry, the closing address to the audience at the end of a play.

EPI'PHANY. (Gr. *ἐπιφανης, manifest.*) A church festival, signifying the manifestation of Christ, and referring to the appearance of the star which announced our Saviour's birth to the Gentiles. It is observed on the 5th of January, being the twelfth day from Christmas.

EPIPHONE'MA. (Gr. *ἐπι, upon*, and *φωνεω, I speak.*) In Rhetoric and Composition, a short reflection added by way of corollary, or passing remark, to the end of a course of narrative or reasoning.

EPI'PHORA. (Gr. *ἐπι, upon*, and *φερω, I bear.*) In Rhetoric, the emphatic repetition of a word or series of words at the end of several sentences or stanzas. The finest instance of this figure with which we are acquainted in modern oratory occurs in Fox's defence of himself and his measures in the House of Commons after the dissolution of the Coalition Ministry. Anaphora is a similar repetition at the beginning of several sentences.

EPI'PHORA. A disease occasioned by a superabundant secretion of tears.

EPIPHY'LLOUS. (Gr. *ἐπι*, and *φυλλον, a leaf.*) In Botany, something inserted upon a leaf.

EPI'PHYSIS. (Gr. *ἐπι, upon*, and *φυσις, nature*.) A process of a bone separated at first by a layer of cartilage from that to which it is attached.

EPIPLOCE'LE. (Gr. *ἐπιπλοον, the omentum*, and *κηλη, tumour.*) A hernia or rupture formed by a protrusion of the omentum.

E'PIPLOON. (Gr.) The *omentum.*

EPISCE'NIUM. (Gr. *ἐπι, upon*, and *σκηνη, a scene.*) In Ancient Architecture, the upper order of the scene in the theatre.

EPI'SCOPACY. (Gr. *ἐπισκοπος, an overseer.*) The government of a church by three distinct orders of ministers — bishops, priests, and deacons. The nature of the argument upon which this constitution is best defended will be most clearly seen in a quotation from Mr. Short's *History of the English Church.* Speaking of the points at issue between the Presbyterians and the Church party in the reign of Elizabeth, he says, "Were there three distinct orders in the primitive church? and if so, was the right and office of [illegible] to the highest of these?" He then proceeds to argue thus: — "In the apostolical history, as contained in the New Testament, these questions are not clearly answered, and there is much indistinctness about the names of bishop and priest or elder; but if we suppose, by way of hypothesis, that there were bishops, priests, and deacons, we shall find no statements which cannot be easily reconciled with the supposition As we proceed with ecclesiastical history, those same traces become more decisive, till we find that at an early period the questions are both answered in the affirmative, and we infer, therefore, that unless it can be shown that a change in this particular took place, we may presume that the same ecclesiastical constitution existed from the time of the apostles. A Presbyterian might argue that in the apostolical history of the New Testament there is nothing which militates against the hypothesis of the two orders only, at least nothing which proves the point, that St James might have been the chief elder, the moderator of the church of Jerusalem; that Titus and Timothy might have held no higher office than that of dean in a cathedral church, or archdeacon in a diocese; and that as the presbytery had the power of ordaining, they, as its superintendants, were directed by St. Paul to set all things in order. But then this hypothesis does not account for the introduction of episcopacy, without even a hint from the historians that any alteration in the church government was effected. When to this it is added, that there never existed a church without episcopacy till the Reformation, the proof seems as strong as moral proof can be that it is most probable that episcopacy is derived from the times of the apostles." He adds in a note — "The argument concerning the name of bishop is frequently mistaken There is no doubt that *ἐπίσκοτος* is equivalent to *πρεσβυτερος* in the New Testament, but then the terms used in the New Testament for bishop are *ἀπόστολος*, or *ἀγγελος*. The concession, therefore, of the use of the name *ἐπίσκοτος* proves nothing. The Presbyterian is forced to say, that the order equivalent to that of the apostles does not now exist in the church, and to explain *ἀγγελος* by *the chief pastor of the church.* So that the argument from the names is rather in favour of episcopacy." It will be observed that this defence mainly relies upon the argument from antiquity and immemorial usage; and this is the authority to which the episcopalian always pays the highest regard when the Scriptures do not appear to be decisive. But the Presbyterians and Independents very generally take a different ground, and argue in the words of Dr. Maclaine, the translator of Mosheim — "that Christ, by leaving this matter undetermined, has of consequence left Christian societies a discretionary power of modelling the government of the church in such a manner as the circumstantial reasons of times, places, &c. may require; and therefore the wisest government of the church is the best and the most divine; and every Christian society has a right to make laws for itself, provided that these laws are consistent with charity and peace, and with the fundamental doctrines and principles of Christianity."

E'PISODE. In Poetry. From the Greek *ἐπεισόδιον*,

which in its original sense denotes those parts of a classical drama which are between the entrances, εἰσόδοι, of the chorus; and thence, by analogy, has the signification which has adhered to the derivative word in modern use,—an incidental narrative or digression in a poem, more or less connected with the main plot, but not essential to its development.

EPISPA'STIC. (Gr. ἐπισπάω, *I draw upon.*) A term applied to substances which raise a blister upon the skin.

E'PISPERM. (Gr. ἐπι, *upon*, and σπέρμα, *a seed.*) In Botany, the testa or integuments of a seed.

EPI'STATES. (Gr. ἐπιστάτης.) The title of the presidents of the two great councils of the Athenians, viz. the Ecclesia and the senate of the Five Hundred. They were both respectively elected from the number of the prohedri of the ecclesia and senate, and their office only lasted one day. The latter of these two officers had the post of the greatest trust, as in his hands were placed the keys of the citadel and public treasury.

E'PISTA'XIS. (Gr. ἐπιστάζειν, *to drop from.*) Bleeding at the nose. In young persons, and where it is produced by accidental causes, this is of no consequence; unless, indeed, it should be very profuse, and then the topical application of cold and of styptics, especially a strong solution of alum, or a plug of lint properly introduced, will check it; but when it occurs frequently in advanced life, and is independent of nasal disease, it is apt to indicate an alarming fulness of the vessels of the head It is also a dangerous omen in disorders of great debility, and more especially in putrid fever.

EPISTHO'TONOS. (Gr ἐπισθεν, *forwards*, and τείνω, *I bend*) A spasmodic affection, in which the body is bent forwards.

EPI'STLE. (Gr ἐπιστολή) The use of this word is now confined in our language to the designation of those written addresses by apostolical writers to their Christian brethren which are contained in the canon of Scripture: a few others, either spurious or of high antiquity, although not recognized among inspired writings, are also so denominated. The Epistles of St Paul, and others contained in the volume of the New Testament, are not arranged according to their date, but, in all probability, according to the views which those who arranged the canon entertained of the relative importance either of the writings themselves, or of the parties to whom they are addressed Thus the Epistles of St Paul to the different churches, and the Catholic Epistles of St John (*i e.* addressed to the universal church), are ranked before the Epistles of those saints to individual Christians An exception to this rule is to be found in the Epistle to the Hebrews, which is placed last among those of St Paul, and seems to have been admitted into the canon at a comparatively recent period. The practice of reading a portion of an Epistle in the service of the church is extremely ancient, and said to be noticed by Justin in his *First Apology*

E'PISTY'LIUM. (Gr. ἐπι, *upon*, and στύλος, *a column.*) In Architecture, the same as *architrave*, which see.

E'PITAPH (Gr. ἐπι, and τάφος, *a tomb*) Literally an inscription on a tomb As has been well observed, inscriptions in honour of the dead are perhaps as old as tombs themselves; though they were by no means bestowed in such profusion in ancient as in modern times Among the Greeks, for instance, this honour was paid only to the tombs of heroes, as in the case of Leonidas and his gallant comrades. (*Her.* vii 228) The Romans were the first to deviate from this course. Every Roman family who consecrated a tomb to their relations had the privilege of inscribing an epitaph thereon, and as their tombs were usually situated on the highway, the attention of passers-by was sought to be arrested by the words "sta viator,"—the formula with which all their epitaphs were prefaced. But how much soever the epitaphs of the ancient Greeks and Romans differed in point of number, there were three qualities which they possessed in common—brevity, simplicity, and familiarity, qualities which a modern critic, Boileau, has pronounced to be indispensable in this species of writing.

At what period sepulchral inscriptions came into use in England, has not been precisely ascertained; though there can be little doubt that this practice was introduced by the Romans at the period of their invasion of Britain. During the first twelve centuries of the Christian era, the monumental inscriptions of this country were all written in Latin. About the 13th century, the French language was adopted, and continued to be used for this purpose till the middle of the 14th century; at which time monumental inscriptions in the vernacular tongue became common, though the clergy and learned of that time, as might have been expected, still preferred the Latin, as their more familiar idiom. The modern English, French, and German epitaphs, of which several collections have been made, are infinitely more numerous than those of any time or nation, and exhibit every variety of style and sentiment; from the most chaste and majestic gravity, impressive tenderness, and laconic terseness, to the most puerile epigrammatic conceits, pointed satire, and heraldic prolixity. It would be out of place here to give specimens of all the various kinds of epitaphs included in this category; but we cannot refrain from citing, in illustration of our assertion, one or two instances, exhibiting each in an eminent degree the different characteristics of the class to which it belongs.

*Epitaph on the Countess of Pembroke, by Ben Jonson.*

Underneath this sable hearse
Lies the subject of all verse;
Sidney's sister, Pembroke's mother:
Death, ere thou canst find another
Good and fair and wise as she,
Time shall throw a dart at thee.

*Epitaph on Robespierre.*

Passant, ne pleure point mon sort;
Si je vivais, tu serais mort!

*Epitaph on a French General.*

Siste, viator; heroem calcas!
Stop, traveller; thou treadest on a hero!

E'PITHALA'MIUM. (Gr. ἐπιθαλάμιον.) A nuptial song, sung by a chorus of boys and girls when the bride and bridegroom entered the bridal chamber, and again on the first morning after the marriage This was the custom in Greece, which was somewhat varied at Rome, where the chorus consisted of girls only, who sang before the door of the nuptial chamber till midnight The most perfect examples of this species which antiquity has left us are by Theocritus and Catullus

E'PITHET (Gr ἐπίθετον, *something imposed upon another*), in Rhetoric and Composition, denotes a term employed in an adjective sense to express an attribute or quality of another substantive term The abundance and the propriety of epithets form peculiar characteristics of various poetical styles In the strict rhetorical sense, epithets are only such adjectives as convey a notion already implied in the noun substantive itself, and add nothing to the sense. Thus, the "glorious" sun is a mere epithet, while the "rising" or the "setting" sun would, as conveying some additional idea into the sense of the passage, not be considered as epithets. The former sort, however, are sometimes called in disparagement by writers on rhetoric "otiosa," or idle epithets.

EPITI'THIDES. (Gr. ἐπι, and τίθημι, *I place.*) In Architecture, the crown or upper mouldings of an entablature

EPI'TOME. (Gr. ἐπιτέμνω, *I cut short.*) In Literature, an abridgment: a work in which the contents of a former work are reduced within a smaller space by curtailment and condensation In the later classical period, extending through the declining age of the Western Empire, the practice of epitomizing the writings of older writers, especially in history, became very prevalent; and while some regard the works of Justin, Eutropius, and similar writers as having preserved to us much historical knowledge which would otherwise have been lost, others have maintained that these laborious compilers have done great disservice to literature, inasmuch as the voluminous works which they abridged being superseded by their more popular and cheaper compendia, in an illiterate age, have from that cause for the most part perished. *See* ABRIDGMENT.

EPIZO'ANS, *Epizoa.* (Gr ἐπι, *upon*, and ζῶον, *animal*) The name of a class of parasitic animals, which chiefly infest fishes, and of which the Linnæan genus *Lernæa* is the type.

E'POCH (Gr ἐποχή, from ἐπέχω, *I stop*) In Chronology, a fixed point of time from which dates are numbered, or at which a new computation begins It is consequently the commencement of an æra *See* ÆRA.

E'PODE (Gr ἐπωδός, *something added to the* ᾠδή, *or ode*) In the strophic choruses of the Grecian drama, the last portion following the strophe and antistrophe is so called. The name of *Epodes*, applied to a book of Horace's poems, merely signifies additional or supplementary odes.

EPOPEE. *See* EPIC.

E'POPT. (Gr. ἐποπτης, *inspector.*) A functionary of the Eleusinian Mysteries, which see.

EPROUVE'TTE. In Gunnery, a machine for proving the strength of gunpowder. A small gun is attached to a frame, which is suspended from a horizontal rod, about which it oscillates like a pendulum. On the gun being fired, the recoil causes the frame to swing; and the force of the recoil is measured by the angle which the frame describes. In this manner the relative strength of different sorts of gunpowder is ascertained.

E'PSOM SALT. Sulphate of magnesia; formerly obtained by evaporating the water of certain springs at Epsom in Surrey.

EPU'LIS. (Gr. ἐπι, *upon*; οὖλα, *the gums.*) A small tubercle on the gums.

EPULO'TIC. (Gr. ἐπι, and οὐλη *a scar.*) Applications which promote the skinning over of sores; hence the *epulotic ointments* of old pharmacy.

**E'QUANT**, in the Ptolemaic Astronomy, denotes a circle which was conceived to be described in the plane of the deferent or eccentric, for regulating and adjusting certain motions of the planets, and reducing them to easier calculation.

**EQUA'TIONS, ALGEBRAICAL.** An algebraical equation is an expression of equality between two quantities involving the ordinary symbols of algebra in any manner whatever. The "Theory of Algebraical Equations" forms an important subject or department of analysis, and is always understood to embody the discussion of equations when presented in their most convenient form for solution; and its great object is to develop the properties and to evolve the values of the real and imaginary roots. The equations are supposed to be cleared from radicals, and are classed in degrees according to the highest exponent of the unknown quantity.

Thus, if $x$ denote the unknown quantity, and $c_0$, $c_1$, $c_2$, $c_3$, &c. the given numbers or coefficients;

$c_1 x + c_0 = 0$ is a *simple equation*, or an equation of the *first* degree;

$c_2 x^2 + c_1 x + c_0 = 0$ is a *quadratic*, or an equation of the *second* degree;

$c_3 x^3 + c_2 x^2 + c_1 x + c_0 = 0$ is a *cubic equation*, or an equation of the *third* degree;

$c_4 x^4 + c_3 x^3 + c_2 x^2 + c_1 x + c_0 = 0$ is a *biquadratic equation*, or an equation of the *fourth* degree, &c &c.

And $c_n x^n + c_{n-1} x^{n-1} \ldots + c_2 x^2 + c_1 x + c_0 = 0$ is an equation of the $n$th degree.

We shall here consider two or three of the most important and useful general properties of an equation of the $n$th degree.

The complete solution of every equation of the $n$th degree must always comprise as many as $n$ roots, real and imaginary, the imaginary roots being of the forms $p + q\sqrt{-1}$, $p - q\sqrt{-1}$. When a real root is substituted for $x$ in the equation, the involved terms must counteract one another, and cause the result to vanish, and when an imaginary root is substituted for $x$ in the equation, both the real and imaginary portion of the result must separately vanish. If the substitution of $p + q\sqrt{-1}$ causes both the real and imaginary parts to vanish, it is evident that the substitution of $p - q\sqrt{-1}$ will have the same effect, since the result will only differ from that of the former in the imaginary terms having changed all their signs. It follows from this remark that if an equation possesses a root of the form $p + q\sqrt{-1}$, it must likewise possess a corresponding imaginary root of the form $p - q\sqrt{-1}$. The roots $p + q\sqrt{-1}$, $p - q\sqrt{-1}$ are called a pair of imaginary roots; and as these roots must thus enter equations in pairs, every equation must have an even number of impossible roots, or else none at all.

Suppose the roots of an equation to be all real, and let them be denoted by $r_1$, $r_2$, $r_3$ ... &c; then the equation will in all cases be produced by multiplying together the factors $x - r_1$, $x - r_2$, $x - r_3$, &c. The equation may therefore be put in the form,

$$(x - r_1)\ (x - r_2)\ (x - r_3) \ldots . \&c. = 0 \ldots (A).$$

If, however, the equation likewise contains pairs of imaginary roots, $p + q\sqrt{-1}$, $p - q\sqrt{-1}$, $p' + q'\sqrt{-1}$, $p' - q'\sqrt{-1}$, &c., it will also embody the factors $(x - p - q\sqrt{-1})\ (x - p + q\sqrt{-1})\ (x - p' - q'\sqrt{-1})\ (x - p' + q'\sqrt{-1})$ &c; or $\left((x-p)^2 + q^2\right)\left((x-p')^2 + q'^2\right)$ &c.; and will consequently take the form,

$$(x - r_1)\ (x - r_2)\ (x - r_3) \ldots . \left((x-p)^2 + q^2\right)\left((x-p')^2 + q'^2\right) \ldots . \&c. = 0 \ldots (B).$$

The equation, when thus put in the form (A) or (B), is evidently satisfied when $x$ is made equal to any one of the roots $r_1, r_2, r_3 \ldots . p + q\sqrt{-1}$, $p - q\sqrt{-1}$, $p' + q'\sqrt{-1}$, $p' - q'\sqrt{-1}$ ... &c.; and the idea is very clearly conveyed how an equation of the $n$th degree may be fulfilled by $n$ different roots, determined by equating the factors severally with *zero*.

If the factors of (A) be incorporated by actual multiplication, we shall derive expressions for the coefficients of the equation in terms of its roots. The operation will be as follows:

$$\begin{array}{l} x - r_1 \\ x - r_2 \\ \hline x^2 - r_1 \\ \quad - r_2 \end{array} \Big| \; x + r_1 r_2$$

$$\begin{array}{l} x - r_3 \\ \hline x^3 - r_1 \\ \quad - r_2 \\ \quad - r_3 \end{array} \Big| \begin{array}{l} x^2 + r_1 r_2 \\ \quad + r_1 r_3 \\ \quad + r_2 r_3 \end{array} \Big| \; x - r_1 r_2 r_3$$

$$\begin{array}{l} x - r_4 \\ \hline x^4 - r_1 \\ \quad - r_2 \\ \quad - r_3 \\ \quad - r_4 \end{array} \Big| \begin{array}{l} x^3 + r_1 r_2 \\ \quad + r_1 r_3 \\ \quad + r_2 r_3 \\ \quad + r_1 r_4 \\ \quad + r_2 r_4 \\ \quad + r_3 r_4 \end{array} \Big| \begin{array}{l} x^2 - r_1 r_2 r_3 \\ \quad - r_1 r_2 r_4 \\ \quad - r_1 r_3 r_4 \\ \quad - r_2 r_3 r_4 \end{array} \Big| \; x + r_1 r_2 r_3 r_4$$

By continuing the process we infer, generally, that for any equation in which the highest power of $x$ has the coefficient unity, the coefficient of the second term is equal to the sum of the roots with the sign changed; that of the third term is equal to the sum of the products of every two roots; that of the fourth term is equal to the sum of the products of every three roots with the sign changed, &c. &c; and the last term $c_0$, unaccompanied by $x$, is equal to the continued product of all the roots, with the proper algebraic sign when the degree of the equation is even, but with the sign changed when the degree is odd.

The consideration of an equation resolved into its simple factors (A) also, amongst other useful matters, suggests the method of eliminating a known root from an equation so as to descend to another equation of the next less degree, which contains the remaining roots. If $r_1$ be the known root, it is only necessary to divide the equation by the factor $x - r_1$, and in this operation the occurrence of no remainder will assure us that $r_1$ is in reality a true root of the equation. It will therefore be an advantage to ascertain a systematic plan by which the process of division by such a factor may be performed with facility. To preserve generality, suppose $m$ to be any number that either may or may not be one of the roots of the equation, $c_n x^n + c_{n-1} x^{n-1} + c_{n-2} x^{n-2} \ldots + c_2 x^2 + c_1 x + c_0 = 0$. And on the equation being divided by $x - m$, suppose the quotient to be

$$c'_{n-1} x^{n-1} + c'_{n-2} x^{n-2} \ldots + c'_1 x + c'_0.$$

Then the actual work of the division will stand thus:

$$\begin{array}{l} x - m \;)\; c_n x^n + c_{n-1} x^{n-1} + c_{n-2} x^{n-2} + \&c \\ \quad c'_{n-1} x^n - m c'_{n-1} x^{n-1} \\ \hline \\ \quad\quad c'_{n-2} x^{n-1} + c_{n-2} x^{n-2} \\ \quad\quad c'_{n-2} x^{n-1} - m c'_{n-2} x^{n-2} \\ \hline \\ \quad\quad\quad c'_{n-3} x^{n-2} + \&c. \end{array} \quad \left( \begin{array}{l} c'_{n-1} x^{n-1} \\ \quad + c'_{n-2} x^{n-2} \\ \quad + \&c. \end{array} \right.$$

By equating the several subtractions we hence derive the following relations for determining the coefficients $c'_{n-1}$, $c'_{n-2}$, &c.; viz.

$$c'_{n-1} = c_n$$
$$c'_{n-2} = c_{n-1} + m c'_{n-1}$$
$$c'_{n-3} = c_{n-2} + m c'_{n-2}, \text{ \&c.}$$
$$c'_0 = c_1 + m c'_1$$

and the remainder, $p = c'_0 + m c'_0$.

Thus it appears that the coefficient of the $p$th term of the depressed equation is successively found by adding $m$ times the coefficient of the preceding term to the $p$th term of the original equation. As an example, let it be required to divide the equation $3x^3 + 3x^2 - 48x + 60 = 0$ by $x - 3$.

Coefficients proposed, 3 + 3 − 48 + 60
+ 9 + 36 − 36

| $3x^2 + 12x - 12$ | $+ 24$ |
|---|---|
| Quotient. | Remainder. |

Again, let it be required to divide the same equation by $x - 2$.

Coefficients proposed, 3 + 3 − 48 + 60
6 + 18 − 60

| $3x^2 + 9x - 30$ | 0 |
|---|---|
| Quotient. | Remainder. |

Here the existence of no remainder points out 2 to be a root of the proposed equation, and $3x^2 + 9x - 30 = 0$, or $x^2 + 3x - 10 = 0$ to be the depressed equation containing the other two roots, which are therefore 2 and −5.

This expeditious method of dividing an equation by a simple factor may be employed with advantage in transforming an equation into another, whose roots shall differ from those of the former by any given quantity. Let the proposed equation be

$$c_4 x^4 + c_3 x^3 + c_2 x^2 + c_1 x + c_0 = 0.$$

Suppose that $x = x' + r$, and the substitution of this value instead of $x$ will manifestly give a transformed equation, the roots of which will be less than those of the former by the quantity $r$; and this transformed equation will be of the form,

$$c_4 x'^4 + c'_3 x'^3 + c'_2 x'^2 + c'_1 x' + c'_0 = 0.$$

Now, if $x - r$ be put for $x'$, this must return to the original equation; and hence the proposed equation is the same as $c_4 (x-r)^4 + c'_3 (x-r)^3 + c'_2 (x-r)^2 + c'_1 (x-r) + c'_0 = 0$. The following process of successive division,

which may be rapidly executed by the foregoing rule, thus furnishes a simple method of arriving at the sought coefficients:

$$x-r)\,c_4(x-r)^4 + c'_3(x-r)^3 + c'_2(x-r)^2 + c'_1(x-r) + c'_0$$
$$x-r)\,c_4(x-r)^3 + c'_3(x-r)^2 + c'_2(x-r) + c'_1 \mid \text{rem. } c'_0$$
$$x-r)\,c_4(x-r)^2 + c'_3(x-r) + c'_2 \mid \text{rem. } c'_1$$
$$x-r)\,c_4(x-r) + c'_3 \mid \text{rem. } c'_2$$
$$c_4 \mid \text{rem. } c'_3$$

Example: Let it be required to transform the equation $x^4 + 5x^3 + 4x^2 + 3x - 105$ into another, whose roots shall be 2 less than those of the proposed equation.

| | $c_3$ | $c_2$ | $c_1$ | $c_0$ |
|---|---|---|---|---|
| 1 | + 5 | + 4 | + 3 | − 105 ( 2 |
| | 2 | + 14 | + 36 | + 78 |
| 1 | + 7 | + 18 | + 39 | − 27 = $c'_0$ |
| | 2 | + 18 | + 72 | |
| 1 | + 9 | + 36 | + 111 = $c'_1$ | |
| | 2 | + 22 | | |
| 1 | + 11 | + 58 = $c'_2$ | | |
| | 2 | | | |
| 1 | + 13 = $c'_3$. | | | |

The transformed equation is therefore $x'^4 + 13x'^3 + 58x'^2 + 111x' - 27 = 0$. If the several addends be suppressed and performed mentally, the operation will be reduced to the following:

| | | | | |
|---|---|---|---|---|
| 1 | + 5 | + 4 | + 3 | − 105 ( 2 |
| | + 7 | + 18 | + 39 | − 27 |
| | + 9 | + 36 | + 111 | |
| | + 11 | + 58 | | |
| | + 13 | | | |

It is on the principle of this operation that Mr Horner has founded his general method of evolving the numerical value of a real root of an equation, which consists in similarly diminishing the equation by the successive digits of the root.

Some of the most useful properties of equations are here annexed

1. If the real roots of an equation, ranged in the order of their magnitudes, be $r_1, r_2, r_3 \ldots$, $r_1$ being the greatest, $r_2$ the next in magnitude, &c., and if a number $a$ greater than $r_1$ be substituted for $x$, the result will be positive; if a number $b$, in magnitude between $r_1$ and $r_2$, be substituted for $x$, the result will be negative, &c., and so on with alternate signs.

2. No equation can have a greater number of positive roots than there are changes of sign from + to − and from − to +, in the terms or coefficients of its expression, nor can it have a greater number of negative roots than of permanencies of sign in the same terms.

3. Let $p$ and $q$ be any two numbers, such that $q$ with its sign is greater than $p$ with its sign, then, if an equation in $x$ has $m$ real roots comprised between $p$ and $q$, the transformed equation in $(x-p)$ will have *at least* $m$ variations more than the transformed equation in $(x-q)$

4. For conciseness let $X = 0$ denote any equation, and let the differential coefficient $\frac{dX}{dx}$ be denoted by $X_1$; then will the real roots of the equation $X = 0$ be limits to those of the equation $X_1 = 0$; that is, the roots of the latter equation, taken in the order of magnitude, will fall severally *between* those of the original equation.

5. Assuming the same notation as in the last, the greatest common measure of the two expressions $X$, $X_1$, equated with *zero*, will determine the values of all *equal* roots that may be repeated in the equation $X = 0$; if there be *no common measure*, the roots will be *all unequal*.

A very important theorem has been recently discovered by M. Sturm, by which we are enabled, without fail, to ascertain, by a direct process, the nature and situation of all the real roots of an equation. It is as follows Let $X = 0$ be any equation whose coefficients are real, and whose roots are unequal; and let $X_1$, as before, be the differential coefficient, $\frac{dX}{dx}$, of $x$. Let the operation of finding the greatest common measure of $X$ and $X_1$ be performed; and in the several remainders which successively arise in the course of the process change all the signs from + to −, and from − to +. Suppose now that in the several resulting expressions,

$$X, X_1, X_2, X_3 \ldots . X^m$$

two numbers, $p$, $q$, such that $p < q$ be successively substituted for $x$, the results will furnish two series of signs; and, according to Sturm's theorem, the difference between the number of variations of algebraic sign in the first series and that of the second will always express *exactly* the number of real roots of the proposed equation comprised between $p$ and $q$. If $-\infty$ and $+\infty$ be taken for $p$ and $q$, the *total number* of real roots may thus be immediately ascertained.

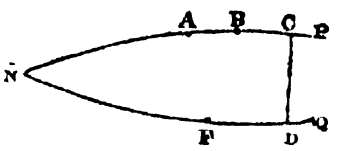
For a demonstration of this remarkable theorem, see *Young's Treatise on Equations.*





**EQUA'TION OF TIME**, in Astronomy, denotes the difference, expressed in mean solar time, between the true or apparent right ascension of the sun and its mean right ascension. It may be popularly defined as the difference between the times indicated by an accurately constructed sun-dial and a well-regulated clock.

The equation of time arises from the combined operation of all the causes which tend to produce inequalities of the sun's motion in right ascension. The first of these is the eccentricity of the solar orbit, in consequence of which the sun's motion in longitude is unequal. The second is the obliquity of the ecliptic, in consequence of which the arcs of the ecliptic and equator, counting from the intersection of these circles to the meridian, are in general unequal. The third cause of the equation of time arises from the perturbations of the moon and planets, which sensibly affect the sun's motion in longitude. The different parts of the equation of time are collected and computed in the following manner —Let N P represent the ecliptic, N Q the equator; and let N be the intersection of these circles, or the first point of Aries.




Take N A to represent the mean motion of the sun in any given time T, reckoning from the vernal equinox; then, if the sun advanced equably in the ecliptic, his place at the time T would be at the point A. But suppose that in consequence of the eccentricity of the orbit he would have advanced to B; then A B is what is called the equation of the centre. Suppose, further, that by the combined action of the planets during the time T he is carried forward to C; then the *true* arc of the ecliptic described by the sun is N C. Now, if we put

$l$ = N C, the sun's true longitude,
$m$ = N A, the sun's mean longitude,
$e$ = A B, the equation of the centre,
$p$ = B C, the effect of the perturbations,

there will result the equation $l = m + e + p$. Through C let the arc C D be drawn perpendicular to the equator; the point D will be that point of the equator which passes the meridian at the same time with the sun. If we now make $r$ = N C − N D, then $r$ is the *reduction to the ecliptic*, and the sun's *true* right ascension is $l - r$ = N D. Let N F = N A = $m$, then F is the point of the equator which the sun would occupy at the instant he occupies the point A in the ecliptic if he moved uniformly in the equator, and N F is the sun's *mean* right ascension. The mean sun would consequently pass the meridian with the point F, whereas the true sun passes it with the point D, therefore at the instant of true noon, when the points C and D are on the meridian, the mean sun is at the distance D F from the meridian But D F = N D − N F = $l - r - m$ = $e + p - r$, which is the equation of time expressed in degrees of a circle To convert it into mean solar time, we must multiply by $\frac{24}{360} = \frac{1}{15}$ (24 hours corresponding to 360 degrees); therefore, representing the equation of time by $t$, we have

$$t = \tfrac{1}{15}(e + p - r).$$

This equation still requires to be corrected for the effect of nutation The variation of the mean longitude resulting from the nutation is expressed by the formula 18″ sin (360° − moon's node) = 18″ sin N; and this reduced to the equator is 18″ sin. N cos $\omega$ ($\omega$ being the obliquity of the ecliptic) Consequently the effect on the equation of time, being the difference of the variations on the ecliptic and equator, becomes 18″ sin N (1 − cos. $\omega$). But 18″ (1 − cos $\omega$) being reduced to time, becomes 0 09925 seconds, therefore, including the correction for nutation, the equation of time becomes finally

$$t = \tfrac{1}{15}(e + p - r) + \sin N \times 0\ 09925 \text{ sec.}$$

The last term of this expression is very small, amounting when greatest to less than the tenth of a second, and is therefore scarcely sensible. The part depending on the perturbations is also very small, and can scarcely exceed two seconds. The principal parts, therefore, are the two depending upon the eccentricity and obliquity; and these were known in the time of Ptolemy.

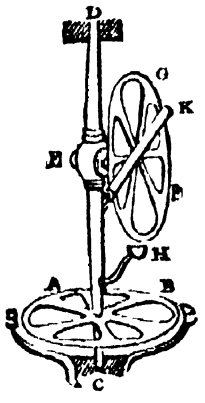
The equation of time is at its maximum about the beginning of November, when it amounts to about 16 min 16 sec; and is subtractive, that is to say, the clock is faster than the dial by that quantity. At four times in the year the equation vanishes, or the clock time and dial time agree. This happens about the 25th of December, the 16th of April, the 16th of June, and the 1st of September. But these epochs, depending on the longitude of the sun's perigee, are subject to some variation. The equation is given in the *Nautical Almanac* for every day of each year.

EQUATOR. In Astronomy, the great circle of the celestial sphere, of which the plane is perpendicular to the axis of the earth's diurnal motion. It is called the equator, because when the sun is in its plane the days and nights are exactly equal all over the world. The equator divides the sphere into the northern and southern hemispheres and the apparent diurnal motions of all the celes-

tial bodies are performed in circles which are parallel to it. The right ascensions are measured on the equator; and the declinations on circles which intersect it at right angles. The equator, in the heavens, is often styled the *equinoctial*.

In Geography, the equator is the great circle of the terrestrial sphere which is every where equally distant from the two poles, and divides the earth into the northern and southern hemispheres. Terrestrial *longitudes* are measured on the equator, or some one of its parallel circles; commencing from some arbitrary point, which different nations assume variously, most of them adopting the meridian which passes through their capital city or principal observatory. *Latitudes* are counted from the equator along the meridian.

EQUATO'RIAL. An astronomical instrument, contrived for the purpose of directing a telescope upon any celestial object of which the right ascension and declination are known, and of keeping the object in view for any length of time, notwithstanding the diurnal motion.




For these purposes, a principal axis C D, resting on firm supports, is placed parallel to the axis of the earth's rotation, and consequently pointing to the poles of the heavens. On this polar axis there is fixed, near one of its extremities, a graduated circle A B, the plane of which is perpendicular to the polar axis, and therefore parallel to the earth's equator. This circle is called the *equatorial* circle, and measures by its arcs the hour angles, or differences of right ascension. The polar axis is pierced at E F, and penetrated by the axis of a second circle G H, at right angles to it. The axis of the second circle has consequently no connection with any external support, but is sustained entirely by the polar axis. The plane of the second circle G H, which is called the *declination* circle, and carries the telescope K, is thus in all positions at right angles to the plane of the first or equatorial circle A B. Now it is easy to conceive, from this general description, that when the telescope is pointed to a star, the angle between the direction of the telescope and the polar axis is equal to the polar distance of the star, consequently, when a motion is given to the polar axis without altering the position of the telescope on the declination circle, the point to which the telescope is directed will always lie in the small circle of the heavens coincident with the star's diurnal path; and hence, if the motion communicated to the polar axis be just equal to the earth's diurnal rotation, the star will remain constantly, and as long as we please, in the field of the telescope, at least while above the horizon. In many observations this is indispensable, and it is an advantage which attaches to no other instrument. The polar axis may be moved by a peculiar kind of clock machinery, adjusted to sidereal time; and the best and largest equatorials are now furnished with such an apparatus. Besides relieving the observer from the fatigue of turning the instrument, the motion thus given is perfectly equable, and all those jerks avoided which, when the instrument is turned by the hand, often prove fatal to an observation. (For the method of adjusting the equatorial, see a paper by Professor Littrow of Vienna in the *Memoirs of the Royal Astr. Society*, vol. ii. p. 45.)

E'QUERRY. (Fr. ecuyer.) In the British Court, a subordinate officer under the master of the horse. The chief equerry is also styled clerk marshal, with a salary of 560*l* per an. There are also four equerries in ordinary, whose salary is 300*l* a year, and an equerry of the crown stable. A queen consort has three equerries.

E'QUIA'NGULAR FIGURE. (Lat. æquus and angulus.) In Geometry, a figure of which all the angles are equal among themselves, as is the case with all the regular polygons. Two figures also of the same kind, having each angle of the one equal to a corresponding angle of the other, are said to be *equiangular*, although when considered separately they may not be equiangular figures.

EQUILA'TERAL BIVALVE. A shell is so called when a transverse line drawn through the apex of the umbo bisects the valve into two equal and symmetrical parts.

EQUILA'TERAL FIGURE, in Geometry, is one that has all its sides equal to each other. Equilateral figures inscribable in circles are necessarily equiangular; but the converse does not always hold true. When the number of sides is odd, the equiangular figure inscribable in a circle is always equilateral; but when the number of sides is even, they may either be all equal, or one half equal to each other, and the other half equal to each other, though not to the former, the two sets being placed alternately.

EQUILA'TERAL HYPERBOLA, is that which has the two axes equal to each other, the asymptotes forming a right angle. *See* HYPERBOLA.

EQUILI'BRIUM. (Lat. æquus, *equal*, and libra, *balance*.) In Statics, results from the simultaneous action of several forces on a body, or material point, when they reciprocally destroy each other's action, so that the body or point, though free to move, remains at rest. Two equal forces, acting in contrary directions, destroy each other; and when a body submitted to the action of several forces remains at rest, it is necesary that the resultant of one part of the forces be exactly equal and opposite to the resultant of the remainder, or that the resultant of the whole be nothing. The science of equilibrium is thus founded entirely on the composition of forces. *See* STATICS.

EQUILIBRIUM. (Lat.) In the Fine Arts, the just poise or balance of a figure or other object, so that it may appear to stand firmly. Also the due equipoise of objects, lights, shadows, &c. against each other by some striking feature. This quality is obvious in the works of nature, as well in the human form as in landscape. In the latter, for instance, the sun is generally the medium of producing it by strong contrasts of light and shadow. In architecture, the same means are employed to produce the most striking effects, on the theory of which Le Roy has ably written.

EQUILIBRIUM. In Politics. *See* BALANCE OF POWER.

E'QUIMU'LTIPLES. The products of quantities multiplied by the same numbers. For example, $5a$ and $5b$ are equimultiples of $a$ and $b$; and $m^2np$ and $m^2nq$ are equimultiples of $p$ and $q$. Equimultiples of quantities have to each other the same ratio as the quantities themselves.

EQUINO'CTIAL. (*See* EQUINOX.) The great circle formed by the intersection of the plane of the earth's equator with the sphere of the heavens. This term is chiefly met with in the older books of astronomy, the term *equator* being now generally given to the same circle. *See* EQUATOR.

EQUINOCTIAL POINTS. The two opposite points of the celestial sphere, in which the ecliptic and equator intersect each other; the one being the first point of Aries, and the other the first point of Libra. The equinoctial points do not retain a fixed position relatively to the stars, but retrograde or move backwards from east to west with a slow motion, equal to about 50 seconds yearly, requiring 25,000 years to accomplish a complete revolution. This motion is called the precession of the equinoxes.

E'QUINOX (Lat. æquus, and nox, *night*), in Astronomy, is the time at which the sun passes through the equator in one of the equinoctial points. When the sun is in the equator the days and nights are of equal length all over the world, whence the derivation of the term. This happens twice every year; namely, about the 21st of March, and the 22d of September: the former is called the *vernal* and the latter the *autumnal* equinox. The equinoxes do not divide the year into portions of equal length; for in consequence of the sun being at his greatest distance from the earth during the summer months, and his angular motion in his orbit being consequently slower, the interval from the vernal to the autumnal equinox is greater than that from the autumnal to the vernal. In other words, the sun continues longer on the northern than on the southern side of the equator. At the beginning of the present century, the difference amounted to 7 days 16 hours and 51 minutes. The summer in the northern hemisphere is consequently longer than in the southern by this quantity; and to this circumstance some meteorologists ascribe, in part at least, the higher temperature that is found to prevail in the northern hemisphere under the same parallel of latitude.

E'QUIPAGE (Fr. equipper), in ordinary language, signifies the carriage, horses, and liveries which indicate the fortune or rank of any gentleman when he appears abroad. — *Equipage*, in marine affairs, signifies the crew of a ship, together with all a ship's furniture, masts, sails, ammunition, &c. In the art military, it denotes all sorts of utensils and artillery, &c., necessary for commencing and prosecuting with ease or success any military operation.

E'QUISETA'CEÆ. (Equisetum, one of the genera.) A natural order of Gymnosperms, inhabiting the ditches and rivers of most parts of the world. They have no decided affinity with any known order, but are more like flowering plants than flowerless; and therefore are best considered as a degeneration of *Coniferæ*, to which they have so much resemblance, rather than as a race in affinity with ferns, with which they have no resemblance. They have no medicinal qualities; but for economical purposes are useful for polishing furniture, owing to the quantity of silex contained in their epidermis. They are considered by the farmer, who calls them horsetails, as a sign of heavy, bad, wet land.

E'QUISE'TIC ACID. A peculiar acid, discovered by Braconnot existing, combined with magnesia, in the *Equisetum fluviatile*.

E'QUITANT. In Botany, a term used in describing the vernation of leaves, to denote that they overlap each other parallelly and entirely, without any involution, as the leaves of iris. They seem as if they bestrode each other in opposite directions, whence the name.

E'QUITES. In Ancient History, a class of Roman citizens, commonly represented by the English word

knights, but not answering in all respects to its meaning. The origin of the Equites was the body of Celeres, instituted by Romulus; and they originally consisted of those who were rich enough to serve in war on horseback, but afterwards they became a distinct order. They were chosen promiscuously from the patricians and plebeians whose age was above 18 years, and fortune, at least towards the end of the republic, not less than 400 sestertia, or 3229*l*. The badges of the equites were a golden ring and a robe with a narrow purple border; and to them were appropriated the fourteen rows of seats in the theatres next the orchestra, where the senators sat. This body disputed with the senate the privilege of forming the jury who assisted the prætor in trials; but, after repeated transfers of this office from one to the other, it was finally shared between both. The equites also furnished the farmers of the public revenue, or *publicani*, but though they had enjoyed this privilege under the republic, it was only during the empire that they looked to such offices as their birthright. Cicero affirms that the flower of the Roman chivalry, the ornament of Rome, the strength of the empire, lay in these engrossers of the public revenue: "florem equitum Romanorum, ornamentum civitatis, firmamentum reipublicæ, publicanorum ordine contineri." (See *Niebuhr's Roman History*.)

E'QUITY. (Lat. æquitas) In Jurisprudence In the words of Blackstone (*Comm* i. 61), "Since in laws all cases cannot be foreseen or expressed, it is necessary that when the general decrees of the law come to be applied to particular cases, there should be somewhere a power vested of defining those circumstances which (had they been foreseen) the legislator himself would have expressed." In the same view, Grotius defines equity, as "Correctrix ejus in quo lex propter universalitatem deficit" (*De Æquitat.* i. s. 12); and distinguishes it from the dispensing power, which does not mitigate law, but dispenses certain persons from the obligation of it Pufendorf considers it under two heads,—as declaring a case to be excepted out of the general provisions of a law; and as deciding omitted cases on which the law does not pronounce at all. (*Elements*, i. 22, 23) The necessity of some power to modify and apply, with allowances for particular cases, the strict rules of law, is necessarily felt in every jurisprudence, and provided for in different ways Thus in ancient Rome the prætor, "juvare, supplere, interpretari, mitigare, jus civile potuit; mutare vel tollere non potuit." (*Digest*, l. i. t. i. 7.) So, in English law, the judges have constantly assumed the authority to pronounce cases to be within the "equity," as it is termed, of statutes or rules, when they are not within its words; as, for example, action of waste given by the Statute of Gloucester against tenant for life "or years" is extended by equitable construction against tenants who hold for a year or half a year only. But the word equity, in English jurisprudence, is now more properly applied to a separate body of law, created and sustained on the strength of precedents, and administered by tribunals distinct from the common law courts of the country. The separation of equity from law originated in the necessity which has already been spoken of; but from the circumstance of the former being administered by a different class of functionaries, it has by degrees assumed this distinct shape and substance. By seeking relief in equity is now meant, not so much applying for a mitigation of the strict rules of law, as seeking a remedy before a tribunal having a jurisdiction either concurrent with the courts of law or (in some cases) exclusive, but exercising it according to a different process and on different principles. The origin of this peculiar system is to be traced, in part, to the system of uses (*see* USE, TRUST); in part to the obvious advantages resulting from the examination of the parties, and compelling discovery on oath in cases of fraud, account, &c.; and to the power, gradually acquired by equity judges, of compelling the specific performance of contracts where courts of law could only award damages for their breach; in part, also, to the peculiar functions imposed by statute and usage on the lord chancellor as guardian of infants, idiots, and lunatics, superintendent of charities, &c The general view of the system of equitable jurisprudence as at present existing is given in the articles CHANCERY and TRUST (See *Blackstone's Commentaries*, vol. iii.; *Fonblanque on Equity; Mitford's Pleadings in Chancery*.)

EQUI'VALENTS, CHEMICAL. A term introduced into chemistry by Dr. Wollaston to express the system of definite ratios in which substances reciprocally combine, referred to a common standard of unity. If we assume hydrogen as unity, it being the substance which combines with others in the smallest relative weight or proportions, then all other substances may be represented by certain multiples of that unit, expressed with sufficient precision for all ordinary purposes by whole numbers. (*See* ATOMIC THEORY and AFFINITY.) Thus, upon this system the equivalent number of oxygen will be 8, and that of water will be 9, for 8 oxygen + 1 hydrogen = 9 water; and the equivalent of potassium will be 40, and of potassa or oxide of potassium 48, for 40 potassium + 8 oxygen = 48 potassa. Upon the same principle the equivalent of hydrochloric acid, which is a compound of chlorine and hydrogen, is 37, for it consists of 1 part by weight of hydrogen and 36 of chlorine; or, in other words, of an atom of hydrogen = 1 + an atom of chlorine = 36. The equivalent of sulphur is 16: to form sulphuric acid one atom of sulphur = 16 combines with 3 atoms of oxygen (8 × 3) = 24; hence the equivalent of an atom of sulphuric acid is 16 + 24 = 40. These equivalents are often expressed by certain abbreviations, termed *chemical symbols;* which, as far as single equivalents of the simple substances are concerned, are represented, together with their equivalent numbers, in a table in the article CHEMISTRY.

E'QUIVALVE. A bivalve is so called when its two valves are of similar size and form.

EQUI'VOCAL TERM. In Logic, a term which has several significations, applying respectively and equally to several objects. A word is generally said to be employed equivocally where the middle term is used in different senses in the two premises (*see* SYLLOGISM); or where a proposition is liable to be understood in various senses, according to the various meanings of one of its terms

EQUU'LEUS (Lat.), called also *Equiculus* and *Equus Minor*. The *Little Horse*, one of Ptolemy's constellations in the northern hemisphere.

EQUULEUS was also the name given in antiquity to a species of rack used in extorting confessions. It was originally practised on slaves, but at a later period it was employed against the Christians

E'QUUS. (Lat. *a horse*) The generic name of the quadrupeds with a single digit and hoof on each foot, as the *horse*, *ass*, and *zebra* Of these species the horse is the largest, most docile, most valuable, and most widely distributed over the globe. Of the Mammalia which existed on the earth's surface during the tertiary periods of geology, the horse is one of the few which have been preserved to the present epoch; and in the American continent, where it once became extinct, along with the Mastodon and Megatherium, it now again ranges wild in vast troops, the descendants of the war horse introduced by the European discoverers and conquerors of the so called "new world"

The first record of the taming and application of the horse to the purposes of man is in Genesis, 19; in which it is written, that when Joseph transferred his father's remains from Egypt to Canaan, "there went up with him both chariots and horsemen" The period when the horse is thus indicated as a beast both of draught and burden, is calculated to have been 1650 years before the birth of Christ. Horse and chariot races formed part of the Olympic games in Greece, 1450 years B. C.

The wild horses which inhabit the steppes of Tartary are supposed to be, like those that traverse the pampas of South America, descendants of certain individuals which had escaped from the thraldom of man. The best of the wild Asiatic races are those which inhabit Tscherkessi, Abassi, and the northern slopes of the Caucasian range. The principal varieties which Pallas indicates in the Asiatic horse are, first, the "moustachoed horse," characterized by numerous strong bristles on the upper lip; the "woolly horse," a Russian variety, covered with a crisp woolly hair, and common among the Baschkirs; a naked or hairless horse, not uncommon amongst the Krim Tartars, who keep it always clothed, lastly, the variety delineated by Johnston, in which a woolly mane is continued from the neck along the middle of the back to the tail, and which Pallas saw among the Buracti.

The wild horses appear to be free from nearly all those diseases to which the domestic breed are prone They are generally of a pale or greyish brown colour, with brown mane and tail, a whitish muzzle, changing to black about the mouth. They are less than the domestic breed; with a larger head; longer legs; larger ears, with the apices sub-reflected; the forehead is more convex above the eyes, the hoofs are contracted and sub-cylindrical (*ungulæ contractæ*, *subcylindraceæ*); mane sub-erect, less lax than in the domestic horse; the coat, in winter, looser and sub-undulated along the back (*in dorso subundulatum*); the tail not very large. They recognize the presence of man at a great distance when he approaches them to windward, and fly from him with wonderful speed; they prefer sunny slopes, and avoid forests and steep places. They do not wander beyond the 50th degree of north latitude. Wild stallions attracted by domestic mares are often taken and killed.

The first change which domestication works upon the form of the wild horse is to increase the bulk of his trunk as compared with his head and limbs. This change is beautifully exemplified in the Arabian, which we must regard as an early, if not first remove, from his wild [illegible] of the more northern deserts, and which the Bedouin still hunts for the sake of their flesh The head is not only proportionally smaller, but is remarkable for the breadth and squareness of the forehead, the shortness and fineness of the muzzle, the prominence and brilliance of the eye, and the smallness of the ears The body is still somewhat light, and narrow at the forepart;

but the shoulder is superior in its formation to that in any other breed. The Arabian seldom stands more than 14 hands 2 inches. The "Barb," so called from its native country, Barbary, is somewhat smaller than its near ally the Arabian; it seldom exceeds fourteen hands and an inch; the shoulders are flat, the chest round, the legs rather long, and the head small and very beautiful. The Barb is remarkable for its fine and graceful action; but though it is superior to the Arabian in its general form, it has not its untiring spirit or its speed. Our most valuable English varieties of the horse date from the introduction of, and interbreeding with, the Barb and Arabian.

We have no means of ascertaining the nature or peculiarities of the horses which the ancient British charioteers managed with such dexterity in their destructive charges through the disciplined troops of Cæsar. They must have been subsequently modified by crossing with the Roman horses. King Athelstan received from Hugh Capet of France several German running horses; William the Conqueror and his followers introduced the Spanish horse, with the blood of the Barb. The first Arabian horse is recorded to have been introduced in the reign of Henry I.; and a greater admixture of Arabian blood was a natural consequence of the return of the Crusaders. King John devoted especial attention to the improvement of his stud, and he imported one hundred choice stallions of the Flanders kind. The size and strength required to carry the warrior clad in the heavy armour of those days led to the frequent introduction in subsequent reigns of the large and heavy war horses of the Low Countries. Afterwards, when the nobles derived their amusements more from the sports of the turf and field, they were induced to cross their stately and heavy breed of war horses with those of lighter structure and greater speed; the latest improvement seems to have been derived from a direct intermixture of the pure Arabian.

The principal varieties or breeds of English horses are — The hackney or road horse. "He should be," Mr Youatt observes, "a hunter in miniature; with these exceptions: His height should rarely exceed fifteen hands and an inch He will be sufficiently strong and more pleasant for general work below that standard He should be of a more compact form than the hunter, of more bulk according to his height It is of essential consequence that the bones beneath the knee should be deep and flat, and the tendon not *tied in* The pastern should be short, and less oblique or slanting than that of the hunter or race horse. The foot should be of a size corresponding with the bulk of the animal, neither too hollow nor too flat, and open at the heels. The forelegs should be perfectly straight; for a horse with his knees bent will from a slight cause, and especially if overweighted, come down. The back should be straight and short, yet sufficiently long to leave comfortable room for the saddle between the shoulders and the *hack* without pressing on either Some persons prefer a hollow-backed horse It is generally an easy one to go. It will canter well with a lady, but it will not carry a heavy weight, or stand much hard work The road horse should be high in the forehead, round in the barrel, and deep in the chest."

The origin of the better kind of *coach horse*, says Mr. Youatt, is the "Cleveland bay," confined principally to Yorkshire and Durham, with Lincolnshire on one side and Northumberland on the other, but difficult to meet with pure in either county The Cleveland mare is crossed by a three-fourth or thorough-bred horse of sufficient substance and height, and the produce is the coach horse most in repute, with his arched crest and high action.

There is, or rather was, a breed called, from its round punchy make, the *Suffolk punch*. "It stood from fifteen to sixteen hands high, of a sorrel colour; was large-headed low-shouldered, and thick on the top; deep and round-chested; long-backed; high in the croup, large and strong in the quarters; full in the flanks; round in the legs, and short in the pasterns It was the very horse to throw his whole weight into a collar, with sufficient activity to do it effectually, and hardihood to stand a long day's work." This valuable breed is now nearly extinct: it is thought to have been produced from the Norman stallion and the Suffolk cart mare. Excellent carriage horses are obtained by crossing the Suffolk breed with a good hunter.

The best dray horses are produced from the Suffolk punch crossed with the Flanders.

The breed of English racers is traced authentically to an Arabian stallion introduced into this country by a Mr. Darley, and hence called the "Darley Arabian." Anterior to this period the pedigree of a racer can rarely be carried back beyond some obscure reference to an Eastern horse. The Darley Arabian was the sire of Flying Childers, and the great grandsire of Eclipse. Eclipse was remarkable for the very great size, obliquity, and lowness of his shoulders; the shortness of his forequarters; his ample and finely proportioned quarters, and the swelling muscles of his fore-arm and thigh. He was, moreover, what is termed a thick-winded horse, and puffed and roared so as to be heard at a considerable distance; yet he never had an opponent on the turf sufficiently fleet to put his full speed to the test. Eclipse died at the age of twenty-five years, having begot the extraordinary number of three hundred and thirty-four winners.

Another stream of Eastern blood was introduced into the swelling veins of our thorough-bred horses by a beautiful Barb, called the Godolphin Arabian.

The hunter, a favourite English variety, includes as much of the blood and high breeding of the racer as is compatible with the power and endurance demanded by the chase. The author of the excellent work on the horse in the *Library of Useful Knowledge*, thus describes the good points of a hunter. — "The first property of a good hunter is, that he should be light in hand. For this purpose his head must be small; his neck thin, especially beneath; his crest firm and arched; and his jaws wide The head will then be well set on. It will form a pleasant angle with the neck, which gives a light and pleasant mouth"

The more extreme varieties which we have in England are the ponies and Galloways: of these the Sheltie or Shetland pony is the most diminutive; it rarely exceeds nine hands high, and sometimes does not reach seven and a half His strength is proportionally far greater than his size, he is perfectly docile, and will fatten on the hardest fare

The dental character of the horse, and of the genus *Equus*, is thus expressed in zoology: —

Incisors $\frac{6}{6}$, Canines $\frac{1 \cdot 1}{1 \cdot 1}$, Molares $\frac{6 \cdot 6}{6 \cdot 6} = 40$; *i. e.* it has six incisors or nippers in the front of both the upper and lower jaws, one tusk or canine, and six molars or grinders, on each side of both jaws They appear in the following order: — The two middle incisors, and the two anterior grinders, come into place at about a week after birth; the third grinder in the course of the first month; the two adjoining incisors before the end of the sixth week; the two outer incisors between the sixth and ninth month; making the six incisors above and below, and completing what is termed the colt's mouth. There are also two very small deciduous canines developed about the sixth month; the fourth grinder generally makes its appearance at the end of the first year; and thus the formula, incisors $\frac{6}{6}$, molares $\frac{4 \cdot 4}{4 \cdot 4}$, is characteristic of the yearling foal A fifth grinder makes its appearance at the end of the second year; and now commences the displacement of the first set, and the protrusion of the second or permanent set of teeth. The deciduous teeth are lost in the order of their acquisition; the two middle incisors of both the upper and lower jaws are displaced *between the second and third years;* the first and second deciduous grinders are shed at two years and eight months A *three-year old* colt has the permanent middle incisors above the gum, but not on a level with the adjoining deciduous incisors; they are also characterized by a large and deep groove containing a black substance traversing transversely the working edge of the crown of the tooth, the *sixth grinder is also coming into place.* At *three years and a half* or little later the adjoining deciduous incisors are shed, and their large successors begin to peep above the gum: the small lateral incisors are diminished in size and much worn. This gives a very characteristic condition to the mouth.

At *four years* the sixth grinder has attained the level of the others; the permanent tusks begin to appear; the second permanent incisors have come into place, and are marked with a deep fissure extending quite across the edge of the crown; the corresponding mark in the middle incisors is worn wider and fainter; the third deciduous grinder is shed. The external incisors are shed *between four and a half and five years.* At *five years* their permanent successors are in place, with a long deep mark on the inner side of the edge of the crown. The corresponding mark is much worn in the middle incisors, and to a less degree in the adjoining ones. The tusks are about an inch in length. At *six years* the mark or fissure on the middle incisors is worn away, but a discolouration on the part remains; the mark in the adjoining incisors is shorter, broader, and fainter; and the lateral incisors present the edges of the enamel in a more regular state, and evidently worn; the tusks are an inch in length and pointed; the third permanent grinder has taken its place in the dental series. At *seven years* the mark is worn away on the four middle incisors in both jaws, and in progress of obliteration in the lateral incisor: the apex of the canine or tusk is blunted. At *eight years* the mark is gone from all the lower incisors, and they cease to afford any indication of the subsequent age of the horse. The tusks are rounded off; the marks remain longer on the incisors of the upper jaw. Of course the marks are obliterated in proportion to the friction to which

the teeth are subject; they are sooner lost in a stall-fed horse than in one at grass; they are prematurely worn away in the crib-biter.

The age of a horse being always calculated from the 1st of May, it is very difficult to determine whether an animal be a late foal of one year or an early one of the next. A horse may be made to appear older than he really is by premature extraction of the deciduous teeth; or younger by imitating artificially the natural marks of the incisors after they have been obliterated by attrition; but these frauds are readily detected when all the concomitant conditions of a horse's mouth are scanned by the practised eye.

Owing to the premature labour to which the horse is in general condemned in this country, and to the present rapid rate of travelling, he has rarely a chance of living out his natural term of existence. A well-used horse may last between thirty and forty years. Mr. Percival gives an account of a barge-horse that died in his sixty-second year. Mr. Youatt quotes the record of another horse that received a ball in his neck at the battle of Preston in 1715, and which was extracted at his death in 1758.

ERA. *See* ÆRA.

ERA'SED, in Heraldry, signifies any thing forcibly torn off, leaving the edges jagged and uneven; as, a lion's head erased, &c.

ERA'STIANS. The followers of Erastus, a German divine; a sect which obtained some notoriety in England in the time of the civil wars. They referred the punishment of all offences, civil or religious, to the civil magistrate; and asserted that the church had no power to enforce any acts of discipline, nor to refuse the communion of the Lord's Supper to any one who desired it.

E'RATO. (Gr. ἔρως, *love*.) In Ancient Mythology, the muse who presided over love poetry. (See *Callimachi Epigramm.*) She is frequently confounded with Terpsichore; and in the 7th Book of the *Æneid* she is invoked by Virgil as synonymous with Calliope.

E'REBUS. (Gr. Ἔρεβος.) According to the classic mythology, the son of Chaos and Darkness, who dwelt in the lowest part of hell, which is frequently called by his name.

ERETHI'SMUS. (Gr. ἐρεθίζειν, *to excite*.) This term is generally applied to a peculiarly irritable state of constitution, which occasionally results from the use of mercury, and in which there is great depression of strength and irregularity of pulse, anxiety, paleness, and tremors

E'RGOT, or CLAVUS, is a disease of the rye, produced by the attack of fungi which take possession of the ovary and destroy it, producing in its room a long, black, hard, hornlike body. It is remarkable for the specific stimulating effects it produces upon the uterus, on which account it is much employed in cases of difficult parturition.

ERICA'CEÆ. (Erica, one of the genera.) A natural order of shrubby Exogens, inhabiting the Cape of Good Hope and many other places. It differs from *Vaccinaceæ* and *Campanulaceæ* in the superior ovary; from *Epacridaceæ* in the anther being two-celled; from *Pyrolaceæ* and *Monotropaceæ* in the structure of the seeds, and in habit, and from all the orders represented by *Scrophulariaceæ* and *Gentianaceæ* in the number of the cells of the ovary agreeing with the lobes of the calyx and corolla. Their general qualities are astringent and diuretic, some few being poisonous. The *Arbutus*, *Andromeda*, *Kalmia*, *Rhododendron*, *Azalea*, all well known shrubby plants of great beauty, belong to this order.

ERI'CHTHIANS. *See* ERICHTHUS.

ERI'CHTHUS. (Gr. ἠρι, *early*, and χθων, *the earth*.) A genus of long-tailed Decapod Crustaceans, inhabiting the tropical ocean. These crustacea are remarkable for the delicate and often transparent and colourless character of their large and undivided thoracic shield or carapace, which always is terminated anteriorly in a styliform rostrum: they have no moveable rostral plate, and the gills are in general very small and simple, and sometimes wholly inconspicuous. The genus thus characterized is now subdivided into *Squillerichthus*, *Alima*, and *Erichthus* proper; and the whole are included under the family name of *Erichthians*, or *Erichthidæ*, which in the natural system ranks next to the *Squillidæ*, or sea mantises.

ERI'DANUS. (The river Eridanus.) One of the ancient constellations in the southern hemisphere, first mentioned by Aratus.

ERINA'CEUS. (Lat. erinaceus, *a hedgehog*.) A genus of useful insectivorous Mammals, of which our common hedgehog is a well-known and unmeritedly persecuted species. The teeth are small, and form a series of sharp bristling points, well adapted for the crushing of beetles, or cracking the back-bone of a snake; but quite inadequate to the purpose of self-defence against larger carnivorous quadrupeds. Nature has, however, provided the hedgehog with a compensatory coat of armour, thickly bristled over with strong elastic spines, and capable of being drawn by powerful cutaneous muscles over every part of the body. When the hedgehog thus puts himself in a defensive attitude, he resembles a bristled sphere; and is capable of enduring hard blows or heavy falls without suffering material injury.

Mr. Bell says, in his excellent history of British quadrupeds, "The strength and elasticity of this covering is such, that I have repeatedly seen a domesticated hedgehog in my own possession run towards the precipitous wall of an area, and without hesitation throw itself off; and contracting at the same instant into a ball, in which condition it reached the ground from a height of twelve to fourteen feet, after a few moments it would unfold itself and run off unhurt."

As the food of the hedgehog consists almost entirely of cold-blooded animals, which in our climate almost entirely disappear from the scene of nature in the winter season, the hedgehog must have starved if he had not been endowed with the singular property of subsiding into a state of suspended animation during the period of famine. In order, however, to preserve the low temperature which he then possesses, he prepares in some retired hole a soft nest of moss and leaves; and thus passes his winter "undisturbed by the violence of the tempest, and only rendered still more profoundly torpid by the bitterest frost." All the store of nutriment which he carries with him to his place of hybernation is a thick layer of fat about his viscera and beneath his skin, which is slowly absorbed, as the little waste of his inactive life requires, and more rapidly during the first few days of his resuscitation in spring. The female produces from two to four young ones in the summer; they are blind, and covered with soft and flexible spines. The hedgehog has thirty-six teeth. The intermaxillary bones contain six teeth, of which the two anterior are longer than the rest, placed wide apart, directed obliquely downwards with a slight convergence. The six upper incisors are opposed to six below, of which the two anterior ones have the same disproportionate size as the corresponding ones above. Of the remaining teeth the four posterior ones on each side of both jaws are large, multicuspidate, true molares. The intermediate teeth are small, with two fangs, and represent the spurious molares.

E'RIOCAULO'NEÆ. (Eriocaulon, one of the genera.) A natural order of Endogens, inhabiting the marshes of most parts of the world: usually combined with *Restiaceæ*. It is composed of herbaceous plants, with their flowers growing in close heads, and contains no species of any known use.

ERIO'METER. (Gr. ἔριον, *wool*, and μέτρον, *a measure*.) An optical instrument proposed by the late Dr. Young for measuring the diameters of minute particles and fibres, by ascertaining the diameter of any one of the series of coloured rings they produce. "The eriometer is formed of a piece of card or a plate of brass, having an aperture of about a fiftieth of an inch in diameter in the centre of a circle about half an inch in diameter, and perforated with about eight small holes. The fibres or particles to be measured are fixed in a slider; and the eriometer being placed before a strong light, and the eye assisted by a lens applied behind the small hole, the rings of colours will be seen. The slider must then be drawn out or pushed till the limit of the first red and green ring (the one selected by Dr. Young) coincides with the circle of perforations, and the index will then show on the scale the size of the particles or fibres." (*Brewster's Optics*, *Cabinet Cyclopædia*.)

ERI'PHIA. (Gr. ἐρίφος.) A genus of short-tailed or Brachyurous Crustaceans, including the *Cancer spinifrons*, Herbst; *Cancer conagra*, Fabr.; and other later discovered species.

ER'MINE ("This," says Gwillim, "is a little beast less than a squirrel, that hath his being in the woods of the land of *Armenia*, whereof he taketh his name.") In Zoology, a species of *Mustela*, or stoat, differing from the common weasel in being about one third larger, and in having a somewhat broader head and a longer tail. In the summer season the upper part of the head, neck, and body, and the greater part of the tail, are of a pale reddish brown colour; the under parts white, with a very slight tinge of yellow; tip of the tail black, and somewhat bushy. In the winter the whole of the body becomes white, slightly tinged with yellow; but the black termination of the tail is permanent. The fur is closer and finer at this season, especially in the colder latitudes, from which countries the ermine affords one of the most beautiful and valuable of furs. When made up the tails are inserted one to each skin, at regular distances, and in the quincunx order; and thus arranged the ermine fur forms the distinctive doubling of the state robes of sovereigns and nobles, as well as of their crowns and coronets.

ERMINE. In Heraldry, one of the furs used in blazonry. It represents the skin of that animal white, spotted or timbered with black. *Ermines* is black, spotted or timbered with white. *Erminites* differs from ermine in having the side hairs of the timberings red. *Erminois* is the same as ermine, except that gold is substituted for the white. *Pean* is black, timbered with gold.

ERO'DED. (Lat. erodo, *I gnaw*.) In Zoology, when

a part has its edges irregularly jagged, as if gnawed or eaten.

ERO'TIC (Gr. ἐρως, *love*), is an epithet applied generally to all that relates to the passion of love. Thus whatever excites that passion, or depicts its effects, is termed *erotic*. In a more confined sense, this appellation has been conferred on a certain class of Greek and Latin authors, both in prose and poetry, of whose writings love formed the principal theme. Of these the most distinguished are Achilles Tatius, Heliodorus, Anacreon, Sappho, Ovid, Tibullus, Propertius, &c. (See the learned work entitled *Scriptores Erotici Græci, cura Mitscherlichii.*)

ERO'TOMA'NIA. (Gr. ἐρως, and μανια, *madness.*) Mental aberration, supposed to be occasioned by the passion of love.

ERPETO'LOGY, more properly *Herpetology*. (Gr. ἑρπετος, *a reptile*, and λογος, *a discourse.*) The branch of zoological science which specially treats of the class *Reptilia*. This class of animals is characterized by having a heart so constructed as to transmit to the lungs a part only of the circulating mass of blood which it receives from the systemic veins, the remainder being sent again to the body without having been purified in the lungs. There thus results a less amount of reaction of oxygen upon the blood than takes place in Mammalia, and consequently a lower grade of animal heat, and an inferior activity of muscular contraction; but, as the proportion of venous blood transmitted by the heart to the general system varies in different reptiles with the various modifications of the heart, there is a corresponding difference in the manifestation of their vital phenomena

As reptiles are thus exempt from the office of preserving the temperature of a circulating fluid many degrees warmer than that of the external atmosphere, they have no need of teguments adapted to retain heat, and are accordingly naked, or covered with scales or hard bony plates. Their brain is very small, and without the great commissures. The lungs serve more or less as reservoirs as well as decomposers of the atmospheric air, and thus with a certain degree of independence of the general circulation, the reptiles are enabled to remain much longer under water than either birds or mammalia. Some species, indeed, have in addition to their lungs gills for breathing water, either during their immature state, or throughout life, and thus are truly amphibious. With a cold blood, low respiration, low sensation, and sluggish habits, is associated an extraordinary power of endurance of abstinence and bodily injury.

Reptiles are either oviparous, or ovoviviparous: they do not incubate. They present a great variety of forms, and constitute altogether a much less natural group than either birds or mammals. The character which Cuvier has assigned to the *Reptilia* would not seem to distinguish them from certain fishes with highly developed air bladders, without the additional statement that the organ of smell in the class *Reptilia* is situated in a canal communicating both with the cavity of the mouth and the external surface.

Cuvier divides, after Brongniart, the reptiles into four orders, viz .—

The *Chelonia* (tortoises and turtles); of which the heart has two auricles, and the body is supported on four legs, and inclosed between two plates or shields formed by the ribs and sternum.

The *Sauria* (lizards and crocodiles); of which the heart has two auricles, and the body, supported on four legs, is covered with scales.

The *Ophidia* (slow-worms and serpents); of which the heart has two auricles, and the body is without legs

The *Batrachia* (frogs, toads, newts, &c); of which the heart has but one auricle, and the body is naked, and supported on four, or in a few cases two legs. Most of these pass, as they advance to maturity, from the condition of a fish breathing by gills to that of a quadruped breathing by lungs. Some, however, never lose their gills.

Such are the characters assigned by Cuvier (in 1829) to his primary divisions of the class *Reptilia*, but they are not a true expression of the organization of the groups so distinguished. The *Batrachia*, for example, have since been proved to have two auricles, although not so distinct externally as the other reptiles Some of Cuvier's *Sauria*, again, have two distinct ventricles; whilst the rest have but one, like the *Chelonia* and *Ophidia*. The crocodiles, alligators, and gharrials are the higher organized *Sauria* here alluded to; and since they differ also from the *Lacertine Sauria* in having a simple undivided tongue and intromittent organ, and a well-marked modification of the tegumentary system, they deserve to rank as a distinct order, at the head of the class *Reptilia*. This order has been termed by Merrem *Loricata;* for the skin, in fact, instead of being covered by imbricated scales, is strengthened and protected by several rows of flattened and generally elliptical bones, developed between the cuticle and true skin, and often supporting a longitudinal crest; these bones or scutæ are situated chiefly along the back part of the neck, body, and tail.



Another order of *Reptilia* is clearly indicated by the remains of several large or even gigantic species now extinct, in which the extremities were modified to serve as fins on the plan of the paddles of the *Cetacea*. These reptiles are chiefly referable to the genera *Ichthyosaurus* and *Plesiosaurus;* they were marine, and of predaceous habits, and constitute the order *Enaliosauria*.

The *Chelonia* form a third and very natural order.

Those *Saurians* of Cuvier which have a heart composed of a single ventricle and two auricles, which have a bifid tongue and double intromittent organ, and which have a scaly and generally imbricated covering, form a fourth order of reptiles, to which the term *Squamata* has been given.

The *Ophidia* of Cuvier constitute the fifth order of reptiles. Some naturalists have proposed to unite the serpents with the lizards in the same order, on account of the gradual transition traceable in different genera from one to the other group; but the class of reptiles, by parity of reasoning, ought to be merged in that of fishes; and the naturalists who favour the blending of the tetrapodal with the apodal reptiles seem to forget that an order is a conventional division, a group of convenience, and not an entity circumscribed by nature. To separate the *Batrachia* as a distinct class from the *Reptilia*, seems to be an error in the opposite extreme. The viviparous four-footed salamander, breathing air by membranous lungs, and circulating blood by a biauricular heart, is thus placed in a distinct class from the four-footed lizard, without any essential difference in the pulmonary or sanguiferous systems to warrant the separation; the only differences that can be urged for such a step are a modification of the tegumentary covering, and a greater development and later continuance of the temporary branchial apparatus, of which traces are met with in the embryos of all the air-breathing Vertebrata; and a modification of the reproductive system. The naked integument, the presence of external gills in the young state; the almost simultaneous fecundation, sometimes without intromission, of numerous ova,—may be grounds for regarding the *Batrachia* or *Amphibia* as a subclass, or a group somewhat higher than an order; but seem not to warrant their separation from the scaled reptiles as a distinct class, as a group equivalent among Vertebrata to that of birds or mammals. For the subdivisions of the above orders see LORICATA, ENALIOSAURIA, CHELONIA, SQUAMATA, OPHIDIA, BATRACHIA, and also AMPHIBIA.

E'RPETON. *See* HERPETON.

ERRA'TA. (Lat.) The term applied to the faults that have escaped in the impression, or, as the case may be, in the composition of a work; usually inserted in a list either at the commencement or the end of the book. This manner of indicating typographical errors is coeval with the art of printing itself. Various dissertations have been devoted to this subject; among others may be mentioned that of Lindenberg, *De Erroribus Typographicis*, which, although of a somewhat impracticable nature, contains many ingenious observations.

E'RROR. In Law, a writ of error is one which authorizes the judges of a superior court to examine a record on which judgment has been given in an inferior court on an allegation of error in pleading a process, &c., and to affirm or reverse the same. It is the common remedy for erroneous judgments in courts of record. Error lies from inferior courts of record, and from the Common Pleas, to the King's Bench; from each of the three superior courts to the judges of the other two sitting in the Exchequer Chamber, from the Exchequer Chamber, and in certain cases directly, to the House of Lords. It lies in criminal as well as civil cases Writ of error must be brought within twenty years. Correctly speaking, it is applicable only for the reversal of judgments on account of errors in law, and not of fact.

ERSE. The name given by the English and Scots to the dialect of Celtic spoken by the inhabitants of the Highlands of Scotland. The term is evidently another form of the word Irish. The people speaking the Erse tongue call themselves *Gael* (written, but not pronounced, *Gaidheal*), and their language *Gaelig*. The inhabitants of the low country of Scotland, it is remarkable enough, they call *Gall*, a term which they occasionally apply also to any stranger. England in the Erse language is called *Sasson*, meaning Saxony, and the people and language *Sassonach*, the latter being often called *Beurla*, which means speech in general, and in this case "the language" *par excellence*. The Irish are called by the Scots Highlanders *Gael*, like themselves, with the distinction of belonging to Erin, or Ireland. For the Welsh and their country there appear to be no names known to the Erse language. The Erse or Gaelic has been asserted to be one of the dialects of that Celtic or Gaulish language which is once supposed to have pervaded nearly the whole western portion of Europe, including France, Spain, and Britain. For such an hypothesis, however, there is no good evidence; and all analogy is wholly opposed to the supposition that a people so rude, so divided, and so scattered as the inhabitants of Europe were 2000 years ago, should

have had a common language. The great probability, on the contrary, is that in such times there were in Europe, as there are now in America, in Hindostan, and in the great group of the Oriental Archipelago, *many* languages; a few so closely connected as to amount only to dialects of each other, but the greater number either differing wholly, or agreeing only in a few words, — communicated possibly through the medium of religion, or adopted for convenience by the rest from one tribe or nation, which through good fortune or favourable position had obtained the start in civilization. The languages supposed to be of the Celtic stock, and of which we have sufficient evidence either by remains or as living tongues, are the Welsh, the Bas Breton or Armorican, the Irish, the Erse or Gaelic, the Manks or language of the Isle of Man, the Cornish, and the Basque or language of the provinces of the same name in Spain. An examination of these appears to prove the truth of the theory we have now suggested. The Welsh and Armorican are but dialects of the same language, and the same observation holds true of the Irish and Erse. These languages agree respectively with each other, not only in grammatical structure, but in that numerous class of words which constitutes the groundwork of every language; viz. prepositions, adverbs, conjunctions, with such verbs, adjectives, and nouns as are of most frequent and familiar use. The Irish and Erse so nearly resemble each other, that after a short familiarity with the pronunciation, the Irish and Scots Highlanders have no difficulty in understanding each other; and the same is said to be the case with the Welsh and Bas Breton. On the other hand, the languages of the two latter are wholly unintelligible to the first, and *vice versa*. The Manks is but a dialect of the Irish or Erse, and the now extinct Cornish was unquestionably a dialect of the Welsh. As to the Basque, long supposed to be a Celtic tongue, a careful examination of it by the late Baron William Humboldt showed not only that it bore no resemblance to the Welsh, the Irish, or their dialects, but that it had nothing in common with any known language, ancient or modern.

Respecting the causes which produced a similarity between the languages of Wales and Britany we possess some historical evidence. In the fourth and fifth centuries the Welsh, or people speaking the Welsh language in Britain, emigrated in great numbers to the opposite shore of the Continent, driven from their own country by the tribes of the northern part of the island Their number was so considerable that they acquired a superiority over the native population of the part of Gaul where they settled, and succeeded ultimately in imposing on it their own name and language. A similar emigration from Ireland, although we have no historical record of it, probably propagated the name and language of the Irish, with their manners, customs, and traditions, over the poor and mountainous portion of Scotland which is now the site of the Gaelic or Erse language It does not necessarily follow, in this case, that the Highlands of Scotland were without inhabitants when the Irish colonists or conquerors planted themselves there. A primitive race of inhabitants no doubt previously existed, whose name and language were lost in the strength and multitude of the invaders that occupied their country, as happened in America as the result of a British invasion, and in Britain itself as the result of a Saxon one. It may perhaps be said, in this instance, that the emigration is as likely to have taken place from the Highlands of Scotland to Ireland, as from Ireland to the Highlands; but the answer to such a supposition is obvious, viz. that conquest is more likely to have proceeded from an extensive and fertile country to a poor one destitute of resources, than from the latter to the former.

Although we have stated that between the Irish and Gaelic on one hand, and the Welsh and Armorican on the other, there is no such connection as would imply an identity of origin, there is still much evidence exhibiting an early and frequent communication, and probably to some extent even an intermixture of races, originating in an unsettled and stirring period of the history of the inhabitants of Europe; in such a state of society, in short, as produced within the memory and knowledge of history the migrations and invasions of the Gauls, and of the Cimbri and Teutones. The similarity of language to which we now allude bears no inconsiderable resemblance to that which is ascertained to exist between most of the languages of the great Oriental Archipelago and Pacific Ocean, and which has been satisfactorily traced from Madagascar to Easter Island. We may take as an example the numerals, which, with few exceptions, are the same in the Irish, Erse, Welsh, and Armorican, just as they are in many, although not in all, the languages of the innumerable nations and tribes occupying the scattered islands which lie between Asia and Australia north and south, Africa, and America west and east. But the numerals, it should be recollected, are not essential and indispensable portions of rude language; but, on the contrary, as much comparatively recent inventions as an alphabet, or the Arabian system of notation; and indeed an invention, particularly when carried to the length to which it has been in this case, implying a very considerable advancement in early society. The system is, as usual, decimal; and although it contains evidence of rude attempts at local and less perfect plans, is obviously of single origin. It reckons by ten up to twenty, and then counts by scores up to a hundred. Thus nineteen is "one and nine," and expressed by the very same words in all the languages. The word for twenty in the two classes of languages differs. Thirty is expressed by the circumlocution of "one score and ten," forty by "two scores," and fifty by "two score and ten," &c. One hundred is expressed by the same term in all the languages; and it is the utmost limit of native enumeration, for a thousand and the numbers above it are borrowed from the Latin. In the example of the numerals, then, we discover, what might be looked for, evidence of considerable simplicity and even rudeness in these Celtic languages.

Of the four languages now spoken of, the Welsh appears to be that which was longest and most cultivated. It was unquestionably a written language in the 10th century; and the perfect alphabet, by which every sound in it is invariably expressed, consisting of sixteen radical and twenty-seven derivative characters, forming in all forty-three letters, is still preserved. The Erse or Gaelic was the least cultivated; and until late years even the Bible which was used in the Highland churches was no other than the Irish It first attracted notice after the publication in the English language of the poems of Ossian, said to be derived from it about the middle of the last century. These, it was pretended, were translated from manuscripts in the translator's possession; but such poems in a written form, it is now sufficiently known, never had any existence, either in the Irish or Gaelic language. Although not committed to writing, or rather not handed down in writing, these poems, committed to memory and handed down from one bard or story-teller to another, still exist in the Highlands of Scotland, and in a dress not remote from that in which they were rendered by Macpherson into English. Their scene is sometimes laid in Scotland, but more frequently in Ireland. In short, they are the Iliad and Odyssey of the Celtic race of the two islands, handed down by tradition only,— what the poems of Homer were in all likelihood to the Greeks themselves before the art of writing was known to them. The Erse, although a rude and uncultivated language, is a nervous and manly one, both as to expression and sound, and well suited to poetry, whether sublime or tender. The range of its sounds is very great; for it possesses twelve vowels, and no less than eighteen diphthongs and triphthongs, with forty-one consonants, including aspirates Many of the consonants are guttural; and of these, as well as of the vocalic sounds, there are several utterly unpronounceable by a stranger. the attempts made to express such a variety of sounds by the Roman alphabet are, of course, both awkward and imperfect As to the grammar, that of the Gaelic is of complex structure, implying a primitive language which has undergone little change by admixture with other tongues.

ERYSI'PELAS. (According to etymologists, from the Gr ερυσθαι, *to spread*, and πελας, *near* -spreading over the neighbouring parts; but the derivation is doubtful.) Called also *Saint Anthony's Fire*, that saint having miraculously cured it. This disease usually commences with fever, followed by an eruption of a very red colour, sometimes vesicular, and attended by tumefaction. It commonly attacks the head and face, and is at its height from the third to the sixth day; but its duration and progress are very variable in different individuals. The fever which attends this form of erysipelas is more or less inflammatory, and at first cooling diet and aperients are required; and the local irritation and itching may be quelled by cooling lotions, or by sprinkling the part with a puff of hair powder, which is sometimes singularly soothing to the sufferer. From the eighth to the twelfth day, the eruption scabs or scales off. If sickness, shiverings, and delirium attend the height of the disorder, an unfavourable termination may be anticipated Sometimes suppuration occurs, especially of the eyelids and scalp. The greater number of cases of this disorder have a tendency, in their latter stages, to debility; and bark, or sulphate of quinine, with other tonics, are indicated. But where inflammatory symptoms run high, aperients and diaphoretics must be persevered in; and blistering, and even cupping, are necessary.

Where erysipelas is attended with typhoid symptoms, it is dangerous from the beginning; and wine, bark, ammonia, and other stimulants, are usually prescribed.

In that form of erysipelas which attacks different parts of the body in successive patches aperients, diaphoretics, and alteratives are useful; but in every case of this disease, lotions and ointments should be used with the utmost caution, and warm or cold water, and milk and water, are generally the best applications. There is a variety of erysipelas which attacks infants, and which is sometimes alarming from its gangrenous or suppurative tendency. Erysipelatous inflammation is also often a sequel of surgical operations, especially in crowded and ill-

ventilated hospitals, where it sometimes spreads among the patients to a very alarming extent. Cleanliness, ventilation, fumigation, and, above all, the removal of the affected persons to a better air, are the only chances of eradication.

ERYTHE'MA. (Gr. ἐρυθρος, *red.*) All *rashes*, as they are commonly called, and rednesses of the skin, attended by marked constitutional affection, and very mild forms of *erysipelas*, come under this denomination.

ERY'THRIC ACID, applied by Brugnatelli to a *red* substance obtained by the action of nitric on uric acid.

ERY'THROGEN. A peculiar substance, discovered in 1821, by M. Bizio of Venice, in the gall-bladder of a person who died of jaundice. It was a green tasteless liquid, which became *deep purple* in nitric acid and ammonia, and when heated in the air produced a purple vapour; hence its name, from ἐρυθρος, *red*. He supposes it identical with the colouring matter of the blood.

ERYTHRO'NIUM. A name originally given to the metal since called *Vanadium*, from the *red* colour of its acid.

E'RYX. (Gr.) A genus of serpents with a short obtuse tail and a single series of subcaudal scutæ, as in Boa; but having both the abdominal and caudal scutæ much narrower, and the anal hooks inconspicuous.

E'SCALADE. (Fr.) The scaling of a fortification by means of a ladder is so called.

ESCAPA'DE. (Fr.) A term almost naturalized in England, signifying any impropriety of speech or behaviour of which an individual is unconscious.

ESCA'PEMENT, in Clock and Watch-work, is the name given to that part of the mechanism by which the circulating motion of the wheels is converted into a vibratory motion, as that of the pendulum of a clock or balance of a watch. Various contrivances are employed for this purpose, depending on different mechanical principles, as the *dead-beat* escapement, the *lever* escapement, the *duplex* escapement, the *detached* escapement, &c. *See* HOROLOGY.

ESCA'RP (Germ. scharf, *sharp*), in Fortification, signifies any thing high and precipitous. Sometimes it is used to denote the side of the ditch next the place; in which case it is opposed to *counterscarp*, which denotes the side next the country. In a fortress, the escarp is the exterior surface of the revetment wall supporting the rampart.

ESCA'RPMENT. In Geology, the steep face often presented by the abrupt termination of strata where subjacent beds "crop out" from under them. The two most extensive lines of hill which traverse the centre and south of England are formed by the escarpments of the oolite and chalk formations respectively. The first extends through Yorkshire, the West of Lincolnshire, Rutland, Northampton, Warwick, Gloucester, Somerset, Dorset; being bounded throughout on the N. W. by the outcrop of the *lias* formation. The latter commences in Yorkshire, rises again in Norfolk, and extends through Cambridge, Hertford, Bucks, Oxford, Berks, Wilts, and Dorset, in a parallel line to the former.

E'SCHAR. (Gr. ἐσχαρα, *the crust of a scar produced by burning*.) When a living part has been burned, it becomes hard, rough, and of a grey colour, forming what is properly called an eschar: it is a slough produced by fire or caustics. The English *scar* is evidently derived from this term.

ESCHARO'TICS. Applications which form eschars. The term is generally applied in surgery to mild caustics.

ESCHE'AT, in Law, happens when tenant in fee-simple dies without having left any heir to the land, and without having incurred a forfeiture to the crown (as for treason). This case arises on sentence of death for murder; but not for other felonies, which, since 54 G. 3. c. 145, leave the power of disposition of his estate after death to the offender. In this case the land goes to the lord of the fee. There is no escheat of equitable estates.

E'SCROW. (Fr. ecreu, *scroll.*) In Law, a deed delivered to a third party, to be the deed of the party making it upon a future condition when a certain thing is performed, until which it has no effect as a deed.

E'SCUAGE, or SCUTAGE. (Either derived from scutum, *a shield*, or the same word signifying a piece of money; which latter denomination of coin, indeed, perhaps originates in the fact of money having been levied under the name of this tribute.) A pecuniary satisfaction, paid in lieu of military service by tenants in chivalry. There have been doubts among our antiquarian lawyers whether escuage were, properly speaking, a tenure in itself, or merely an incident to tenure; but the latter is probably its proper character. Littleton says, that tenant by homage, fealty, and escuage is tenant by knight service. The assessment of escuage was uncertain in amount, and, by Magna Charta and 25 Ed. 1., could only be taken by assent of parliament. Escuage, together with the other appendages of military tenures, was abolished by 12 C. 2. c. 24.

ESCU'RIAL, or EL ESCURIAL. A royal palace of Spain, about twenty-two miles from Madrid, at the foot of the Carpentani mountains, which divide the two Castiles. It was commenced by Philip II., from two motives — the dying injunction of his predecessor Charles V., who was desirous that a tomb should be constructed for the royal family of Spain; and the other to erect a monument surpassing all triumphant arches and similar buildings, to commemorate the famous victory of San Quintin, won on the festival of St. Lawrence, to whose intercession the king attributed his success. Its foundations were laid in 1563; Giovanbatista of Toledo being the architect who planned and continued to superintend the building till his death in 1567, when his pupil Giovanni d'Herrera carried on and finished it. As an architectural composition it is unworthy to be attributed, as it has been, to Bramante, Pellegrini, or Vignola. They as well as others may have given designs for it, but such were not selected. It is considered by Spaniards as entitled to be called the eighth wonder of the world; and numberless fables are told about the number of its doors, windows, and columns, as well as its cost having been twenty-four millions of ducats, though the expense of erecting it was not quite one fourth of that sum. The whole pile comprises a magnificent monastery, which was given to the fathers of San Girolamo; of a college, a seminary, and a royal palace. In plan the form resembles a gridiron, the instrument of martyrdom of St. Lawrence, of which that part used for the royal palace is supposed to represent the handle. It is internally disposed into fifteen courts of various dimensions, the largest whereof are ornamented with porticoes and galleries; and the material employed is a species of granite. The principal façade, looking towards the west, is 740 feet long, and 60 feet high to the cornice. Towers flank the façade at each angle of the edifice 200 feet high. The masses are much cut up by the division of the principal façade into no less than five stories of windows. The elevation to the east is 1100 feet long, and that to the south 580 feet long. The church of the monastery is 364 feet long, 230 feet wide, and 170 feet high; and is divided and supported by piers 53 feet distant from each other. From the centre a cupola rises of good form exteriorly, but clumsily composed inside. Its diameter is 66 feet, and from the pavement to the top of the cross the height is 330 feet. The pantheon here is a crypt under the high altar of the church, and is used as the place of sepulture of the Spanish royal family. On extraordinary occasions it is lighted by a superb lustre. The staircase leading to this mausoleum has fifty-nine steps, divided by one landing; at the sides of which are two bronze statues, — one of Human Nature stripping herself of the illusions of the crown and sceptre, the other of Hope. On the two inferior landings are two doors, — one leading to the vault, where are laid the remains of the infants and infantas, and queens who have had no issue: the other to the chamber, 36 feet diameter and 38 feet high, where the remains of the kings are deposited. The whole of the building is profusely ornamented, particularly with paintings from the best masters of Italy, Flanders, Spain, and Germany. The adjacent buildings are worthy of so august a pile. Attached to the monastery by an arched gateway is an edifice called the Campagna, which has two galleries, each 100 feet long and 20 feet wide. This was built by Francesco de Mora, the successor of Giovanni d'Herrera. Here are the hospitals, granaries, pantries, and other offices; here also are the gardens, which from being seated on the acclivity of a hill appear hanging. The garden on the south side of the monastery is 8000 feet in circuit. Adjoining the eastern and northern façades is a spacious gallery or esplanade surrounded by a parapet. On this side are the quarters for the guards, the riding school, the aqueduct, &c. &c. Beyond the outer buildings is the Fresnada, about half a league to the east. This villa is surrounded by a wall, and contains courts, gardens, meadows, fountains, trees of all sorts, lakes with islands, fisheries, &c. Here also is a church of fine and simple form, by Francesco de Mora. In 1773 many works were executed at the Escurial for the infants Don Antonio and Don Gabriele by Villaneuva, the then architect of the palace; indeed from the time of Philip II. all his successors have made some additions to this superb edifice, which, like the the original fabric, contain great beauties and great defects.

ESCU'TCHEON, or ESCOCHEON. In Heraldry, a shield on which arms are emblazoned: derived from the French écu or écusson, Italian scudo, Latin scutum. The favourite shape for the purpose of heraldry is that commonly called the Norman shield; but women, daughters of parents entitled to coat-armour, bear their father's arms on a lozenge-shaped shield. The points of the escutcheon are the parts named in order to express the local position of the charges borne on the field. (*See* CHARGE.) They are nine in number. *Escutcheon of pretence* is the shield on which a man carries the arms of his wife; in England only borne if she is an heiress, and he has children by her. It is borne in the centre of his own shield, and generally of the same shape. *Inescutcheon*, an escutcheon borne also within the shield in the middle of the coat (but smaller than an escutcheon of pretence), or in chief. It is a species of ordinary.

ESOTE'RIC, opposed to *Exoteric*. (Gr. ἐσω, *within*, ἐξω, *without.*) Much dispute has prevailed among the

learned as to the precise import of this distinction. By some it was thought that the ancient philosophers had a set of mysterious doctrines which they communicated only to the more enlightened of their disciples, and another more popular doctrine which they promulged to the multitude. In the case of Aristotle, to whose writings the distinction properly applied, this opinion is, to a certain extent, well founded; except so far as regards the suspicion of intentional concealment implied in it. The exoteric or *published* writings of that philosopher appear to have been written in the form of dialogues, all of which are lost. His esoteric works, we gather from the synonymous term *acroamatic* (*ακροᾶσθαι, to hear*), were not intended to supersede the necessity of oral instruction to render them intelligible. This agrees well enough with the brevity, the frequent repetitions, and the perplexed arrangement of the works of Aristotle which survive. (See *Ritter, Gesch. d. Ph.* b. ix. c. 1.)

E'SPALIER. In Horticulture, a substitute for a wall on which to train fruit trees, and sometimes ornamental shrubs. The objects are to expose the foliage of the plants more perfectly to the light, to prevent the branches from being blown about by the winds, and to economize space by confining them within definite limits. The espalier is either constructed of wood or iron; and commonly of two horizontal rails joined by upright rods, six or eight inches apart. The most elegant and economical structure of this kind at present in use is a double espalier formed of hoop iron posts in the shape of the letter A, twenty inches wide at bottom, and six or seven feet high, at which height the hoops meet in a point Through the hoop iron posts wires are inserted horizontally at six inches apart, and drawn quite tight; the result of which is a double surface on which to train the trees. (See *Loudon's Suburban Gardener*, p. 232.)

ESPA'RTO. (Span.) A species of rush; the *Stipa tenacissima* of botanists. It is found in the southern provinces of Spain. It is made into cordage, much used in the Spanish navy; and is platted for other purposes, such as mats, shoes, &c.

ESPLANA'DE, or GLACIS. In Fortification, the sloping of the parapet of the counterscarp or covered way towards the open country.

ESQUI'RE, *Ecuyer, Escudero.* (In Latin, armiger) A well-known title of rank; derived from the French écu, Lat. scutum, *a shield*. Some suppose that it has its origin from the Scutarii, a sort of soldiery in the Roman armies; others derive it from equus, *a horse*, and suppose that esquire and equerry denoted orignally the same thing, viz. *a groom*. But it is generally supposed to have belonged to the shield or armour bearers (armigeri) attached to the person of knights. This office, in the times of chivalry, was honourable, and generally borne by persons of good family. Hence the term esquire became gradually appropriated, in England, to a rank above the simple gentleman and below the knight. Younger sons of peers (now called Honourables), their eldest sons, eldest sons of knights, sheriffs of counties, serjeants at law, justices of the peace, and doctors of divinity, are esquires by virtue of their respective rank or office Heads of ancient families are considered esquires by prescription; and hence has originated the use of the word, in the present day, as a common addition to the names of all those who live in the rank of gentlemen The king creates an esquire, by putting round his neck a silver collar of SS; to which ceremony was formerly added the putting on of a pair of silver spurs.

E'SSAY. In Literature, an attempt; a species of composition. In general, this title is given to short disquisitions on subjects of taste, philosophy, or common life. In this sense it has been applied to periodical papers, published at regular intervals under a collective name, by one or more writers, containing remarks on topics of the day or on more serious subjects. From the appearance of the *Tatler*, in the beginning of the last century, which was chiefly written by Sir Richard Steele, this species of literature continued to be a favourite in England for seventy years, and many similar series of essays were produced; the best of which are united in one collection under the name of *The English Essayists*. The most celebrated of these works was the *Spectator*, to which Addison was the best contributor; and next to it the *Rambler*, published and almost wholly written by Samuel Johnson. The title of essay has been also adopted, by way of indicating diffidence in the completeness of their work, by various authors of more extended performances; as by Locke (*Essay on the Human Understanding*).

E'SSENCE. (Lat. essentia, from esse, *to be or exist.*) In Philosophy, a scholastic term, denoting what the Platonists called the idea of a species. The school philosophers give two significations of the word essence: the first denoting the whole essential perfection of a being, and consequently its entity, with all its intrinsic and necessary attributes taken together; the second denoting the principal or most important attributes of any thing. The essences of things were held by many to be uncreated, eternal, and immutable. *See* METAPHYSICS.

E'SSENCE D'ORIENT. A term applied to a pearly-looking matter found principally at the base of the scales of the *bleak*, a small fish of the genus *Cyprinus*: it is used to line the interior of glass bubbles or beads, as in the manufacture of artificial pearls.

ESSE'NES. A sect among the Jews in the time of our Saviour, of whom an account is preserved to us by Josephus and Philo, though they are not mentioned in Scripture. They were few in number, and lived chiefly in solitude, taking no part in public affairs, but devoting their lives to contemplation. There were indeed two classes of them, distinguished as the practical and contemplative, who differed in the degree of strictness and austerity which they observed. They believed in the immortality of the soul, and held the Scripture in the highest reverence; interpreting it, however, after an allegorical system of their own. (See *Blackwood's Mag.*, 1840.)

ESSE'NTIAL OILS, or VOLATILE OILS. Under this term are included all those peculiar compounds obtained by distilling vegetable substances with water, and which pass over along with the steam, and are afterwards condensed in the liquid or solid form. They appear to constitute the *odorous* principles of vegetables. Their specific gravity fluctuates on either side that of water: they are very sparingly soluble in water, and these solutions constitute the *medicated waters;* rose, peppermint, and other waters being such solutions of the respective essential oils. They dissolve in alcohol and form *essences*, many of which are used as perfumes. When these oils are pure, they evaporate from paper when held before the fire; but if adulterated with fixed oils, they leave a greasy stain, and seldom dissolve perfectly in alcohol. The more expensive of these oils are frequently adulterated with the cheaper ones, and this fraud can only be detected by an experienced nose. Their chief use is in perfumery, on account of their odour, and in medicine they form valuable stimulants. They are inflammable, and are, with few exceptions, compounds of hydrogen, oxygen, and carbon. The essence of turpentine, of lemons, and a few others, are *hydrocarbons*.

ESSOI'GN. In Law, an excuse for one who is summoned to appear and answer an action or perform suit in a court, &c, by reason of sickness or other prevailing cause. The first return day in every term was called the essoign day, because the court sate on it to take essoigns; *i. e.* excuses for such as did not appear according to the summons of the writ. The essoign day seems to be done away with by the effect of the statutes 11 G. 4., 1 W. 4. c. 70., and 1 W 4. c 3

ESTA'BLISHMENT. *See* FOUNDATION.

ESTABLISHMENT OF THE PORT A term used by writers on the tides, to denote the interval between the time of high water at any given port and the time of the moon's transit immediately preceding the time of high water, when the moon is in syzygy; that is, at the new or full moon. This interval is influenced by local circumstances, and consequently different at different places. *See* TIDES

ESTAFE'TTE. (Span. estafeta) Applied originally to military couriers, but now used in all the countries of modern Europe to signify an *express*. The difference between a courier and an estafette consists in this, that while the former must deliver the despatches, &c. entrusted to him personally at the place to which they are addressed, in the latter the despatches, letters, &c. to be forwarded are consigned to the care of postillions, who are changed with every relay of horses successively till they arrive at the place of their destination

ESTA'TE, in common parlance, is applied to the landed property held by individuals; and a man is said to be of good or of small estate, according to the magnitude of his landed property.

Estates vary exceedingly in size and value in most parts of England. The largest estate in the kingdom may be worth 100,000*l.* or upwards a year; and there are estates of most inferior degrees of magnitude, down to the annual value of 40*s.*! In some counties property is more, and in others it is less, subdivided. In Cheshire, the East Riding of Yorkshire, and one or two other counties, there are comparatively few small proprietors; but the latter predominate in most parts of the West of England, in the North, and generally throughout the country. On the whole, we believe it may be safely affirmed, that by far the largest portion of the kingdom is parcelled into properties of less than 1000*l.* a year. It is not difficult to account for the prevalent misconceptions on this point. Though few in number, the owners of large estates engross the attention of common observers, and hinder them from fixing their eye on the mass of obscure, petty landowners, that constitute the great bulk of the class. Dr. Beeke, whose authority as to such matters is deservedly high, estimated the total number of proprietors in England and Wales at 200,000; and supposing the gross rental of the kingdom to be 30,000,000*l.* a year, the average annual income of each, in his capacity of landlord, will be only 150*l.*! and seeing that a few have much more, it follows that many must have good deal less. Hence it is

that few lead a more laborious life, or are more under the necessity of abstaining from luxurious indulgences, than the owners and occupiers of small landed properties. Nothing, in fact, can be a greater mistake than to suppose, as is generally done, that the landowners are an extremely opulent and an extremely indolent body. These may be the characteristics of a few individuals amongst them; but it would be quite as wide of the mark to affirm that they are generally applicable to the entire class, as that they are generally applicable to the classes of manufacturers and traders. (See *M'Culloch's Statistics*, vol. ii.)

ESTATE FOR LIFE, in Law, is a freehold interest in lands and tenements, whether enjoyed for the life of the tenant, or for the life of another party (in which latter case it is termed an estate pur auter vie). This species of interest includes estates granted for an uncertain period limited within the duration of a life; as, for instance, an estate granted to a widow during her widowhood. An estate for life is created wherever lands or tenements are given by means adequate to the conveyance of a freehold, without any express limitation of an estate. If tenant for life convey an estate greater than his own by feoffment, fine, or recovery, he forfeits his estate; but if he does so by any of those conveyances which are termed innocent, he creates an estate determinable on his own death. With respect to estates pur auter vie, it is observable that formerly, when lands were given to A. for the life of B., if A. or A.'s assignee happened to die in B.'s lifetime, the estate belonged to the first person who could take possession, termed an *occupant*, but if given to A. *and his heirs* for the life of B. on the same event, A.'s heir succeeded as special occupant. Now, by the Statute of Frauds (29 C. 2 c. 31. s. 12.), estates pur auter vie are devisable, and, if there be no special occupant, they go to the executors or administrator of the deceased.

ESTATE FOR YEARS. In Law, an estate limited for a term of years, or other determinate time, in lands, tenements, or hereditaments, is a chattel or personal interest; and, on the death of the owner, devolves, like other personal property, on his executors or administrator. An estate for years is properly created or *demised* by an instrument termed a lease; which, at common law, has not full operation until the entry of the tenant. It may also be created by declaration of use, or by devise in a will, and may be made either to commence immediately, or on a future day and event: in which latter case, unless there be any particular estate to support it as a remainder, it is called an *interesse termini*, until the time arrives for its reduction into possession. Covenants between the lessor and lessee, relating to the land (which are usually inserted in the lease), are said at common law to run with the land: they pass, along with the term of years, to a party to whom the lessee conveys it by assignment; but the lessee's covenants do not pass to a party to whom he conveys part of the term by underlease. A tenancy from year to year is a species of estate for years.

ESTATE OF INHERITANCE. In Law, an estate in fee-simple or fee-tail. (See these articles; and REAL PROPERTY, LAW OF.)

ESTA'TES, POLITICAL. *See* STATES.

ESTIVA'TION. A term applied to the parts of a flower when unexpanded: it is used, in connection with various adjectives, to express the manner in which sepals or petals are rolled up before the flower unfolds.

ESTO'PPEL. In Law, an impediment or bar to a right of action, arising from a man's own act, or that of one to whom the party estopped is privy. As, if a party is bound by a particular name in an obligation, and afterwards sued by that name on the same obligation, he is estopped, *i.e.* forbidden in law to say in abatement that he is misnamed; as he cannot say contrary to that which he has admitted by his own deed. All parties to a deed are estopped to say any thing against what is contained in it; and privies are also bound.

ESTRE'AT. In Law, the extract, copy, or note of some original writing or record, and especially of fines and amercements; entered on the rolls of the court, to be levied by its bailiff or other officer. Fines to the king are estreated into the Court of Exchequer. Estreats are made out in that court by the remembrancer for the lord treasurer, and received from him by the clerk of the estreats, who writes them out to be served for the king, &c. Provision is made for the due return, estreating, and levying of fines, &c. in the superior and some other courts by 3 & 4 W. 4. c. 99.

ES'TRICH. The commercial name of the fine down of the ostrich.

ES'TUARY. *See* ÆSTUARY.

ETÆ'RIO. In Botany, an aggregate fruit, having the ovaries distinct, pericarp indehiscent; either dry upon a fleshy receptacle, as the strawberry; or dry upon a dry receptacle, as the ranunculus; or fleshy upon a dry receptacle, as the rubus: the parts being achenia or small drupes.

ET CÆTERA, usually expressed by the sign *&c.* means *and so on.*

ETCHING. *See* ENGRAVING.

ETCHING NEEDLE. An instrument of steel with a fine point, for tracing outlines, &c. on the copper plate.

ETE'RNITY. An attribute of the Deity, the existence of whom is without beginning or end. It is the immediate consequence of the self-existence which we attribute to him. Being the cause of all things, he is himself independent of any cause.

Eternity being infinite, is inconceivable by our finite understandings; at the same time, we cannot imagine an infinite being to exist without it. There is a distinction made between an *anterior* and a *posterior* eternity. The latter belongs to creatures whom God proposes to preserve for ever; the former to himself alone. We suppose God to exist without parts, and also without succession. It is an inconsistency in atheism to suppose a succession of generations from an anterior eternity: nothing that is successive can be actually infinite and eternal.

ETESIAN WINDS. *See* WINDS.

E'THAL. A substance formed during the saponification of spermaceti. Chevreul derived the name from the first syllables of *ether* and *alcohol*, on account of its analogy to those liquids in point of composition.

E'THER. (Gr *αἰθὴρ*) In Chemistry, this term is applied to a highly volatile, fragrant, inflammable, and intoxicating liquid, produced by distilling a mixture of equal weights of sulphuric acid and alcohol. When these liquids mutually act on each other, a series of complicated changes ensue, which terminate in the conversion of alcohol into ether. Ether, like alcohol, may be regarded as a compound of hydrocarbon and water; and if alcohol be considered as consisting of *one* equivalent of olefiant hydrocarbon = 14, and *one* of water = 9, ether may be regarded as constituted of *two* of olefiant hydrocarbon (14 × 2) = 28, and *one* of water = 9: hence, the equivalent of alcohol being 14 + 9 = 23, that of ether will be 14 × 2 = 28 + 9 = 37; and the process of etherification may be stated to consist in the abstraction from alcohol of one half of its elemental water. By some, ether is regarded as the oxide of a peculiar hydrocarbon, which they term *ethule*, composed of 4 equivalents of carbon and 5 equivalents of hydrogen; and alcohol must in that case be considered as hydrate of ether.

Ether, or, as it is often called, to distinguish it from analogous products obtained by the intervention of other acids, *sulphuric ether*, is a limpid colourless fluid, of an agreeable odour, and a hot pungent taste. Its specific gravity is about 0·713, though that of the shops is usually heavier, it boils at about 98°, and freezes at the low temperature of 46° below 0°. The specific gravity of etherial vapour compared with atmospheric air is as 258 to 100. Ether is sparingly soluble in water, which takes up about a tenth of its bulk; it dissolves in all proportions in alcohol. The principal use of ether is in medicine. When taken internally, it is stimulant; and it is sometimes applied externally, by reason of the cold produced during its evaporation, as an ingredient in refrigerating lotions.

ETHE'RIA. (Gr. *αἰθω, I shine*) A genus of Lamellibranchiate Dimyary Bivalves, with a large ventral muscular plate or foot, as in the *Uniones*; but having their shell adherent, as in the oyster, to foreign bodies: the hinge is toothless, irregular, undulated, and callous; the ligament external, but penetrating in a pointed form into the interior of the shell. The term *Etheria* has also been applied by Rafinesque to a genus of Macrourous Crustacea.

E'THERIN. A name applied by some chemists to quadrihydrocarbon, that is, to an hydrocarbon 1 atom or equivalent of which is constituted of 4 atoms of carbon and 4 of hydrogen. It is obvious that such a compound may be regarded as the base of ether; its equivalent would be 6 × 4 = 24 + 4 = 28.

E'THICS. (Gr *ἦθος, custom, moral character.*) The science the object of which is to determine what ought to be in relation to voluntary action, and to those dispositions, faculties, or affections of mind which tend mediately or immediately to voluntary action. It has been our aim throughout the present work, in all articles relating to abstract or speculative subjects, especially to such as have been matter of long controversy, rather to present our readers with a history of the opinions which have been held by others, and to direct them to the works in which those opinions are maintained with the greatest ability, than to give a systematic account of what appeared to us the correct view of the particular department of inquiry before us. The definition with which we preface this article may appear to be in some degree a deviation from this our practice, inasmuch as it contains by implication a decision of certain questions in the science before us, which some of our readers may consider to be still "sub judice," besides including the use of terms to which it has been asserted by certain modern writers on ethics that no intelligible meaning can be attached. Our answer is, that we can conceive of no definition, not including the terms in question, or their equivalents, which shall justify us in assigning to the science of ethics an independent existence, or, by consequence, in giving to

the word which designates it a distinct place and a separate treatment. Whether the words "ought" and "voluntary" have any meaning or not, must appear from the sequel: it is enough for our present purpose that the majority of moralists have believed them to possess one.

There is no subject within the limits of speculation concerning which controversy has been waged with greater vehemence, with the exception, perhaps, of theology, than that of ethics. We have not far to search for the general reasons of this fact. Besides being a science of pre-eminent interest to those who unite high moral feeling and a concern for the interests of their kind with a capacity for speculation, it is a science also the treatment of which is peculiarly liable to be affected by the moral nature and habits of those who take it in hand. Without taking upon us to assert that to be a good ethical writer it is necessary to be a good man, we think that the history of speculation justifies us in the belief that a partial or confined view of moral science indicates, for the most part, a corresponding excess or defect in the moral qualities of the person holding it; at least where such peculiarity cannot be traced either to imperfect intellectual qualifications, or to singularly unfavourable circumstances of time, place, or education. Systems which have sprung up under such influences commonly expire with the circumstances which called them into being. The youthful student may indeed be attracted by the ingenuity or confounded by the subtlety with which they have been maintained; but, with a person of sound mind, who has access to writers of larger and deeper views, they cannot long maintain a place in his understanding, much less in his practical habits. We have introduced these remarks, partly as our justification for omitting from this article all notice of such systems as those of Epicurus in ancient, and Hobbes, Helvetius, and Mandeville in modern times; and partly as an introduction to what we shall make the central point of our observations—an account of the controversy which at present divides ethical speculators in England. We allude, it will be perceived, to the dispute which has for some time prevailed between the respective partizans of what have been called the "utilitarian" and "sentimental" schools. Those who are acquainted with the most recent records of opinion which have been published on both sides of this controversy will see reason to wonder at two things: at the very small real discrepancy between the parties engaged; and at the singular vehemence with which they disclaim all community of opinion, and strive to establish a difference which does not exist, or to exaggerate one which does. An historical examination of the origin and growth of the two schools will in a great degree explain these two facts; inasmuch as it will show that the difference between the disputants is one rather of feeling and habit than of pure theory. It will also serve as a thread whereon to hang such notices of past systems as it was necessary to give, in order to impart to this article the same historical character with that possessed by the articles on similar subjects which occur during the course of this work. We shall thus have an opportunity of communicating to our readers by far the most of what is really important in English ethical speculation; and in the attempt which we shall make to show the essential incompleteness of both theories, and to indicate the true central point from which the science of morals ought to be viewed, we shall be enabled to introduce an account of some of the leading features which distinguished the systems of antiquity. We begin with those whom we have named the sentimental moralists.

The most eminent of these have been men who have devoted their attention chiefly or entirely to what may be called empirical psychology; that science, namely, which determines the sequences of mental phenomena, and their dependence on each other in the relation of cause and effect; in one word, to the *physics* of the mind. In this department of science the most fruitful discovery that has been made is what is commonly named the Law of Association. This law, according to which Hobbes and Condillac attempted to account for the origin of our perceptive and intellectual faculties, was applied with better success by Hartley to the analysis of our emotive principles. The moral sentiments, the ultimate source of which Hutchison held to be benevolence, and Adam Smith sympathy, Hartley sought still lower, in the simple capacity of organic pleasure and pain. From these original elements are formed, by successive or co-ordinate processes of association, the feelings of sympathy, gratitude, resentment, shame, and the like; and, as the last and most perfect formation, the faculty of moral approbation or disapprobation. This theory, which must not be, as it frequently is, confounded with the selfish theory, is that which the celebrated dissertation of the late Sir James Mackintosh, prefixed to the *Encyclopædia Britannica*, is intended to illustrate. It is in reference to the successive stages of development of the associative principle that this elegant work is alone valuable. Its author may be considered as ending the series of sentimental moralists; in which, in addition to the names given above, may be inserted that of Dr. Thomas Brown. The result of their speculations is, that they have established the existence of a moral faculty in man, as a fact of natural history; a fact, also, which holds a distinct and defined place in a physical theory. It is, as we shall see, by no means an insignificant circumstance that, of the five names we have enumerated, two were physicians by profession, and one had dedicated great part of his youth to the study of practical medicine.

The reputed father of the "utilitarian" moralists is the celebrated Jeremy Bentham. The labours of this unquestionably powerful thinker were principally devoted to the sciences of legislation and jurisprudence; to which, also, much of the attention of those who profess themselves his followers or admirers has been directed. It is only as auxiliary to these sciences that Mr. Bentham has handled the subject of morality. The most complete account of the utilitarian principle is to be found in Mr. Austin's work on jurisprudence. This principle is thus enunciated: — "The morality or immorality of an act consists in the beneficial or pernicious consequences resulting from it; the morality or immorality of an agent, in the goodness or badness of his intention, the goodness or badness of the intention being determined by the nature of the consequences which are foreseen, or might be foreseen, as resulting from the act." Here, we are told, we must carefully distinguish between *intention* and *motive*, between foresight of the consequences of an action, and the state of mind which causes the action. To quote an instance used by the acute author of a recent work named *A Fragment on Mackintosh*, — "A man, to save his family from starving, wires a hare on my estate. My first impulse is to throw him into jail. Before I determine to do so, however, I consider the misery which I shall bring on the man himself, and the state of want, wretchedness, and probable demoralization, into which I shall plunge his family. In spite of these foreseen consequences, I resolve to prosecute him. Here my *motive* is the preservation of my game, my *intention* the production of misery and vice in a multitude of my fellow-creatures. The immorality of this act manifestly consists in the intention; the motive is neither moral nor immoral." Having given this preparatory illustration, we shall extract from the same work what is there denominated "A list of the requisites of a moral act." These are — "1 *The motive*. There is no act without a motive; but the motive is in itself neither moral nor immoral. 2 *The volition*. There is no act which is not willed; but the act of willing is neither moral nor immoral. 3 *What is called the external act*, to wit, *the bodily part or motive*. That, like the motive, is in itself neither moral nor immoral. The same bodily operation is indifferently a part of every sort of act. It is, however, a necessary part of every act. 4 *The consequences of the act*. An act which has no consequences that are materially either beneficial or hurtful is not called a moral act. That alone receives this denomination which has consequences material to some one or more human beings. 5. *The expectation of the beneficial consequences in the mind of the agent*. 6 This is not all: it is not enough to make an act moral that the agent expects from it beneficial consequences to somebody, it is further necessary *that he have no reason to expect from it evil consequences equivalent* to any other body; that is, in other words, that he have *a conviction of its general utility*."

In order to obviate an objection to the principle so enunciated,—viz. that it supposes a laborious calculation of consequences to precede every moral action,—Mr. Austin, in the work to which we previously alluded (*The Province of Jurisprudence Determined*), qualifies the statement by the admission that the principle of utility itself requires that our conduct should be guided by *general rules*, formed according to the principle of utility, and not by an immediate appeal to utility itself in each particular instance. Thus qualified, the principle is precisely the same with that laid down by Kant, as the "groundland of the pure practical reason:"—"Act so that the maxims of thy will, in each particular instance, may hold equally as the principle of a universal legislation." And this philosopher, in common with the English utilitarians, regards this principle as a postulate which lies at the foundation of morality. Thus explained, it will be seen that there is no theoretical inconsistency between the utilitarian and sentimental moralists. Sir James Mackintosh expressly admits that the only criterion of morality in action, — that is, the only criterion by which right and wrong in human conduct can be determined, — is the consequences of such conduct on the happiness of mankind. It has been with reason objected, that the second department of the two into which he divides the science of ethics, "the nature of those feelings with which right and wrong are contemplated by human beings," does not in itself belong to morality at all. It is in truth a part of psychology, and nothing more, and that by his own admission, that the purpose of moral science is "to answer the question '*what ought to be*.'" The *obligation* of the rule of action is the same, whatever are the feelings with

which we may happen to regard right and wrong; and whatever may be their origin, and the process of their formation. That the nature of these feelings ought to be made an important item in every calculation of the consequences of our actions, would be admitted by any consistent utilitarian who is capable of such considerations, and that in obedience to his own principle. The science of psychology is admitted by such persons to be a valuable auxiliary to that of ethics, and as such has been elaborately treated by Mr. Mill, in his *Analysis of the Human Mind*. This we conceive to be all that Sir James Mackintosh, in the principles of his general philosophy, had a right to claim for that branch of science, to the elucidation of which he has devoted by far the greater part of his dissertation. The relation between utilitarianism and sentimentalism may consequently be expressed thus: It is our duty so to frame our conduct, that it may contribute as much as possible to the happiness of mankind. The happiness of a man consists, as experience proves, not in the gratification of one or two desires, but of as many as possible. But the more faculties a man can exercise the more numerous are his desires, and the greater the happiness of which he is capable; consequently, it is our duty to contribute as much as we can to the development of the faculties of all with whom we have to do: the means to this end are supplied by the science of experimental psychology, including the doctrine of the formation, among other faculties, of the moral sentiments

The question now arrives, is this a complete theory of morals? We think not; and we will proceed to state our reasons for this opinion. It will be admitted, that in order to conceive of the existence of a particular class of pleasures, and by consequence of a particular class of faculties or desires of which these pleasures are the exercise or the gratification, we must be conscious of the existence of the same class in our own constitution. What is true of one class is true of all Before, therefore, we can take upon us to determine wherein the *greatest* happiness of man consists, we must take care that our idea of human nature be a complete one; we must see to it that we leave out of consideration no element in the constitution of man. Nor is this enough. It will be admitted, as a fact of experience, that the gratification of certain of our desires does, if carried beyond certain bounds, impair and interfere with the free action of certain other equally important sources of enjoyment. Consequently, what is true of the constitution of a state is true, likewise, of the constitution of man. the action of its constituent parts requires to be determined by some measure or law which shall appoint to each the sphere and limits of its exercise. The Greek philosophers, who, whatever may be their deficiencies in subordinate inquiries, saw more distinctly than any before or since the true problems which philosophy ought to solve, have pointed to this law under different names—whether of the *chief good*, the *rule of right*, the *harmony of the soul*, or the like—as the great difficulty of ethics to the clearing up of which all other inquiries ought to be regarded as subordinate and tributary. Of all the moralists of antiquity Plato perceived this with the greatest clearness His *Republic* is meant as an approximation to the determination of this law, alike in the individual and in the state That we may not be accused of blind veneration for antiquity, we will adduce the most celebrated ethical writer of the last century in our justification. Those of our readers who have formed their conception of the objects of Bishop Butler's moral writings from the strangely partial view of them taken in Sir James Mackintosh's dissertation, will probably be surprised to hear that his is the name to which we allude. The preface which he has prefixed to his *Sermons* is intended as a brief preliminary statement of what he calls "the occasion, scope, or drift" of the detached inquiries which follow. Of what this scope or drift was we are bound to accept his own account; and before we can rightly apprehend it, he tells us we must "begin by stating to ourselves exactly the idea of a system, economy, or constitution, of any particular nature, or particular anything. We shall, I suppose, find that it is a one, or a whole, made up of several parts; but yet that the several parts, even considered as a whole, do not complete the idea, unless in the notion of a whole you include the relations and respects which these parts have to each other. Every work, both of nature and art, is a system; and as every particular thing, both natural and artificial, is for some use or purpose out of and beyond itself, one may add, to what has been already brought into the idea of a system, its conduciveness to this one or more ends. Let us instance a watch: Suppose the several parts of it taken to pieces, and placed apart from each other; let a man have ever so exact a notion of these several parts, unless he considers the respects and relations which they have to each other, he will not have anything like the idea of a watch. Suppose these several parts brought together and united anyhow; neither will he yet, be the union ever so close, have an idea which will bear any resemblance to that of a watch. But let him view those several parts put together, or consider them as to be put together in the manner of a watch; let him form a notion of the relations which those several parts have to each other—all conducive in their respective ways to this purpose, showing the hour of the day; and then he has the *idea* of a watch. Thus it is with regard to the inward frame of man. Appetites, passions, affections, and the principle of reflection, considered merely as the se eral parts of our inward nature, *do not at all give us the idea of the system or constitution of this nature; because the constitution is formed by somewhat not yet taken into consideration, namely, by the relations which these several parts have to each other.*" Bishop Butler goes on to remark, that "what in fact or event commonly happens is nothing to this question;" for, "one may determine what course of action the economy of man's nature requires, without so much as knowing in what degrees of *strength* the several principles prevail, or which of them have actually the greatest influence." But between a machine and a man, says Butler, in allusion to the illustration from the watch, "there is a difference too important ever to be omitted. A machine is inanimate and passive; but we are agents. Our constitution is put in our own power. We are charged with it; and therefore are accountable for any disorder or violation of it." The inference which an impartial reader of these quotations, after comparing them with the *Sermons on Human Nature*, will necessarily draw is this, that not only has Butler's object and purpose been misconceived by Mackintosh, but that it was an object which, consistently with the rest of his philosophy, Mackintosh must have held to be unattainable. For it implies two things: first, that in order to complete the rule of human action, we must have an idea of perfect humanity; secondly, that before such rule can be binding upon man, we must show, not only that he *feels himself* or may be made to feel himself, but that he really *is*, accountable for its violation. Whether these two questions can be adequately disposed of without the introduction of higher, that is, of theological or metaphysical considerations, is a matter which each man must decide according to the tenor of his general philosophy The former of the two was so distinctly perceived by Aristotle, that his whole ethical system must be viewed in reference to it, the latter lies at the root of the moral philosophy of Kant. Until the first is disposed of, the rule of action is implicated in an inevitable circle; without the second, no rule can be shown to be obligatory, and ethics can no longer be distinguished on the one hand from the history of internal, on the other from that of external, phenomena *See* VIRTUE.

E'THIOPS MINERAL. The black powder obtained by rubbing mercury with sulphur.

ETHMOI'D. (Gr. ἠθμος, *a sieve*, and εἰδος, *form*.) The ethmoid or cribriform bone. A bone of the head enclosed in the *os frontis*, between the orbitary processes; it is very light and spongy, and consists of a network of convoluted plates.

ETHNO'GRAPHY. (Gr. ἔθνος, *nation*, and γράφω, *I describe*) The science which treats of the particularities of nations, describing their customs, peculiarities, &c. Although a peculiar name has been given to it, it is in general considered as a branch of the sciences of geography and history. (See *Balbi's Ethnography*.)

I'THU'LE. (Gr. αἰθης, and ὑλη, *principle*.) A term applied by Berzelius to the elementary carbon and hydrogen of ether; he regards ether as an oxide of a compound of 5 equivalents of hydrogen and 4 of carbon.

E'TIOLA''TION, or CHLOROSIS, is that condition of a plant in which all the green colour is absent Such a state is produced by want of light, and is artificially obtained by keeping plants in the dark in order to ensure their being more tender and insipid than is natural to them. Etiolated parts become green by exposure to light.

ETIQUE'TTE. (Fr. a ticket.) Is the ceremonial code of polite life, more voluminous and minute in each portion of society according to its rank. The word is derived from the custom of arranging places at processions, &c. by tickets delivered beforehand to applicants. The Byzantine court appears to have carried the practice of ceremonial observances to the most inconvenient and ludicrous extent. But of modern courtly etiquette, Philip the Good, Duke of Burgundy, is regarded by some as the founder (see *Conversations Lexicon*) His desire to conceal his inferiority in rank (as a great feudatory only) to the great sovereigns of Europe, whom he equalled in power, induced him to surround his presence with a multitude of officers and numberless formalities. At no time, probably, was the spirit of etiquette so predominant and so tyrannical as in the court of Louis XIV.; and the *Memoirs of Saint Simon* are full of the most extraordinary proofs of the subjugation of the minds of men of sense, wit, and even independent character in other respects, to its engrossing influence,—their pride in attaining any little point of precedence, and their mortification in failing of it. The smaller courts of Germany caricatured the ceremonial of that of the Great Monarch, and carried its strictness to an absurd extent. At the present day the ancient

etiquette of courts is continually losing something of its strictness.

ETYMO'LOGY. (Gr. ἔτυμος, *true*, and λογος, *description*, &c.) The science which treats of the origin or root of individual words, and of the relation borne respectively by their several meanings to that origin. It is a branch of the general science of philology. *See* PHILOLOGY.

EU'CHARIST. (Gr. εὐχαριστια.) Signifying properly giving of thanks, but generally used in theological language to denote the sacrament of the Lord's Supper. The celebration of this rite is derived from the account given by the Evangelists of the action of our Lord in offering to the apostles bread and wine, saying at the same time, "Take and eat, this is my body," and "Drink ye all of this, for this is my blood of the new testament, which is shed for many for the remission of sins;" and adding at the same time, "Do this as oft as ye shall do it in remembrance of me." This commemoration is spoken of in the N. T. and by the Fathers as a sacrament and a mystery; it must be supposed, therefore, that there is an interior signification conveyed under our Saviour's words—a further effect to be derived from the communion in the bread and wine besides that which is obvious and external. Under the head of TRANSUBSTANTIATION will be found the solution which the Roman Catholics discover for this mystery. Consubstantiation, or the simultaneous presence of the body and blood with the bread and wine, is the attempt made by Luther to explain the operation of a divine mystery according to the literal interpretation of Scripture. According to the doctrine of the Anglican church, there is an inward and spiritual grace conveyed in the Eucharist to those who partake of it, and it is in this that our church differs from many Protestant communities, who conceive the communion to be nothing more than an outward act of obedience enjoined upon us as a commemorative ceremony, and only instrumental to our salvation in the same way as any other act of obedience. *See* SACRAMENT.

It is common in the Fathers to meet with the term sacrifice applied to the Eucharist, and this has been considered by the Romanists as favouring their view of its nature. They appeal also to the prophecy of Malachi, which alludes to a pure offering or an unbloody sacrifice, which shall be offered up to the Lord from the rising to the setting of the sun; and maintain, therefore, that the consecrated elements are offerings made to God for the sins of the people, in the same sense as the expiatory sacrifices of the Jewish law, and not merely commemorative tokens. From hence follows the supposed necessity of the sacrifice of the Mass, and its efficacy for the absent, or even dead, and the mediatorial character attributed in the Romish church to the priest. The Protestants, however, while they do not deny the applicability of the word sacrifice to the Eucharist, restrict it to one of the senses which it bears in the Hebrew phraseology; and consider the pure offering prophesied by Malachi to be an offering of prayer and thanksgiving, such as is constantly referred to by the Psalmist; as, CXLI 2, "Let my prayer be set forth before thee as incense, and the rising up of my hands as the evening sacrifice;" LI. 17., "The sacrifices of God are a broken spirit," &c. The seventh chapter of Hebrews is considered decisive against the mediatorial character of the Christian priest; and the Eucharist is held by the church of England to be not a propitiatory but a commemorative sacrifice—a federal act of professing our belief in the death of Christ, and of renewing our baptismal covenant with him; and endued with virtue to confer grace upon those who partake of it sincerely and devoutly.

EU'CHLORINE. (Gr. εὐ, *very*, and χλωρος, *green*.) A name given by Sir H. Davy to the oxide of chlorine, in consequence of its deep yellow-green colour.

EUCHO'LOGY. (Gr. εὐχη, *prayer*, and λεγω, *I collect*.) A book of prayers; synonymous, in the phraseology of the Roman Catholic church, with *missal* or *breviary*.

EUCLA'SE. (Gr. εὐ, *well*, and κλαω, *I break*.) A very rare mineral, brought in small greenish crystals from Peru and Brazil. It is a silicate of glucina and alumina.

EU'CRASY. (Gr. εὐ, and κρασις, *temperature*.) An agreeable well-proportioned mixture of qualities, by which a body is said to be in good order, and disposed for a good state of health.

EUDIO'METER. (Gr. εὐδια, *calm air*, and μετρον, *measure*.) This term is generally applied to instruments for facilitating the analysis of atmospheric air, or rather for determining the quantity of oxygen contained in a given volume of air; under the idea that the salubrity of air depended upon its relative quantity of oxygen. We now know, however, that this is not the case, and that the relation of the oxygen to the nitrogen in the atmosphere is not subject to any discernible fluctuation.

EU'LABES. (Gr. εὐλαβής, *timid*.) A genus of Passerine birds, belonging to the family of thrushes, and distinguished by having broad strips of naked skin on each side of the occiput, and a bald spot on the cheek. The bill nearly resembles that of a thrush; their nostrils are round and smooth. The species are termed *Mainates* by the French ornithologists; and the Javan *mainate* (*Eulabes javamens*) of all birds is said to imitate most completely the language of man.

EULI'MA. (Derivation unknown.) A genus of marine shell-clad Gastropods, whose characters are *shell* turreted, acuminate, with many whorls; aperture ovate, acuminated posteriorly; outer lip thickened, and bearing numerous obsolete *varices* or wart-like processes; operculum horny, thin, and with its nucleus anterior.

EU'LOGY. (Gr. εὐ, *well*, and λεγω, *I speak*.) In a general sense, an encomium pronounced on any person for his meritorious or virtuous qualities; but, in a more restricted meaning, it was used in ecclesiastical history to denote any present bestowed on the church after having been *blessed* or *hallowed*.

EUNI'CE. (Gr. The name of a Nereid in *Apollodorus*.) A genus of Marine Dorsibranchiate Anellidans, having tufted branchia, and a mouth armed with three pairs of horny jaws. One species (*Eunice gigantea*) attains the enormous length of between four and five feet.

EU'NUCH. (Gr. εὐνη, *a bed*, and εχειν, in the sense of *to have the care of*.) A term applied to those who have been subjected to the operation of castration. The fortunes of such individuals form an eventful chapter in the history of the human race; whether we consider the purposes for which the operation was performed, or the numbers of those who have undergone it. This practice seems to have originated in the jealousy which prevails in eastern countries. As far back as the time of Herodotus, it was carried to a great extent by the Persians, who not merely intrusted to eunuchs the care of their wives and daughters, but considered them in every respect as more trustworthy than other individuals. In the middle ages the "chief of the eunuchs" was one of the most important functionaries of eastern government, and the seraglios of these countries are superintended by eunuchs even in the present day. In modern times the loss of virility is in some countries believed to preserve and improve the voice, and hence, especially in Italy, this operation is practised upon children intended to supply the operas of Europe with singers. Zeal for religion has also caused many persons to undergo this operation, in the view of guarding themselves from sensual pleasures. As early as the third century there arose a class of enthusiasts, who, animated by the example of Origen, not only castrated those of their own persuasion, but even all persons on whom they could lay their hands. Several of the Christian Roman emperors instituted severe prohibitions against this revolting practice, and at a later period the Council of Nice excluded from the pale of the church all who, actuated by whatever motives, had allowed themselves to be thus mutilated.

EUPA'TRIDÆ. (Gr. εὐπατρίδαι.) In Ancient History, the nobles of Attica, in whose hands in early times all the power of government was vested, in consequence of which the lower orders sunk into a low state of degradation, being particularly oppressed by their debts which the pressure of their circumstances compelled them to incur, and which, if not paid, gave the creditor power over the bodies and liberties of the debtor and his family. These evils were remedied by the legislation of Solon, who reduced the interest of debts, and deprived the creditor of his power over the body of the debtor, and at the same time threw the judicial and much of the legislative power into the hands of the people at large or Demus (Δῆμος). The alterations in the constitution of Athens subsequent to the time of Solon by degrees deprived the Eupatridæ of all their political privileges, and finally established an unmixed democracy.

EU'PHEMISM. (Gr. εὐφημεῖν, *to speak well of a person or thing*.) A figure in rhetoric, by which one expression is substituted for another, conveying, through some association of ideas, an image offensive to the hearer or reader. In classical writers, euphemism often arises from a superstitious avoidance of certain words and phrases; and among ourselves similar fastidiousness prevails on some points, as in the constant use of the words "deceased" and "departed" for "dead."

EU'PHONY (Gr. εὐ, *well*, and φωνη, *sound*), in contradistinction to *Cacophony* (quod vide). That agreeable quality in language which results from happy combinations of the enunciative elements; such especially as, though essentially different in their characteristic powers, melt easily into each other, so as to preserve an uninterrupted flow through the respective members of a sentence, without labour to the speaker or offence to the hearer. No rules can be laid down to ensure this agreeable quality in composition: his taste, ear, and discrimination must be the guide of every writer.

EUPHORBIA'CEÆ. (Euphorbia, one of the genera.) A natural order of Exogenous plants, inhabitants of almost all parts of the globe; nearly allied to *Malvaceæ* and *Rhamnaceæ*, especially agreeing with the former in the starry structure of the hairs, the monadelphous stamens, and the definite number of ovules in three united

carpels. Their sensible properties are, on the whole, poisonous and exciting, both being of a volatile nature and often dispelled by heat. Thus the stem of *Jatropha manihot*, or *Cassava*, which, when raw, is one of the most violent of poisons, becomes a wholesome nutritious food when roasted: in the seeds the albumen is harmless and eatable, but the embryo itself is acrid and dangerous. Independently of the volatile principle there are two others,—viz. 1. Caoutchouc, the most innocuous of all substances, produced by the most poisonous of all families. 2. Turnsol, the bark of several crotons, the wood of *Croton tiglium* and common box,—the leaves of the latter, of *Cicca disticha*, and of several euphorbias, are sudorific,—and many other species, amongst which *Ricinus* may be mentioned, are purgative: the latter produces from its seeds by pressure the well-known castor oil.

EUPHO'RBIUM. (From Euphorbus, physician to king Juba, in honour of whom the plant was named.) An acrid gum resin, the produce of the *Euphorbia officinalis;* it is virulently purgative and emetic, and the dust of it is dangerously stimulant to the nose.

EU'PION. (Gr. ευ, *very*, and πιων, *greasy*.) A very limpid liquid which stains paper like oil, and which exists in the tar produced during the destructive distillation of animal and vegetable substances. Its specific gravity is 0 74, and it boils and evaporates at 340°. It is insoluble in water, but dissolves in ether and alcohol. It is insipid and inodorous, but highly inflammable

EURI'PUS. (Gr. ευριπος.) In Ancient Architecture, the space which separated the arena from the seats in the circus.

EURO'PA. In Fabulous History, the daughter of Agenor, king of Sidon. She is represented as having been of such surpassing beauty that Jupiter became enamoured of her. In order to gain her affection the god transformed himself into a bull of wonderful whiteness, and while Europa was gathering flowers in a meadow near the sea shore, mingled with her father's herds. The virgin, attracted by the beauty of the bull, began to caress him, and at length, in the playfulness of youth, ventured to get on his back. Upon which the bull, taking advantage of her situation, made a retreat towards the sea, through which he carried her in safety Arrived in Crete, the god resumed his real form, and declared his passion, which was returned; and from their connection sprang Minos, Rhadamanthus, and Æacus, the celebrated Elysian judges. The simple statement of Herodotus, that Europa was carried off by some Cretan merchants, who, according to some authors, arrived at Sidon for mercantile purposes with a ship bearing a white bull on its prow, but, according to Diodorus, with a commander named Taurus (bull), offers one of many probable solutions of this fabulous story From her, according to mythologists, the quarter of the globe which we inhabit received its name. The word is possibly derived from Gr. ευρυς, *large*, and ωψ, *the eye;* large eyes having been regarded by the Greeks as a mark of great beauty.

EURY'DICE. In Fabulous History. *See* ORPHEUS.

EURY'THMY. (Gr. ευρυθμια, *justness of proportion*.) In Architecture, the regular, just, and symmetrical measure resulting from harmony in the proportions of a building or order. It is one of the six essentials of Vitruvius.

EUSTA'CHIAN TUBE Named after the celebrated Italian anatomist Bartholomew Eustachius, who is said to have discovered it, though it is accurately described by Aristotle, who quotes an earlier Greek anatomist, Alcmeon, as having known it. This communication between the ear and the mouth begins in the anterior part of the tympanum, and runs in a bony canal forwards and inwards, terminating with the petrous portion of the temporal bone. It then proceeds, partly cartilaginous and partly membranous, gradually enlarging to its termination behind the soft palate. It is through this tube of communication with the ear that persons who have a perforated tympanum blow tobacco smoke: when the Eustachian tube is stopped or obliterated it produces deafness.

EUSTA'CHIAN VALVE. A semilunar membranous valve, which separates the right auricle of the heart from the inferior *vena cava*, first described by Eustachius.

EUSTA'THIANS. A sect of heretics of the 4th century; so called from their founder Eustathius, a monk whose opinions were condemned at the council of Gangea.

EU'STYLE. (Gr. ευ, *well*, and στυλος, *column*.) In Architecture, that species of intercolumniation or space between columns, which, as the name imports, the ancients considered the most beautiful, and which Vitruvius says exceeded all others in strength, convenience, and beauty; it was two diameters and a quarter of the column in width.

EUTE'RPE. (Gr. ευ, and τερπω, *I delight*.) In Mythology, the muse which presided over wind instruments.

> Si neque tibias
> Euterpe cohibet, nec Polyhymnia
> Lesboum refugit tendere barbiton. (*Hor.* Ode I. 1. 54.)

To this muse is ascribed also the invention of tragedy.

EUTHANA'SIA. (Gr. ευ, and θανατος, *death*.) Literally, an easy death. By political writers it is employed in various senses to indicate such peculiar theories as have the best tendency to uphold the state or disentangle it from difficulties. Thus, for instance, it is maintained that the issue of inconvertible paper money is the true *euthanasia* of public debts in modern countries.

EUTY'CHIANS. A sect of the fifth century, who appear to have been seduced into an erroneous view of the nature of Christ by the vehemence of their opposition to the heresy of the Nestorians. These latter had asserted the distinctness of the two natures in Christ; the Eutychians confounded them together, and supposed the human to be merged in the divine. Their originator, Eutyches, was the abbot of a monastery at Constantinople, and was excommunicated in the year 448 by a synod which was convened there for that purpose. This decision was controverted by another council at Ephesus in the following year; but the new opinions were finally condemned by the council of Chalcedon in 451, which established the orthodox doctrine that Christ was perfect God and perfect man, consubstantial with the Father as to his divinity, and with man as to his humanity, the two natures being united in him without conversion, without confusion, and without division.

EVANGE'LICAL. (Gr. ευαγγελιον, *gospel*, literally good tidings: from ευ, *well*, and αγγελος, *messenger*.) A title assumed by different branches of different Protestant churches, by way of marking their peculiar orthodoxy. In Prussia, the United Lutheran and Calvinistic churches have styled themselves the Evangelical church.

EVA'NGELIST. (Gr. ευαγγελιστης.) One who brings good tidings. Hence the authors of the Four Gospels are called Evangelists.

EVA'NTES. Priests of Bacchus; so called from their usual exclamation during their orgies, "ohe evan."

EVAPORA'TION. The conversion of substances into vapour is one of the most important and general effects of heat During this process, a considerable quantity of sensible heat passes into the *latent* or insensible state When a vessel of water is placed upon the fire, its temperature gradually rises till it attains 212°; then, although it remains upon the fire, and of course receives heat as before, it does not become hotter, but is gradually converted into steam or vapour: so that the effect of heat is not to elevate temperature, but to change state or form; that is, in the case of water, to convert it into steam Hence we assume that steam, though not hotter than water, contains a much larger quantity of heat, and this heat again makes its appearance when the steam is condensed or re-converted into water. At whatever temperature vapour is produced, it is similarly constituted; and that which escapes from water at ordinary temperatures, by the process usually called *spontaneous evaporation*, resembles the former in all respects: hence it is that evaporation is to surrounding bodies a cooling process, and that in the converse change, or the return of the vapour to the liquid state, heat is evolved and rendered sensible The same general phenomena are observed with all other liquids, and those which evaporate rapidly at common temperatures often give rise to the production of a great degree of cold; such as spirit of wine, or ether. If the latter fluid be suffered to dribble over the bulb of a thermometer, it will cause it to sink below the freezing point of water; and by accelerating similar cases of evaporation, we obtain most intense degrees of artificial cold.

The circumstances that principally influence the process of evaporation are, extent of surface, and the state of the air as to temperature, dryness, stillness, and density.

EVE'CTION. (Lat. eveho, *I raise up*.) An inequality of the moon's motion, depending on the position of the transverse axis of the lunar orbit in respect of the line of the syzygies, or line joining the sun and earth. When the transverse axis lies in the same direction with that line, the quantity by which the solar force diminishes the gravitation of the moon is greatest when the moon is in the apogee, and least in the perigee. In this situation of the orbit, therefore, the difference between the moon's gravitation at her apogee and perigee is increased by the solar action, and the orbit consequently appears to have its eccentricity augmented. When the line of the apsides is in the quadratures, the contrary happens; the difference between the amount of gravitation at the apogee and perigee is diminished, and the eccentricity of the orbit appears also to be diminished. The evection is proportional to the sine of twice the angular distance between the sun and moon, diminished by the moon's mean anomaly; and its greatest value amounts to 1° 20′ 29·9″ This inequality (sometimes called the *second* inequality of the moon's motion, the equation of the centre being the *first*) was noticed by Hipparchus, and Ptolemy gave a construction which represents its general effects with great accuracy. The term *evection* was first applied to it by Bullialdus.

**EVEN KEEL** A ship is said to be on an even keel, properly speaking when she draws the same water abaft as forward the expression is often used [illegible] indicates not only the [illegible]

**EVERGREEN** A [illegible] whose leaves remain perfect upon a stem beyond a single season as the *Ivy aquifolium*

**EVIDENCE** In law, has been defined "any matter of fact, the effect, tendency, or design of which, when presented to the mind, is to produce a persuasion, affirmation, or disaffirmation of the existence of some other matter of fact"

A witness in a court of common law, is compelled to give his attendance, in civil cases, by subpœna, or by habeas corpus if the witness be in custody Reasonable expenses both [illegible] tendered to the witness [illegible] A witness, refusing to attend on subpœna, may be attached for contempt of court, and is liable to an action at the suit of the party damaged In criminal cases, the attendance of a witness for the prosecution is enforced either by subpœna, or more usually by the magistrates who take the depositions in the first instance binding him over to appear His expenses in a case of felony, [illegible] by statute The defendant may compel [illegible] his witnesses by subpœna

When the witness appears in court objections may be taken to his competency, and those arising from his ignorance or unbelief, or turpitude of character ought, in the usual course, to be taken before he is sworn

*Incompetency* —1 Incompetency from defect of religious principle is where the witness disbelieves or is ignorant of the existence of a God and of a future state of rewards and punishments Infidels, therefore are excluded, but no others of whatsoever sect or opinion 2 Incompetency from turpitude arises from a conviction for treason, felony and several misdemeanors, but is removed by pardon, or by reversal of the judgment, or by endurance of the punishment awarded by the sentence 3 Interest was formerly a source of incompetence But the distinctions arising out of so general a proposition created constant difficulty in practice, and the act 14 & 15 Vict c 99 has greatly simplified the procedure in civil cases, by admitting any parties interested in a suit to the witness box (See SUPPLEMENT) The old law of evidence was based on the following leading rules

All parties to the suit although but nominal are excluded from giving evidence A prosecutor, in a criminal case, is not a party, nor directly interested in the verdict, and is consequently admitted A person to whom a liability would immediately result from the verdict is incompetent to give evidence for the party in whose success he is interested, as for instance one who has guaranteed a party against the event of the suit, or a co partner, or an agent liable to his principal in the case where a principal is sued for any damage arising from the agent's neglect A witness is also incompetent where he has an interest in the record, that is to say where the judgment of the court, if his party succeeded, would be evidence of a matter of fact to entitle him to some legal advantage In criminal proceedings however, no verdict obtained wholly or partly on the testimony of any witness can be evidence for or against that witness in any other proceeding, and therefore he cannot be objected to on that ground Some exceptions also to this rule of exclusion arise from the necessity of the case upon this principle the testimony of the servants of tradesmen to prove the delivery of goods and payment of money is daily admitted

The objection to competency is removable in some cases by a release of all liability to the witness But it is now provided by 3 & 4 W 4 c 42, that whenever a witness is objected to as incompetent on the ground that the verdict would be evidence for or against him he shall nevertheless be heard, and his name being entered on the back of the record the verdict so obtained shall never be used as such evidence

All testimony must be given under a judicial oath, with an exception only in favour of Quakers, which is now extended [illegible] as well as civil cases

*Immediate, and mediate* —Besides the exclusion of *witnesses* on the score of competency, large classes of *evidence* are inadmissible Admissible evidence must be, in general immediate, that is, it must convey the actual knowledge or belief of the witness This rule excludes, as a general proposition, all hearsay, that is, all narration of the declarations made by others to the witness There are, however, several classes of mediate testimony which are admissible Such are general reputation in certain cases, and declarations, made by a party to the suit, which contain admissions contrary to his own interest So, in various cases, letters or entries made in books are admissible, where they contain similar admissions Upon the same principle, the confession of a prisoner is evidence (if unextorted by fear or hope) in a criminal case Depositions of a witness now deceased, but who had formerly given evidence on the same dispute, are admissible Evidence may also be considered as divided into original or best, and secondary evidence For instance the reading of a document is better evidence of its contents than statements, either written or oral respecting them It is [illegible] that all [illegible] evidence excluded [illegible] (that is, evidence of a class which the law recognizes as better) happen to be attainable Other exclusive rules rest on grounds of public policy Thus husband and wife are excluded from giving testimony for or against each other [illegible] client, and, for particular purposes, some other private communications between parties, are in their nature privileged and cannot be given in evidence

*Examination of Witnesses* —A witness, on being admitted in court, is first subjected to the examination of the party in whose behalf he is called, which is termed the *examination in chief*, and the principal rule to be observed by the party examining is, that leading questions are not to be asked What are leading questions, it is not always easy to ascertain, but questions to which the answer yes or no would be conclusive of the issue [illegible] All questions [illegible] are [illegible] considered in one sense, as leading questions, but they are not all equally objectionable The witness is then cross-examined by the opposite party The object of cross examination is twofold to weaken the evidence given by the witness as to the fact in question either by eliciting contradictions or new explanatory facts, or, secondly, to invalidate the general credit of the witness In the latter case, it is a general rule, that a witness may refuse to answer any question, if his answer will expose him to criminal liability, and this whether immediately or by collateral inference Whether he can refuse to answer a question tending to disgrace him without involving him in danger, is a point which has been frequently debated, but which the general practice of our courts seems to settle in the affirmative The credit of a witness may likewise be impeached by the general evidence of others as to his character But in this case no evidence can be given of particular facts which militate against his general credit, as this would be in contravention of another rule, that collateral issues—questions of fact unconnected with the subject of dispute—shall not be raised during the course of a trial Re-examination of a witness by the party who first examined him must be directed to such new points only as have been raised by the cross-examination If it is wished to put a question not connected with these points the proper course is for the counsel to apply to the court to put the question for him

*Evidence, Documentary* —Written instruments, considered as evidence in a court of justice have been divided into public judicial documents, public non judicial, private documents, and mixed, which are partly public and partly private The contents of the record of a court of justice are properly proved by inspection of the record itself, otherwise by *exemplification* or by *sworn copy* A copy of a record, under the seal of the Court of Chancery or of one of the King's other courts, is an exemplification, as are also the records of some inferior tribunals Office copies are evidence wherever the law has entrusted a particular officer with the making of them Sworn copies are copies proved on oath to have been examined with the original All public documents, whether judicial or non judicial, which cannot be removed can be and usually are proved in this manner But before it can be read it must be proved that the original came out of the hands of the officer of the court, or from the proper place of deposit A copy of a copy is in no case admissible

Mixed documents are of a nature partly public and partly private, such as court-rolls of manors, and corporation books Examined copies of these are evidence The books of public companies—as, for instance, the East India Company—are evidence in questions between parties interested in them Private writings are of two sorts first writings to which the person against whom they are offered was party or privy, secondly writings of third persons All documents of the first class are, in general evidence against the party And an admission under seal (as a deed or bond) is, in [illegible] evidence against the obligor, or party [illegible] that is, he is *estopped*, or prevented, from offering to rebut it

A discussion of the rules which govern the admissibility of written instruments not under seal as evidence would occupy far too wide a field for the present purpose Oral evidence can in no case be received as an equivalent or substitute for an instrument, where a writing is required by law, or to give effect to such an instrument, if defective in any particular required by law, or to vary its terms, if it have been appointed, either by act of law or by compact of the parties, as a memorial of the transaction between them This rule proceeds on the general principle already adverted to, that where the best evi

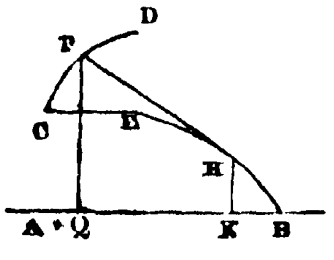
dence can be had secondary testimony shall not be substituted for it But oral evidence is admissible in various cases, to explain, to restrict, and to defeat instruments, on the ground of fraud or mistake

Entries in writing, as well as declarations by third persons, are in general excluded The cases in which they may be admitted are, either where they serve to explain and accompany material facts, or, in some cases, on a principle of necessity, where the party who made them is supposed to have had peculiar grounds of knowledge as to the fact in dispute In the first category, as a common instance, we may cite declarations of a trader at the time of his quitting his place of business, which are commonly received in evidence on bankruptcy questions The second may be instanced by entries of bailiffs or stewards, which are received where the payment of rent is disputed

*Proof of Written Documents* —This is effected either by witnesses, by admission of the adversary, or by enrolment, the latter mode of proof being confined to a few classes of documents by virtue of acts of parliament

In the first and common mode of proof, the instrument must either be produced, or its absence must be accounted for by loss or destruction (and if either of these negative assertions, as they may be called, cannot be directly proved, evidence of diligent search will be received, and its contents may be proved by counterpart or secondary evidence), or it must be proved to be in possession of the adversary, and that notice was given him to produce it In the case where the instrument itself is produced it is either attested or not attested If the former, the attesting witness must be called, or his absence must be accounted for and his handwriting proved, or it must appear that the instrument is thirty years old, and has come out of proper custody in which case its authenticity is presumed Where a subscribing witness is called to prove a deed, proof of sealing and delivery is required from him, where there are several subscribing witnesses, one is sufficient Where there are no attesting witnesses to an instrument, the handwriting of the party binding himself is generally sufficient proof On the proof of handwriting —a very difficult matter of evidence,— we can only observe that it is ordinarily proved by the testimony of a witness who has acquired a general knowledge of the party's hand, either by having seen him write (although but once), or by a correspondence with him, or other transactions It is a general rule, that evidence by comparison of writings is not receivable, and this although a skilled person (as a clerk from the post office) offer his opinion *Public* documents, when the originals are not procurable, are commonly proved by examined copies (For a summary of the [illegible] into the law of evidence by the 14 & [illegible] the SUPPLEMENT)

EVOLUTE (Lat evolvo *I unroll out*), in the theory of curve lines, is a curve from which any given curve may be supposed to be formed by the *evolution* or unlapping of a thread from a surface having the same curvature as the first curve For example, let BHI be a model of a plane curve made of a solid material having some thickness, and let one end of a thread HIC be fastened to a point B on the edge of the model, and applied along its convexity, so as to coincide with it entirely between [illegible] the portion [illegible] of the thread forming a straight line [illegible] Suppose [illegible] to be gradually unlapped from the curve BI, keeping it always tight the extremity C will describe another curve CPD The curve EHB, by which the curve CPD is generated is called the *evolute* of CPD, and the curve CPD is called the *involute* of EHB All curves in which the curvature is neither infinitely great nor infinitely small, may be generated in this way by the evolution of a thread from another curve




From this mode of generating curve lines it is obvious, first, that PH, the part of the thread disengaged from the arc EH, is a tangent to the evolute at H, second that PH is a perpendicular to the tangent to the involute CPD at the point P, third, that it is the radius of curvature of CPD at P, fourth, that the point H is the centre of curvature of CPD at P, and that the evolute EHB is the *locus* of the centre of curvature of every point in the involute CPD Hence the problem to find the evolute of any curve is the same as to find the locus of the points which successively form the loci of its centres of curvature

Let AQ = $x$, ar[illegible] PQ [illegible] linates of the poin[illegible] P[illegible] [illegible] t A Let also A[illegible] [illegible] H [illegible] the co-ordinates of H, the centre of curvature of CPD at P, and their values are found from the formulæ,

$$v = x - \frac{dy}{dx} \cdot \frac{dx^2 + dy^2}{d^2y}, \quad u = y + \frac{dx^2 + dy^2}{d^2y},$$

in which $x$ and $y$ are the independent variable, and $y$ [illegible] which is determined by [illegible]

Since the radius of curvature HP is the sum of the arc HI and the straight line CI it follows that HP is the difference of two curve lines, and since it is possible to form innumerable curves whose radii of curvature are expressible in algebraic terms, therefore corresponding to every such curve there is another curve, namely, its evolute, which can be exactly rectified The theory of generating curve lines by evolution was proposed by Huygens before the invention of the differential calculus, and published in his *Horologium Oscillatorium* His object was to find the evolute of the common cycloid, with a view to the mechanical means of causing clock pendulums to vibrate in cycloidal arcs, for he had already discovered the beautiful property of this curve,— that all vibrations in its arc are synchronous, or performed in equal times, whether the arcs be great or small *See* CYCLOID

EVOLU'TION (Lat evolvo, *I unfold*) In Physiology, the theory of generation, in which the germ is held to pre-exist in the parent, and its parts to be unfolded and expanded, but not actually formed, by the procreative acts The principal and most consistent supporters of this theory maintain that the first created individuals contained the germs of all future possible successors, successively included one within the other, and that generation is merely the act of unfolding, or an evolution of the germ Swammerdam, Bonnet, Spallanzani, Haller, and Cuvier maintain this theory

The theory of evolution is opposed to that of epigenesis [illegible] in which the germ is held to be actually formed as well as expanded by virtue of the procreative powers of the parent Its chief supporters are Harvey, Caspar Fred Wolff Blumenbach, and the professors of the modern German physiological school

EVOLUTION in Arithmetic and Algebra, denotes the extraction of roots (*See* EXTRACTION) In Geometry, evolution is the opening or unfolding of a curve

EVOVE In Music, the vowels used with the ending notes of the ecclesiastical tones it is a word for brevity's sake, formed of the six vowels in the words *sæculorum amen*, which are subjoined to the notes in Antiphonaries, &c, to indicate that those are the ending notes

EXACERBA'TION (Lat exacerbo, *I grow violent*) An increase in the violence of symptoms of disease, as of pain or especially of fever

EXE'RESIS (Gr ἐξαίρεω, *I remove*) One of the divisions of surgery adopted by old writers, and confined to operations concerned in the removal of parts of the body

EXALTA'DOS In Spanish History, the name of the party attached to what [illegible] *liberal* system of politics [illegible] gauche of the French, or W[illegible]

EXANTHE'MA (Gr ἐξανθέω, *I effloresce*) An eruptive disorder

EXARCH (Gr ἔξαρχος) The title of the viceroys of the Byzantine emperors in the provinces of Italy and Africa after they had been conquered by Justinian The exarch of the former province fixed the seat of his government at Ravenna They were also styled patricians

EX CA'THEDRA A Latin phrase, originally applied to decisions rendered by prelates chiefly popes, from their cathedra or chair [illegible] in a solemn judicial manner Hence applied to every decision pronounced by one in the exercise of his peculiar authority a professor in his lecture room a judge from the bench, &c

EXCELLENCY A title of honour in various European states It was borne successively by the Lombard kings, by some emperors of the West, by various minor Italian potentates, and it is now appropriated to persons in the actual execution of certain official services ministers some court dignitaries and ambassadors, but not charges d'affaires Governors of English colonies are styled Excellency

EXCE'NTRIC (Lat ex, *out*, and centrum, *centre*), in the Ancient Astronomy, is the deferent circle in the circumference of which the centre of the epicycle of a planet is carried forward in its orbit round the earth It was *excentric* in respect of the earth, that is, though the orbit of a planet was a circle described about the earth, the earth was not placed at the centre of that circle In modern astronomy, the excentric is the circle which circumscribes the elliptic orbit of a planet Hence, *Excentric Anomaly* is the arc of the excentric between the perihelion of the orbit and the straight line drawn through the centre of the planet perpendicular to the major axis. *See* ANOMALY

EXCENTRI'CITY In Astronomy, the distance of the foci from the centre of the elliptic orbit of a planet or satellite, the semi axis major being regarded as unity, or, it is the ratio of the distance between the focus and centre to the semi axis major Thus, if $a$ and $b$ denote respectively the semi axes major and minor, and $e$ the excentricity, we have $ae = \sqrt{a^2 - b^2}$ *Excentricity* is thus

For the excentricities of the different planets, see PLANET

EXCEPTION In Law a form or stay to [illegible] triangle exceeds two right angles

EXCHANGE, in Arithmetic, is the finding the value of one commodity or denomination of money in terms of another When a unit of each denomination is determined in terms of a common standard, all the operations of this rule are applications of the rule of proportion

EXCHANGE In Commerce, a term used to designate that species of mercantile transactions by which the debts due to individuals at a distance from their creditors are paid without the transmission either of money or goods

Among cities or countries having any considerable intercourse together the debts mutually due by each other approach for the most part, near to an equality There are at all times, for example, a considerable number of persons in London indebted to Hamburgh, but, speaking generally, there are about an equal number of persons in London to whom Hamburgh is indebted, and hence when A of London has a payment to make to B of Hamburgh, he does not remit an equivalent sum of money to the latter, but he goes into the market and buys a bill upon Hamburgh for an equal amount —that is he buys an order from C of London addressed to his debtor D of Hamburgh, directing him to pay the amount to A or his order A having indorsed this bill or order, sends it to B who receives payment from his neighbour D The convenience of all parties is consulted by a transaction of this sort The debts due by A to B and by D to C, are extinguished without the intervention of any money A of London pays C of ditto and D of Hamburgh pays B of ditto The debtor in one place is substituted for the debtor in another, and a postage or two, and the stamp for the bill, form the whole expenses

A bill of exchange may therefore be defined to be an order addressed to some person residing at a distance, directing him to pay a certain specified sum to the person in whose favour the bill is drawn, or his order In mercantile phraseology, the person who draws a bill is termed the drawer, the person in whose favour it is drawn the remitter, the person on whom it is drawn the drawee, and after he has accepted the acceptor Those persons into whose hands the bill may have passed previously to its being paid are from their writing their names on the back termed indorsers, and the person in whose possession the bill is at any given period is termed the holder or possessor

The negotiation of inland bills of exchange, or of those drawn in one part of the United Kingdom on another is almost wholly in the hands of bankers Many of the banks established in different parts of the country have a direct intercourse with each other, and all of them have correspondents in London Hence an individual residing in any part of the country who may wish to make a payment in any other part, however distant, may effect his object by applying to the nearest bank Thus suppose A of Penzance has a payment to make to B of Inverness To send the money by post would be hazardous, and if there were fractional parts of a pound in the sum, it would hardly be practicable to make use of the post How then will A manage? He will pay the sum to a banker in Penzance, and his creditor in Inverness will receive it from a banker there The transaction is very simple The Penzance banker instructs his correspondent in London to pay to the London correspondent of a banker in Inverness the sum in question on account of B, and the Inverness banker being advised in course of post of what has been done, hands over the money to B The whole charges are limited to a trifling commission and two-pence for postage, so that the affair is transacted in the cheapest as well as in the most commodious possible manner Bills drawn by the merchant of one country upon another are termed foreign bills of exchange, and it is to their negotiation that the following remarks principally apply

I *Par of Exchange* The par of the currency of any two countries means, among merchants, the equivalency of a certain amount of the currency of the one in the currency of the other, supposing the currencies of both to be of the precise weight and fineness fixed by the respective mints Thus the standard gold coin of Great Britain and France is of the same weight and fineness, the former being called a pound sterling, and the latter a napoleon of 20 francs, which are consequently said to be at par between London and Paris And the exchange between the two countries is said to be at a par when bills are negotiated on this footing, that is, for example, when a bill for 1*l* drawn in London is worth 25 fr 20 cents in Paris, and conversely When 1*l* in London buys a bill on Paris for more than 25 fr 20 cents, the exchange is said to be in favour of London and against Paris, and when on the other hand, 1*l* in London will not buy a bill on Paris for 25 fr 20 cents, the exchange is against London, and in favour of Paris (See table of the Par of Exchange, at the end of this article)

II *Circumstances which determine the Course of Exchange* —The exchange is affected, or made to diverge from par, by two classes of circumstances First, by any discrepancy between the actual weight or fineness of the coins, or of the bullion for which the substitutes used in their stead will exchange, and their weight or fineness as fixed by the mint regulations, and, secondly, by any sudden increase or diminution of the bills drawn in one country upon another

*a* It is but seldom that the coins of any country correspond exactly with their mint standard, amd when they diverge from it, an allowance corresponding to the difference between the actual value of the coins and their mint value must be made in determining the real par Thus, if while the coins of Great Britain corresponded with the mint standard in weight and purity, those of France were either 10 per cent worse or debased below the standard of her mint, the exchange it is obvious, would be at real par when it was nominally 10 per cent against Paris, or when a bill payable in London for 100*l* was worth in Paris 2772 fr, instead of 2,520 fr In estimating the *real* course of exchange between any two or more places it is always necessary to attend carefully to this circumstance that is, to examine whether their currencies be all of the standard weight and purity, and if not how much they differ from it When the coins circulate either so worn or rubbed as to [illegible] below their mint standard, or when paper money is depreciated from excess or want of credit the exchange is at real par only when it is against such country to the extent to which its coins are worn or its paper depreciated When this circumstance is taken into account it will be found that the exchange during the latter years of the war [illegible] against this country, was [illegible] pression was nominal only, being occasioned by the great depreciation of the paper currency in which bills were paid (See art 'Exchange,' new edition, *Ency Britannica*)

*b* Variations in the actual course of exchange, or in the price of bills, arising [illegible] currency of either of two [illegible] *nominal* only, such as are *real* grow out of circumstances affecting their trade

When two countries trade together, and each buys of the other commodities of precisely the same value, their debts and credits will be equal, and, of course, the real exchange will be at par The bills drawn by the one will be exactly equivalent to those drawn by the other, and their respective claims will be adjusted without requiring the transfer of bullion or of any other valuable produce, but it very rarely happens that the debts reciprocally due by any two countries are equal There is almost always a balance owing on the one side or the other and this balance must affect the exchange If the debts due by London to Paris exceeded those due by Paris to London the competition in the London market for bills on Paris would because of the comparatively great amount of payments our merchants had to make in Paris be greater than the competition in Paris for bills on London, and consequently the real exchange would be in favour of Paris and against London

It is plain, however that all fluctuations of the real exchange must be confined within comparatively narrow limits, and that, though they may be under they can never exceed, the expense of transmitting bullion from the debtor to the creditor country, for, if they exceeded this amount, it would plainly be more for the debtor's advantage to transmit bullion rather than bills, and the exchange would immediately sink to par

It is usual to suppose when the exchange is against a country, that it can only be adjusted by an exportation of bullion, but provided the fall of the exchange be *real*, and not *nominal*, —that is, provided the currency of the country which has the unfavourable exchange be in a sound state, and that it is neither depreciated from excess, nor from the coins being reduced below their mint standard, but that the depression originates in some circumstances affecting the trade of the country, as the occurrence of a bad harvest, the breaking out of a war &c, —then, in such a case, it may, and most probably will not be necessary [illegible] Suppose, to illustrate [illegible] 100*l* to pay in Petersburgh [illegible] is 3 per cent against England, or that a bill that cost 103*l* in London will only fetch 100*l* in Petersburgh now, suppose that the cost of transmitting bullion to Petersburgh is also 3 per cent, the question is, what will the merchant do? If he had no other resource but to send a bill or bullion, it is plain it would be indifferent

him which he sent But he is not so restricted He [illegible] London [illegible] export- [illegible] that will [illegible] expenses carriage, he will obviously gain *d* by exporting it, ther than transmitting bullion or a bill The fact is, at a nation might cancel a foreign debt of 10 or 100 illions without sending abroad a single ounce of gold d silver the latter are never exported, unless when it ppens to be more profitable to export them than any- ing else They always go abroad to find, and not to se, their level

III A fall of the *nominal* exchange, that is, a fall of the change occasioned by the depreciation of the currency, is no influence whatever over trade When the currency depreciated, the premium which the exporter of commodities derives from the sale of the bill drawn on his rrespondent abroad is countervailed by a precisely equal se in the price of the commodity occasioned by the deciation, so that the result is nothing But it is otherise when the *real* exchange is depressed, or when the ms payable to the foreigner exceed those receivable om him In this case, there is no rise of prices and e depression of the exchange operates as a stimulus exportation As soon as the real exchange diverges om par, the mere inspection of a price current is no nger sufficient to regulate the operations of the mer ant If it be unfavourable, the premium which the porter will receive on the sale of his bill must be included in the estimate of the profit he is likely to derive om the transaction The greater that premium the ss will be the difference of prices necessary to induce m to export, and hence an unfavourable real exchange s an effect exactly the same with what would be pro ced by granting a bounty on exportation equal to the emium on foreign bills

But, for the same reason that an unfavourable *real* ex- [illegible] e price of commodities imported from abroad must be much lower than their price at home as not merely afford, exclusive of expenses, the ordinary profit of ock on their sale, but also to compensate for the premium which the importer must pay for a foreign bill if remit one to his correspondent or for the discount, dded to the invoice price if his correspondent draw upon m A less quantity of foreign goods will therefore suit r market when the *real* exchange is unfavourable, and wer payments having to be made abroad, the competion for foreign bills will be diminished and the *real* change rendered proportionally favourable In the me way, it is easy to see that a favourable *real* exchange ust operate as a duty on exportation and as a bounty on portation



It is thus that fluctuations in the real exchange have a necessary tendency to correct themselves They can never, for any considerable period, exceed the expense of transmitting bullion from the debtor to the creditor country [illegible] either permanently this extent When favourable, it corrects itself by restricting exportation and facilitating importation, and when unfavourable, it produces the same effect by giving an unusual stimulus [illegible] by throwing obstacles in the way of [illegible] *par* forms the centre of these oscillations, and though the thousand circumstances which are daily and hourly affecting the state of debt and credit prevent the ordinary course of exchange from being almost ever precisely at par, its fluctuations, whether on the one side or the other, are confined within certain [illegible] has to correct itself, is powerfully assisted by the operations of the bill merchants

England, for example, might owe a large excess of debt to Amsterdam, yet, as the aggregate amount of the debts due by a commercial country is generally balanced by the amount of those which it has to receive, the deficiency of bills on Amsterdam in London would most probably be compensated by a proportional redundancy of those on some other place Now it is the business of the merchants who deal in bills, in the same way as of those who deal in bullion or any other commodity, to buy them where they are cheapest, and sell them where they are dearest They would therefore, buy up the bills drawn by other countries on Amsterdam, and dispose of them in London, and by so doing would prevent any great fall in the price of bills on Amsterdam in those countries in which the supply exceeded the demand, and any great rise in Great Britain and those countries in which the supply happened to be deficient In the trade between Italy and this country the bills drawn on Great Britain amount, almost [illegible] greater sum than those drawn on Italy [illegible] however, the Italian bills on London ar [illegible] and other countries indebted to England prevent the real exchange from ever becoming much depressed (For further information as to the principles involved in this curious and interesting department of commercial and international economy, see the able and excellent tract, entitled *Observations on the Course of Exchange*, by William Blake Esq, and the art "Exchange" in the new edition of the *Encyc Britannica*, and for the practical details connected with the subject, see *Commercial Dictionary*) We subjoin from the latter a table of the par of exchange between London and some of the principal foreign places for the negotiation of bills of exchange

ar of [illegible] England and the following Places, — viz Amsterdam, Hamburgh, Paris, Madrid, Lisbon, Legh [illegible] and Venice, the same [illegible] ined from the intrinsic Value of their principal Coins, by [illegible] with Gold, and Silver with [illegible] according to their Mint Regulations, and to Assays made at the [illegible] Mints

| | Gold | | Silver | | | | Explanations |
|---|---|---|---|---|---|---|---|
| | | | Old Coinage | | New Coinage | | |
| | Mint Regulations | Assays | Mint Regulations | Assays | Mint Regulations | Assays. | Moneys of Exchange |
| msterdam, banco | 36 8 | 36 6 8 | 37 3 | 37 10 5 | 35 0 | 35 6 5 | Schillings and pence Flemish per pound sterling Agio 2 per cent |
| Do current - | 11 4 5 | 11 3 8 | 11 8 5 | 11 11 8 | 10 14 6 | 10 17 6 | [illegible] and livers per pound sterling |
| amburgh - | 34 3 5 | 35 1 5 | 34 1 | 35 1 3 | 32 11 | 32 11 5 | [illegible] per pound sterling |
| aris - - | 25 20 | 25 26 | 24 73 | 24 91 | 23 23 | 23 40 | [illegible] per pound sterling |
| adrid - - | 37 3 | 37 2 | 39 2 | 39 0 | 41 7 | 41 5 | Pence [illegible] per piastre or dollar of exchange |
| isbon - | 67 4 | 67 5 | 60 41 | 58 33 | 61 30 | 62 69 | [illegible] sterling per [illegible] |
| eghorn - | 49 1 | 49 0 | 46 46 | 46 5 | 49 60 | 49 5 | [illegible] per [illegible] at |
| enoa - - | 45 5 | 45 5 | 46 46 | 48 9 | 49 4 | 52 0 | [illegible] per [illegible] * |
| aples - - | 41 22 | | 41 42 | | 43 9 | - | Per [illegible] ordered [illegible] ce of 1515 |
| enice | 46 3 | 46 0 | 47 5 | 49 9 | 41 6 | 46 1 | [illegible] per [illegible] |

The currency of Genoa has consisted, since 1826, of *Lire Italiane* of exactly the same weight and fineness as francs, so that the par of hange with Genoa is now the same as with Paris

EXCHE'QUER CHAMBER, COURT OF, in Law, is nstituted by 1 W 4 c 70 the proper tribunal for the al of writs of error from the three superior courts, ich before was only partially the case In this court the it is tried before the judges, or judges and barons, of e two courts which did not give the first judgment ror from this court lies to the House of Lords, which [illegible] of the country

EXCHEQUER COURT OF [illegible] *v*, was originally tabli hed for the recovery of the king's debts and ordinary revenues of the crown In its modern shape, it is fact a combination of the distinct inferior courts It quired concurrent jurisdiction with the other two perior courts in all personal actions (*see* COURTS, SUPERIOR) by the fiction of the complaining party being btor to the king, a fiction which is now removed It s exclusive jurisdiction in cases in which the king's venue is concerned, whether personal actions, or informations filed under the various revenue acts It has also an equitable jurisdiction exclusive with respect to matters connected with the revenue, concurrent with the cour [illegible] civil suits It has also the original and jurisdiction in cases of tithes (*See* CHANCERY) The chief and four puisne or younger judges of the Exchequer are termed Barons

EXCHEQUER, COURT OF (in Scotland) established on its present footing by 6 Anne, c 26, should consist of a chief baron and four junior barons (but three only have been [illegible] vative jurisdiction as to [illegible] revenues of the crown

EXCHEQUER BILLS are also credit [illegible] by the Parliament [illegible] for various sums and bearing interest [illegible] from 1½*d* to 2½*d* per diem per £100 according to the usual rate at the time The advances of the Bank to Government are made upon exchequer bills, and the daily transactions between the Bank and Govern-

ment are principally carried on through their intervention Notice of the time at which outstanding exchequer bills are to be paid off is given by public advertisement Bankers prefer vesting in exchequer bills to any other species of stock, even though the interest be for the most part comparatively low [illegible] received at the Treasury at the [illegible] it, the holders being exempted from any risk of fluctuation Exchequer bills were first issued in 1696, and have been annually issued ever since

Account of the Amount of the Exchequer Bills outstanding in each Year since 1815, and the Rate of Interest [illegible]

| Years ended 5 Jan | Amount outstanding | Rate of Interest on Exchequer Bills | Years ended 5 Jan | Amount outstanding | Rate of Interest on Exchequer Bills |
|---|---|---|---|---|---|
| | *L* | Per cent per diem *d* *d* *d* | | *L* | Per cent per diem *d* *d* *d* |
| 1816 | 11,411,000 | 3½ | 1847 | [illegible] | 2 |
| 1817 | 11,[illegible] | 3½ | 1848 | [illegible] | 2 1½ 1½ |
| 1818 | [illegible] | 3 4½ 2 | 1849 | [illegible] | 1½ |
| 1819 | 13,[illegible] | 2½ 2 | 1850 | [illegible] | 1½ |
| 1820 | 30,[illegible] | 2½ 2 | 1851 | [illegible] | 1½ |
| 1821 | 31,[illegible] | 2½ 2 | 1852 | [illegible] | 1½ |
| 1822 | 31,[illegible] | 2 | 1853 | [illegible] | 1½ |
| 1823 | 31,[illegible] | 2 | 1854 | [illegible] | 1½ |
| 1824 | 31,[illegible] | 2 | 1855 | [illegible] | 1½ 2 2½ |
| 1825 | 32,[illegible] | 2 1½ | 1856 | [illegible] | 2½ 2 |
| 1826 | 27,[illegible] | 1½ 2 | 1857 | [illegible] | 2 |
| 1827 | 21,[illegible] | 2 | 1858 | [illegible] | 1½ |
| 1828 | 2,510,500 | 2 | 1859 | 21,[illegible] | |

EXCISE DUTIES, in Revenue and Finance, are duties imposed on articles produced or manufactured at home, while in the possession of the producers or manufacturers They were introduced into England by the Long Parliament in 1643, being then laid on the makers and venders of ale, beer, cider, and perry The royalists soon after followed the example of the republicans both sides declaring that the excise should be continued no longer than the termination of the war But it was found too productive a source of revenue to be again relinquished, and when the nation had been accustomed to it for a few years the parliament declared in 1649 that the impost of excise was the most easy and indifferent levy that could be laid upon the people It was placed on a new footing at the Restoration and notwithstanding Mr Justice Blackstone says, that "from [illegible] time its very name has been [illegible] land" (*Com*, book 1 c 8), it has continued progressively to gain ground and is at this moment imposed on several important articles, and furnishes nearly a third part of the entire public revenue of the kingdom

For the more easy levy of the excise duties England and Wales are divided into about fifty-six collections some of which are called by the names of particular counties, others by the names of great towns Where one county is divided into several collections or where a collection comprises the contiguous parts of several counties, every such collection is subdivided into several districts, within which there is a supervisor, and each district is again subdivided into out rides and foot-walks within each of which there is a surveying officer or gauger Some excise duties, that were justly objected to have been repealed within these few years, and, with the exception of the duty on glass, which interferes injuriously with the manufacture, we are not sure that there is one of the existing duties that can be fairly objected to on principle, though the rate of duty might in some instances be [illegible] It has been said that [illegible] the cost of subsistence to the labouring classes" But this assertion has really no foundation In fact, the only excise duty that can be said to fall on a necessary of life is that on soap, which produced in 1850 (in Great Britain) nearly 900,000*l*, but as the population of Great Britain amounts at present to about 20,000,000, the soap tax cannot, at an average, impose a burden of 11*d* a year on each individual If we estimate its annual pressure on a labouring family of five persons at from 2*s* 6*d* to 3*s*, we shall not be within but beyond the mark

The only taxes, in the various departments of the revenue, that can be truly said to fall on articles necessary to the labourer, are besides soap principally those on tea and sugar We incline to think that the duties on these articles might be very materially reduced without affecting the revenue but, however that may be, it cannot be truly affirmed that they entail any grievous burden on the labouring classes The entire nett produce of the excise duties in Great Britain in 1850 amounted to 12,913,102*l*, of which the duties on spirits and malt, that is, on spirits and beer, produced no less than 8,600,000*l* In Ireland during the same year, the excise duties amounted to 1,231,548*l*, of which the spirit and malt duties furnished above four-fifths The rate at which this revenue was collected was nearly 6½ per cent in Great Britain, and 9½ per cent in Ireland Now, we are bold to say, that no equal amount of revenue was ever raised with so little inconvenience or injury to the contributors Even though they were not required by the public exigences [illegible] obstruct a pernicious habit and should not be given up They are the best of all [illegible] duties, and the only thing to be attended to in their imposition, is not to carry them to such a height as to defeat their object by encouraging smuggling We have yet to learn, supposing they are not carried beyond this limit, that a single good objection can be made to these duties

The obscurity and complexity of the excise laws has been justly complained of It is needless to say, that they ought to [illegible] of every one [illegible] are in most instances [illegible] intelligible [illegible] duties and so for the others It is, in fact, all but impossible for any one to tell what the law really is on many points, so that the trader is left at the mercy of the officers and a wide door is opened to favouritism and fraud This disgraceful state of things might, however, be easily remedied by getting the treasury or the excise to prepare a short abstract of the law as to each duty, drawn up in the clearest and least ambiguous manner possible, and without any of that verbosity repetition, and technical jargon that infects acts of parliament, and renders them all but incomprehensible to ordinary persons A manufacturer abiding by this abstract should be held to have abided by the law, and should not be further questioned on the subject A measure of this sort might be easily carried into effect It would be an immense improvement, and would go far to obviate the only good objection to the excise duties

EXCITABILITY A disposition to be affected by exciting causes It is a term chiefly used in medicine, in reference to that state of system which is more or less susceptible of morbid excitement

EXCOMMUNICATION An ecclesiastical censure, by which a man is cut off from communion with his church The right possessed by any community of ejecting any person who contravenes the laws by which it is governed [illegible] It we suppose however, one society to be the depositary of all God's covenants and mercies and to afford the exclusive means of salvation, excommunication will in such case involve eternal perdition and must be defended on some higher grounds than those of social expediency An appeal is made to scripture in defence of this practice on the following grounds — The power of binding and loosing is undoubtedly given to the apostles St Paul delivers over to Satan a heretic or one who troubled the church, the sudden death of Ananias and Sapphira is to have been inflicted upon them by the apostle himself as a punishment for their crimes, the faithful are charged to keep no company with heretics, Titus is directed by St Paul to reject such after the first and second admonition Upon the authority of these passages many Christian churches have assumed the power of excommunication Protestants however do not generally venture to pronounce upon the future condition of a person thus excluded from covenanted benefits, whereas in the forms of excommunication of the Greek and Roman churches the excommunicated person is solemnly devoted to the devil

The English church retains a form of excommunication, in cases of adultery incontinence heresy, simony, and neglect of public worship, &c the practice, however, has long become obsolete In English law, excommunication was the ordinary mode by which contempt of the ecclesiastical jurisdiction was punished and its process enforced Forty days after sentence the writ *de excommunicato capiendo* issued (called [illegible] recital of the bishop's certificate) under which the [illegible] the sheriff By stat 53 G 3 c [illegible] excommunication is abolished, and [illegible] substituted for the former one

EXCORIATION (Lat excorio, *I remove the skin*) An abrasion of the cuticle

EXCRETION (Lat excerno, *I separate from*) A [illegible] which is rejected from the body as useless

EXCURRENT In Botany, a term used in describing the ramification of any body whose axis always remains in the centre, the other parts being regularly disposed around it, as the stem of *Pinus abies*

EXECUTION [illegible] a judgment, [illegible] be taken out within a year and a day after the judgment has been given, the judgment must be revived by writ of scire facias Execution may be against the person of defendant by imprisonment, which is under a writ of capias ad respondendum. There are also various writs of execution against the goods of a defendant and against his lands Criminal execution is in the country directed

by the judge of assize who tries the prisoner, and in London by the recorder

EXECUTION In the Fine Arts, the performance of that part of a work of art, and the dexterity with which it is accomplished

EXECUTIVE In the system of Government of that part of the powers of a state which is charged with putting into execution the laws made by the legislative or the decrees of the judicial power In England, all executive power is supposed to be vested in the king, and in inferior officers by his delegation

EXECUTOR In Law, an executor is a person appointed by a testator, and whose appointment is confirmed by the proper ecclesiastical court, to execute his will, and to represent him in his personal rights and liabilities Thus the rights and liabilities of an executor in his representative capacity (the same as those of an administrator), are those of the testator or intestate, arising,—for or against him—either out of contract, or from injury done to his property, real or personal, or from injury done by him to the real or personal property of another, but the liabilities of an executor or administrator do not overreach the property or assets which he has received, or might but for his negligence or default have received by virtue of his office

The first and most important duty of executors and administrators is the payment of debts which attach to the property in their hands [illegible] the reasonable expenses of the funeral [illegible] incurred in obtaining letters of administration [illegible]

1st Debts due to the crown by record or on specialty

2dly Debts due to the subject by virtue of the judgment of any court of record

3dly Debts acknowledged upon record, as by recognizance

4thly Debts due upon specialty, or on account of rent

5thly Debts of the crown not upon specialty or record

6thly Debts by simple contract

Creditors of each class are entitled to be paid in full before any thing is allowed to debts of an inferior order, and as between themselves they are paid pro rata as far as the assets will extend But an executor will be allowed, upon account, any debt that he may have paid without notice of another debt of a higher class, and as between creditors of equal degree he may, before action brought at law, or decree to account in equity give preference to any He may also at any time as against creditors of an equal class retain a debt due to himself

Next to debts stand, in the first place specific legacies, i e gifts of specific parts of personal estate, and in the next place [illegible] money payable [illegible] what remains [illegible] any, or where there are none after payment of debts, is divisible among the next of kin according to the Statute of Distribution Specific legacies may be recovered at law, but the rights of general legatees, and of next of kin are enforcible only in courts of equity, or in the ecclesiastical courts

Most frequently also claims in the nature of debt or legacy to which the personal estate of testators or intestates is subject are prosecuted in courts of equity, which do not only like courts of law take cognizance of each individual right as it is brought forward, but will take upon themselves the whole administration of the estate and retain it in their hands for the purpose of doing justice to all claimants

In so doing courts of equity are bound to follow the legal order of priority above stated, so far at least as the assets are legal, i e either recoverable in courts of common law, or arising upon [illegible] proper and coextensive with the legal interest [illegible] to which the principle of *æquitas sequitur legem* applies But where there are assets recoverable only in equity, and arising upon implied or resulting trusts these are called equitable, and in the application of such assets the rule obtains of equality between all debts, the priority of debts to legacies, and among these of specific to general, being still observed Where there are both legal and equitable assets, creditors availing themselves of their priority against the legal assets will not be admitted to any participation in the equitable assets till other creditors shall have received out of them the same proportion of their debts as the creditors of a higher degree shall have been already paid out of the legal assets

By the recent act of the 3 & 4 W 4 real estate not [illegible] of debts is made [illegible] administered by courts of equity according to the legal order of priorities, but real estate so devised or charged still remains as before equitable assets Executors and administrators as such have no concern in either case with the application of real assets

Many questions arise in regard to legacies,—as to when they are vested, when specific or [illegible] which it is impossible to notice within the limits of this summary

EXEGESIS (Gr ἐξηγέομαι, *I lead*) The term [illegible] exposition or interpretation [illegible] also used, however in an unusual [illegible] department of biblical learning has been most assiduously cultivated in modern times, especially by the Germans, as the writings of Michaelis Schleusner Rosenmuller, Gesenius, &c amply testify

EXERGUE (Fr) In Numismatics, the basis or lower limb of a coin or medal, when separated by a line from the rest of the face, which usually contains words [illegible] of the coin, or other subsidiary [illegible]

EXFOLIATION (Lat exfolio, *I scale off*) The separation of a piece of dead bone from the living

EXHALATION *See* VAPOUR, EVAPORATION

EXHAUSTION In Geometry, a method of demonstration employed by the ancient geometers to prove the equality of two magnitudes, by showing that their difference is less than any assignable magnitude The ancients employed this method in their difficult researches, particularly in the theory of curve lines and surfaces, and in determining the areas and volumes which those surfaces contain As they admitted no demonstrations but such as are perfectly rigorous, they did not consider curves as polygons of a great number of sides, but in attempting to discover the properties of any curve, they regarded it as the fixed term or limit to which the inscribed and circumscribed polygons continually approached and approached nearer as the number of their sides was increased Thus they *exhausted*, as it were, the space between the polygons and the curve, and hence this method of procedure was called the *method of exhaustion*

As polygons bounded by straight lines were known figures, their continual approach to the curve gave a more precise idea of its properties in proportion as the difference was diminished, and [illegible] law of continuity, an exact knowledge [illegible] was at length obtained But when the properties of the curve were thus divined, as it were, it remained to verify them by a *geometrical* demonstration, and this was done by proving that every contrary supposition necessarily leads to a contradiction This method of demonstration is the *reductio ad absurdum*

By the method of exhaustion the ancients demonstrated that the areas of circles of different diameters are to each other as the squares of their diameters, that the volumes of spheres are to each other as the cubes of their diameters, that pyramids of the same altitude are in proportion to their bases, that the cone is the third of a cylinder of the same base, &c In the same manner Archimedes demonstrated that the convex surface of a right cone is equal to the area of the circle whose radius is a mean proportional between the side of the cone and the radius of the base, that the area of a sphere is four times that of one of its great circles, and that the area of any of its zones is equal to the circumference of a great circle multiplied by the height of the zone The differential calculus of the moderns is only the method of exhaustion of the ancients reduced to a simple and commodious analysis (See *Maclaurin's Fluxions*, and [illegible] *Infinitésimal*)

EXHIBITION (Lat ex, *out of* and [illegible] *a chair*) In [illegible] Bath and other [illegible] conversation

EXHIBITION (Lat exhibeo, *I show*) A term applied in modern times to the public display of works of art This word is also used to denote private benefactions instituted for the maintenance of scholars in the universities See BURSARS

EXHUMATION (Lat ex, *out of*, and humus, *the ground*) The act of digging up a body interred in holy ground by the authority of the judge In France the laws enforce exhumation on proof that any person has been killed in a duel

EXIGENT In Law, a writ which lies when the defendant in an action personal or in an indictment, cannot be found, and where, in the former case, nothing of his can be found within the county whereby he may be attached or distrained upon The writ is directed to the sheriff, to proclaim the absent party on five county court days, one after another, and if he do not answer on the fifth, he is outlawed

EXILE (Lat exsilium, from exsul, *one banished ex solo from the soil of his country*) In Roman law, the punishment of banishment, or, more strictly speaking, the consequence of the interdiction from the use of fire [illegible] not known [illegible] jurisprudence (*Cicero ad Herenn*) In modern France (before the Revolution), there was a distinction between banishment and exile The former was a punishment assigned by the law and producing infamy, the latter a measure of discipline, inflicted by the arbitrary act of the monarch (usually through lettres de cachet) Thus political offenders

were frequently exiled to their estates, to a certain distance from court, &c

EXISTENCE. *See* PERCEPTION, MATERIALISM

E'XIT A word placed in the margin of plays to mark the time at which the player leaves the stage

EXO'DIUM, in Greek Tragedy, signified the end or denouement of the play, or more properly that portion of it (generally the last act) in which the catastrophe is indicated or the plot begins to be unravelled

EXODUS *See* PENTATEUCH

EX OFFI'CIO (Lat *by reason of office or duty*) In general language, every act done by an officer either in prosecution of the general duty of his office, or in executing some special duty imposed by it, is said to be done *ex officio* But, in more strict phraseology, a proceeding *ex officio* is one taken by an officer of his own will, in execution of what he takes to be the duty of his office, as, where a justice of the peace demands and takes surety of his own discretion, without the request of the injured party An ex officio information is an information at the suit of the king filed by the attorney general without [illegible] (See INFORMATION) [illegible] are employed in cases [illegible] when officially prosecuted

EXOGENOUS (Gr ἐξ, and γινομαι, *I grow*) A [illegible] plants a transverse slice of whose stem exhibits a central cellular substance or pith, an external cellular and fibrous ring or bark, and an intermediate woody mass, and certain fine lines radiating from the pith to the bark through the wood, and called medullary rays They are called Exogens, because they add to their wood by successive external additions, and are the same as what are otherwise called Dicotyledons They constitute one of the primary classes into which the vegetable world is divided, characterized by their leaves being reticulated, their stems having a distinct deposition of bark, wood, and pith, their embryo with two cotyledons, and by their flowers usually formed on a quinary type

EXOMPHALOS (Gr ἐξ, and ὀμφαλος, *the navel*) A [illegible] near the navel

EXOPHTHALMIA (Gr ἐξ, and οφθαλμος, *the eye*) The protrusion of the eyeball from the orbit It is usually the consequence of concussions or blows, sometimes it is produced by a tumour in the orbit, which gradually pushes the eyeball out of its socket

EXOPHYLLOUS (Gr ἐξ, and φυλλον, *a leaf*) A term invented by Dumortier to be applied to the young leaves of Exogens, since they are said to be always naked while those of Endogens sheath each other

EXOPTILES (Gr ἐξ, and πτιλον, *a feather*) A term invented by M Lestiboudois for Dicotyledonous [illegible]

EXORCISM (Gr [illegible], *I bind or charge upon oath*) The [illegible] which those endowed with certain powers were believed to be able to subject evil spirits to their obedience more particularly to compel them to leave the bodies of [illegible] supposed to be subject to demoniacal possession The [illegible] form one of the [illegible] the church of Rome

EXORDIUM (Lat exordior *I begin an oration*) In Oratory and Literature, the opening part of an oration which [illegible] to ancient critics, should be drawn either from the subject itself or from the situation of the speaker, presenting either brief remarks on the general character of the topic on which he is about to deliver himself, or insinuations (according to the advice of Cicero) ca[illegible] favour of [illegible]

EXORHIZ[illegible] (Gr [illegible] *root*) A term invented by Richard to be [illegible] plied to the embryo of Dicotyledons, inasmuch as their radicle always elongates downwards, directly from the outside of the base of the embryo

EXOSMO'SE (Gr ἐξ and ωσμος *impulsion*) The passage of gases, vapours, or liquids through membranes or porous media from within outwards Mr Dutrochet having found that if two fluids of unequal density are separated by an animal or vegetable membrane, the denser will attract the less dense, through the membrane that divides them this property he called Endosmose when the attraction is from the outside to the inside, and Exosmose when it operates from the inside to the outside of the body acted upon

EXOSTO'MI (Gr ἐξ, and στομα, *a mouth*) A term invented by Mirbel to denote the passage through the outer integument of an ovule, commonly called the foramen

EXOSTO'SIS (Gr ἐξ, *from*, and οστεον, *a bone*) [illegible] a swelling or tumour of a bone

Exostosis In Botany a disease to which the roots and stems of trees are subject, when knots or large tumours are formed upon or among the wood It is caused by a stoppage of growth on the one hand, and an attempt at excessive development on the other It is from sections of the exostoses of trees that some of the most beautiful wood used by cabinetmakers is obtained

EXOSTRA [illegible] as connected with the scene of a theatre.

EXOTERIC *See* ESOTERIC

EXOTHE'CIUM (Gr ἐξω, *without*, and θηκη, *receptacle*) That portion of an anther from which the pollen is incorrectly supposed to separate, it is the coating of the anther

EXO'TIC (Gr ἐξωτικος, *foreign*) Any thing in[illegible] country In [illegible] which require [illegible] which are not European

EXPA'NSION One of the most common and obvious effects of heat, which expands or enlarges the bulk of all the forms of matter The expansion of solids by increase of temperature is comparatively small, but it may be rendered sensible by carefully measuring the dimensions of any substance when cold, and again when heated an iron bar, for example fitted to a gauge which shows its length and breadth will no longer pass through the apertures when heated Among solids the metals are most expansible and contractile by heat and cold, but they vary much in this respect, as shown in the following table which exhibits the change of dimensions which several of them undergo when heated, from the freezing to the boiling point of water —

| | Temperature | |
|---|---|---|
| | 32° | 212° |
| Platinum | 120000 | 120104 |
| Steel | — | 120147 |
| Iron | — | 120151 |
| Copper | — | 120204 |
| Brass | — | 120230 |
| Tin | — | 120290 |
| Lead | — | 120345 |
| Zinc | — | 120360 |

The average expansion of glass is very nearly the same as that of platinum The expansibility of different *liquids* is also very variable, ether, for instance, and alcohol, are more expansile than water, and water more than mercury The expansibility of mercury is applied to a very useful purpose in the construction of the common thermometer In general all liquids expand and contract in proportion as they are heated and cooled, but to this law there is a remarkable and anomalous exception in regard to *water* When a large thermometer tube is filled with water of the temperature of 60°, and placed in a cold situation or in a [illegible] and salt, the water goes on shrinking [illegible] it has attained the temperature of about 40°, and then instead of continuing to contract till it freezes (as is the case with other liquids), it slowly *expands* and actually rises in the tube until it congeals In this case the expansion above 40° and below 40° seems to be equal so that water will be of the same bulk at 48° and at 32° This anomalous expansion of water by cold is productive of some important consequences, considered as a natural operation, for if water like other fluids, went on increasing in density till it froze, the consequence would be that large bodies of water instead of being only superficially frozen in winter, would be converted throughout into solid masses of ice Let us take a fresh water lake as an example The earth being in winter warmer than the air, the heat is withdrawn from the surface of the water by the cold breezes that blow over it, and the whole body of water has its temperature lowered to 40°, *which is the point of its greatest density* and a temperature perfectly congenial to fish and most other aquatic animals The cold now continues to operate upon the surface of the water, but, instead [illegible] its bulk and therefore rendering it [illegible] than the warmer water beneath, it expands it, and renders it *lighter*, so that under these circumstances a stratum of ice-cold water (at 32°) will be found lying upon the mass of warmer water beneath it (at 40°) The influence of the cold continuing, the surface of the lake will soon freeze, but the water immediately below the superficial covering of ice will be found comparatively warm, and as water is almost a non conductor of heat, it will be a long time before the ice attains any thickness, and the whole body of water, if of any depth, can never freeze throughout Indeed, it will be obvious that the retardation of freezing will be proportional to the depth of water which has to be cooled, and hence some very deep basins or lakes are scarcely ever even covered by ice

As liquids are *enlarged* [illegible] cifically lighter by heat, [illegible] duced by applying heat to different parts of the vessels containing them If the heat be applied to the bottom of the vessel, it is soon heated equally throughout, and made to boil, but if the surface only be heated it may then be boiled and evaporated, while the lower parts remain quite cold

Aeriform bodies and vapours are the most expansible

forms of matter, and they present an important peculiarity, for in other substances each individual has its own degree of expansion and contraction whereas all pure aeriform bodies expand and contract alike, so that if we accurately determine the expansion and contraction of any one of them, that knowledge applies to all the rest 100 measures of air [illegible] boiling point of wat [illegible] 37 5 parts, so that 100 cubic feet of air at 32° become dilated [illegible]

EX PARTE In law of the one part A commission ex parte in chancery is that which is taken out and executed by one side or party alone, on the other party's [illegible] join

EXPECTATION OF LIFE By this term writers on annuities and reversions express the mean duration of human life, after a [illegible] given table of mortality W [illegible] of a given age, the *expectation of life* is the mean number of future years which individuals of that age, one with another, actually live, those who live longer than that period enjoying as much more life in proportion to their numbers as those who live a shorter time enjoy less The *expectation of life*, according to this definition, differs altogether from what is called the *probable life* or the number of years which an individual has an equal chance of surviving The [illegible] the period of time at the end of wh [illegible] being alive is equal to the probability of being dead, or is equal to $\frac{1}{2}$, and this is manifestly the period in which the number of lives in the table, beginning with any given age, is reduced to one half For example, if in a given table of mortality we find that 1000 individuals are living at [illegible] and that of these 500 only are living at the [illegible] the *probable life* of an individual aged 40 [illegible] that table, would be 23 years, that is to say it is an even wager whether he will be alive or dead at the end of 23 years The *mean life*, or *expectation of life*, is, however, quite different in principle (though in most tables not very differe [illegible] Is on the same mathematical [illegible] each future year of life, to the last in the table, is are employed in the calculation of life annuities It is computed as follows —

Let the probabilities that a life of a given age will live over

| 1, | 2, | 3, | 4 | $x$ years, |
|---|---|---|---|---|
| be $p_1$ | $p_2$ | $p_3$ | $p_4$ | $p_x$ respectively, |

then the probability that the life will fail in any given year $x$, is $p_{x-1} - p_x$

N [illegible] the portion of existence which an [illegible] $x_1$ to enjoy in respect of any future year $x$, there are two contingencies to be considered — 1st, The individual may live over that year in which case he will enjoy a whole year of life = 1 But the probability of this event is $p_x$, therefore $p_x \times 1 = p_x$ is the portion of time he may at present expect to live in respect of that year 2d, The individual may die in the course of that year, and as the chances of dying at any particular part of the year are equal, we must suppose him to die at the middle of the year, in this case, therefore, he enjoys half a year of life = $\frac{1}{2}$ But the probability his death will happen in the $x$th year is $p_{x-1} - p^x$, consequently $\frac{1}{2}\left(p_{x-1} - p^x\right)$ is the portion of time he may hope to live, in respect of that year, on the second contingency

Adding the two results together, we get $p_x + \frac{1}{2}\left(p_{x-1} - p_x\right) = \frac{1}{2}\left(p_{x-1} + p_x\right)$ for the whole of his expectation of life in respect of the $x$th year from the present Substituting successively the numbers 1, 2, 3, &c for $x$, in order to get the expectation for each succeeding year till the last age in the table, and denoting the sum of the expectations by L, we find (since $p_0 = 1$)

$$E = \tfrac{1}{2}(1 + p_1 + p_2 + p_3 + \&c) + \tfrac{1}{2}(p_1 + p_2 + p_3 + \&c),$$

consequently,

$$E = \tfrac{1}{2} + p_1 + p_2 + p_3 + \&c \qquad (1)$$

Thus it appears that the true value of the expectation of life is equal to the sum of the probabilities of the life enduring through 1, 2, 3, &c years to the limiting age of the table of mortality, increased by $\frac{1}{2}$ The labour that would be required to sum this series for every different [illegible] the next order, as [illegible] annuity tables Thus, let $E_1$ denote the [illegible] for an individual of any [illegible] than the former, and let the probabilities of his living for 1, 2, 3, &c years be respectively $q_1$, $q_2$, $q_3$ &c, then we must have

$$E_1 = \tfrac{1}{2} + q_1 + q_2 + q_3 + \&c \qquad (2)$$

But from the nature of the probabilities in question,

$$p_2 = p_1\, q_1$$
$$p_3 = p_1\, q_2$$
$$p_4 = p_1\, q_3, \&c$$

Substituting, therefore, these values in (1), we find

$$E = \tfrac{1}{2} + p_1 (1 + q_1 + q_2 + q_3 + \&c) \qquad (3)$$

Whence, on eliminating $q_1 + q_2 + q_3 + \&c$, from the two equations (2) and (3), we get

$$E - \tfrac{1}{2} = p_1 (E_1 + \tfrac{1}{2}),$$

which is the most convenient form under which the formula can be put for computation

For the explanation of the manner in which the probabilities $p_1\, p_2\, p_3$, &c, are determined from the ordinary tables of mortality [illegible] ANNUITY

The following table, from Mr Milne's *Treatise on the Valuation of Annuities and Assurances* (vol ii p 565) shows the expectation of life at every age, according to the law of mortality at Carlisle —

| Age | Expectat | Age | Expectat | Age | Expectat | Age | Expectat. |
|---|---|---|---|---|---|---|---|
| 0 | 38 72 | 26 | 37 14 | 52 | 19 68 | 78 | 6 12 |
| 1 | 44 68 | 27 | 36 41 | 53 | 18 97 | 79 | 5 80 |
| 2 | 47 55 | 28 | 35 69 | 54 | 18 28 | 80 | 5 51 |
| 3 | 49 82 | 29 | 35 00 | 55 | 17 58 | 81 | 5 21 |
| 4 | 50 76 | 30 | 34 34 | 56 | 16 89 | 82 | 4 93 |
| 5 | 51 25 | 31 | 33 68 | 57 | 16 21 | 83 | 4 65 |
| 6 | 51 17 | 32 | 33 03 | 58 | 15 55 | 84 | 4 39 |
| 7 | 50 80 | 33 | 32 36 | 59 | 14 92 | 85 | 4 12 |
| 8 | 50 24 | 34 | 31 68 | 60 | 14 34 | 86 | 3 90 |
| 9 | 49 57 | 35 | 31 00 | 61 | 13 82 | 87 | 3 71 |
| 10 | 48 82 | 36 | 30 32 | 62 | 13 31 | 88 | 3 59 |
| 11 | 48 04 | 37 | 29 64 | 63 | 12 81 | 89 | 3 47 |
| 12 | 47 27 | 38 | 28 96 | 64 | 12 30 | 90 | 3 28 |
| 13 | 46 51 | 39 | 28 28 | 65 | 11 79 | 91 | 3 26 |
| 14 | 45 75 | 40 | 27 61 | 66 | 11 27 | 92 | 3 37 |
| 15 | 45 00 | 41 | 26 97 | 67 | 10 75 | 93 | 3 48 |
| 16 | 44 27 | 42 | 26 34 | 68 | 10 23 | 94 | 3 53 |
| 17 | 43 57 | 43 | 25 71 | 69 | 9 70 | 95 | 3 53 |
| 18 | 42 87 | 44 | 25 09 | 70 | 9 18 | 96 | 3 46 |
| 19 | 42 17 | 45 | 24 46 | 71 | 8 65 | 97 | 3 28 |
| 20 | 41 46 | 46 | 23 82 | 72 | 8 16 | 98 | 3 07 |
| 21 | 40 75 | 47 | 23 17 | 73 | 7 72 | 99 | 2 77 |
| 22 | 40 04 | 48 | 22 50 | 74 | 7 33 | 100 | 2 28 |
| 23 | 39 31 | 49 | 21 81 | 75 | 7 01 | 101 | 1 79 |
| 24 | 38 59 | 50 | 21 11 | 76 | 6 69 | 102 | 1 30 |
| 25 | 37 86 | 51 | 20 39 | 77 | 6 40 | 103 | 0 83 |

EXPECTORANTS (Lat expectorare *to expectorate*) Medicines which increase the secretion of the tracheal and bronchial mucus The term *expectoration* is applied to any thing cast off from those vessels or from the cells of the lungs by spitting or coughing

EXPIATION (Lat ) signifies, in its most extended [illegible] by which a guilty person makes atonement [illegible] to the gods or civil magistrate for any crime or fault he may have committed, whatever be its nature or extent The belief in the efficacy of expiation as a means of compensating for a breach of the moral law, formed an important feature in all the religious creeds with which we are acquainted In this respect there is a wonderful coincidence in the mythological system of the ancients, the creed of the Jews and that of the Christian world These ceremonies, of course, were very diversified, and varied with the character of every nation and the nature of the crime which it was intended to expiate Among the Greeks and Romans, expiations were sometimes made for whole cities, and, in the more ancient times, to remove or prevent, or to avert an impending calamity, human victims were immolated We need here hardly advert to the numerous kinds of expiations in use among the Jews, as the Old Testament is filled with accounts of them, and under the heads ATONEMENT and SACRIFICE, we have defined the great act of expiation by which the guilt of the human race has been atoned for, and God reconciled to man in the Christian dispensation

EXPILATION In the Roman Law, any injury done to the property of a minor was so designated

EXPLETIVE (Lat expleo, *I fill up*) In Composition, chiefly poetical, a word not necessary to the sense, but used merely to fill up the measure of a verse, or give roundness to a period

EXPLOSION (Lat explosio) In Natural Philosophy a sudden and violent expansion of the parts of any object Explosion differs from expansion in this, that whereas the former is always sudden, and only of momentary duration, the latter is the effect of some gradual and [illegible] considerable [illegible] MATTER PROPERTIES OF

EXPONENT, in Algebra, is used in various senses, thus we say the *exponent* of a power, the *exponent* of a rank, the *exponent* of a ratio The exponent of a power is [illegible] or [illegible] For example, in the expression $a^4$, 4 is the exponent, denoting that $a$ is raised to the fourth power In the expression $a^m$ the exponent $m$ is indeterminate, as it may represent any number whatever The exponent may also be fractional, in which case it denotes not the power, but the root of the quantity, thus $a^{\frac{1}{2}}$ denotes the

third or cube root of $a$ Or it may be regarded as the quotient that arises from the division of it by the quantity raised to that power, for example, $a^{-n}$ is the same thing as $\frac{1}{a^n}$ The earliest writers [illegible] ie powers of numbers by an abbreviation [illegible] the power Harriot repeated the quantity, and for $a^3$ wrote $aaa$, the present convenient system was introduced by Descartes

The exponent of a rank is the number or place of any term in a series, thus, in the series of uneven numbers, 1, 3, 5, 7, 9, 11, 13, 15, &c, 7 is the exponent of the rank of the term 13, because 13 is the 7th term from the commencement

The exponent of a geometrical ratio is the quotient that arises from dividing the [illegible] of the ratio Thus in the progression, here one is $\frac{8}{2}=4$, and in the ratio of 8 to 2, the exponent is $\frac{2}{8}=\frac{1}{4}$ Some mathematicians, however, consider logarithms as the exponents of ratios

EXPONENTIAL This term is variously applied The *exponential calculus* is the method of performing algebraic operations on *exponential quantities*, by which is understood quantities raised to powers of which the exponents are indeterminate or variable *Exponential curve* is a curve defined by an exponential equation, or an equation of the form $y=a^x$, or $y=x^x$ *Exponential equation* is an equation which contains an exponential quantity This [illegible] For example, if we have the equation $a^x=b$ in which $x$ is the unknown quantity, by taking the logarithms of both sides we should get $x \log a = \log b$ and consequently $x=\frac{\log b}{\log a}$ But this method of solution is not always possible, for in the equation $ax+b^{2x}=c$ (and an infinity of others), the value of $x$ can only be found by trial and error *See* LOGARITHM

EXPORTATION The act of [illegible] modities out of [illegible]

EX [illegible] literally, *by something done afterwards*) A punishment inflicted in consequence of a law made with a view to a particular offence already committed is said to be inflicted ex post facto, and the phrase "an ex post facto law," is popularly [illegible] effect and [illegible] justly regarded as tyrannical That species of laws which the Romans termed *privilegia*, i e laws passed in order to [illegible] citizens, were frequently [illegible] ctice of *a bill of pains and penalties* is a species of ex post facto legislation and was much animadverted on in the debates which took place on the occasion of its adoption against Queen Caroline in 1820

EXPOSURE OF CHILDREN *See* FOUNDLINGS

EXPRESSION (Lat expressio) In the Fine Arts, the representation of the various passions of the mind "Care," says Sir Joshua Reynolds in his Fourth Discourse, "must be taken not to run into particularities Those expressions alone should be given to the figures which their respect [illegible] Nor is this enough, each person should [illegible] expression which men of his rank generally exhibit The joy or the grief of a character of dignity is not to be expressed in the same manner as a similar passion in a vulgar face"

EXTANT (Lat) In [illegible], that still [illegible] The [illegible] art of the writings of [illegible] Cicero, Cæsar, &c are *extant*, the rest being lost

EXTEMPORE (Lat) A [illegible] ing that is done without premeditat [illegible]

EXTENT, in Law, is a writ of execution (sometimes called an *extendi facias*), directed to the sheriff, against the body, lands, and goods, or the lands only, of a debtor Writs of extent were of two kinds—extent *in chief*, and extent *in aid*, to both of which the king was entitled by ancient prerogative, for the purpose of obtaining satisfaction of debts originally due to him, or assigned to the crown The writ of *extent in chief* is a proceeding by the king for the recovery of his own debt, and in which he is the real plaintiff The writ of *extent in aid* is also sued out at the instance and for the benefit of the crown against the debtor of a crown debtor, but in this proceeding the king is the nominal plaintiff only Under this writ the lands, tenements, and possessions, as well as the person of the defendant, may be taken in execution, and if within seven days he do not liquidate the debt a writ of "venditioni exponas is issued to sell the same," the crown claiming a priority of satisfaction over every other creditor

EXTRACT, or EXTRACTIVE MATTER The term extract is applied in pharmacy to the brown substance which remains after the evaporation of certain decoctions or infusions of vegetables thus we have *extract of bark*, *extract of rhubarb* and so on These extracts are usually mixtures of gum, starch, sugar, or other soluble matters, along with a certain portion of a peculiar vegetable principle of a brown colour or which becomes [illegible] soluble in water and [illegible] It combines with alumina, and is often the basis of brown dyes it is this principle which chemists call *extractive*, and which is frequently closely allied to various forms of colouring matter

EXTRACT OF LEAD A term applied to the impure subacetate of lead obtained by boiling litharge in vinegar It was first used by a surgeon of the name of [illegible] *lead*

EXTRACTION OF ROOTS An operation which consists in finding the [illegible] quantity, or in finding the [illegible], which multiplied into its [illegible] will produce the given [illegible] quantity If we take the series of numbers,

1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

and multiply each into itself, we shall obtain the series of 2d *powers* or *squares*,

1, 4, 9, 16, 25, 36, 49, 64, 81, 100,

and multiplying each of these again by its corresponding number in the first column, we get the series of 3d *powers* or *cubes*,

1, 8, 27, 61, 125, 216, 343, 512, 729, 1000

Taking any one of the first series of numbers, for example 7 we see that its 2d power (the 1st power is the number itself) or square is 49 and its 3d power, or cube, 343 Reciprocally, 7 is said to be the 2d or square root of 49 and the 3d or cube root of 343 It is obvious, on inspecting the above series, that out of all the numbers, consisting of one or two digits there are only nine which are the squares of other whole numbers, and that of all numbers composed of not more than three digits, that is to say all numbers up to 999, there are only nine which are the cubes of whole numbers The roots of all the other whole numbers are not only not integers, but, what is very remarkable, are not expressible by exact fractional numbers, and it is only approximations to their values that can be found

The rules for extracting the square and cube roots of numbers are to be found in every elementary treatise of arithmetic, but require too many explanations and illustrations to be introduced here to any good purpose The extraction of the cube root in particular is an intricate and laborious operation, and, since any root of a number can be found immediately from a table of logarithms it is an operation of very little use It is to be regretted that so much time as is frequently given to it in our schools should be so unprofitably employed

The general solution of algebraic [illegible] the fourth degree, has hitherto resis [illegible] greatest mathematicians, but in the case of equations with numerical coefficients (whatever the order of the equation) a value of the unknown quantity that is [illegible] root of the equation can always be found by an arithmetical process A general method of accomplishing this was first given by Vieta, another was proposed by Newton, which has been very commonly employed, but the important discovery by Mr Horner of Bath of an easy means of performing the arithmetical computations required in Vieta's method has greatly simplified the operation, and in fact rendered the solution of an affected equation of any degree scarcely more laborious than the ordinary process of [illegible] t For an account of Horner's [illegible] in the *Philosophical Transactions* for 1819, see *Young's Theory of Algebraic Equations*, or the *Companion to the British Almanac* for 1839, in which the reader will find an interesting historical [illegible] oblem of evolution [illegible] curve of an arch Generally the term is used to denote the upper curve of the *voussoirs* or stones which immediately form the arch

EXTRAVAGANTES CONSTITUTIONES In the Canon Law, certain papal constitutions not included in the Corpus Juris Canonici are so called, and comprised in a separate volume They are those of John XXII and a few of his successors in the papacy

EXTRAVASATION (Lat extra, *external to*, and vas, *a vessel*) A term applied to fluids when out of their proper receptacles or vessels Thus when blood is thrown out upon the brain, or into any of the cavities of the body, it is said to be extravasated

EXTREME (Lat extremus) In Logic, has the same meaning with *term*, whe [illegible] position The subject and [illegible] xtremes of a proposition, the copula being, as it were, placed between them In speaking of a syllogism, the extremes are understood to mean the extremes or terms of the conclusion

EXTREME In Music, a word employed in describing

those intervals in wh[illegible] are increased or diminished [illegible]

EXTREME AND MEAN RATIO When a straight line is said to be divided in extreme and mean ratio when the whole is to the greater part as the greater part to the less, or when the rectangle contained by the whole line and [illegible] to the square of the greater [illegible] w a line may be divided in this manner in the 11th prop of his 2d book, and it is by means of this proposition that he constructs the decagon on a given straight line

EXTREME UNCTION One of the seven sacraments of the Romish church, founded upon the passage in the Epistle of St James in which he says, "If any be sick among you, let him call upon the elders of the church, and let them pray over him, anointing him with oil in the name of the Lord" (v 14) The performance of this ceremony is supposed to purify the soul of the dying person from any sins that he may have committed, and which have not been previously expiated by participation in the other means of grace The Protestants usually answer the text above cited by [illegible] next verse, where it is sa[illegible] save the sick, and the Lord shall raise him up," from which they argue that reference is made to a miraculous gift which was exercised in the Apostles' time, and has no application to our days With respect to the usage of antiquity, to which the Romanists lay claim, it is answered that the passages to which they refer allude to the ceremony not as a sacrament for the good of the soul, but only as a rite that carried with it health to the body When the Apostle goes on to say, that the Lord will forgive the sins of the sick man, this evidently supposes him to have a lively futh, and that such faith is the condition of the miraculous cure

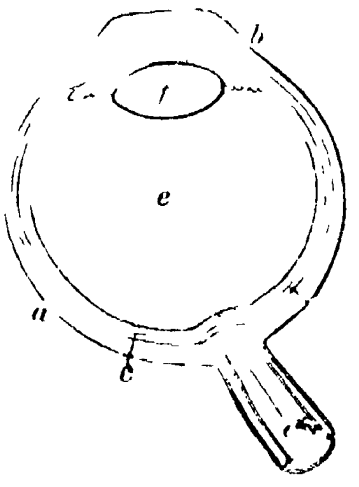
EXTREMITIES (Lat extremus) In Painting and Sculpture, the head, the hands, and the feet In Zoology, the arms and legs, and analogous members in the lower animals

EXTRORSAL A term used in describing the direction of bodies to denote their being turned from the axis to which they appertain, thus anthers whose line of dehiscence is towards the petals, are said to be extrorsæ

EXUVIÆ (Lat *cast clothes*) This term was applied by the Roman naturalists and poets to the shed skin of the snake 'Positis exuviis novus coluber, says Virgil And it is extended in modern zoology to the external layer of the integument of every animal, when it is periodically shed entire or in large portions The films of mucus thrown off from the external surface of most zoophytes and mollusks may be regarded as exuviæ, also those portions of the shell which are deserted and partitioned off by a new-formed plate as in the *Spondylus varius*, and univalve chambered shells, but the exuvial layers are retained by adhesion to the last secreted portion of the shell In insects the whole integument is shed generally several times in succession, the last *cadysis* taking place in the transition from the pupa to the imago state In the *Crustacea* the exuvial shell is commonly cast annually, the cephalo-thorax or carapace cracks longitudinally down the back and the limbs are withdrawn after successive painful efforts, the lining membrane of the stomach is at the same time shed

Fishes seem to cast off exuvial layers of mucus only, but in most reptiles the epidermis is periodically moulted, either entire or in large coherent masses In some species the moulting could only have been detected by careful watching as the main evidence the cast skin is made away with the moment the operation is ended Mr Bell thus describes the *cadysis* of the common toad — "On watching carefully I one day observed a large toad, the skin of which was particularly dry and dull in its colours, with a bright streak down the mesial line of the [illegible] her I discovered a correspondent [illegible] This proved to arise from [illegible] which [illegible] new and brighter skin underneath [illegible] what was about to happen, I watched the whole detail of this curious process I soon observed that the two halves of the skin thus completely divided continued to recede further and further from the centre, and become folded and rugose, and after a short space, by means of the continued [illegible] animal's body, it was brought down in front [illegible] the hinder leg first on one side and then on the other, was brought forward under the arm, which was pressed down upon it, and on the hinder limb being withdrawn, its cuticle was left inverted under the arm, and that of the anterior extremity was now loosened, and at length drawn off by the assistance of the mouth The whole cuticle was thus detached, and was now pushed by the two hands into the mouth in a little ball, and swallowed at a single gulp" The common snake (*Coluber natrix*) when in confinement moults as follows — The formation of the new cuticle produces a detachment of the old from the subjacent living parts, and the latter then loses part of its transparency and smoothness. As the cuticle is continued over the cornea the sight of the serpent is dimmed, its motions are also in some degree cramped and [illegible] [illegible] circumference of the mouth, and is turned back over the head, and the impediment to vision being thus removed, the snake proceeds with [illegible] and rapidity to detach and turn back [illegible] repeating the same actions as those with which it commenced the operation, and at length it literally creeps out of its skin, which is left inverted, and more or less entire according to the degree of the animal's health and [illegible] of the operation The rattle-snake [illegible] inverting and drawing off its own skin After having rubbed back the cuticle from the head, it throws the posterior part of the body in numerous coils around the anterior, one coil is placed in front of the detached part of the integument [illegible] pressing the body strongly it pushes forward the head and neck gradually unfolding the coils behind, and [illegible] the skin, as it advances forwards In the warm-blooded classes the periodically moulted feathers of birds, and hairs of various species of Mammalia, may be regarded as exuvial deposits, as also the small scales of the scarf-skin which are incessantly cast off in man

EYE In describing the structure of the organ of vision [illegible] refer to external and internal parts [illegible] the eyebrows, or *supercilia*; the eyelashes, or *cilia*, and the eyelids, or *palpebræ* The cartilaginous edge of the eyelids is called the *tarsus*, in which and in the inner surface of the eyelids, are small glands which secrete a lubricating serous fluid, called, after their discoverer, the glands of Meibomius Near the external corner or *canthus* of the eye, and in a depression of the frontal bone, are the lachrymal [illegible] which secrete tears, their [illegible] ace of the upper eyelid The little projection at the inner angle of the eye is called the *lachrymal caruncle* There are also two small orifices observable at the inner angle, one in the upper and one in the lower eyelid, which are called the *puncta lachrymalia*, they convey the tears by means of two small tubes to the *lachrymal sac*, from whence they pass by the *nasal duct*, which opens under the inferior spongy bone into the nose The conjunctive membrane of the eye, called [illegible] of the eye, is a membrane [illegible] the fore part of the globe of the eye The internal parts of the eye are, the *sclerotic membrane*, which is the hard outer case of the globe, the *choroid membrane*, which is the interior coat of the [illegible] optic nerve and proceeding [illegible] [illegible] the pupil of the eye, which [illegible] reflects inwardly forming the *iris* the posterior surface of which is called the *uvea*, and its central opening the *pupil*, which is muscular, admitting of [illegible] so [illegible] of light admitted into the inner chambers of the eye The *crystalline lens* is a pellucid body included in a delicate *capsule*, and lodged in a concave depression of the front of the *vitreous humour* which is a transparent and pellucid pulpy texture filling the ball of the eye behind the lens, and covered externally by the *hyaloid* or *arachnoid* membrane The optic nerve enters the back of the eyeball by a perforation in the sclerotic and choroid coats, and is spread upon the poste[illegible] the latter, forming a pulpy film [illegible] the *retina* The eye is moved by six [illegible] muscles.




In the annexed cut representing a [illegible] of the eye, *a* is the sclerotic membrane or coat, *b* the iris, *c* the retina, *d* the optic nerve, *e* the vitreous humor, and *f* the crystalline lens *See* VISION

EYE OF A DOME In Architecture, the circular aperture in its summit

EYE OF A VOLUTE In Architecture, the circle in its centre

EYE-TEETH T[illegible] in consequence of the [illegible] which extend upwards nearly to the orbit of the eye

EYRE, in Law, signifies the court of justices itinerant The term is in all probability derived from the Lat iter, *journey*, as Bracton styles the justices who presided in these courts *justiciarii itinerantes*.

# F.

F The sixth letter of the English and Latin alphabets a labiodental aspirate It bears the same relation to the other labiodental aspirate V which the letters called *tenues*, *p*, *k*, *t*, bear to the *mediæ*, *b*, *g*, *d* It corresponds with the Digamma (quod vide) of the Æolian dialect, to which it is closely related both in form and power, and is susceptible of a few interchanges, chiefly in the Spanish and Italian languages

F or F A In Music the letter on the fourth line in the bass clef generally, but it stands on the third line when the part is Barytone The ordinary character of the F or bass cleff is 𝄢, which Kepler has much laboured to deduce from F itself

FA In Music one of the syllables invented by Guido Aretino to mark the fourth sound of the modern scale of mu

[illegible] An extensive natural order of plants *See* LEGUMINOSÆ

FABLE (Lat fabula) In Literature a term applied originally to every fictitious tale, but confined in modern usage to a class of tales, either in prose or verse, which inculcate a moral precept through the medium of a short fictitious story In the very ancient Indian fables of Pilpay, the Arabian of Lockman and the Greek of Æsop the fictitious personages introduced are chiefly animals endued for the purpose of the story with human faculties and language, and hence modern fabulists have generally introduced [illegible] of their fables In t [illegible] with apologue, and a species of the class allegory Fables are either in prose or verse, but if the latter, they will not bear with propriety a highly poetical or ornamented character Herder has divided fables character of their meaning into three classes — [illegible] retic, intended to form or exercise the understanding, 2 M [illegible] the regulation of the will, 3 [illegible] which the narrative contains no maxim of self-conduct as it merely represents a series of [illegible] ght on by necessary connection But [illegible] whether every fable in the sense in which the name is generally used does not belong properly to the second class, the instances cited by Herde [illegible] to the first and third were certainly [illegible] inventors to bear a moral meaning

FABLIAUX In French literature, the metrical tales of the Trouvères or early poets of the Langue d Oil, or dialect of the north of France, composed, for the most part in the 12th and 13th centuries

FAÇADE (Fr) In Architecture, the face or front of any building towards a street court, garden, or other place, a term, however, more commonly used to signify the principal front

FACE, in Geometry denotes in general one of the planes which form the surface of a polyhedron In Fortification, *face* denotes a line of rampart or the extent between the outermost points of two adjacent bastions

FACIAL ANGLE, is that angle which is formed by the concurrence of two ideal lines, one of which passes by the hole in the skull termed the meatus auditorius externus to the anterior extremity of the alveolar margin of the upper jaw, while the other extends to the same point from the most prominent part of the forehead

FACIES (Lat) In Zoology, a term applied to express the general aspect or external character of an animal, as it appears on a casual or first view, mostly with reference to another to which it bears a superficial resemblance

In Anatomy, it signifies the anterior part of the skull [illegible] and mouth

FACIES HIPPOCRATICA The peculiar expression of countenance which indicates the approach of death; it has [illegible] by Hippocrates, whence the ab [illegible]

FACING In [illegible] the [illegible] of [illegible] a building seen by [illegible] employed to signify a better sort of material which masks an inferior one [illegible]

FAC SIMILE (Lat *fac* to make and *simile* like) expressed in French by the words *fais-semblable*, signifies an exact and faithful copy of any writing, engr [illegible] of art

[illegible] In Ancient History, an appellation given to the different troops or companies of combatants in the games of the circus Of these factions [illegible] white, to which [illegible] and [illegible] by the emperor Domitian, — the purple and the yellow In the time of Justinian 40,000 persons were killed in a contest between two of these factions, so that [illegible] by universal consent The term faction is applied in a more general sense, to any party in a state which attempts without adequate motives to disturb the public repose, or to assail the measures of government with uncompromising opposition In the ancient Greek republics, faction was carried to an extent unparalleled in modern times. "We may always observe," says Hume (*Essays*, vol i 423), [illegible] whether the nobles or [illegible] in this respect that [illegible] the opposite party that came into their hands, and banished such as had been so fortunate as to escape their fury No form of process, no law, no trial, no pardon" The middle ages were distinguished chiefly by two factions, the Guelfs and Gubelins, who long kept Italy in a state of alarm In the present day, in England, the term *faction* is bandied about between the three great parties of the country the Whigs, Tories, and Radicals, being applied indiscriminately by the adherents of one party to those of the other *See* PARTY

FACTOR (Lat facio) In Mercantile Law, a mercantile agent, who is entrusted with the possession of the property which he is commissioned to dispose of Under the law which obtained previously to the passing of the act 6 G 4 c 94 it was held that a factor, as such, had authority to sell only, and not to pledge, the goods of his principal, and, consequently, that a party who had made a bonâ fide advance to the factor on the credit of the goods was liable to restore them to the principal without his being bound to repay the advance By that statute it is enacted, that any person intrusted, for the purpose of consignment or sale, with goods, &c, and in whose name such shall have been shipped shall be deemed the true owner, so far as to entitle the consignee to a lien thereon in respect of any money or negotiable security advanced by such consignee for the use of the person in whose name such goods, &c shall have been shipped, provided the consignee has no notice, by bill of lading *or otherwise*, that such party is not the true owner Various other provisions are added by the same act to the effect that persons in possession of bills of lading shall be deemed owners, so far as to make valid contracts, that no person can acquire a security upon goods in the hands of an agent for an antecedent debt beyond the amount of the agent's interest in the goods, that persons may contract with known agents in the ordinary course of business, or out of that course, if within the agent's authority, that person may accept and [illegible] from known agents, and a right is [illegible] owner to follow his goods, while in the hands of his agent or the agent's assignee, in case of the bankruptcy of such agent or assignee A factor has a general lien on goods consigned to him, not only for incidental charges, but as an item of mutual account for the balance due to him, as long as he remains in possession

In Scotland the term *factor* is used synonymously with *steward* in England

FACTOR in Arithmetic and Algebra, is the name given to each of the quantities which we multiply into one another in order to form (*facere*) a product, that is to say, to the multiplicand and the multiplier Factors are otherwise called *divisors*, especially in speaking of a number as [illegible] fact of several others

FACTORY [illegible] supplied with machinery for the purpose of carrying on any branch of manufacture, are usually called *factories* Hence we have woollen, cotton, flax, &c factories according to the different branches of industry carried on in each Factories on an extensive scale are to be found only in countries far [illegible] imp [illegible] of society, manufactures are necessarily carried on upon a small scale, with very imperfect instruments and little or no division of labour In factories, on the contrary, the most improved machinery is introduced, every individual has a peculiar task to perform, in the execution of which he cannot fail to acquire the greatest proficiency We need not, therefore, be surprised to learn that, wherever factories are generally introduced, domestic manufactures are totally superseded, as all classes find it to be more for their advantage to buy the products furnished by the factories than to attempt to supply themselves with similar products by their own labour

Many complaints have been made as to the injurious influence of factory labour on the health of the labourers, and especially of the young persons, employed in them This, however, is a subject as to which there has been much misrepresentation Children, that is, young persons between the ages of nine and fourteen years, as well as adults, are largely employed in factories, and, while the health and morals of the latter are said to suffer severely, the former have been described as being stunted in their growth, and rendered decrepit and [illegible] These representations of the injurious effects of what has been called *white slavery*, were at length embodied in a Report of a Committee of the House of Commons in 1832 We believe, however, that we run little risk in affirming that this report contains more false statements and

exaggerated representations than any other document of the kind ever laid before the legislature It made a great sensation, and the discussions to which it, or rather the proposal that grew out of it, for limiting factory labour to ten hours a day, gave rise, induced government to appoint a commission to inquire, on the spot, into the actual condition of the labourers, and especially of the children, employed in factories This commission collected a great deal of valuable and authentic information, and much light has since been thrown on the question of factory labour It were absurd to pretend, as some have done, that the statements and representations as to its pernicious influence have been proved to be *wholly* destitute of foundation, but they have been shown [illegible] That great inattention [illegible] revolting abuses, have existed in some factories, particularly in those of the smaller class, is quite certain, but the instances of abuse bear but a small proportion to the total number, and, speaking generally, factory work-people, including non-adults, are as healthy and contented as any class of the community obliged to earn their bread in the sweat of their brow

We do not, however, know that we should object to the total exclusion of children, from nine to thirteen years of age, from factories provided we had any reasonable security that they would be moderately well attended to and instructed at home But no such security is to be looked for The parents of such children frequently want the ability, oftener the opportunity, and sometimes the wish, to keep them at home in any thing like a decent condition, to provide them with instruction, or to impress on them the importance of habits of cleanliness, sobriety, and industry Were they turned out of the factories, few would either go to the country or to school Four fifths of them would be thrown loose upon the streets, to acquire a taste for idleness and to be early initiated in the vicious practices prevalent among the dregs of the populace in Manchester Glasgow Leeds and other great towns Whatever may be the state of society in these towns, we hesitate not to say that *it would have been ten times worse but for the factories* They have been their best and most important academies Besides taking the children out of harm's way, they have imbued them with regular, orderly and industrious habits Their earnings are considerable, and are a material assistance to their parents, at the same time that they make them perform their tasks with a zeal and alacrity that is rarely manifested by apprentices serving without, at least by that they may learn some art, trade or mystery Many factories have also day schools or Sunday schools, or both attached to them which the children attend But, independently of this, the training they undergo in factories is of inestimable value, and is not more conducive to their own interests than to those of the public

Besides supposing that the health of the population is injured by the extension of manufactures, it has been supposed that the extreme subdivision of labour in manufacturing establishments, and the undivided attention which every one employed in them must give to the single operation in which he is engaged has a most pernicious influence over the mental faculties The genius of the master is said to be cultivated, but that of the workmen to be condemned to perpetual neglect "Many mechanical arts," says Dr Fergusson (*Essay on Civil Society*, p 303), 'require no capacity, they succeed best under a total suppression of sentiment and reason, as ignorance is the mother of industry as well as of superstition Reflection and fancy are subject to err, but a habit of moving the hand or the foot is independent of either Manufactures accordingly prosper most when the head is least consulted, and where the workshop may, without any great effort of imagination be considered as an engine, the parts of which are men" Similar statements have been made by others Even Dr Smith, who has given so beautiful an exposition of the benefits derived from the division of employments, has in this instance concurred with the popular opinion, and has not hesitated to affirm that constant application to one particular occupation in a large manufactory "necessarily renders the [illegible] *as it is possible* [illegible] ever, can be [illegible] representations Instead of its being true that the workmen employed in manufactures [illegible] acute than [illegible] distinctly and completely the reverse The weavers and other mechanics of Glasgow, Manchester, and Birmingham possess far more information than is possessed by the agricultural labourers [illegible] And this is really what [illegible] subject would have led [illegible] The various occupations in which the husbandman has to engage, their constant liability to [illegible] as variable a power as the weather, and [illegible] the appearance of the objects which daily meet his eyes, and with [illegible] render his [illegible] extrinsic and adventitious excitement which must ever be felt by those who are constantly engaged in burnishing the point of a pin, or in performing the same endless routine of precisely similar operations This want of [illegible] supplied or effectually [illegible] by the cultivating that [illegible] Workmen [illegible] but they had the wages of labour are too low, and the propensity to save and accumulate too powerful, to allow of any large proportion of them seeking to divert themselves by indulging in riot and excess They are thus driven [illegible] in mental excitement, and their [illegible] every facility for amusing and diverting themselves in this manner Agricultural labourers, spread over a wide extent of country, are without the means of assembling, except on some rare occasions, for the purpose either of amusement or instruction, but, by working together, those engaged in [illegible] establishments have constant opportunity [illegible] topics of interest and importance They are thus gradually trained to [illegible] reflection, their intellects are [illegible] of conflicting opinions, and a small contribution from each individual enables them to establish lectureships and libraries, and to obtain a large supply of newspapers and periodical publications But whatever doubt may exist respecting the *cause*, whether it be ascribed to the better elementary instruction of the lower classes in towns and villages, or to the circumstances under which they are placed in after life, there can be none as to the [illegible] of manufacturing workmen has [illegible] their numbers have increased, and as their employments have been more and more subdivided There is not, we apprehend, any real ground for supposing that they were ever less intelligent than the [illegible] though, whatever may have been the case formerly, none will now venture to affirm that they are inferior to them in mental requirements, or that they are mere machines without sentiment or reason

No statutory restrictions respecting the employment of children in the mills and factories of the United Kingdom existed until the year 1802, when an act of parliament was passed (42 Geo 3) for the preservation of the health and morals of apprentices and others employed in cotton and other factories, and directing the magistrates to report whether the factories were conducted according to law, and to adopt such sanatory regulations as they might think fit This act was followed, in 1816, by an act, generally called Sir Robert Peel's Act imposing various regulations on the employment of children in cotton-mills

Both of these acts were repealed in 1831 by an act, 1 & 2 Will 4 c 39, commonly called Sir John Hobhouse's Act which provided that in cotton factories, to which alone it related, no child could legally be employed till it had attained the age of 9 years, and that no person under 18 years of age could be suffered to remain in the factories more than 12 hours in one day, and that on Saturdays they should only be employed in the factories for 9 hours

Sir John Hobhouse's Act was repealed, in 1833, by the act 3 & 4 Will 4 c 103, and this last mentioned statute together with the 7 Vict c 15, 12 Vict c [illegible] and 13 & 14 Vict c 54, comprehend the whole statutory regulations at present applicable to cotton and other factories in the United Kingdom By these acts the British Islands were mapped out into four great divisions the cotton and woollen district of Yorkshire, Lancashire, and the immediate neighbourhood forming the 1st, the Eastern and Southern Counties of England, the 2nd, some parts of the West of England, nearly the whole of Wales and the southern half of Ireland, forming the 3rd, the northern half of Ireland, the whole of Scotland, and the four northern counties of England, the 4th Each district was placed under one inspector, who made arrangements for becoming acquainted with every factory in his district An office was established in London called the Office of the Factory Inspectors, under the management of one of the secretaries of state The inspectors, besides discharging their other duties, are empowered to appoint surgeons for the purpose of examining persons brought before them to obtain the certificates of age required by the factory acts, and to make regulations for their guidance The term "child" is explained to mean a person under the age of thirteen, and the term "young person" to mean a person of thirteen and under the age of eighteen By the operation of the act, all the children in a factory are bound to attend school for a certain period each day, those who work in the forenoon must attend school in the afternoon, and those who work in the afternoon are at school in the forenoon

The last act contains the following important provisions — That no young person or female above 18 years of

age shall be employed in any factory before 6 o'clock in the morning, or after 6 in the afternoon, or on Saturdays after 2 o'clock in the afternoon, the meal times to be taken between half-past 7 o'clock in the morning and 6 in the afternoon No young person or female to work after 7 in the afternoon to recover lost time, nor more than one hour extra in any one day Between Sept 30 and Apr 1, the hours may be from 7 in the morning till 7 at night [illegible] above 11 years of age and under 18 may be classed as young persons

These acts also contain regulations extending the hours of work, where time shall be lost by the want of or an excess of water in mills situated upon a stream of water, respecting the steps to be taken in order to obtain regular certificates of age for the children requiring them, [illegible] schools where necessary, and [illegible] to be had before inspectors and magistrates for enforcing the act, and the right to appeal from their decisions

We can speak with great satisfaction of the acts of 3 & 4 Will 4 c 103, and 7 & 8 Vict c 15, which, among other things limited the labour of young persons under 18 years of age and of women to 12 hours a day But we doubt whether the same measure of approbation [illegible] for the provisions of the act 12 Vict above mentioned restricting the working hours of women and of young persons between 13 and 18 years of age to 10 hours a day Had it been practicable to confine the operation of the act to these parties alone we should have hesitated before questioning its policy But such is not and could not be the case, and in truth it has limited the labour of all or of [illegible] a great variety of [illegible] riction had been laid on the power by which their machinery is set in motion And we must, therefore, regard the measure, not as applying to a class, but as really reducing most sorts of factory labour to 10 hours a day (See *Principles of Pol. Econ*, 4th edit, pp 427—429)

Account of all the Cotton, Woollen, Worsted, Flax, and Silk Mills or Factories in each County of England and Wales and in the Kingdom for the Year 1838 [illegible] Amount and Description of the Moving Power, and the Number Age and Sex of the Persons [illegible] compiled from Returns of the Factory Inspectors, printed by Order of the House of Commons in 1839

| Counties | No of Mills | | Moving Power | | | | | | Persons employed | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Steam | | Water | | Total Horse Power | [illegible] | [illegible] | | | Ages above 13 | Totals | |
| | Working | Empty | Engines | Horse Power | Wheels | Horse Power | | | Age | 13 | 18 | | Males | Females |
| ENGLAND—*Cotton Mills* | | | | | | | | | | | | | | |
| Chester | 154 | 12 | 210 | 6,921 | 60 | 1,726 | 8 647 | 7,104 | - | 1,190 | 11,970 | 23,192 | 17,676 | 18,676 |
| Cumberland | 13 | | 11 | 293 | 5 | 66 | 359 | 359 | | 21 | 764 | 1,200 | 720 | 1,263 |
| Derby | 76 | 7 | 56 | 960 | 91 | 2,135 | 3,038 | 2,753 | - | 727 | 3,721 | 6,014 | 4,231 | 6,231 |
| Gloucester | 1 | | 1 | 20 | - | | 20 | 20 | | | 21 | 8 | 15 | 14 |
| Lancaster | 1,125 | 62 | 1,008 | 29,909 | 272 | 3,558 | 33,467 | 33,422 | | 7,579 | 58,562 | 85 982 | 69,889 | 82,234 |
| Leicester | 3 | - | 4 | 36 | - - | | 36 | 36 | - - | | 102 | 112 | 54 | 190 |
| Middlesex | 11 | - | 11 | 131 | - - | - | 131 | 131 | 1 | 14 | 212 | 314 | 289 | 250 |
| Norfolk | 1 | - - | 1 | 12 | - | - | 12 | 12 | | - | 54 | 76 | 6 | 121 |
| Nottingham | 13 | - | 9 | 170 | 9 | 137 | 307 | 307 | | 34 | 564 | 862 | 494 | 1,006 |
| Salop | 1 | - | 2 | 28 | - | | 28 | 28 | - | 6 | 17 | 16 | 15 | 44 |
| Stafford | 15 | - | 4 | 139 | 14 | 357 | 496 | 496 | | 230 | 698 | 1 190 | 731 | 1,314 |
| Surrey | 3 | - | 2 | 26 | | | 26 | 26 | | | 60 | 128 | 78 | 110 |
| Warwick | 4 | - | 5 | 155 | | | 155 | 173 | | 3 | 14 | 67 | 43 | 41 |
| York, ex of W Riding | 69 | 4 | 31 | 619 | 38 | 515 | 1 134 | 1 134 | | 394 | 1 695 | 2,177 | 2,171 | 2 055 |
| York, W Riding | 100 | | 67 | 1 170 | 83 | 980½ | 2,150½ | 2 071½ | | 711 | 3,347 | 4,172 | 3,491 | 4,722 |
| WALES | 1,589 | 85 | 1,422 | 40,089 | 572 | | | | 1 | 10,914 | 81,671 | 125,278 | 99,866 | 118,286 |
| Flint | 5 | | 7 | 108 | 2 | | | 4 | | 78 | 395 | 537 | 376 | 634 |
| Totals | 1,594 | 85 | 1,429 | 40 697 | 577 | 9 617½ | 50,314½ | 48,061 | 1 | 11,020 | 82,066 | 126,07[illegible] | 100 212 | 118 9[illegible]0 |
| ENGLAND—*Woollen* | | | | | | | | | | | | | | |
| Chester | 13 | - - | 2 | 15 | 14 | 81 | 96 | 96 | | 30 | 51 | 90 | 133 | 39 |
| Cornwall | 8 | - | - | - | 10 | 1½ | 45½ | 42 | | 1 | 88 | 117 | 9 | 197 |
| Cumberland | 14 | 2 | - | - | 15 | 135 | 135 | 135 | | 53 | 102 | 116 | 176 | 98 |
| Derby | 3 | - | 1 | 6 | 3 | 31 | 37 | 26 | | 7 | 2 | 26 | 31 | 4 |
| Devon | 39 | 2 | - - | - | 48 | 521 | 521 | 469¼ | | 286 | 585 | 938 | 360 | 1,450 |
| Dorset | 2 | - | - | | 3 | 26 | 26 | 21 | | 9 | 23 | 26 | 29 | 29 |
| Durham | 3 | - | 2 | 39 | 1 | 10 | 49 | 39 | | 21 | 37 | 31 | 33 | 54 |
| Essex | 1 | - | - | - | 1 | 4 | 4 | 4 | | | 6 | 4 | 6 | 4 |
| Gloucester | 96 | 29 | 49 | 843½ | 213 | 1 628½ | 2,172 | 1,987½ | - | 91 | 2,010 | 3,314 | 2,677 | 2,738 |
| Hampshire | 2 | - - | - - | | 2 | 11 | 11 | 11 | | | 8 | 6 | 5 | 9 |
| Hereford | 4 | - | | | 4 | 19 | 19 | 17 | | 8 | 5 | 13 | 23 | 3 |
| Kent | 1 | - | 1 | 4 | 1 | 8 | 12 | 12 | | | 7 | 9 | 4 | 12 |
| Lancaster | 101 | 4 | 61 | 1,024 | 70 | 607 | 1,631 | 1,631 | - | 947 | 1,726 | 2,274 | 3,086 | 1,861 |
| [illegible] | 1 | - | 1 | 6 | | | 6 | 6 | | | 9 | 3 | 9 | 3 |
| [illegible] | 4 | - - | 3 | 22 | 2 | 8 | 30 | 30 | | 1 | 10 | 2 | 11 | 2 |
| [illegible] | 9 | - - | - - | - | 10 | 25 | 25 | 19 | | 25 | 25 | 21 | 34 | 37 |
| [illegible] | 3 | - | 2 | 9½ | - | - | 9½ | 9½ | | 20 | 35 | 66 | 83 | 38 |
| [illegible] | 1 | | - - | - - | 1 | 8 | 8 | 8 | | 9 | 8 | 8 | 11 | 14 |
| [illegible] | 3 | | | | 4 | 28 | 28 | 28 | | 9 | 6 | 38 | 30 | 23 |
| Oxford | 8 | - | 1 | 8 | 11 | 106 | 114 | 113 | | 26 | 146 | 104 | 187 | 89 |
| Salop | 4 | - - | - | - | 4 | 38 | 38 | 34 | | 3 | 21 | 30 | 53 | 4 |
| Somerset | 30 | 1 | 13 | 200 | 41 | 372 | 632 | 54[illegible] | | 179 | 773 | 1,181 | 1,188 | 945 |
| Surrey | 4 | - | 2 | 36 | 4 | 36 | 72 | 72 | | 3 | 38 | 49 | 63 | 7 |
| Westmoreland | 14 | | 5 | 107 | 11 | 123 | 230 | 230 | - - | 41 | 198 | 143 | 201 | 181 |
| Wilts | 53 | 2 | 39 | 718 | 56 | 412 | 1,130 | 807 | | 62 | 1,250 | 1,916 | 1,976 | 1,252 |
| York, ex of W Riding | 63 | 7 | 15 | 248 | 52 | 424 | 672 | 672 | | 165 | 583 | 620 | 917 | 451 |
| York, W Riding | 543 | - | 362¼ | 7,492 | 191 | 2,067 | 9,559 | 9,302 | 4 | 3,617 | 9,568 | 12,991 | 17,818 | 8,302 |
| WALES | 1,029 | 47 | 559½ | 10,838 | 777 | 6,774 | 17,612 | 16,369⅜ | 4 | 5,613 | 17,330 | 21,118 | 29,157 | 17,908 |
| Brecon | 10 | 1 | - | | 10 | 31 | 31 | 29½ | | 17 | 19 | 40 | 48 | 31 |
| Cardigan | 9 | 1 | - | - - | 9 | 13 | 13 | 10 | | 12 | 8 | 16 | 33 | 3 |
| Carmarthen | 19 | 2 | - | | 21 | 26 | 26 | 25 | - | 30 | 34 | 33 | 72 | 25 |
| Denbigh | 8 | 1 | - | | 9 | 41 | 41 | 35 | | 27 | 66 | 103 | 146 | 50 |
| Glennorgan | 15 | 1 | 1 | 4 | 15 | 51½ | 55½ | 48½ | | 50 | 40 | 50 | 56 | 84 |
| Merioneth | 25 | 3 | - | - | 26 | 54 | 54 | 48 | | 18 | 50 | 66 | 75 | 59 |
| Montgomery | 61 | 1 | 3 | 22 | 60 | 262 | 284 | 253 | | 174 | 362 | 187 | 507 | 216 |
| Radnor | 3 | 1 | | | 3 | 9 | 9 | 9 | - | 2 | 8 | 17 | 19 | 8 |
| Totals | 1,179 | 58 | 563½ | 10,864 | 936 | 7,261½ | 18,125½ | 16,827⅜ | 4 | 5,943 | 17,917 | 24,636 | 30,113 | 18,387 |
| ENGLAND—*Worsted* | | | | | | | | | | | | | | |
| Chester | 1 | 1 | 1 | 20 | - | | 20 | 2 | - | | 2 | 1 | 2 | 1 |
| Derby | 1 | - | - - | - | 2 | 36 | 36 | 36 | | 11 | 26 | 84 | 32 | 39 |
| Durham | 4 | - - | 5 | 116 | 1 | 20 | 136 | 136 | - | 36 | 209 | 187 | 130 | 302 |
| Lancaster | 12 | 1 | 10 | 181 | 5 | 80 | 261 | 261 | - - | 68 | 419 | 437 | 337 | 587 |
| Leicester | 26 | - | 25 | 421 | - | | 421 | 409 | - | 72 | 679 | 983 | 662 | 1,072 |
| [illegible] | 1 | - - | 1 | 4 | - | | 4 | 4 | - | 4 | 1 | 4 | 3 | 6 |
| [illegible] | 3 | - - | 3 | 90 | 1 | 12 | 102 | 192 | | 38 | 223 | 124 | 86 | 299 |
| [illegible] | 1 | - - | 1 | 12 | 1 | 12 | 24 | 24 | - - | 13 | 24 | 20 | 11 | 46 |
| [illegible] | 1 | - - | - | - | 1 | 3 | 3 | 3 | - - | - - | 1 | 3 | 4 | |
| Nottingham | 4 | - - | 4 | 75 | 1 | 25 | 100 | 100 | - - | - - | 154 | 209 | 150 | 213 |
| Salop | 1 | - - | 1 | 22 | - | - | 22 | 22 | - | 25 | 32 | 44 | 22 | 79 |
| Stafford | 2 | - - | 1 | 3 | 2 | 33 | 36 | 36 | - - | - - | 40 | 76 | 51 | 65 |
| Warwick | 2 | - - | 2 | 21 | - | - | 21 | 20 | - - | - - | 32 | 104 | 56 | 80 |
| Worcester | 9 | - - | 3 | 106 | 9 | 93 | 199 | 192 | - - | 63 | 252 | 381 | 156 | 540 |
| York, ex W Riding | 6 | - - | 1 | 25 | 5 | 70 | 95 | 95 | - | 57 | 11,170 | 142 | 102 | 267 |
| York, W Riding | 342 | - - | 225¾ | 4,767 | 87 | 929 | 5,696 | 5,325 | 5 | 4,142 | 619 | 10,468 | 6,890 | 19,344 |
| Totals | 416 | 2 | 283¾ | 5,863 | 115 | 1,313 | 7,176 | 6,857 | 5 | 4,529 | 13,883 | 13,217 | 8,694 | 22,940 |

TABLE — *continued*

| Counties. | No of Mills | | Moving Power | | | | | Actual Power employed | Persons employed | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Steam | | Water | | Total Horse Power | | Under 9 Yrs of Age | Ages between 9 and 13 | Ages between 13 and 18 | Ages above 18 | Totals |
| | Working | Empty | Engines. | Horse Power | Wheels | Horse Power | | | | | | | Males / Females |
| ENGLAND —*Flax* | | | | | | | | | | | | | |
| Cumberland | 9 | - - | 2 | 66 | 8 | 97 | 163 | 163 | - | 16 | 144 | 206 | 57 / 309 |
| Derby | 1 | - | 1 | 16 | 3 | 15 | 31 | 31 | - | 15 | 40 | 41 | 23 / 73 |
| Devon | 3 | 1 | - - | - | 4 | 51 | 51 | 45 | - - | 1 | 28 | 72 | 10 / 91 |
| Dorset | 18 | 1 | 4 | 72 | 21 | 202 | 274 | 214 | - | 19 | 250 | 387 | 113 / 543 |
| Durham | 8 | 1 | 7 | 126 | 2 | 35 | 161 | 161 | - | | 164 | 258 | 100 / 322 |
| Gloucester | 3 | - - | 4 | 63 | - - | - | 63 | 39 | - | 2 | 66 | 74 | 18 / 121 |
| Hampshire | 2 | - - | - - | - | 2 | 28 | 28 | 28 | - | - | 52 | 84 | 3 / 83 |
| Kent | 1 | - - | 1 | 20 | - | | 20 | 20 | - | - | 37 | 38 | 37 / 38 |
| Lancaster | 16 | 2 | 21 | 480 | 3 | 42 | 522 | 522 | - - | 78 | 1,392 | 1,411 | 1,083 / 1,798 |
| [illegible] | 1 | - - | 2 | 24 | - | - | 24 | 24 | - | - - | 33 | 29 | 19 / 43 |
| [illegible] | 3 | - - | 4 | 68 | 1 | 2 | 70 | 56 | | 2 | 4 | 57 | 10 / 53 |
| [illegible] | 3 | - | 4 | 74 | 1 | 12 | 86 | 86 | - - | - | 120 | 132 | 42 / 210 |
| [illegible] | 1 | | 2 | 116 | - | | 116 | 116 | - - | 101 | 342 | 358 | 369 / 432 |
| [illegible] | 13 | 1 | 5 | 67 | 16 | 124 | 191 | 138 | - | 11 | 189 | 227 | 64 / 363 |
| Surrey | 1 | - - | 1 | 10 | - | | 10 | 10 | - | - | 20 | 21 | 4 / 37 |
| [illegible] | 4 | - - | 2 | 70 | 4 | 24 | 94 | 94 | | 32 | 213 | 204 | 185 / 264 |
| [illegible] Riding | 31 | 5 | 6 | 153 | 43 | 466 | 619 | 619 | | 312 | 770 | 999 | 751 / 1,330 |
| [illegible] | 60 | - - | 59 | 1,709 | 3 | 32½ | 1,741½ | 1,625½ | | 831 | 3,396 | 3,346 | 2,489 / 3,084 |
| Totals | 178 | 11 | 125 | 3,134 | 111 | 1,130½ | | | | | | | 5,377 / 11,194 |
| ENGLAND —*Silk* | | | | | | | | | | | | | |
| Berks | 3 | 1 | | - | 3 | 30 | 30 | 30 | 1 | 48 | 57 | 73 | 28 / 151 |
| Bucks | 2 | - | 2 | 8 | 1 | 4 | 12 | 12 | 8 | 65 | 36 | 9 | 65 / 53 |
| Chester | 92 | 12 | 81 | 794 | 28 | 240 | 1,034 | 786 | 454 | 2,709 | 4,154 | 4,515 | 4,870 / 6,962 |
| Derby | 20 | 1 | 17 | 178 | 2 | 6½ | 181½ | 204 | 47 | 640 | 839 | 1,690 | 1,013 / 2,203 |
| Devon | 3 | 1 | - | | 4 | 72 | 72 | 48 | 4 | 79 | 119 | 203 | 62 / 343 |
| Dorset | 5 | - - | 1 | 8 | 5 | 38 | 46 | 40 | 44 | 72 | 92 | 125 | 37 / 295 |
| Essex | 7 | - - | 6 | 77 | 6 | 59 | 136 | 129 | 6 | 233 | 561 | 641 | 204 / 1,237 |
| Gloucester | 2 | | - | | 2 | 5½ | 5½ | 5½ | 11 | 62 | 27 | 23 | 22 / 101 |
| Hampshire | 2 | - | - | - | 2 | 18 | 18 | 18 | 13 | 56 | 79 | 74 | 21 / 201 |
| Hertford | 6 | - | 5 | 41 | 4 | 52 | 93 | 93 | 56 | 272 | 217 | 209 | 367 / 417 |
| Kent | 1 | | 1 | 8 | 1 | 6 | 14 | 14 | | 1 | 11 | 28 | 2 / 38 |
| Lancaster | 31 | 1 | 29 | 529 | 5 | 36 | 565 | 557 | 89 | 1,176 | 2,013 | 2,283 | 1,689 / 3,902 |
| Middlesex | 1 | | 1 | 18 | | - | 18 | 18 | 2 | 44 | 61 | 44 | 33 / 121 |
| Norfolk | 4 | - - | 4 | 120 | | | 120 | 120 | 26 | 329 | 990 | 929 | 162 / 2,112 |
| Nottingham | 4 | - - | 3 | 27 | 1 | 12 | 39 | 29 | 18 | 110 | 129 | 192 | 177 / 272 |
| Somerset | 24 | 1 | 16 | 125 | 19 | 149 | 274 | 235 | 166 | 560 | 559 | 780 | 406 / 1,659 |
| Stafford | 12 | 3 | 10 | 103 | 2 | 35 | 138 | 122 | 58 | 394 | 441 | 601 | 508 / 986 |
| Suffolk | 3 | | 1 | 9 | 1 | 3 | 12 | 12 | 19 | 198 | 160 | 88 | 47 / 418 |
| Surrey | 1 | | - | | 1 | 8 | 8 | 8 | 8 | 22 | 13 | 22 | 21 / 44 |
| Warwick | 9 | 2 | 8 | 53 | 2 | 12 | 65 | 58 | | 99 | 133 | 303 | 218 / 317 |
| Wilts | 5 | | 3 | 18 | 4 | 26 | 44 | 39 | 7 | 74 | 109 | 160 | 26 / 324 |
| [illegible] | 10 | - | - | | 12 | 50 | 50 | 38½ | 46 | 97 | 75 | 116 | 68 / 266 |
| [illegible] | 16 | | 11 | 193 | 5 | 66 | 259 | 270 | 2 | 102 | 366 | 613 | 603 / 480 |
| Totals | 263 | 22 | 199 | 2 309 | 110 | 928 | 3 237 | 2,886 | 1,085 | 7,412 | 11,304 | 13,721 | 10,619 / 22,903 |
| Grand Totals | 3,630 | 178 | 2 600 | 62,867 | 1,819 | 20 250½ | 83 117½ | 78 523½ | 1,095 | 30 354 | 132,430 | 185,540 | 105,075 / 194,344 |

FA'CULÆ . In Astronomy, certain spots sometimes seen on the sun's disc, which appear brighter than the rest of his surface These bright spots, and the variable [illegible] n rise to much spe- [illegible] the sun *See* SUN [illegible] ) In the origin of the university of Paris (which is considered as the model of all European institutions in the middle ages) the seven liberal arts (grammar logic, rhetoric, arithmetic, geometry, astronomy, and music) seem to have been the subjects of academic instruction These constituted what was afterwards designated the Faculty of Arts Three other faculties — those of divinity law and medicine — were subsequently added In all these four lectures were given, and degrees conferred by the university The four faculties were transplanted to Oxford and Cambridge, where they are still retained, although in point of fact the faculty of arts is the only one in which substantial instruction is communicated in the academical course By an anomaly of ancient date, the English universities also give degrees in what is not properly a faculty, but only a branch of one of the faculties, viz music On the Continent, the faculty of arts is synonymous with that of philosophy In England, that of divinity is not wholly distinct from, but superior to, that of arts, degrees in the latter being preliminary qualifications for those in the former

FA'CULTY, DEAN OF In Scotland, the elective president of the faculty of advocates, answering to barris [illegible] which see

FAHLERZ A mineralogical synonym of grey copper ore

FAHLUN [illegible] m *Fahlun*, in Sweden It [illegible]

FAIENCE (from Faenza the original place of manufacture ) In the fine arts, porcelain enriched with painted designs Raffaelle in his early days is believed to have been much engaged on this department of the art, but the matter is very doubtful It is certain, however, that many of his designs were transferred to porcelain, which hence obtained the name of Raffaelle's ware, but the date of their execution is posterior to that artist's death

FAINTING *See* SYNCOPE

FAINTS The impure and weak spirit constituting th [illegible]

FAIR [illegible] riæ or forum ) A meeting held at stated times of the year in particular places, for the purposes of traffic, to which merchants resort with their wares Fairs, in Christian countries, were usually held on particular festivals, and are so still in England, unless where they have been fixed to particular days in the month by later grants of privileges By the English law, the king's authority only is supposed to confer the privilege of holding a fair, with the court of pie-powder to determine disputes arising there, which is incident to it Fairs are considered free, unless toll is due to the owners by special grant, or by custom, which supposes such grant

FAIRIES Imaginary beings, who occupied a distinguished place in the traditional superstitions of the nations of Western Europe, and especially in these islands Their English name is probably derived from "fair" or has the same etymology with that word, and, although some similarity has been traced between them and the Peris of the Persians (pronounced Feri by the Arabians), it is not probable that the resemblance of name is more than accidental There is also a distinction between the fairy of our island and the Fata or prophetic sybil of the Italians, from which last the French Fée is derived, although the French, in their romantic mythology, have somewhat mingled the characteristics of the two The British fairies also, although they have [illegible] Dress and Game of [illegible] and them, they are in fact peculiar to people of Celtic race, and the [illegible] peasantry, the prevalent among the Celtic population in Scotland Wales and Ireland fully to a remarkable degree The popular belief, however, was nowhere invested with so poetical a character as in the Lowlands of Scotland where it forms a main ingredient in the beautiful balla [illegible] The fairies of the Scottish and [illegible] diminutive beings, who render themselves occasionally visible to men, especially in exposed places on the sides of hills, or in the glades of forests, which it is their custom to frequent They have also dealings with men, but of an uncertain and unreal character Their presents are sometimes valuable, but generally accompanied, in that case, with some condition or peculiarity which renders them mischievous more often they are unsubstantial, and turn into dirt or ashes in the hands of those to whom they have been given Mortals have been occasionally transported into Fairy-land, and have found that all its appa- [illegible] deceptive One of the most ordinary employments of fairies in vulgar superstition, is

that of stealing children at nurse, and substituting their own offspring in place of them, which after a short time perish or are carried away The popular belief in fairies has been made the subject of poetical amplification in the hands of so many of our greatest writers, from Shakspeare to Scott, that it is not easy to disentangle the embellishments with which it has been invested from the original notions on which they are founded The Fata of the Italians, who figures in their romantic epics, and from whom the French have made the Fée of their fairy tales, is quite a different personage a female magician sometimes benevolent, and sometimes malevolent, partaking both of the supernatural character, and peculiarly gifted with the spirit of prophecy Such is the Fata Morgana, to whom the celebrated optical delusion occasionally produced in the Straits of Messina was formerly attributed by popular belief

FAITH (Gr πιστις, Lat fides) In Theology It is observable that the writers of the New Testament employ one and the same word for faith and belief In most modern languages, the use of two different terms has, perhaps strengthened the feeling of a difference between the conviction of the heart and that of the understanding the German, like the Greek has one only Faith, in the language of St Paul, is "the substance of things hoped for, the evidence of things not seen" Perhaps these strong expressions might be more accurately rendered confidence In things hoped for (compare 2 Cor ix 4 xi 17) conviction of things not seen (Heb xi 1) Through the faith the apostle proceeds to declare, men receive as true things delivered to them on divine authority, to which neither their senses nor their uninstructed reason bear testimony and endure sufferings and do great actions for God's sake And without it "it is impossible to please him" Such faith "was imputed" to Abraham "for righteousness (Rom iv [illegible] have peace with God [illegible] It is evident from these as well as many other passages in the Epistles of St Paul, that this justification is only by that faith which obeys the command as well as relies on the promise of God, termed by theologians effectious or saving faith Nevertheless, it may be supposed that these passages were misinterpreted by many of those to whom they were addressed as conveying the doctrine of salvation through the mere act of belief Perhaps they were among those expressions of St Paul which, according to St Peter, those who were unstable "wrested to their own destruction," since the Apostle James found it necessary to insist so strongly on the inefficacy of faith without works (ii 17), or a dead faith (*ib* 20) and to assert that "by works a man is justified, and not by faith only" (24) It is needless to state how much theologians, in every age of the church have been perplexed by the difficulties thus presented Their difficulties may be thought to arise, in great measure from the inadequacy of our mental powers to separate the naked act of belief to which, as far as is perceptible to our faculties no quality of ethical right or wrong can attach from the moral predispositions which have produced that belief, and the influence on the character which results from it, the whole, perhaps, entering into the Apostolic view of faith In all ages and churches, there has been a tendency in some to insist exclusively on the doctrine of justification by faith, — a tendency which has sometimes proceeded so far, as in the case of Luther at one period of his life, as to induce them to undervalue or altogether reject the Epistle of St James, in others, to postpone it to the other great truth of judgment according to works But the former characteristic has more particularly marked the tenets which are commonly called Calvinistic, in which it is combined with the peculiar doctrine of election, the latter has been apt to prevail in Roman Catholic teaching and to mingle with what is termed Arminianism in Protestant churches

FAKI'R, an Arabic word signifying *poor*, applied in some Eastern countries to a sect of enthusiasts, who retire from the world and devote themselves to religious observances They are chiefly remarkable for their assiduity in "mortifying the flesh," [illegible] no infliction of the body as too severe, provided they can inspire the observer with reverence towards them There are, however, some classes of Fakirs distinguished for good sense, learning and piety

FALCA'TE (Lat falx, *a sickle*, *sickle-shaped*) In Zoology when a part is curved with the apex acute

FA'LCATED (Lat falx) The moon is said to be *falcated* when her illuminated part appears in the form of a crescent or sickle, which happens when she is in the first [illegible]

FALCIFORM PROCESS OF THE BRAIN (Lat falx) A process of the *dura mater*, which arises from the *crysta galli* and terminates in the *tentorium*, separating the [illegible] brain

FALCO (Lat falco, *a falcon*) The name of a Linnæan genus of Accipitrine Diurnal birds, characterized by a beak crooked, and covered with a cere at the base, head closely invested with feathers. To the short Linnæan phrase descriptive of this group of birds of prey may be added, that the supraciliary arch projects above the eye, giving a bold and threatening physiognomy to these rapacious birds, the majority of which subsist on living prey The first plumage differs from that of maturity, which is not acquired before the third or fourth year The female is generally one third larger than the male The Linnæan genus is now subdivided into the subgenera *Falco*, Bechstein, *Hierofalco*, Cuv, *Aquila*, Brisson, *Haliætus*, Savigny, *Pandion*, Sav, *Circætus*, Vieillot, *Harpyia*, Cuv, *Morphnus*, Cuv, *Astur*, Bechstein, *Nisus*, Cuv, *Milvus*, Bechstein, *Pernis*, Cuv, *Buteo*, Bechstein, *Circus*, Bech, *Gypogeranus*, Illig

Of these subgenera the first two form what are termed the "noble" birds of prey, and they are the most courageous in proportion to their bulk This quality is associated with a powerful form of the beak, of which the arch commences from the base, and which is armed with a strong tooth on each side near the apex Their wings are strong, long, and pointed, the second quill-feather being the longest It is from this division of falcons that the birds are selected for the sport of falconry

In the 'ignoble" division of the birds of prey, the longest quill feather of the wing is almost always the fourth, and the first is very short, which gives the wing an appearance of having the extremity obliquely truncated The bill is not armed with lateral tooth-like processes

FALCONINES *Falconinæ* (Lat falco, *a hawk*) A subfamily of Accipitrine birds, having the genus *Falco* proper as the type, and characterized by a beak short, hooked from its base and toothed near the apex, wings long second quill shortest It includes the genera *Hierax* and *Falco* The term *Falconidæ* is used by some ornithologists in a sense as extended as *Diurnæ*, which see

FALCONRY The origin of this celebrated sport has given occasion to much controversy It has been said that it was unknown to the Greeks, it is however described by Ctesias and Aristotle as practised in their time in India and Thrace Martial and Apuleius present us with plain indications of the knowledge of this pastime among the Romans In modern Europe, it appears to have been practised earliest, or at least with most ardour in Germany the title of the emperor, Henry the Fowler (A D 920) is said to be derived from an anecdote respecting his fondness for it In the 12th century it was the favourite sport of nobles and knights throughout Europe, and in that which followed its rules were reduced into a system by the Emperor Frederic II (Barbarossa) and by Demetrius, physician to the Greek Emperor Palæologus In that court the grand falconer was an officer of distinction, and the title was borrowed from it by the western sovereigns According to the opinion of Strutt the sport was not known so early in England as on the Continent, yet there are traces of it as early as the 8th century From the commencement of the 17th we may date its gradual decline James I, devoted to hunting, was no admirer of falconry, which up to his time had been the favourite royal sport But its final abandonment except as the fancy of a few individuals was owing to the gradual improvement in fire-[illegible] far easier methods of obtaining game [illegible] curious works which exist on this subject once so universally interesting may be mentioned the treatise *De la Fauconnerie* of Charles d'Esperon, Paris, 1605, the celebrated *Book of St Albans* by the Prioress Juliana Berners 1486, *Latham on Falconry*, 1658, *Ray's Idea of Falconry*, published with *Willoughby's Ornithology* The Emperor Frederic II (Barbarossa) did not disdain to [illegible] the results of his experience in the art [illegible] published in 1596 from his MS, under the title *Reliqua librorum Friderici II Imp de arte venandi cum avibus*

FALCULA (Lat falx, *a sickle*) In Zoology, a claw is so called when it is compressed, elongate, curved, [illegible]

FALL The sea term for the rope of any pulley or system of pulleys To *fall aboard* signifies to run foul of another vessel

FALLACY (Lat fallo, *I deceive*), in Logic and Rhetoric, has been defined "any argument, or apparent argument, which professes to be decisive of the matter at issue while in reality it is not" Fallacies have been divided into those "in dictione," in the words, and "extra dictionem," in the matter The latter of these it is not the province of logic to discover and refute, they being, strictly, instances in which the conclusion follows from the premises, and which therefore depend on the unsoundness of these premises themselves, which can only be detected by a knowledge of the subject-matter of the argument Logical fallacies, or fallacies in dictione, are those in which [illegible] to follow, but in reality does not, [illegible] and which, consequently, can be detected by one unlearned in the subject-matter of the argument, but acquainted with the

rules of logic These are subdivided, however, into fallacies purely logical, *i e* vicious syllogisms (*see* SYLLOGISM, PARALOGISM) and fallacies semi-logical, those, namely, which arise from the employment of a middle term in argument (*see* SYLLOGISM PROPOSITION, MIDDLE TERM) ambiguous in sense In rhetoric, a common set of artifices, by which the mind of the reader or hearer is diverted from the question at issue and fixed on some collateral topic, are termed fallacies, as, where the character of the proposer of a measure is discussed as a reason [illegible]

FALLING HOME The [illegible] or upper parts of the sides of a ship when they curve inwards The old ships fell home, or tumbled in (as it is also called), much more than the modern ones, which approach more [illegible]

FALLING STARS *See* SHOOTING STARS

FALL OF MAN The [illegible] Adam and Eve as related in the book of Genesis, by which sin and death were introduced into the world

The word *fall* is universally employed in the United [illegible]

FALLOPIAN [illegible] given to a canal or [illegible] at each side of the fundus of the uterus, and terminating in the ovarium

FALLOW In Agriculture, lands are said to be under fallow when they are without a regular crop of corn or pulse A naked fallow is one in which the soil remains a whole year without any crop whatever, and a turnip or green crop fallow is one in which the lands after being without a crop from harvest till the beginning of summer, and being properly laboured during that period are sown with turnip or other similar crops in rows and the ground cultivated in the intervals Fallowing was practised by the Romans on all soils whatever and has been continued through the dark ages, in all the cultivated parts of Europe so as to have become, till lately, a general habit in the treatment of arable lands The practice of taking two corn crops, and then allowing the land to rest or lie fallow was, till the commencement of the present century prevalent throughout Europe, and it is still a very common practice in most parts of the Continent [illegible] been first broken through by [illegible] end of the 16th century, and [illegible] with the culture of turnips, above a century and a half later Fallows, under the most improved systems of agriculture, are no longer had recourse to in the case of free or easily worked soils, where turnip fallows are made or drill crops of legumes are substituted but in very strong clays they are still found necessary, and this will probably continue to be the case till by the 'frequent drum system' [illegible] other free soils

FALSE CADENCE In Music, one wherein the bass rises a tone or semitone, instead of rising a fourth or falling a fifth

FALSE KEEL The timber added below the main keel, both to serve as a defence and also by deepening the [illegible] hold a better wind

FALSETTO [illegible] of a person's voice which lies above its natural compass and is produced to various extents in different subjects, male as well as female It rarely extends more than four or five notes above the natural voice, and is produced by diminishing

[illegible] A house or family being a subdivision of *gens* or clan (*see* GENS) Its members were distinguished by having the last of them three names or [illegible] same

[illegible] or FAMILIAR SPIRIT, mentioned in the book of Samuel in a passage which has produced much observation from commentators The genius or δαιμόνιον, which Socrates and some other celebrated ancients were said to have possessed as a companion was a species of familiar In modern Europe and Asia, the belief in familiar spirits forms an important feature in the widely spread superstition respecting the magical art The subject is curiously examined in the article in the *Encyclopædia Metropolitana*

FAMILY In Zoology, the group next in value and comprehensiveness above the genus, existing in fact, though under the name of the genus in the classification of Linnæus, who indicated the different groups of species therein comprehended by numbers, instead of collective appellations

Such divisions of the Linnæan genus occur only in [illegible] ber of species [illegible] of the clear-sighted Swede The progress of modern discovery has added so many new forms to the animal catalogue as to render necessary a corresponding subdivision of most of the Linnæan genera To these subordinate groups of species distinct names are given, for the sake of convenience and in order to designate the natural family which these groups compose, the name of the original or typical genus is generally retained, with the



[illegible] applicable to a vast number of Rodents, which scientific precision requires to be arranged in numerous subordinate [illegible] generic [illegible] is applied [illegible]

FAN, FANNERS, FANNING MACHINE A machine for separating the chaff, husks, dust, or other light matters from seeds which are to be preserved for sowing, or for some other purpose in general or domestic economy The air is put in motion by a wheel, commonly driven by hand with leaves or fans instead of spokes, directed in a stream against the seeds to be fanned, which seeds are placed in a hopper, so regulated as to proportion their descent through the stream of air to the force of the current created by the fan wheel Before fanners were invented the process was performed by hand in a manner the reverse of what it is now by machinery, that is, the seeds and refuse to be separated from them were taken up in shovelfulls, and thrown to as great a distance as possible through the calm air, when the full-bodied seeds, being the heaviest, were found at the [illegible] of the chaff [illegible] other matters nearer, [illegible] With the progress of the arts a system of screens and sieves was added to the fanning machine, in consequence of which, as it separated the seed from every kind of refuse, it is called a winnowing machine, and in that case, it not only separates the chaff and other light matters generally from the heavy matters, but it parts both according to their bulk and weight so that the seed comes from the winnowing machine fit for being measured up for the market or store room, and the various kinds of inferior products in a state fit for immediate use

FANATIC (Lat fanum, *a temple*) An enthusiastic and visionary person, who, in matters chiefly relating to religion disregards reason and scripture, and under the influence of his feelings alone adopts the wildest and [illegible] opinions The term *fanaticus* was applied [illegible] of prophetic priests (*Strutt Antiq Rom* p vi p 312), who performed the sacrifices in a wild and extravagant manner, and hence, by an easy transition, has been bestowed in modern times on those who make pretensions to inspiration or who conduct their worship with extravagance or licentiousness

FANCY *See* IMAGINATION

FANDANGO (Spanish) An air for dancing to, in triple time and of a quick and lively character It is the favourite dancing air of the [illegible] it is of great antiquity The dancers [illegible] with castanets,—a practice borrowed from the Moors,—which serve to mark the time more distinctly than a stringed instrument alone would do The Spaniards in dancing to this species of air often carry their gestures beyond the bounds of decency

FANTASIA (It) In Music, a species of composition in which the author ties himself to no particular theme, ranging as his fancy leads amidst various airs and movements Rousseau in his definition of this word confines its meaning to extempore composition, and makes this distinction between the *Capriccio* and the *Fantasia*, namely, that the former is a collection of singular and whimsical ideas strung together by an excited imagination and written down at one's leisure, whilst the latter is an off-hand display of whatever comes across the mind at the instant of execution

FANTOCCINI (It fantoccio, *a puppet*) Dramatic representations in which puppets are substituted in the scene for human performers

FARCE (From the French word, which again is derived from the Italian and this from the Latin farcire, *to stuff*) In [illegible] of low comic [illegible] the Lanx Satura of the Romans, which gave its denomination to the satire, to signify a miscellaneous compound or mixture of different things In modern languages it has borne various significations Certain songs which were [illegible] between the prayers on the occasion of religious worship are said to have been denominated Farces in Germany, during the middle ages, whence the word appears to have denoted simply an interlude of any kind In England, the farce appears to have risen to the dignity of a regular theatrical entertainment about the beginning of the last century, since which time it has formed one of the most popular of our exhibitions, and usually performed by way of contrast, after a tragedy at the national theatres The farce is restricted to three acts as its limit, but frequently consists only of two or one Of all the pieces of this class which have successively amused English audiences, none have acquired a permanent literary reputation except those of Foote,—performances in which the licence of the theatre in satirizing living persons was carried to the utmost height The *Fabulæ Atellanæ* of the Romans, which appears to have been short dramatic entertainments of a miscellaneous character, sometimes pastoral, sometimes tragi-comic, &c

but not so coarse in plan or diction as the *Mimes* and their *Exodia*, which were satirical dialogues in verse between some set characters or stage-buffoons, appear to have filled in some respects the place of the modern farce On the French stage the vaudeville answers to the English [illegible] VILLE

FARCY FARCIN, is a disease of the horse which [illegible] tics of the skin, either generally pro- [illegible] appearance of the vessels like moles or buttons, when it is called the bud or button farcy, or locally, [illegible] tions in [illegible] of [illegible] and, like the glanders, an [illegible] to cure The button [illegible] burning off the buttons [illegible] by the exhibition of mercury, and the water farcy by the exhibition of mercury alone Both diseases are sometimes cured by feeding the animal entirely on green food See Blaine in *Encyc of Agr* 2d edit page 985

FARI'NA (Lat far, *corn*, of which it is made) Meal or flour, obtained by grinding and sifting wheat and other seeds, hence the term *farinaceous food*

FA'RM In Agriculture a farm is a portion of land, with suitable buildings fences, and other arrangements necessary for carrying on the business of farming, which is let to the farmer or occupier for rent Farming is no doubt coeval with the invention of property in land, because we may suppose that when a proprietor had taken possession of a portion of territorial surface and called it his own, he would require the assistance of various persons to cultivate it, and these persons he could only remunerate by giving them a share of the produce Hence the origin of what on the Continent is called the Metayer system — in which the landlord supplies the farmer or tenant with the soil buildings, and the whole or a certain portion of the stock, while the latter supplies the labour of cultivation and management, and takes as a remuneration the half, or some other measure of the produce In process of time, as the tenants or farmers began to acquire capital, they furnished the whole of the live and dead stock as well as the labour of cultivation and management, and paid the proprietor or landlord a fixed rent in money or produce To enable the tenant or farmer to do this with the greater security leases were invented, by which the tenant holding the land for a certain number of years was enabled to lay out money for its improvement at the commencement of his lease and to receive it back again in the form of increased produce before its termination

At the commencement of this system of what may be called free farming all farms were undoubtedly of very limited extent, but with the increase of capital and skill on the part of the farmer they have become greatly enlarged Much has been [illegible] most profitable size of farms for the [illegible] may safely be left to the interest of the parties immediately concerned Whatever size of farm brings in the highest rent to the landlord will be the best size for the public, because the higher the rent the greater the amount of the produce that must be sent to market to pay it That there is a natural limit to the size of farms there can be no doubt, but that this is is a different question, and has no connection with the other It depends on the character of the surface, the kind of farming and the climate But though there is a natural limit to the size of farms, and which in any given case can be readily defined, there is no limit to the number of farms that an individual may hold but those of his capital and his skill

FA'RMERY The buildings and yards necessary for carrying on the business of a farm Their situation should be central to the farm lands, in order that the distance from which the crops are brought from the fields to the farmery, and the manure carted from the farmery to the fields, may be reduced to the lowest degree, for when the farm buildings are on one side of the farm lands it is evident that the carriage to or from the more distant fields must be attended with considerable loss of labour and time The characteristic yard of the farmery is the stack yard, and the principal feature among the buildings is the barn

FARMING The [illegible] cultivation of lands held [illegible] different countries and climates, but one point is common to them all,—viz that no article shall be cultivated which shall not fully remunerate the cultivator or farmer within the limits of [illegible] Hence, as few leases in any part of the world exceed twenty years in duration, timber trees are never objects of cultivation by farmers, and it is only in particular cases that orchards and vineyards can be planted by them As a business, farming may be described as that which under ordinary circumstances yields a lower degree of profit than any other mode in which capital and skill can be employed, but where abundance of capital and extraordinary skill are brought to bear on farming its profits, on an average of a long series of years, may perhaps not be much inferior to those of commerce and manufactures, on the average of a very long period The great advantages of farming as a pursuit are —1 That the articles produced, being of the first necessity, there is always a market for them at some price, without the necessity of any or of much exertion on the part of the farmer, 2 The certainty of always having a home and the means of existence on the farm, and 3 The comparative degree of independence which these circumstances are calculated to create in the mind These advantages, however, depend much on the length of lease, and [illegible]

FARROW [illegible] farrow when [illegible] forth pigs, and the pigs brought forth are called a litter or farrow

FA'RTHING A small English copper coin, amounting to one fourth of a [illegible], it was anciently called fourthing, [illegible] the fourth of the integer or penny

FARTHINGALE [illegible] bone used [illegible] pean countries to spread out the petticoat to a wide circumference It was introduced into England in the reign of Queen Elizabeth and continued to be used on state occasions down to the commencement of the present century (See *Strutt's Manners and Customs*)

FA'SCES (Lat) In Ancient History, some of the insignia of authority of the chief magistrates of Rome They consisted of bundles of wooden rods each enclosing an iron axe so that its head appeared above and were used as instruments of punishment the rods being applied for minor offences, and the axe for capital crimes They were carried before the magistrates on public occasions by officers called *lictors* and the number appointed to each varied for the different magistracies Thus the civic praetors had two proconsuls and provincial prætors six the consuls twelve and dictators twenty-four The municipal decemvirs also had the privilege of having two fasces carried before them in their own towns

FA'SCIA (Lat *a band*) In Architecture, a flat member in an entablature or elsewhere, like a flat band or broad fillet The architrave, when subdivided for instance has three bands called fasciæ, of which the lower is called the first fascia, the middle one the second and the upper one the third See IONIC and the other Orders

FA'SCIÆ In Astronomy, bright stripes or belts observed on the discs of some of the planets, particularly Jupiter The fasciæ or belts of this planet are sometimes broader and sometimes narrower, and alter their situation on the body of the planet though they always appear parallel to his equator See JUPITER

FASCIA In Anatomy, the tendinous expansions of muscles The *fascia lata* is a strong tendinous sheath of the muscles of the thigh

FA'SCICULA'RIA (Lat fasciculus *a bundle*) A genus of extinct Zoophites whose calcareous cases are in the form of tubes aggregated [illegible] bundles, like those of the organ-pipe [illegible] The *Fasciculariæ* are abundant in the English coralline crag formation

FASCI'CULUS In Botany, a form of inflorescence exactly similar to that called a corymbus, with the exception of the expansion being centrifugal in place of being centripetal

FASCINA'TION The fact of being charmed, operated upon, or influenced by the look of certain individuals generally taken in an evil sense The word is originally derived from the Greek βασκαινειν (*Theocr* Idyl VI), whence the Latin fascinare *Fascination* is the power supposed to be possessed by certain persons of working mischief to others by means of a glance of the eye We find it mentioned in Theocritus, and it was so prevalent among the Romans that it was personified as the god Fascinus, the patron of the evil eye Virgil alludes to it thus —

> Nescio quis teneros oculus mihi fascinat agnos
> *Eclog* 3

It is to this day a common belief among the vulgar in almost all countries, but probably it is nowhere more generally retained than in Turkey and the kingdom of Naples and Sicily In the former country, the Mussulmans deem it necessary to have recourse to a variety of amulets and charms, in order to preserve themselves from the evil eye of an enemy, or of an infidel In Naples, the evil eye and its fascination (known to them by the name of gettatura) are subjects of dread and superstitious precaution among all classes of the people There is a treatise on fascination by Vairus, prior of a convent at Benevento in that country (1589), another by Trommann (1675)

FA'SCINES (Lat fascina, *fagot*), in Fortification, are bundles of fagots, twigs, or branches of trees which, being mixed with earth, are made use of for filling up ditc[illegible] [illegible]rapers &c

FASCIOLARIA (Lat fasciola, *a swathing band*) A genus of Pectinibranchiate Mollusks, dismembered from the rock-shells (*Murices*) of Linn[illegible] [illegible] of the smooth band-like surface of their whirls which have

not any "varices," and distinguished from the species of *Fusus* in having plaits on the columella, which are [illegible]

FASHION [illegible] *to make* or *form*) A term used to signify the prevailing mode or taste in any country, the only recognized quality which it possesses being mutability It may safely be averred that in proportion to the [illegible] non exercises in any country may its be vindicated, nothing being so characteristic of a rude and barbarous state of existence as a rigid adherence to the customs of antiquity The term *fashion* has generally been [illegible] to the adornment of the p[illegible] prevailing taste as introduced by some individual of consideration in society, but it has a much wider signification, being applied to the most trivial kind of conventional usages a disregard or ignorance of which is sufficient in the eyes of the votaries of this tyrannical goddess to banish the offender beyond the pale of civilized society The remark which Horace makes on the introduction disuse, and revival of [illegible] to the term in question, that we [illegible] in this place —

> Multa renascentur quæ jam cecidere cadentque
> Quæ nunc [illegible] volet usus,
> Quem penes arbitrium [illegible], et jus, et norma loquendi
>
> *Ars Poetica*, v 70

FASSITE In Mineralogy, a variety of *augite* from Fassa in the Tyrol

FASTI In Ancient History, the records of the Roman state, in which all public matters, military and civil, were registered by the high priest [illegible] days on which they took place The *Fa* [illegible] [illegible] n year and the cere- [illegible] with their historical [illegible] ooks containing the [illegible] with January, have come down to us the rest are lost

FASTIGIUM In Architecture, the same as PEDIMENT, which see

FASTING In a theological sense the abstaining from food [illegible] commended in the New Testament by the example of the Apostles and early Christians who are frequently represented as fasting especially on solemn occasions such as when Paul and Barnabas were sent forth by the Apostles to preach to the Gentiles At the same time it must be observed, that during our Saviour's lifetime his disciples were notorious among the Jews for not fasting, as was the common religious practice of the day from which we must not suppose that Christ did not appoint stated days or periods of fasting such as among Christians in later times, as well as among the Jews then have generally degenerated into heartless ceremonial observances but left such exercises rather to the judgment and feelings of his disciples to be made by them part of their own private devotions The observances however of stated fast days prevailed very early and universally in the church and the Church of England has not hesitated accordingly, to point out the practice of early antiquity as a guide to its children in this matter

In the Romish church Wednesday and Friday are observed as fasts throughout the year those being the days on which our Lord was betrayed and crucified respectively There are a considerable number of fast days that occur also in the course of the year, and the whole period of Lent is held as a term of abstinence, in which the stated fast days that occur are observed with especial rigour (in imitation of our Lord's forty days fast in the wilderness) These were periods of real abstinence in the primitive church, but the little that was eaten does not appear to have been limited in early times, either in kind or quantity, by any positive precept Fasting was practised differently by churches and individuals

The objection then that is brought against the Romish church in this particular is, first that it commands and enforces that which was originally left to the discretion of Christians, [illegible] by multiplying the o[illegible] is enjoined, it causes the practice to be looked upon as a work meritorious in itself and efficient for the expiation of sins, which was never intended to serve any other use than that of a means towards attaining a godly frame of mind

FATALISM The belief in an overruling fate or destiny w[illegible] actions [illegible] NECESSITY, for those religious opinions which have as- [illegible] ELECTION, PREDESTINATION

[illegible] called also *Castle of the Fairy Morgana*, the spectacle being supposed to be under the influence of the Queen of the Fairies, the *Morgan la Fay* of popular legends) A remarkable phenomenon of *mi-* [illegible] is a [illegible] the vicinity of Reggio [illegible] appearance [illegible] the surface of the sea of [illegible] plied images of the objects on the surrounding coasts It is thus described by Minasi — "A spectator on an eminence in the city of Reggio, with his back to the sun and his face to the sea, and when the rising sun shines from [illegible] Rhegium's coast [illegible] columns, lofty towers, superb palaces with balconies and windows, villag[illegible] armies of men [illegible] armies [illegible] copied, and even admitted into treatises on optics, has received considerable embellishment from the aid of the imagination Captain Smyth, in his excellent work on Sicily observes, "I never met with a Sicilian who had *actually seen* any thing more than the loom or 'mirage' consequent on a peculiar state of the atmosphere, but which, I must say I have here observed many times to be unusually strong" (*Memoir descriptive of the Resources, Inhabitants, and Hydrography of Sicily and its Islands* p 109) *See* MIRAGE

FATE *See* DESTINY, NECESSITY

FATES (Lat fatum, *that which is spoken*) In Mythology, the three sister goddesses named Clotho (Spinster), Lachesis (Allotter), and Atropos (Unchangeable), whose office it was to spin the destinies of men, and break the threads when their [illegible] of death came They were also called [illegible] as Their Greek name was *Μοῖραι* [illegible]

FATHERS OF THE CHURCH The early Christian writers whose works have thrown light upon the history, doctrines, and observances of the primitive church, and who are thereby entitled to be looked up to by us to a certain extent as guides and instructors The period to which the list may be extended is, of course, arbitrary St Bernard in the 12th century is generally styled the last of the Fathers The writers of the 1st century or [illegible] are distingu[illegible] general character of the writings of these celebrated men, their trustworthiness as witnesses, their authority as judges in matters of doctrine and discipline and the utility of studying their works, have been, unfortunately, discussed by divines of different parties with far more of prejudice and the spirit of system than the love of truth It has [illegible] sometimes the fashion to exalt and sometimes to depreciate them seldom have they been used by learned men of any church for the simple and serious purposes of edification A voluminous controversy was carried on upon this subject between some Protestants, chiefly of the Calvinist churches who attacked the Fathers, and others both Protestant and Catholic, who defended them, towards the end of the 17th century On the former side, two works of some notoriety were produced —*Daille's Treatise on the Use of the Fathers*, and *Barbeyrac, Morale des Peres de l'Eglise* Among many answers may be cited that of Cellier to Barbeyrac 1715 In England, Burnet, Hill Peter Allix, Reeves *Apology for the Fathers with Dissertations* 1709), took part in it The Benedictines of Paris in the 17th century published valuable editions of the principal Fathers both Greek and Latin [illegible] of that order published an *Appe* [illegible] collection, the *Bibliotheca Patrum*, in which much information is collected Of late years Mr Collinson by his *Bampton Lectures* (1817), raised anew a spi[illegible] At Oxford and at Paris [illegible] valuable character of the Fathers are no[illegible]

FATHOM An English measure of [illegible] equal to two yards, or six feet

FAT OF ANIMALS [illegible] cellular membrane of anim[illegible] or yellowish, with little smell or taste and varies in consistency according to the relative quantities of *stearine* and *elaine* which it contains The ultimate elements of animal fat are the same as those of vegetable oils according to the analysis of Chevreul, 100 parts of human fat are composed of 79 0 carbon, 11 4 hydrogen and 9 6 oxygen Hog's lard and mutton suet are very similarly constituted

FATTENING DOMESTIC ANIMALS The difference between feeding and fattening, as far as respects domestic animals, consists in this, that the object of the former is to maintain the animal in a state of health and vigour for the purpose of facilitating its growth to maturity, or if mature keeping it in good working condition, while the object of the latter is to accumulate on the animal more flesh and fat than is sufficient for either of these purposes and in general as much as possible, so as to increase the bulk and [illegible] and fat in proportion to the size of t[illegible] within these few years, the means used by all fatteners of domestic animals, whether quadrupeds or poultry were preventing the animals from taking exercise and forcing them with food The excessive fat produced by these means was especially in sheep and swine, was found to be both disagreeable and unwholesome, and accordingly the most

approved system of fattening animals of every description, at the present day consists in not merely supplying them with abundance of food but also of the means of taking exercise Hence the farmers in the most enlightened districts such as Berwick hire [illegible] instead of tying up their fattening cattle in stables like horses and placing their food before them, put two or three together in small yards with sheds attached, in which they can run about, eat when they choose, and take shelter from the rain, the cold, or the sun at pleasure under the open shed Swine are treated in the same manner and [illegible] are fattened for the market Poultry are not [illegible] or rabbits in hutches, but the former are allowed to take exercise in fields sown with various herbs and the latter are kept in a species of artificial warren, where they can take exercise by burrowing

FAU'CES (Plural of faux) The posterior part of the mouth, terminated by the *pharynx* and *larynx*

FAULT In Mining and Geology, a dislocation of strata, whether from a break or slip, or the introduction of [illegible]

[illegible] peculiar to a country constituted, derived from the Fauni or *rural deities* of Roman mythology

FAUNUS An Italian rural deity resembling the Grecian Pan, and, like him endued with the gift of prophecy Mention is sometimes made of several Fauni, who were represented, like the satyrs, with the horns and feet of goats There was an annual festival instituted to their honour, called *Faunalia*

FAUSSE-BRAYE In Fortification, a low rampart going quite round the body of the place, the height being about 3 feet above the level ground

FAUX The orifice of the tube of the corolla, the tube being formed by the confluence of the petals

FEALTY In Feudal Law, the oath of fidelity (Fr féauté) taken by every tenant on admission to be true to his superior lord General fealty is that due from the [illegible] special fealty from tenant to mesne [illegible] to differ from homage in being due to every new lord The oath, as administered in England, was fixed by stat 17 E 2 c 2, but it has long been obsolete although, in copyhold tenements the memory of it is still preserved by the customary entry of respite of fealty on the admission of a new tenant

FEASTS, or FESTIVALS are days set apart by the church, either for the grateful celebration of the most remarkable events connected with the scheme of redemption, or upon which to commemorate the actions and sufferings of such persons as have been most instrumental in carrying forward the designs of God for the salvation of mankind This was a practice of the primitive church, but in process of time (as early as the 4th century) the great number of names which had been introduced into the calendar, and the many corruptions which the honour paid to their memory had engendered rendered its observation both burdensome and superstitious Accordingly at the Reformation the Protestants directed their attention to the retrenchment and purification of these ceremonies The English church retains the festivals of the nativity, circumcision, manifestation the death and resurrection and ascension of Christ the purification of the Virgin and the annunciation (or Lady-day) Whit Sunday in honour of the Holy Spirit, and Trinity Sunday Besides these the most remarkable of the Apostles and the Evangelists are commemorated on their respective days, and one day is set apart for the remembrance of all the saints From this calendar therefore the names of the martyrs and saints of later ages are excluded (with which the Romish calendar is so crowded), partly from the uncertainty which hangs over the stories of many of them, and partly also in order to cut away what would otherwise have furnished a dangerous precedent Festivals are either moveable or immoveable, the former depending upon Easter, the latter being fixed to certain days of their respective months

FEATHERBEDDED In Architecture, a term applied to [illegible] or sculptured [illegible]

FEATHERS In Ornithology, those productions of the dermal system which form the most exterior covering of birds and which consist of the following parts, viz a quill (*calamus*), a shaft (*rhachis*), and vanes (*pogonium externum et internum*)

The [illegible] to the [illegible] transparent possessing in an eminent degree the [illegible] properties of strength and lightness The end which is implanted in the skin [illegible] is pierced by an orifice called the [illegible] the opposite end, where it is continued into the shaft, and just at the meeting of the two lateral vanes there is another orifice called the upper umbilicus The cavity of the quill contains an imbricated series of conical capsules, united together by a [illegible] he membranous remains of the [illegible]

The shaft is quadrilateral, with a smooth convex surface on [illegible] opposite concave and the two [illegible] [illegible] [illegible]

FE'CIALS, or FETIALS The Roman heralds, [illegible] and conclude [illegible] with the following ceremonies —They were first sent to demand redress, and if it was not given within thirty-three days, they returned to the confines of the hostile state and [illegible] then have proclaimed war [illegible] This ritual, which is the oldest in the Roman people in concluding a treaty of peace, was called *Pater Patratus* The college of Fecials was instituted by [illegible] have been borrowed [illegible] twenty in number

FECULA, FECULA (Latin *fæculum*, *a sediment*) When certain vegetable products are bruised and mixed with water, the pulverulent matter which subsides is called the *fecula* or *fæces*, it is commonly of a starchy nature

FE' [illegible] fœdus, *a league or treaty*) A government formed by the union of several [illegible] surrendering a portion of its power [illegible] But the amount of the power thus surrendered varies in different federations Thus the government of the German empire as it existed before the French revolution, and that of the United Provinces of the Netherlands, were both termed federal, and the Swiss cantons, under the present Swiss constitution, have retained more of their individual sovereignty, both as to foreign relations and as to domestic arrangements, than those of the United States of America, each being at liberty, in some cases, to make treaties with foreign powers, and also having almost unlimited power to modify its own institutions, while the latter states have transferred the whole of their foreign affairs to the general government, and are moreover bound by their articles of union to remain democratic in constitution The best work on the federative governments of antiquity is that of St Croix, *Des Anciens Gouvernements Federatifs*

FEE-FARM RENT, in Law, is defined a rent charge in fee, issuing out of an estate in fee of at least one quarter of the value of the land at the time of its reservation Some authorities consider the amount as immaterial No grant in fee farm can be made since the statute of Quia Emptores

FEELERS Organs fixed to the mouth of insects, generally less than the antennæ, and often jointed See PALPS

FEES In Law perquisites allowed to ministers of justice, fixed either by act of parliament or ancient usage The word fee is derived either from an Ang Sax word [illegible] or the French for *faith*

FEE SIMPLE in Law is an estate of freehold of inheritance in lands, tenements, or hereditaments Tenant in fee simple absolute, or as it is more briefly expressed in *fee*, is one who has the fullest power of disposing of his tenement which the law allows, and not being disposed of by him either in his lifetime or by devise, it descends to his heirs general

An estate to a man and his heirs qualified by a condition or limitation capable of abridging it as an estate to A and his heirs on condition of paying a sum of money on a stipulated day, and if he fail to do so then to another is termed a fee conditional, or with less propriety of language, a fee-simple conditional

FEE TAIL, in Law, arose out of the statute *De Donis* 13 Edw I, which restrained the alienation of lands and tenements by one to whom they had been given with a limitation to a particular class of heirs A gift for instance, to a man and the heirs of his body constituted before the statute a fee-simple conditional, which could be alienated as soon as a child was born to the donee after the statute it became inalienable, until more latitude was given by the invention of certain refined fictions of law

A deed creating an estate tail is properly called a gift, and the giver and receiver the *donor* and *donee* Estates tail are *general*, where only one person's body is specified from which the issue must be derived, *special*, where both the progenitors are marked out, as in a gift to A and the heirs of his body to be begotten upon B It may also be descendible to all the issue or to male or female issue, in which case estates are said to be in tail male or in tail female Half blood is no impediment in the descent of an estate tail general Where lands and tenements are given to a man and his heirs in special tail (by a wife named in the grant), [illegible] husband is tenant in [illegible] tenant, and his estate is in most respects equivalent to one for life only

Estates tail being contrary to the general policy of the [illegible] to invent [illegible] whereby the [illegible] of the gift, and acquire an estate in fee simple without incurring forfeiture This fiction of *common recoveries* (of which was established in the courts in the reign of Ed 4), and by that of fines recognized by statute (4 H 7 c 24, 32 H 8 c 36) A simpler process has been substituted for these ancient contrivances by the recent Real Property Act (3 & 4 W 4 c 74)

FELIS (Lat *a cat*) The name given by Linnæus to the genus of Ferine or carnivorous quadrupeds of which the common cat is an example The essential characters of this genus repose on the strong, sharp, retractile talons with which all the four feet are armed, and the corresponding destructive nature of the dentary organs These consist of six small incisors in each jaw, the [illegible] two long, and [illegible] strong lower [illegible] jaw of small greatest ground strength, conical, sharp-pointed, slightly incurved, and separated from the incisors by an interval corresponding in size with the summits of the inferior laniaries, which always pass, when the mouth is closed, in front of those of the upper jaw

The molar teeth are four in number on each side of the upper jaw, and [illegible] the two anterior [illegible] the two, and furnished each with a single conical pointed middle process The third molar is the largest in both jaws, and presents a very characteristic form in the lower one being compressed, and terminating in two sharp-pointed trenchant triangular lobes, which play upon the inner surface of three corresponding lobes of the tooth above The [illegible] of the lower carnassial or sectorial tooth is [illegible] upper gum defended, by an internal tubercle in the upper sectorial The fourth molar in the upper jaw is placed within the posterior margin of the third, and presents a simple transverse slightly convex plate, affording additional surface for the inferior sectorial to work against The claws and teeth above described are better adapted for the seizure and destruction of living animals than are those of any other mammalia, and the power of wielding these weapons is enjoyed in a corresponding degree of perfection There are no quadrupeds [illegible] muscles of the jaws and limbs are more fully developed The teeth, as we have seen, are few, though formidable those of the lower jaw occupy only its anterior half, the rest of the jaw consisting chiefly of a broad and high coronoid, and a strong angular process for the implantation of the immense muscles destined for its movements The skeleton of the feline animals presents a light but well-built mechanism the bones, though slender are extremely compact, the trunk, having to contain the simple digestive apparatus requisite for the assimilation of highly organized animal food, is comparatively slender, and flattened at the sides The muscular forces are thus enabled to carry the light body along by extensive bounds and it is thus that the largest felines generally make their attack When the impetus of the spring is added to the stroke of the paw, the lion or tiger has power to fell an ox or smash the skull of a man at a single blow, and as the strength of the neck corresponds with that of the jaws and limbs, they are enabled to bear away with ease animals bigger and heavier than themselves It fortunately happens that the feline animals have not the instinct of sociality, otherwise what terrestrial species could withstand a troop of lions or tigers hunting in concert like a pack of wolves? "Conscious of their [illegible]" says the author of a favourite [illegible] secures them against the attacks of other animals, each with his female partner occupies a solitary den which is usually concealed in the depths of the forest Hence when pressed by hunger, they issue forth in search of their prey, which they rarely attack with open force, but stealing on with noiseless tread or stationing themselves in ambush in such situations as appear suitable to their purpose, watch with in- [illegible] their victim Their [illegible] their habits and mode of life Incapable of long-continued speed, their usual gait is slow cautious and stealthy with their posterior limbs bent beneath them, and their ears distended to catch the most trifling noise Guided by these organs, the internal structure of which is highly developed, they trace the sound or footsteps to an almost incredible distance, and direct themselves towards their prey with unerring certainty In this quest the sense of smell, which they possess in a very low degree, affords them but little assistance, their sight, however is good and serves them equally well both by day and night, their extremely dilatable pupils adapting themselves with admirable precision to various intensities of light The frequently elongated form of their pupils [illegible] or yellow colour [illegible] their eyes, and the [illegible] their nictitating membrane [illegible] contribute

No sooner is the object of their pursuit within reach of the [illegible], suddenly bursting forth from their lurking place, or changing their slow and stealthy pace for a furious and overwhelming bound, they dart with the velocity of lightning upon their terrified victim The great strength and extreme flexibility of their fore-paws enable them at once to dash him to the earth, and to seize him with an irresistible grasp They then proceed

to rend him in pieces by the united efforts of their teeth and claws, and gorge themselves upon his lacerated flesh."

The feline animals or cats constitute a well defined and circumscribed genus. The leopards panthers jaguars, and tigers are the most typical or truly feline species, in these the beauty of colouring, sleekness of skin, elegance of form, craft, suspicion, bloodthirstiness agility under excitement, and sloth during repletion, are most strongly manifested. The lion combines more robustness of body with the feline attributes, and his pre-eminent stature receives an air of nobility and grandeur from the mane that decorates his head and neck. He has the credit, too, of a greater share of boldness and generosity than the other cats. His vocal organs also exhibit a modification of structure not present in the other felines, by which he has the power to utter his tremendous roar, —a roar which, when sent forth under the excitement of hunger, scares from their hiding places the timid ruminants which may be lurking within the compass of its fearful reverberation. Next, the [illegible] group is characterized by the shortness of head and the tuft of hairs on the tip of the ears, this includes the lynxes.

The [illegible] or hunting leopard deviates most in the [illegible] condition of the talons and the upright carriage of his body from the true feline characters, and with these physical modifications is combined so much of the canine disposition as enables this species to be used in packs for the purposes of the chase.

The middle-sized cats, which lurk in the branches of trees, as the leopards, ocelots, &c. have a fulvous ground colour broken by irregular dark spots, a marking which admirably adapts them for concealment amidst foliage. A similar relation of adaptation to the peculiar theatre of their destructive habits may be traced in other species. The tiger for example, which prowls on the ground, and creeps stealthily towards his victim between the stems of the trees and plants of the jungle has his bright ground colour interrupted with black vertical stripes. The lion which traverses the parched deserts of Africa and lies in wait to intercept the antelopes which bound in troops from one oasis to another would be rendered too conspicuous if his tawny hide were ornamented by the stripes or spots that characterize the feline livery, these therefore, which are [illegible] the earlier periods of his existence, become [illegible] he attains to maturity. A smaller feline species the puma or American lion, which plays the predatory character in a corresponding theatre of the New World, presents a similar uniformity of colour.

The feline animals bring forth from two to six young ones at a birth. The domestic cat is the most fertile, a circumstance which arises from the abundance of food, shelter and protection consequent on her alliance with man. But, as has been frequently remarked this, of all domesticated animals is the least servile or restrained and though instances of personal attachment are not wanting the affection of the cat is rather to the house than to its owner. There are many singularities in the nature of the cat which perhaps our comparatively limited acquaintance with the other felines leads us to regard as peculiar to this species. She is remarkably nervous, and readily startled, gives out the electric spark when her fur is rubbed contrary to its direction as is very conspicuous when this is done in the dark. Under the excitement of fear, the same effect is produced on the long hairs of the tail as if a stream of electricity were transmitted through them, and they all stand out from the surface to which they are attached, giving the tail an appearance of treble its usual thickness, at the same time the back is raised and the body drawn into its smallest compass. Cats are attracted by peculiar odours and exhibit a violent fondness for catmint and valerian, rubbing their noses and [illegible] in the latter with signs of great and [illegible] excitement. Cats are very cleanly are fond of warmth, and seek a soft place for their repose. They express their satisfaction by a peculiar [illegible] called "purring."

FELLING TIMBER. In Arboriculture, when a full-grown tree is cut down it is said to be felled, but this term is never applied to young trees or bushes, undergrowth, or hedges, which are said to be rooted out or cut over. Much has been written respecting the proper season for felling trees, some arguing in favour of midwinter, and others in favour of midsummer. The question principally turns upon the quantity and the value of the soft or outer wood in the trunk of the tree to be felled known by foresters and carpenters as the sap. As this sap or outer wood is the only portion of the trunk in which the sap or juices of the tree circulate it is evident that if no value be set upon it the tree may be cut down at any season because the truly valuable part of the trunk, the mature timber, is impermeable to the sap in its ascent through the soft wood, and is therefore in the same state at every season of the year. On the other hand, where much value is attached to the soft or outer wood, where this outer wood is wished to be made as valuable as possible, or where, as in the case of comparatively young trees, the greater part of the trunk consists of sap wood, felling ought to take place when there is least sap in the course of circulation. This season is without doubt midwinter, which, all other circumstances being equal, is unquestionably the best season for felling timber, the next best being midsummmer, when the sap is chiefly confined to the young shoots, the circumference of the soft wood, and the bark. As the worst is the spring, just before the development of the buds, when the tree is fullest of sap and receiving constantly fresh supplies from the root, and in autumn, immediately before the fall of the leaf when there is a superabundance of sap, from its being as it were thrown out of employment by the falling of the leaf. In general, all the soft woods such as the elm, lime poplar, willow, &c., should be felled during winter, hard woods, like the oak, beech, ash &c. when the trunks are of large size, and valued chiefly for their heart wood, may be felled at any time.

FE'LLOW. In the colleges of the English Universities and some other collegiate institutions the superior members of the foundations are so termed in general. In some however all members of the foundation are fellows from their admission. The usages of different foundations in the two universities vary so much that [illegible] account will apply equally to all. The fellows [illegible] they do not take orders at a certain period. There are however, lay fellowships in both universities. Fellowships are also vacated in the universities (without exception) by marriage, and by the acceptance of preferment in the church from the college, or in some instances of other preferment of a certain value. From among the resident fellows are selected for the most part the governing officers and tutors of the colleges. The principal or head of the college is generally elected either by the whole or a select body of the fellows. There is a distinction in some colleges between senior and junior fellowships, in point of emolument, which does not exist in others. At Cambridge there is also a distinction between foundation fellowships and bye or appropriation fellowships, the former only in most colleges entitling the possessor to college offices. The value of fellowships is extremely various nor do they always maintain the same amount, being generally dependent on corn rents. The advantages obtained by the fellow are partly in income, partly if resident in free lodging and allowances towards board. There are fellowships of the value of 500*l.* or 600*l.* per annum and others of 100*l.* or less, but a large proportion may be said to average from 150*l.* to 300*l.* a year. *Fellow* is also [illegible] members of learned academies and

FELLOWSHIP. A rule in Arithmetic of considerable use in balancing accounts among partners in trade. Considered as an arithmetical process it is simply a method of dividing a number into parts which shall have given proportions to each other. Fellowship is either simple or compound. To simple fellowship belongs a question of this sort — 'A contribution of 20,000*l.* is levied on three towns, and each is required to pay in proportion to the number of its inhabitants. Now the 1st contains 2000 inhabitants, the 2d 3000 and the 3d 5000, what sum must each contribute?' This question is obviously the same as it it had been required to divide the number 20,000 into three parts having the ratios of 2, 3 and 5 which is done by dividing 20 000 by the sum of 2, 3 and 5, that is by 10, and multiplying the quotient by each of those numbers separately the several results are the sums required. Here $20\,000 - 10 = 2000$, and $2000 \times 2 = 4000$, for the share of the first, $2000 \times 3 = 6000$, for the share of the second, and $2000 \times 5 = 10{,}000$, for the share of the third. These results are in the given proportions, and their sum amounts to 20,000.

Compound fellowship is when the parts into which the given number is to be distributed are proportional to more than one set of numbers. This is usually called *fellowship with time*, because in distributing the profits of a mercantile transaction carried on by several partners the share of each must be proportional, both to the amount of the capital he contributed and to the time it was employed. It must therefore be proportional to the product of these two. Hence the rule for compound fellowship — Multiply each stock by the time of its continuance, the products are the numbers to which the several parts of the sum to be distributed must be proportional, and with these numbers proceed as in the case of single fellowship. Both cases, it may be remarked below, to what is more correctly termed *Distributive Proportion*.

FE'LO DE SE. In Law, one who is found by the coroner's jury to have laid violent hands on himself, or occasioned his own death feloniously. This verdict occasions forfeiture of chattels, real and personal, but not of lands of inheritance. One found felo de se was formerly buried in the king's highway, with a stake driven

through the heart; but since 1823 (4 G 4 c 52), privately buried in a burial ground, between the hours of [illegible]

FELONY (Law) of uncertain derivation Sir H Spelman derives it from the word fee or fief, and the T[illegible] that which costs or for[illegible] the same root with the verb *to fail*) In Law, in the general sense, comprises every species of crime which occasioned at common law the forfeiture of lands and goods Treasons, therefore, are, strictly speaking, felonies, though in common language distinguished from them The term felony appears, in feudal law, to have been synonymous with forfeiture to the feudal lord T[illegible] punishment attached to felony at common law was d[illegible] and if any statute, even now, makes a new offence felony without specifying the punishment, the law implies it to be capital But some species of felony were not thus punishable at common law, and the gradual operation of altered opinion upon our code has removed this punishment from all but a few The principal species of felony are,—1 Offences against the person, such as murder, manslaughter, rape, &c, assault with felonious intent, that is, with intent to injure the sufferer in a greater or less degree The highest of these offences against the person are still punishable by death The acts respecting these offences were consolidated by 7 & 8 Geo 4 c 31 Some of them as common assaults, &c, are only misdemeanors 2 Of offences against property the great body is comprehended under the ancient appellation of *larceny* 3 Embezzlement 4 Burglary 5 Malicious mischief to property, arson, riotous demolition of churches, chapels, houses, &c, are capital offences within this class 6 Forgery 7 Numerous offences of a public nature (many such, however amount only to misdemeanor)—1 Either against the king and government, as treason, sedition, embezzlement of the king's stores, &c, 2 Against public justice, 3 Against the public peace, 4 Against public trade, 5 Against public police and economy Under this head also are to be ranked some offences relative to game, while others come under the description of larceny

FELSPAR (Germ feldspath) An important mineral composed of silica, alumina, and potash, with traces of lime, and often of oxide of iron Common felspar is of various shades of white and red, it forms an ingredient in granite, and is the base of some other rocks It is often crystallized, and cleaves into rhomboidal fragments

FELTING (Germ filzen) The process by which different kinds of fur or wool are blended into a compact texture for the manufacture of hats The anatomical peculiarities of the different hairs or furs are much concerned in the perfection of the felt they must be such as to enable them to interlace and intertwine with each other Hare and rabbit fur wool and beaver are the chief materials used they are mixed in proper proportions, and are tossed about by the strokes of a vibrating string or bow till they become duly matted together

FELUCCA (Span falúca, Fr felouque, Ital felucca) A small vessel [illegible] by oars and sails used [illegible] on the adjacent coasts for coasting voyages Small war boats used in [illegible] are also so called

FEMME COVERT (Law, a term borrowed from the French to signify a married woman

FEMUR (Lat *a thigh*) In Vertebrate Anatomy, the first bone of the leg or pelvic extremity, in Entomology, the third joint of the leg, and is long, and usually compressed

FEMUR In Architecture, the interstitial space between the channels in the triglyph of the Doric order These femora are sometimes called the legs of the triglyph

FENCE Any continuous line of obstacle interposed by art between one portion of the surface of land and another for the purpose of [illegible] The kind of obstacle or material [illegible] animals which are to be separated, excluded, or confined and the nature of the soil and situation All fences are either live or dead, or a compound of these Live fences are hedges, that is, rows of shrubs placed close together, and pruned on the sides, so as to form a sort of living wall Dead fences are either stone walls, mounds of earth, or of other materials raised above or upon ditches excavated in it The latter are sometimes filled with water Mixed fences are those in which some kind of dead fence is used with some kind of live fence, for example a ditch with a bank of earth on one side, or a ditch with a wall or a hedge on one side, the latter the commonest of all fences The introduction of fences into agriculture was about as great an improvement in the progress of that art as the [illegible] of the division of labour to the art of [illegible]

FENDER A contrivance for [illegible] off a boat or any heavy body to break the shock or avoid contact

FENESTRATE (Lat fenestra, *a window*), in Entomology signifies the naked hyaline transparent spots on the wings of butterflies

FENLANDS Lands, the subsoil of which is constantly in a state of saturation with water, and the surface is liable to be overflown by rivers or streams during spring or autumn The soil of these lands is generally black, light, and rich, to the depth of two or three feet, and as the surface water readily filtrates through this soil to the subsoil fenlands generally produce bulky crops of grass and corn As they have very seldom any natural outlet for drainage, this is generally performed by machinery, and when this is the case few lands are more productive Till lately windmills were employed for draining the English fens but steam is now frequently had recourse to as the moving power and the advantages to the cultivator are immense, because he can lay his lands dry at the season when it is most convenient that they should be so, whereas the operation of the windmill is always a matter of chance For an account of the Fens in England, see *British Statistics*, and *M'Culloch's* G[illegible], art "Bedford Level"

FEOFFMENT In Law, a species of conveyance It was in early times the public and solemn mode of alienating lands and tenements in possession, and was performed by a deed accompanied by livery of seisin, which last was the delivery of the land itself, effected by certain symbolical acts and customary words As secret conveyances to uses gradually prevailed, feoffments fell comparatively into disuse The grantor is termed the feoffor, and the person [illegible] the feoffee

FERÆ (Lat ferus, *wild*) The name given by Linnæus to the order of Mammalia comprehending those which subsist more or less exclusively on the flesh of other animals They are characterized by having three kinds of teeth, incisors, canines, and molars, unguiculate extremities, [illegible] but with the [illegible] order corresponds with the *Insectivora* and the Plantigrade Digitigrade, and Pinnigrade *Carnivora* of Cuvier's *Carnassiers*

FERGUSONITE [illegible] pound of columbic acid [illegible] of zirconia and of oxides of tin, cerium, iron, and uranium It has hitherto only been found in Greenland

FERIÆ In Roman Antiquities, solemn religious festivals The most celebrated were the Feriæ Latinæ (Latin holidays) celebrated on the Alban mount by all the states of Latium in common The deputies of the various cities, with those from Rome, met on the Alban mount where under the presidency of the latter, they sacrificed a bull to Jupiter Latialis and under sanction of this ceremony took oaths to preserve their mutual friendship and alliance This festival was originally instituted by the second Tarquin in whose time and long subsequently it lasted for one day only, but in process of time it extended to four It was observed by the con[illegible] before they set out for their provinces

FERINES (Lat ferus, *wild*) The English equivalent of the *Carnassiers* of the system of Cuvier, but generally employed to designate the group corresponding with the *Feræ* of Linnæus, and excluding the bats (*Cheiroptera*), which form the first family of Cuvier's *Carnassiers*

FERMENT (Lat ferveo, *I boil*) The substance which is essential to the process of fermentation It is either naturally present in the fermentable juice, as in the grape, or it is added as in the manufacture of beer, where *yeast* constitutes the ferment Ferments are of an albuminous or glutinous character, the presence of nitrogen seems essential in their composition, hence they are classed by [illegible] azotised compounds Their modus operandi is still unexplained

FERMENTATION (Lat) When certain vegetable substances are dissolved in water and subjected to a due temperature (between 65° and 85°), they undergo a series of changes which terminate in the production of alcohol or spirit, these changes constitute the phenomena of *vinous fermentation* Sugar and some ferment are essential to the process, and [illegible] of the al[illegible] or [illegible] ation is that of *must*, or of the expressed juice of the grape, which when exposed, either in close or open vessels, to a temperature of about 70°, soon begins to give off carbonic acid, and to become turbid and frothy, after a time a scum collects upon the surface, and a sediment is depo[illegible] [illegible] sweet taste, and is converted [illegible] The [illegible] ponent parts of must are water sugar, [illegible] and tartar During the fermentation carbonic acid [illegible] the sugar disappears and with it the greater part of the mucilage, the gluten chiefly forms the scum and a [illegible] of the sediment, and the tartar [illegible], is thrown down in the crust [illegible] It appears, therefore that the new products, [illegible] are principally formed at the expense of the sugar, and Gay Lussac's

experiments have shown that 45 pounds of sugar are resolved, in the process of fermentation, into alcohol and 22 of carbonic acid Sugar and water alone will not ferment, the ingredient [illegible] of the change is the gluten, which absorbs in the first instance a little oxygen from the air, becomes insoluble, and induces the subsequent changes The reason why grapes never ferment till the juice is expressed, seems to depend upon the exclusion of air by the husk or membranes, and if grapes be bruised in close vessels so carefully excluding access to the juice, undergo no change, so that the mere breaking down of the texture of the fruit is insufficient But a very short exposure of the pulp to air is sufficient to induce that change in the juice which leads on to fermentation, and which is afterwards independent of the further contact of air, the evolution of carbonic acid being exclusively referable to the decomposition of sugar In *beer* the alcohol is derived from the sugar, original and produced, of the malt When wine is exposed to air and due temperature, a second fermentation [illegible] which terminates in the production of *vinegar* During this process oxygen is absorbed, and more or less carbonic acid in most cases evolved, but the apparent cause of the [illegible] the alcohol seems to be a [illegible] charcoal, [illegible] and acetic acid of charcoal and water [illegible] the air, therefore, converts the hydrogen of the alcohol in [illegible] into vinegar

[illegible] *Aspidium filix mas* or male fern About two drachms of the dried root, in powder, followed up by a brisk purge, is occasionally given as a vermifuge It was Madame Nouffer's celebrated specific

FERNS Cryptogamic plants of the highest grade of development, and more especially remarkable for the perfection of [illegible] See FILICES

FERROCYANIC ACID [illegible] of 3 atoms of cyanogen, 2 of hydrogen and 1 of iron It is the *ferro-chyazic acid* of Mr Porrett the term *chyazic* being composed of the initials of carbon hydrogen and azote, which are the ultimate elements of hydro-cyanogen

FERRUGO In Botany, a disease of plants commonly called rust It is caused by the presence of myriads of minute fungi, chiefly of the genus *Uredo*, which are to plants what intestinal worms are to animals

FERRY (Germ and Sax fahren, *to pass over*) In Law, a right arising from royal grant or prescription to have a boat to carry men and horses across a river and to levy reasonable toll The land on both sides ought to belong to the owner

FERULA A genus of Umbelliferous plants with thin flat fruit resembling that of the parsnip and yellow flowers The species are chiefly natives of Persia where they yield the drug asafœtida According to Kempfer this fetid gum resin is an exudation from the root of *Ferula asafœtida*, but there is no doubt that it is [illegible] by several other species

FESCENNINE VERSES (Verses Fescennini) so called from Fescennia, an Etrurian town where they were [illegible] Extemporaneous pieces of [illegible] and Etrurian rustic [illegible] with gestures adapted to the [illegible] They consisted principally of raillery and playful rustic abuse, a species of humour very much in [illegible] [illegible] having given rise to satire, the only class of poetry of native Italian growth

FESCUE GRASS A valuable grass for meadows and pastures (*Festuca pratensis*, Lin) In deep rich soils somewhat moist it is considered as the most bulky and nutritive of all grasses, but in poorer soils it is equalled if not surpassed, by the rye grass (*Lolium perenne*), and the meadow foxtail grass (*Alopecurus pratensis*) The meadow fescue grows to the height of between two and three feet, but the sheep fescue (*F ovæna*), and several other species, seldom grow above six inches or a foot in height, and are chiefly sown on sheep pastures, and used to lay down lawns and grassy surfaces to be mown in pleasure grounds All the fescues are perennials, and they are all natives of Britain

FESS (Lat fascia, *a wide belt*) In Heraldry, one of the ordinaries [illegible] the escutcheon, [illegible] centre of the escutcheon A fess not reaching to the sides of the escutcheon is said to be *couped* (cut) or *humetty* The diminutives of the fess are the *bar*, the *closet*, and the *barulet* A fess with a barulet on each side of it is said to be *cotised* A fess removed to the top of the escutcheon is termed a *chief*, and held to be an honourable [illegible]

FESTOON (Fr feston) In Architecture, a carved representation of a wreath or garland of flowers, or leaves and fruit [illegible] over together thick in the [illegible] where it is lowered, and frequently turned over

FETIALS See FECIALS

FETICH, *Fetichism* The word Fetich is said to be derived from the Portuguese, and appears to have been brought into common usage from the writings of some travellers on the western coast of Africa It is now comprehensively employed to signify any object of worship not representing [illegible] or rather perhaps a human) figure, thus excluding all properly so called Fetichism is the worship of material substances This perverted form of religion prevails very extensively among barbarous nations, and especially those of the [illegible] Among the latter tribes families, and individuals [illegible] receive fetiches, which are often objects casually selected, or chosen under the influence of some occasional superstition, as stones, weapons, vessels, plants, &c &c

FETLOCK (Quasi *footlock*, whence the derivation) In the *Manege*, [illegible] behind the pastern joint of horses, [illegible] where it grows is called the fetlock joint

FETTERED, in Zoology, is applied to the feet of animals when they are stretched backwards and appear unfit for the purpose of walking, or when they are concealed within the integuments of the abdomen

FETTSTEIN (Germ *fat stone*) See FELDSPAR

FEU (Lat feodum, *fief*), in Scottish Law, is used in contradistinction to [illegible] tenure, to signify that holding [illegible] has a return in grain or money in lieu of military service The *feu contract* is that which regulates the giving out of land as between superior and vassal, the rent paid being termed the *feu duties*

FEUDAL SYSTEM (From the modern Latin word *feodum* or *feud*, in English *fief* or *fee*) A body of institutions of a peculiar character, introduced into Europe by the German and Gothic tribes which conquered the provinces of Rome which prevailed for a long period, and has left important traces of its existence in most European countries The words fief and feud are both, it is conjectured with much probability, corruptions of the [illegible]

enjoyment of a piece of land without the absolute property in it Hence by contraction came *fef* or *fief* and by the addition of a neuter termination *fevodum*, *feudum*, *feodum* Another derivation recently suggested is from the Irish "fuidhur, 'fuidh,' signifying, in the Brehon Laws, a stranger who enjoys land within the domains of a clan and the tenure by which he enjoyed it It [illegible] the word "vassal" is also probably of Celtic derivation (See VASSAL) The English word 'feud" (quarrel or strife) is of an entirely distinct origin, being the same with the German *fehde* The German equivalent for *fief* is another original word *lehn*

It is clear that feudal usages were absolutely unknown to the ancient Romans, but as among that people and especially in the later times of the empire there existed certain customs which were analogous [illegible] although not in origin, — such as the [illegible] military colonies on the frontier where the tenant of land was a soldier and liable to be called into active duty, and the cultivation of great part of the empire by *coloni*, a distinct class of men, raised above the condition of the slave and yet bound to render services to the proprietor, and in some instances annexed to the soil —the barbarians in many instances adopted the conventional language and the laws of Rome to their own native customs, thus producing a confusion of idiom and practice, of which a better instance cannot be found than the fact already mentioned that the word "feud" itself is derived from a legal term of the Greek empire (emphyteusis)

The immediate result of the conquest of Gaul, Italy, and Spain by the various barbarian tribes, was the division of the lands (except such portions as were left in the possession of the Roman cultivators and only rendered liable to tribute) between all the armed men of the nation The shares were undoubtedly unequal even in the earliest of these divisions, but however differing in point of wealth, all the free proprietors were equal in rights all were held liable to serve with the national force when called into the field, all had a voice, at least nominally, in the making of laws and in the choice of a sovereign These free citizens are called by various names in the legislation of the different tribes, the Lombard title of *Arimannus* (ehren-mann, *man of honour*, or heer-man, *warrior*) seems to have been the most permanent Such, however, was the general constitution of the kingdoms of the Lombards in Italy, the Franks in Gaul the Visigoths, Ostrogoths, and [illegible] and of the various states which grew up with [illegible] of Germany itself, after the confusion occasioned by the great migrations had passed away

The decay of [illegible] is brought about by nearly [illegible] In under-

mining all systems founded on equality of rights and classes The constant wars and vicissitudes to which [illegible] verted a great body of the freemen into dependents upon these [illegible] men, became [illegible] the free citizens, wherever unable to associate for mutual protection, were subject to innumerable vexations From the earliest times, and before the fall of the Roman empire, it had been customary among the Germans for the princes and chief men to be attended by a select body of faithful companions, whose dependence on them, and services due to them were recognized and fixed by general usage This custom, under the new circumstances of the Germanic and Gothic kingdoms, acquired peculiar force It became an object of ambition to the chieftains to have as many dependents as possible With this view, every species of vexation was exercised by them towards the unprotected Arimannus, to induce him to abdicate his own independence and enrol himself under their command During the wars and confusions of the eighth and ninth centuries, the foundations of the feudal system were laid by this personal dependence assuming gradually the character of a territorial dependence also The Arimannus was induced to surrender up his free or allodial lands to the king or count and became his "liegeman" (fidelis), "antrustion" (our English word *trust* comes from the same origin), "vassal" or "man" (homo, whence *homagium*, homage), receiving back his lands to hold of the superior This process can only now be traced by insulated documents and historical facts, but, arising out of the same circumstances in most countries of Western Europe, it took in all of them nearly the same course It is ably developed by Hallam (in his first chapter on the *Feudal System*), and Meyer (*Institutions Judiciaires* livre i)

The success and energy of Charlemagne arrested for a time the decomposition of the old form of society, his empire extended over nearly all those portions of Europe which afterwards became feudal, and his various laws (in the end of the eighth and beginning of the ninth century) present us with a remarkable picture of what may be called the state of transition from the allodial to the feudal system We find in them that the free proprietors, or Arimanni, still formed a very numerous body, and that the exigencies of military service fell most heavily upon them They were obliged to serve at their own cost, while the counts, &c brought their vassals to the field at their own expense These laws are full of the vexations endured by the former class from the powerful military chieftains On the other hand the practice of attaching individuals to the person of the sovereign or superior by the grant of lands (*benefices*), and the obligations imposed on the inferior by the grant, are clearly developed The distinction between *allodial* and *feudal* [illegible] hereditary it is doubted by the most learned writers, whether or no they were, generally or frequently, precarious and revocable

The decay of Charlemagne's empire, and the disasters of the two centuries which followed his reign completed the formation of the feudal system The great step by which that change was completed was when the benefices or fiefs became, like the former allodial properties, hereditary There can be little doubt that this change was merely the result of those disastrous circumstances of civil and barbarian wars which during that period relaxed the slight bonds of the Carlovingian monarchy, and rendered every man as far as possible dependent on an immediate superior and independent of a central authority The earliest express creation of an hereditary fief is considered to be the donation of the duchy of Aquitaine to Eudes and his heirs by Charles-le-Chauve The great vassals established their families permanently in the lands which they held of the fisc or royal domain their [illegible] fied by acquiring the same [illegible] fiefs There can be no doubt that the [illegible] ern Europe owes its origin, in general, to nearly the same period and the same causes those families which succeeded in acquiring extensive fiefs, and preserving them for several generations, became noble by prescription In the meantime, the Arimanni, or allodial proprietors, found their condition became worse from generation to generation they were loaded with services and dues until in the tenth century (as is shown by Meyer), the term "arimannia" became synonymous with exaction But although the feudal system became so generally prevalent, that the maxim "Nulle terre sans seigneur" (importing that lands were presumed feudal until the contrary was shown) became generally received [illegible] became wholly exti[illegible] country the maxim was reversed, and lands were presumed allodial (See *Hallam*)

*Character and Features of the Feudal System* — This institution is generally supposed to have been fully consolidated [illegible] the eleventh century: the law [illegible] Lombardy (1039), contains all its main features the *Assises de Jerusalem*, and other compilations, show that in a century more it had been invested with all the refinements of a legal system

By the principles of this system, the king was in the last resort, proprietor of all the feudal lands of his kingdom Those who were infeoffed of lands directly from the crown, and owed homage and service to the king, [illegible] them, and this practice (called sub infeudation) might be carried on through several gradations Thus the same individual was a *vassal* or dependent of the crown, and *lord* or *suzerain* with reference to his own vassal who held of him, also termed *mesne* or mediate lord, a term which comprehended both these relations But although all perfect fiefs resembled each other in their theoretical character, and particularly in their great attribute of military service, yet, in point of fact, tenants holding immediately of the crown stood in very different degrees of subordination Thus, in France, the great vassals (the Dukes of Normandy, Brittany, &c) were immediate tenants of the crown but in effect almost independent of it, while they exercised much stricter sovereignty over their own immediate tenants But other lands, being the demesne of the crown itself, were held of it by lesser tenants in chief, who stood to the king in the same close relation as the vassals of the great feudatories did to them Thus the government of France, at the period when the feudal system was in greatest vigour, was that of a collection of independent sovereigns, of whom one, the king, had a certain supremacy over the rest, but each, within his own domains, exercised an equal authority and such was in theory at least, the constitution of every feudal kingdom The ceremonies used in conferring a fief were chiefly three —1 *Homage*, by which the vassal owned the lord's supremacy, but *homage per paragium*, or simple homage, was unaccompanied by any feudal obligation, homagium ligeum, or liege homage, implied such obligations the former only was rendered to the king by the great feudatories above mentioned (See *Hallam's Middle Ages* c 2 part 1) 2 The oath of *fealty* 3 *Investiture* or the conveyance of feudal lands, actual or symbolical The chief *obligation* of a feudal tenant was military service, but the laws which regulated this essential part of the contract were so various that it is not possible [illegible] of them In some [illegible] to serve personally for his fief whether large or small, in others (as England), the land was divided into a certain number of equal parcels from each of which a soldier's service was due the term of service was also variously regulated by custom The conflicting rights of superior and inferior lords to the vassal's military service were also never satisfactorily adjusted When feudality was in its most flourishing state, he commonly followed the banner of his immediate superior even against the crown, but with the progress of the royal power his obligations were gradually transferred to the king as lord paramount military service was in most cases rendered commutable in process of time for an amercement in money (See ESCUAGE) There were other inferior obligations which attached to the military tenures commonly called feudal incidents These were chiefly, 1 *Reliefs*, i e sums of money paid to the lord by tenants of full age on taking fiefs by descent 2 *Fines* upon alienation, which were sums paid on alienating a fief, a privilege which was only gradually acquired by feudal tenants being contrary to the principles of the institution 3 *Escheats*, i e the reversion of the fief to the lord, on failure of the tenant's heirs or forfeiture 4 *Aids* sums paid by tenant to the lord on certain specified occasions And to these may be added the feudal rights of *wardship*, by which the lord, in some countries, had the custody of his tenant's person, and the enjoyment of his lands until he was of full age, and *marriage*, by which the lord had the right of disposing of such ward's land in marriage or, if the marriage were rejected, to a sum of money equivalent to the marriage, *i e* as much as it was presumed the [illegible] would have given the lord for [illegible] of the fief to the feudal lord was incurred by the tenant's violating any of the original conditions of fealty, homage, and military service But the vassal was protected from the unjust aggression of the lord by that which seems to have been an inherent and necessary condition of the feudal system, the judgment, namely, of his peers, without which such forfeiture could not be incurred, supported, as it were by the right of private warfare, which in the last resort was the resource both of the lord to [illegible] the lord [illegible] fiefs [illegible] were also a great variety of tenures by rendering particular stipulated services, created, for the most part, in

comparatively late times, which were also deemed feudal in their character, and constituted *improper* fiefs; such were, especially, tenures by the performance of menial or other personal services, from which arose the English *grand serjeanty* (which see) All these tenures were of a higher or noble character but in some countries large portions of the land were held either immediately of the king, or mediately of feudal lords by base or inferior tenures Such lands were called *tenures roturières* in French jurisprudence and in English the class of tenures comprehended under the common term of *socage*, which comprised both tenures in *free* or common socage, and those in *villein* socage, from which are derived tenures in [illegible] (*See* SOCAGE )

[illegible] of ranks under the feudal system corresponded [illegible] original nobility of the soil, nor has the class of gentry, in most countries, any other origin The bearing of arms, the distinctive character of surnames, &c &c, became afterwards, in course of time, the distinctive marks of the class of nobility which no longer adhered so closely to the soil from which it sprang Thus in France we find that a noble might, in later times hold a fief roturier, while a roturier might hold a proper fief, although in such a case, services such as were rendered by the [illegible] were of course commuted But it may be in general observed, that almost the whole soil of France, north of the Loire, was under noble tenures, in the south only were free tenants, not noble — a numerous class In many parts of Germany the distinction between [illegible] it was abolished in 1807 In England the course of the feudal system was somewhat different, the class of free tenants in socage was far more numerous and influential hence the yeomanry of England formed a body of men to which a parallel could hardly be found in any other country The burgesses, or inhabitants of towns, constituted in feudal realms a class apart, and their communities were either really or by fiction, emancipated by royal charters from the tenure by which they were supposed to hold their land either of the king or some mesne lord Lastly the lowest class of the population consisted of serfs or villeins, attached to the soil in many instances, but whose state varied so greatly under different circumstances as to render it impossible to give any general description of their condition

Such is a very brief and general outline of the complicated system of rights and duties which bears the historical name of feudal It is necessary, however, to add that this system assumed very different shapes in the different countries in which it prevailed In France was the country in which feudalism had, if not its origin, at least its greatest extension, and was most nearly reduced in practice to its theoretical form Up to the fall of the Carlovingian empire, that country must be regarded as an aggregate of provinces, inhabited by different nations and governed by a variety of laws but acknowledging the sovereignty of a monarch whose power was more or less obeyed according to his own personal talents and other casual circumstances After the separation of France and Germany by the treaty of Verdun in 813, a succession of feeble princes and the invasions of the Normans almost broke up the slender frame of the French monarchy The governors or masters of extensive provinces who had by this time secured to themselves the hereditary sovereignty of their respective benefices became independent [illegible] when feudal royalty was confirmed under the Capets [illegible] these ranked as the great vassals of the crown [illegible] powers have been classed (by Mr Hallam) under five heads 1 the right of coining money, 2 that of waging private war, 3 the exemption from all public tributes except the feudal aids, 4 the freedom [illegible] and 5 [illegible] charters were obtained, declaring the [illegible] of these the fourth was [illegible] the [illegible] an assembly of the [illegible] France as a whole This circumstance, which in the first instance seemed to the great vassals their independence, proved in the end the cause of their decay, as with the gradual increase of the royal powers, the legislative authority of the king himself, [illegible] any recognized national council to assist him, acquired continually increasing force Meanwhile the exorbitant power of the great vassals in France, [illegible] that [illegible] weakened in the highest relation (that between the great vassals and the crown) were the strongest and the great lords and the lesser barons characterized [illegible] and [illegible] establishments of St. Louis, could not declare any new law in the territory of his baron without his consent, neither could the baron in that of his vavassor, but [illegible] point of view, the king and the baron, with their respective demesnes exercised a much more real sovereignty than that which the former possessed over the latter It was about the reign of Philippe-le-Bel in the beginning of the 14th century, that the feudal system which had lasted up to that time from its establishment in the 10th without material innovation was in effect overthrown, and that the king [illegible] reality master of his kingdom [illegible] brought about by [illegible] power by means of the parliaments, and lastly by the convocation of the states general as the representative body of the whole nation the greater fiefs were re-annexed in the course of events to the crown, with the remaining power and privileges of their lords —2 There can be no question that feudal principles prevailed to a considerable degree in the polity of the Saxons in England, but when that kingdom was conquered by the Normans they imported with them the entire system, already invested (in the 11th century) with a legal and regular character Hence, while feudalism grew up from the circumstances of society in France, it may be said to have been transplanted, as to most of its details, into England from a foreign soil The land was parcelled out, as [illegible] feudatories and inferior tenants [illegible] knight-service But two circumstances chiefly produced the very different shape into which the system ultimately resolved itself 1 The existence of the great body of freemen of Saxon descent, who were neither reduced into villenage, nor deprived of their lands nor yet ennobled by being ranked along with the Norman military tenants 2 The permanent national council, which seems to have been every where a peculiarity of the Norman system of government, and which, by taking cognizance of matters pertaining to the general interests of the realm, at once controlled the power of the king and that of the great barons as single and independent chiefs Thus the country remained even in the most troubled period of the [illegible] by the common law of the land, and also by various statutes of which that commonly styled by its first words Quia Emptores passed in the reign of Edward II which put an effectual stop to all farther *sub infeudation*, was perhaps the most effectual —3 In Germany, as well as France the feudal usages seem to have grown into a system under the sovereignty of the Carlovingian emperors But in that country owing perhaps, partly to the constant danger from foreign invasion on the eastern side which kept the people more together under the central authority, the sovereigns never lost, during the dark period of the 9th and 10th centuries so much of their power as those of France Hence the greater vassals did not acquire such complete independence, but when, after the 11th century the elective character of the empire was more fully recognized the imperial power decayed, and that of the vassals rose during the period in which the contrary progress was taking place in France And as the inferior barons had not been depressed, as in the latter country, by the overgrown power of the superior, Germany presented the example of a country in which the feudal system was carried out more completely, and for a greater length of time into actual existence than any other nor is there any in which the frame of society to the present day shows so many relics of its long predominance —4 In Italy the feudal system, under the Carlovingian government, was widely prevalent The chief cause in that country which weakened and brought it to decay or rather prevented its complete establishment, was to be found in the power and independence of the large towns, which at first effectually resisted and afterwards broke down the strength of the nobility —5 In Spain feudal tenures were of late introduction, and very partially known except in the kingdom of Arragon — 6 In the northern and eastern kingdoms of Europe (Sweden Denmark, Hungary Bohemia) they were never introduced at all, except in some few instances wholly without general effect

FE'VER (Lat febris) A disease, one of the most general symptoms of which is increased heat of the body The temperature is often actually higher than it should be, and often the sensations of heat, dryness, and even [illegible] ferent writers are not less varied than numerous In fevers there is generally great constitutional derangement, unaccompanied by local or perceptible organic disease Fevers generally begin with languor of body and mind, chilliness, [illegible] shivering, though the skin often at the same [illegible] hot, the pulse is quicker than it should be, respiration hurried or laboured; pains are complained of in various parts, and especially about the head, back, and loins, the appetite falls off, or there is nausea and vomiting the mouth is dry, the bowels generally constipated, and the urine small in quantity and deep in colour These, which constitute

the first stage of ordinary febrile symptoms, are succeeded by alternate shivering and burning heat, and by mental [illegible] variety [illegible] stage [illegible] the leading appearances are a cleaner tongue, a more natural pulse, a moist skin, calm mind, and the urine becomes more copious in quantity, and deposits a sediment as it cools The symptoms of fever generally undergo an increase every evening, which is called an *exacerbation*, and this fluctuation often takes place more than once in the twenty four hours, the violence of the attacks increasing with their occurrence, and forming what is called a *continued fever* After some days, a *crisis* takes place, that is, the symptoms either take a favourable or an unfavourable turn If the exacerbation and remission of symptoms are well marked and occur once or oftener in the day the fever is called a *remittent*, if the fever leaves the patient after some hours' duration, and returns at stated intervals, it is called an *intermittent* (*See* AGUE) Fevers are also variously denominated, according to the prevalent symp- [illegible]

FIARS [illegible] land, the prices of grain for the current year in the different counties, fixed by the sheriffs respectively in the month of February, with the assistance of juries The form of striking the fiars, says Mr Bell, in his Law Dictionary, is prescribed by the Acts of Sederunt, Dec 21 1723, and July 29 1728 A jury must be called, and evidence laid before them of the prices of the different grains raised in the county, and the prices fixed by the opinion of the jury, and sanctioned by the judge are termed the *fiars* of that year in which they are struck, and regulate the prices of all grain stipulated to be sold at the fiar prices The fiar prices also regulate the price in contracts concerning grain (the product of the county) to be delivered, and where no price has been otherwise agreed upon between the parties Having the prices of grain ascertained in each county has greatly facilitated the introduction into Scotland of the practice of letting land for corn rents convertible at the prices of the day In England, where there is no such authentic local returns there is great difficulty in converting corn rents into money rents, inasmuch as reference can only be made to the prices in some particular market or in the kingdom at large, the one of which is too limited and the other too extensive See *Bell's Law Dictionary*, and the authorities there referred to

FIAT (Lat) In Law a short order or warrant of some judge for making out certain processes &c

FIAT In Bankruptcy See BANKRUPTCY

FIBRE One of the two bases of all vegetable structures It may be compared to a hair in inconceivable fineness, its diameter often not exceeding $\frac{1}{1200}$ of an inch, also the name of the finer divisions of roots

FIBRILLÆ In Botany the minute subdivisions of the root each being a small bundle of annular ducts or sometimes of spiral vessels incased in woody tissue covered by a lax cellular integument, and in direct communication with the vascular system of the root The apex is composed of lax cellular tissue and mucus

FIBRIN A term applied by chemists to the muscular fibre when cleansed by washing from all adhering impurities, or to the coagulum of the blood when the whole of the colouring matter is washed out of it It is white insipid, and inodorous, its ultimate elements are, according to Gay Lussac and Thenard,

| | |
|---|---|
| Carbon | 53 36 |
| Hydrogen | 7 02 |
| Nitrogen | 19 93 |
| Oxygen | 19 69 |

It is merely a form of *albumen*

FIBROLITE A rare mineral of a peculiar fibrous texture, accompanying *corundum* from the Carnatic and from China

FIBULA A [illegible] placed upon the outer side of [illegible] which forms the external ancle

FICOIDEÆ A natural order of shrubby or herbaceous Exogens, inhabiting hot sandy plains They are [illegible] and perigynous stamens The succulent leaves of some are ea [illegible]

FICTION [illegible] See NOVEL, ROMANCE

FICTION OF LAW, as been defined, by writers on the civil jurisprudence, to be an assumption of the law upon an untruth in something possible to be done but not done The utility of such fictions is merely, by substituting the imaginary for the true state of the case, to pass more rapidly over those parts of the subject which are not disputed, and arrive at the points really in issue Among the more notorious fictions of the English law may be noticed the course of proceedings in the action of ejectment, in which an imaginary tenant brings his complaint of having been turned out of possession by a wrongdoer in order to try the validity of the title of the landlord that of a common recovery, by which estates tail were bound through a complicated proceeding (removed by [illegible] See FEE-TAIL), consisting of an [illegible] The general rule is, that such fictions are not traversable, *i e* cannot be contradicted by him against whom they are used, so as to defeat the end for which they are invented And for the same purpose the court will take notice that they are only fictions, if necessary, in order to prevent mere technical objections to them

FID A short bar of wood or iron put through the heel or lower part of a topmast, and resting by its ends on the trestle-trees, and on which the mast is therefore supported [illegible] down, it is first lifted [illegible] nch is then withdrawn

FID, or SPLICING FID, is also a sharp cone of wood [illegible]

FIDEICOMMISSUM Lat *committed or entrusted to faith*) A species of testamentary disposition recognized by the Roman law, by which a testator, in indirect terms charged his heir to deliver over to a specified person the whole or a part of the goods which he inherited Fidei commissa were frequently adopted as a means of bequeathing property to persons legally incapable of directly receiving the bequest Fidei commissa were, as their name implies, at first dependent entirely on the faith of the heir for their execution, but that execution was rendered compulsory by Augustus in some cases, and this became afterwards [illegible] ever, entitled, [illegible] and charged himself with its execution, to retain one fourth of the property entrusted to him for delivery

FIDEJUSSOR In the Civil Law, one who engages himself for the debt of another, promising to pay in case of default who is called in

FIEF (Lat feodum) The French name for an estate in lands held of a feudal superior In English law language a *fee* also termed a *feud* by writers on feudal jurisprudence (*See* FEUDAL SYSTEM) In the legal language of France, a *fief* was opposed to an *aleu*, or estate held allodially, without any lord paramount Various derivations of the word have [illegible] probable is that which traces [illegible] feudum emphyteuticum, from the [illegible] contract whereby the use of the land without the property in it was surrendered to a tenant

FIELD [illegible] by a fence or [illegible] so as to adapt it for culture In former times, and until within the last two centuries, almost all the land cultivated [illegible] throughout Europe was unenclosed, [illegible] applied in Britain at least, to the lands under [illegible] by the plough Subsequently, when farmers enclosed and subdivided a portion of the lands near the farm yard these portions were called fields, and the more distant portion which remained open was called open field or common field, while grass land unenclosed were called commons In the present improved state of agriculture every farm is divided into fields, either simply by lines of demarcation, which are sufficient when no animals are to be grazed on the farm, or by lines of separation which will act as fences, such as walls hedges ditches &c where cattle are to be grazed Without some regular fixed division of arable lands, it would be next to impossible to conduct a rotation or succession of crops It is interesting to observe that as agriculture in a rude state had no fences, so this is also beginning to be the case in agriculture in its most refined form, because it is found much more advantageous, both for the production of butcher's meat and manure, to consume the grass and herbage grown on farm lands in farm yards, with the single exception of that portion which is eaten by sheep, and these are confined to successive portions of [illegible] visible at a short [illegible] of every description, from a tenth to a fifth will be added to the contents of the greater number of corn farms, [illegible] first cost and annual expense will be [illegible] hedges or building walls, and in keeping them in repair afterwards

FIELD In Heraldry, the tincture, or combination of tinctures, which forms the ground of the escutcheon on which the device or charge is delineated *See* TINCTURE

FIELDFARE A bird of the thrush tribe (*Turdus pilaris*, Linn) which is a seasonal visitant in this island It makes its appearance about the beginning of October migrating from the colder northern parts of the Continent in flocks, numerous according to the severity of the

season They fly in a body, and if alarmed when dispersed over a field in quest of food they collect together as they fly off, and often settle in a swarm on the same tree They leave us about the latter end of February, or the beginning of March, and retire to breed in Sweden, Norway, Russia, and the northern parts of Asia as far as Kamtschatka

FIELD LARK *See* LARK

FIELD MARSHAL The highest military title in this and some other countries It is conferred only on officers [illegible] for brilliant military services or exalted [illegible] The term is derived from the *maréchal de camp* in the old French service, and was long in use among the Germans before it was adopted in this country There are at present only seven marshals in the British army, the Duke of Wellington, the King of Hanover, the King of the Belgians, Prince Albert, and Marquis of Anglesea

FIELD OF VIEW, in a telescope or microscope, is the space within which objects are visible when the instrument is adjusted to focus

FIELDVOLE A name of the short-tailed field-mouse, or meadow-mouse (*Arvicola agrestis*, Cuv) A species which subsists exclusively on vegetable productions, and being, like the rest of the rat tribe extremely prolific, multiplies occasionally to such a degree even in this country, as to become the most injurious of our wild quadrupeds "After having shared the labours of the reaper, and taken their [illegible] harvest, the fieldvoles," says Mr Bell, "attack the newly sown fields burrowing beneath the surface, and robbing the husbandman of his next year's crop, and at length retreating to the woods and plantations, commit such devastations on the young trees as would scarcely be credible, were not the evidence too certain to be doubted In the years 1813 and 1814 these ravages were so great in the New Forest and the Forest of Dean, as to create considerable alarm lest the whole of the young trees in those extensive woods should be destroyed by them" A timely and assiduous attention to destroying the nests of this pernicious species by the aid of terriers [illegible] is imperative on those who have the charge of young plantations, but when the numbers of the fieldvole have surpassed the usual bounds, then it is recommended to dig holes about a foot in depth and the same in diameter taking care to make them much wider at the bottom than at the top, so that the animal when once in cannot easily get out again In holes of this kind Mr Jesse states that at least thirty thousand fieldvoles were caught in the course of three or four months, in Dean Forest plantations, that number having been counted out and paid for by the proper officers of the forest

FIERI FACIAS In Law, a judicial writ that lies where judgment is [illegible] recovered in the king's courts, [illegible] is commanded to levy [illegible] the goods and chattels of the defendant [illegible] sued out within a year and a day after judgment, or the judgment must be revived by *scire facias*

FIFE (Germ pfeiffe) A small wooden musical wind instrument of the flute species [illegible] shrill in tone and rarely used

FIFTEENTH In Music, an interval of two octaves, also a name given to a stop on the *organ*, a double octave above the diapason as its name imports

FIFTH In Music, one of the harmonical intervals or concords It is the second in order of the concords, the ratio of the chords that afford it being as 3 2 It is [illegible] fundamental The ancients called it *Diapente*, and the Italians at present call it *Quinta* The *imperfect, defective*, or *false fifth* called by the ancients *semi-diapente*, is less than the [illegible]

FIFTH-MONARCHY MEN A fanatical sect, who formed [illegible] or Christ's Personal Reign [illegible] next to the Second Coming of Christ, which they expected to be the Fifth, the Persian, the Grecian, and Roman, and in which Jesus Christ should reign with the saints on earth for the space of a thousand years Upon the restoration of the royal family, and the return of the kingdom to its former principles in church and state, a party of these enthusiasts, headed by a man of the name of Venner [illegible] in London, which was put down with the slaughter of a great number of them

FIGS (Lat ficus, *a fig tree*), are the fruit of a small tree with broad-lobed leaves, inhabiting the south of Europe and similar latitudes in Asia This fruit is not of the same nature as the apple, the orange, and other fleshy seed vessels but is a hollow receptacle containing a great multitude of minute flowers the ripened fruit of which is the seed as it is wrongly called that is imbedded in the pulp It is remarkable that the fig tree although it produces so agreeable a fruit, is in some measure poisonous, its milky juice being acrid to the taste, and of the same nature, although less intense, as that of certain Indian species called *F toxicaria*, *Dæmonum*, &c, because of their venomous qualities The genus *Ficus* itself is of considerable extent, and its species are among the most noble objects belonging to the vegetable kingdom in [illegible] where they often yield caoutchouc [illegible] *Ficus elastica* is particularly valuable for this purpose, as are also various unknown species in the island of Java The banyan tree, so celebrated for the large extent of ground covered by single individuals, which carry an enormous canopy of branches and leaves upon columnar trunks provided for the purpose as the tree advances in diameter, is a kind of [illegible]

FIGURATE CONCORDS In Music, that which contains a mixture of discords together with the concords

FIGURATE NUMBERS In Arithmetic, the name given to series deduced from any [illegible] differences of which the first term is [illegible] ratio a whole number by taking successively the sum of the two first, the three first, the four first, &c terms of the progression, and then operating on the new series thus obtained in the same manner as on the original progression, in order to obtain a second series and so on

For example, let the progression be that of the natural numbers the common difference of which is 1, then the progression and the different series of figurate numbers successively deduced from it are as follows —

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | 1, | 2, | 3, | 4, | 5, | 6, | 7, |
| B | 1, | 3, | 6, | 10, | 15, | 21, | 28, |
| C | 1, | 4, | 10, | 20, | 35, | 56, | 84, |
| D | 1, | 5, | 15, | 35, | 70, | 126, | 210 |

The first line A, is the progression from which the series arises The second line B, is the series of *triangular numbers*, or *polygonal* numbers of the first order Its formation is obvious each term being the sum of the corresponding and all the preceding terms of the progression, whence, by the theory of series, its general term is,

$$\frac{n\,(n+1)}{1\ \ 2}$$

The third line, C is the series of triangular pyramidal numbers, and is formed from B in the same manner as the latter was formed from A Its general term is,

$$\frac{n\,(n+1)\,(n+2)}{1\ \ 2\ \ 3}.$$

The fourth line, D, is formed from C in the same manner as C from B or B from A Its general term is,

$$\frac{n\,(n+1)\,(n+2)\,(n+3)}{1\ \ 2\ \ 3\ \ 4}.$$

If the original progression be,

1, 3, 5, 7, 9, 11,

the common difference of which is 2, then the series of figurate numbers successively derived from it are,

1, 4, 9, 16 25 36,
1, 5, 14, 30, 55 91, &c

The first of these is the series of square numbers, the second that of quadrangular pyramidal numbers In like manner, if the common difference of the assumed progression be 3, then the successive sums will be the series of pentagonal numbers, if it be 4, the sums will give the hexagonal numbers, and so on The formation of these different orders of figurate numbers will be readily understood from inspection of the following table

| Progressions | Figurate numbers of the first order | Figurate numbers of the second order |
|---|---|---|
| 1, 2, 3, 4 | Tri 1, 3, 6 10 | 1, 4, 10, 20 |
| 1, 3, 5, 7 | Sq 1, 4, 9, 16 | 1, 5, 14, 30 |
| 1, 4 7, 10 | Pent 1, 5, 12, 22 | 1, 6, 18, 40 |
| 1, 5, 9 13 | Hex 1, 6 15, 28 | 1, 7, 22, 50 |

The [illegible] triangular numbers squares pentagons hexagons &c have been applied on account of certain analogies which the numbers so denoted have with the geometrical figures bearing the same denominations Thus, in the second column of the above table, which contains the polygons of the first order the terms forming the first line or series express the different numbers of points which may be [illegible] so as to form an equilateral triangle [illegible] series gives the different numbers of points which may be arranged in squares, the third those which form regular pentagons, the fourth those which form regular hexagons and so on In the third column of the table, the first series contains the several numbers of points which may be so disposed [illegible] the second those [illegible] pentagonal [illegible] and so on

The different series formed as above possess several curious properties, of which one of the most remarkable

is, that the general term, and the sum of any number of terms $n$, can always be expressed rationally in terms of $n$ In fact, the expression of the $n$th term of any series is the same as that of the sum of the $n$ first terms of the series immediately preceding it, or from which it is immediately derived

FI'GURE, in Rhetoric has been defined generally as a mode of speech in which words are charged from their literal and prim[illegible] sense It is almost impossible to give, within the limits of a definition, the precise and numerous meanings of which this term is susceptible, but [illegible] ANTITHESIS, METAPHOR, [illegible] different figures used in composition In Logic, the [illegible] to the form of a syllogism with reg[illegible] of the middle term *See* TROPE

FIGURE, in Geometry, is used in two different senses In the first sense it denotes, generally, a space bounded on all sides, whether by lines or by planes, in the second sense, it signifies the representation (on paper for example) of the object of a theorem or problem, in order to render the demonstration or solution more easy to be understood and followed In this last sense, *figure* is synonymous with *diagram*

All bodies are necessarily enclosed by one or more boundaries, and therefore possess figure hence *figurability* is reckoned one of the essential properties of matter

For *Figure of the Earth*, see EARTH and DEGREE, for *Figure of the Planets* see PLANET

*Apparent F[illegible]* object preser[illegible] situation of the eye of the spectator, and may be very different from the real figure of the object, for a straight line when placed in a particular direction, will be seen only as a point, a plane as a straight line, and a solid which presents only one of its faces will appear as a simple surface (PERSPECTIVE)

FIGURE HEAD The figure, statue or bust, on the projecting part of the head of a ship, called the cutwater

FIGURES in Arithmetic, are the numeral characters, or ten digits, by which numbers are expressed They are supposed to be of Indian origin, and to have been introduced into Europe by the Moors of Spain in the 13th century, but the date of their introduction is much disputed (ARITHMETIC)

FI'LACER, or FILAZER (Fr fil *thread*) An officer of the court of Common Pleas who files writs The filacers (of whom there are fourteen) are mentioned as early as the stat 10 H 4 There are also filacers of the Queen's Bench

FI'LBERT, or FILBERD the well-known fruit of the cultivated hazel nut, or *Corylus avellana* is a seed-vessel enclosed within an involucre or cupule which is the part commonly called the husk This organ is of the same nature as the cup of the oak and the prickly case in which the nuts of the sweet chestnut and the mast of the beech are enclosed In the filbert it is much larger than in the common nut, and it is this character together with the lengthened figure of the nut, which distin[illegible] the two [illegible] of which [illegible] The [illegible] varieties of the filbert are the red, the frizzled, and the white the latter being the kind most commonly grown in this country

FILE (Germ feile) This instrument is formed by cutting teeth upon a plate or tool of soft steel by the repeated blows of a straight-edged chisel These teeth either form a single series of straight lines or they are crossed by a second series the former are called *single cut* the latter *double cut* files Files are required to be extremely hard, and unless they are carefully and skilfully hardened, they are apt to warp The best files are made exclusively of cast steel, and are cut by hand, none of the file-cutting machines producing unexceptionable tools

FILIFORM (Lat filum, *a thread*) In Zoology when a part is slender, thread-shaped, and of equal thickness

FILL The sea term for bracing a yard which had been laid aback, so that the wind may act on the after or proper side of the sail

FI'LLET (Fr filet) In Architecture, a small square member placed above or below other larger members in an order The term as used by carpenters and joiners means a small piece to which boards, joists, or quarters are nailed

FI'LLIGRANE, or FILLI'GREE (Lat filum, *thread*) In sculpture, a kind of [illegible] ornamental work of flowers fruits &c, formed [illegible] or twisted in serpentine layers, or plaited and worked to cruise together and [illegible] It is a eastern invention

FILOSE [illegible] In Zoology, when a part [illegible] with [illegible]

FILTRATION (Lat) The process by which liquids are separated from substances mechanically suspended in them; it is also sometimes resorted to to separate colouring matters and other bodies which are in a state of solution, and which are removed by the substance or matter through which the liquids are filtered Unsized paper is commonly used in the chemical laboratory for the former purpose and is known under the name of filtering paper, it is properly folded and placed for sup[illegible] In the arts linen and calico bags [illegible] are frequently employed, containing well-burned charcoal or other materials, through which the liquids requiring purification are suffered slowly to trickle In *water filters*, the coarser particles are generally collected in a piece of sponge and the further separation of the more finely divided matters or organic taints is effected by layers of sand of various degrees of fineness mixed with a proper quantity of charcoal (See *Faraday's Chemical Manipulation*, and *Ure's Dict of Arts, &c*)

FIN (Lat finna) A flattened expanded organ, projecting from the body, and serving as an instrument of locomotion in water

Many species of the whale tribe possess an immoveable fin upon the back, composed merely of a reflection of integument over a mass of dense and ligamentous cellular membrane, the tail fin in the same order has a similar structure, but is moved by the action of the muscles upon the caudal vertebræ, which are co[illegible] in the middle part The anterior fins, [illegible] the pectorals in fish, are susceptible of greater variety of mo[illegible] [illegible] [illegible] [illegible] [illegible] In fishes the fins are supported by elongated filamentary bones or rays, the nature and number of which afford the zoologists important characters for distinguishing the different groups, and in works of Ichthyology a system of notation is employed, which briefly but clearly expresses these characters Thus the formula of the number of fin-rays in the perch is thus expressed —

D 15, 1 + 13, P 14, V 1 + 5, A 2 + 8, C 17

Which signifies that D, the dorsal fin, has in the first fin 15 rays, all spinous or bony, in the second fin, 1 spinous plus 13 that are soft P, pectoral fin, 14 rays, all soft V, the ventral fin, with 1 spinous ray plus 5 that are soft A, the aural fin, with 2 spinous rays plus 8 that are soft C, the tail or caudal fin, 17 rays In enumerating the rays, those only which extend from the longest ray in the upper portion to the longest ray in the lower portion, both inclusive, are counted

FINA'LE. (It) In Music, the last of a series of movements in a composition, also the closing scene of each act of an opera buffa

FINANCE The revenues of a king or state The word is derived by some from the German *finanz*, by others from the barbarous Latin word *financiatio*, a loan

FINCH *See* FRINGILLIDÆ

FINE, in Law, as a [illegible] or amende imposed by [illegible] party thus mulcted for offences against a feudal superior was said in the language of that jurisprudence, "finem [illegible] domino," &c, to *make* word is derived Fines are in no case determined as to amount by common law, and seldom by statute, except as to their maximum, but by the general cautions of Magna Charta and the Bill of Rights, excessive fines ought not to be imposed Courts of record have in general the power of imposing fines in case of contempt, and also on conviction of offences punishable in this manner The mode of returning, estreating (or entering on the rolls of a court), and levying fines [illegible] by 3 & 4 W 4 c 99

FINE OF LANDS In Law, a [illegible] or record for the settling and securing [illegible] ments, now abolished by stat 3 & 4 W 4 c 74, although, as long as questions can still arise on the validity and effect of fines levied before that period, the legal doctrines respecting it cannot be said to be wholly obsolete A fine was, in its original signification, an agreement or composition of a suit (whether real or fictitious) made between demandant and tenant in respect of lands and tenements, with the consent of the judges, and enrolled among the records of the court Hence, by a common fiction, such an imaginary agreement was employed in certain cases as a mode of conveyance Its chief properties were, — the extinguishment of dormant titles by barring strangers (unless they claimed within five years, under 1 Ric 3 c 7), and, when levied of an estate in tail, the barring the issue in tail immediately, but not those in remainder or reversion, except when tenant in tail had such reversion in himself A fine was [illegible] with [illegible] termination [illegible] The party conveying was termed the cognisor or conusor, the party to whom conveyance was made the cognisee of the fine A fine, besides its peculiar properties in the settlement of lands held in tail, was the usual method whereby a feme covert joined in the sale, settlement, or incumbrance of an estate, for which, by the stat 3 & 4 W 4 above mentioned, a peculiar deed is substituted, to be executed and acknowledged by the married woman after examination by commissioners

**FINE'SSE** (Fr ) may be defined simply as a peculiar aptitude of discernment in any business, the best means of attaining [illegible] view, or as the power of embracing in one comprehensive glance the various interests of any subject, together with ingenuity to devise and tact to carry out the plan best calculated to obtain success

**FINE STUFF** In Architecture plaster used in common coatings and walls for the reception of paper or colour It is composed of [illegible] a fine sieve, then mixed [illegible] fine sand A mixture of lime and hair, used in the *first coat* [illegible] stering is called *coarse stuff*

**FINGER BOARD** In Music, the black board attached to the neck of instruments of the viol class, on which [illegible] essed by the fingers for the purpose [illegible] lengths so as to produce the different sounds

**FINGERING** In Music, the art of arranging the fingers on instruments of all classes, so that they may be in the best positions for performing the different passages written for such instruments

**FINIAL** (Lat finis, *the end*) In Gothic Architecture, the top or finishing of a pinnacle or gable, as it is now generally understood, but in ancient documents an [illegible] by this term

**FINISH** (from *finis*, *the end*) In the Fine Arts, the last working up of any object of art, whereby its completion is effected

**FINISHING COAT** In Architecture, the best coat of stucco work when three coats are used When in the [illegible] is used for paper, it is called setting

**FIORITE** A siliceous incrustation, from *Fiora* in Ischia

**FIRE** *See* FLAME and HEAT

**FIRE BALLS** (called also *Bolides*, and *Fiery Meteors*), in Meteorology, are luminous bodies which suddenly appear in the sky, usually at a great height above the earth, and shoot through the heavens with immense velocity and are sometimes accompanied with the fall of an aerolite These meteors are of frequent occurrence, and numerous descriptions of their appearances at different times are to be found in the *Transactions of the Royal Society*, but by far the most remarkable apparition of the kind on record, is that which was observed in America on the 13th of November, 1833 and is described in vols xxv and xxvi of the *American Journal of Science* and also the *American Almanac* for the year 1835 We will give a brief abstract of the relation, which is of extreme interest, not only on account of the extraordinary nature of the appearances but also as it seems to indicate that these phenomena, hitherto but little heeded, may serve to make us better acquainted with the constitution of the planetary system

"The meteors began to attract notice by their frequency as nine o'clock on the preceding evening [illegible] exhibition became strikingly brilliant about eleven, but most splendid of all about four o clock and continued with but little diminution until merged in the light of day A few large fire balls were seen even after the sun had risen The entire extent of the exhibition is not ascertained, but it covered no inconsiderable portion of the earth s surface It has been traced from the longitude of 61° in the Atlantic Ocean to [illegible] ude 100° in central Mexico, and from the North American lakes to the southern side of the island of Jamaica Every where within these limits the first appearance was that of fire-works of the most imposing grandeur covering the entire vault of heaven with myriads of fire balls resembling sky-rockets On more attentive inspection, it was seen that the meteors exhibited three distinct varieties, the first consisting of *phosphoric lines*, apparently described by a point, the second, of large fire balls, that at intervals darted along the sky, leaving luminous trains which occasionally remained in view for a number of minutes, and in some cases for half an hour or more, the third of undefined luminous bodies, which remained nearly stationary for a long time

"One of the most remarkable circumstances attending this display was, that the meteors all seemed to emanate from one and the same point They set out at different distances from this point, and proceeded with immense velocity, describing in some instances an arc of 30° or 40° in less than four seconds At Poland, on the Ohio, [illegible] course the heavens for a great length of time, and then was heard to explode with the noise of a cannon The point from which the meteors seemed to emanate, was observed by those who fixed its position among the stars to be in the constellation Leo, and, what is very remarkable, this point was *stationary* among the stars during the whole period of observation, that is to say, it did not move along with the earth in its diurnal rotation eastward, but accompanied the stars in their apparent progress westward It is not certain whether the meteors were in general accompanied by any peculiar sound. A few observers reported that they heard a hissing noise like the rushing of a sky rocket, or slight explosions like the bursting of the same bodies Nor does it appear that any substance reached the ground which could be clearly established to be a residuum or deposit from the meteors A remarkable change of weather from warm to cold accompanied the meteoric shower, or immediately followed it in all parts of the United States"

The particulars which have now been stated afford data for entering on the explanation of these mysterious phenomena And, as the meteors appeared to emanate from a point which did not follow the earth's rotation, it is clear that they had not their origin in the atmosphere but in the regions of space beyond it The next question that occurs is what was the distance from the earth of the region of space in which they had their origin? It was ascertained that observations made in different latitudes [illegible] parallax in declination, and [illegible] collected and carefully compared, give an average distance from the surface of the earth of 2238 miles as the height of the meteoric cloud This estimate must be [illegible] approximation,—the best, however, [illegible] from data that are imperfect and often discordant Assuming this result to be nearly correct, it is easy to compute the velocity with which the meteors would enter the atmosphere A body falling from a height of 2238 miles by the attraction of gravity alone would acquire, at the distance of fifty miles from [illegible] height of the atmosphere) a velocity [illegible] *second* which is more than ten times the velocity of a cannon-ball The meteors therefore, on entering the atmosphere, would produce a sudden and powerful compression of the air before them But when air is suddenly compressed, a great quantity of heat is extricated from it In the present case the heat would produce in the falling bodies an intense ignition, and if they were combustible set them on fire On submitting the subject to accurate calculation on established principles, it is ascertained that the quantity of heat extricated from the air by the falling meteors exceeded that of the hottest furnaces, and can only be compared to those immeasurable degrees of heat produced in the laboratory of the chemist And this supposes the meteors to have entered the atmosphere with only the velocity due to the earth's attraction but if we suppose that they had also a relative velocity arising from the earth's motion towards them, they might then enter the atmosphere with a velocity of fourteen instead of four miles per second In this case the heat extricated from the air would be proportionally augmented It is evident that the meteors must have been constituted of very light materials, for had their quantity of matter been considerable with so prodigious a velocity they would have had sufficient momentum to reach the earth and the most disastrous consequences might have followed From the apparent magnitude of many of the meteors, and their probable distance it was conjectured that they were bodies of very large size, though of course it is impossible to fix the limits of their magnitude with any certainty Those masses were only stopped in the atmosphere and prevented from reaching the earth, by transferring their motion to columns of air large volumes of which would be suddenly and violently displaced Now it is a remarkable fact, that the state of the weather and the condition of the seasons following the meteoric shower, corresponded to those consequences of the disturbances of the atmospheric equilibrium It is from the great and sudden changes of temperature caused by phenomena of this kind that [illegible]

*Theory of Fire Balls* Various [illegible] have been proposed to account for these remarkable phenomena In general, they have been regarded as meteors having their origin in the atmosphere, and electricity, magnetism hydrogen gas, have in turn been assigned as their immediate causes Others again suppose them to be products of *nebulous* matter (perhaps of the same nature as the tails of comets) floating in the planetary regions, and which, when it happens to lie near the path of the earth in its revolution about the sun, will be attracted by terrestrial gravitation The parallax of the meteors of 1833 indicates, as we have seen, that they proceeded from a point far beyond the limits of the atmosphere The attentive examination of the circumstances of their appearances leads to other indications of a very remarkable nature On projecting a diagram to represent the respective places of the earth in its orbit, and the place of the body from which the meteors proceeded it appears that the earth was moving almost directly towards the meteoric body Now the meteoric cloud remained apparently at rest, and of course nearly in the earth's path, for at least two hours This could not have happened unless it had been moving nearly in the same direction as the earth, and with nearly the same angular velocity round the sun, for had it been at rest, the earth carried forward at the rate of 19 miles per second, would have

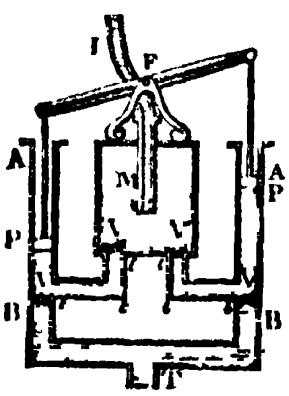
overtaken it in less than two minutes, and had the angular velocities of the two bodies not been nearly equal they could not have remained so long apparently stationary with respect to each other. Hence it is inferred *that the meteors were pursuing its track with*

But supposing there is a body or which is more probable are composed of myriads of little bodies whose orbits intersect the plane of the ecliptic in a point, does the earth must encounter some of them every time it passes through the point of intersection? A more attentive observation of these meteors than has yet been bestowed on them is perhaps necessary to solve this question. At present the following facts have been collected. — On the 12th of November, 1799, at Cumana, in South America, thousands of meteors or falling stars were seen to succeed each other during four hours. Of this exhibition an account is given by Humboldt and Bonpland. On the 13th of November, 1831, M. Berard, commander of [illegible] observed [illegible] luminous [illegible]. During more than three hours there occurred, on the average, at least two a minute. One of these meteors, which appeared near the zenith, in leaving an enormous train in its direction from east to west, presented a very large luminous band (equal to half the diameter of the moon) in which several of the colours of the rainbow were distinctly exhibited. Its trace remained visible during more than six minutes. (Arago *Annuaire* for 1836.) On the 13th of November, 1832, remarkable exhibitions of meteors were seen at Mocha in Arabia, and on the 19th of the same month in various parts of England. On the 13th of November, 1835, a large and brilliant meteor fell near Belley in the department of the Ain in France, and set fire to a barn. On the same night a shooting star larger and more brilliant than Jupiter, was observed at Lille by M. Delezenne, and what is very remarkable, a number of extremely brilliant meteors were seen also on the same night, by Sir John Herschel and his assistant at the Cape of Good Hope, who apprized of the phenomena that had been observed in America were looking out for their appearance. The attention of observers being now generally called to the subject, the lapse of a few years will probably decide the question whether the recurrence of the meteors on the same day of the year has been merely accidental, or a stream of nebulous matter has a temporary or permanent existence in that part of space through which the earth passes in its annual revolution about the 13th of November. (See AEROLITE, SHOOTING STARS.)

FIRE BLAST. A term of very doubtful meaning, like the word blight. In Agriculture it is sometimes applied to plants which are suffering from the mildew fungi, or from minute insects, but its legitimate use would appear to be applicable only when the delicate parts of plants are too suddenly exposed to a brilliant sun, and the rapid transpiration which takes place in consequence dries up and shrivels their leaves.

FIRE DAMP. The carburetted hydrogen gas of coal mines.

FIRE ENGINE. This most useful machine is constructed in a variety of forms which all however agree in one principle. It generally consists of a double forcing pump communicating with the same air vessel, and instead of a force-pipe a flexible leathern hose is used, through which the water is driven by the pressure of the condensed air in the air vessel. The annexed diagram represents a section of the apparatus. The pipe I descends into a receiver or vessel containing a supply of water. This pipe communicates with two suction valves V, which open into the pump barrels of two forcing pumps A B in which solid pistons P are placed. The piston rods of these are connected with a working beam E, elongated so that a number of persons may work at both ends of it at once. Force-pipes *t t*, proceed from the sides of the pump barrel above the valves V, and they communicate with an air vessel M by means of forcing valves V, which also open upwards. The [illegible] to the air vessel near the bottom. This [illegible] with the flexible leathern hose L, the [illegible] is adapted to the purposes to which the [illegible] can be applied. The extremity of the hose may be curved [illegible] and may be introduced through the doors and windows of [illegible]. By the alternate action of the pistons, water is drawn through the suction valve and propelled through the forcing valves, until the air in the top of the vessel M is highly compressed. The pressure acts on the surface of the water in the vessel, and forces it through the leathern hose in a continued stream, so as to spout from its extremity with a force depending partly on the degree of condensation, and partly




on the elevation of the extremity of the hose above the level of the engine. It is to be considered that the pressure of the condensed air has, in the first instance, to support a column of water, the height of which is equal to the level of the end of the tube above the level of the water in the air vessel, and until the pressure exceeds what is necessary for this purpose, no water can spout from the end of the hose, [illegible] force with which it will so spout [illegible] to the excess of the pressure of the condensed air above the weight of the column of water, whose height is equal to the elevation of the end of the hose above the level of the water in the air vessel. (*Cabinet Cyclopædia*, "Hydrostatics and Pneumatics," p. 326.)

The fire engine has received various improvements from Bramah, Dickenson, Simpkin, Raventree, Philips, and others. The above description applies to Newsham's engine. Braithwaite's *steam fire engine* is an application of the power of steam to the working of the fire engine. The mechanical arrangement consists of two cylinders of about six inches in diameter, one of them being the steam cylinder, and the other the water pump, and they are placed horizontally, so that a parallel motion is easily produced. This engine will deliver 500 gallons of water an hour at the height of 90 feet. The time of getting the machine into action, from the time of igniting the fuel (the water being cold) is only 18 minutes. Some of the Fire Insurance Companies in London have floating engines on the Thames, which are extremely serviceable in [illegible] the application of hose upon the river.

FIRE ESCAPE. Any machine or apparatus for the purpose of enabling persons to escape from the upper stories of houses on fire. The contrivances which have been [illegible] very [illegible] prising those by means of which the escape is effected without external aid, and the second those requiring the assistance of persons without. Of the first kind the most obvious is a rope ladder which may be kept in a sleeping apartment and used upon occasion by fastening one end of it to a window sill or bed post. Mr. Mastyn invented an apparatus which consists of a long rope and an assemblage of cordage or belts, so disposed as to form a seat, the person about to descend binds himself into the seat and then lowers himself to the ground by allowing the rope which is fastened to the window sill to slide slowly through his hands, and in order that this may be done easily, the rope is made to pass through a series of holes in a block. But unfortunately contrivances of this kind can rarely be expected to be of any use, for supposing them at hand when the alarm of danger is given, few persons can command the coolness and attention [illegible] adjusting the apparatus [illegible] long and active who could safely descend by such means from a considerable height.

With regard to escapes of the second kind the object is to enable persons without to establish speedily a communication with an upper room, so as to afford the inmates the means of safe descent, or to remove them if necessary as in the case of the feeble or children. A very portable sort of ladder invented by Mr. Young, is described in the *Transactions of the Society of Arts* for 1813. It consists of a number of cross bars or rounds, connected with ropes, which form the sides of the ladder, the ends of the rounds are fitted into each other, so as to form a pole which is readily elevated to a window, and [illegible] are properly fixed, a sudden jerk suffices to separate the rounds which immediately fall into their places when the ladder is formed and suspended from the frame. But this apparatus only answers the same purpose as a rope ladder, and is therefore liable to the same objections. Mr. Braby's fire escape described in the 34th vol. of the same Transactions, consists of a car or cradle, which is made to slide on a slip of plank fixed to a pole, and is governed by a rope. Mr. Ford's escape consists of a spar of timber about 35 or 40 feet long, having two projecting arms at the top furnished with prongs, by which a firm bearing against the wall of a house is obtained. A grooved pulley is mortised into the spar near the top, and another near the bottom, over the pulleys runs an endless rope, to which is attached at one point a main rope, and at another the semicircular brace of a large grooved roller which traverses up and down the space between the pulleys. This brace carries on the under side of the spar a hook, to which a cradle is attached, whereby persons can be easily lowered to the ground.

For a description of various [illegible] of a similar kind, we refer to the [illegible] *of Arts* above quoted.

FIRE FLY. A name commonly given to those insects which have the singular property of emitting a luminous secretion. This power is not confined to insects of one organization or order. Among the Coleoptera, the *Elater noctilucus* and the female glow-worm are conspicuous examples. The *Fulgoridæ*, or lantern and

andle flies, are also described, but some think apocryhally as [illegible]

FIRE GREEK A fire which was employed in he wars of the Christians and Saracens in the middle ages, said to have been invented during the reign of Conantine Pogonatus in the year 668 by Callinicus, an arhitect of Heliopolis Naphtha was probably its principal ngredient, which, if skilfully prepared and continued reates great heat and will burn even in water Its extreme combustibility and the difficulty of quenching its ame (See a learned paper on this subject, by *Dr M'Culloch*, in the *Quarterly Journal of Science*, vol xiv )

FIRE-LOCK, or LUNT A musket or small gun, hich is fired with a flint and steel, and thereby distinuished from the old musket, or *match-lock*, which was red with a match The date of the invention of firecks is uncertain

FIRE, ST ANTHONY'S *See* ERYSIPELAS

FIRE-WORKS Artificial preparations made of unpowder, sulphur, and other inflammable ingredients isplayed at public rejoicings and on other occasions *See* YROTECHNY

FIRKIN A measure of capacity being the fourth art of a barrel, or containing 9 ale gallons, or 7½ impeal gallons, that is 2 [illegible] cubic inches

FIRLOT A dry measure used in Scotland but of ifferent capacities, according to the article it is used for easuring The Linlithgow *wheat firlot* is to the impeal bushel as 998 to 1, and the *barley firlot* to the impeal bushel as 1 156 to 1

FIRMAMENT, in the language of the old astronomers, is the orb of the fixed stars or the most remote f all the celestial spheres In common language it signifies the same [illegible] as *heaven* or *sky* See HEAVEN

FIRMAN [illegible] (pron *Ferman*) in the Per[illegible] Turkey, Persia [illegible] the sovereign issued for various purposes Those st known to Europeans are given to travellers and rve as passports The Firmân has placed at its head Turkey the cipher of the reigning sultan written in complicated manner, affixed by the chief secretary of e sign manual

FIRST COAT In Architecture the *laying* the plaser on the laths, or the *rendering*, as it is called on brick hen only two coats are used When three coats are ed, it is called *pricking up* when upon laths and *ughing in* when upon brick

FIRST FRUITS (Annates, or Primitiæ) The pros of every spiritual living for the first year after its oidance, which the new incumbent paid in Catholic nes to the Pope, but since the Reformation to the king, he valuation is that which was made by Henry VIII he stat 2 Anne transfers the first fruits and tenths of l livings over 50*l* at that time to a fund called Queen ne's Bounty for the increase of the smaller benefices ich are released from any payment of the kind

FIRTH *See* FRITH

FISC (Lat fiscus) The term used in the Roman w, and laws derived from it to denote the property of e state Under the emperors, however, it had acquired e signification of the peculiar domain or treasure of the ince, in contradistinction to *ærarium* the public treary The word confiscation is derived from fisc, and ery lord or body corporate to which things may be conceated in course of law has properly speaking the ht of fisc Fiefs, being originally lands granted to lividuals out of the king's domain are sometimes med *fisc* in writers of the middle ages *See* FEUDAL STEM

FISCAL Something relating to the pecuniary inest of the sovereign, or the community

FISH In Architecture, a piece of wood secured to other to strengthen it

FISH *See* PISCES

FISHERY The fisheries of the British Islands are tly coast and river, and partly carried on in the open at a greater or less distance from the shore Of the mer, salmon, herring pilchard and oyster are most portant, of the latter, cod, turbot and whale 1 The mon fishery has considerably diminished in importe of late years That of Scotland is regulated by 4 c 39 and subsequent acts 2 The herring fishery, first almost engrossed by the Dutch, was fostered in [illegible] bounty granted on vessels employed in [illegible] system the fishery does not appear to e thriven The bounty was [illegible] ally ceased in 1830 The most [illegible] present day are the coasts of [illegible] In 1834, 11,000 boats and 82,000 sons (fishermen and boys, coopers, curers, &c ) were [illegible] 3 The pilchard fishery is a li[illegible] on almost entirely on the coasts of von and Cornwall 4 Oysters are found on most parts our coasts but the principal seats of the trade of breedthem for the London market are Kent and Essex Turbot, cod, and mackerel are the principal articles of the fisheries off the British coasts Turbot are chiefly caught by Dutch fishermen and close to the shores of Holland In 1838 a report was made by a committee on the British Channel Fisheries in which the decline of those fisheries is much commented upon, and attributed to three causes the extensive interference and aggression of the French fishermen on the coasts of Kent and Sussex, the large quantities of foreign-caught fish illegally imported and sold, and the great decrease and comparative scarcity of fish in the channel, which last they attribute to the destruction of spawn But by far the greatest fishery of cod, hake, ling, &c is that carried on on the great bank of Newfoundland, and on the neighbouring coasts The former is now chiefly engrossed by the French and Americans, but the British fishery, although [illegible] the coasts of Newfoundland [illegible] Mr M'Gregor in his work on the North American Colonies, estimates the value of the produce on an average of five years to 1832, at 857 000*l* per annum (ii 596 ) 6 The Greenland whale fishery was engaged in by the English in the 17th century but not with vigour until encouraged by a bounty in 1740 During the late war it became extremely valuable, afterwards it declined in importance In 1815, 146 vessels sailed, in 1834 76 only The southern whale fishery is a more modern branch of the traffic (See *M'Culloch Statist of Great Britain*, ii 21 &c , article "Fisheries," in *Enc Brit*, new ed , Report of the Committee on the Channel Fisheries 1833 the former writer estimates the annual value of the fisheries at about 3,000,000*l* per annum ) The coast and sea fisheries are protected by a variety of enactments [illegible] by the commissioners of [illegible] As to inland fishing, the law of offences in private fisheries is now consolidated by 7 & 8 G 4 c 27 Taking or destroying fish in water running through, or in land adjoining or belonging to the dwelling-house of the owner of the water is a misdemeanour, in any water not within this description but private property or in which there is a private right of fishing it is punishable with fine on summary conviction Angling in the daytime is not within these enactments but is punishable summarily with less penalty The right of fishing in a river prima facie belongs to the lord of the manor, who has the ownership of both banks Fishery is said to be either several or free or common of piscary The first is in the owner of the soil or one deriving title from him, the second is a royal franchise conveying an exclusive right of fishing in a public river Common of piscary is a liberty of fishery in common with others in a stream or river the soil whereof belongs to a third person, and resembles other commonable rights

FISHPONDS are ponds made by art, in which different kinds of fish are bred and fattened In general this is only attempted with fresh-water fish, but in some places ponds have been formed on the sea shore and so contrived as to have their waters renewed every tide, and in these sea fish have been kept for use for a considerable time The fresh-water fish which is the most successfully managed in ponds is the carp

FISSIPARA (Lat findo *I divide* and pario *I engender*) Those animals are so called which propagate by spontaneous fission or the detachment of a greater or less proportion of the body having inherent power of self support and growth As the animals which manifest this mode of generation differ widely among themselves in their general organization, the term *fissipara* cannot be applied to designate any natural group, spontaneous fission is limited to the lowest classes of animals, as *Infusories*, *Polyps*, certain worms, as the *Naïs*, &c

FISSIROSTRALS, *Fissirostres* (Lat findo and rostrum *a beak*) The name of a tribe of perching birds (*Insessores*) comprehending those which have a very wide gape as the swallow

FISSURELLA (Lat findo) A genus of Gastropodous Mollusks having a shell shaped like that of a limpet (*Patella*), but with a fissure at the apex of the cone which opening is associated with a different form [illegible] the breathing organs

FISTULA (Lat *a pipe*) A long sinuous ulcer, often communicating with a larger cavity, and having a small external opening

FISTULA SPIRALIS In Botany, a term used by Malpighi to denominate that kind of vegetable tissue now called the spiral vessel

FISTULIDANS, *Fistulides* (Lat fistula, *a pipe*) A tribe of Echinodermatous animals, comprehending those which have an elongated cylindrical tube-like body

FIVE POINTS The principal points of controversy between the Calvinists and Arminians, which became the subjects of the decisions of the Synod of Dort They relate to predestination, satisfaction, regeneration, grace, and [illegible] perseverance See article ARMINIANS.

FIXED AIR The old term for *carbonic acid*, from its existence in a fixed state in limestone, &c.

**FIXED OILS** The common greasy oils are so termed in consequence of the high temperature which they sustain before [illegible]

**FIXED STARS** Those which retain the same, or very nearly the same position with respect to each other It has been discovered by the accurate observations of modern times, that many of the stars have a proper motion See STARS

**FIXTURE**, in Law, is a term generally applied to all articles of a personal nature affixed to land This annexation must be by the article being let into or united with the land, or with some substance previously connected therewith Thus a barn, built on a frame not let into the earth, is not a fixture, a brewer's stills, set in brickwork resting on a foundation, are fixtures, and the application of the same principle gives, in every case, the true rule to judge whether any thing be a fixture or not Whatever is thus fixed becomes, by law, parcel of the freehold or realty It is, therefore, on general principles, not removable, but there are exceptions to this rule established by custom, of which the principal arise out of the right of tenants to remove fixtures set up for purposes of trade, and in some instances for ornament and convenience (commonly called tenants' fixtures), and the right of executors to some fixtures, generally of the same description, as against the heir or devisee of the realty

**FLAG** In Naval affairs, the flags are,—the royal standard, the admiralty flag an anchor on a red ground, the union, or jack, in which are blended together the crosses of St George, St Andrew, and St Patrick this is carried by the admiral of the fleet

**FLAGELLA** A term used by the older botanists to denote the twigs

**FLAGELLANTS** A sect of enthusiasts who first appeared in the middle of the 13th century, and being then repressed sprang up again with renewed violence in the 14th Beginning first at Cremona in Italy [illegible] of the example spread in a few years through [illegible], and every city was infested by multitudes who went naked from the loins upward, and inflicted upon themselves several daily flagellations with the idea of obtaining thereby merit in the eyes of God They formed themselves into a society and at first were at least innocent in their behaviour, but as their numbers increased, they gave way to great excesses, and were eventually suppressed by a holy war proclaimed against them by Pope Clement VI

**FLAGELLUM** In Botany, a trailing shoot of the vine, sometimes used to denominate that form of stem called a runner

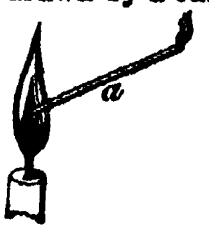
**FLAGEOLET** (Fr) A wooden musical wind instrument played with a mouth-piece, the holes and keys whereof are stopped with the fingers, in the same way as the flute

**FLAIL** A wooden implement [illegible] hand It consists of the handle or [illegible] bourer holds in his hand and uses as a lever to raise up and bring down the swiple or part which strikes the corn and beats out the grain and chaff from the straw The swiple is joined to the hand staff by the caplins or couplings which are thongs of untanned leather and sometimes the skins of eels or of other fish These thongs are passed through holes in the ends of the handle and swiple and made fast by being sewed together The flail was in use among the Romans, though the prevailing mode of separating corn from straw among the nations of antiquity was by treading it out with cattle in the open air In the colder parts of Europe this could never have been generally the case for obvious reasons, and hence the flail was the universal threshing implement till the introduction of [illegible] which is now taking the place of [illegible] where capitalists engage in farming *See* THRESHING MACHINE

**FLAKE WHITE**, A term often applied to the purest *white lead*

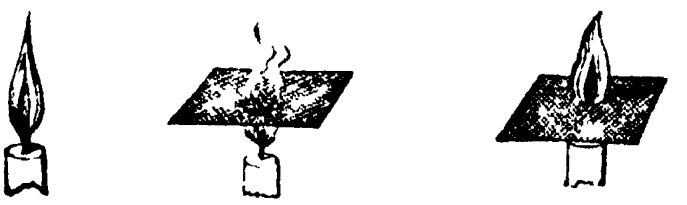
**FLAME** (Germ flamme) When the temperature of inflammable gases or vapours is raised very high, and in the contact of air, they are said to *burst into flame*, if previously mixed with a due proportion of oxygen or of atmospheric air, they *explode* In the former case the combustion only goes on at the surface in contact with air and is quiet and gradual, in the latter every particle of the inflammable body being in contact with the supporter of combustion, the inflammation extends instantaneously through the whole mass The nature of flame was first explained by Hooke in 1677 (in his *Lampas*), but the relation of the light to the heat of flames, and the whole philosophy of their constitution, was first developed by Sir H Davy in his researches published in the *Philosophical Transactions* between 1815 and 1817

All the leading phenomena of flame are well exhibited by a large gas-flame burning from a wide orifice It presents a hollow cone, the heat and light of which are confined to its exterior surface A transverse section of such a flame exhibits a ring of light surrounding a central uninflamed core the inflammable gas or vapour may be drawn by a tube out of this central portion, as in the annexed figure, where *a* represents the tube inserted into the central non-luminous part of the [illegible] and [illegible] its extremity (See illustrations of this subject in the papers of Mr Sym and Mr Davies, *Ann of Phil* vols viii and x)




A flame may be extremely hot without being proportionately luminous, as is the case with the flame of hydrogen, which is scarcely visible in daylight, but the heat of which is shown by introducing into it a coil of fine platinum wire, which immediately becomes white hot and emits abundance of light The *light* of all flames is of a similar origin, and depends upon a *solid matter* heated and rendered incandescent by the heat of the flame thus if magnesia or lime in fine powder be projected into the flame of hydrogen, the luminosity of the flame is immediately increased. Finely divided charcoal is the substance to which all common flames owe their luminosity It is derived from the hydrocarbon produced by the decomposition of oil, wax, tallow, &c, as contained in coal gas, but as charcoal unlike magnesia and lime, is itself combustible, it not only renders the flame luminous, but is burned in the act of so doing and passes off in a well regulated and perfect flame in the invisible form of carbonic acid gas

When flames are cooled, they at the same time extinguished, hence a flame cannot be made to traverse or recede through a metallic tube of small bore, and hence a flame may as it were, be bisected by a piece of wire gauze held transversely across it in which case the smoke, gas or vapour and charcoal go through, but not hot enough to inflame, having been cooled down by their passage through the metallic meshes, but by applying a flame to this smoke, it may again be kindled In this way the upper portion of the flame may be burned while the inflammation of the lower half is prevented by the interposed cooling medium These experiments are best illustrated by the flame of a gas-burner, and the two cases just cited are represented in the annexed figures



**FLAMEN** The title applied by the Romans to the priests of any particular deity as distinguished from priests in general Originally Numa instituted three orders of flamens, viz those of Jupiter, Mars, and Quirinus (Romulus) But in after times this number was much increased by the introduction of new gods and superstitions, and by the worship paid to deceased emperors

**FLAMINCO** *See* PHŒNICOPTERUS

**FLANK** (Fr flanc) In Architecture, the side of any building

**FLANK** in Fortification, is that part of the bastion which reaches from the curtain to the face the flank of one bastion serves to defend the ditch before the curtain and [illegible] bastion *See* FORTIFICATION

**FLANNEL** *See* WOOL

**FLASHINGS** (Probably from flaque, *a splash*) In Architecture pieces of lead or other metal let into the joints of a wall so as to lap over the gutters or other conduit pieces and prevent the splashing of rain injuring the interior works

**FLAT** In Architecture that part in the covering of a house of lead or other metal which is laid horizontal

**FLAT** In Music a character of this form ♭, which depresses the note before which it is placed a chromatic semitone Flats and sharps were originally contrived to remedy the defects of musical instruments whereon temperament was required the natural scale of music being limited to certain fixed sounds and adjusted to an instrument in many points defective, for we can only proceed from one note to another by a particular order of degrees Hence, from one note to another, upwards or downwards, we cannot find any interval at pleasure To supply or remedy this defect, musicians have had recourse to a scale proceeding by twelve degrees, making therefore thirteen notes to an octave, including the extremes, which, though it does not make the instrument perfect, leaves little room for complaint In instruments whose sounds are fixed, a sound or [illegible] it into two unequal parts, called semitones, is placed between the extremes of every tone of the natural scale, so that we have twelve semitones between thirteen notes in the compass of an octave In order then to keep the diatonic series distinct, the inverted notes [illegible] the name of the next below, with this character ♯ called a sharp, or the name of the natural note next above it, with this character ♭, called a

flat Thus D . . . a . . one below D natural (♮) On keyed . . . keys are the representatives of these flats and sharps The system, however, does not strictly produce what it represents it is only an approximation See TEMPERAMENT

FLAT FIFTH In Music an interval of a fifth depressed by a flat, called by the ancients *semidiapente*

FLAT FISH See PLEURONECTES

FLAT'TEN A SAIL To extend it fore and aft, whereby its effect is lateral only

FLATTING In Architecture, a coat of paint, which, from its mixture with turpentine, leaves the work flat, or without gloss

FLA'TULENCY (Lat flatus, *blast*) A morbid collection of gas in the stomach and bowels, commonly symptomatic of . . . . . kinds of vegetable food . . . . . and well . . . ed animal food, with weak brandy and water as a beverage at dinner, are the usual and effective remedies

FLAX (Germ flachs) The fibre of the *Linum usitatissimum*, which is spun into thread and woven into *linen* textures

The flax is reaped a little before the seeds are ripe, it is stripped and the stalks are then soaked in water or *retted* (rotted), when fermentation running into putrefaction ensues, so as to destroy the foreign matters with which the fibres are blended in the plant, the flax is then dried, and broken or beaten and winnowed, so as to separate the fibrous from the other parts these are afterwards heckled and prepared for the spinner (For an account of these operations and of the machinery by which they are effected, see Ure's *Dictionary of Arts, &c*, art "Flax")

FLECHE In Fortification a simple redan usually constructed at the foot of a glacis See REDAN

FLEECE ORDER OF THE GOLDEN One of the . . . . . . . . . . . . . and as by its foundation his successors were declared to be hereditary grand masters that title passed with the Burgundian inheritance to the house of Austria thence after the death of Charles V to the Spanish line of that house but when the monarchy of Spain passed to the Bourbons and the Spanish Netherlands to Austria, the archdukes of Austria claimed the grand mastership and claims are made on it at present both by the emperor of Austria and king of Spain, the order is consequently conferred both at Vienna and Madrid, and is in both courts, the highest in point of rank As its nominal object is the protection of religion it is rarely conferred on any Protestants with the exception, by courtesy, of Protestant sovereigns

FLEET, in its most extended signification is applied to a number of ships, pursuing in company either mercantile or warlike purposes, or both, but is more generally confined to the different detachments which form the *navy* of any country stationed in various parts of the world for the purposes of defence, aggression, or intimidation. See NAVY SQUADRON

FLEET The sea term for shortening any thing, by taking it up that had been pulled out or stretched

FLE'MISH SCHOOL In Painting the school formed in Flanders. The works of this school are distinguished by the most perfect knowledge of chiaro scuro, high finishing without dryness, by an admirable union of colours well blended and contrasted and by a flowing luxurious pencil Its defects are somewhat similar to those of the Dutch school The Flemish painters, like the Dutch, represented nature as they found her, and not as she should be Rubens and Vandyke (the glory of this school) though men of the greatest genius, were not free from this defect, and the former especially Teniers was another great master of the school in question, to it also belong Snyders, Steenwick, Neefs, Schwaneveldt Van Eyck &c

FLE'TA The title of an ancient treatise on English law attributed to the reign of Ed I and named (according to tradition) from its composition by a judge in the Fleet prison

FLEUR-DE-LIS In Heraldry, a charge supposed to represent a lily borne from a very early period in the royal arms of France It is however, more probably conjectured that the shape of this bearing was intended to represent the iron of a javelin

FLEXIBILITY (Lat flecto, *I bend*) That property of bodies in virtue of which, when a sufficient force is applied to them, they change their form, and are bent Flexibility is opposed to *stiffness* on the one hand, and to *brittleness* on the other, stiff bodies being such as resist bending and brittle those which cannot be bent without a disruption of their parts Of unorganized bodies the most flexible are the metals, and their flexibility is in general increased by heat, though brass is rendered brittle when subjected to a high temperature Of organized bodies, young fresh . . . and . . . . . . (ex . . . . . . . flexible . . . . . . this class . . . . . . . flexible by heat and moisture In many machines where great stability is required it is often a matter of much importance to be acquainted with the flexibility of the component materials, in order to determine the load they can support without yielding. (See COHESION Flexibility is only a relative term, for all bodies are more or less flexible . . . . . . . . . metal the stiffness or resistance to flexure . . . . . . the breadth and cube of the depth, and inversely as the cube of the length See STRENGTH OF MATERIALS

FLEXU'RA (Lat flecto, *I bend*) In Mammalogy, the joint between the antibrachium and carpus, usually called the fore-knee in the horse, analogous to the wrist-joint in man

FLE'XURE The bending or incurvation of a line or surface *Point of contrary flexure* is a term used in analytical geometry to denote that point of a curve at which the curvature passes from convex to concave, or *vice versa*, with respect of the axis At this point the radius of curvature is infinite At the points of the curve . . . . . . . . . . lowing, the centre of curvature . . . . . . . . . the curve

FLINT . . . . . . . nearly pure *silica* They usually occur in irregular nodules in chalk Their origin is . . . . . . problem

FLINT GLASS CRYSTAL A species of glass which derives its name from flint, because that substance was formerly employed in its manufacture It is very extensively used for domestic purposes, but is chiefly interesting to the philosopher on account of the property which it possesses of causing a greater dispersion of the rays of light which pass through a prism or lens formed of it than any other of the vitreous compounds This property renders it invaluable in the manufacture of the object glasses of telescopes and microscopes, for by combining a concave lens of flint glass with one or two convex lenses of *crown glass* which possesses a much less dispersive power a compound lens is formed in which the prismatic colours arising from a simple refraction are destroyed, and the lens rendered achromatic This construction of object glasses was first discovered by a Mr H . . . . . in Worcestershire about 1729, . . . . . . was forgotten and no further notice taken of it for nearly 30 years when it was again brought to light by John Dollond after a long-continued course of experiments undertaken for the purpose of perfecting the telescope It is however very difficult to prepare flint glass fit for the purposes of achromatic telescopes This difficulty arises not from the want of sufficient dispersive power in the substance but from the want of purity or homogeneity the slightest impurity or inequality of composition in the glass giving rise to a streaked or imperfect image by reason of the unequal refraction of the rays The composition of pure flint glass long remained a secret in the family of the Dollonds and its manufacture formed a very profitable article of exportation, for till about the beginning of the present century, no flint glass of good quality was made on the Continent Of late years however a great change has taken place in this respect and glass of the best quality has been manufactured both in France and Germany in much larger masses than our English artists have yet succeeded in obtaining This result has been mainly produced by the experimental researches of D Artigues, Fraunhofer Cauchoix Guinand and Korner Formerly, an object glass exceeding five inches in diameter could scarcely be produced Fraunhofer succeeded in making them of nine and even twelve inches The object glass of the large parallactic telescope belonging to Sir James South, at Campden Hill was manufactured by Cauchoix, it exceeds twelve inches and is throughout of the utmost purity The exact proportion of the ingredients which enter into these choice specimens is not known, and probably their excellence depends in part on some accidental circumstances in the preparation Korner produced some of his best specimens by employing the following ingredients —100 parts of quartz, first treated with muriatic acid, 80 parts of litharge, or red lead, and 30 parts of the bitartrate of potash Flint glass for common purposes is usually made of 120 parts of fine white sand, 40 parts of well purified pearl ash, 35 parts litharge or minium 13 parts nitre, and a small quantity of the black oxide of manganese, the . . . . . . . used to correct the green colour . . . . . . presence of oxide of iron in the sand The principal difference between this and the glass used for optical purposes consists in the much greater quantity of lead in the latter, and which is introduced for the purpose of increasing its dispersive power There is a valuable paper on the manufacture of glass for optical purposes containing the results of an extensive series of experiments upon the subject made in the laboratory of the Royal Institution, by Mr Faraday, in the *Philosophical Transactions* for the year 1830, vol cxx See GLASS

FLOAT BOARDS The boards fixed to the rim or outer circumference of undershot wheels, which receive the impulse of the water and communicate the motion to the wheel

**FLOA'TED LATH AND PLAISTER** In Architecture, plaistering of three coats, whereof the first is pricking up (*see* FIRST COAT) the second, floating or floated work and the last of *fine stuff*

**FLOA'TED WORK** In Architecture plaistering made of a perfectly plane surface, by means of a tool (which is a long rule with a straight edge) called a float

**FLOA'TING MEADOWS** Meadow lands the surface of which is flat, adjoining a river or other source of water, which can be flooded or covered at pleasure The water is usually drawn off in the winter season when it is more or less muddy and leaves a deposit that serves as a kind of manure It is also useful to vegetation, by preserving a higher temperature in the surface soil than it could maintain through the winter fully exposed to the action of the atmosphere, because, wherever water is in a fluid state its mean temperature, and that of the bodies immediately in contact with it, must be above 32°, and at that temperature the grasses common in British meadows will grow There are probably other benefits which grass lands receive from being covered with water during a portion of the winter season, but these have not yet been satisfactorily explained by science

**FLOA'TING SCANTLINGS** (Ital, probably from schierato, *ranged*) In Architecture strips of plaister arranged and nicely adjusted for guiding the *floating-rule* (*See* FLOATED WORK)

**FLOA'TSTONE** A porous variety of flint, which floats upon water

**FLO'CCI** (Lat) In Botany the woolly filaments that are found mixed with the sporules of many *Gastromyci* The same name is also applied to the external filaments of *Byssaceæ*

**FLOCCILLA'TION** Picking the bed-clothes This is a very alarming symptom in many acute diseases

**FLO'CCUS** In Mammalogy, the tuft of long flaccid hairs which terminate the tail

**FLOETZ ROCKS** A term applied by the German geologists to the secondary strata, because they generally occur in *flat* or horizontal beds

**FLOOR** (Sax flore) In Architecture the pavement or boarded lower horizontal surface of an apartment It is constructed of earth brick stone, wood, or other materials Carpenters include in the term the framed timber work on which the boarding is laid, as well as the boards themselves

**FLOOR** The lower part of a ship's bottom

**FLOOR CLOTH** This useful and ornamental manufacture originated in this country about the year 1740, when a manufactory of it was established at Knightsbridge near London by Mr Smith It was originally made of narrow canvass sewn together like sail cloth to which successive coats of paint were applied, but the seams proving inconvenient a canvass was wove for the purpose, about four yards wide, it was then extended to seven yards in width, and afterwards to nine, which is the widest at present made The manufactory at Knightsbridge, now carried on by Mr Baber is the largest establishment of the kind, the common dimensions of the oil cloths produced there being 20 yards by 4, and 30 yards by 7 giving therefore entire pieces of 160 and 210 square yards without seams These canvasses are stretched upon frames and accessible over their whole surface by stages erected for the purpose these are the circumstances which render the large dimensions of the manufactory requisite The canvass being duly strained is rubbed over with pumice stone which renders its surface smooth and even, and then brushed over with a weak solution of size, when this is dry the first coat of oil colour is laid on, not with brushes but with trowels, something in the manner of plastering, when this is dry a second coat follows it, and in this way seven coats of paint are usually applied in succession, three on the back and four on the front When the cloth in this state, and of one colour, is sufficiently dry it is removed from its frame upon a large roller and carried to the upper part of the building to be *printed*, that is, to receive its pattern This was originally effected by a process of stencilling, but in the year 1780 Mr Smith introduced the [illegible] which the colours [illegible] greater body and variety The printing table which is about 30 feet long, [illegible] wide, [illegible] very firmly constructed of deal timber [illegible] and clamped together, the surface being truely planed, the roll of painted cloth is placed underneath it, and as it is unrolled it gradually passes over the table, where it is printed, and is then drawn forward so as to hang perfectly [illegible] the height of the building [illegible] admit of this, without [illegible] doubling or folding the material, which in these stages would of course injure it The colours, which are the usual oil colours very carefully prepared, are put on in succession with wooden blocks, which are made of pear tree, box, or holly wood, and upon which the patterns are cut in relief, they are about eighteen inches square, and are applied in succession over the whole of the surface of the cloth lying upon the printing table Every colour is put on by a separate block and much dexterity is required in so placing them that the patterns may correctly interlace and join each other without in any case overlapping or interfering to effect this the workman is aided by guide pins or *pitches* as they are termed which direct him in placing the block Colours are first brushed or thered upon hard cushions, from which they are transferred to the block, and thence to the cloth and though many are often required it is astonishing how much effect is sometimes obtained by the judicious arrangement or mixture of two only, upon a third, which forms the ground It will be obvious, from what has been stated, that the weight of the finished oil cloth, as compared with the naked canvass, is no unimportant criterion of its goodness, each square yard when finished weighing from three pounds and a half to four or four and a half this distinguishes a good oil cloth from those which are swamped up and stiffened with size and other perishable materials

[illegible] cloth, it is not [illegible] employed as a roofing material especially for covering verandas and other light structures When used for this purpose, the canvass should be made of picked long flax, and thoroughly saturated with good oil paint, it will then stand our climate and last for 14 or 15 years

**FLOOR, FOLDING or FOLDED** In Architecture, one in which the floor boards are so laid that their joints do [illegible] of the [illegible] ore boards each

**FLOOR, STRAIGHT JOINT** In Architecture, one in which the floor boards are so laid that their joints or edges form a continued [illegible] the direction of their length, in opposition to the floor, where the joints end in folds

**FLORA'LIA** A festival celebrated with some magnificence in honour of Flora, the Roman goddess of flowers.

**FLO'RETS** The flowers of a capitulum or anthodium, which are smaller in size but not different in structure from ordinary flowers Those which are placed in the middle of the capitulum are called *discoidal* or *of the disk*, those in the circumference are named *radiant*, or *of the ray*

**FLORIN** *See* MONEY

**FLOS-FERRI** A coralloidal carbonate of lime, often found in veins of spathose *iron* ore

**FLOTA** A name given by the Spaniards to the ships that formerly sailed together, or under convoy, from Cadiz and the other ports of the Peninsula authorized to trade directly with the Transatlantic possessions of Spain

**FLOTILLA** (Span) Literally a little fleet, in which sense however, it is seldom used, being applied almost invariably to a fleet, how large soever, composed of small vessels Thus the term flotilla was given to the immense naval force with which Napoleon meditated the invasion of Great Britain, and which consisted of 2365 vessels of every description, was manned by about 17,000 sailors and carried 160 000 soldiers, and 10,000 horses In Spain the name flotilla is given to a number of vessels appointed to announce to the home government the departure and nature of the cargo of the flota or mercantile ships from foreign ports on their homeward voyage

**FLOTSAM** (floating), *Jetsam* (Fr jeter, *to throw*), and *Lagan* (lying), as law terms are usually joined together The first according to Blackstone, designates goods cast from a ship and swimming in the waves, jetsam [illegible] sinks, but remains attached to a buoy by the owners Goods of either of these two descriptions belong to the king if the owners be not known, and may by him be granted with other franchises

**FLOWERLESS PLANTS** Those plants that are destitute of flowers and sexes They are the same as *cryptogamous* or *acrogenous* or cellular plants

**FLOWERS** The old chemists gave this name to several light flocculent substances obtained by sublimation, such as *flowers of sulphur*, *flowers of benzoes*, &c

**FLUE** In Architecture, the long open tube of a chimney from the fireplace to the top of the shaft for voidance of the smoke

**FLUENT or FLOWING QUANTITY**, in Analysis, is the variable quantity considered as increasing or diminishing It term [illegible] as *integral*, which is now universally used in its stead, the differential and integral calculus having superseded the methods of fluxions and fluents *See* FLUXION, INTEGRAL

**FLUID, or FLUID BODY**, is that whose parts yield to the least pressure and are moved among each other with the [illegible] Some writers distinguish between *fluid* and *liquid* confining the latter term to those substances which *wet*, or whose [illegible] to other bodies plunged into them Thus air, mercury, water, alcohol, &c are all fluids, but water and alcohol are also *liquids*, because they wet other

bodies, while air and mercury do not. The term liquid is, however, very frequently used in the same general sense as fluid. Fluids are of two kinds, elastic and non-elastic. The mechanical properties of elastic fluids, comprehending air and the different gases, constitute the science of *Pneumatics*, those of the non-elastic fluids, water, [illegible] *Hydrostatics* and *Hydraulics*. It is to be remarked, however, that the terms elastic and non-elastic are here used in a relative, not in an absolute sense, for water, alcohol, and probably all other fluids of the same class, are, to a certain extent, compressible and elastic, though they resist compression with a very great force.

FLUIDITY (Lat. fluo *I flow*), is that state of a substance in which its constituent particles are so slightly cohesive that they yield to the smallest impressions. The term is usually confined to express the condition of the non-elastic fluids, and hence it denotes one of the three states in which matter exists, fluid or liquid, and the gaseous. It is best defined as that in which bodies tend to form *drops*, as this disposition does not belong either to bodies in a gaseous form, or to solid bodies reduced to fine powder. The formation of drops arises from this—that the molecules of fluid bodies adhere to each other with a certain force, at the same time that they glide over one another without any sensible resistance. It is incorrect to say that the molecules of bodies in a state of fluidity offer no resistance to separation, for, on bringing a flat disc of [illegible]

That adhesion exists among the molecules of fluid bodies is also proved by various other phenomena. Water or mercury on a flat plate of metal collects in globules, and when slowly poured into a wine glass will remain heaped up as it were above the level of the edge.

Various [illegible]ed by philosophers to explain [illegible] matter is found to exist. Considered [illegible] the most general views we may regard all bodies as assemblages of particles constantly maintained in equilibrium between two forces,—an attractive force which tends to unite the particles, and a repulsive force [illegible] is to increase the distance between them. [illegible] results from the preponderance of the attractive force. Conceive the repulsive force to receive an augmentation until it becomes equal to, or forms an equilibrium with, the attractive force. When the two forces are thus balanced, the particles exert on each other neither attraction nor repulsion, and the body is in the fluid state. Lastly, if the repulsive energy be still increased, the particles will be separated from each other to such distances that their mutual attractions will cease altogether to be sensible, and then the body passes into the gaseous state. Hence we may pronounce that there is no *natural* state of body, and that fluidity, solidity, the state of vapour, and the aeriform state are only accidental and determined by the temperature of the medium in which the body is placed. *See* CRYSTALLIZATION, CAPILLARY ATTRACTION, GAS, &c.

FLUKE. A name commonly applied to a species of flat fish, or *Pleuronectes*, and also to an *Entozoon* of a similar form (*Distoma hepaticum*) which infests the ducts of the liver of different animals, especially of the sheep.

*Fluke* is also applied in navigation to the broad part of the anchor which takes hold of the ground.

FLUOBO'RIC ACID. A gas obtained by heating to redness a mixture of dry boracic acid and powdered fluor spar. Its specific gravity is 2·36. It is colourless, pungent, and produces a dense white cloud when it escapes into a moist atmosphere, it is resolved by the action of water into boracic and hydro-fluoric acids. It acts with great energy upon animal and vegetable substances, and chars them. It is probably a compound of 20 parts of boron and 108 of fluorine, or of one atom of boron and six atoms of fluorine.

FLUO'RIC ACID. *See* HYDROFLUORIC ACID.

FLU'ORINE. The hypothetical base of the hydrofluoric acid. It has not yet been obtained in a separate state.

FLU'OR SPAR. This is a common mineral product, found in great beauty in Derbyshire, hence known in this country under the name of the *Derbyshire spar*. It is generally crystallized in cubes, but its primitive form is an octahedron. It is of various colours, and often beautifully banded, especially when in nodules, which are much prized for the manufacture of vases, and occasionally used for beads, brooch stones, and other ornamental purposes. It is probably a compound of fluorine and calcium, hence a *fluoride of calcium*. The term *fluor* is derived from the fusibility of this substance, on which account it is sometimes used as a flux to promote the fusion of certain refractory minerals. It is manufactured at Matlock and Derby [illegible] of articles.

FLUOSILICIC ACID. A gas obtained by applying a gentle heat to a mixture of one part of powdered fluor spar, one of silica, and two of sulphuric acid, in a retort. It is colourless, pungent, fumes when it escapes into a humid air, and is rapidly absorbed by water. Its specific gravity is about 3·6, 100 cubic inches weighing nearly 112 grains. It [illegible] water and forms silica and hydrofluoric acid. It consists of 8 parts by weight of silicium, and 18 of fluorine, its equivalent (upon the hydrogen scale) being 26.

FLUSH (Lat. fluxus). In Architecture, the continued surface in the same plane of two contiguous masses.

FLUTE (Fr.). A wooden musical wind instrument played by holes and keys, stopped and opened with the fingers. The lips and tongue are both used in playing it. The octave flute is a smaller but similar instrument, whose pitch is an octave higher than the flute, as its name implies.

FLUTES, or FLUTINGS (Fr.). In Architecture, upright channels or the shafts of columns usually ending hemispherically at top and bottom. Their plan or horizontal section is sometimes circular or segmental, and sometimes, as in the Grecian examples elliptical. The Doric column has twenty round its circumference, the Ionic, Corinthian, and Composite twenty-four. The Tuscan column is never fluted. They are occasionally *cabled*. (See that word.)

FLUVIALES (Lat. fluvius *a river*). A natural order of Endogenous water plants common in all extra-tropical countries [illegible] to flowerless plants. Pollini [illegible] De Candolle, asserts that spiral vessels do exist in them, while Amici urges the contrary. Agardh refers to this order both *Ceratophyllum* and *Sparganium*, but those genera are nearer allied to *Juncaginaceæ*. Their sensible properties are unimportant. *Zostera*, or sea wrack, one of the genera, is used to stuff cushions, and as a material for packing.

FLUX (Lat. fluo, *I flow*). Applied in technical chemistry to substances which are in themselves very fusible, or which promote the fusion of other bodies. When tartar is deflagrated with half its weight of nitre, a mixture of charcoal and carbonate of potash remains, which is often called *black flux*; when an equal weight of nitre is used, the whole of the charcoal is burned off, and carbonate of potassa remains, which when thus procured is called *white flux*. For flux and reflux of the sea, *see* TIDES.

FLUX. In Pathology, a disease attended by inordinate secretion from the bowels.

FLUXION (Lat. fluxus, *flow*), in Analysis, signifies the same thing as differential, the term being suggested by a particular view of the manner in which variable quantities increase or diminish. Newton considered a curve as generated by the uniform motion of a point, and decomposed at every instant the constant velocity of this point into two others, one parallel to the axis of the abscissa, and the other parallel to the axis of the ordinates. These velocities are what he called the *fluxions* of the co-ordinates, while the arbitrary velocity of the point which describes the curve is the fluxion of the arc. Reciprocally, the arc described is called the *fluent* of the velocity with which it is described by the moving point; the corresponding abscissa is the fluent of the velocity estimated in the direction of the abscissa, and the ordinate the fluent of the velocity of the point estimated in the direction of the ordinate. The same considerations may be extended to the areas bounded by curve lines, to surfaces, and the volumes which they determine, to forces which give rise to motion in bodies, and to the effects which they produce. In fact, the theory is applicable to every thing which forms the object of the mathematical or physico-mathematical sciences.

The method of fluxions is derived naturally from that of *prime* and *ultimate ratios*, for the variable velocity of a point is not the path described by it in a given time divided by this time, but it is the prime or ultimate ratio of that quotient, that is to say, the quantity to which that quotient approaches more and more in proportion as the time is supposed to be shorter. This observation has occasioned an objection to the method of fluxions—namely, that of introducing into geometry, which is a branch of the pure mathematics, the idea of velocity, which belongs to the mixed mathematics, and of defining an idea which ought to be simple by one that is complex. The objection is frivolous, the only question of any consequence being whether the theory is more easily apprehended by this manner of exposition than by any other.

In [illegible] the method of fluxions to mathematical [illegible] the procedure is precisely the same as in the differential calculus, from which indeed, it differs in no respect save that of notation. The method was invented by Newton, and the notation which he used was adopted by all English writers, and long obstinately adhered to, although the notation of Leibnitz, the inventor of the differential calculus, possesses over it many advantages, particularly in the more abstruse theories of analysis. At length, however, the great number of excellent works which appeared on the Continent, in all of which the differential notation was used, the manifest advantage of uniformity in the symbols employed in sci-

entific researches, and the intrinsic superiority of the foreign notation, caused that of fluxions to be gradually abandoned and at the present time it has entirely disappeared in all mathematical works possessing any claim to merit [illegible] in our language, in which [illegible] employed to [illegible] *Edinburgh Encyclopædia* [illegible]

FLY In Mechanics, a piece [illegible] for the purpose of equalizing the [illegible] as in the windlass, jack, pile-engine &c , and sometimes for collecting force in order to produce a very great instantaneous [illegible] it is formed [illegible] axis, sometimes of heavy knobs at the extremities of a bar having the same position The fly is of great use in all cases where the power, or the resistance, acts unequally in the different parts of a revolution

FLY-CATCHER *See* MUSCICAPA

FLYING BUTTRESS In Gothic Architecture, a buttress in the form of an arch, springing from a solid mass of masonry and abutting against the springing of another arch which rises from the upper points of abutment of the first It is seen in most of our cathedrals, and its office is to act as a counterpoise against the vaulting of the nave If flying buttresses were built solid from the ground, it is obvious that they would interfere with the vista along the aisles of the church, hence the project of continuing a resistance by means of arches Their stability depends on the resistance afforded by the weight of the vertical buttress from whence they spring See the diagram, art GOTHIC ARCHITECTURE AFTER THE 12TH CENTURY

FLYING FISH The species of two distinct genera of fish, in which the pectoral fins are so developed as to enable them to sustain themselves for a short time in the air, are so called The more common species are the Exocœte (*Exocœtus volitans*), and the flying gurnard (*Dactylopter a volitans*)

FLY POWDER An imperfect oxide of arsenic, formed by the exposure of native arsenic to the air, when mixed with sugar and water it is used to kill flies

FO The name given by the Chinese to Buddha, by one of those phenomena in literature whereby appellations are introduced from one language into others with which it has little or no affinity Originally the name Buddha was expressed in the Chinese language with sufficient exactness by the term Fo-thau pronounced Foudah, but as is usual in China with proper names, the last syllable was subsequently dropped According to the Chinese historians, the religion of Buddha was introduced into China in the reign of Ming-ti, of the dynasty of the Hans, about the 64th year of the Christian era, but there is good reason to believe that the doctrines of the Indian reformer had been carried thither by some of his enthusiastic adherents long before that period, and that it is only to their official recognition by the government that this later date refers This is not the place to give an exposition of the religious and philosophic principles of Fo (*see* BUDDHISM) suffice it to say that the same principles are adopted by all the Buddhists of the various countries where they are professed with the exception of a few trifling deviations which the various translations of the Buddhist writings from their original Sanscrit have naturally generated It is only when these writings or at all events the chief of them, shall have been translated into the languages of Europe (which we have good grounds to suppose will soon be the case), that an accurate idea can be formed of the doctrines which they inculcate and which have exercised so mighty an influence on the largest portion of the inhabitants of Asia (See the *Penny Cyclopædia*)

FO'CAL DISTANCE (Lat focus *a hearth*) In Optics, the distance between the centre of a lens or mirror, and the point into which the rays are collected

FO'CUS, in Geometry, is applied to certain points belonging to the conic sections, which possess very remarkable properties The focus of the parabola is a point in the axis having this property, that a radius drawn from it to any point in the curve makes the same angle with the tangent at that point that the tangent makes with the axis Hence a ray of light proceeding from the focus, and reflected by the curve, proceeds in a direction parallel to the axis, or, if parallel rays fall on the concave side of a parabola, they are reflected into the focus In the ellipse the two foci are situated in the greater axis, at equal distances from the centre, and if from both foci straight lines be drawn to the same point in the circumference, the two lines make equal angles with the tangent at that point A ray of light, therefore, issuing from the one focus, is reflected by the curve into the other focus In the hyperbola a similar property [illegible], that whereas in the ellipse [illegible] both on the concave side of the [illegible] falls on the concave and the other on the convex, in other words, the two lines drawn from the foci to any point in the hyperbola make equal angles with the tangent on opposite sides of it A ray of light, therefore, proceeding from one focus of a hyperbola will be reflected by any point of the curve into the direction of a ray coming from the other focus and passing through that point In the solar system, the sun occupies one of the foci of the orbits of all the planets and comets

[illegible] Since the [illegible] rays of light are [illegible] of the apparent diameter of the sun's disc, the solar rays cannot be collected into a single point, even if we could [illegible], and its magnitude has the same relation to the apparent diameter of the sun, as the image of any other object formed in the focus of the lens or mirror has to the object itself Let A C be any [illegible] proceeding from the centre of the [illegible] and B C another proceeding from its border, then the angle L C M is equal to the apparent semidiameter of the sun, that is 16′, and if we make the focal distance L C $= f$, we have the semidiameter of the focus L M $= f$ tan 16′ But the tangent of 16′ is very nearly $= \frac{1}{216}$, therefore the semidiameter of the focal circle is very nearly the 216th part of the focal distance Hence we derive a rule for finding the intensity of the heat in the focus of a burning glass, since all the rays which fall on the glass are collected within the focal circle, the intensity of the heat in that circle is to the intensity of the heat falling on the glass in the ratio of the area of the glass to that of the focal circle But circles are to each other as the squares of their diameters, whence, calling the diameter of the [illegible] on it to be represented [illegible] or heat within the focal circle is $d^2$ divided by $(\frac{1}{108})^2 f^2$, or it is directly proportional to the square of the diameter of the glass, and inversely to the square of the focal distance. For a spherical lens, convex on both sides the diameter of the focal circle is one-eighth of the thickness of the lens, but though it cannot be less than this quantity in imperfect glasses it will considerably exceed it See LENS




FODDER (Germ futter) In Agriculture, the food given to quadrupeds, which consists of the stems and leaves of plants, such as the culmiferous stems of the grasses, the haulm of legumes potatoes, &c , or in short, whatever is given as the ordinary food is designated fodder, whereas corn, beans, and other articles, which present nourishment in a more concentrated form, are not included under the term fodder, but rather known as solid food

FODDER is the name of a weight formerly used in the weighing of lead it was of various magnitudes, but most commonly amounted to about 2400 lbs

FOE'TUS (Lat feo, *I bring forth*) From about the fifth month after pregnancy till the period of its birth, the child in the womb of its mother is termed a *fœtus*

FOG (Dan fog) In Meteorology, a dense vapour near the surface of the land or water Fogs, in general, are the consequence of the nocturnal cooling of the atmosphere The air, by its rapid cooling, becomes surcharged with moisture, a part of which, being precipitated in the form of a cloud, gives rise to the ordinary fog During the day the heat of the sun generally disperses the fog, because the quantity of moisture which the air is capable of holding becomes more considerable in proportion as its temperature is increased

In calm weather the surfaces of rivers, lakes, &c are frequently in the morning covered with fog The reason is this During the night the air is colder than the water, the strata of air in contact with the water are consequently heated and become saturated with moisture The mixture of the vapour with the air, together with its elevation of temperature, renders the air specifically lighter It rises in consequence, and mixing with the cold air in the superior strata is cooled and precipitates its moisture The cloud or fog resulting from this precipitation can only rise to a small height, because the uniformity of temperature is soon restored Hence it is easy to see how [illegible] in the air, prevent the formation [illegible] of the surface of water In the [illegible] cons[illegible] Lima is often covered with a fog half the year, especially in the mornings and evenings, and that along the whole of that coast fogs supply the place of rain, which is extremely rare In the polar seas thick fogs often prevail, even during the warmest months, and they are so dense that objects frequently cannot be distinguished at the distance of a few yards

Sometimes, though rarely, fogs occur of which the cause is not very well understood In 1783, the whole of

Europe was covered with a dense fog during nearly two months On the 22d of May, 1822 about 5 o'clock in the afternoon, a fog covered Paris and the neighbourhood, which had the odour of nitrous gas it continued about an hour Dry fogs, or those in which no moisture is pre- [illegible] are supposed to be the vapours and ashes ejected by [illegible] the atmosphere by the winds

FOIL (Fr [illegible] or Lat folium, *a leaf*) This term is generally applied to varnished metal Common foil is [illegible] the process is follows — A copper plate, covered with a thin layer of silver is rolled out into sheets under the flatting mill the silver surface is then highly polished or covered with a colourless varnish The *coloured foils* are similarly prepared with coloured varnishes

FOLD (Sax fealde) A temporary enclosure for keeping cattle or other agricultural animals together, either for the purpose of protection during night, or [illegible] Sometimes, also sheep [illegible] manuring The barrier of which folds are constructed is commonly wooden hurdles, but sometimes, when the fold is only to contain ewes and lambs, netting stretched between posts is made use of, there being a strong rope fixed to the lower parts of the posts close to the ground to which the under edge of the netting is attached, while its upper edge is attached to a rope stretched along the tops of the same posts The [illegible] naked fallows, with a view to [illegible] mon in several parts of England, but the more improved sheep farmers consider that it deteriorates the wool, and impedes the fattening of the sheep, by keeping them for the greater part of every night wholly without food

FOLD In Painting the doubling or lapping of one piece of drapery over another

FO'LIAGE (Lat foliatus, *leaved*) In Architecture and Sculpture, a group of leaves of plants and flowers so arranged as to form architectural or sculptural ornaments, as in friezes, panels, and also in the capital of the Corinthian order

FO'LIATE, in the doctrine of curve lines is the name given to a curve of the third order, defined by the equation $x^3 + y^3 = axy$ It is one of the species of defective hyperbolas having one asymptote and two infinite branches, and its figure has some resemblance to a leaf, whence the name (See *Newton's Enumeratio Linearum Tertii Ordinis*)

FO'LIA'TION The manner in which the nascent leaves are [illegible] within a leaf bud

FOLIO (Lat *a leaf*) In Account books signifies page Thus folio 7, — written abridgedly fo 7 — denotes the seventh page, Folio recto or Fo Ro, signifies the first page, Folio verso, or Fo Vo the second page of a leaf A book in folio, or simply a folio is that where the sheet is only folded in two each leaf making half a sheet

FOLI'OLUM A leaflet borne upon the axis of a leaf

FO'LKMOTE, among our Saxon ancestors signified any popular or public meeting of all the folk or people of a place or district, for instance of all the tenants at a court leet or court baron, or of all the freemen of the county, or of all the barons of the kingdom Antiquaries are, however, by no means agreed as to the nature of the folkmote, some considering it an institution of great others of minor importance (See *Somner's [illegible] Saxon Dictionary, Brady's Introduction to Old English History, Fabian's Chronicles*, and *Wilkins's Leges [illegible] Saxon*)

FOLLICULUS A one-celled one or many seeded one-valved superior fruit, dehiscent by a suture along its face and bearing its seeds at the base or on each margin of the suture, differing from the legumen in having but one valve instead of two

This term has also other significations, viz 1 According to Linnæus, any kind of capsule 2. The cases bearing the reproductive organs of *Equisetaceæ* 3 According to Gartner, a double, one celled, one valved, membranous, coriaceous capsule [illegible] and either bearing the seed on each [illegible] or on a receptacle common to both margins, as *Asclepias*, &c 4 According to Willdenow, any oblong pericarpium bursting longitudinally on one side, and filled with seeds as *Vinca*

FO'MALHAUT A star of the first magnitude in Piscis Australis

FOMENTA'TION Local bathing with hot water, or medicated decoctions

FONT (Lat *fons*) In Architecture and Sculpture, a vessel generally of stone or marble for containing the water of baptism in the Christian church Some of the early fonts are extremely beautiful, and wrought with extraordinary [illegible] The [illegible] scription which [illegible] [illegible] [illegible] NIXON ANOMEMATA MH MONAN OYIN which reads equally forwards or backwards, admonishing the reader to cleanse himself from evil deeds not less than use the [illegible] v of baptism

FONTANEL The interstice, or *mould*, as it is often called, which exists at birth between the frontal and parietal bones it is closed by bony matter about the end of the third year

FOOD All substances susceptible of digestion and assimilation may come under the denomination of *food*; but the proximate principles of organic bodies on which their nutritive powers depend are comparatively few Hence, although the articles employed in different countries for the support of animal life are almost infinitely various, their sustaining powers may be referred to certain substances capable of being separated and indentified by chemical analysis and tests [illegible] elements of vegetable food gluten [illegible], starch, gum, sugar, and lignin or woody fibre, are by far the most important, and amongst those of animal food albumen, gelatin, and their modifications together with fats and oils, which are common to both kingdoms of [illegible]

[illegible] the actual simplicity of our food as compared with [illegible] complexity, it may suffice [illegible] st all the esculent grains consist principally of starch and gluten, that the same ingredients are found in many fruits and roots, that sugar gum or a relation of gum which is called vegetable jelly together with minute traces of aromatic principles which give flavour, and more or less abundance of water, and of vegetable acids, are the chief component parts of apples pears, peaches, currants, gooseberries and all analogous tribes of fruits, a very few also contain oil When as regards *animal* food, the muscular fibres of various animals closely resemble each other in composition and nutritive power in some cases texture merely and in others minute additions of foreign matters confer upon them their relative digestibilities, and their different aspects and flavours albumen or fibrine and gelatin small proportions of saline bodies, and a large quantity of water are found in them all

It often happens that the truly nutritious part of food is so combined with or protected by indigestible matters, as to escape the solvent powers of the stomach unless previously prepared and modified by various chemical and mechanical agents Indurated woody fibre, for instance or *lignin* as chemists call it will often resist the joint action of the stomach and bowels and pass through the alimentary canal with scarcely any alteration The husks of many seeds and fruits are composed almost exclusively of this material This is the case with the kernels of the apple, pear, &c, the seeds of the currant, gooseberry melon and so on, the skin or husk of peas, beans &c and of wheat barley and oats so that unless this woody part is either broken down by the teeth or previously removed the food which it envelopes is protected from the solvent action of the secretions of the stomach This is in some respects a wise and curious provision in nature, for birds in this way become the carriers of seeds which pass through them not only undigested but even retaining their vegetative powers and in this way uninhabited and sterile portions of the globe may gradually become clothed with verdure, and shrubs and trees Bones are highly nutritive, but unless broken into very small fragments by the masticatory powers of the animals which eat them, they too would elude digestion In reference, however to the food of man much of its digestibility and nutritious power is referable to the important chemical operations preparatory to its use which are carried on in the kitchen in other words cookery is essentially a chemical art, and substances totally unfit in their raw state for reception into the stomach are rendered palatable, digestible and nutritious by the skill of the cook And here salt and a variety of *condiments*, as they are called and which are aromatic and stimulant substances chiefly of vegetable origin play an important part, nor must the mere effect of heat be overlooked, for it is most important Meat by boiling and roasting, is not only softened in its fibre, but new substances are generated in it Among these a peculiar extractive matter and *osmazome* or the prin- [illegible] which vegetables suffer under the influence of heat less obvious

There is another important point in the history of our food, namely, its *ultimate composition* We have spoken of starch, sugar, gum, albumen, and other substances, as the *proximate* principles upon which we live, but what is the *ultimate* constitution of these secondary products what are their true *elements*? It is curious that four *elements* only are principally concerned in the production of our food These are carbon, hydrogen, oxygen, and nitrogen Among vegetable substances gluten (including vegetable albumen) is the only one which abounds in nitrogen, gum, sugar, starch, and the rest are constituted of carbon, hydrogen, and oxygen only, and what is very remarkable is, that in all these important principles, and also in lignin, the oxygen and hydrogen bear to each other the same relative proportions as in water, so that they may be figuratively described as compounds of *charcoal* and *water* Now there are two

very curious points in reference to that part of the chemical history of our food which has been adverted to the one is, that no animal can subsist for any length of time upon food which is destitute of nitrogen, and the other, that a certain mixture of different kinds of food is absolutely essential An animal fed *exclusively* on starch, or sugar, or albumen, or jelly, soon begins to suffer in health, peculiar diseases make their appearance, and his existence is painful and brief, but mix these together, and occasionally modify their proportions, and he then thrives and fattens Magendie's experiments on this subject [illegible] those of Tiedemann and Gmelin, well [illegible] Thus, geese fed upon gum died on the 16th day, those fed upon starch on the 24th, and those fed on boiled white of egg on the 46th in all these [illegible] and died as if of starvation

[illegible] will do much in accustoming the stomach to particular descriptions of food, many persons live exclusively, or almost so, on vegetable, others on animal matters, and particular kinds of diet are forced on the inhabitants of many regions of the globe, but as far as we are concerned, a due mixture of vegetable and animal matter is not only most palatable, but most conducive to health Nothing is fit for food which has not already undergone organization, and *water*, though an essential part of the food of all animals is obviously not in itself nutritious, though it performs the extremely important function of dissolving nutritive matter, so as to render it conveyable by the lacteals and other absorbents into the blood No compound then of nitrogen hydrogen carbon, and oxygen, which can be formed artificially, can constitute food Air, water and charcoal, though involving the *elements* of our nutriment, are themselves unfit for our support, and it is only by passing through the hidden processes which are carried on in the vessels of living things that they are so recombined and modified as to be rendered capable of supporting animal life It is the vegetable world which commences this wonderful operation Plants absorb their nutriment from the air and from the soil, they assimilate inorganic as well as organic matter, they become the food of the [illegible] tribes and from these man derives the greater [illegible] of his animal food

In speaking of the composition of food that of *milk*, the most important of all food must not be forgotten, in it nature has wonderfully provided a mixture which though secreted by an animal partakes also of the nature of vegetable food and it presents a perfect analogy to that combination of vegetable and animal matter which has been mentioned as most congenial to the palate and stomach The albumen or *curd* of milk is a highly elaborated animal principle, abounding in nitrogen yet from its attenuated and soluble state, easy of digestion A second principle of milk is what is termed *sugar of milk*, in composition and properties it resembles a vegetable product and is intermediate between gum and sugar The third component of milk is *butter* partaking of the nature of vegetable oil and animal fat, there are certain saline and acid substances in small proportion, and all these matters are either dissolved or suspended in a large relative proportion of water

I Table showing the average quantity of nutritive matter in 1000 parts of several varieties of animal and vegetable food

| | | | | | |
|---|---|---|---|---|---|
| Blood | 215 | Wheat | 950 | Apples | 170 |
| Beef | 260 | Rice | 880 | Gooseberries | 190 |
| Veal | 250 | Barley | 920 | Cherries | 250 |
| Mutton | 290 | Rye | 792 | Plums | 290 |
| Pork | 240 | Oats | 712 | Apricots | 260 |
| Bram | 200 | Potatoes | 260 | Peaches | 200 |
| Chicken | 270 | Carrots | 98 | Grapes | 270 |
| Cod | 210 | Turnips | 42 | Melon | 30 |
| Haddock | 180 | Cabbage | 73 | Cucumber | 25 |
| Sole | 210 | Beet root | 148 | Tamarind | 310 |
| Bones | 510 | Strawberries | 100 | Almonds | 650 |
| Milk | 72 | Pears | 160 | Morels | 896 |
| White of egg | 110 | | | | |

The above table represents the relative proportion of solid digestible matter contained in 1000 parts of the different articles of food which are enumerated When blood, for instance, is evaporated to dryness at a temperature not exceeding 212°, the residue amounts to 215 parts in 1000, and may be regarded as almost entirely composed of digestible matters, it consists of albumen and colouring matter with small proportions of saline substances The different kinds of meat were dried in the same way The loss of weight during their desiccation is almost wholly referable to water, and the dry residue composed of albumen or fibrine, with some gelatine, and perhaps traces of fat and of saline matters, represents the true nutritive value Upon an average, therefore, the nutritive matter in a pound of meat is not more than four ounces This however [illegible] for raw meat, for when dressed a considerable [illegible] constituent water is often dissipated The nutritive matter of wheat is chiefly starch and gluten, and in this species of grain the gluten is in much greater relative proportion to the starch than in barley, oats, or rye In rice there is little else than starch There can be little doubt that the great value of wheat as an article of food depends upon this excess of gluten, which is a nitrogenous substance, and has not inaptly been termed the vegeto-animal principle In the esculent roots, such as carrots, &c, but especially turnips, sugar is the leading nutritive matter, and the common fruits contain sugar, gum, albuminous matter, and acids, together with a highly attenuated form of woody fibre, or lignin, which, in that state, is probably digestible

The following table shows the ultimate composition of those proximate principles which have been above adverted to as constituting the nutritive part of food —

II Table showing the ultimate elementary composition of 1000 parts of the following proximate principles of animal and vegetable food

| | Carbon | Hydrogen | Oxygen | Nitrogen |
|---|---|---|---|---|
| Albumen | 516 | 76 | 258 | 150 |
| Gelatin | 483 | 80 | 276 | 161 |
| Fat | 780 | 122 | 98 | |
| Curd of milk | 609 | 73 | 116 | 203 |
| Sugar of milk | 404 | 61 | 485 | |
| Gluten | 557 | 78 | 220 | 145 |
| Starch | 438 | 62 | 500 | |
| Gum | 419 | 68 | 513 | |
| Sugar | 444 | 62 | 494 | |
| Lignin | 500 | 56 | 444 | |

FOOLS, FEAST OF A festival anciently celebrated in almost every church and monastery of France on New Year's Day in which every absurdity and even indecency was practised It was equivalent to the Saturnalia among the Romans, whence indeed it is said to be derived This festival received some modifications in the different districts where it was celebrated, and acquired [illegible] the multifarious ceremo[illegible] Thus it was termed la fete des diacres souls des cornards, des innocents," &c Several bishops and councils attempted, though in vain to abolish this festival, but at length about the 15th century it became less generally observed and soon after [illegible] its characteristic absur[illegible] in the Carnival of the present times For full details on the Feast of Fools see the *Encyclopedie des Gens du Monde*, under the head Fous (Fete [illegible] the authorities there referred to

FOOL'S PARSLEY An umbelliferous plant common in waste ground and so called from its resembling parsley enough in appearance to deceive ignorant persons It is a poisonous [illegible] like hemlock upon the human system, and [illegible] involucels having each three leaflets, which are always placed next the circumference of the umbel It is the *Æthusa cynapium* of botanists

FOOT (Germ fuss) A measure of length As this term is employed in almost all languages as a linear measure, it has doubtless been derived from the length of the human foot Though the denomination is the same, the measure itself varies considerably in different European countries In all of them however it is divided, like the English foot, into twelve equal parts or inches *See* MEASURES

FOOT In Prosody, a measure consisting of two, three or four syllables long, short or long and short All the combinations of which these numbers are susceptible amount to twenty eight, and such is accordingly the number of feet enumerated by Greek and Latin prosodists, according to the following table —

| | |
|---|---|
| ⏑ ⏑ Pyrrhich | – ⏑ – ⏑ Ditrochæus |
| – – Spondee | ⏑ – ⏑ – Diambus |
| – ⏑ Trochee | – ⏑ ⏑ – Choriambus |
| ⏑ – Iamb | ⏑ – – ⏑ Antispastus |
| ⏑ ⏑ ⏑ Tribrachys | ⏑ ⏑ – – Ionicus a minore |
| – – – Molossus | – – ⏑ ⏑ Ionicus a majore |
| – ⏑ ⏑ Dactylus | – ⏑ ⏑ ⏑ Paon primus |
| ⏑ ⏑ – Anapæst | ⏑ – ⏑ ⏑ Pæon secundus |
| ⏑ – ⏑ Amphibrachys | ⏑ ⏑ – ⏑ Paon tertius |
| – ⏑ – Amphimacer | ⏑ ⏑ ⏑ – Pæon quartus |
| ⏑ – – Bachæus | ⏑ – – – Epitritus 1 |
| – – ⏑ Palimbachæus | – ⏑ – – Epitritus 2 |
| ⏑ ⏑ ⏑ ⏑ Proceleusmaticus | – – ⏑ – Epitritus 3 |
| – – – – Dispondeus | – – – ⏑ Epitritus 4 |

But by rejecting those which are merely reduplications of disyllabic feet (Proceleusmaticus, Dispondeus, Ditrochæus, and Diiambus), the number is reduced to twenty-four, and by also striking off those which are compounds of disyllabic feet (Choriambus, Antispastus, two Ionics, four Paons, and four Epitrites), the number of simple feet becomes twelve only *See* RHYTHM

FOOTINGS In Architecture, the spreading courses at the base or foundation of a wall

FORAGE in Military affairs, signifies the provisions brought by the troops into the camp for the sustenance of the army &c during a campaign

FORAMEN (Lat foro, *I pierce*) In Anatomy, a

small opening The *foramen ovale* is an opening between the two auricles of the heart of the fœtus, which closes at birth

FORA'MEN In Botany, the opening that exists in the [illegible] of every ovulum

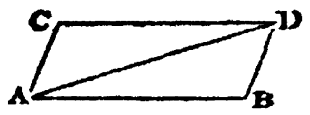
FORAMINIFERS, *Foraminifera* (Lat foramen, fero, *I bear*) A name applied by D Orbigny to a tribe of minute shells which he believed to be formed by Cephalopods, they are now proved to belong to a lower-organised class of animals See SYMPLECTOMERA

FORCE In Mechanics, is that which produces motion or a change of motion Forces may be of different kinds, but they are all compared and measured by the quantities of motion which they respectively produce in a given time in fact we know nothing whatever of forces except through their effects

In order to determine what will be the effect of a force upon any given mass of matter, three circumstances respecting the force are necessary to be known; namely, its intensity, the place where it acts or its point of application, and its direction Its intensity is proportional to the space through which a unit of mass is moved in the direction of the line, when the time in which the space described is proportional to the velocity (supposed uniform), if the mass remains constant a double force will produce a double velocity, and if the velocity is constant a double mass must be urged by a double force Hence the force of the body is proportional to the mass and to the velocity conjointly Thus let $m$ and $m'$ be two masses, or the quantities of matter in two bodies, and $v$ and $v'$ be the velocities with which they respectively move in consequence of the two forces whose intensities are $f$ and $f'$, then $f$ is proportional to $m\,v$, and $f'$ to $m'\,v'$

When a body is acted upon by more forces than one it is obvious that it will not move in the direction or with the velocity due to one of the forces alone, but in a direction and with a velocity due to their collective influence The effect produced by the joint action of the several forces is called their *resultant*, and it is determined both in magnitude and direction by the following theorem celebrated under the name of the *Composition of Force* — If the lines which each of two forces acting singly would have caused a body to describe in a given time make any angle whatsoever with one another, the line which the body will describe in that time when both the forces act upon it [illegible] of the parallelogram [illegible]

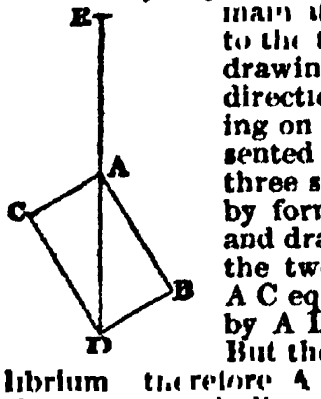
Thus, let a body at A be acted upon by two forces at the same instant, one of which, if acting alone would cause it to move over the line A B in a given time, and the other acting alone would cause it to move over the line A C in the same time, then the direction of the motion resulting from the action of both forces will be that of the diagonal A D of the parallelogram A B D C, and at the end of the given time the body will be found at D The theorem may be derived [illegible] velocity of the body in one of the directions produced by the force impelling it in the other, but of this principle it is not easy to give a satisfactory demonstration, without introducing considerations drawn from the resources of the higher mathematics (See *Poisson, Mecanique* tome i)




It is obvious that by means of this theorem the resultant of [illegible] for all the [illegible] may conceive them to be removed and their resultant substituted, when the resultant of this and the third force will be the resultant of three of the forces This last resultant may then be combined with a fourth force and so on till the whole of the forces have been included This construction is called the polygon of forces

As the forces represented by the straight lines A B and A C are *compounded* into a single force, represented in intensity and direction by A D so any given force may be *resolved* into two others such that the straight lines by which they are represented form the two sides of a parallelogram of which the line representing the given force is the diagonal This composition and resolution of forces is of constant application in Mechanics

If a body impelled at the same time by three forces remain at rest these forces are proportional to the three sides of a triangle formed by drawing straight lines parallel to their directions For, let the three forces acting on the point A be respectively represented in intensity and direction by the three straight lines A B, A C, A E, then by forming the parallelogram A B D C, and drawing the diagonal A D we have the two forces represented by A B and A C equal to the single force represented by A D and [illegible] A D But the point A is by hypothesis in equilibrium therefore A D must be equal to A E, and in the same straight line with it, whence, since B D is equal to A C, the three forces by which the point A is kept in equilibrium are respectively proportional to the three sides A B, B D, and [illegible] A B D




Let the three forces be respectively denoted by P, Q, and R then, the sides of a triangle being proportional to the sines of the opposite angles,

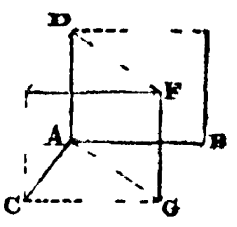
$$P \;\; Q \;\; R \;\; \sin A D B \;\; \sin D A B \;\; \sin A B D$$

But by reason of the parallel lines the angle A D B is equal to D A C, and A B D being the supplement of C A B their sines are equal, whence

$$P \;\; Q \;\; R \;\; \sin D A C \;\; \sin D A B \;\; \sin C A B$$

From this we infer that if a point A be kept in equilibrium by the action of three forces P, Q, and R, each of these forces is proportional to the [illegible] and the sine of the angle between the directions of the other two It is a consequence of this proposition that if three forces be in equilibrium they must all act in the same plane, and any two of them must be greater than the third

The resultant of three forces X, Y, Z, applied to the same point A [illegible] and [illegible] represented in magnitude and direction by the straight lines A B A C A D is represented by A F, the diagonal of the parallelepipedon, of which the sides are A B, A C, and A D For the two forces X and Y, which are represented by A B and A C, the two sides of the parallelogram A B G C will have for their resultant a force P, represented by A G, the diagonal of this parallelogram And because A D is equal and parallel to G F the figure A D F G is a parallelogram, and consequently the two forces P and Z, represented by A G and A D, will have for their resultant a force R represented by the parallelogram A D F G, which is the parallelepipedon




From this theorem it follows that any force whatever R can always be decomposed into three others, X, Y, Z, respectively parallel to three straight lines given in space provided that no two of them be parallel, and if each of the three given lines be at right angles to the plane of the other two and the angles which A F (the direction of the given force R) makes respectively with A B A C, A D (the directions of the forces X, Y, Z) be denoted by $a$, $b$, $c$, we have then, evidently,

$$X = R \cos a,\quad Y = R \cos b,\quad Z = R \cos c,$$

the three angles $a$, $b$, $c$, being connected by the relation

$$\cos^2 a + \cos^2 b + \cos^2 c = 1$$

In those investigations in mechanics where a number of forces are concerned, it is usual to resolve them all into three forces parallel to three rectangular co ordinates, when the resultant of the three sets of rectangular forces will evidently be the common resultant of all the forces If P P′ P″, P‴, &c be the forces, $a$, $a'$, $a''$, $a'''$ &c the angles which they make with one of the three axes, $b$, $b'$, $b''$, $b'''$, &c the angles which they make with another of the axes, and $c$, $c'$, $c''$ $c'''$, &c the angles which they make with the third, and X, Y, Z [illegible] which are the sums of the [illegible] forces, P P′, P″, P‴, &c, then,

$$X = P \cos a + P' \cos a' + P'' \cos a'' + P''' \cos a''' + \&c$$
$$Y = P \cos b + P' \cos b' + P'' \cos b'' + P''' \cos b''' + \&c$$
$$Z = P \cos c + P' \cos c' + P'' \cos c'' + P''' \cos c''' + \&c$$

As the three forces X, Y, Z are not situated in the same plane, and can therefore never be in equilibrium so long as any one of them has a real value, in order that the body may remain at rest under the action of all the given forces P, P′, P″ P‴, &c, it is necessary that the three conditions be fulfilled, namely, $X = 0$, $Y = 0$, $Z = 0$

Forces have different denominations according to the manner in which they act, thus we have *Accelerating Forces*, *Central Forces*, *Parallel Forces*, *Uniform* and *Variable Forces*, &c See ACCELERATION, CENTRAL FORCE, PRESSURE &c

*Accelerating Force* — An accelerating force is that which continues to act upon a body after it has been put in motion, whence the body moves with a variable velocity, and, when the action of the force is constant, receives equal [illegible] of velocity in equal intervals of time We have a familiar example of an accelerating force of this kind in terrestrial gravity under the influence of which heavy bodies dropped from a [illegible] ground with a constantly accelerated velocity

When a body is urged by an accelerating force, the relations between the force, the velocity, the space passed over, and the time, are expressed by three equations, which are called the equations of motion, and may be investigated as follows —

Let $t$ denote the time from the commencement of the motion $v$ the velocity acquired at the end of the time $t$, and $a$ the space described by the moving body During

produces the best wool and is consequently most celebrated for the works of its looms In England it is principally found in the Western districts

KETCH [illegible], An old English term, applied to a vessel equipped with two masts, and from 100 to 200 tons burden It was nearly synonymous with the modern term *yacht*, being used chiefly by ambassadors [illegible] on the English coast, or passages in voyages from one place to another, and was furnished with all the appa- [illegible] aggression

KETCHUP [illegible], which exudes from salted mushrooms

KEUPER [illegible] by the German geologists to the upper [illegible] new red sandstone formation

KEY (Sax cæze) In Architecture, a piece of wood let into the back of another in the contrary direction of the grain, to preserve the last free of warping

KEY, or KEY NOTE In Music, the principal or fundamental note in a composition, on which frequent closes or cadences are made It is that in which the piece begins and usually ends, and is, as it were, the musical subject to which regard must be had in all the other combinations of sounds in the composition, and under whose influence they are

KEY-BOARD In Music, the series of levers in a keyed instrument, as a piano-forte, organ, or harpsichord, upon which the fingers press to produce percussion of the strings, or in the organ the opening of valves It consists of short black and long white keys

KEYSTONE The middle voussoir in the arch of a bridge, or the arch-stone in the crown or immediately over the centre of the arch The length of the keystone, or thickness of the archivolt at top is allowed to be about 1-15th or 1-16th of the span by the best architects

KHALIFF *See* CALIPH

KHAN In Persia properly speaking, the title of an officer or governor added after his name The sovereigns of many independent states of northern Asia are styled Khans Khan is frequently used by our own countrymen to signify in Eastern caravansera (which see), in which travellers find a gratuitous lodging, provided their stay be limited to a single night

KHOH A Persian word signifying *bald* and used as a prefix in many geographical terms It has been suggested that the name Caucasus has been derived from Khoh Kasp or *bald mountain*, the having the summit without vegetation But be this as it may it is singular enough that the same metaphorical expression has been introduced into two modern languages, the French and the German, in the former of which is found *Chauvont* and in the latter *Kahlenberg* both indicative of a mountain *bald* or without vegetation

KHOTBAH (Arab), denotes a peculiar form of prayer, used in Mohammedan countries at the commencement of public worship in the great mosques on Friday at noon It was originally performed by the Prophet himself and by his successors till the time of Mohammed VIII (A D 936), who appointed special ministers for the purpose, on which footing it has continued to the present time The khotbah is chiefly a 'confession of faith' and a general petition for success to the Mohammedan religion It is divided into two distinct parts, between which the officiating khatib or priest makes a considerable pause, and is regarded by the Mussulmans as the most solemn and important part of their worship The insertion of his name in this prayer has always been considered one of the chief prerogatives of the sultan of Turkey

KIDNAPPING In Law, the forcible abduction of any one from his own country into another It is an offence at common law By the 11 & 12 W 3 c 7 pe- [illegible] common in those days, of carrying away by force or fraud labouring persons to serve in the plantations in America This clause is repealed by 9 G 4 c 31 by which masters of [illegible] of their [illegible] back if [illegible] away from [illegible] lawful custody of them popularly [illegible] is felony under the same statute

KIDNEYS The organs in which the urine is secreted there is one on each side in the loins, near the first lumbar vertebra, and behind the peritonæum The pelvis of the kidney terminates in the ureter, and is divided into several portions called *calyces*, into each of which a papilla projects, through the minute orifices of which the secreted urine passes [illegible] called the pelvis, and thence by the ureter into the bladder

KILLAS A provincial term, applied to the clay-slate rocks of Cornwall

KILLINITE A mineral sometimes described as a variety of spodumene, from Killiney, near Dublin It is a hydrated silicate of alumina, containing potash and oxide of iron

KILN A term applied to various furnaces and stoves as *brick* and *lime kilns* and *hop* and *malt kilns* (See

KILO [illegible] A French measure of weight, equal to 2 lbs. 3 oz 5 drs avoirdupois

KILT A loose dress, extending from the belly to the knee in the form of a petticoat, worn in the Highlands by men, and by children [illegible] Islands The [illegible] reason, [illegible] of that Gaelic [illegible] the plaid the *philabeg* This singular national dress is fast hastening into disuse; and but for a few Highland regiments in which it is still maintained, it would probably long ere now have been universally superseded by the dress of the Lowlanders

KING A title of dignity in the languages extinct and living, of the Gothic and Teutonic races The term has long been considered of uncertain origin, but there can be little doubt that it is derived from the German word konnen, *to be able*, thus in the very threshold giving an idea of superior power or ability In its primary acceptation it denotes a person in whom is vested the chief executive authority [illegible] a variety of shades of [illegible] tions to be governed [illegible] to the limited sovereign of France, the sovereign of Prussia, to the chief [illegible] in former times, who was *elected* [illegible] and who succeeds by *hereditary* right, to the head of a savage tribe or barbarous horde, as well as to that of the most refined and civilized nation It is expressed in Greek by the word Basileus, and in Latin and its cognate languages by Rex, but all the nations of Europe have adopted into their respective languages the equivalent terms in use among the people with whom they carry on intercourse Thus we speak of the Shah of Persia, the Grand Sultan, the Pasha of Egypt the Dey of Algiers, &c

In countries where the kingly office is hereditary some form has always been gone through on the accession of a new king in which there is a recognition on the part of the people of his right, a claim from them that he should pledge himself to the performance of certain duties, and generally a religious ceremony performed, in which investing him with oil, by which a certain sacredness is thrown around his person, and placing a crown upon his head as a symbol of supremacy, are conspicuous acts, the whole solemnity thus performed being styled the coronation In modern Europe the Pope and the Emperor of Germany assumed as a joint prerogative the right of conferring the dignity of king Frederic I of Prussia was the first sovereign who assumed the title, and had it acknowledged by the other states of Europe without their authorization

KING The sacred books of the Chinese contain at once the principles of their domestic and public morality and the foundation of their historical traditions According to a learned dissertation by M Freret, in vol xv of the *Memoires de l'Ac des Inscr et Belles Lettres*, the original books known properly under this title are only [illegible] The first four contain the writings of Confucius (See also vols xxxvi xxxviii, and *Lesch and Gruber's Encyclopedia*)

KING AT ARMS An officer of heraldry and form [illegible] whose business is to preside over [illegible] and direct in matters of heraldry The [illegible] there are three kings at arms in England—Garter, Clarencieux, and Norroy, the first of whom is styled *principal king at arms* and the two latter *provincial kings*, because their duties are confined to the provinces The name Clarencieux is said to be derived from Clarence, brother of Henry V, first king at arms for the south of England, that of Norroy (Norman French for *northern king*) is self-explanatory There is also a Lyon king at arms for Scotland as well as an Ulster king at arms for Ireland, whose duties are nearly analogous to those of England (See *Noble* [illegible] *Office of Arms*)

KING, THE, OF ENGLAND exercises the supreme [illegible] legislative [illegible] (For his [illegible] PARLIAMENT) The right to the [illegible] was extended to Great Britain and [illegible] subject to the authority of parliament to limit the succession This was last done by the stat 12 & 13 W 3, when it was fixed in the heirs of the electress Sophia of Hanover, being Protestants The duties of the king according to the constitu- [illegible] the coronation oath, fixed by stat 1 W & M [illegible] and prerogatives are legal exceptions in favour of the crown where its claims clash with those of a subject, relating to such matters as descents of land, debts, &c The direct prerogatives of the crown are those which attach to his person in respect of his political authority such as the sanctity of his person,

his prerogatives as head of the executive, the power of making war and peace, treaties with foreign powers, military and naval command, the supreme dispensation of justice through his courts, the power of erecting and disposing of offices and honours, the power of issuing proclamations binding on the subject in certain cases, with the advice of his privy council, and, lastly, the supreme government of the national church The king's revenue [illegible] The ordinary [illegible] s subsisted in the crown time out of mind [illegible] exist [illegible] f the supplies annually granted by parliament *See* PARLIAMENT, PREROGATIVE

KING CRAB *See* LIMULUS

KING FISH A name sometimes applied to the *opah* (*Lampris guttatus* Retz )

KING POST In Architecture, the middle post of an assemblage of trussed framing, for supporting or hanging the tie beam at the middle from the lower end of the straining

KING'S BENCH COURT OF in Law, originated in the ancient Aula Regia, in which the king was accustomed (as he still is supposed in the King's Bench by fiction of law) to sit in person, and which followed him in all his progresses The judges of the court of King's Bench, as well as of the other superior courts, formerly varied in number according to the royal discretion At a later period they were reduced to four, now increased, by stat 1 W 4 c 70, to five—the chief justice, who is the highest common law judge, and four *puisné* or *younger* judges The court of King's Bench, besides those branches of its jurisdiction which it has in common with the other two superior common law courts (*see* COURTS, SUPERIOR), has also peculiar authority, or presents more advantages in some particular proceedings

It is the preferable although not the only tribunal for discharging prisoners under the Habeas Corpus Acts It has controul over all inferior courts by means of the process called *certiorari* which is a writ sued out of this [illegible] may be removed [illegible] he her in criminal or civil cases It has also an exclusive authority (except in a few cases) to compel all inferior courts and officers, and in some instances private persons to perform acts of a public nature, and connected with a public duty By means of a *prohibition* it can restrain all other courts from proceeding where they exceed or misuse their jurisdiction there is likewise a writ directed to the judge and the plaintiff in the inferior court A writ of error in law from all [illegible] with certain exceptions, returnable [illegible] This court likewise hears and determines cases stated by courts of sessions The greater proportion of these are questions on the validity of poor's rates, or on parochial settlements When a court of sessions entertains a doubt on a point of law arising in the argument, it will usually authorize the party against which it decides to have the judgment thus reviewed the case is stated [illegible] The criminal jurisdiction of the King's Bench [illegible] It has, according to law, cognizance of every species of criminal offence committed in Middlesex, and in practice misdemeanors, as conspiracies or perjuries, committed in the county, are still indicted in this court and tried after term at nisi prius among the civil causes [illegible] one special application [illegible] [illegible], which [illegible] proceeding which supersedes the necessity of an indictment found by a grand jury An information is filed either by the attorney general *ex officio*, as it is termed, — a proceeding generally adopted in certain misdemeanors of a public nature, or at the suit of a private party, by leave of the court

An information in the nature of a *quo warranto* is in form a criminal, but substantially a civil proceeding It is granted where any subject or body politic has usurped a franchise or privilege not being legally entitled, and to the injury of some other party or the public Any indictment, presentment, &c found in any part of England, may be moved by *certiorari* into this court, as may be also all convictions or orders of justices of the peace, unless where such appeal is prevented by particular statutes

KING'S EVIL Scrofula attacking the glands, respecting which a superstitious notion long existed that it [illegible] of royalty

KINGSTON [illegible] sometimes given to the angel fish [illegible] Dumb ) *See* SQUATINA

KING'S YELLOW A pigment, the basis of which is [illegible] arsenic

KINO ACID [illegible] th which quinia and cinchonia are combined in yellow and pale Peruvian bark Its ultimate elements are, according to Lubig, 15 atoms of carbon 9 of hydrogen, and 9 of oxygen

KINKAJOU The native name of a Plantigrade quadruped of South America, of arboreal habits, with a long prehensile tail, a short muzzle, and a thick coat of woolly hair It forms the type of the genus *Potos* of Cuvier, which name [illegible] to *Cercoleptes* Only one species is well established the *Cercoleptes caudivolvulus* of Illiger

KINO An Indian word, applied to an astringent vegetable extract, the source of which is doubtful, it is probably a [illegible] plants in [illegible] America The finest kino is in brilliant fragments of a deep brownish red colour, and highly astringent It contains tannin, gum, and extractive matter

KIOSK A Turkish word signifying a kind of open pavilion or summer house, supported by pillars These ornaments have of late years been introduced to a considerable extent into [illegible]

KIRK (Germ [illegible] with church, and used chiefly to designate the form of religion established in that country *See* PRESBYTERIANISM

KIRK SESSION The lowest ecclesiastical court of the kirk of Scotland It is composed of the minister of the parish, and of lay elders It takes cognizance of cases of scandal of the poor's fund and of matters of general ecclesiastical discipline There is an appeal from its decisions to the presbytery

KIRSCHWASSER (Germ *cherry water*) An alcoholic liquor, obtained by fermenting the small and sweet black cherry The liquor produced is distilled, and often flavoured with hydrocyanic acid, derived from the bruised kernels of the fruit this gives to kirschwasser, when sweetened the character of noyau

KIT CAT CLUB The name of a celebrated association instituted about 1688 by "some young men of wit and pleasure about town" originally for convivial purposes, but as its most distinguished members were Whigs in politics it gradually assumed a political character, till in the reign of Queen Anne it came to be regarded as exclusively political in its objects At that period it comprised above forty noblemen and gentlemen of the first rank and quality merit and fortune, firm friends to the Hanoverian succession, among whom were Addison Steele Marlborough Walpole, &c &c It was originally formed in Shire Lane and derived its name from one Christopher (Kit) Kat, who supplied the members with mutton pies The fame of this club has been transmitted chiefly by the collection of the portraits of the members painted by Sir Godfrey Kneller, himself a member, who was obliged to invent a new sized canvass accommodated to the height of walls, whence has originated the application of the epithet *kit cat* to any portrait about three quarters in length It was dissolved in the year 1720 (*Quart Rev* vol xxvi )

KITE A well known toy, first employed by Romas in France, and Dr Franklin in America to elevate a conductor into a thunder-cloud whereby the identity of lightning with the electric spark was ascertained It is formed of a slender frame of wood and pack-thread, rounded at one end and terminating in a point at the other resembling in some measure a cross-bow, and covered with paper A long string is attached to the frame, near its centre of gravity by which it is held in the hand In order that the kite may be capable of being raised, it is necessary that its flat surface be presented obliquely to the direction of the wind, a string or *tail* carrying some light substance, is therefore attached to the shorter end of the frame and serves by means of its gravity to maintain the proper inclination The force of the wind, impinging obliquely on the surface, is resolved into two parts, one perpendicular and the other parallel to the surface the first of these parts is counterbalanced by the tension of the string held in the hand, and the second is expended in elevating the kite The position in which the wind acts with the greatest effect is when the perpendicular to the surface is inclined to the direction of the wind (that is, to the horizon) in an angle of about 54½ degrees

KITE The native bird so called is a species of the genus *Milvus* separated by Bechstein from the genus *Falco* of Linnæus on account of the forked tail, length of wings, and the short and weak beak and feet in proportion to the size of the body This deterioration of their destructive instruments renders the kite the most cowardly of the birds of prey The common kite, or glead (*Milvus vulgaris*), preys chiefly on the smaller quadrupeds and birds young chickens, &c , yet the courage of the mother hen renders her more than a match for the robber, and she generally repels his attacks on his favourite prey The female lays two or three eggs of a whitish colour, spotted with pale yellow, and of a roundish form

The term *kite* is applied in some places, as Devonshire and Cornwall, to the brill [illegible]

KIWI-KIWI The native [illegible] New Zealanders for their singular bird the *Apteryx australis* *See* APTERYX

KNEE (Sax, cneo ) In Architecture, a naturally or artificially bent piece of timber, on which another is received to relieve a weight or strain

KNEE PAN A small flat heart shaped bone placed

at the fore part of the knee joint It is an important defence to that large joint, and also serves to increase the powers of the muscles which extend the leg It is attached by [illegible] end of the tibia

KNIGHT-ERRANT, [illegible] age of Chivalry, a knight wandering in search of adventures sometimes under vows, for a certain period Knight errantry was not altogether a fiction of romance It originated, as Mr Turner says, partly from the frequency of private war in feudal times, which made military aid constantly acceptable to [illegible] knight had, for the most part, [illegible] his duties towards his feudal [illegible] to follow his own [illegible] Such [illegible] men of that age, and in some degree served the exigencies of society "Knights, therefore, were perpetually errant, or travelling in quest of adventures or employment some from the pleasure of the expedition, and some for its expected profits They often [illegible] unsuccessful, and they cheerfully undertook to redress those wrongs which laws were too feeble to remedy or afford redress for which either plunder or rich [illegible] (*Turner's History of England*, book vi ch xiii)

KNIGHTHOOD The word knight is undoubtedly derived in its first origin from the root 'to knit," or connect, from whence also the German knecht *slave* or *servant* The Anglo Saxon cniht bore the same meaning, and this etymology points to the primitive meaning of the institution of knighthood This may be found in the usage recorded by Tacitus and other writers of the ancient Germans among whom the kings and chiefs were attended in war and peace by a select body of faithful companions Kings and great thanes and aldermen had each among the Anglo-Saxons their attendant cnights or military servants, who owed them a species of fealty rather personal than territorial But the order of knighthood, in the more recent sense of the word was introduced among us from France Among the French and Germans, indeed, the order of knights was [illegible] another name—*chevalier* or *ritter*, from their [illegible] on horseback in battle, and holding a rank above the footmen But the Norman chevalier so completely answered to the Saxon cniht in the peculiar attribute of being personally attached to the military service of some chieftain, that the English appellation was soon in general use as it to express the same meaning conveyed by the French title and by its Latin equivalent miles The Saxons appear, indeed, to have occasionally practised long before the Conquest some ceremonies resembling those which became usual in later times on the creation of a knight thus Alfred is said to have honoured Athelstan by the gift of a belt and robe, and girding him with a sword

Like most other enquiries into the ancient usages of Europe, that into the origin of knighthood as an order — that is, the period when the term miles or chevalier instead of merely denoting the higher class of military companions of a chief, came to signify one enjoying a definite rank in society and admitted by certain ceremonies, — is altogether inconclusive It is said in general that knighthood had become an established institution in the 11th century, but that the characteristic which belonged to it in later times that of being restricted to men of noble birth did not become general until the fourteenth The privilege of conferring knighthood seems to have belonged originally to the sovereign, and to have been retained [illegible] all European constitutions, although [illegible] to or usurped by high feudatories, generals of armies, &c, although in later times and when [illegible] romantic character [illegible] knights were allowed [illegible] sought for the distinction of knighthood at their hands It was a prerogative of high value and importance, and we frequently find the states and other authorities in feudal sovereignties interfering to limit its exercise especially before usage had absolutely restricted it to those of noble birth

It was common to create knights on various occasions The most honourable species of [illegible] conferred on the field and after a battle [illegible] common fashion, especially in France, the parent country of chivalrous institutions was to make knights when a battle was expected Five hundred were created at once in the French army before the battle of Agincourt Some inconvenience attended this practice For example on one occasion in Flanders, in the 14th century when two armies were ranged in battle order, on the eve of engagement, the French, according to their usual practice, created a great number of knights but on the following morning the forces separated without coming to action A hare having been seen crossing the space between the armies, the French knights made on that occasion received the nickname of Chevaliers du Lièvre Knights were also created on other solemn occasions, as great festivals coronations, princely marriages, &c

In describing the ordinances of knighthood as they existed when that institution was brought to the point of imaginary perfection, the period to which we must refer is the 14th century, and the countries chiefly France, [illegible] and Spain, and generally [illegible] the chivalrous customs of the first-named regions were imitated, but do not appear to have grown up spontaneously as part of the popular usages Before this epoch, indeed, the Crusades had communicated to the institution much of its religious character, and the poems of the Troubadours and Trouveurs attest how much of gallantry had already been fancifully interwoven with the military habits of the age But it was not, perhaps until the epoch alluded to, when the favourite fictions of romance had begun to act strongly on the popular imagination, that the ideal usages of chivalry were completely engrafted in practice on the substantial [illegible]

The orders of chivalry were [illegible] was first educated, in general, as a page attached to the family, and especially to the ladies of some noble house when of full age, he became a squire (écuyer) The proper office of the squire, in the theory of chivalry, was, as his name of "shield bearer" denotes, to attend on the person of a knight, to whom he was bound to render devoted and faithful service In this capacity he was a sort of apprentice to knighthood, but as many esquires never reached the order of knighthood at all, but remained independent the rank of esquire, in ordinary usage, became an intervening order between the knight and the simple gentleman in which sense it is still retained in England The order of knighthood followed this double probation Knights however were often made without having passed regularly through the intervening stages, and even in the age of chivalry, the honour was occasionally conferred on mere children, although this was an evident abuse and regarded as such When the order of knighthood was conferred with full solemnity in the leisure of a court or city in peace preliminary ceremonies were required of the candidate He prepared himself by prayer and fasting watched his arms all night in a chapel and was then admitted with the performance of religious rites Knighthood was conferred by the *accolade*, which, from the derivation of the name should appear to have been originally an embrace, but afterwards consisted as it still does, in a blow of the flat of a sword on the neck of the kneeling candidate The oath of [illegible] previously administered, which contained [illegible] times various fanciful clauses in France there were twenty vows comprised in it (See on this subject among many other authorities, the *Memoirs on Chivalry* of the French antiquary Sainte-Palaye)

Knighthood was an institution which served in some respects as a compensation for the inequalities of rank incident to the feudal system All knights, from the king to the lowest bachelor were brethren of the same order, and when chivalry was in its most flourishing state, it may almost be said that they were all of the same country National distinctions had little place between knights, who were only enemies in time of warfare from their feudal duties, which attached them to the banner of a particular king or suzerain At tournaments, court festivals, &c, in time of peace, knights of all nations were admitted indifferently, and the candidate for knighthood sought that honour at the hands of the [illegible] name in chivalry rather than of a [illegible] chief distinction of rank which subsisted between knights, in France and England, was rather of a feudal than a chivalrous character, it was that of knights-bachelors and knights bannerets The knight-bachelor was of the lower order His name has been variously derived It is by some considered as a corruption of 'bas-chevalier,' but others deduce the name from the barbarous Latin word 'baccalare" said to signify a small fief such as was originally considered as entitling its possessor to the honour of knighthood But in the more chivalrous times (as in all later periods) this honour was conferred without any reference to a qualification of property Many knights-bachelors were in fact mere adventurers, unconnected by feudal ties of any sort, who offered their services in war to any successful leader, and who found in their sword a means of subsistence not only by pay and plunder but by the regularly established system of ransom which every knight taken in action paid for his liberty The "chevalier-banneret' was one who possessed fiefs to a greater amount, was obliged to serve in war with a greater attendance, and carried a banner Under Charles VII the bannerets of France made remonstrances against the services required of them, on the ground of their impoverishment by the English wars, and it appears that this order fell afterwards into disuse in that country In England the distinction appears to have been of a somewhat different character The "knights' fees," into which England was divided by the Conqueror, were such portions of land as could maintain a simple knight or

bachelor, and by a statute of Edward II persons who had the amount of 20*l* a year in fee, or for life, were obliged to take this order of knighthood This statute grew into disuse, except when occasionally put in force, as it was for the last time under Charles I, as a means of extorting money, by way of fines, for not taking up the order Bannerets, on the other hand, in England, appear to have been such knights as were made or promoted from [illegible] the field of battle (*See* BANNERET) [illegible] in the field between the different orders of chivalry was, at least at one period, the following —The esquire bore the *pennoncel* or triangular streamer, the knight-bachelor the *pennon* or forked streamer [illegible] de by dividing the end of the penn [illegible] a banner (which was, in strict usage, of an oblong shape, barons being entitled to the square banner) Thus, when a banneret was made on the field the ceremony was accomplished by cutting off the forked end of his pennon and converting it into a banner Common knights and esquires were then under his command

The confinement of the order of knighthood to men of noble birth (on the Continent for the strict line of demarcation between nobility and commonalty was never accurately drawn in England), although necessary in theory to the completion of the chivalric system tended in practice to its decay Knighthood after the 14th century, became more and more an honorary distinction, to which birth alone gave a title, and which was not considered to represent any actual duty or service, and finally, through various steps, it became again a mere personal distinction which it was part of the sovereign's prerogative to confer, either to military persons or any others, and by the multiplication of orders, into which nobility of birth was not always a necessary qualification for admission, this peculiar property of the knightly order became again effaced There are however in most Continental countries, several orders into which nobility still constitutes a necessary title for admission

*Orders of knighthood* are of two classes either they are associations or fraternities possessing property and rights of their own as independent bodies into which knights are admitted as members into a religious foundation, or they are merely honorary associations, established by sovereigns within their respective dominions, consisting of members whose only common tie is the possession of the same titular distinction To the former class belonged the three celebrated religious orders founded during the Crusades — Templars Hospitallers, and Teutonic Knights, which were societies, not belonging to any particular crown or realm, pos- [illegible] respects [illegible] Several of the Spanish and Portuguese orders of knighthood partake of both characters they were originally religious, but have become secular The kings of those countries, as grand masters, exercise the privilege of admission and make use of it as a means of conferring distinction, but the knights, as a body form an independent society possessed of property and privileges (*See* ORDERS of CALATRAVA, ALCANTARA &c) The other class, consisting of orders merely titular, embraces most of the European orders, including all those of our own country These were probably founded in imitation of the great military societies [illegible] ans have traced real or imaginary [illegible] under the reigns of princes of much more remote date as Charles Martel, Charlemagne, &c But [illegible] and no subsisting order [illegible] the Crusades, except a few of those in Spain and Portugal, which, as we have said, were framed on the model of the great societies first mentioned (See as to foreign orders of k[illegible] the work of Carlisle, 1839)

KNIGHT OF THE SHIRE, is the designation given to the representative in parliament of English counties at large, as distinguished from such cities and towns as are counties of themselves (which are seldom if ever called shires), and the representatives of which, as well as the members for other cities and towns, are called citizens or burgesses It was formerly imperative on knights of the shire, as well as their choosers, either to be resident or to have a household in the county, but this regulation, which had long fallen into disuse, was formally repealed by 14 Geo 3 c 58

KNIGHT SERVICE *Servitium Militare* The tenure by which a knight held his land *See* FEUDAL SYSTEM

KNIGHT'S FEE, *Feodum Militare* In the language of English feudal usage, a portion of land held by custom sufficient to [illegible] such for the king W[illegible] ry grants is said to have created 60,000 such fees But although William's vassals were undoubtedly bound to follow him to war, it is doubted by modern antiquarians whether feudal services, strictly so called, were attached to these grants by the Conqueror, or whether they were not peculiarities arising subsequently when the feudal system grew into vigour and attributed to the Conqueror by the [illegible]

KNOLL A [illegible] used in many parts of England for the [illegible] of a small hill or to the hill itself

KNOPPERN A [illegible] gall-nut or excrescence formed by the puncture of an insect upon several kinds of oak They are flat, hard, and prickly they abound in Croatia, Styria, Sclavonia, and Natolia, and are used in Austria and Germany for tanning and dyeing

KNOT *See* LOG

KNOUT, THE An instrument used in the infliction of a well-known Russian punishment The following description is by a writer in the *New Monthly Magazine* for 1830 (vol xxviii p 128) — "The handle may be two [illegible] less, to which is fastened a flat [illegible] the length of the handle, terminating with a large copper or brass ring, to this ring is affixed a strip of hide about two inches broad at the ring, and terminating at the end of two feet, in a point This is soaked in milk, and dried in the sun to make it harder, and should it fall in the culprit on the edge, it would cut like a [illegible] At every such stroke the tail is changed In the hands of a stranger it would be a most innocent weapon, nor could I after a quarter of an hour's practice, make any considerable impression on the snow, while the executioner will leave a pretty fair mark on a deal plank" Notwithstanding the assertion of Dr Granville to the contrary (*Travels to St Petersburgh* ii 451), there is no doubt of the excessive severity of the punishment

KOA'LA The native name of a Marsupial quadruped of New Holland (*See* PHASCOLARCTUS) The Mahrattas apply the same name to the jackal

KO'BOLD A German word [illegible] spirit, or spectre and corresponding to the [illegible] which it is probably the origin In [illegible] Germany there is scarcely a house or a family to which kobolds are not said to be attached, notions of the peasantr operations, many of which they perform The name of the metal *cobalt* is derived from the above

KOLPO'DES, *Kolpoda* (Gr *κολπωδης, sinuous*) The name of a genus of Polygastric Infusories, characterized by their flat and sinuous figure

KO'RAN *See* ALCORAN

KOSSACKS *See* COSSACKS

KOU'MISS or KUMISS A vinous liquid obtained in Tartary by fermenting the whey of mares milk

KO'UPHOLITE (From [illegible] A species of zeolite or [illegible] occurs in small rhomboidal plates, of a pearly lustre, and of a yellowish or green colour

KRAAL The name given to the villages of the Hottentots

KRA'KEN A name applied in the fabulous epoch of zoology to a marine monster of gigantic size

KRAMERIA'CEÆ (Krameria one of the genera), is a small natural order of plants [illegible] and chiefly remarkable for the [illegible] of their roots, one of the species furnishing the rhatany or rhatuhia root of the druggists a substance notoriously used in the adulteration of port wine

KRAMI'RIC ACID An acid obtained from the root of the *Krameria triandria*, or rhatany

KRI'OSOTE *See* CREOSOTE

KRY'OLITE (Gr *κρυος, ice*, and *λιθος, a stone*) A hydrated fluate of alumina and soda When heated it suddenly fuses, hence its name

KRY'STALLINE A term applied by Unverdorben to a salifiable base which forms crystallizable compounds with the acids, and which he obtains from animal empyreumatic oil

KU'FIC An epithet [illegible] racters, from Kufa, a tow[illegible]

KU'PFERNICKEL (Germ) An ore of nickel of [illegible]

KU'PFERSCHIEFER (Germ *copper slate*) A term applied by G[illegible] rocks at the base [illegible] Thuringia they are impregnated with copper, and abound in fossil remains of fishes These rocks appear to correspond to the marl slate of Durham and Northumberland

KY'ANITE (Gr *κυανος, blue*) A mineral which [illegible] and occasionally massive, [illegible] of Haüy and the *sapphire* of some other [illegible] *See* CYANITE

KYRIOLO'GICAL, or CYRIOLOGICAL (Gr. *κυριος, proper*, *λογος, discourse*) A term applied by Warburton, in his *Divine Legation* (book iv s 4), to that class of Egyptian hieroglyphics in which a part is conventionally put to represent a [illegible] a pair of armed hands for a battle, a scal[illegible] a siege, &c, distinguished from the *tropical*, in which visible objects are used as emblems, or figuratively *See* HIEROGLYPHICS

# L.

L The first of those letters in the English and most other alphabets called liquids or semivowels, because, like vowels, they can be pronounced for any length of time, which is not the case with the consonants called mutes, as *p*, *d*, &c It is derived from the Greek lambda, or the Hebrew or Phœnician lamed, and is found in the languages of almost all nations, excepting those of some Brazilian and Japanese tribes In the ancient Greek Hebrew, Phœnician, Celtic, and Latin languages, and in those derived from them, the letter L consists invariably [illegible] ugh in every possible shape and com- [illegible] the most ancient Greek alphabets it is written ⋀ ⋁ ⋀ in the Etruscan ≻, in the Celtic ≺ ⋁, in Hebrew ל, and in Latin L (For the interchanges which this letter has undergone, see the *Penny Cyclo*) L, as an abbreviature, stands for Lucius, L L D Doctor of Laws and L L S for a sestertium As a numeral, L re- [illegible] ancients, as at present, the number [illegible] to the line—

Quinquies L denos numero designat habendos

L A In Music the syllable by which Guido denoted the last sound in the hexachord

LA'BADISTS, or LA'BBADISTS A sect of religious enthusiasts in the 17th century, so called from Jean Labadie, a native of France domiciled in Holland, who was deposed from his preachership by the synod of Dort They endeavoured to introduce among Protestants similar notions to those of the Quietists in the Roman Catholic church (see that word), and were accused of similar perversities in practice (See *Mosheim*, translated 1790 v 511)

LABARRA'QUE'S DISINFECTING LIQUID A solution of carbonate of soda impregnated with chlorine

LA'BARUM The standard of Constantine which he caused to be formed in commemoration of the vision of the cross in the heavens It is described as a long pike surmounted by a golden crown inclosing a monogram which contains the two first letters of the name of Christ and is at the same time a representation of the figure of the cross Ancient monuments exhibit the figure under two forms, ☧ or ☩ (*sc* χ ρ) The silken banner which depended from it was embroidered with the figure of Constantine and his family The labarum is engraved on some of his medals with the famous inscription,

IN TOTTΩI NIKA,

and it was preserved for a considerable time and brought forward at the head of the armies of the emperor on important occasions, as the palladium or safeguard of the empire The origin of the word is still undecided (See Beugnot, *Hist de la Des* [illegible] *I* 57, Milman *Hist* [illegible]

LA'BDANUM, or [illegible] *Cystus Creticus*

LA'BEL In Heraldry a figure chiefly used by way of distinction or difference in the coat armour of an eldest son during the life of the father, in which case it has three points, five points when borne by the heir presumptive of [illegible] living, and so forth

LABELLUM (Lat) A term given to the lower lip of a labiate corolla It is usually differently formed from the other divisions of the corolla, and in the natural order *Orchidaceæ* assumes various [illegible] appearances

LA'BIALS (Lat [illegible] The letters B P V F, M, are so called, on account of the organ chiefly employed in their pronunciation

LA'BIATÆ, or LAMIACEÆ A natural order of Monopetalous Exogenous plants, consisting of many hundred species inhabiting the more temperate regions of the earth A two lipped monopetalous corolla, an irregular number of stamens, and a four-lobed ovary, are the essential marks by which it is known from all others [illegible] with square stems, [illegible] rubs The flowers are all colours but pure blue is uncommon in the order Many of the species are valued for their fragrance, as lavender and thyme, others for their stimulating qualities, as mint and peppermint, some as aromatics, as sage, basil, and marjoram, while a few are regarded as febrifuges Numerous species are objects of great beauty, on which account the order is well known in gardens Among the most ornamental are various kinds [illegible] dracocephalum

[illegible] *a lip*), in Entomology is a moveable organ, often bifurcate which, terminating [illegible] rs the mouth from beneath, and

[illegible] a place properly constructed and fitted up for the purpose of carrying on chemical investigations Those who are about to fit up a chemical laboratory will do well to consult the first section of *Mr Faraday's Chemical Manipulation*

LA'BOUR (Lat labor) In Naval language, the action of a ship in a heavy sea when she jerks or is *uneasy*

LA'BOUR *See* POLITICAL ECONOMY.

LA'BOURED In the Fine Arts, a term applied to works of art wherein are apparent the marks of constraint in the execution, and used in opposition to the term *easy* or *free*

LA'BRADORITE Labrador spar A beautiful variety of opalescent felspar from the coast of Labrador it exhibits brilliant and mutable tints of blue, red, green, and yellow and is susceptible of a good polish It is cut into small slabs, and employed in ornamental jewellery It is a silicate of alumina, lime, and soda, with traces of oxide of iron

LA'BRAX (Lat) A genus o Percoid fishes, dismembered by Cuvier from the Linnæan *Perca* on account of certain modifications of the gill-covers and tongue, the differences being that the opercula of the *Labrax* terminates in two spines and the tongue, instead of [illegible]

[illegible] LABRIDÆ [illegible] The Bream tribe A family [illegible] genus *Labrus* as the type [illegible] be recognized by their oblong scaly body, a single dorsal fin supported in front by spines, each of which is generally furnished with membranous appendages the jaws are covered with fleshy lips, and the pharyngeal bones are armed with numerous and strong teeth, disposed like a pavement

[illegible] Entomology is the usually [illegible] with [illegible] th lace anteriorly, covers the mouth from above, and represents the upper lip

LA'BRUS (Lat labrum, *a lip*) A genus of spiny-finned fishes in the system of Cuvier, so called on account of their well developed double fleshy lips The fishes of this genus are termed "breams," and are further characterized by their conical maxillary teeth, of which the middle and anterior are the longest, and by their cylindrical and obtuse pharyngeal teeth, which are arranged like a pavement,—the upper ones on two large plates, the lower ones on a single one, which correspond with the two others

LABYRINTH (Gr λαβυρινθος) Literally a place, usually subterraneous full of inextricable windings Ancient history gives an account of four celebrated labyrinths the Cretan, Egyptian Lemnian, and Italian The first was built by Dædalus at [illegible] of Minos to secure the Minotaur, the [illegible] said to have been constructed by Psammetichus, king of Egypt, the third was on the island of [illegible] by columns of great beauty, [illegible] by Porsenna king of Etruria, as a tomb for himself and his successors Of these labyrinths the Cretan is most celebrated in the historical and mythological writings of antiquity, but the Egyptian was by far the most important both in extent and magnificence The latter, which was built on the isle of Meroe, was a vast edifice, composed of twelve palaces, all contained within the compass of one wall and communicating with each other It had only one entrance, but the innumerable turnings and windings of the terraces and rooms of which it consisted rendered it impossible for those who had once entered within its walls to get out without a guide It is said to have been designed either as a burial-place for the Egyptian kings or for the preservation of the sacred crocodiles, the chief objects of Egyptian idolatry It was partly demolished between the reigns of Augustus and Titus but even at the period of Pliny's visit, its ruins were magnificent [illegible] xxxv) *Pococke's History of the East* (vol i [illegible] *Journey through the Levant* (p 381), contain a plan and description of the modern state of this labyrinth With regard to the labyrinth of Crete, no doubt can now remain, after the statements of Cockerell and Tournefort that its existence was a reality, and not merely a fabulous creation of the Grecian imagination According to these travellers, the island of Crete abounds even at the present day in extensive caverns one of which, consisting principally of many long windings and narrow passages that can only be safely explored by means of a clue, exhibits a wonderful similarity in all essential particulars to the famous labyrinth of Dædalus It is impossible, at this distant period, to pronounce with certainty on so difficult a question, but the substantial coincidences that exist between the ancient and modern labyrinths seem to leave little doubt as to their identity (See *Geo Dict* art "Crete")

LA'BYRINTH In Metallurgy, a series of troughs attached to a stamping mill, through which a current of water passes for the purpose of washing away the suspended pulverized ore and subsequently depositing it at different distances, depending upon its state of comminution

LA'BYRINTH [illegible] ernal parts of [illegible] assuages *See* EAR

LABYRINTHODON (Gr λαβυρινθος, and οδους, *a tooth*) The name of an extinct genus of Reptiles, probably of the Batrachian order, characterised by teeth of a peculiarly complicated structure, the outer coat of enamel being inflected in complex wavy folds into the body of the tooth, and alternating with corresponding wavy plates of dentine, which give the [illegible] labyrinth to the transverse section of t[illegible] Remains of the reptiles of this genus peculiarly characterise the Keuper formation of Germany, and the corresponding [illegible] as that of Warwick in England

LAC [illegible] flows from the *Ficus indica*, the *Rhamnus jujuba*, and some other trees, in the form of a [illegible] a [illegible] f [illegible] in its natural state, investing the small twigs of the tree, *seed lac*, which is the same, broken off the twigs, and which when melted and formed into thin cakes constitutes *shell lac* These varieties of lac have been examined by Mr Hatchett (*Phil Trans*, 1804), with the following results —

| | Stick lac | Seed lac | Shell lac |
|---|---|---|---|
| Resin | 68 0 | 88 5 | 90 0 |
| Colouring matter | 10 0 | 2 5 | 0 5 |
| Wax | 6 0 | 4 5 | 4 0 |
| Gluten | 5 5 | 2 0 | 2 8 |
| Foreign bodies | 6 5 | | |
| Loss | 4 0 | 2 5 | 1 8 |
| | 100 0 | 100 0 | 100 0 |

The great consumption of lac is in the manufacture of dye stuffs, sealing wax, and of certain varnishes and *lacquers*

LA'CCIC ACID A peculiar acid separated from stick lac by Dr John It is yellow, crystallizable, and forms soluble salts with potassa, soda and lime and insoluble salts with the oxides of mercury and lead It occasions no precipitate in solution of baryta or of oxide of silver

LACCINE A substance discovered in shell lac by Unverdorben It remains after all the soluble matters in water, alcohol and ether have been extracted It is brittle yellow, translucent, and soluble in caustic potash, and in sulphuric acid

LAC DYE, LAC LAKE These are two preparations of lac imported in small cubic cakes from the East Indies and extensively used in the production of scarlet dye They are said to be prepared by digesting lac in an alkaline solution, which produces a deep pink liquid the colouring matter of which is thrown down in combination with alumina by the addition of a solution of alum

LACE (Lat lacinia, *the hem of a garment*) An ornamental fabric of linen or cotton thread formerly made by hand (when it was called *pillow* or *bone* lace) but of late years produced by machinery, and [illegible] termed *bobbin-net* "This manufacture,' says Dr [illegible] "may be said to surpass every other branch of human industry in the complex ingenuity of its machinery, one of Fisher's spotting frames being as much beyond the most curious chronometer in the multiplicity of mechanical device, as that is beyond a common [illegible]

The costly and complicated machines by means of which bobbin-net is produced are termed *lace frames* They are constantly undergoing improvement and this beautiful branch of manufacture is [illegible] destined to become much more perfect than even at present

A *rack of lace* is a certain number of meshes counted perpendicularly, and contains 240 meshes or holes and much has already been the improvement in this manufacture, th[illegible] which was twenty [illegible] is now reduced t[illegible] price of a 4-rack piece, five quarters broad, was 17*l* sterling, the same is now sold for seven shillings In the *Commercial Dictionary* will be found full statistical details of the value of the lace manufacture in this country, together with a learned and curious account of the origin and history of the fabric

LACE'RNA [illegible] cloak, worn at first only by the [illegible] which increased so much in fashion that at the period of the triumvirate it became a favourite piece of dress with all the higher classes of Roman citizens, both civil and military and remained so till the times of the emperors Valentinian and Theodosius, when the senators were prohibited from wearing them in the city Martial speaks of lacernæ which cost 10,000 sestorces (80*l*)

LACE'RTA (Lat) The *Lizard*, a constellation of the northern hemisphere, near Cepheus and Cassiopeia, formed by Hevelius

LACE'RTIANS, or LACERTINE SAURIA A name sometimes given to a primary division of the order *Sauria* of Cuvier, including all those species which differ from the Loricate or Crocodilian Saurians in having a direct communication between the ventricles of the heart, a double intromittent organ, a tongue bifurcate or emarginate at the tip, an ear-drum unprotected by an opercular fold, and a covering of scales sometimes bony without osseous plates or scutæ

LACE'RTIDÆ (Lat lacerta, *a lizard*) A group of the order *Sauria*, forming the second family in the Cuvierian system, in which the characters are given as follows —Tongue long, slender, extensible, and bifurcate at the extremity, as in the serpent tribe, ear-drum membranous on a level with the surface of the head, or very slightly sunk [illegible] production of the skin with a [illegible] by a sphincter, and a rudimental [illegible] body elongated, feet with five [illegible] unequal, particularly the hind ones, all armed with nails, scales on the belly and round the tail arranged in transverse and parallel bands Cuvier subdivides the *Lacertidæ* into the two great genera *Monitor* and *Lacerta*, each of which have been [illegible] subdivided

LA'CHES (Fr lâche, *negligent*) In Law, slackness or negligence A term used to signify that degree of negligence which throws on the party committing it the evil consequences resulting to him from it

LACHRYMAL Relating to tears as the *lachrymal glands*, by which they are secreted They are placed in a depression of the frontal bone, above the external angle of the eye the tears pass from them to the eye by the lachrymal ducts which are six or eight in number

LACHRYMATORY A small vessel of glass or earthenware which it was customary at Roman funerals to fill with the tears of the mourners, and deposit them with the ashes of the deceased in the sepulchre

LACK In Commerce, a word used in the East Indies, to denote the sum of 100,000 rupees, or 12,000*l* sterling

LACINIA In Botany a term given to the abruptly inflexed acumen of each of the petals of an umbelliferous flower

LACONICUM (Lat) In Ancient Architecture, an apartment in the baths which received its name from having been first used in Laconia

LACONISM A short and pointed saying, so termed from the celebrity which the Lacedæmonians enjoyed in antiquity for their brief and sententious mode of expressing themselves, produced by the severe discipline of their institutions and the gravity which it engendered When they became famous for the quality they appear to have begun to aim at the [illegible] of it in rather an affected manner, of which some curious instances are contained in Herodotus None of the many Laconisms recorded in ancient history are more noble than the expression of the Spartan mother to her son when presenting him with his buckler η ταυν η επι ταυν —'either bring it back or be brought home dead upon it" There is an essay by Puteanus *De Laconismo*

LACQUER A yellow varnish, consisting of a solution of shell lac in alcohol coloured by gamboge saffron annotto or other yellow, orange, or red colouring matters Lacquers are chiefly used for varnishing brass and some other metals In order to give them a golden colour and preserve their lustre

LACTARIUM (Lat) In Architecture, strictly a dairy house In Ancient Architecture it was a place in the Roman herb market, indicated by a column called the Lactaria Columna, where foundlings were fed and nourished

LACTEALS (Lat lac *milk*) The absorbents of the mesentery which convey the milky fluid called *chyle* from the small intestines to the thoracic ducts

LACTIC ACID (Lat lac) The acid of sour milk A similar acid is obtained from the fermented juice of the beet root It appears to consist of 6 atoms of carbon, 5 of hydrogen, and 5 of oxygen, its equivalent being 81

LACTOMETER (Lat lac and metrum, *a measure*) A term applied to a glass tube for ascertaining the proportion which the cream bears to the milk of any particular cow or of the produce of a whole dairy The tube is about half an inch in diameter, and a foot in height with a graduated scale marked on the outside It is filled with milk when newly drawn from the cow, and as it cools the cream rises to the surface, and the proportion which it bears to the milk is ascertained by [illegible] opposite to each

LACTUCARIUM The inspissated milky juice of the *Lactuca sativa*, or common garden lettuce It possesses slight anodyne properties, and is sometimes [illegible] for opium

LACTUCIC ACID A peculiar acid, discovered by [illegible] of the *Lactuca virosa* It bears some resemblance to oxalic acid, but differs from it in giving a green precipitate with the protosalts of iron, and a brown [illegible] with sulphate of copper

LACUNA (Lat) In Botany, a term applied in describing lichens, to denote one of the small hollows or

pits on the upper surface of the thallus Also a name given occasionally to the [illegible] called an air-cell, lying in [illegible] of plants

LACU'NAR (Lat ) In Architecture, the ceiling or under surface of the member of an order [illegible] under side of the larmier or corona of a cornice The under side also of that part of the architrave between the capitals of columns The ceiling of any part in architecture only receives the name of lacunar when it consists of compartments sunk or hollowed without spaces or bands between the panels if it is with bands, it is called *laquear*

LACUNO'SE (Lat lacuna *a break*) In Zoology, when a surface has a few scattered, irregular, broadish, but shallow excavations

LACUSTRINE (Lat lacus, *a lake*) Belonging to a lake The term *lacustrine deposit* is applied by geologists to certain fresh-water formations which occur in the newer rocks *See* GEOLOGY

LADDER The sea term for the staircases between the decks Ladders are also made of rope

LA'DY A title said to be compounded of two Saxon words, and to signify the giver or distributor of bread, *i e* the mistress of a family It properly belongs to the daughters of all peers above the rank of a viscount, and is extended, by courtesy, to the wives of knights of every degree

LA'DY DAY In the Calendar, the 25th of March, being the annunciation of the Holy Virgin It is one of the immoveable festivals of [illegible] Christmas, or the day of the [illegible] precedes by nine months

LÆMODI'PODS *Læmodipoda* (Gr λαιμος *throat*, πους, *foot*) The name of an order of Crustaceans, in which the head is confluent with the first segment of the thorax, and supports the four anterior feet The *Læmodipods* are the only Malacostracans with sessile eyes, and in which the posterior extremity of the body exhibits no distinct branchiæ The females carry their ova beneath the second and third segments of the body in a pouch formed of approximated scales All the species are marine

LAGOMYS (Gr λαγος *a hare*, μυς *a mouse*) The generic name of certain Rodents called "rat hares" now peculiar to Siberia They differ from the hares proper in having moderate sized ears legs nearly equal, clavicles nearly perfect, and no tail The fossil bones of a species of *Lagomys* have been discovered in the osseous breccia of Corsica

LAGOON (Lat lacuna, *a morass*) The name given particularly to those creeks extending along the coast of the Adriatic and which are formed by water running up in the land In some places they are deep, [illegible] are so shallow as to emit noxious exhalations [illegible] contain many islands, on sixty of which the city of Venice is built Towards the sea these islets are secured by duns, either natural or artificial

LAGO'PUS (Gr λαγως, *a hare*, πους, *a foot*) The generic name of those birds of the grouse tribe which have a round or square tail, and whose toes are feathered as well as the legs

LAGO'STOMA (Gr λαγως, and στομα, *the mouth*) The hare-lip.

LA'GOTHRIX (Gr λαγως, θριξ *a hair*) A genus of South American or Platyrrhine monkeys characterized by their round head a thumb on the anterior hand, and the tail partly naked The grison, or silver-haired monkey, is a species of this genus

LAGRIMO'SO (Ital) In Music, a direction to the performer, when appended to a piece of music denoting that it is to [illegible]

LAIRD [illegible] "a landed gentleman [illegible] but regarded by many philologists as originally equivalent to *lord* (quod vide) Anciently the title of laird was given only to those proprietors who held immediately of the crown, and this distinction is still preserved in the Highlands The designation *tiern*, corresponding to laird and rendered by it, is given to no one whose property is not worth two or three hundred per annum, while it is withheld from another whose rental extends to as many thousands, because the former acknowledges no superior [illegible] does

LAITY (Gr [illegible]) The great body of the people, as opposed to those who are set apart for the ministration of the services and sacraments—the clergy This distinction is plainly observed in the writers of the third century—Origen, Cyprian and Tertullian, and is generally supposed to have [illegible] ation of Christianity [illegible] neral name for the people In the writings of the Fathers [illegible] private men and λαικοι, lay- [illegible] to express this class

LAKE [illegible] In Geography a collection of water surrounded by land Lakes are divided into four distinct classes—1 Those which have no outlet, and receive no running water 2 Those which have an out- [illegible] of water 4 Those which receive streams of water, and [illegible] outlet or communication with the [illegible] Sea, which receives the Wolga and several other large rivers, and Lake Aral, which receives the Amoo, belong to this class It is a remarkable fact, that all lakes of this class are salt Some lakes present the curious phenomenon of disappearing and reappearing periodically, without regard to the rainy season Lake Chirtunitz in Illyria is of this description Some of them, as Loch Lomond in Scotland, and Lake Wetter in Sweden, experience violent agitations during severe weather This may be supposed to proceed from an escape of subterraneous gases, or winds blown into some cavern with which they communicate, though a coinci- [illegible]

LAKE A compound of aluminous earth with the red colouring matter of certain animal and vegetable substances, thus we have cochineal and lac lakes, madder lake &c Sometimes the term *lake* is indiscriminately applied to all compounds of alumina and colouring matter

LALLATION The imperfect pronunciation of the letter *r*, which is made to sound like *l*, hence also the term *lambdacismus* The imperfect pronunciation of the letter *r* is peculiar to the Chinese.

LAMA (Mother or pastor of souls) Among the Mongols a title given to priests in general, among the Calmucks to the higher classes of priests only The Dalai-Lama (*i e* Great Lama) is honoured as the representative of divinity, or rather as a real divinity dwelling on the earth, by various tribes of Tartaric descent This personage resides at Lassa in Thibet and pilgrimages are made to his residence by the inhabitants of more distant regions of Tartary He is now chiefly dependent, in a political sense, on the Chinese empire When the actual Dalai Lama dies, his spirit is supposed to seek another body in which to be born again, and the new Dalai-Lama can only be discovered by a certain favoured class among the priests The worshippers of the Dalai-Lama also pay peculiar reverence to two other subordinate Lamas (Teeshoo and Taranaut Lama) They are distinguished by the title of *Yellow Caps* the *Red Caps*, another sect in Tartary, are under three other Lamas, styled the three *Shamonars*

LAMA, LLAMA, or GUANACO The name of a species of the camel tribe peculiar to South America *See* AUCHENIA

LAMA'NTIN The name given by French naturalists to the manatee or sea cow *See* MANATUS

LAMBDOI'DAL SUTURE The union of the parietal with the occipital bones, shaped something like the Greek letter Λ or *lambda*

LAMELLA In Botany, a term applied by some writers to the foliaceous erect scales appended to the corolla of many plants, as in *silene* Also used in describing fungi, to denote the gills forming the hymenium of an agaric

LAMELLIBRANCHIATES, *Lamellibranchiata* (Lat lamella, *a thin plate* [illegible] Acephalous Molluscs [illegible] the gills in the form [illegible] symmetrically, two on [illegible]

LAMELLICORNS (Lat lamella, *a plate*, cornu, *a horn*) The sixth and last section of Pentamerous Coleoptera of the system of Latreille, in which the antennæ are inserted into a deep fossula under the lateral margin of the head they are always short usually consist of nine or ten joints and are always [illegible] usually composed of the three last, [illegible] sometimes flabelliform, or [illegible] and closing in [illegible] contorted and fitting into each other, the first or inferior [illegible] the axis, and [illegible] of comb

[illegible] generally ovoid or oval, and thick The exterior side of the two anterior tibiæ is dentated, and the joints of the tarsi, with the exception of those of some males are entire, and without brush or pellet beneath

The anterior extremity of the head most commonly projects, or is dilated in the manner of an epistome The mentum is usually large, covers the labrum, or is incorporated with it, and bears the palpi The mandibles of several [illegible] Coleopt [illegible] the females, either by prominences on the thorax or head in the form of horns or tubercles, or by the largeness of [illegible]

[illegible] very numerous, and with respect to the size of the body, and the variety of forms exhibited in the head and thorax, is one of the most beautiful of the order, and frequently also as regards the splendour of the metallic colours which ornament those species feeding on living vegetables The other species, however, feed-

ing on decomposed vegetable matter are usually of one black or brown hue Some of the Coleoptera however do not yield even in this respect to the former They are all furnished with wings, and their gait is heavy

The body of the larva is long thin semicylindrical soft, frequently rugose whitish and divided into twelve annuli with six squamous feet the head is squamous, and armed with stout mandibles Each side of the body is furnished with nine stigmata or breathing pores Its posterior extremity is thicker, rounded, and almost always doubled under it, so that the back being arcuated or convex, the animal cannot extend itself in a straight line, crawls badly on a level surface, and falls backwards or on its side every instant

Some of them require three or four years to become pupæ they construct in their place of residence an ovoid shell, or one resembling an elongated ball, composed of earth or the remains of substances they have gnawed, the particles of which are cemented by a glutinous matter produced from their body Their aliment consists of the dung of various animals, mould, and the roots of vegetables (frequently such as are necessary to man) of which they sometimes destroy immense quantities, to the great loss of the cultivator of the soil

LAMELLIRO'STRALS, *Lamellirostres* (Lat lamella, *a thin plate,* rostrum, *a beak*) A tribe of swimming birds, the fourth in the system of Cuvier, comprehending those in which the margin of the beaks are furnished with numerous lamellæ or dental plates arranged in a regular series, as in the swan goose and duck The birds comprised in this family pass most of their time in the fresh waters Some come on shore to graze, others feed on aquatic plants insects vermes, or small fish, and reptiles which their long neck enables them to reach or seize with facility Some of the species dive in quest of their prey, and can remain a considerable time under water All the Lamellirosters of Cuvier were comprised in the great genus *Anas* of Linnæus

LA'MIA (Gr Λαμια) An imaginary being concerning which the superstitious notions were prevalent among the Greeks and Romans, sometimes represented as a species of monstrous animal sometimes as a spectre or vampire The Lamiæ of Pliny are animals with the face and head of a woman and tail of a serpent inhabiting the deserts of Africa Among the mythologists the first Lamia was a queen of Libya and a malevolent goddess who seizes and devours new-born infants in their cradles whence Horace's caution to tragic writers against indulging in the description of unnatural horrors —

Nec pransæ Lamiæ vivum puerum extrahat alvo

In the well known story of Machates and Philomon from which Goethe has borrowed his magnificent ballad of the *Bride of Corinth*) a young man is represented as marrying a Lamia, or Empusa who sucks his blood at night A similar tale occurs in the *Life of Apollonius of Tyana* by Philostratus The Christian superstition of incubi, and the oriental belief in vampires, seem to bear marks of the same origin

LAMI'DÆ (Lat lamia, the name of an imaginary animal in Pliny) The subdivision or family of *Lamina* in which the sides of the thorax are either smooth and rounded, or tuberculate, rugous or spiny, but not furnished with moveable tubercles or spines

LAMI'NÆ (Lat lamina) A tribe of Longicorn beetles, distinguished according to Latreille by their vertical head, filiform palpi whose terminal joint is more or less ovoid and tapers to a point, maxillæ with the outer lobe slightly narrowed at the end, antennæ frequently setaceous and simple, and thorax, exclusive of the lateral spines or tubercles nearly equal throughout Some species are apterous, a modification which occurs in no other tribe of Longicorn beetles

LA'MINARITES A term applied by Brogniart to a species of fossil fucies found in the secondary strata of Aix near La Rochelle

LA'MMAS DAY In the Calendar, the 1st of August Dr Johnson supposes this term to be a corruption of *Lattermath*, which signifies a second mowing of grass Others derive it from a custom which once prevailed in some parts of England, of bringing a lamb alive on this day into the church at *high mass* Others again derive it from a custom of bringing a *loaf-mass* so named as an offering of the first fruits of the corn

LAMP [illegible] The general term for the [illegible] tion of artificial light, [illegible] at a very early period, rendered the use of lamps universal among the nations of antiquity The Egyptians, the Hebrews, Greeks, and Romans, vied with each other in the construction of these instruments, and the specimens of some that have been transmitted to our times display much taste and elegance of external design It would seem, however, that the ancients had confined themselves merely to the external embellishment of the lamp, for it is a singular circumstance, that notwithstanding the simplicity of the invention, and its obvious capability of improvement, it is only within the last sixty years that any material improvement has been effected in its original construction To give any thing like a complete view of the principles and structure of the numerous lamps of which the present age has witnessed the invention would be quite impracticable without a multiplicity of illustrative diagrams, which would be foreign to the purpose of this work, but a brief notice of the principle on which the action of every lamp, both simple and complicated, depends, and of some of the most celebrated improvements in their structure, may not be considered out of place

The most simple lamp consists in a vessel of any shape filled with oil or other inflammable liquid, and having a short depression or spout on one side in which lies a wick composed of any fibrous substance, and capable of imbibing the oil by capillary attraction The oil thus [illegible] admits of being heated to such a degree of temperature as is capable of volatilizing the oil, the vapour of which in a state of combustion, constitutes the flame of the lamp The wick of a lamp serves only for the purpose of raising up the oil by capillary attraction, and thus giving a constant and adequate supply to the flame It furnishes no part of the light by the combustion of its own substance, for the quantity consumed is too small to merit attention, and it is usually coated over with a broad deposit of carbonaceous matter which cannot burn for want of the access of air from which it is kept by the flame To render the air accessible to every part of the flame in order to ensure the most perfect combustion of the oil is one of the most essential objects in the modern improvement of lamps and hence the texture materials, and dimensions of the wick are matters of much importance If on the one hand the wick be large a great deal of carbon vapour remains unburnt in the interior of the flame and breaks out in the form of smoke producing a most disagreeable smell and if on the other hand, the wick be too small, though the unconsumed carbon will naturally be less and the flame consequently clearer than those of the larger wick it will yield but very little light, as the light diminishes with the superficies of the flame The inconvenience of a thick wick had been long observed and attempts were often made to remove it, in some instances by substituting two or more small wicks for one large one and in others by making the wick flat instead of cylindrical These experiments though limited in their operation were no doubt beneficial, and in houses where economy more than elegance was studied, they procured for the lamp a more extended use than it previously enjoyed Still, however the smoke and disagreeable smell arising from the burning of oil in common lamps and the unsightly appearance of the whole process had long banished the lamp from the apartments of the wealthy and it was not till the year 1780 when M Argand invented the well known lamp which bears his name, that the instrument came into general use This invention embraces so many improvements upon the common lamp and has become so general throughout Europe, that it may be justly regarded as one of the greatest discoveries of the age As a substitute even for the best wax candles it combines the advantage of economy and convenience with much greater brilliance, while even as a means of producing heat it is found to be of most essential service in chemical operations The great principle on which the superiority of this lamp depends is the admission of a quantity of air into the centre of the flame This Argand accomplished by making the wick of a circular form, instead of a solid cylinder as before by which means a current of air rushes through the hollow cylinder while the wick is burning thus admitting air into the centre of the flame Improving upon this invention which was found perfectly to succeed, he added a glass cylinder or chimney, open at bottom, to surround the flame at a short distance, by which another current of air is made to pass upwards on the exterior part of the flame and between it and the glass Thus every part of the thin circular flame is between two currents of air, which supply the combustion with such a quantity of oxygen as to create a heat sufficient to convert into a brilliant flame the smoke which escapes from an ordinary lamp

Such is a brief account of the leading principles of Argand's invention Various improvements have since been made on the original by the Sinumbra, the French, the Iris lamp (now in general use as a table lamp), and a variety of others, which it would be superfluous to enumerate, all of which, however, may be regarded as improvements more of *detail* than *principle* Indeed, the great merit of Argand's invention consists in the facility with which it can be ingrafted on lamps of every variety of form and structure, while not all the beauty of [illegible] of the [illegible]

to procure for them any considerable notice, if they were destitute of the Argand principle This facility of general application has recently been exemplified in an ingenious invention, by which lamps on the Argand principle have been made to burn the common fish oil, instead of spermaceti, which had hitherto been indispensable This improvement, which is so desirable in an economical point of view, consists chiefly in an extension of Argand's original principle, viz in [illegible] with a greater quantity of oxygen [illegible] been effected These are accomplished by means of apertures in the sides of the lamp and a cap with a *deflector*, but in applying this improvement to lamps on Argand's principle a larger tube or chimney must be employed and the reservoir must be raised higher, the wick also supplied with oil must also be enlarged Lamps constructed on this principle are designated *solar lamps* The best account of lamps may be found in *Peclet, Traité [illegible]*, and in *Krünitz's Encyclop*, art "Lampe" See also the *Haus Lexicon*

LA'MPADEPHO'RIA (Gr λαμπαδηφορία, *a carrying of torches*) A torch race, which it was customary to exhibit at certain sacred festivals at Athens The performers were three young men, to one of whom, chosen by lot, was given a lighted torch which he was to carry to the goal [illegible] or if he failed, to deliver it to the second [illegible] ealed also gave it to the third whence a metaphor is sometimes derived by ancient writers, to be applied to persons who anxiously wait for the deaths of others If the runners slackened their pace they were driven on by the blows of the spectators This ancient usage is beautifully alluded to by Lucretius to the succession of human [illegible]

Et, quasi cursores, vitai lampada tradunt

LAMPBLACK Finely divided charcoal It is the soot obtained by the imperfect combustion of resin of turpentine, this is burned in chambers hung with old sacking, upon which the smoke collects and is from time to time scraped off It contains about 20 per cent of peculiar resinous products water, and saline matter

LA'MPIC ACID A term given by Mr Daniell to the acid produced by the slow combustion of the vapour of alcohol and ether in the lamp without flame he has since ascertained that it is acetic acid modified by the presence of a peculiar hydrocarbon

LAMPOO'N *See* SATIRE

LAMP, SAFETY *See* SAFETY LAMP

LAMPY'RIDÆ, *Glow-worms* (Gr λαμπυρις *a glow worm*) A family of soft skinned Serricorn beetles, of the tribe *Lampyrina* (which see) characterized by antennæ closely approximated at their base, head concealed beneath the thorax, or produced in the form of a snout, eyes of the males large and globular, mouth small In one division the abdomen of the female is luminous, and the male, which is destined to be attracted by this luminosity has his head almost entirely occupied by his largely developed eyes, and it is not produced in the form of a snout The luminous property of the glow-worm is confined to the two or three terminal segments of the flattened abdomen which differ in colour from the rest and are usually yellowish or whitish, this character is peculiar to the [illegible] and announces their phosphorescence [illegible] by the glow worm is of a lambent, electric, greenish colour the insect can vary or suspend its [illegible] segments preserve their peculiar [illegible] after being separated from the rest of the body, and manifest it even *in vacuo*, or when immersed in gases which are not supporters of combustion

In a second division of [illegible] not luminous, but are provided [illegible] exposed, and is mostly produced in the shape of a snout, the thorax is widened posteriorly, with pointed lateral angles The elytra, in several, expand posteriorly where they are sometimes strongly dilated or rounded, especially in the females To this group belong the genera *Lycus Dictyoptera*, and *Omalisus*

LAMPY'RINI (Gr λαμπυρις, *a glow-worm*) A Linnæan genus of Coleopterous insects, which constitutes the type of the present tribe of the soft skinned or Malacodermous Serricorns in the system of Latreille This tribe is characterized by the enlarged termination of the palpi or at least of the maxillary palpi, by their soft, straight, depressed, or but slightly convex body, and by the thorax, sometimes semicircular, at others nearly [illegible] over the head, which [illegible] The mandibles are usually small, and terminate in a slender, arcuated, very acute point, which is generally entire The penultimate joint of the tarsi is always bilobate, and the terminal claws have neither dentations nor appendages

The females of some of the Lampyrine tribe are apterous, or have but very short elytra, and are luminous All the Lampyrines when seized, press their feet and antennæ against their body and remain as motionless as if they were dead *See* LAMPYRIDÆ

LA'NATE (Lat lana, *wool*) In Zoology, when a part is covered with hair, very long flexible, and rather curled like wool

LANCASTER, CHANCELLOR OF THE DUCHY OF The officer before whom, or his deputy, the court of the Duchy-Chamber of Lancaster is held, which is a court having special equitable jurisdiction as to lands holden of the duchy The office has long been a sinecure, and is one of the most valuable at the disposal of the ministry of the day, the salary is 4000*l* per annum

LANCE (Fr) A weapon consisting of a long shaft with a sharp point, much used by the nations of antiquity, and also by the moderns before the invention of gunpowder The Macedonian phalanx and the Roman infantry, as well as [illegible] bands of mounted warriors, all considered the lance as [illegible] most effective weapons, and even at the present day it is still considered of great value, though it is now almost universally borne by cavalry Almost all the armies of Europe have now regiments of *lancers*, so called from the lance being the chief offensive weapon with which they are armed The lances in use among the European cavalry have a shaft of ash or beech wood, eight, twelve, or in some cases even sixteen feet long, with a steel point eight or ten inches in length, adorned by a small flag, the waving of which is said to frighten the enemy's horses The ancient lancea was a general term for missile weapons or javelins the pilum is termed lancea in Lucan —

Cujus torta manu commisit lancea bellum (Lib vii)

For a detailed description of the lances of knights in the middle ages, see *Mem de l Ac des Inscr* vol xx From its being the common knightly weapon, the force of the mounted gendarmerie on its first institution in the 15th century was usually numbered by "lances," each "lance" having four or five attendants The lance has become again a favourite cavalry weapon of late years, owing to the exploits of Napoleon's Polish lancers and the Cossacks

LA'NCEOLATE (Lat lancea, *a lance*) In Zoology, an animal or a part is so called when it is oblong [illegible] towards each extremity

LAND (Sax) In its widest acceptation is used to [illegible] of which the globe is composed, in contradistinction to the liquid matter, or water, but in its most restricted signification it is confined to *arable ground* The latter is the legal meaning of the term, and in this sense it is used in all original writs, and in all correct and formal pleadings

LA'NDAMMAN, in Switzerland the president of the diet of the Helvetic republic The highest magistrate in ten of the cantons also bears the title of landamman, in the others he is designated by various appellations

LA'NDAU The name given to a peculiar kind of carriage which opens and closes at the top, so called from Landau in Germany, where they were originally made

LA'NDFALL The first land seen after a voyage is so called A *good* landfall is when the land is seen as expected

LA'NDGRAVE A title taken by some German counts in the twelfth century, who wished to distinguish themselves from the inferior counts under their jurisdiction, and thus assumed the [illegible] title of land-graf, or count of the whole country This was the origin of the landgraves of Thuringia, of Lower and Higher Alsace, the only three who were princes of the empire

LAND-LOCKED A term applied to a harbour or piece of water which is so environed by land on all sides as to exclude the prospect of the sea, unless over some intervening land If a ship is at anchor in such a place, she is said to ride land-locked, and is therefore considered to be safe from the violence of winds and tides

LA'NDMARK signifies, in a general sense, any thing by which the boundary of a property is defined In ancient times the correct division of lands was an object of great importance, and various means were adopted to give distinctness and permanency to the boundaries of every man's property Stones and hillocks were the most usual landmarks The importance of this subject, [illegible] his neighbour's landmark" In naval language, *landmark* is applied to any conspicuous object which serves as a guide in entering [illegible] danger

LANDREEVE [illegible] an extensive estate, who acts as an assistant to the land steward

LANDSCAPE The [illegible] the country, as also, in [illegible] picture representing such scenery A landscape in the latter sense may, however, become allegorical and historical, in the meaning applied by artists to those terms The chief study of the landscape painter is the vegetable world, air, water, rocks and buildings To these he may impart an ideal beauty, and thus elevate his art

above mere topographical painting, which may be applied to his work, if he merely copies without refinement what is presented to his eye

LANDSCAPE GARDENING The art of laying out grounds so as to produce the effect of natural landscape Its principles are the same as those upon which the landscape painter proceeds in composing a picture, and though it is an art of which, like many others, every body thinks he is a judge, it requires to be properly practised, [illegible] or than fall to the lot of most [illegible] called Capability Brown [illegible] this country [illegible] an artist To lay down the principles of the art would be quite impossible [illegible] must follow [illegible] hat has slid down in consequence of disturbance by an earthquake, or from [illegible] by the action of water

[illegible] NGS Land springs are sources of water which only come into action after heavy rains, while constant springs which derive their supply from a more abundant source, flow throughout the year All springs owe their origin to rains In the case of land springs, the water, when it sinks through the surface, is speedily interrupted by a retentive stratum and there accumulating soon bursts out in a spring, which ceases to flow a short period after the cause which [illegible] ceased to operate, but the water which springs sinks deeper into the earth and accumulates in rocky or gravelly strata, which become saturated with the fluid

LAND STEWARD A person who has the care of a landed estate, and whose duties vary in different countries according to the mode in which landed property is managed In England, where the landlord very commonly undertakes to keep the buildings and fences of his tenants in repair the duties of the land steward are constant and multifarious, while in Scotland, where the building and fences are kept in repair by the tenant, the duties of the steward are confined to receiving the rents and seeing that the covenants of the leases are duly fulfilled In many parts of the Continent, and particularly in Italy, where the landlord is a partner with his tenant and shares the produce with him, the duties of the land steward, or *fattore*, as he is there called, are much more onerous than in Britain It is generally considered, both by British and Continental writers on agriculture that one principal cause of the retardation of this art has been the employment of lawyers as land stewards, and the truth of this can hardly be denied, more especially in those countries where the tenant is bound down by his lease to particular modes of cropping, or where there is a discretionary power as to cropping on the part of the steward The objection to lawyers as stewards is founded on their general habits of acting from precedent rather than from principle, and hence such a habit, exercised in the case of an art that is calculated to be so rapidly progressive as agriculture, must materially impede its advancement At the same time the convenience to a landed proprietor of having a land steward who possesses legal knowledge is so great, as generally to overpower the objections that are made against them by farmers and agricultural writers

LANDWAITER An officer of the customs whose duty it is upon landing any merchandise to taste, weigh, measure, or otherwise examine the various articles, &c and to take an account of the same

LANDWEHR [illegible] The militia of Prussia [illegible]

LANGRIL A particular kind of shot formed of bolts, nails, and other pieces of iron, tied together and forming a sort of cylinder which corresponds with the bore of the cannon from which it is discharged It is used chiefly to destroy the masts and rigging of the enemy's ships

LANGUAGE (Lat *lingua*, *tongue*) has been defined "the expression of our ideas and their various relations by certain articulate sounds, which are used as the signs of those ideas and relations"

Whether language was originally given to man by his Creator, or is the fruit of human invention, is a subject of dispute, on which philosophy is scarcely capable of arriving at satisfactory conclusion Among those writers who have maintained the latter thesis, three (*Lord Monboddo on the Origin and Progress of Language*, *Adam Smith's Considerations on the Formation of Languages*, and *Stewart's Philosophy of the Human Mind*) are particularly deserving of attention [illegible] these, in his ingenious speculation on the subject, mentions four ways in which he conceives that ideas could have been communicated before the invention of speech viz, 1 Inarticulate cries, expressive of sentiment sand passions, 2 Gestures, and the expression of countenance, 3 Imitative sounds expressive of audible things, and, 4 Painting, by which visible sounds are represented

And he appears to consider language to have been produced by gradual development out of the *first* of these

Many, whether satisfied with Lord Monboddo's speculations or not, are ready to condemn the supernatural theory as "unphilosophical" But our views on this subject must materially depend on those which we may take of the kindred speculations respecting the origin of civilization If we are led to the conclusion — once commonly adopted, with little inquiry, by philosophical writers — that the progress of man from the lowest state of barbarism to refinement has been gradual in all societies, we shall probably also believe that the formation of language accompanied this development in its course But if we are more forcibly impressed with the strength of the *historical* difficulties which oppose this theory, that all our researches only testify the history of one family of civilized men (in the proper sense of that word) succeeding another, that the more barbarous races appear to have lost civilization — to have fallen back from some better condition, instead of being at the lowest or commencing step (a notion strongly entertained by the gifted historian Niebuhr, among many others), and that the languages of some of the most savage races (such as several of the American Indians), instead of partaking in their want of refinement in other respects, are remarkable for the number and delicacy of their inflexions, — we shall probably arrive at the conclusion, that the more likely speculation is that which coincides best with the faint indications afforded by the inspired writings and points out Revelation as the source both of knowledge and of the primary laws of human society

Considering the phenomenon of language as it now presents itself, the most interesting philosophical questions to which it gives rise are those which concern the connection and relative antiquity of existing languages, and their comparative utility and beauty as modes of communicating ideas The first lead the mind to consider the history of language, the latter the principles of its structure

The former of these subjects is one of those which may be most emphatically pronounced peculiar to modern research The affinity of the great family of European and Western Asiatic languages those with which we are the most familiar, was scarcely studied with serious attention before the time of Adelung (whose great work, [illegible] we believe, in 1804) The affinities [illegible] ier oriental tongues had been, perhaps earlier investigated, but their elucidation remains nevertheless still more imperfect at the present day On a topic now pursued with great interest especially by the learned men of Germany and Britain we must content ourselves with indicating a few simple rules for the guidance of the student

The importance of the coincidence of single words as a proof of the connection of languages is rather under than over estimated in common opinion The late Dr Young whose researches into this question are of such high value calculated that nothing could be inferred, as to the relation of two languages, from their agreement in *one* word, that the odds are only [illegible] casual agreement in *two*, but that there are nearly 100 000 chances to one against their casual agreement in *eight*

But again nothing could be inferred as to the relationship of languages from their agreement in particular words, if the nations which spoke them were neighbours and the words such as the one might easily borrow from the other by mutual intercourse The Latin word *vinum* and the low German word for wine are the same, *vinum*, *wyn*, pronounced *veen* But the Germans learnt the use of the thing from the Romans, and along with it they doubtless borrowed the name No conclusion could therefore be drawn from this example, as to the connection between German and Latin The Greek name for a lion *lis*, is nearly the same with that used in a very different family of languages the Semitic (Hebrew, *Labi*, Arabic, *laith*) But the animal itself although at one time occasionally found in Greece was probably a wanderer from Asia, and the fact of its [illegible] to both tongues proves therefore nothing as to their relationship

In examining the connection of languages by their agreement in words, two things are to be considered the root, and the inflexions [illegible] off the inflective part of the [illegible] *us* (properly *os* or *o*) is the inflective part, in the nominative, of a numerous order of masculine nouns in Latin as well as Greek The root of "equus" is *equ*, or *ec*, the root of "albus" [illegible] these roots that we are first to look for [illegible] languages; and in examining them it is necessary to acquire a knowledge of one of the most important and most difficult to ascertain among the primary facts relating to languages, the ordinary substitution of letters, especially consonants, in different cognate languages of the same family With reference to the [illegible] class of languages already alluded to, [illegible] Indo-European," these substitutions have been only of late classified, and that as yet

imperfectly Thus it has been found that the Greek aspirate is often represented in Latin by *s, ἑξ, ἑπτα, sex, septem*, that the Greek π is frequently represented in [illegible] by *f* as πατηρ, *foot, father*, that the Greek and Latin dentals [illegible] in German, *dens, digitus, decem—zahn, zehe, zehen* A good list of the most common [illegible] will be found in the *Penny* [illegible]," taken from *Potts' Etymo-* [illegible] sions is a still closer sign of [illegible] class of Greek verbs commonly called in our grammars "verbs in *μι*" has a corresponding class in the Sanskrit, Zend, and some Sclavonic tongues

| | Greek | Sanskrit | Lithuanian |
|---|---|---|---|
| *I stand,* | ἱστημι | Tisthêmi | Stowmi |
| *Thou standest* | ἱστης | Tisthâsi | Stowi |
| *He stands,* | ἱστησι | Tisthati | Stow. |
| *I give,* | διδωμι | Dadâmi | Dudmi |
| *Thou givest,* | διδως | Dadâsi | Dusi |
| *He gives,* | διδωσι | Dadato | Dusti |

In other cognate languages this mode of conjugation is either lost or much altered Here, therefore, is an indication (not, of course, a conclusive one) of a nearer connection between these than others of the same family, Celtic and Latin, for instance

The connection between languages being established, the mind is next led to consider their derivation one from another And here historical assistance soon fails us We say that Spanish and Italian are derived from Latin because we know the fact historically, but at the earliest period of which we have any authentic account we find several independent nations using different, but strongly resembling varieties of speech of whose historical connection we know nothing We know little, for example, on the question in what consisted the relationship between the Latins and the Greeks, and nothing whatever as to the connection of either with the Celts or the Sclavonians And hence it is easy to perceive the absurdity of the fashion of which we still constantly meet with examples in dictionaries and works of reference, of speaking of words in cognate languages as "derived" from one another, for example, a Latin word is "derived" from the Greek, an English as "derived" from the German The Romans undoubtedly in later ages, borrowed a few words from the richer vocabulary of Greece, *e g historia, poema,* and the English have borrowed a very few from the Germans But Greek and Latin [illegible] and German are respectively only [illegible] from some ancient original which our inquiries are unable to reach

The distinction between a separate language and a dialect is very arbitrary We speak of Spanish and Portuguese, Swedish and Danish as distinct languages, yet they resemble each other quite as nearly as some varieties of French, perhaps of Italian The name seems appropriated, in ordinary usage to every variety of speech which is in national use for purposes of government and literature

The relative antiquity of languages is a subject involved in obscurity, and on [illegible] than conjectural [illegible]

search is, by accurate classification to reduce the number of original tongues from which those in actual use are derivative varieties

The following table of languages divided into classes or [illegible], Dr Young in the art "Language," [illegible] *Britannica*

1 Monosyllabic class
- Chinese
- Siamese
- Avanese
- Tibetan

2 Indo-European class
- Sanskrit
- Zend (Median)
- Semitic (Arabian, Syriac, Hebrew, &c)
- Lycian
- Phrygian
- Greek
- Germanic
- Celtic
- Etruscan
- Latin
- Cantabrian
- Sclavic

3 Tartaric class
4 African class
5 American class

This classification, however, is rather geographical than [illegible] For example, the [illegible] Sanskrit, Greek [illegible] with [illegible] same [illegible]

peculiar group apart, and should be excepted from the Indo-European class

Languages have also been classed in the following manner —

1 Languages composed of monosyllabic roots without any form of grammar These have no inflexions, and variety of meaning is only shown by the position of words [illegible] long the languages which [illegible]

2 Languages composed of monosyllabic roots with a great abundance of grammatical forms Of these the great Indo-European family are an example

3 Languages whose verbal roots consist, in their present form, of two [illegible] to express their [illegible] appears to comprehend the Semitic languages only, as far as is at present ascertained

The comparative perfection of a language, as an instrument for the communication of thought, depends mainly on its copiousness In order to estimate this, it must be borne in mind that the classes of words employed in [illegible] are all reducible into two, which have been termed by some *notional* and *relational* The former express distinct ideas [illegible] the latter serve to display the relation, [illegible] Nouns and verbs belong to the first class, prepositions, adverbs, &c, and the signs denoting the inflexions of verbs and nouns, to the latter With respect to the former class, [illegible] But the comparative richness of a language is mainly shown by the manner in which this is done As nations advance from barbarism towards civilization new notions, and new varieties of notions, are constantly requiring utterance In those in which this can easily be done by composition (as in Greek and German), great facilities are afforded for the easy expression of thought, comparatively with those in which it can only be effected by the laborious process of borrowing and adopting words from the vocabularies of more advanced nations

But it is in the *relational* words, or modes in which relations of ideas are expressed, that the genius of different languages most varies The Chinese, in their singular and obscure tongue, seem never to have reached beyond the process of varying the collocation of their unchangeable roots in the sentence, in order to express varieties of meaning The next process should appear to be that of using auxiliary words In many languages (our own among the number) relations are almost wholly expressed in this manner But in others the auxiliary words have, in course of time, coalesced with the principal, so that many relations are expressed by varying the beginning, termination, &c of the principal word This, at least, is the most probable origin of those forms termed in grammar *inflexions* or forms of declension and conjugation, in which Greek, Latin, Sanskrit, German, and their derivative languages are more or less rich, the Greek for example, being more copious than the Latin or modern German, in having the dual form and additional tenses (the aorists, and the paulo-post futurum). And some languages (especially among the American Indians) are so curiously constructed as to carry the power of inflexion far beyond this point A complex idea which, in English, would require to be expressed by a pronoun, an adverb, and an auxiliary verb (or perhaps a second auxiliary verb also, *e g* 'I desire," or "I abstain'), together with the principal verb, would in some American languages be expressed merely by a variety of the form of the principal verb itself

As a general rule, the power of inflexion adds greatly to the copiousness of a language, and although some enthusiasts in their admiration of [illegible] maintained that the process of conjugating or declining by auxiliary words and particles is more convenient, and affords more [illegible] reasoners will hold the same opinion But there are distinctions in language, arising out of relations simply imaginary, which may be pronounced unnecessary and cumbersome Such are the genders, common to almost all languages of the Indo-European family except our own, but for which it would be difficult [illegible]

Another and a [illegible] languages rich in inflexions, if the fact be true, is to be found in the [illegible] common people are supposed [illegible] accurately under this system [illegible] the niceties of a language, it has been urged, the greater the difference must inevitably be between the variety spoken and written by educated men and that in use among the uneducated, and it has been contended that in ancient Italy for instance, the rustic language was altogether different from the written Latin But the facts on which this reasoning rests may be pronounced extremely controvertible There are certainly some [illegible] for the supposition that there was an unusual difference between the vulgar and the polished Roman

tongue, at least in the later times of the empire but if this was always the case it is singular that Plautus and Terence should nowhere furnish us, by way of heightening the ludicrous with instances of ungrammatical locution The language of ancient Greece was more refined and inflective than that of Rome, and there is no appearance that there was a greater diversity between the speech of the peasant and the philosopher and rhetorician than in any modern country In Attica the very reverse seems to have been the truth, since its most elegant writers and orators appear carefully to have modelled their language on the colloquial dialect of their countrymen And, finally, the wild Indian of America speaks with purity a language often surpassing in variety of inflexions those of the most civilized and illustrious nations of the Old World

Among the numerous and valuable works which may assist the reader in acquiring a knowledge of the existing varieties of speech to which [illegible] *Vater's Linguarum Totius Orbis Index Alphabeticus*, *Marsden's Catalogue of Dictionaries*, [illegible] *Miscellaneous Works* (as to Oriental languages), *Adelung's Mithridates*, already cited the Works of Dr Prichard, a very valuable article in the *Penny Cyclopædia*, of which much use has been made in the above pages

LANGUI'NI (Ital) In Music, a direction to the performer, when prefixed to a composition denoting that it is to be performed in a languishing or soft manner

LA'NIARIFS *Dentes Laniarii* (Lat lanio *I rend*) The long conical and sharp-pointed teeth which are placed next behind the incisors They are also called *dentes canini* and *cuspidati*. They never exceed $\frac{1}{1}\frac{1}{1}$ in number in the Ferine Mammalia

LA'NIUS (Lat lanio) A Linnæan genus of Passerine birds, forming the typical family of the Dentirostral division of that order in the system of Cuvier The birds of the family *Laniadæ*, or shrikes, are characterized by a strong compressed beak, more or less hooked, with a notch near the point as in the other Dentirostres They shrikes live in families and fly irregularly and precipitately, uttering shrill cries, they build in trees, lay five or six eggs and take great care of their young They have the habit of imitating a part of the songs of such birds as live in their vicinity The [illegible] are predatory, and attack, slay, and devour [illegible]

LA'NSQUENETS, *Lansknechts* The German infantry first raised by the Emperor Maximilian to confront that of the Swiss, in the end of the fifteenth century The name is derived from the German words *landes knecht*, countryman or country lad and not as is sometimes stated, from *lanz* a lance or pike The lansknechts were very irregularly armed, the greater part with pikes, but certain companies in every division with muskets They were raised by voluntary enlistment and their leaders passed with little reluctance into the service of any power which was willing to pay them This infantry played a conspicuous part in the wars of Italy, in the first half of the sixteenth century, after which the name fell into disuse

LANTA'NIUM (Gr λανθανειν, *to conceal*) A metallic substance discovered by Mosander in *cerite*, it is associated with, and concealed as it were by, the oxide of cerium The oxide of lantanium is of a brick red colour

LANTERN (Fr lanterne) In Architecture a drum-shaped erection, either square, circular, elliptical [illegible] dome, or on that of an apartment [illegible] CUPOLA

LANTHORN, MAGIC *See* MAGIC LANTERN

LA'NTERNWHEEL In Mechanics, a kind of pinion, having, instead of leaves cylindrical teeth or bars called *trundles*, or spindles, on which the teeth of the main wheel act The ends of the trundles being fixed in two parallel circular boards or plates, the lantern wheel has the form of a box or lantern, whence the name

LA'NYARD The sea term for certain lashings, which [illegible]

LAOCOON In Fabulous History, the priest of Apollo or Neptune [illegible] Trojan war While he was engaged in sacrificing a bull to Neptune, two enormous serpents sent by Minerva in revenge for his having endeavoured to dissuade the Trojans from admitting the famous wooden horse within their walls, issued from the sea, and having fastened on his two sons, whom he vainly endeavoured to save at last attacked the father himself, and crushed him to death in their complicated folds Virgil has thus described the occurrence —

——— Et primum parva duorum
Corpora natorum serpens amplexus uterque
Implicat, et miseros morsu depascitur artus
Post ipsum auxilia ferentem et tela ferentem
Corripiunt spirisque ligant ingentibus et jam
Bis medium amplexi, bis collo squamea circum
Terga dati, superant capite, et cervicibus altis

This story [illegible] ing the subject [illegible] sculpture in the whole history of ancient art The composition is pyramidal, and represents Laocoon and his two sons writhing and expiring in the convolutions of the serpents Agony in an intense degree is exhibited in [illegible] convulsed body of Laocoon, who is [illegible] himself from the serpents, and [illegible] [illegible] But the [illegible] tured upon a criticism of the group have discovered that its complexity destroys its effect, but we doubt the value of the criticism and to counteract it give the opinion [illegible] judge), from his *Lectures on Painting*

"In the group of the Laocoon the frigid ecstasies of German criticism have discovered pity like a vapour swimming on the father's eyes, he is seen to suppress in the groan for his children the shriek for himself, his nostrils are drawn [illegible] sufferings, whilst he [illegible] celestial help To these are added the winged effects of the serpent poison, the writhings of the body, the spasms of the extremities To the miraculous organization of such expression Agesander, the sculptor of the Laocoon was too wise to lay claim His figure is a class, it characterizes every beauty of virility verging on age the prince, the priest, the father, are visible, but, absorbed in the man seem only to dignify the victim of *one* great expression Though poised by the artist, for us to apply the compass to the face of the Laocoon is to measure the wave fluctuating in the storm this tempestuous front, this contracted nose, the immersion of these eyes, and above all that long-drawn mouth, are, separated and united seats of convulsion — features of nature struggling within the jaws of death"

Of this famous group of sculpture Pliny says that it is "*opus omnibus picturæ et statuariæ artis præferendum*" It was discovered at Rome among the ruins of the palace of Titus, at the beginning of the 16th century, and afterwards placed in the Farnese palace, whence it found its way to the Vatican It was executed by Polydorus, Agesander, Athenodorus, the three celebrated artists of Rhodes The *Penny Cyclopædia* has an excellent article on this subject, to which we beg to refer

LAPIDARY STYLE (Lat lapis, *a stone*), denotes the style proper for monumental or other inscriptions, and is thence sometimes used to express a terse, expressive style The rules of this style have been prescribed by Cicero — 'Accedat oportet oratio varia, vehemens, plena spiritus Omnium sententiarum gravitate, omnium verborum ponderibus est utendum"

LAPILLI (Lat lapillus *a little stone*) Small volcanic cinders

LA'PIS (Lat) In Roman Antiquity literally a stone, but used among the Romans to signify a mile, at the end of which lapides or stones were erected with a mark thereon to show the distance from Rome Hence the phrases "tertius lapis," "centesimus lapis," &c, for 3 100, &c miles, and sometimes even the ordinal number was used, with *lapidem* understood, as "ad duo decimum,' — twelve miles distant The Roman practice of indicating the distance of one place from another by the erection of stones has been borrowed by almost all the nations of modern Europe

LA'PIS CAUSTICUS Caustic potash

LA'PIS INFERNA'LIS Fused nitrate of silver, often called *lunar caustic*

LA'PIS LA'ZULI A blue mineral found in masses or nodules consisting chiefly of silica and alumina, with about twenty *per cent* of soda, and some peculiar combination of sulphur, to which it probably owes its colour, it is often sprinkled with yellow pyrites It furnishes the valuable pigment known under the name of *ultra marine*, and was formerly much employed in ornamental inlaid work Persia, China, and Russia are its chief sources

LA'PITHÆ In Ancient [illegible] Thessaly chiefly known to us [illegible] with the Centaurs The battle [illegible] and the Lapithæ has been described by Hesiod, and by Ovid with [illegible] (*Met* xii) To the Lapithæ has [illegible] invention of bits and bridles for horses

LAPSE (Lat lapsus, *a slip*), in Ecclesiastical Law, is the omission of a patron to present a clergyman to a benefice within six months after its being void, in which case the benefice is said to be void, and the right is lost to the patron In England the right of presentation then accrues to the bishop, and to the sovereign by the neglect of these, and in Scotland it devolves on the presbytery

LA'PWING The name of a native species of the genus *Vanellus*, dismembered by Bechstein from the *Tringa* of Linnæus (*See* VANELLUS and TRINGA) The lapwing or pee-wit (*Vanellus cristatus*, Bechst) is a constant inhabitant of this country, subsists chiefly on worms and the animalcules of the sea-shore, which it frequents

a infinitely small time $dt$ [illegible] as before, and the [illegible] is $dx$, there [illegible] velocity is [illegible] and time conjointly, we have $dx = v\,dt$ (1)

Let $\phi$ represent the force which accelerates the body at the end of the time $t$, since the motion [illegible] as uniform during an infinitely small [illegible] velocity at the end of the time $t$, then $v + dv$ is the velocity at the end of the time $t + dt$, and therefore $dv$ is the increment of velocity due to the force $\phi$ during the time $dt$. Assume F = a constant force which produces a velocity = V in the portion of time which is assumed as unity (for instance, one second), then the velocity generated by F in the time $dt$ will be $V\,dt$. Now, since $\phi$ produces the velocity $dv$ in the instant of time $dt$, and F produces the velocity $V\,dt$ in the same instant, and since the forces are proportional to the impressed velocities, we have therefore $\phi : F :: dv : V\,dt$. Now, suppose F to be the unit of force, and V the unit of velocity, and the proportion becomes $\phi : 1 :: dv : dt$, whence $dv = \phi\,dt$ (2)

Differentiating the equation $dx = v\,dt$ on the supposition that $dt$ is cons[illegible] result-ing value of $dv$ in (2), we [illegible])

The three differential equations now found, which define the motion of a body urged by an accelerating force, are usually exhibited as follows —

$$v = \frac{dx}{dt},\ \phi = \frac{dv}{dt},\ \phi = \frac{d^2x}{dt^2}$$

On eliminating $dt$ from the first and second, we obtain a fourth, $v\,dv = \phi\,dx$, which it is often convenient to employ. These equations, which may be considered as the foundation of the science of dynamics, are easily integrated when the accelerating force $\phi$ is supposed to be uniform. Their [illegible] taken on this supposition, give the equations of the motion *in vacuo*, of bodies accelerated by gravity, the discovery of which sheds so much lustre on the names of Galileo and Newton. See GRAVITY.

*Living Force* or *Vis Viva*, is a term frequently used by the mathematicians of the last century to denote the action of a force when it is estimated in such a manner as to be proportional to the square of the velocity. It has been stated above that when the masses moved are equal,

But the [illegible] under different aspects. If we conceive the effect to be measured by the *time* which elapses before a resistance of uniform intensity reduces the body to rest, then the force is proportional to the velocity simply; but if, on the other hand, we conceive the effect to be measured by the distance passed over by the moving body while subjected to the uniform resistance, then the force will be proportional to the square of the velocity. These two measures may both be considered as correct, and they are not inconsistent when rightly understood. A warm controversy, however, arose on the subject in which some of the most distinguished mathematicians of the time took a part, but when the ambiguity arising from the use of the word *force* in different senses was cleared away both sides were found to be in the right. (See *Playfair's Dissertation Fifth Part*.)

FORCER. In Mechanics, a solid piston applied to pumps for the purpose of producing a constant stream, or of raising water to a greater height than it can be raised by the pressure of the atmosphere. See PUMP.

FORCIBLE ENTRY AND DETAINER. In Law, a species of offence against the public peace committed by violently taking or keeping possession of lands and tenements with menaces, arms, and force, and without authority of law, to the hinderance of him who has right of entry. The remedy is, under several statutes, by action, by the intervention of justices of the peace, who have power, on view of the force, to make a record of it, and [illegible]

FORCING, [illegible] the art of accelerating the growth of plants, so as to obtain fruits or flowers at [illegible] the open [illegible] Romans, [illegible] is fond of cucumbers, forced them to bear fruit in the winter time by growing the plants in boxes kept in houses with talc [illegible] fine days, [illegible] or in cold weather. From some epigrams of Martial it has been thought that the Romans had both vineries and peach houses, talc (*lapis specularius*) being used instead of glass. In England forcing appears to have been practised from a very early period, radishes having been raised on dung beds covered during night by wheat straw from time immemorial, [illegible] forced on wooden walls or boarded [illegible] by linings of hot dung at the back, at least [illegible] ne of Charles II., and probably long before, since it is certain that melons and cucumbers were grown at Hampton Court for the royal table in the time of Henry VIII. At the present time forcing is carried on in Britain [illegible] climates throughout Europe are [illegible] under glass roofs [illegible] are known, as frames, pits, and [illegible] ve glass roofs, but there are also structures for forcing without glass roofs, such as cellars and sheds for growing mushrooms in the winter season, and also seakale, rhubarb, blanched succory, and such other stalks or leaves of plants as are eaten in a blanched state, and consequently do not re-[illegible] The art of forcing plants must never [illegible] the art of growing them in artificial climates, though in [illegible] the principles by which the gardener proceeds are essentially the same, viz. the [illegible] The chief difficulty of accomplishing [illegible] forcing is the want of light, and hence the earlier in the season that any forced crop is produced, the greater is its deficiency in colour and flavour. Gentle forcing, so as, as it were, to anticipate spring, and bring fruits so far forward as to enable them to profit from the full influence of the sun during our short summers, may be considered as a real advantage, which will never cease to be sought for, and as a case in point we will mention the grape, the fruit of which is never brought to perfection in this country unless the plants have been partially forced. To force, in any country, the fruits which come to perfection in the open air in that country, such [illegible], in Britain, [illegible] only be considered [illegible] which would be more elegantly and usefully expended in forcing the fruits or in growing the flowers of warm climates, which can only be brought to perfection in this country under glass. Even this kind of forcing is open to criticism, on what may be called the greatest enjoyment principle. For example, there are certain fruits, such as the mango, the dourion, mangosteen, &c., which could only be grown in this country at an enormous expense, and probably when grown would not be worth eating, while there are certain other fruits, such as the pine apple and the banana which can be grown in this country at a moderate [illegible] per [illegible] kind of fruit merely for the sake of overcoming the difficulty of doing so, we hold to be in bad taste, though we allow that some good might result from it to horticultural science, by calling forth the skill and ingenuity of gardeners. This, indeed, may be considered as [illegible] which will be produced by fe[illegible] of intercommunication by means of steam and railways, it seems highly probable that the fruits of warm climates will cease altogether to be cultivated in cold climates, with the exception of some, such as the cucumber, melon, banana, fig, &c., which require to be eaten when freshly gathered. Even at the present time, with the comparative [illegible] which exists between this country and the south of Spain and the West Indies, there is no reason why we should not be supplied with pines, grapes, and oranges throughout the year. The hothouses of gardens will then be chiefly employed for the culture of exotic flowers and exotic plants of curiosity.

FORCING PUMP. *See* PUMP.

FORE. The sea term for the part of the ship near the head.

FORE AND AFT, implies lying in the direction of the head and stern, also, the whole of the vessel generally.

FORECASTLE. The upper deck near the head; this was formerly much raised, hence the name.

FOREFOOT. A piece of timber at the fore extremity of the keel.

FORELAND. In Fortification, a piece of ground between the wall of a place and the moat. Foreland is also used synonymously with promontory, cape, headland, &c., as the North Foreland in Kent.

FORESHORTENING. In Painting, the representation of any object presented obliquely to the eye.

FOREST. (In Germ. *forst*, from whence our word is probably derived, although the ultimate etymology is unknown. The Saxon word *hurst*, with which the names of so many places in the South of England terminate, has probably the same origin. In the primitive meaning of the word it probably signified an enclosed place from which intruders were excluded; hence some have derived it from the Latin *foris*.) An extensive surface, covered [illegible] opposed to a plan-[illegible] In former times the greater part of every country in the temperate parts of Europe was undoubtedly covered with forest, and these by nourishing wild animals of every description, particularly wild swine, afforded a principal part of the food of man. With civilization, however, they gradually disappeared before the spread of extensive pastures or arable land. In every country a large portion of the forests belonged to the government, and formed a main source of its revenue. This is still the case in France and Germany, and till lately it was also the case to a

certain extent in Britain Hence extensive tracts in England still bear the name of forest, though they are now in a state of cultivation and in a great measure without trees Many ancient laws and customs are recorded in books respecting the forests of the crown, but at present, as there are only three or four government forests in Great Britain, these laws and customs are of very little consequence, excepting to those living in their immediate neighbourhood

Many of the spots which in England bear the name of forest have [illegible] having been covered with trees at any [illegible] became stocked The English forests (with the exception of the New Forest of which the history is well known and has been carefully ascertained that we possess no record of their origin) There has been reckoned [illegible] to 76 but some of these are probably only parts of the same forest with different [illegible] A forest is created by the king by a commission issued out of the Court of [illegible] and when laws and ordinances have been framed and the limits proclaimed it becomes a forest by matter of record [illegible] Savernake Forest in Wiltshire [illegible] Marquis of Allesbury is we believe at present the only instance By the ancient forest laws the Courts of the Forest were,—1 The Justice Seat, a court of justice in eyre of the forest held every third year to take cognizance of trespasses, pleas and causes (The last justice seat held in England for any other than mere formal business was for Windsor Forest in 1632) 2 The Swain-Mote, or meeting of freeholders of the forest, held to receive and try presentments against offences in matters connected with the forest laws (in *vert* and *venison*), which presentments, 3 The Wood Mote was held every forty days to receive and inquire into, but not to try The principal officers of the forest were, its two justices in eyre, warden, regarders, foresters rangers, &c, some of which are still retained The forest laws are of early date in England those of K[illegible] Under the first [illegible] went on gradually [illegible] one of the chief oppressions under [illegible] suffered But in 1224 the Carta de Foresta granted by Henry III, fixed the limit of these aggressions The capital punishments and mutilations of the former laws were rendered commutable for fines and the king assented to a new perambulation of the forests at which time and subsequently, portions which had been illegally annexed to forests were disafforested These portions are called Purlieus In 1297, this charter was fully confirmed by Edward I For an account of [illegible] orests of this country, see *Statistics of the Br[illegible]*

FORE-STAFF A rude instrument formerly used at sea for taking altitudes, and so called because in using it the observer turns his face to the object instead of turning his back to the object, as is necessary in using the *back-staff* Both these instruments have been superseded by the *sextant*

FORESTALLING THE MARKET, in Law, is defined to be the buying up or bargaining for goods on their way to the market, in order to dispose of them at a higher price But all mercantile practices having a tendency to enhance the common price have been by a very [illegible] within the same description [illegible] classed with ingrossers (those who bring up commodities to retail) and regraters (said to be derived from Fr regratter *to scrape over* in the dressing or scraping c[illegible] again) Severe statutes have been passed at different times, from 5 & 6 Ed 5 downwards, against this alleged offence They were all repealed by 12 G 3 c 71 But it is said that the offence at common law still subsists nor was it until 1827 (7 & 8 G 4 c 38) that constables were expressly relieved from the (obsolete) duty of making presentments of forestallers at the quarter sessions Although acts of this description have ceased to be subjects of criminal prosecution [illegible] them is yet wanting [illegible] and has been often observed that [illegible] for most commodities be rendered steady [illegible] protected from the injurious consequences of excessive dearness, and the seller from those of glut and overcheapness, as by the intervention of an intermediate body of wholesale dealers between the former and the latter

FORFEITURE (Lat forisfactura, *expulsion or outlawry*), has been defined to be a punishment annexed by law to some illegal act or negligence in the owner of real property, whereby he loses all his interest therein, and they go to the parts injured as a recompence for the wrong which either he alone or the public with him hath sustained Forfeiture is either civil or criminal Civil forfeiture takes place when some alienation is made contrary to law as in mortmain, or when a particular tenant alienes for a larger estate than he himself hath [illegible] when tenant for life makes a conveyance in fee Forfeiture for crimes or causes takes place in treason or felony, and for one or two other offences After judgment has been given, and the guilty party is said to be attainted, the forfeiture has a retrospective operation to the time when the offence was committed, so as to invalidate all sales and incumbrances that may have been effected since that time Except in treason or murder, the forfeiture is only for the life of the offender, in treason [illegible] the forfeiture extends to the [illegible]

FORFICULA (Lat forfex, *pincers*) A Linnæan genus of insects, now [illegible] *Dermoptera* (which see), and [illegible] *Labidura*, *Labia*, *Ch*[illegible] of which the labours of modern entomologists have made known numerous species, the common ear-wig (*Forficula auricularia*) is the type of this group of insects

FORGE [illegible] The workshop in which iron is hammered and shaped by the aid of heat The term is generally applied to the places in which these operations are carried on upon the comparatively small scale, the great workshops in which iron is made malleable for general purposes [illegible] A common forge consists [illegible] which is merely a cavity in masonry or brick-work well lined with fine clay or brick, upon which the ignited fuel is placed, and upon the back or side of which a powerful blast of air is driven in through the nozzle of a double-blast bellows, which in a common forge is generally worked by a hand lever Forges are sometimes constructed so as to be portable, when the bellows is most conveniently placed under the hearth, these are used in ships, and for various jobs on railways, &c

FORGERY, in Law, is defined to be the fraudulent making or alteration of any record [illegible] ment, register, stamp &c, to the [illegible] r man's right The statutes respecting this offence were [illegible] the act of 1830 (11 G 4 and 1 W 4 c 66), which also after long and reiterated discussions, finally abolished the punishment of death in all cases, except for the forgery of wills and bills of exchange This last remnant of the ancient code was finally removed in 1832 and 1837 by the statute 2 & 3 W 4 c 123 and 1 Vict c 84 by which the present punishments are fixed, varying from imprisonment for various terms to transportation for life, according to the classification of the offences comprehended under this general title

C[illegible]

st[illegible]

convicted of forging and uttering forged notes amounted to 104 in 1816 from whence it increased to 352 in 1820, fell to 134 in 1821 and since that time has diminished to a very small amount The number of executions in 1812 was 23 in 1818 (the greatest) 24 The last execution for forgery took place in 1829

FORLORN HOPE in Military affairs signifies certain men detached from several regiments or otherwise appointed to assume the initiative in an engagement, or, at a siege to storm the counterscarp, mount the breach, &c They are so called from the great danger to which they are inevitably exposed in such cases

FORM (Lat forma) In the Fine Arts, the bounding line of a material object In Painting, the word is more generally applied to the human form *See* BEAUTY

FORMATION A geological term, applied to a group of deposits or strata apparently referable to a common [illegible] period

FORMEDON In Law a writ in the nature of a writ of right which lies for him who has right to lands or tenements by virtue of an entail (*See* FEE TAIL) Formedon is in the *descender* the *remainder* or the *reve*[illegible] estate of the party who sues [illegible] *ancestor*)

FORMICA (Lat *ant*) A Linnæan genus of insects now [illegible] of the most numerous and extensively distributed [illegible] *Hymenoptera* and to that section which is negatively characterized by not being armed with sting and by not possessing any instrument for piercing the bodies of animals or the substance of plants for the purpose of oviposition

The procreative economy of these well-known and most interesting insects is that to which all their wonderful habits and peculiarities are essentially related, and amongst those genera which the wisdom of Providence has ordained should form associations for the purpose of multiplying, preserving, and providing for their kind, the ants stand in a prominent and interesting rank, whether viewed as presenting some of the higher traits of animal instinct, or as [illegible] Intelligence whose mute but potent overlords [illegible] thus so implicitly and cheerfully obeyed

In every species of insect the parents are relieved from the charge of providing for their offspring they neither attend to their wants, nor defend them from harm in their immature and helpless state, and this, not from any deficiency of natural attachment, but from the brief period of their existence after having attained the state [illegible] lose of [illegible] which

he has impregnated are excluded; and the female, whose last care has been to select a proper place for their development, soon dies after oviposition

In the instincts and habits of which we are about to give a brief notice, the exception to the above rule is more apparent than real, for the individuals which manifest the feelings and discharge the duties of the mother are but foster-parents, and consist of females with undeveloped ovaria, and which are consequently unprolific, and are termed *neuters* The males perish, and are destroyed by the neuters soon after having fulfilled their office, the prolific females, upon whom, on the contrary, the cares and affections of the neuters or workers are abundantly lavished die soon after the ova are matured and excluded This apparently threefold distinction of sex is peculiar to gregarious insects, as bees and ants

Our countryman Gould describes five species of ants, viz, 1 The hill ant (*Formica rufa*, Latr.), 2 The dusky ant (*F fuliginosa*, Latr.), 3 The red ant (*Myrmica rubra*, Latr., *Formica*, Linn.), 4 The common yellow ant (*F flava*, Latr.), and, 5 The small black ant (*Formica fusca*, Linn.)

In incipient societies of ants, as well as humble-bees (*Bombi*, Latr.) and wasps (*Vespæ*, Linn.), one female lays the foundation of the future colony, and the first brood which is hatched is very small The larvæ, when first hatched are hairy, and continue in the larva state twelve months or more

The larvæ of the red ant do not, as other ants do spin a cocoon when they assume the pupa state The societies of ants as also of other *Hymenoptera* differ from those of the *Termites*, or white ants in having inactive larvæ and pupæ, the neuters or workers combining in themselves the office of nurses, soldiers, and attendants These undeveloped females never acquire wings The female ants are furnished, at their first exclusion, with two pair of wings, which, after swarming in concourse with the males, they almost immediately cast The office of the perfect or winged female is to provide a constant supply of eggs for the maintenance of the population These are usually the least numerous part of the community The office of the males (which are also winged during the time of swarming and are extremely numerous) is merely the propagation of the species, after the season for this is past they die Sometimes the swarms of a whole district unite their infinite myriads, and seen at a distance produce a beautiful and curious effect, from the glancing of their silvery wings The males and females quit the nests their nursing places, about the end of July, or later to the beginning or middle of September The commotion which these winged individuals create in the nests before they issue forth to fulfil their proper functions is excessive The whole swarm, when unhoused alternately rises and falls with a slow movement to the height of about ten feet, the males flying obliquely with a rapid zigzag motion, and the females though they follow the general movement of the column, [illegible] in the air, like balloons seemingly [illegible] motion, and having their heads turned towards the wind

The noise emitted by countless myriads of these insects does not however, exceed the hum of a single wasp, for their wings are weak and bend to the wind, which carries the swarm irresistibly along All the males, and the greater part of the females are destroyed by becoming the prey of birds and fish and other insectivorous creatures, for the loss of their wings only lent them till the swarming season be past, renders them the most helpless and inactive beings and they fall into the water in shoals, as well as bestrew the land Dr Bromley, while surgeon of the ship Clorinde witnessed a scene which will give some idea of the multitudes of these insects which fall a prey to fishes alone

"In September, 1814,' he observes "being on the deck of the hulk to the Clorinde, my attention was drawn to the water by the first lieutenant (since Captain) Haverfield, observing there was something black floating down with the tide On looking with a glass, I discovered they were insects The boat was sent and brought a bucket full of them on board They proved to be [illegible] of ant, and extended from the upper part [illegible] Reach out towards the Great Nore, a distance of five or six miles The column appeared to be in breadth eight or ten feet, and in height about six inches, which I suppose must have been from their resting one upon another"

These ants were winged, so that they had probably been driven into the water by violent weather When [illegible] has taken place, the females alight, and [illegible] have been seen to seize and make prisoners of them, hanging upon their legs to detain them, leading them back to the formicary, and never quitting them till they are ready to lay their eggs, or become reconciled to state imprisonment, for such it really appears to be They pay every attention to the royal prisoner's wants or comforts, leading her to the most genial spots in the nest, and regularly feeding her, but all this under a body guard which, as her powers of locomotion become impeded [illegible] of the ovaria is gradually reduced [illegible], is constantly relaxed The situation of this attendant is remarkable, being mounted on the queen-mother's body, and its office seems to be that of waiting till the eggs are produced, when it seizes and carries them off to the nurseries, or cells, prepared for this purpose One of these queen ants will lay upwards of four or five thousand eggs in a year

Gould gives an amusing account of the homage paid to the fertile mother of the future colony by the working ants They will press round her, offer her food, conduct her by her mandibles through the difficult or steep passages of the formicary they even carry her about their city She is then suspended upon their jaws, the ends of which are crossed, and, being coiled up, she is packed so close as to incommode the bearers but little When she is alighted others surround and caress her, one after another tapping her on the head with their antennæ They have a particular way of skipping, leaping, and standing upon their hind legs, and prancing with each other These frolics they make use of [illegible] when they meet, and to show their [illegible] for their queen Some of them gently walk over her, others dance round her, and if separated from her will soon collect in a body and enclose her in the midst When she dies, they have been known to pay her the same attentions for months, and to brush and lick her continually Different species vary in their instincts, which produces some variation in their domestic proceedings, but the general line of conduct is the same throughout In some nests several female ants have been known to live together on amicable terms showing none of the spirit of exclusive rivalry so observable in the queen bee Of all insects the ants seem to have the most perfect mode of communicating with each other On this curious subject, the learned entomologists Kirby and Spence thus express themselves — 'The fact being certain that ants impart their ideas to each other, we are next led to inquire by what means this is accomplished It does not appear that, like the bees they emit any significative sounds, their language, therefore must consist of signs or gestures, some of which I shall now detail In communicating their fear or expressing their anger, they run from one to another in a semicircle, and strike with their head or jaws the trunk or abdomen of the ant to which they mean to give information of any subject of alarm But those remarkable organs, their antennæ, are the principal instruments of their speech, it it may be so called supplying the place both of voice and words When the military ants before alluded to go upon their expeditions, and are out of the formicary previously to setting off they touch each other on the trunk with their antennæ and forehead this is the signal for marching, for, as soon as any one has received it, he is immediately in motion If a hungry ant wants to be fed it touches with its two antennæ moving them very rapidly, those of the individual from which it expects its meal The helpless larvæ also, of the ants are informed by the same means when they may open their mouths to receive their food Whether ants with man and some of the larger animals, experience any thing like attachment to individuals, is not easily ascertained, but that they act as if they felt the full force of the sentiment which we term patriotism, or the love of the community to which they belong, is evident from the whole series of their proceedings Distress or difficulty falling upon any member of their society generally excites their sympathy, and they do their utmost to relieve it'

The attachment of the neuters is continued to the offspring of the perfect female through the states of ova, larva, and pupa, and even increases at each progressive stage, their greatest cares are lavished on the cocoon which they may be seen bringing out into the air in fine weather, and carrying back again into the nest when the heat is too great or on the approach of rain, of which they have an instinctive knowledge It is the cocoons also, which are the first objects of their solicitude when the formicary is broken in upon and although the cocoon is double the size of the entire ant, yet it bears it away with an agility which shows that the weight is no incumbrance

The combats between the ants of neighbouring communities are generally caused by the instinctive fondness which the workers have for the cocoons, and which they cannot see without attempting [illegible] as an object of care and attention In [illegible] fight with fierceness and obstinacy, sometimes carrying off the head of the vanquished upon their antennæ, like an American Indian who bears his enemy's scalp about his neck as a trophy, not that the ant warrior voluntarily carries this troublesome proof of his valour, for he would [illegible] an incumbrance, but this is seldom [illegible] lives

The males and females never fight, the neuters alone attacking or defending Besides their other weapons, ants are furnished with the power of ejecting an acrid

juice from their abdomen, in sufficient quantity and force to repel any small antagonist

Huber also gives a most terrific account of the civil wars between ants of the same species, but composing different communities Nothing can exceed the ferocity or pertinacity of these battles The infuriate creatures tear [illegible] single combat [illegible] ter [illegible] tide of war and gives victory to one side But these battles are frequently renewed day by day, the combatants retiring as night approaches, till the rainy season brings the fierce little citizens to reason, and both parties retire to their citadel It is a curious fact that though the opposing armies are of one species, each party knows a fellow-lodger even in the wildest part of the action, for Huber states, that if by accident an ant had attacked a friend, caresses immediately succeeded to blows M P Huber states as a fact [illegible] which they carry off in predatory excursions while in an infant state These slaves are of a small black species and when reared perform the offices which generally devolve upon the neuters or workers in other societies besides which they have to feed their masters and carry them about the nest Indeed so totally dependant are these masters upon these indefatigable little slaves that the term should rather be reversed, for it appears that these lords of the community may not venture forth from the nest but with permission of the negroes, and M P Huber proved by experiment that they would die of starvation if not fed by these indispensable servants There is likewise another species (the *F cunicularia* L) which are forcibly carried off by the rufescent ants, but from their being more courageous than the negro species the depredators are obliged to go with greater strength of numbers and more precaution The account which M Huber gives of these excursions after slaves is highly curious and interesting the enemy, making use of manœuvres and tactics, and the assailed receiving them with such arrangements as any but a close observer of insect economy and habits would declare to be impossible but to human intellect The *F sanguinea* is not, however so helpless and utterly dependant on the black ants but will rouse themselves upon occasion, and protect their slaves, and even transport them to another habitation when changing their residence, which is sometimes the case

The negro and miner ants, when attacked by the marauding species in their dwelling make every effort to place the young brood and the newly excluded females out of danger carrying them to some distant place of security as soon as the alarm is given, and during the combat hundreds are so employed, but when tranquillity is once more restored they bring back these precious charges, and place them within the walls of the fort of which they barricade the entrances and place a strong guard near in case of future attempts To prove how dependant the rufescent ants are upon their little notable black servants, Huber tells of an experiment he made by shutting up thirty of them in a glazed box supplying them with honey in one corner of their prison and placing with them larvæ and pupæ both of their own species and that of the negro At first they made some little exertions in regard to the young carrying them from one place to another but soon seemed to find this too great an effort and though food was in the box most of them died in a few days, rather than help themselves to it Huber in commiseration of their wretched condition, then put in a single little negro ant which actively set to work, making a cell in the earth, into which it collected the larvæ and feeding the pupæ ready to emerge, as well as the still surviving neuters Huber also mentions other experiments tending to the same end, which perfectly succeeded in showing the vital importance of these slave ants to their masters under various circumstances, and proved that this curious habit depends on something more than the mere blind attachment of the imperfect females for *pupæ*

Linnæus speaks of the strange fact of "ants milking their cows, the *Aphides*," and Huber relates many highly interesting particulars in addition He says, the ants not only suck the sweet juice which is constantly passing through the body of the *Aphides*, but make use of their [illegible] to produce a ready evacuation [illegible] the sides pretty briskly They are very jealous of the possession of these their milch cows, sometimes fighting fiercely in their defence, and forming earthen boundaries for their detention The Brazilian ant, *Formica fulva* Gmel is [illegible] herds, [illegible] ants tending the eggs as it would their own brood This yellow ant exceeds all the other species of Aphis loving *Formica* in the great number of its herds

It appears, from observations made both by Gould and Huber, that when a nest becomes overpopulated, or from some other reason, emigrations take place, which are conducted in a very interesting and singular manner A few having apparently made up their minds on the subject, endeavour, by the usual signs, to induce others to accompany them to the spot chosen for the new encampment, and as pairs accost carry the newly-persuaded recruit [illegible] thither, who in his turn goes back with his conductor to the old nest, and engages a fellow-citizen to accompany him also, and thus by degrees the whole congregation emigrate This emigration does not, in all instances, proceed by dint of persuasion, for the recruiting ant will, without warning, sometimes seize upon another, and carry it off suddenly to the new site which rough proceeding does not however prevent the ant so removed in joining in the attempt to raise more recruits, for it returns, like the others, and fetches a companion The turf ants (*F cæspitum* L) upon these occasions, carry their fellow emigrants in an uncoiled form, with the head downwards These observations chiefly apply to the great hill ant (*F rufa*) though several other species migrate They will in case the new settlement is at a considerable distance form temporary colonies by the way, all, however, uniting at last in one principal formicary

Ants work during the night as well as by day

Our native ants usually make their first appearance in March and continue in activity till the middle or end of October They are fond of basking and sporting in the sun, and their antics at these times are described by the best observers as exceedingly amusing, some appearing to wrestle, and others actually carrying each other on their back in the most playful manner They are not torpid during the whole winter but are in genial and mild days sometimes to be seen in full activity Extreme cold causes them to cluster together in compact bodies, as if by this means to preserve a sufficient quantity of animal heat to allow of their occasional return to the labours of life That ants will attack and kill, for food, insects and animals infinitely larger than themselves, is very well known their strength is prodigious compared with their size Mr Kirby says "I have seen an ant dragging a wild bee many times bigger than itself"

The bite of some foreign ants is very severe Sir Joseph Banks observed a green species in New South Wales which inflicted a wound scarcely less painful than that of a bee One called the fire ant is so called from its bite resembling the pain occasioned by a spark of fire Some ants in Ceylon produce great anguish from their bite Those species usually found in Great Britain may almost be called harmless in this respect

There is a species in Cayenne (*Formica bispinosa*) which collects from the bombax and silk cotton tree a sort of lint which the natives value much as a styptic in cases of hæmorrhage, but though this species benefits man, there are several whose ravages have sometimes more than counterbalanced the good produced by these insects Within the last century, what might truly be called a plague of ants appeared at one period in the island of Grenada in such hosts as to put a stop to the cultivation of the sugar cane The destruction of this plant is not caused by the ants devouring it, but by their [illegible] under its roots At the time of the attack the numbers were only to be compared with sand strewed over every place and thing They descended from the hills and covered the plantations, and did not confine their attacks to plants, but rats, mice, and even birds, when alighting on the ground fell a prey to them Streams of water only opposed their frightful progress for a moment, masses of them rushing or being impelled by the hosts behind, into the water and only forming by their carcasses a raft or bank for the rest to pass upon Fire was tried in vain as a barrier to their progress, such infinite swarms rushed into the blaze as to extinguish it A reward of 20 000*l* was offered to whoever should discover an effectual method of destroying them but in vain The standing crops of sugar cane were burnt down, and the earth dug up but no human means was found effective At length, in the year 1780 they were annihilated by the torrents of rain which accompanied an awful hurricane, which was most fatal in its effects to the other West India islands But it is only fair to state, after such an account of devastation, that such an occurrence is exceedingly rare, and that these all-devouring creatures, besides being admirable in their household economy and laws, benefit us by removing and destroying multitudes of tormenting insects and reptiles, and in their turn serve as food to thousands of other animals

Several species of Mammalia, in foreign countries, are [illegible] for restraining the undue increase of [illegible] the *Myrmecophaga* having claws of prodigious strength for making a breach into the strong walls of the formicaries of the exotic ants, and a long glutinous tongue for sweeping off thousands of the disturbed community In England, the habitations of

the various species of ants are less conspicuous, but not less curious, than the formicaries of tropical countries They are thus described by Kirby and Spence —

"The nest of the large red ants (*F rufa*, L ), which are common in woods, at the first aspect seems a very confused mass Exteriorly it is a conical mount, composed of pieces of straw, fragments of wood, little stones, leaves, grains, in short, of any portable materials within their reach, but, however rude its outside and the articles of which it consists, [illegible] admirably calculated at once for a [illegible] the excessive heat of the sun, and yet to retain a due proportion of genial warmth It is wholly composed of numerous small apartments of different sizes, communicating with each other by means of [illegible] stories, some very deep, [illegible] the former for the reception of the young [illegible] the mount consists, and thus give solidity to the whole Besides the avenues which join the apartments together, other galleries varying in dimensions, communicate with the outside of the nest at the top of the mount These open doors would seem ill calculated for protection against nocturnal enemies, but [illegible] continually, according to circumstances, and they wholly close them at night, when all gradually retire to the interior, and a few sentinels only are left to guard the gates On rainy days too, they keep them shut, and when the sky is cloudy open them partially

"The habitations of these ants are much larger than those of any other species in this country and sometimes as big as a small haycock, but they are mere molehills when compared with the enormous mounds which other species, apparently of the same family but much larger, construct in warmer climates Malouet states, that in the forests of Guiana he once saw ant-hills which, though his companion would not suffer him to approach nearer than forty paces for fear of his being devoured seemed to him to be fifteen or twenty feet high and thirty or forty feet in diameter at the base assuming the form of a pyramid truncated at one third of its height, and Stedman, when in Surinam once passed ant-hills six feet high, and at least one hundred feet in circumference

"The nest of *Formica brunnea*, Latr, is composed wholly of earth, and consists of a great number of stories, sometimes not fewer than forty,—twenty below the level of the soil and as many above, which last, following the slope of the ant-hill, are concentric Each story separately examined, exhibits cavities in the shape of saloons, narrower apartments, and long galleries, which preserve the communication between both The arched roofs of the most spacious rooms are supported by very thin walls, or occasionally by small pillars and true buttresses, some having only one entrance from above, others a second communicating with the lower story The main galleries of which in some places several meet in one large saloon, communicate with other subterranean passages, which are often carried to the distance of several feet from the hill These insects work chiefly after sunset In building their nest, they employ soft clay only, scraped from its bottom when sufficiently moistened by a shower, which, far from injuring consolidates and strengthens their architecture Different labourers convey small masses of this ductile material between their mandibles, and with the same instruments they spread and mould it to their will the antennæ accompanying every movement. They render all firm by pressing the surface lightly with their fore feet, and, however numerous the masses of clay composing these walls and though connected by no glutinous material, they appear, when finished one single layer, well united, consolidated, and smoothed Having traced the plan of their structure, by placing here and there the foundations of the pillars and partition walls, they add successively new portions, and when the walls of a gallery or apartment, which are half a line thick, are elevated about half an inch in height, they join them by springing a flattish arch or roof from one side to the other Nothing can be a more interesting spectacle than one of these cities while building In one place, vertical walls form the outline, which communicate with different corridors by openings made in the masonry, in another, we see a true saloon, whose vaults are supported by numerous pillars; and further on are the cross ways or squares where several streets meet, and whose roofs, though often more than two inches across, the ants are under no difficulty in constructing, beginning the sides of the arch in the angle formed by two walls, and extending them by successive layers of clay till they meet, while crowds of masons arrive from all parts with their particle of mortar, and work with a regularity harmony, and activity which can never enough be admired So assiduous are





they in their operations, that they will complete a story, with all its saloons, vaulted roofs partitions, and galleries, in seven or eight hours If they begin a story, and, for want of moisture, are unable to finish it, they pull down again all the crumbling apartments that are not covered in

"Another species of ants (*F fusca*, L ) are also masons The societies of *F fuliginosa*, Latr, make their habitations in the trunks [illegible] and *F atrata* and *F flava*, Latr ) use saw-dust in forming their habitations Some ants form their nests of the [illegible] of these was observed by Sir Joseph Banks in New South Wales, which was formed by glueing together several leaves as large as a hand To keep these leaves in a proper position, thousands of ants [illegible] and if driven away, the leaves spring back with great violence"

FORMIC ACID A sour liquor which ants eject when irritated, and which was formerly obtained by bruising them, mixed with water [illegible] over It has been ascertained by Döbereiner, that an analogous acid may be artificially obtained by distilling, from a capacious retort a mixture of 2 parts of tartaric acid, 3 of peroxide of manganese, and 3 of sulphuric acid diluted with 5 of water The tartaric acid acquires oxygen from the oxide of manganese and is resolved into water, carbonic acid, and formic acid From the analysis by Berzelius of formiate of lead, it appears that formic acid is a compound of 2 atoms of carbon 3 of oxygen and 1 of hydrogen, or of 2 atoms of carbonic oxide and 1 of water

FORMICA'TION (Lat formica, *an ant*) The [illegible] on the skin, resembling the crawling of ants on different parts of the body

FO'RMULA In Algebra, the expression of a theorem or general rule for the solution of some problem Thus the area of a triangle is expressed in terms of its three sides, $a, b, c$ and the semiperimeter, $s$, by the formula

$$\sqrt{s\,(s-a)\,(s-b)\,(s-c)}$$

FORMULA, or FORMULARY, in Medicine, &c, signifies a prescription

FORNIS A term occasionally applied by medical writers to the infectious causes of diseases

FORNIX (Lat ) An arch In Anatomy, this term is applied to a part of the *corpus callosum* of the brain, which, when viewed in a particular direction, somewhat resembles the shape of a Gothic arch It is the medullary body, composed of two anterior and two posterior *crura*, situated at bottom and inside of the lateral ventricle, over the third ventricle and below the *septum lucidum* See BRAIN

FORSTERITE A mineral named after Mr Forster, it forms brilliant and small crystals, colourless and translucent, and is found at Vesuvius accompanied by pyroxene It contains silica and magnesia, but has not been carefully analyzed

FORT A castle or small fortress, a place of inconsiderable extent, fortified by nature or art *Field-fort*, or fortlet is a small fort principally constructed for the defence of a camp or for defending a *pass* or *post*

FO'RTE (Ital ) In Music, a direction to the performer to execute the part loudly to which the word is affixed It is indicated by the single letter F If two F F's, thus are used the part is to be played or performed *fortissimo*, very loud

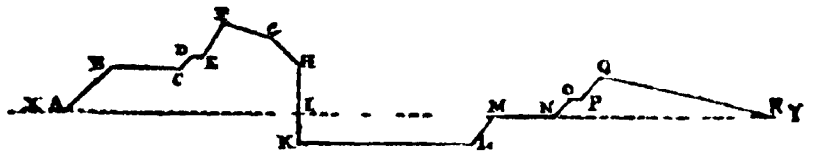
FORTIFICATION, also called *Military Architecture*, is the art of constructing such works of defence as may enable a comparatively small number of men to maintain possession of a city or place against the assaults of a superior force

The nature of constructions necessary for defence will be determined by the means of aggression In early ages, when the sling and the bow formed the principal weapons of offence, men considered themselves sufficiently defended by a single wall or a bank of earth, from behind which they could discharge their missiles against their assailants In progress of time projecting towers were added, which served the double purpose of increasing the front of the besieged, and of enabling them to attack in flank the besiegers when approaching to scale the wall The invention of the battering ram rendered no other change necessary than that of increasing the thickness and strength of the wall To aid the means of defence, projecting galleries were constructed at the summit of the wall and round the towers, through the pierced floors of which stones and other missiles were [illegible] on the heads of the assailants These galleries were called *machicoulis* or *massecoulis*, from the French *mâcher des masses*, because they served the purpose of enabling the besieged to let fall heavy masses, to which cords were attached in order that they might be drawn up again and let fall anew when the enemy returned to sap Apertures or loop-holes for the discharge of arrows and javelins were made in the battlements, or

pierced in the walls, and the defensive means were completed by surrounding the whole place with a deep moat or ditch. But the invention of gunpowder rendered it necessary to adopt an entirely different system of defence. Walls of masonry however thick, can withstand for but a short time the assault of heavy artillery, hence those successive circumvallations and constructions of earth which constitute the defences of a modern fortress.

Happily for Great Britain, who...'s insular situation has exempted her from foreign invasion, her internal dissensions have neither been so frequent nor so protracted as to render the art of constructing permanent fortifications of much national importance. It has been on the continent of Europe, where war has flourished in greater vigour, that the art has been created and chiefly cultivated. A modern fortification consists of a great number of parts, to which, for the purposes of description, it is necessary to give distinct names, and it would naturally happen that those who first contrived the particular forms of the different parts would designate them by names drawn from their own language. These appellations, chiefly of French, but occasionally of Italian origin, have been transferred into our language by the ignorance of translators, and carefully retained through the pedantry of our military engineers, so that all our works, without exception, which treat of fortification are obscured by a mass of barbarous jargon through which it is difficult to catch a glimpse of the few simple principles which determine the forms of all defensive constructions.

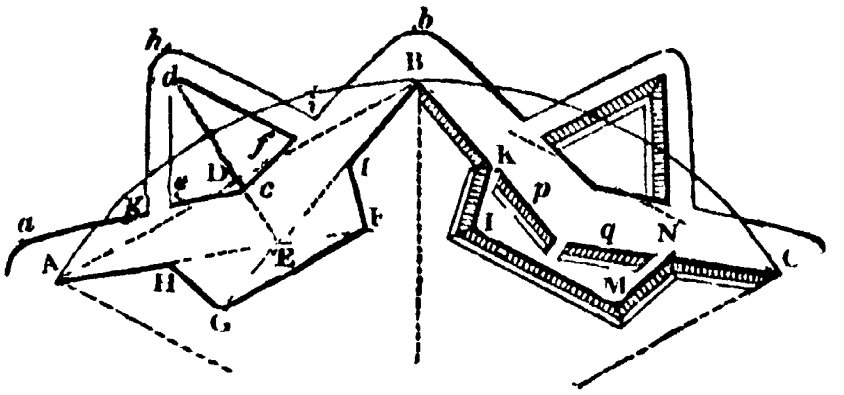
Modern fortifications, though differing in some subordinate details, which differences are dignified by the name of *systems* closely resemble one another in all their essential parts. In order to explain their structure it will be convenient to consider them first without reference to their form or the position of the ground lines in respect of each other, but merely as defences against an army with artillery advancing directly in front. The annexed figure represents a vertical section of a regular



fortification on the ground line X Y, the place to be defended being supposed between X and A. The mass of earth A B C D E F G H forms the rampart with its parapet. A B is the interior slope of the rampart, B C is the *terre-plein* of the rampart, having a breadth of about 40 feet, on which the troops and cannon are placed. D E is called the *banquette*, or step on which the soldiers mount to fire over the parapet, E F G is the *parapet*, of a height (about 7 feet) sufficient to protect the men and guns on the terre-plein, and sloped in the direction F G [illegible] edge of the ditch, so that a man [illegible] be seen and fired at, G H is the exterior slope of the parapet, H I is the *revetment* or wall of masonry supporting the rampart, and strengthened by buttresses placed at small intervals behind it. This must be of sufficient height to prevent its being easily scaled, but yet must not rise higher than the edge of the exterior work at Q, in order that it may not be seen and breached by distant batteries. The exterior front of the rampart, covered with the revetment H K, is called the *escarp*, I K L M is the ditch, the dimensions of which will be determined by the nature of the ground, but must be such, in general, that its excavation or *déblai* must produce sufficient earth or *remblai* to form the rampart, the opposite side of the ditch I M is the *counterscarp*, also supported by a revetment of masonry, M N [illegible] 10 yards in breadth, having a [illegible] N O P, [illegible] by a parapet P Q, the superior slope of which, Q R, is called the *glacis*. The use of the covered way is to allow troops to be drawn up, unseen by the besiegers, for the purpose of making sorties, it also enables the garrison to keep up a closer fire on the approaches of the enemy, and its parapet forms a strong protection to the revetment of the rampart.

It is easy to see that the strength of a place will be increased by a succession of such works, so that when the besieged are driven from one they may retire to the next behind it. Sometimes there are three ditches with [illegible] works, or rather works raised within the ditch itself similar to the rampart, though of a less height in order that the guns on the rampart may range above them. A work of this sort, between the inner and the main ditch, is called a *tenaille*, that between the main ditch and the outer ditch is called a *ravelin*. All works [illegible]

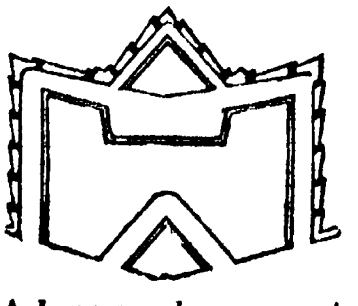
[illegible] fortification, it is necessary [illegible] lines will differ in some respects according to the system adopted, but the following description, which properly belongs to Vauban's first system, will explain the general method. — When the works nearest the sides are all equal, and therefore the [illegible] be that of a polygon inscribed in a circle. The first thing to be done is to determine on the number of sides. We shall suppose these to be six, and the radius of the circle to be 360 yards, when [illegible] follows. — Let A B, B C



be two sides of a hexagon inscribed in a circle, each of these lines will be equal to the radius, or 360 yards. Bisect A B in D, draw the perpendicular D E, on which set off D F, equal to one-sixth of A B, or 60 yards, draw the lines A F I and B I G, in which take A H and B I, each equal to 100 yards, or five ninths of A D, make H I and I G each equal to the distance H I, then the line A H G F I B is the principal outline of the front, and by making the same construction on each of the sides of the hexagon, we obtain the principal outline of the whole fortification, or that by which the first figure of the work is defined.

The part F I B K L is called the *bastion*, B I and B K are the *faces* of the bastion, I I and K L are its *flanks*, I L is the *gorge*, G I is the *curtain*, A F and B G are the *lines of defence*, B is the *flanked angle*, I and K are the *angles of the shoulder*, G F I and M the *angles of the flank*. From the points A and B as centres, and a radius of 40 yards describe circular arcs, if lines be drawn from the opposite angles of the shoulder H I to touch those arcs the parts of those lines *a c*, *b c*, together with the arcs will represent the *counterscarp* of the ditch. The curtain is defended by a *ravelin* which is constructed thus. — From c [illegible] angle of the counterscarp set off on [illegible] D I a line *c d* equal to 110 yards, and from *d* draw *d e*, *d f* in the directions of H and I to meet the counterscarp, then *d e* and *d f* are the *faces* of the ravelin and *c e* and *c f* its *semigorges*. The counterscarp *g h i* of the ditch of the ravelin is parallel to its faces, and rounded off at *h*. Stairs, called *pas-de-souris* are constructed to facilitate the descent from the ravelin to the ditch. Besides the ravelin there is usually another appendage to the bastion and curtain. This is the *tenaille*, represented in the [illegible] *p q* made in the direction of the lines [illegible] it has sometimes other forms. The tenaille is made in the ditch before the curtain, with passages between the ends and the flanks of the bastion. It is a low work, having its parapet only about 3 feet higher than the level ground of the ravelin and its use is to defend the bottom of the ditch by a grazing fire.

Such are the works which form the envelop of the place fortified, but various other constructions are in most cases added according to the nature of the ground and other circumstances, for the purpose of protecting or strengthening such parts as are most exposed, or of interrupting the works of the besiegers. These additional constructions are either internal or external. Among the former are *retrenchments* of various kinds, either constructed at the same time with the principal works or thrown up during the siege. They are made behind the ramparts, or the bastions most exposed to attack, their use being to enable the garrison to continue the defence from behind a fresh obstacle when a rampart or bastion has been breached. When a hill or rising ground overlooks any of the works, a *cavalier* is raised, about ten or twelve feet higher than the rest of the works. This is commonly placed within the bastion when it has the same form, but sometimes on the middle of the curtain when its form is semicircular. Of the exterior works one of the most important is the *counterguard*, constructed to cover some of the principal parts, as the bastion or the cavalier, in such a manner that without obstructing their fire it prevents them from being breached till itself is taken. The coun- [illegible]



destined to cover, and it must be lower than the principal work, though of a sufficient height to screen its revetment. A *horn-work*, represented in the annexed figure, is composed of [illegible] two half bastions [illegible] body of

the place It is here represented as made before the curtain, but it may be also constructed before a bastion *A crown-work* is of the same nature as a horn-work, but larger and having two fronts, which give it somewhat the appearance of a crown Horn-works and crown-works are constructed where a large spot of ground lies beyond the fortification which might be advantageous to an enemy, or to cover a gate or entrance into a town *Lunettes, a a*, are placed on both sides of the ravelin, and are constructed on lines bisecting the faces of the ravelin at right angles A *bonnet, b*, is a work covering the salient angle of the ravelin *Tenaillons* are similar in construction to lunettes, but having one of their faces formed on lines which are the production of the faces of the ravelin, instead of bisecting those faces The use of all these and other works of a similar description depends on the nature of the localities, and it must be left to the judgment of the engineer to determine in each particular case which is best adapted to the ground



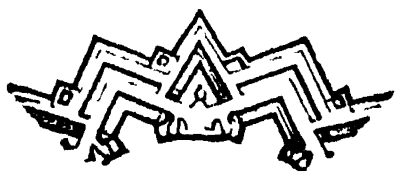
We have already alluded to the use and importance of the covered way In order to increase its strength *traverses*, or portions of parapet, are thrown across it, which screen it from an enfilading fire, and enable the defenders to dispute its possession foot by foot *Places of arms*, or places for assembling troops, and protected by traverses and *redoubts*, are also formed on it at the re-entering and salient angles of the counterscarp The redoubts serve not only as a place of retreat but facilitate the making of sorties upon the enemy's lodgments

The descriptions given above belong more especially to that method of fortification which, in the military schools, is denominated Vauban's first system Marshal Vauban served in the wars of Louis XIV, and in the course of his life directed the construction of thirty three new fortresses, and the improvement of three hundred others From the different constructions observed in these works have been compiled his *three* systems, which, however, in a general view of the subject may be considered as only differing in points of detail or in a greater or less degree of complication In his second system, represented in the annexed figure he separated the bastions from the body of the place by a ditch about 10 feet wide, in order that the besieger after the breach and capture of the bastions, might be compelled to renew his operations against the *enceinte* or body of the place The angles of the polygon are crowned by pentagonal towers of masonry, called *tower bastions* to which, in fact the regular bastions only form counterguards It was from a desire to take advantage of these tower bastions, which he found already existing at Landau when called upon to fortify that place that he was led to adopt the system in question Vauban's third system does not differ in any material respect from the second He increased the size of the ravelin and gave it a redoubt The tower bastions were likewise made larger and the curtain which united them was broken inwards so as to form two small flanks underneath, while casements for cannon were constructed, to co operate with those of the tower bastions in the defence of the ditch





*Cochorn's System* — Contemporary with Vauban was the Baron de Cochorn, director-general of the fortifications of the United Provinces of Holland This celebrated engineer is also the author of three different systems, though the third has never been constructed His methods are only applicable in low swampy countries, like Holland, and the object which he kept principally in view was to throw such obstacles in the way of a besieging force that the place could only be approached with great difficulty and hazard This he sought to accomplish by covering and flanking his works more effectually than had previously been done and by depriving the assailant of the room necessary for erecting his batteries An idea of his methods may be formed from the annexed figure, which represents his first system It is constructed on a hexagon, the second was on a heptagon, and the third on an octagon And it may be remarked of his systems in general, that they differ from Vauban's principally in the greater width of the ditch (which is nearly twice as wide as in Vauban's systems) and the narrow space between the flanks Cochorn's principles have been adopted in the construction of the fortresses of Nimeguen, Breda, Manheim, Namur, and Bergen-op-zoom



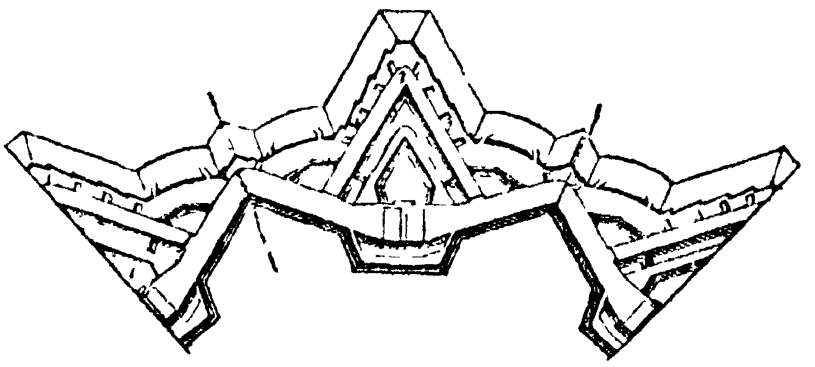
C [illegible] — T [illegible] V [illegible] Im [illegible]



French officer of engineers, who died in 1750 In the system which he adopted and which is here represented the faces of the bastion are made longer than in Vauban's methods, and the flanks are placed at right angles with the faces of the bastion The enlargement of the bastion [illegible] containing interior retrenchments, and the flanks, though shortened, are better covered His ravelins are also constructed on a larger base, and contain a larger redoubt, from which the besiegers can keep up a reverse fire on breaches made in the collateral bastions, so that the assault upon the latter becomes impracticable until the ravelin and its redoubt are both captured The communication round the extremities of the traverses of the covered way are arranged in a zig-zag line, so that the passage round the extremity of one traverse is defended by the fire of another in its rear, and the advance of the assailants along the covered way thereby checked In general, Cormontaigne's system possesses greater defensive properties, and is more economical of materials



*Modern System* — The annexed figure represents what



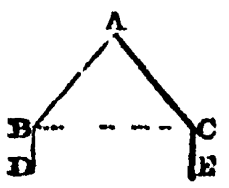
is called the modern system it varies but little from that of Cormontaigne The ravelin is made to cover the shoulder of the bastion more effectually by a greater projection, and its faces are retrenched by *coupures* or cuts through the rampart perpendicular to the faces of the bastion, which prevent the enemy from taking the redoubt in the re-entering place of arms without first possessing himself of the redoubt in the ravelin

All the systems above enumerated however they may differ in details agree in their principal features, and present the same general outline They may be all included under the name of the bastion system Some engineers however, among the most celebrated of whom are Montalembert and Carnot, have pointed out defects which appear to be inherent in the system, and proposed to give the polygon a different form By suppressing the curtain and the tenaille and producing the faces of the bastions inward a line of rampart would be formed presenting simply a succession of salient and re-entering angles According to this plan, the defence is made to depend on the number of reverse fires that can be maintained from casemated (or bomb proof) batteries but as the plan has never been practically carried into effect it is unnecessary to enter into particulars In the present state of the military art a fortress can be regarded as nothing more than a means of stemming for a time the torrent of an [illegible] such is the superiority of the means of [illegible] defence that however strong the works may be and however skilfully disposed, their reduction when assailed by adequate means is, generally speaking a matter of absolute certainty The besieging army, sheltered by its trenches from the missiles of the garrison, advances in zig-zag lines parallel to the faces of the ramparts, till it passes over or circumvents all the exterior defences of the place, and arrives at the main wall, where a breach has been made by batteries erected for the purpose To this covered mode of attack, supported by the ricochet batteries, by which the defenders are driven from the ramparts and the guns dismounted, it is perhaps impossible to offer any effectual resistance Indeed such is the perfection to which the art of attack has been reduced that even the length of time which any fortress will be able to hold out against an enemy provided with the proper train of sappers and miners, and the implements necessary for carrying on their operations, may be computed with the greatest precision

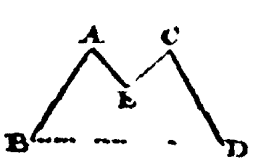
*Field Fortification* — Field Fortification is the art of constructing all kinds of temporary works for assisting the operations of an army in the field, and enabling it to maintain a position against a superior force In the disposition and construction of such works, the engineer must have regard to the nature of the locality, and endeavour to turn to the best account all its natural advantages, as well as the buildings, enclosures, &c, which may be found on it, and there is no part of his art in which talent and skill are so requisite, or in which he must rely so exclusively on the resources of his own judgment On account of the endless varieties and accidents of the ground on which he has to act, the observance of fixed rules is indeed impracticable, nevertheless

there are certain general maxims which apply to the construction of fortifications of all kinds, whether temporary or permanent and which must be observed in all his operations For example, works constructed to flank [illegible] works is also the same in all cases, namely, a ditch and a parapet, though, as the pick-axe and the spade are the only implements which an army in the field can carry about with it, the depth and width of the ditch and the height of the parapet are in field-works necessarily limited to what can be effected by these simple means

Field-works are usually divided into three classes — 1 Works open at the gorge, 2 Works enclosed all round, and 3 Lines either continued or with intervals To the first class belong *redans*, single and double *tenailled heads*, and *bastioned heads*, to the second, *redoubts*, *star forts*, and *bastioned forts*, and to the third, lines of various kinds for defending a position The *redan* is the simplest of all works, consisting merely of two lines A B and A C, forming an angle with each other It is only employed for such purposes as

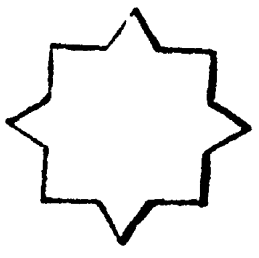



about 50 yards When the redan is thrown out in front of other works it is called a *fleche*, or arrow Lunettes are also applied for similar [illegible] formed by adding two parallel faces B D and C E redan, at the extremities of its open flanks The *double redan* or *bonnet de pretre* consists of two faces A B and C D, and two flanks, A E and C E usually shorter than the faces and affording a reciprocal defence to each other The re-entering angle at E should be a right angle, if it is less the two flanks are in danger of being struck by each other's fire, and if it is much greater than a right angle the defence will be weakened, for it is found by experience that soldiers placed behind a screen invariably fire straight before them or at right angles to the screen When a greater extent of front is to be fortified the lines are disposed in the form of bastions or tenailles, and thence called *bastioned heads* and *tenailled heads*

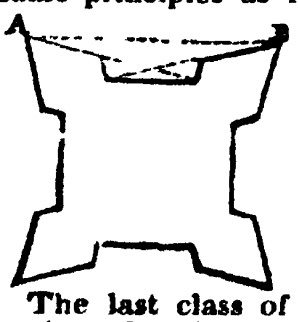



*Redoubts* are works closed on all sides of a polygonal or quadrilateral figure, and usually square An opening is left in one of the sides for communication with the exterior, and a traverse is thrown up within for protection As the work is without flanks the ditches are left without defence The angles are sometimes rounded or cut off, in order that a fire may be maintained on an assailant advancing in the direction of the diagonal

*Star forts* are enclosed works constructed upon an equilateral triangle or a square In the former case they have six points, in the latter eight When constructed on a square each of the sides (which may be about 90 yards long) is divided into three equal parts and on the middle part an equilateral triangle is constructed which gives the trace of the figure The object of this work is to remedy the defects of the redoubt by flanking the angles of the square, but as a considerable space is consumed by the re-entering angles, it scarcely admits of sufficient troops and artillery being placed in it for its defence



*Bastioned forts* are constructed in the field on the same principles as in permanent works, but are only constructed on the square or pentagon The distance A B or exterior side of the polygon, should not exceed the range of musketry or about 200 yards They are employed only in fortifying important positions, and require accordingly to be constructed in a more solid manner than other works of a temporary nature



The last class of field-works comprehends *lines* of various descriptions *Continued lines* are constructed to enclose a front, or connect principal works with one another by a continued parapet They are constructed, according to circumstances, with redans, tenailles, or bastions placed at certain intervals, seldom exceeding 180 yards From the descriptions given above, the different forms of the *redan line*, *tenailled line* and *bastioned line* will readily be conceived Sometimes they are formed of a succession of faces and flanks at right angles In this case they are called *lines-en-crémaillères* The flanks are about a fourth of the length of the faces, and afford a defence to the ditches Lines with intervals consist of isolated works, as redans or redoubts, [illegible] exceed 200 yards. [illegible] defence

Besides these works, [illegible] various expedients are resorted to in order to prevent, or at least to render more difficult, the appproaches of an enemy Among these are *palisades*, *abatis*, *trous-de-coup*, *chevaux-de-frize crow's feet* &c

The principal authors on Fortification are Errard, Stevinus, Antoine de Ville, Compte de Pagan, Coehorn, Vauban, Muret, Belidor, Blondel, Montalembert, Bousmard, Carnot, Meuze &c For a practical treatise [illegible] reference to the article "Fortification" [illegible]

FORTLESS Any fortified place (See the preceding)

FORTIN, FORTRET A sconce or small fort

FORTU'NA In Mythology, the goddess who presided over [illegible] speaking, represented as blind, with winged feet, and resting on a wheel This goddess was not known in the more ancient systems of the Greek theogony all the guidance of human affairs, for instance is intrusted by Homer to Destiny, but in Italy and chiefly at Rome, Actium, and Præneste, her worship was most assiduously cultivated

FO'RUM (Lat) In Ancient Architecture, a public market, also a place where the common courts were kept, and matters of judgment determined The fora of the Romans were large open squares surrounded by porticoes; parts of which answered for market places, other parts for public meetings of the inhabitants, and other parts for courts of justice The forum was also occasionally used for shows of gladiators There were in Rome seventeen, of these fourteen were for the sale of goods, provisions and merchandize and called Fora Venalia, the other three were for civil and judicial proceedings, and called Fora Civilia et Judicialia of the latter sort was the forum of Trajan of which the Trajan column formed the principal ornament The forum of the Romans was identical with the αγορα of the Greeks

FO'SSA (Lat fossa *a trench*), In Zoology, is applied to certain depressions on the external surface, generally the seat of cutaneous glands, as the lachrymal fossa in deer and antelopes, the *jugular fossa*, *inguinal fossa* &c

FO'SSA OVA'LIS A depression in the right auricle of the heart which in the fœtal state opened into the left auricle forming the *foramen ovale*

FOSSE (Fr), in Fortification is the moat or ditch [illegible] rampart See FORTIFICATION

FO'SSIL (Lat fodio *I dig*) Literally, any thing dug out of the earth The term is now chiefly confined to organic remains

FO'SSIL MARINA A soft carbonate of lime

FOSSO'RES (Lat fodio, *I dig*) An extensive group of Aculeate Hymenopterous insects most of the species of which are organized for excavating cells in earth or wood, in which they bury other insects in a wounded and feeble state, and at the same time deposit their eggs so that the larvæ when hatched, find a store of food prepared for their sustenance The Fossorial Hymenoptera are solitary in their habits, and some species which have not the requisite structure of the legs [illegible] parasitic and, like the cuckoo among [illegible] in the nests of other species, at whose ex[illegible] are reared

[illegible] (Lat fodio, *I dig*) In Zoology, animals which dig their retreats and seek their food in the earth are so called The locomotive extremities, which are organized for burrowing as those of the mole, or mole cricket are called 'pedes fossorii"

FOSSULATE (Lat fossa *a trench*) When a surface presents one or more somewhat long and narrow depressions

FOTHER, or FODDER, A SAIL This is thrumming a sail, and covering it with loose stuff, and then passing it under the bottom of a ship that has sprung a leak or been aground, the pressure of the water forces th[illegible] bottom, and partly stops the leak

FOUGASSE Fortification, a small mine, from 6 to 8 feet under ground It is derived from the Lat *focata*

FOUL The term applied to the wind when contrary, also to the bottom when uneven and rocky *See* ANCHOR, FALL, HAWSE

FOUNDA'TION (Fr fondation) In Architecture, the lower part of a wall, on which the insistent wall is raised, and always of much greater thickness than such insistent wall A practice has lately been introduced in this country of laying foundations (if not in water) on a bed of what is called *concrete*, which is a mixture of rough small stones or large gravel stones with sand and stone, lime and water, with just enough of the lime to act as a cementitious medium, with the best effect *See* CONCRETE

FOUNDATIONS (Lat fundo, *I institute*) In Polit[illegible] name given to institutions established and endowed by individuals, associations, or

the public, for the promotion of what is believed to be at the time when the foundation is made some useful or benevolent purpose In most old-settled and rich countries there are foundations for a vast variety of objects During the Middle Ages it was common to [illegible] monastic institutions [illegible] The two great universities of Oxford and Cambridge are noble examples of the last species of foundations, and by far the greater number of the grammar and free schools in most parts of England, and indeed of Europe, owe their origin to the same source A great deal of property has also been bequeathed by benevolent individuals in this and other countries for the erection and endowment of hospitals, or foundations, of various descriptions, for the relief and assistance of the poor, and not unfrequently also property is appropriated, or a foundation instituted, for the amusement and recreation of the public

But notwithstanding the large amount of property that has been appropriated in most countries to the establishment of foundations, and their extreme importance in a public point of view, it may appear rather singular that the principles and conditions on which they should be established are far from being well ascertained No one can doubt that it is highly expedient to allow individuals or associations to institute foundations or to bequeath property for the promotion of beneficial public purposes But, admitting this, the knotty question arises, how far should the legislature go in authorizing private parties to lay down the conditions under which the property so bequeathed, or the foundation, is to be administered If, on the one hand, government interference be carried too far, the institution of foundations will be discouraged, and if, on the other hand, government do not interfere at all, the folly or the presumption of individuals will be allowed to legislate for all future ages, and a large amount of property may [illegible] the support of institutions which, [illegible] to be beneficial, experience may prove [illegible] geous The regulation of foundations is therefore a matter of at least as much difficulty as importance, and involves a great variety of considerations It is impossible, perhaps, to lay down any principles with respect to it that should apply in all cases but some leading positions may notwithstanding be established, that should always be kept in view and referred to We shall endeavour to state some of these in our articles on PROPERTY (RIGHT OF) WILLS AND TESTAMENTS, UNIVERSITIES, &c., to which we [illegible]

FOUNDING or FOUNDRY The building in which various metals are cast into moulds or shapes Such of the details of the processes carried on in the respective metal foundries as are consistent with the plan of this work will be found under the heads of the metals to which they refer The furnaces used in fusing and founding metals are variously constructed according to the nature of the metal and the quantity to be operated upon, and frequently two or more furnaces of different constructions are employed in the same foundry The wind furnace blast furnace and reverberatory furnace are the forms which are most generally employed The wind furnace is either square or circular, and varies in dimensions according to the size of the crucibles which it is intended to contain, and which are placed upon proper supports resting generally upon the bars or grating of the furnace It has three apertures, one above, for the purpose of introducing the crucible and fuel, and which is usually closed by a fire tile or brick, another below for the purpose of admitting the air, so as to pass through the grate and fuel, and up the chimney, and the third [illegible] the chimney, which should be [illegible] a damper, for the purpose of regulating the draught of air through the fireplace, and consequently also the heat produced

The blast furnace differs from the preceding in having no grating, and in the air being supplied by a bellows or blowing machine The construction of these furnaces is much varied, according to circumstances, but the largest and most perfect are those employed in the iron works

The reverberatory furnace is so constructed that the flame and hot air from the fireplace are directed into a separate cavity intermediate between it and the chimney in this cavity, commonly called the *hearth* the materials to be fused are placed, and there is an aperture connected with it by which the fused metal is suffered to run out or through which it may be removed in ladles for the purpose of supplying the moulds

The materials of which the *moulds* are formed are very various In some cases, as in stereotype founding, they consist of plaster of Paris, in bronze works for figures and statues, they are made of a mixture of plaster of Paris, sand, and brick-dust, and require the utmost skill and care in their preparation Iron is usually cast in sand, brass and other metals in clay, and very frequently the moulds are made of cast iron



FOU'NDLING HOSPITALS In those ancient nations with the details of whose social life we are acquainted, the [illegible] to have been [illegible] kept [illegible] Neither Plato nor Aristotle, nor [illegible] writers of antiquity, condemn it, they merely profess to lay down rules for the preservation of the healthier [illegible] more weakly [illegible] chose the market-place, or some temple, for the exposure of her child, in order to have the chance of some charitable hand succouring it if its death was desired, it was abandoned in solitary places, and their dramas and romances are full of narratives in which this custom forms the foundation of the interest Thebes, in republican Greece, is the only state in which the exposure of children is known to have been forbidden by law The practice of exposure was common in republican Rome the law is doubtful The street called Velabrum (*Juvenal*, Sat vi), and the column called Lactaria (from this circumstance according to some antiquaries) were places usually selected for the purpose Abandoned children were declared by law to be the slaves or absolute property of those by whom they were brought up, and several were saved from death, not from humane motives, but that their [illegible] might by mutilating their persons and [illegible] the streets derive an infamous livelihood from the alms given them by the [illegible] When the progress of Christianity put [illegible] The exposure of children was made a punishable offence in A D 374, and their slavery was abolished by an edict of Justinian in 530

Infanticide has most properly been prosecuted with the utmost rigour, and made a capital offence in almost all modern countries But it was early supposed that were the exposure or abandonment of children wholly prohibited, there would, despite of all that could be done to prevent it, be a great deal of infanticide In consequence of the prevalence of this feeling, it has been customary in the Christian world from a very remote period to connive at the abandonment of children, and to provide means for the support of those that might be abandoned, and hence the origin of Foundling Hospitals

The first distinct trace of an express foundation for foundlings is at Milan in 787 In 1070 the order of Brothers of the Holy Ghost was established with the express purpose of taking care of sick, orphans, and foundlings After that time this species of foundations rapidly multiplied in every part of Europe But while private beneficence was thus exerted in their behalf, the church which in the earlier period had undertaken the general care of them, seems by degrees to have thrown on the commonalty in most European countries the charge of nourishing such as were not received into any of the foundation Traces of legal contests between the religious and civil establishments on this subject are to be found in the history of France through the whole 16th century The uncertain state of the law rendered their preservation in that country extremely precarious St Vincent de Paule in the 17th century, undertook their cause, and the foundation of the great Foundling Hospital of Paris in 1670 is due to his efforts In the provinces and in most Catholic countries and in those under the Greek church public charity took the same direction

It has been customary in these establishments to receive all children brought to them, without inquiring whether they were the fruit of regular marriages or of illicit amours It seems idle to deny that the multiplication of such establishments, by providing a ready method [illegible] of children, must have hindered a few cases [illegible], but the injury they have done to public morals and the waste of human life that they have occasioned are ten times greater evils than any they have obviated It is long, indeed since well informed persons in this and other countries were aware of the pernicious tendency of foundling hospitals, and it is probable that, at no very distant period, they will be every where suppressed In France the multiplication of these hospitals, and of exposures, has called at last the attention of the public to the frightful immorality, mortality and expense which attend it In 1680, ten years after its foundation the great hospital at Paris admitted 890, in 1750, 4000, in 1850, nearly 8000 In all France there were nourished at the public expense, in 1784, 40 000 children, in 1809 69,000, 1826 118,000 The number is now about 130,000 It varies greatly in the different departments, being greatest in the north, centre and south, least in the eastern departments bordering on Germany, and in the western or Brittany La Vendee, &c And the statistics of France plainly show, as Messrs Terme and Montfalcon, the authors of the most comprehensive work on the subject, explicitly declare, that it [illegible] ary, which produces exposures [illegible] for reducing the burden which have lately been partially put in execution, are the sup-

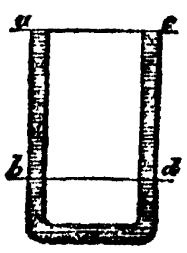
other words, render
d the removal of the
new-born children into another department which, it is
said always produces when tried a great reduction in
the number of exposures In Italy Belgium &c similar
institutions prevail and a similar increase of burden has
of late years been felt It has no doubt, been augmented
by the improvement which has taken place in the ma-
nagement of these unfortunate creatures Formerly
death was considered the usual issue of their admission
Towards the end of the last century 90 per cent of
children are said to have died at Paris at the Foundl
at Marseilles, at Dublin It is certain now
much diminished though it is thought that in France
nearly 60 per cent still die in their first year The whole
number of children annually exposed is said to be, at St
Petersburgh about 4 per cent of those born, Rome, 28,
Lisbon 26, Vienna 23 Paris, 21 In England, Captain
Thomas Coram is celebrated for his establishment of
the Foundling Hospital in 1739 It was extremely po-
pular at the time, and for many years was assisted by
frequent votes of parliament Similar institutions were
projected in other parts of the country, but the enor-
mous increase of abandonments, and the expense which
they occasioned, produced such an alteration in public
opinion, that the system of the Foundling Hospital was
entirely altered, and, notwithstanding its name it is
now destined merely for the reception of orphans Aban-
doned children in England become burdens to the parish
in which they are found

We may remark, by the way that the statements now laid before the reader, as to the injurious influence of foundling hospitals, strikingly corroborate the principles laid down in the article FOUNDATIONS, as to the necessity of the legislature exercising a certain control over the property left to promote what is believed to be at the time a charitable or benevolent purpose (See *Gouraff Essai sur les Enfans Trouves*, 1819, *Quart lev* vol xi, *L' Hôs Gaillard Recherches* 1817 and the excellent work of Messrs Terme and Monfalcon, already cited, *Histoire des Enf Trouvés*, 1837)

FOUNT (Fr fonds) The quantity of types of any particular sort in a printing office whether it be great or small Thus a small fount may consist of fifty or one hundred pounds weight comprising the usual proportion of the various letters of the alphabet, and a large fount of thirty thousand or forty thousand pounds weight, or more

FOU'NTAIN (Lat fons) By this term is designated any natural or artificial apparatus by means of which water springs up In natural fountains the ascensional effort is produced by the hydrostatic pressure of the water itself, in artificial fountains it is produced either by the same pressure, or by that of compressed air or sometimes by machinery

The theory of natural fountains is extremely simple and depends on the well-known property of fluids — that, when enclosed in tubes or vessels communicating with one another, the fluid rises to the same level in all of them, and that its pressure on the sides of the tube at any point is proportional to the height of the vertical column above that point Suppose *a b* and *c d* to be two pipes communicating with each other, and that water is poured into the first at *a*, it will ascend equally in both tubes, though they may be of very different sizes, and stand at the same level *a c* Let us now suppose the tube *c d* to be cut away at *d*, and let the line *b d* be horizontal, then the pressure at *d* being the same as at *b*, the water will spring

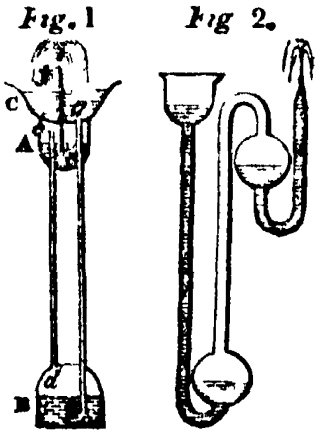



from *d* with a velocity $V = 2\sqrt{gh}$, where *g* is the accelerating force of gravity (equal to 32 feet in a second of time), and *h* is the altitude of the column *a b* (See HYDRODYNAMICS) The water, therefore if it suffered no resistance from the air, or other impediment, would spring up from *d* to *c*

Now it is precisely on this principle that all natural fountains are explained The rain which falls from the atmosphere is absorbed in three different ways One part of it collects in rills on the surface of the ground, these unite in streams or rivulets, which flowing into one another form rivers, and thus it is conveyed to the ocean A second part is taken up in giving humidity to the soil, from which it is returned to the atmosphere by evaporation A third portion descends into the earth, through soils of a spongy or porous nature, or through crevices and interstices in the strata, until it meets, frequently at a very considerable depth, with strata through which it cannot penetrate, and is then collected in subterraneous reservoirs When confined in this manner it is subject to the pressure of the water which fills the channels through which it has descended, and when this pressure is sufficient to overcome the resistance of the superincumbent mass of earth, the water breaks through the superficial strata, and gushes forth in a spring But if the strength of the superincumbent materials exceed the hydrostatic pressure the water will remain stored up as it were in the subterraneous reservoir Now if the ground above such a reservoir, or any channel commu-
nicating with it perforated the water having free
access to it will rise in a well to a height
equal to that of the level at which it is supplied
If the level above the water will have a tendency to rise, and when the ascensional force is considerable, it may by proper means be formed into a fountain That subterraneous reservoirs formed in this manner exist in great abundance and at great depths under the surface, we have sufficient evidence in the facility with which water may be obtained in almost all countries from *Artesian Wells*

FOUNTAIN OF HERO An ingenious hydraulic machine, of which the invention is ascribed to Hero of Alexandria, who lived about 150 years before our era Its principle depends on the transmission of the pressure sustained by a body of water in one vessel to that in another by means of the elasticity of air The essential parts of the apparatus consist of two close vessels, A and B, the first placed at some height above the other, and connected by a frame, and of three tubes or pipes, of which the first, *a b*, descends from a basin C to very near the bottom of the lower vessel B, the second, *c d*, rises from the summit of the vessel B to the top of A, the third, *e f*, rising from the lower part of A to some height above A, and forming the jet at *f* Conceive the vessel A to be filled with water and B with air In

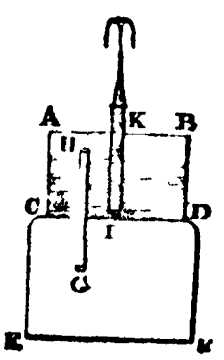
*Fig.* 1 *Fig* 2.




this disposition of into
the basin C this , and
gradually fill the air
in that vessel escapes through the pipe *c d*, and is compressed at the top of A and by its spring or elasticity, forces the water through the tubes *e f* and thus produces a jet at *f* which will continue until the vessel A is nearly emptied or B nearly filled The force which produces the jet is equal to the pressure of a column of water the height of which is equal to the difference of the levels of the water in C and B according to theory, therefore the water should spout to a height above its level in A equal to that distance

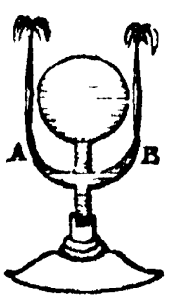
The second figure represents the fountain of Hero in another form on this prin-
ciple is employed om the mines of Schemnitz in Hungary

Artificial fountains are also produced by means of the elasticity of heated air, or of air condensed by any other means Two different apparatus for this purpose are frequently met with in cabinets of natural philosophy The first consists of two close vessels of tin, placed the one above the other the lower one, C D I L, being of a considerable size, and the upper, A B C D, furnished with a tube or jet, K I which reaches to near the bottom of the vessel On applying the heat of a lamp to the lower vessel the air within it expands, and making its way through the open tube G H is compressed at the top of the vessel A B C D and thus by its pressure forces the water in that vessel through K I, forming a small jet at K This apparatus being generally constructed in the form of a temple, produces a very




pleasing effect

The other apparatus to which we have alluded exhibits the appearance of a *fire-fountain* and when neatly constructed forms an exceedingly elegant toy On a pedestal of wood or metal, a glass globe with a pretty long neck, from the middle of which spring two branches, A and B is placed in an inverted position, the globe being first filled with spirits of wine, and the neck well corked The pressure of the atmo-




, B, -
perature is undisturbed, but on applying the flame of a taper to the drops which form at these orifices, the globe is heated, steam is formed at the upper part, the elastic force of which causes the spirit to spring from the orifices, and this taking fire heats the globe to a still the action, so burning spirit of wine are produced As the pressure of steam is very apt to burst the globe, the exhibition of this experiment is attended with some danger

FOURTH In Music, one of the harmonical intervals, so called because it contains four sounds or terms between its extremes, and three intervals or a beat [illegible] fourth in order of the natural or diatonic scale from the fundamental

FOWL'LA In Botany, the matter contained within the [illegible] pollen

FOWLING The art of catching birds with nets, [illegible] is also used for [illegible] birds of prey, more properly called falconry and hawking In Latin this sport was called aucupium, from avis, *a bird*, and capio, *I take*

FOX *See* VULPES and CANIS

Fox A particular kind of strand made of rope-yarns

FO'XGLOVE The *Digitalis purpurea*, a common indigenous plant, the leaves of which, when carefully dried and powdered, or made into a tincture or infusion, are used in medicine In small and repeated doses it lowers the pulse in an extraordinary manner, and produces debility and fainting combined with other remedies, it for [illegible] some powerful *diuretics*

FRACTION, in Arithmetic, is an aliquot part of unity In order to form a precise idea of a fraction of any unit, we must consider the unit to be divided into a certain whole number of equal parts, of which parts we take one, two, three, &c the number of parts so taken is what constitutes the fraction The expression of a fraction therefore necessarily involves two whole numbers, namely, one to denote the number of parts into which the unit is divided, and the other to express how many of these parts are to be taken to form the fraction The first of these numbers is called the *denominator*, and the second the *numerator* Thus, *seven eighths* of a foot, *five twelfths* of a pound are fractions In the first we suppose the foot or unit to be divided into eight equal parts, of which seven are taken, so that eight is the denominator and seven the numerator In the second the unit or pound is supposed to be divided into twelve equal parts, of which five are taken, here twelve is the denominator and five the numerator From these considerations it results that a fraction is a magnitude referred to a certain part of the principal unit which part may itself be considered as a particular kind of unit Thus the fraction *seven eighths* of a foot being the same as seven times the eighth part of a foot this eighth part is a particular unit which the proposed fraction contains eight times Hence two fractions are said to be of the same kind when their denominators are the same For example, *five twelfths*, *six twelfths* *eleven twelfths*, are fractions of the same kind, but *two thirds* and *three fourths* are fractions of different kinds, because their denominators are different

In order to express fractions by the numerical digits the numerator is placed over the denominator, with a line or bar between them Thus the fraction three fourths is written $\frac{3}{4}$, five twelfths $\frac{5}{12}$, &c Reciprocally $\frac{13}{15}$ $\frac{17}{20}$ &c designate the fractions thirteen fifteenths, seventeen twentieths, &c

A fraction may also be regarded as the quotient that arises from the division of its numerator by its denominator For example the expression *seven eighths* or seven times the eighth part of unity is identical with the expression *the eighth part of seven*, or *seven divided by eight*

From the definition which we have given of the numerator and denominator of a fraction, the following consequences result —1 If, without altering the denominator of a fraction, we multiply or divide its numerator by any number the new fraction will be so many times greater or less than the original fraction 2 If without altering the numerator we multiply or divide the denominator of a fraction by any number, the new fraction will be so many times smaller in the former case and so many times greater in the latter than the original fraction 3 The value of a fraction is not altered by multiplying or dividing both numerator and denominator by the same number It is on these three principles that the practical rules for the addition, subtraction, multiplication, and division of fractions are grounded

*Addition and Subtraction of Fractions* —In order that two fractions may be added together, or the one subtracted from the other, it is necessary that they be both of the same kind, or denomination, for it is only homogeneous things that admit of amalgamation The fractions $\frac{1}{3}$ and $\frac{3}{4}$ cannot be added together in their present form, because they are of different denominations But fractions can always be reduced to the same denomination, or to a common denominator, by means of the third principle above laid down, for numbers can always be chosen such that if we multiply the terms of each fraction by them severally, the results [illegible] will have the same denominator Thus, multiplying the terms of the fraction $\frac{2}{3}$ by 4, we get the equivalent fraction $\frac{8}{12}$, and multiplying the terms of $\frac{3}{4}$ by 3, we get the equivalent $\frac{9}{12}$

The two proposed fractions are therefore reduced to the two others, $\frac{8}{12}$ [illegible] $\frac{9}{12}$ [illegible] $\frac{17}{12}$ and the difference $\frac{1}{12}$. When [illegible] are to be added together they are most conveniently reduced to a common denominator by this rule —Find the least common multiple of all the denominators, divide this multiple by each of the denominators one after the other, and multiply the terms of the proposed fractions respectively by the [illegible] the results will have the same denominator, and this expressed by the lowest possible number When this operation has been performed, the sum or difference of the fractions is obtained by placing the sum or difference of their numerators over the common denominator

*Multiplication of Fractions* —Let it be proposed to multiply $\frac{3}{5}$ by $\frac{6}{7}$ As the multiplier $\frac{6}{7}$ is equal to six times the seventh part of unity, it is obvious that the product must be equal to six times the seventh part of three-fifths Now by the second principle above laid down, the seventh part of $\frac{3}{5}$ is found by multiplying the denominator by 7, this gives $\frac{3}{35}$ And in order to obtain a fraction six times greater than $\frac{3}{35}$, we must multiply the numerator by 6, which gives $\frac{18}{35}$ for the product required Hence for the multiplication of fractions we have this rule —Multiply all the numerators together for the numerator of the product, and all the denominators for its denominator

As a whole number can always be expressed in the [illegible] or a denominator,

*Division of Fractions* —Let it be proposed to divide $\frac{3}{5}$ by $\frac{8}{11}$ Here the divisor $\frac{8}{11}$ being equal to 8 times the 11th part of unity, the dividend $\frac{3}{5}$ must (from the nature of division) be equal to 8 times the 11th part of the quotient But, by the second principle, the 8th part of $\frac{3}{5}$ is $\frac{3}{40}$, therefore $\frac{3}{40}$ is the 11th part of the quotient required, consequently 11 times $\frac{3}{40}$, or $\frac{33}{40}$ is the quotient itself Hence we deduce the general rule for the division of one fraction by another —Multiply the numerator of the dividend by the denominator of the divisor, the product will be the numerator of the quotient, and multiply the denominator of the dividend by the numerator of the divisor, the product will give the denominator of the quotient required It is obvious that this amounts to the same thing as to invert the terms of the divisor, and then proceed as in multiplication

Fractional expressions are divided into several kinds —proper and improper, simple and compound A *proper fraction* is one whose numerator is less than its denominator, and its value consequently less than unity An *improper fraction* is one whose numerator is equal to or greater than its denominator, and its value consequently equal to or greater than unity A *simple fraction* is an expression consisting of one fraction only A *compound fraction* is a fraction of a fraction, or a fractional part of some whole or mixt number And a *mixt number* is an expression consisting of a whole number and a fraction

The fractions of which we have now spoken are common or *vulgar* fractions, when the denominators are 10, 100 or in general any power of 10, they become *decimal* fractions, and are expressed by a different notation *See* DECIMAL

FRA'CTURE (Lat frango, *I break*) In Mineralogy When minerals are broken they either exhibit a smooth regular surface to which the term *cleavage* is generally applied, or they give an irregular or uneven surface, termed a *fracture* Werner, who first employed this character in his description of minerals, divides their various fractures into compact, fibrous, radiated and foliated The terms *earthy granular*, *uneven*, *hackly* and *splintery*, the meanings of which will be sufficiently obvious, are employed by other mineralogists

FRACTURE In Surgery [illegible] is limited to broken bones Such accidents [illegible] are the result of external force, but it occasionally happens that the powerful action of certain muscles may cause a fracture, as is frequently the case in regard to the *patella* or knee-pan Fractures are distinguished by surgeons into *transverse*, *oblique*, and *longitudinal*, depending upon the direction in which the bone is broken, and into *simple* and *compound* dependent upon the circumstances with which the injury is accompanied "By *simple fracture* surgeons mean a suddenly formed breach in the continuity of one or more bones, without any external wound communicating [illegible] the fracture, by a *compound fracture* [illegible] the same sort of injury of a bone or bones, attended with a laceration of the integuments, which laceration may be produced by the protrusion of one or both ends of the fracture through the skin, or by a ball or other body which enters or otherwise wounds

the soft parts at the same moment that it breaks the bone"

The history and treatment of fractures is an extensive and important department of surgery, upon which several treatises have been written by very eminent practitioners An excellent article upon the subject will be found in [illegible] which work we have borrowed [illegible]

FRAISE In Fortification, a kind of defence which is formed by driving pointed stakes at a small angle with the horizon into the retrenchment of a camp, &c

FRAMBŒSIA (Framboise, *a raspberry*) The yaws, a disease endemic in the Antilles and some parts of Africa, which is attended by cuticular excrescences something like mulberries, which discharge a watery fluid It is contagious but not dangerous

FRAMING (Sax gramman, *to form*) In Architecture, the rough timber-work of a house, including [illegible] Generally any [illegible] ices and tenons are said to be framed', as doors, sash frames, sashes &c

FRANCHISE In Law a species of incorporeal hereditament, synonymous with liberty, which is defined "A royal privilege or branch of the king's prerogative subsisting in the hands of a subject" For an account of the nature of the *elective franchise* see PARLIAMENT

FRANCISCANS One of the four Mendicant Orders founded by St Francis of Assisi, in Umbria, in the year 1209 *See* art ORDERS, MENDICANT

FRANK A coin in use in France, equivalent to 9 69*d* *See* MONEY

FRANK A privilege enjoyed by the members of both houses of Parliament, some government offices and certain public functionaries, of sending and receiving a certain number of letters *post free*, abolished Jan 10 1840 *See* POSTAGE

FRANKALEU In Law, an absolute right to real estate in Lower Canada, and also in Guernsey and Jersey, acknowledging no feudal superior, and consequently not a *tenure* *See* ALLODIUM

FRANKALMOIGN (From two Norman French words, signifying free alms) In Law a tenure by spiritual service where an ecclesiastical corporation sole or aggregate hold land to them and their successors of some lord and his heirs in free and perpetual alms Donations in Frankalmoign are now out of use as none but the king can make them, but they were expressly excepted from the operation of stat 12 C 2 c 24, which abolished military tenures

FRANKINCENSE (said to be so called from its liberal distribution of odour) The gum-resin *olibanum* which is the produce of the *Boswellia serrata*, and imported from the Levant, bears the commercial name of *frankincense* When it is burned, or sprinkled upon hot coals, it exhales a very fragrant and diffusible odour

FRANKPLEDGE or FRITHBOLG (German burge *pledge*) A celebrated Anglo-Saxon usage which appears to have been of two kinds 1 That which may be termed *seignorial frankpledge*, by which every lord (hlaford) was rendered responsible for the appearance of his own *men* or dependants, when accused before justice, in the hundred court, when if the party absconded, the lord
of the "were" or
lective or public frankpledge, which is the sense in which the word is most commonly used by modern writers is of very obscure origin, but appears to have existed after the [illegible]
[illegible]
were enrolled [illegible]
or decennaries (in many instances equivalent to the townships), under the superintendence of a chief pledge or tything-man The tything thus organized was bound for the appearance of any one of its members under accusation The "view of frankpledge" originated in the usage of calling together the individuals who were enrolled in each of these bodies at certain stated times, which were usually held at the court leet, but were not (as Blackstone states it) the main object of that institution, since courts leet were held from an early period in the northern parts of England, in which frankpledge never existed, as well as in the southern On the view of frankpledge, the members of each tything also took the oath of allegiance under the Norman kings (See *Turner's Anglo-Saxons*, *Sir F Palgrave's Commonwealth of England*, and art COURT LEET)

FRANKS A general appellation conferred by the Turks and other Asiatic nations on all the inhabitants of Europe

FRATERCULA The generic name for the puffins *See* MORMON

FRATERNITIES, were associations of laymen in the middle ages, formed for the purposes of general benevolence, and for the discharge of other Christian duties

FRAUD, in Law, is the general name for any species of deceit in contracts, either by suppression of truth or assertion of falsehood The most complete definition of it is that given by Forbes:—"Dolum malum esse omne machinationem, fallaciam machinationem ad circumvenendum, fallendum decipiendum alterum adhibitum" (*Story's Commentaries on Equity Jurisprudence*) With a view to [illegible] frauds may be divided into such as are cognizable by courts of common law, such as are cognizable in equity only, and such as are expressly provided against by statutes, It has been laid down as a general principle, that courts of common law can relieve against the consequences of fraud (by making contracts void, &c) as well as courts of equity, wherever the fraud is clearly established, and that their inadequacy to provide a proper remedy arises only from their inability to attain the necessary evidence But however this may be, it has long been a general principle, that courts of equity, in the language of Lord Coke, have jurisdiction over frauds, covin, and deceits, for which there is no remedy by the ordinary course of law Hence arises one of the three great branches of equity jurisdiction—trust, fraud, account (See CHANCELLOR, [illegible] that jurisdiction appears to [illegible] relative by considering acts as performed of which the performance has been fraudulently prevented, by setting aside bargains made in ignorance of rights or where there is material concealment of title, value &c, or, finally, misrepresentation in material particulars Various acts have been made fraudulent, so as to produce the consequence of annulling contracts and voiding conveyances by statutes e g conveyances with intent to defraud creditors, by 13 Eliz c 5, voluntary conveyances, 27 Eliz c 4, various contracts, conveyances &c not executed with the formalities required by the Statute of Frauds 29 C 2 c 3 Some frauds are of a criminal nature, and punishable by indictment, but they are chiefly such as affect the public or such as are effected by means of false tokens

FRECKLES Small yellow specks and spots which appear upon the face, especially of fair persons much exposed to the weather The best application is a dilute spirituous lotion (one part of brandy to eight of water), with a few drops of muriatic acid, so as to render it just perceptibly sour

FREEBOOTERS (Germ freibeuters Fr flibustiers) A name given to some adventurers of all nations, but especially of France and England who have obtained a place in history by the courage and intrepidity which they displayed in executing the most difficult enterprises The origin of their history is merged in obscurity and it is impossible to ascertain precisely whence their name is derived, but the *flibustiers* of the French naval historians are identical with the *buccaneers* of our own language (See BUCCANEERS) The South American islands formed the chief theatre of their depredations, and such was the relentless hostility with which they visited the Spaniards that during the latter half of the 17th century which embraced the most formidable period of the freebooters career, their commercial operations in the Indian seas were nearly destroyed At the commencement of the 18th century the freebooters sustained in their expeditions a series of disasters which sensibly diminished their numbers, and since that period the designation has been applied indiscriminately to any individual who regards 'the universe as his property' and appropriates to himself either furtively or forcibly the possessions of another

FREEHOLD In Law is a term which is used in two different senses 1 To express the quantity of estate which a man may have in lands or tenements, and, 2 To express a tenure by which lands and tenements are held Thus an estate of freehold, to satisfy the full acceptation of the term, must be both sufficient in quantity of interest and sufficient in tenure

1 As to quantity of interest all estates for a term uncertain in duration are estates of freehold, and they are divided into estates of inheritance and not of inheritance The first of these are either absolute (fee-simple) or limited (fee-tail or fee-simple conditional) The second are estates for life, or for an uncertain period limited within the term of a life, as, an estate granted to a widow durante viduitate Such estates as this are by the law regarded as estates for life, determinable on a given event 2 With respect to tenure, freehold tenure is derived from the ancient free socage, and lands held by copy of court roll according to the custom of a manor, viz copyholds are not within this denomination But lands held by custom of the manor, *not* by copy of court roll, are not copyholds, but customary freeholds

In order, therefore to give the privileges or impose the duties attached by the law to freeholders (such as serving on juries, voting at county elections, &c), the estate in respect of which such right or duty attaches must be either for life or a greater interest, and must be held in freehold tenure

FREEMASONRY A well-known institution, the origin of which has given [illegible] and idle speculation [illegible] masonry from those of the priests of Eleusis, and these

arts from Egypt, others from the secret associations of the Templars (*See* TEMPLARS, BAPHOMET) The last opinion was illustrated at great length by M Barruel (*Memoires du Jacobinisme*), who conceived both Freemasons and Jacobins to be the relics of a long-established conspiracy for the subversion of religions and empires But our distinct historical information merely amounts to this, that the fraternity of architects or builders in the middle ages extended over all Catholic countries, and was especially patronized by the see of Rome It is to [illegible] we the magnificent Gothic edifices [illegible] which contrast so strangely with the barbarous efforts of those ages in the [illegible] departments of art It is said that this association was introduced into Scotland in the 13th century, and about the same time into England, it being ascertained that the Abbey of Kilwinning in the former country was raised by this fraternity, and it is believed to have continued to exist [illegible] number, in these two countries [illegible] from the Continent The Kilwinning and York lodges are respectively the most ancient in either country But the mode and period in which the association became changed from a mere professional fraternity to a society of persons of all descriptions connected by secret symbols, is unknown It certainly excited great attention, and numbered individuals of high rank as honorary members, as early as the 15th century The Scottish masons appointed St Clair of Roslin their hereditary grand-master in 1630, and the office was resigned by his descendant in 1736, when the grand lodge of Scotland was instituted In 1725, the first French lodge was established, in 1730, the first American, in 1731, the first German From that period until the present, while the society has existed among ourselves as a mere convivial and benevolent association, and has been patronized even by royalty and the nobility it has been subjected on the Continent to a variety of suspicions, and it is most probable that political intriguers have availed themselves of the secrecy afforded by it to further their schemes Indeed, in this country, the 'Royal Arch' degree is said to have been devised by the Scottish Jacobites Pope Clement XII excommunicated the Freemasons in Spain and Portugal until recent events, their name was synonymous with that of deists and revolutionists But the most singular chapter in the history of the society relates to its fortunes in America, where it has given origin to two violent political parties The story [illegible] William Morgan, [illegible] the fraternity, [illegible] not cleared up [illegible] uled and commented on in Miss Martineau's recent work (See *Lawrie's History of Freemasonry* Edin 1804, *Anderson's* ditto, *Preston's Illustrations of Masonry*, the *Freemason's Quarterly Magazine*, the German *Freimaurer Encyclopædie*, &c)

FREE'THINKER A term, usually of reproach applied to those who reject the ordinary modes of thinking in matters of religion It is almost synonymous with *Deist* which see

FREEZING *See* FROST

FREEZING MIXTURES When five parts of powdered nitre and five of powdered sal ammoniac are mixed with sixteen parts of water, the thermometer falls in the mixture from 50° to about 10°, so that in this way a degree of cold much below the freezing point of water may be artificially and cheaply obtained, for the salts may be again procured by evaporation and used repeatedly When ice or snow can be obtained, the most effective freezing mixture is produced by mixing it with about half its weight of salt, it carries the thermometer nearly to 0° The utmost degree of cold produced by the skilful combination of the best freezing mixtures has not exceeded 140° below 0°

FREIGHT In Mercantile Law, the sum paid by the merchant or other person hiring a ship or part of a ship, for the use of such ship or part for a specified voyage, or for a specified time Freight must be mentioned eo nomine, in a policy of insurance, and is not covered by a policy on goods

FRESCO PAINTING (It fresco, *fresh*) In Painting, a method of painting by incorporating the colours with plaister before it is dry, by which it becomes as permanent as the wall itself This method of painting is [illegible] It was used by the Greeks, and [illegible] Egypt From difficulty of alteration when the colour is once absorbed, the greatest precision of [illegible]

FRET [illegible] Architecture, a species of ornament consisting of one or more small fillets meeting in vertical and horizontal directions The section of the channels between the fillets is rectangular The subjoined diagram shows two sorts of simple frets, but they are often much more complicated.



FRETS The cross bars on the finger boards of stringed instruments of ivory or brass by pressure whereon the hand the string is stopped to produce a certain note in the scale The use of frets is still continued on the Spanish guitar and was formerly in constant use upon what was called the bass-viol for learners, and taken off when they had learnt by practice to measure the accurate distance of the stops On lutes and viols they were always permitted to remain

FRIAR (Lat frater, *brother*) A brother or member of [illegible] exclusively applied [illegible] which the four chief Carmelites, and Augustines *See* ORDERS, MENDICANT

FRICTION (Lat frico, *I rub*) In Mechanics, the resistance produced by the rubbing of the surfaces of two solid bodies against each other If the surfaces of bodies were perfectly smooth and polished, they would slide along one another without suffering any resistance from their contact, and all the simple relations between power and resistance determined by theory in respect of the different machines would hold good without any modification whatever But this state of perfect polish never exists The surfaces of all bodies with which we are acquainted, even when most carefully polished, retain a greater or less degree of asperity, which prevents them from sliding over one another without impediment, and in many cases the resistance thus created amounts to [illegible] Therefore [illegible] of the effect of [illegible] ance to that which is given by the theory of mechanics

The determination of the laws of friction, and its amount with respect to particular substances, have occupied the attention of many experimental philosophers and mathematicians, as Amontons Euler, Desaguliers, Vince, &c, but the first complete set of experiments on the subject was made by Coulomb about the year 1780 His results, though they have been partly modified by subsequent experiments, throw much light upon the subject, and are of great value to the practical engineer

There are two modes by which the nature and operation of friction may be ascertained The first is very simple and consists in merely placing a heavy body W on a horizontal plane A B, and [illegible] the end of the plane till the body begins to [illegible] When this motion commences it is evident that the force of gravity just begins to exceed the resistance occasioned by the friction, and as the gravity is known from the weight of the body and the inclination of the plane we have thus the means of comparing the friction with [illegible] For let A E be drawn perpendicular to [illegible] C B, then, since the weight [illegible] and the pressure in the equilibrium if we take A B to represent the weight W the force down the plane (which is equal to the friction) will be represented by A E, and the pressure perpendicular to the plane by B E Hence putting P = the pressure, F = the friction, and *i* = A B C, the inclination of the plane, we have P = W cos *i*, F = W sin *i*, and consequently F = P tan *i* The angle *i* is called the *limiting angle of resistance*, and tan *i*, or the ratio of friction to pressure, is called [illegible]




But [illegible] some uncertainty Most bodies [illegible] on contact for some time require a [illegible] to keep up progressive motion, but it appears that the [illegible] of the plane of descent marks only the initial obstruction Coulomb accordingly adopted a different mode of proceeding His general method was to draw a sort of loaded sledge along a horizontal bench by means of weights placed in a dish attached to the sledge by a cord passing over a pulley The sledge was mounted on sliders of the substance on which the experiments were to be made, and corresponding slips of the [illegible] or different substance placed under the sliders of the bench This apparatus has been called a *tribometer* The following are some of the results which were obtained —

Assuming the pressure as equal to 100 parts, the friction of oak against fir was 66 in the direction of the fibres, but amounted only to 16 when moved with the velocity of a foot each second, the friction of oak against oak in the direction of the fibres was 43, and across them only 27, the effect being still reduced by motion to 10, the friction of fir against fir in the direction of the fibres was 56, which sunk to [illegible] elm against elm in the [illegible] reduced by motion to 10 On the other hand, the friction of copper upon oak, lengthwise, was at the commencement of the motion, but increased to 18 when the velocity was a foot in a second, the friction of iron upon oak with the initial velocity was 11, and was increased by the motion to 18 But the mutual friction of metals appeared in general to be scarcely, if at all, affected by motion In these experiments no unguents were used

When metals rub against wood [illegible] two bodies [illegible] first [illegible] against wood at least 4 or 5 hours must elapse before the [illegible] disappears, whereas in the [illegible] a single minute was sufficient But the resistance appears to increase by contact though less sensibly, even for several days The application of grease to the surfaces of wood produces a similar effect and the resistance does not attain its maximum till after a very considerable time At the end of 5 or 6 days the resistance is perhaps 11 times greater than it was at the first instant, if the surface of contact is considerable in respect of the pressure, but when the surface is small, the friction reaches its maximum much more quickly

An important part of the investigation was to ascertain whether the friction is increased by the velocity of the rubbing bodies With respect to bodies of the same kind descending on inclined planes, Coulomb found that the time required for passing over the first half was a little more than double that required for passing over the second But a body put in motion by a constant accelerating force employs for passing over one space, and over two equal consecutive spaces times that are to each other in the ratio of $\sqrt{1}$ $\sqrt{2} = 100$ 142, that is to say, if 100 units of time are consumed in passing over the first space 142 will be consumed in passing over the first and second together, and consequently 42 in passing over the second Now this agrees as nearly as possible with the result of the experiments, consequently we infer that a load drawn along a smooth plane by a constant accelerating force (that of a descending weight for example) is uniformly accelerated But this requires that the friction, at every instant destroys only a proportional [illegible] added by the constant action of [illegible] therefore is, that, for moderate velocities at least *the resistance due to friction is a constant quantity*, and very nearly the same for every degree of velocity

Another point of great importance was to ascertain the relation the friction bears to the pressure, for example in what ratio the friction is increased by doubling or trebling the load Coulomb found that when wood has been allowed to rest on wood for some time without the intervention of any unguent the resistance occasioned by the friction is proportional to the pressure This resistance for a short time increases rapidly by the contact, but attains its maximum in a few minutes The friction of wood sliding on wood with any velocity is still proportional to the pressure, but the resistance is much less in amount than that which is required to detach the surfaces after some minutes of contact In the case of oak for instance, the force required to detach the surfaces after being some minutes in repose is to that which is necessary to overcome friction alone after motion has commenced in the ratio of 100 to 23 The friction of metals on metals is also proportional to the pressure, but the intensity is the same whether the surfaces have been any length of time in contact, at rest, or are gliding along with an uniform velocity

The friction of heterogeneous substances as wood and the metals, is entirely different from the above In the case of wood against wood dry or of metal against metal the friction of the rubbing bodies is very little influenced by the velocity, but in the present case the friction increases very sensibly with an augmented velocity Coulomb inferred that the friction increased as the natural numbers, when the velocities are increased as the squares of those numbers In all cases of a hard body rubbing against a very soft substance, the friction increases remarkably with the velocity

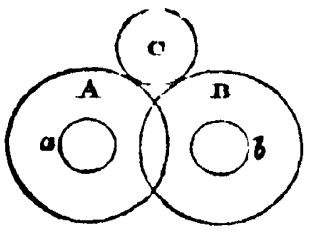
Since the friction is in general proportional to the pressure it follows that [illegible] and diminish the extent of the [illegible] unless by certain [illegible] the friction is sensibly diminished when the surfaces in action are reduced to the smallest dimensions The while the friction of a ruler of brass against a similar one of iron is expressed by 26, it was found to be only 17 after the sledge had been mounted on 4 round-headed brass nails

On the whole, the following conclusions may be stated as the general results of Coulomb's experiments respecting the friction of bodies *sliding* on each other

1 Between similar substances, under similar circumstances, friction is a constant retarding force 2 Friction is greatest between bodies whose surfaces are rough and is lessened by polishing them 3 It is greater between surfaces composed of the same material than between the surfaces of heterogeneous bodies 4 If the [illegible] surfaces remain the same the friction increases and decreases as the pressure 5 If the pressure continue the same, the friction has no relation to the magnitude of the surface 6 The application of grease in general diminishes the friction, though in very different degrees

The obstruction which a cylinder meets with in rolling along a smooth plane is quite distinct in its character, and far inferior in its amount, to that which is produced by the friction of the same cylinder drawn lengthwise along a plane For example in the case of wood [illegible] on wood, the resistance is to the pressure as the cylinder be small, as 1 or less [illegible] this may be reduced to 6 to 1000 The friction from sliding, in the same cases, would be to the pressure as 2 to 10, or 3 to 10 according to the nature of the wood Hence, by causing one body to roll on another, the resistance is diminished from 12 to 20 times It is therefore a principle in the composition of machines that attrition should be avoided as much as possible, and rolling motions substituted whenever circumstances admit

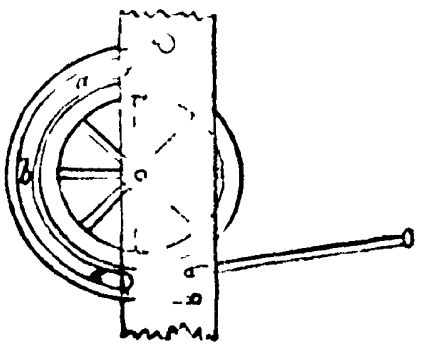
[illegible] resting in a cylindrical socket, is made to rest on the circumferences of two wheels, A and B, to the axles of which, *a* and *b*, the friction is transferred, and consequently diminished in the ratio of the radius of the wheel A to the radius of the axle *a* This ingenious contrivance appears to have first been applied by Henry Sully in the year 1716 (*Descr Abrégée d'une Horloge*, &c Bordeaux 1716)




The following are deductions from Coulomb's experiments relative to the friction of rolling bodies —1 Like the friction of sliding bodies it is a constant force 2 It is affected by the nature of the surface so far as polish is concerned, but is not lessened by the interposition of unctuous substances 3 It is less between heterogeneous than between homogeneous substances 4 It is directly proportional to the pressure 5 It has no relation to the magnitude of the surface 6 It is much less than in the case of sliding surfaces and varies in the inverse ratio of the diameter of the rolling body

The friction of the axle of a wheel or pulley (whether the axle itself turns, or the wheel turns on the axle) is of a different kind from that of a cylinder rolling on a plane It is less than that of sliding but greater than that of rolling bodies and follows in all respects the laws of the friction of sliding bodies A great advantage is here obtained by greasing the surfaces By the application of fresh tallow the friction is reduced to one half

Friction is one of the most effectual means of arresting motion In some machines, especially wind mills, cranes, &c, it is very important to have the power of suddenly stopping the machine or at least of controlling its motion This is effected by means of a strong bridle of wood or iron, *a b c* fixed at one end, and at the other furnished with a lever, by pressing on which the bridle is brought into close contact with the broad rim of a wheel which participates in the general motion of the machine The bridle may be made to bear on the whole circumference of the wheel, and a moderate pressure on the lever will produce a resistance sufficient to destroy the motion almost instantaneously




Coulomb's experiments were also directed to ascertain the resistance arising from the rigidity of ropes when bent round rollers or cylinders The results are as follow —1 The resistances of ropes are directly proportional to the tensions to which they are subjected 2 The resistance increases with some determinate power of the diameter, and is greatest in [illegible] twisted or are coated with [illegible] inversely as the diameters of the cylinders about which the ropes are bent

When a rope is wound more than once round a cylinder, the resistance increases in a geometrical progression This principle is frequently applied in practice thus, in arresting the progress of a vessel, a rope is wound round a post and a very few turns is sufficient to resist the force which the rope is capable of [illegible]

A valuable series of experiments [illegible] some years ago by Mr George Rennie, the details of which are given in the *Phil Trans* for 1829 The following are a few of the results [illegible] before the pressure equal to 100 pounds, friction of steel upon ice is 1 4, ice upon ice 2 8, hard wood upon hard wood 13, brass upon wrought iron 13 5, soft steel upon soft steel 14 6, feather upon iron 25, granite upon granite 30, yellow deal upon yellow deal 35, sandstone upon sandstone 46, woollen cloth upon woollen cloth 43 Some of the conclusions deduced by Mr Rennie are as follow. —1 In fibrous substances, such as cloth, friction is increased by surface and time, and diminished by pressure [illegible] 2 In hard [illegible] woods, [illegible], the friction varies as the pressure,

[illegible] velocity 3 Friction [illegible] with hard substances 4 The effect of unguents is as the nature of the unguents, with reference to the substances to which they are applied

In the *Memoires de l'Institut* for 1833, two very extensive sets of experiments are described, which were made by M Morin, at Metz, under the auspices of the French government, for the purpose of verifying or correcting the results of Coulomb In general, M Morin's results differ widely in absolute amount from those of C[illegible] me instances ratios three times as [illegible] int to, and indeed fully establish [illegible] conclusions See Coulomb, *Théorie d[illegible]*, (Paris, 1821), and *Mem des Savans Etrangers* tom ix and x , Ximenes, *Teoria e Pratica delle Resist de Solidi ne' loro Attriti* (Pisa, 1782), Vince, *Phil Trans* , 1785 , Rennie, *Phil Trans* , 1829 , Morin, *Mem de l Institut*, 1833 , *Ency Brit* , art "Mechanics," &c

FRICTION-WHEELS See [illegible]

FRI'DAY (Germ Freitag ) [illegible] week The name is derived from *Freya* or *Frega* a Saxon goddess It is a fast day in the Romish church

FRIENDLY SOCIETIES, or BENEFIT SOCIETIES Voluntary associations of subscribers, for the purpose of forming a fund for the assistance of members in sickness, or other occasions of distress It is supposed by Mr Turner (in his *History of* [illegible] that the ancient [illegible] de scription Of the [illegible] that [illegible] in this view and for [illegible] the [illegible] source against sickness and old age none seem so likely to accomplish their object as the institution of friendly societies and savings' banks The former are founded on a principle of mutual insurance Each member contributes a certain sum, by weekly monthly or annual subscriptions, while he is in health , and receives from the society a certain pension or allowance when he is incapacitated for work by accident, sickness, or old age Nothing it is obvious, can be more unexceptionable than the principle of these associations Owing to the general exemption from sickness until a comparatively late period of life if a number of individuals under 30 or 35 years of age form themselves into a society, and subscribe each a small sum from their surplus earnings, they are able to secure a comfortable provision for themselves in the event of their becoming unfit for labour Any single individual who should trust to his own isolated efforts would plainly be placed in an infinitely more hazardous position Whenever an unfavourable contingency exists the best and cheapest way of obviating its effects is by uniting with others, each subjecting himself to a small privation, so that no [illegible] calamity However [illegible] not a member of a friendly society might not be able to insure his independence inasmuch as the occurrence of any accident, or an obstinate fit of sickness might, by throwing him out of employment, and forcing him to consume the savings he [illegible] reduce him to a state of [illegible] come dependent on the bounty of others Hence the paramount utility of the societies in question

"For these and other reasons" says Mr M'Culloch, "we are glad to find that friendly societies have been very widely introduced There were enrolled from the 1st of January, 1793, to the commencement of 1832 no fewer than 19 783 such societies, of which 16 596 were in England, 769 in Wales, 2144 in Scotland and 274 in Ireland The societies existing in 1815 are said to have comprised 925 429 individuals We have, however, some doubts as to the authenticity of this statement, but, if it may be depended on, the societies now in existence must comprise above 1 200 000 members! It should also be recollected that the progress of these societies, though [illegible] labouring population of Great Brit[illegible] has been not a little counteracted by the ignorance and mismanagement of their officers, and by the total [illegible] of establishing them on a secure foundation The great error has consisted in their fixing too high a scale of allowances At their first institution they are necessarily composed of members in the prime of life , there is, therefore, comparatively little sickness and mortality amongst them In consequence their funds rapidly accumulate , and they are naturally tempted to give too large an allowance to those members who are occasionally incapacitated But the circumstances under which the society is placed at an advanced period are materially different Sickness and mortality are then comparatively prevalent The contributions to the fund decline at the time that the outgoings increase , and it has not unfrequently happened that the society has become altogether bankrupt , and that [illegible] been left, at the close of a long [illegible] support from a fund on which they had relied, and to which they had largely contributed

[illegible] Benefit societies [illegible] have been [illegible] Parliament, [illegible] tects, have been made by private individuals and associations, and by the legislature, to obviate the chances of their failure, and to encourage their formation on sound principles Two reports, by committees of the House of Commons, on the laws respecting friendly societies, printed in 1825 and 1827 supply a great deal of important and useful information and the reports and tables published by the Highland Society are also valuable There are, doubtless several important points that still remain to be satisfactorily cleared up, but, in the mean time, enough has been done to en[illegible] with effect in assisting the [illegible] on a solid foundation In this view several statutes have, at different times, been passed , but the act 10 Geo 4 c 56 repealed all previous statutes, and, with the act 4 & 5 Will 4 c 40 , embodies the existing law upon the subject All friendly societies, claiming the benefit of these acts, are obliged to submit a statement of their rules and regulations for the approval of the officer appointed by government for that purpose , and it is only in the event of their being approved by him, and the tables of payments and allowances appearing suitable to the justices, that the society is to be confirmed by the latter, and becomes entitled to the privileges conferred by the act in question These consist in being allowed to invest the funds of [illegible] at a minimum rate of [illegible] and in the funds of savings' banks But it is, of course, open to any individuals, not seeking any connection with [illegible] to establish friendly societies on any terms [illegible] (*Statistics of the British Empire* )

FRIEZE (Ital fregio, *adorned* ) In Architecture, the member in the entablature of an order between the architrave and the cornice It is always plain in the Tuscan , ornamented with triglyphs and sculpture in the Doric , in the Ionic it is occasionally, in modern or Italian architecture, swelled, in which case it is called a *pulvinated* or *cushioned* frieze , and in the Corinthian and Composite it is variously decorated, according to the taste of the architect

FRIGA, or FREYA, in Northern Mythology *See* ODIN

FRIGATE, is applied to a ship with one covered gun [illegible] twenty-eight guns

FRIGIDARIUM [illegible] lus *cold* ) In ancient Architecture the apartment in which the cold bath was placed It is sometimes used to denote the bath itself

FRIGID ZONE The space about either pole of the earth terminated by the parallel of 66½ degrees of latitude At this parallel the sun at noon, in the middle of winter, is 90 degrees from the zenith , and consequently, were it not for the refraction would only be visible for an instant in the horizon Within this parallel the sun continues invisible in winter, and constantly visible in summer, for a shorter or longer space of time, depending on the distance of the place from the pole, where the sun remains for one half of the year above the horizon, and the other half below it *See* ZONE

FRINGILLA (Lat fringilla, *a chaffinch* ) A Linnæan genus of Passerine birds, characterised by a broad-based sharp pointed strong conical bill now raised to the rank of a family, *Fringillidæ*, including the buntings (*Emberiza*) , the cross-bills (*Loxia*) , the grosbeaks (*Coccothraustes*) , the linnets (*Linaria*) , canary-birds (*Canaria*) , finches (*Carduelis*) , and many exotic subgenera of seed and grain-eating Conirostral birds

FRITH or FIRTH (Lat fretum *a narrow sea*), is a term chiefly applied to a narrow and deep inlet of the sea upon a river as the Frith of Forth in Scotland This term corresponds to the fiord of the Danes and Norwegians, who, in all probability borrowed it from the English Both Latin and Teutonic are derived not improbably from the same root *fahren* to pass over , whence ferry, ford, furt (Germ ) as in Frankfurt, Erfurt, &c

FRITT The materials of glass are first mixed together, and heated so as to expel water, and induce fusion the mass thus obtained is called *Fritt*

FROG *See* BATRACHIA and RANA

FROND A combination of stem and leaf in one organ, as in *Jungermannia* and such plants It is often also applied to the leaves of palm trees and ferns, which differ in no respect from [illegible]

FRONDE, WAR OF THE That maintained by the malcontent partizans of the parliament in France, under the regency of Louis XIV , against [illegible] of Cardinal Mazarin The name of [illegible] was given to this war in consequence of a street quarrel, which have been differently represented The party opposed to government was called that of the Fronde , and the word Frondeurs has hence acquired in the French language the signification of discontented politicians Among the best authorities to consult on this period of French history are, Mailly, *Esprit de la Fronde*, 2 vols Paris, 1772 , the well known *Memoirs of*

*Cardinal de Retz*, and those of *Guy Joly* [illegible] 1718 See also other Memoirs in *Petitot's Collection*

FRONS In Mammalogy, the region of the cranium between the orbits and the vertex In Ornithology, the space between the base of the bill and the vertex

FRO'NTAL BONE The front bone of the head, which forms the forehead

FRO'NTIER (Ital frontiera [illegible] means the boundary of a state, or the territories adjacent to the boundary The best frontier is the sea, next best, great rivers or mountains, as the Rhine, Rhone, Alps, and Pyrenees Prussia has the worst frontier of any European state, and will run a great chance of being annihilated on the occurrence of a Continental war

FRO'NTISPIECE (Lat frons, *front*, and inspicio, *I look upon*) In Architecture, the face or fore front of a house, but more usually applied to the decorated entrance of a building This term is also used for the ornamental first page of a book, being as the derivation imports that part which first meets the eye

FRONTLET In Ornithology the margin of the head behind the bill of birds, generally clothed with rigid bristles

FROST [illegible] the freezing or congelation [illegible] the atmosphere by cold Water begins to freeze when the temperature of the air is such that the mercury in Fahrenheit's thermometer stands at 32° At this temperature ice begins to appear, unless some circumstance, for example the agitation of the water, prevents its formation As the cold increases the frost becomes more intense, and liquids which resist the degree of cold required to congeal water at length pass into the solid state Frost is peculiarly destructive to vegetation During severe frosts almost all vegetables fall into a state of decay and even a moderate degree of frost is sufficient to destroy many of the more tender kinds The injury which vegetables sustain from frost is greatest when it is preceded by a thaw or copious rains, for the plants are then saturated with moisture, which, expanding in bulk as it passes into the solid state, produces the rupture of the vegetable fibres Fruits are in like manner destroyed by frost Their watery portion [illegible] which occupying a greater [illegible] which they were produced burst the small vessels in which they are formed, hence the fruit is deprived of its flavour, and, when thaw takes place, falls into putrefaction

The *hoar frost* or *white frost*, which appears in the mornings, chiefly in autumn and spring is merely frozen dew It is generally the consequence of a sudden clearing up of the weather after rain when a considerable degree of cold is produced by the rapid evaporation In our European climates, it usually happens that after a fall of rain the wind shifts into a northern quarter and the atmosphere suddenly clears up When this takes [illegible] or early in [illegible] the earth co [illegible] effect of which is increased by the copious evaporation from the wet surfaces of the plants and the grass The influence of evaporation on the phenomenon is obvious from this, that the moisture which appears in the form of dew before sunrise is often changed into rime or hoar frost on the appearance of that luminary The reason is, that as the atmosphere begins to be warmed by the sun's rays, the evaporation is accelerated, and consequently the cold at the wet surface of the ground augmented Hence we see the reason why frosty nights are so much more prejudicial to the tender shoots of plants when they are succeeded by very bright mornings Hence also hoar frost is forme[illegible] plants when the thermometer, placed a few [illegible] ground indicates a temperature three or four degrees above the freezing point

Various projects have been proposed at different times to avert the disastrous effects of the morning frosts on vegetation in spring, but unfortunately it is only on a very limited scale that any means can be adopted for the purpose Whatever prevents the formation of dew will protect plants, hence a covering of net or [illegible] often preserve the [illegible] Bu[illegible] effectual means is [illegible] by screening the plant from the chilling aspect of the clear sky *See* DEW

FRUIT, in Botanical language, is the ovarium or the pistillum arrived at maturity, but the term is commonly extended to whatever is combined with the ovarium when it is ripe It comprehends many kinds of what are commonly called seeds as those of corn buckwheat, caraway, parsley, &c, as well as the succulent inflorescence of the pine-apple, which is a mass of ovaria and envelopes in a consolidated condition

FRUSTUM or FRUSTRUM (Lat frustum, *cut off*) In Architecture a piece cut off from a regular figure as the shaft of a column is a frustum of a paraboloid

FRUSTUM In Geometry, the part of a solid next the base, formed by cutting off the top, or it is the part of any solid as a cone, a pyramid &c between two planes, which may be either parallel or inclined to each other The frustum of a pyramid when the cutting plane is parallel to the base, is equal to the sum of three pyramids whose bases are,—1st, the lower base or end of the frustum; 2d, the upper base, and 3d, a surface which is a geometrical mean between these two Hence the solid content of such a frustum, whatever be the figure of the base, is found by this rule —Add into one sum the area of the two ends and the mean proportional between them, then one third of that sum will be the area of the base of an equal prism having the same altitude as the frustum, and consequently this area multiplied into the altitude gives the solid content of the frustum

FRU'TEX (Lat *a shrub*), is a plant whose branches are perennial, and proceed directly from the surface of the earth without any supporting trunk

FUE'L (Norm Fr fuayl) Any combustible substance which is used for the production of heat constitutes a species of fuel, and in this extended sense of the term, alcohol wax, tallow, coal gas, oil, and other inflammable bodies which are occasionally used, especially in the chemical laboratory, as sources of heat as well as light, might be included under it But the term *fuel* is more properly limited to coal, coke, charcoal, wood, and a few other substances, which are our common *sources of heat*, and as such are burned in grates, stoves, fireplaces, and furnaces of different descriptions

In this country coal, from its abundance and cheapness, is the commonly employed fuel, but where wood is abundant or where its value is little more than that of felling it it is used either in its original state or in the form of charcoal But whatever substance is used, the ultimate elements of fuel are carbon and hydrogen, and the heat which is evolved by their combustion is derived from their combination at high temperatures with the oxygen of the air the results or products of this combustion are carbonic a[illegible] the atmosphere by the [illegible] to furnaces and fireplaces

It is essential to good and profitable fuel that it should be free from moisture, for unless it be dry, much of the heat which it generates is consumed in converting its moisture into vapour hence the superior value of old, dense, and dry wood, to that which is porous and damp, hence also the greater quantity of heat evolved during the combustion of charcoal as compared with that of wood for even the driest wood always retains a certain quantity of water, hence also coke gives out more heat than pit coal, partly because it is absolutely dry, and partly because during the combustion or heating of coal, tar, oil, water and gas are evolved all of which carry off a certain proportion of the heat in a latent form A pound of dry wood will, for instance, heat 35 pounds of water from 32° to 212°, and a pound of the same wood in a moist or fresh state will not heat more than 25 pounds from the same to the same temperature, the value, therefore of different woods for fuel is nearly inversely as their moisture, and this may be roughly ascertained by finding how much a given weight of their shavings loses by drying them at 212°

Charcoal is itself very hygrometric and when exposed to air increases in weight to the amount of 10 or 12 per cent in consequence of the absorption of humidity a pound of dry charcoal is capable of [illegible] perly burned 73 pounds of water from [illegible] boiling point

The different kinds of pit coal give out variable quantities of heat during their combustion, upon an average, one pound of coal should raise 60 pounds of water from the freezing to its boiling point The heating power of coke as compared with coal is nearly in the ratio of 75 to 69 a pound of good coke will heat from 64 to 66 pounds of water from 32° to 212°, its power, therefore, is about nine tenths that of wood charcoal

The value of turf and peat as fuel is liable to much variation and depends partly upon their density, and partly upon their freedom from earthy impurities A pound of turf will heat about 26 pounds of water from 32° to 212°, and a pound of dense peat about 30 pounds by compressing and drying peat its value as a fuel is greatly increased

The following table, by Dr Ure, shows the quantity of water raised from 32° to 212° by one pound weight of the

| Combustible | Pounds of [illegible] | [illegible] Weight of [illegible] one [illegible] Ore |
|---|---|---|
| Dry wood - | 35 00 | 6 36 |
| Common wood | 26 00 | 4 72 |
| Charcoal - | 73 00 | 13 27 |
| Pit coal - | 60 00 | 10 90 |
| Coke - - | 65 00 | 11 81 |
| Turf - - | 30 00 | 5 45 |
| Coal gas - | 76 00 | 13 81 |
| Oil, wax, or tallow | 78·00 | 14 18 |
| Alcohol - | 82 00 | 9 56 |

different combustibles enumerated in the first column, it also shows the number of pounds of boiling water which the same weight of fuel will evaporate, and the quantity of atmospheric air absolutely consumed during combustion The quantity of air, however, as given in the last column, is much less than would be necessary in practice, where much of the air passes the fuel without coming into contact with it so as to have its oxygen consumed The [illegible] presented by this table can seld [illegible]

FUE'ROS, is the term by which in Spain the peculiar r- [illegible] said to be derived either from the Latin word *forum*, or (what is more probable) from the Spanish *fuera*, which signifies *outside* or *without*, thereby indicating the difference which exists between the administration of the provinces in which the fueros prevail from that of the other constituent parts of the Spanish monarchy The history of the fueros is lost in their profound antiquity, but there can be little doubt that their origin may be fairly associated with the political existence of the brave Cantabrians, who were never wholly subjugated to the Roman yoke, and who even when partially vanquished still maintained their ancient laws and customs inviolate Be this as it may, it is well known that from their earliest origin the Basque Provinces enjoyed certain privileges unknown to the rest of the Spanish kingdom, and which, though originally not reduced to writing and existing like our own common laws of old in the traditions of the country, were mutually and religiously observed both by the monarch and the people In this state they remained till the year 1235 when, on the accession of Thibault a French prince to the crown of Navarre, some misunderstanding having arisen respecting the nature and extent of the fueros, it became necessary to embody them in a written code which, with some considerable enlargement sanctioned by Charles V was down to the period of the last revolution, faithfully recognized by all the monarchs of Spain as the magna charta of the Basque Provinces Though the immunities of the provinces, Guipozcoa Alava Biscay and Navarre exhibit considerable difference in detail, their main features are marked by a striking uniformity, the form of government which prevails in each province being essentially republican in all its branches In the province of Biscay, for instance, which, with a few modifications more or less important, may serve as an example for the other provinces, the royal authority is purely nominal The only privilege of the crown consists in nominating the corregidor, the highest officer in the state but even this appointment is subject to the approval of certain members (called *deputation*) of the *junta* or states in whose assemblies he has a seat and vote In the junta is vested the chief management of affairs This assembly forms, with the exception of the American congress by far the most popularly constituted representative body in modern times the right of voting being conferred on every man who possesses a domicile within the lordship, and its chief duties consist in administering the affairs of the commonwealth, in collecting the taxes in providing for the protection and defence of the country in nominating the official servants of the government and in forming of [illegible] any imposts but those due from the inhabitants to their own lordship and which are fixed by themselves, and additionally whatever gratuitous contributions may be deemed necessary to [illegible] of the state, the enjoy[illegible] in the Castilian dominions on merely proving a descent from pure Biscayan blood, exemption from appearing before any tribunal beyond the limits of the lordship, to tolerate no royal intendant or comptroller within the province, to permit no *estanco* or royal monopoly, as in the rest of Spain, exemption from duty on imported merchandise, to have no royal administration, except that of the post-office, to admit no Spanish troops within the territory, to furnish no recruits for the royal army, to defend their territory with their own means and blood, and to visit with summary punishment all who may be convicted of extort[illegible] to interfere with the [illegible] These details, borrowed chiefly from an able article on this subject in the *Monthly Chronicle* for Nov 1839, will convey to the reader some idea of the nature and extent of the *fueros*, [illegible] formed the sole ground for the [illegible] which for the last few years devastated the northern provinces of the Spanish territory, — hostilities which have at length happily been put an end to by the formal recognition of all the rights, privileges, and ancient customs of the Basque Provinces, on the part not only [illegible] of the Cortes (For [illegible] the reader is referred to a masterly resumé of a work entitled *El Fuero — Privilegios, Franquezas, &c, confirmados por el Rey Don Carlos, nuestros senor, &c* 1762; commenced in *The Times* of Oct 14, continued in the same journal 16th Nov 1839 and ended March 1840)

FUGA, or FUGUE (Lat fuga *flight*) In Music, a composition wherein the different parts follow each other, [illegible] a certain interval above or [illegible]

FUGLEMAN or FUGELMAN A non-commissioned officer, appointed to take his place in front of a [illegible] movements of [illegible] during the exercising

FU'LCRA (Lat fulcrum, *a prop*) A term invented by Linnæus to denote a tendril, a prickle, a spine, a hook, or any other process by which plants are enabled to support themselves upon other plants

FU'LCRUM (Lat), in Mechanics, is the fixed point about which a lever moves *See* LEVER

FU'LGORA (Lat fulgor, *an effulgence*) The generic name of certain singular insects of the order *Homoptera*, and family *Cicadariæ*, which have the fore part of the head produced in the form of a snout or large hollow receptacle, and the antennæ inserted beneath the eyes, only three jointed, and terminated by a slender bristle It is asserted by one naturalist (Mad Merian), that the frontal projection emits a bright light, but others who have had opportunities of making observations on the [illegible] called, have not [illegible] powers if it really possess them

The [illegible] native of South America, the *Ful* [illegible] There are many other species included in the Linnæan generic character, but w[illegible] *Fulgur Cirrus*, *P*[illegible] *Diopper*, &c, ar[illegible]

FULGURATION [illegible] saver to the sudden brightening of the fused globule of gold or silver when the last film of oxide of lead or copper leaves its surface

FU'LICA (Lat fulica, [illegible] of a genus of Wading birds [illegible], now restricted to those which have a strong, moderate-sized, straight conical and compressed bill, with a dilated naked plate at the base of the upper mandible the toes are furnished at the sides with a scalloped membrane, the wings middle-sized The British species, or common coot (*Fulica atra*) is well known all its congeners approach more or less to its sooty or blue-black colour

FU'LLERS' EARTH A mineral essentially composed of silica and alumina, with about 24 per cent of water, used in fulling cloth Like other soft aluminous minerals it has the property of absorbing grease It occurs in Hampshire near Woburn in Bedfordshire, and at Nutfield in Surrey its exportation was formerly forbidden under severe penalties In most cases soap is now substituted

FU'LLING The art of cleansing, scouring, and pressing stuffs cloths, stockings, &c, to render them stronger, firmer, and closer, it is also [illegible] cloths &c are in fact scoured [illegible] *Dictionary of Arts &c*)

FU'LMINATES (Lat fulmen, *a thunderbolt*) Compounds of the fulminic acid with various bases, all more or less possessed of the property of exploding or detonating by heat or friction The fulminates of silver and mercury (or fulminating silver and mercury) are objects of manufacturing interest, the former being used in detonating *bonbons* and the latter more largely and importantly as a priming for the percussion caps of gun locks

FU'LMINATING POWDER A compound of three parts of nitre two of purified pearlash, and one of flowers of sulphur carefully mixed and dried before the fire about 20 grains of this powder heated upon an iron plate over a slow fire become brown and pasty, a blue flame then appears upon it and immediately after the whole exp[illegible]

FULMINATION, [illegible] anonymously in a general sense with *denunciation*, [illegible] more particularly to the excommunications or [illegible] issued by the papal see

FULMI'NIC ACID An acid composed of 2 equivalents of cyanogen = 52, and 2 of oxygen = 16 corresponding therefore in ultimate composition with the *cyanic acid* In combination with the oxide of silver and oxide of mercury, this acid constitutes fulminating silver an[illegible]

FUMARIACEÆ [illegible] A natural [illegible] found in temperate climates, and related to *Papaveraceæ* so nearly as to be incorporated with them by some writers Their sensible properties are not of any value, a few are objects [illegible]

FUMIGATION [illegible] The diffusion of certain vapours through the air, for the purpose of destroying contagion and infection goods are also fumi-

gated for the same purpose Acid vapours have frequently been used for this purpose there are, however, very few which are at all effectual, and some of them, such as vinegar, only serve to cover bad smells without destroying noxious effluvia There is no substance so certain in its effects as *chlorine*, and it is cheap, and easily obtained either from muriatic acid and black oxide of manganese or from a mixture of salt, sulphuric acid, and black oxide In inhabited rooms it requires to be cautiously used in consequence of its bad effects upon the respiratory organs, but even here it may be so extensively diffused as to be effective in destroying noxious matters, without serious injury to persons who breathe the atmosphere When a room can be shut up it may be freely used, and it should be generated in vessels placed in different parts of the apartment, and not upon the ground, but upon shelves high up in the room, for chlorine being heavier than air is thus more quickly and rapidly diffused Infected clothes and furniture may at the same time be subjected to its action Of all common diseases the scarlet fever is that which appears to require the most scrupulous attention to careful fumigation

FUNCTION, in Analysis, signifies any mathematical expression considered with reference to its form and not to the value which it receives by giving particular values to the symbols contained in it Thus $a + x$ and $a^2 + x^2$ are both functions of $x$, though of different forms In whatever manner an expression may be compounded of constant and variable quantities, it is always called a function of the variable quantities only, because it is only with reference to the manner in which the variables enter into the expression that it is necessary to consider the function Thus the above expressions as well as the following, $a + \log x$, $b + \sin p x$, &c are all functions of $x$ the quantities $a$ $b$ $p$ &c being constant and independent of $x$ The calculus of functions may be regarded as standing in the same relation to algebra that algebra occupies with regard to common arithmetic The definite abstract numbers about which arithmetic is concerned are in algebra laid aside for symbols of general number thus enabling us to express a definite operation performed on an indefinite number In the calculus of functions the generalization is carried a step further, the definite character of the operation is dropped and indefinite symbols of operation are used, which may be unknown, but determinable by certain conditions, or arbitrary, or conventionally definite to denote particular operations (See "Calculus of Functions" in the *Ency Metrop* by Mr De Morgan also *Babbage's Elementary Treatise on the Calculus of Functions*, Lagrange, *Theorie des Fonctions Analytiques*, Cauchy, *Cours d'Analyse* and *Elemens du Calcul Infin*, *Peacock's Algebra* &c)

FUNDAMENTAL BASS In Music, the lowest note or root of a chord, which is found by inverting its notes so as to set them in thirds above such root

FUNDS, PUBLIC The name given to the public funded debt due by government

The practice of borrowing money in order to defray a part of the war expenditure began, in this country in the reign of William III In the infancy of the practice it was customary to borrow upon the security of some tax or portion of a tax, set apart as a fund for discharging the principal and interest of the sum borrowed This discharge was, however, very rarely effected The public exigencies still continuing the loans were, in most cases either continued, or the taxes were again mortgaged for fresh ones At length the practice of borrowing for a fixed period, or, as it is commonly termed upon *terminable* annuities, was almost entirely abandoned, and most loans were made upon *interminable* annuities, or until such time as it might be convenient for government to pay off the principal

In the beginning of the funding system, the term fund meant the taxes or funds appropriated to the discharge of the principal and interest of loans, those who held government securities and sold them to others selling, of course, a corresponding claim upon some fund But after the debt began to grow large, and the practice of borrowing upon interminable annuities had been introduced, the meaning attached to the term fund was gradually changed, and instead of signifying the security upon which loans were advanced, it has, for a long time, signified the principal of the loans themselves

Owing partly, perhaps, to the scarcity of disposable capital at the time, but far more to the supposed insecurity of the revolutionary establishment, the rate of interest paid by government in the early part of the funding system was, comparatively high But as money became richer, and the confidence of the public in the stability of government was increased, ministers were enabled to take measures for reducing the interest, first in 1717 and again in 1749

During the reigns of William III and Anne, the interest stipulated for loans was very various But in the reign of George II a uniform rate was established, and Instead of varying the interest [illegible] according to the state of the money market at the time, the rate of interest was generally fixed at *three* or *three and a half* per cent, the necessary variation being made in the principal funded Thus, suppose government were anxious [illegible] in return for every 100*l* advanced, 150*l* 3 per cent stock, that is, they bound the country to pay him or his assignees 4*l* 10*s* a year in all time to come, or otherwise to extinguish the debt by a payment of 150*l* In consequence of the prevalence of this practice, the principal of the debt now existing amounts to nearly *two fifths* more than the sum actually advanced by the lenders

Some advantages are, however, derivable, or supposed to be derivable, from this system It renders the management of the debt, and its transfer, more simple and commodious than it would have been had it consisted of [illegible] affords to the dealers in stocks bearing a low rate of interest has enabled [illegible] additional capitals, [illegible] count of interest than would have been necessary had no such increase of capital been made *See* NATIONAL DEBT

FUNERAL (Lat *funus*), may be defined generally as the last rites performed to a deceased person, of whatever nature they may be, whether of interment, burning, embalming, &c Among the ancients ceremonies of this nature were accompanied by [illegible] combats, called *funeral games*, [illegible] particularly where the deceased was of high rank or otherwise distinguished, by a discourse, or funeral oration, pronounced in his praise (See SEPULTURE, RITES OF)

FUNGI A large natural order of plants of a very low organization consisting chiefly of cellular tissue sometimes intermixed with flocculent matter, and very rarely with spiral vessels They inhabit dead and decaying organic bodies and are also a common pest to living plants upon which they prey in the same manner as vermin and intestinal worms upon animals A vast number of species are described by writers upon fungi, called mycologists, and they are often of great importance to man either for their use or their mischievous qualities The common mushroom, the truffle, and morel, are delicacies well known at table Ergot is valuable in obstetric practice as a uterine stimulant, very many are dangerous poisons Blight, mildew, rust, brand &c are diseases caused [illegible] of microscopic fungi, and finally the [illegible] dry rot are owing to the attacks of *Merulius lachrymans* and many other species some of which are microscopic The best general work on fungi is *Linnæus's Systema Mycologicum* Numerous species are figured in the works of Greville, Bulliard Sowerby, Corda and Nees von Esenbeck

FUNGICOLA (Lat *fungus a mushroom*, and *colo, to inhabit*) The name of a family of Coleopterans, comprising [illegible] which are found on mushrooms

FUNGIFORMIS A term signifying *mushroom-headed* is applied to any bodies having a short thick figure, one end of which is much more dilated than another

FUNGIN The fleshy part of mushrooms purified by digestion in hot water

FUNGUS, in Surgery, is a term applied to the too luxuriant formation of flesh about an ulcer, or what is commonly called *proud flesh*

FUNICULAR MACHINE (Lat *funis, a rope*) In Mechanics, if a body fixed to two or more ropes is sustained by powers which act by means of those ropes, the assemblage is called the *funicular machine*, or *rope machine* If a rope is stretched horizontally between two points, its own weight alone will prevent it from becoming perfectly straight, whatever force be employed in stretching it, [illegible] point at right [illegible] overcome very great resistance at the points to which its extremities are attached In this manner a very small force [illegible] height [illegible] who free [illegible]

FUNICULUS A prolongation of the placenta in the shape of a cord, to which the ovules are attached

FUNNEL (Lat *infundibulum*) In Architecture, the upper part of a chimney In common life, it is a trumpet-mouthed utensil, with a pipe fixed to the apex [illegible] for pouring liquors into a vessel without [illegible]

FUNNEL SHAPED In Botany used in describing the general form of a calyx, corolla, or other organ, the tube of which is like a funnel or inverted cone, that is, narrow at the base and wide at the orifice

FUR (Fr *fourrure*) The coated skins of wild animals [illegible] of the colder and high northern latitudes, such as the wolf, bear, beaver, &c The hair or fur is cleansed, and the skin is generally slightly tanned or tawed The most valuable furs, such as ermine and sable, come chiefly

from Russia When unprepared, or merely dried, the fur [illegible]

FURFURACEOUS (Lat furfur, *bran*) A term applied to certain eruptions in which the cuticle peels off in scales also to a branlike sediment which is sometimes observed in the urine

FURIES (Furiæ) in Mythology, called by the Greeks [illegible] Eumenides (Εὐμενίδες), were the [illegible] who punished gods and men for their transgressions against those whom they were bound to esteem and reverence Their number was not fixed, though [illegible] sisters The [illegible] (Soton), were particularly addicted to this sort of *euphemism*, called them also Σεμναὶ Θεαὶ, the *venerable goddesses*, their true names being considered ominous By this name they were mentioned in the oaths taken at the Areopagus

FURL In Navigation to roll the sail up and confine it closely to the yard, the sail being gathered up by the men on the yard, the leech or edge is passed along the yard to the middle or *bunt*, where the body of the sail, the foot and clews, are collected In this way the sails of a man of war are removed nearly out of view in an almost incredibly short space of time

FURLONG An English measure of length, containing the eighth part of a mile

FURLOUGH, in [illegible] mission granted to [illegible] for a given time from military duty

FURNACE (Lat fornax) An apparatus wherein is placed a cavity to contain combustible matter, which in various ways is supplied with air to facilitate its combustion The two classes into which furnaces are divided are air or wind furnaces and blast furnaces In the former the air is conducted through the fire by the [illegible] pneumatic apparatus supplies the air The word furnace has generally, however, a more circumscribed application, being applied usually to an apparatus for the fusion of metals or to that used in a chemical laboratory

FURNITURE In Printing, the materials used to extend pages of type to their proper length, also to separate them when imposed, to a just distance from each other, so that when the sheet is printed and folded the margin shall be regular and uniform (See IMPOSING) It consists of pieces of oak wood planed up to specific thicknesses, and to about half an inch high, sidesticks and footsticks, which are placed at the outside of the pages, and made thinner at one end than the other, to allow the quoin to secure them more effectually, and quoins or wedges, usually made of beech wood, with which [illegible] wedged up in a chase See CHASE

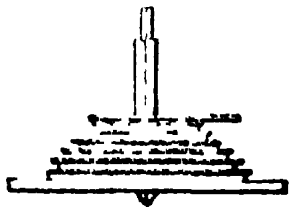
FURNITURE (Fr fourmir *to furnish*) In Architecture, the visible brasswork of locks, knobs to doors, window shutters, and the like

FURRING (Fr fourrer, *to thrust in*) In Architecture, the small slips nailed on joists or rafters where some parts of them are lower than others or where the surface is not regular so as to bring the boarding they are to receive into the same plane

FURUNCULUS (Lat furo, *I rage*) A boil, an inflammatory tumour, which generally has a central core, and appears in full and healthy habits Where boils prevail in delicate constitutions, they generally indicate a cachectic state, which is often corrected by a course of sarsaparilla

FURZE A prickly bush found abundantly in exposed heaths in England and the more southern countries of Europe from which it is by some supposed to have been introduced, a conjecture rendered probable by its not being able to bear the more rigorous of our winters Its preference for sterile soil has caused it to be extensively used for fences in such land, as a cover for game and a shelter for young plantations Its young and tenderer shoots are browsed upon by sheep and cattle Botanists call it *Ulex Europæus*, and class it with the [illegible]

FUSE [illegible] that part of the machinery about which the chain is wound, and which is immediately acted upon by the main-spring The use of the fusee is to equalize the action of the spring In proportion as the spring becomes unwound, its effort continually relaxes, so that if the first wheel were attached to the barrel, as is often the case in common watches, the inequality of the impelling power would [illegible] in the rate of going [illegible] the chain is attached to and wound round the barrel in which the main-spring is contained, while the other end is coiled about the fusee, which has a conical shape, and is fixed on the axis of the first wheel The principle generally adopted for determining the figure of the fusee is, that its radius, at any point to which the chain is a tangent, should be inversely as the tension of the chain in that position With certain limits this is nearly true, and if we assume with Hooke that the force of a spring is proportional [illegible] from the position [illegible] ation of the length would be easy to [illegible] generated by the [illegible] about its asymptote This conclusion is, however, by no means correct, but though the subject has been treated by several eminent mathematicians, very little practical advantage has been derived from the theoretical investigations In fact, a moderate approximation to the true [illegible] all that can be attained [illegible]



FUSIBLE METAL [illegible] of eight parts of bismuth, five of lead, and three of tin. It liquefies at a temperature below 212°

FUSIBLE SALT OF URINE A name by which the old chemists designated the *ammonio-phosphate of soda* obtained by the evaporation of urine

FUSIL (Fr fusee), in Heraldry, is a bearing of a rhomboidal figure more slender than the lozenge, its upper and lower angles being more acute than the two middle ones

FUSIL A light musket nearly similar to a carabine, but in general more neatly finished The fusil was originally used by officers attached to light companies, and in the British army it has given its name to several regiments called the *fusiliers* The bore is usually calculated for balls of eighteen to the pound, and the length of the barrel is from thirty four to thirty eight inches

FUSIL The same as *Frust*, which see

FUSTIAN (Fr fustaine) A thick twilled cotton, of which velveteen, corduroy, and thickset are varieties (See VELVET) Fustian is generally dyed of a deep olive or lead colour

FUSTIAN in Criticism, is applied to writings remarkable for a forced elevation of style, or for an exaggerated or unnatural use of metaphors or other rhetorical figures

FUSTIC A yellow dye stuff There are two kinds of fustic occasionally used by dyers *Old fustic* is the wood of a large tree the *Morus tinctoria*, which grows abundantly in many parts of the West Indies and America, it gives a dingy yellow dye, and is chiefly useful in the production of compound colours *Young fustic* is the *Rhus cotinus* or Venice sumach, a shrub growing in Italy and the south of France, it gives a greenish-yellow dye, and is also used as an accessory material

FUTTOCK PLATES Flat iron bars or plates, receiving at one end the lower dead-eye of the topmast rigging and at the other the futtock shroud

FUTTOCKS In Nautical language, the timbers between the floor timbers and the top timbers

# G.

G The seventh [illegible] third in those of [illegible] Greek The form of our G is borrowed from the Roman alphabet G in English has two sounds before *a o*, and *u* and occasionally before *i* and *e*, it is the medial letter of the guttural order, the other sound, which it possesses only before *e* and *i*, is one of the medials of the sibilant series The guttural G is liable to a variety of changes in different dialects and languages (See *Penny Cyclo*) G, as a Roman abbreviature, is used for gratis gens, gaudium, &c G V signifies genio urbis, G I genio loci and G P R gloria populi Romani As a numeral it denoted 400, —

G quadringentos demonstrativa tenebit

On the French coins G indicates the city of Poictiers, and [illegible] it is the seventh Dominical letter G, in music, the fifth note or degree of the diatonic scale, corresponding to the sol of the French and Italians It is used also to designate the treble clef

GABELLE (Probably derived, through some unknown inflexion from the Teutonic word geben, *to give*) Any impost laid on commodities was originally thus termed in France, as, gabelle de vin, de draps, &c but the word acquired in the course of time the peculiar signification of a duty on salt, which is meant when the word "gabelle" is used simply The Gabelle was first established in the early part of the 14th century, during the reign of Philip de Valois, and with a brief interruption of five years, from [illegible] down to the reign of [illegible] XVI at which time the revenue it produced was [illegible] millions of francs The distribution of this tax was most capricious and arbitrary, some provinces having been altogether exempt from, some more and others less subject to its operation and it may safely be affirmed that the gabelle was one of the greatest curses imposed on France previously to the

Revolution (See *Com Dict*, art "Salt," art "Taxation" *Supp Encyc Brit*)

GA'BIONS, in Fortification are baskets made of twigs, which, being filled with earth, are used as a screen from the enemy's fire

GA'BLE (Brit from gavel) In Architecture the vertical triangular piece of wall at the end of a roof, from the level of the eaves to the summit

GA'DFLY *See* ŒSTRUM

GA'DOIDS, *Gadoidæ* (Gr γαδος, *a fish*) A family of soft finned fishes, which belong to the section *Subbrachians*, or those which have the ventral fins below or in advance of the pectorals, and of which the cod-fish (*Gadus morrhua*, Linn) may be regarded as the type

The general character of the Gadoid family is as follows —Body moderately elongated, sub compressed, and covered with soft and very numerous scales, head smooth, jaws and front of the vomer armed with pointed, unequal, moderate, or small teeth disposed in several rows like a rasp, gill openings large, and with seven rays, most of the species with two or three dorsal and one or two anal fins, stomach strong and capacious, cœcal appendages very numerous, air bladder large with strong parietes, often dentated laterally The greater number of the cod tribe inhabit the seas of cold or temperate latitudes, their flesh is white and well-flavoured, they are most prolific and constitute the most important subject of fisheries The great sand bank of Newfoundland is the most famous of the cod fisheries here 100 000,000 pounds weight have been taken by the British alone in one year

GA'DOLINITE A mineral found almost exclusively in Sweden [illegible] oxide of cerium, named in honour of Dr Gadolin who discovered yttria

GAFF The boom or yard extending the upper edge of what are called *fore* and *aft* sails The gaff turns round the mast against which it rests in a circular opening (called the *jaws*) as an axis It is supported by two independent ropes, the *throat halliards* at the mast and the *peak halliards* at the outer end It is steadied when the sail is not set, by ropes at the extremity called *vangs*

GAGE or GAUGE (Ang S Gæccan *to bind or confine*) In Architecture the length of a slate or tile below the lap, also the measure to which any substance is confined Plasterers use the word to signify the greater or less quantity of plaster of Paris used with the common plaster to accelerate its setting

GAGE In Physics, an instrument or apparatus for measuring the state of a phenomenon *Gage of the air pump* is merely a barometer communicating with the inside of the receiver, which marks in the usual manner the pressure of the air within the receiver by the height of the equiponderant column of mercury, and consequently shows the degree to which the air is rarefied A short barometer may be employed for this purpose, but in this case it will not be affected till the rarefaction of the air has been carried so far as to correspond with the length of the tube An instrument for the same purpose, but on a different principle, was invented by Smeaton and from its form called the *pear gage* It is a vessel suspended in the receiver and exhausted to the same degree, but when the rarefaction is carried as far as intended, the open orifice of the gage is let down into a vessel containing mercury, which on the readmission of the air, is forced up into the pear, and the degree of rarefaction is judged of by the quantity of mercury introduced The idea is ingenious, but the indications given by this instrument are not correct For *wind-gage* see ANEMOMETER, *water-gage*, see HYDROMETER

GAILLARDE (Ital) The name of a lively dance peculiar to Italy, and supposed to have been practised by the ancient Romans, whence it is sometimes designated Romanesque

GALACTOPHORITES (Gr γαλα, *milk* and φερω *I* [illegible] by some medical writers to diet and medicine supposed to promote the secretion of milk

GALA'NGAL A dried root brought from China, it has an aromatic smell, and a pungent bitter flavour, and was formerly used in medicine The greater galangal is the produce of the *Kampferia galanga*, and the lesser of the *Maranta galanga*

GALATHÆ'A A genus of long tailed (*macrourous*) Crustacea, including some very beautiful species (*Gal rugosa strigosa, et squamifera*), occasionally found on the British coasts The true *Galathæa* have the thorax oblong or ovoid, the median antennæ produced and the pincers elongated This term is derived from the cele-

[illegible] (Gr γαλα, *milk*) In Astronomy, "that great luminous band which stretches every evening all across the sky [illegible] and which forms a zone completely encircling the whole sphere, almost in a great circle At one part it sends off a kind of branch [illegible] main body, after remaining [illegible] This remarkable belt has maintained from the earliest ages the same relative situation among the stars, and when examined through powerful telescopes is found to consist entirely of stars, scattered by millions, like glittering dust, on the black ground of the general heavens" (*Herschel's Astronomy, Cabinet Cyclopædia*) The phenomenon of the Galaxy was seen the same illustrious author was led to suppose that the stars of our firmament, instead of being scattered in all directions indifferently through space form a stratum, of which the [illegible] is small in comparison with its length and breadth, and in which the earth occupies a place somewhere about the middle of its thickness, and near the point where it subdivides into two principal laminæ, inclined at a small angle to each other For it is certain that to an eye thus situated, the apparent density of the stars supposing them pretty equally scattered through the space they occupy, would be least in a direction of the visual ray perpendicular to the lamina, and greatest in that of its breadth increasing rapidly in passing from the one direction to the other, just as we see a slight haze in the atmosphere [illegible] the horizon by the [illegible] visual ray Accordingly such is the view of the construction of the starry firmament taken by Sir William Herschel whose powerful telescopes have effected a complete analysis of this wonderful zone, and demonstrated the fact of its consisting entirely of stars" (P 476) (For a more detailed account of this subject, see SUPPLEMENT)

GA'LBANUM A lightly fetid gum-resin produced [illegible] It is imported from Turkey [illegible] use, but is a drug of little importance

GALBULA (Lat the name of a bird in Martius) A genus of Scansorial birds closely allied to the kingfishers by their elongated sharp pointed beak the upper ridge of which is angular and by their short feet the anterior toes of which are almost wholly united these toes however are not precisely the same as those of the kingfishers The plumage of the species of *Galbula* which are called by the French jacamars, is not so smooth as that of the kingfishers and always has a metallic lustre They are solitary birds that live in wet forests, feed on insects and build on low bushes

GALBULUS In Botany a term invented by Gærtner to denote a form of fruit similar to a cone excepting that the galbulus is round and has the heads of the carpels much enlarged Example —the fruit of the juniper

GALEA In Antiquity was the headpiece or helmet used in battle by the Roman soldiers

Jam galeam Libyæ teritis et pectora thoracas
Cuncta micant radiisque vomunt incendia Mavors

The *galea* was used for the same defensive purposes as the *cassis*, but differed from it in this that while the cassis was of *metal* the galea was originally of *hides* It was too heavy for general use hence each army was attended [illegible] of military domestics, whose duty it was [illegible] of the soldiers

GALE'NA (Gr γαλεω, *I shine*) Native sulphuret of lead

GALENISTS In Ecclesiastical History a subdivision of the sect called Waterlndians in the 17th century (*Mosheim* Transl, vol v 196) In Medical History the followers of Galen were so termed, in opposition to the practitioners of the chemical school

GALE OF WIND The sea term for a continued storm of wind the lowest degree is the fresh gale the next a strong gale and the next a heavy or hard gale

GALEOPITHECUS (Gr γαλεη *an ape*) A genus of Insectivorous the bones of the arm and leg but not those of the digits excessively elongated, and supporting extensive lateral folds of skin serviceable as a parachute but not as organs of flight The species are restricted to the great islands of the Indian archipelago, their inferior incisors are remarkable for their complex form, like the teeth of a comb

GALERU'CA (Lat galerus, *a cap or tuft*) A genus of Tetramerous Coleoptera, now the type of an extensive family (*Galerucida*), including amongst other subgenera the noxious turnip flies (*Haltica*) All the *Galerucida* are very [illegible] both in their larva and perfect state There are about a dozen known British species of *Galeruca* proper which are small, and generally dark or dull-coloured beetles

GALIA'CEÆ (Galium, one of the genera) A natural order of herbaceous Exogens inhabiting the cooler parts of the world They are distinguished from *Cinchonaceæ* by their square stems and verticillate leaves without stipules The *Rubia tinctoria* yields madder, and some of [illegible] substance [illegible] the flowers of *Galium*

GALL *See* BILE

GALL BLA'DDER An oblong membranous recep-

tacle attached to the under part of the liver It retains the bile which [illegible] in the hepatic duct, and sends it through [illegible] which proceeds from its neck into the *ductus communis choledochus*, and thence [illegible]

GALLEON (Sp) Spanish treasure ships with three or four decks, formerly employed in communicating with Peru

GA'LLERY In the Fine Arts, a term applied to a collection of works in painting or sculpture The earliest gallery of which there is any record was that of Verres It is described by Cicero and was rich in pictures as well as sculpture In Europe, at the present day the gallery of the Louvre, though much reduced in 1815 by the restoration of many works of art which conquest had enabled the French to acquire, is the finest in Europe, if taken as a whole That founded at Florence by Cosmo II long enjoyed the first rank but must be now considered secondary to the French collection The other principal galleries of Europe are those at Munich, Dresden Berlin and though last not least both in size and importance, that of the Vatican at Rome, which however, is more generally called the Museum of the Vatican The building for the reception of the National Gallery in London is wholly unworthy of the nation and of the fine situation which it occupies The collection of pictures in this gallery is small, but some of them are of rare and unrivalled excellence The gallery of antiques at the British Museum is in many respects, matchless The galleries of the Duke of Sutherland, Lord Ellesmere Mr Hope and other private individuals contain many very fine pictures

GA'LLERY In Fortification a covered passage across the ditch of a fortified town In Mining *gallery* is a narrow passage from one part of the mine to another

GA'LLEY (Fr galère) A low built vessel propelled by sails and oars either on a single tier, or on tiers of benches one above the other The war vessels of antiquity were all galleys Among the Greeks those chiefly mentioned are the pentecontori, which appear to have had fifty oars disposed in a single tier, and the triremes (Latin [illegible]ssels with three banks of oars, concerning the [illegible] of which much controversy has taken place It is commonly supposed that a trireme had three banks of oars one above the other but this is rendered improbable by the circumstance of Pliny making mention of galleys having thirty forty and even fifty banks of oars for it seems hardly credible that so many could have been arranged directly above each other Some have suggested that the rows of oars in the trireme were disposed not horizontally but obliquely, in which case an increase in the number of banks of oars would augment the length, and probably the height would be increased in proportion (See *Meibomius, De fabrica veterum Triremium*)

Galleys were likewise chiefly employed by the maritime nations of the middle ages in the Mediterranean Their use in naval war hardly ceased until the end of the 17th century and the Venetian republic, down to the period of its extinction always maintained a number of war galleys The Venetian galleys had a single tier only and all modern galleys followed the same construction These were formidable vessels in a calm, but unfit for sea and accordingly found chiefly in the Mediterranean The Venetians had also a large high pooped sort of galley called galeazza, whence the word galleass and galliott in old English writers

The *Deal galley* is a long narrow boat used by the Deal boatmen, and managed on the most hazardous occasions in [illegible]win the crew of stranded vessels with consummate skill, it is also used by smugglers on account of its velocity The *galley* is also the kitchen of a ship

The punishment of the *galleys* or the employment of condemned criminals in the toilsome employment of rowing them is said to have originated under the Greek [illegible] λεμεροι, or galley slaves—in [illegible] used by all the nations border- [illegible] In France under the old jurisprudence the punishment of the galleys was the severest after that of death About the end of the reign of Louis XIV, when galleys themselves began to be disused, the galley slaves were employed in hospitals public works, &c, and the name of the punishment was changed by the constituent assembly (1798) to *travaux forcés*, compulsory labour, whence the word *forçat* for a criminal so condemned Under the code of the empire the punishment was accompanied with forfeiture of property, infamy, and branding By an alteration of the law effected in 1832, the brand was abolished, and the criminals, who had hitherto been intermingled in the three penal fortresses (Toulon, Rochefort, and Brest), were classified Toulon is now appropriated to those condemned for 10 years and under, Brest, to those from 10 to 20, Rochefort, to the condemned for life The name *Bagne*, which is applied in France to prisons in which those condemned to compulsory labour are confined, is derived from the famous Bagnio prison at Constantinople, so called on account of some baths situated there The principal crimes now punished in this manner by the French law are—some acts of violence against the government or public law, coining and forgery, assaults followed by death on legal officers, murder, unless under such aggravated circumstances as are punished by death, cutting and maiming, rape, abduction, burglary, highway robbery, burning of insulated buildings threatening letters, perjury, &c

GA'LLI The priests of Cybele were so named at Rome from the country (Galatia or Gallo-Græcia) in which Pessinus, the head quarters of her worship, was situated also termed Curetes, Corybantes, and Idæi Dactyli Cybele, the mother of the gods, was introduced to Rome from Asia on the occasion of a pestilence by the advice of the Sybilline oracles (*Liv* 29 c 14), and her worship became in time one of the most popular in the city Her priests were eunuchs, of which Lucretius (lib ii) gives the alleged reason They are described as the vilest of mankind by the Roman satirists, yet they had extraordinary power over the vulgar Juvenal describes them among the low companions of his debauched consul Damasippus —

Et resupinati cessantia tympana Galli

GA'LLIC ACID An acid obtained from galls and several other vegetable astringents Its ultimate components are $7\,car + 3\,h + 5\,o$, its equivalent number is 85

GA'LLICAN CHURCH The distinctive title of the Roman Catholic church in France, which maintains a certain degree of independence in respect of the Romish see The liberties of the Gallican church, first asserted in the Pragm[illegible] [illegible]s were defined and confirmed in the [illegible] P[illegible] Cleri Gallicani, promulgated in 1682 The occasion of this declaration was a dispute between Louis XIV and Pope Innocent XI concerning the right long practised by the French kings of occupying in their own persons the inferior preferments of a diocese which lapsed during the vacancy of the see It was then determined by an assembly of the French clergy, that the pope has no temporal but only spiritual rights as the vicegerent of Christ, that even these are limited by canons and councils, and that the decrees of the holy see are subject to reversal upon the decision of the clergy in general (See the *Declaration of the French Clergy on [illegible] Ecclesiastical Power* drawn up by the famous Bossuet Bishop of Meaux, in the assembly convoked by Louis XIV in 1682) While, however, it asserts this liberty in speculative points, the Gallican church does not differ from the Romish in any points of faith or ceremonial observances It was upon the basis of these liberties that the concordat was founded by which the Catholic religion was re-established in France in 1801, and they continue to be maintained upon their original footing now that the church is no longer connected with the state It has always been the object of the Jesuits to bring the French church into more deferential submission to the Romish see, and at the present day the party among the clergy who desire this consummation is said to be on the increase The controversy on this subject was carried on in the last century between the two classes called Cismontane and Ultramontane divines The new Gallican church of the Abbe Chatel, founded at Paris in 1831, seems not to have met with much success The abbé styles himself primate of it It denies the infallibility of the pope and of councils rejects the celibacy of priests, leaves confession voluntary, and performs service in the mother tongue In all these respects its doctrines approach those of the church of England (See the *Profession de Foi de l'Eglise Catholique Française*, Par 1831)

GA'LLICISM Literally, a phrase or construction peculiar to the French language, but used generally to denote such phrases or modes of speech in English as are formed after the French idiom

GALLICOLA (Lat galla, *a gall* colo, *I inhabit*) The name of a family of Pupiparous Hymenopterans, including those of which the larvæ inhabit the galls or vegetable excrescences caused by the perforation and oviposition of the parent insect

GA'LLINACEANS, *Gallinacea* (Lat gallus, *a cock*) See RASORES

GALL-INSECTS *Gall-insecta* The name of a family of Hemipterans, comprehending those the females of which, towards the period of oviposition, assume a globular form, analogous to the galls caused by the *gallicolæ*

GA'LLINULE, or WATER-HEN The type of the subgenus *Gallinula*, now dismembered from the *Fulica* of Linnæus, which term is restricted in modern systems of ornithology to the Coots proper

GALLIOT A strong and cumbrous vessel used by the Dutch, having a main and mizen mast, which is often close aft

GALL NUTS Excrescences produced by the cynips, a small insect which deposits its eggs in the tender buds of the *Quercus infectoria*, a species of oak abundant in Asia Minor When the maggot is hatched it produces

Revolution (See *Com Dict*, art "Salt," art "Tax-at

GA'BIONS are baskets made of twigs, which, being filled with earth, are used as a screen from the enemy's fire

GA'BLE (Brit from gavel) In Architecture, the vertical triangular piece of wall at the end of a roof, from the level of the eaves to the summit

GA'DFLY *See* Œstrum

GA'DOIDS, *Gadoidæ* (Gr γαδος, *a fish*) A family of soft-finned fishes, which belong to the section *Subbrachians*, or those which have the ventral fins below or in advance of the pectorals and of which the cod-fish (*Gadus morrhua*, Linn) may be regarded as the type

The general character of the Gadoid family is as follows —Body moderately elongated, sub compressed, and covered with soft and very numerous scales, head smooth, jaws and front of the vomer armed with pointed, unequal moderate, or small teeth disposed in several rows, like a rasp, gill-openings large, and with seven rays, most of the species with two or three dorsal and one or two anal fins, stomach strong and capacious, cæcal appendages very numerous air bladder large with strong parietes often dentated laterally The greater number of the cod tribe inhabit the seas of cold or temperate latitudes their flesh is white and well-flavoured they are most prolific and constitute the most important subject of fisheries The great sand bank of Newfoundland is the most famous of the cod-fisheries here 100 000 000 pounds weight have been taken by the British alone in one year

GA'DOLINITE A mineral found almost exclusively in Swe len oxide of cerium, named in honour G Di Ga s discovered y thria

GAFF The boom or yard extending the upper edge of what are called *fore* and *aft* sails The gaff turns round the mast against which it rests in a circular opening (called the *jaws*) at its axis It is supported by two independent ropes, the *throat halliards* at the mast and the *peak halliards* at the outer end It is steadied when the sail is not set, by ropes at the extremity called *vangs*

GAGE, or GAUGE (Ang S Russian *to bind or confine*) In Architecture the length of a slate or tile below the lap, also the measure to which any substance is confined Plasterers use the word to signify the greater or less quantity of plaster of Paris used with the common plaster to accelerate its setting

GAGE In Physics, an instrument or apparatus for measuring the state of a phenomenon *Gage of the air pump* is merely a barometer communicating with the inside of the receiver which marks in the usual manner the pressure of the air within the receiver by the height of the equiponderant column of mercury and consequently shows the degree to which the air is rarefied A short barometer may be employed for this purpose, but in this case it will not be affected till the rarefaction of the air has been carried so far as to correspond with the length of the tube An instrument for the same purpose but on a different principle, was invented by Smeaton and from its form called the *pear gage* It is a vessel suspended in the receiver and exhausted to the same degree, but when the rarefaction is carried as far as intended the open orifice of the gage is let down into a vessel of which, on the readmission of the air pear and the degree of rarefaction is judged of by the quantity of mercury introduced The idea is ingenious, but the indications given by this instrument are not correct For *wind-gage* see Anemometer, *water-gage*, see Hydrometer

GAILLARDI (Ital) The name of a lively dance peculiar to Italy, and supposed to have been practised by the ancient Romans, whence it is sometimes designated Romanesque

GALACTOPOIE'TIC (Gr γαλα, *milk* and ποιεω *I make*) A term applied by some medical writers to diet and medicine supposed to promote the secretion of milk

GALA'NGAL A dried root brought from China, it has an aromatic smell, and a pungent bitter flavour, and was formerly used in medicine The greater galangal is the produce of the *Kampferia galanga*, and the lesser of the *Maranta galanga*

GALATHÆ'A A genus of Crustacea, including some ver *rugosa, strigosa, et* sionally found on the British coasts have the thorax oblong or ovoid, the median antennæ produced and the pincers elongated This term is derived from the celebr

GALAXY or MILKY WAY (Gr γαλα, *milk*) In Astronomy, "that great luminous band which stretches every evening all across the sky, from and which forms a zone completely sphere, almost in a great circle At one part it sends off a kind of branch which rejoins the main body, after remaining distinct for about degrees This remarkable belt has maintained from the earliest ages the same relative situation among the stars, and when examined through powerful telescopes is found to consist entirely of stars, scattered by millions, like glittering dust, on the black gro ns" (*Herschel's Astronomy*, phenomena of the milky wa authority, "agree with our firmament, instead o ions indifferently through space form a stratum, of which the thickness is small in comparison with its length and breadth, and in which the earth occupies a place somewhere about the middle of its thickness, and near the point where it subdivides into two principal laminæ, inclined at a small angle to each other For it is certain that to an eye thus situated the apparent density of the stars, supposing them pretty equally scattered through the space they occupy, would be least in a direction of the visual ray perpendicular to the lamina, and greatest in that of its breadth, increasing rapidly in passing from the one direction to the other, just as we see a slight haze in the atmosphere thickening into a decided fog bank near the horizon by visual ray Ac tion of the starry firmament taken by Sir William Herschel whose powerful telescopes have effected a complete analysis of this wonderful zone, and demonstrated the fact of its consisting entirely of stars" (P 376) (For a more detailed account of this subject, see Supplement)

GA'LBANUM A slightly fetid gum-resin, produced by the *Galbanum officinale* It is imported from Turkey and the East Indies for medical use, but is a drug of little importance

GA'LBULA (Lat the name of a bird in Martius) A genus of Scansorial birds closely allied to the kingfishers by their elongated sharp pointed beak the upper ridge of which is angular and by their short feet the interior toes of which are almost wholly united these toes, however are not precisely the same as those of the kingfishers The plumage of the species of *Galbula*, which are called by the French jacamars is not so smooth as that of the kingfishers and always has a metallic lustre They are solitary birds that live in wet forests, feed on insects and build on low bushes

GALBULUS In Botany a term invented by Gartner to denote a form of fruit similar to a cone excepting that the galbulus is round and has the heads of the carpels much enlarged Example—the fruit of the juniper

GALEA In Antiquity, was the headpiece or helmet used in battle by the Roman soldiers

Jam galeam Jovis et regiæ
Currusque et arbiem parat

The *galea* was used for the same defensive purposes as the *cassis*, but differed from it in this that while the cassis was of *metal* the galea was originally of *hides* It was too heavy for general use, hence each army was attended by *galearii* a species of military domestics, whose duty it was to carry the galeæ of the soldiers

GALENA (Gr γαλεω, *I shine*) Native sulphuret of lead

GALENISTS In Ecclesiastical History, a subdivision of the sect called Waterlandians in the 17th century (*Mosheim* Ecclesiastical Hist, vol v 196) In Medical History the followers of Galen were so termed, in opposition to the practitioners of the chemical school

GALE OF WIND The sea term for a continued storm of wind the lowest degree is the fresh gale the next a heavy or hard gale

GALEOPITHECUS (Gr γαλεη *an ape*) A genus of Insectivorous the bones of the arm and leg but not those of the digits, excessively elongated, and supporting extensive lateral folds of skin serviceable as a parachute, but not as organs of flight The species are restricted to the great islands of the Indian archipelago, their inferior incisors are remarkable for their complex form, like the teeth of a comb

GALERU'CA (Lat galerus, *a cap or tuft*) A genus of Tetramerous Coleoptera now the type of an extensive family (*Galerucida*), amongst other subgenera the noxious turnip *Haltica* All the *Galerucida* are vegetable-feeders, both in their larva and perfect state There are about a dozen known British species of *Galeruca* proper, which are small, and generally dark or dull-coloured beetles

GALIA'CEÆ (Galium, one of the genera) A natural order of herbaceous Exogens, inhabiting the cooler parts of the world They are distinguished from *Cinchonaceæ* by their square stems and verticillate leaves without stipules The *Rubia tinctoria* yields madder, and some of the other species produce a similar colouring substance The tor of *Galium* are said to be a good substitute flowers of *Galium verum* are used to curdle milk

GALL *See* Bile

GALL BLA'DDER An oblong membranous recep-

tacle attached to the under part of the liver It retains the bile which regurgitates from the hepatic duct, and sends it through the cystic duct, which proceeds from its neck into the *ductus communis choledochus*, and thence [illegible]

GA'LLEON [illegible] Spanish treasure ships with three or four decks, formerly employed in communicating with Peru

GA'LLERY In the Fine Arts, a term applied to a collection of works in painting or sculpture The earliest gallery of which there is any record was that of Verres It is described by Cicero, and was rich in pictures as well as sculpture In Europe, at the present day, the gallery of the Louvre, though much reduced in 1815 by the restoration of many works of art which conquest had enabled the French to acquire, is the finest in Europe, if taken as a whole That founded at Florence by Cosmo II long enjoyed the first rank but must be now considered secondary to the French collection The other principal galleries of Europe are those at Munich, Dresden, Berlin, and, though last not least both in size and importance, that of the Vatican at Rome, which however, is more generally called the Museum of the Vatican The building for the reception of the National Gallery in London is wholly unworthy of the nation and of the fine situation which it occupies The collection of pictures in this gallery is small but some of them are of rare and unrivalled excellence The gallery of antiques at the British Museum is in many respects matchless [illegible] of the Duke of Sutherland Lord Ellesmere Mr Hope and other private individuals contain many very fine pictures

GA'LLERY In fortification a covered passage across the ditch of a fortified town In Mining *gallery* is a narrow passage from one part of the mine to another

GA'LLEY (Ital galèra) A low built vessel propelled by sails and oars either on a single tier or on tiers of benches one above the other The war vessels of antiquity were all galleys Among the Greeks those chiefly mentioned are the pentecontori which appear to have had fifty oars disposed in a single tier and the triceres (Latin [illegible] vessels with three banks of oars, concerning the [illegible] of which much controversy has taken place It is commonly supposed that a trireme had three banks of oars one above the other, but this is rendered improbable by the circumstance of Pliny making mention of galleys having thirty forty and even fifty banks of oars for it seems hardly credible that so many could have been arranged directly above each other Some have suggested that the rows of oars in the trireme were disposed not horizontally but obliquely, in which case an increase in the number of banks of oars would augment the [illegible] would be increased in proportion [illegible] *abrica veterum Inventorum*)

Galleys were likewise chiefly employed by the maritime [illegible] Their use [illegible] e 17th century and the Venetian republic, down to the period of its [illegible] maintained a number of war galleys [illegible] Venetians had a single tier only and all models [illegible] the same construction These were formidable vessels in a calm, but unfit for a sea, and accordingly found chiefly in the Mediterranean The Venetians had also a large high pooped sort of galley called galeazza, whence the word galleass and galliott in old English writers

The *Deal galley* is a long narrow boat used by the Deal boatmen, and managed on the most hazardous occasions to save the crew of stranded vessels with consummate skill, it is also used by smugglers on account of its velocity The *galley* is also the kitchen of a ship

The punishment of the *galleys* i.e. the employment of condemned criminals in the toilsome employment of rowing them is said to have originated under the Greek empire, as well as the name [illegible] or galley slaves—in French [illegible] used by all the nations bordering on [illegible] In France, under the old jurisprudence, the punishment of the galleys was the severest after that of death About the end of the reign of Louis XIV when galleys themselves began to be disused, the galley slaves were employed in hospitals, public works, &c, and the name of the punishment was changed by the constituent assembly (1798) to *travaux forces*, compulsory labour, whence the word *forçat* for a criminal so condemned Under the code of the empire the punishment was accompanied with forfeiture of property, infamy, and branding By an alteration of the law effected in 1832, the brand was abolished, and the criminals, who had hitherto been intermingled in the three penal fortresses (Toulon, Rochefort, and Brest), were classified Toulon is now [illegible] to those condemned for 10 years and [illegible], Brest to those from 10 to 20, Rochefort, to the condemned for life The name *Bagne*, which is applied in France to prisons in which those condemned to compulsory labour are confined, is derived from the famous Bagnio prison at Constantinople, so called on account of some baths situated there The principal crimes now punished in this manner by the French law are—some acts of [illegible] or public [illegible] death [illegible] murder, unless under such aggravated circumstances as are punished by death, cutting and maiming, rape abduction, burglary highway robbery burning of insulated buildings threatening letters perjury &c

GA'LLI The priests of Cybele were so named at Rome from the country (Galatia or Gallo-Græcia) in which Pessinus, the head quarters of her worship, was situated also termed Curetes, Corybantes, and Idæi Dactyli Cybele, the mother of the gods, was introduced to Rome from Asia on the occasion of a pestilence by the advice of the Sybilline oracles (*Liv* 29 c 14), and her worship became in time one of the most popular in the city Her priests were eunuchs, of which Lucretius (lib ii) gives the alleged reason They are described as the vilest of mankind by the Roman satirists, yet they had extraordinary power over the vulgar Juvenal describes them among the low companions of his debauched consul Damasippus —

Et resupinati cessantia tympana Galli

GA'LLIC ACID An acid obtained from galls and several other vegetable astringents Its ultimate components are $7\,car + 3\,h + 5\,o$, its equivalent number is 85

GA'LLICAN CHURCH The distinctive title of the Roman Catholic church in France, which maintains a certain degree of independence in respect of the Romish see The liberties of the Gallican church, first asserted in the Pragmatic Sanction [illegible] were defined and confirmed in the Quatre Propositions du Clerg Gallicani, promulgated in 1682 The occasion of this declaration was a dispute between Louis XIV and Pope Innocent XI concerning the right long practised by the French kings of occupying in their own persons the inferior preferments of a diocese which lapsed during the vacancy of the see It was then determined by an assembly of the French clergy, that the pope has no temporal but only spiritual rights as the vicegerent of Christ, that even these are limited by canons and councils, and that the decrees of the holy see are subject to reversal upon the decision of the clergy [illegible] *Declaration of the French Clergy [illegible] Power*, drawn up by the famous Bossuet bishop of Meaux, in the assembly convoked by Louis XIV in 1682) While, however, it asserts this liberty in speculative points, the Gallican church does not differ from the Romish in any points of faith or ceremonial observances It was upon the basis of these liberties that the concordat was founded by which the Catholic religion was re-established in France in 1801, and they continue to be maintained upon their original footing now that the church is no longer connected with the state It has always been the object of the Jesuits to bring the French church into more deferential submission to the Romish see, and at the present day the party [illegible] desire this consummation is said to [illegible] The controversy on this subject was carried on in the last century between the two classes called Cismontane and Tramontane divines The new Gallican church of the Abbé Chatel, founded at Paris in 1831, seems not to have met with much success The abbé styles himself primate of it It denies the infallibility of the pope and of councils rejects the celibacy of priests, leaves confession voluntary and performs service in the mother tongue In all these respects its doctrines approach those of the church of England (See the *Profession de Foi de l'Eglise Catholique Française*, Par 1831)

GA'LLICISM Literally, a phrase or construction peculiar to the French language but used generally to denote such phrases or modes of speech in English as are formed after the French idiom

GALLICOLA (Lat galla, *a gall*, colo, *I inhabit*) The name of a family of Pupiparous Hymenopterans, including those of which the larvæ inhabit the galls or vegetable excrescences caused by the perforation and oviposition of the parent insect

GA'LLINACEANS, *Gallinacea* (Lat gallus, *a cock*) See RASORES

GALL-INSECTS, *Gall-insecta* The name of a family of Hemipterous comprehending those the females of which, towards the period of oviposition, assume a globular form, analogous to the galls caused by the *gallicolæ*

GA'LLINULE, or WATER-HEN The type of the subgenus *Gallinula*, now dismembered from the *Fulica* of Linnæus, which term is restricted in modern systems of ornithology to the Coots proper

GA'LLIOTT A strong and cumbrous vessel used by the Dutch, having a main and mizen mast, which is often close aft

GALL NUTS Excrescences produced by the *cynips*, a small insect which deposits its eggs in the tender shoots of the *Quercus infectoria*, a species of oak abundant in Asia Minor When the maggot is hatched it produces

a morbid excrescence of the surrounding parts and ultimately eats its way [illegible] The best galls are imported from Aleppo [illegible] their [illegible] The infusion [illegible] white precipitate in solution of jelly, and a black precipitate with the persalts of iron The latter property leads to the use of galls in the manufacture of ink and of black dye, they are also used as an [illegible]

GALL [illegible] The salts and other impurities which float upon the fused materials for the manufacture of glass, and which is skimmed off It is also called [illegible]

GALLON An English measure of capacity By act of parliament the imperial gallon is to contain 10 lbs avoirdupois of distilled water, [illegible] of 62° of Fahrenheit and the [illegible] inches This is equivalent to [illegible] old English gallon, wine measure contained 231 cubic inches, beer measure, 282 cubic inches See MEASURES

GA'LLOPER In Artillery, the carriage on which the very small guns are conveyed

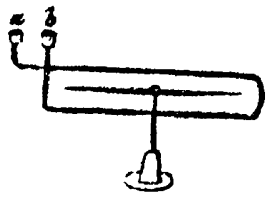
GALLS Local affections or diseases of plants caused by the puncture of insects They are produced by an excessive deposition of cellular tissue and are of no consequence to the general health of the individual subject to them

GA'LL-STONES Concretions occasionally found in the gall bladder and biliary ducts They consist either of a peculiar fatty matter called *cholesterine* or of inspissated bile, or of mixtures of the two The gall-stones of the ox generally contain a peculiar yellow colouring matter, which is much valued by painters

GA'LLY-WORM See JULUS

GA'LVANISM (From Galvani professor of anatomy at Bologna the discoverer of some of the phenomena connected with this form of electricity in the year 1790) Under this term are frequently included the phenomena of *Voltaic electricity* (which see) We shall here limit it to the apparent evolution of electricity by the contact of different metals this is best observed by the muscular contractions which are produced in the leg of a frog recently killed, when two different metals such as zinc and silver tin and gold &c, one of which touches the crural nerve and the other the muscles are brought into contact Every time the metals touch each other the limb becomes powerfully convulsed, and if the experiment be made with a dead rabbit, so that one of the metals be in contact with the brain and the other with the muscles of the extremities, the whole body of the animal is strangely agitated Similar experiments have been made upon the bodies of criminals shortly after execution These results which have till lately been considered to depend upon the effects of electricity excited by the contact of the metals upon the nervous and muscular systems led Volta to his celebrated researches, which terminated in the discovery of the *Voltaic battery* Nearly all the cases, however of the apparent production of electricity by contact have been satisfactorily traced by Faraday to chemical action *See* VOLTAIC BATTERY

GA'LVANO'METER. An instrument for ascertaining the presence of a current of electricity especially Galvanic or Voltaic electricity by the deviation which it occasions in the magnetic needle




The simplest form of galvanometer is a magnetic needle poised upon a point, and surrounded by one or more coils of copper wire covered with silk the ends *a* and *b* being either left free, or terminating in two small copper cups containing mercury, for the convenience of communication with the source of electricity When this needle is placed parallel to the coil, and in the magnetic meridian (as represented in the margin), it immediately deviates when the electric current passes through the [illegible] either to the east or the west, according to the direction of the current *See* ELECTRO-MAGNETISM

GA'MBA A technical term in Mammalia applied by Illiger to the elongated [illegible] the Ruminants and Solipeds

GAMBO'GE A yellow gum resin much used as a pigment, and in medicine as a drastic and nauseating purge It is chiefly imported from Ceylon in cakes rolled up in flag leaves, and is the produce of the *Garcinia cambogia* and of the *Stalagmites cambogioides*

GAME LAWS The principal statutes relating to game, now in force, are the 7 & 8 Geo 4 c 29, the 9 Geo 4 c 69, and 1 & 2 W 4 c 32 by which last statute important changes have been made By the common law which followed the old forest law as introduced into this country by the Normans, all game was the property of the king, no person whatsoever could enjoy the diversion of sporting unless authorized by royal grant of a chase or free warren, and to kill a deer was deemed almost as heinous an act as to kill a man But although at common law no persons could with impunity encroach upon [illegible] those were [illegible] of the statute law who committed this offence not being possessed of a certain rank or dignity, or of a certain amount of landed property Strictly speaking then, the superior condition in life of a party constituted the ground of his exemption from additional punishment, and not as commonly [illegible] dification to do that which was [illegible] whether to the peer or the peasant [illegible] nce under the statutes, namely, [illegible] rank or fortune, being in later times severely visited, while the original offence at common law was passed over, rank and fortune were, in the end looked upon as a qualification, and a freehold estate of 100*l* a year, or leasehold for 99 years of 150*l* a year, or being the son and heir apparent of an esquire or person of superior degree, were accounted as so many qualifications The statute law prohibited any persons whatsoever whether qualified [illegible] or not, from making it the subject of [illegible]

By section 2 of the new act above mentioned, the word "game" shall include hares pheasants, partridges, grouse, heath or moor game black game and bustards The principal alterations in the law made by this act are 1st that all qualifications are now done away with, and that any person taking out a proper certificate may kill game on his own land or that of another person with his leave, and 2dly, that every person having such a certificate may sell game to any person licensed to deal in it according to the act, who again is at liberty to retail it without restriction

Most trespasses and offences relating to game are punishable upon summary conviction, before magistrates The most serious of these offences is what is called night poaching After two convictions before a magistrate for this offence it becomes a misdemeanor, to be proceeded against by indictment and punishable by transportation for seven years or imprisonment and hard labour Night poaching committed by three or more persons in company together is a misdemeanor in the first instance and punishable by transportation for fourteen years or imprisonment and hard labour

GAMES have been resorted to in all ages and among all nations for the purposes of mental or physical exercise or amusement, according to their nature and peculiarities The games of the ancient Greeks were in their original [illegible] religious solemnities founded, according to [illegible] by gods and heroes and continuing to be celebrated in their honour They were the most important national assemblies which brought the citizens of all the independent states of Greece in contact, and these festal communions (*πανηγυρεις*) served as the most popular bonds of social union among all who bore the Hellenic name The four principal were the Olympian, Pythian, Nemean and Isthmian (See those several articles See *Wachsmuth's Historical Ant of the Greeks*, chap I part II s 22, *Hermann's Antiquities*, Oxf trans, sec 10 See also the treatise of Barbeyrac on the *Morality of Games*)

GAMING In Law All common [illegible] nuisances in the consideration of [illegible] first statute against public gaming is the 33 H 8 c 9 By 9 Ann c 54 securities given for the repayment of money lent for purposes of gaming are void, and any person losing and paying 10*l* at one sitting may, within three months recover the same, with costs, in any court of record By 5 & 6 W 4 c 41 if any person make, draw, or execute any note bill, or mortgage for a gaming debt and actually pay to any indorsee holder, or assignee of such note bill, or mortgage the sum thereby secured or any part thereof such money shall be deemed to be paid on account of the person to whom such note, bill, or mortgage was originally given (upon the illegal consideration), and shall be deemed to be a debt due from such last-mentioned person to the person who shall so have paid such money, and shall be recoverable by action at law in any court of record But though the English law has always been hostile to the practice of gaming, it has never been found sufficiently strong, or perhaps sufficiently willing, to suppress it In London and in other large towns the existence of "Hells," as the places of resort for gaming are appropriately called, is notorious to all the world In many of the Continental states gaming houses are licensed, and large revenues are in many instances derived from this source It is only within the last few years that the French government abolished the practice of granting licences

Previously to that period the privilege of keeping gaming houses was farmed by a company, for which they paid [illegible]

GAMMARINES (*Gammarus* Gr *καμμαρος*, a *lobster*) The name of a family of Amphipodous Crustaceans, having the genus *Gammarus*, or the sand-hopper, as the type

GA'MMONING The rope by which the bowsprit is

bound firmly down to the cutwater, in which is a hole [illegible] turns of it [illegible] whereon the musical [illegible] orders Its invention is attributed to Guido Arctino, a monk of Tuscany It is also called the harmonical hand, from Guido having made use of the figure of the hand to demonst [illegible] s sounds

GA'NGLION [illegible] (Gr γαγγλιον, *a knot*) An enlargement in the course of a nerve A tumour in the sheath of a tendon

GA'NGLIONE'URA (Gr γαγγλιον, and νευρον, *a nerve*) A name applied by Rudolphi to the Molluscous and Articulate divisions of the animal kingdom, which are characterized by a ganglionic type of the nervous system In the articulated ganglated animals the ganglia are always disposed symmetrically along the middle line of the body, and brought into communication by a double chord these have therefore been termed *Homogangliata* In the Mollusca on the contrary, the ganglions are dispersed, and placed at a distance from each other and from the mesial plane and [illegible] these [illegible]

GA'NGRE'NE (Gr γεραιν, *to feed upon*) The loss of vitality of a part of the body

GA'NGWAY The sea term for a narrow passage way, particularly that part of the upper deck which is next the ship's side between the fore and main masts

GA'NNET See PELICANS and SULA

GAOL (Fr geole Lat caveola, *a cage*) A prison The present law as to building repairing and maintaining [illegible] the statutes [illegible] 2 & 3 Vict c 56 (1839), the latest act on the subject No gaol can be erected under any less authority than that of an act of parliament There must now be at least one common gaol and one house of correction in every county Gaolers are appointed by the high sheriff, by 4 G 4 they are allowed to exercise no other trade or office and must reside within the prison As to the discipline and management of gaols see PRISON

GAPE In Ornithology, the opening between the mandibles of birds

GA'RDANT, or GUARDANT In Heraldry a term applied to a beast when represented full-faced as looking at the spectator *Re-guardant*, when looking backwards

GA'RDEN (Fr jardin) A piece of ground generally of limited extent, and attached to a house and enclosed in which are cultivated various vegetables fruits and flowers for the use of man In the infancy of civilized society all these objects were cultivated in one enclosure, but as mankind advanced in civilization and refinement and the number of objects to be cultivated increased it became necessary to adopt separate departments, and culinary vegetables came to be cultivated in the kitchen garden, fruits in the orchard flowers in the flower garden ornamental trees and shrubs in the shrubbery or pleasure grounds timber trees in plantations woods and forests Hence the word garden, in the extensive sense in which it is at present used is no longer confined to a limited enclosure but extends to an extensive area in which are contained various scenes of utility, comfort, convenience and luxury

GA'RDENING The art [illegible] which, as we have seen in the [illegible] hands a great variety of object [illegible] the present time are generally included under the following heads —Horticulture which comprehends the culture of [illegible] and fruits, floriculture which include [illegible] rnamental and curious flowers shrubs, and trees, arboriculture, which implies the culture of trees or shrubs used for various purposes in the arts and in general economy, and landscape gardening, or the general disposition of the scenery or landscape about a country residence Horticulture includes the culture of the kitchen garden and orchard, floriculture, the culture of flower gardens [illegible] berries and pleasure grounds, [illegible] of nurseries for fruit and forest trees and shrubs, and landscape gardening, the formation and management of lawns, roads, walks lakes, ponds and artificial rivers of rock work, and of every description of objects in artificial scenery which come under the denomination of ornamental or picturesque *See* HORTICULTURE, BOTANIC GARDEN, ARBORICULTURE, and LANDSCAPE-GARDENING

GA'RGARISM (Gr γαργαριζειν, *to gargle*) A wash for the throat

GA'RNET A mineral of which there are several varieties The *precious garnet* is transparent, red, and in crystals or rounded grains, it is a silicate of alumina and iron, and is used for ornamental jewellery *Common garnet* is often found in large crystals and masses, translucent, and of various colours

GA'RNISHMENT In Law, a warning or notice given to a party to appear in court or give information, a technical term, used only in one or two instances Thus *garnishment* or [illegible] in whose hands money [illegible] the city of London by [illegible] wh [illegible]

GA'RRISON [illegible] *military stores*, &c [illegible] tress to defend it against the enemy, or to keep the inhabitants of the town where it is situated in [illegible] The term *garrison* is sometimes used synonymously with *winter quarters*, viz a place where a number of troops are laid up in the winter season without keeping the regular guard

GARRO'TE, THE A mode of capital punishment employed in Spain The criminal is seated on a stool with his back to a stake A tight collar is passed round his throat, of which the ends nearly meet, the executioner, [illegible] him twists them closer by means of a screw [illegible] instantaneous

GA'RTER ORDER OF THE The various accounts respecting the original foundation of this noble order are for the most part well known The commonly received story which attributes [illegible] the Countess of Salisbury's garter [illegible] recent writers, who attribute [illegible] who tied thongs of leather as marks of distinction round the legs of several of his officers at the siege of Acre In the opinion of Dr Meyrick (*On Armour* vol ii p 54), the garter is nothing more than a symbol of unity The order was, however, either founded or restored by Edward III and according to general opinion, either in the year 1344 or 1350 The first of these dates was that of a festival in which the king formed himself and his associates into a company, under the patronage of St George, but nothing is said respecting the garter until the latter year The statutes of the Garter have been revived and augmented by King Henry V, Henry VIII, and George III in 1805 It was generally called the order of St George until the reign of Edward VI St George of [illegible] of England, being likewise p [illegible] nally consisted of twenty six knights the king being the chief, and the same number is still retained, with the addition of princes of the blood royal as supernumeraries In the beginning of the present century, it was estimated that eight emperors and twenty-eight foreign kings had been members of it The number has been since much augmented It is the most ancient of all the lay orders of chivalry, and may rightly be accounted the noblest in the world The college of the order is held at the chapel of St George, in the castle of Windsor The vestments and ensigns of the order are the mantle of blue velvet, changed to purple by Queen Elizabeth, but restored to the original colour by Charles I the surcoat now of crimson velvet, the hood which is now fixed to the mantle a cap of black velvet with [illegible] feathers being worn on the head ins [illegible] of gold composed of twenty-six pieces made to resemble garters, with the badge of the order (the figure of St George and the Dragon) pendent from it, and the garter of blue velvet The lesser George as it is called, is attached to a blue ribbon passing from the left shoulder to the right hip The officers of the order are, the prelate (the bishop of W [illegible] the chancellor (the bish [illegible] (the dean of Windsor) garter king at arms (this officer combines two functions being herald to the order of the garter and also principal king at arms the highest officer of the Heralds College under the earl marshal), and the usher or black rod It has also a dean and twelve canons &c, with twenty-six pensioners or poor knights The most authentic work on the order of the Garter is that of the learned antiquary Elias Ashmole, printed at London in 1715

GAS (Probably from the German *geist*, or spirit) This term is applied to all permanently elastic fluids, or [illegible] tospheric air

GAS ILLUMINATION Under the head CARBURETTED HYDROGEN we have adverted to two gaseous compounds of carbon and hydrogen, which perform an important part in the economy of gas illumination There are several other analogous compounds, which are produced in various relative proportions during the destructive distillation of pit coal and which, therefore are more or less concerned in the history of *coal-gas*, which, as far as gas illumination is concerned may be defined as a mixture of two or more hydro-carburetted gases or vapours with small portions of other gaseous bodies, among which free hydrogen and carbonic oxide are the most common

The application of the gases produced during the destructive distillation of pit coal to the purposes of illumination is a very modern invention But the germ of it may be traced back exactly 100 years, for the first mention of the production of a permanently elastic and inflammable gas from coal occurs in the *Philosophical Transactions* for 1739, in which there is a paper by the Rev Dr Clayton describing a method of

filling bladders with what he calls the *spirit of coal*, obtained by distilling coal in a retort in the open fire He says, "I filled a good many bladders therewith, and might have filled an inconceivable number more, for the ... eral hours, and filled the ... could have blown them with his mouth, and yet the quantity of coals distilled was inconsiderable I kept this spirit in the bladders a considerable time, and endeavoured several ways to condense it, but in vain, and when I had a mind to divert strangers or friends I have frequently taken one of these bladders and pricked a hole therein with a pin and compressing gently the bladder near the flame of a candle till it once took fire, it would then continue flaming till all the spirit was compressed out of the bladder, which was the more surprising, because no one could discern any difference in the appearance between these bladders and those which are filled with common air" Dr Clayton seems also to have observed those curious phenomena which have lately excited so much attention under the terms *exosmose* and *endosmose*, for he goes on to say that he found "that this spirit must be kept in good thick bladders as in those of an ox or the like, for if I filled calves' bladders therewith, it would lose its inflammability in twenty-four hours, though the bladders became not relaxed at all"

Dr Hales (in his *Vegetable Statics*) and Dr Watson (in his *Chemical Essays*) have each alluded to the properties of the gas from coal, but it was not until the end of the last century that the practicability of substituting ... flammables as a means of lighting ... became an object of attention

The ... ing coal gas to economical purposes seems first to have occurred in 1792 to Mr William Murdoch, then residing at Redruth in Cornwall His apparatus consisted of an iron retort with tinned copper and iron tubes, through which the gas was conducted to a considerable distance, and there as well as at intermediate points, was burned through apertures of varied forms and dimensions he also washed the gas with water, and used other means for its purification In 1798 Mr Murdoch constructed a larger and improved apparatus for the purpose of lighting Boulton and Watt's celebrated manufactory at Soho near ... on the occasion of the peace in 180 ... minated by the same means (See *An Account of the Application of Gas from Coal to Economical Purposes*, by Mr W Murdoch, *Phil Trans* 1808 p 124)

But the attention of the public in London was first called to this important subject by the experiments of Mr Winsor, who, in 1803 and 1804, lighted the Lyceum theatre, and shortly afterwards one side of Pall Mall with gas from coal From that period the manufacture of gas suggested itself as a lucrative speculation, several private gas works were erected, and companies were formed for the purpose of carrying it on upon an extended scale Oil lamps were soon after banished from all the great thoroughfares of the metropolis, and in the course of from ten to fifteen years not only was every street and alley illuminated from the same source, but it was generally introduced into shops and houses, was adopted in the theatres and other public buildings was carried into the suburbs, and has now become general in every town and city of the empire

When coal is subjected to what chemists term *destructive distillation* that is when it is heated red-hot in close vessels it yields a great variety of complicated products which as far as our present subject is concerned, may be classed under three heads namely first, permanent gas secondly vapours which are condensable into the liquid or solid state by cooling, and thirdly the fixed or residuary matter which remains in the retort The object of gas manufacture is to separate these from each other and so to purify the gaseous products as to render them fit for combustion

The ... purpose consists, first of the ... or cast-iron cylinders in which the coal is subjected to heat, secondly the apparatus for condensing the solid and liquid products, thirdly, the purifiers, by which the gas is cleansed from various matters which would be prejudicial if retained, and, fourthly, the gasometers in which the purified gas is ultimately received, and which are connected with the service pipes for its distribution The following is a brief description of these several parts —

The retorts are usually about 7 feet 6 inches long and 1 foot in diameter, and in the shape of an arched cylinder, from five to eight of them are set in brickwork so as to be heated red-hot by one fire Each retort has what is called a mouth-piece which projects from the front of the brickwork, and from which there rises an upright pipe, about 12 feet high and 3 or 4 inches in diameter and which carries the products of distillation into the hydraulic main Each retort has a cover, which is kept in its place by holdfast screws and rendered air-tight by ... hydraulic main is a long horizontal ... 12 or 14 ... in diameter, and into which the dip pipe of each retort dips, so as to be sealed by the fluid which fills the lower half of the main, and which is allowed to run off at that level This fluid is of a very complicated nature, but tar and ammoniacal liquor are the terms applied to its chief component parts, and these, being condensed in the hydraulic main, serve to seal the ends of the dip pipes, and are constantly running off into what is termed the tar vessel Those products of the distillation of the coal which are not thus in the first instance condensed are conveyed, by a pipe continued from the hydraulic main, through a series of tubes or other contrivances, so as to expose a large and cold surface This part of the apparatus is called the *condenser*, in it the more volatile vapours are brought to the liquid state and are collected in an appropriate receiver The uncondensed gases then pass on to the *purifiers*, which are vessels so constructed as to expose them to the action of a very large surface of lime and water, or of slaked lime, by which carbonic acid and sulphuretted hydrogen are abstracted, and thence the gas now purified, passes into the *gasometers*, where it is stored up for use

It would be impossible within the limits of this article, and indeed irrelevant to the object of this Dictionary, to enter into minute details respecting the structure, uses, and arrangement of each of the above parts of the apparatus for the production of coal gas, but the reader may be enabled to form some idea of the importance and extent of the whole manufacture from the following outline of results

There are in the largest gas manufactories of London, from 500 to 600 retorts each of ... a day with 2 bushels of coal ... either side of the retort house and the flues from their respective furnaces are generally so arranged as to meet in one central chimney but as coke is the usual fuel used for heating the retorts there is commonly little or no smoke Each chaldron of coals submitted to distillation yields on an average 24 gallons of tar ammoniacal liquor, and other condensable products and 12 000 cubic feet of purified gas while there remains in the retorts a chaldron and a quarter of coke To purify those 12 000 cubic feet of gas there is required about one bushel of lime, which after its removal from the purifying vessels, is used for making mortar luting the retorts and other similar purposes, while the fetid liquor which runs from it is transferred to the ashpits of the furnaces, where it is consumed by evaporation its vapour passing through the fire, and tending materially to preserve the bars of the furnaces by keeping them cool

In a well-conducted gas establishment two men are required for the management of sixteen retorts, which are charged four times in the 24 hours, the retorts are kept in constant work throughout the 24 hours so that relays of men are required for the night-work In sm ... by ... ly one or more steam engines on the premises for this purpose and for pumping water, lifting coals, and other heavy work

The number and dimensions of the gasometers will of course vary with the circumstances space and extent of the manufacture in the works of the Chartered Gas Company at their station at Westminster, there are twenty one gasometers, each containing on the average 30,000 cubic feet

There are, besides those parts of the apparatus above adverted to, and which are essential to the manufacture, several other ingenious and beautiful contrivances in our larger gas works which may be considered as auxiliaries One of these is the station meter, a large instrument through which the whole of the gas passes in its way to the gasometers and by which its volume is registered, so that the quantity made during any given time can be immediately ascertained and the weekly monthly, or annual production accurately determined The gas meter was invented by Mr Clegg formerly engineer to the Chartered Gas Company It consists of a hollow cylinder which is made to revolve upon its axis by the ingress and egress of gas into and from the three compartments into which it is divided, the cylinder being partly immersed in water, and by a train of wheel work connected with it the number of its revolutions in a given time is registered and the number of cubic feet of gas which traverse it in a minute, hour, day, or year, shown upon separate dials The invention of this instrument forms an important epoch in the history of gas manufacture, for it is now constructed upon any scale, and is applicable to any case of the consumption of gas, so that by having a meter in each house of a size appropriate to the number of burners employed the companies are enabled to sell their gas by measure, and have an unerring check upon the quantity which each instrument consumes

Another beautiful contrivance, adopted in most of our gas works, is that by which the pressure upon the gas in the main and service pipes is adjusted, so that when a

to prevent either excess or deficiency of supply, or, in other words, to prevent the lights which remain from flaring up on the one hand, or being nearly or quite extinguished on the other This is effected by a small and nicely adjusted gasometer connected with the service main, and which, by its rising and falling with diminished or increased pressure of the gas within the main, points out the necessity of opening or [illegible] by which the gas is admitted from [illegible] to a greater or less extent This small regulating gasometer has a vertical rod connected with it, which carries a pencil made to bear upon a paper cylinder properly ruled and divided, and which is made to rotate upon its axis by communication with a timepiece, so that every change of pressure which takes place during the [illegible] is shown by the aberration of the line [illegible] to whom the improvement of the gas-meter, by which it is rendered universally applicable, is due, is also the inventor of these pressure registers

The following particulars may serve to give an idea of the quantity of gas annually consumed in London of the quantity of coal required for its production, and of the general economy of this mode of illumination It must also be borne in mind that gas is an article of increasing consumption, and that in proportion as attention is paid to its manufacture and more especially to the *fittings* as they are called—that is to the pipes cocks burners and other arrangements required for its use and distribution in houses—it will become more generally adopted in private dwellings so as, in all probability to supersede candles oil lamps and all other sources of artificial light Nor are the attempts which have been made to employ it as a source of *heat* unimportant Gas stoves although hitherto made upon very erroneous principles are not without their advantages and it has been promiscuously applied to some of the operations of cooking

The oldest of the London gas works is the establishment belonging to the Original Chartered Company They have three stations the largest situated in Peter Street Westminster, the second in Prick Lane St Lukes and the third in the Curtain Road Shoreditch This company consumes 50 000 chaldron of coals annually the produce of which, in gas may be estimated at about six hundred million cubic feet, or about eighteen million seven hundred and fifty thousand pounds *weight* of gas It may be assumed that each chaldron of coals weighs 2880 lbs and yields an average produce of 12 000 cubic feet of purified gas The prime cost of gas is about four or five shillings per 1000 cubic feet, the usual retail price is from seven to ten shillings per 1000 cubic feet

The Chartered Company probably supply about a fifth part of the whole of the gas consumed in London and the suburbs, so that the total annual consumption of coal employed for this important manufacture in the London district only probably exceeds two hundred and fifty thousand chaldrons and the quantity of gas produced for the supply of this district amounts annually to three thousand million cubic feet The *weight* of this quantity of gas exceeds 7 millions of pounds and the *light* produced by its combustion may be considered as equivalent to that which would be obtained by the combustion of 160 millions of pounds of mould candles of six to the pound

The operations of the London Gas Light Company which was established in the year 1833 are also on a scale of great [illegible] mpany was called into existence by [illegible] which existed among gas consumers at the defective supply both in quantity and quality previously afforded Their works situated at Vauxhall, are not only the most powerful but the most complete in arrangement of any in the world From this point their mains run to a prodigious extent in Middlesex as well as Surry and by the admirable mode in which they are laid aided by the power of their works, they are enabled to supply gas at Highgate Hill (seven miles off), with the same precision and in the same abundance as at Vauxhall The extent of their pipes exceeds one hundred and fifty miles

The cost of light equivalent to that of seven mould candles (six to the pound) is in coal gas, $\frac{3}{4}d$ per hour in an Argand oil lamp $3d$ per hour, in mould candles, $3\frac{1}{2}d$ per hour, in wax candles 1s $2d$ per hour

GA'SKET A platted cord by which the sails when furled, are kept bound up close to the yards or gaffs The same term is applied to the platted hemp used for packing [illegible] engine and its pumps

GASTEROPODA *Gasteropoda* (Gr γαστηρ, *the belly*, and πους *a foot*) The name of a class of Molluscous [illegible] those which have a ventral [illegible] or less extent, adapted for creeping The class is divided, according to the modifications of the breathing organs into the orders *Pulmonata*, *Nudibranchia*, *Inferobranchia* *Lethibranchia*, *Pectinibranchia*, *Tubulibranchia*, *Scutibranchia* and *Cyclobranchia* The carinaria, in which the ventral foot is reduced to a rudimental compressed plate, forms the type of an aberrant group or order, called *Heteropoda* The pulmonated snail or slug may be regarded as types of the Gasteropodous Mollusks

GASTRÆ'UM (Gr γαστηρ) A term in Zoology, applied to the whole of the prone or under surface of an animal's body

GA'STRIC JUICE The peculiar fluid secreted by the stomach, and essential to the process of *digestion* When collected from the stomach of an animal killed [illegible] and Dr Prout [illegible] the free acid which it contains is the *muriatic* One of the most characteristic properties of the gastric juice is its solvent power over the varieties of animal fibre, or albumen, and the facility with which it coagulates milk, and then dissolves [illegible] See DIGESTION

[illegible] See VENTRILOQUIST

GASTRI'TIS Inflammation of the stomach It is attended by great irritability of the stomach, indicated by hiccup, vomiting and much pain and general uneasiness the pulse is small and hard, and there is fever, attended by prostration of strength It is a very dangerous disease and requires prompt treatment, especially bleeding general and local, blisters, hot bath, or fomentation The constant sickness usually prevents the exhibition of any of the ordinary remedies When it arises from poison the stomach pump and other distinct treatment is often requisite

GASTROCHE'NA (Gr γαστηρ, and χαινω, *I gape*) A genus of Bivalve Mollusks in which a large hiatus or gape intervenes between the closed valves on the ventral aspect of the animal The mantle is perforated, opposite to this gape by a small aperture for the passage of the foot and is prolonged posteriorly into two muscular tubes or siphons The Gastrochenes inhabit burrows which they perforate in the substance of madrepores or calcareous rocks and they line their perforations with a calcareous tube

GASTROCNE'MIUS (Gr γαστηρ and κνημη, *the leg*) The muscle which forms the protuberant part of the leg the calf

GASTRODYNIA (Gr γαστηρ and οδυνη *pain*) A painful affection of the stomach, often attendant upon dyspepsia

GASTROMANCY (Gr γαστηρ and μαντεια *prophecy*) A kind of divination practised among the ancients by means of words issuing or seeming to issue from the belly This term is applied also to a species of divination performed by means of glasses or other round transparent vessels in the centre of which certain figures appear by magic art

GAUGE or GAGE See GAGE

GAUGE-POINT is a term used in Gauging to denote the diameter of a cylinder whose altitude is one inch, and its content equal to that of a unit of a given measure For example, the old wine gallon contained 231 cubic inches The diameter of a cylinder of the same capacity and whose altitude is one inch is 17 5 inches, which, therefore [illegible] measure

GAUGING [illegible] is the measuring of the capacities of vessels chiefly casks barrels vats &c and determining the contents of the substances contained in them The principles of gauging are those which geometry furnishes for the measurement of solids in general but as the contents of vessels of the kind now mentioned are so frequently required to be known, at least approximately for the purposes of commerce and the collection of the revenue a set of technical rules and appropriate instruments have been contrived by the help of which the art can be and generally is practised mechanically by those who are utterly ignorant of the principles on which it depends The instrument generally used for the purpose is the *gauging rod* or *diagonal-rod* by which the contents of a cask are inferred from its [illegible] square rule generally about four feet long is a scale of inches for taking the measure of the diagonal, and on the opposite face is a [illegible] the corresponding contents of the cask [illegible] It is obvious that this method of proceeding can only give approximate results, on the supposition that all casks are similar solids (See *Symons's Practical Gauger*, *Leadbetter's Treatise on Gauging*, *Hutton's Mensuration*, &c)

GAUGING RULE See SLIDING RULE

GAULT A provincial name in the east of England for a series of beds of clay and marl, the geological position of which is between the upper and lower greensand

GAUNTLET RUNNING THE A barbarous punishment of former times by which the criminal was obliged to pass between the seamen arranged in two rows, and provided with knotted cords, with which they flogged him

GAUZE A textile fabric generally made of silk, and said to have been invented in Gaza, a city of Palestine

GA'VELKIND An old English custom or tenure annexed to all lands in the county of Kent not especially exempted, by which the land of the father is equally divided at his death among all his sons or the land of the brother among all his brethren if he have no issue of his own Its origin is considered by Blackstone to have been in the nature of free socage In most places the gavelk the power of devising by will before the The same custom seems to have been prevalent in Wales, where all gavelk nd lands were made descendible to the heir at common law by stat 34 & 35 H 8 c 26 In Kent the lands have been for the most part de descendible quasi by and shall be shown

GA'VIAL *See* CROCODILE

GA'VOT (Fr gavotte) In Music, an air for a dance, which has two strains, the first having usually four or eight bars, and the second eight or twelve more, each of which over It is of a brisk nature

GAZELLE The name of a small swift and elegantly formed species of antelope the *Antelope dorcas* of Linnæus, long famed for the peculiar lustre and soft ex yes

GAZETTE paper, published at short intervals, containing articles of general intelligence Both on the Continent and in England such sheets were generally termed *Mercuries* in of their invention, and appeared only occasionally, the earliest among ourselves were published during the general apprehension from the presence of the Spanish armada, but some doubt has been lately thrown on the authenticity of the specimens preserved in the British Museum The first gazette produced in France (under that title) was in 1631 the first in England in 1665, when the court resided at Oxford on account of the plague of London From that period the Gazette has regularly appeared twice a week, containing such notifications as are either published by the court or the government or such as are authoritatively required by law in private transactions The name Gazette is said to be derived from Gazzetta a small Venetian coin, being the price that was paid for one of the flying sheets of commercial and military information (notizie scritte) which were first published by that republic in 1563 See NEWSPAPER

GAZETTEER, is applied in England to a work containing a brief account of all or any of the countries of the world al order To this class belong B cz, and similar works

GA'ZONS the turfs or pieces of earth covered with grass with which the faces of works raised of earth are lined in order to keep them up and preserve their form

GECKO'TII A family of lizards having for its type the genus *Gecko*, in which most of the species present a curious organization of the foot, by which the sole is converted into a sucker, creep up vertical walls and along like the flies upon which they feed

GEHE'NNA A term in Scripture, adopted from the usage of the Jews to signify hell or the place of eternal punishment The word is a slight corruption of Gehinnon, or the Valley of Hinnom, in the neighbourhood of Jerusalem, wherein, at a place named Tophet it was recorded that certain idolatrous Jews had sacrificed to Moloch The sewers of the city were emptied into this hollow, and perpetual fires were kept up to consume the noxious matter, and prevent pestilential effluvia Hence, it is said, the name of the place came to be used metaphorically in the sense above described From this word seems to be derived the old French gehenne, *torture*, and from thence the common word gêne *constraint*

GE'HLENITE A mineral in small grey or yellow crystals, found in the valley of Fassa in the Tyrol named in honour of Gehlen the chemist It is a ferrosilicate of alumina and lime

GELATIN (Lat gelu, *ice*) An abundant proximate principle in animals It is confined to the solid parts of the body, such as tendons, ligaments, cartilages, and bones, and exists nearly pure in the skin, but it is not contained in any healthy animal fluid Its leading character is the formation of a tremulous jelly, when its solution in boiling water cools, and it may be repeatedly liquified, and again gelatinized, by the alternate application of heat and cold Isinglass, glue and size are various forms of gelatine the first being this substance in a very pure state Its most distinctive chemical character is the formation of a dense white precipitate when its solution in warm water is poured into an infusion of galls or other form of vegetable tannin A solution of one part of gelatin in 5000 of water is rendered slightly turbid by the addition of a strong tincture of galls Gelatin is a nutritious article of food The ultimate components of gelatin are 47 8 carbon, 7 9 hydrogen 16 6 nitrogen 27 4 oxygen

GE'LATINS Mr Kirby thus renders the term *Radiaires en lasses* of La ick, in which are de the same radiated l Cuvier the bodies gelatinous consistency

GELD (Ger *money*), in the Laws of the Saxon and other Teutonic communities, is used in the fine or payment in the case the and pecuniary compensation in the compound *weregild*, the

GEM (Lat *gemma*) Stone or precious used for the purpose of sculpture The practice of carving gems is of is doubtful whether they were or use the emerald and topaz for sculptural purposes The stones usually selected are rock crystal of different colours, jasper, chalcedony onyx, cornelian, and blood stone Among the Greeks the art was tion, but having fallen with revival was effected in Italy in the 15th century, and modern masters have more than rivalled some of the ancient productions

GE'MINI (Lat *the Twins*) The third constellation of the zodiac, into which the sun enters about the 21st of May in each year The Twins are named from Castor and Pollux, sometimes also, from Apollo and Hercules The constellation is easily distinguished by means of two conspicuous stars of the second Castor being that which is Pollux that which is furthest to the east

GEMMIPARIS *Gemmipara* (Lat gemma *a bud*, and pario *I produce*) The animals which propagate by buds, as the *hydra* or fresh water polype &c

GEMS ARTIFICIAL These are made of a very fusible transparent, and dense glass or *paste* as it is called containing a large proportion of oxide of lead and generally some borax the colours are given by metallic oxides Much of their perfection depends upon the skill with which the exact tint of the real stone is imitated, and upon the care with which they are cut and polished

GE'NA (Lat gena *the cheek*) A term applied in Zoology to the region between the eye and the mouth, over the

GENDARMES or GEN In the 15th and 16th centuries the heavy French cavalry, which constituted the only national force were termed Gendarmes, or men at arms Each lancer had four, five, or six followers on horseback attached to him in various capacities, so that a *lance* in the language of historians of that epoch comprehends six or seven men After the cuirass and lance had become obsolete, the name of gendarmes ceased to be thus applied It was afterwards transferred to a corps of police In consequence of the unpopularity of this corps in Paris the the revolution of 1830 under the title of Municipal Guard (See the *Univers des Gens du Monde*) In all the German states, there is a body of mounted military police with this appellation, of which the German equivalent is

GE'NDER (Lat *genus*) In the designation of sex by the form of a word (See an elaborate article in the *Penny Cyclopædia*)

GENEALOGY (Gr γενεα *family*, and λογος *description*) The pedigree of each family A series of several persons descended from a common progenitor is called a line A direct line is either ascending (father, grandfather &c in the civil law particular names were given to seven degrees in this line) or descending (son, grandson &c) The collateral lines comprehend the several lines which unite in a common progenitor and are either equal or unequal according as the number of degrees in the lines is the same or different The collateral relations on the father's side are termed in the civil law co nati on the mother's agnati

GENERAL in the Army, is, next to field marshal, the highest military title adopted by the European states Like most military designations it owes its origin to the French, who, about the middle of the ferred the title of lieutenant-general to whom the monarch (by virtue of his birth the commander or general of the national forces) entrusted the superintendence of the army The title of general is conferred either on the commander in-chief of the forces of a nation, or on the commander of an army or grand division, it is also given to the officers next in rank to the general, who besides performing functions peculiar to their own offices, frequently act as the substitutes of their superior, with the designation of lieutenant-general

GENERAL ASSEMBLY OF THE CHURCH OF SCOTLAND See ASSEMBLY, PRESBYTERIANS

GENERALISSIMO A title conferred, especially by the French, on the commander in-chief of an army consisting of two or more grand divisions, each under the superintendence of a general According to Balzac, this dignity was first assumed by Cardinal Richelieu on the occasion of his leading the French army into Italy, but

the term does not appear to have found favour among the other European states

GENERALITY A French term, formed [illegible] under the [illegible] superior to the Revolution The [illegible] rank [illegible] This [illegible] was principally [illegible] to the [illegible] orders

GENERALIZATION, Logic has been [illegible] as the act of comprehending under a common name several objects agreeing in some point which we abstract from each of them and which that common term serves to indicate [illegible] *Logic* p 388)

GENERATION, or GE'NESIS, in Geometry, denotes the formation or produc[illegible] or quantity A line is said to [illegible] of a point, a surface by the m[illegible] by that of a surface A sphere or spheroid is generated by the revolution of a semicircle, or semi-ellipse, about its diameter, and a circle by the revolution of its radius about one of its extremities The figure thus produced, or generated is called the *generant*, and it is a general property of every such figure that its area or content is [illegible] its centre of gravity All quantities may be considered as generated by motion, and hence arose the terms *fluxion* and *fluent* in the infinitesimal analysis

GE'NESIS, BOOK OF *See* PENTATEUCH

GENETHLIAC (Gr γενεθλιακον, from γενεθλον, *a birth*) An ode or other short poem composed in honour of the birth of an individual

GENEVA *See* GIN

GE'NIA (Gr γενειον, *the chin*) Terms in Anatomy compounded of this word, and applied to muscles attached to the chin

GENI'CULATE (Lat genu, *the knee*) Bending abruptly in an obtuse angle like the knee when a little bent

GE'NII, called by the Eastern nations Genn or Gien, are a race of beings created from fire, occupying an intermediate place between man and angels, and endowed with a corporeal form, which they are capable of metamorphosing at pleasure They are said to have inhabited this earth many ages before the creation of man, and to have been at last driven thence for rebellious conduct against Allah Their present place of abode is *Gannistan*, the Persian Elysium, but they are represented as still interesting themselves deeply in the affairs of this earth, over which they exercise considerable influence Every one is aware of the important part which the genii perform in the interesting stories of the East, and indeed a more correct idea may be formed of their origin characteristics, and history, from a perusal of the *Arabian Nights Entertainments*, than can be conveyed by the most elaborate dissertation For an account of the superstitions of the modern Arabs in regard to genii, see *Lane's Modern Egyptians*

GE'NITIVE CASE (Lat genitivus [illegible] That inflexion of the noun which denotes [illegible] property *See* GRAMMAR

GE'NIUS (Lat gigno, *I produce*) According to the belief of the old Italian races, especially the Etruscans, the genius was a spiritual agency of very indeterminate character which seems to have been appropriated not only to every human family and individual as a companion, but to every god, and even to places and things This conception was altogether foreign to Grecian mythology although in later times it became mingled in that of Rome with the Grecian notions respecting demons (See DÆMON) As, for instance, in the idea of a double genius, good and bad Censorinus (*De Die Natali*) says "The genius is that god under whose protection every mortal is born and lives" Hence the worship of the genius was closely connected with all domestic ceremonies and feelings the marriage bed was *lectus genialis*, the day of the genius, *genialis dies* sacred to mirth and relaxation, the genius accompanied human fortunes in their vicissitudes (Vultu mutabilis, albus et ater—*Hor*), and death was typified by the figure of a genius with a lamp reversed The genii of places were usually represented and worshipped under the figure of snakes Whether there is any connection between the Italic genius and the djinn of oriental nations (*see* GENII) is a doubtful point

GENS In Ancient History, a clan or sect, forming a subdivision of the Roman people next in order to the curia or tribe The members and houses (*familiæ*) [illegible] clans were not necessarily united [illegible] re originally brought together by a political distribution of the citizens, and bound by religious rites, and a common name, derived probably from some ancient hero This common name, which distinguished the *gentiles* or members of the same clan, was the second of the three borne by a Roman citizen, and was specially termed the *nomen* It is supposed that each of the *curiæ* originally contained ten *gentes*, and that each of these was represented in the senate by one of its members (See *Vico, Scienza Nuova*, *Niebuhr's History of Rome*, 2d ed p 387)

GE'NTIAN In Pharmacy, the root of the *Gentiana lutea*, a plant abundant in the Swiss and Austrian Alps, and in the mountainous parts of Germany An infusion or tincture of gentian root is an excellent stomachic bitter

GE'NTIANWORT (Gentiana, one of the genera) A [illegible] herbaceous exogens, inhabiting most parts [illegible] world [illegible] very near to *Apocynaceæ*, from which [illegible] herbaceous habit, permanent corolla, want of milk, and in many other characters From *Scrophulariaceæ* they are distinguished by their regular flowers, the stamens of which are equal in number to the lobes of the corolla, but they are with difficulty distinguished if the flowers are absent Lastly, they have a natural relation to *Cinchonaceæ*, inasmuch as the genera *Mitreola* and *Houstonia* have both been mistaken by good botanists for Cinchonaceous plants Their chief characteristic sensible property is an intense bitterness, which resides both in the stems and roots rendering them tonic, stomachic, and febrifugal, on which account the roots of *Gentiana lutea* and others are admitted into all pharmacopœias Many of the species are beautiful in the hands of the cultivator The prevailing colours are red and blue

GE'NTILE (Lat gens *nation*) The original meaning of the Latin word *gentilis* is one of the *same* kith or nation with the speaker In a later age of Latinity, individuals of foreign or barbarous races were called Gentiles (*Ausonius*, and *Cod Theodos*) The Jews designated all not professing their religion indiscriminately as 'the nations' τα εθνη (N T), and hence the Greek word εθνικος (whence our heathen and the corresponding Latin [illegible] sense by St Jerome, Prudentius, and Christian writers of that age in general The jealousy with which the Jews regarded all foreign nations, and the bigotted obstinacy with which they clung to their notions of their own peculiar sanctity and favour in the sight of God, are well known The earlier half of the history of the Acts contains the account of the struggle which Christianity maintained against these prejudices before it finally subdued them even in the breasts of [illegible] themselves The design of [illegible] be admitted to the benefits of his mission, is clearly shown in many of his own words and actions, but, upon his crucifixion, his fol[illegible] [illegible] the first [illegible] to have shrunk from [illegible] [illegible] people Their preaching is confi[illegible] [illegible] Jerusalem, and there, it is to be remarked, they are treated with no severity, and obtain considerable success But upon the appointment of the deacon [illegible] to be Hellenists — much more lax in their [illegible] [illegible] than the Jews of Palestine,—and upon the preaching of Stephen which was probably the first bold declaration of the equality of the Gentile with the Jew, the anger of the people is immediately roused, the flame of persecution breaks suddenly forth, the disciples are driven from Jerusalem, and scattered abroad in places where they are brought more in contact with foreigners, and the vision which is vouchsafed to Peter recognizes distinctly the claim of the Gentiles to the benefits of the Gospel The observance of certain Jewish [illegible] was continued however, for a long [illegible] to block to the most devout and sincere Christians St Paul combats the notion of the necessity of submitting to some of these,—especially circumcision, yet even he feels obliged to make some indulgence to the prejudices of the Judaizing party In after times this party occupied one distinct division of the Christian world, split itself into various sects, such as the Ebionites and Nicolaitans, and for a long time exercised considerable influence even within the pale of the church

GE'NTLEMAN (The English word *gentle*, in its original sense, signifies one belonging to a *race* or *family*, Lat gens) In Heraldry, a rank expressed in Latin by the term generosus All entitled to coat-armour are gentlemen, but the name is more commonly applied to the lowest rank of those who have no other distinguishing title Gentlemen by blood were those who could show four [illegible] gentlemen, both in the paternal and maternal [illegible] who could not prove this, but against whom the contrary was not known within memory of man, were gentlemen by prescription Gentlemen were also created by letters patent of the king Officers (not menial) of the king's household, persons holding a royal commission civil or military, persons who had taken a degree [illegible] adopted by gentlemen, were [illegible] to this rank, which has now been [illegible]

GENTLEMEN PENSIONERS [illegible] a band of forty gentlemen, entitled esquires, whose office is to attend the king's person to and from the Chapel-Royal, and on other occasions of solemnity They were instituted by Henry VIII

GE'NTILS The maggots or apodal larvæ of the flesh fly (*Musca carnaria*), and other Diptera, are sometimes so called

GE'NUS (Lat ) In Zoology, that distinct but sub- [illegible] ich gives its name as a pre- [illegible] which it is composed

GENUS In Logic, one of the predicables, which is considered as the material part of the *species* of which it is affirmed *See* LOGIC, PREDICABLE

GENUS In Music, the general name for any scale of music If a scale proceed by tones, it is called the *diatonic* genus, if between the tones semitones are introduced it is called the *chromatic* genus When the subdivisions are smaller, as quarter tones, it is called the *enharmonic* genus

GE'OCE'NTRIC (Gr γη *earth* and κεντρον, *centre*) A term frequently used in Astronomy, signifying literally *having the earth for its centre* The apparent motion of any planet, as seen from the earth is called its *geocentric motion* [illegible] a planet is the angle formed by [illegible] to be drawn from the planet to the earth, with the plane of the earth's orbit or the plane of the ecliptic *Geocentric longitude* of a planet is the angle at the earth formed by two straight lines, one of which is drawn to the first point of Aries and the other to that point of the ecliptic which is intersected by a perpendicular circle the plane of which passes through the earth and planet *Geocentric* is opposed to *heliocentric* which refers to the centre of the sun These terms are only used in speaking of bodies belonging to the solar system The fixed stars are at such prodigious distances that they are referred to the same points in space whether we consider them as seen from the earth or the sun

GE'ODES (Gr γεωδης *earthy*) Nodules of iron-stone, hollow in the centre Rounded pebbles having an internal cavity lined with crystals are also so called

GEO'DESY (Gr γη and δαιω *I divide*) literally signifies the *division of the earth* in which sense it is synonymous with land surveying, but it is usually employed in a more general sense to denote that part of practical geometry which has for its object the determination of the magnitude and figure either of the whole earth, or of any given portion of its surface In this sense it comprehends all the geometrical or trigonometrical operations that are necessary for constructing a map of a country measuring the lengths of degrees &c In order to construct an accurate map or determine the form and dimensions of a country it is necessary in the first place to determine the absolute distances between the several stations or points, secondly to determine the azimuths of the lines thus measured that is, their situation with respect to the meridian of latitude and longitude of the [illegible] necessary for determining the absolute distances comprehending the measurement of a base the observation of angles, the computation of the sides of the triangles, and their reduction to the same level are called the *geodesical* or *geodetical* operations while those which are [illegible] [illegible] figure and dimensions of the earth is a problem of very great importance to astronomy and geography and has accordingly at all times been a subject of much interest to mathematicians, but it is only since towards the middle of the last century that operations on an adequate scale for its solution have been undertaken in different parts of the world For the results of the more important of these operations see DEGREE

GEO'GNOSY See GEOLOGY

GEO'GRAPHY (Gr γη, and γραφω *I describe*) The description of the earth The etymology of the term indicates the nature and extent of this department of knowledge, which, in fact embraces every thing relating to the circumstances and condition natural or artificial, of the globe which we inhabit The immense variety of subjects comprehended in the science of Geography are usually arranged under three great divisions, — *Mathematical*, *Physical*, and *Political Geography*

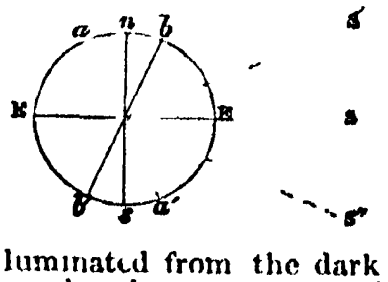
*Mathematical Geography* — [illegible] graphy has for its object the determination of the form and dimensions of the earth, its relations with the celestial bodies, the relative positions and distances of places on its surface, and the representation of the whole or portions of its surface on globes or maps

In order to describe the earth the first element that must be ascertained is its general form That the surface of the earth is convex is apparent even to the senses Let a spectator stand on the sea shore, and attend to the successive appearances of a ship proceeding to sea First, the lower part becomes invisible, then the whole hull, and lastly, the masts and rigging, the lower parts disappearing first Now this phenomenon can only be explained by the convexity of the portion of the water between the ship and the spectator, and when the curvature of [illegible] be avoided that [illegible] equalities, participates in the same curvature, and that the earth is a round body The same conclusion is drawn from the gradual coming on of day and night, and the deplacement of the stars in proceeding towards the north or south, for if the earth were flat, the sun in appearing above the horizon, would illumine the whole of its surface at the same instant, and on the supposition of its being either flat or cylindrical, the pole star would maintain the same elevation, whereas to the traveller who advances northward it gradually appears more elevated and to him who advances southward more [illegible] and from them alone the globular form of the earth might be inferred even if the fact had not been placed beyond doubt by the voyages of circumnavigators Astronomers in modern times have indeed discovered that it is not a perfect sphere, being flattened in a slight degree at [illegible] nts (which are the poles of rotation), [illegible] from perfect sphericity is so small that for all the purposes with which geography is concerned it may be neglected without sensible error *See* FIGURE OF THE EARTH

In order to determine the relative positions of points on a sphere in the most commodious manner mathematicians refer them to two *great circles*, that is to say circles formed by the intersection of the surface of the sphere by a plane passing through its centre The earth is a body which revolves about an axis of rotation, the position of this axis therefore with respect to the ce- [illegible] the two poles of rotation, and divides the globe into two opposite hemispheres The equator, therefore being marked out by nature or by the [illegible] revolutions of the celestial bodies arising from [illegible] rotation of the earth is a circle to which all places are most conveniently referred and it has this property that it never undergoes any change of place on the sphere for astronomers have proved that since the date of the earliest observations the poles of rotation and consequently the equator have always maintained the same invariable position on the earth's surface

The distance of a place from the equator cannot be directly measured but by means of astronomical observations we can determine that distance in aliquot parts of the earth's circumference that is in degrees of a great circle It is not however sufficient to know how many [illegible] It is necessary [illegible] other places, to know how it is situated with respect to a certain *meridian*, or great circle perpendicular to the equator and consequently passing through the poles In reference to the diurnal rotation of the earth all meridians are in precisely the same circumstances the choice is consequently entirely arbitrary and geographers as well as astronomers generally select that which passes through the capital of their own country as the circle to which they refer all other places The equator and the assumed meridian thus form the co-ordinates of the sphere The distance of any place from the equator measured on the arc of the meridian is the *latitude* of the place, and its distance from the assumed meridian measured on a circle parallel to the equator is its *longitude*, and when the latitude and longitude of any place are both known the position of the place itself is entirely determined The latitude of a place is ascertained by observing the height of the pole above its horizon, and the longitude of one place in respect of another by the interval of time which elapses between the passage of any celestial body over their respective meridians *See* LATITUDE and LONGITUDE

Besides the rotatory motion about its axis, the earth has also a motion of revolution about the sun which is completed in the course of one year The first of these motions causes the succession of day and night, the second the vicissitudes of the seasons and the inequality of the length of the natural days These two last phenomena depend on two circumstances — 1st, that the axis of the earth is not perpendicular to the plane of the ecliptic or the plane in which the annual revolution is performed, and 2d, that the extremities of this axis, or the two poles of rotation continue to be directed to the same points of the celestial sphere during the whole time of the revolution Hence it follows that the plane of the equator, though invariable in respect of absolute space is continually changing its position in respect of the sun, and the apparent effect is the same as if the sun had a vibratory motion in the heavens, rising above the plane of the equator [illegible] one half of the year, and falling below it during the other half When the sun is in the equator at S, the two poles of the earth *n* and *s* are in the great circle which divides the illuminated from the dark hemisphere When the sun reaches his greatest northern declination at S', the il-



luminated hemisphere is *a* E *a'*, and the north pole *n* comes considerably within it On the other hand, when h, as at S'', the south pole *s* hemisphere, while *n* is left in darkness When the sun is at S his apparent diurnal motion is performed in the equator, and the days and nights are of equal length all over the world The angle which the planes of the equator and ecliptic make with each other is about 23½°, ce the greatest declination of the sun is the same midsummer the sun is and at midwinter 23½° to the south of it The inequality of the natural days is an immediate consequence of the sun's declination, for as the solar rays come to the earth parallel, one half of the globe must always be illuminated at once, and the other half in darkness, consequently when the sun declines 23½° to the north of the equator, all that part of the earth which is within 23½° of the north pole will remain, while the earth performs its diurnal revolution, within the illuminated hemisphere A small circle of the sphere parallel to the equator and at the distance of 23½° from the pole, is called the *polar circle*, and at this latitude the sun, when at his greatest declination, comes exactly to the horizon at midnight, without setting, consequently the length of the longest day is twenty-four hours At the equator the length of the day is always twelve hours, and from the equator to the polar circle the length of the longest day is greater and greater as the latitude increases At the pole the sun is one half of the year above the horizon and the other half below it, and from the polar circle to the pole the length of time the sun continues above the horizon without setting increases with the latitude from twenty-four hours to six months The two small circles of the sphere parallel to the equator, which limit the sun's greatest declination, are called the *tropics*, and the whole surface of the globe is divided by the two tropics, and the two polar circles into five *zones* or spaces, namely the *torrid zone* which is included between the two tropics, or extends 23½° on either side of the equator, the two *temperate zones* or the spaces included between the tropic and polar circle in each hemisphere, and the two *frigid zones*, or the spaces between the poles and their respective polar circles These may be called the astronomical divisions of the globe as they depend on the position of the earth's axis of rotation with respect to the plane of its orbit, and are determined by astronomical observations

*Physical Geography* has for its object the description of the principal features of the earth's surface as consisting of land and water the extent and configuration of the continents and islands, the elevation and direction of the mountain chains, the conformation of the plains and valleys, their altitude above the level of the sea, and the soil, climate and animal and vegetable productions of different countries It embraces also the various phenomena of the ocean, which may be classed under the term *Hydrology*, the depth of the sea and the inequalities of its depth, its saltness and temperature, the direction and velocity of currents the tides the polar ice &c In like manner it comprehends also many of the questions which are usually treated under the terms *Meteorology* and *Climate*, the mean temperature of different countries, the height of the snow line, the prevailing winds the barometric pressure, the quantity of annual rain or evaporation &c, and the effect of all these circumstances on the condition of the human race

On casting our eye on a globe or map we immediately perceive the very unequal distribution of land and water on the surface of the earth The land occupies very little more than one third of the whole surface and the water all the remaining portion Nor is the inequality of the distribution in respect of the two hemispheres less remarkable Of the whole land about four fifths is situated in the northern hemisphere, and the remaining one fifth in the southern In a general view the land consists of three great masses the *old continent* which comprehends Europe, Asia, and Africa, the *new continent*, or America, and *New Holland* —which are separated from each other by the great oceans The general features of the two continents differ remarkably In the old continent the general direction of the land, and of the great mountain chains, is from west to east, almost parallel to the equator, while in America the general direction is from north to south, along the meridian Thus the four — namely, the A l k nd the Himalaya, —all stretch from west to east, and the Andes which extends from one extremity of America to the other, ranges in the perpendicular direction from north to south Another striking feature of the land is, that all the great peninsulas are pointed to the south pole This is the case with South America, Africa, Arabia, Hindostan, Malaya Cambodia, the Coren, Kamt- of Mexico, and Japan in the Great South Sea, which are





both formed of alluvial land, and may therefore be supposed to owe their formation to partial influences which T suggest the idea of the terraqueous masses having been shaped into their existing forms by the action of a great wave or current flowing from the southern to the northern pole (*See* Atmospheric Climate, Geology, Tides, Wind, &c See also an excellent article on this subject by Dr Traill in the *Encyclopedia Britannica*)

*Political Geography* considers the earth as the abode of mankind, and has for its object the description of all that relates to the moral or social condition of the different nations, their language, religion, government, degrees of civilization, and the population, resources, and local relations of different countries This part of geography is consequently related to history and statistics, and does not fall within the scope of this work (See *M'Culloch's Geographical Dictionary*, *Murray's Encyclopedia of Geography*, the work of Malte Brun and Balbi, of which there is an English translation, and for the most recent discoveries, the *Journal of the Royal Geographical Society of London*)

GEOLOGY (Gr γη, *the earth*, λογος, *a discourse*) An account of the structure of the earth, and of the various theories entertained respecting its formation Till within the last five-and-thirty years geology consisted of a very limited collection of facts, strung upon amusing but insufficient theories and hypotheses, but it may now be said to have taken its place amongst the rigid and exact sciences It requires for its successful exposition not only an intimate acquaintance with the mineralogical history of the crust of the globe, but it also involves a series of extensive and distinct inquiries respecting the physical and chemical causes that are and have been active in producing present and and it branches out into several distinct connected with the discovery of organic remains, in the successful pursuit of which no small share of zoological and botanical information are requisite and which also demand the aid of comparative anatomy

There is this therefore to recommend geology, that it excites a distinct interest in the external characters of a country or district, independent of the beauties or ruggedness or sublimity of its aspect, or of its geographical peculiarities and endeavours to trace a connection between its *exterior* features and *interior* structure, and in these its simplest details it bears upon agriculture, and ultimately upon all those numerous arts in which mineral substances are concerned The farmer should be a geologist and so should the architect the miner and the mineralogist *must* be so But this is, as it were, the mere title of the volume, for when we come more narrowly to peruse its contents, we do indeed find it "as a book wherein men may read strange matters" It is full of relics so extraordinary as to arrest the attention of the most superficial inquirer, and to awaken the deepest interest in the philosophic observer it is thronged with records of true and mighty changes and convulsions, of revolutions in climate and in the genera and species of the organic creation, it carries the mind back to a period indefinitely remote, when our present continents were at the bottom of an ocean, from which they seem to have been elevated sometimes by the slowest degrees and at others by a more rapid and violent cause, and when both sea and land were tenanted by distinct tribes and races of extraordinary animals and vegetables, it shows that every thing as we *now* find it has been gradually and successively developed as it were, and that man himself has appeared but late upon this singular stage

In this article our principal object will be to give an outline of the present state of the terms of the science which we have principally consulted, and from which, with the kind permission of their authors, we have made copious extracts are those of Lyell and De la Beche the and Buckland, and to the *Transactions of the Geological Society*, we must refer our readers for details which would have been inconsistent with the objects of this Dictionary

place in the elements of the orbits of the planets by reason of their mutual attraction, the general balance of the parts of the system will always be preserved, and every departure from a mean state periodically compensated But, in saying that *we* can discover nothing that points to a beginning or threatens an end, we only mean that mere human powers are as yet inadequate to such a discovery

There are, it is true, some circumstances in the physical constitution of our own planet which do obscurely point to an origin and a formation, but from them no definite conclusion can be concluded On the other hand neither the researches of astronomy nor of geology give us the slightest grounds for regarding either our system or the globe we inhabit, as of eternal duration, and we should speculate to any purpose, either upon the former state of our globe, or upon the succession of events which from time to time may have changed the condition and the form of its surface, we must confine our views within limits far more restricted, and to subjects much more within the reach of our [illegible] or the end of the world [illegible] sole inquiries of the older geological school, the favourite speculations of a race of geologists now nearly extinct Within the limits of the present century even geology has undergone an entire change of character, and is, as we have already remarked brought within the list of the inductive sciences Geologists now no longer ransack their imaginations for theories of the formation of the globe from chaos, or bewilder themselves with its hypothetical transformations, but they aim at a careful and accurate examination of the records of its former state, and of the indisputable evidences of former life and habitation which the organic remains of its strata afford

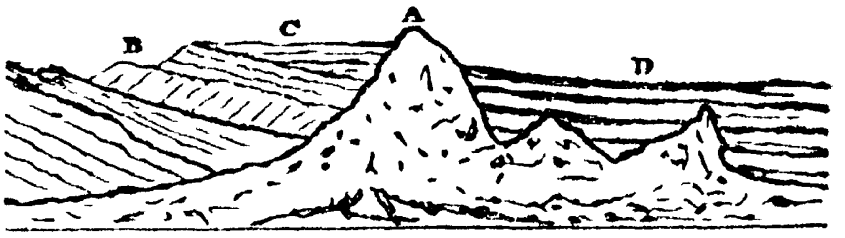
These wonderful wrecks of a former state of nature preserved, like ancient medals and marbles in the ruins of an extinct empire, afford a kind of rude chronology by the aid of which the successive depositions of the strata in which they are found may be marked out in epochs more or less definitely terminated and each recognized by some peculiarity which enables the diligent observer to recognize the deposits of any period in whatever part of the globe they may occur And so far at least as investigation has hitherto gone these deposits are in the same *order of succession* in every part of the world

But, in using these terms, we must not forget how very little we do actually know of the earth's surface We talk of certain [illegible] globe for [illegible] ered by the water of the [illegible] of that portion we can know but little, and that little imperfectly, and that of the fourth which remains in the shape of dry land not one thousandth part has been at all examined or at least not investigated Again, we speak of the *crust* of our globe, and of the *bowels* of the earth and the *depth* of the sea, and the *loftiness* of mountains forgetting how insignificant all these things really are, compared with the entire bulk of our planet, that our deepest mines hardly penetrate to a depth surpassing the ten thousandth part of the distance from the surface to the centre, that the profoundest recesses are mere scratches upon the surface that the loftiest hills and most inaccessible mountains are only as grains of dust and of sand sprinkled on the surface of one of our moderate-sized artificial globes

Such being the real state of our information, and such the limitations to which all further pursuit is subjected we may well be animated by the magnitude and extent of the inquiries which this limited range displays "And finding, even in these restricted bounds, the amplest proofs of order and design, the mind is naturally led to the sublimest inferences respecting what is unseen and even to the conception of a power and intelligence to which [illegible], since we not only [illegible] they are manifested, but find, on the contrary, that they continually open upon us in increasing abundance, in proportion as we are enabled to extend our sphere of observation and inquiry, and that as the study of one prepares us to understand and appreciate another, wonder follows on wonder, till our faculties become bewildered in admiration and our intellect falls back on itself in utter hopelessness of arriving at an end"

We may now state of what the external film or cuticle of the globe appears to consist, and examine how far we are justified in [illegible] respecting the nature of its deeper-seated parts, and of such portions as are out of the reach of actual inspection

We say that the crust of the earth is *stratified*, because it consists chiefly of distinct strata or layers of different materials These differ in depth and extent, but what is most essential to our present purpose, they follow each other, on the large scale and as masses, in an apparently regular and uniform succession in all places districts, and countries where they admit of examination and have been attentively studied They appear, in most instances, to rest upon, and are blended with invaded, and in some few instances overflowed as it were by, substances which are *not* distinctly stratified, and which most geologists have agreed in calling *unstratified rocks* The former, or the stratified rocks, from their texture and contents have apparently been formed under water, and some of them, especially the uppermost series [illegible] the organized kingdom The *unstratified* rocks, on the other hand, are in many instances of indisputable [illegible] from their position, texture, [illegible] neighbours, are also presumed to be of igneous formation *Water*, therefore, on the one hand, and *fire* on the other, seem to have been the great agents to which the present aspects of the earth's surface are referable In proceeding to enumerate the principal *divisions* of the stratified rocks in their order from above downwards, we must remind the reader that the series is frequently rendered irregular by the deficiency of one or more of its members, and that sometimes whole series of strata seem to have been removed from certain districts by causes which we shall afterwards endeavour to trace, constituting what have been called *denudations*




In this diagram A represents the crystallized or *unstratified* rocks, presumed to be of igneous origin, upon which lie the *stratified* rocks B, C, and D The rocks A were formerly called *primitive* and were supposed to be the original crystalline crust of the globe upon which the strata B C D had been subsequently deposited, but it is now supposed that the rocks B, C, and D have been upheaved by the subsequent intrusion of A by volcanic agencies from beneath

The substances which usually constitute the ground we tread upon are produced chiefly by causes in daily operation—soils and detritus of various kinds washed down from the neighbouring hills by the influence of rain and torrents and forming what have been generally called *alluvial* deposits these are more or less associated with matters probably of a similar but more ancient origin, and which, suspected by some to be relics of the deluge have been termed *diluvial* deposits, such as *gravel* and *boulder stones*

We then find in many parts of England and elsewhere occasional patches of what have been termed *tertiary* rocks which often are of singular interest and frequently consist of detached and insulated deposits surrounded by other rocks and in reference to their neighbours occupying a position very like that of the water of lakes, inland seas and gulfs, in relation to a continent and like such waters, being often very deep but of limited extent hence they are often designated as *basins* They consist of clays and calcareous and arenaceous matters in which are embedded remains of marine animals blended with fresh-water species quadrupeds and even birds These lie upon chalk, which is the newest rock of the secondary series They constitute the *supracretaceous* rocks of which the basins of Paris London and the Isle of Wight and parts of Suffolk furnish instances Chalk constitutes the uppermost of the secondary series of the European area, and it is immediately succeeded by certain varieties of sand and sandstone included by Mr De la Beche in his *Cretaceous* group We then (in the same area) come to the *Oolite* group composed of calcareous freestone and of lias resting upon the varieties of red sandstone and succeeded by coal, mountain limestone and *old* red sandstone, and these are followed by the *Greywacke* group forming the *transition* series of Werner, a part of which has been ably described under the name of *Silurian system* by Mr Murchison resting upon a lower portion termed *Cambrian system* by Professor Sedgwick The Greywacke may be conveniently divided into three portions —1 *Upper*, equivalent to the old red sandstone of England, 2 *Intermediate*, equal to the Silurian system, and 3 *Inferior* equivalent to the Cambrian series These are often made up of fragments of the older series, or contain a few ancient organic relics They rest upon the *inferior* order of stratified nonfossiliferous rocks, and upon the *unstratified* or primary series

In endeavouring to trace out the history of the respective strata to which we have adverted, it would perhaps, be most philosophical to commence our inquiries with the causes that are now active in producing alterations upon the surface of the globe, to consider the action of changes of temperature and of water and other agents that tend [illegible] to wear down its [illegible] order of things,—among which earthquakes and volcanos form a prominent feature But the narrative will be more clear if we first sketch out the history of the *formations*, considering them in reference to their position, their composition, their organic relics, and the purposes to which they are applied in the arts, and then, having adverted to their relative durabilities and aspects as mountain masses, we may consider the action of rivers, and of the ocean, both as destructive and as renovating agents, tracing out their connection with meteoric phenomena, and with the effects of volcanic fires We shall thus be

enabled to compare present with past changes, and to form [illegible] upon the great comparative question whether the [illegible] were formed under circumstances similar to those in which we now see them, or whether our globe has been subject to great and destructive changes and convulsions out of the ordinary course of nature

§ 1

First, then, as respects those superficial and insulated formations constituting the *tertiary* or *supracretaceous* group of rocks Our knowledge of their distinct existence is chiefly due to the labours of Cuvier and Brongniart, whose *Memoir on the Environs of Paris* was published in 1811 In this part of Europe they form patches or basins, but there is much reason to believe that they have once been more continuous and extensive, and that their present insulated character is, partly at least, due to the elevation of the strata below them by which they have been broken up, and in part also removed by denudation

Amongst these formations we may also class many extensive series of rocks in different parts of Europe, which, although they bear records of having been deposited at different and probably remote periods, are still compared with the strata beneath them of comparatively modern origin, and belong to the general epoch of the supracretaceous series

It will easily be understood that one characteristic test of the date or age of a rock formation is to be found in the fossils which are entombed in it If these [illegible] *and species now existing* it is an inference [illegible] modern formation, if the *genera* are extant, but the *species* extinct we are carried back to a more remote date, and if [illegible] presume upon a yet more [illegible] It is obvious also, that other conclusions of great importance may be deduced from the same source and that the remains of certain quadrupeds amphibious animals and fresh-water and marine fish and shells will announce the existence of dry land lakes or seas, at the periods of the respective depositions, — and again from *alternations* of these deposits, we are often enabled to infer the successive or alternate states of dry land lakes and the ocean, upon one and the same spot All these inferences require to be drawn with the utmost circumspection and many concomitant circumstances to be taken into the account, but the data when judiciously used are of the greatest interest and [illegible] most unexpected and extraordinary [illegible] clues to the discovery of a former and very remote state of things upon the surface of the globe

The tertiary rocks when tried by the test just hinted at may be subdivided into three or four periods founded upon the comparison of their respective fossils, all these periods are distinct from and anterior to that which has elapsed since the earth has been tenanted by man, and which may therefore be called the historical, *recent*, or contemporaneous period

In the most modern of the above periods the formations are such as contain fossil testaceous remains of which the *greater part* are referable to recent species In some of these there is an immense preponderance of recent species and the formations pass by insensible gradation into those of the historical period, as in part of Sicily and the district about Naples In others the recent species vary from one third to one half of the entire number, as in the subappenine hills and in the English crag The formations of the next period contain a minority only of imbedded fossil shells of recent species (Touraine and the beds of the Loire), and in the last, they are of such very sparing occurrence as to indicate what may be considered as the first commencement of the existing state of the animal creation (Paris and London basins)

These three periods or formations Mr Lyell designates by the terms *Pliocene*, *Miocene*, and *Eocene* (Pliocene from πλειων *major*, and καινος *recent* because the major part of the fossil testacea of this epoch are referable to recent species, Miocene, from μειων, *minor*, a minority only of fossil shells embedded in the formations of this [illegible] Eocene from ηως *aurora* tion of living species contained in these strata indicates the dawn, as it were of the present state of the animal creation) To give some idea of [illegible] of these strata, we may bring forward Paris, Hampshire, and London districts

A descending section of the strata near Paris presents the following orders of succession — The uppermost rock consists of various marls and siliceous compounds, containing organic remains, which characterize it as of fresh-water formation, to this succeed marls, sand, and limestone, with marine shells, then fresh-water marls, siliceous limestone, and gypsum, with the bones of animals, then a coarse limestone abounding in marine remains, often [illegible] beneath the surface of the chalk plastic clay with beds of sand containing lignite, amber, and shells both of marine and fresh-water animals

In this extraordinary assemblage some of the organic relics are of great interest The gypseous strata contain the bones of extinct mammalia and other animals, which have been almost recalled, as it were, into existence by the scientific skill of Cuvier, who has given sketches of their probable forms and habitudes There are the remains of about fifty species of quadrupeds, all extinct, and nearly 4-5ths of them belonging to a division of the order *Pachydermata*, now only represented by four living species, namely, three tapirs and the daman of the Cape There are a few [illegible] a species of fox [illegible] squirrel, bat, and an opossum (a marsupial animal, now confined to America and Australia) There are about ten species of birds, and, among the reptiles, crocodiles and tortoises

Though we [illegible] and apparent causes [illegible] relics, it may be worth while to refer to some general points connected with the geology of the Paris district, which seem to explain certain states of the earth's surface then existing

In the first place, as respects their general arrangement, we find that they do not repose horizontally upon each other, but that there are irregularities, announcing hills and valleys upon the original surface of the chalk on which all these deposits rest So that the plastic clay and its associates were deposited in these hollows, filling them more or less up upon this the lowest marine stratum (*calcaire grossier*) was formed, also following the uneven surface beneath Then came the gypseous deposit, containing land and river shells, with fragments of wood and the assemblage of skeletons respecting which it deserves particular notice, that they are often entire the most delicate extremities being preserved, as if the carcasses clothed with their flesh and skin had been floated down soon after death, so that Prevost has suggested that a river may have swept away the bodies of the animals and plants which lived on its borders or in the lakes which it traversed and may have carried them down to a gulf in which flowed waters impregnated with sulphate of lime and by which they were gradually consolidated But whatever was the cause of this singular state of things, it is clear that the deposit of sulphate of lime afterwards ceased, that the relative level of the sea and land apparently became altered, and that marls with sea shells were formed and pebbles were produced, to which oysters became attached some of the pebbles being pierced by boring shells To these deposits succeeds sand with *broken* organic remains, filling up inequalities of surface and [illegible] a long-continued action of water [illegible] which prevented the development of organic remains ceased, and marine exuviæ became entombed in great abundance, and lastly, to close this eventful history a varied deposit follows, containing the remains of such animals and vegetables as are known only to exist on dry land, or in marshes or fresh water This variety of mineral structure has been supposed to result from springs holding various substances in solution entering various parts of a shallow lake That it was shallow is probable, from the remains of the small seed vessels of fresh water plants belonging to the genus *Chara* These curious remains were once supposed to be microscopic shells they have been called *Gyrogonites* (from γυρος *curved* and γονος *seed*) They occur frequently in fossil formations of different eras

In the Isle of W[illegible] and marine strat[illegible] in many respect[illegible] character they are very [illegible] chusively mechanical, [illegible] and of sulphate and carbonate of lime, which seem to have prevailed about Paris, are not to be traced here But the bones of mammalia corresponding to the celebrated gypsum deposits of Paris have been disinterred at Binstead, near Ryde

Here as elsewhere we find signs of an upheaving of the strata as announced in the different succession of formations, and in the verticality of certain neighbouring beds In the Isle of Wight, and also on the opposite coast of Hampshire, the fresh-water beds rest upon sand, and there seems, as in the Paris beds, to have been alternations of currents with more quiescent deposits

A peculiar clay underlies London and the adjoining district, commonly known as *London clay* It is of various colours, and contains argillaceous and calcareous matters, but the latter rarely so far predominate as to form limestone, or even marl It contains layers of argillo-calcareous nodules, called *septaria*, and occasional beds of sandstone Its thickness varies, sometimes exceeding 500 feet As many of the marine shells found in it have been identified with those of the Paris basin, it is probable that the formations belong to the same epoch No remains of terrestrial mammals have as yet been found in it, so that we want that evidence of the vicinity of dry

land at the time of its formation, but, that such was the case appears probable from the immense number of nuts and fruits, some of them resembling the cocoa nut and spices of tropical regions. The lower beds of the London clay, called *plastic clay*, are contemporaneous with the equivalent plastic clay of Paris, they contain beds of sand, shingle, clay, and loam [illegible] and re[illegible] is not found in the distinct manner noticed in the Paris basin, the clay of London is in many places abundant in it, and it is sometimes found in fine crystals. Its presence is also announced in the hardness of the spring waters that issue from it, as contrasted with the softness of the springs from the plastic clay sands.

In Norfolk and Suffolk there is a rock already mentioned, known l[illegible] its [illegible] with species inhabiting the neighbouring seas. Its mineral character is dull [illegible] consists of sand, gravel, and marl, and sometimes presents itself in the form of a soft stratified rock composed almost entirely of corals and echini, or of loam and clay, containing bones of terrestrial quadrupeds and drift wood with fragments of older rocks, and gradually passing into alluvium.

Having thus enumerated some of the peculiarities of these tertiary strata, there are two or three questions connected with the formation generally, which, before we leave it, it will be right briefly to advert to. In the first place, the great elevation at which some of these strata occur above the level of the sea would seem to indicate to the superficial observer a retreat or falling of the waters of the ocean. But more accurate inquiry forbids such a conclusion, and leads to another, at first more extraordinary inference, namely that the land has often been elevated: the proofs and illustrations of which we shall again recur to. Secondly, that the organic remains animal as well as vegetable, and also the mineral structure of many of these rocks, show that the temperature of these parts of the globe has undergone a considerable declension from its former state, for there are among them evidences of something more than a tropical climate and of thermal or even boiling springs. The cause of this change of the globe's temperature forms an important subject of discussion with geologists. Some, however have contended that this evidence of change of temperature as far as it rests upon organic relics, is insufficient, for say they we do not absolutely know that such animals and vegetables though they *now* require a high temperature, may not at some former period have been adapted to a lower one, and they adduce the Siberian elephant, and a few analogous cases, as proofs. But as we now find every animal and vegetable adapted to their proper situations we have a right to infer the existence of the same fitness and design at all antecedent periods and under every possible state of the globe and therefore to conclude that similarly constituted animals and vegetables have in general had similar habitats.

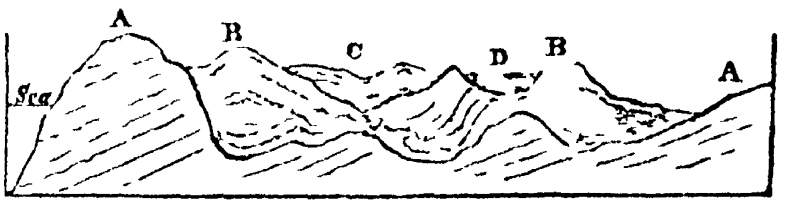
We therefore are obliged to conclude that the earth's surface has suffered a notable decrease of temperature or at least that there has been a great change of climate over large tracts of the globe. In relation to this question, some have argued the possibility of a decrease of temperature from internal causes,—have considered the whole globe as having cooled from absolute fusion,—and that this process has now only gone to a certain extent so as that [illegible] warmth which we experience in deep mines is attributable to this central source of heat.

In so far as this hypothesis of a central heat is resorted to [illegible] in *climate*, it seems inadequate, for it [illegible] to assume that the same effects would result from such a cause as those which are produced by the influence of the sun's rays and by peculiarities of surface.

Another, and perhaps upon the whole a more plausible explanation of this [illegible] of the globe. A change of such distribution in the lapse of ages, by the wearing down of old continents and the elevation of new, is a fact which we shall be able to demonstrate, and the influence of such a change on the climates of particular regions, if not of the whole globe, may be fairly concluded from what we know by actual observation of insular, oceanic, and continental climates. Here then, "in language of very high authority," we have a cause on which a philosopher may consent to reason, though whether the changes actually going on are such as to warrant the whole extent of the conclusion, or are even taking place in the [illegible] must be considered as undecided till the matter has been more thoroughly examined. It will be observed that this *theory* for so it may fairly be called, supposes a combination of external and internal causes, the [illegible] or depressing the [illegible] the former supplying the necessary heat. It also infers the possible return of a warm climate, so that the same situations might be alternately placed under the influence of a raised and depressed temperature, or as it were of an equatorial and polar clime.

Lastly and the suggestion is sanctioned by the authority of Sir John Herschel, we may look to the astronomical fact of the actual slow diminution of the excentricity of the earth's orbit round the sun. This, as a general cause, affecting the mean temperature of the whole globe, and as one of which the effect is both inevitable and susceptible [illegible] exact estimation, certainly deserves [illegible] is evident that the mean temperature of the whole surface of the globe, in so far as it is maintained by the action of the sun at a higher temperature than it would have were the sun extinguished, must depend on the mean quantity of the sun's rays which it receives, or, which comes to the same thing on the total quantity received in a given invariable time, and the length of the year being unchangeable in all the fluctuations of the planetary system, it follows that the total annual amount of the solar radiation will determine, *cæteris paribus* the general climate of the earth. Now it is not difficult to show that this amount is inversely proportional to the minor axis of the ellipse described by the earth about the sun regarded as slowly variable, and that therefore the major axis remaining as we know it to be, constant, and the orbit being actually in the state of approach to a circle, and consequently the minor axis being on the increase the mean annual amount of solar radiation received by the whole earth must be actually on the decrease. We have here, therefore an evident real cause of sufficient universality and acting in the right direction to account for the phenomenon. Its adequacy is another consideration. (*Herschel's Preliminary Discourse.*) We may suggest the possibility of the three causes adverted to acting in unison to account for the complicated and curious effects of which we seek an explanation.

Such then are the leading considerations arising out of the inspection of the most superficial and apparently the most recent, of the earth's strata. They suggest a general change in the disposition of sea and land, an alteration in their relative levels sometimes often repeated, the existence of animals and vegetables now extinct, and a remarkable alteration in the general temperature of the globe. How far the supposed causes of these changes are borne out by observations upon the more ancient formations will be seen as we proceed in our examination of the descending series.




In the above diagram A A represents the chalk upon which the tertiary strata B C D have been deposited, the latter may be supposed to be of different ages as indicated by their included fossils and all of a more recent date than the chalk upon which they lie.

The tertiary rocks rest either upon chalk or upon the geological equivalents of chalk, and the formations of this series constitute a prominent feature of the district which surrounds the London basin, for as soon as we leave the tertiary deposits which characterize the vicinity of the metropolis we enter upon the cretaceous strata. The ranges of chalk in this part of the kingdom are very extensive, and in consequence of their smooth and rounded outline, and [illegible] deep hollows in w[illegible] monotonous peculiarity on the scenery. They are, however, of much interest in their geological relations. Salisbury Plain and Marlborough Downs form as it were a centre from which the chalk emanates in a north-east direction, through Buckingham, Bedford, and Cambridge shires, and terminates in one direction upon the coast of Norfolk. Another branch intersected by the valley of the Humber, traverses Lincolnshire, and terminates at Flamborough Head in Yorkshire. The extreme western point of the chalk is not far from Honiton in Devonshire, whence it branches towards the south-east to the Isle of Purbeck, and again [illegible] of Wight. [illegible] terminating [illegible] the coast of Sussex. In these districts some of the chalk hills are of no inconsiderable elevation. [illegible] for instance, it forms [illegible] above the level of the sea. Between Lewes in Sussex and Alton in Hampshire there are several similar ele-

vations Between Alfred and Dover the highest ridges is about 800 f t Dover Castle Hill by actual

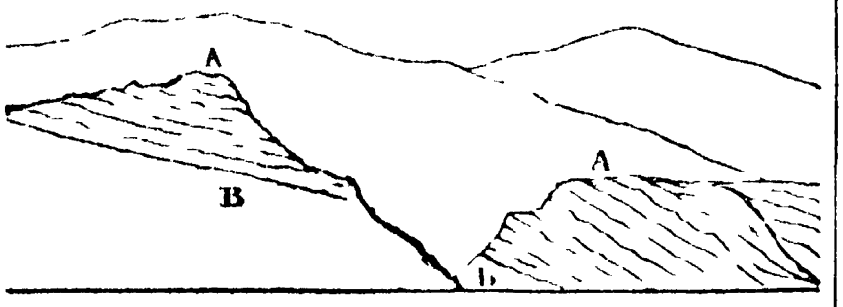
The geological features and fossil remains are of interest We find the chalk in valleys and hollows deposits, and also under the present surface of water-worn, and the fissures which have evidently been filled with rolled masses, debris and flints One of its most remarkable characters in England and France is the presence of flints in nodules and layers in the upper part of the chalk strata, while the lower beds are generally deficient in flints, and argillaceous or sandy These flints are commonly in distinct nodules, horizontally arranged, but they sometimes are vertical or variously inclined, and occasionally form seams, cutting the chalk at different angles

The great abundance of organic remains in the chalk has been observed from a very early period, they have recently been carefully examined, and proved to be almost entirely marine No remains of mammalia have been detected in them, but in Yorkshire and Sussex *reptiles*, one of them of a considerable size have been observed The *Mososaurus Hoffmanni*, and a crocodile, fish and shark's teeth have been found, as also zoophites, shells, mollusks and a few crustaceous animals

The origin of chalk it is difficult to explain There appears no evidence of its having been deposited from chemical solution, but, on the other hand it bears marks of a mechanical deposit, as if from water loaded with it in fine division And upon this principle some gleam of light may perhaps be thrown upon the enigmatical appearance of the flints for it is found that if finely powdered silica be mixed with other earthy bodies and the whole diffused through water, the grains of silex have under certain circumstances a tendency to aggregate into small nodules, and in some chalk small grains of quartz are discoverable

Many of our chalk strata afford decided evidence of great disturbances having taken place among them probably at the period of their elevation from the sea Illustrative instances of such disturbances are given by Mr Lyell in the case of the chalk of Newbury in Berkshire, and of the ravine called the Coomb near Lewes, in Sussex, the latter shows how narrow openings of this kind may have been accompanied by shifts and dislocations as well as fracture of the strata The steep declivities on each side and the bottom of the ravine are covered with green turf, and no outward signs of disturbance are visible, but when we examine the section in the neighbouring chalk pits, we find that there has been much internal derangement

The evidence of this derangement is shown in the annexed diagram where A and B represent the chalk with and the chalk without flints on each side of the gap




These dislocations or shifts or faults are common in all strata, though most observed in coal districts, from the importance of the material affected by them

It must be confessed that such appearances are favourable to the idea of those local convulsions alluded to in regard to certain tertiary strata For if portions of the secondary rocks emerged from the sea during that period it is probable that the chalk underwent many oscillations of level that certain tracts became land and then sea and then land again, so that parts of the surface first excavated by currents or rivers were occasionally submerged and after having been covered by tertiary deposits upraised again and assuming the elevation of the chalk to have been slow, every part of it must have been exposed for some time to the action of the waves hence the valleys upon its surface, and the broken and rolled flints which overspread it

In describing the general characters of the chalk we have limited ourselves to England, but in other countries the mineralogical characters of this formation are such as would lead us to arrange it with other groups, were it not that the included organic remains mark them as of the same epoch such are the hard limestone and sandstone of the Alps, Pyrenees, and some other primitive countries

The lower beds of chalk graduate into a variety of sands and sandstones of different aspects and degrees of induration and often abounding in green particles composed of silicate of iron, whence the term *green-sand* These beds are associated as one formation in consequence of the general character of their fossil remains there is also an argillaceous deposit, provincially known under the name of *gault*, which belongs to the same class

But we now descend by gradual transition to the clays,

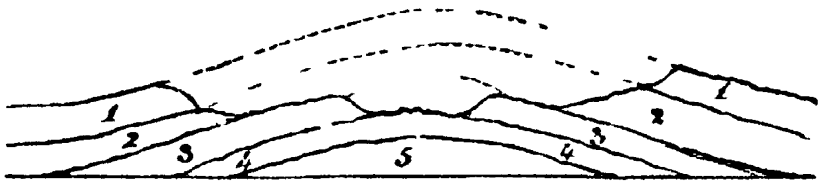
[illegible] the [illegible] found with the preceding [illegible] but a closer examination of their organic remains shows them of distinct origin, for, strange to say, after what we know of the chalk, they abound in terrestrial and fresh-water remains showing the existence of dry land, and lakes and rivers before the chalk rocks were formed, and showing also, by the way in which they blend with the sands above, that the change of circumstances which permitted the residence of marine animals over a surface previously inhabited by fresh-water animals was not sudden, but [illegible] formation of these strata has been ably illustrated by Mr Mantell whose splendid illustrative collection is now in the British Museum

The clays and sandstones of this formation contain [illegible] the riches of ancient iron works, and by the abundance of remaining slags which are at this day still used for mending the roads about Rotherfield Mayfield, &c The extensive triangle of which Folkstone, Beechy Head, and Alston are the points is characterized by this formation, forming greater part of the region intervening between the North and South Downs, known as the *Valley of the Weald*

This district is very instructive, both as to theoretical and practical geology It seems highly probable that the chalk has once been continuous, but that it has been washed away by breakers and currents, and fractured by the power which has elevated the strata In illustration [illegible] ferred to

If we set out from London, travelling southwards, on leaving the immediate vicinity of the metropolis we ascend an inclined plane of flinty chalk, and then find ourselves on the summit of a declivity consisting chiefly of the different members of the chalk formation This is called the *escarp* [illegible] excavated chiefly [illegible] tion, such as sandstones and gault, and is continuous along the southern termination of the North Downs, so that it may be traced from the sea at Folkstone westward to Guilford and the neighbourhood of Petersfield, and thence to the termination of the South Downs at Beechy Head where the strata are cut off abruptly by the inroads of the ocean but where it is evident that they must have at one time been continued

This denudation is frequently referred to by geological theorists as rendering it extremely probable that the secondary districts were gradually elevated and denuded when the basins of London and Hampshire were still submarine and while they were progressively filling up with tertiary sand and clay It would also appear that subsequently to the emergence of the secondary rocks an immense mass of the upper portions has been removed by the force of water and the materials thus carried away were probably conveyed into the depths of the contiguous sea




The above diagram will serve to explain a valley of denudation, the strata 1, 2, and 3 being to a greater or less extent removed or washed away, and different surfaces of these, and of 4 being now exposed

We now again advert to the organic contents of the Weald rocks, which as already stated are such as indicate the existence of fresh water and dry land before the present chalk deposits were formed, and although some of the inferences of geologists upon this subject appear at first startling and even romantic, they are perfectly fair deductions from the phenomena observed

The Hastings sands consist of sand and sandstone, with occasional beds of clay and shale, containing silicified wood and fragments of carbonized vegetables, lignite, ironstone and argillaceous limestone, and the Purbeck beds include varieties of sand and limestone much used for pavement From the organic remains of these rocks it would appear that they were formed chiefly in fresh water, in lakes, rivers, or estuaries There is a formation in the Isle of Portland belonging to this series which has been called the *dirt bed*, and which has also been found near Weymouth and elsewhere It appears from its contents to announce the first appearance of dry land, succeeded by submersion of the same land under fresh water in which the Weald rocks were formed, not suddenly, for there are no marks of violence, but gradually, the shells being tranquilly entombed in the sandy and [illegible]

[illegible] examining the oolitic rocks upon

which these rest, that they abound in marine remains, so that we must suppose a rise of the land or a depression of the sea to such an extent as to permit the sea-formed rocks to become dry land, upon which tropical plants flourished Then this land again became in its turn depressed, but so quietly that the trees were apparently left in their natural positions, and even the pebbles and soil not washed away There is, in short, a great resemblance between these very ancient relics and those of submarine forests of later date upon the coast, except that the former are tropical plants, the latter oak, hazel, &c

In the sands we find entombed tortoises, crocodiles, plesiosauri and megalosauri, and huge iguanodons (Mantell, *Phil Trans* 1825)

It is probable that these monstrous reptiles sported in the waters and basked upon the banks of the lake or estuary into which trees and different vegetables were drifted Now it will be remembered that the sea again resumed its dominion after this state of things, because these strata are covered by the chalk rocks already recognized as marine deposits, and as there are no marks of violence where the Wealden rocks and the green-sands of the cretaceous series come together, but, on the contrary, as they gradually pass into each other these extraordinary strata must seem to have been gradual and not attended by any violent or sudden event

Such, then, are the remarkable records of the Wealden rocks, and there are analogous cases in other parts of Europe

The *oolitic rocks* form a very important and curious, but rather complicated series of strata, in this country, in which, however, there are certain analogies which enable us to group them into one general assemblage Mr Lonsdale's paper on the Bath district may be referred to as giving a lucid account of the varieties and peculiarities of these rocks The oolitic limestones are well known from their common use as building materials under the names of Bathstone, freestone &c They are intermingled with limestones which do not possess the oolitic structure, and with arenaceous and argillaceous beds *Lias*, the lowest member of the series, is an argillo-calcareous deposit, commonly containing numerous organic remains

In England, this formation extends from the sea coast of Dorset, near Bridport to the northern extremity of the Cleaveland Hills, in Yorkshire, in one range of hills, broken by the vale of the Humber The lias is often bituminous and is impregnated with sulphate of soda, sulphate of magnesia, and common salt It abounds in ammonites, belemnites, and other chambered shells, and in bivalves, and some univalves gryphites (a deeply incurved bivalve), encrinites and pentacrinites and other zoophites, and the remarkable saurian animals already noticed

To the rocks enumerated under the general term of the *oolitic group* there succeed a series of sandstones which from their prevailing colour are generally known as the *red* sandstone and marl formation, and which are incumbent upon the coal deposits of this country Their organic relics are numerous, and they derive interest from being the repositories of great beds of salt, which occur in the counties of Chester and Worcester

In the salt itself there is nothing very remarkable, except, perhaps its occasional purity It is sometimes colourless, and contains not more than 2 per cent of foreign matter, in other parts it is tinged red and more or less mixed with earthy impurities The *brine springs* which often yield 20 per cent of salt, are doubtlessly derived from the accession of water to similar solid masses

How the salt came where we now find it, is a question of no easy solution It has been supposed that it was produced at the bottom of salt-water lakes and the existence of beds of salt in certain lakes of Africa and South America is quoted in favour of such an hypothesis

Another substance abundant in this formation, and apparently more or less connected with the salt deposits, is gypsum, or sulphate of lime, known, also, under the name of alabaster It has been already mentioned as occurring in the tertiary strata, forming the cement which entombs the organic remains of the Paris basin, and where it was probably formed by sulphuric exhalations and springs acting upon the detritus of the secondary chalk, which there appears to have suffered such extensive degradation

In our red-sand districts the salt and gypsum are distinct, [illegible] and in Egypt a high [illegible] is a substitute for salt This rock, when exposed to air and water, would of course lose its more soluble common salt, and hence, probably, the scriptural and oriental allusion to the inefficiency of *salt* [illegible]

In the north of England [illegible] limestone is associated with these [illegible] It is usually of a yellowish or fawn colour, not abundant in organic remains, and is often a valuable and durable building stone

The next substances which occur in descending order are the coal *strata* or *measures* or *coal basins*, as they are sometimes called, and if upon our journey downwards, we have been struck with the extraordinary portion of the *animal* kingdom at certain periods or epochs of the earth's [illegible] we shall meet with matters quite as wonderful in the [illegible] we have brought before us a substance of such importance to our commercial welfare and national resources, that every trifle connected with its history assumes an air of peculiar and distinct interest

There are two or three points, and those of much theoretical importance, respecting the origin of coal, in which geological authorities seem nearly unanimous The one is that our present coal is exclusively of vegetable origin, formed [illegible] the destruction of vast forests, and from [illegible] quantities of timber drifted by some of the great rivers of the world into the present ocean, it is by no means improbable that a similar formation is now going on in the depths of certain parts of the sea and, secondly from the nature of the preserved vegetables, it would seem that the climate of these parts of Europe *was* of a tropical character It may also be inferred that these strata were deposited in the neighbourhood, and often probably upon the verge, of extensive tracts of dry land, for the trees that are found in coal strata are often like those of our submarine forests, or of the Portland dirt-bed, as far as position goes, and, finally that they were afterwards elevated, and often singularly dislocated and contorted by forces, the nature of which we shall afterwards consider

In some coal fields [illegible] the term *coal basin*, [illegible] dip as it were to a common centre, and consist of various beds of sandstone shale and coal irregularly stratified, sometimes mixed with conglomerates,—the whole showing a mechanical origin

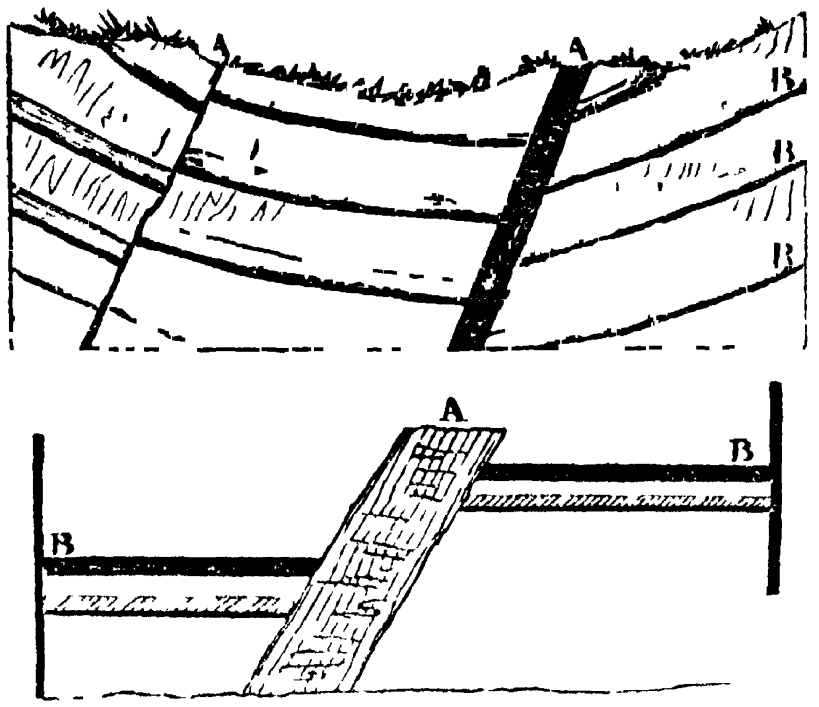
That these depositions have taken place, and that the change of the wood into coal has often been effected under great pressure and often under pressure and heat, seems evident from [illegible] some of the vegetable masses and [illegible] manner in which the carburetted hydrogen escapes in the form of *blowers* from the strata, as if it were pent up in their cavities under vast condensation, and sometimes perhaps even in a liquid form

An opinion respecting [illegible] of coal first published by De Luc, and more recently by Mr [illegible] Bakewell [illegible] particular *peat bogs* which have, one after the other, been submerged and covered by sand and silt There are numerous facts in favour of this view, which has also been sanctioned by Mr De la Beche, as upon the whole, more consistent with the phenomena presented by coal formations

It has been well observed by one of the most instructive geological writers that in the present condition of the coal measures we have opportunities of observing design even where things are so disposed as at first sight apparently to preclude any such inference The accumulation of vegetable matter at a remote epoch in the history of the world for the convenience and consumption of creatures which were long afterwards to exist upon its surface, must strike the least inquiring, but when the twisted dislocated upturned, and broken strata so common in the coal districts are before us the design appears to the superficial observer to be frustrated, especially when the miner complains of them as interrupting or even preventing his progress, so that this apparent confusion has sometimes been regarded as a bar to the ingenuity and industry of man in extracting the combustible so valuable and requisite When however, we contemplate the subject more closely, we find that these very irregularities and inconveniences are in reality highly advantageous, for they often heave up seams of coal that would otherwise be beyond reach, and they perform the yet more important service of excluding the passage of subterraneous waters from one part of the workings to another so that the miners in collieries situated in one particular mass have only to contend with the waters in it, whereas if the strata were always unbroken and continuous, such would be the abundance of water flowing [illegible] and expense [illegible] would often be necessary altogether to abandon the further extraction of the coal The section of strata in [illegible] curiously they [illegible] and in the coal measures at Little Haven, St Bride's Bay (Pembrokeshire), we have a good instance of their occasional contortions

The annexed [illegible] tion of a coal basin, and the [illegible] of the strata by dykes or cross-courses A A, in the first figure, are the dykes by which the shales and coal, B B B, are disturbed, and, in the second, the seam of coal B B,

which as in the other case, was once continuous, has been dislocated by the intrusion of the dyke A







T[illegible] beds and seams of coal in [illegible] of them are worked, they are generally of uniform thickness through a great extent, but are sometimes subject to irregularities When less than two feet thick, they are seldom worked to any great extent

The nature of the upper stratum of stony matter or *roof*, is very important If compact it is secure from falling and keeps out water, if loose the expense incurred in supporting it absorbs the profits of the coal The deepest coal mines of England are those of Northumberland and Durham, which are worked nearly 1000 feet below the surface The thickest bed of coal is said to be at Wood Mill Hill colliery in Staffordshire and to exceed 40 feet From 6 to 9 feet is the average thickness of the most productive seams

Coal strata are often accompanied by *clay ironstone* an ore of iron not so rich in metal nor so pure as many others but which has acquired infinite importance from its association with coal and limestone the substances which are requisite to reduce and purify it The richest varieties of this ore are said to yield about 25 to 30 per cent of metal and it is the chief source of the enormous quantities of iron manufactured in this country

## § II

MOUNTAIN LIMESTONE which is the next rock in descending order may be considered as forming the foundations as it were or basins in which the coal is commonly deposited, and in this respect bears some correspondence to the chalk and its tertiary formations

This kind of limestone is of various colours and often so full of organic remains as to appear almost entirely made up of them, especially of encrinal columns, but sometimes scarcely an organic relic is to be detected and it is veined and variegated with streaks of calcareous spar Both these varieties form useful and often handsome marble

This rock is of further interest as being that which in the centre and north of England is the seat of our most productive lead mines hence it is called *metalliferous limestone* The great patch of limestone extending from the Tweed to the Tees bounded by the coal measures on the east, and on the west by the Cheviot Hills is especially known as the *lead measures* The characters of the rocks are very variable The veins hitherto worked occupy a space of about 15 miles north and south and 20 west and east, and run, with little exception, nearly west and east

The Yorkshire limestone district, exclusive of its metallic veins, is traversed by others, which as they are only filled with lapideous substances are of little interest to the miner, but of deep importance to the geologist They often intersect the metallic veins disturbing the parallelism of the strata, and often occasion much irregularity and confusion There is here an instance of the elevation of the strata to more than two fathoms upon the side of one of these cross veins The contents of [illegible] very miscellaneous, and where the [illegible] with is much harder and more durable than the assailed strata their course is often perceptible upon the weather-worn surface of the country which they traverse Such is the cross vein of the lead measures called the Devil's Backbone, forming a ridge that may be traced a considerable distance along the country through which it passes

The Derbyshire limestone district is well known, and frequently visited on account of the romantic scenery and wonders in which it abounds Castleton is its northern point and it extends southward about 25 miles to Weaver Hill Its breadth is very irregular, but nowhere [illegible] miles [illegible] tributes [illegible] varied [illegible] and its north-western extremity is celebrated for the wonders of the Peak

In regard to the varied aspect of this district, it may be observed that the different strata of limestone differ considerably from each other, [illegible] another species of rock intervene, [illegible] *toadstone*, and that the respective edges of these strata come to the surface, and, lastly that the country is traversed by a great fault or dislocation

The singular [illegible] these limestone rocks [illegible] their various masses occasionally assume are well seen in Dovedale, and some of their other peculiarities, especially their curvatures, and some of the dislocations which they have suffered, are evident in Matlock and its neighbourhood In the High Tor the stratification appears horizontal and regular when viewed in front, but a more accurate examination shows that it is curved and irregular a section made by the river Derwent, near the toll bar, well illustrates this peculiarity Another instance of *curved* strata may be seen in Crich Cliff, about 4 miles east of Matlock it is an isolated hill about 900 feet above the level of the river According to Mr Bakewell the mass of the hill consists of arched strata of limestone The different beds of limestone are of very different qualities and composition, the upper cherty, and often bituminous, abounding in corallites and encrini &c, often curiously seen in relief upon its weather-worn surface Beneath the rock contains beds of magnesian limestone and siliceous limestone or dunstone, and towards its lower parts beds of black marble The lowest limestone stratum is that which forms the Peak Forest, the downs of Buxton, and the Weaver Hills, and in it are several remarkable caverns Here also we find at Castleton those curious nodules of fluor spar celebrated for the manufacture of vases &c, also that very [illegible] bitumen, or fossil caoutchou [illegible] which traverse many of these caverns the *stalactites* and *stalagmites* in which they abound, and the thermal waters which characterize the district, are all important points to be noticed The toadstone of Derbyshire is sometimes represented as regularly stratified between the limestone beds, but this requires further investigation, and at all events the beds, if such they are, are liable to many extraordinary irregularities The toadstone never contains shells or organic remains, calcedony, zeolite and globules of calcareous spar are not uncommon in it and whatever theory may be entertained in respect to it, it evidently bears the character of a formation distinct from its associates In the cave at Castleton it forms a large irregular column, having the appearance of the rock called basalt

The veins in the limestone in Derbyshire contain the ores of lead manganese copper, zinc and iron the proper repository of the lead appears to be the limestone, though it also occurs in some other strata, and rarely in the toadstone in which it is always in small quantities, and [illegible] very large veins Near Bristol [illegible] and form the edges of the coal basin In some places it is very bituminous as on the Avon at Chepstow, and even exudes petroleum On the Welsh coast of the Bristol Channel we have another ridge of [illegible] basin as it were in which the gr[illegible] Wales is situated The hills on the west of Swansea and the cliffs on the south of Pembroke are of this formation, and again on the banks of the Wye it constitutes scenery of a soft but most romantic character There is something singularly fascinating in the landscape of the limestone districts, resulting not only from the varied forms and groupings of the mountain masses, but depending also upon the nature of the substance, and of the soil derived from its decay Upon the perpendicular and projecting precipices lichens of various and singular hues alternate with the grey surface of the uncovered rock, a variety of shrubs are scattered by nature's hand upon its picturesque and waving sides, ivy and other creeping plants issue in gay luxuriance from its crevices, and the glens and valleys are adorned by every variety of verdure

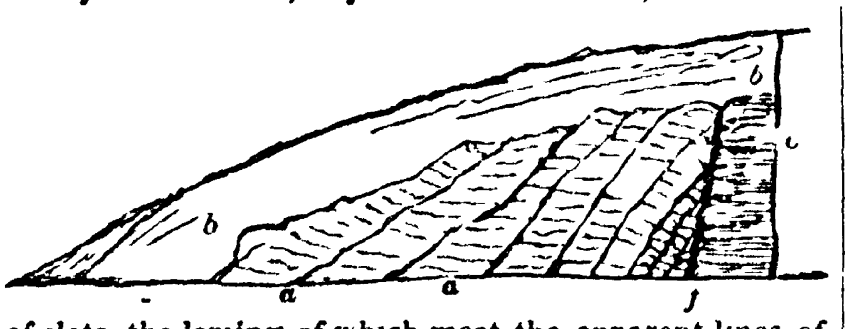
We may now cast a glance upon the probable state of the globe at the period at which the coal and the subordinate limestone rocks were formed In regard to the latter it would appear that they extend over a great part of central and northern Europe, and that rocks containing the same organic remains are found in the lake district of North America, and are even abundant upon the borders of the Arctic Sea The great quantity of corals found in this formation, as well as its vast extent, seem to prove that it was formed in a deep and extensive sea, in the midst of which there were many isles These isles were apparently composed of primary and of volcanic rocks, which being exposed to the erosive action of torrents, to the artillery of the waves, and to superficial

[illegible] mineral springs and volcanic eruptions, contributed the inorganic parts of the carboniferous strata In regard to the fossil remains of these strata the vegetation of the coal districts is stated by botanists to possess the characters of an insular and not of a continental flora, and we may suppose the carbonaceous matter to have been derived from trees swept into the sea by torrents and from peaty matter, which even in our climate often blackens the rills of marshy grounds It has been acutely observed by Mr Lyell, that if we seek for present points of analogy to this state of things, we must either turn to the North Pacific and its numerous submarine or insular volcanos between Kamschatka and New Guinea, or, in order to obtain a more perfect counterpart to the coralline and shelly limestones we may explore the archipelagos of the South Pacific between Australia and South America, where coral reefs consisting in great part of compact limestone, are spread over an area not inferior perhaps to that of our ancient calcareous rocks though we even suppose these to be prolonged from the North American lakes to central Europe

In these remarks we anticipate a subject requiring more full discussion, and they are merely introduced here to direct attention to the coincidences and analogies between the present order of things produced by causes now active and by the ordinary proceedings of nature, and th[illegible] this surface often [illegible] catastrophes and convulsions

Beneath this great limestone formation strata of sandstone occur, which from their position as opposed to those *above* the coal, are known under the name of the *old red sandstone* It often appears more as a conglomerate than a sandstone, that is, made up of fragmented [illegible], and ranges of it sometimes follow the [illegible] rocks and are evidently composed of their debris On the north coast of Somerset and Devon, upon the Bristol Channel, it may be seen recumbent upon slate and [illegible] but it often [illegible] geologists [illegible] term of *grauwacke* These rocks, considered *en masse*, consist of a large stratified deposit of sandy and slaty matters often extending over considerable districts Sometimes, from the coarseness of their texture, they pass into *conglomerates*, and sometimes from its fineness, graduate into *roofing slate* apparently formed of highly comminuted detritus In this formation the sandstones are comparatively deficient in organic relics but they abound in the limestone Upon the whole they exhibit marks of *slow* deposition This series of rock [illegible] the [illegible] upon rock [illegible] their being best developed in that part of England and Wales formerly included in the ancient British kingdom of the *Silures* The lower part of the Grauwacke series constitutes the Cambrian rocks of Professor Sedgwick

There are some curious facts respecting the stratification of the slaty portions of these rocks which as they apply to slate generally it may be proper here to mention, and as an illustrative instance, that noticed by Mr De la Beche as occurring at Bovey Sand Bay on the east side of Plymouth Sound, may be referred to *a a, curved* beds




of slate, the laminæ of which meet the apparent lines of stratification at various angles, being even perpendicular to them The beds are cut off by the fault *f* from the slates *c*, the laminæ of which are confusedly horizontal The whole is covered by detritus of fragmented slate *b*

We are now gradually descending into the *non-fossiliferous* rocks, for the lower grauwackes graduate into slates destitute of organic remains, and into rocks of chemical rather than of mechanical origin Thus we arrive at that very remote condition of our planet, when neither animal nor vegetable life seems to have existed on its surface, and instead of wandering in imagination amid forests, lands, and seas, surrounded by strange vegetables, and by animals yet more strange, our attention must be directed to the laws which govern inorganic matter

Of these *inferior, stratified*, and *non fossiliferous* rocks, one of the most abundant and important is *argillaceous* or *clay slate* It differs in texture and composition, and except from its geological position, is often scarcely distinguishable from the slates of the grauwacke series When chlorite prevails, it is called *chlorite slate*, and it passes into *hornblende slate*, and into *mica slate*, and is associated with *quartz rock*

The origin of these rocks is extremely ambiguous In regard to clay slate it is apparently a mechanical deposit of very finely comminuted matter It often contains regular crystals of pyrites [illegible] colours generally grey, black, or [illegible] and like [illegible] owes its colours from the oxides of iron Beds of this slate, when finely lamellar, are valuable, as furnishing materials for roofing Those which are least absorbent of water, and which split into the thinnest and smoothest plates, are selected, but they should not be *too thin*, as they then fail in durability and do not resist the force of storms Slate is also largely employed for other architectural purposes, and for the construction of tanks and cisterns In this country there are extensive quarries in Westmoreland Yorkshire, Leicestershire, North Wales, Cornwall, and Devonshire

The forms [illegible] and general [illegible] and outlines of some of the [illegible] of Cumberland especially and the English lake scenery [illegible] the mountains of the grauwacke and slate formations The former exhibit united softness and grandeur, the latter a more elevated and rugged aspect We have varied and grand instances of slate in the mountainous district of North Wales and in Cumberland and Westmoreland The cluster of hills of which Skiddaw forms the highest elevation may perhaps be referred to as genuine clay slate, and in Devonshire and Cornwall the granitic range which traverses the promontory like a backbone, beginning at Dartmoor and terminating at the Land's End has slate overlying it on both sides The scenery of Lower Looe Lantagel, and other places on the north and south sides of Cornwall derives its grandeur and charms from the various assemblages of slaty headlands, promontories creeks and islands Sometimes its strata jut out in bold fantastic forms upon the ocean, and sometimes gradually shelve away into gentle slopes Their verdure is usually scanty and uncertain, but here and there a clayey soil finds a resting place, and cherishes patches of shrubs interspersed with trees of loftier growth, and attracting attention by the sterile and fragmented surface which often surrounds these insulated spots The beauties of the coast of Cornwall are singularly contrasted by the barren exterior of its central [illegible] district where scarcely a blade of [illegible] and sombre hues of the ground but where heaps of rubbish once rich in embowelled treasures give a gloomy irregularity to the surface, and where the ponderous heaving of machinery raises subterranean rivers to a new level and into new channels and enables the miner to arrive at treasures which but for the inventive genius of Watt would have remained inaccessible

The mountainous aspect of slate is seen to great perfection on the western side of Wales, where Snowdon, Plynlimmon and Cader Idris with many of their respectable associates present the peaked summits the dark and narrow valleys the steep precipices and the fragmented slopes that peculiarly belong to this formation

Associated with the rocks of the inferior stratified group (slate mica slate gneiss) there are those beautiful varieties of white and crystalline limestone known as the statuary marbles of Greece and Italy They vary in their texture That of the Lake of Como, which is the building stone of Milan cathedral is a good instance of coarse-grained marble, and sometimes it acquires a slaty fracture from the admixture of mica or talc and passes into *dolomite* from the presence of magnesia

Before we quit these rocks there is one remarkable feature which belongs to them and others and which may now be adverted to, though its *cause* will perhaps be more evident hereafter, namely, the singular contortions to which they are subject The strata of slate, for instance, are often waved to a greater or less extent, and sometimes an entire bed affects a serpentine irregularity which gradually merges into a straight line above and below These contortions are sometimes, to all appearance, independent of any other kind of rock Sometimes they are apparently caused by veins of a granitic, porphyritic or basaltic character, invading the slate as it were from below, and bending it into various irregularities, or sometimes merely dislocating and breaking its strata as if, in the one instance, it had acted upon soft, yielding, and unconsolidated matter, and in the other, as if it had been violently protruded into the surrounding strata of an already hardened mass These contortions are not peculiar to the slaty rocks, they may also be seen in the newest and in the oldest formations, varying infinitely in their forms and dimensions They have sometimes misled geologists as to the relative positions or conformity and nonconformity of alternating rocks, so that it requires great care, though at first sight it may appear extremely easy, to determine whether one rock rests on the upturned edges of another or not

In taking leave of the stratified rocks, we lose sight of

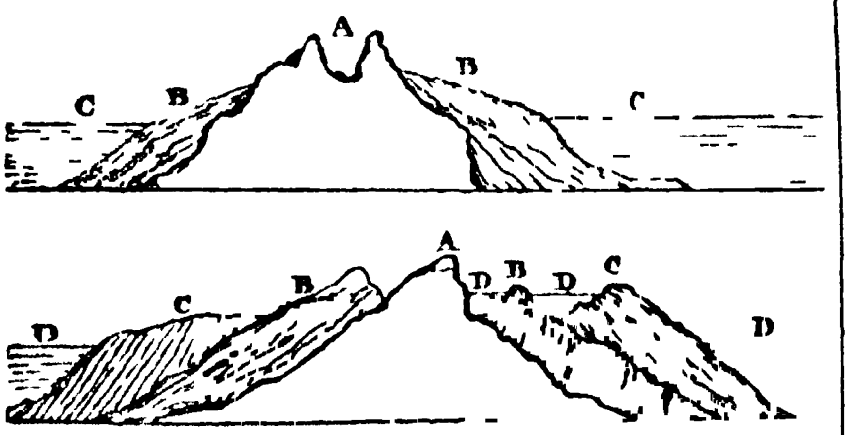
that regularity of superposition which is of so much use in assigning to them the [illegible] which [illegible] such [illegible] and the circumstances of [illegible] been deposited

Their minute examination shows the caution with which certain theories connected with them require to be received The gradual transitions of one kind of rock into others on the one hand, and their sudden and abrupt lines of demarcation on the other, their verticality in one place, and their horizontality in others, their occasional resemblances and frequent dissimilarities, are circumstances which will lead the unprejudiced observer to receive all geological hypotheses with the utmost circumspection Another important point relates to the dissimilar texture and contents [illegible] the same series, but occurring [illegible] countries thus the *equivalent* of our chalk is a granular limestone in part of the Alps, and here, as in other cases, it is the identity of the organic remains that determines the geological era

We have now then arrived at the crystalline, massive, and unstratified rocks, which seem to form the bases or foundations upon which the others have been deposited They have therefore been called *primary* or *primitive rocks*, and as they are destitute of organic remains, they were regarded at one time as [illegible] the superincumbent strata but the progress of inquiry has led to a very different view of the origin and antiquity of these rocks, [illegible] an igneous orig[illegible] formed at different epochs, they are often of more recent production than the older stratified rocks, and even sometimes of a date subsequent to those depositions which form the tertiary series

Upon this subject the theories of M de Beaumont have excited much attention He assumes that the different mountain chains of the world have been thrown up at different geological periods, that each great chain runs in a certain uniform direction, and that their relative dates of protrusion may be ascertained by their effects upon the sedimentary strata If for instance, we find [illegible] crystalline rock on all sides surrounded [illegible] horizontal sedimentary deposits, we infer the deposition of the latter *subsequent* to the former But if we find the sedimentary deposits *upheaved* by the crystalline rocks we then infer the posterior date of the latter, and if other horizontal sedimentary deposits lie upon the upraised series, another geological date is obtained as respects them

The [illegible] will perhaps assist the illustration [illegible] De B[illegible] theory A may represent a chain of granitic rocks, and B, C, and D the incumbent rocks or strata From the dislocated and inclined position of B, and the horizontal and undisturbed state of C, it may be presumed that the chain A was elevated subsequently to the existence of B B, but before the deposition of C C On the other hand, in the lower figure, C C have also been elevated, whilst D D are undisturbed, whence the inference that in this diagram the chain A is of a later date here D D represent the undisturbed or horizontal deposits




Reasoning upon such grounds, it has been attempted to prove that the great mountain chains of the earth are of various dates, some formed prior to and others subsequent to their secondary or sedimentary neighbours Thus also, if we assume that these great crystalline masses have been thrust up from below, may we account for the elevation of rocks abounding in organic remains Whether these mountains have been *suddenly* or *gradually* up[illegible] other by Mr Lyell According to De Beaumont, there have been long periods of repose in the history of the earth, during which the deposition of sedimentary matter has gone regularly on, and there have been short periods of violence, during which that continuity was broken by the sudden formation of great mountain chains It is supposed that all the chains thrown up by a particular revolution, or at one time, are nearly parallel, but that those thrown up at different periods have different directions, so that they sometimes cross each other that, therefore, there has been a recurrence of these paroxysmal movements from the remotest geological periods; and, of course, that they may still be reproduced, and break the present repose of our globe It is presumed that the latest of these revolutions (even within the historical period) was that which upraised the Andes, for that chain is the best defined and least obliterated feature in the present exterior configuration of the globe, and as the instantaneous appearing of such enormous mountain masses must have caused a prodigious agitation in the waters of the ocean, it is probable that a deluge was one of its effects, and, lastly, as common volcanic powers are apparently inadequate to these successive revolutions, they are assumed to depend upon the secular refrigeration of the interior nucleus of our planet causing a fracture of the outer crust, and the consequent spirting out as it were, of some of its interior contents

There is much that is imposing and to all appearance satisfactory, in parts of this bold theory, but the question is, how far is it strictly consistent with facts? Have we any evidence of such frightful convulsions? are they consistent with what we actually know of the earth's structure? are they in accordance with present phenomena? or can we frame any other theory equally applicable, and less at variance with the changes now in progress, and with [illegible]? These are questions [illegible] self to, and which involve the effects of existing [illegible] of decay and reproduction [illegible] the earth, and to which we shall allude afterwards they are discussed at length in his valuable work which we have already so abundantly quoted — his *Principles of Geology*

Proceeding in the retrospective survey of geological monuments, from those of recent to those of more ancient date, we have traversed a series of strata, each characterized by their relative positions in respect to the others, but more unequivocally distinguishable into regular epochs of formation by their organic relics These we have found gradually to diminish, and ultimately to disappear, the rocks slowly losing their sedimentary character and appearing as crystalline aggregates, and consequently as products of chemical rather than of mechanical action

The formations at which we have now arrived include granite, and its associates greenstone and basalt, and from these more ancient substances we pass by regular analogies to a variety of evidently volcanic products, — some of remote antiquity, others formed within the historical period How this interesting series of rocks are thus connected into one group, and what the evidences are of [illegible] sedimentary [illegible] central [illegible] the same time passing down and forming the interior parts of the crust of the earth, they were once, as already stated, called *primitive rocks*, and regarded as having been formed anteriorly to the others, but the more close examination of their relations to the sedimentary deposits just adverted to, and of the changes which they have effected upon them, have induced modern geologists to reject such an hypothesis, and to consider them as of a later date, varying, however in this respect among themselves, and hence divided into *ancient* and *recent* groups, or *plutonic* and *volcanic* formations

[illegible] in a liquid or semifluid state from below by processes analogous to those exhibited by the volcanos and earthquakes of present times, has been by some regarded as a bold but improbable conjecture, and as outreaching in improbability many of those theories which have been unanim[illegible] sufficient But when [illegible] the rocks which compose them, and their influence upon those which they invade and elevate, and examine the vast powers of existing volcanos, the enormous quantities of matter which they have ejected, the force with which they act, the upraising power of earthquakes as manifested within the historical period, and their evident connection with volcanic phenomena, and more especially when these forces are considered as operating under the great pressure of a superincumbent ocean, we find a connected series of facts and analogies which justify the conclusion We may here examine the rocks in question, and the evidences which they bear of a distinct formation, reserving the history of contemporaneous volcanic phenomena, and of the effects of earthquakes, for a subsequent section

The first circumstance which [illegible] ations is the height to which [illegible] mentary rocks In Britain, Ben Nevis and Cairngorm, in Inverness-shire, are between 4000 and 5000 feet above the level of the ocean, Mont Blanc is between 15,000 and 16,000 feet above the same level, and is the highest

mountain in Europe, Soxate, the highest summit of the Andes from 24 000 to 25,000, and the highest peak of the Thibet chain 26 000 to 27,000 feet

[illegible] into which it merges, either from the predominance of one or other of its ingredients, from the loss of one or [illegible] from the occasional addition of some [illegible] may also include in this division of rocks those substances which are their occasional accompaniments

When mica abounds, granite passes into *gneiss*, and when the felspar is nearly or altogether wanting, it forms *mica slate*, and this again often passes into *quartz rock* from the scantiness or absence of mica These would seem to be sedimentary rocks gradually passing into granite They may be traced upon the one side into clay slate, and into granite on the other *Hornblende*, which is an alumino-silicious mineral containing magnesia, and abundant in black oxide of iron [illegible] matic crystals, is often intermixed with [illegible] sometimes with felspar only, forming *syenite* and *syenitic rocks*, and when crystals of felspar are as it were embedded in massive felspar, the rock is called *porphyritic* [illegible]

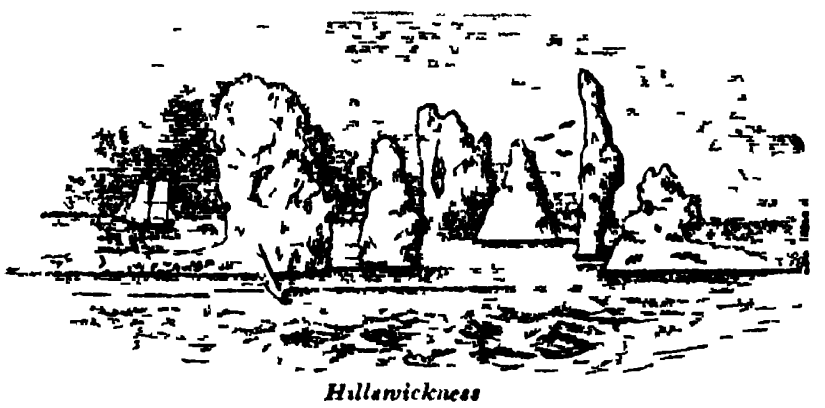
[illegible] granular or crystalline marble amidst these rocks has already been mentioned Respecting its source there is room for difference of opinion, but it possibly may have been fossiliferous limestone the organic relics of which have been destroyed by the heat which conferred upon it its semicrystalline form and it has been proposed to account, upon the same principle, for the absence of organic relics in the slaty rocks of this series

*Serpentine* is a rock which it is somewhat difficult to define Hornblende, schiller spar or diallage and felspar and perhaps [illegible] be essential to its constitution, and [illegible] distinctly visible while at others the rock is so fine-grained as to be nearly homogeneous Its variety of colours (whence its name) recommends it for ornamental purposes, but it is too soft to admit of a permanent polish *Talc* forms inclastic laminæ soapy to the feel, and differs little from *steatite*, which often pervades serpentine in veins

Such are the varieties of the granitic group, the *hypogene rocks* of Lyell (from ὑπο *under* and γινομαι *I am formed*) that is, nether-formed rocks he calls the stratified rocks of this class *metamorphic*

The largest granite tract of England is that of Devon and Cornwall, where its sides are covered by slate but where it rises in several places to the surface, it also forms the rocky promontory of the Land's End There is here nothing either picturesque or sublime belonging to the granite formation Dartmoor appears the head quarters of dreariness and desolation, forming a large mountain tract of nearly 80,000 acres in extent strewed with boulders and fragments [illegible] set cultivation at defiance This granite nowhere of any considerable elevation, its highest point, near Okehampton, is 2070 feet

The peculiarities of the West of England granite are best seen at the Land's End where a large patch of it protrudes in a wedge-shaped promontory It appears formed of fragments and masses placed upon each other in the rudest disorder and sometimes in fantastic piles and insulated blocks, which, though arising from the peculiar manner in which the rock is decomposed and dislodged by the weather, have been mistaken for Druidical remains These *tors*, as they have been called have been described by Dr M'Culloch (*Geol Trans*) and some of them are depicted in the engravings annexed to his paper One, called the *Cheesewring*, near Liskeard consists of five blocks, of which the upper are larger than the lower, the whole pile being about 15 feet high The stones composing this and other similar piles suffer by the action of the weather most rapidly upon their edges and angles which gradually become rounded and the blocks then begin to totter and ultimately fall This tendency of square blocks to become spheroidal, and which has sometimes been mistaken for the effect of friction, shows that attrition and transportation by streams are not always essential to their rounded appearance The celebrated *Logging stone* well exhibits the tendency of this kind of granite to cuboidal separation Some of the Shetland Isles present magnificent specimens of the wear and tear of granite On the west of Yell Sound the softer veins have mouldered away, while the firmer rock which included them has remained unaltered, and in this way long narrow ravines are laid open which give access to the waves The singular cluster of rocks at Hillswickness,



*Hillswickness*

which has been compared, when seen at a distance, to a small fleet of vessels [illegible] instance of granitic [illegible] of its permanence [illegible] an ocean which would long ago have consigned softer materials to utter destruction

There are, however some varieties which decay with comparative [illegible] of the Highlands [illegible] of that [illegible] turbid by the pulverulent felspar that comes from the *Aiguilles de Chamouny* and other points that border the *Mer de Glace* The road across Dartmoor from Ashburton to Chagford traverses, in one place such loosely compacted granite as to resemble a bed of gravel The granite of the Carglaise mine near St Austle, is so soft [illegible] ities of white porcelain earth as it is called is of similar origin [illegible] apparently derived from the perishable nature of the felspar which in giving way suffers the grains of quartz and mica to fall out Chemical analysis points to the loss of the alkali of the felspar as the cause of this extreme proneness of some kinds of granite to decay Independent however of chemical composition mere mechanical texture and the general aggregation of mountain masses have much to do with their relative durabilities When the arrangement of granite resembles that prevalent in the greater part of Cornwall water gradually penetrating between the blocks and masses freezes there, and thus slowly removes or transfers them to unstable ground, while the more solid texture of other varieties of granite denying the access of water to its fissures, is slower in suffering the decay referable to that powerful cause

Gneiss and mica-slate often form mountain masses in association with each other and with the varieties of granite The former is seen singularly contorted upon the coast of Lewes and mica slate rock is associated with the serpentine of Cornwall and is seen in great perfection among the Scotch granitic scenery more especially in the vicinity of Dunkeld, and in extraordinary magnificence in the lofty mountain of Benmore Ben Lawers, on the north of Loch Tay and many of the neighbouring mountains furnish highly instructive specimens of granite passing into gneiss mica slate and chlorite-slate About three miles south of Dunkeld a stratum of grauwacke is seen incumbent upon chlorite-slate gradually passing into a fine gray roofing slate and this recumbent upon mica-slate The peculiar and differing dip of the respective strata the singular manner in which they are pierced and traversed by veins of felspar and quartz, and their association with micaceous iron are circumstances highly interesting in respect to the origin of hypogene rocks, and the beauty and [illegible] district in regard to scenery is not less [illegible] geological peculiarities

Mica-slate abounding in garnets and often sprinkled with red patches originating in their decomposition and becoming syenitic from the interspersion of hornblende, is prevalent upon the banks of the Tay and about Dunkeld but it is in Glentilt that the geologist both practical and theoretical will find the most ample materials for the study of the association and junctions of this series of rocks

In [illegible] of Blair, the Tilt exhibits [illegible] the rocks forming [illegible] bed, and the micaceous strata here and at the falls of the Bruar incline nearly at the same angle to several points [illegible] glen we observe granular limestone in the midst of the granite, which sends forth so many veins as to *reticulate* the slate, and often there appear to be detached fragments of granite in the limestone and shistose rocks

There are other places in which analogous peculiarities of granite and its associates may be observed, for instance in St Michael's Mount, upon the south coast of Cornwall, where the granite not only graduates into mica-



*Cheesewring*

slate, but the latter is traversed by granite veins which appear to break and indurate it [illegible] rocks are com- [illegible] and The Malvern Hills, Mount Sorrel in Leicestershire, and a few of the ridges of Cumberland and [illegible] cimens of these rocks In th [illegible] Anglesey granite is associated with clay-slate, and near Gwindy in Anglesey the points of granite curiously protrude from beneath the slate

In reference to the origin of granitic rocks, it appears almost impossible to reject that theory which regards them as having been formed by the [illegible] fusion of sedimentary rocks, while it cannot be [illegible] peculiar circumstances must have conspired in conferring upon these formations their distinct and peculiar characters Their analogy to basalt greenstone, and trap will presently be noticed and the close resemblance of the latter to existent and contemporaneous volcanic products traced out But then why is not granite formed by our present volcanos? or why are more modern lavas so distinct from these ancient rocks? The probable cause of the difference lies in the circumstances under which the subterranean fusions have been effected, in the case of granite, probably under *great pressure*, and out of the contact of air and water What is now going on at great depths, and under the pressure of fused masses and a fathomless ocean, it is impossible actually to ascertain and analogy only can guide us but the circumstances just mentioned appear essential to the formation of highly crystalline rocks and the extremely slow cooling of these fused masses would also favour many of their peculiarities In demanding this liquefaction and gradual refrigeration the plutonic geologist has often been sneered at for the exorbitancy of his postulates but the great length of time which lava streams require to cool even in the open air, justifies the conclusion The melted matter poured out of Jorullo in Mexico in 1759 which accumulated in some places to the height of 550 feet retained a high temperature for fifty years after the eruption For what immense periods then may not great masses of subterranean lava remain red hot and how gradual must be the process of their refrigeration! This process, indeed may be retarded for an indefinite time for the lava in the crater of Stromboli has been in a state of constant ebullition for the last 2000 years and this mass of fused matter must of course communicate with some great reservoir below In the Isle of Bourbon also where there has been an eruption every two years for a very long period the lava below must be in a state of permanent liquefaction In adverting to the effects of long continued fusion upon earthy and alkaline compounds and to the various textures and characters of rocks which may thus result from the liquefaction of similar materials sometimes producing distinct crystalline aggregates at others more homogeneous products we are sanctioned by the result of actual experiments, and although our artificial products are necessarily formed upon a scale of trifling [illegible] in nature as compared with the natural ones we sometimes obtain texture [illegible] and unexpected results — to such an extent that it is impossible by any *a priori* reasoning to determine what new mineral products may not be obtained by the varied effects of heat upon components little dissimilar

When therefore, melted matter is injected into the fissures of a contiguous rock, it may either cool *rapidly* if that rock had not previously acquired a high temperature, or if it had it may continue for centuries at a high temperature, and consequently attain various textures, and present a variety of distinct minerals

We have already stated what our means are of judging of the relative ages of these rocks Some of the granitic chains appear to be of great antiquity antecedent to the secondary and tertiary rocks though perhaps there may be a few cases in which they are apparently contemporaneous It is also probable that they are constantly in a state of *production* perhaps to be upheaved at some future period by operations which we shall afterwards endeavour to unravel

From granite and its associates we pass to a class of rocks often designated as the *trap formation* including whinstone, basalt greenstone &c They are apparently of igneous origin, and approach in many instances very closely in their effect and character to the lavas of contemporaneous volcanos

The term *trap rock* has been especially applied to those *step-like* or scalar declivities which mountain masses of this substance sometimes present In employing this term, we shall rather [illegible] the rocks in question, than as [illegible] materials of which they are composed, and since the varieties known [illegible] basalt, toadstone whin, [illegible] ng to this same class and [illegible] these terms may be occasionally employed as characterizing individual specimens of [illegible] fine-grained homogeneous rocks, the [illegible] varieties which especially occur [illegible] approximate to the [illegible] consist of granules of calc-spar, quartz [illegible] and *toadstone*

The general character of these rocks is that they appear to be [illegible] stratified deposits of all dates, and among the oldest and newest rocks sometimes graduating through greenstone and hornblende rocks into varieties closely connected with granite, at others degenerating, as it were, into substances closely resembling the lavas of existing volcanos When they assume a stratified character, it arises from their apparent injection in a state of fluidity amongst other rocks, or from having been subjected to peculiar laws of action whilst cooling, and where they come into contact with other rocks, they often fill their [illegible] or alter [illegible] cords of their igneous origin — converting chalk into marble, coal into cinder or coke, sandstone into chert and jasper, and the veins themselves present different textures, dependent on their bulk or breadth, and upon the greater or less rapidity with [illegible] ed The following may [illegible] of the aspects, characters and situations of trap rocks — Under the name of greenstone it is seen in characteristic masses, associated with the granite, mica-slate, and serpentine of the Lizard Point in Cornwall Near Kington and Padnor in Wales, it accompanies clay-slate and old red sandstone, and upon the northern side of Snowdon, Plynlimmon, and Cader Idris coarse grained and with regular crystals of hornblende prone place, and in another fine [illegible] In D [illegible] associated with mountain limestone, and with new red sandstone or red marl in the coalfields of the north of England and elsewhere In Antrim we find it variously blended with the sandstone and chalk and even sometimes superior to the newest secondary formations These instances will serve to show the varied *position* of these rocks In regard to their *aspects*, we observe them in Cornwall forming blocks and masses, not unlike the granite of the county Sometimes as in the coalfields it forms immense walls or dikes, and even axes of elevation, sometimes as in Derbyshire it has the *appearance* of stratification In the Isle of Mull and elsewhere it is massive and amorphous and in many places it is columnar, of which the coast of Antrim, the island of Staffa, and some parts of Mull furnish such magnificent instances The Isle of Mull Ulva and the Treshamish Isles exhibit trap rocks and veins in the greatest variety, and the veins of the Isle of Sky are not only remarkable for their singular extent and arrangement, but for the changes they produce upon the rocks they penetrate, and which are of such a nature as to throw some few rays of light upon the most recondite chemical phenomena connected with geology Two of the veins penetrate the white marble of Strath At their junction the trap passes into a substance resembling serpentine and is penetrated by fissures containing steatite, while the marble acquires all sorts of colours and changes in composition, from argillaceous to magnesian and from magnesian to silicious In other parts the trap veins exhibit the several varieties of greenstone basalt and amygdaloid

The island of Staffa is one of the most celebrated basaltic monuments of the world it is about a mile and a half in circumference, and its greatest elevation which is upon its north-west side is about 144 feet Its lowermost bed upon that side is a basaltic conglomerate The columns are compact and uniform in texture, dark greyish-black interiorly, and rusty brown where exposed to the weather Amorphous and columnar basalt and a stratum of pebbles foreign to the island form its upper portion



Fingal's Cave

Fingal's Cave is justly considered as the most beautiful of ocean caverns, and owes its existence to the circumstance of the columns being jointed in that place, while their general character is to be without divisions, hence the successful invasion of the waves in this particular quarter The entrance is 70 feet high and resembles a Gothic arch, the width 40 to 50 feet, the length 227 feet Its interior preserves a considerable degree of regularity throughout, its sides being columnar, and in many places broken and irregularly grouped, so as to catch a variety of direct and reflected tints, mixed with unexpected shadows, and producing a picturesque effect which no regularity could have conferred The sea never entirely ebbs out of this cave but the broken range of columns which forms the exterior causeway is continued on each side within it "This cave, says Dr M Culloch, 'has been frequently described, but no description is adequate to the representation of its varied beauties and singular associations

If it [illegible] richness [illegible] greatness of dimensions and simplicity of style which it possesses [illegible] the prolonged length the twilight gloom half concealing the powerful and varying effect of reflected light the echo of the measured surge as it rises and [illegible] the pellucid green of the water in the profound [illegible] sole tint of the whole scene, could never fail vividly to impress any mind alive to the wonders and beauties of nature" Mackinnon's Cave and the Boat Cave in the [illegible] grandeur and interest

The Causeway itself consists of three piers of columns, which extend into the sea, and are walled round as it were by precipitous rocks from 200 to 400 feet high, in which are several striking columnar assemblages, vertical, inclined, curved [illegible] like wedges driven in [illegible] pice Bengore, which bounds the Causeway on the east, consists of alternate ranges of tabular and massive with columnar basalt Pleskin presents several colonnades of great height and [illegible] separated from each other by tabular basalt, [illegible] there is a range of columns from 200 to nearly 300 feet in height, supported by a steep declivity which forms a terrace nearly 600 feet above the level of the sea beneath

Sometimes basalt rises in massive and abrupt rocks, [illegible] dency to columnar regularity which we have just had occasion to admire in Staffa and the Causeway The castles of Dumbarton, Edinburgh, and Stirling are built upon such masses At other times it forms low, rugged, and unpicturesque strata, sometimes remarkably bent, but without forming decided columns

We have already noticed the effects of these rocks upon their neighbours, and upon the strata which they penetrate and invade As these involve a variety of important theoretical considerations it will be proper to consider them a little more in detail

In describing the effects of the intrusion of granite into the superincumbent slates and stratified rocks we noticed the fragments that occ [illegible] veins, their induration, and [illegible] violence, and in the veins and dykes of basalt we meet with precisely similar effects Near Edinburgh the sandstone is hardened and rendered like jasper by the whin dykes, and loose pieces are occasionally seen to have been floating as it were in the fused basalt In Antrim the limestone is sometimes [illegible] and the dykes as they traverse [illegible] of marble, and the neighbouring flints are reddened In coal mines those accumulations of carburetted hydrogen gas which form what are called th[illegible] to have resulted from the action of [illegible]

In addition to this evidence, we have some of a chemical nature, which is not less decisive, and it is to be regretted that such experiments have not been extended

The first great experiment of this kind was made by Mr Gregory Watt, he fused 7 cwt of fine-grained basalt and suffered the fused mass [illegible] so that the whole process lasted eight [illegible] after fusion was three feet and a half long, two feet and a half wide, eighteen [illegible] other [illegible] places there were aggregations of spheroids of a radiated texture, not unlike the globular structure exhibited by some kinds of decomposing basalt, and occasionally forming by their mutual pressure a tendency to prismatic or columnar arrangement

In glass which has been slowly cooled we occasionally observe somewhat similar and highly interesting effects, its texture [illegible] and crystalline [illegible] rangement of its molecules And, lastly, certain sandstones and clays may assume in some instances a columnar texture by the [illegible] long-continued heat short of fusion Dr M'Culloch observed in a hearthstone of an old furnace which had been in constant work for 18 years, that a prismatic structure extended through its whole mass, and he thus explains the occasional columnar structure of sandstone when in contact of basalt, and in regard to some kinds of basalt itself, he observes that its frequent amygdaloidal structure proves that it was originally [illegible] cells having been [illegible] ion of the various substances found in them It is a mere dispute about terms, therefore, to refuse to these ancient eruptions the name of *submarine volcanos*, for such they are in every essential point, though they no longer eject fire and smoke

The examination of the igneous rocks of Sicily has proved that all the ordinary varieties of trap have been produced under the waters of the sea, since the Mediterranean has been inhabited by a great proportion of the existing testaceous species. "We are therefore entitled to feel the utmost confidence that if we could obtain access to the existing bed of the ocean, and explore the igneous rocks poured out within the last 5000 years beneath the pressure of a sea of considerable depth, we should behold formations of modern date scarcely distinguishable from the most ancient trap rocks of our island We cannot, however, expect the identity to be perfect, for *time* is ever working some alteration in the composition of these mineral masses, as, for example, by converting porous lava into amygdaloids"

## § III

We have now examined the structure of the crust of our [illegible] of a succession of sedimentary [illegible] characterized by peculiarities of mineral structure and composition, and by distinct organic relics, upheaved and displaced by a series of crystalline rocks apparently of igneous origin, and in many instances [illegible] in composition and effects to the products of existent volcanos

These must be now more particularly examined, for the purpose of ascertaining how far we are justified in attributing to [illegible] agents those stupendous powers of elevation [illegible] which the theory of the crystalline or hypogene rocks has obliged us to call to our aid The extent of volcanic fires, their connection with earthquakes, the nature of their products their usual effects, and their modified action under the influence of pressure, are the principal points now requiring attention

The geographical extent of volcanic districts is very considerable and demonstrates the universality of subterranean fire in all quarters of the globe It is true that the points of eruption and the movements of great earthquakes are confined to certain regions in which the volcanic vents are distributed at intervals, and most commonly in a linear direction, but there is abundant evidence that the igneous powers are at work continuously throughout the intermediate spaces, for the [illegible] is from time to time convulsed, gases and [illegible] engaged and hot springs issue, the waters of which are very commonly impregnated with the same mineral matters which are discharged by the eruption of the volcano

There are also abundant proofs of the existence of volcanic fires under various parts of the bed of the ocean where their effects, though at present unseen and unknown, are probably destined to become evident at some future but very remote period

The substances thrown out by volcanos are chiefly earthy and alkaline bodies in a state of fusion masses of red-hot and melted rock, stones, cinders, ashes steam [illegible] ter, their product [illegible] are doubtless all [illegible] What that cause is, is a question which has long been agitated but is as yet not very satisfactorily determined, although considerable advances have been made towards an explanation of the phenomena by those great discoveries in chemistry which bear the stamp of Davy's name, and which have taught us the existence of a class of bodies possessed of previously unknown and unsuspected properties, and which are in some respects applicable to the solution of the problem before us

These bodies are the metallic bases of the alkalies and earths, many of which, the moment that they touch water, explode, burn melt, and become converted into red-hot matter, not unlike some sorts of lava

It has been said that if we adopt the existence of great masses of [illegible] within the [illegible] that they would remain inactive without water, consequently that the access of water is a necessary condition We find, in fact, that many of the great volcanos of the world are not far from the sea or from lakes, but it must also be admitted that there are great volcanic districts to which water has no apparent access In central Asia there is a volcanic district, with an area of nearly 3000 geographical miles, between 300 and 400 leagues distant from the sea The central chain of the Andes too is at a great distance from the sea, and yet has several active volcanic vents. But we know too little of the interior of our globe, of what hidden waters it may contain, or what may be the subterranean communications of the ocean, to justify us in excluding this theory upon such grounds, were it otherwise satisfactory and accordant

[illegible] and as hydrogen is very rarely traced as a product of volcanic eruptions, its absence has been urged as fatal to this theory But upon this point we are also not well informed, the hydrogen may be evolved, and yet its presence not determinable, or, if evolved at a high temperature and in the contact of air, it would burn probably with explosion, and reproduce water Now aqueous va-

pour is often ejected with explosive force from volcanos, and this sudden generation of steam, in part perhaps resulting from the explosive union of hydrogen and oxygen, m [illegible] and of [illegible]

I[illegible] properties of these singular metals which ar[illegible] and may yet play an active part where their mutual affinities are concerned In certain proportions sodium and potassium form an alloy liquid at water, highly inflammable, and when touched by certain other metals, mercury for instance, becoming red hot and explosive Now these properties, curious as they are may possibly belong, in a yet more eminent degree, to certain alloys and other compounds of the metallic bases of the earths, for we know as yet little of the chemical properties of these bodies, and it may be presumed, upon strict analogy, that there may be other agents of similar kind, and gifted perhaps with yet more energetic powers for who could even have ventured to imagine the existence of such remarkable bodies as potassium and sodium before their discovery? So that upon the whole, if we cannot frame a perfect theory of volcanos upon these chemical principles the[illegible] power and [illegible] matter [illegible] of heat [illegible], it will appear from the details we are about to enter upon One difficulty, however we are certainly not prepared to meet, namely, the perpetuity, as it may almost be called, of some active volcanos,—volcanos which have continued to burn and throw out lava and cinders not only for years, but for successive ages The lava in the crater of Stromboli has been in a state of ignition for 2000 years, so that there must here be a constant accession of heat, if not renovation of fuel

We have ample evidence of the connection of earthquakes with volcanos, and all great eruptions have commonly been preceded by violent convulsions which have ceased upon the bursting forth of the volcanic fires as if the pent-up matters had found a vent All this shows the *cause* of the eruption to be deep below the surface, and perhaps sanctions the notion of the existence of great masses of ignited matter below the rocks that form our mountains, or even the idea of some of the ancient as well as modern geologists, that the interior and nucleus of the globe is in a state of most intense incandescence,—an idea already alluded to when noticing the evidences of change of climate deduced from the examination of fossil plants Another fact in reference to this view deserves notice, namely, that there is a very manifest connection between volcanic vents situated at great distances from each other Such a connection has been suspected between Vesuvius and Etna, and some of the volcanos of the Andes appear to alternate in their eruptions, though at great distances from each other

When lava is examined as near as possible to the vent whence it issues it is usually a semifluid mass about the consistence of honey It soon cools externally and its surface becomes rough and irregular, but being a very bad conductor of heat, the interior remains red-hot long after the surface has cooled It is probable that large masses of lava ejected into the sea retain their high temperatures in the central parts of the mass for a great and even indefinite length of time

The *quantity of matter* which has been thrown to the surface by volcanic agencies during the historical period is very enormous, and may serve to give an idea of their influence in modifying the surface of the globe, when such powers are considered in reference to great periods of time In illustration of this point we may select the volcanos of Iceland, because our details respecting them are well authenticated, though it must be recollected that they probably fall into insignificance when compared with what has happened in some of those districts of Asia and South America which are ravaged by subterranean fires In the following sketch of these volcanic districts we shall avail ourselves as hitherto of Mr Lyell's excellent abstract of [illegible] given in his *Principles of Geology* [illegible] else than a mass of lava, and so [illegible] of volcanic action in that region [illegible] Hecla have lasted six years without ceasing Earthquakes have often shaken the whole island, causing a complete revolution in its geographical physiognomy, such as the rending of mountains, the elevation of some and the sinking down of others, the desertion by rivers of their channels, and the appearance of new lakes Upon the coast too, and in great depths of water, new islands have been thrown up, some of which have remained and others disappeared In this island too, the volcanic vents are often in alternate action, one serving, as it were, for a time as a safety valve to the rest, and when, as is often the case, new cones are thrown up, they generally take a linear direction In 1783, a new island was thrown up off the coast, consisting of high cliffs, and with such an ejection of pumice, that the ocean was covered to the distance of 150 miles, and ships impeded in their course by the shoals of floating stones Ere a year had elapsed however the sea resumed her ancient domain, the volcanic cliffs had disappeared, and nothing was left but a rocky reef from 5 to 30 fathoms under water In June, Skaptar Jokul [illegible] from the new isles, threw out a torrent of lava which [illegible] place flowed down into the river Skapta, and completely dried it up, its channel was between high rocks, and was in some places 400 to 600 feet deep and 200 broad Not only did the lava fill these great defiles up to the brink but overflowed [illegible] and filled up a deep lake [illegible] to the eruption but in a few days it was resumed and the newly ejected lava flowed rapidly over the surface of the first, and damming up numerous streams, deluged the neighbouring country with water, and destroyed several villages,—when, after flowing for several days, it was precipitated down a tremendous cataract, and filled the profound cavity which the waterfall had been hollowing out for ages Afterwards the lava took a new direction, and discharging itself into the bed of another [illegible] occasioned a scene of destruction [illegible] the lava accumulated to a great [illegible] the plains spread out into broad lakes of fire, some of which were from 12 to 15 miles wide and 100 feet deep When the fiery lake which filled the valley of the Skapta had been augmented by new supplies, the lava flowed up the course of the river to the foot of the hills where it rose This eruption continued two years, and when Mr Paulson visited it eleven [illegible] the lava was still smoking, and [illegible] water Although the population [illegible] exceed 50,000 twenty villages were destroyed exclusive of those inundated by water, and all the cattle of the district, and more than 9000 human beings perished

We have quoted the narrative of this eruption as giving upon good authority some notion of the *enormous volume* of melted matter produced Of the two beds of lava and they flowed nearly [illegible] to the [illegible] one was 50 and the other 40 miles in length the extreme breadth of one branch was from 12 to 15 and of the other about 7 miles The ordinary height of the currents was about 100 feet but in deep ravines and defiles they sometimes attained 600 feet How striking a feature Mr Lyell remarks, would these streams form in the geology of England had they been poured out on the bottom of the sea after the deposition, but before the elevation of our secondary and tertiary rocks! and how easily may we now refer the trap and basaltic rocks to similar causes!

But there are some phenomena connected with volcanic action which seem to be caused by yet more extraordinary agents than those we have adverted to namely their *great projectile and explosive force*—the effects of which are in some instances upon so stupendous a scale as to appear utterly incredible, had we not the clearest and most unobjectionable evidence Let us select one or two illustrative relations, and then see how far we are acquainted with any powers or agents in nature adequate to explain the results

From the era of the discovery of the New World to the middle of the last century the great volcanic [illegible] of Mexico had remained [illegible] It stretched a plateau between 2000 and 3000 feet above the level of the sea, and bounded by hills of ancient igneous origin It was occupied by fields [illegible] by two brooks [illegible] quakes preceded the bursting forth of flame from the ground and fragments of red-hot rocks were thrown to prodigious heights A great chasm was formed, from which six volcanic cones were thrown up the least of which was 300 feet high, and Jorullo, the central volcano, was elevated 1000 feet above the level of the plain It sent forth streams of basaltic lava [illegible] fragments of granitic rocks and its [illegible] to 1760 Humboldt visited the country forty years afterwards there then appeared round the base of the cones, and spreading from them over an extent of four square miles, a convex mass of matter between 500 and 600 feet high, gradually sloping in all directions towards the plains and which was still so hot that he [illegible] in one of its fissures It was covered with [illegible] of little mounds which emitted *steam and sulphuric acid* The two small rivers lost themselves below the east extremity of the pla[illegible] s hot springs at its western limit [illegible] the convexity of the plain to inflation from below supposing the ground for the extent of four square miles to have puffed up like a bladder to the elevation of 550 feet in the highest part, but of this there seems no good evidence except the hollow sound made by the steps of a horse upon the plain, and this might result from any porous material A subsequent eruption of Jorullo happened in 1819, and it is much to be regretted that no European travellers have since visited the spot It is known however, that ashes fell in Guanaxato, 140 miles from Jorullo, in such quantity as to lie 6 inches deep in the street, and the tower of the cathedral was thrown down [illegible] matter from below, and thr[illegible] lofty mountains, we have numerous other instances, and in

further illustration of their great power may cite the elevation of islands in deep water by submarine volcanos Those off Iceland have been already noticed In 1811 a volcano forced its way from beneath the sea off the island of St Michael one of the Azores forming a crater above the water a mile in circumference, and about 300 feet high In the middle of the 17th century an island was thrown up among the Hebrides, which in a month again disappeared In July, 1731 a volcano rose in the sea between the island of Pantellaria and the coast of Sicily, forming a crater 240 feet diameter and 20 feet above water Many shoals are no doubt of volcanic origin

The Pacific ocean, in equatorial latitudes, seems to be [illegible] and Georgia [illegible] here and there interspersed Of such a formation Owhyhee is a magnificent example The whole mass, estimated as exposing a surface of 4000 square miles, is composed of lava, the highest peaks of which are between 15,000 and 16,000 feet above the level of the sea The crater of Kirauea is described by Mr Ellis as situated in a lofty elevated plain, bounded by a precipice 15 or 16 miles in circumference, apparently sunk from 200 to 400 feet below its original level The surface of this plain, he says, was uneven, and strewed over with loose stones and rocks, and in the centre of it was the great crater At the edge of it a sublime and appalling spectacle presented itself — an immense gulf in the form of a crescent, about 2 miles long and 1 wide, and apparently 800 feet deep, yawned beneath, the bottom was covered with one vast flood of burning matter in a state of terrific [illegible] to and fro its fiery surge and flaming [illegible] conical islands as it were forming as many distinct craters, rose round the [illegible] lake, emitting columns of smoke or [illegible] and several of them vomited from [illegible] streams of lava, which rolled in blazing torrents down their black indented sides into the lake below

We may conclude this part of our subject with a brief notice of one other volcano, namely that of Tomboroo in the island of Sumbawa the account of which we owe to the late Sir S Raffles It began on the 10th April 1815 It appears that a Malay prow while at sea on the 11th was enveloped in utter darkness, and that afterwards passing the Tomboroo mountain at the distance of 5 miles the commander observed that the lower part appeared in flames, while the upper portion was concealed in clouds Upon landing to procure water, he found the ground 3 feet deep in ashes and several large vessels thrown on shore by the concussions of the sea

At the commencement of the explosion the commander of the E I C cruiser Benares, which was at Macassar supposed that there was an engagement of pirates somewhere in the neighbourhood, so closely did the reports resemble those of cannon On the 11th the ship was again shaken, as it was thought by the discharge of cannon At 8 a m on the 12th the face of the heavens to the south and west had assumed a dingy aspect and it became darker than it had been at sunrise A dusky red appearance gradually spread over the heavens, and by 10 it was so dark that a ship could hardly be seen a mile off By 11 the whole heaven was obscured except a small space in the east horizon whence the wind came The ashes now fell in showers, and the appearances were most awful and alarming By noon the light which had lingered in the horizon disappeared and complete darkness ensued At half past 7 the next morning there was a glimmering of light, and objects could just be perceived on deck When day returned the appearance of the ship was most singular, every part being covered with grey dust, which lay in heaps of a foot deep on many parts of the deck On the 13th the vessel left Macassar, and made Sumbawa on the 18th Approaching the coast she encountered an immense quantity of pumice, with numerous burnt trees and logs, and the anchorage was greatly altered, for the vessel grounded on a bank where there had previously been 6 fathoms water The shores were entirely covered with ashes and cinders ejected from Tomboroo, although 40 miles distant The explosions were terrific, and there is evidence of their having been heard in Sumatra, upwards of 900 nautical miles from Sumbawa Lieut Phillips, who was despatched to afford relief to the perishing inhabitants, learned from the Rajah of Saugar that on the 10th of April the fire and flame raged with exhaustless fury, till all became dark from the quantity of falling matter At this time stones fell very thick, from the size of a walnut up to that of two fists Then a whirlwind arose, which destroyed every house in the village of Saugar, tore up the trees, and carried them into the air, together with men and cattle The sea rose 12 feet above its usual levels and swept away all within its reach, including some thousands of the inhabitants

Extraordinary and appalling as these narrations are, they might be greatly extended In 1772 the inhabitants of a district of Java were alarmed by flashes of light [illegible] They took flight but [illegible] thundering reports like cannon The extent of ground swallowed up was 10 miles by 6 Forty villages were ingulfed, and 3000 persons destroyed We have not space to advert to the historical details of Vesuvius and Etna In the Bay of Naples, Monte Nuovo was thrown up in one day, — nearly 500 feet high, and a mile and a half in circumference Of the eruptions of Vesuvius there are numerous and excellent narratives It deserves especial notice in relation to this mountain that before the Christian era, and from the remotest periods of which we have any tradition the volcano was in a state of inactivity, affording no other indications of its volcanic character than such as were deducible from the resemblance in [illegible] like the *extinct volcanos*, as [illegible] day Pliny does not include it in his [illegible] volcanic aspect [illegible] that which it now exhibits, and the sides were covered with fertile fields, and at its base were the populous cities of Herculaneum and Pompeii The first symptom of renovated activity was 63 years after Christ, when an earthquake shook the neighbourhood, and in August, 79, it erupted lava The elder Pliny who commanded the Roman fleet then stationed at Misenum, in his anxiety to get a near view of the phenomena was suffocated by the exhalations His nephew has given a lively description of the scene but has inexplicably passed over the destruction of Herculaneum and Pompeii Indeed, so vague are the narratives long subsequent to that event, that had those buried cities never been discovered, the accounts of their tragical end would probably have been regarded as fabulous Tacitus, the friend and contemporary of Pliny merely says that cities were destroyed, Suetonius is silent respecting them, Martial adverts to their immersion in cinders but the first writer who alludes to them by name is Dion Cassius, who flourished about a century and a half after Pliny We have some interesting historical facts showing that Pompeii and Herculaneum were destroyed by ashes and mud and not by red hot lava When the amphitheatre at Herculaneum was first cleared out ashes were arranged on the steps just as snow would lie had it fallen there the whole superincumbent mass was from 70 to 112 feet deep The foundation of both cities is ancient lava It is curious that notwithstanding the much greater depth of Herculaneum than Pompeii it was first discovered by the accidental circumstance of a well being sunk in 1713 which came directly down upon the theatre, where the statues of Cleopatra and of Hercules were soon discovered

In both cities records have been found commemorating their having been rebuilt after they had been thrown down by an earthquake which happened in the reign of Nero 16 years before the inhumation of the cities Very few skeletons have been discovered in either city, so that it is probable the greater number of the inhabitants escaped carrying with them no doubt the principal part of their valuable effects In the barracks at Pompeii were the skeletons of two soldiers chained to the stocks and in the vaults of a villa in the suburbs were the skeletons of seventeen persons who probably fled there for safety they were found enclosed in indurated tufa in which was preserved a perfect cast of a woman with an infant in her arms Although her form was imprinted in the rock nothing but her bones remained to these was suspended a chain of gold and rings with jewels were on the fingers of the skeleton Further amphoræ were ranged along the side of the vault The writings scribbled by the soldiers in their barracks and the names of the owners of each house written over the doors are still legible The colours of many of the paintings on the stuccoed walls are almost as vivid as if recently painted, and a collection of shells was found in the house of a painter, who probably amused himself with natural history, in as good a state of preservation as if they had remained the same number of years in a museum The beams of the houses are black exteriorly, but little altered within, and the state of preservation of [illegible] and almonds chesnuts, and walnuts in a fruiterer's shop In a baker's shop [illegible] with a name stamped upon it, and a box of pills upon the counter of an apothecary, with a small cylindrical roll by the side of it, evidently prepared to be cut into pills In 1827, olives in a square jar, and caviar, were found in a state of wonderful preservation At Herculaneum the animal and vegetable substances are preserved by having been apparently enveloped in a paste which consolidated, and then allowed them to become slowly carbonized At Pompeii they are penetrated by a grey pulverulent tufa The history of the Papyri is well known It is supposed that only a small part of Herculaneum has as yet been explored, and that the quarters hitherto cleared out at great expense are those where there was the least probability of discovering manuscripts

It would however, be irrelevant here to enlarge upon these and other details of buried cities, but the few facts mentioned, and which are abridged from Mr Lyell's summary, are not without geological importance, as giving some idea of the little change which the lapse of seventeen centuries has effected

There are many instances of rocks of decided volcanic origin, that is, *extinct* volcanic vents, in districts where all other trace of activity has been lost since the earliest historical times except hot and mineral springs such as the Vivarais and Auvergne in central France, and the district of Eifel, near Coblentz, on the Rhine The attempts to determine the ages of these rocks, or to ascertain the periods of their activity by their association with primitive, secondary or tertiary strata are not in general satisfactory those who are curious upon this point may be referred to the details given by Mr Lyell

[illegible] results of volcanic action [illegible] extend over greater areas, and produce extensive changes in the configuration of the earth's crust, demand perhaps even greater attention

There can be little doubt as to the unity of cause in volcanos and earthquakes, they frequently precede violent volcanic eruptions, and often seem to arise from explosive matters accumulating their force from want of vent They are often felt over great extents of territory The earthquake which destroyed Lisbon in 1755 was felt over the whole of Europe, and extended even to the West Indies What enormous powers or forces, therefore, must be called into action in order to produce such extensive results!

It would be useless here to quote long details respecting the effects of earthquakes, but it will be necessary to select two or three illustrative cases and especially to direct our attention to those phenomena connected with them which immediately bear upon geological changes

The great earthquake at Lisbon occurred on the 1st of November, 1755 A sound like loud thunder was heard under ground, and instantly afterwards the greater part of the city was shaken down, so that in six minutes at least 60 000 persons are said to have perished The sea first retired but was violently agitated and presently rolled in in a huge wave sixty feet high Many of the largest mountains in Portugal were shaken from their foundations and most of them were wonderfully split and rent It was supposed that they emitted fire and smoke, but lightning and dust perhaps, give rise to the appearance The New Quay, a massive marble structure sunk down with an enormous concourse of persons upon it who had taken refuge there for safety and it was so ingulfed that not one of the dead bodies ever floated to the surface, and many vessels anchored near it and full of people, were swallowed up as in a whirlpool No fragments of the wrecks ever rose again and the water upon the spot was deepened by 100 fathoms Many ships at sea experienced violent concussions Off St Lucar the captain of the Nancy frigate thought he had struck on the ground, but on heaving the lead found he was in great depth of water Another ship 40 leagues west off St Vincent experienced so violent a concussion that the men were thrown up a foot and a half perpendicularly from the deck

The agitation of the sea during earthquakes has almost always been remarked and probably such effects are more common than is supposed for in almost all parts irregularities in its motion are at times observable which cannot be referred to temporary currents or winds in the offing The movement is generally a quick flow and reflow of the water, and often so trifling as to escape the attention of all ordinary observers though detected by seamen and fishermen who are surprised to find the boats suddenly floated or as suddenly left dry

In the Lisbon earthquake many of the rivers and lakes of Great Britain were singularly disturbed Loch Lomond suddenly rose between two and three feet, and as suddenly subsided

In the great Calabrian earthquake, in 1783 an interesting narrative of which is given by Mr Lyell, the aspect of the country was singularly changed The earth appears to have had an undulating vibratory and horizontal motion, there were the usual tremors in the neighbouring [illegible] landslips took place, and extraordinary lacerations, large buildings and farms were ingulfed, and in some places the chasms closed upon their prey with such violence that on excavating afterwards to recover articles of value the workmen found detached parts of buildings jammed together in one compact mass Some of the resulting gaps and ravines were upwards of a mile long and from 200 to 300 feet deep and broad Large lakes were formed sometimes filled with thermal waters from below, and sometimes the consequence of the obstruction of streams, land and houses were in some places uplifted, in others depressed, in others transferred with all their plantations to a distance varying from a few feet to upwards of a mile

In these narratives it is a matter of much geological importance to establish clearly the fact of elevations and depressions of districts and strata, and, if possible, to ascertain the amount of such change in perpendicular position Upon these points the Chilian earthquake of 1822 affords some satisfactory evidence According to Mrs Graham's (now Lady Calcott's) account, the shock [illegible] coast, [illegible] for a length of more than a hundred miles, the beach and the bottom near the shore being raised from three to four feet The uplifting of the former was rendered evident by the adhesion of the shell fish to the rocks, and it was observed that there were other lines of beach *above that newly elevated at nearly parallel lines a height of about fifty feet above the sea*, seeming to show that previous elevations had been effected by the same causes An old wreck of a ship which before could not be approached, became accessible from the land, cones of earth were thrown up in several districts by the forcing up of water, mud, and sand, through funnel-shaped hollows The elevation inland appeared, by the effect upon watercourses, to have been two or three times greater than upon the beach

There are some other points connected with earthquakes and volcanos which, though generally considered of subordinate importance, seem to refer very immediately to their causes, such, for instance, as intermittent and boiling springs and the escape of carbonic acid gas

The geysers of Iceland are fine specimens of the former, their waters hold so large a quantity of silica in solution over They rise [illegible] geyser springs from a spacious basin at the summit of a mound formed of siliceous incrustations deposited by the spray of its waters In the centre of this basin is a pipe 78 feet deep, through which the water rises flows over, and is thrown up in jets attended by loud explosions and subterranean rumblings and slight tremors of the ground When these jets are most violent, they shoot to 200 feet high, and after playing for some time a snorting noise is heard, which gradually becomes as loud as thunder, and steam rushes forth with prodigious violence This deafening roar lasts for a variable time and the eruption terminates, coming on again after a variable interval of rest

Of this phenomenon we have a plausible explanation, and one which bears most importantly upon the theory of volcanos and earthquakes

Suppose the surface water of the country to penetrate into the chasm A by the fissures B B, while at the same time steam of great force and temperature emanates from the fissures D D A portion of this steam is first condensed by the water in A, which it gradually raises to its boiling point then it forms high-pressure steam, and drives the boiling water through the pipe into the basin C and after the whole has been ejected the steam itself rushes out Now if we suppose a number of large subterranean cavities at the depth of several miles below the surface in which melted lava accumulates, and that water [illegible] these is converted into steam, this, to- [illegible] gases pent up, and perhaps liquefied by pressure in similar cavities, or generated by the decomposition of melted rocks may press upon the lava and force it up the duct of a volcano in the same manner as the column of water is driven up the pipe of the geyser But the weight of lava being immense the pressure exerted on the sides and roots of such large cavities and fissures may [illegible] not merely slight tremors Sometimes the lateral pressure of the lower extremity of the high column of lava may cause the more yielding strata to give way, and so for a time give relief to the fused matter Sometimes on the contrary, a weight equal to that of the vertical column of lava, pressing on every part of the *roof* may heave up the superincumbent strata, and force lava into every fissure, which on consolidation, may support the arch and cause the land above to be permanently elevated on the other hand, subsidences may follow the condensation of vapour when cold water descends through fissures, or when heat is lost by the cooling down of the lava

Besides aqueous vapour several gases are emitted by volcanos and among them *carbonic acid*, which is also frequently given out by fissures in the earth, and by mineral springs not associated with direct volcanic action Its occurrence in the Grotto del Cane is well known It is given out in enormous quantities near the lake of Laach and in Brohlthal on the Rhine where it is used in a chemical manufactory 600 pounds of the gas are calculated to be discharged from only one of the jets in twenty-four hours Near Hort Dhidine on the Euphrates, it issues through the cracks of the limestone rocks with a loud hissing noise, and in such quantities as to kill [illegible] The Upas valley, in [illegible] to a certain height with carb[illegible] and about a mile in circumference, and about 35 feet deep, without vegetation, and covered

with skeletons of men and various animals such as tigers hogs, deer, &c , which have perished by their entrance into the gas

We [illegible] show that it often issues from the strata of the earth in enormous volume and there can be little doubt from reservoirs where it is pent up under great pressure and in all probability there are large accumulations of it in a liquid form, in which state it exerts a pressure, at common temperatures, of from 50 to 60 atmospheres upon the walls that confine it, and at higher temperatures of much greater force We are also [illegible] that there are subterr [illegible] this, but probably with other gases, perhaps also in their liquid forms, and of still greater tensive force, and if so, what may not be the mechanical and chemical energies of some of these, acting upon the highly inflammable metals at very elevated temperatures ? Upon the whole, it does not appear that powers are wanting adequate to the greatest observed effects, that these are constantly in activity, and that stupendous as the results appear in their collective effects, the great mountains of the globe *may* have been elevated by causes now in action, that, at all events, we *need* not call to our aid unknown powers, since existing causes (especially if it be admitted that they were once more energetic than at present, and that the agents have, as it were, spent a part of their force) appear adequate to the explication of this class of geological phenomena, and if we now have powers in activity, and we have seen that such there are, which are capable of elevating 100 miles of rocky coast 3 or 4 feet, why may not a succession of such elevations, even admitting them not to have been greater than at present, carried on through an indefinite period of time have occasioned those liftings up of the mountains which we have had such abundant occasion to advert to ? It is well known that slight forces continuously repeated produce gigantic effects It has, says Mr Lyell, been argued by t [illegible] useless to appeal [illegible] its powers are capable of performing If say they, a mouse be harnessed to a large piece of ordnance, it will never move it, even if centuries upon centuries were allowed This is true enough But let us suppose a lever applied capable of propelling it forward at the rate of an inch in a century, it is clear that in a sufficient succession of centuries we should have advanced a mile any force that could move it at all must, if it continue in action, continue to propel it "

The full bearing of this question however, will be more evident when we have considered the causes which are now effective in producing sedimentary formations in wearing down the present surface of the globe and in conjunction with those more violent powers which we have just noticed in giving rise to various superficial inequalities

## § IV

We have now surveyed the structure of the earth's surface, and have traced the apparent causes of many of the changes which it has undergone, and which have contributed to its present state and aspect, but there are a variety of processes now active and of changes now going on, which [illegible] dify the existing order of things and which [illegible] in reference to their continuity through past ages and to their accumulated effects through ages to come, will perhaps assume an air of unexpected importance

Among the powers of matter which change the earth s surface, heat and cold are obviously at all times concerned in [illegible] thus keeping up a [illegible] the particles up [illegible] he sum is the [illegible] whose varying influence the earth in its [illegible] upon its axis and in its annual circumvolutions through space, is always exposed * It may perhaps *seem* that the mere influence of change of temperature derived from the solar rays must [illegible] surfaces in [illegible] and the solid rocks [illegible] but when we reflect upon the very extensive range of natural temperatures and on the great receptive and emissive powers in respect to radiant heat which the surfaces of some rocks present, very considerable transitions from heat to [illegible] certain *structures* and [illegible] general work of decay which is commonly called the *weathering* of rocks

But when the influence of change of temperature is conjoined with the varied agency of water the powers of destruction will not only be materially increased, but rendered, in many instances, rapid and irresistible About three fourths of our globe are covered by the waters of the ocean, the mean depth of which is probably about 3 miles The [illegible] level does [illegible] land might be so distributed over the bottom of the ocean that the surface of the globe would present a mass of waters This is an important possibility, when geologically considered, because, with it at command every variety of superficial land and water may be imagined and consequently every variety of organic life, each suited to the various situations and climates under which it would be placed In consequence of the general uniformity of level preserved by the ocean, it enters the numerous irregularities of the land, and sometimes forms inland seas as it were in which geological changes, differing from those which occur in the open ocean, may occasionally take place as in the Mediterranean and the Baltic There are also inland seas or *lakes*, as they are usually called, not in direct communication with the open sea, some of salt and others of fresh water The latter cover very large tracts, and it is obvious that in *them* depositions may take place exclusively characterized by terrestrial and fresh water remains

It is also obvious that earthquakes and volcanos will materially contribute towards existing changes, and co-operating with aqueous forces may often produce a joint effect to which neither could separately give rise, as when frequent earthquakes aid the excavating power of water in carving out a valley or widening one which already exists Of these powers the statements in the preceding section furnish abundant proofs, so that we may now more exclusively attend to aqueous causes some of which are of a destructive, others of a renovating or reproductive character

When lands are much elevated above the sea they condense the vapours of the atmosphere in consequence of their low temperature, and thus become reservoirs of water which irrigate the valleys and plains below, and descending, often by steep declivities acquire an impetuosity calculated to surmount powerful obstacles The summits, therefore of mountains are particularly subject to atmospherical influences, and to great alternations of temperature and moisture We have already alluded to the gigantic force of water freezing in the chasms and crevices of rocks, and it is in this way that great havoc is effected where comparatively little wet falls and that the decay of rocks in high latitudes goes on as rapidly, or more so, than where they are deluged by the tropical torrents of rain This mechanical power of water is often aided by its solvent energies, and although these are usually very slow in their operation, the time for which they are continued and the extent of surface upon which they operate produce a great aggregate effect. Some granitic [illegible] out of th [illegible] acid aids the solvent power, and in others the air in water converts black oxide of iron into red, and the decay of the rocks is rapid in proportion to the extent of this conversion The *granite tors* of Dartmoor and of the Lands End furnish curious instances of the effect of *slow* decay from several causes, among which the tendency in the rock to cubical and prismatic fracture must not be overlooked By degrees the surfaces become separated, and the wearing continuing to proceed more rapidly near the parts which are most external, and therefore most exposed, the masses which once were angular and prismatic acquire an irregular curvilinear boundary, and the stones assume that appearance which has sometimes been regarded as artificial and has induced persons to consider them Druidical remains Enormous stones are thus thrown from their original positions, and becoming rounder and rounder by the progress of decomposition assume a spheroidal figure, often referred to the continuous action of running water under favourable circumstances *logging stones* are, as we have previously observed, thus produced The weathering of some of these tors is so gradual that the life of man scarcely allows an individual to observe a change, whence we may infer the long periods that have been requisite to bring about their present appearances It is possible that chemical changes may sometimes be aided by the electrical powers called into action, and as a more imme-

* [illegible] surface of the earth [illegible] turbances in the [illegible] to the [illegible] [illegible] [illegible]

diate agent electricity is not without its influence The thunder storm shivers rocks and hurls them down in mighty fragments often fusing their surfaces and sometimes consolidating soft materials Near Drig in Cumberland, the sandy soil contains hollow tubes produced by lightning striking and penetrating the ground, some of these have been traced to a depth of 40 feet, and furnish curious illustrations of the passage of the electricity When running water is mixed with sand and pebbles it acquires a mechanical power and the materials carried along by streams grind down and excavate the adjacent strata so that the superincumbent portions are ultimately precipitated into the stream The obstruction causes a temporary accumulation of water behind, which afterwards bursts the barrier, and in this way small ravines are slowly widened into narrow valleys in which sinuosities are caused by the deflection of the stream first to one side and then to the other The unequal hardness of the materials through which the channel is eroded tends also to modify the lateral power of excavation and thus the little streams acquire a serpentine direction When the flexures are great, a direct line is often restored by the river cutting through the isthmus which separates two or more of its curves These windings occur from similar causes in some of the largest rivers of the world, and not only in those which flow through flat alluvial plains, but large valleys are excavated to a great depth through solid rocks in this serpentine form These tortuous flexures of rivers show that the valleys in which they flow were not produced or excavated by any flood of uncommon power and magnitude or by any diluvial operation, for such causes would probably have produced straight channels

In referring to the transporting powers of water it has been justly observed by Mr Lyell that we are often surprised at the facility with which small streams bring down sand and gravel, for we usually estimate the weight of rocks in air, and do not sufficiently reflect on their comparative buoyancy when submerged in a denser fluid The specific gravity of most rocks is only from twice to thrice that of water, so that the fragments lose from a third to half of what we usually call their *weight*

The power of riv[illegible] gravel is shown by [illegible] at their mouths where they terminate either in lakes or in the sea, and the history of storms and floods affords many memorable instances of the force with which they transport heavy materials In August 1829 Aberdeenshire and the adjacent counties of Scotland were visited by a storm and hurricane which extended over a space of 5000 square miles — flooding the rivers carrying away [illegible] k of some tons weight [illegible] tons of gravel to great distances in one day

In alpine countries the moving of massive stones is facilitated by the ice which adheres to them, and forms with the rocks a mass of less specific gravity The glaciers also, formed of consolidated snow, carry down prodigious loads of rock and sand, which are generally ranged in long ridges running parallel to the glacier and from 20 to 40 feet high They are slowly protruded into the valleys, where the ice melts, and the whole accumulation is swept away by torrents

If the materials which streams have to work upon are but loosely consolidated, the rapidity with which they sometimes excavate deep channels is truly astonishing After the heavy rains which followed the eruption of Vesuvius in 1822, the water flowing from the Atrio del Cavallo cut, in *three days*, a new chasm 25 feet deep

We may also adduce striking examples of the erosion of deep chasms in comparatively hard and durable materials Some of the clearest illustrations of this excavating power are presented in the valleys of central France, where the ancient channels of rivers have been filled up by lava, through which the present streams have re-excavated a passage from 20 to 70 feet deep, and often of great width

This subject has been well illustrated by another case quoted by Mr Lyell, upon the base of Etna where a great current of lava descending in 1603 from near the summit of the volcano flowed into the alluvial plain of the Simeto, one of the largest of the Sicilian rivers, which skirts the base of Etna, and falls into the sea a few miles south of Catania It entirely filled up and obliterated the bed of the river with indurated lava, yet now (that is in the course of two centuries) it has re-excavated for itself a new passage which is from 40 to 50 feet deep, and more than 100 wide

But of the numerous examples which might be cited of the powers of rivers to carve out their courses and excavate valleys in their rocky boundaries, the falls of Niagara are perhaps the most magnificent That river flows from Lake Erie to Lake Ontario, the distance between them being 32 miles, and the level of the former lake is 330 feet above that of the latter As it leaves Lake Erie, the Niagara is almost level with its banks, and three quarters of a mile wide, so that should it rise 8 or 10 feet, Canada and the state of New York would be inundated Proceeding towards the falls, it has a descent of 50 feet [illegible] At the verge of the cataract [illegible] 1800 feet wide, and 158 feet perpendicular, the other 600 feet wide, and 164 feet high This enormous body of water is precipitated over a ledge of hard limestone in horizontal layers which rests upon a soft shale This crumbles away so rapidly that the [illegible] forms a projecting mass which overhangs the space below, and being left without support falls from time to time in large masses into the [illegible] like thunder As soon as the river [illegible] its character is completely changed, it runs furiously in a deep trench cut in the horizontal strata, so that the ravine is only perceived on approaching the edge of the precipice Through this deep chasm the river flows for 7 miles, and then the table land, which is nearly level with lake Erie, suddenly sinks down at a town called Queenstown, and the river traverses a plain which continues to the shore of Lake Ontario

No [illegible] great cataract of the river [illegible] has gradually retrograded from that place to its present position, about 7 miles up Within the last 40 years the falls have receded [illegible] ion never [illegible] required nearly 10 000 years for the excavation of the whole ravine, and should it not be accelerated in future, it will require nearly 30 000 years for the falls to eat their way backwards to Lake Erie, to which they most undoubtedly seem destined to arrive Of course this calculation is only provisional, and may be interfered with by many causes, but supposing Lake Erie to remain nearly in its present state, the sudden escape of such an immense body of water would cause a tremendous deluge But Lake Erie is constantly [illegible] in depth by the enormous quantities of [illegible] brought down by the rivers which feed it Long Point, near the influx of Big Creek River, has advanced three miles within the last three years another important effect of rivers There are other causes which in this case would probably prevent a sudden debacle, for the waters of a lake with a rocky barrier can only be suddenly let out so as to produce a deluge when the hard barrier separating it from the land at a lower level presents a perpendicular face to the whole depth of the lake and accordingly inundations from such causes are comparatively rare (See *Lyell s Principles* )

We come now then to consider the [illegible] progress of the *detritus* carried down by rivers It is clear that their tendency will be to fill up valleys and hollows lakes will gradually diminish in depth, or even be choked up and again cut through, and low lands flooded, and deposits left upon them In some situations, rivers raise their beds when restrained by artificial embankment Of this the Po furnishes a remarkable example traversing the plains upon a high mound like an aqueduct, even more elevated than the roofs of the houses in the city of Ferrara

In other cases, where two or more streams unite into one river, so that the water does not expose a surface equal to the two previous surfaces, the action of the united waters is to deepen the channel

Of the matters carried down by rivers large quantities are transported to their mouths, and there deposited either in lakes or in the ocean bed The Lake of Geneva is thus receiving enormous supplies of detritus from the Rhone, so that from calculations which have been made of its increase, and of the diminution of the depth of the lake it appears probable that if we could obtain a section of the accumulation formed during the last eight centuries, we should see a great series of strata from 600 to 900 feet thick, and nearly two mi[illegible] a slight angle We should also [illegible] deltas at the mouths of the smaller rivers, each composed of such materials as the respective rivers happen to have brought down

When the Rhone again issues from this lake, it is as pellucid as crystal [illegible] mixed with the turbid sediments of the [illegible] bringing down the granitic detritus of the glaciers of Mont Blanc It afterwards receives vast contributions from the Alps of Dauphiny and from the primary and volcanic mountains of central France, and when at length it enters the Mediterranean it discolours its blue waters with a whitish sediment for the distance of between six and seven miles from its mouth throughout which space the current of fresh water is perceptible Mr Lyell has collected a [illegible] and other [illegible] general results

It appears that by the confluence of the Rhone, and the currents of the Mediterranean driven by winds from the south, sand bars are often formed across the mouths of the river, by which means considerable spaces become divided off from the sea, and subsequently from the river

also when it shifts its channels of efflux As some of these are subject to the occasional ingress of the river when flooded, and of the sea during storms, they are alternately salt and fresh, so that both fluviatile and marine shells are found in them Of the new deposits in this delta great part consists of calcareous and arenaceous rock cemented by carbonate of lime A cannon taken up near the mouth of the river was entirely entombed in solid calcareous rock

The delta of the Po in the Adriatic presents another instance of the vast accumulations of matter that are thus deposited by rivers, and it appears that within the historical period, that is, within 2000 years, the accessions of land have increased from 2 to 20 miles in breadth Adria, a sea-port in the time of Augustus, is now about 20 miles inland and Ravenna, which was also a sea-port, is 4 miles from the main sea

The delta of the Nile also affords some interesting geological considerations but we must look to the great rivers of Asia and America for the most instructive examples of these formations

Of the delta of the Ganges and Barrampooter we have some curious information from Major Rennel These rivers descend from the highest mountains in the world into a gulf which runs 225 miles into the continent The part of the delta bordering on the sea is composed of a labyrinth of rivers and creeks infested by tigers and alligators, and equal in extent to the whole principality of Wales The mud and sand poured into the gulf in the flood season is so great that the sea only recovers its transparency at the distance of 60 miles from the coast And in further proof of the immense transportation of earthy matter, we have the great magnitude of the islands formed in the channels of the river during a period even far short of a man's life Some of these many miles in extent, have originated in large sand banks thrown up at points, and afterwards insulated by the stream, others are caused by various accidental obstructions such as sunk trees or boats In the great gulf below Luckipoor, some of the islands rival the Isle of Wight in size These newly-formed lands are soon overrun with reeds grass and shrubs, which form impenetrable thickets where tigers buffalos deer and other wild animals take shelter, so that both animal and vegetable remains must continually be precipitated into the flood and sometimes become embedded in the sediment of the delta Crocodiles also swarm upon the shoals, and the habits of these animals are such as to render them particularly liable to become imbedded in the horizontal strata of mud which are annually deposited in the Bay of Bengal over many hundred square miles Mr Lyell has also gone into the history of [illegible] structive, in [illegible] state of its banks, and the varieties of climate through which it flows Its delta is divided into innumerable lakes marshes, and streams inhabited by multitudes of alligators, and millions of [illegible] down at particular seasons [illegible] or bound together by adventitious vegetation, so as to retard the river and become embedded in mud

We thus find that matters washed down from the decay and disintegration of the land into lakes and seas are there accumulated, and are *now* forming *stratified deposits*, varying in their nature and texture and often abounding in organic relics, but to form a just notion of the magnitude of these processes they must be compared with objects with which we are more familiar Now it is probable that the waters of the Ganges hold in suspension from 2 to 3 per cent of solid matter, but if we only assume *one* per cent, which is perhaps the average of most rivers, we are, says Mr Lyell, brought to the extraordinary conclusion that there passes down every two days, into the Bay of Bengal, a mass equal in weight and bulk to the great Egyptian pyramid

We have already adverted to the enormous quantity of matter occasionally ejected by volcanos The most voluminous current of lava which has flowed from Etna within historical times was that of 1669 calculated at 140 million cubic yards Now this would only equal in bulk one seventh of the sedimentary matter carried down in a single year by the Ganges (ten parts in 1 per cent of sand), so that allowing seven such eruptions in a century it would require 100 Etnas to transfer a mass of lava from the subterranean regions to the surface equal to the mud carried down in the same time from the Himalaya mountains into the Bay of Bengal (*Lyell's Principles of Geology*)

That enormous quantities of matter, therefore, are thus by slow and silent operations carrying down into the deep, and there forming strata which may one day be upheaved and assume the character of dry land, will now be obvious, and shows how some of the mightiest operations in nature are effected insensibly, without noise or disorder, and without the aid of extraordinary convulsions, mighty deluges, or other temporary and sudden [illegible] Which [illegible] form some curious speculations respecting [illegible] the strata thus forming Some will be argillaceous, some calcareous, hard and soft, coarse and fine, depending upon a variety of obvious interfering causes some abounding in organic remains, others without them, and among these, from the number of shipwrecks and other casualties, human remains and works of art must often be abundantly interred

From the wearing down of rocks and strata, and the excavation of valleys by rivers [illegible] of temperature, we may now [illegible] action of the sea on coasts

The waves of the ocean operate, in many instances, like mighty artillery, battering and breaking down the solid barriers opposed [illegible] If the rocks are soft, the wear is proportionately rapid, as we see upon the east coast of our island, where many spots now standing in the sea, or even covered by its waters, are marked in old maps as sites of towns and villages, the inhabitants having gradually retreated inland Where the rocks are hard, or where they are so stratified as to oppose resistance the declension of coast is much more gradual The substances thus delivered into the sea are acted on according [illegible] forms, and textures some [illegible] cents, others rolled about, and ground down upon the shore, and where indurated masses are continued in softer materials, flints for instance in chalk they remain at the base of the cliff, and tend to protect it from the breakers and check its further excavation

Veins and dikes sometimes are curiously exposed and insulated by this wear and tear Arches are cut out and caverns excavated and even the hardest rocks often drilled as it were in various directions

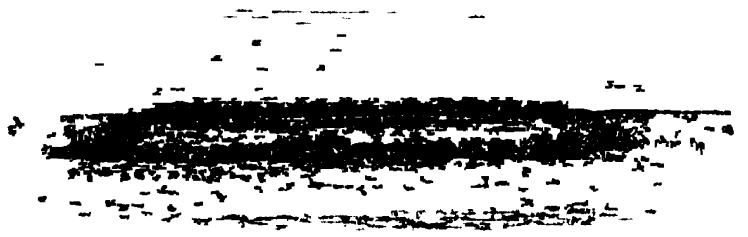
The protecting influence of the waves is seen in those long lines of shingles and sand which often defend low and marshy land especially at the mouths of valleys, from the access of the sea and the higher the tide and the heavier the gale the farther up it is that is raised These beaches travel in the direction of the prevalent winds, and of this engineers are practically aware as we see by the works which they erect to arrest their progress

An instructive example of the nature and effects of accumulations of this sort is furnished by the Chesil Bank, which connects the Isle of Portland with the mainland, it is about 16 miles long, and the size of the pebbles increases from west to east Its formation is probably due to a meeting of tides between the promontory and the land The storm of 1824 burst over it and overwhelmed the village of Chesilton Another example of land thus protected is on the south coast of Devon What is called Slapton Sands is in fact a ridge of pebbles which protects and blocks up the mouths of several valleys Sand is also often accumulated and thrown up in the same way as shingles and when it is left by the tide and dried by the sun winds often transport it to great distances so as even to overwhelm large districts – houses cultivated lands and even forests disappearing beneath them On the eastern shore of the Bay of Biscay, these moving heaps force lakes of fresh water before them derived from the rains which are pent up, and several villages in the department of the Landes have been thus buried and others are now threatened with destruction They have been calculated to advance at the rate of 60 to 70 feet in a year Sometimes these sands become consolidated by the percolation of calcareous or ferruginous waters Of this we have an example on the north coast of Cornwall where the sand is formed of comminuted shells, and the drift having taken place at different times the recent sandstone thus formed is striated with occasionally interposed vegetable remains Where church-yards have existed human remains have been entombed, and an old pot of coins has been found in this formation This rock is so hard that holes are bored in it for the purpose of securing vessels The parish church of Crantock is built of it The fossil skeletons of Guadaloupe appear to have been preserved by this species of rock formation

Among reproductive causes now in action, none are of more curiosity or interest than the operations of the small zoophytic animals which produce coral, and which labouring on through long periods of time, gradually accumulate such enormous masses of carbonate of lime as to form, together with shells which they entangle and envelope islands of no inconsiderable dimensions

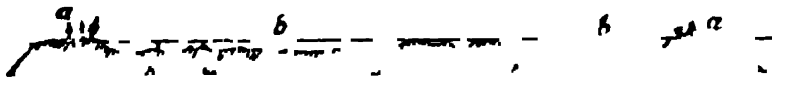
Coral reefs are usually of a form approaching to the circular, and the water is shallow in the centre, but surrounded by a very deep, and even unfathomable sea When the reef is so high as to remain nearly dry at low water, the animals leave off building, and then the rim or edge of the great basin becomes covered by calcareous sand which offers a foundation for the growth of marine vegetables, and afterwards a resting place for the seeds of trees and plants cast upon it by the waves Trunks of trees, also carried by rivers from continents and islands, [illegible] and some [illegible] such as lizards [illegible]

the thirteenth parallel of latitude on each side of the equator, is a great nursery of coral islands, also the Arabian and Persian gulfs Between the coast of Malabar and that of M[illegible] is a sea of coral Flinders describe[illegible] long upon the coast of New Holland, and between that country and New Guinea coral formations extend throughout a distance of 700 miles, interrupted by no intervals exceeding 30 miles in length The growth of coral is, when compared with human epochs, extremely slow, but the facts just cited show that they have produced results of no mean importance, as influencing the general aspect of the earth's crust Their circular form, the steep angle at which they plunge into the sea, and the countries in which they occur, render it extremely probable that they are the crests, as it were, of submarine craters, and occasionally lava and volcanic rocks have been found in their central lagoons these have generally a deep narrow passage which is kept open by the efflux of the ocean at low tides These openings are almost always on the

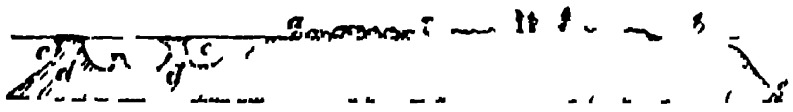


*Whitsunday Island in the Pacific, with its enclosed Lagoon*

leeward side, and the windward side of the islands is more complete and perfect than the other, so that from this fortunate circumstance ships can enter and sail out with ease, indeed the safety of many of these harbours is entirely dependent upon this cause It would seem most probably to arise from the large masses of coral rock that are thrown up by the waves on the windward side These rocks are probably subject to elevations and depressions connected with volcanic agencies Mr Lyell thinks that the carbonate of lime, which is the building material employed by the busy little architects of these islands is in all probability derived from calcareous springs issuing into the sea from fissures in the volcanic bottom



*Section of a Coral Island* — *a a* the habitable part, *b b* the lagoon



*Section of a Coral Island upon a large Scale* — *a b* the habitable part *b c* slope of the side *c c* parts of the lagoon *d d* knolls of coral

We may now conclude this subject by a brief reference to those erratic blocks and pebbles which are so widely scattered over different districts and which with the deposits of bones and stalactite in certain caverns, are often regarded as especial proofs of diluvial action

Where pebbles occur immediately upon the beach and are evidently derived from the fragments of neighbouring rocks rolled into form by the action of waves or where larger masses forming what are called *boulder stones* are found in similar situations or lying upon the strata of which they constitute the fragments and relics there is no great difficulty in accounting for one or the other, but where immense deposits of gravel are found not only inland, but out of the reach of all [illegible] and where boulder stones are found in [illegible] and very distant from the rocks of which they are the apparent remains our curiosity and ingenuity are then excited to ascertain how they came into their present places and whence they are derived We must of course always carefully distinguish between these importations as they may be called, of foreign matters and those kinds of detritus which merely result from the weathering of the rocks

We have elsewhere pointed out the numerous evidences which we have of fractures elevations and depressions of the strata, of the consequent existence of *faults*, and of the formation of valleys, frequently in the line of such faults and fractures Now it seems clear that all these effects must have been attended in many instances by proportionate changes in the levels of waters and that there must have been great inundations and torrents passing over such districts at the times of their disturbance, and further, that where land once covered by water has been elevated rounded masses of rock or boulders, as well as gravel of all degrees of fineness and all manner of composition, may have been elevated along with them Here, then, are two apparent causes of gravel and boulders

But independent of these sources of such appearances, there are other geological phenomena, which seem to indicate the [illegible] of great masses of water over the British [illegible] from north to south upon the neighbouring continent of Europe, too, evidences of current setting in the same direction [illegible] gravel [illegible] Occasionally [illegible] by the valleys, hills, and mountains which they encountered, so that their detritus is in many instances scattered in other directions In some cases ice, in the form of glaciers, appears to have been a cause of the transportation of masses and fragments of rock to places far remote from their original source The glaciers which descend from alpine [illegible] any current of water [illegible] which they descend would float them and their burthens It is probable that those immense masses of ice called icebergs are portions of polar glaciers, and these, with their contents, are often floated into warmer climates, so that the debris which they carried with them may thus have been dispersed at the bottom of parts of the ocean far distant from the source of such materials These circumstances show (when taken in conjunction with the facts already enumerated respecting the causes which influence the decay of rocks) how careful we must be in reasoning respecting the age and sources of blocks gravel, and those remains generally called *diluvial*, and how difficult it is to form any inference respecting their sources and transport, excepting in cases where these are at hand and obvious Whatever may have been the cause of such passages of torrents over the land and the evidences of them are quite sufficient, it is obvious that they must have destroyed nearly all such living beings as came in their way or as frequented those parts of the earth over which they swept Accordingly the remains of various animals are found in such deposits, and their examination and comparison with living genera and species, and with those more ancient animals before alluded to in the tertiary and secondary strata, is a very curious and interesting [illegible] Dr Buckland's researches [illegible] have given them additional interest especially as connected with certain theoretical points [illegible] and with their assemblage in caverns [illegible] bones are usually mixed with mud, stones, and fragments and circumstances sometimes seem to show that the animals resided in them for a great length of time they are covered by *stalagmite* which forms the pavement as it were of the cave and effectually conceals and preserves the organic remains The celebrated Kirkdale cavern in Yorkshire, discovered in 1821, contains the remains of the hyæna tiger bear, wolf, fox, weasel elephant, rhinoceros hippopotamus horse, ox, deer, hare, rabbit, rat, mouse, raven, pigeon, lark thrush, and a species of duck From the mode in which these remains were strewed over the bottom of the cavern when the mud was removed, the great proportion of hyæna's teeth over those of other animals and the manner in which many of the bones were gnawed and fractured, Dr Buckland inferred that this cavern was the den of hyænas during a long succession of years, that they brought in, as prey, the animals whose remains are now mixed with their own, and that this state of things was suddenly terminated by an irruption of turbid water into the cave, which buried the whole in mud In other caves other animals have been found indicating the same general facts of the existence of animals now no longer known in these latitudes Where the bones of man or works of art have been found in these caves there is generally good evidence of their being of a much later date than the remains of quadrupeds, but occasionally the bones of extinct quadrupeds are so mixed with those of existent testacea as to show that they at least were co-existent

GEOMANCY (from [illegible]) Divination by points [illegible] was termed by old writers 'a sport of natural magic the daughter and abbreviation of astrology Geomancy was among the arts of divination most sedulously cultivated by professors of that science in the 15th and 16th centuries Nativities were cast, fortunes predicted, and oracular answers obtained to questions, by the inspection of certain combinations of lines and figures representing the conjunctions of the planets &c *See* ASTROLOGY

GEOMETRICAL Something relating to geometry Thus *geometrical construction* is the reference of a proposition, or of an algebraic equation, by means of a diagram formed by geometrical lines, as straight lines, circles &c

*Geometrical curve* [illegible] are those in which the relation [illegible] and ordinates is expressed by a finite [illegible] *See* CURVE

*Geometrical locus* is [illegible] a point which varies its position according to some determinate law For example, if from any number of given points straight lines are to be drawn to meet in another point, under this condition that the sum of their squares shall be equal to a given space, then innumerable points may be found by which the condition will be satisfied, and the *locus* of all those points is the circumference of a given circle (See *Simson's Loci Plani*, or *Leslie's Geometrical Analysis*)

*Geometrical progression* is a progression in which all

the successive terms have the same ratio Thus the progressions

1, 2, 4, 8, 16, 32, 64, &c
$a$, $a^2$, $a^3$, $a^4$, $a^5$, $a^6$, $a^7$, &c

are geometrical, the common ratio of the first being 2, and of the second $a$ The general property of a geometrical progression is, that the product of any two terms, or the square of any one single term, is equal to the product of every other two terms taken at an equal distance before and after the former

*Geometrical Proportion* —Four quantities are said to be in geometrical proportion or simply proportionals, when the ratio of the first to the second is equal to the ratio of the third to the fourth Thus, if $a$ $b$ is equal to $c$ $d$, then the four quantities $a$ $b$ $c$ $d$ are in geometrical proportion A general property of this proportion is that the product of the two extreme terms is equal to the product of the two means *See* PROPORTION

GEOMETRY (Gr $\gamma\eta$, *earth*, and $\mu\epsilon\tau\rho\omega$, *measure*) The science which treats of the properties of figured space The etymology of the term suggests the object to which geometry was first applied, viz the measurement of land It is pretended that the science was invented in Egypt, where the annual overflowing of the waters of the Nile obliterated the land marks and rendered it necessary to have recourse to measurement in order to ascertain the proper allotment of each individual, but whatever may have been the origin of the *term* the occasions on which it is necessary to compare things with one another in respect of their forms and magnitudes are so numerous in every stage of society, that a geometry more or less perfect must have existed since the first dawn of civilization

*Objects of Geometry* —In geometry bodies are considered only in reference to the properties of extension or magnitude, figure, and divisibility Every body occupies an indefinite space a certain determinate place or finite portion of space, which is called its *volume* The limits or boundaries which distinguish the place of the body, and separate it from the surrounding space are called *surfaces*, a surface is therefore common to the two portions of space which it separates As the limitation of space gives rise to the idea of surface, so the limitation of surface produces *lines*, a line being the boundary of a surface, or the place in which two surfaces intersect each other, and therefore common to both In like manner the limitation of a line, or the intersection of two lines produces a *point* But a point marks only position, and has no properties A line has length, a surface length and breadth, and a volume length, breadth and thickness Hence the properties of lines the properties of surfaces, and the properties of volumes or solids, comprehend the objects of geometry

Although the notion of a point is acquired from the consideration of lines, that of a line from the consideration of surfaces, and that of a surface from the consideration of bodies or material objects, it does not follow from this that points lines, and surfaces are themselves really material Geometry regards all bodies in a state of abstraction very different from that in which they actually exist, and the truths which it discovers and demonstrates are pure abstractions, —hypothetical truths which are not, however, on that account, the less useful For example, it is impossible by any mechanical means to draw a line absolutely straight or to describe a perfect circle but the nearer the line approaches to perfect straightness and the more accurately the circle is described the more will their properties approach to those of the ideal straight line and circle which are the objects of geometrical consideration The theorems of geometry are therefore not strictly true in their application to material bodies, but they approximate sufficiently to truth for all practical purposes They enable us to ascertain with all the precision of which our senses are capable, the distances of inaccessible objects, the dimensions of a given surface, the contents of a given solid, to compute the distances and motions of the planets, to predict the celestial phenomena; and to navigate a ship from any given point of the globe to any other

*Divisions of Geometry* Geometry is divided into elementary and transcendental *Elementary geometry* treats only of the straight line and circle, of figures bounded by straight lines and circles and of solids bounded by these figures The circle is the only curve line introduced into the elements of geometry, the simplicity of its description, the ease with which many of its most useful properties are deduced, and the necessity of making use of it in the simplest constructions,—such as raising a perpendicular, measuring an angle, and even making one straight line equal to another,—being reasons for this preference The construction of algebraic equations of the second degree and of all problems that can be solved by means of [illegible] referred to elementary geometry *Transcendental geometry*, properly speaking is that which has for its object all curves different from the circle, as the conic sections and curves of the third [illegible] It comprehends, also, the consideration of the third and fourth as well as of the higher degrees But some writers understand by *transcendental geometry* the application of the differential and integral calculus to the investigation of the properties of curve lines and surfaces Geometry is also divided into *ancient* and *modern*, ancient geometry being that form of demonstration and investigation which was employed by the Greeks, and of which *Euclid's Elements* form a well-known example, modern geometry that in which algebra, or the differential or integral calculus is made use of We also speak of *pure* [illegible] *metry* [illegible] under that term

*Methods of Demonstration* —Of the different methods of demonstration [illegible] the simplest is the [illegible] that two figures being applied to each other, or being laid the one upon the other, exactly coincide or fill the same space, from which coincidence we infer the equality of all their parts each to each Thus Euclid, in order to prove that two triangles which have two sides of the one equal to two sides of the other each to each and also the angles contained by those sides equal, are equal in all respects, [illegible] triangle to be placed upon the other, [illegible] from the hypothesis an entire coincidence must necessarily take place, whence it follows that the remaining angles of the one triangle are equal to those of the other each to each and the remaining side of the one to the remaining side of the other On this principle is founded the whole doctrine of the comparison of triangles and consequently, of all rectilineal figures, for it is demonstrable that any two equal and dissimilar [illegible] be applied [illegible] entirely to coincide

Another frequently convenient method of demonstration is that which is called by logicians the *reductio ad absurdum* It consists in assuming the proposition which is announced to be not true and in reasoning from this assumption till consequences are deduced which are either contradictory of the hypothesis, or of some proposition previously demonstrated Many examples of this method occur in the *Elements* of Euclid but it is to be remarked, that though the proof which it gives is perfectly rigorous and satisfactory, the procedure is in some respects indirect and therefore should not be adopted unless when it affords a shorter and simpler demonstration than can be obtained by a direct mode of reasoning It is especially [illegible] those propositions which are the reciprocals of [illegible] already demonstrated, and to incommensurable quantities

In their more difficult researches, and particularly in those relative to curve lines and surfaces, the ancient geometers had recourse to the *method of exhaustions* Admitting no demonstrations but such as are perfectly rigorous, they did not consider it consistent with the strictness of geometrical reasoning to regard curve lines as polygons of a very great number of sides, but when they proposed to investigate the properties of any curve, they regarded it as the fixed term to which the inscribed and circumscribed polygons continually approach in increasing the number of their sides The continual approximation of these polygons to the curve afforded an idea of the properties of the latter, the more accurate as the number of sides was greater But it still remained to prove, by some recognized principle of demonstration, the truth of the properties that had thus in a manner been divined, and this was done by showing that every supposition contrary to them necessarily led to a contradiction In this manner they demonstrated that the areas of different [illegible] other as the squares of their respective [illegible], the volumes of spheres as the cubes of their diameters, [illegible] the same height are as their bases, &c [illegible] *tions sur la Metaphysique du Calcul Infinitésimal*)

*Analysis and Synthesis* —The Greek geometers employed two distinct modes of investigation, *analysis* and *synthesis*, the one, as the names imply, being the inverse of the other In the *Mathematical Collections* of Pappus, book vii, analysis and synthesis are thus described —Analysis is the method which, setting out from the thing demanded, arrives by means of certain established consequences to something known before, or placed among the number of principles acknowledged as true It passes from a proposition through all its antecedents, and is therefore called *analysis*, or *resolution*, or an *inverted solution* In *synthesis*, on the contrary, we begin from the proposition with which the analysis concluded, ordering properly the above antecedents, which now present themselves in the form of consequents, and pass from one to another till we arrive at the conclusion sought, or that from which we started in the case of analysis These two methods have each their peculair use The first is the method of invention, and is employed in

order to discover a construction which will satisfy the proposed conditions, the second is the method of demonstration, and employed to prove the sufficiency of the construction to which the analysis has led In general, both [illegible] when the object is to discover [illegible], the solution of new problems, but when the object of the geometer is to [illegible] has discovered, [illegible]

*Application of Algebra to Geometry* — A different kind of analysis from that of which we have now been speaking consists in the application of algebra to the solution of geometrical problems This has opened up a new and rich field, entirely unknown to the ancients, and been the direct cause of the great extension of the modern mathematics In general when a problem is of a certain degree of difficulty, the use of the algebraic notation, which substitutes the simple arithmetical operations of multiplication and division for the complex geometrical methods of the composition and resolution of ratios, is attended with [illegible] By the aid of algebra, the properties [illegible] their tangents, points of inflexion, asymptotes branches, rectification and quadrature — subjects which the ancient geometry could reach only in some limited cases, and with great difficulty — are demonstrated with the utmost facility Some mathematicians of eminent rank, delighted with the beautiful specimens of investigation afforded by the ancient geometry, have regretted the extensive application of algebra which characterizes the scientific works of the present day, but in a science which presents so many real difficulties and in which so many discoveries remain to be made, the path which leads most directly to the object aimed at, and which moreover, is the easiest to follow, is that which ought to be preferred Without the aid of algebra and the new calculus, geometry could not have been applied to dynamics, and only in a few limited cases to any other branch of natural philosophy

*History of Geometry* — It has already been mentioned that geometry is supposed to have had its origin in Egypt [illegible] that country it is said to have been transported into Greece by Thales The celebrated proposition of the square of the hypothenuse was the discovery of Pythagoras Anaxagoras of Clazomene composed a treatise on the quadrature of the circle, and Plato had certainly made considerable advances in the science as is proved by the simple and elegant solution which he gave of the duplication of the cube About fifty years after the time of Plato, Euclid collected the propositions which had been discovered by his predecessors, and formed of them his famous *Elements*, a work which continues to the present day to be regarded as one of the best (if not the very best) introductions to the mathematical sciences It consists of fifteen Books of which thirteen are known to have been written by Euclid, but the 14th and 15th are supposed to have been added by Hypsicles of Alexandria Apollonius of Perga, about 200 years B C, composed a treatise on the *conic sections*, in eight books, and he is said to have been the first who applied to those curves the appellations by which they have ever since been distinguished, — namely the parabola the ellipse and the hyperbola (See Conic Sections) About the same time flourished Archimedes the most illustrious of the ancient philosophers who distinguished himself in geometry by the discovery of the beautiful relations between the sphere and cylinder, by his work on *conoids* and *spheroids* by his discovery of the exact quadrature of the parabola and his very ingenious approximation to that of the circle In the list of names which have come down to our times in connection with geometry, we may mention Eudoxus, Archytas, Eratosthenes, Aristaeus, Dinostratus, and Nicomedes, but for an account of the discoveries or inventions by which they are individually celebrated we must refer to Montucla's *Histoire des Mathématiques* [illegible] Pappus [illegible] it was understood [illegible] may be said to have reached its limits in the hands of Archimedes and Apollonius, and a long interval of 17 centuries elapsed before this limit was passed In 1637 Descartes published his *Geometry*, a work which will ever be remarkable, as containing the first systematic application [illegible] geometrical propositions [illegible] discovery of the *infinitesimal calculus*, and from that time to the present geometry has shared in the general progress of all the mathematical sciences

*Works on the Ancient Geometry* — Euclid, *Elements of Geometry*, and *Book of Data*, Apollonius, *Conics*, Archimedes, *Opera*, Pappus *Mathematicæ Collectiones*, Vieta, *Opera Mathematica*, Huygens, *Opera*, R Simson, *Opera Reliqua*, and *Loci Plani*, Stewart, *Propositiones Geometricæ*, Thompson, *Elements of Geometry*, Legendre *Elements of Geometry*, Leslie, *Elements of Geometry*, &c [illegible] of the numerous editions of *Euclid's Elements* (which have been translated into every European language), see Murhard, *Bibliotheca Mathematica*, but to the list contained in that work should be added the more recent edition of Peyrard, in Greek, Latin, and French (Paris, 1814) An edition of the first six books, in Greek and Latin, by Camerer and Hauber (Berlin, 1824), also deserves to be noticed, on account of [illegible] which is accompanied

GEOPONICA (Γεωπονικὰ *Husbandry*) The name of a Greek compilation of precepts on rural economy, extracted from ancient writers The name of the compiler is unknown, but the authorities which he quotes are numerous, and deservedly celebrated (See Niclas's edition, 4 vols 8vo Leipsic, 1781)

GEORGICS (Γεωργικὰ τὰ περὶ γεωργίαν καὶ τὰ πρὸς γεωργίαν *All that relates to husbandry*) The title of [illegible] four books, on agriculture, and [illegible] It is considered the most perfect of his works

GEORGIUM SIDUS *See* URANUS

GERA'NIACEÆ (Geranium, one of the genera) A natural order of herbaceous or shrubby Exogens, [illegible] world, nearly related to [illegible] *Tropaolaceæ*, with which they are by some botanists associated They are distinguished by the peculiar dehiscence of their fruit, the tumid joints of their stem, and their stipulate leaves Their sensible properties consist in an astringent principle, and an aromatic or resinous flavour Many of them, especially those of the genus *Pelargonium*, are beautiful objects and much cultivated in gardens

GERMAN SCHOOL In Painting In this school we find an attention to individual nature as usually seen, without attempt at selection, or notion of ideal beauty The German painters seem to have set a particular value on high finishing, rather than on a good arrangement and disposition of the subject Their colouring is far better than their drawing, but their draperies are generally in bad taste Though among the painters of this school some are free from the application of these observations they are not sufficient in number to ch[illegible] [illegible] must be passed, in it W[illegible] Holbein and Albert Durer are the heads of it [illegible] is not a pl[illegible] a school which seems [illegible] in Germany and which, with such leaders as [illegible] [illegible] to put the school of painting there on a level with its highly splendid intellectual powers in all other branches of the arts and sciences

GERMEN (Lat *a bud*) In Botany, the organ commonly called the *ovarium*

GERMINATION (Lat germen) The process by which a plant is produced from a seed The phænomena of germination are best observed in dicotyledonous seeds, such for instance, as the bean pea lupin, &c These seeds consist of two lobes or cotyledons, enveloped in a common membrane, when this is removed a small projecting body is seen which is that part of the *germ* which afterwards becomes the root and is termed the *radicle* the other portion of the germ is seen on carefully separating the cotyledons, and is termed the *plumula*, it afterwards forms the stem and leaves When the ripe seed is removed from the parent plant it gradually dries, and may be kept often for an indefinite period without undergoing any change, but if placed under circumstances favourable to its germination, it soon begins to grow these requisite circumstances are a due temperature moisture and the presence of air The most favourable temperature is between 60° and 80°, at the freezing point none of the more perfect seeds vegetate, and at temperatures above 100°, the young germ is usually injured No seed will grow without moisture water is at first absorbed by the pores of the external covering, and decomposed, [illegible] its membranes burst and the germ expand The root is at first most rapidly developed the materials for its growth being derived from the cotyledons, and when it shoots out its fibres or rootlets, these absorb nourishment from the soil, and the plumula is developed, rising upwards in a contrary direction to the root and expanding into stem and leaves For this growth the presence of air is requisite, if it be carefully excluded, though there be heat and moisture, yet the seed will not vegetate Hence it is that seeds buried very deep in the earth, or in a stiff clay, remain inert, but, on admission of air by turning up the soil, begin to shoot forth From experiments which have been made upon the germination of seeds in confined atmo[illegible] [illegible] decomposed [illegible] the seed, and carries it off in the form of carbonic acid, and that the consequence of this is the conversion of part of the albumen and starch of the cotyledons into gum and sugar, so that most seeds, as we see in the conversion of barley into malt, become sweet during germination Light is injurious to the growth of a seed It is, therefore, obvious that the different requisites for germination are [illegible] by placing a seed under the surface of the soil [illegible] by the sun's rays, when it is moistened by its humidity and by occasional showers

excluded from light, but within reach of the access of air.

When the young plant is perfected the cotyledons if not converted into leaves, rot away and the process of nutrition is carried on by the root and leaves the principal nourishment is taken up from the soil by the root and chiefly by its small and extreme fibres, so that when these are injured or torn, as by careless transplantation, the plant or tree generally dies The matters absorbed, consisting of water holding small portions of saline substances and [illegible] form the *sap* of the plant, [illegible] the vessels of the stem, or of the outer layer of wood into the leaves, here it is exposed to the agency of air, or of light it transpires moisture, and occasionally carbonic acid But the leaves also at times absorb moisture, and during the influence of light they decompose the carbonic acid, and, retaining the carbon, evolve oxygen, the sap thus becomes modified in its composition, and the characteristic proximate principles of the vegetable are formed These return in appropriate vessels from the leaves chiefly to the inner bark, where we accordingly find the accumulation of the peculiar products of the plant they also enable it annually to form a new layer of wood Hence it is that the transverse section of the wood exhibits as many distinct zones as the tree is years old We are ignorant of the causes of this circulation of the sap, but that it does follow the cause which has been stated is proved by the operation which gardeners call *ringing* and which they sometimes resort to, to make a barren branch bear flowers and fruit it consists in cutting out and removing a circular ring of bark so as to prevent the return of the sap by the descending vessels, which at first ooze copiously, but afterwards the wound heals and the juices are accumulated in all parts above the extirpated ring, producing tumefaction in the limb, and often inducing a crop of flowers and fruit or causing those to appear earlier than on the uncut branches If a tree be wounded so as to cut into the central portions of the wood, or the outer layer of new wood, the flow of ascending sap is then seen to take place upon the lower section where the vessels are that carry it up to the leaves and the flow of descending is principally confined to the upper section of the inner bark, from which, after a time, new bark is produced, and the parts again united

GE'ROCO'MIA (Gr *γερων, an aged person* and *κομεω, to be concerned about*) That part of medicine which relates to the diet and treatment of old age

GERU'SIA (Gr *γερουσια, an assembly of elders*) In Ancient History the senate of Sparta The number of this council was thirty including the two kings and the qualifications of its members were pure Spartan blood and an age not below sixty years The election was performed in a primitive manner by acclamation the candidates being brought forth one by one before the people He who was greeted with the loudest applause was held to receive the highest honour next the throne The functions of the gerusia were partly deliberative, partly judicial, and partly executive It prepared measures which were to be laid before the popular assembly, it exercised a criminal jurisdiction, with power of capital punishment, and also wielded a kind of censorial authority for the correction of abuses (See *Mem de l Acad des Inscrip* vol xv, *Muller's Dorians*)

GE'SNERA'CEÆ (Gesnera one of the genera) A natural order of herbaceous [illegible] the tropics allied to *Bignoniaceæ*, from which [illegible] the partly inferior one-celled variable ovary [illegible] habit from *Cyrtandraceæ* [illegible] many-seeded placenta, and albuminous seeds, from *Scrophularineæ* by the same characters, with the exception of the seeds [illegible] sometimes eatable much like [illegible] Many beautiful species of *Gloxinia* [illegible] are known in our gardens

GEYSERS (Icel Icelandic word signifying *raging* or *roaring*) The celebrated spouting fountains of boiling water in Iceland The Geysers are situated about 30 miles from the volcano Hecla, in plains full of hot springs and [illegible] Their jets are intermittent [illegible] their rise appears to vary much at different times Olafsen and Povelsen state that of the Great Geyser, when they saw it at 550 feet Few English travellers have seen it spout higher than 90 or 100, but Mr Henderson saw it reach 150 feet in 1815, and one of the smaller Geysers, when a stone was thrown into it, 200 The latest account of the Geysers is in the work of the Hon A Dillon (*A Last Trip to Iceland* 1840)

GHAUTS A term applied originally to the narrow and difficult passes in the mountains of Central Hindostan, but which has been gradually extended to the mountains themselves They consist of two great chains extending along the east and west coasts of the Deccan parallel to each other, or rather diverging, and leaving between them and the sea only a plain of 40 or 50 miles in breadth The precise altitude of these mountains has not been ascertained but their general [illegible] is from [illegible] to 8000 feet, and while the [illegible] of the Eastern Ghauts has been limited to a line of 300 miles, the chain of Western Ghauts is said to extend without interruption nearly 1000 miles. See *Murray's Encyc of Geography*

GIBBRIS See GITTERN

GIBELLINES [illegible] the name of a political party, which [illegible] German emperors over [illegible] to investure [illegible]

GHOST See DÆMON DEMONOLOGY APPARITION

GHOST, HOLY, ORDER OF The principal military order of France under the old regime, instituted in 1574 by Henry III for nobles only, abolished at the Revolution, reconstituted by the Bourbons

GIANT (Gr *γιγας*, said to be [illegible] with *γη, earth*, *earth-born*) The giants of [illegible] same with the Titans, although frequently confounded with them in poetry the latter were produced by Earth to combat Saturn, the former afterwards, against Jupiter (*Servius ad Æn* iii 40) They were destroyed by the gods of Olympus, in the famous giganto-machia, or giant-fight of which the scene was laid in the Campi Phlegræi of Campania The appellation "giant" in the Old Testament given to various races of men, is thought rather to refer to violence power, &c, than to actual stature, but individual giants, such as Og and Goliath, are undoubtedly recorded In Northern Mythology the giants were the [illegible] inhabitants of the earth (*Olaus Magnus* book v) called [illegible] There is a learned as well as amusing article on this subject in the *Enc Met* (See for remarks on natural deviations from ordinary stature in individuals and races of men, *Prichard's History of Mankind*, vol ii, Lawrence, *Lectures on Man*)

GIAOUR (Turk *a dog*) An epithet conferred on all, but more especially on Christian unbelievers, as those who do not profess an adherence to Mohammedanism are styled by the Turks

GIBBET, or JIB The projecting beam of a crane on which the pulley is fixed

GIBBOUS (Lat gibbus *a hunch*) Humped When a surface presents one or more large elevations

GIBBOUS (Lat gibbus *convex, protuberant*) This term is applied in Astronomy to the appearance of the moon when more than half full or enlightened In the telescope, the planet Venus exhibits a similar appearance

GILSECKITE A mineral discovered in Iceland by Giesecke It is a hydrated silicate of alumina and potash it occurs in brownish hexagonal prisms

GIFT in Law is in its general sense, a conveyance which passes either lands or goods But when restricted to immoveable property, it signifies in its proper sense the creation of an estate tail (See FEE-TAIL) It is so termed from the operative words of the conveyance, which are always I give or "have given" A gift of personal property differs from a grant in being wholly gratuitous and without consideration

GIGA or JIG (Ital) In Music, an air for dancing in triple time usually $\frac{6}{8}$ or $\frac{12}{8}$

GIGANTOMACHIA (Gr *γιγας a giant* and *μαχη, a battle*) In Painting representations of combats with or between giants The term is more particularly applied to the conflicts waged between Jupiter and the giants See GIANT

GIG A well known kind of light carriage drawn by one horse [illegible] covered with [illegible]

GILDING The application of a superficial coat of gold on wood, metal and other materials The beauty and durability of gold render it the most valuable of all ornamental substances, but on account of its [illegible] its use in these respects would be [illegible] were it not the most extensible and divisible form of matter, so that it may be made to cover a larger surface than an equal quantity of any other body Metals are usually covered with gold by the process of *water gilding* It consists in perfectly cleaning their surface, and then, in the case of silver, for instance, rubbing it over with a solution of gold in mercury, called *amalgam of gold* the vessel is then heated over a clear charcoal fire, by which the mercury is driven off, and the gold left adhering to the silver surface, upon which it is afterwards burnished The surface of copper or brass is usually prepared by cleaning and rubbing it over with a solution [illegible] which amalgamates the surface, and [illegible] when subsequently applied, to [illegible] burnishing are then resorted to as before Brass and copper buttons are gilt in this way, and the requisite quantity of gold is so small that twelve dozen buttons of one inch diameter may be completely gilt upon both surfaces by five grains of gold Other kinds of gilding are performed by gold leaf, which, if intended for out door work, is laid on by the help of *gold size*, which is drying oil mixed with calcined red ochre, or, if for picture and looking-glass frames, they are pre-

pared by a size made by boiling parchi[illegible] to a stiff jelly and mixed with the [illegible] ochre The leaves of books are [illegible] brushing them over, while in the binder's press, with a composition of four parts of Arminian bole and one of powdered sugar candy mixed up with white of egg, this coati[illegible] then [illegible] burn[illegible] leath[illegible] iron [illegible] heated and pressed upon a piece of leaf-gold, which slightly adheres to it, being [illegible] to the leather with a certain force [illegible] impression, and, softening the mastic, transfers and fixes the gold In gilding glass and porcelain, powdered gold is blended with gum water and a little borax, and applied by a camel hair pencil, the article is then put into an oven or furnace, the gum burns off, and the borax, by vitrifying, cements the gold to the surface, upon which it may afterwards be polished by the burnisher Within [illegible] ilt articles manufactured [illegible] neck-chains, ear-rings, [illegible] process patented by Mr Elkington, in which, after the articles have been properly cleansed by a weak acid, they are immersed in a hot solution of nitromuriate of gold, to which a considerable excess of bicarbonate of potash has been added, in the course of a few seconds they thus receive a beautiful and permanent coat of gold

GILLIESIACEÆ (Gilliesia, one of the genera) A small natural order of Exogens, allied very nearly to *Liliaceæ*, of which they may in fact be considered an anomalous form Their principal peculiarity consists in [illegible] externally by calyx- [illegible] little known, and of no known use

GILLS Parts of the body are so called in which the blood-vessels are in greater number than is necessary for mere preservation or growth, and are minutely subdivided for the purpose of submitting the blood to the influence of air contained in water

GIMBALS, or GIMBOLS (Lat gemellus, *a pair*) A piece of mechanism consisting of two brass hoops or rings which move within one another, each perpendicularly to its plane, about two axes placed at right angles to each other A body suspended in this manner, having a free motion in two directions at right angles will assume the vertical position hence the apparatus is employed for suspending portable or mountain barometers, sea-compasses, &c

GIMLETTING THE ANCHOR Turning it by the stock round its shank as an axis, like a gimlet

GIMP Silk twist, interlaced with brass or other wire

GIN (Fr genievre, *juniper*) Ardent spirit flavoured by the essential oil of juniper It was originally made by the Dutch and is hence distinguished in this country by the name of Hollands The liquor bearing the above name in this country is of British manufacture and is frequently flavoured by oil of turpentine, and rendered biting upon the palate by caustic potash In Holland, the finest gin bears the name of Schiedam, the principal place of its manufacture, and where there are many distilleries Owing to the excessive duty 22*s* 6*d* per gallon, gin is one of the principal articles of clandestine importation *See* SPIRITS

GIN, in Mechanics, is a machine used for raising great weights, driving piles &c It usually consists of three long legs or spars, which support a pulley at the top, round which a rope is passed [illegible]

GINGER The dried rhizome of *Zingiber officinale*, a native of the East Indies and [illegible] cultivated in America and the West India islands, whence Europe is chiefly supplied It is a good stimulant and carminative, and the fresh root preserved makes an agreeable, warm, and not very unwholesome sweetmeat The acrimony of ginger appears to reside in a peculiar extractive matter which is soluble in alcohol, hence a spirituous tincture of [illegible] the root

GINSENG [illegible] word applied to the root of [illegible] lavour [illegible] where its consumption is very great It is found chiefly in the [illegible] to China 407,067 lbs of ginseng, valued at 99,303 dollars (Se[illegible]

GIRAFFE, The tallest quadruped on the face of the earth and the largest animal of the Ruminant order Pliny tells us that it was called *Nabun* by the Troglodytes of Ethiopia and *camelopardalis* by the ceremonial at Rome *Nabun* Tulit ipse vocant collo similem cervo pedibus et cauda bos camelo capite albus iaculis suae tantum distinguentibus, unde appellata *cum Dictatore Caesaris* circensibus ludis primum visa Romæ" (*Hist Nat* lib. viii) The natural philosophers of Rome had again, subsequent to the gorgeous spectacles of Cæsar, the means of studying the [illegible] Not fewer than ten of these rare and beautiful animals were publicly exhibited at one time by the third *Gordian*, which afterwards were [illegible] the naturalists of Rome is comprised in the brief notice above quoted from the writings of Pliny, a notice which is too vague to have served to enable us again to recognize the strange compound of horse, ox, camel, and pard exhibited to the wondering Romans, had it not been more intelligibly recorded in medals, mosaic pavements, and the ornaments of public buildings The resemblance of the giraffe to the horse in regard to its neck is restricted to the presence of a mane, composed of short stiff black hairs, which resembles rather that of the gnu or ass In the length, slenderness, and flexibility of the neck the giraffe surpasses all other quadrupeds the comparison of the leg and foot of the giraffe to those of the ox is still less fortunate, because the two posterior or spurious hoofs common to the ox with most other Ruminants are wanting in the giraffe, as in the camel, but the toes are not joined to a common broad elastic sole, as in the camel, they are completely separated, and provided each with a well-formed sharp-pointed hoof The head of the giraffe resembles that of the camel in the absence of a naked muzzle and in the shape and organization of the nostrils, which are oblique and narrow apertures, defended by the hair which grows from their margins, and surrounded by cutaneous muscular fibres by which the animal can close them at will This is a beautiful provision for the defence of the air passages and the irritable membrane lining the olfactory cavities, against the fine particles of sand which the storms of the desert raise in almost suffocating clouds The large, dark, and lustrous eyes of the giraffe, which beam with a peculiarly mild but fearless expression, are so placed as to take in a wider range of the horizon than is subject to the vision of any other quadruped While browsing on his favourite acacia the giraffe, by means of his laterally projecting orbits, can direct his sight so as to anticipate a threatened attack in the rear from the stealthy lion, or any other foe of the desert To an open attack he sometimes makes a successful defence by striking out his powerful and well-armed feet, and the king of beasts is said to be frequently repelled and disabled by the wounds which the giraffe has thus inflicted with his hoofs The horns of the giraffe, small as they are and muffled with skin and hair, are by no means the insignificant weapons that they have been supposed to be We have seen them wielded by the males against each other with fearful and reckless force, and we know that they are the natural arms of the giraffe most dreaded by the keeper of the present living giraffes in the Zoological Gardens, because they are most commonly and suddenly put in use The giraffe does not butt by depressing and suddenly elevating the head, like the deer, ox, or sheep, but strikes the callous obtuse extremity of the horns against the object of his attack with a sidelong sweep of the neck One blow thus delivered at full swing against the head of an unlucky attendant would be fatal —the female once drove her horns in sport through an inch deal board Notwithstanding those natural arms of hoofs and horns, the giraffe does not turn to do battle except at the last extremity, where escape is possible, it seeks it in flight This is extremely rapid, especially along rising ground, but cannot be maintained for a sufficient period of time to enable it to escape the Arab mounted on his long winded steed The paces of the giraffe, owing to the disproportion between his long legs and short body, are very peculiar, when walking at a brisk rate, it seems to move forward simultaneously the two legs of the same side, as noticed of old by the learned bishop of Sicca in his account of the presents brought to Hydaspes by the ambassadors of the Axeomitæ (Abyssinians) "It differed," says Heliodorus, "in gait from every other land or water animal, and waddled in a remarkable manner each leg did not move alternately, but those on the right side moved together independently of the other, and those on the left in the same manner, so that each side was alternately elevated" Both legs of the same side are undoubtedly off the ground at [illegible] the greater part of the step, but upon a close inspection the hind-leg is always seen to be first lifted from the ground and after [illegible] the leg of the same side is moved In the Surrey [illegible] to the giraffes in the Zoological Gardens, [illegible] in the warm days of summer all their various and singular paces In the simple walk the neck, which is then stretched out in a line with the back, gives them a stiff and awkward appearance, but this is entirely lost when they commence their graceful undulating canter To judge by the movement of the legs, this pace appears to be less rapid than it

actually proves, when the extent of ground is observed over which it has carried them in a given time The motions of the legs are now very peculiar and uncommon, the hind pair are lifted alternately with the fore, and are carried, or rather swung forward, outside of and beyond them at each bound When excited to a swifter pace they often kick out their hind-legs during their course, and their nostrils are then actively and unwontedly dilated The general figure of the giraffe, its raised anterior parts elongated neck light and tapering head and long slender and flexible tongue are all admirably harmonize with its geographical position and the nature of its food No Ruminant of its magnitude could exist in the arid tropical regions to which the giraffe is peculiar if it were not modified so as to be able to obtain vegetable sustenance independently of ordinary pasturage But in those localities shrubs and trees continue to put forth buds and leaves when all the herbage on the surface of the earth is scorched up, and it is for the purpose of [illegible] food supplied by lofty branches that the Ruminant type is modified in so extraordinary a manner as we witness it in the giraffe A zoologist, ignorant of the giraffe could never have anticipated or conceived so beautiful and perfect a solution of this difficult problem in the scheme of animal enjoyment The tongue is an organ exquisitely formed for prehension, it is used to hook down the branches which grow beyond the reach of the muzzle of the giraffe, and the animal in captivity instinctively puts it to use in a variety of ways We have seen the giraffe in the Jardin des Plantes at Paris, stretching upwards its neck and head, and protruding its tongue to the full extent to hook out single straws, which were platted into the partition separating [illegible] contiguous inclosure In our own metropolis at Regent's Park many a fair lady has been robbed [illegible] which adorned her bonnet by the nimble filching tongue of the rare object of her admiration The giraffe seems, indeed, to be guided more by the eye than the nose in the selection of objects of food, and if we may judge of the apparent satisfaction with which the mock leaves and flowers so obtained are masticated, the tongue would seem by no means to enjoy the sensitive in the same degree as the motive powers The difference in the size of the nerves of sensation and motion which we observed in the dissection of the tongue accords with these habits of the living animal From the same dissection it was proved that the movements of the tongue, both those of extension, prehension and retraction were due to muscular, and not, as Sir Everard Home supposed to vascular action Observations of the living animal, and dissection of the dead have at length dispelled most of the errors and doubts which obscured the exact knowledge of the nature and zoological affinities of the giraffe Up to a very recent period we find it described as having callosities on the knees and over the sternum like the camel and as bearing on the head three horns, of which one being articulated over a suture in the middle line of the forehead, seemed to take away from the chimerical nature of the unicorn by indicating a transition to that heraldic monster The truth is however that the giraffe possesses neither those callosities nor this median articulated horn It is essentially a true Ruminant, having a stomach divided into four compartments, the paunch being simply papillose, without water bags, and the reticulum with extremely shallow hexagonal cells, as in the reindeer It is also a horned Ruminant, the horns being two in number small straight and simple, like those of the pricket deer But in the giraffe the bony base of each horn is articulated by a broad rough epiphysial basis to the cranium, it is covered by a vascular periosteum and a hairy integument, which is not deciduous These horns, or rather antlers terminate [illegible] covered with a callous plate and [illegible] black hairs these horns are present in both sexes as in the reindeer, and are larger in the male The median protuberance is a simple thickening of the contiguous parts of the frontal and nasal bones In the form of the mouth the giraffe differs from every other Ruminant The upper lip is not bifid, as in the camel [illegible] enlarged and covered with hair, as [illegible] elegant and tapering form

The giraffe has a long neck and it has not spurious hoofs and this far it resembles the camel, but the cervical vertebræ in the camel tribe present a peculiarity of structure combined with [illegible] which the giraffe does not participate The camel-tribe have many other peculiarities of internal organization, to some of which we find resemblances in certain ordinary Ruminants but not in the giraffe Its place in the Ruminant series is between the deer and antelope These extensive families are respectively distinguished, not only by the nature of their horns, but by a well-marked anatomical character the gall-bladder is present in the antelopes, and not in the deer In three giraffes lately dissected in this country a gall-bladder was [illegible] in that in which it was discovered it presented an abnormal structure being bifid at the fundus, and divided into two compartments We may infer, therefore, that in this part of their organization as in the structure of their horns, the giraffes are more nearly akin to the deer tribe than to the antelopes Yet it must not be forgotten that while we search in vain among the *Cervidæ* for an equine mane and tufted tail, such as ornament the giraffe, we find both these peculiarities combined in the gnu among the antelopes A giraffe more than two thirds grown will eat daily in confinement eighteen pounds of clover-hay and eighteen pounds of a mixed vegetable diet, consisting of carrots, mangel-wurzel barley, split beans, and onions, and will drink four gallons of water They copulate in March The female has four inguinal udders she brings forth one young one at a birth, and the period of gestation is fifteen months The new-born giraffe measures six feet from the fore-hoofs to the top of the head In a few hours it is able to follow the dam It resembles the mature animal in the markings of the hide The first giraffe known to have been produced in captivity was brought forth in June, 1839, at the gardens of the Zoological Society of London

GI'RASOL A milk-white or bluish opal, which, when turned to the sun or any bright light, reflects a reddish colour, hence its name, from gyro, *I turn*, and sol *the sun*

GI'RDER (Sax gyrdan, *to inclose*) In Architecture a principal beam in a floor for supporting the binding or other joists, whereby their bearing or length is lessened Perhaps so called because the ends of the joists are inclosed by it

GI'RDLE (Anglo Sax girdan, *to encircle*) A belt or band of leather or some other substance used in girding up the loins The girdle (Gr ζωνη Lat cingulum) was in use among the Hebrews, Greeks, and Romans for various purposes more or less important By the Hebrews it was worn chiefly upon a journey, and sometimes as a mark of humiliation and sorrow and by the Greeks and Romans it was used as a military ornament Hence in the Latin phrase [illegible] *præcinctus* denoted 'to quit the service' [illegible] girdle was the deepest mark of ignominy with which he could be branded and even to [illegible] the civil [illegible] who always wore a girdle over the [illegible] to render their motions unembarrassed, the want of this appendage was considered strongly presumptive of idle and dissolute propensities In conformity with this opinion or perhaps in allusion to the occasional substitution of the girdle for the purse among the Romans Horace has affirmed that 'you may do what you please with him who has lost his girdle,"—

Ibit eo quo vis qui zonam perdidit

*Zonam solvere virgineam* was a well-known phrase appropriated to the marriage ceremony To Venus was attributed by the poets the possession of a particular kind of girdle called *cestus*, which was said to have the power of inspiring love

It was formerly the custom in England for bankrupts or other insolvent persons to put off and surrender their [illegible] courts

GI'RONDE, THE In French History, a celebrated political [illegible] the Revolution, its members were termed [illegible] The name was derived from that of the department La Gironde (in which Bordeaux is situated) which sent to the legislative assembly of [illegible] eloquence and [illegible] who were among the chief leaders of the party Its principles were republican During the continuance of that assembly the Girondists formed a powerful, but not always consistent party Out of these Louis XVI chose his republican ministers in the beginning of 1792 But after the massacres of September in that year the party in general withdrew from all connection [illegible] and approximated towards the [illegible] Convention the Girondists at first commanded a majority, but on the king's trial they were much divided, and, being pressed by the violence of the sections of Paris, they were at length expelled the assembly thirty-four of them were outlawed, and finally twenty-two of their leaders guillotined (7th and 31st October, 1793), while a few escaped, and others put an end to themselves Perhaps the most celebrated member of the Gironde party was a lady, Madame Roland, the wife of the minister of that name, who was executed when the party fell, and whose writing — the *Appel au Peuple* — bears all the stamp of that high republican enthusiasm which characterized them (The remaining part of her memoirs is of suspicious authenticity) Various apologies and eulogies of the party have appeared Its members were not without [illegible] but its counterpart will be found in all revolutions, in that body of men of high theoretical views of social reform and little practical knowledge, who are commonly lifted into power by supporters more energetic but less high-principled than themselves at one turn of affairs, and sure to be thrust down in a short time by their own former adherents (See Particularly the

histories of Mignet and Thiers, for general views on the subject, for details the *Histoire Parlementaire* of Messrs Buchez and Roux, who are perhaps too unfavourable to the party

GIRT LINE A rope to lift the rigging up to the mast head on first rigging the ship

GIVEN, in Geometry, signifies something that is known The straight line is given in *position* when we know the situation of two points through which it must pass, and it is given in *magnitude* when we know its length A triangle is given in *species* when we know the magnitude of each of its three angles, and a circle is given when we know its centre and radius

GLA'BROUS (Lat glaber, *smooth*) A term applied in Mammalogy to those parts of the surface of a quadruped which are naturally devoid of hair, and in Entomology when a surface is smooth and devoid of hair or pubescence

GLA'CIERS (Fr) The name given to the immense masses of ice which accumulate on the peaks and slopes, and in the upper valleys, of lofty mountains The phenomena [illegible] of the most interesting subjects [illegible] whether we regard their formation, structure, or appearance In all parts of the globe they have the same general characteristics, but though the glaciers of other countries have often been described by geographers and naturalists, it is chiefly in respect to those of Switzerland that we possess detailed information In that country, as indeed in every other, those parts of the mountains that rise above the line of congelation are covered with perpetual snow, which being partially thawed during the summer months, is on the approach of cold converted into ice thus constituting what is called a *glacier* The [illegible] slopes of the mountains [illegible] ridges are furrowed, where it accumulates into vast beds or fields, presenting, where the descent is gradual, a very level surface, and with few crevices, but where there is a rapid or rugged [illegible]*, and covered with [illegible] Though the snow line on the Alps is found at an elevation of about 8000 feet above the level of the sea some of the glaciers descend so far downward that their lower extremity is not more than 3500 feet above it This is particularly the case in the valley of Chamouni, where the singular spectacle is presented of huge pyramids of ice of a thousand fantastic shapes in juxtaposition with the most luxuriant pastures, or towering in majestic grandeur in the midst of verdant forests The principle of the descent of the glaciers is twofold viz one of a slow and gradual character, like the dunes of France by which a progressive movement of about twenty-five feet annually is effected, the other of a rapid and impetuous kind in which a portion of the ice having been disrupted from the main body glides down the mountain's side, accumulating as it goes, and precipitating into the valleys beneath immense stones, fragments of rock, and other substances to which it had adhered Philosophers and naturalists have attributed this downward movement of a glacier to various causes, but by far the most prevalent opinion respecting it is that of Saussure, who maintained it was nothing more than a slipping upon itself, occasioned by its own weight On the other hand, M Agassiz ascribes this motion to the expansion of the ice, resulting from the congelation of the water which has filtered into it and penetrated its cavities, while Mr R Mallet is inclined to attribute it to the hydrostatic pressure of the water which flows at the bottom and makes rents in the mass When the debris which the [illegible] in their descent has been deposited [illegible] constitutes what in Savoy is termed their *moraine* or border, an essential feature in the Alpine glaciers These borders present every variety of aspect, but their most usual appearance is that of unfathomable bogs or morasses wholly destitute of vegetation and in [illegible] infinite peril to the traveller [illegible] ranged in long ridges or mounds from 30 to 40 feet high, and being often two, three, or even four in number, resemble so many lines of entrenchment

The Alpine glaciers occupy a superficial extent of 1484 square miles From Mont Blanc to the borders of the Tyrol there are reckoned about 400, of which the greater number varies from 10 to 15 miles long, and from 1 to 2½ broad, their mean vertical thickness ranges from 100 to 600 feet Besides the grand and picturesque appearance they present externally, their lower extremities are sometimes excavated by the melting of the ice into the form of immense grottoes, adorned with the finest stalactitic crystallizations, whose brilliant azure tints are reflected on the foaming streams and torrents which generally issue from these caverns, forming altogether so

* "These chasms are frequently many feet wide and more than 100 deep Their formation, which never takes place in winter, but [illegible] a loud noise resembling adjacent mountains [illegible] Thus are [illegible] Lucretius [illegible] Ovid [illegible] Sublime Dryden [illegible] Gray *Progress of Poesy*



beautiful and imposing a picture as to defy the most faithful pencil to portray it adequately The glacier ice does not resemble that of lakes and rivers not being [illegible] crystals [illegible] less, the solidity, nor the transparency of river ice, and though 'every single crystal seems perfectly white, the whole mass is of a blue colour, passing through every variety of shade, from the most feeble sky blue to that of the lapis lazuli" From the large accessions of snow and ice which the glaciers receive, especially in winter it might reasonably be conjectured that they must be gradually increasing in size, and would consequently in the course of time break through their usual limits and overwhelm the cultivated lands of the surrounding country This, however, is by no means the case It no doubt often happens that on some occasions the glaciers are observed to descend lower than usual, but, when this takes place, the warm atmosphere of the lower valleys into which they have advanced (whose temperature rises in proportion to their depression) operates with such powerful effect in reducing their bulk, that they are invariably found to recede proportionably Thus nature has established a compensating process, by which an effectual [illegible] valleys There are various other phenomena connected with the glaciers, for a full account of which the reader is referred to *Saussure's Voyage dans les Alpes*, and the elaborate researches of Prof Forbes See also *M Culloch's Geographical Dict*, art "Alps," *Penny Cyclo*, art "Glacier"

GLA'CIS In [illegible] earth, extending from th [illegible] to the level country

GLADIA'TORS (Lat gladiatores, from gladius, *a sword*) Sword players, who were originally employed to fight at the funerals of illustrious Romans, in order to appease their manes by the effusion of blood They were subsequently introduced into the public amphitheatres, and became one of the most favourite spectacles of the Roman people The gladiators were either captives or condemned criminals, or else people of the lowest rank, who served for hire, the profession being considered one of the greatest infamy In spite of this, however, under some of the emperors, persons of the first families who had enjoyed the highest honours of the state, entered the arena, either at the command of the despot, or in order to gratify him, and even females of patrician blood, in some instances followed their example Gladiators did not merely use the sword, as their name strictly implies, but were armed in various ways (*See* MIRMILLO and RETIARIAN) The gladiators were, in general desperate and ruthan characters, and considerable bodies of them were sometimes kept in the pay of wealthy and turbulent citizens, or hired as bullies Perhaps the best exposition of the opinion of the more philosophical Romans on the subject is thus given by Cicero —'Crudele gladiatorum spectaculum et inhumanum nonnullis videri solet et haud scio an non ita sit, ut nunc fit cum vero sontes depugnabant, auribus fortasse multa, oculis quidem nulla poterat esse fortior contra dolorem et mortem disciplina" (*Tusc Quæst* 2 It is true but inexactly said that the shows of [illegible] were put a stop to by the Christian emperors They certainly had not ceased in A D 404 and probably not before the conquest of Italy by the Goths (Beugnot, *Destruction du Paganisme en Occident*, book ix ch 2)

GLADIUS (Lat) The name of the internal horny plate of the calamaries, which was called by the Greeks ξίφος or the sword

GLANCE COAL *See* ANTHRACITE

GLAND In Anatomy This term is applied to those organs of the body in which *secretion* is carried on, and which appear to consist of a congeries of blood-vessels, nerves, and absorbents they are frequently distinguished according to their secretion, into mucous, sebaceous, lymphatic, and lachrymal, or, according to their form and texture, into simple, compound, conglobate, and conglomerate

GLANDS LENTICULAR In Botany, a term in[illegible] [illegible] the bark [illegible] [illegible] They are, in fact, nothing but protuberances formed by the pressure upon the epidermis of subjacent roots attempting to pierce through it

GLASS (Germ) A transparent, impermeable, and brittle substance There are several varieties of glass, applicable to different [illegible] in their composition Its essential ingredients are silica and potash or soda, to which a variety of other substances are occasionally added, one of the most common and important of which is oxide of lead, by which the fusibility and density of the glass is increased, so that it is more easily worked, and more brilliant, especially when ornamented

by cutting of this latter description is the glass called *flint glass*, used for decanters drinking glasses, chandeliers, &c It consists of about 52 parts of silica, 34 of oxide of lead, and 14 of potash Chemically speaking, therefore, it is a double silicate of potash and lead, containing 12 atoms of silica, 1 of potash, and 1 of oxide of lead *Crown glass*, used for windows, is a compound of silica and soda, with a portion of lime *Green bottle glass* is made of a mixture of sand with impure wood ash, kelp and a portion of brick clay These kinds of glass are manufactured by the operation called *blowing Plate glass* was invented in Britain [illegible] was first introduced in Paris in 1688 It may be composed of 300 lbs of fine sand 90 of soda 100 of [illegible] 2 of black oxide of manganese, 3 of cobalt azure, and 300 lbs of fragments of good glass These materials, when in perfect fusion, are poured upon a heated [illegible] the mass is then rolled out and reduced to a board olished by grinding with sand, emery and colcothar The difficulty of producing a perfect plate, without specks, bubbles, or waves, together with the risk of breakage, render large plates very expensive on account of their necessary thickness they are also very heavy

The manufacture of glass is one of the highest beauty, and considering the worthlessness of the materials of which it is made, and the various purposes of a useful, ornamental, and scientific nature which it subserves, may be regarded as perhaps the most important in the history of inventions The period of its invention is involved in great obscurity, but if we believe Pliny we are indebted for this necessary of life, as we are for the gift of letters, to the Phœnicians The popular opinion upon this subject refers the discovery to accident*, but, as Dr Ure has observed, there were circumstances in the ancient arts likely to lead to it, such as the fusing and vitrifying heats required for the formation of pottery and for the extraction of metals from their ores But be this as it may, the Egyptians were certainly acquainted with the art of glass-making, for in some nomes glass beads have been found coloured with a metallic oxide, and pieces of glass have been discovered in the ruins of Thebes (See M Boudet *Desc de l'Egypt*, vol ix , *4ul Memoires*) In Strabo and Pliny's time, the inhabitants of Sidon and Alex were famed for the production of beautiful glass, which they cut, engraved, gilt, and stained of the richest colours, in imitation of precious stones and exported to all parts of the then civilized world At Rome too, glass was manufactured into various articles of convenience and ornament, and so great was the luxury of this article or so exquisite its manufacture in those days, that Nero is reported to have given 6000 sesterces for two glass cups For a long time Venice is said to have excelled all the countries of Europe in this manufacture, of which indeed, it may be said to have enjoyed a monopoly till about the middle of the 17th century, when the invention of blown mirror glass by Colbert gave France a decided superiority over its rival At what period the manufacture of glass was introduced into England is not precisely known, but there can be no doubt that till near the close of the 17th century this country was obliged to have recourse to foreigners
article of drinking glasses [illegible]
ingham materially improved the fabrication of British plate glass by bringing over several Venetian artisans to the works at Lambeth, which were under his patronage, and the manufacture was still further improved by the arrival of the French refugees subsequently to the revocation of the edict of Nantes The above works however, were soon abandoned, and it was exactly one century (1773) later that the first establishment of magnitude for the production of plate-glass was formed under the title of "The Governor and Company of British Cast Plate-Glass Manufacturers" This company was incorporated by act of parliament, and soon after erected works on an extensive scale at Ravenhead, near Prescot, in Lancashire, which have continued in constant operation down to the present time Since that period immense improvements have been made in the manufacture of every species of glass [illegible] all the countries of Europe, though the art [illegible] to have reached perfection [illegible] land and Bohemia

[illegible] glass to the glazing of windows is of [illegible] though it was [illegible] ings as early as the third or fourth century In London, this manufacture was first begun in 1557, but that the use of window-glass was by no means universal even twenty years later [illegible] Castle the residence of the Duke of No[illegible] glass casements used at that period to be taken down in the absence of the family, to preserve them from accident

In Scotland, even in the early part of the last century, glass was seldom seen in the windows of country houses, and a few years previously, even in the royal palaces and the town houses of the nobility, the windows of the upper stories alone were furnished with it Since that period, however, a mighty change has been effected, for now even the windows of the meanest cottage in Great Britain are, almost without exception, supplied with glass which ought rather to be considered as a necessary of life, than as the most elegant and useful of conveniences

The principal seats of the manufacture are beyond all comparison Newcastle and South Shields, but it is also carried on with great success at Stourbridge, Dudley, [illegible] Warrington, and to a considerable [illegible] Leeds, Manchester and London The value of the glass annually produced in the United Kingdom is estimated at 2 000,000*l*, and the workmen employed in the different departments at upwards of 50,000

We are glad to have to state that the glass manufacture has been emancipated from all fiscal restraints the duties on glass having been abolished by the act 8 Vict c 6, which took effect from the 5th of April, 1845 The beneficial influence of this liberal and most judicious measure is already obvious in the increased cheapness and greater variety of descriptions of glass in the market, and there can be no doubt that its advantages will become still more and more obvious from the facilities it gives for the introduction of improvements, and consequently, for ameliorating the quality as well as reducing the cost of one of the most useful and admirable of the products of art and industry (For further information see the article "Glass," in McCulloch's *Commercial Dictionary*)

GLASS PAINTING In Painting The method of staining glass in such a manner as to produce the effect of representing all the subjects whereof the art is susceptible A French painter of Marseilles is said to have been the first who instructed the Italians in this art, during the pontificate of Julius II It was however, practised to a considerable extent by Lucas of Leyden, and Albert Durer The different colours are prepared as follows —*Black* is composed of two thirds of iron scales or flakes and the other third of small glass beads or a substance called *roccaglia* by the Italians *White* is prepared from sand, or small white pebbles, calcined pounded and then ground finely, one fourth part of saltpetre is added, and the mixture is then again calcined and pulverized when dyed a little gypsum or plaster of Paris is added *Yellow* is formed from leaf silver ground and mixed in a crucible with saltpetre or sulphur then ground on a porphyry stone, and lastly ground over again with nine times the quantity of red ochre *Red* one of the most difficult of the colours to make, is prepared of litharge of silver and iron scales, gum Arabic ferretta glass beads, and bloodstone in nearly equal quantities Experience alone will command success in making this colour *Green* is formed from æs ustum one ounce the same quantity of black lead, and four ounces of white lead, incorporated by the action of fire When calcined a fourth part of saltpetre is added, and after a second calcination a sixth part more, after which a third coction is made before using it *Azure*, *purple*, and *violet* are prepared in a similar manner to green, omitting the æs ustum, and in its stead using sulphur for azure, perigneux for purple, and both these drugs for violet *Carnations* are compounded colours, are calcined, and mostly mixed with water, and must be finished part by part, and each with great despatch, before the plaster dries, and there is little opportunity for blending The lights cannot be heightened, but the shadows may when they begin to dry, be a little strengthened Promptitude and facility in execution are the great requisites for this method of painting *See* CARTOON

GLAUBER'S SALT Sulphate of soda originally made by Glauber, in his process for obtaining muriatic acid, by distilling a mixture of common salt and sulphuric acid

GLAUCOLITE (Gr γλαυκος, *blue*) A mineral of a bluish green colour, found near the lake Baikal, in Si [illegible] alumina and lime

GLAUCOMA (Gr γλαυκος) A disease of the eye, supposed to arise from dimness of the vitreous humour, and giving it a bluish green colour

GLAUCOPIS (Gr γλαυκος, and ωψ *an eye*) A genus of Passerine birds established by Forster and including certain species remarkable for the presence of fleshy wattles attached to the base of the beak, whence they are commonly termed wattle birds Temminck characterizes the genus as follows —Bill moderate, strong, and thick, with the base enlarged towards the commissure, upper mandible convex, vaulted, curved [illegible] and without any notch, lower mandible [illegible] nature of the upper, straight below, hidden in part by the sides of the upper mandible Nostrils basal, lateral, round, partially closed by a large

* [illegible] accident —A [illegible] mouth of the river Hermus, [illegible] weather, [illegible] peas [illegible] the vessels [illegible] lumps of the natron upon the sand as supports to the kettles found, to their surprise, masses of transparent stone among the cinders

membrane, and entirely hidden by curled feathers advancing from the forehead Feet robust the [illegible] than the mid toe, toes nearly of the same [illegible] base of the inner toe, and nearly the whole of the outer toe, attached to the middle toe Wings short, the first quill short, the three following graduated, and the fifth [illegible] Tail long and graduated

GLAUCOUS Sea green, a term used in describing the colour of bodies, to denote a dull green passing into blue Also used in describing the polish of bodies, to [illegible] olour [illegible] this

GLAUCUS (Gr γλαυκος, *blue*) In Grecian Mythology the name of a marine deity, the son, according to some of the [illegible] of Neptune, and one of the Naiads, [illegible] of Polybius and Alcyone He enjoyed the power of prophecy

In Zoology, *Glaucus* is the name [illegible] of Nudibranchiate Mollusks, remarkable [illegible] azure tint The species of *Glaucus* are found in the warmer la[illegible] the open sea

GLEANING (Fr glaner) The practice of collecting corn left in a harvest field after the harvest has been carried, which (Levit c 19, Deut c 24) appears by the Mosaic law to have been allowed to the poor The right of the poor to glean is, however, not admitted in the English common law

GLEBE (Lat gleba, *arable soil*) In Law church land, usually taken for that which is annexed to a parish church of common right, and belongs to the parson or vicar

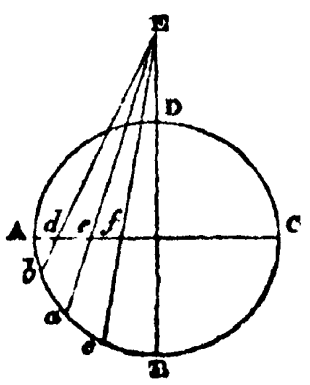
GLEE In Music, a composition for voices in three or more parts The subjects of the words are various being gay grave, amatory, pathetic, or bacchanalian It may consist of only one movement but usually has more

GLEEMAN (From the Anglo Saxon gleo glig, &c signifying *music*) Itinerant minstrels were so called by the Saxons their [illegible] is translated joculatores by the Latin [illegible] middle ages The name appears to have been supplanted by the Norman minstrel, shortly after the Conquest

GLIRIS (Lat glis *a dormouse*) The Linnæan name of the order of Mammalia distinguished by two long chisel-shaped incisors in each jaw See RODENTIA

GLOBE A round body, or sphere, a term commonly applied to the earth The term *artificial globe* is more particularly used to denote a globe of metal plaster paper &c on the surface of which a map of the earth or of the celestial constellations is delineated with the principal circles of the sphere In the former case it is called the *terrestrial* in the latter the *celestial globe* Artificial globes are used for the purpose of conveying to children the first ideas of the figure and rotation of the earth of latitude and longitude, and the situation of places with respect to each other and to the sun at the different seasons of the year It is usual to employ them also for the purpose of solving mechanically a few elementary problems of astronomy, relative to the difference of the hour of the day at different places the times of the rising and setting of the sun, the limits of the visibility of eclipses, &c The answers, however, which can be found to questions of this nature, by means of ordinary globes at least, [illegible] the use of globes [illegible]

GLOBULAR CHART [illegible] the [illegible] restrial surface, or any part of it, on a plane, according to the principles of the *globular projection* Let A B C be the hemisphere to be projected, and A C the plane of projection, in order to make a globular projection the eye is placed at the point E in the straight line B D which passes through the pole B and the centre of the sphere and at a distance D E above D equal to the sine of 45° The peculiar advantage of this projection is that equal arcs, *a b*, *a c*, of great circles, are represented by straight lines *d e*, *e f* which are nearly equal If the plane of pro[illegible] meridians will be repre[illegible] parallels of latitude by concentric circles But in general the projection is made on a meridian, in which case the projections of the other meridians are ellipses The [illegible] was first proposed by Lahire See [illegible]




GLOBULARIA'CEÆ (Globularia, one of the genera) A small natural order of shrubby or herbaceous Exogens inhabiting the hot and temperate parts of Europe Placed by Jussieu and De Candolle near to *Primulaceæ*, but in greater affinity with *Dipsaceæ*, with [illegible] pects, differing from them [illegible] Their sensible properties are bitter tonic and purgative

GLOBULAR SAILING See NAVIGATION.

GLOBULE A word derived from the Greek [illegible] word has been applied by Turpin, a French phytotomist, to all minute vesicular granules of a vegetable nature, which he considers the [illegible] elements of vegetation It is either cellular or vesicular tissue in a young state and disintegrated [illegible] of [illegible]

GLORY [illegible] In Painting and Sculpture, [illegible] the heads of [illegible] The term glory is used in the sacred writings in various senses, all of which, however may be easily deduced from the original meaning of its Hebrew equivalent, which signifies *weight* Thus *the glory of God* means all those attributes and qualities which give him *weight* in our eyes, or inspire us with reverence (See *Taylor's Concordance*)

GLOSS (Gr γλωσσα, *tongue*) In the Rhetoric of Aristotle, this word is used in the sense of a foreign, obsolete, or otherwise strange idiom, which, judiciously employed, he reckons among the ornaments of style From [illegible] the we[illegible] of a single word or phrase In the twelfth century, the comments or annotations of learned jurists on passages in the text of the Roman law were denominated glosses, when these extended to a [illegible] ing commentary they were termed an apparatus The glosses were collected by Accursius in the 13th century, and from that period they formed for a long time a body of authority reckoned equal or even superior to the text itself

GLO'SSARY (Lat glossarium) A dictionary of difficult words and phrases in any language or writer, sometimes used for a dictionary of words in general Of all the works published under the title of glossary, the most celebrated by far is the *Glossarium Mediæ et Infimæ Latinitatis* of Du Cange The best edition of this learned and admirable work is that edited by Carpentier, in 6 vols folio, 1733—1736 Carpentier's *Supplement*, in 4 vols folio 1766, is an indispensable addition

GLO'TTIS (Gr γλωττα *the tongue*) The superior opening of the larynx or windpipe

GLOVES (Anglo Sax glof) Well known articles of dress used for covering the hand The practice of covering the hands with gloves has prevailed among almost all the nations of the earth from time immemorial and is common at once to the rude Tartar, who seeks by their means to protect himself from cold, and to the refined European, with whom their use is an emblem of luxury (*Gough Sep Mon* 1 p 185) In the middle ages, gloves constituted a costly article of dress, being often highly decorated with embroidery and richly adorned with precious stones In the age of chivalry it was usual for the soldiers who had gained the favour of a lady to wear her glove in his helmet, and, as is well known the throwing of a glove was the most usual mode of challenging to duel This [illegible] so early as the year 1245 *Matt Paris Hist* (see the *Penny Cyc* and the authorities there referred to)

GLOW-WORM See LAMPYRIS

GLUCI'NIUM The metallic base of the earth glucina discovered by Vauquelin in 1798, and hitherto only found in three rare minerals,—the emerald, beryl, and euclase The name is derived from γλυκυς, *sweet*, in consequence of the sweet taste of its salts The metal which is of a dark grey colour was first obtained in 1828 by Wohler, he procured it by acting upon the chloride of glucinium by potassium The equivalent of glucinium is 18, and glucina consists of 18 glucinium + 8 oxygen

GLUE (Lat gluten), is [illegible] of hides, hoofs, &c These are [illegible] afterwards boiled and skimmed the solution is then strained through baskets, and gently evaporated to a due consistency, then cooled in wooden moulds, cut into slices, and dried upon nets Good glue is semitransparent, deep brown, and free from spots and clouds When used it should be broken in pieces, and steeped for twenty-four hours in cold water, by which it softens and swells, the soaked pieces are then melted over a gentle fire, or, what is better, in a water bath, and in that state applied to the wood by a stiff brush Glue will not harden in a freezing temperature, the stiffening depending upon the evaporation of its superfluous water The chemical properties of glue are those of an impure *gelatine*

GLU'TEN (Lat) The viscid elastic substance which remains when wheat flour is wrapped in a coarse cloth, and washed under a stream of water, so as to carry off the starch and soluble matters Gluten exists in many grains, and occasionally in other parts of vegetables, but it is a characteristic ingredient in wheat, giving wheat flour its peculiar toughness and tenacity, which particularly fits it for the manufacture of bread, and for viscid pastes, such as macaroni and vermicelli There is generally more gluten in the wheat of warm climates than of cold, hence the excellence of that grown in the

south of Europe for the manufactures just mentioned Gluten contains nitrogen, and has consequently been called the vege … yields ammonia … a peculiarly …

GLU'TEUS (Gr γλουτος, *a buttock*) The large and thick muscle upon which we sit, and which serves to extend the thigh by pulling it directly backwards It also assists in its rotatory motion

GLU'TTON The … quadruped (*Gulo arctos*), … by …

GLY'CERINE (Gr γλυκυς, *sweet*) A sweet substance formed in the process of saponification It was originally observed in the formation of common plaster … of lead and water

GLY'CYRRHIZ'IN The peculiar saccharine matter of the root of *Glycyrrhiza glabra* or common liquorice

GLYPH (Gr γλυφω, *I carve*) In Architecture a vertically sunken channel From their number those in the D…

GLY'PTICS, … culpture, a term denoting the art of carving on stone or any other hard substance

GLY'PTODON (Gr γλυφω and οδους *a tooth*) The name of an extinct gigantic quadruped belonging to the family of Armadillos (*Dasypodidæ*), and covered like them, with a tessellated osseous armour It is distinguished from the existing armadilloes not only by its size, which equals that of the rhinoceros but by its teeth, which are long and nearly fluted whence its generic name

GLY'PTOTHE'CA (Gr γλυφω, and θηκη *a repository*) … works of sculpture, … in the instance of the celebrated Glyptothek at Munich

GNAT S. CULEX

GNATHI'DIA (Gr γναθος, *a jaw*) A technical term in Ornithology for the lateral parts or rami of the mandible or lower jaw which are joined to the cranium behind, and meet in front at a greater or less angle

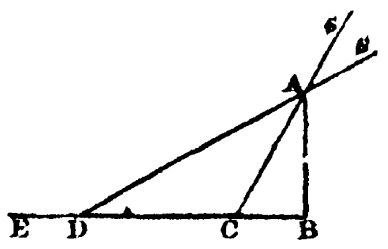
GNATHOTHE'CA (Gr γναθος, and θηκη *a sheath*) In Ornithology, the horny or cutaneous integument of the beak

GNEISS A species of granite, which from excess of mica is generally of a lamellar or slaty texture It is a German miner's term

GNOME A name given by the fanciful writers of the Cabalistic school to that class of their supposed elemental spirits which inhabit the earth Their name is more properly *Gnomans*, derived from the Greek γνωμων *knowing* … (See *Darwin's Botanic Garden*)

GNO'MIC POETS (Gr γνωμη *a sentence or opinion*) Greek poets whose remains chiefly consist of short sentences, precepts and reflections, are so termed in classical bibliography The principal writers of this description, of whom a few fragments are extant are Theognis and Solon, who lived in the 6th century before the Christian era With them Tyrtæus and Simonides are joined by Brunck in his edition (*Gnomici Poetæ Græci*, Argent…) … these writers have little of a gnomic character The metre of these poets is elegiac

GNO'MON (Gr γνωμων) In Astronomy an instrument for measuring the lengths of shadows and thereby determining the altitudes of the sun Let A be the top of a vertical style column or pillar, or a small hole in a wall A B, the height of which above the horizontal line B F is accurately known, a ray of solar light coming in the direction S A reach… at C, and t… shadow gnomon is B C Now, as the length of B C can be accurately measured, and as A B is known and the angle at B is a right angle, it is easy to find by the rules of plane trigonometry the angle A C B, or the sun's altitude Suppose S C B thus found to be the sun's meridian altitude on the day of the summer solstice, and S′ D B his meridian altitude on the day of the winter solstice, then half the difference between these two altitudes is the obliquity of the ecliptic, or the sun's greatest declination And when the sun's declination and meridian altitude are both known, the latitude of the place of observation is likewise determined In this way Pytheas, in the time of Alexander the Great, found at Marseilles the ratio of the height of the gnomon to the meridional shadow on the day of the solstice to be 120 to 41⅔ (*Montucla*, vol i p 191), whence the obliquity of the ecliptic is concluded to have been at that time about 23° 49′




Gnomons were probably the first astronomical instruments, and they appear to have been much in use among the Egyptians, the Chinese, and even the Peruvians (*Goguet, Origine des Loix*) The Egyptian obelisks are supposed to have been intended as gnomons It is evident that observations of this kind cannot give the sun's altitude with much exactness However slow it is never so well defined its limits can be ascertained with astronomical precision, besides, the observations require to be corrected for parallax, refraction, and the sun's semidiameter,—elements which can only be determined by means of instruments of a very superior description to … and which … the latter … the best … of Oriental Sanscrit … the Hindoo … with Persia …

GNOMON, in Dialling, is the style of the dial, the shadow of which marks the hour … edge is parallel to the axis …

GNOMON In Geometry, the part of a parallelogram which remains when one of the parallelograms about its diagonal is removed, or the portion of the parallelogram composed of the two complements and one of the paral… … The term is seldom used, …

GNOMONIC PROJECTION The representation of a hemisphere on a plane touching it at the vertex, the eye being placed at the centre of the sphere In this projection all great circles of the sphere are projected into indefinite straight lines, small circles parallel to the plane are projected into circles, and those which are oblique to it into ellipses or hyperbolas *See* PROJECTION

GNOMONICS The art of constructing dials *See* DIALLING

GNO'STICISM (Gr γνωσις, *knowledge*) A philosophical system of religion which prevailed in the East during the four first centuries of our era, and exercised great influence upon Christian theology, giving birth to numerous and widely diffused heresies and insinuating itself under a modified form even into the writings of the most orthodox fathers The origin of the system is involved in considerable obscurity In its leading principles it seems to point to the oriental philosophy as its genuine parent, but it is objected to this solution that the fathers refer it together with the errors similarly introduced by Platonism to a Greek origin and appeal to the cosmogonies of Hesiod and others as the real exemplars from which it is imitated It is to be remarked, however, that the fathers were universally ignorant of the oriental philosophy from which we may conclude that their opinion upon such a point is not necessarily decisive A modern solution conceives Alexandria to have been the central point to which the speculations of the Greeks and the orientals converged and from whence they frequently reissued, after having undergone the process of fusion into a common mass It is certain … the time we have spoken … Gnostic opinions, both within and without the church

The grand principle of this philosophy seems to have been an attempt to reconcile the difficulties attending upon the existence of evil in the world Evil, it was supposed, being the contrary of good, must be contrary to, and therefore the opponent of, God If the opponent of God, then independent of him and coeternal From the many imperfections which are involved in all outward and sensible objects it was held that matter must contain in itself the principle of all evil The human soul, on the contrary which aspires after and tends to a higher and more perfect development was held to be the gift of the Supreme Deity imparted to man for the sake of combating against the material principle, and with the prospect of finally subduing it From the Supreme God on the one hand and matter on the other, succeeding philosophers produced various fanciful genealogies of superior intelligences, under the name of Æons a Greek word signifying properly periods, thus representing these divinities themselves by a name expressive of the time and order of their generation much as in our current lan… … are frequently put … the Demiurgus, who formed the world out of matter, appears to have been an Æon derived from the evil principle He was also the God of the Old Testament, who was considered by the Gnostics to be an object of aversion to the One Supreme God, to counteract whose machinations the Æon Christ was sent into the world This is the earlier and simpler system, which is attributed to Simon Magus the number of the Æons was fancifully multiplied in later times, and an extravagant theory of morals founded upon the system The object of these principally was, as may be supposed, to depreciate the honour due to the body, as being a part of matter, and to elevate the thinking faculty, or at least to remove it from all consideration of worldly things The Gnostics imagined that by assiduous practice of cer… … with it, and this part of their system is adopted to a considerable extent by Clemens Alexandrinus, whose opinions, as expressed in his *Pædagogus*, are very similar to those of a Pietist of more modern times

The Gnostics split in process of time into various sects,

distinguished rather by the different cosmogonies they invented, than by any variation in principle Of these the principal were those called by Carpocrates Besides, Tatian, and Valentinus The system died away in the 4th century The Christians seem sometimes to have adopted the general designation of Gnostics (See *Burton's Bampton Lectures*, *Neander*, *Mosheim*, vol i (Transl ) p 133, &c , Gieseler, *Text-Book of Eccl Hist* i , *Riddle's Christian Antiquities*, p 133 )

GOAT, the English name for the well-known ruminant of the genus Capra The goat is characterised by its long horns, which are rounded posteriorly, angular on the anterior edge, transversely rugose, and rise at first perpendicularly, afterwards bending outwards and a little backwards It is clothed by long hair, which, in the Cashmere breed, is soft and fine, and forms the staple of the celebrated shawls of that name Beneath the long hair is a soft wool The female produces two kids at a birth, which derive their nourishment from two teats supported on a large pendulous udder The period of gestation is five months The milk of the goat is less apt to curdle on the stomach than that of the cow, and is thus better adapted for the weak and consumptive The flesh of both the goat and kid is much esteemed in many countries, though of a peculiar flavour which is probably from the aromatic shrubs and herbs on which the goat delights to browse In Portugal and other countries the goat is used as a beast of draught A notion of the wholesome influence imparted by the goat to the stable in which it may sleep is very prevalent among the grooms of this country

GO'BBING In mining, the refuse thrown back into the excavations remaining after the removal of the coal

GODROO'N (Fr godron ) In Architecture an inverted fluting beading, or cabling used in various ornaments and members

GO'DWIT *See* LIMOSA

GOG and MAGOG The names of two warriors noticed in different portions of the sacred writings (Gen x Ezekiel, xxxviii &c ) and which since the Christian era have been regarded as nearly synonymous with Antichrist The author of the Apocalypse (xx 8 ) uses the terms to express the nations hostile to Christianity and Mohammed, in the Coran (21 96 ) employs them in a somewhat analogous sense As is well known, the names Gog and Magog are given to the two huge warlike figures that adorn the Guildhall of London, but it is impossible to account for this singular application of the words

GOITRE *See* BRONCHOCELE

GOLA or GULA (Lat ) In Architecture, the same as *Cyma*, which see

GOLD (Germ ) The most valuable and longest known of the metals It sometimes occurs in regular veins in primary mountain districts, but the largest quantity is [illegible] and Siberia It is generally separated by washing away the lighter materials with which it is mixed and subsequently [illegible] Gold has been from the earliest period [illegible] of value and universal equivalent For details on this subject see MONEY

Gold is characterised by its yellow colour its extreme permanence in air and fire, its density which is about 19 3, its malleability which is such that it may be beaten into leaves not more than one two hundred and eighty thousandth of an inch in thickness and its ductility a grain of gold being drawn out into 500 feet of wire Gold is not acted upon by the common acids, but chlorine and nitro-muriatic acid corrode and dissolve it, forming a chloride of gold which is soluble in water

The *alloys* of gold have been examined in detail by Mr Hatchett (*Phil Trans* 1803 ) Of these the most important is that used for the gold coin of the realm commonly called *standard gold*, which consists of eleven parts of pure gold and one of copper it is extremely ductile and malleable but harder than pure gold, and therefore better calculated to resist the wear and tear of circulation The specific gravity of this alloy is 17 157 20 lbs troy of it are coined into 934 sovereigns and one half sovereign, 1 lb troy, therefore, produces $46\frac{29}{40}$ sovereigns, the same weight was formerly coined into $44\frac{1}{2}$ guineas The colour of this alloy is deeper yellow than that of pure gold, and verges upon orange it frequently happens that a part of the alloy of gold coin is silver, hence the pale colour of some sovereigns as compared with others Among the metals which destroy the colour and malleability of gold none is so remarkable as lead It appears from Mr Hatchett's experiments that when lead forms about one two thousandth part of the alloy, it is too brittle for rolling and that the fumes of lead destroy the good qualities of gold The chemical equivalent of gold is probably about 200, and that of the protoxide 208, and of the protochloride 236 The peroxide is a compound of one proportional of gold and three of oxygen, and the perchloride contains three proportionals of chlorine When ether is agitated with solution of chloride of gold it takes up the metal and forms a yellow ethereal solution of gold, which polished steel instruments are dipped into a solution and immediately washed in water and wiped with a piece of soft leather, they become beautifully gilt with a very thin film of gold *See* GILDING

GOLDEN FLEECE *See* ARGONAUTS FLEECE, &c.

GO'LDEN NUMBER *See* CYCLE

GO'LDEN RULE *See* RULE

GO'LDFINCH The common name of our well-known and brightest-plumaged songster the *Carduelis elegans* of most modern ornithologists, *Fringilla carduelis* of Linnæus This species feeds chiefly on the seed of the thistle and plantain, but builds its nest, which is of the neatest construction, in the fork of a branch of some densely-leafed tree, and lays four or five eggs of a bluish white, spotted with brown at the greater end The female is less brightly clad than the male, and the young have a comparatively simple plumage, in which brown predominates In captivity the goldfinch is remarkable for [illegible] is prized for its beauty as well as its song, [illegible] are bred between the goldfinch and canary and are much admired

GOLF A game with a ball and clubs, almost peculiar to Scotland, where it enjoys a degree of popularity equal to cricket in England

GOLI *See* GAULT

GO'MARISTS In Ecclesiastical History, the Calvinist divines of the church of Holland in the 17th century were so called from Francis Gomar, a colleague and opponent of Arminius at Leyden *See* ARMINIANS *Mosheim* (Transl ) ed 1826, v 325 )

GOMPHI'ASIS (Gr γομφος, *a nail* ) A disease of the teeth when they loosen and fall out of the sockets The grinding teeth are also called *gomphioi*

GOMPHO'SIS (Gr γομφος ) A species of junction of bones where they are let into each other, something like pegs in a board

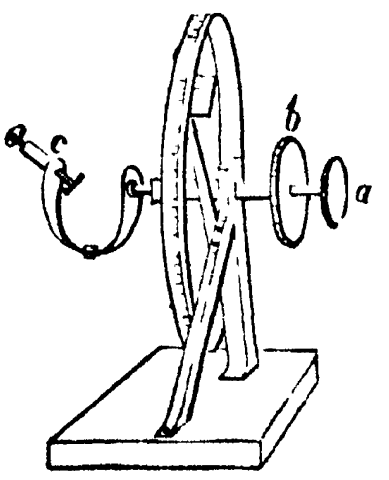
GO'NDOLA (Ital ) The name given to the pleasure boats used at Venice, where the numerous canals with which it is intersected peculiarly render it necessary to substitute boats for carriages The gondola is from 25 to 30 feet long, and 5 feet wide in the centre, in which a sort of cabin is constructed for passengers They are sharp pointed both at the prow and stern and are rowed by two men called *gondolieri* The cabins are always furnished with black curtains which give a sombre appearance to the gondola at a distance For an accurate description of [illegible]

GO'NFANON, GONFALON Heraldry a banner, that of the Roman Church [illegible] the Pope's army The gonfalonier or standard-bearer was a high officer in the Italian republics of the middle ages

GONG, or TAM-TAM (of the Chinese) A species of cymbal which, on being struck, produces a very loud sound According to the analysis of Klaproth, it consists of seventy-eight parts copper and twenty-two parts tin As this alloy is extremely brittle and the instrument always exhibits marks of the hammer, it is inferred that the Chinese possess the art of rendering the alloy malleable and restoring it to its natural state of elasticity and brittleness when the instrument is formed It is struck with a wooden mallet covered with leather

GO'NIATITES (Gr γωνια, *an angle* ) A genus of extinct Cephalopods with chambered spiral shells, nearly allied to the *Ammonite* [illegible] of the septa free from [illegible], so that the outline of these is continuous and uninterrupted Goniatites are found in the mountain limestone of Yorkshire

GONIO'METER Gr γωνια, *angle*, and μετρον, *measure* ) An instrument for measuring angles, and more particularly the angles formed by the faces of crystals The instrument chiefly used by mineralogists, was invented by Dr Wollaston It consists of a brass circle graduated on the edge, and furnished with a vernier, by which the divisions may be read correct to a minute. The circle moves in a vertical plane and is supported on a stand The axis of the circle is a hollow tube, within which is a smaller axis, fitting so tightly that when turned round it carries the other axis and consequently the wheel along with it, un-




[illegible] terior with a milled head *b*, so that when the head *a* is held and *b* turned the circle may be moved independently of the smaller axis, and when *b* is held and *a* turned the smaller axis may be

turned independently of the circle Attached to the end of the smaller axis is a sort of universal joint, capable of being fixed in different positions by means of screws The crystal to be examined is attached to the joint at *c* by a little soft wax, and placed so that its edge shall be parallel to the axis of motion, which adjustment is obtained by placing it so that the image of some horizontal object, as the bar of a window, successively [illegible] adjustment has been made, the instrument is turned till the horizontal object is seen reflected from one of the faces The smaller axis is then held fast, and the other turned till the index of the vernier points to the zero of the graduated limb The circle is then turned round, along with the smaller axis, till the same object is seen in the same position by reflection from the other face of the crystal, when the arc passed through by the circle is obviously the supplement of the angle formed by the two faces of the crystal In order, however, to avoid calculation the supplements of the angles are marked on the limb, so that the angle to be measured is read off immediately

Other forms of the goniometer have been proposed by Charles, Malus, and Brewster (See Biot *Traité de Physique* tom iii, and *Brewster's Treatise on Philosophical Instruments*)

GO'NOPLAX (Gr γονια, *a knee*, and πλαξ, *a plate*) A genus of crabs or short-tailed Crustaceans (*Brachyura*), characterized by the angular square or rhomboidal form of their upper crustaceous plate or carapace, and by the length of the eye stalks One species (*Gonoplax rhomboides*) inhabits the Mediterranean, and is a good swimmer, but most of the rest of the genus are tropical

GO'NYS (Gr γονυ) In Ornithology, the inferior margin of the symphysis of the lower jaw, or the united anterior extremities of the gutthid

GOOD FRIDAY The name given in England to the anniversary of our Saviour's crucifixion The French and many other [illegible] constitute the epithet *bon* [illegible] this day Stillerfreitag, [illegible] the latter appellation being derived [illegible] "charen," signifying *to do penance*, [illegible] the first dawn of Christianity Good Friday has been regarded as a solemn festival by the great body of the Christian world

GOOD WILL In Law the custom of any trade or business A contract to transfer it is in general good at law, though not usually enforced in equity In what cases the good will of a partnership can be claimed as property by the representatives of a deceased partner ap-

[illegible] SAIL OF A SAIL Half the sail loosed, the other half being kept furled, from the violence of the wind

GO'RDIAN KNOT, in History, was a knot made by Gordius, king of Phrygia, in the harness of his chariot so intricate as to baffle every effort to untie it The oracle having declared that he who untied this knot should be the conqueror of the world, Alexander the Great, as is well known made the attempt but fearing lest in the event of his failure it should be considered as a bad omen, and interpose an obstacle to his future conquests, he cut it asunder with his sword and thus says Quintus Curtius, either fulfilled the oracle or eluded it Aristobulus, however, gives a different version of the story (See *Arrian*, book iii c 20, and *Plutarch*, *in vit Alex*)

GORGE (Fr) In Fortification the entrance into a bastion or other outwork The *gorge* of a bastion is what remains of the sides of the polygon of a place after cutting off the curtains The *gorge* of a traverse or demilune is the space between the two ends of the faces next the place The *demi gorge* is that part of the polygon between the flank and the centre of the bastion See FORTIFICATION

GORGE In Architecture, the same as *cavetto*, which see

GO'RGET (Fr *gorge a throat*) In Plate armour, the piece covering the neck attached to the helmet The old covering for the neck was called *camail*, made of leather or cloth, and attached to the hood, on this plates of steel were riveted, and thus the gorget was formed, about the time of Edward II The name is supposed to have originated in Lombardy

GORGET. A surgical instrument used in the operation of lithotomy

GORGONEI'A (Gr) In Architecture, carvings of masks imitating the Gorgon or Medusa's head

GO'RGONS In Mythology, three sister deities, fabled by the Greeks to dwell near the Western Ocean Their heads, which were twined with serpents instead of hair, had the power of turning all who beheld them to stone, of which property Perseus is made to offer the head, by the help of Minerva cut off the head of Medusa

GOSPEL, is used to signify the whole system of the Christian religion, and more particularly, as the term literally implies, the good news of the coming of the Messiah The word was also originally applied to the books which contained an account of the life of Christ, many of which [illegible] the Christian [illegible] Matthew, Mark, Luke, a[illegible], were [illegible] the fathers

GO'THIC ARCHITECTURE *See* ARCHITECTURE, an[illegible]

GOULARD'S EXTRACT OF LEAD A subacetate of lead, obtained by boiling powdered litharge in vinegar

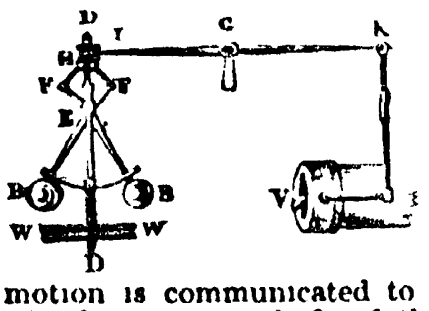
GOUT The origin of this term, from the French *goute*, is obscure it is a common disease among the higher classes of society especially among those who indulge in the luxuries of the table, or inherit a disposition to its attack Females are much less subject to it than males Medical [illegible] several species of gout, [illegible] form the *regular gout* The first symptoms of its attack are those of dyspepsia and irregularity of bowels, low spirits, and some fever and restlessness, but these often pass unobserved till, the patient is roused in the night by violent pain in some part of the leg, generally in the vicinity of the great toe, and of one foot only there is much throbbing and uneasiness, with more or less swelling and inflammation, and the least motion commonly produces great increase of suffering After some hours the pain and fever abate, perspiration comes on, he falls asleep and awakes comparatively easy These fits or paroxysms are apt to return at intervals, and often every evening but they decrease in violence, and at length go off frequently with some decided increase of perspiration or other evacuation the affected part itches, and the cuticle peels off more or less lameness or uneasiness remaining But the fit only thus leaves the patient for a time, and returns at intervals of longer or shorter duration according to his habit of body and the care which he takes of himself, and the attacks not only become more frequent and severe, but last longer, and extend to other limbs, and when they have been frequently repeated they leave a permanent stiffness of the joints, upon which *gouty concretions* are often deposited and if much attention is not paid to the state of the urine, fits of sand and gravel not uncommonly precede or accompany those of gout Where the disease is of long standing, and the form of it severe, the body becomes maimed and decrepit and the mind often worn and irritable, the joints of the feet and hands, and even the larger joints of the extremities, are stiff and nearly immovable, and the formation of the chalky matter, as it is called, about the joints increases If we consider the nature of this secretion in the joints which is *urate of soda*, and the tendency of gouty persons to those morbid states of the kidneys and urine which depend upon excess of uric acid, [illegible] whether gout is not a symptom of what is often termed the *uric diathesis* and whether the remedies applicable to it may not be beneficial in gout, and that in many cases they are so seems to have been amply proved by experience (See CALCULI) It was once a favourite maxim that the gout was an effort of the system to relieve itself of some peccant matter, that therefore, it was to be left almost to itself and that patience and flannel were the chief remedies this method still has its advocates, chiefly in consequence of the dangerous results that have sometimes attended more active plans of treatment in causing the revulsion of the gout from the limb to the stomach or head But though there may be a difference of opinion in regard to certain energetic modes of relieving the disease no one can object to the adoption of gentle means of quieting the urgency of the symptoms and to the adoption of such diet and plan of living as appears to diminish the frequency of their recurrence Warm laxatives, moderate diaphoretics and diuretics, and occasionally opiates are among the former, and plain food or vegetable diet, with moderate exercise and tonics, are good preventives Those, however, who have witnessed the sufferings of a regular paroxysm, and the evils of its duration and repetition will see the necessity of doing something more, that is, of speedily quelling the pain and carrying off the attack, if it can be done with any chance of safety and success, and this experience shows to be often the [illegible] and judgment are undoubtedly [illegible] treatment In strong and [illegible] of cold water is one of the most effective palliatives of the pain and inflammation by [illegible], *in proper cases*, [illegible] Another celebrated remedy in this disease, and which by some has improperly been called a *specific*, is *colchicum*, or *meadow saffron*, — a due dose of which, taken at bed-time, has carried off the paroxysm, and this it often does without any remarkable evacuation though it sometimes handles the patient severely as a purgative, and nauseates and

depresses to an alarming extent This method of cure must not be unadvisedly and generally adopted, but in some cases, where gout had been long established, and where the frequency and duration of the fits and their inroads upon the constitution were increasing to an alarming extent, and that at an advanced period of life, colchicum, carefully administered, seems to have carried off the severity, if not the frequency of the attacks and to have prolonged existence in consequence [illegible] the management [illegible] it is sometimes transferred or translated from the limbs to some internal part, in which case it is called *retrocedent gout*, [illegible] action of spirits, fainting, [illegible] what is termed *atonic gout*, [illegible] internal part, especially the stomach, and is then called *misplaced gout* In [illegible] the head and heart the symptoms are often fraught with severe and [illegible] and as these forms of gout are of most common occurrence in debilitated habits and broken constitutions, they become, on that account, the more difficult to treat the expulsion of the disease to the extremities is in such cases sometimes effected by ether, brandy, or what are termed *gout cordials*, which generally consist of warm aperient tinctures, but before these are administered, it must be ascertained that the symptoms are really those of gout, and not idiopathic or common inflammatory actions In such cases putting the feet in warm water has sometimes been serviceable The moderate use of alkaline remedies, of a vegetable diet, of certain diuretics, and generally speaking the adoption of those plans of regimen and medicine which are useful in the uric diathesis, are also useful in gout, and every thing which tends to repair the constitution generally will lessen the liability to its attacks and render them more manageable when they occur The indolent and sedentary must use moderate exercise, and those who habitually over-exert either body or mind must endeavour to tranquillize both without such precautionary measures are most peremptorily enforced, no gouty person can expect much benefit from physic

GOUTY CONCRETIONS These form in the [illegible] especially of the toes and fingers [illegible] from their appearance called *chalk stones*, they are composed [illegible]

GOVERNMENT In Politics, a word used in different senses —1 As the collective body of the fundamental laws of a state as when the government of a country is said to be monarchical aristocratical &c 2 The body of persons charged with the conduct of the executive in any country thus, the king or presiding magistrate, the cabinet ministers, chiefs of departments, &c in every country, form what is commonly styled its government

GOVERNOR A contrivance for regulating the speed of machinery, which has long been in use in millwork, but has of late years attracted more attention by its adaptation to the steam engine It consists of two heavy balls B B, attached to the extremities of two rods B F, B F, which play upon a joint at F, passing through a mortise in the vertical shaft D D These are united by joints at I to the short rods F H, which again are connected by joints at H to a ring which slides on the shaft D D A horizontal wheel, W, is attached to D D, having a groove to receive a rope or strap on its rim, by means of which the motion is communicated to D D from a corresponding wheel on some shaft of the machinery to be regulated It is evident, from the disposition of the rods, that if the balls B B are by any means raised or drawn asunder, the extremities F F of the rods turning on the pivot E will also be separated and their distance from the axis increased This will draw the rods F H in the same direction, and cause the ring or collar H to descend This ring is connected with the end I of a lever, whose fulcrum is at G, and whose other extremity K is connected by some means with the part of the machine which supplies the power Suppose now the velocity from any cause to undergo a sudden increase, by reason of the increased force arising from the whirling motion, [illegible] recede from the shaft D D, and raise the [illegible] of the lever On the other hand, if the velocity is diminished, the centrifugal force of the balls will be diminished, and they will fall by their own weight nearer the axis and cause the end K of the lever to descend When the governor is applied to a steam-engine the rod K I communicates with a flat circular valve V placed in the principal steam pipe and so arranged that when K is elevated as far as the divergence of the balls will allow the opening of the pipe will be closed by the valve V, and the passage of steam entirely stopped On the other hand, when the balls subside to their lowest position, the valve will be entirely open Thus when the velocity is increased the supply of steam is checked and when it is diminished the supply of steam is immediately increased, by which means a uniform proper velocity of the machinery is maintained




When the governor is applied to a water-wheel, the lever is made to act on the shuttle through which the water flows, and thereby controls its quantity When applied to a wind-mill, it regulates the sail-cloth so as to diminish the efficacy of the power upon the arms as the force of the wind increases, or *vice versâ* (*Lardner's Cyclopedia*, art "Mechanics," *Gregory's Mechanics*, vol ii) See also REGULATOR

GOVERNOR-GENERAL, THE, OF INDIA, is also the head of the local government of the presidency of Bengal He exercises some of the most important rights of sovereignty, as, declaring war and making peace, framing treaties and, to a certain extent, enacting laws He has a council, consisting of five members, of whom three are servants of the Company [illegible] by the directors but not a servant of [illegible] the fifth is the commander-in-chief [illegible] general is independent of his council, except in a judicial capacity If the council dissent, its members can record their reasons, such dissent, however, only operates as a suspensive veto on the decision of the governor-general for 48 hours He has the commission of captain-general, and may head military operations in any part of India He has also the power of [illegible] the governors of the other presidencies But [illegible] with his own council or other governor, he is under the supervision of the Court of Directors and Board of Control at home Regulations passed by the governor-general in council become immediately effective, but are subject to reversal by the home authorities

GRACE (Lat *gratia*), in the language of the New Testament, is primarily the favour and love of God towards any person from thence it comes to be used in various derivative senses, being put generally for all the extraordinary means and assistances with which men are endowed [illegible] to salvation in all of which regard is had to the [illegible] of Christ as the ground upon which God vouchsafes them The term is used, farther, for the [illegible] men which may be supposed [illegible] operation of the grace of God in the first instance

The explanation of the term "grace" has given rise to some of the most remarkable controversies in ecclesiastical history It is evident that it borders close upon the question of free will and necessity and the discussion of the one is inextricably entangled in the difficulties that beset the other The Pelagians, holding extreme opinions on the side of the freedom of the will, conceived the idea of grace operating from without and controlling or in any way affecting men's actions to be subversive of their fundamental principle they contrived, therefore, to understand the words of Scripture throughout of the *natural* good dispositions of men, whom they supposed to find favour in the sight of God by their own merit, and by their own voluntary acceptance of his promises to inherit eternal life St Augustin, on the contrary, maintained against them that the mere desire for grace itself [illegible] gift of God,—a free grace independent of and antecedent to any human actions, to the exclusion of any counteracting principle, a doctrine which, if rigidly interpreted, seems certainly irreconcilable with that degree of liberty which is a necessary element in the moral government of the world

GRACE In the Fine Arts, a quality arising from elegance of form and attitude combined A figure may be just in its proportions its parts and members may be all perfectly regulated, yet it may be deficient in grace It is scarcely possible in words to express this quality, yet it is constantly seen in nature, and it is scarcely possible to contemplate a picture by Raffaelle without feeling its power

GRACE AT MEALS, THE SAYING OF, is a [illegible] (Matt xiv 19) It is mentioned by Jerome and Tertullian as usual among [illegible] meals by [illegible] (*Livy*, xxxix 43 *Quarterly Review*)

GRACE, DAYS OF, in Commercial Law, are certain days allowed by the custom of merchants to be added to the time requisite for presentment of a bill Thus, if an instrument drawn in this country be payable "a certain time after date," three days of grace are added a bill drawn on the 27th of August, payable "two months after date," is therefore due on the 30th of October So if a foreign bill be drawn at one, two, or more "usances," the days of grace are added to the usance The usance between London and Paris is one calendar month a bill drawn in London on Paris, "at one usance," on the 2d January is consequently due on the 5th February The number of days of grace varies in different countries In France none are allowed.

GRA'CES. (Gr χαριτες, Lat. gratiæ) In Mythology, the three sister goddesses, Euphrosyne, Aglaia, and Thalia, attendants on Venus The Graces, in Sculpture, were represented clothed, but in later [illegible] (*Hor Od* lib iii *Pausan* lib ix) In one of the groups of statues described by Pausanias they held respectively a rose, a die and a leaf of myrtle In the *Iliad* they appear as attendants of Juno, in the *Odyssey*, of Venus Their temples were often dedicated also to Venus, to Cupid, the Muses, Mercury, or Apollo (There is a dissertation on these goddesses by Massieu, *Acad des Inscr* vol iii)

GRACES In Music, ornamental notes attached to principal ones, such as the appoggiatura, shake, &c, which see

GRACIO'SO The [illegible] the Spanish stage (S [illegible]

GRA'CULA (Lat graculus, *a jay*) A genus of Dentirostral Passerine birds, characterized by a moderately long, slightly arched, and notched beak, nostrils situated anterior to the base of the beak, oblong, open, and notched tongue with a short apex often bifid One species of this genus (*Gracula tristis* Cuv) is a native of India, and has been imported into the islands of Bourbon and the Mauritius, where it is held in the highest estimation for the services it performs in restraining the undue increase of locusts The bird commonly called the mino grackle (*Gracula religiosa* of Linnæus) is the type of the genus *Eulabes* of Cuvier

GRADA'TION (Lat gradus *a step*) In Painting, the gradual blending of one tint into another

GRADA'TION In Music [illegible] ascending or descending succession of chords

GRA'DATORY (Lat gradus) A term applied in Mammalogy to the extremities of a quadruped which are equal, or nearly so, and adapted for ordinary progression on dry land In Ornithology the "pedes gradarii" are those in which the whole tibia is covered with feathers

GRA'DIENTS *See* RAILWAYS

GRA'DUATE (Lat gradus) One who has taken a degree in a college or university *See* DEGREE, COLLEGE, UNIVERSITY

GRADUATED In Ornithology, when the quill-feathers of the tail increase in length by regular gradations

GRADUA'TION In Practical Astronomy, the division of circular arcs into degrees minutes, &c This is an art which, though depending on the geometrical properties of the circle, requires, to be successfully executed the application of very great practical skill For the principles see Mascheroni *Geométrie du Compas*, and for the practical part, *Troughton's Account of a Method of Dividing Astronomical and other Instruments &c* in the *Phil Trans* 1809, also the article "Graduation" in *Brewster's Encyc* by the same eminent artist

GRADUATOR Contrivances for accelerating spontaneous evaporation by the exposure of large surfaces of liquid to currents of air have been termed graduators, and in some salt works, where the brine is strengthened by allowing a shower of it to trickle over faggots, the process is called *graduation* Vinegar is sometimes manufactured by suffering a mixture of alcohol and water previously mixed with a little vinegar or some ferment to filter through a tub filled with beech shavings, through which a current of air is at the same time passing

GRAFTING In Horticulture the operation of affixing one portion of a plant to another in such a manner as that a vital union may take place between them [illegible]

varieties of fruit trees A grafted plant consists of two parts the stock or stem which is a rooted plant fixed in the ground, and the scion, sometimes but erroneously, termed the graft, which is a detached portion of another plant to be affixed to it The operation of grafting can only be performed within certain physiological limits, but what these are science has not yet absolutely determined

In general, all the species of [illegible] on one another reciprocally, but [illegible] the case, because the apple cannot be grafted on the pear, at least not for any useful purpose In general it may be presumed that all the species of a natural order, or at least of a tribe, may be grafted on one another, but this does not hold good universally The reverse of this doctrine, however, viz that the species belonging to different natural orders cannot be grafted on one another, holds almost universally true, and therefore a safe practical conclusion is that in choosing a stock the nearer in affinity the species to which that stock belongs is to the scion the more certain will be the success

Grafting is one of the most important operations in horticulture affording the most eligible means of multiplying and perpetuating all our best varieties of fruit trees, and many kinds of trees and shrubs not so conveniently propagated by other means Varieties of fruits are originally procured by selection from plants raised from seed, but they can only be perpetuated by some mode which continues the individual, and though this may be done by cuttings and layers, yet by far the most eligible mode is by grafting as it produces stronger plants in a shorter time than any other methods

Grafting is performed in different ways, but the most [illegible] is what is commonly called [illegible] grafting In executing this mode both the scion and the stock are pared down in a slanting direction, afterwards applied together, and made fast with strands of bass matting in the same manner as two pieces of rod are spliced together to form a whip handle To insure success, it is essentially necessary that the alburnum or inner bark of the scion should coincide accurately with the inner bark of the stock, because the vital union is effected by the sap of the stock rising up through the soft wood of the scion After the scion is tied to the stock the graft is said to be made, and it only remains to cover the part tied with a mass of tempered clay, or any convenient composition that will exclude the air The season for performing the operation is for all deciduous trees and shrubs the spring immediately before the movement of the sap The spring is also the most favourable season for evergreens, but the sap in this class of plants being more in motion during winter than that of deciduous [illegible] thought necessary, might be per[illegible]

*Grafting by approach or marching* is a mode of grafting in which to make sure of success, the scion is not separated from the parent plant till it has become united with the stock For this purpose the stock and the plant containing the scion must be growing close together, and the scion being drawn to one side and made to approach the stock is spliced to it by cutting off a portion of its bark and wood and a similar portion of the bark and wood of the stock [illegible] so that their alburnums may [illegible] fast by matting and exclud[illegible] wax or moss When the scion has effected a vital union with the stock its lower extremity is cut through, so as to separate it from the parent plant, and it now becomes an independent graft In this way trees of difficult propagation may be propagated with certainty, while if any of the other modes of propagation, whether by cuttings or grafting were adopted a proportion of the cuttings or scions would in all probability, be lost

*Grafting herbaceous plants* differs in nothing from grafting such as are of a woody nature, excepting that the operation is performed when both stock and scion are in a state of vigorous [illegible] Grafting herbaceous plants is but little practised [illegible] the Continent chiefly as a matter [illegible] The most useful purpose to which it has hitherto been applied is that of grafting the finer kinds of dahlias on tubers of the more common and vigorous growing sorts In the Paris gardens the tomato is sometimes grafted on the potato the cauliflower on the borecole, and one gourd on another, as matter of curiosity

*Grafting herbaceous shoots of woody plants*—the [illegible] of the French—is scarcely known among [illegible] but it has been extensively employed by French nurserymen, and even in some of the royal forests of France The scions are formed of the points of growing shoots and the stocks are also the points of growing shoots cut or broken over an inch or two below the point where the shoot is as brittle as asparagus The operation is performed in the cleft manner, that is, by cutting the lower end of the scion in the form of a wedge and inserting it in a cleft or slit made down the middle of the stock The finer kinds of azalias, pines, and firs are propagated in this way in the French nurseries, and thousands of *Pinus laricio* have been so grafted on *Pinus sylvestris* in the forest of Fontainebleau At Hopetoun House near Edinburgh this mode of grafting has been successfully practised with *Abies Smithiana* the stock being the common spruce fir

GRA'LLE (Lat grallæ *stilts*) The Linnæan name of the order of [illegible] wading birds

GRA'MINA'CEÆ An order of Endogenous plants, commonly called grasses in which the parts of fructification are essentially perfect, although they are in a very unusual state in what may be called their accessory organs They have neither calyx nor corolla, but, in lieu of them, imbricated scales, called palæ and glumes the latter of which give rise to the name *glumaceous*, often [illegible] leaves slit and their stems hollow Corn of all kinds, [illegible] Ergot is the ovary of rye attacked by a fungus called *Ergotalia abortans* The flinty surface of the stems or straw renders many valuable for domestic use, as for forming the *plat* from which straw bonnets, &c. are

manufactured. The systematical arrangement of grasses is a difficult and unsatisfactory task, and has occupied the attention of many botanists. The most recent work upon the subject is *Kunth's* [illegible] published at Berlin; *Smith's* [illegible] *Eburnensis* is a useful account of the relative qualities of pasture grasses.

GRAMMAR (Gr. γραμματικη τεχνη, *the grammatical art*, from γραφω, *I write*.) The science which has for its object the laws which regulate human language. Language, in its widest acceptation, may be defined to be the expression, by means of outward signs, of what passes in the mind. If, therefore, it is to admit of rules, or general laws, it is plain that we must seek those laws either in the constitution of the mind where it originates, or of the outward materials of which it is composed. These are either sounds, visible images, or gestures. The first two of these, as admitting of the greatest variety, and capable of being most easily distinguished from each other, form by far the most considerable part of language, and that part alone which grammar takes account of. The material of language, when it is *sound*, is capable of analysis into a definite number of simple elements. It is not our object at present to enter on the consideration of this part of language, whether consisting of sound, or marks to designate sound. We pass on to its more important class of laws which result from the internal conditions of the mind, and which, viewed in that reference, constitute the subject matter of philosophical grammar, properly so called. An analysis of our mental faculties must therefore precede any attempt to define the province and settle the principles of grammar. Of the various divisions of the human faculties proposed by philosophers, we shall adopt, as best suited to our purposes, that which distinguishes them into two grand classes,—the province of affection, and that of perception or intellection. The discriminating mark of the former class, under which we include alike the outward senses and the inner sense or emotion, is this, that the faculties which it includes imply a state of mind or consciousness and that only. By perception or intellection, on the other hand, are meant those states of mind which refer to a real or supposed *object* out of the mind itself. 'To know' and 'to know nothing' are contradictory conceptions, every act of knowledge implies at once an object and a mind to which that object is present. Each of these portions of the mind has its appropriate expression, its peculiar language. The language of emotion is common to men and animals. It consists, for the most part of certain simple sounds or exclamations, which, if capable of being reduced to rules at all, must rest for those rules on physiological considerations, which form the province of philosophical grammar. We must seek that province, consequently, in the language of intelligence or reason. Rational discourse, or human language, may be figuratively expressed as the outward *type* or *form* which thoughts, and the laws which regulate them impress on the *material* of sound. In the words of Plato, "reason and discourse are one, only the former, as the conversation of the soul with herself, which goes on without the intervention of sound has obtained among us the name of discourse of reason." We do not deny that language, in this limited sense may become the expression of emotion in ourselves, and excite emotion in others. Both these objects, however, it can effect only *mediately*: the first, by converting through reflection, an emotion into an object of consciousness, by rendering it *intelligible* to ourselves: the [illegible] the second, only *through* the [illegible] whom we address. The laws of language must therefore correspond with the laws of the intellect. If there is any thing universal and necessary in the one, its representative or image must be found repeated in the other. But the necessary laws of thought are the object matter of logic. It might, therefore, seem that logic and universal grammar are convertible terms. Both sciences consider alike the forms of the intellect, and the right mode of expressing the [illegible] forms in language. But they differ in this, that logic considers the intellectual process primarily, and its expression in language only incidentally, whereas grammar considers the former only in so far as it conduces to the right understanding [illegible] the latter. Having previously distinguished [illegible] from merely practical or empirical grammar, we may now distinguish philosophical grammar itself into universal and particular. The first, as we have seen, corresponds to logic—as the one is the science of those conditions which must be presupposed in order to render *thought* and *intelligence* possible, so the other contemplates the conditions which are to render possible the *outward expression* of thought and intelligence. The same relation which universal grammar bears to logic, particular grammar, philosophically treated, may be said to hold to the kindred science of psychology. It considers the experimental laws of the mind with the same view with which universal grammar contemplates those that are necessary. It takes into the account the effects of accidental association, in order to explain the idioms or peculiarities of the particular language before it. It calculates, so to speak, the disturbing forces which act on [illegible].

[illegible] of universal grammar, we shall [illegible] various kinds of words or "parts of speech" into which language is ordinarily distinguished.

The first class of words corresponds to the faculty called by logicians apprehension, or simple apprehension. They are commonly named *nouns*, or *substantives*, or *nouns substantive*, and express either individuals, as "John, Charles," or classes, as "man, animal." They are called substantives, because they express a real or supposed substance [illegible] which is conceived to stand under, or in the phrase language, to be the support of, certain qualities. These qualities may in their turn be considered as substances, and expressed by substantives, as *whiteness*, *greenness*. When considered in relation to the substance of which they are properties, they constitute the second class of words,—*adjectives*, or *nouns adjective*. Thus we say "a *white* horse and dazzling *whiteness*," where the same conception which in the former case is regarded as a quality, and expressed by an adjective, is in the second converted into a substance, itself the *support* of other properties.

Thus far the only intellectual power implied in language is that of forming general conceptions. A conception, when formed, is capable of being resolved back into its constituent parts. In the conception "stag" we find the property of swiftness contained. This *attribution* of a quality to a substance is [illegible] *judgment*, its expression in language [illegible] or *proposition*. The sign of this attribution is called the *copula*. 'The stag *is* swift.' Every judgment which has regard to matter of fact considers an event either as past, present, or future. "The hair *was* light, *is* dark, *will be* grey." When the attribute property or quality is combined with the copula or word signifying the affirmation or attribution, a third class of words is produced to which we give the name of *verbs*. Thus instead of saying, "the sun *is* bright," we may say, "the sun shines," where the latter form of expression is equivalent to, or capable of being analyzed into, the former. A *verb* is therefore a compound part of speech, consisting of an adjective and a *copula* or *affirmation*, and signifying not only the conception of a *property*, but our perception or judgment that such property does inhere or belong to some substance, or else that it *has* belonged or *will* belong to it. The relation between property and substance, expressed in every proposition, may be differently stated as the relation of part to whole, of species to genus, of individual to species, distinctions which do not concern us at present, inasmuch as grammar, no less than logic, has regard only to our mode of conceiving things, not to things as they are in themselves.

The three parts of speech which we have thus analyzed—the substantive, the adjective, and the verb—are called the *primary* or *essential* parts of speech. They are those without which no discourse could take place, no act of judgment be communicated, in other words, without which no sounds could have *meaning*. The parts of speech which remain to be considered are the *pronoun*, the *article*, the *adverb*, the *preposition*, the *conjunction*, the *interjection*.

The *pronoun* is so called from its being a substitute for a noun, a compendious contrivance to avoid repetition, or needless and inconvenient specification as, 'John is tall and *he* is handsome," which is equivalent to saying 'John is tall and *John* is handsome.' They are commonly subdivided into personal or substantive, adjective, demonstrative, relative, indefinite, and interrogative pronouns.

*Articles* are words joined to substantives, for the purpose of defining whether the substance or conception is to be understood in a general sense, or in particular relation to an individual. When the first is our intention, we use in English no article whatever as, "*Man* is corrupt,' by which we mean that corruption is an attribute of the genus "man," and not of any particular individual to the exclusion of others. In Greek, however, the use of the article is frequently equivalent to the omission of it in English, as η ευσεβεια, *piety*. If we used the article *a* or *an*, we should, in most instances, mean that some individual or other of the species was contemplated. "I saw *a* horse." When we use the definite article *the* we mean to specify which individual of the species we have in view.

The *adverb* derives its existence from the difficulty of defining by one word the precise quality of a particular object. When we say a thing is "green," we may call up in the minds of our hearers the image of a very different shade of greenness from that which we are describing. If we say it is "*very* green," our language is more definite. An adverb may consequently be described as a *modifying* part

of speech, joined with adjectives to express accurately the degree of the quality or circumstance of the action predicated That it is not an essential part of language is evident from the circumstance that its place may be supplied either by a termination as "greenish," for "rather green," or by a periphrasis as "he walks with speed" instead of "he walks rapidly"

*Prepositions* are those parts of speech which express relations between substances and are consequently joined only with substantives as "*from* the city *to* the country" We shall consider them more at length when we come to treat of the inflections of words

As prepositions express objective relations, so *conjunctions* may be said to represent those of a subjective nature, or those relations which we perceive to exist between the judgments of our own intellect, whether of mere succession, of inference, or the like They are consequently used to connect propositions together, as "John is wise *therefore* [illegible]" "John is wise *because* he is [illegible] to the syllogistic faculty, or the faculty which perceives the connection and dependence of simple judgments, what the *copula* is to the faculty which forms these judgments As the one forms words into propositions, so the other are necessary to combine propositions into sentences

The *interjection* is the expression of emotions and emotions only It is not therefore confined to *human* discourse, and as it has nothing to do with the operations of the intellect, is incapable of logical combination with other words It might therefore be doubted whether it can with propriety be called a part of speech or not

We have said that the last-mentioned "parts of speech" were not *necessary* constituents of language We so far qualify that assertion, in regard to prepositions in particular, as to admit that they are the expressions and modes of conception which the human understanding unavoidably forms Whether in technical language the necessity be a *formal* or a *material* necessity we forbear to discuss at large, since it is a subject on which logicians are not agreed We ourselves are inclined, with Kant to think it *formal* We conceive the relations of cause and effect, of time and place of action and passion to be as much pure educt of the understanding and as independent for their *form* on experience, as those of *part* and *whole substance* and *attribute* which we have seen to constitute the necessity for the primary parts of speech They differ however in this, that the latter *must* enter into every proposition to render it a proposition at all, while those we are now considering [illegible] to the matter [illegible] In all languages [illegible] expressed more or less perfectly In our own and in the other branches of the Teutonic stock, this expression is effected in two ways Either the relation intended to be implied is expressed by an affix or prefix to the radical or abstract portion of the word itself, or the relation is regarded as abstracted from all particular objects between which it [illegible] and so abstracted is embodied [illegible] particle Thus what the Latins expressed by the termination *o* or *i* as *domino* "nubi," is represented in English by prepositions "to" or "for" Generally speaking the farther any language the richer it is found to be in terminations, which as the faculty of abstraction becomes habitual are commonly abridged in number, and replaced by particles A word which admits a variety of such modifications is said to be *declinable* The only *declinable* or *inflected* parts of speech are the substantive and the verb and in some languages the adjective and participle with the representative parts of speech, the pronoun and article The reason of this is sufficiently obvious It is between supposed *substances* that the relations of cause and effect and those of place are conceived to exist, while the relations of *time* pertain to action and passion, or those changes in the state of substances which are expressed in language by verbs The declension of adjectives is an anomaly in language It probably results from the facility with which we convert in our thoughts a quality or attribute into a substance unless it is to be accounted for by what grammarians call 'a [illegible] influence which the inflexion of a word has immediately in contact with it, and which is owing partly perhaps to the desire of euphony, and partly to a confusion of thought, the effect of association The sum total of the modifications which the words of a language admit constitute what is called the *accidence* of that language The circumstances under which such modifications or inflexions take place are the subject-matter of that part of grammar which is named *syntax* These inflexions are, in *nouns*, case, number, and gender, in *verbs*, tense, mood, person, and, in most languages, number

The *cases* of nouns are the expression of the relations of substances In Latin there are, besides the nominative, or absolute form of a conception, and the vocative, used in addressing or calling to another person (a compound of a noun and an interjection) four cases properly so called, the genitive, the dative, the accusative, and the ablative. Of these the English language retains in its [illegible] only the genitive; in its pronouns two, the [illegible] All other cases it replaces by [illegible]

The genitive case expresses the relation of *property* [illegible] is capable of being analyzed into a [illegible] parts, which are either necessary to the whole conception, or bound up with it by association more or less habitual We represent this process in language by some change either in the word which signifies the *property*, or in that which denotes the containing substance The last is the case in most European languages Thus, we speak of a "horse's colour," of "Socrates' philosophy"

The dative case implies *participation* in the effect of an action, expressed in English by the preposition "to" or "for" "Dedi ei"—"I gave it *to him*," where the effect of my act of giving is *shared only* by another

The accusative is used where the effect of an action is conceived as passing over *entire* to another substance "Laceravi librum,"—"*I tore the book*," where the whole of the immediate effect is conceived as confined to the book which I tear It is also called the objective case

The ablative [illegible] should [illegible] In this sense it ought to be considered as a modification of the dative or the case which expresses the incidental or participated effects of an action, and we accordingly find that in Latin the English preposition "from" is frequently expressed by the dative There is however, a kind of relation which no other case serves precisely to convey that of outward proximity which is expressed in English by such prepositions as *at near by*, *upon*, and in Latin by the ablative case which consequently is not so useless or superfluous a form as some grammarians have considered it to be

Besides the inflexion of case, nouns admit, in most languages, those of number and gender The latter is a mere generalization from experience, and though it may be convenient to have a termination to designate it it is not necessary as is apparent from our own language, which expresses this distinction only in its pronouns, and in some few of its substantives Our conceptions of number are doubtless conditions of our mental constitution They may be generalized under the forms of unity simple unity comprehensive and plurality Unity, whether regarded simply or as an aggregate is expressed by the singular number Many languages, besides singular and plural, have a form to denote duality, or *two things together*, a fact which probably is owing to the duality of the parts of the human body, as the hands, feet &c

We proceed to consider the different kinds of *verbs*, and their modifications Verbs are divided into transitive intransitive and passive They admit necessarily of time and mood, accidentally and by usage of *person* and *number*

A property, taking the word in the most general sense of which it is capable may be [illegible] a process or as a power [illegible] To the first two correspond the verbs commonly called intransitive or neuter as 'I rest' 'I grow," I fall" When a power is in action we measure it by its effects on some substance, we conceive the action as *passing on* to another object as 'the clouds bring rain' The verb which expresses this transition is called the verb active or transitive But not only are we able to conceive an object exerting power, we may also consider it as susceptible of influence or change from the action of another object This is expressed by the verb passive, as 'the dog *was beaten*' Many other modifications of action and change have their appropriate forms in different languages Such are the verb middle or reflex in Greek, the verbs frequentative and desiderative in Greek and Latin These, however, are matters of idiom, not of universal necessity

Equally extensive with the conceptions of cause and effect is that of time, as the universal condition of all change in nature The words which signify the one must therefore be capable of expressing the other Hence the necessity for *tenses* in verbs, or the inflexions which determine the time of the action, as present, past, or future We may further abstract an action from its relation to [illegible] and this abstraction is in some languages, [illegible] represented by a form appropriate to the purpose, called the aorist

The modifications of verbs which we have been considering [illegible] or action objectively, or in relation to the [illegible] which they are supposed to affect Our judgments themselves are also liable to certain modifications, which, as regarding only the way in which we conceive of events, may be said to constitute the subjunctive conditions of verbs Our knowledge of an occurrence may be either certain or uncertain, and uncertain either absolutely, or only under particular suppositions When we simply express our judgment that a thing is, has been, or will be, in such and such a state,

we are said to speak [illegible] or in the *indicative mood* When we consi[illegible] as possible merely, we [illegible] sh by the aux- [illegible] we speak of it as [illegible] conditions, or in case of its occurrence as connected with certain probable or [illegible] we use the *conjunctive mood* [illegible] *ld* let me Different languages express these modifications of judgment more or less perfectly, none, perhaps, with absolute accuracy

Two other modal forms still remain to be considered They have been called by grammarians the *imperative* and *optative moods*, as conveying the expression of a command or a wish They may be included under the general term of desiderative, and imply at once the conception of an event and our desire that that event should take place They may therefore be regarded as forming the connecting link between verbs and interjections, between the words which belong to the perceptive and those which pertain to the emotive part of our nature

What is commonly named the *infinitive mood* may be considered as the point of transition from a verb to a substantive It is, so to speak, a *substantized attribute*, and is used as the subject of a proposition as correctly as substantives themselves *e g* '*To die* is gain"

The *participle* is usually ranked as a separate part of speech It may be said to hold the same intermediate place between a verb and an adjective, as the infinitive holds between a verb and a substantive It possesses all the properties of the verb, save affirmation, that is to say, to the properties of the adjective it adds the power of denoting time

The attribution to verbs of number and person is logically as anomalous as it is to assign gender and number to adjectives Most languages fall into this error, which is, however, susceptible of a very easy historical solution It arose, doubtless, from the original custom of annexing the pronoun to the terminati[illegible] the use of the inflection after [illegible] and when the pronoun had been formed into an independent part of speech

Those who wish to investigate the principles of grammar more closely, would do well to consult Mr Harris's *Hermes* [illegible] where the paradoxical opinions of Mr Horne Tooke on this subject are ably confuted Professor Thiersch in his *Greek Grammar*, some time since translated into English, has interspersed some ingenious and valuable inquiries into the general principles of language from which the student may derive many important hints

GRAMMA'RIAN Literally one versed in grammar, but the term was used by the classic ments as a title of honourable distinction for all who were considered learned in any art or faculty whatever (See Vossius's work on Grammar)

GRANA'DE *See* GRENADE

GRA'NARY (Lat granum *corn*) A building in which to lay or store corn especially that designed to be kept a considerable time Various scientific principles have been laid down for the erection of buildings of this nature, of which the reader will find a full account in *Rees's Cyclopædia*, but the most curious as well as most efficient contrivances for housing and keeping grain in good order, are to be met with in some parts of Sicily They consist either of excavations into calcareous rocks, or holes in the ground shaped like a bottle, walled up, and rendered waterproof by the neck of the bottle being hermetically closed with a stone fastened with gypsum They contain about 200 salme, or about 1600 English bushels of corn, which may be thus preserved for an indefinite period, at least it has been found in perfectly good condition after the lapse of a century (*Simond*, p 25, *Swinburne*, vol ii p 405)

GRAND (Fr) In the Fine Arts a quality by which the highest degree of majesty and dignity is imparted to a work of art Its source is in form freed from ordinary and common bounds, and to be duly felt requires an investigation of the different qualities by which great and extraordinary objects produce impression on the mind

GRANDEE (Span grande, Fr [illegible] *I pana*) The highest title of Spanish [illegible] The collective body of the higher nobility in Spain is termed *la grandeza* They were originally the same with the *ricos hombres* Grandees bear different titles — duke, marquis, &c, but there is no essential difference of rank between these titles all are equal among themselves Grandeeships descend through females, and thus become accumulated in families (*Quart Rev*, 1838)

GRAND JURY *See* JURY

GRANGE A farm-yard or farmery, which consists of a farm-house, and a court of offices for the different animals and [illegible] in farming, and also of barns, feeding [illegible] houses, &c *See* FARM-YARD OR FARMERY

GRA'NITE A crystalline aggregate of quartz, felspar, and mica, with the occasional addition of other minerals. It is regarded by modern geologists as of igneous origin, and as having been protruded from below so as to elevate and dislocate the adjacent strata, and occasionally to pe[illegible] [illegible] Granite is a hard and [illegible] importance as a build- [illegible] to pavements The [illegible] very large and distinct and constitute the whitish imbedded masses which are seen in such perfection in some of [illegible] of London, especially of London [illegible] When the mica prevails in granite, its texture becomes lamellar, and it passes into the rock which has been called *gneiss*, which again, by the gradual secession of the felspar, degenerates into *mica-slate* There are some kinds of granite which are undergoing rapid disintegration and decay in consequence of the joint action of air and water upon the felspar, the potash of which appears to be removed, and the residue falls into a white powder, composed chiefly of silica and alumina in a state of very fine division it is thus that the celet[illegible] is produced, which is in such request [illegible] pottery The curious district in which the Carglaise tin mine, near St Austle, is situate, is a good and characteristic specimen of decomposing granite *See* GEOLOGY

GRANI'VORÆ (Lat granum, *a grain*, voro, *I eat*) The name given by Temminck to an order of birds, in- [illegible] other [illegible] and granivorous

GRANT In Law, a mode of conveyance by deed, appropriate to estates in lands and tenements not in possession, and also to incorporeal hereditaments

GRA'NULATE (Lat grana, *a grain*) When a surface is beset with many very small elevations like [illegible]

GRANULATION The method of dividing metallic substances into grains or drops It is usually effected by pouring the melted metal into water, and if fine division is required, it must pass through a perforated ladle or sieve, and in order to obtain spherical particles, it must fall from such a height as to have become solid before it meets with the water hence the height of the towers in which *shot* is made

GRA'NULATIONS This term is applied to the little granular formations which arise in sores that are healing and by which the destroyed parts are filled up and the edges brought together When healthy they are of a red colour, not exuberant, when unhealthy they are pallid and become soft, spungy, and irregular

GRAPE-SHOT In Artillery, a quantity of small shot put into a canvas bag, and corded together in the form of a cylinder, the diameter of which is adapted to the piece of ordnance from which it is intended to be [illegible] superseded by *canister-shot*

[illegible] (Gr γεαφω, *I write*, and μετρεω, *measure*) A mathematical instrument used in land surveying, otherwise called a *semicircle*

GRA'PHITE (Gr γεαφω) The substance improperly called *black lead*, of which pencils are made It is a peculiar form of mineral carbon with a trace of iron The finest is found only at Borrodale in Cumberland Coarser varieties are not uncommon

GRA'PNEL A small anchor for a boat

GRA'PPLING IRONS Small grapnels with four flu[illegible] ips together in action

GRAPTOLITES (Gr γεαφω, *I write*, λιθος, *a stone*) A genus of fossil *Zoophites*, nearly allied to the existing sea-pens (*Pennatulæ*) found in the bituminous shales of the silurian sandstone deposits

GRASSHOPPER *See* LOCUST.

GRASS LAND In Agriculture, land kept perpetually under grass, as contrasted with land which is alternately under grass and tillage Perpetual grass lands are generally such as from the soil and situation are too moist to be ploughed with advantage, or too hilly and irregular on the surface to be ploughed at all Hence we have hill pastures and low moist meadows The former admit of very little improvement excepting that of drainage, and occasionally, in low hills, of irrigation, while the latter may not only be drained, but may be manured, and in some cases irrigated *See* PASTURE MEADOW, and IRRIGATION

GRATE, may be described as the iron frame and bars for holding the fuel burnt in our fireplaces It is, however, confined to the use of coal, wood fires being better kept up on what are called 'dogs"

GRAU'WACKE A German miner's term, implying *grey rock*, adopted in Geology to designate some of the lowest secondary strata, which form the chief part of the *transition rocks* of some geologists *See* GEOLOGY

GRAVE In Music *See* ALLEGRO

GRA'VEL A term applied to a well-known material of small stones, which vary in size from a small pea to a walnut, or something larger It is often intermixed with other substances, such as sand, clay, loam, flints, pebbles, iron ores &c, from each of which it derives a distinctive appellation *See* GEOLOGY.

**GRA'VEL.** In Gardening, gravel is an important article, being that of which walks are formed whenever it can be procured. In selecting gravel two qualities are chiefl[illegible], viz. a fine colour, and the property [illegible] most common colour of pit gravel is a rusty brown, and that of river or sea gravel a gray, with different shades of white, red, or brown. The best colour is considered to be a deep rich yellow, which is that of the gravel of Kensington, the stony parts of which are flints, — supposed to be the finest in the world, and which used formerly to be shipped, not only to different sea-ports of Great Britain and Ireland, but to various places on the Continent, to Petersburgh, to India and even to South America. The binding properties of gravel are two: the presence of ferruginous clay of the same rich colour as the gravel, and which causes the gravel to set or become hard as soon as it is exposed to the action of the atmosphere; and the irregular and angular shapes and sizes of the stones. Where the stones are round or oval, with regular smooth surfaces, they never form a good binding gravel, even if they should be mixed with ferruginous clay. The reason is that those stones which are on the surface, having no mechanical hold on those which are beneath or beside them, but being merely slightly cemented by means of ferruginous clay, are easily loosened and thrown out of their places by the action of frost, or even by the alter[illegible]. Hence, where no other grave[illegible] rivers or on the sea shore can be found for making garden walks, one half of the stones ought to be broken and mixed with the other half before laying them on the walks. [illegible] gravel, applying that term to all those of [illegible] and quality in England, binds better than any other not only on account of the ferruginous clayey matter with which it is mixed becoming hardened by the atmosphere, but also because the stones are exceedingly irregular in size and shape.

GRAVEL, URINARY. *See* CALCULUS and URINE.

GRA'VER, called also BURIN. The sharp tool, whose extremity is of a triangular form, for cutting the lines of engraving on the copper. *See* ENGRAVING.

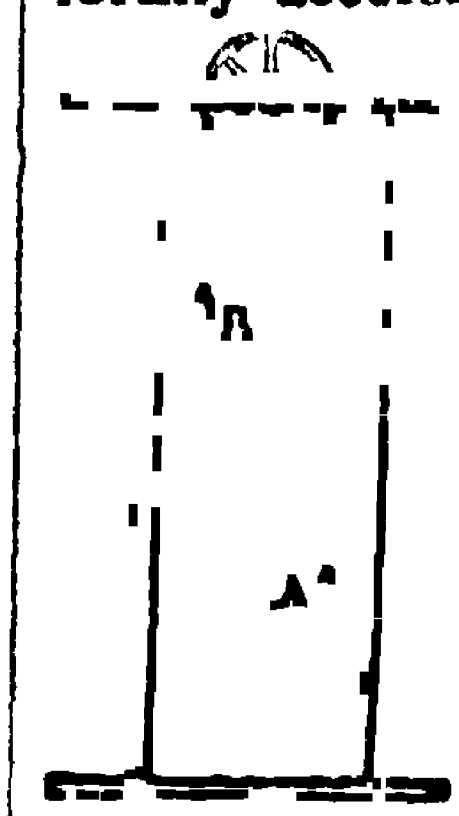
GRAVIMETER. (Lat. gravis, *heavy*, and Gr. μετρον, *measure*.) An instrument for ascertaining the specific gravities of bodies whether liquid or solid. The particular instrument to which the term is usually appropriated was invented by M. Guyton, who adopted this name in preference to *areometer* or *hydrometer*, because these latter terms imply that the liquid is the thing weighed; whereas, when solids are weighed, the liquid is only the term of comparison to which the unknown weight [illegible]. *See* HYDROMETER.

GRAVITATION, GRAVITY. (Lat. gravis, *heavy*.) These terms are often used synonymously to denote that mutual tendency which all the bodies of nature have to approach each other, with forces which are directly as their masses and inversely proportional to the squares of their distances.

That every particle of matter in the universe has a disposition to press towards, and if not opposed to approach to every other, is a fact of which we derive the knowledge partly from our constant experience of what takes place at the earth's surface, and partly by reasoning from the observed motions of the celestial bodies. This mutual tendency of all the particles of matter to each other is called the *attraction of gravitation*. In reference to any particular body, or mass of matter, the aggregate attraction of all its particles is usually called simply its *gravity*.

*Of Terrestrial Gravity.* — Universal experience demonstrates that all heavy bodies, when unsupported, fall towards the surface of the earth. The direction of their motion may be ascertained by a plumb-line, and it is found to be always perpendicular to the level surface of the earth, that is, to the surface of stagnant water. But the earth is very nearly spherical, and a line perpendicular to the surface of a sphere must pass through its centre; hence the direction of a body moving in consequence of the force of terrestrial gravity is towards the centre of the earth. And this is the direction in which it must move if the force of gravity is the resultant of the attraction of all the particles of terrestrial matter on the falling body; for it has been demonstrated (by Newton) that a sphere attracts an exterior body in the same manner as if all its matter were condensed into a single point at its centre.

As bodies when left without support fall from all heights to [illegible]d, it may be inferred that gravit[illegible] whole time of their descent, and is therefore a uniformly accelerating force. This might also be inferred from the fact, which is easily rendered sensible, that bodies which fall from a greater height arrive at the earth with a greater velocity. But Galileo was the first who proved by experiment that the [illegible] of falling bodies is uniform, and [illegible] the spaces [illegible] through are [illegible] as the squares of the times of descent. Experiments of this kind are attended with [illegible] of the resistance [illegible] inclination to the horizon, in which case (neglecting the effects of friction) the velocity is diminished in the ratio of the sine of the plane's inclination. By mounting the descending body on wheels, and forming the inclined plane of a hard substance capable of receiving a perfect polish, the friction may also be so much diminished as not to change the nature of the motion. But the best method of showing experimentally that gravity is a uniformly accelerating force is by means of an apparatus



called (from its inventor) Attwood's machine. This consists of a pulley, the axle of which turns on friction rollers, and having a groove on its edge to receive [illegible]g. Over the wheel a fine silken [illegible]s stretched, to the ends of which are [illegible]ed two equal weights, A and B. In th[illegible]ate the weights counterbalance each [illegible] and no motion ensues; but if to the weights a small load *m* be added, to give it a preponderance, the loaded [illegible] it will immediately begin to descend. [illegible] motion which now takes place is ex[illegible] of the same kind with that of a body descending freely, but the velocity is diminished in the proportion of the additional load *m* to the sum of the three, *m*, A, and B; for the force, which is impressed by the additional weight, is expended in giving velocity not only to it, but also to the two weights A and B attached to the string. By this machine the properties of uniformly accelerated motion are experimentally shown to hold true in the descent of falling bodies; for if the additional load be such as will carry the weight to which it is added through 1 foot in the first second of time, it carries it through 4 feet in 2 seconds, through 9 in 3 seconds, and so on. A proof is therefore afforded by this means that terrestrial gravity is a uniformly accelerating force.

Terrestrial gravity acts equally on all bodies; that is to say, impresses on all of them an equal quantity of motion, whatever their nature may be. This property of gravity was also demonstrated by Galileo. In different hollow spheres, of equal weight and diameter, he enclosed equal weights of different substances; the spheres were suspended by strings of equal length, and made to vibrate in very small arcs, and it was found that the time of an oscillation was the same in all of them. Common experience would seem to be at variance with this result. Light bodies, as feathers, paper, &c., fall slowly and irregularly; and some substances, as smoke, vapours, &c., even ascend. But this, as is well known, arises from the buoyancy of the atmosphere. In the exhausted receiver of an air pump a piece of gold and a feather fall with the same speed, and strike the bottom at the same time.

*Measure of Terrestrial Gravity.* — Having ascertained the law according to which gravity acts on bodies at the surface of the earth, the next question is to determine its absolute intensity, or the velocity which it communicates to a body falling freely in a given time. On account of the rapidity of the descent of heavy bodies this cannot be done by direct experiment, nor could Attwood's machine be employed for the purpose with sufficient certainty. The only mode by which an accurate result can be obtained is by measuring the length of a pendulum which makes a given number of oscillations in a given time. Let $l$ be the length of the seconds pendulum, $\pi$ the ratio of the circumference to the diameter, and $g$ the accelerating force of gravity, that is, twice the space through which a body falls by the action of gravity in the first second of time; then (PENDULUM) we have the equation $g = l\pi$. Now the length of the pendulum vibrating seconds of mean solar time in London, in vacuo, and reduced to the level of the sea, has been determined to be 39.1393 British standard inches, and $\pi = 3.14159$; therefore $g$ is found = 386.3 inches, or $32\frac{1}{5}$ feet. The height, therefore, through which a body would fall in vacuo in a second of time at London is half of this quantity, or $16\frac{1}{10}$ feet. It will be observed, however, that this value of $g$ does not express the whole of the earth's attraction, a small part of which (about the 1-464th) is counteracted by the centrifugal force corresponding to the latitude; it is the force of gravity diminished by the centrifugal force, or what is properly called *gravitation*.

From experiments made with the greatest care, it appears that the extreme amount of the variation of the gravitating force between the equator and the poles is one part in 194 of the whole quantity; that is to say, any body which at the equator weighs 194 pounds, if transported to the pole would weigh 195 pounds. The difference of gravitation, therefore, at the equator and the poles, is expressed by the fraction $\frac{1}{194}$. Now it has been demonstrated by Newton that the ratio of the centrifugal force at the equator to gravitation there is $\frac{1}{289}$. This is

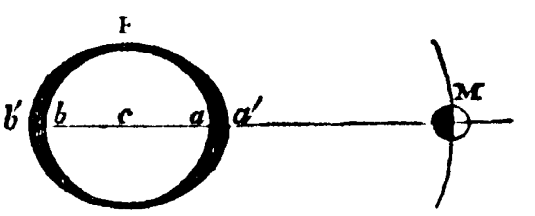
considerably smaller than the fraction $\frac{1}{194}$; but the difference, which is $\frac{1}{300}$, arises from the oblate figure of the earth In consequence of which a body placed at the pole is at a less distance from the centre than one at the equator, and is therefore attracted more than it would be at the equator, even if the earth were solid and there was consequently no centrifugal [illegible] it may be readily understood that the figure of the earth is determined by measuring the intensity of gravitation [illegible] *See* DEGREE, EARTH

*Universal Gravitation* —Galileo, who had so [illegible] beyond the speculative genius of Kepler led him to speak of gravity as a force acting mutually from planet to planet, and particularly from the earth to the moon, and he even supposed the tides to be produced by the gravitation of the waters of the sea towards the moon He did not however suppose it to have any concern in the regulation of the celestial motions Hooke also supposed the heavenly bodies to have a gravitation to each other, but his notions respecting its nature were inaccurate, and he did not attempt to define the law of its variation This great discovery was reserved for Newton While meditating on the nature of this force, the thought occurred to him that since gravity is a tendency not confined to bodies on the very surface of the earth but reaches even to the summits of the loftiest mountains without its intensity or direction suffering any sensible change may it not reach to a much greater distance and even to the moon? Before this question, however, could be answered it was necessary to suppose a law according to which its intensity diminishes Newton soon perceived that this law would require the force of gravity to diminish exactly as the square of the distance increases, or that the attractive force of the earth at the distance of the moon must be as much less than it is at the surface of the earth as the square of the radius of the earth is less than the square of the moon's distance from the earth In a general way the hypothesis is easily verified The moon's orbit differs not much from a circle whose radius is equal to 60 times the semidiameter of the earth and the circumference of her [illegible] nearly 8000 miles and the period of the moon's revolution being 27d 7h 43m, it is easy to compute that the versed sine of the arc described by the moon in a minute (which is the same as her deflexion from the tangent or straight line she would describe if there were no force attracting her to the earth) is $16\frac{1}{12}$ feet But the mean distance of the moon from the earth being 60 times the distance of heavy bodies at its surface from its centre and her gravity increasing in proportion to the square of the distance, her gravity would be $60 \times 60$ times greater at the surface of the earth than at her present mean distance, and therefore would carry her through $60 \times 60 \times 16\frac{1}{12}$ feet in a minute near the surface But by what was proved by Galileo respecting the descent of heavy bodies the same force would carry her through $60 \times 60$ times less space in a second than in a minute, and therefore the same force which compels the moon to move in her orbit about the earth supposed to vary according to the inverse square of the distance, would cause her to fall, near the surface of the earth through 16 1 feet in a second Now this is exactly the space through which heavy bodies descend in a second, therefore the moon *may* be retained in her orbit by the power of terrestrial gravity

Newton however, did not allow the argument for universal gravitation to rest on loose considerations of the lunar orbit is a circle described with an average velocity about the earth He demonstrated that bodies [illegible] force which [illegible] the distance must describe conic sections having a focus at the centre of force, and observe the laws of motion which Kepler had discovered to belong to the planetary orbits He succeeded also in proving that some of the principal inequalities of the lunar and planetary orbits are necessary consequences of the mutual gravitation of the different bodies of the system to each other and that the same mysterious power not only regulates the motions of all the planets and satellites in space, but also determines the figure of the earth causes the precession of the equinoxes, and produces the tides of the ocean

Assuming the different bodies which compose the solar system to be acted upon by their mutual gravitation, according to the law proposed by Newton namely that each body attracts every other with a force proportional to its mass directly and to the square of the distance inversely, the determination of the motions of the several planets and satellites becomes a question of pure geometry when the requisite data are determined by observation If, however, the problem were required to be solved in its most general terms, and it were necessary to consider simultaneously the effects of all the bodies in the system, the difficulties of calculation would be enormous, and in fact no methods of analysis hitherto discovered would be sufficient to grapple with them Fortunately the actual condition of the system is such as to afford great simplifications The principal planets are isolated in space, at great distances from each other, and their masses are very small in comparison of that of the central body, so that the effects of their mutual attractions are not such as to alter the general elliptic form of their orbits, but merely produce small *perturbations* of their orbits and motions, which admit of being separately computed By availing themselves of these favourable conditions, mathematicians have succeeded in expressing the whole of the complicated movements of the planets and satellites by analytical equations, and such is the perfection to which this branch of physical science has attained, that there is now no irregularity in the motions of the bodies of the solar system, no deviation from their mean state appreciable to the most delicate astronomical observations, which has not been explained, and its period and amount accurately calculated on the principle of universal gravitation according to the law discovered by Newton *See* PLANET

The effects of gravitation as manifested in the influences of the [illegible] bodies on each other, enable us to form several conclusions respecting its nature and mode of action That gravity belongs not only to matter in the aggregate, but to every particle of which bodies are composed is rendered evident by the manner in which the moon disturbs the waters of the ocean Let L be the earth, and M the moon If the moon's gravity acted only on the aggregate mass and not on each particle, it would have no effect on the figure of the earth, and consequently no tide would be produced But the action of the moon on the different parts is unequal Those at *a* which are nearest the moon, are more attracted than those at the centre *c*, which again are more attracted than the parts at *b*, which are farthest from the moon The consequence is that a fluid particle at *a* is drawn away as it were from the general mass, and an accumulation takes place at *a'* For the same reason, the attraction at *c* being stronger than at *b*, the mass of the earth is drawn away from the parts at *b* and the fluid is in a manner left behind and accumulates at *b'* Hence we perceive the reason why it is high water on opposite sides of the earth at the same instant of time In fact, in consequence of the moon's attraction, the fluids on the surface of the earth have a tendency at every instant to arrange themselves in the form of an elongated spheroid, the greater axis of which points towards the moon




It is also proved by astronomical phenomena that gravity is a force which is transmitted from body to body, not successively, but instantaneously Were gravity transmitted with a measurable velocity, the *rate* of velocity would sensibly affect the secular variation of the mean motion of the moon By a comparison of the results of theory with observation Laplace found that the velocity of the attracting force, if not infinite, must be at least [illegible] of times greater than the velocity of light (Mec. Cel. liv. xvi.)

Another question which may be put with regard to the nature of gravity is, whether its action is in any degree modified by the interposition of the substances through which it penetrates? For example whether the attractive force of the earth which must penetrate the whole substance of the moon before its influence reaches the particles on the opposite side of that body, acts with the same intensity on those particles as on those nearest the earth, regard being had to the law of the distance? Now, if the attractive force suffered any diminution in passing through the lunar substance the parallax would thereby be affected, and from the amount of the parallax it is certain that the intensity of terrestrial gravitation on the different molecules of the moon suffers no variation, excepting what arises from the different distances of the molecules It may therefore be considered says Laplace, as sufficiently established that the force of gravity is of so subtle a nature that the densest bodies of the universe offer no obstacle to its free passage

A third conclusion is that the law of gravity is not modified in any respect by the different natures of the celestial bodies If the action of the sun on the molecules of the earth differed only by a millionth part from its action on the molecules of the moon, the difference would occasion a variation [illegible] ing to several seconds [illegible] such variation is impossible [illegible] gravitating force of the sun, in equal times and at equal distances impresses equal velocities on the earth and moon It is also demonstrated from the theory of Jupiter

and Saturn, that Jupiter acts on Saturn according to the same law as on his own satellites Gravity is therefore a force altogether independent of the nature of the substances on which it acts

GRAVITY, SPECIFIC The specific gravity of a body is the ratio of its weight to the weight of an equal volume of some other body assumed as a conventional standard The standard usually adopted for this purpose is pure distilled water at a given temperature In England, the temperature is generally taken at 62° of Fahrenheit's scale, the French take it at 32°, or that of melting ice, sometimes at the temperature at which its density is the greatest (about 39 4° of Fahrenheit) The latter is by far the more convenient, inasmuch as it can be easily maintained without variations, whereas it is hardly possible to perform experiments at the exact temperature of 62°, in consequence of the continual variations of the temperature of the air It is only, however, when very great precision is required, that it is necessary to make the experiment with water at any particular temperature, in general, it is sufficient to note the temperature and apply a correction depending on the known density of water at the different degrees of the thermometric scale

The most obvious method of ascertaining the *relative weights* or specific gravities of two different bodies is to immerse them successively in a cylindrical or prismatic vessel of a known area, containing a liquid of less density than either When a solid is immersed in a liquid, the liquid occupies as much more space than it did before as is exactly equal to the bulk or volume of the body, and therefore by immersing equal or known weights of different bodies in a vessel of the form specified the relation between the heights at which the liquid stands will give the relation between their densities This was the method proposed by Archimedes for solving the famous problem of the crown of Hero

The method now employed is susceptible of far greater accuracy It depends on this principle that a body when immersed in a fluid loses just as much of its weight as is equal to the weight of an equal volume of the fluid By weighing a body, therefore, first in air (or rather in vacuo), and then in a liquid the ratio of its specific gravity to that of the liquid will be found as follows — Let $s$ = the specific gravity of the body $v$ = its volume $w$ = its weight in air and W = its weight in the liquid, also let $s'$ = the specific gravity of the liquid and $v'$ and $w'$ be respectively the volume and weight of a given portion of it Now it is evident, in the first place that if the volume of a body be supposed constant, its specific gravity will be directly proportional to its weight, and in the second place, if the weight remains constant the [illegible] inversely as the volume, that is to say, as the volume the greater is the specific gravity The specific gravity of a body is therefore directly as its weight and inversely as its volume Hence we have

$$s : s' :: \frac{w}{v} : \frac{w'}{v'}$$

But if we suppose $v = v'$, the weight of the portion of liquid whose volume is $v'$ will be equal, by the principle laid down to the difference between the weight of the body in air and in the liquid, that is, equal to $w - W$, whence $w' = w - W$, and the proportion becomes

$$s : s' :: w : w - W,$$

from which we deduce $s = s' \frac{w}{w - W}$ Now let the liquid be pure water at the standard temperature, then $s' = 1$, and we have simply $s = \frac{w}{w - W}$, so that in order to obtain the specific gravity of a solid body, its weight in air must be divided by the loss of weight it sustains when weighed in pure water

The process of finding the specific gravity of any solid body denser than water is rendered very simple by means of the *hydrostatic balance* When the solid is less dense than water, its weight in that liquid cannot be ascertained directly, but it may be found by attaching the body to another sufficiently dense to cause both to sink Let $l$ = the weight of the light body in air, and $x$ = its weight in water, $h$ = the weight of the heavy body in air, and $h'$ = its weight in water, $c$ ($= l + h$) = the weight of the compound or united mass in air and $c'$ = its weight in water All these quantities are found by experiment, excepting $x$ Now we have obviously $l - x + h - h' = c - c'$, therefore $l - x = (c - c') - (h - h')$ But if $s$ denote the specific gravity of the light body, we have, by what has already been shown, $s = \frac{l}{l - x}$, therefore, $s = \frac{l}{(c - c') - (h - h')}$

In this manner, the specific gravity of a solid in the state of powder may be found by placing it in a vessel whose weight in air and in water has been previously determined

The specific gravity of a liquid may be found in several ways by means of the hydrostatic balance Let a solid body of any convenient form, for example a sphere of glass, be taken, and let $w$ = its weight in air, $w'$ = its weight in water and $w''$ = its weight in the fluid whose specific gravity is to be ascertained, then taking $s$ to denote the specific gravity of the solid body, $s'$ the specific gravity of water and $s''$ the specific gravity of the liquid, we have by the first formula $s = s' \frac{w}{w - w'}$, and also $s = s'' \frac{w}{w - w''}$, therefore $s' \frac{w}{w - w'} = s'' \frac{w}{w - w''}$, and making $s' = 1$, we deduce $s'' = \frac{w - w''}{w - w'}$ It is evident that this process is equivalent to finding the ratio of the density of the solid body first to water, and then to the liquid to be experimented on

Another method is to take a phial of known weight and weigh it when filled with water, the increase of weight is of course the weight of the water It is then filled with [illegible], and the weight of the [illegible] We have then the weights of equal bulks of the water and the liquid, whence the ratio of their specific gravities is known

For many practical purposes and especially for determining the specific gravities or *strengths* of spirituous liquors it is necessary to have recourse to more expeditious methods than that of the hydrostatic balance In such cases the instrument called an hydrometer is employed (*See* HYDROMETER)

The specific gravities of the gaseous fluids are usually determined in terms of that of atmospheric air The difference between the weights of a flask when exhausted of air by means of the air-pump and when filled with the gas gives the weight of the gas which it contains But experiments of this kind require to be made with great care, as they are much affected by small variations of [illegible] pressure and degree of the state of the atmosphere For a detailed account of the method of proceeding and the manner of applying the requisite corrections, see *Biot's Traité de Physique*, tome i

The subjoined tables give the specific gravities of the substances which most frequently occur for a more extended list we refer to Brisson's Table (*Pesanteur spécifique des Corps*), or to the *Ency Britannica*, art "Hydrostatics"

I Table of the Specific Gravities of Solids and Liquids at the Temperature of 32° of Fahrenheit, the Density of Water being 1

| | | |
|---|---|---|
| Acid, Acetic | | 1 062 |
| Arsenic | | 3 391 |
| Arsenious | | 3 728 |
| Benzoic | | 0 667 |
| Boracic, crystallized | | 1 479 |
| fused | | 1 803 |
| Citric | | 1 034 |
| Formic | | 1 116 |
| Fluoric | | 1 060 |
| Molybdic | | 3 460 |
| Muriatic | | 1 200 |
| Nitric | | 1 271 |
| Do highly concentrated | | 1 583 |
| Phosphoric, liquid | | 1 558 |
| solid | | 2 800 |
| Sulphuric | | 1 850 |
| Agate | | 2 590 |
| Alcohol, absolute | | 0 797 |
| of commerce | | 0 836 |
| Alum | | 1 714 |
| Amber | from 1·064 to | 1 100 |
| Ambergris | from 0·780 to | 0·926 |
| Amethyst, common | | 2 750 |
| oriental | | 3·391 |
| Amianthus | from 1·000 to | 3·3 |
| Ammonia, aqueous | | 0·875 |
| Arragonite | | 2 900 |
| Azure-stone | | 2 850 |
| Barytes, Sulphate of, | from 4 000 to | 4 558 |
| Carbonate of, | from 4 100 to | 4 600 |
| Basalt | from 2 421 to | 3 000 |
| Beryl oriental | | 3 549 |
| occidental | | 2 723 |
| Blood, human | | 1 0,3 |
| crassamentum of | | 1 245 |
| Borax | | 1 714 |
| Butter | | 0 942 |
| Camphor | | 0 988 |
| [illegible] rubber | | 0 933 |
| [illegible] | | 2 613 |
| [illegible] | from 2 600 to | 2 65 |
| Chalk | from 2 252 to | 2 657 |
| Chrysolite | | 3 400 |
| Cinnabar, from Almaden | | 6 902 |
| Coals | from 1 020 to | 1 300 |
| Copal | | 1 045 |
| Coral, red | from 2 630 to | 2 857 |
| white | from 2·540 to | 2 570 |
| Corundum | | 3 710 |
| Cyder | | 1 018 |
| Diamond, oriental, colourless | | 3 521 |
| Ditto, coloured varieties, | from 3 523 to | 3·550 |
| Diamond, Brazilian | | 3 444 |
| coloured varieties, | from 3 518 to | 3 550 |
| Dolomite | from 2 540 to | 2 830 |
| [illegible] | | 1 204 |
| [illegible] | | 0 866 |
| [illegible] | | 0·729 |
| Nitric | | 0 908 |
| Sulphuric | from 0 632 to | 0·775 |
| Emerald | from 2 600 to | 2 770 |
| Fat of beef | | 0 923 |
| Felspar | from 2 438 to | 2 700 |
| Flint, black | | 2 582 |
| Gamboge | | 1 222 |
| Garnet, precious, | from 4 000 to | 4 230 |
| common, | from 3 576 to | 3 700 |
| Glass, crown | | 2 520 |
| green | | 2 642 |
| flint | from 2 760 to | 3 000 |
| common plate | | 2 760 |
| Granite | from 2 613 to | 2 956 |
| Gum arabic | | 1 452 |
| Gunpowder, loose | | 0 836 |
| solid | | 1 745 |
| Gypsum, compact, | from 1 872 to | 2 288 |
| crystallized, | from 2 311 to | 3 000 |
| Heliotrope, or Bloodstone, | from 2 629 to | 2 700 |

# GRAVITY, SPECIFIC.

## Table I (*continued*).

| | | |
|---|---|---|
| Honey | | 1 450 |
| Hornstone, or Mellite, | from 1 560 to | 1 666 |
| Hornblende | from 3 250 to | 3 830 |
| Hone stone | from 2 33 to | 2 810 |
| Humus | from 1 [illegible] to | 4 780 |
| Jasper | from 2 555 to | 2 816 |
| Jet | | 1 300 |
| Indigo | | 1 009 |
| Ironstone from Carron | | 3 281 |
| Lancashire | | 3 573 |
| Isinglass | | 1 111 |
| Ivory | | 1 825 |
| Lard | | 0 947 |
| Lead — Grance or [illegible] Dr | | |
| [illegible] | to | 7 786 |
| [illegible], | from 2 85 to | 3 000 |
| Magnesia, native Hydrate | | 2 330 |
| Carbonate of, from | | 2 220 to 2 612 |
| Malachite compact, | from 3 572 to | 3 994 |
| Marble, Carrara | | 2 716 |
| Parian | | 2 560 |
| [illegible] | | 1 [illegible] |
| [illegible] Granite from Jura | | [illegible] |
| Metals, Native | | |
| Arsenic | | 5 763 |
| Bismuth | | 9 880 |
| Brass | from 7 824 to | 8 396 |
| Cadmium | | 8 600 |
| Chromium | | 5 900 |
| Cobalt | | 8 600 |
| Columbium | | 5 600 |
| Copper | | 8 900 |
| Gold, cast | | 19 258 |
| hammered | | 19 361 |
| Iridium, hammered | | 23 00 |
| Iron, cast at Carron | | 7 248 |
| forged into bars | | 7 788 |
| Lead | | 11 352 |
| Manganese | | 8 000 |
| Mercury | | 13 598 |
| Molybdenum | | 8 600 |
| Nickel, cast | | 8 279 |
| forged | | 8 666 |
| Osmium and Iridium, alloy of | | 19 500 |
| Palladium | | 11 800 |
| Platina, forged | | 20 336 |
| drawn into wire | | 21 042 |
| in plates | | 22·069 |
| Potassium at 32° Fah | | 0 865 |
| Rhodium | | 11 000 |
| Selenium | | 4 3000 |
| Silver | | 10 474 |
| hammered | | 10 510 |
| Sodium at 59° Fahr | | 0 972 |
| Steel, soft | | 7 833 |
| tempered | | 7 816 |
| hardened | | 7 810 |
| Tellurium, | from 5 700 to | 6 115 |
| Tin, Cornish | | 7 291 |
| hardened | | 7 299 |
| Tungsten | | 17 40 |
| Uranium | | 9 000 |
| Zinc | from 6 200 to | 7 191 |
| Mica | from 2 650 to | 2 934 |
| Milk | | 1·032 |
| Mineral Pitch, or Asphaltum, from | | 0 905 to 1 233 |
| Mineral tallow | | 0 770 |
| Myrrh (a resin) | | 1 360 |
| Naphtha | from 0 700 to | 0 847 |
| Nitre | | 1 900 |
| [illegible] | from 2 348 to | 2 370 |
| Oils, Fixed [illegible] | | 0 868 |
| Aniseseed | | 0 986 |
| Carrawayseed | | 0 904 |
| Cinnamon | | 1 043 |
| Cloves | | 1 036 |
| Lavender | | 0 894 |
| Turpentine | | 0 870 |
| Wormwood | | 0 907 |
| Expressed — Sweet Almonds | | 0 932 |
| Hempseed | | 0 926 |
| Linseed | | 0 940 |
| Olives | | 0 915 |
| Poppyseed | | 0 939 |
| Rapeseed | | 0 913 |
| Whale | | 0 923 |
| Opal, precious | | 2 114 |
| common | from 1 958 to | 2 114 |
| Opium | | 1 336 |
| Orpiment | from 3 048 to | 3 500 |
| Pearl, Oriental | from 2 510 to | 2 750 |
| Pearlstone | | 2 340 |
| Peruvian Bark | | 0 784 |
| Phosphorus | | 1 770 |
| Pitchstone | from 1 970 to | 2 720 |
| [illegible] | from 1 987 to | 2 400 |
| Porcelain [illegible] | | 2 384 |
| Sèvres | | 2 145 |
| Porphyry | from 2 458 to | 2 972 |
| Seltzer | | 1 003 |
| Proof spirit | | 0 923 |
| Pumice stone | from 0 752 to | 0 914 |
| Quartz | from 2 624 to | 3 750 |
| Realgar | from 3 225 to | 3 338 |
| Rock-crystal | from 2 581 to | 2 888 |
| Ruby Oriental | | 4 283 |
| Sapphire Oriental, | from 4 000 to | 4 200 |
| Sardonyx | from 2 602 to | 2 628 |
| Scammony of Smyrna | | 1 274 |
| Schorl | from 2 922 to | 3 152 |
| Serpentine | from 2 264 to | 2 999 |
| Silver Glance | from 5 300 to | 7 208 |
| Slate (drawing) | | 2 110 |
| Spar, Fluor | from 3 094 to | 3 791 |
| calcareous | from 2 620 to | 2 837 |
| Spermaceti | | 0 943 |
| Stalactite | from 2 323 to | 2 516 |
| Stone, Bristol | from 2 510 to | 2 640 |
| grinding | | 2 142 |
| Portland | | 2 496 |
| rotten | | 1 981 |
| Sugar | | 1 606 |
| Sulphur, native | | 2 033 |
| fused | | 1 990 |
| Talc | from 2 080 to | 3 000 |
| Tallow | | 0 941 |
| Topaz | from 4 010 to | 4 061 |
| Tourmaline | from 3 086 to | 3 361 |
| Turquoise | from 2 500 to | 3 001 |
| Ultramarine | | 2 362 |
| Vinegar | from 1·013 to | 1·080 |
| Water, distilled | | 1 000 |
| sea | | 1·029 |
| of Dead Sea | | 1 248 |
| Wax, Bees | | 0 964 |
| Shoemakers' | | 0 897 |
| Whey, cows' | | 1·019 |
| Wine, Bourdeaux | | 0 993 |
| Burgundy | | 0 991 |
| Constance | | 1 081 |
| Malaga | | 1 042 |
| Port | | 0 997 |
| White Champagne | | 0 997 |
| Wood, Alder | | 0 800 |
| Apple tree | | 0 793 |
| Ash | | 0·845 |
| Bay tree | | 0 822 |
| Beech | | 0 852 |
| Box, French | | 0 912 |
| Dutch | | 1 328 |
| Brazilian, Red | | 1 031 |
| Campeachy | | 0 913 |
| Cedar, Wild | | 0 596 |
| Palestine | | 0 613 |
| Cherry tree | | 0 715 |
| Citron | | 0 726 |
| Cocoa | | 1 040 |
| Crab tree | | 0 765 |
| Cork | | 0 240 |
| Cypress, Spanish | | 0 644 |
| Ebony, American | | 1 331 |
| Indian | | 1 209 |
| Elder tree | | 0 695 |
| Elm tree | | 0 671 |
| Filbert tree | | 0 600 |
| Fir, Male | | 0 550 |
| Female | | 0·498 |
| Hazel | | 0 600 |
| Juniper tree | | 0 556 |
| Lemon tree | | 0 703 |
| Lignum Vitæ | | 1 333 |
| Mahogany | | 1 063 |
| Maple tree | | 0 750 |
| Mulberry Spanish | | 0 897 |
| Oak heart, 60 yrs old | | 1 170 |
| Olive tree | | 0 927 |
| Orange tree | | 0 705 |
| Pear tree | | 0 166 |
| Plum tree | | 0 785 |
| Pomegranate tree | | 1 301 |
| Poplar | | 0 383 |
| White Spanish | | 0 529 |
| Vine | | 1 327 |
| Walnut | | 0 681 |
| Willow | | 0 585 |
| Yew, Dutch | | 0 788 |
| Spanish | | 0 807 |
| Woodstone | from 2 045 to | 2 675 |
| Zeolite | from 2 073 to | 2 718 |
| Zircon | from 4 385 to | 4 700 |

## II Table of the Specific Gravities of the Gases and Vapours, that of Atmospheric Air being 1

| | | | | | |
|---|---|---|---|---|---|
| Gases — Atmospheric Air | 1 000 | Gases — Euchlorine | 2 440 | Gases — Nitrous Oxide | 1 527 |
| Ammonia | 0 590 | Fluoboric Acid | 2 371 | Oxygen | 1 111 |
| [illegible] | 1 527 | Fluosilicic Acid | 3 632 | Phosphuretted Hydrogen | 0 902 |
| [illegible] | 0·972 | Hydriodic Acid | 4 340 | Prussic Acid | 0 937 |
| [illegible] Hydrogen | 0 972 | Hydrogen | 0 069 | [illegible] | 0 555 |
| [illegible] | 2 500 | Muriatic Acid | 1 284 | [illegible] | 0 972 |
| Chlorocarbonous Acid | 3 472 | Nitric Oxide | 1·041 | Sulphuretted ditto | 1 180 |
| Chloroprussic Acid | 2 152 | Nitrogen | 0 972 | Sulphurous Acid | 2·222 |
| Cyanogen | 1 806 | Nitrous Acid | 2 638 | | |

GRAYLING *See* SALMON

GRAZIOSO (It) In Music, an instruction to the performer that the music to which this word is affixed is to be executed elegantly and gracefully

GREAVE (Fr grève) A piece of armour defending the shin (in the patois of Burgundy, greve still signifies shin) The greave was a piece of steel hammered out to the form of the leg and fastened with straps behind The [illegible] common epithet [illegible] In the *Iliad* it appears that the [illegible] was used in some instances by the Roman soldiery, but only on one leg, the other being covered with the buckler It is said to have been discontinued in the armies of the Greek empire, under the emperor Maurice (about the end of the 6th century), and again brought into use in those armies of the middle ages about 1320 They were also called *jambs*, *bein bergs*, &c They were originally of leather, quilted linen, &c The *clavons* were a species of [illegible] of cloth

GREAVES, or GRAVES The sediment of melted tallow, composed of the membranous, vascular, nervous, and muscular matters blended with the fat, and which not being fusible are easily separated from it by straining they are made up into cakes and sold by the tallow-chandlers, being chiefly used as a coarse food for large [illegible]

GREBE *See* PODICIPS

GRECIAN ARCHITECTURE *See* ARCHITECTURE

GREEK CHURCH, THE, comprises the great bulk of the Christian [illegible] of Russia and Greece, Moldavia and Wallachia, besides various congregations scattered throughout the provinces of the Turkish and Austrian empires, who acknowledge the patriarch of Constantinople as their head This prelate, although possessing a certain spiritual supremacy over this extensive community has never ventured to assert any claim to the temporal power so long wielded by his rival at Rome His ambition was curbed in the first instance by the jealousy of the emperors with whom he was brought into closer contact, and since the Mohammedan [illegible] the state of weakness and poverty [illegible] church in Turkey has been thrown has annihilated all [illegible] In earlier times, however, the [illegible] clergy showed that they did not lack the will to raise themselves to an equal station in the East with the growing authority of the popes in the West The origin of the separation which has now prevailed for many hundred years between two such important sections of Christendom as the Latin and Greek churches [illegible] as they do in many of their [illegible] principles, is to be attributed to the rival pretensions set up by the bishops of the two imperial cities, and dates almost from the foundation of the younger capital

As early as the year 451 the council of Chalcedon assigned Asia Minor, Pontus, Thrace and the frontiers of Illyricum for the extent of the spiritual jurisdiction of the church of Byzantium, and conferred upon its bishop the same honours and privileges as had been already conceded to the pope of Rome The patriarchs of Antioch and Alexandria maintained still a special and independent authority but were practically reduced under the predominant influence of the patriarch of the East The aggressions, however, of the rival [illegible] proceeded pari passu the Roman, being further removed from the Imperial authority which was seated at Ravenna assumed by degrees a direct temporal authority over the neigh-

bouring districts, which led the way to the prodigious indirect supremacy which he usurped after the lapse of several ages The Constantinopolitan on the contrary was always strictly watched, and fettered by the proximity of the Eastern emperors, and the extension or declension of his authority depended in most cases more upon the particular character of the wearer of the crown than of the mitre The first doctrinal ground of dispute was the assertion of the Latin church, about the beginning of the 9th century of the double processio of the Holy Ghost from the Father and the Son The word *filioque*, first surreptitiously inserted into the Constantinopolitan creed many years after its promulgation, became the badge of the Western church, and whatever appearance there was for the shameful forgery above mentioned on the part of the opposite party it is very certain that the original creed, the procession from the Father alone, had never been declared by a council of the church And the silence of the symbols upon it was no argument against either the truth of the doctrine or the fact of its having been held as much as any doctrine may be said to be so, before it has been brought forward into discussion and settled in men's minds by the great mass of the learned world

The discussions produced by this controversy were brought to a head by the sudden elevation of Photius a layman, to the patriarchate, by the command of the emperor In six successive days he passed through the six preliminary orders he became successively monk reader, subdeacon, deacon priest bishop and finally on the seventh day was consecrated patriarch and all this to the violent exclusion of the existing pontiff, Ignatius The appointment of Photius who was a man of extraordinary talents, alarmed the Romish see The cause of Ignatius was supported in the West and the intruder excommunicated by Nicholas I The thunder of Rome was retorted by a charge made on the part of Photius against the Latin church of five distinct heresies which it may be as well to enumerate in order to show the frivolity of the greater part of the round of [illegible] It was objected that 1 [illegible] seventh day of the week, 2 [illegible] use of milk and cheese in the first week of Lent 3 That they forbade their priests to marry, 4 That they authorized bishops to baptize with the chrism, and forbade the priests, 5 That they had interpolated the creed of Constantinople with the word *filioque*, and held the doctrine therein implied

These proceedings widened the breach which had already in fact taken place by the formal transference which the emperor had effected of several provinces east of the Adriatic from the jurisdiction of Rome to that of Constantinople The Roman party continued however still powerful in the East and the intrigues of the papal see were frequently successful, until in 1054 the mutual excommunications pronounced upon each other by Leo IX and Cerularius caused the final separation, which has continued to the present day

The opinions of the Greek church bear considerable affinity to those of the Latin The fundamental distinction is the rejection of the spiritual supremacy of St Peter and the denial of any visible representative of Christ upon earth In the view which it takes of the procession of the Holy Ghost it is at variance not only with the Roman Catholic church, but with Protestants also It recognizes however the seven sacraments, authorizes the offering of prayer to the saints and Virgin, and encourages the use of pictures, though forbidding that of images It holds in reverence also the relics and tombs of holy men, enjoins strict fasting and the giving of alms, looking upon them as works of intrinsic merit, and numbers among its adherents numerous orders of monks and nuns It allows, however the marriage of its secular priests, and rejects auricular confession It holds that modified form of the Roman doctrine of the eucharist which is denominated consubstantiation, and apparently entertains some confused notions of a purgatory, in consideration of which it offers prayers for the dead It administers [illegible]

The services of the [illegible] of ceremonial observances, preaching and the reading of the scriptures form but a small part of them the former, indeed, was at one period altogether forbidden in Russia The mass of the people are in a state of the grossest ignorance upon religious subjects, and the worship of the lower orders, under the influence of a poor and [illegible] from the grossest superstition

**GREEN CLOTH, BOARD OF** A court of justice belonging to the king's household, daily sitting in the king's palace under the lord high steward It is attended by various officers of the household, and by the steward of the Marshalsea, who is always a barrister They meet for the purpose of taking daily accounts of expenses, making provision and payments for the household, and paying the wages of the king's servants under the lord high steward It has jurisdiction in all offences committed in the king's palaces, and within the verge of his court

**GREEN-HOUSE** In Gardening, a house with a roof and one or more sides of glass, for the purpose of containing plants in pots which are too tender to endure the open air the greater part of the year The green house, being a structure of luxury, ought to be for the most part situated near the house, in order to be enjoyed by the family in inclement weather, and, if possible, it should be connected with [illegible] the same character with refe[illegible] d breadth may be varied at pleasure, but its height should never be less than that of the loftiest apartments of the house to which it belongs The best aspect is to the south or south-east, but any aspect may be chosen, provided the roof is entirely of glass, and abundant heat is supplied by art In green-houses facing the north, however, the more tender plants will not thrive so well in winter more artificial heat will be required at that season, and the plants should be chiefly evergreens, and other plants that come into flower in the summer season, and grow or flower but little during winter In most green-houses the plants are kept in pots or boxes and set on stages or shelves, in order that they may be near the roof, so as to receive the direct influence of the rays of light immediately on their passing through the glass An orangery differs from a green-house in having an opaque roof and in being chiefly devoted to plants which produce their shoots and flowers in the summer season and in the open air, and they are set in the orangery merely to preserve them through the winter Such a structure might with more propriety be termed a conservatory, but custom in the present day has applied this term to structures having glass-roofs in which the plants are not kept in pots, but planted in the free soil and in which a part of them are encouraged to grow and flower in the winter months *See* ORANGERY and CONSERVATORY

**GREEN ROOM** in the Theatre the name given to the actors' retiring room so called in all probability, from its being originally painted or otherwise ornamented with [illegible]r

**GREENSAND** Beds belonging to the chalk formation they often contain *chlorite* or *green earth* scattered through the sandstone and limestone of which they consist *See* GEOLOGY

**GREEN SCHEELE'S** An arsenite of copper *Mineral green* is a subcarbonate of copper, and *Brunswick green* an oxychloride of copper

**GREEN SICKNESS** *See* CHLOROSIS

**GREENSTONE** A variety of traprock composed of felspar and hornblende *See* GEOLOGY

**GREEN VITRIOL** The metallic salts of sulphuric acid were formerly designated *vitriols* sulphate of iron was termed *green vitriol* It is a compound of 1 atom of oxide of iron and 1 atom of sulphuric acid the crystals contain 7 atoms of water, hence the crystallized salt consists of 36 protoxide of iron 40 sulphuric acid and 63 water and its equivalent is = 139 Sulphate of copper is called *blue vitriol* and sulphate of zinc *white vitriol*

**GREGORIAN CALENDAR** The reformed calendar of the church of Rome introduced by Pope Gregory XIII in 1582 in which the error of the civil year of the Julian calendar was corrected by the omission of three intercalary days in four centuries, and the moon's age, with the time of Easter with the other moveable feasts depending on it, indicated by the table of epacts *See* CALENDAR

**GREGORIAN EPOCH** The epoch or time at which [illegible] the Gregorian calendar commenced [illegible] 582

**GREGORIAN TELESCOPE** The first and most common form of the reflecting telescope invented by James Gregory, professor of mathematics in the university of St Andrew's and afterwards of Edinburgh, and described by him in his *Optica Promota*, published in 1663. *See* TELESCOPE

**GREGORIAN YEAR** The civil year of the Gregorian calendar In the Gregorian calendar the common year consists of 365 days, and every fourth year is a leap year or contains 366 days excepting the last years of every century of which the number is not divisible by 4 Thus the years 1700, 1800, 1900, are not leap years, but 1600 and 2000 are leap years, the numbers 16 and 20 being divisible by 4 The period is consequently 400 years, in the course of which there occur 97 intercalations so that 400 years contain 365 × 400 + 97 = 146097 days, and therefore one Gregorian year consists of 365 2425 mean solar days, or 365 d 5 h 49 m 12 sec But the true solar year consists of 365 d 5 h 48 m 49 62 sec The Gregorian year, therefore, errs in excess by 22 38 seconds, but the error is not worth taking into account, as it only [illegible] 3866 years

**GRENADE** A ball of iron about two inches [illegible] filled with gunpowder and furnished with a proper fuse, It is often called a hand grenade being thrown from the parapets of besieged places upon the invaders beneath

**GRENADIERS** was the name given at first to the soldiers who threw the grenade, but it was afterwards

conferred on certain troops of the line, distinguished from the latter chiefly by some peculiarities of dress, accoutrements, &c This appellation originated with the French in 1667, but was speedily adopted into all the armies of Europe, and wherever the name has been introduced, the finest-looking and tallest men of the regiment have always been selected to form what is called the [illegible]

GRI[illegible] stone or grit

GRLSSO'RIAL, in Ornithology, is applied to the feet of birds which have three toes forward, two of which are connected, and one behind

GRE[illegible]NA GRI[illegible]N MARRIAGES A species of marriage, so called from its being usually celebrated at

[illegible]

lumns

'The marriage ceremony merely amounts to an admission before witnesses that certain persons are man and wife, such acknowledgment being sufficient, *provided it be followed or preceded by* the law of Scotland to constit[illegible] certificate to this effect being signed by the officiating priest (who has never been above the rank of a tradesman), and by two witnesses, the union under the above condition, becomes indissoluble The marriage service of the church of England is sometimes read, in order to please the parties The marriages of this sort celebrated at Gretna Green are estimated at between 300 and 400 a year, but as similar marriages are celebrated at Springfield Annan, Coldstream, and other places along the border, their total number is said to amount to 500 a year! The parties are generally from England and of the lowest ranks, though there are not a few instances of persons of the higher ranks, and even of lord chancellors, having had recourse to the services of the *soi disant* parsons of Gretna Green A trip to Gretna, or the presence of a self-dubbed parson, is not however, at all necessary Parties crossing the Scottish border, and declaring before witnesses that they are man and wife, are under the previously mentioned conditions married according to the law of Scotland This law has been much objected to, but we are inclined to think with no good reason It would, indeed, be no difficult matter to show that it is on the whole productive of numerous advantages No where perhaps are there so few rash or improvident marriages as in Scotland, and the retrospective effect of the existing law, or its influence in legitimising the children born before marriage, is perhaps its most valuable feature But it is necessary to observe, that though legitimated in Scotland children born previously to a Scotch marriage are not legitimated in England, and do not succeed except by special bequest, to heritable property in that part of the U Kingdom In all respects however Scotch marri[illegible] enjoy the same rights and privileges in England as English marriages The practice began at Gretna Green about 60 years ago by a person named Paisley, a tobacconist who died so lately as 1814 It is now carried on by various individuals indeed each inn has its rival priest in addition to others who carry on the business on their own account, and so far has competition reduced the fees that though large sums (40*l* or 50*l*) have been received the solatium in some instances, is now so low as half-a-crown One of these functionaries who breaks stones daily on the verge of England, has the best chance of succeeding for he accosts every party as they pass, and tries to strike the best bargain'

GRI'WACKI See GRAUWACKE GEOLOGY

GRI'FFIN (Gr γρυψ) A fabulous animal of antiquity represented with the body and feet of a lion, the head of an eagle or vulture and is being furnished with w[illegible] but it belongs more to the romantic than the classical mythology It plays a prominent part in the fairy tales and romances of the middle ages, and like the dragon which was fabled to guard the golden apples of the Hesperides its chief duties consisted in watching over hidden treasures, and in guarding captive princesses, or the castles in which they were confined The griffin is at once the symbol of strength and swiftness, courage prudence, and vigilance—qualities which its form is well calculated to represent, and hence it has been adopted into the language of heraldry, where it constitutes a prominent feature in the armorial bearings of many princely and noble families

GRIMA'CE (Fr) In Painting and Sculpture, an unnatural distortion of the countenance, from habit, affectation, or insolence

GRIPE The fore part of a ship —*To gripe*, the tendency af a ship to bring her head up to the wind when carry ng sail on the w[illegible]d

GRIT Hard sandstone, employed for millstones and grindstones, pavement, &c

GROAT An old English silver coin equal to 4*d* of our present money It was introduced by Edward III about the year 1351, and has lately been again adopted and issued from the mint the first coinage of these modern silver groats or four-penny pieces took place in 1835

GROATS, in Agriculture are the small grains formed from oats by bruising them in the mill, after having the husks or shells taken off from the grain

GROIN (Sax γπoιτπ *to grave*) In Architecture, the line formed at the intersection of two arches which cross each other at any angle

GRONI'NGENISTS In Eccl History a subdivision of the sect of Anabaptists (See *Mosheim*, Transl, vol v p 492)

GROOM A name now usually applied to servants who are employed about horses From the Flemish grom *a boy* The *groom-porter* was an officer of the royal household in the lord steward's department, whose place is said to have succeeded that of the master of the revels Groom is still the denomination of several officers of the royal household, chiefly in the lord chamberlain's department, such as grooms in waiting, groom of the stole or robes, &c &c

GROOVE (Sax γπaran *to dig*) In Architecture, a sunken rectangular channel It is usually employed to connect two pieces of wood together, the piece not [illegible] its edge a projection or *tongue*, whose [illegible] to and fits the groove

GROSS In Commerce, the number of 12 dozen

GROSSULA'CEÆ (Grossularia, one of the genera) A natural order of shrubby Exogens, natives of most parts of the world excepting Africa and the tropics, formerly confounded with *Cactaceæ* Placed by Von Martius between *Saxifragaceæ* and *Onagraceæ*, but nevertheless on account of their albuminous seeds appearing to have affinities of another nature, especially with *Berberaceæ* and the vir[illegible]ant are fruits of this order [illegible] shrubs co[illegible] belong

GROSSULA'RIA (Lat grossula, *a gooseberry*) A gre[illegible] found in Siberia

GROTESQUE (Fr) In the Fine Arts, a term applied to capricious ornaments which as a whole have no type in nature, consisting of figures, animals, leaves, flowers fruits, and the like all connected together

GROTESQUE In Architecture, artificial grotto-work decorated with rockwork shells &c

GROTTO (It) The name given to subterraneous natural excavations formed in the heart of mountains or other places Many of these cavities are famed for the mephitic exhalations that issue from them and to this class belongs more especially the Grotto del Cane, near Naples, but there others not less celebrated for their beauty and grandeur, of which the grottoes of Antiparos and Ingal are well-known examples In picturesque gardening the term is applied to an artificial or ornamental cave or low building intended to represent a natural grotto The best specimen of this kind is the grotto attached to the Colosseum, which may be considered a model for all similar designs

GROUND (Sax γπunδ) In the Fine Arts, a word [illegible] in Sculpture it is the surface from which, in *relievo*, the figures rise and in Architecture, it is used to denote the face of the scenery or country round a building

GROUND BAIT Balls made of greaves, bran, boiled grain gentles &c, mixed up with clay and thrown into the water by which the fish are brought together upon those spots which the angler selects for his sport

GROUND PLATE or SILL In Architecture, the lower part of a timber building, which receives the principal and other posts

GROUNDS In Architecture, pieces of wood flush with the plastering, for which they serve as a guide, &c, to which mouldings and other finishings are attached

GROUP (Fr groupe) In P[illegible] a collection of objects, whose lighted parts [illegible] and their shaded parts a mass of shadow the word is also used to denote any adjoining assemblage of figures, animals, fruits, flowers, &c In speaking also of objects of different sorts, it is usual to say that one object *groups* [illegible] wanting In Sculpture, the word *group* is applied to a design in which there are two or more figures In Music, *group* signifies a number of notes linked together at the stems

GROUSE *See* TETRAO

GROUT (Sax γπuτ) In Architecture, mortar reduced to a state of fluidity by the addition of water a mixture of plaster and fine stuff, putty, or coarse stuff, used [illegible] also for mouldings, and sometimes for setting walls

GRUIDÆ The name of the family of wading birds represented by the stork (*Grus*)

GRUS (Lat the *Crane*) One of the modern constellations in the southern hemisphere *See* CONSTELLATION

GRY'LLIDÆ (Lat gryllus, *a locust*) The name of the family of locusts having the genus *Gryllus* for the type

GRYPA'NIUM (Gr γρυπος, *incurved*) In Ornithology, the *rostrum grypanium* is that form of beak in which the culmen is more or less carinated, and is so continued to the apex of the incurved maxilla

GRYPHÆ'A (Gr γρυπος) A genus of Ostracean Bivalves, remarkable for the curvature of the apex or beak of the shell, it is chiefly represented by fossil species, one of which, *Gryphæa virgula* characterizes the Kimmeridge clay, near Oxford, and the upper oolite of parts of France

GRYPHO'SIS (Gr γρυποω, *to incurvate*) A growing [illegible] nails

GUAIACUM is a peculiar resinous substance obtained from the *Guaiacum officinale*, a tree of the West Indies It has some chemical peculiarities which distinguish it from the common resins especially its property of becoming blue and green by the action of certain oxidizing substances Decoction of the wood of the tree and the tincture of the resin have been employed in the cure of rheumatism, and as an alterative, but it is an unimportant medicine

GUA'NO A substance found upon certain small islands, especially in the South Sea which are the resort of large flocks of birds, and chiefly composed of their excrement it is said to form beds fifty to sixty feet in thickness It is an excellent manure

GUARANTEE' in Law, is an undertaking to answer for the failure of another By the Statute of Frauds a person is not liable on a special promise in the nature of a guarantee unless a written agreement or memorandum of such promise shall be signed by the party making the promise, or some person lawfully authorized by him

GUA'RDIAN in Law, he who has the custody of such persons as are incapable of directing themselves and especially of infants Guardians at common law were—1 In chivalry (under the feudal principle of wardship abolished with [illegible] military tenure by 12 Ch 2 c 2 By nature the father in all cases, the mother to daughters, where no guardian is assigned by the father's deed or will 3 For nurture, appointed by the ordinary in default of father or mother 4 In socage being the nearest of kin to an infant entitled to real estate who cannot inherit that estate

GUA'RDIAN OF SPIRITUALTIES In Ecclesiastical Law, the person to whom the spiritual administration of a diocese is entrusted during the vacancy of the see —Of *Temp*[illegible] king during such vacancy [illegible] profits, [illegible] the Exchequer

[illegible] OF FRANCE This famous institution was first devised by the Municipal Committee of Safety of 1789, which sate at the Hotel de Ville in Paris before the taking of the Bastille The corps which was then raised at first carried green colours afterwards replaced by the tricolor It was more fully organized by a decree of September, 1791, to be raised by voluntary enlistment, both in Paris and the departments in the proportion of one man out of every twenty citizens The staff of the national guard was dissolved by the Convention after the 13 Vendemiaire (17[illegible], and it was placed under control of the military authorities Napoleon made of the national guard a species of military nursery and large portions of it volunteered in 1813 to act beyond the frontiers Under the Restoration the national guards were deprived of the [illegible] officers, and in 1827, in [illegible] demands for the dismission of the ministry (Villele's) they were dissolved By their constitution, as remodelled in 1830, they elect their own officers up to the rank of sub-lieutenant inclusive

GUARD, THE IMPERIAL In the armies of the Emperor Napoleon, was formed from a small corps of life-guards (as they might be termed) which had served to defend the Convention, the Corps Legislatif of 1795, the Directory, and afterwards the Consulate In 1805, when Napoleon became emperor, the consular guard had already been increased to 3300 infantry and 2100 cavalry, besides artillery and marines Its augmentation and equipment became [illegible] afterwards one of Napoleon's favourite [illegible], and as soldiers could not be enrolled except after serving four campaigns in the line with distinction or from the preparatory corps called the young guards, it was an institution of the highest military policy In the end of 1812, the Imperial Guard, old and young, consisted of 56,000 men, and its farther increase was only prevented by the calamities of the following years At the Restoration, the soldiers of the [illegible] to the line, those of the old guard were [illegible] regiments

GUARD, YEOMEN OF THE, were first raised by Henry VII in 1485, and appear to have been the first standing military corps ever set on foot in this country They were at first fifty men, half armed with bows and arrows, and half with arquebusses, afterwards some carried halberds The arquebusses [illegible] tizans (which they now carry) [illegible] III

GUARDS Troops attached to the person of the sovereign In modern times, the designation is applied in most countries to a body of men distinguished from the line by difference of pay, dress, &c, and possessing a certain military rank Body-guards have been an inseparable accompaniment of monarchy from the earliest ages the Assyrian and Persian monarchs employed them The corps of Argyraspides, or silver-shields were selected by Alexander out of the bravest men of his army The Roman emperors had their Prætorian guard Napoleon first created a small troop of body guards, with the title of Guides while yet only general, in his first Italian campaign From this arose by degrees the great institution of the Imperial Guard, itself an army with its two great divisions of old and young, and 120 pieces of cannon, the whole of which corps was broken up at the Restoration On the revolution of 1830, the royal guards of France were disbanded and none have been since embodied in that country In England, the guards (otherwise called household troops) consist of the life-guards, the royal regiment of [illegible] and three regiments of foot guards Many of the European sovereigns, before the French Revolution had small corps of foreign troops which served in this capacity Thus the French kings had in early times a body of Scotch guards, termed archers, at a later period a body of Swiss guards, called the Cent-Swisses, and after the Restoration of 1815 several battalions of Swiss guard were organized on the same service This system has since [illegible] the troubles of the Revolution have introduced a spirit at once more military and more national into the councils and populations of Europe The Pope still retains his Swiss guards

GUA'VA The fruit of the *Psidium pomiferum*, from which a jelly is made in the West Indies

GU'DGEON The common name of a small species of the Cyprinoid family of soft-finned fishes, having, like the barbel cirri or feelers at the mouth, and both the dorsal and anal fins short, but without a strong bony ray at the commencement of either The species consequently forms the type of a distinct subgenus called *Gobio*

GU'DGEONS In Machinery, the pins inserted in the extremities of a shaft or the axle of a wheel, on which it turns and which support the whole weight In order to diminish friction gudgeons are made as small as possible in diameter, leaving however, sufficient strength to support [illegible] frequently formed of cast iron on [illegible], but wrought iron of the same dimensions is considerably stronger, and will support a greater load

GU'EBERS or GULBRES (*i e* Ghours, *infidels*) The sectaries of the ancient Persian religion, of which the chief peculiarity consisted in the worship of fire, are so termed by the Mohammedans They still exist in some of the southern and eastern districts of Persia, but a colony of them has been long [illegible] Bombay and other parts of the western coast [illegible] attained to wealth and distinction These are termed in India *Parsees*, from the nation from which they originally sprang The Guebres explain the worship of fire by professing to regard it as a symbol only of the Divinity Their sacred books are termed the Zend-Avesta *See* PARSEES

GUELF, ORDER OF, or ROYAL GUELPHIC ORDER An Hanoverian order of knighthood, founded in 1815 by George IV, then Prince Regent It consists of grand crosses, commanders, and knights, both civil and military

GUELFS [illegible] a political party [illegible] opposite party of Ghibellines The former name is derived from that of the great German house of the Welfs or Guelfs These in the 12th century, were dukes of Bavaria, and carried on war in Germany with the house of Hohenstauffen, from one of whose castles (Weiblingen) the name Ghibelline is supposed to have been derived The latter house having become the ruling power in Germany under Frederic I, that prince invaded Italy in order to reassert the rights of the empire, and thus these party names, first used in a German feud, were transplanted into that country The chief adversaries of the house of Hohenstauffen in Italy were the Popes, who thus became the heads of the Guelf party, and the struggle between the two became, in the 13th century, when Frederic II was involved in contests with several successive pontiffs, a contest [illegible] Italy, and, in the beginning of the following century,

the invasion of the emperor Henry of Luxemburg added considerably to their power In the early part of that century the leading Ghibeline powers generally were, Milan under the house of Visconti, Verona under that of La Scala, and the Angevine kings of Sicily, the chief Guelf states the republic of Florence, the Angevin kings of Naples, &c Other states were alternately under the control of the two parties as they in turn predominated At this time the poet Dante, who had em-

his genius over the civil feuds of his age In the course of the 14th century, especially after the removal of the papal seat to Avignon, the original principles of the two parties were entirely lost, while the names continued, and factions bearing those appellations constantly agitated the interior of Italian cities and monarchies down to the middle of the 15th century, or even to a still later period The most complete works which can now be consulted on the subject are those of Raumer (*Geschichte der Hohenstaufen*) and Sismondi (*Republiques Italiennes*)

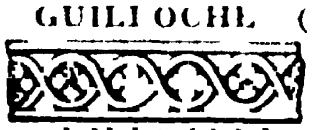
GUERRILLA (Span *little war*) The plan of harassing the French armies by the constant attacks of independent bands, acting in a mountainous country, was adopted in the north of Spain during the Peninsular war It was first reduced into a kind of system in 1810 (See *Napier's Peninsular War*, book ix chap 1) The bands which conducted this desultory warfare were called Partidas the name of Guerrillas is by a misapplication of the term, frequently applied to them

GUIDE (Fr) In Music, the leading part in a canon or fugue

GUILD, or GILD (Sax gildan, *to pay* said to be derived from payments made by a member of a guild on admission) A fraternity or association generally of merchants The Collegia Opificum of the later Roman empire appear to have been societies of this description in which a body of artizans or traders exercising the same craft were united together for purposes of mutual assistance, and possessed what we should term corporate rights The Anglo Saxons were voluntary associations for various purposes religious and social as well as commercial, and the oldest of guild of which the history is at all ascertained is said to have been the Cnighten guild of London which has been thought by its name to have been a military company, but this is doubtful and its history is altogether extremely obscure But the more important guilds of later times have been all mercantile The guild-merchant in many boroughs of England seems to have been a trading society into which all persons wishing to exercise trade within the borough were obliged to be admitted and hence in process of time the freedom of the borough which originally depended with admission rate body of the borough became co extensive A more remarkable change took place in the constitution of London where the several trading companies by degrees so completely engrossed the government that admission into one or the other of them (the livered companies) became a necessary qualification for the exercise of municipal rights, while some relics still remain (such as the division of the city into wards) of the more ancient state of things The name guild is still preserved in the ancient boroughs of Scotland and the dean of guild is the second municipal magistrate of a Scottish borough The zunfte of German cities and the trading companies of those of France and Italy have acted an equally important part in the history of those countries

GUILLEMOT *See* URIA

GUILLOCHE (Fr) In Architecture an ornament



composed of curved fillets, which by repetition form a continued series

GUILLOTINE (Fr) The name given to the instrument of capital punishment used in France, so called from by whom it was introduced into son was born at Saintes and, established as a physician at Paris, obtained a certain celebrity in the early period of the Revolution by the strong part which he took in favour of the rights of the Tiers-Etat He was elected in consequence a deputy to the National Assembly When that body was occupied in its long discussions relative to the reform of the penal code (in 1790) Guillotin proposed the adoption of decapitation, — up to that time used only for nobles, — as the only method of capital punishment From sentiments of humanity he recommended the employment of a machine which had been long known in Italy under the name of "mannaja," and in other countries also, for something much resembling it had been used in Scotland (*see* MAIDEN), and in England within the jurisdiction of the borough of Halifax The Assembly applauded the idea, and the machine was adopted, to which the Parisians have given the name of "Guillotine," and of which Guillotin is most erroneously supposed to have been the inventor It consists of two upright pieces of wood fixed in a horizontal frame, a sharp blade of steel moves up and down by means of a pulley in grooves in the two uprights, the edge is oblique instead of horizontal in shape, which gives it the mechanical power of the wedge The criminal is laid on his face, his neck immediately under the blade, which severs it at a blow from his body It is equally a vulgar error that Guillotin perished by the instrument which bears his name He was also during the Reign of Terror, but escaped the scaffold died in 1814 after having held the office of to the Academy of Medicine

GUINEA An English denomination of money, formerly a coin, but now disused Its value is 21*s* The coin weighed 129½ grains, and contained 118 7 grains of pure gold Guineas were first coined in the reign of Charles II (1662) of gold brought from Guinea, whence the name

GUINEA PEPPER A species of *capsicum*

GUINEA WORM The *Filaria medinensis* A worm which affects the skin, especially of the legs, in warm climates Whilst it remains under the skin this worm produces little uneasiness, till a part suppurates, and it puts out its head, much pain being experienced on attempting to draw it out especially if it be broken

GUITAR (It chitarra) A musical stringed instrument whose invention is attributed to the Spaniards The strings are stretched over a body much larger than the violin but of somewhat similar shape, except that the sharp corners are rounded off and the strings, which are more in number than the violin, and are not carried over a bridge are struck or pulled with the fingers

GULA in Zoology is the region of the throat nearest the lower jaw

GULA In Architecture *See* GOLA

GULES (Fr gueule, *a throat*) In Heraldry red, one of the colours, or tinctures, employed in blazonry It is equivalent to ruby among precious stones, Mars among planets In engraving it is represented by a vertical line

GULL *See* LARUS

GULPH In Geography, an arm of the sea extending more or less into the land and distinguished from a *bay* only in being of greater size and extent than the latter It is derived from the Gr κολπος signifying *bosom*, and has been adopted with a slight variation into all the languages of modern Europe

GUM A vegetable product, distinguished by solubility in water, and insolubility in alcohol, it is tasteless and inodorous Gum-arabic, which is the produce of the *Acacia vera* may be taken as a sample of the purest form of gum It is imported from Barbary and Morocco Its specific gravity is 1 45 Its solution is viscid, and is termed *mucilage* Gum is used as a demulcent medicine and for giving gloss and stiffness to calico, silk &c It consists of carbon 41 4, oxygen 52 09, hydrogen 5 51, or in other terms, of 41 4 charcoal and 58 6 water

GUM-RESIN An exudation from many trees, composed of a mixture of gum and resin, or of a substance intermediate between the two

GUN Under this general term most of the species of firearms are included, the pistol and mortar being almost the only exceptions Great guns, or cannon (*see* CANNON) began to be used as military engines about the middle of the 14th century, but small guns, or muskets, appear to have been introduced nearly two centuries later, namely 1521 They were first used by the Spanish infantry at the siege of Rhege Muskets were at first of very clumsy construction, being so heavy that they could not be levelled and fired from the shoulder, accordingly the soldier was provided with a rest which it was necessary to carry along with him and plant in the ground in order to support the weapon before it could be used The gun was generally fired with a match, sometimes by means of sparks generated by the revolution of a notched wheel of steel, placed directly above the pan containing the priming Muskets with rests were employed so late as the civil wars in the time of Charles I, afterwards a lighter matchlock musket came into use, and about the beginning of the last century the troops throughout Europe were armed with firelocks

The barrel forms the essential part of the gun, and the first requisite to a good barrel is toughness in the material of which it is made, for safety in using it depends mainly on this quality The best iron for the formation of musket barrels is that which has been much worn, and toughened by the loss of its fiery particles, and, accordingly old horse stub-nails are much in request for this purpose, and sold at a high price to the barrel-forgers Formerly the best gun barrels were made in Spain, and their superiority was attributed to the excellency of the iron made use of, which consisted almost exclusively of stub nails, and the old shoes of the horses and mules but the barrels now made in this country are not inferior to those of any country in the world The method of making the barrel is this —the iron is first formed into a thin flexible bar, something like a cooper's

hoop, and when heated is plied or twisted round a mandril, much in the same manner as a rope of leather is turned round the handle of a whip If the bar be twisted before the breadth of the bar does not exceed half an inch, and it is turned round the mandril in such a manner that the edges are brought close together but do not overlap In this position it is welded by horizontal strokes with the hammer But in common guns a broader bar is employed, and its edges, which are placed obliquely to each other, considerably, are welded [illegible] In Damascus barrels, prized for their beauty, though inferior in strength, are composed of iron and steel in certain proportions [illegible] together the whole length of the tube After the barrel has been forged the inside is rendered smooth and perfectly cylindrical by boring it with a bit, or rather bits of different sizes used in succession In rifles a certain number of parallel grooves, either straight or slightly twisted are cut in the inside of the barrel, of equal depth and fineness and through its whole length The exterior is [illegible]

By [illegible] barrel offered for sale must be tried by a certain quantity of powder and weight of shot according to its size, but the best gun-makers do not trust to this legal test and subject them to a severer trial by water-proof For fowling pieces and other guns of the best description the flint lock is now laid aside and the percussion or detonating lock almost universally substituted This ingenious invention belongs to a Scottish clergyman the Reverend Mr Forsyth minister of Belhelvie in Aberdeenshire, but it has since received some great improvements especially in the application of the copper cap,—to which indeed may be attributed all its superiority The following are the dimensions of the new pattern musket carried by the British troops —

| | |
|---|---|
| Length of the barrel in inches - - - | 42 |
| Diameter of the bore - - - - | 75 |
| Diameter of the ball for service - - | 676 |
| Weight of the ball for service in ounces avoirdupois - - - - - | 1 06 |
| Weight of the firelock with bayonet, in pounds avoirdupois - - - - - | 12 25 |
| Length of barrel and bayonet, in inches - | 69 |

The carbine carried by regiments of light cavalry is 16 inches in length, and weighs 6 pounds (*Encyc Brit*, art "Gun-making")

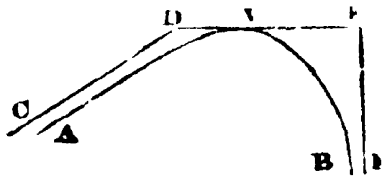
*Great guns*, or cannon, used formerly to be very long in the bore and constructed with a view to support large charges of powder but the experiments of Robins and Hutton proved that neither great length of the bore nor large charges are ever necessary In consequence of these experiments, a great improvement took place in the artillery services of Europe about the beginning of the French revolutionary wars The best length has been found to be about 17 calibres No field piece has now a bore of more than 18 calibres in length In the English service the regulation length is 14 calibres in America during the late war, it was reduced to 12, but has since been increased on what principle it does not appear, to 18 The length of the gun must, however be regulated in many cases by the service for which it is destined In battering guns a certain length in front of the trunnions is *absolutely* necessary, for generally speaking, they are fired from embrasures of earth which would be injured by the firing if the mouth of the gun did not reach beyond it Navy guns should also project to a certain distance beyond the side of the vessel and the same reasons apply to garrison as to battering guns

With regard to the shape of guns it is easy to see that it ought to be such as to give them the greatest strength at the part which suffers the greatest strain in firing This is probably at the part where the ball is lodged Count Rumford therefore proposed to make the thickness of the metal greatest at this point, and planned a gun swelling in a curve from the breech to the [illegible] of the ball and again contracting in a curve from that point to the projection of the muzzle In some guns as the American navy 32-pounder, the form is cylindrical from the base ring to the trunnions and thence conical to the swell of the muzzle In respect of British guns, the proportion of the weight of metal of an iron gun is to that of the shot, in heavy guns as about 224 to 1 or 2 cwt to 1 lb, in medium guns as 168 to 1, and in light guns 112 to 1 The [illegible] 32-pounder, used in the lower deck of line of battle ships, is 9 ft 6 in, and its weight 56 cwt being about 192 times that of the ball The medium 12-pounder brass gun is 9 ft 6 in in length, weighs 18 cwt, and has a calibre of 4 6 in in diameter The length of brass 18, 12, 9, 6, and 3 pounders is 17 calibres (See *Ency Brit*, "Gunnery") The greater quantity of metal at the breech of a gun than at the muzzle not only gives greater strength to the gun at the part where the danger of bursting is the greatest but also tends to diminish the force of recoil

GUNNER The first of the three warrant officers of a king's ship He has the charge of the ordnance, ammunition and other duties

GUNNERY A branch of [illegible] which has for its object the [illegible] of charging and [illegible] mark at any distance within the range of the shot To accomplish this purpose, it is necessary to know the nature of the [illegible] with a given [illegible] necessary to [illegible] must be given [illegible] of gravity and the resistance of the air on the ball in its flight Various other considerations require also to be attended to, as the proportion between the length of the gun and the diameter of its bore the proper *windage* or excess of the diameter of the bore above that of the ball, and the size or weight of the ball proper to produce a certain effect,—to batter down a wall for example or to penetrate a ship's side The method of mounting and working guns, so as to render them most serviceable in military operations belongs to the head ARTILLERY

If we abstract from the effect of the resistance of the air, the path described by a projectile is easily determined The only force which acts on the ball to deflect it from the straight line in which it is [illegible] consequently describes an arc [illegible] But any deductions from the parabolic theory of projectiles are of little or no use in the actual practice of gunnery, for in consequence of the great resistance which the air opposes to a body moving through it with the velocity of a cannon ball the circumstances of the motion are completely changed In the parabolic theory the motion of the ball in the horizontal direction is assumed to be constant and uniform But the resistance of the air brings another force into action the intensity of which depends on the velocity of the ball, and which is exerted in a direction exactly opposite to that of the ball's motion, hence the velocity of the ball is continually diminished through its whole course and in consequence the ascending and descending branches of the trajectory AV and VB are unequal and dissimilar Instead of being branches of the same parabola, they become different arcs of the hyperbolic kind having [illegible] D and E, diametrically situated the former being inclined to the horizontal line DI and the latter perpendicular to it The motion of the ball in its [illegible] resistance of the air as well as by [illegible] ascend so high nor range to so [illegible] parabolic theory and in descending through the branch VB its motion downwards is constantly accelerated by gravity while its horizontal motion is constantly retarded, so that its direction continually approaches to the perpendicular or is parallel with LI This resistance of the air is so great as to amount in some cases to twenty or thirty times the weight of the ball itself, insomuch that a ball which in the air ranges only to the distance of one mile, if projected with the same velocity in vacuo would range ten or twenty times that distance




The determination by theory of the trajectory described by a projectile in the air is as Dr Hutton remarks one of the most difficult problems in dynamics "Even the solutions of Newton Bernoulli, Euler Borda, &c &c, after the most elaborate investigations assisted by all the resources of the modern analysis amount to no more than distant approximations and are rendered nearly useless even to the speculative philosopher from the assumption of a very erroneous law of resistance in the air and much more so to the practical artillerist, both on that account and from the very intricate process of calculation which is quite inapplicable to actual service" (*Tracts* vol II) It may easily be inferred from these remarks that no practical rules can be founded on deductions from pure theory, and that it is necessary to have recourse to trial and experiment in order to obtain even [illegible] knowledge of the path of a body projected with [illegible] velocity is that of a cannon ball

The first extensive series of accurate experiments on this subject was made by Benjamin Robins and is described by him in his *New Principles of Gunnery*, published in 1742 In this work, which is one of very great merit and elegance, Mr Robins has treated very fully of the resistance of the atmosphere, the force of gunpowder, the advantages and defects of different guns and indeed of almost every thing relating to the flight of military projectiles Another set of experiments was undertaken by Dr Hutton at Woolwich, in 1775, of which an account was published in the *Phil Trans* for 1778 A second course of experiments was performed by Dr Hutton in 1783, 1784, and 1785, the principal objects of which were to determine the [illegible] velocity of the ball, [illegible] of powder, the effect of varying the weight of the piece, the penetration of balls into blocks of wood, the ranges

and times of flight, &c The details of these experiments, which were conducted with great skill and ability, are given in the 2d and 3d volumes of his *Tracts* Previous to this time a number of experiments similar to those of Robins were made in France by D'Arcy, an account of which is given in the *Memoirs of the Academy* for 1751, and in his *Essai d'une Théorie d'Artillerie*, published in 1760 There is also an extensive series of experiments on the effects of musket balls of different weights and [illegible] lished with additions in 1802 Since the days of Dr Hutton further experiments with heavy guns appear to have been made from time to time at Woolwich, under the direction of the ordnance department, as there is an account of a very heavy ballistic pendulum, weighing 7408 lbs avoirdupois, constructed under the care of Dr Olinthus Gregory in 1815 and 1818, together with some results from experiments on it with a 24-pounder, given in the *Annales de Chimie* tom v and ix, and also in Dupin's *Bretagne*, but as we are not aware [illegible] ever been published in any official form, we know not what credit is to be attached to them The experiments of Dr Hutton continue to the present time to afford the best data for the theory of practical gunnery

There are various methods by which the initial velocity (the principal element in the theory) of military projectiles may be determined The first is by the *ballistic pendulum*, which consists merely of a heavy block of wood suspended in such a manner that it can swing freely about an axis, into this the ball is fired, and as it is too thick for the ball to pass through it the whole momentum of the ball is transferred to the block and the extent of the arc through which it vibrates shows what this momentum has been, whence as the weights of the block and the ball are known the velocity with which the latter entered the block may be computed (BALLISTIC PENDULUM) Another method of determining the initial velocity of the ball is by means of the recoil of the gun The principle is that the explosive force of the powder must communicate equal quantities of motion to the gun and to the ball in opposite directions consequently, by suspending the gun loaded with additional weight in the manner of a pendulum, the extent of [illegible] will give the means of estimating the quantity of motion impressed on it, whence the initial velocity of the ball can be computed Both the above methods were employed by Dr Hutton Robins employed the first only A third method consists in transferring the momentum of the ball to a rotatory machine instead of a pendulum An ingenious apparatus for this purpose was contrived by Dr Gregory but the method has been little used

The following are the practical conclusions deduced by Dr Hutton from his experiments —

1 The velocity is directly as the square root of the weight of the powder, as far as to the charge of about eight ounces, and so it would continue for all charges were the guns of an indefinite length But as the length of the charge is increased and bears a more considerable proportion to the length of the bore, the velocity falls the more short after that proportion

2 That the velocity of the ball increases with the charge to a certain point which is peculiar to each gun, where it is greatest, and that by further increasing the charge the velocity gradually diminishes till the bore is quite full of powder

3 It appears that the velocity continually increases as the gun is longer, though the increase of velocity is very small in respect of the increase in length, the velocities being in a ratio somewhat less than that of the square roots of the length of the bore but somewhat greater than that of the cube roots of the length and is indeed nearly in the middle of the ratio between the two

4 The range increases in a much less ratio than the velocity, and indeed is nearly as the square root of the velocity, the gun and elevation being the same Very little is gained in the range by a great increase in the length of the gun, the charge being the same and indeed the range is nearly as the 5th root of the length of the bore an increase so small as to amount only to about one-seventh part more range for a double length of gun

5 It appears that the time of the ball's flight is nearly as the range, the gun and elevation [illegible]

6 It appears also that there is no [illegible] caused in the velocity or range by varying the weight of the gun, nor by the use of wads, nor by different degrees of ramming, nor by firing the charge of powder in different parts of it

7 But a great difference in the velocity arises from a small degree of windage Indeed with the usual established w[illegible] only [illegible] 1-20th of the calibre, no less than between [illegible] 1-4th of the powder escapes and is lost, and as the balls are often smaller than that size, it frequently happens that half the powder is lost by unnecessary windage

8 It appears that the resisting force of wood to balls fired into it is not constant, and that the depths penetrated by different velocities or charges are nearly as the logarithms of the charges instead of being as the charges themselves, or which is the same thing as the square root of the velocity

9 These, and most other experiments, show that the balls are greatly deflected from the directions they are projected in, so much, indeed, as 300 or 400 yards in a range of a mile, or almost 1-4th of the range, which is [illegible] 15 degrees (*Dictionary*,

Dr Hutton gives the following table as the results of his experiments with a medium one-pounder gun, the iron ball being nearly two inches in diameter, showing the velocity of the ball the range, and time of flight, corresponding to different charges, the elevation of the gun being 15 degrees —

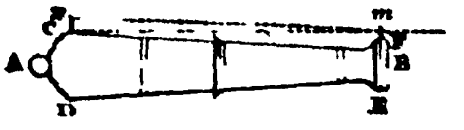
| Powder | Initial Velocity per Second | Range | Time of Flight |
|---|---|---|---|
| Ounces | Feet | Feet | Seconds |
| 2 | 860 | 4100 | 9 |
| 4 | 1230 | 5100 | 12 |
| 8 | 1640 | 6000 | 14½ |
| 12 | 1680 | 6700 | 15½ |

In the [illegible] of the rules derived from experi[illegible] it is necessary to take into consideration [illegible] is intended to be produced The power of penetration which a ball possesses is proportional to the square of its velocity, hence, when the object is merely to penetrate [illegible] Thus in breaching [illegible] is to cut grooves in the wall, in order to detach as it were a portion from the rest of the mass This is done by the penetration of the balls but the detached portion must then be battered so as to cause it to fall For this purpose a heavy ball with small velocity is most effectual In close naval engagements great velocities are less destructive than small ones The ball for example, which has just force sufficient to go through a ship's side, generally breaks and splinters the interior surface, and thereby causes far more damage than when it retains a considerable velocity after having passed through, for in the latter case it will only cut a hole without splintering the wood On this principle the *carronade* (a short species of ordnance fired with a small charge of powder in proportion to the ball) has been introduced into the naval service

*I* [illegible] — I [illegible] pointing cannon [illegible] two things, 1st on placing the gun in such a position that its axis is [illegible] With

A line drawn from the highest point of the base ring to the highest point of the swell of the muzzle is called the *line of metal* Now [illegible] to the object that line will [illegible] ertical plane with the object, but by reason of the conical shape of the gun, the line of metal has an inclination to the axis which is called the *dispart*, and in consequence of which the axis will only be in the same vertical plane with the line of metal when the trunnions are perfectly horizontal If they are not so (and the condition cannot be easily attained or preserved) the shot will be thrown to that side of the object on which the lower trunnion is This inconvenience is obviated by placing a dispart sight on the muzzle, at a height perpendicularly above its highest point equal to half the difference of the diameters of the muzzle and base ring, for then a line which passes from the highest point in the base ring to the extremity of the dispart thus placed on the muzzle ring will be parallel to the axis and consequently the shot will not be thrown to the right or left of the object, however much the one trunnion may be lower than the other

In order to determine the proper elevation to be given to the gun, it is necessary to know the distance of the object fired at Tables have been constructed from actual practice showing the angles of elevation which in different guns correspond to different distances, and the angle being found from the table, the proper elevation is given by means of a brass tangent-scale which slides up and down in the breech Thus suppose C D F F to be the piece A B its axis, *n m* half the difference of the diameters of the muzzle ring and base ring set upon the muzzle [illegible] that C *m* may be the line of dispart, then if C *n* be [illegible] upon the base ring equal to the tangent of the elevation found from the table, the line *n m* will be the proper line for pointing the piece, or the gun will be justly laid when *n m* is directed to the object In practice the length of C *n* is found with sufficient accuracy by multiplying the length of the gun in feet by 21, the product giving C *n* in inches This rule is founded on the supposition that the tangent of one



degree of a circle whose radius is one foot, is equal to the 21-100ths of an inch which is very near the truth

The following table (from the *Ency Brit*, art "Gunnery"), constructed from actual practice at Woolwich, shows the [illegible] ranges with the [illegible] —

| Nature. | Weight of Gun | Charge | Elevation | Range | Elevation | Range. | Elevation | Range. |
|---|---|---|---|---|---|---|---|---|
| | Cwt | lbs Oz | | Yds | | Yds | | Yds |
| 42 pr | 56 | 11 0 | 1 00 | 600 | 1 33 | 1 [illegible] | [illegible] | 1 [illegible] |
| 32 | 45 | 10 11 | 1 25 | 700 | [illegible] | 1 [illegible] | [illegible] | 1 [illegible] |
| 24 | 37 | 8 | 1 50 | 800 | 2 [illegible] | 1250 | 4 | 1[illegible] |
| 18 | 42 | 6 | [illegible] | [illegible] | [illegible] | 1 40 | 5 | 1[illegible] |
| 12 | 34 | 4 | 1 00 | 800 | 2 75 | 1350 | 6 | 1980 |
| 9 | 31 | 3 | 1 25 | 900 | 3 00 | 1400 | 7 | 2148 |
| | | | 1 50 | 1000 | 3 25 | 1450 | 8 | 4000 |

(*Robins's Math Tracts*, *Hutton's Tracts*, *Sir Howard Douglas's Naval Gunnery* Paixhans *Force et Faiblesse de la France*, and the *United Service Journal* for 1834 — For a very complete theoretical discussion of the experiments hitherto made, the reader may consult a *Memoire sur la Vitesse initiale des Projectiles* in the *Journal de l'Ecole Polytechnique* tom xv 1835)

GUNNEY (Bengal) A coarse sackcloth made in Bengal of the fibres of two species of *corchorus* Rice saltpetre pepper and other articles exported from Calcutta are packed in bags of this material, they also form a considerable article of exportation

GUNPOWDER A compound of about 78 parts of saltpetre, 12 of charcoal and 10 of sulphur The ingredients should all be perfectly pure separately reduced to powder, thoroughly mixed moistened and beaten or pressed into a cake which is afterwards broken up granulated or corned dried and polished by attrition Coarse powder is less carefully and nicely manufactured The force of the explosion of gunpowder is the consequence of the sudden and abundant production of gaseous matter expanded by the intense heat resulting from the action of the combustibles upon the nitre The gases evolved are chiefly carbonic oxide carbonic acid nitrogen and sulphurous acid, and their volume probably exceeds two thousand times the bulk of the powder Count Rumford's experiments show the immense energy of this astonishing agent as a source of mechanical power (*Phil Trans* vol 87) 28 grains of gunpowder, confined in a cylindrical space which it just filled tore asunder a piece of iron which would have resisted a strain of 400 000 lbs applied at no greater mechanical advantage [illegible]

The discoverer of this compound, and the person who first thought of applying it to the purposes of war are unknown It is certain however that it was used in the fourteenth century From certain archives quoted by Wiegleb, it appears that cannons were employed in Germany before the year 1372 No traces of it can be found in any European author previously to the thirteenth century, but it seems to have been known to the Chinese long before that period There is reason to believe that cannons were used in the battle of Cressy which was fought in 1346 They seem even to have been used three years earlier at the siege of Algesiras but before this time they must have been known in Germany as there is a piece of ordnance at Amberg on which is inscribed the year 1303 Roger Bacon, who died in 1292, knew the properties of gunpowder, but it does not follow that he was acquainted with its application to fire-arms

GUNPOWDER PLOT In English History the celebrated conspiracy of certain disappointed Roman Catholics to destroy the king, James I, and the two Houses of Parliament, by gunpowder, which was detected on the 4th of November, 1605 Its details are among the most popular portions of English history, and too well known to need repetition But the miraculous exercise of sagacity by which King James is commonly said to have detected the nature of the plot, from the mysterious letter sent to Lord Monteagle is now perhaps negatived beyond a doubt It had long been remarked that Salisbury and Carlisle (probably before the scheme between themselves and their royal master was concerted) had claimed *for themselves* the credit of the discovery; and it now appears that Lord Monteagle had been previously rewarded [illegible] so that it is highly probable that he was acquainted with the design of the malecontents, and that the celebrated letter was an invention destined to conceal the real mode of discovery Those who are anxious to study the Roman Catholic version of the story will find it ably detailed in the pages of *Lingard* (vol viii ch 1 4to ed) That writer seeks to throw the whole onus of the conspiracy on Catesby, its chief promoter and to exculpate Father Garnet, but Mr Jardine (in his *State Trials*), who has fully investigated the subject, is of a different opinion.

GUNTER'S CHAIN, so called from its reputed inventor, is the chain commonly used for measuring land It is 66 feet or 4 poles in length, and is divided into 100 links, each of which is joined to the adjacent one by three rings, and the length of each link including the connecting rings is 7 92 inches The advantage of this measure consists in the facility which it affords to numerical calculation The English acre contains 4840 square yards, and Gunter's chain being 22 yards in length, the square of which is 484, it follows that a *square chain* is exactly the tenth part of an acre A square chain again contains 10,000 square links, so that 100,000 square links are equal to an acre, consequently, the contents of a field being cast up in square links, it is only necessary to divide by 100,000, or to cut off the last five figures, to obtain the contents expressed in acres

GUNTER'S LINE A logarithmic line engraved on scales, sectors, &c, serving to perform the multiplication and division of numbers instrumentally, as a table of logarithms does arithmetically The numbers are usually drawn on two separate [illegible] In rough calculations the [illegible] lities

GUNTER'S QUADRANT A quadrant of a peculiar kind adapted to the problems of finding the hour of the day the sun's azimuth, and other common problems of the sphere

GUNTER'S SCALE, casually called by seamen *the Gunter* is a large plain scale having various lines of numbers engraved on it by means of which questions in navigation are resolved with the aid of a pair of compasses On one side of the scale the natural lines (as the line of chords the line of sines, tangents rhombs, &c) are placed, on the other the corresponding logarithmic ones

GUNWALE means generally the upper part of the solid workmanship of the vessel's side the part above this is called the bulwark

GUTTA SERENA *See* AMAUROSIS

GUTTÆ In Architecture *See* DROPS

GUTTIFERÆ or CLUSIACEÆ A natural order of arborescent shrubby and occasionally parasitical Exo[illegible]

GULLET (*gula throat*) in Mammalogy, is applied to the whole under surface of the neck

GUTTURALS Letters pronounced by a peculiar effort of the throat There are no gutturals properly so called in the English language although the guttural sound may often be heard in some provincial pronunciations of the letter *r* Nor are there in the pure French or Italian although they are frequent in the dialects e g the letter *c* hard (as in *casa*) has the Tuscan a strong guttural sound In the Spanish language alone, of those derived from the Latin gutturals are common In German, the guttural *ch* is largely used In the Celtic languages *gh* and *ch* are also sounded with much variety of guttural intonation

GUY A rope used to swing any weight or to keep steady any heavy body and prevent it from swinging while being hoisted or lowered

GYMNASIARCH (Gr γυμνασιαρχος) An Athenian officer who had the charge of providing the oil and other necessaries for the gymnasia This was one of the offices called λειτουργιαι at Athens, the expenses of which were defrayed from the private pocket of the individual on whom they devolved and who received no salary from the state

GYMNASIUM (Gr γυμνασιον, from γυμνος *naked*) Originally a space measured out and covered with sand for the exercise of athletic games Afterwards, among the classical Greeks the gymnasia became spacious buildings or institutions for the mental as well as corporeal instruction of youth They were first built at Lacedæmon whence they spread through the rest of Greece &c into Italy They did not consist of single edifices but comprised several buildings and porticoes, used for study and discourse for baths anointing rooms, palæstras in which the exercises took place and for other purposes Two of the Athenian gymnasia, viz the Lyceum and Academy were rendered famous by being the scenes of the lectures of Aristotle and Plato respectively

The term Gymnasium has descended to modern times In Germany the higher schools, intended to give immediate preparation for the universities, are termed gymnasia In Prussia the scholars undergo examination on leaving them their compositions at this examination are sent to the minister of instruction and ecclesiastical affairs, and they receive testimonials of fitness No 1, 2, or 3, according to their degree of proficiency Persons who have fitted themselves for the universities without passing through the gymnasia are examined by a committee appointed by government, which sits half-yearly for the purpose

GYMNASTICS Under this name were comprised by the ancients all those games and exercises which were performed with the body partly naked (γυμνος), such as wrestling, boxing, running, throwing the quoit, playing

at ball, &c They were first instituted at Lacedæmon, where they were not confined to men, but were also considered a necessary part of the education of females In the rest of Greece, where they subsequently spread, they were also held of the highest importance, and as such were conducted under the superintendence of the government and entered conspicuously into the political [illegible] principally exercised by the mercenary athletes

GY'MNODONTS, *Gymnodontes* (Gr *γυμνος, naked* and *οδους, a tooth*) The name of the [illegible] gnathic fishes comprehending those which have the jaws protruding, and covered with a more or less complex la [illegible] teeth

GYMNOSOPHISTS, *Gymnosophistæ* (Gr *γυμνος, naked* and *σοφιστης, a learned philosophers*) A sect of Indian philosophers who lived naked in the woods, whence they derived their name, and submitted to other strange austerities They believed in the immortality of the soul and its migration into several bodies They enjoyed great reputation for astronomical and physical science

There was likewise an African sect of philosophers bearing the same name, who are said to have lived in Æthiopia near the sources of the Nile whose habits differed from those of the Indian sect, inasmuch as they lived as anchorites, while the latter congregated in societies

GYMNO'TUS or rather *Gymnonotus* (Gr *γυμνος naked* and *νοτος the back*) The name of the genus of electric eels which are found in the fresh waters of South America they have a median fin extended along the belly but none on the back Although to all outward appearance the gymnotus is nearly allied to the eel, yet were that part of the body cut off which contains the nutrient, respiratory and generative organs — all the parts in fact which are essential to [illegible] as a mere fish — it would present [illegible] form, very different from that of the eel The long electric organs are tacked on as it were behind the true fish and thus give the gymnotus its anguilliform body The back-bone and muscles are of course coextended with the electric organs for the [illegible] and the air-bladder is continued trophorous trunk, to give it convenient specific levity Two long dorsal nerves are continued from the fifth and eighth cerebral nerves for ordinary sensation and motion The spinal chord is continued [illegible] for the exclusive supply of the electrical [illegible] These organs are four in number two very large above, and two small ones below The electricity discharged from them decomposes chemical compounds produces the spark and magnetizes iron, as does that of the torpedo But the magnetizing power seems to be relatively weaker, while the benumbing shock communicated to other animals is [illegible] any other electric fish

GYNÆCEUM (Gr *γυναικειον*) In Ancient Architecture, the portion of a Grecian house set apart for the occupation of the female part of the family

GYNÆCE'UM In Botany, a term invented by Rœper to denote that organ commonly called the pistillum it may be understood to signify the female apparatus in plants

GYNA'NDRIA (Gr *γυνη* and *ανηρ, a male*) The name of one of the classes in the sexual system of plants invented by Linnæus Its character is to have the stamens, style, and stigma consolidated into a body called a column The class chiefly consists of the plants now named *Orchidaceous*

GYNOCRA'CY (Gr *γυνη*, and *κρατεω, I govern*) A term sometimes used to indicate that state in which women are legally permitted to assume the reins of government It is used by way of contradistinction to the *Salic law*, which precludes the fair sex from the privilege of sovereignty There are only five states in Europe to which the operation of the Salic law does not extend — England, Russia, Spain, Portugal, and Denmark

GY'NOPHORE (Gr *γυνη*, and *φερω, I bear*) The stalk upon which some ovaria are seated, as in the Passion-flower

GYNOSTE'MIUM (Gr *γυνη*, and *στημων, a stamen*) A term invented by Richard to denote the column of an Orchidaceous plant It is a combination of a filament and a style

GYPOGE'RANUS (Gr *γυψ, a vulture*, and *γερανος, a crane*) This name was invented by Illiger for a most singular genus of Accipitrine birds in which the structure of the bird of prey is modified by a lengthening of the legs and neck to adapt the species to combat with and destroy the most poisonous of the serpent [illegible] The instincts of [illegible] as termed, correspond [illegible] principally on serpents, not refusing, however, lizards, or even insects The bill is shorter than the head, curved nearly from its base, not toothed, the wings are armed with a short, strong, and obtuse spur, the feathers are continued down the long tibia to the tarsal joint, covering the front but not the back part of it, the toes are short, but strong, the anterior ones united by a membrane at the base Species of the genus inhabit the Cape, the Gambia coast, [illegible] Philippine Islands The Cape secretary (*Gypogeranus serpentarius*) lives in pairs, builds on high trees, and runs with considerable swiftness

GY'PSIES The history of the strange nation of vagrants has been recently illustrated by the labours of several German writers [illegible] Grellmann (*Historical [illegible]*) [illegible] tian" the French call them Bohemians, but the names [illegible] quarian research In western Europe, they made their first appearance early in the fifteenth century, under a leader who styled himself the Duke of Lower Egypt fortune-telling and thieving were then, as now, their predominant occupations They were at that time treated as heathens and sorcerers, and the most severe laws were repeatedly enacted against them, but without effect At present they are found not in Europe only but in Asia Minor, Egypt, Turkey, &c, forming everywhere a distinct race In Germany, as well as England they profess various trades, as itinerant horsedealers, smiths farriers, &c, but have never been reclaimed in any number to settled occupations In England their most ordinary haunts are in the midland and southern counties chiefly, whither they are invited by the abundance of green lanes, downs, forests or chases They possess a language of their own, and are apparently destitute of religion, although in most countries professing that of the people among whom they dwell (See *Marsden on the Language of the Gypsies*, *Hoyland's Hist Survey*, 1816, *Quart Rev* vol lv Mr George Borrow's *Account of the Gypsies of Spain*, 2 vols 12mo 1841, may also be consulted with great advantage)

GY'PSUM (Probably derived from *γη, earth*, and *ψω I concoct*) Crystals of native sulphate of lime

GY'RI (Gr *γυρος, a circle*) in Mammalogy, the annular series of scales in the tails of certain quadrupeds

GY'RODUS A fossil fish of the family of *Pycnodonts* It occurs in the oolite of Baden

GYROGONITES (Gr *γυρος*, and *γονος, seed*) Bodies found in fresh-water deposits originally mistaken for small shells but afterwards ascertained to be the seed-vessels of plants of the genus *Chara*.

GY'ROMANCY (Gr *γυρος* and *μαντεια, prophecy*) A species of divination performed by drawing a ring or circle and walking round it

# H.

H An aspirate of the guttural kind, used in all modern and in most ancient languages The claims of *h* to be regarded as a letter have been denied by many grammarians, and certainly, when it is remembered that the sound of this letter is produced by a mere emission of the breath, without any conformation of the organs of speech, this opinion would seem well founded There are others, however, who insist that there is no feature in the sound or qualities of this letter which it does not possess in common with some other consonants, and consequently any attempt to invalidate its claim to the distinction militates equally against them The figure H was used by the Greeks to signify the aspirate, until about the 5th century before Christ After that time it was gradually abandoned in Greek writing while its use was still preserved by the Latins In the former language it was superseded by the small mark called the *spiritus asper* ( ), which was placed above the letter to which the aspirated [illegible] The various [illegible] The chief of these is the substitution in Latin, of the letter *s* for the aspirate of the Greeks, as *sub* for *υπο*, *sal* for *αλς*, *sex* for *ἑξ*, *septem* for *ἑπτα*, *serpo* for *ἑρπω*, &c In English, this letter is frequently dropped altogether in pronunciation In German, it is sounded only at the be [illegible] of words, and wherever it otherwise occurs, it [illegible] vowel after which it is [illegible] In Latin, many words are written indifferently with or without this letter, as aruspex, haruspex, onustus, honustus, &c As an abbreviation, *h* was used by the Latins for homo, hæres, and hora, and as a numeral it expressed 200

HAA'RKIES (German) Capillary pyrites in very delicate acicular crystals The term is also applied by the German mineralogists to a native sulphuret of nickel

**HA'BEAS CO'RPUS** (Lat ) In Law, the title of a writ, of which there are several kinds *Habeas corpus ad respondendum*, is to remove a prisoner, confined by the process of an inferior court, in order to charge him with a new action in a court above *Habeas corpus ad sub-* [illegible] writ directed to a person [illegible] command [illegible] to produce the body of the prisoner This is the writ which by stat 31 C 2 c 2, must be granted on application of any party committed and charged with any crime except treason or felony, or, if charged with those crimes, having been acquitted or not tried on the second term or session after his commitment

**HABE'RE FACIAS POSSESSIONEM** (Lat ) In Law, a judicial writ, whic[illegible] recovered a term of years in action of ejectment to put him into possession *Habere facias seisinam*, a similar writ to give seisin of a freehold estate recovered by ejectment or other action

**HA'CKLE** A board set with sharp iron spikes for combing or pulling out hemp

**HA'DES** (Gr ἅδης, also αΐδης which is said to be derived from α and ιδω, *I see*, *invisible* ) In Classical Mythology the abode of the dead According to Hesiod the immortals of the brazen age were the first who descended to Hades (See especially the 11th book of the *Odyssey*, Hesiod, Γεγα και Ηεραι, *Æneid* book vi Warburton's Dissertation on the latter, Heyne *Excursus* 8 ad loc, *Spence's Polymetis* Dial 16) Hades was also an appellation of the god Pluto, in which sense alone it is said, Hesiod uses it

**HA'DING** In Mining the direction of a slip or *fault* The deviation from the vertical of a mineral vein is called its *hade*

**HADJ** (Arab ) The Mohammedan pilgrimage to Mecca and Medina whence Hadji a pilgrim or one who has performed this pilgrimage, Hedjaz the Holy Land where these cities are situated By far the most authentic description of it is that of Burkhardt who performed it in the guise of a Mohammedan in 1814 It is fixed to a particular lunar month, and consequently takes place in every season of the year It was a custom long anterior to the establishment of Islamism when the famous black stone" of the Caaba at Mecca was an object of idolatrous veneration Every year a black silk stuff is now sent by the sultan to cover the Caaba There are usually five or six caravans, from Syria Egypt Barbary the East and the North In 1814 the number of pilgrims was about 70,000, and this was considered small The pilgrims go through several ceremonies at Mecca of which the principal are the *touaf*, or procession round the Caaba and drinking of the well Zemzem, they then proceed to the summit of Mount Ararat, and lastly to Medina the place of the prophet's burial (*Burkhardt's Travels in Arabia* 1829 *Quart Rev* vol xliii )

**HÆMATEMESIS** (Gr αιμα *blood* and εμειν *to vomit* ) Vomiting of blood from the stomach generally preceded by weight and uneasiness about the region of the stomach, and unaccompanied by cough and the other symptoms of *hæmoptysis*

**HÆ'MATITE** (Gr αιμα ) Native oxide of iron its streak and powder are blood-red

**HÆMATOCE'LE** (Gr αιμα, and κηλη *a tumour* ) A tumour a[illegible] from extravasated blood

**HÆMATOSINE** (Gr αιμα ) The red colouring matter of the blood

**HÆMATO'XYLINE** The colouring principle of the wood of the *Hæmatoxylon campechianum*, or logwood

**HÆMATU'RIA** (Gr αιμα, and ουρον, *urine* ) A discharge of bloody urine

**HÆMODORA'CEÆ** (Hæmodorum one of the genera ) An natural order of Endo[illegible] New Holland Have differe[illegible] flowers and equitant leaves, from *Iridaceæ* in their stamens, and in the anthers bursting inwards They are curious, but not useful or beautiful plants, except in the case of *Anigoranthus*, a genus containing some striking herbaceous species

**HÆMOPTYSIS** (Gr αιμα, *blood*, and πτυω, *I spit* ) The coughing up of blood sometimes produced by fulness of the blood-vessels of the lungs or by the rupture of blood-vessels as a consequence of ulceration It is distinguished from blood coming from the stomach by the comparative smallness of its quantity, and by its usual florid colour the latter is usually blackened by the acid, and often mixed with the contents of the stomach The age at which this disease commonly shows itself is from fifteen to five-and-twenty, and it is sometimes brought on by violent exercise or a fit of coughing It is not very uncommon as a symptom of suppression of some natural evacuation, and when unattended by symptoms of consumption and constitutional cough, and occurring in persons otherwise strong and healthy, it is often not dangerous when it occurs in some fevers, and in inflammation, it may even be a favourable symptom Bleeding [illegible] cautious diaphoretics, nauseants, and occasionally the exhibition of small doses of sugar of lead and of styptic astringents, are the remedies usually resorted to

**HÆMORRHAGE** (Gr αιμα, and ῥαγη, *rent* ) A bleeding or flow of blood This may arise from two causes either a full state of the vessels, or *plethora*, when it has been called *active hæmorrhage*, or from a debilitated state of the vessels, or of the system generally when it is called *passive hæmorrhage* When hæmorrhage occurs from either of these causes, it usually requires methods of treatment adapted to the particular case Where hæmorrhage is the consequence of wounds, the bleeding vessels must be secured by ligature, or where this cannot be done, styptic applications are applied

**HÆMORRHOIDS** (Gr αιμα, and ῥεω *I flow* ) Tumours of the veins of the rectum, constituting the disease commonly called piles

**HÆRESIARCH** (Gr αιρεσις *heresy*, αρχω, *I begin* ) In Ecclesiastical History, the founder of an heretical sect *See* HERESY

**HERESIMACHÆ** (Gr αιρεσις, [illegible] μαχομαι *I fight* ) In Ecclesiastical History, those w[illegible] controversial works against heresies Of the earliest Christian writers of this description who wrote chiefly against Basilides Marcion, and the Montanists, we have only fragments remaining The first complete treatise of this description extant is that of Irenæus against the Gnostics (A D 180)

**HAG** or **HAG-FISH** A vernacular name for a species of Cyclostomous fish called *Myxine glutinosa* and *Gastrobranchus cæcus*

**HAGIOGRAPHA** (αγιος *holy*, γραφη *writing or Scripture* ) The Holy Scriptures The term is also applied to histories or legends respecting the lives and actions of the saints *See Riddle's Christian Antiquities* 1839 p 394 as to that particular class of the Hebrew Scriptures which were termed by the Jews *Hagiographa*

**HAIL** (Germ hagel ) A well known meteor which occurs chiefly in spring and summer not unfrequently accompanied with thunder It is formed of rain or atmospheric [illegible] the [illegible] masses or *hailstones* On examining attentively the interior structure of hailstones they are usually found to contain an opaque nucleus of a spongy or porous texture, [illegible] transparent layers are distinguishable, and sometimes the layers are alternately transparent and opaque Hailstones have also been observed having a radiating structure Their form is exceedingly various in general it is roundish but sometimes pyramidal, angular or even thin and flat with irregular surfaces The usual size of hailstones is about a quarter of an inch in diameter but they are frequently of much [illegible] ide, and instances are on record in which [illegible] would appear incredible if they were not attested by observers of known character Halley relates that on the 9th of April 1697 there fell in Flintshire hailstones which weighed 5 ounces On the 4th of May 1697 Robert Taylor in Hertfordshire observed hailstones which measured 11 inches in circumference that is, about 4 inches in diameter Parent on the 15th of May, 1703 found them at Blois as large as his fist On the 11th of July, 1753 at Toul, some were collected by Montignot measuring 3 inches in diameter Volta affirms that on the night of the 19th of August 1787 in a hail storm which ravaged the city of Como and its environs, some of the stones were found to weigh 9 ounces In the terrible hail storm which traversed the whole of France and the Netherlands on the 13th of July 1788 M Lessier relates that hailstones were picked up which weighed 8 ounces And Dr Noggerath informs us that on the 7th of May, 1822, hailstones fell at Bonn weighing from 12 to 13 ounces From these relations we may form some idea of the destruction occasioned by a severe hail storm in a cultivated country

Of the different circumstances accompanying a fall of hail the following are the most remarkable — Hail usually precedes storms of rain sometimes accompanies them, but never, or very [illegible] em, especially if the rain is of any [illegible] Its continuance is always very short generally only a few minutes, and very seldom so long as a quarter of an hour The quantity of ice which falls from the clouds in so short a time is prodigious, the ground being sometimes covered with it to the depth of several inches The clouds from which hail is precipitated appear to be of very considerable extent and depth in such as they produce a great obscurity It has been remarked that they have a peculiar grey or reddish colour, and that their lower surfaces present enormous protuberances, while their edges exhibit deep and numerous indentations. Hail is always accompanied with electric phenomena

Various hypotheses have been proposed to explain the physical cause of hail, and the phenomena by which it

is accompanied The theory requires the solution of two questions first, how the cold which causes the congelation of the aqueous particles is produced? and, secondly, how a hailstone, after attaining a sufficient size to fa[illegible] remains suspended a[illegible] volume of twelve or nineteen inches in circumference But both these questions are attended with very considerable difficulty, and after all that has been written on the subject, the theory of hail is still involved in great obscurity

The first hypothesis we shall mention is that of the celebrated Volta In order to solve the first question, Volta supposed that the solar rays which impinge on the upper surface of a dense cloud are almost entirely absorbed whence a very rapid evaporation results and that this evaporation produces a sufficient degree of cold to freeze water To this part of the theory it has, however, been objected that the evaporation of a liquid through the effect of heat can only become more rapid in consequence of the liquid acquiring a higher temperature, in other words that it can not, at the same time, receive an additional quantity of caloric and have its temperature diminished without the intervention of some other cause For instance, let two sheets of paper be moistened to the same degree and one of them be exposed to the sun's rays, and the other placed in the shade, it will soon be seen that the one on which the sun's rays fall dries more quickly its evaporation is greater, but at the same time it becomes warmer than the other, whereas according to Volta's argument, it ought to become colder

Volta's solution of the second question is ingenious, but not satisfactory [illegible] stones to be formed, a[illegible] gree of cold to produce their enlargement by freezing the aqueous vapour He supposes large strata of clouds, charged with [illegible] to be disposed the one over the other, in which case the hailstones still very small falling on the lower stratum would experience the two following effects —In the first place they would penetrate the stratum on which they fall to some extent and be covered with a new coating of ice In the second place, they would acquire the same electricity as the cloud, and consequently be repelled by it, while at the same time they would be attracted by the upper stratum, on account of its preserving the opposite electricity And the electric attraction of the cloud being supposed greater than the force of gravity the hailstones would thus pass from the lower to the upper stratum where analogous effects would take place and whence consequently, they would be repelled to the lower stratum Thus they would be kept [illegible]y from the one stratum to the other [illegible] becoming too heavy or the clouds losing their electricity or being carried by the wind to too great a distance from each other, the cause which kept the hailstones suspended in the atmosphere becomes inadequate to support them, and they are precipitated to the ground

It is obvious that the accuracy of this theory cannot be proved by any direct experiment, and doubts have even been raised whether the existence of electric forces sufficient to move masses of ice of the size which hailstones are frequently found to have, in the manner the theory supposes be really possible The following, which is much simpler, seems adequate to the effects We may suppose the cold necessary for the formation of hail to be produced by the wind, and that when the hailstones are formed they are also carried along through the atmosphere by currents of wind in a direction very oblique to the horizon by which means they may be kept suspended a sufficient length of time to acquire the dimensions they possess by congealing the particles of humid vapour with which they successively come in contact Thus the same cause, namely the wind determines the production and the enlargement of hailstones, and the electricity with which the phenomenon is always accompanied is only the effect of the passage of the particles of water from the liquid to the solid state

For further information on this subject the reader is referred to an interesting article by
*nuaire Presenté au Roi* for 1829, also [illegible]
*de Physique*, tome ii

HAIR (Germ haar) The characteristic covering of the Mammiferous class of animals It consists of slender more or less elongated horny filaments secreted by a matrix, consisting of a conical gland or bulb, and a capsule, which is situated in the mesh-work of the corium, or true skin The hairs pass out through canals in the corium, which are lined by a thin layer of cuticle adherent to the base of the hair the straightness or curl of the hair depends on the form of the [illegible] through which it passes Spines, bristles, fur, and wool are all modifications of hair, having the same chemical composition, mode of formation, and general structure

In the spines of the porcupine the bulb secretes a fluted pith, and the capsule invests it with a horny sheath, the transparency of which allows the ridges of the central part to be seen like whiskers of [illegible] the twofold structure of the hair is very conspicuous, but in the finer kind of hair, as of the human head and beard, the central pith can only be demonstrated in fine transverse sections viewed with a microscope Some kinds of hair, as of the human head, the mane and tail of the horse, are perennial, and grow continuously by a persistent activity of the formative capsule and pulp, other kinds, as the ordinary hair of the horse, cow, and deer, are annual, and the coat is shed at particular seasons In the deer the horns are shed contemporaneously with the deciduous hair

Many quadrupeds, especially those of cold climates, have two kinds of hair a long and coarse kind, forming their visible external covering, and a shorter, finer, and more abundant kind, which lies close to the skin, and called 'fur' It is one of the processes in the arts to remove the coarse hair, and leave the fur attached to the dried skin, as in the preparation of seal-skin, &c The peculiar characteristic of wool, and that on which its valuable qualities chiefly depend, is the serrated character of its surface, arising from its structure, which consists of a series or succession of inverted cones, the base of each being directed from the root of the woolly fibre, and receiving the apex of the succeeding cone It results from this structure that the pressure to which the workman subjects the wool in moving it backwards and forwards, brings the fibres together and multiplies their points of contact The agitation gives to each hair a progressive motion towards the root, and the serrations of one hair fix themselves on those of another hair which happens to have its root turned in the opposite direction, and the mass at length assumes that compact form which is termed 'felted" wool The microscope has likewise demonstrated various other remarkable modifications in the form of the hair in different quadrupeds In the mole, *e g*, each hair is alternately constricted and expanded from its root to its apex, whereby it readily assumes any position and lies flat and smooth either towards the head when the little bur [illegible] neous galleries or [illegible] forwards The organization of the hair is such as to allow of its undergoing certain changes when once formed according to the state of health and general condition of the rest of the frame, and even to be affected by loss of colour in consequence of violent mental emotions in the human subject Some of the lower animals, as the Alpine hare, are subject to periodical change of colour of their fur, by which it is made to harmonize with the prevailing hue of the ground which they habitually traverse

The chemical properties of hair were first pointed out by Mr Hatchett, in his paper in the *Phil Trans* for 1800 It chiefly consists of an indurated albumen, and when boiled with water it yields a portion of gelatine Soft flexible hair, which easily loses its curl, is that which is most gelatinous Vauquelin discovered two kinds of oil in hair the one colourless, and in all hair, the other coloured and imparting the peculiar tint to hair Black hair also contains iron and sulphur

HAIRS In Botany minute transparent, filiform processes, composed of cellular tissue more or less elongated and arranged in a single row They spring from the surface of plants appear always to have a circulating system and probably act both as absorbents of moisture and protectors of the surface in which they grow Many sorts are distinguished by phytotomists the principal of which are [illegible] which are composed of cellules either at the apex or base into receptacles of fluid, and the lymphatic, which consist of tissue tapering gradually from the base to the apex

HALBERT A word of uncertain derivation, applied to an *offensive* weapon, which consists of a shaft five feet long, with a steel head partly in the form of a crescent This weapon was formerly in considerable use in the army and indeed gave its name to a body of men called halberdiers, but it is now rarely to be met with except in some boroughs in Scotland, where it is used by the civic officers who attend the magistrates in processions and on other public occasions

HALCYON *See* ALCEDO

HALCYON DAYS A name given by the ancients to the seven days that precede and follow the winter solstice from the circumstance of the halcyon or alcedo selecting that period for incubation While this process was going on, the weather was generally remarkable for its calmness, and [illegible] signify [illegible] This circumstance [illegible] in the following lines —

HALCYONI'DÆ (Gr ἁλκυων, *a king-fisher*) The family of Fissirostral birds, having the kingfisher as the

type (*Halcyon* from ἁλκυων itself is derived from Gr ἁλς, and κυω *I procreate*, because the halcyons build their nest on the sea-shore )

HALIO'TIDÆ (Gr ἁλς, *the sea*, and ους *the ear* ) A family of Gastropods, having as its type the genus *Haliotis*, or the sea-ear

HALL (Sax heal ) In Architecture, properly a large room for the transaction of public business also a manor house where courts are held for the admission of tenants and other manorial business It is perhaps a term improperly applied now, to the entrance of a dwelling-house, or to a servants' hall At Oxford an unendowed college is styled a *hall*, but at Cambridge the term is used indiscriminately for *college*, whether endowed or not

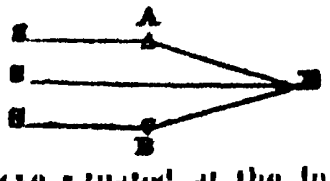
HALLELUJAH A well-known [illegible] It was used, among the early Christians at Easter and during the interval from thence to Whitsuntide (*Greg Epist* ix Ep 12 ) See *Riddle's Christian Antiquities*, p 334

HA'LLIARDS *Haulyards* Ropes by which yards, sails, and signals are hoisted

HA'LO (Lat halo ) In Meteorology, a luminous circle or ring, usually coloured, surrounding the sun or moon under certain conditions of the atmosphere Of such rings there are two kinds which appear to depend on essentially different physical causes The first are of small dimensions, their diameters being between 5° and 12°, and generally three or more concentric rings appear together, differently coloured and presenting appearances similar to the optical phenomena of the rings of thin plates These are usually called *coronæ*, and they appear either when a small quantity of aqueous vapour is diffused through the atmosphere, or when light fleecy clouds pass over the sun or moon The second kind consists usually of a single luminous ring, but of much larger dimensions the diameter being about 45° It is to the meteors of this second kind that the term *halo* is usually appropriated

The apparent diameters of halos of the second kind have frequently been measured and are always found to subtend at the eye of the observer an angle of between 44° and 46° The lunar halo is simply a white luminous circle, without colour, excepting a pale red, which sometimes fringes the interior edge of the circle But the colours of the halos about the sun, though not so bright as those of the rainbow are however, marked with sufficient distinctness The red occupies the interior part of the luminous circle the indigo and violet the outer part, and shade away by insensible degrees till they are blended with the general colour of the sky In some circumstances a second halo is observed concentric with the former, but [illegible] extent, its apparent diameter being about [illegible] colours of this secondary [illegible] to [illegible] attended by a horizontal white circle, with brighter spots or *parhelia*, near their intersections with this circle, and with portions of inverted arches of various curvatures *See* PARHELIA

Various causes have been assigned for the origin of halos, but the most probable is that of Mariotte who supposes the phenomenon to arise from the refraction of light in passing through all transparent and prismatic crystals of ice floating in the higher regions of the atmosphere When water is [illegible] congealing, a great variety of [illegible] 60°, this [illegible] angles of [illegible] tions and consequently [illegible] all different [illegible] By [illegible] prism with respect to the incident light, the rays which traverse it suffer a minimum deviation which happens when the refracted ray makes an isosceles triangle with the two sides of the prism The path of the ray in the interior of the crystal in this case makes an angle of 60° with the face of the crystal, or an angle of 30° with the perpendicular to that face This last angle is the angle of refraction, and it is known by experiment that in the case of ice, the angle of refraction being 30°, the angle of incidence is 41°, hence the ray falls on the crystal at an angle [illegible] ently the deviation of the ray [illegible] = 60° − 49° = 11° On escaping from the crystal, the ray suffers a second flexure of the same amount and the total deviation from its first direction is now 2 × 11 = [illegible] of the halo It follows, therefore [illegible]




S A, S B, from the sun falling on such prisms at A and B at angles of incidence equal to 41 will be refracted into the directions A E and B E, which make angles A E S and B E S equal to 22°, and an eye situated at the intersection E will see a luminous circle of which the apparent diameter or angle A E B, is about 44° With respect to the secondary or external halo, whose diameter is about 90°, it may be attributed, says Dr Young (*Lectures*, vol i p. 444 ), either to two successive refractions through different prisms, or with greater probability as Mr Cavendish suggested to the refraction of the rectangular terminations [illegible]

This theory explains the order in which the colours are disposed The ratio of the refraction of the violet ray being greater than that of the red ray, the former will suffer a greater deviation, and consequently the violet band of the halo will have a greater diameter than the red Supposing this theory to be correct, the condition necessary for the appearance of halos is the existence of particles of ice in the upper regions of the atmosphere The appearance of a halo, therefore, furnishes information respecting the temperature of the air at great altitudes above the earth

The formation of *coronæ*, or the small halos so frequently seen round the sun and moon in fine weather, is ascribed by Fraunhofer and Sir John Leslie, not to the *refraction* but to the *deflection* of light in passing by the small watery globules suspended in the atmosphere If a piece of tinfoil punctured with the point of a needle be held close to the eye the sun will appear through it surrounded with a halo very near his disk, but spreading more in proportion as the hole is contracted Supposing that an aqueous globule of equal dimensions would produce an equal deflection, the magnitude of the globules might thus be inferred from the diameter of the halo When the halo approaches nearest to the luminous body, the largest globules are floating and therefore the atmosphere is surcharged with humidity, whence the justness of the remark that a dense halo close to the moon portends rain For a full exposition of the theory of halos and other similar meteors the reader is referred to a Memoir by Fraunhofer in *Schumacher's Astronomische* [illegible] eft, or to the article "Hof" in [illegible] *Worterbuch* See also *Newton's Optics*, *Smith's Optics*, Pouillet, *Elémens de Physique*, *Cabinet Cycl*, art Optics," *Ency Brit*, art "Meteorology"

HA'LOGENS (Gr ἁλς, *salt* ) Substances which by combination with metals produce saline compounds, such as chlorine iodine bromine fluorine, which are simple halogens, and cyanogen, which is a compound halogen

HA'LOID (Gr ἁλς ) This term is applied to a class of chemical combinations composed of two bi-elementary compounds, one or both of which are analogous in composition to sea salt The principal groups consist of double chlorides, iodides, fluorides, and cyanurets

HALTICA A genus embracing numerous species of small and often minute Coleopterous insects of the family *Galerucidæ* and section *Tetramera* These insects have the [illegible] than the foreign ones but are more noxious than might be expected from their diminutive size The notorious turnip fly, or rather turnip flea (*Chrysomela nemorum* of Linnæus), is a species of the present genus

HAMADRY'ADS (Gr ἁμα, *together*, and δρυς, *an oak* ) Certain nymphs or inferior deities supposed by the Greek and Roman poets to preside over woods and forests and as their name implied, to live and die with the particular trees to which they were attached

HA'MITES (Lat hamus, *a hook* ) A genus of extinct Cephalopods which inhabited chambered shells, losing their spiral form soon after their commencement and then continued for a considerable extent with a single bend upon themselves like a hook The *Hamites* are found in the greensand formation in England

HA'MLET (Diminutive of the Saxon ham, *home or house* ) A small village In Law, a hamlet is a portion of a village or parish and synonymous with *vill*

HA'MMERBEAM (Sax hamep ) In Architecture, an horizontal piece of timber from or near, but above, the foot of a rafter, the object of which is to act as a tie

HA'MMOCK The sailors' bed An oblong piece of hempen cloth at each end are fastened several small lines, meeting in a grummet or iron ring, these form the *clues* [illegible] in it, is [illegible] *niards*, between two battens or screws in the beams of the deck over head about nine feet distant asunder The hammock is a very agreeable bed, especially in cold weather, but some little practice is requisite at first in getting in and out successfully During the day the hammocks, lashed up tight in the form of caterpillars, are stowed in the nettings along the upper edge of the bulwark

HA'MSTER A Rodent quadruped, somewhat larger than a rat, common in all the sandy regions that extend from the north of Germany to Siberia, extremely noxious from its fertility and great destruction of grain, but an object of interest on account of the economic instincts which conduce to its preservation and support The hamster excavates a complicated burrow, consisting of different apartments for rearing the young hibernating, and storing up winter food. An old hamster will often

amass a hundred pounds' worth of grain, and fill up a subterranean magazine [illegible] with a means of transport in two large cheek pouches, which, during [illegible] crams full of grain, beans or peas, and empties of its return to its hole by pressing the two fore paws against the cheeks The hamster, however, is not wholly dependent on its own store for existence During the intense cold of winter, when the frost becomes severe, animation is in great measure suspended and the need of nourishment abrogated respiration ceases, the animal heat falls, sensation is benumbed, and a kind of vegetative life is maintained by a slow circulation of dark or venous blood through both sides of the heart When the returning warmth of spring stimulates the organic machinery to its wonted activity, the awakened hamster finds in the nourishment which it has providently stored up the means of supplying the consequent waste, and of maintaining its vital energies They are thus enabled to commence the business of procreation in April, and the female rears a litter of six or eight twice or thrice every year In about three weeks the young are able to provide for themselves, and are driven from the holes of the parents The hamster (*Mus cricetus* of Linnæus) is the type of the genus *Cricetus* of Cuvier, characterized by the short tail and cheek-pouches The teeth nearly resemble those of the rat

HAMULA'RIA (Lat hamus, *a hook*) A species of worm said to have been found in the bronchial glands of a person who died of typhus

HA'NAPER OFFICE A common law office in the court of Chancery in which writs were anciently kept in small separate wicker baskets (hampers, *hanaperia*), abolished by 5 & 6 Vict c 103, and duties transferred Writs relating to the subject were deposited there, those concerning the crown in the Petty or Little Bag, whence another office of the same court is denom[illegible]

HA'NDLING (From *hand*) In Painting management of the pencil by touch Handling should be bold, with freedom, firmness, and spirit

HA'NDSPIKE A wooden lever employed on board a ship in working the windlass and capstan one end of which is squared to fit the holes in the capstan head and in the barrel of the windlass

HANK In Spinning, the name given to two or more skeins of yarn, silk or cotton, when tied together When single they are called skeins

HANKS Rings of ash or iron, by which sails are confined to their stays, upon which they traverse while setting or hauling down

HANNO'S PERIPLUS See PERIPLUS

HANSA, HANSE, or HANSEATIC LEAGUE In European History, a celebrated confederacy of cities on the coasts of the Baltic, and in the adjoining countries The first league was formed in 1239, between Hamburg Minden, and many other towns, to which Lubeck soon afterwards acceded It was for the purpose of mutual defence against the depredations of the Danish kings Waldemar as well as the neighbouring princes of Germany The league rapidly spread and comprehended, at one period, eighty-five cities, divided into four provinces It had four chief foreign depots at London, Bruges, Novgorod, and Bergen In the 14th and 15th centuries the league became of high political importance, and made war and peace as an independent power, but it was never recognized by the Empire Its decay was gradual, and, owing to the increased protection given to commerce by the princes of the several states in which the cities were situated rendering the alliance for mutual defence unnecessary The name is derived from Hansa, an old Teutonic word signifying *league*

HA'QUEBUT A word of French origin, or more probably a corruption of the term *arquebuse* or *harquebuse*, with which it is identified in meaning See ARQUEBUSE

HA'RBOUR, has been defined to be a piece of water communicating with the sea, or with a navigable river or lake, having depth sufficient to float ships of considerable burden, where there is convenient anchorage, and where ships may lie, load, and unload, screened from the winds and beyond the reach of the tide For a view of the utility of harbours in general, and the qualities essential in good harbours, with a notice of the principal harbours in this [illegible] see *The Commercial Dictionary*

HARD BODIES Natural Philosophy, are such as resist any pressure or percussion whatever in opposition to soft bodies, the parts of which readily yield to pressure, and do not recover themselves, and to elastic bodies, the parts of which also yield to pressure or impact, but presently recover themselves when the disturbing force ceases to act

HA'RDNESS [illegible] quality of bodies in virtue of which [illegible] action of any external force tending to alter their relative positions, or to impart to them any motion in respect of each other Newton supposes the primary particles of all bodies to be perfectly hard, and not capable of [illegible] by any power in nature, but we [illegible] quainted with the constitution of matter to determine with any certainty [illegible] of the primary particles which do [illegible]

HARDNESS In Mineralogy Minerals may occasionally be distinguished and classed by their relative degrees of hardness, to specify which various scales have been proposed by different Mohs is perhaps the most simple Several of the relative degrees of hardness are expressed in the following standard [illegible] which readily obtained in a state of purity, or crystallized, namely,

| | |
|---|---|
| 1 Talc | 6 Adularia (Felspar) |
| 2 Rock salt | 7 Rock-crystal |
| 3 Calc-spar | 8 Topaz |
| 4 Fluor spar | 9 Corundum |
| 5 Apatite | 10 Diamond |

Any mineral which neither scratches nor is scratched by any one of the above substances is said to possess the hardness expressed by the attached number Thus if a mineral neither scratches nor is scratched by calcareous spar, its hardness is represented by 3, if it scratches felspar and not rock-crystal, its hardness is stated to be between 6 and 7

HA'RDWARE, is used to signify every kind of goods manufactured from metals, comprising iron, brass, steel, and copper articles of all descriptions The hardware manufacture is one of the most important carried on in Great Britain Its principal seats are Birmingham and Sheffield, which furnish immense quantities of knives, [illegible] plated ware, fire-arms, &c, both [illegible] and exportation The total aggregate value of the joint hardware manufactures of England and Scotland may be estimated (*Statistics of British Empire* 1) at not less than 17,500,000*l* a-year, affording direct employment in the various departments of the trade to 360 000 persons

HARE See LAGOMYS and LEPUS

HARE LIP A fissure or perpendicular division of the lip, so named from its [illegible] lip of a hare Children [illegible] malformation, and sometimes it is the consequence of accidents or wounds It most usually affects the upper lip, and is not only a serious deformity but may prevent the infant from sucking and cause impediment of speech The cleft is sometimes double This malformation admits of partial or entire relief by a surgical operation, which should generally not be performed upon very young infants, in consequence of the risk of convulsions

HA'REM (Turk) The name given to those apartments in the houses of the East to the exclusive use of the female [illegible] SERAGLIO

HARLEQUIN, in the Italian Comedy, is the name given to the person who performs a part similar to that of the clown or merry-andrew to bank stages in our own country Harlequin forms also one of the standing characters in the grotesque entertainment of the pantomime The word is of doubtful etymology See PANTOMIME

HARMONICA See MUSICAL GLASSES

HARMO'NICAL INTERVAL In Music, the same as *Concord*, which see

HARMO'NICAL PROGRESSION A series of numbers, such that any three consecutive terms are in harmonical proportion The principal property of this progression is, that the reciprocals of the terms form an arithmetical progression, and, conversely, the reciprocals of an arithmetical form an harmonical progression

HARMO'NICAL PROPORTION called also *Musical Proportion* Three [illegible] are said to be in harmonical proportion when the first is to the third as the difference of the first and second is to the difference of the second and third thus, 2, 3, and 6, are in harmonical proportion, because 2 6 1 3 And four numbers are said to be in harmonical proportion when the first is to the fourth as the difference of the first and second is to the difference of the third and fourth thus 9, 12, 16, and 24, form an harmonical proportion, for 9 24 3 8

HARMO'NICS In Music, the doctrine of the differences and proportions of sounds with respect to acute and grave This doctrine was by the ancients divided into seven parts, viz of sounds, of intervals, of system, of the genera, of the tones or modes, of mutation, and of melopœia

HARMO'NIC TRIAD In Music, the chord of a note consisting of a third and perfect fifth, or, in other words, the common chord

HARMONITES A sect of enthusiasts, founded by one Rapp, in Wurtemberg, about 1780, who, finding no toleration there, emigrated with his followers to America He first settled in Pennsylvania and afterwards removed to Indiana but about 1822 again returned to the former state and established himself near Pittsburg Many details will be found on the subject of his sect in books of

travels in America, but few written with any knowledge of the subject beyond mere external observation It is a [illegible] celibacy, [illegible] the discipline of their church, and treated it as a civil act only

HA'RMONY (Gr *ἁρμονία*) In Music, an agreeable combination of sounds heard at the same instant As a continued succession of single musical sounds produces melody so does a continued combination of several together in a successive progress produce harmony

HA'RMONY OF THE SCRIPTURES, GOSPELS, &c The correspondence of the several writers of different parts of the Scriptures in their respective narratives, or statements of doctrine The earliest Harmony of the Gospels was composed by Tatian, in the second century, with the title *Diatessaron* Among many other valuable works of this description may be mentioned Osiander, *Harm Evangelica*, Chemnitz *Harm Ev Concinnata illustrata* 1617, Le Clerc *Harmonia Ev* 1699 *Macknight's Harmony of the Four Gospels*, 1756

HA'RMONY, PRE-ESTA'BLISHED A hypothesis invented by Leibnitz, to explain the correspondence between the course of our sensations and the series of changes actually going on in the universe of which, according to that philosopher and many others, we have no direct knowledge (See Perception) This hypothesis is connected, in the Leibnitzian system, with the doctrine of monads,—certain spiritual powers or substances, one of which constitutes the principle of vitality and consciousness in every living being Each of these is in its degree a mirror, in which the changes going on in the universe are reflected with greater or less fidelity But between simple substances, such as spirit and matter, soul and body, no real reciprocal action can take place The Author of the universe has consequently so ordained that the series of changes going on in any particular conscious monad, corresponds precisely to those of the monads in contiguity to which it is placed Hence arises our belief that mind is acted on by matter, and vice versa, a belief which leads to no practical errors in virtue solely of this pre-established harmony (See *Tennemann Grundr* p 389 *Brown's Lectures*, 31)

HARMOSTS (Gr *ἁρμοστής* from *ἁρμόζω I fit*) In Ancient History a Spartan magistrate, called also sometimes *sophronistes* (*σωφρονιστὴς*, *moderator*) who was appointed to superintend a conquered state It is conjectured from *Thucyd* iv 53 that the office was annual Other Greek states which made conquests afterwards borrowed the name Xenophon speaks of Theban *harmostæ* in Achæa (*Hist* l vii)

HA'RMOTOME (Gr *ἁρμὸς a joint* and *τέμνω I divide*) A mineral chiefly from Andreasberg in the Hartz, the crystals of which often intersect each other and are easily separable It is also called cross stone, or staurolite See CROSS-STONE

HA'RMUS (Gr *ἁρμὸς*) In Ancient Architecture, a tile used for covering the joint between two common tiles

HARP. (Germ harfe) A musical stringed instrument of great antiquity, in which the strings are stretched on a triangularly formed frame, and pinched, or rather pulled by the fingers to set them in vibration and produce the different sounds The harp is represented on many Egyptian monuments, and though it is usually admitted to be of Eastern origin, it seems doubtful whether it was known to the Greeks and Romans in any shape analogous to its present form Of late years this instrument has been much improved by pedals and other devices, but it is still imperfect, and more suited to the chamber than the orchestra

HARPA (Gr harpe) A genus of Pectinibranchiate Mollusks distinguished from the Linnæan *Buccinum* and remarkable for the elegance of form and beauty of the markings of the shell this is traversed by longitudinal compressed sinuous parallel ribs, which may be compared to the strings of a harp

HA'RPALUS (Gr [illegible]) A genus of [illegible] family (*Harpalidæ*) [illegible] sions of the Linnæan genus *Carabus*

The *Harpalidæ* are divided into three principal sections characterized by modifications of the anterior tarsi in the male

1 *Harpalinæ*, having the four anterior tarsi of the males dilated
2 *Feroninæ*, having the two anterior tarsi dilated, and the joints heart-shaped
3 *Patellimana*, having the two anterior tarsi of the males dilated, the joints being square or rounded

Each of these sections contains numerous subgenera, of which *Harpalus proper* contains many British species *Harpalus ruficornis* is perhaps the most common, it exceeds half an inch in length, with opaque black elytra and body and red legs and antennæ

HARPAX A genus of fossil shells, oblong and somewhat triangular the hinge being formed by two projecting teeth (*Parkinson*)

HARPIES (Gr Ἅρπυια, from *ἁρπω*, *I seize*) In Greek Mythology, the daughters of Pontus and Terra, according to some mythologists Hesiod makes them three in number, with the names Iris, Aello, Ocypete They were a species of furies or monsters, winged and clawed like birds They are best known from the celebrated description in *Virgil* (*Æn* iii 211 &c) See a memoir in vol xii of the *Mem de l'Ac des Inscr* for the varying mythological accounts respecting them

HARPOON A well-known spear for striking the whale

HA'RPSICHORD (Fr) A keyed musical instrument, in which the sounds are produced by means of small vertical sticks, called jacks, upon which the keys act as levers In the jacks are inserted short pieces of quill, these, upon passing the strings set them in vibration This instrument is now little used, indeed, we believe, in the [illegible]

HARPYIA (Gr Ἅρπυια) This term has been applied both to a genus of Raptorial birds and to a genus of Lepidopterous insects

HARROW In Agriculture, a rectangular frame with a number of spikes inserted in it on one side This frame, [illegible] for the purpose of preparing the land for seed in some cases and for covering the seed in others The most common form of the frame of the harrow is rectangular and the usual material employed is wood, with the spikes of iron, but in some cases both the frame and the spikes are of wood, and in others both are of iron Occasionally the frame is a circle of iron, and the spikes are inserted in it, at such distances that when the frame is drawn along in a straight line the spikes, or times as they are technically termed pass through every part of the soil traversed by the frame or harrow In the common kinds of harrows the spikes are inserted at right angles to the frame, but in the improved forms they are inserted at an oblique angle or point forwards by which means the harrow is drawn much more easily through the soil The best implement of this description at present in use is Finlayson's harrow This implement, by means of a long lever can be regulated to such a nicety as to stir the soil to the depth of only one or two inches for the purpose of covering grass or clover seeds, or it can be pressed into it of such a depth as to serve in the case of stubble lands instead of ploughing Wilkie's harrow and Kirkwood's harrow can be used for similar purposes They differ nothing from Finlayson's in principle, but being on a smaller scale can be worked with fewer horses than Finlayson's, which commonly requires four or six

HARROWING The process of drawing a harrow through the soil for the purpose of reducing it to a level, of covering seed or of turning up weeds in ploughed ground, or moss in grass lands In agriculture the harrow is drawn by horses or oxen, and in market-gardening, where a light harrow is sometimes employed, by men In either case the more rapid the motion of the harrow, up to a certain point the more efficient will be its operation For meadow lands, the object of harrowing is to disperse the little heaps of earth raised during winter and early spring by moles and worms, and for this purpose the harrows in some parts of the country are turned upside down, while in others as in Middlesex thorn branches are tucked into a frame resembling a harrow, and dragged over the surface for the purpose of effecting the same object This is called a bush harrow

HARTSHORN, SPIRIT OF An impure solution of carbonate of ammonia, obtained by the destructive distillation of harts horn or any kind of bone An impure solid carbonate of ammonia, called *salt of hartshorn*, is formed at the same time

HA'RVEST (Germ herbst) In Agriculture, the period at which any crop is reaped The term is more commonly applied to the crops of corn or hay, though it might, with propriety be applied to the potatoe crops, or to hops and other field products

HA'RVESTING The operation of pulling, cutting, rooting up, or gathering field crops and drying or otherwise preparing them for being stored up for winter use The first harvest which occurs in Britain and similar climates is that of the forage grasses, or other plants made into hay, the next is the harvest of cereal grasses, or of corn crops, and the third the potatoe harvest, or harvest of root crops, such as potatoes, carrots, turnips, mangel wurzel, &c There is also the harvest of occasional crops, such as that of rape seed, turnip-seed, dyers' wood hemp flax, and various other articles

HASTATI (Lat *hasta*, *a spear*) One of the three grand divisions of the Roman infantry, so called because they were armed with spears It consisted of young men in the flower of life, who were always drawn up in the first line of battle The other two divisions were called Principes and Triarii, to which, in the first Punic war, was added another, called Velites, or *light* troops, from volare, *to fly*

HATCH, is the covering of a hatchway In very bad weather the hatches are battened down, to keep the [illegible]

HA'TCHETINE [illegible] occasionally in nodules of ironstone named after Mr Hatchett It is usually placed by mineralogists amongst bitumens

HATCHMENT In Heraldry, a species of *achievement* or funereal escutcheon, suspended in front of a house to mark the decease of one of its inmates These escutcheons are always drawn up with heraldic precision, so that those acquainted with the science of heraldry can discover at a glance, from the form and accompaniments of the field and the colour of the ground of the hatchment the sex, position, and rank of the deceased *See* HERALDRY, ESCUTCHEON

HA'TCHWAY A large opening in a ship's deck for communicating with the decks below, the hold, &c there are the fore main, and after hatchways

HAT (Germ hut) What is usually called a *beaver* hat is made of a variety of furs, chiefly those of the hare [illegible] with wool, and in the best hats a proportion, but the latter is altogether omitted in common *stuff* hats The furs are mixed, the long hair is picked out and they are then placed on a hurdle, which is shaken and made to vibrate by being struck with a bow-string, in this way the dust is shaken out, and the fibres are to a certain extent interwoven (*See* FELT) A quantity of this mass of fur sufficient for one hat is called a *bat* or *capade* (see *Ure's Dictionary*, art "Hat-making") it is pressed, kneaded, and at length moulded so as to form a kind of conical cap, the irregularities or small fibres of the different furs entangling with each other so as to keep the whole adherent The cap is then dipped into warm water acidulated by sulphuric acid and wrought by the hands for several hours, by which it is thickened or fulled, the knots are picked out of it fresh felt here and there added and the beaver ultimately applied, the hat is then shaped water proofed by a lac varnish tied upon a block, dyed, stiffened by the application of a solution of glue, steamed brushed and ironed, the brim is then trimmed, and it is ready for lining and binding

Silk hats have a foundation of woollen felt similar to those which are covered by beaver, upon which a silk plush is afterwards applied

Various processes have lately been suggested and some of them carried into effect, for the purpose of improving this manufacture Several of these are described and figured in *Ure's Dictionary*, but their extension and introduction have hitherto been successfully opposed by the journeymen hatters among whom "says Dr Ure "there exists an organized combination by which the masters throughout the kingdom are held in a state of complete servitude" The public of a free country he adds ought to counteract this disgraceful state of things by renouncing the wear of stuff hats a branch of the business entirely under the control of this despotic union and betake themselves to the use of silk hats which from recent improvements in their fabric and dyeing are not a whit inferior to the beaver hats in comfort appearance or durability while they may be had of the best quality for one fourth part of their price"

HA'TTEMISTS An ecclesiastical sect in Holland, so called from Pontian von Hattem, a minister in Zealand nearly allied to the Verschoorists They arose in the latter part of the 17th century They appear to have denied the *expiatory* sacrifice of Christ It is added that they denied the corruption of human nature, and the difference between moral good and evil (*Mosheim*, Transl, ed 1826 v 386)

HAU'BERK (Ital usbergo) A piece of armour supposed to be of German origin common in the chain-mail or rather ringed mail of the twelfth century, being a jacket or tunic with wide sleeves reaching a little below the elbow, the hood being of one piece with it The hauberk of ringed mail ceased to be worn about the reign of Henry III, when the oriental chain mail, properly so called, came into fashion for a short period

In France only persons possessed of a certain estate, called *un fief de hauber*, were permitted to wear a hauberk, which was the armour of a knight esquires might only wear a simple coat of mail, without the hood and hose

HAUGH A Scotch term, applied to lands which in England would be called meadow or pasture

HAUL The sea term for pulling upon a rope directly *To haul the wind*, [illegible] close by the wind after running large

HAUPTTON (Germ *Hauptton*) In Music, that note on which the mark *tr* is placed, when a shake is indicated, the [illegible] *hauptton*

HAUSTELLATA (*Haustellum* a sucker) A group of [illegible], including all those which in the perfect state have the oral apparatus adapted for suction

HAUTBOIS *See* OBOE.

HAÜYNE A blue mineral in small granular or spherical masses, [illegible] basalt or lava Named after Hauy, [illegible] mineralogist

HA'VEN (Germ haven) The same as *harbour*, which see

HAWK *See* FALCO

HAW'KERS, PEDLARS, and PETTY CHAPMEN In Law persons travelling from town to town with goods and merchandize for the purpose of sale They are required to take out licences under 50 G 3 c 41 Wholesale traders are exempt from the provisions of this act, as are also licensed auctioneers going from town to town

HAWKING *See* FALCONRY

HAWK-MOTH *See* SPHINX

HAWSE The part of the bows close to the cables The cables pass through the *hawse holes*, which are made in the timbers and in the *hawse piece* outside When the ship has two anchors down and the cables diverge from each other the hawse is said to be *clear*, when crossed by the ship turning half round, there is a *cross* in the hawse Another cross makes an *elbow*, then a *round turn* in the last two cases the hawse is said to be *foul* The process of disengaging the cables is called *clearing hawse* The danger of a foul hawse is, that if it comes on to blow the cables cannot be veered from their friction against each other

*Freshening hawse* is veering out a little cable to expose a new surface to the friction in the hawse hole, or across the cutwater

*Athwart hawse* implies across the bows of a vessel at anchor

HAWSER A large rope or small cable

HAY'MAKING The operation of cutting down, drying and preparing forage grasses and other forage plants for being stacked for winter use The plants are mown down at the time when they are supposed to contain diffused throughout the whole plant a maximum of nutritious juices viz when they are in full flower Dry weather and if possible that in which sunshine prevails, is chosen for this *operation*, and the mown material is spread out and turned over two or three times in the course of the same day in which it is cut In the evening it is put into small heaps In the morning of the second day these heaps are spread out, and turned over two or three times, and in the evening they are formed into heaps somewhat larger than they were the day before If the weather has been remarkably warm and dry, these heaps in the course of the third day, are carted away and made into stack, but if the weather has been indifferent, the process of opening out the heaps and exposing them to the sun is repeated on the third day, and stack-making is not commenced till the fourth A great deal might be said on the subject of haymaking, but it would be altogether unsuitable in a work of this nature Suffice it to state, that the grand object in making hay is to preserve the colour and natural juices of the herbage, which is best done by continually turning it so as never to expose the same surface for any length of time to the direct influence of the sun In stacking the hay the object is to preserve this green colour and at the same time induce a slight degree of fermentation, which has the effect of rendering the fibres of the plants which compose the hay more tender and changing a part of the parenchymous matter into sugar on the same principle as is effected by malting barley This sweet taste renders the hay more palatable to horses The best directions for haymaking will be found in *Middlesex Agricultural Survey of Middlesex*

HAY-WARD [illegible] An officer anciently appointed in the lord's court to take care of the cattle of a manor, and prevent them from injuring the hedges or fences

HEAD The fore extremity of a ship It generally means the cutwater, which is adorned with a figure *By the head* implies that the ship's head is depressed in the water *Head sails head yards*, are the sails and yards in the fore part of the ship

HEADACH This is a common symptom in various diseases, it frequently occurs both in full and in debilitated habits, and also in persons who are otherwise healthy One form of headach consists in a degree of torpor and of confusion with a dull pain over the whole head dimness of sight, and inability to attend to [illegible] Sometimes [illegible] bowels, but it also comes on without any such assignable cause These headachs are relieved by nervous stimulants, such especially as camphor, ether and ammonia A cup of strong coffee or of green tea often acts like a charm, and if the pain prevents rest, a small dose of opium is sometimes necessary, with perfect rest and quiet [illegible] blesome cases are relieved by cold [illegible] temples and head, others by snuff and [illegible] There is a peculiar form of headach which consists of throbbing and pain of one particular part or sometimes over one side of the head, it lasts an hour or two and then goes off, and returns again at stated intervals This is called *hemicranium*, or *intermitting headach*, and for

its permanent cure often requires bark or sulphate of quinia blisters behind the ears are also of service In bilious or sick headach emetics and purges are required Obstinate headachs are not unfrequently got rid of by change of air scene and occupation especially when th of too intense intellectual appli cation

HEADBOROUGH (Sax borg *pledge*) The chief of the ten *pledges* in frankpledge (*see* FRANKPLEDGE), holder, tythingman, &c

HEADING In Architecture, bricks or stones with

HEADING Architecture, those courses which consist entirely of headers

HEADLAND In Geography, a term nearly synonymous with cape mull or promontory, which see

HEADLAND or HEAD RIDGE, in Agriculture, is a ridge or border, commonly ten or twelve feet broad, which is continued round a field in some cases, and which in others is only formed at the two opposite sides, for the purpose of affording space for the horses to turn on while ploughing

HEALDS The harness for guiding the warp threads in a loom

HEARING TRUMPET An instrument for concentrating sound, and conveying it to the ear It is generally a short bent tube, wide at the one end where the sound enters, and narrow at the other where the ear is applied The principle on which it acts is the reflection of sound at an angle equal to that at which it strikes a smooth surface, and accordingly the form of the instrument ought to be so regulated that the whole of the vibrations are collected into a focus at the smaller end But it is not necessary that the form which theory points the principal advancing sound by a continual reflection from preceding laterally and lost

HEART (Germ herz) The human heart is a hollow muscular broad part of its apex It base is placed upon the right of the bodies of the vertebræ a *right and left ventricle*, the former anterior, and the latter almost posterior, in consequence of the oblique manner in which it is placed Its inferior surface rests upon the diaphragm Attached to the base of the heart are two *auricles* so called from their resemblance in shape to the ear of an animal they are muscular sacs In the right auricle are four apertures, two of the venæ cavæ, one of the coronary vein, and one an opening into the right ventricle In the left auricle there are five apertures, namely one into the left ventricle, and those of the four pulmonary veins Each ventricle has two orifices, one from the auricle by which the blood enters, and another into the artery by which it passes out They are supplied with valves, those at the arterial openings being called, from their form, *semilunar valves*, those at the orifice of the right auricle *tricuspid* and those at the orifice of the left auricle *mitral* The valve at the termination of the vena cava inferior, just within the auricle, is called the *valve of Eustachius* The cavities are lined with a strong smooth membrane The *pulmonary* ventricle, and conveys venous having been changed into arterial blood by the action of the air, it returns by the *pulmonary veins* which terminate in the left auricle, the venæ cavæ, which bring back the mass of venous blood from all parts of the body, terminating in the right auricle The circle, therefore, which the blood takes is this — It is returned from the various parts of the body by the venæ cavæ into the right auricle whence it is forced into the right ventricle, and then through the lungs, whence it returns into the left auricle, and from it into the left ventricle, and thence, by the aorta, through the general arterial circulation The substance of the heart is supplied by nerves and vessels of its own, which are called *coronary vessels*, the coronary arteries branch off from the aorta, and the coronary veins return their blood into the right auricle The nerves are branches of the eighth and great intercostal pairs

HEART WHEEL. The name given to a well-known mechanical motion into an alternating cotton mills It is an ellipse turned either on an axle, or by means of a winch and handle on one of its foci, or its centre, the latter receives and the circumference of the ellipse, it to different distances from the centre of motion The practical disadvantages of this contrivance are the inequality of pressure and of moving force which will be required at different parts of the rotation of the ellipse, and the consequent wearing of some parts of it faster than others (*Gregory's Mechanics*, vol ii)

HEART WOOD In Botany, the English term for duramen It is the central part of the trunk of a tree hardened by deposition its use of which is secured, which thing through them

HEAT This term has been applied both to the sensation experienced on touching a hot body, and to the cause of that sensation in the latter sense it is synonymous with the term caloric The cause of the phenomena of heat is unknown, but they are supposed to depend upon the presence of a highly attenuated, imponderable, and subtle form of matter, the particles of which repel each other, but are attracted by other bodies The escape of heat through space is called the *radiation* of heat, and its communication by contact *conduction* The term *specific heat* is applied to the quantity of thermometric heat required to raise different substances to the same temperature Thus experiments prove that the quantity of heat which will raise olive oil two degrees will only raise water one degree, hence a pound of water at 212° may be said to contain twice as much heat, or to have twice the capacity for heat that belongs to oil or the specific heat of water being =1, that of oil is 0 5 When heat changes the state or form of bodies a large quantity disappears and remains in them so long as they retain one form To heat in this state of combination, and inappreci the term *latent heat* or *caloric* *See* EXPANSION, EVAPORATION &c

HEATH, or HEATHER In a general sense the term *heath* is applied to waste land in which the pre- one or more of the common species and *Erica* (*Calluna vulgaris*, Sal The *Erica communis* of Linnæus) This plant covers many hundreds of acres in the Highlands of Scotland, in Ireland, and in similar climates on the Continent It attains, in many places, the height of three or four feet, and is used for thatching houses and for a variety of other purposes form a substitute for mattresses in Highland cottages, and they are also eaten green and in a dried state by horses, cattle and sheep in countries where the grasses and clovers do not begin to grow till late in the spring

HEAVE, in nautical phrase, to employ force to move great weights by the lever, &c, as *to heave up* the anchor by the capstan or windlass, *to heave down* the ship, or pull her over on one side to get at a leak, also *to heave taught* (tight), or turn the capstan till the rope or chain applied to it becomes tight

HEAVEN, the Celestial Sphere or Firmament, or Sky, in Astronomy denotes the spaces in which the celestial bodies are placed or through which they apparently perform their diurnal revolutions Aristotle and his disciples believed the heavens to be composed of incorruptible elements, incapable of destruction or of any change whatever, and this opinion long continued to exercise a baneful influence on the progress of astronomy as it led to the consequence that the celestial bodies are altogether of a different nature from the earth, and have I was finally overof Galileo The term *heaven* is also frequently used to denote the orb sustain the bodies placed in them, and spherical, because perfect motion must be performed in a circle which is formed by the section of a sphere, and crystalline, because the different bodies are visible though their orbs include one another The first heaven was that of the Moon the second of Venus the third of Mercury, the fourth of the Sun, the fifth of Mars, the sixth of Jupiter, and the seventh of Saturn The eighth, which is that of the fixed stars was called particularly the firmament Ptolemy added a ninth, which was the *Primum Mobile* All these reveries have been exploded by the discovery of the true system of the world, and the laws of the planetary motions

HEAVY SPAR Native sulphate of baryta This is a common mineral in many mining districts It occurs stalactitic Some beautiful specimens of the latter variety have been found in Derbyshire of a brown colour The crystals are usually white, or nearly colourless The specific gravity of sulphate of baryta is 4 1 to 4 6 It consists of 77 baryta, 40 sulphuric acid, its equivalent being 117 It enters into the composition of some kinds of pottery, but its chief consumption is in the adulteration of white lead

HEBE (Gr Ἥβη), in Grecian Mythology, was the goddess nectar of Jupiter and Juno

HECATE (Gr Ἑκάτη) In Mythology, a Grecian goddess daughter of the Titan Perses and Asteria She presided over popular assemblies, war, the administra-

tion of justice and the revenge of children There is a good deal of [illegible] to this goddess, who is [illegible] dess, and was supposed to wander along the earth at night Statues were set up to her in market places, and [illegible] Properly a sacrifice of a hundred oxen, but the word is often used to signify a large sacrifice of any kind of victims

HECATOMPEDON (Gr *ἑκατον*, *a hundred* and *πους*, *a foot*) In Ancient Architecture, any temple of the length of one hundred feet

HECATOMPYLON (Gr *ἑκατον*, and *πυλος*, *a column*) In Ancient Architecture, a building having a hundred columns

HECKLE (Germ heckel) An instrument used in separating the fibres of flax and placing them in parallel tresses

HECTIC FEVER (Gr *ἑξις*, *habit*) A constitutional fever, attended by debility, a small quick pulse, paleness, loss of appetite, excessive perspiration, and emaciation It [illegible] it usually announces in other febrile attacks It is often symptomatic of some particular disease, and requires to be treated accordingly Where this is not the case, or where it merely seems an attendant on general debility a course of sarsaparilla and a milk diet are often very beneficial, but where this remedy induces perspiration and nauseates, a great deal of [illegible] required in carrying it on for a sufficient length of time to prove of service

HEDGE A living wall formed of woody plants, sown or planted in a line, and cut or clipped in such a manner as to form a compact mass of any degree of width and height that may be required for the purpose of shelter, separation, or defence The fences most [illegible] made of the white [illegible] because it has spiny branches, and forms a strong defence against cattle Fences for the purposes of shelter and separation are chiefly used in gardening, and for the most part are formed of evergreen shrubs, such as the holly, yew, box, &c, or sub-evergreens such as the privet, of flowering shrubs, such as the *Cydonia japonica*, or of deciduous shrubs or trees with persistent leaves, such as the hornbeam and beech In the management of hedges of every description an important point is to keep them thick, and impervious to wind or animals near the ground, for which purpose the section of the hedge requires to be made broader at the base than at the top, in order that the exterior leaves in every part of the hedge may enjoy in an equal degree the [illegible] perpendicular rains

HEEL The after extremity of the ship's keel also the foot of a mast — *To heel over*, to incline to one side

HEGIRA In Chronology, the era used by the Mohammedans in the computation of time The epoch or first day of this celebrated era, so extensively employed in [illegible] corresponds to Friday the 16th day of July in the year 622 of the Christian era It is a problem of some importance to convert dates expressed by the Mohammedan computation into the corresponding dates of our calendar, for [illegible] ry to be acquainted with the [illegible] M year

This year is strictly lunar, and the civil months are adjusted to the lunar months by means of a cycle of 30 years, containing 19 common years of 354 days, and 11 intercalary years of 355 days, the cycle thus containing 10 631 days or 29 Julian years and 39 days Each year is divided into 12 months, containing alternately 30 and 29 days, excepting that the last month of the intercalary year contains also 30 days The intercalary years are the 2d 5th 7th 10th 13th 16th 18th, 21st, 24th, 26th, and 29th of the cycle The names of the Mohammedan months, with the number of days in each, are as follow —

| | Days | | Days |
|---|---|---|---|
| Moharem | 30 | Shaban | 29 |
| Saphar | 29 | Ramadan | 30 |
| Rabiu I | 30 | Shawall | 29 |
| Rabiu II | 29 | Dhu'l Kadah | 30 |
| Jomadhi I | 30 | Dhu'l Hajah | 29 |
| Jomadhi II | 29 | in intercalary years | 30 |
| Regeb | 30 | | |

Such are the chronological [illegible] which Mohammedan dates are rec [illegible] era The rule by which the reduction may be accomplished is as follows —

1 Divide the number of years (of the Hegira elapsed by 30, the quotient will be the number of cycles, and the [illegible] mainder B, and let $x$ be the number of intercalary years in B; then the number of days that have elapsed from the commencement of the Hegira to the beginning of the year in which the date occurs is given by this formula,

$$10631\,A + 354\,B + x,$$

for 10,631 is the number of days in the cycle, and 354 the number of days in the common lunar year To the sum [illegible] from the commencement of the Hegira to the given date

2 To the number of days from the commencement of the Hegira to the given date add the number of days between the commencement of our era and the Hegira, and the sum is the number of days from the first of our era to the given date The number of days from the beginning of our era to the Hegira, or to the 16th of July, 622, is 227,016

3 Having now found the number of days from the Incarnation to the given date, it only remains to convert the sum into Julian years For this purpose divide by [illegible] in the Julian intercalary period), [illegible] Divide the remainder by 365, and call the quotient D, and the remainder of this last division $y$ Then 4 C + D is the number of Julian years [illegible] Christian era, and $y$ is [illegible] the current year This gives the date in Old Style To reduce it to the Gregorian Style, it is only necessary (during the present century) to add twelve days (*See* CALENDAR)

HEIGHT In Geometry, the same as *altitude*, which see

HEIGHTEN (From *height*) In Painting, a verb signifying to make prominent by means of touches of light or [illegible]

HEIGHTS In Geometry, the determination of the relative altitudes of points on the earth's [illegible] usually effected When it is required to determine not only the height of one point or station relatively to another, but the relative heights of a number of points above a common horizo [illegible] of a canal) recourse is [illegible] The second method is [illegible] pression of one st [illegible] pute, from the observation and from the distance of the two stations, the difference of altitude by the rules of trigonometry The third method, and the most important, as being, generally speaking, the most applicable, is to deduce, by means of the known physical properties of the atmosphere, the di [illegible] the observed differences [illegible] cated by the barometer To this method we shall here confine our attention

Pascal, who first explained the true cause of the suspension of the mercurial column in reference to the pressure of the atmosphere, and established the fact of the pressure by his celebrated experiment on the Puy de Dome was also the first to suggest the application of the barometer to the measurement of mountains, but as the constitution of the atmosphere and the laws of gaseous bodies were in that [illegible] the numerous attempts which were made to estimate heights in this manner, soon after the introduction of the instrument, had very little success The first considerable step towards the introduction of a correct theory was the discovery that the [illegible] me as the pressure) is [illegible] — an important relation, which is true of all the gases and vapours, and goes by the name of Mariotte's law Dr Halley next discovered the remarkable relation which connects the density of the atmosphere with the altitude, and proved that the densities decrease in a geometrical [illegible] roughly estimated the variation to amount to a fifteenth part between winter and summer

De Luc was the first who gave precision to barometrical [illegible] by taking into account the influence of heat in expanding the air, and by substituting the mercurial for the spirit thermometer, he rendered the determination of temperatures, on which the method so mainly depends, a [illegible] it had formerly bee [illegible] of air at different [illegible] or the computation of barometrical measurements, which was adapted to the English system of measures by Dr [illegible] some alterations in the values [illegible] George Shuckburgh and by General Roy in the determination of the altitudes of many of the [illegible] in Britain

Laplace, in the *Mécanique Céleste* has given a formula which embraces all the different circumstances on which the solution of the problem depends, and enables us to [illegible] when the constants

to be found from observation have been accurately determined Among these are the ellipticity of the earth, the relative densities of air and mercury at a given temperature, their expansion by heat, and the variation of the elastic force of atmosphe [illegible] ture of dry gases and watery [illegible] given thermometric change In the present state of our knowledge, some doubt still remains on several of these points, but they are all known with sufficient approximation to render the barometer a most valuable instrument for geodetical purposes It not only gives the relative altitudes, above the general level, of places however distant at which simultaneous observations are made, but even enables us to assign the height of any station on the earth at which the *mean* height of the barometer is ascertained We now proceed to give the formula by which the height is computed from the observations

The temperatures being expressed in degrees of the centigrade scale, let us assume

$\varpi$ = the atmospheric pressure at temperature zero
D = density of atmospheric air at temperature zero,
$\theta$ = the temperature in degrees
$\alpha$ = (.0037), the dilatation of air for 1° of increased temperature,
$k = \frac{\varpi}{D}$, the ratio of the pressure to the density

If the pressure remains constant, and we suppose that while the temperature changes from 0 to $\theta$ any volume V of air becomes V′, and its density D becomes D′, then $V' = V(1 + \alpha\theta)$, and therefore, the densities being inversely as the volumes, $D' = \frac{D}{1 + \alpha\theta}$

Let us next suppose the pressure to vary while the temperature $\theta$ remains constant, and that D′ becomes $\varrho$ when $\varpi$ becomes $p$, then, by the law of Mariotte $\varpi : p :: D' : \varrho$ Substituting for D′ its above value, and observing that $\varpi = k D$, this proportion gives

$$p = k \varrho (1 + \alpha\theta) \qquad (1)$$

This formula holds good for all the gases and vapours, and for their mixtures as well as for air

To form the differential equation of the equilibrium of the atmospheric column at any altitude $z$ above the surface, suppose a column of air whose base is 1 to be divided into thin horizontal slices, then the difference of the pressures on the under and on the upper surface of any slice will be equal to the weight of the slice Let, therefore, $p$ be the pressure, and $g'$ the force of gravity at the height $z$, then $\varrho$ being the density, and $dz$ the thickness of the slice, we have

$$dp = -g' \varrho \, dz \qquad (2)$$

Let $g$ be the force of gravity at the foot of the column, or at the surface of the earth, and $r$ the mean radius of the earth = 20,887,030 feet (*see* EARTH), then, neglecting the small variation of centrifugal force due to the height $z$, $g' = g r^2 - (r + z)^2$ Substituting in equation (2) this value of $g'$ and eliminating $\varrho$ by means of equation (1) there results

$$\frac{dp}{p} = \frac{-g r^2 dz}{k(1 + \alpha\theta)(r + z)^2}$$

Integrating this equation on the supposition of $\theta$ being constant, and determining the constants so that $p = \varpi$ when $z = 0$, we find

$$\log \frac{\varpi}{p} = \frac{+ g r z}{k(1 + \alpha\theta)(r + z)} \qquad (3)$$

To apply this formula to the determination of the difference of altitudes of two stations, let

$h, h'$ = heights of the mercury in the barometer at the lower and upper stations respectively in inches,
$m, m'$ = the densities of the mercury at the two stations,
T, T′ = the temperatures of the mercury (in centigrade degrees),
$t, t'$ = the temperatures of the air,
$g, g'$ = force of gravity at the lower and upper station,
$\varpi, p$ = the pressures, then

$$\varpi = m g h, p = m' g' h'$$

Now it has been determined by experiment that the density of mercury increases by the 1-5550th part for each centigrade degree by which the temperature diminishes, therefore,

$$m' = m\left(1 + \frac{T - T'}{5550}\right), \text{ and } g' = g\frac{r^2}{(r + z)^2},$$

whence assuming $c = 1 + \frac{T - T'}{5550}$, $\frac{\varpi}{p} = \frac{h(r + z)^2}{c h' r^2}$, and therefore

$$\log \frac{\varpi}{p} = \log h - \log c h' + 2 \log \left(1 + \frac{z}{r}\right).$$

Substituting this in equation (3), and transposing,

$$z = \frac{k}{g}(1 + \alpha\theta)\left[\log h - \log . c h' + 2 \log \left(1 + \frac{z}{r}\right)\right]\left(1 + \frac{z}{r}\right) \qquad (4)$$

It now remains to convert the quantities in this formula [illegible] perbolic [illegible] used it is necessary to divide the second member by the modulus M = 43429

2 The quantity $k$, which expresses the ratio of the pressure [illegible] density, depends upon the [illegible] the temperature, and must therefore be determined with respect to some particular place Let G denote the accelerating force of gravity at Greenwich, H the standard height of the barometer, $m$ the density of mercury, and D that of air, both at the freezing temperature, then $\varpi = m$ G H, and $k = \frac{\varpi}{D} = \frac{m}{D}$ H G For the height, H = 76 metres, or 2 449348 feet, the ratio of $m$ to D, in respect of dry air, was found by Biot and Arago to be 10462 According to this determination, we have $k = 26086\,8 \times$ G For air saturated with moisture they found $k = 26152\,3 \times$ G Hence if we adopt the mean of the two coefficients as representing the ordinary state of the atmosphere, we have

$$k = 26120 \times \text{G, in feet}$$

3 The [illegible] equation (4) is that which corresponds to the [illegible] station, and to the latitude of the place of observation Denoting the latitude of the station by $l$, and that of Greenwich (to which G corresponds) by L, we have from the theory of the earth

$$\frac{g}{G} = \frac{1 + n \sin 2l}{1 + n \sin 2L} = \frac{1 - \frac{1}{2}n \cos 2l}{1 - \frac{1}{2}n \cos 2L}$$

(very nearly) Here the coefficient $n$ is $\frac{5}{2}$ times the ratio of the centrifugal force to gravity at the equator, diminished by the ellipticity, or $\frac{5}{2} \times \frac{1}{289} \times \frac{1}{302} = .005145$ (*see* EARTH), and $\frac{1}{2}n = .00257$ But L = 51° 28′ 39″, and cos 2 L = − .2212 whence we find

$$g = \frac{(1 - .00257)\cos 2l}{1.00058} G,$$

and we have therefore in feet

$$\frac{k}{M g} = \frac{26120 \times 1.00058}{43429(1 - .00257 \cos 2l)} = \frac{60168}{1 - .00257 \cos 2l}$$

4 For $\theta$ we may take $\frac{1}{2}(t + t')$, the mean temperature of the lower [illegible] In the case of perfectly dry air, $\alpha$ = [illegible] but as the [illegible] of air mixed with vapour increases as the temperature is diminished in a faster ratio than dry air, we may assume as the nearest probable value, $\alpha = .004$ This gives $\alpha\theta = \frac{2(t + t')}{1000}$

For the sake of abridging, put

$$K = \frac{60168}{1 - .00257 \cos 2l}\left(1 + \frac{2(t + t')}{1000}\right),$$

then the equation (4) becomes

$$z = K\left[\log h - \log c h' + 2 \log \left(1 + \frac{z}{r}\right)\right]\left(1 + \frac{z}{r}\right).$$

In computing from this formula, an approximate value of $z$ is obtained by making

$$z = K(\log h - \log c h');$$

by the substitution of which in the second member of the above equation a more exact value is found, and the result is the height of the second station above the first in feet

Instead of the numerical factor 60168 feet in the coefficient K, Poisson (*Mécanique*, tom ii) has 18337 46 metres which is equal to 60163 feet The difference arises from our having assumed a slightly different value for the eccentricity of the earth, and having referred the gravity G to the latitude of Greenwich instead of Paris

The temperatures have been assumed to be expressed on the centigrade scale, as the most convenient for computation If T and $t$ are for Fahrenheit's thermometer, it is only necessary to substitute $1 + \frac{T - T'}{9990}$ for $1 + \frac{T - T'}{5550}$, and $1 + \frac{t + t' - 64}{900}$ for $1 + \frac{2(t + t')}{1000}$, respectively, in the [illegible] not very considerable the fraction $z - r$ is very small and may be considered as [illegible], in which case it may be incorporated with the factor 60168 [illegible] substituting for 60168 the number 60384 deduced from a [illegible] number of [illegible] by Raimond, and supposing the [illegible] to change K into K′, the formula for the altitude will become

$$z = K'(\log h - \log c h'),$$

which [illegible] very used

The [illegible] recent and complete investigation of the

subject of barometric measurements is that of Bessel, in *Schumacher's Astronomische Nachrichten*, vol xv See also Biot *Astronomie Physique*, tom iii

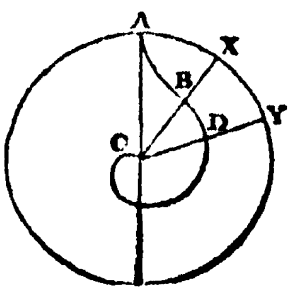
HEIR (Lat *hæres*) In Law, one who succeeds by descent to lands, tenements, and hereditaments Strictly speaking, a person is not properly called heir in the lifetime of his ancestor, according to the ancient maxim, *nemo est hæres viventis* (For the rules which govern this succession in England by common law and statute, see Dr Sm *Hist* tom) [illegible] survive the present tenant, as, at common law, the eldest son *Heir-presumptive*, he who stands nearest in succession in the default of an heir-apparent, as an eldest brother where there is no issue *Heir-at-law*, or *heir-general*, is he who succeeds by descent to lands in fee-simple *Heir-special*, issue in tail claiming by the form of the gift (*See* FEE-TAIL) *Heir by custom*, he who succeeds to lands or tenements by custom, as all the sons by gavelkind *Heir-male*, i e the nearest male in the succession, is not strictly a term of English law since lands cannot descend in this way, but some deeds are thus limited A devisee is sometimes called *heir by devise*, or *hæres factus* Bastards, aliens, persons attaint of treason and felony, cannot be heirs, but idiots and lunatics may Things that pass with the land, as conditions and covenants real, goods and chattels annexed to the freehold (*see* FIXTURES), and terms of years to attend the inheritance are in ordinary legal language said to go to the heir as also *heir-looms*, being such goods and chattels as go by special custom along with the inheritance In Scottish law, the word *heir* is taken in a larger acceptation, as to personal as well as real property Heirs-at-law are termed in it *heirs whatsomever* It recognizes several species of heirs as the heir-active who has the right of action, heir of line, or lineal heir, heir by conquest, who succeeds to estates to which the deceased donor did not himself succeed by descent, heirs portioners, in English law coparceners, heir of tailzie (or in tail) and so forth By the civil law, heirs are of two kinds legitimate or by act of law and instituted, or by the will of the possessor the former only answering to those who are properly designated as heirs in our own law, the latter to our *purchasers* Legitimate are either *heirs of blood*—heirs under the title "unde vir et uxor" (by which in default of heirs of blood, a husband or wife succeeded to the goods of the deceased spouse, a provision not generally preserved in modern Continental law) and *heirs irregular*,—such as the lord to whom an escheat falls &c Heirs instituted are of many kinds

HEIR-LOOMS In Law such goods and personal chattels as go to the heir along with the realty The quality of heir-looms is fixed by custom, deeds, charters, deer in a park, &c, are usually such 'Loom' is from an old Saxon word 'limb' or member

HELIACAL (Gr ἥλιος *the sun*) Something relating to the sun In the ancient astronomy, a star is said to rise *heliacally* when after being in conjunction with the sun, and consequently invisible, it rises so soon before the sun as to be visible in the eastern horizon in the morning twilight, and it is said to set *heliacally* when the [illegible] when he has disappeared At the opposite season of the year the same star rises as the sun sets and sets as the sun rises, it is then said to rise and set *acronically* When a star or planet rises and sets at the same instant with the sun, it is said to rise and set *cosmically* These technical terms occur frequently in the works of Hesiod, and in Ovid's *Fasti* The ancients fixed the commencement of the seasons by the positions of the stars relatively to the sun at his rising and setting

HELIÆ'A (Gr Ἡλιαία) In Ancient History the chief of the ten courts among which the 6000 Athenian jurymen were distributed, and which on important occasions sometimes contained them all It probably derived its name from being open to the sun (ἥλιος) Before this tribunal causes of consequence to the state and individuals which did not involve bloodshed were brought (*See Mem de l'Acad des Inscrip* vol xviii, *Boeckh's Public Economy of Athens*)

HELICOID, or PARABOLIC SPIRAL (Gr ἕλιξ, *a spiral*), in Geometry, is a curve line which is generated as follows — Suppose the axis of the common or Apollonian parabola to be bent into the [illegible] of a circle, the ordinates A B, A D, [illegible] places and perpendicular positions with respect to the axis, then the spiral curve, A B D, which passes through the extremities of the ordinates, is the helicoid It is obvious from this definition that all the ordinates, being perpendicular to the circumference of the circle, meet in its centre C, and if $x$ represent any circular abscis A X, and $y$ the corresponding ordinate

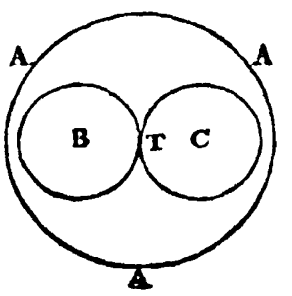



X B, the equation of the curve will be the same as that of the parabola namely $y^2 = ax$, $a$ being the parameter

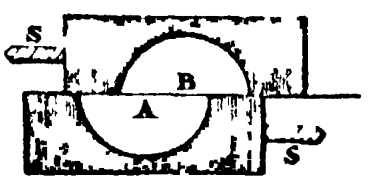
HELIODAMEIA (Gr ἥλιος *the sun* and καμινος, *a furnace*) In Ancient Architecture, an arched apartment [illegible] of the sun

HELIOCENTRIC (Gr ἥλιος, and κεντρον, *centre*) The *heliocentric latitude* of a planet is the angle at the sun's centre formed with the projection of its radius vector on the ecliptic and the straight line drawn from the centre of the sun to the place of the planet and the *heliocentric latitude* of a planet is the inclination of the straight line at which it appears to the sun to the plane of the ecliptic The heliocentric longitude and latitude is consequently equal to the inclination of the planet's orbit

HELIOMETER (Gr ἥλιος and μετρον *a measure*) A kind of micrometer for measuring the diameters of the sun, moon, and planets, or the small apparent distance between celestial objects The instrument best known by this name (for several have been proposed or suggested by a Mr [illegible] *Phil Trans* vol xlviii), about the year 17[illegible] was [illegible] by Bouguer in 1747, and has since been improved by Dollond and Fraunhofer The principle on which the instrument is constructed is as follows — Two object-glasses of the same focal distance, or rather the two halves of a divided object-glass, are placed side by side in the same tube with an apparatus so contrived that the distance between the centres can be increased or diminished at pleasure In this manner two images of the sun are formed at the focus of the common eye-glass Thus the circle A A A representing the field of view of the telescope, or the visible circle at the common focus of the two object-glasses and the eye-glass, and the two small circles representing the two images of the sun formed by the two object-glasses, when the observer proposes to measure the diameter of the sun the two object-glasses are brought by means of a tangent screw to such a distance from each other that the two images touch in a point I, and the distance between the centres of the two object-glasses, estimated in seconds, gives the distance between B and C, the centres of the images, that is, the diameter of the sun

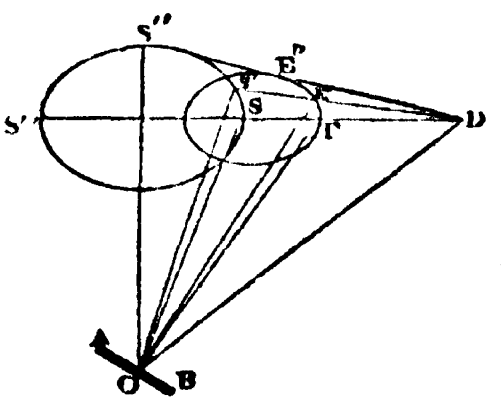



Formerly the heliometer was formed by two complete lenses, but as it was found very difficult to give them precisely the same focal length, and as the size of the tube was required to be inconveniently large, they are now made of the same lens by dividing it across its centre The centres of the two semi-lenses are separated by means of the screws S S, which act on the plates in which they are mounted, and the distance of the centres A and B is measured by a scale and vernier This apparatus is otherwise called the *divided object-glass* micrometer The principle has also been applied to the microscope *See* MICROMETER




HELIOSCOPE (Gr ἥλιος, and σκοπεω, *I view*) The name given by Scheiner to an instrument of his own invention for observing the sun without hurting the eye The ordinary method is to place a disc of coloured glass before the eye-piece of the telescope

HELIOSTAT (Gr ἥλιος, *the sun*, and στημι, *I stand*) An instrument invented by Gravesande for the purpose of obviating in optical experiments the inconvenience arising from the continual change of direction of the solar rays, by reflecting them in the same straight line The principle on which the heliostat is constructed may be explained as follows — Let S S' S'' S''' be the diurnal circle described by the sun, O a point on the surface of the earth which may be regarded as the centre of the circle S S' S'' S''', A B the mirror, and O D the direction in which it is required that the ray shall be reflected The solar rays will successively coincide with the straight lines which form the sides of the conical surface O S S' S'' S''' Let therefore O S' be one of these rays, and let [illegible] will be necessary to give to the [illegible] the rays O S, O S'', &c may be reflected by the mirror in the direction O D Produce O D till it meet the plane of the earth's diurnal circle in D, and let D S S''' pass through the centre of the circle Join D S', and draw O E' [illegible] to A B, and [illegible] D S'



in E′ The angles of incidence and reflexion being equal the angle S′ O E′ is equal to I′ O D therefor S′ E′ is to E′ D in the ratio of S′ O to O D But S′ O and O D are constant, therefore the ratio of S′ E′ to E′ D is constant But D is a given point, therefore by a simple theorem in elementary geometry (*Leslie's Geom Analysis*, b iii prop 2) the locus of E′ is a given circle It follows, therefore, that the axis of the mirror must describe in 24 hours the surface of a cone, the base of which, parallel to the plane of the equator, is a circle determined in magnitude and position by the given direction O D and the parallel which the sun is describing on a given day of the year

It is easy to conceive a mechanism by which this object may be accomplished Suppose a clock to be placed with its dial parallel to the equator or the axis of the index hand [illegible] connected with [illegible] axis [illegible] a mirror fixed perpendicularly to the rod will have the motion required

For a description of the original instrument see *Gravesandes' Phys Elementa*, but it has been greatly improved by Charles, Malus, &c See *Journal de l'Ecole Polytechnique*, cahier 16, *Biot, Physique Experimentale*, tom ii

HE'LIOTROPE A deep-green siliceous mineral, somewhat translucent, and often variegated with blood-red spots from Gr ηλιος, *the sun*, and τρεπω, *I turn* Its vulgar name is *bloodstone* There is also a common sweet scented *plant* of this name

HELIX (Gr ελιξ, *a whorl*) The name of a Linnæan genus of the *Vermes Testacea*, characterized by the entire and crescent-shaped opening of the shell, and forming in the system of Cuvier the type of a family of terrestrial and air-breathing Gastropods including the genera *Vitrina*, Draparnaud, *Bulinus*, Adanson, *Pupa* Lam, *Chondrus*, Cuv, *Succinea*, Drap, and *Helix* proper of which our common garden snail, *Helix hortensis*, is an example

The great vine snail (*Helix pomatia*, Linn) formed one of the luxuries of the tables of the ancient Romans and by peculiar feeding and other treatment was brought to attain an immense size It is still an article of food in certain cantons in Switzerland and France The snails do much damage to the vegetables in cultivated grounds, biting off pieces of the leaves by means of a semicircular dentated horny plate, which is affixed to the upper lip

HELIX, in Anatomy, is applied to the reflected margin of the [illegible]

HELIX In Architecture, the curling stalks or volutes under the flowers in each face of the abacus of the Corinthian capital

HE'LLEBORE (Gr ) In Pharmacy this term is applied to the roots of the black and white hellebore The root of [illegible] (*Helleborus niger*), called also *Melampodium* [illegible] and is a drastic purge and emetic the root of the white hellebore is similar, but more active in its operation (*See* VERATRIA) It was formerly used in the cure of gout, and in some maniacal cases where no effect is produced except by very powerful means, but these remedies have now fallen into disuse The leaves of the *Helleborus fœtidus*, or stinking hellebore have also been used to evacuate worms from the intestines, but they are dangerously active

HELLE'NIC The name given to the common dialect which prevailed very generally among the Greek writers after the time of Alexander It was formed with very slight variations, from the pure Attic of the age preceding [illegible]

HELLENISM The name given to that dialect of the Grecian language that was used by the Jewish writers Its peculiarities consisted in the introduction of foreign words very little disguised but more especially of oriental metaphors and idioms, but not at all in the inflexions [illegible] the Hellenic

HE'LLENIST (Gr [illegible] Ελλην *a Greek*), the name by which the Jews who from their foreign birth or travel used the Greek (Hellenic) language are distinguished in the Acts of Apostles The word is derived according to a common method of formation in the Greek language, from the verb ελληνιζειν, *to Hellenize*, or adopt the manners of a Greek There were great numbers of Jews scattered throughout the Roman empire at this period, more especially in the Asiatic and East African provinces, where the Greek was the current language, and as they were in the habit of making frequent journeys to and from Jerusalem, they heard the preaching of the Apostles, and became efficacious instruments in conveying the knowledge of the word throughout all lands [illegible] were distinguished from the Hebrews by the great liberality of their views with respect to the nature of the promises of the Old Testament It appears from Acts, vi 1, that these Jews retained the distinctive name of Hellenists after their conversion to Christianity, and that there consequently subsisted some jealousy between them and the native Christians

HELM implies the mechanism of the steerage especially the tiller as to put the helm *a starboard* is to put the tiller over to the right side, *a-port*, to the left side, *up*, to the weather side, *down*, to the lee side

HELM, or HELMET Defensive armour for the head a word of Scandinavian derivation The armour of the ancients, which particularly guarded the head, was known by the general denominations of head-piece, casque, and helmet Helmets were anciently formed of various materials, but chiefly of skins of beasts, brass, and iron An open helmet covers only the head, ears, and neck, leaving the face unguarded Some open helmets have a bar or bars from the forehead to the chin, to guard against the transverse cut of a broad sword, but it affords little defence against the point of a lance or sword A close helmet entirely covers the head, face, and neck, having on the front perforations for the admission of air, and slits through which the wearer may see the objects around him, this part, which is styled the visor (from the French word *viser*, to take aim), lifts up by means of a pivot over each ear Some helmets have a bever (from *buveur*, drinker, or from the Italian *bevere*, to drink), which, when closed covers the mouth and chin, and either lifts up by revolving on the same pivots as the visor, or lets down by means of two or more pivots on each side near the jaws The use of the bever was to enable the wearer to eat and drink more commodiously than could be done in a helmet with a visor only The helmets of the Greeks and Romans were mostly open, not unlike scull caps as formerly worn by our dragoons Montfaucon says he never saw an ancient helmet with a visor to raise or let down, although he is of opinion that they had those contrivances It seems as if the Romans, at least those of which Pompey's army was composed at Pharsalia had open helmets as Cæsar directed his soldiers to strike them in the face which order, had their faces been covered he would not have given The two Grecian helmets in the British Museum have a kind of contrivance to cover the nose Over the top of the helmet rose an elevated ridge called the crest representing lions or dragons &c to make the warrior appear taller and more terrible (*Mirror* 1839)

HELMET or HELMET SHELLS *See* CASSIS

HELMINTHOLOGY (Gr ελμινς, *a worm*, and λογος *a discourse*) The natural history of worms *See* INTESTINALIA

HE'LMSMAN The man who steers A good helmsman opposes in time the tendency of the ship to deviate from her course by a small motion, which he relaxes as soon as the effect is felt, and thus disturbs her sailing as little as possible A bad helmsman gives her too much helm and keeps her perpetually yawing from one side to the other The steerage therefore, is of the utmost consequence in chase

HELOPIDÆ (Gr Ἑλοψ, the name of an obnoxious reptile) A family of Heteromerous Coleopterans belonging to the section *Stenelytra*, and including numerous subgenera and species The typical genus *Helops* is remarkable for having the anterior tarsi of the males dilated Of this genus there are four British species known, of which the *Helops cæruleus* may be found at the roots and under the bark of trees It presents a lengthened ovate form, a brown colour, a punctured surface, and dusky red antennæ and tarsi

HE'LOTS (Gr ειλωτες) In Ancient History, the slaves of the Spartans, who consisted originally of the Achæan inhabitants of Laconia who were subdued by force of arms by the Dorian invaders The name was derived from Helos, a town of Laconia of which the inhabitants were thus reduced to servitude, but to this class were afterwards added the Messenians who still clung to their native soil after its subjugation by the Spartans They were employed either as domestic slaves, cultivators of the land, or in the public works, and though they do not appear to have been treated ordinarily with much severity, yet the recollection of their former state urged them frequently to revolt, while their numbers rendered them so formidable to their masters as to drive the latter to schemes of the most abominable treachery for their repression (See particularly *Müller's Hist of the Dorians*, [illegible] *Ant of Greece* [illegible])

HELVIE [illegible]

HEMACHROMES *Hemachromes* (Gr αιμα *blood* and χρωμα [illegible]) A term by which Laurillard designates the animals with cold blood

HE'MATHERMS *Hematherma* (Gr αἷμα, θέρμη, *heat*) The name given by Latreille to the animals with warm blood

HE'MATIN (Gr αἷμα) The red colouring prin-

HEMATITE One of the varieties of native oxide of iron It occurs in nodules, and in radiated masses of a crystalline fracture Its name is derived from the red colour which it presents superficially or when rubbed to powder.

HI MATOSIN *See* HÆMATOSINE

HI MI'LYTRA (Gr *ἡμισυς, half; ελυτρον, a sheath*) The name given to the superior wings or wing-covers of Tetrapterous insects, when they are coriaceous at the base and membranous at the extremity, as in the order *Hemiptera*

HI MERALOPIA (Gr *ημερα, day*, and *ωψ, the eye*) A [illegible] which renders vision very imperfect except in broad daylight, it has been relieved by tonics and gentle stimulants, with the occasional application of blisters behind the ears

HI'MEROBAPTISTS (Gr *ημερα, day, βαπτιζω, I baptize*) An ancient sect among the Jews so called from washing themselves as a religious solemnity every day It is thought by some that the Christians of Saint John, or Sabians, descend from them (*Mosheim*, Transl, ed 1826, iv 226)

HI MERO'BIANS, *Hemerobidæ* (Gr *ημερα*, and *βιος, life*) A family of Neuropterous insects, of the section called *Planipennes* by Latreille, characterized by having a slender body, which is greatly exceeded in length by the finely reticulated wings The ova are deposited in clusters, attached each by a long glutinous pedicle to the leaves of various plants, and by some mycologists have been described as fungi The larva of these insects are remarkable for their ravenous habits, and as they feed chiefly on the plant lice (*Aphides*) are highly beneficial They subsist on their juices suck them to death and with a singular instinct they clothe themselves with the skins of their victims Of the typical genus *Hemerobius* there are fourteen known British species, of which the *Hem perla* Linn, is the most beautiful It is sometimes called the "golden eye," is of a green colour, the wings transparent, and veined with green

HI MICRA'NIA (Gr *ημισυς, half* and *κρανιον, the head*) A pain of one side of the head it is often intermittent

HI MI'GAMOUS (Gr *ημισυς* and *γαμος, marriage*) In Botany, a term employed in speaking of grasses, when of two florets in the same spikelet one is neuter and the other unisexual, whether male or female, as in *Ischæmum*

HE'MIHOLO'GAMOUS (Gr *ημισυς ολος entire* and *γαμος marriage*) A term employed in speaking of grasses, when in the same spikelet one of two florets is neuter and the other hermaphrodite, as in several species of *Panicum*

HI MIO'PIA, or HI MIO'PSIA (Gr *ημισυ*, and *ωψ, the eye*) A disordered vision in which objects appear divided

HI MI'PTERA (Gr *ημισυς*, and *πτερον a wing*) An order of [illegible] wing-covers of a consistence [illegible] lytra of beetles and the ordinary membranous wings By Latreille the term is restricted to those insects the wing covers of which are coriaceous at the base and membranous at the top, the term *Homoptera* being applied to those Fabrician *Hemiptera* of which the elytra are deflected and of uniform consistence throughout

When the *Hemiptera* quit [illegible] of small hexapod larva, differ [illegible] fect insect save in the absence of wings before these are acquired the skin is shed several times during which the larva acquires an increase of general bulk The pupa is active, and is distinguished by having the wings and elytra concealed in small dorsal cases the next moulting exhibits the perfect insect with the hemelytra and wings fully developed The bed bug (*Cimex lectularius*), and water-boatman (*Notonecta*), are examples of the present order of insects

HI'MISPHERE (Gr *ημισυς*, and *σφαιρα, a sphere*) In Geometry, the half of a sphere, bisected by a plane passing through its centre In Astronomy it is used to designate the half of the terrestrial sphere divided by the equator Hemisphere also denotes a map or projection of half the terrestrial or celestial sphere on a plane

HI MISTICH (Gr *ημιστιχιον*, from *ημι half*, and *στιχος, verse*) In Poetry, half a verse The unfinished verses in Virgil's *Æneid*, concerning which it is not known whether they were purposely left in that state, or are owing to the incompleteness of the poem, are usually called hemistichs The alexandrine, or French hemi verse, requires a regular pause at the end of the first hemistich

HI'MLOCK A common umbelliferous plant of a peculiar odour, and possessed of narcotic powers For medical use the leaves should be collected just before the plant flowers, if intended for powder they should be carefully dried at a temperature not exceeding 212°, if for extract, the juice should be squeezed out by moderate pressure, and evaporated in a water or steam bath to a proper consistency The *extract of hemlock* is perhaps the best preparation, but as its activ [illegible] should be given with caution An [illegible] grains, an over dose produces giddiness, wandering of the mind, dilated pupil, convulsive motions of the muscles of the face, and the other symptoms of this class of poisons

Hemlock is a powerful sedative, and often serviceable as a substitute for or accompaniment to opium In allaying morbid irritability of the system arising from any local or general excess of vascular action, as in certain stages of [illegible] dular tumours and unhealthy sores, hemlock is often preferable to opium It has also been found very useful in chronic rheumatism, and occasionally in the treatment of whooping cough A poultice composed of a mixture of [illegible] hemlock with bread and water or [illegible] lock, is [illegible] of irritable ulcers and cancerous [illegible] gularly effectual, at others it seems inert, and sometimes appears to increase irritation The virtues of hemlock reside in a peculiar alkaline principle which has been termed *conia*, combined in the herb with a distinct acid, the [illegible]

HEMP (Germ hanf) The fibres of the bark of the *Cannabis sativa* It is prepared for spinning in the same way as flax, and is made into strands or yarn for ropes, sailcloth, &c This plant is supposed to be a native of [illegible] but has been [illegible] and extensively cultivated [illegible] and many other countries of Europe, particularly Russia and Poland, where it forms an article of primary commercial importance It is also cultivated to a considerable extent in many parts of America, but in the United Kingdom it is but little grown, except in a few districts of Suffolk and Lancashire

HEN'BANE This is a common plant, flowering in July, the *Hyoscyamus niger* The expressed juice of the leaves evaporated to the consistency of extract has long been used as a sedative or narcotic It has a peculiar strong and disagreeable odour, and a nauseous bitterish taste From two to five grains of the extract of henbane [illegible] in many cases henbane and various forms of opium may be combined Henbane is apt to produce [illegible] does not constipate the bowels, and has [illegible] tendency

HEN'DECASYLLA'BIC (Gr *ενδεκα*) A verse of eleven syllables The Latin hendecasyllabic, of which the principal specimens left to us are from the pen of Catullus, consist of a spondee, dactyl, and three trochees —

Vivamus, mea Lesbia, atque amemus.

The Italian heroic verse and those of England and Germany, when increased by the addition of a final short syllable are iambic hendecasyllabics

The licence of adding an eleventh syllable (and sometimes also a twelfth) is more frequently admissible in dramatic than epic versification

HENRI'CIANS The followers of an Italian monk of the name of Henry, who in the twelfth century preached with fanatic zeal principally against the corruptions and impostures of the Romish church He traversed the south of France from Lausanne to Toulouse, and met with great success at all the towns at which he halted He rejected the baptism of infants declaimed vehemently against the vices of the clergy and exposed the vanity and absurdity of many of the ceremonies of the church At length his followers were turned against him by the eloquence of St Bernard and he died in prison, into which he had been [illegible] III, in the year 1148 (*Waddington's H* [illegible] *ch* 10)

HE'PAR (Gr *ηπαρ*) This term, signifying *liver*, was applied by the old chemists to various compounds of sulphur with the metals, having a brown-red or liver colour

HEPALGIA (Gr *ηπαρ, the liver*, and *αλγος, pain*) A painful affection of the liver

HEPA'TICÆ (Hepar, *liver*, in allusion to the form of some of the species) A natural order of flowerless plants growing in damp shady places in all temperate climates, in some respects allied to mosses, and in others to lichens They are of no known importance, but are interesting to systematic botanists, because they offer strong traces of sexual apparatus in plants of a very low kind of [illegible]

HEPATITIS (Gr *ηπαρ*) Inflammation of the liver The acute or active form of this disease is ushered in with pain in the region of the liver, sickness, costiveness, and a strong, hard, and frequent pulse, there is also generally great pain about the clavicle and shoulder Bleeding and purging with salts, senna, and calomel, and a blister, are usually effectual in Europe in subduing an attack of this disease In warm climates, calomel and mercurials must often be continued till they affect the mouth In *chronic* hepatitis the same general plan of treatment must be followed up, especially as regards the use of mercurials with these, and gentle aperients and mild bitters, the yellowness of the complexion, lowness of spirits, and other concomitants of what in warm climates is [illegible] and at least in Europe [illegible] always requires for its permanent cure a change of climate

**HE'PTAGON** (Gr ἑπτα *seven*, and γωνια, *angle*) In Geometry, a plane figure of seven sides The area of a regular heptagon is equal to the square of one of its sides multiplied into the constant number 3 6339124, or seven fourths of the tangent of the angle at the base to radius 1

**HEPTA'GONAL NU'MBERS** are a kind of polygonal numbers, of which the difference of the terms of the corresponding arithmetical progression is 5 Thus,

| | |
|---|---|
| Arithmeticals | 1 6, 11, 16, 21, &c , |
| Heptagonals | 1, 7, 18, 34, 55, &c ; |

the latter being formed by the continual addition of the terms of the first Among other properties of heptagonal numbers there is one very remarkable, namely that if any heptagonal number is multiplied by 40, and 9 added to the product the sum is a square number

**HEPTANDROUS** (Gr ἑπτα, and ανηρ, *a man*) Any flower having seven stamens

**HEPTARCHY** (Gr ἑπτα and ἀρχω *I govern*) In English History the division of England into seven Saxon kingdoms, which are represented in most of our histories to have existed at the same time with and independently of each other The seven kingdoms in question according to the common divisions, were Kent, Sussex Wessex Essex East Anglia, Mercia, Northumberland But in point of fact there was no period of history when these seven kingdoms existed [illegible] in the constant fluctuations of conquest and unions of territory were continually made by the fortune of war The sovereign who succeeded in obtaining a temporary supremacy over his neighbour kings generally assumed the title of Bretwalda or ruler of the Britons, of whom Ella king of Wessex, was the first, but it was afterwards borne by kings both of Kent, East Anglia, and Northumbria In 617, Edwin, king of the latter district, appears to have acquired a temporary sovereignty over the whole of England, which was also gained by his nephew Oswald in 634, but after the brother of the latter king Oswio no Saxon monarch assumed the title of Bretwalda After the death of the latter Mercia rose in the scale, and its kings, Offa ruled nearly the whole of the Saxon territories in the last half of the eighth century After his death Egbert king of the West Saxons, raised his power on the ruins of that of Mercia, and having subdued and rendered tributary the other kingdoms then subsisting, he became about 830 master of the whole Saxon realm and is reckoned as the eighth Bretwalda or ruler of Britain With his reign the heptarchy is usually considered to have ended (See *Palgrave's History of England*, *Turner's Anglo Saxons*)

**HERACLEONITES** An early sect of heretics belonging to the Gnostics, so called from Heracleon, whose tenets they embraced They rejected all the ancient prophecies, regarded themselves as superior to the Apostles and under the pretext of a sublime or elevated exposition of the Scriptures, propounded the wildest and most extravagant [illegible]

**HERACLIDÆ** A general designation for the descendants of Hercules, who after the death of that hero were expelled from the Peloponnesus by Eurystheus king of Mycenæ The return of the Heraclidæ, which took place about 140 years after their expulsion or 80 years after the siege of Troy forms a celebrated epoch in ancient chronology and has been generally considered to mark the transition from the heroic or fabulous ages to the period of authentic history

**HERÆ'A** The name of a celebrated festival instituted at Argos in honour of Juno whom the Greeks called Hera Another festival of this name in honour of the same goddess was held at Elis every five years

**HERALD** (Gr κηρυξ) An officer of arms, possessed of important functions The ancient heralds (κηρυκες among the Greeks, feciales among the Romans) were privileged persons, sacred by superstition as well as by the law of nations Modern heralds, besides their employment in messages between states and in matters of public negotiation (in which capacity their services are grown into disuse, or become merely [illegible] acquired a new character from the prevalence [illegible] of chivalry [illegible] The multiplicity of these [illegible] that there should be certain [illegible] ed in interpreting or in "blazoning" them, according to the rules of the imaginary science to which these fanciful creations were subjected (*See* HERALDRY) It became also necessary that they should have a [illegible] of knowledge of the hereditary arms, ensigns armorial [illegible] &c belonging to each family in order that [illegible] constitute an [illegible] the distinctions [illegible] of individuals [illegible] the heralds became in modern European countries, the depositaries of much [illegible] general science [illegible] conversant in the [illegible] of noble [illegible] genuine families They have also important parts to fulfil on occasions of public solemnity, pageants, installations, nuptials, funerals, &c

Edward III was the first [illegible] two heraldic kings at-arms [illegible] office was exercised south and north of Trent respectively Richard II gave the earl-marshal power to preside in a court of chivalry assisted by the heralds But the first [illegible] chapter was held at the siege of Rouen, [illegible] kings at-arms were fixed at three, their present number, by Henry VIII Edward VI fixed the establishment [illegible] they [illegible] Heralds [illegible] heralds, and pursuivants are five [illegible] consists of 1 Three kings of arms Garter Clarenceux and Norroy, of which the first [illegible] the highest rank His duties are chiefly to grant supporters, arrange funerals, and present the order of the Garter to foreign princes. 2 The heralds are six in number, styled Windsor, Chester, Lancaster, Somerset, York and Richmond they with the kings at-arms form the collegiate chapter 3 The four pursuivants (Portcullis Rouge Dragon Blue Mantle, and Porte Croix) are junior officers or probationers who afterwards succeed to the higher offices. The duties of the officers of the Heralds' College are various, and their powers have been considerable, although curtailed by modern indifference to the purity of their ancient science They keep the records of the arms crests and cognizances of every gentleman or person entitled to bear them, and they have considerable authority for the purpose of preventing parties from bearing arms to which they have no right Their title to confer arms or rather to assign coats of arms to persons applying for permission to bear them, is still generally recognized Heraldic visitations of counties, with a view to collect information on the subject of genealogies and coat-armour was held as early as the reign of Henry IV In 1528, a regular commission was granted for the whole kingdom, and visitations were held at intervals of twenty or thirty years from that time to the beginning of the last century (See *Noble's History of the College of Arms*, 1805)

**HERALDRY** The science of conventional distinctions impressed on shields banners and other military accoutrements Heraldry has been divided into personal and national The first of these treats of [illegible] to individuals either in their own or in [illegible] Devices adopted by champions in the field and borne on their shields or on their banners are of very high antiquity The sculptures on the shields of Achilles and Hercules in *Homer* and *Hesiod* are rather ornamental than heraldic But in the Seven Chiefs against Thebes of Æschylus we find the cognizances of these renowned leaders distinctly blazoned as worn by them on their shields, in the same fashion with those of the knights in the middle ages The Romans do not seem to have had any customary devices for individuals resembling our armorial insignia, except their distinctive crowns for particular services The jus imaginum, or right of possessing small

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### EXPLANATION OF THE PLATE

I *Lines*

1 Horizontal or straight 2 Angled 3 Bevilled 4 Escarteléé 5 Nowy or Fr[illegible] 6 Arched or enarched 7 Double arched 8 Wavy or undée 9 Invected 10 Engrailed 11 Battled-embattled, or crenellee 12 Battled embattled 13 Nebuly 14 Potent 15 Indented 16 Dancettee 17 Dove tailed 18 Urdee. 19 Rayonnée, or radiant

II *Points of the Escutcheon, Colours, and Furs*

20 Escutcheon, points of 21 Or 22 Argent 23 Gules 24 Azure 25 Sable 26 Vert 27 Purpure 28 Tenne 29 Sanguine 30 Ermine 31 Ermines 32 Erminois 33 Pean 34 Vair 35 Varry cuppy

III *Differences, or Filiations*

36 (First son) Label of three points 37 Se[illegible] Crescent 38 (Third) Mullet 39 (Fourth) Martlet 40 (Fifth) Annulet 41 (Sixth) Fleur-de-lys.

IV *Ordinaries, &c*

42 Chief 43 Pale (between two annulets) 44 Pallet 45 Party per pale 46 Border 47 Bars 48 Fess 49 Bend 50 Bend sinister 51 Border 52 Chevron 53 Cross 54 Cross of St. John of Jerusalem, or Malta. 55 Cross patonce 56 Cross moline 57 Cross of St Andrew 58 Cross [illegible] Cross moline in saltier 60 Cross bottonee, [illegible] Cross posslet, fitchée 62 Cross flory 63 Cross in [illegible] 65 Lozenge, fleury

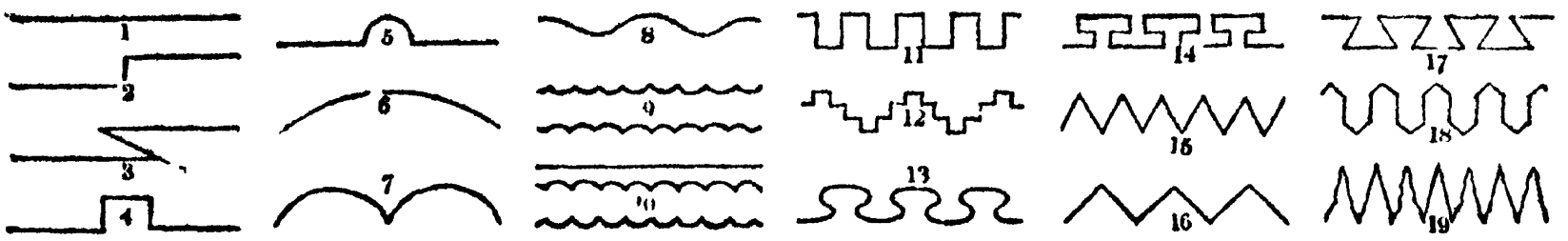
V *Mascles, Fusils, Rustres*

66 Lion, statant guardant [illegible] Passant guardant 69 Rampant. 70 Rampant guardant 71 Rampant regardant 72 Sejant [illegible] 75 Stag at gaze Stag's head caboshed. 76 [illegible] 79 Dragon's head erased [illegible] two heads 82 Boar's h[illegible] bowed debruised 85 [illegible] 88 Clarion, or rest [illegible]

VI *Crowns Coronets, &c*

90 Crown of [illegible] Wales 92 Coronet of a duke [illegible] 96 Baron 97 Mitre of a [illegible] 99 Celestial crown 100 [illegible] cap of state 102 Chaperon [illegible] France 104 Cardinal's hat 105 Crown triple, or tiara of the pope

The principal of these heraldic terms will be found explained under their several articles in the Dictionary.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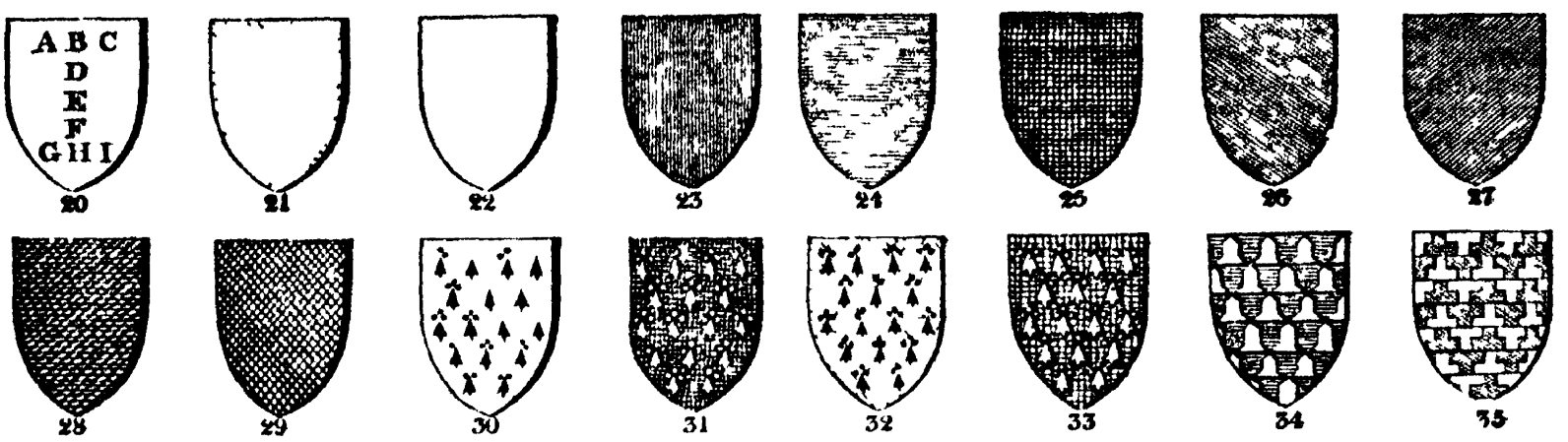
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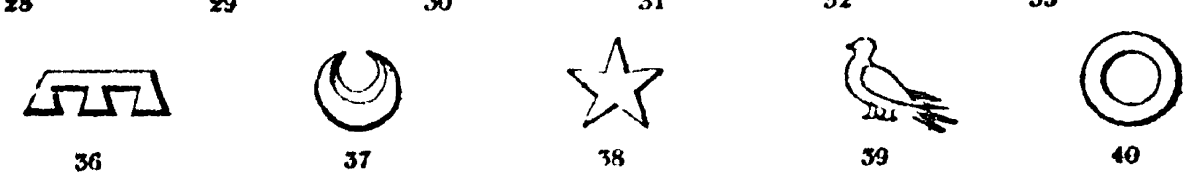
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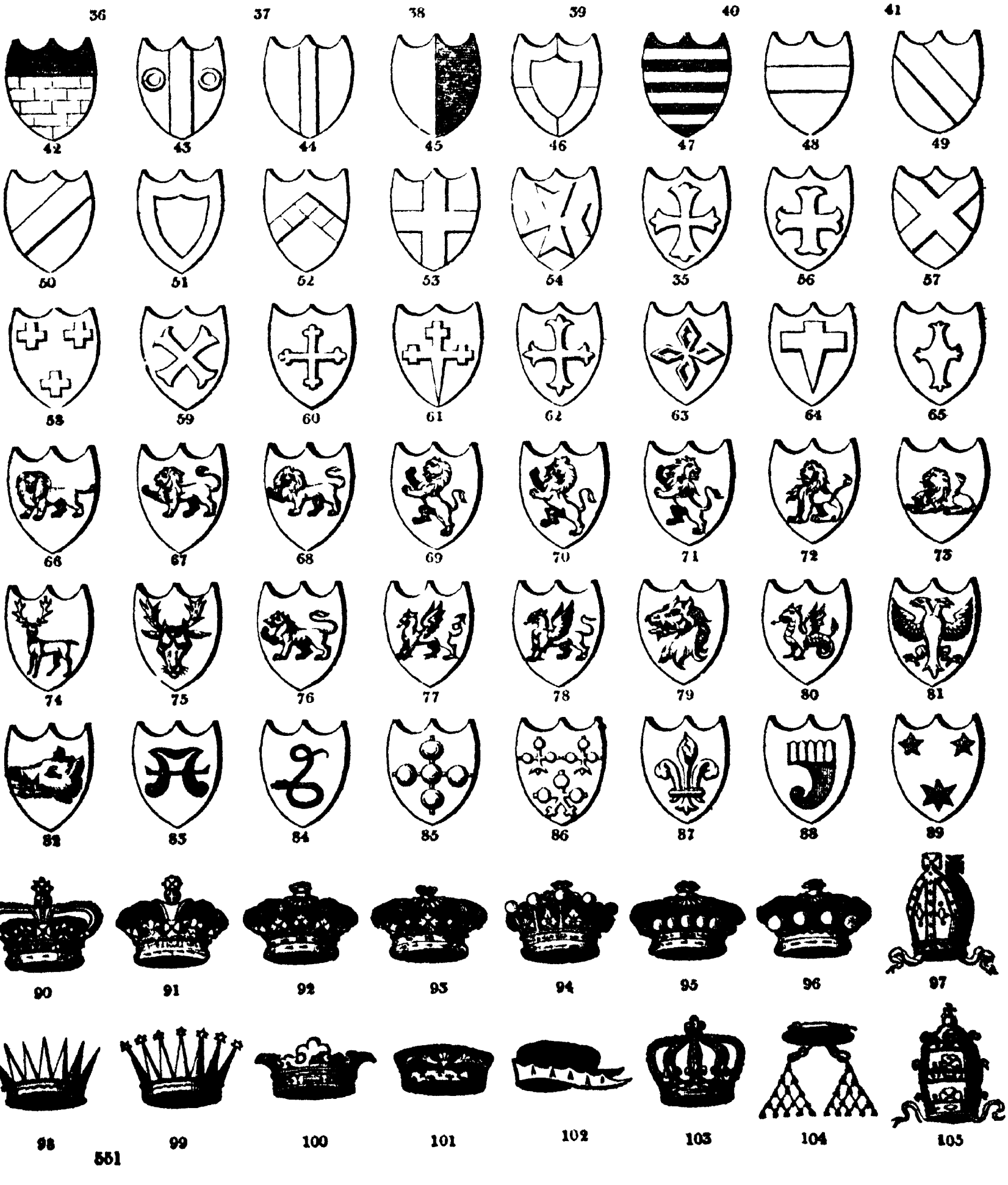
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statues of distinguished individuals of the family, seems to have been their only external hereditary distinction Early in the middle ages, however, we find abundant notice of cognizances borne by individuals These were more especially in use in tournaments, where the knights, being clad in complete armour, were unknown to the spectators, except by their banner or shield (*see* BLAZONRY), and probably it was in the lists of the tournament that the fanciful science of heraldry first found its subject matter This science appears to be a compound of [illegible] very different quarters The [illegible] and symbol seems to have [illegible] Its ordinaries, colours, metals [illegible] be derived from Germany and [illegible] ars to be a national science from the [illegible] terms of [illegible] Britons and French [illegible] test success and reduced it to its present systematic form Our English terms of heraldry are, as is well known, derived entirely from the French language, although not wholly from [illegible] made to the science by the [illegible] coat-armour, it is said, [illegible] to an earlier period than the 13th century, but it seems that, in the reign of Henry III, the vocabulary of heraldry was nearly as full and definite as at the present day National heraldry or the adoption of distinctive emblems by civil communities, is far more ancient than personal Badges we know, were borne on the national standards of antiquity an eagle was the device of Persia and of Rome an owl of Athens, &c, and Turkey and Persia where personal heraldry is unknown [illegible] ss at this day national ensigns of correct heraldic character

Arms are said, in the heraldic science to be of dominion or pretension (national), arms of community belonging to episcopal sees, cities corporations, arms of patronage to governors of provinces, &c, arms of concession or augmentation of honour granted by sovereigns to individuals which in the next generation become hereditary [illegible] hereditary arms arms of alliance [illegible] families and relations of individuals (marked by various devices termed differences &c, *see* DIFFERENCE), arms of succession which accompany the possession of certain estates or lordships, and finally arms of assumption taken up by individuals from caprice or vanity, which, although common enough in the present day, are borne in violation of all heraldic laws, or arms taken up with the permission of the sovereign, through his principal herald (in England king at arms) Armorial bearings were chiefly displayed in the times of chivalry, on the shield or escutcheon They were also borne on the pennon or banner, on sword-hilts as early as A D 1250, on the mantle or surcoat (hence the phrase coat-of-arms), and in modern times on carriages or articles of furniture The science of heraldry united as it is with that of family genealogy, was for centuries one of the most favourite literary pursuits (if it can be termed such) among the higher ranks of the community It has been enriched with much legendary knowledge, and diversified with many fanciful antiquarian theories It is entitled to respect, not merely on account of its intimate connection with historical knowledge, but also on account of the refinement and curious variety of the learning itself, which grounded on merely imaginary principles, has been wrought into a system of the minutest accuracy The best known English work on heraldry is that of *Guillim* The *Encyclopedia Heraldica* of Berry contains many modern additions See also *Edmonson's complete Body of Heraldry* 1780, *Dallaway's Inquiries* 1793, and the article "Heraldry" in the *Inc Metr*, with the various [illegible] and foreign there referred to

HERBA'CEOUS (Lat herba), in describing the texture of bodies denotes their being green and cellular as the tissue of membranous leaves It is also applied to such perennial plants as lose their stems annually, while their roots remain permanent in the ground

HERBA'RIA (Lat herba) Collections of dried plants such as the old botanists called *horti sicci* or dry gardens They are formed by gluing to sheets of paper branches and other parts of plants pressed flat, and dried in the sun or otherwise If well prepared they are as useful to the botanist as plants alive, but it is necessary to have some practical skill to be able to employ them advantageously The largest public herbaria are those of the Museum at Paris the Imperial collection of Vienna the Royal of Berlin, and that of the British Museum formerly Sir Joseph Banks's Nothing certain is known of the extent of these collections, but they probably contain in some cases as many as 60,000 species The herbarium is an unattractive part of public museums, but a very important [illegible] rous purposes of science, both practical [illegible]

HERCULES In Mythology, one of the most celebrated personages of antiquity believed to be the son of Jupiter and Alcmena the daughter of Electryon, king of Mycenæ The history and wonderful exploits of this hero are so well known, that it would be superfluous to dwell upon them here There is perhaps, no subject connected with antiquity to the right comprehension of which such formidable difficulties are presented, and hence the numerous attempts that have been made to separate truth from fiction in the history of Hercules, by divesting it of the mythological traditions with which it had been encumbered by all the writers of antiquity In some shape or another, all the profane nations of antiquity seem to have possessed a divinity to whom they attributed an extraordinary degree of bodily strength, combined with indomitable perseverance and moral energy in prosecuting and overcoming difficult achievements The reader will at once recognise, as belonging to this class, the Baal of the Syrians, the Melkarth of Phœnicia and the Rama of Hindostan, who, like the Grecian Hercules, outstripping in bodily and intellectual endowments the great mass of the people of the rude era in which they lived, achieved a multiplicity of deeds which were looked upon as altogether miraculous and which procured for their authors empire and dominion during their lives, and after death a place among the gods (See *Müller's Dorians*, and the authorities there referred to)

HERCULES One of the old constellations in the northern hemisphere

HERDERITE (So called from Herder who discovered it) A mineral found in crystals embedded in fluor at Ehrenfriedensdorf in Saxony, its primary form is a bright rhombic prism, its lustre is vitreo-resinous, and its specific gravity 2·98)

HEREDITAMENTS In Law all things which pass to the heir being either corporeal (land, with those adjuncts which legally are comprised within that designation), or incorporeal which are things collateral to land or issuing out of it and are enumerated in *Blackstone's Commentaries*, under the heads "Advowsons, Tithes Commons Ways Offices Dignities Franchises, Credits or Pensions Annuities and Rents"

HERESY A word signifying the taking up of certain opinions in theological matters from the Greek αἵρεσις, *choice*, which classical writers apply to the sects of philosophers It is now confined to a theological sense, and is defined by Roman Catholic authorities to be the *voluntary* assumption and *obstinate* maintaining of error in matters of faith They hold all error to be voluntary where the [illegible] rates from the judgment of the church [illegible] do not for the most part profess to have any certain standard by which men may judge whether their fellow men be heretical We may infer from the directions of St Paul to Titus that the nature of heresy was understood by the first preachers of Christianity but it does not necessarily follow that any infallible tests should exist at the present day It seems most consonant to a sense of human infirmity, and is the judgment of most divines of the Reformed persuasion, that those only should be considered as heretics by any community who maintain what are accounted by it erroneous opinions either against their real convictions, or [illegible] and piety should entitle them at all events to attention

HERIOT In Law originally a tribute given to the lord of the manor on occasion of his engaging in a war (here or heer-geld) In English law a heriot is a customary service due for the most part on copyhold tenures, and termed heriot custom, being usually the best beast, whether horse ox or cow that the tenant dies possessed of which is due and payable to the lord of the manor Some heriots however are due on reservation in a grant or lease of land such are termed heriot service In heriot custom the lord may seize the specific article which he seeks to recover for heriot service he may either seize or distrain generally on the goods of the tenant on the land

HERISSON (Fr *a hedgehog*) In Fortification a beam armed with iron spikes, and used as a barrier to block up a passage

HERITABLE RIGHTS in Scottish Law, comprehend in general rights to land and things connected with land which pass to the heir, the distinction being in most practical respects merely identical with that of English law between realty and personalty Heritable jurisdictions were grants of criminal jurisdiction bestowed on great families by the crown They were abolished after the rebellion of 1745 by the act 20 G 2 c 40

HERMES *See* MERCURY

HERMAPHRODITE (Gr, from the well known mythological fable of the [illegible] of the bodies of the nymph Salmacis [illegible] the son of Ἑρμῆς, Mercury and Ἀφροδίτη, Venus) An organized body, in which there is either [illegible] ation of the characteristics of the [illegible] is the "true," the second the "spurious" hermaphrodite. Hermaphrodites are also "natural" or "preternatural"

The animals in which the organs of the [illegible] naturally combined in the [illegible] to the invertebrate division, and are most common in the

Moll scous and Rad ate classes If the term hermaphrodi e m ay be applie l to thos spec es which propagate wi hout the con ourse of the sexe - bu n which no male org s can be d tected, as well as to thos in which both male and female organs are present in the same body, then there may be distinguished three kinds of hermaphroditism

First, The *Cryptandrous* or in which the female or re ductive organs are alone develop l In this case Entozoa, the hydrostatic Acalephes, some Polypes, and Sponges

Second, T H in which the male organs are develo as to fecundate the ova of the same individual — Ex The Cirripeds, the Rotifers, the trematode and cestoid Entozoa, and some Acephala, as the *Cyclas*

Third, The *Allotriandrous*, or in which the male organs are so disposed as not to fecundate the ova of the same body, but where the concourse of two individuals is required, in each of the organs o tropodous Mollusks, with the exception of the Pectinibranchiate order, and class *Annellida*

All the other invertebrates, as the Cephalopods and pectinibranchiate Gastropods, most of the acephalous Mollusks, the insects Arachnidans and Crustaceans the I pizoa and the nematoid Entozoa, the Echinoderms and Medusæ, are, like the vertebrate classes, diœcious, or composed of male and female individuals

The unnatural hermaphrodites may be divided into those in which the parts peculiar to the two sexes are blended together in different proportions, and the whole body participates of a neutral character, tending towards the male and female as the respective organs predominate, and into those in which the male and female organs occupy respectively separate halves of the body and impress on each lateral moiety the characteristics of the sex

This latter and very singular kind of hermaphroditism has hitherto been found only in insects and Crustaceans In the extracts from the Minute Book of the Linnæan S volume of their *Transactions*, it Macleay, Esq Sec L S, exhibited a curious specimen, showing that two Papiliones referred to distinct families by Fabricius are in reality the male and female of the same species This specimen presented the forms and colours of both sexes divided by a longitudinal line on the body, the right wings and side of the body being as in the male (*Papilio polycaon*, Fabr ), and the left as in the female (*Papilio laodocus*, Fabr )

In *Loudon's Magazine of Natural History* (vol iv p 434 ), an experienced entomologist, Mr J O Westwood, has given descriptions and figures not only of dimidiate hermaphrodites (the example is the *Bombyx pavonia*), but also of quartered hermaphrodites The latter singular condition is exemplified in a specimen of the *Bombyx castrensis*, in which the right wing left antenna and left side of the abdomen are male, the left wing, right antenna, and right side of the abdomen are female and again in a specimen of stag-beetle (*Lucanus cervus*), in which the left jaw and right elytrum are masculine, and the right jaw and left elytrum feminine

In most dimidiate hermaphrodites the left side is masculine, but an example of the contrary has been observed in *Sphinx populi* It is to be regretted that the condition of the internal organs of generation cannot be ascertained in the above singular examples, but this deficiency is in some degree supplied by the results of Dr Nicholl's dissection of an hermaphrodite lobster (*Philos Trans* xxxvi p 290 ), in which a testis was found on that side of the body which exhibited externally the male characteristics, and an ovarium on the opposite side

In Botany, hermaphroditism is the rule, and a separation of sexes the exception, in the structure of flowers or reproductive organs

HERMETIC ART The imaginary art or science of alchemy, so termed from Hermes Trismegistus, a personage of questionable reality looked up to by the alchemists as the founder of their art Some spurious works bearing his name are still extant *See* ALCHEMY

HERMETIC SEAL When a vessel or tube is perfectly closed by fusing its mouth or extremity, it is said to be *hermetically* sealed

HERMITS, or HERMITES (Gr ερημος, *desert*) Persons who, in the early ages of withdrew themselves from the world for devotional purposes, betook themselves to desert places (ερημαι), where in the centuries of our era this class of persons was extremely numerous, nor have individuals been wanting in later ages who have undergone the same privations with the same mistaken views, and have acquired great reputation for sanctity in consequence (See *Cave's Prim Christ Hist Lit* vol i, *Riddle's Christian Antiquities*, 1839, p 743 *Herbertus Vitæ Patrum et Eremitarum* 1625 *Catalogus Illustrium Anachoretarum Elogia*, 1625, *Vitæ Metropolitanæ* )

HERMODA'CTYLS (Gr Hermes, a river in Asia, and dactylus, *a date* or from Ερμης, *Mercury*, and δακτυλος, *finger*, i e *the fingers of Mercury* ) This term has long been applied to a species of colchicum tuber, probably that of the *Colchicum luteum* it is irregularly heart-shaped, and has a furrow upon one side, not unlike the tuber of the *Colchicum autumnale*, now much used in rheumatic affections in the shops under the Turkish name of Turbith Some of the older writers, and the dogmatic followers of Galen, compare the shape of the hermodactyl to that of a gouty finger, and have recommended its efficacy in that disease

HERNANDIA'CEÆ (Hernandia, one of the genera ) A small natural order of arborescent Exogens, inhabiting the Indian Archipelago and Guinea They are very near *Thymelaceæ*, differing only in their fibrous drupaceous fruit, lobed cotyledons and involucre, and are very different from *Lauraceæ* and *Myristicaceæ*, to which orders they have been referred The leaves, stem, &c are slightly purgative the roots of *Hernandia* are antidotes to the Mancinella poison, its juice is a depilatory, and its leaves make a good sort of tinder

HERNIA (Gr ερνος, *a branch*) A rupture The term is generally applied to a tumour arising from a protrusion of part of the intestines or omentum into a sac composed of peritoneum the groin, or upper and fore part of the thigh, below Poupart's ligament, are common situations Other viscera may also occasionally form hernial tumours When the condition of the accident is such that the parts cannot be reduced or returned into the abdominal cavity, the hernia is said to be *strangulated*, and in that case the passage through the intestines is interrupted, there is sickness and constipation, and inflammation, and even mortification of the part ensue, unless by an operation the cause of the stricture is removed and the gut returned What is usually called *inguinal hernia* is the protrusion of a portion of intestine along with the testicle in its descent through the abdominal ring into the scrotum Where a rupture exists in early infancy it is commonly referable to this cause The surgical history of ruptures is a very complicated and extensive, but highly important subject it has been ably illustrated by several eminent practitioners, who have published treatises upon their causes and treatment

HERO (Gr ηρως ) Lennep derives it from the verb αειρω *I lift* But the root of it is probably to be found in the same original word which appears in the Latin herus, *master*, Germ ari-mann, perhaps the Sanscrit sura. The heroes of the Greeks were deceased mortals to whom divine honours were paid It is probable indeed, that such was the origin of their gods themselves (*see* POLYTHEISM), but if so, hero worship was a secondary or added system which grew up in a later age The word "hero," in Homer, is simply synonymous with warrior, nor is there any trace (at least in the *Iliad*) of hero-worship It seems to after the composition of that om any honours approaching to divine seem to have been paid were the Athenians slain at Marathon The heroic age, commonly so called in Grecian poetry seems to have ended with the descendants of those who returned from Troy (*Wachsmuth, Hist Antiq of the Greeks, Thirlwall's History of Greece* chap 5 *Carlyle's Hero Worship*)

HERO'DIANS A sect existing among the Jews at the period of our Saviour's preaching (See Matthew, c xvi , Mark c viii v 15 ) Much doubt exists as to their history and tenets some commentators, both ancient and that they were fanatics, who regarded as the Messiah, others that they were a mere political party, attached to the family of Herod, while a third opinion (Bergier, *Dictionnaire de Théologie*) is, that they supported some innovations attempted by Herod in the religious observances of the country by the partial introduction of Pagan usages (See *Milman's History of Christianity*, i 311 )

HERO'IC VERSE, that appropriated to epic or heroic poetry in Greek English, Italian, and with or without rhyme, the iambic

HER'PES (Gr ερπειν, *to creep* ) A cutaneous disease, consisting of clusters of minute vesicles generally containing a brownish or milky lymph in about eight or ten days they scab off, and other crops appear It is not limited to any part of t by more or less fever It is often called the *tetters* Another form of it constitutes the *shingles* These eruptions founded with erysipelas, from which ed by the want of tumefaction and tutional symptoms, and by the between the crops of eruption from some similar eruptions by the vesicular form of the cuticular elevations at their first appearance, by their

HERPETOLOGY (Gr ερπετον *a reptile*, λογος, a

*discourse*) That branch of science which treats of the history of reptiles

HE'RPETON (Gr ἑρπετον, *a reptile*) A genus of serpents, allied to *Eryx*, and characterized by two soft prominences [illegible] the muzzle [illegible] of *Vipera*

HE'RRING (Germ heer, *an army*, in reference to the great numbers in which the fishes so called appear, at stated seasons, along our coasts) The name is commonly applied to two distinct but closely allied species of the genus *Clupea* Linnæus to the one Mr Yarrell restricts the name of *Clupea harengus*, the other is denominated *Clupea Leachii*, in commemoration of the excellent naturalist who first appears to have been aware that our coast produced a second species of herring

The genus *Clupea* is [illegible] allied to the genus *Salmo* that they are both included in the same natural family under the name of *Halecoides* by Mr Agassiz, the principal external difference consists in the absence of the small adipose dorsal fin in the *Clupea* But in the clupeoids, as in the salmon tribe, the upper maxillary as well as the intermaxillary bones enter into the formation of the mouth, and are both armed with teeth, the body is always covered with numerous scales, and, in the greater number of the herring tribe there is an air-bladder, and the duodenum is complicated with many *cæca*, or pyloric appendages

The annual migration of the herring is not, as has been described, from one latitude to another but simply from a deeper to a shallower part of the ocean The common species, impelled by the stimulus of the increasing burthen of milt or row, quits the deeper recesses of the ocean, where it has passed the winter and spring months, and approaches the shallower water near the coasts, where the ova may be deposited and impregnated with the requisite amount of heat, light, and oxygen for their development

The common herring visits different parts of our coast in autumn [illegible] earlier on the southern than on the northern [illegible] and deposits its ova and spawn towards the end of October In this state the fish are termed "shotten herring," and they retire from the shore into deep water

Leach's herring [illegible] sexual migration [illegible] heavy with roe at the end of January, which it does not deposit till the middle of February Its length is not more than seven inches and a half, and its depth near two inches"

During the long period in which the herring stays in deep water, the shoals occasionally travel so far as to appear at the next season of oviposition at a different part of the coast from that where they were previously abundant Hence the herring has been described as a most capricious fish, and it is truly said "that there is scarcely a fishing station round the British islands that has not experienced in the visits of this fish the greatest variations, both as to time and quantity, without any accountable reason

Herrings are taken in drift nets, and during the night The stretching of the nets in the daytime is forbidden, as it is supposed that the practice would alarm and drive away the shoal The darkest nights, and a breeze that ruffles the surface of the water, are the circumstances which most favour the capture of the herring

HERRING, FISHERY OF See FISHERIES

HERRNHUT (Ger Herr *the Lord*, hut, *protection*) An establishment [illegible] Lusatia comprising, it is said at present 120 houses and 1500 inhabitants, which was founded by a few Moravians about the year 1722, under the patronage of Count Zinzendorf The principles of the society thus formed are seclusion from the world, the enjoyment of a contemplative life, and the possession of all goods in common Its members are bound together, under the title of Moravian Brethren, by strict laws and observances Accusations have been thrown out against them of their indulging, in their retirement, in many licentious practices, but it is certain that their industry supplies many of the markets of Germany with various useful and ornamental articles of handiwork that their zeal has prompted them to establish affiliated societies in many parts of Europe and America and that in religious matters they are neither extravagant themselves, nor intolerant of others (See *Mosheim*, vol vi)

HERSE, HERSI'LLON In Fortification, a lattice or portcullis armed with spikes, to block up a gateway, or impede the march of an enemy

HER'THA (sometimes written Aertha, Aortha, and Eorthe) In German Mythology, the name generally assigned in modern times to the chief divinity of the ancient German and Scandinavian nations She was worshipped under a variety of names, of which the chief were exactly analogous to those of Terra, Rhea, Cybele, and Ops, among the Greeks and Romans. Long before the Christian era the knowledge of Hertha appeared to have been extended over a great portion of northern Europe, for in his work, *De Moribus Germanorum*, c 40 in which the reader will find a graphic description of the peculiarities of her worship Tacitus speaks of the wonderful unanimity which tribes that had no other feature in common displayed in worshipping this goddess whom he designates Herthus, or *Mother Earth* Her chief sanctuary was situated, according to the same authority, in a sacred grove in an island of the ocean, *in insula oceani*, which, by some writers, has been supposed to be Riga, and by others Zetland or Heligoland, but no modern researches have been able accurately to fix its locality [illegible] upon this subject is to be found in Grimm's *Deutsche Mythologie*, chap xv

HESPE'RIA (Gr Ἑσπερια, *Evening*, the name of the daughter of Atlas) A genus of butterflies, now the type of a family, including several subgenera, to some of which belong the British species eight or ten in number

HESPE'RIDES In Greek Mythology the daughters of Night or the granddaughters of Hesperus the brother of Atlas three or seven in number possessors of the fabulous garden of golden fruit watched over by an enchanted dragon at the western extremities of the earth Such at least is the most ordinary form of the fable but it is very variously represented, and these varieties are collected by M Massieu in a very complete dissertation on the subject, in vol iii of the *Mémoires de l Ac des Inscrip et Belles Lettres* There are also some observations on the subject in vol xviii p 54 There is a difference among the mythologists whether the treasures of the Hesperides were in reality *fruit* or *sheep*, the word μῆλα signifying either (*Diod Sic* lib v), but the former is the received form of the story among the poets (*Ovid, Metam* 4, *Virg Ecl* 6, *Apollon Rhod*, and in the well-known lines of Milton,

[illegible]

and, the oldest of all, Hesiod,

——αἰς μυλα πεφνη κλυτου Ωκεανοιο,
χρυσια καλα μηλουσι, φερουσα τε δενδρεα καρπον.

Some have explained [illegible] groves of orange and lemon trees [illegible] in the western parts of Africa

HESPE'RIDIUM In Botany, a many-celled, few-seeded superior, indehiscent fruit, covered by a spongy separable rind, the cells easily separable from each other, and containing a mass of pulp, in which the seeds are embedded — example, the orange

HE'SYCHASTS (Gr ἡσυχασται from ἡσυχια, *quiet*, *Quietists*) In Eccl History, a singular class of fanatics, who were established in the 15th century in some of the Greek monasteries of Mount Athos They pretended to have attained a perfect interior life of devotional repose by intense contemplation One of their maxims, apparently derived from some of the strange practices of the Indian ascetics, directs the disciple to "raise his spirit above all vain and transient things repose his head on his breast, and turn his eyes with his whole power of meditation upon his navel" Hence these visionaries derived the nickname of Ομφαλοψυχοι, or Umbilicarii they were also termed Thaborites from their notion respecting a divine light inhabiting the heart of the devotee (*Waddington's Hist of the Church*, chap xxvi)

HETAIRIA (From the Greek ἑταιρεια, derived from ἑταιρος *a companion*) This word is frequently used by classical writers to signify an association of any description thus the fraternities of the early Christians are called Hetæriæ In modern times two celebrated associations among [illegible] The first was [illegible], or friends of the Muses, a society formed for the purposes of education, founded (it is said) by Capodistrias, about 1814 it established schools at Athens and Miliæ in Thessaly, and numbered at one time 80,000 associates It was dissolved in 1821, but renewed in 1824, when Athens was in the hands of the Greeks The more celebrated political Hetæria owes its foundation [illegible] died in 1798 It was renewed [illegible] ramifications through all Greece, and produced the Greek [illegible] in 1821

HETEROCLITOUS (Gr ἑτερος, *various*, and κλισις [illegible] some flower he [illegible] the same individual

HETEROCHROMOUS (Gr ἑτερος, and χρωμα, *colour*) When in a flower-head the florets of the centre or disk are different in colour from those of the circumference or ray

HE'TERODOX (Gr ἑτερος, and δοξα, *opinion*), signifying a person who holds opinions different from some standard with which they are compared, is opposed in theological language to *orthodox*, one who holds the right opinion The standard of orthodoxy by which all heterodox opinions must be tried, resides, humanly speaking, in the judgment of each particular sect of believers It is, however, generally allowed to represent the highest [illegible] of the creeds which were received in the ancient church, and in England is conceded by

general consent to what is called the High Church party The use of these terms is said to have come into fashion in England in the beginning of the last century, when there arose a party within the church who, from the laxity with which they interpreted its formularies, and the assumed liberality of the views they took of its nature and authority, were styled Latitudinarians The High Church or Orthodox party, on the other hand, were those who [illegible] heretical, to which they would probably have been subje[illegible]

HETEROGAMOUS (Gr ἑτερος and γαμος, *marriage*) In Grasses, when the arrangement of the sexes is different in different spikelets from the same root, as in *Andropogon* in Composite plants, where the florets are o[illegible]

HETEROGENEOUS ARRANGEMENT *See* AFFINITY, CHEMICAL

HETEROGENEOUS QUANTITIES, in Mathematics, are such as are incapable of being compared together in respect of magnitude, as lines and surfaces, surfices and solids, &c

HETEROGYNA (Gr ἑτερος, and γυνη *a female*) A tribe of Aculeate Hymenoptera, in which the females are of different kinds, one fertile, the other infertile, called neuters, as the ants, *Formicida* and *Mutillidæ* See those words

HETEROMERANS *Heteromera* (Gr ἑτερος, and μερος *a part*) Insects that have the legs have a different structure from one another The Coleopterous insects are so called which have five joints in the tarsus of the first and second pairs of legs, and only four joints in the tarsus of the third pair Latreille divides this somewhat artificial section into four groups

1 *Melasomes*, having the wing-covers hard, wings ge[illegible] claws simple, and maxillæ with a hook - Ex *Blapsidæ Tenebrionidæ*

2 *Taxicornes*, having the wing covers hard, wings present, antennæ perfoliate or clavate, claws simple, maxillæ without a hook —Ex *Diaperidæ Cossyphidæ*

3 *Stenelytres*, having the wing covers hard and contracted posteriorly, wings present antenna simple, claws simple or toothed —Ex *Helopida Cistelida* &c

4 *Trachelides*, having the wing-covers flexible, wings present, head inserted upon a neck, claws bifid — Ex *Meloe, Mordella Horia Tagria*, &c

HETEROPODS, *Heteropoda* (Gr ἑτερος and πους, *foot*) The name of an order of Gastropods, comprehending those which have the foot compressed and in the form of a thin vertical fin, as in the *Carinaria*

HETEROPTERANS, *Heteroptera* (Gr ἑτερος, and πτερον, *a wing*) The name of a section of Hemipterans comprehending those in which the hemelytra terminate abruptly by [illegible]

HETEROSCIANS [illegible] (Gr ἑτερος, *another*, and σκια, *shadow*) An epithet applied by the ancient geographers to the inhabitants of the two temperate zones because their shadows at mid day are always projected in the same direction in respect of themselves, but in opposite directions in respect of each other, in one case to the north and in the other to the south

HETEROTROPAL (Gr ἑτερος, and τρεπω *I turn*) A term applied to the embryo of a seed when the former lies across the latter, that is to say, neither pointing to its base nor apex

HEXACHORD (Gr ἑξ, and χορδη) In Music, a progression of six notes, to which Guido attached the syllables *ut, re, mi, fa, sol la* The hexachord is also called a sixth, and is twofold, greater and less The former is composed of two greater, two less tones, and one greater semitone, making five intervals, the latter of two greater tones one lesser and two greater semitones

HEXAHEDRON, or CUBE (Gr ἑξ six and εδρα *a seat*) One of the five regular or Platonic solids so called from its having *six* faces The whole surface of a hexaedron is equal to 24 times the square of the radius of the inscribed sphere, and to 8 times the square of the radius of the circumscribed sphere Its solid content is 8 times the cube of the inscribed sphere The other four regular solids are the tetraedron or pyramid, the octaedron, the dodecaedron, and the icosaedron

HEXAGON (Gr ἑξ, and γωνια, *angle*) In Geometry a plane figure bounded by six straight lines When [illegible] the hexagon [illegible] the area is equal to the square of the side multiplied into the constant number 2 598076, that is, into three times half the tangent of 60°.

HEXAMETER [illegible] The most important species [illegible] and Romans It consisted of six feet either dactyls or spondees, which might be used indifferently in any part of the verse, with two important exceptions that the last foot must invariably be a spondee, and the last but one a dactyl In some instances a spondee is introduced into the fifth foot, or last but one, a licence [illegible] gives an agreeable variety [illegible] verse, which is thence termed *spondaic* (See CÆSURA) Hexameter verse was employed on almost every topic to which poetry can be applied In modern times several poets of France England and Germany have [illegible] measure into the language of [illegible] The few specimens we have seen of it in French appeared to us wholly unsuccessful The little countenance given to the attempts made by Dr Southey and others, to introduce it among ourselves is conclusive, we think, against its ever being generally adopted in England, but, on the other hand, it has been cultivated in Germany with great success, as the *Hermann and Dorothea* of Goethe, and many other examples that might be cited, abundantly prove How admirably the spirit of this measure had been caught by the learned Voss, and transfused into his translation of the great Virgilian and Homeric poems, is known to every scholar [illegible] poe[illegible] *Kuchlein*, by Eberhard The qualities and effect of the hexameter have been well described by Schiller in the following distich of which we subjoin an excellent translation by Coleridge who by the way we may state, was long supposed to be the original author —

Schwindelnd trägt er dich fort auf rastlos strömenden Wogen,
Hinter dir siehst du, du siehst vor dir nur Himmel und Meer

Stro[illegible] bear[illegible]
Nothing before [illegible]

(See *Quart Rev* vol xlii, and *Edin Rev* vol xxxv)

HEXANDROUS (Gr ἑξ, and ανηρ, *a male*) Any flower having six stamens

HEXAPLA (Gr ἑξ, and ἁπλοω, *I explain*) The combination of six versions of the Old Testament by Origen is so called viz, the Septuagint, Aquila, Theodotion Symmachus one found at Jericho, and another at [illegible] See BIBLICAL HISTORY &c

HEXAPODS, *Hexapoda* (Gr ἑξ, and πους *a foot*) A name applied by Mr Kirby to a sub-order of Apterous insects including those which have not more than six legs

HEXASTYLE (Gr ἑξ, and στυλος *a column*) In Architecture, that species of temple or other building having six columns in front

HIATUS (Lat *yawning, gaping*) A word which has passed into several modern languages In Diplomatics and Bibliography, it signifies a deficiency in the text of an author, as from a passage erased, worn out, &c In Grammar [illegible] of a final [illegible] of another [illegible] apostrophe [illegible], Greek and Latin poetry admissible in certain excepted cases, as where, in Greek, a final long vowel is succeeded by an initial short vowel, and becomes sometimes short by position, or in Latin, where the *cæsura* (*see* CÆSURA) gave an additional force to the first vowel, as in the celebrated line,

"Ter sunt conati imponere Pelio Ossam,"

which affords an instance of both, the first hiatus being occasioned by the cæsura, the second, an imitation of the Greek prosody In French the hiatus is carefully avoided in English less so although by the more accurate poets still regarded as a blemish, except in some instances where a long vowel is followed by a short one The worst species of hiatus is where the same vowel sound is repeated

HIBISCUS (for Hybriscus, Gr υβρις, *haughtiness*) A genus of very handsome plants, belonging to the Malvaceous order, with unusually large and showy flowers. They are numerous in the tropics, where they generally form fine trees, but some of the species are only annual Of the latter *H trionum* is a commonly cultivated plant, known in the seed shops under the name of *bladder kalmia* Very few of the species are of any interest *H Syriacus* is the *Althæa frutex* of shrubberies, *H abelmoschus* yields the musk-seed of pharmacy, and *H esculentus*, the *Gobbo* or *Ochro* of the [illegible] plant, is remarkable for the property possessed by its [illegible]

HIDALGO A Spanish nobleman of the lower class, [illegible] in Portuguese, [illegible] St Vincent from [illegible] The title is now obsolete

HIDE (Germ *haut*) This term is limited in commerce to the strong and thick skin of the horse, ox, and other large animals

HIDE BOUND In Farriery applied to a certain disease of cows and horses in which the skin adheres to their sides

HIDE OF LAND *See* HYDE

HIERA PICRA (Gr ιερος *sacred*, and πικρος *bitter*) A compound of aloes and cinnamon bark made into a powder with honey

HIERARCHY (Gr ἱερὸς and ἀρχω *I rule*), is a general term comprehending the various ranks and orders of the sacred ministry whether of angels according to an ancient opinion, or of the pastors of the church of God upon earth

HIEROGLYPHICS (Gr ἱερὸς, *sacred*, and γλύφω, *I engrave*) Sculpture-writing or picture-writing, *i e* the expression of a series of ideas by representations of visible objects The name is more peculiarly applied to a species of writing in use among the ancient Egyptians According to the system of Champollion the hieroglyphical writing of the Egyptians consists of three different species of characters —1 The hieroglyphic, properly so called, in which the representation of the object conveys the idea of the object itself either entire, or in an abridged form Many words were thus expressed, chiefly those denoting common visible objects These are termed by Champollion figurative [illegible] *figurative characters* [illegible] *figurative characters* 2 The second class of hieroglyphic characters consists of those which represent ideas by images of visible objects, used as symbols, and these are generally employed in the expression of abstract ideas or complex modes as a *tumult*, represented by a man throwing arrows, *adoration*, by a censer containing incense &c In some of these the connection between the type and antitype is obvious, in others, it depends on associations which are not understood by us, and consequently cannot be traced These characters are what the Greeks more peculiarly termed [illegible] d by Champollion *symbolical* 3 *phonetic characters*, in which the sign represents not an object but a sound This according to Champollion, was effected by the following device The figure representing a letter was the likeness of some animal or other object of which the name began with that letter Thus Champollion has constructed an alphabet of initials in which the letter A is represented by an eagle the initial letter of the Egyptian word [illegible] (Ahorn) being A, and so forth Twenty four elementary sounds were thus represented But the writer was not confined to the use of one representative of a letter only At first sight it would appear that all objects the initial of whose name was a particular letter might be used to express that letter, but custom seems to have applied only a certain number of objects to this use some letters have eighteen or nineteen known representatives others six or seven In selecting out of these the writer seems to have been guided by [illegible] of what was suitable in reference to the word which he was writing, as, for example the S in the word Si, *son*, is commonly represented by the figure of a goose, on account according to Horus Apollo, of the supposed attachment of that bird for its young The honour of the recent progress made in the explanation of hieroglyphical writing is divided between the English orientalist Dr Young and the Frenchman Champollion, but the latter appears to have had no small share in the original discoveries [illegible] s to have carried the science to a high degree of cultivation Besides the hieroglyphic character, the Egyptians used the *hieratic* and *demotic*, which were, both of them conversions of the hieroglyphic into a kind of current hand the latter nearly alphabetical The most civilized people of America, the Mexicans, at the time of the Spanish conquest had advanced as far as the discovery of hieroglyphical or picture writing, although they did not possess a written alphabet The Chinese writing was, originally, wholly ideographic, *i e* expressing ideas by symbols (answering to the second class of Egyptian hieroglyphics with some admixture of the first) But in process of time the greater part of the characters have become simply phonetic (See Dr Young's "Egypt" in the *Enc Brit* and his "Account of Recent Discoveries,' 1823, the works of Champollion, Jablonski, *Panthcon Aegyptiacum*, *Quart Review*, vols xliii liii, *Edinb Rev*, vol xlv, *Salt's Essays*, Seyffarth, *Rudimenta Hieroglyphices*, 1825)

HIEROGRAMMATISTS (Literally *sacred writers*) The name given to certain Egyptian priests whose duty it was to decipher hieroglyphics and preside over th [illegible]

HIEROMNEMON (Gr ἱερομνήμων, *an observer of sacrifices*) In Ancient History, the title of one of the two de [illegible] [illegible] [illegible]

[illegible] by the legislature under the jurisdiction [illegible], such highways are popularly called "turnpike roads" If sufficient materials for the repair of roads cannot be found on the waste lands of a parish, the surveyors have authority to take them from the lands [illegible] the person [illegible] such land is at least a garden and not to [illegible] park, paddock, or inclosed plantation [illegible] dred acres [illegible] The amount of damage done to the materials taken away and the damage done, to be ascertained by the justices at special sessions Any expenses incurred by the above proceedings may be reimbursed to the surveyors by an assessment made upon the occupiers in the parish, under the authority of two justices

The [illegible] have recently been [illegible], Will 4 c 50 By previous acts of parliament, and by the common law, the county at large were bound to repair a public bridge, and also the highways at the end of such bridge to the extent of 300 feet The recent act provides that in future when any bridge shall be built which the county shall be liable to repair, "all highways leading to, passing over, and next adjoining to such bridge, shall be from time to time repaired by the parish person, or body politic or corporate, or trustees of a turnpike road, who were by law before the erection of the bridge bound to repair the highway" A most important alteration has been effected by the same act with respect to the creation of highways by dedication Formerly, as a piece of land had been traversed as a way by the [illegible] a few years without interruption, a highway was at once established, and the liability to repair it was cast upon the parish, but by this act no road is to be deemed a highway which the inhabitants of a parish shall be compellable to repair, unless the person proposing to dedicate it to the use of the public shall give three months notice to the surveyor of the parish of his intention to dedicate such highway, and the inhabitants of the parish, in vestry assembled, shall deem it of sufficient utility to them to justify its being kept in repair at the expense of the parish If the vestry shall not deem it of such utility, a magistrate, on the sur[illegible] is to summon the party pro[illegible] [illegible] before the [illegible] to its utility is to be [illegible]

HIMA'NTOPUS (Gr *ιμας a thong* and *τους a foot* the term Himantopodes is given by Pliny to certain birds remarkable for the slenderness of their legs) The name is now restricted to a genus of *Grallæ* or wading-birds, in which the legs are proportionally longer and more attenuated than in any other species the bill is long and slender, depressed at the base, and compressed toward the tip with the nasal groove extending half the length of the bill This genus includes the British species called the [illegible] *Himantopus melanopterus* [illegible] and a rare bird

HIPPIDÆ The name under which Latreille and Fichwald designate a family of the tribe of Macrourous Decapod Crustaceans, typified by the genus *Hippa*

HIPPOBO'SCA (Gr *ιππος, a horse*, and *βοσκω I feed*) A genus of Dipterous insects belonging to the Viviparous section of the order in which the young are not only excluded from the ovum but undergo their first metamorphosis in the womb of the parent, and are brought forth in the pupa state (*Pupipara*, Latr, *Homaloptera*, Leach) The genus is now the type of a numerous family (*Hippoboscidæ*) generally known by the name of "forest flies," and divided by recent entomologists into numerous subgenera The horse fly (*Hippobosca equina*) is the type of the family

HIPPOCRATIACEÆ (Hippocratea one of the genera) This is a small natural order of plants, distinguished from *Celastraceæ* by little except the flowers being triandrous, and the filaments broad at the base There are no species of any general interest included in the order

HIPPOCRE'NE (Gr *ιππος*, and *κρηνη, a fountain*) A celebrated fountain at the foot of Mount Helicon, supposed to have been produced by the horse Pegasus having struck his foot against the mountain It was regarded in antiquity with peculiar veneration, as it was believed to be a favourite haunt of the Muses and was consequently looked upon as one of the chief sources whence [illegible] *See* MUSES, PEGASUS

HIPPODROMI [illegible], and *δρομος, a course*) In Ancient Architecture, a place [illegible] by the Greeks to equestrian exercises, and [illegible] prizes were contended for The most celebrated in antiquity of these was at Olympia, which was four leagues long and [illegible] The term is still in use

HIPPOPOTAMUS (Gr *ιππος*, and *ποταμος, a river*) A genus of aquatic Pachyderms, represented at the present time by a single species (*Hippopotamus amphibius*, L) which inhabits the rivers of Africa The [illegible] there are four toes on all the feet, inclosed in [illegible], six molar teeth on each side of both jaws, very large and strong canines, of which the upper ones are nearly straight, the lower ones curved, and working upon each other so as to produce a chisel-edge, four incisors in each jaw, the [illegible] short and conical and bent inwards towards the mouth the under ones long, cylindrical, and pointing forwards The hippopotamus lives during the daytime immerged in the waters of its native rivers, rising to the surface and [illegible] its nostrils for the purpose of breathing It comes to the land to feed during the night Remains of species of hippopotamus are found in the tertiary formations of Europe, one of which [illegible] the size of a hog In the tertiary beds at [illegible] in Hindostan an extinct species of hippopotamus has been discovered which had six incisor teeth in each jaw

HIPPOPUS (Gr *ιππος, a horse*, and *πους, a foot*) The name of a genus of Acephalous Mollusks [illegible] of the resemblance which their shell bears to the foot of a horse The valves of this shell are equal, regular, but inequilateral and transverse, the hinge has two compressed unequal teeth, the ligament is marginal and external The *Hippopi* belong to the family *Iridinidæ* of the Lamarckian system, but are distinguished from the genus *Iridacna*, by having the posterior slope and lunule closed, or nearly so, and the inner margin dentated at that part The spines which arm the ribs are tubular, and are never arched or valvulted The type of the genus is the *Hippopus maculatus*, or spotted hippopus, the *Æstrea hippopus* of Linnæus

HIPPURIC ACID (Gr [illegible]) A peculiar compound deposited [illegible] when it is mixed with muriatic acid It closely resembles and is sometimes substituted for *benzoic acid*, but it contains nitrogen, and its salts are distinct from the benzoates

HIPPURITES A genus of extinct Mollusks supposed to be bivalves, and referred to the extensive group called *Rudistes* by Lamarck The principal valve of the present genus is of a sub-cylindrical or elongated conical form, traversed by one or more internal longitudinal ridges, and closed by a small sub-circular discoid valve like an operculum

The *Hippurites* are characteristic of the rocks of the [illegible] in France, Spain, Greece, and other countries bordering the Mediterranean

HIPS (Sax *hype*) In Architecture, the inclined diagonal edges of a roof where the sides intersect, hence a hipped roof is one in which two sides at least must intersect

HI'RCINE (Lat hircus *a he goat*) A term applied by Chevreul to a [illegible] matter which may be separated from mutton suet, and gives it a peculiar rank smell resembling that emitted by the male goat at the period of the rut When saponified, it produces *hircic acid*

HIRING AND SERVICE, in Law, constitute the relation between master and servant The general rule with respect to hiring and service is, that if there be no special agreement but a general one without mention of time, the hiring is for a year certain, if the servant continue in his employment beyond that year, a second year is implied, &c Consequently, if a master dismiss a servant hired generally, the servant is entitled to wages for the current year, unless the dismissal be for such a cause as will legally absolve the master from his contract *ex g* moral misconduct, or refusal to obey orders But in the [illegible] of the contract is by general custom, or [illegible] by a month's warning on either part, or payment of a month's wages

HI'RSUTE (Lat hirsutus, *bristly*) In Zoology, when an animal or part is covered with long stiffish hairs thickly set

HIRUDINIDÆ *See* LEECH

HIRU'NDO (Lat hirundo, *a swallow*) A genus which forms the type of the Fissirostral or wide gaping Passerine bird of the Cuvierian system It is now divided into the subgenera *Cypselus* including the swift and *Hirundo* proper containing the chimney swallow (*Hirundo rustica*), sand martin (*Hirundo riparia*), &c Our British species are occasional visitors, and the heralds, generally speaking of the summer season, though we see now and then a premature straggler, which has given rise to the proverb "one swallow does not make a summer" Africa appears to be the chief [illegible] the winter season [illegible] it is true, been accredited [illegible] the swallows passed the winter in a torpid state, submerged in river-heads or other fresh waters No warm-blooded and quick-breathing animal does or can hybernate under water, and with respect to a bird, it is sufficient to observe that its extra-vascular plumage would be destroyed and decomposed by [illegible] Swallows, like [illegible], migrate [illegible] with the purpose of breeding

HI'SPID [illegible] In Botany a term used in describing [illegible] to denote their being covered with long rigid hairs, as the stem of *Echium vulgare*

HI'STRID In Zoology, when a surface is rough from [illegible] rigid bristles

[illegible] a small group of Coleopterous insects now raised to a family (*Histeridæ*, belonging to the section *Pentamera* and the subsection *Clavicornes* of Latreille Many of the species of this family are remarkable for the instinctive promptitude and perfection with which they alter their ordinary appearance when alarmed by drawing in their antennæ and folding up their legs so as to feign death, and in many cases to take on the resemblance of a small black pebble or seed, whence one of the species is called *Semimulum* It is this habit which probably suggested the generic name, from *histrio*, an actor There are about fifty known British species referable to the Linnæan genus, and now divided into the subgenera *Abræus Orthophilus, Dendrophilus, Platysoma*, and *Hister* proper

HISTO'RICAL PAINTING In Painting, that department of the art which comprehends all representations whereof history furnishes the subject But in modern times head are generally included subjects from fabulous his- [illegible]

[illegible] A professed historian, or writer of histories It has been a common, although not uniform practice in European courts, to confer the place of public historiographer on some learned man as a mark of royal favour Voltaire had at one period the title of Royal Historiographer of France

HI'STORY (Gr *ἱστορία*, from the verb *ἱστορέω*, *I enquire*) This word is first used in the commencement of the work of Herodotus, which he there calls by the title Historia It is probable that this ancient writer thus fixed the sense in which the word has ever since been used — as applicable strictly and properly to the civil history of man although it has been indiscriminately used to express other branches of investigation as the term Natural History, still in use, an application sanctioned by classical usage, in the instances of *Theophrastus's History of Plants*, *Aristotle's History of Animals* &c

Civil history, properly so called has also been subdivided into several branches first according to the class of events or actions which is made the subject of narration, as ecclesiastical, political, and literary secondly according to the extent of the subject, as universal history, in contradistinction to the history of particular nations or districts, or of individual men, more properly termed biography

Our most ancient civil history is to be found in the Old Testament But its objects are confined after the brief and introductory narration of the first ages of the world to the annals of a separate and peculiar people the Jews and such incidental notices of the affairs of other nations (Assyrians Phœnicians, Egyptians, &c) as the inspired writers found necessary for the illustration of their main topic But the great empires and kingdoms which surrounded the little commonwealth of the Hebrews were also connected, by various circumstances of religion and descent, with the first of the two nations (Greek and Roman) whose annals constitute what is termed classical history, with which again our own history, or that of modern Europe, is in intimate association Hence, in a general view of civil history, the whole subject may perhaps not be unappropriately classed under five heads, indicating as it were, five different bodies of history, which in the main are distinct from each other in the subject and partly in the sources from whence our knowledge is derived, although mutually throwing much light on each other

I The Jewish history, as contained in the Old Testament

II The history of the empires and states of antiquity in that portion of the world known to the classical and Jewish historians and illustrated by classical and Jewish history, viz Assyria, Persia Egypt Phœnicia, and its colony Carthage

III Classical history properly so called, the history of the national affairs and conquests of the Greeks and Romans

IV The history of those nations and states (chiefly oriental) which possess annals of their own independent of classical Jewish and modern European literature [illegible] India, modern Persia, Arabia, and the Mohammedan conquests

V Modern European history, including that of the colonies and conquests of Europeans

1 The Jewish history, as we have said, is to be found in the Old Testament, some Apocryphal books, and in the writings of uninspired Jewish authors (Josephus and Philo-Judæus) who have investigated the antiquities of their country

2 Of Assyria, Egypt, Phœnicia, ancient Persia, Carthage, &c, we possess no historical notice except such as is derived, 1 From Jewish or classical authors 2 From monuments, especially in Egypt Phœnician historical authors of repute (Sanchoniatho, Berosus, &c) are alluded to by classical writers, and perhaps in part abridged by them, but we have no actual remains of their compositions on the authenticity of which reliance can be placed With respect to Persia, much industry has been expended in endeavouring [illegible] histories of modern native writers [illegible] narrations of Greek and Roman authors, but hitherto with little success

3 The poems of Homer and Hesiod are reputed as containing the oldest fragments of Greek [illegible] Herodotus is the oldest Greek prose writer His invaluable history comprises a description of several countries bordering on the Mediterranean, concise narrations of Persian and Assyrian history, and a connected account, more or less detailed, according to circumstances, of the history of Greece, both civil and domestic, for about fifty years previous to the invasion of Xerxes, with which his annals close (B C about 480) The history of the Grecian commonwealth is pursued in detail by Thucydides and Xenophon for about a century afterwards After this period our knowledge of Greek domestic history is confined to the incidental notices derived from various cotemporary writers, and the general compilations of later historians Among these may be mentioned, as authors from whom a large portion of our actual knowledge is derived, Diodorus Siculus, the author of a very miscellaneous general history, of which great part is lost, who lived about the age of Augustus, Polybius whose history is more especially devoted to Roman affairs, Arrian and Quintus Curtius, the historians of the conquests of Alexander, Livy, as to the transactions between Greece and Rome, Justin, the compiler of a brief but useful abridgment of general history, Plutarch, in his Lives of Illustrious Men, &c These writers bring the student down to the period of the subjugation of Greece by Rome, after which all history of Greek affairs, properly so called, terminates, until the establishment of the Eastern empire, and we have little knowledge of the state of Greece and the Græco-Asiatic kingdoms in their provincial state

Ancient Roman history, down to the first Punic War, is chiefly known from the compilations of Livy and Dionysius of Halicarnassus, writers whose credit is rendered extremely doubtful by modern investigation, and, where these fail, from incidental sources In the History of the Punic Wars the narrative of Livy is aided by the admirable work of Polybius From the end of the second Punic War to the dictatorship of Sylla (nearly 150 years), our materials for Roman history are very deficient, the want of cotemporary writers being supplied only by later compilations, and by the incidental knowledge derived from writers on various subjects, the course of whose composition led them to touch on past events — of whom by far the most valuable is Cicero From the period of Sylla's dictatorship to the accession of Vespasian (nearly 150 years), we have the advantage of a succession of cotemporary writers, some of them actors in the events which they describe, and [illegible] of the greatest names in literature — Sallust, Cæsar, Velleius Paterculus, Tacitus Yet even here there is one considerable *lacuna*, comprising the last thirty years of the reign of Augustus, as to which our knowledge is scanty From the accession of Vespasian to the reign of Constantine a long period elapses during which our historical acquaintance with the events of an empire then comprising [illegible] part of the civilized world is vague and defective Dion Cassius and Herodian are the two best writers on history who can be named in this long interval, the latter during the short epoch which he illustrates as to [illegible] parts, is full and valuable After the accession of Constantine, we have abundant materials for history, both ecclesiastical and civil, from the hand of cotemporary authors, down to the reign of Justinian in the East and of Theodoric in the West, although the quality of the writers is sensibly degenerated Perhaps the comparative obscurity and uncertainty into which history is plunged after the last of these two epochs, and the absence of all standard writers after Procopius, render it the best period to fix upon for the arbitrary limit between ancient and modern history It will be seen from this brief summary that the only periods of any extent as to which we have the assistance of cotemporary historians (or original authority, properly so called), in the whole extent of classical history, are, — 1 As to Greece, from B C 500 to B C 380, 2 As to Rome from the dictatorship of Sylla to the accession of Vespasian (B C 76 to A D 70), and, finally, the reigns of Constantine and his successors

4 After the downfal of the Roman [illegible] series of revolutions in dynasties and [illegible] before Western Europe was parcelled out into the several great countries [illegible] all subsequent changes in [illegible] subsisted as geographical [illegible] Britain, France, Spain, Germany, Italy, the Scandinavian regions Another period elapsed before the three great countries of Eastern Europe — Russia, Poland, Hungary — were added as distinct members to the family of European states, and the Greek empire in Europe remained apart, distinct in language,

manners, and political history, from both the other divisions.

From the fall of the Roman empire to the revival of literature (a period comprising in round numbers about eleven centuries) our knowledge of the affairs of Western Europe is derived from a series of writers, in each country, who are usually comprehended under the title of chroniclers A chronicle, or book of annals, is properly a history of which the continuous narrative is so interrupted that each year forms a separate section, and events are thus related nearly in strict chronological order This is a form very commonly adopted by the historians of the dark ages, of whom the greater proportion were monks, who appear to have noted down the acts which occurred within their own sphere of knowledge or memory, derived from the accounts of older men, merely to satisfy the vague desire of communicating knowledge to posterity within the limited circle of the monastery or society to which they belonged But a great many of the histories of the middle ages are not even in the form of chronicles, they have all the requisites which the most fastidious criticism can require of a regular history Unity of purpose, and a sustained and energetic style, are qualities in which some of the early national annalists of modern Europe have been unsurpassed by their more instructed successors

The Venerable Bede, who [illegible] sents us with the first name among the annalists of England Of our monkish Latin chroniclers in later times, Matthew Paris is perhaps best entitled to the character of an historian After the period of the invaluable Saxon chronicle, we have no English histories in the native language of the country worthy of note with the exception of a few meagre rhyming chronicles, until the revival of letters and discovery of printing In France, the long collection of native Latin chroniclers presents us with few names of interest after the time of the celebrated Gregory of Tours, but the Crusades called forth for a short space an unusual spirit of historical description When we arrive, however at the 14th and 15th centuries, we find among the native French historians two authors, Froissart and Philip de Commes, whose narratives are no less delightful from the talent and energy of the writers than from the romantic character of the times which they pourtray The annals of Italy are to be sought in the pages of a long series of chroniclers, from the 8th century downwards, of whom the most valuable are published [illegible] in Muratori's great collection Their works are mainly in Latin until the 13th century But towards the end of that age the Tuscan dialect was [illegible] step to the rank of a literary language, and the Italian republics produced a succession of historians, many of them remarkable for the purity of their style, and some (as the three Villani at Florence) for their extensive information and historical talent Germany and Spain, in the middle ages, produced few historical works above the rank of dry chronicles But the annals of the Scandinavian nations form the most important part of their early and peculiar literature The Greek empire produced, also, a series of chroniclers, whose works have been collected in the *Corpus Historiæ Byzantinæ*

The period of the revival of letters, and the following century, were distinguished by the appearance of several writers of first rate merit in the department of history In Italy, Guicciardini, in France, De Thou, in Spain, Herrera, and our own Camden may be added not without justice to the number To follow the progress of history in modern times would be an impossible task Suffice it to say, that with the advance of literary knowledge and the increase of education, historical writers seem to become more strongly divided into two very different classes those who furnish contributions towards the history of their own times, especially the writers of memoirs, — a delightful and useful branch of literature, of which France gave the first examples, and still produces the most numerous, and the historians, more properly so called, who collect, discuss and criticize, endeavouring to extricate the truth from the mass of former materials The latter, in our times, has become more peculiarly the province of literary men Philosophical history, in which the mere narrative of facts is regarded as subordinate to the elucidation of general [illegible] is commonly regarded, not without some truth, as the founder of the school of philosophical historians, among whom the highest rank in popularity has been attained and deserved by Gibbon

5 The history of the more remote oriental nations, and also of those which derive their religion and civiliza- [illegible] sources, and requires, as it were, a peculiar education Chinese and Indian history form two entirely distinct bodies of knowledge. With regard to that of the Mohammedan nations, it may be observed that it is brought into contact with that of modern Europe in several distinct countries and periods, of which the most remarkable instances are the Crusades, the annals of the Moors in Spain, and the history of the Turkish empire in its transactions first with the Greeks, and afterwards with the other nations of Christendom It is a curious subject for the philosophical historian, and one which has not hitherto received the attention it merits, to compare the different accounts of the same events which have been transmitted to posterity by writers of distinct nations, religions, and languages, whose minds, from difference of education, habitually viewed almost every object in a totally different light

HISTRIO'NIC ART The art of acting in dramatic representations is not unfrequently so called, from the Lat histrio, or hister, *an actor* (*See* THEATRE) The word histrio is of Etruscan derivation, as was the Roman dramatic art also See *Mem de l'Ac des Inscr* vol xxvii

HITCH In Naval affairs, a particular kind of knot, of which there are several

HITHE An old Saxon word, signifying a port, wharf, or minor harbour at which goods are shipped or landed Queenhithe on the Thames is an example

HOA'RY, in describing the superficial appendages of bodies, denotes their being covered with very short dense hairs, placed so closely as to give an appearance of whiteness to the surface upon which they grow

HO'BILERS (Lat hobelarii), in England, were feudal tenants bound to serve as light horsemen, or bowmen, for the word seems to have been of somewhat uncertain employment The smaller feudal gentry were long styled in France "Hobereaux"

HOE In Agriculture and Gardening, an instrument for stirring the surface of the soil, cutting annual weeds up by the roots, and earthing up plants The hand hoe is a thin plate of iron six or eight inches broad, and sharpened on the edge, fixed at right angles on the extremity of a pole or rod, which serves as a handle This is called a draw hoe, because in the operation of hoeing the instrument is drawn or pulled towards the operator Another description of garden hoe has the blade or iron plate fixed on the extremity of the handle, and in continuation of it and this is called a thrust hoe, because in hoeing the operator always pushes the hoe forward This kind is also called a Dutch hoe, most probably from having been first introduced from Holland In agriculture there are hoes of the thrust kind drawn by beasts of labour, and commonly called horse hoes In general form they resemble a plough, but instead of the share they have one or more iron blades, or plates with sharp edges, fixed to perpendicular iron rods at their lower extremities These sharpened plates being drawn through the soil, cut through the roots of weeds an inch or two beneath the surface Agricultural or field hoes are only used in the case of those field crops which are sown or planted in rows There are a great many kinds of field or horse hoes, but it is worthy of remark that they differ very little in mechanical merit The implement, indeed, does not seem susceptible of the same degree of improvement as the plough and the harrow

HOEING The operation of stirring the surface, cut- [illegible] otherwise the result will either be useless or injurious Plants rooted up by the hoe in wet weather will produce fresh roots and grow again while plants earthed up under similar circumstances will have the leaves which are covered by the soil decayed by it In either case also, the ground will be hardened by the treading of the feet of men or horses, so as to obstruct the progress of the roots, and to exclude air and water from penetrating through it to them Hoeing is sometimes performed on surfaces which are without weeds, for the purpose of stirring the soil, but [illegible] are more effective than hoes with broad plates or blades

HO'GSHEAD An ancient measure of capacity, containing 63 old wine gallons

HOLD (Sax healdan) The inside of the bottom of the ship It is divided into compartments by bulkheads across, and contains the ballast, water, coals and wood, provisions, and cargo

HOLD In Music the same as PAUSE, which see

HOLIDAYS, are considered to be those days, exclusive of Sundays, on which no regular public business is transacted at public offices They are either fixed or variable, and vary in different public offices The variable holidays [illegible] Good Friday, Easter Monday and Tuesday [illegible] Whit Monday and Tuesday See EASTER

HO'LINESS The title by which the Pope is addressed equivalent to the Latin "Sanctissime"

HO'LING (From hole) In Architecture, piercing the [illegible]

HOLM Sax and Dan holm, an island, or fenny place surrounded by water Two well known islands in the

Bristol Channel are called the Steep Holm, and Flat Holm

HOLM OAK or HOLLY OAK *See* QUERCUS

HO'LOCAUST (Gr ὅλος, *the whole*, and καυστὸν, *I burn*) A solemn sacrifice among the Jews in which the whole of the victim was consumed upon the altar in contradistinction to the usual custom which enjoined that only a portion thereof should be consumed A similar custom prevailed among the Jews, it is called in Scripture a *burnt offering*

HO'LOGRAPH (Gr ὁλόγραφον, from ὅλος, *whole*, and γράφω, *I write*) In the Civil Law, a will written entirely by the testator

HOLOTHU'RIANS (Gr [illegible] *a water-serpent*) The [illegible] form, is defended by a coriaceous not spiny integument, open at both ends, and perforated by numerous small canals, in linear series through which prehensile and adhesive suckers are protruded At the anterior extremity is the mouth, surrounded with complicated retractile tentacula At the opposite end is the aperture of the cloaca, in which the rectum and a respiratory branched tube terminate The intestine is very long and convoluted and frequently ruptured that when the animal is distended it is precluded from the body or ruptured by the violence of the contraction of the muscular parietes of the abdomen The "trepang" of Eastern [illegible] is a dried species of *Holothuria*

HOLT (Sax *a wood*, Germ holz) The termination of many names of places in England, derived from their ancient situation in a wood

HO'LY ALLIANCE THE A league formed between certain of the principal sovereigns of Europe, after the defeat of Napoleon at Waterloo on the proposal, it is said, of the Emperor Alexander It arose from the religious enthusiasm which was prevalent at that period of deliverance from French domination and with which the Russian emperor was just then considerably imbued The act of this alliance is said to have been sent in his [illegible] Emperor of Austria and King of Prussia [illegible] by them It is not supposed that the [illegible] for [illegible] the Gospel But it was subsequently connected with the determination of those monarchs to support in conjunction with England and France [illegible] out Europe, by the Declaration of November 1815 afterwards the congresses of Troppau, Laybach and Verona established the character of the alliance, to which the [illegible] France, the alliance can scarcely be said to have any active existence (See *Ed Rev* vol xxxii xxxix)

HO'LY ROOD, or HOLY CROSS A festival kept on the 14th of September, to commemorate the exaltation of the Holy Cross It is from this circumstance that the royal palace in Edinburgh has derived its appellation

HO'LY STONE A stone used by hand, with sand to scour the ship's decks The large stone worked by ropes is called the *bear* The sand is used with water, but it has long been a very general practice in the navy to use dry sand below this is called *dry holy-stoning*, [illegible]

HOLY THURSDAY [illegible] the Romish Calendar, the 39th day after Easter Sunday A festival in commemoration of Christ's ascension

HO'MÆOMERI'A (Gr ὁμοιομέρεια *similarity of parts*) The name given to the physical theory of Anaxagoras, a Grecian philosopher of Clazomenæ, who flourished in the fifth century B C According to this hypothesis every material substance is made up of infinitely small parts similar to itself Hence the growth and [illegible] for by supposing the [illegible] into its various [illegible] parts [illegible] parts of the substance [illegible] supposed to contain particles of blood, bone, flesh, skin &c, which by the process of digestion were separated from each other, and added to the corresponding parts of the animal body This theory bears some resemblance to that of the *monads* of Leibnitz in modern times *See* MONAD

HO'MEOPATHY (Gr ὅμοιος, *similar*, and πάθος *feeling or affection*) The [illegible] was first proposed by Samuel Hahnemann [illegible] to be treated upon the principle that *similia similibus curantur* Thus they maintain that sulphur produces a pustular eruption upon the skin, and therefore cures pustular eruptions [illegible] febrile symptoms, and [illegible] Not [illegible] the doses in which the homœopathic remedies are administered it being presumed that by infinite subdivisions the virtues of remedies are proportionately refined and exalted A grain for instance of an active remedy such as aloes, is triturated with 100 grains of sugar of milk when this mixture is completed a grain of it again diluted with 100 [illegible] which the ordinary practitioner administers in doses of one or two grains or more, the homœopathist prescribes in the quantity of a millionth or the decillionth of a grain, or even less Hahnemann was also a believer in animal magnetism It is not surprising that enthusiasts of this cast should occasionally start up, but it is remarkable that they should find converts among persons in their [illegible]

HOMAGE (Lat homagium, or hominium, from homo, *man*, the usual term by which the vassal or dependant of a [illegible] in the older writers of the middle [illegible] The [illegible] acknowledgment of dependence due from a vassal to a feudal lord or superior when invested with a fief, or obtaining it by succession In the earliest periods of the feudal system fealty and homage appear to be confounded (see *Sir F Palgrave on the [illegible] ilth*, vol ii p cccxc), but in [illegible] was clearly established, and fealty might sometimes be due where homage was not Homage was either homagium ligeum, *liege homage*, by which full and unreserved allegiance was rendered, or homagium non ligeum, *simple homage*, a mere acknowledgment of feudal superiority with a saving or exception of the rights of other feudal lords The one was personal and could not be renounced (hence the doctrine of *allegiance*), the other bound the vassal only so long as he held the fief [illegible] was due

HO'MALIA'CEÆ (Hom [illegible] one of the genera) A natural order of arborescent or shrubby Exogens, inhabiting the tropics According to Brown related to *Passifloraceæ*, but distinguished by their inferior ovary De Candolle places them between *Samydaceæ* and *Chailletiaceæ* They are plants of some beauty, but of no known use

HOME, in Naval language, is said of any thing that is close in its place it is applied to the sheets of the sails the shot in the cartridge in a gun and any article of stowage

HO'MICIDE (Lat homo, *a human being*, and cædo, *I kill*) In Law the destruction of a human creature which is either justifiable—viz 1 In case of necessity, public or private, 2 By permission of law for the advancement of justice, 3 For the prevention of forcible and atrocious crime Or excusable—1 By misadventure, 2 In self-defence on a sudden affray, or chance-medley Or felonious of which the species are—1 Self murder, 2 Manslaughter [illegible] of another [illegible] Murder, or the wilful [illegible] 4 Petit treason, which by the Statute of Treasons was confined to the cases of a servant wilfully killing his master, a wife her husband or an ecclesiastical person his superior but the distinction in judgment between this offence and murder is now abolished

HO'MILY (Gr ὁμιλία, *an assemblage*), was used by the early fathers in the same sense as our word sermon, to their [illegible] with which [illegible] enforced their doctrines in opposition to the more remote and declamatory orations which were more fashionable at the time Up to the fifth century the practice of preaching was confined to the bishops and the only homilies extant are of their composition The term, which has now become obsolete, was in constant use as late as the Reformation, and the English Book of Homilies is a collection of plain sermons setting forth the principal doctrines of Christianity, and pointing out the principles of Protestantism, of which the first part was published by Cranmer in the reign of Edward VI and the second by order of convocation in that of Elizabeth

HOMOCHRO'MOUS (Gr [illegible] *colour*) When all the florets [illegible] are of the same colour

HOMO'GAMOUS (Gr ὁμου, and [illegible]) In Grasses, when all the florets of the [illegible] same individual are hermaphrodite, in Compositæ plants, when all the florets of a flower-head are hermaphrodite

HOMOGE'NEOUS (Gr ὁμου, and γενος, *kind*) Ho [illegible] those [illegible] the constituent ele [illegible] as can be added to or s [illegible]

HOMO'LOGOUS (Gr ὁμου, and λογος, *ratio*) Having the same ratio or proportion In Geometry those series of similar figures which are opposite to equal [illegible] are proportional to each other [illegible] therefore said to be *homologous* The areas and solid contents of such figures are likewise homologous [illegible]

HOMONYMS (Gr [illegible]) [illegible]

HOMOOUSIANS, HOMOIOUSIANS [illegible] by which the Orthodox and Arian parties were distin-

gulshed in the great controversy upon the nature of Christ in the 4th century the former word signifying that the nature of the Father and Son is the *same*, the latter that they are *similar* (*Gibbon*, vol iii *See* ARIANS ) Homoousian (Gr *ομοουσιος*) is derived from *ομος*, *the same*, and *ουσια*, *being*, Homoiousian (*ομοιουσιος*) fro[illegible] and [illegible] (See also *Milman's Hist of Christianity* iii

HOMOPHONOUS (Gr *ομος*, *the same*, and *φωνη*, [illegible] Music, of the same pitch, or unisonal [illegible] are said to be homophonous when th[illegible] pitch [illegible] *ομος*, and *φωνεω*, *I speak* ) Homophonous words or syllables, in language, are words or syllables having the same sound although expressed in writing by various combinations of letters Languages which abound in homophonies are 1 Some Oriental monosyllabic tongues, namely, the Chinese and its kindred dialects, in which very few sounds comprise the whole vocabulary and the same sound is expressed by a variety of ideographic characters (in Chinese there are only 400 such sounds, multiplied by the distinctions of tone and accent to 1600 or 2000), and, 2 Some European tongues in which, according to the genius of the dialect the syllables of the original languages from which the words are chiefly derived have [illegible] of their sounds drop[illegible] letters is retained Thus in English and still more in French, which is peculiarly a dialect of Latin abounding in contractions, homophonies are numerous (in the latter tongue the number of syllables differently spelt, all having nearly the sound of our broad A amounts to more than a hundred), while in Italian in which the original proportions of the Roman language are preserved, they are [illegible]

[illegible] (Gr *ιμος* and *πτερον* *a wing* ) The name of an order of insects, dismembered from the *Hemiptera* of Linnæus including those in which the wing-covers are of an uniform semi-membranous consistency Latreille divides this order into the three following [illegible]s viz

1 The *Cicadaria* having the tarsi three jointed, and the antennæ very short terminated by a fine bristle

2 The *Aphidiens* having the tarsi two jointed, and the antennæ longer without a terminal bristle, containing the families *Aphidæ* and *Psyllidæ*

3 The *Gallinsecta* having the tarsi one-jointed, terminated by a single claw The males have two wings, and are destitute of a mouth, the females are wingless, and furnished with a sucker

HOMO'TROPAL (Gr *ομος* and *τρεπω* *I turn* ) In Botany, a term used in describing the direction of bodies to denote any one having the same direction as the body to which it belongs but not being straight

HO'NEY (Germ *honig* ) A sweet viscid substance elaborated by the bee from the juices of the nectaries of flowers, and deposited in the waxen cells of the *honey-combs* That which spontaneously runs out of the comb is called virgin honey Pure honey consists of a syrup or uncrystallizable sugar and of a solid or granular sugar which resembles that obtained from the grape

HONEY STONE A yellow mineral found in octoedral crystals at Artern in Thuringia It is extremely rare It consists of a peculiar acid (the mellitic acid) combined with alumina and water

HONG The Chinese name for the foreign factories situated at Canton The hong merchants are those persons who are alone legally permitted to trade with foreigners They are ten in number and are always held responsible by the government for paying all duties whether on imports or exports in foreign vessels No foreign ship that enters the Chinese ports can commence [illegible] has obtained a hong merchant is security [illegible]

HONORARIUM (Lat *honos*, *honour* ) A term used almost synonymously with *fee*, and applied at present chiefly to the fees tendered to professors in universities, and to medical or other professional gentlemen for their services It was originally applied solely to the salaries of the great officers of state whose services it was considered, by a perhaps pardonable euphemism were remunerated only, as it were *honoris causa*, a shade of meaning which is still perceptible in the present use of the term

HONOUR (Lat ), in Law signifies the more noble sort of seigniories, on which other lordships or manors depend by the performance of customary services

The [illegible] is susceptible of [illegible] ever, may easily be traced to its original meaning *esteem or regard built on opinion* Among the Romans honour was deified, and in modern times the term plays a no less important part being used in various terms of phraseology, to indicate certain rules by which society in general, and [illegible] *nable*, has tacitly [illegible] deviation from [illegible] - pale To this class may be referred, with slight modifications of meaning, the phrases *debt of honour*, *law of honour*, *court of honour*, *affair of honour*, &c , which are all self-explanatory The term was formerly the style of a man of rank generally, but it is now distinctively conferred on the Vice-Chancellor and the Master of the Rolls

HONOURABLE A title prefixed to the Christian names of the younger sons of earls and to those of all the children, both sons and daughters, of viscounts and barons It is also conferred on persons filling certain offices of trust and dignity, such as maids of honour of the queen and queen dowager and colleagues of certain public bodies or institutions as the House of Commons, the Congress of the United States, the East India Company, &c &c The title of *right honourable* is given to all peers and peeresses of the United Kingdom, to the eldest sons and all the daughters of peers above the rank of viscount, to all privy councillors, and to some civic functionaries as the lord mayors of London and Dublin the lord provosts of Edinburgh and Glasgow &c

HONOUR, LEGION OF *See* LEGION &c

HOOPING COUGH *See* WHOOPING COUGH

HOP The *Humulus lupulus* of Linnæus the female flowers of which are used for imparting a bitter flavour to malt liquors for the purpose of preserving them from fermentation The hop plant is a perennial indigenous to Britain and different parts of Europe, but to produce abundance of hops it requires to be very carefully cultivated in good soil, and even then is one of the most precarious of crops The fields in which hops are grown are commonly called hop gardens a loamy soil on a dry subsoil is chosen, and the plants are placed in hills, stools, or groups of three or four in a group, the hills being in rows five or six feet apart, and at about the same distance in the row A full crop is not produced till the [illegible] the ground [illegible] summer, and the hills have poles, generally three or four to a hill, for the plants to twine on the purchase of these poles, the fixing them in the soil every spring, the taking them down and sticking them every autumn, and their removal every five six eight or ten years according to the kind of wood used, constitute a considerable part of the expense of hop culture The hops when mature are picked by hand and as they are picked they are carried to a drying kiln, dried and packed into bags or pockets, and this is also an expensive process The hop plant is particularly liable to be injured by insects, by cold and continued rains, and by thunder storms, in consequence of which it is estimated that a full crop is not obtained oftener than above once in five years Hence it is easy to conceive that the price of hops must vary greatly in different years and that the grower who has a command of capital may profit largely by keeping them back from market when the prices are low and only exposing them when they are high In order to keep hops for two or three years they require to be powerfully compressed, and put into much closer canvass bags than when they are to be sent immediately to market, they also require to be kept in dry airy lofts, neither too warm nor too cold The culture of hops was introduced into England from Flanders in the reign of Henry VIII The most extensive plantations are in Kent, Sussex, and Herefordshire, but they are cultivated to a considerable extent in many other counties The hop growers are placed under the surveillance of the excise a duty of 18*s* 8*d* per cwt being charged upon all hops grown in this country In 1837, the number of acres of land under cultivation of hops was 56 323, and in the same year the duty amounted to 310,794*l* 4*s*, of which Kent contributed nearly one half

HOPLITES (Gr *οπλιται*, from *οπλα*, *arms* ) The heavy armed infantry of Grecian antiquity According to the Athenian regulations (similar probably to those of other states) the higher classes of citizens only, as estimated by the census were liable to this expensive form of military service, in process of time however it came that the Thetes or inferior classes were enrolled as Hoplites The Hoplites were armed in early times with the spear, heavy defensive armour and large shield, the latter were exchanged after the time of Iphicrates for the light cuirass and target

HOP OAST A particular description of kiln used for drying hops The floor of the kiln is generally of wire cloth, and the heat is generated in a stove with flues below The hops after being put on the kiln are frequently turned, and in general they are rendered sufficiently dry in the course of a few hours, when dried they are taken to a loft and left to cool for a day or two, and then put into bags, having been previously subjected to the slight action of the fumes of burning sulphur (sulphurous acid), by which they are to a certain extent bleached

HOPPLE A mode of fettering the legs of horses or other animals turned out to graze on a common or other unenclosed place

HOP POLES, are poles or stakes annually inserted at the roots of hop plants for their stems to twine round. When a hop plantation is first made, as the plants are

weak the poles are not required to be more than five or six feet in length, but in the third or fourth year they require to be ten or twelve feet in length Any kind of young trees or saplings may be used as hop poles, but the most durable are those of the oak, the ash the sweet chestnut and the larch The locust or *Robinia* was strongly recommended as a durable hop pole by Cobbett, but though this wood is very durable when of not more than a certain age, it does not appear to be so when of the size most proper for hop poles Much of the durability of the hop pole no doubt depends on the soil in which it is grown, but, all circumstances being alike, poles of larch wood, which are much employed in the neighbourhood of Farnham, have been found to last longer than any other

HO'RARY CIRCLES, on Globes, are hour lines, or circles marking the hours, and drawn at the distance of 15° on the equator from each other They are the same as *meridians*

HO'RARY MOTION is the motion of a point or body in a circle, or the space which it moves through, in an hour The apparent horary motion of the heavenly bodies in their diurnal revolution is 15° for as the whole circle is completed in 24 hours, the 24th part of it, or 15°, must be passed over in one hour

HORDE A collective name given to bodies of nomadic savages who, like the Tartars, lead a pastoral life, but exist by plunder and rapine

HO'RDEIN A modification of starch, which according to Proust, constitutes about 55 per cent of barley-meal

HO'RDEOLUM (Lat dim of hordeum *barley*) A small tumour on the eyelid, somewhat resembling a barley-corn, it is a little boil projecting from the edge of the eyelid, and is commonly called a *stye*

HO'REHOUND This indigenous plant has a bitter and somewhat aromatic flavour, and is considered as an expectorant, and as giving relief in asthma hence the celebrity of *horehound tea* among the common people

HORI'ZON (Gr ορίζω *I bound* or *terminate*) In Astronomy and Geography, is the plane of a great circle of the sphere dividing the visible from the invisible hemisphere The horizon is either *sensible* or *rational* The sensible horizon is a plane which is a tangent to the earth's surface at the place of the spectator extended on all sides till it is bounded by the sky, the rational horizon [illegible] horizon are relative terms, and change with every change of the spectator's position on the surface of the earth in all cases they are perpendicular to the direction of gravity

If the eye of the spectator were in the plane of the sensible horizon stars would not appear to rise till they are above that plane, but if he is elevated above the horizon, a greater extent of the earth's surface will be visible, and the stars
the plane which is a
sensible horizon is sometimes defined to be the conical surface which has its apex in the eye of the spectator and embraces that portion of the earth over which the eye can reach The visual rays which are tangents to the earth are situated in this surface and consequently point below the true sensible horizon or the rational horizon which is parallel to it, and the angle which a visual ray makes with the plane of the horizon is technically called *the depression of the horizon*, or *the dip* The dip can be easily computed from the known dimensions of the earth and the height of the eye above its surface, but the real depression of a visible object below the horizon cannot be determined in this manner, on account of the refraction of the atmosphere, which prevents the rays of light from coming to the eye in a straight line

HORIZONTAL RANGE, in Gunnery is the distance to which a piece of ordnance will carry a ball on a horizontal plane Supposing no resistance from the atmosphere, the greatest range would be when the piece is elevated at an angle of 45°, and in all other positions the horizontal range would be as the double of the sine of the angle of elevation In a resisting medium the maximum horizontal range requires the elevation to be less than 45° It is found by experience that with the ordinary velocity a cannon shot ranges the farthest when the elevation of the piece is about 30° *See* GUNNERY

HORN [illegible] Horn (commonly called French Horn) A brass musical wind instrument of a complex spiral form, increasing in diameter to its end or mouth, which the French call its *pavillon* The inflexion of it is much regulated by the insertion of the hand in the pavillon

HO'RNBLENDE [illegible] colour, abounding in ox [illegible] composition of several of the trap rocks It is the *amphibole* of Hauy

HORNBLENDE-SCHIST A slaty variety of hornblende, generally including felspar and grains of quartz. it is of a dark green or black colour Where clay slate is in contact with granite, it sometimes passes into hornblende slate

HOR'NET *See* VESPIDÆ

HO'RNING, LETTERS OF In Scottish Law, a species of [illegible] They are writs [illegible] warrant of a decree of the Court of Session, or of the magistrates of boroughs, and of various other inferior authorities, but in these cases a warrant of the Court of Session must also be obtained They direct the debt to be paid within a limited number of days (according to the nature of the debt) In default of such [illegible] charge of rebellion and is [illegible] arrest

HO'RNPIPE The name of a well known dance, for the skilful performance of which the British sailors have long been celebrated The origin of the name is uncertain, but it is believed to be derived from a kind of musical instrument called *pib-corn* (Ang *hornpipe*), consisting of a [illegible] at each end, [illegible] Wan (See *Hamilton's* [illegible] 1,7)

HORN SILVER A name given by the older chemists to chloride of silver which when fused puts on a horny appearance For the same reason chloride of mercury or calomel is occasionally called *horn quicksilver*, and chloride of lead *horn lead*

HO'RNSTONE A variety of flint of a semitransparency somewhat resembling that of horn One of the varieties of porphyry goes under the name of hornstone porphyry

HORN WORK In Fortification, a kind of outwork carrying on the head or fore part two demi-bastions re- [illegible] whence the name

HOROGRAPHY (Gr ωρα *hour*, [illegible]

HOROLOGIUM, HOROLOGE (Gr ωρα and λογος *discourse*) A term frequently used by ancient writers to denote a clock, watch, or other machine for [illegible]

HOROLOGY (Gr ωρα, and λογος *discourse*) signifies literally an explanation of the methods of measuring and marking the hours of the day Anciently the term *horologium* was applied to any sort of contrivance for measuring the hours as the clepsydra and sundial (see the terms), but as these instruments have been superseded by clocks and watches horology is now usually understood to signify a description of the principles on which machines for the measurement of time, moved by weights or springs, are constructed

Machines for measuring time are designated by the general appellation of *clocks* and *watches*, but they are also distinguished by peculiar names arising from certain modifications in their construction or from certain particular purposes they are intended to serve By the term *clock* is understood an instrument which not only shows, but also strikes the hours A *time-piece* is one which shows the hours without striking them a *quarter-clock* is one which strikes the quarters as well as the hours an *astronomical clock* is one which shows sidereal time, a *watch* is a portable or *pocket time piece*, a *repeater* is one having a contrivance by means of which it can be made at any time to repeat the hours, a *chronometer* is a watch of the best kind, or one fit to be employed for astronomical purposes

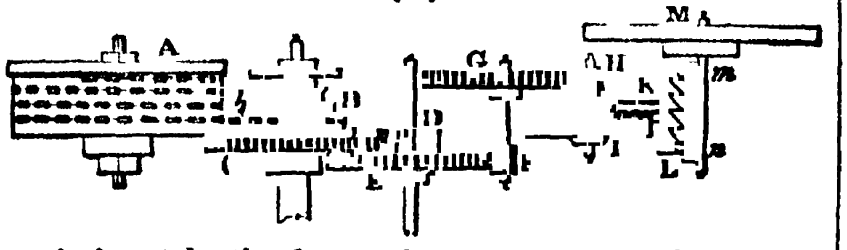
In a general view horological machines may be regarded as consisting of three essential parts — 1st a moving power which produces a rotatory motion about an axle, 2d a train of wheel-work, by means of which a velocity is obtained having any required ratio to that of the primary axle, and 3d a regulator, by which the rapidity of the revolution is determined, and uniformity of motion produced The moving power is [illegible] a heavy weight which descends [illegible] a spring which is coiled up within a barrel and unwinds itself by the force of its elasticity, the first being preferred on account of the perfect regularity of its action when the instrument is to remain fixed in a place, and the second being necessary for pocket time pieces and those which cannot be kept in a fixed position as on ship-board The train of wheel-work is chiefly remarkable on account of the delicacy and accuracy of its construction The regulator is either a pendulum, of which, by the theory of falling bodies, the oscillations are isochronal or performed in equal times, or a heavy balance, the reciprocal vibrations of which are also isochronal *See* BALANCE, PENDULUM

Of the various mechanical contrivances introduced into horological machines for [illegible] purposes, it would be useless [illegible] in this place, as our limits will not permit them to be given with that minuteness of detail which is indispensable in order to convey a clear idea of their action The most important is the *escapement* (or scapement), or that part of the mechanism by which the original rotatory motion

is converted into a reciprocating motion, and gives impetus to the pendulum or balance Some other parts are also of primary importance, as the *maintaining power*, a contrivance by means of which the motion is maintained, or the clock kept going, while the weight or spring is being wound up, the *fusee*, by which in watches and spring-clocks the force acting on the wheel-work is rendered equal in all states of the tension of the spring *See* I USEE

The general arrangement of the wheel-work of a clock or watch may be understood from the following description Fig 1 represents the movement of a common

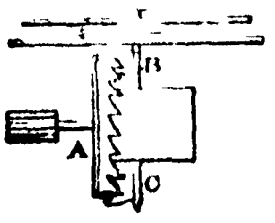
(1)




vertical watch, the frame plates being omitted, and the dial being supposed to be turned downwards A is the *barrel*, containing the spring which produces the motion B is the *fusee*, connected with the barrel by the chain *b* C is the *fusee-wheel*, called also the *first* or *great wheel*, which turns with the fusee, and works into the pinion D, called the *centre-wheel pinion* this pinion, with the *centre wheel* or *second wheel* I, turns once in an hour The centre wheel E works into the *third-wheel pinion* I, and on the same arbor is G the *third wheel* which drives the fourth or *contrate wheel pinion* H and along with it the *contrate wheel* I The teeth of this wheel are placed at right angles to its plane, and act in the pinion K, called the *balance-wheel pinion*, L being the *balance-wheel*, or *scape-wheel*, or *crown-wheel*, attached to the same arbor The balance wheel acts on the two pallets *m* and *n* attached to the *verge* or arbor of the balance M, and these being placed at a distance from each other equal to the diameter of the balance wheel and in different planes, receive alternately from the scape-wheel an impetus in opposite directions which keeps up the vibratory motion of the balance

This last part of the mechanism which it requires some attention to understand is represented more distinctly in fig 2 where A is the scape-wheel and B and C the two pallets The pallets it is to be observed, are not placed on the verge in the same plane, but their planes form an angle equal to the excursion of the balance, so that supposing one of them to be about 10 or 50 degrees from the mean point towards the right, the other is just as many degrees from the same point towards the left The teeth of the scape-wheel are bent forward in the direction of the motion, like the teeth of a saw, and their number is odd Suppose a tooth of the scape-wheel to have caught the pallet B it will continue to bear on that pallet, and to accelerate the balance, until, by the revolution of the verge, the extreme edge of the pallet comes into the plane of the extremities of the teeth when the pallet escapes But as the balance continues for a short time longer to move in the same direction the pallet C now comes in between two teeth at the point diametrically opposite to the front of the tooth which B has just quitted, and as the vibration of the balance now commences in the opposite direction, this pallet is in its turn pressed upon and accelerated by the wheel

(2)




The *crown-wheel escapement*, now described is the oldest and the original form, and is still used in common watches, where it answers sufficiently well but when applied to clocks regulated by pendulums it is exceedingly defective, for as it requires the vibration to be made in an arc of considerable extent, the pendulum must of necessity be short and light, and hence it becomes a very imperfect regulator In order to obviate these defects, Clement, a London watchmaker, in 1680 invented the *crutch* or *anchor* escapement which was greatly improved upon by Graham about the year 1700 Graham's escapement is represented in fig 3 O is the centre of the scape wheel B A C, the crutch or anchor, consists of a heavy piece of metal attached to the rod of the pendulum with which it moves A is its centre of motion, and in the original construction of Graham, the distance of A from O was equal to the diameter of the scape-wheel The extremities of the crutch form the pallets, the acting faces of which are inclined planes, while the parts on which the teeth successively fall are cylindrical surfaces, the radii of which are equal to OA The tooth being received on this surface, slides along it without tending to accelerate or retard the pendulum, until the pendulum arrives near the middle of its vibration, when

(3)

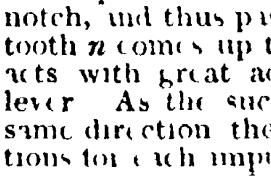





the inclined plane comes to the extremity of the tooth, and the tooth then begins to act upon the plane, and to turn the pallets, and consequently accelerate the pendulum B [illegible] the plane of the pallet, while during the rest of the vibration the tooth rests on the cylindrical surface, and the wheel stands still, or is *dead*, whence this escapement is called the *dead beat*, or the *escapement of repose* In Hooke's form, the impulse gi[illegible] applied at the extremities of the vibrations, tends greatly to disturb their isochronism By Graham's method there is no recoil the impetus is given while the pendulum is near the middle of the vibration, and the velocity the gr[illegible] lu[illegible] them carried successfully [illegible]otion we must refer to the works in which the subject is technically treated There are two, however, which, by reason of the greater ingenuity displayed in their contrivance, and their almost universal application to the best kinds of pocket watches, require particular notice These are the *duplex* and the *detached* escapement, the latter being that which is used in modern chronometers

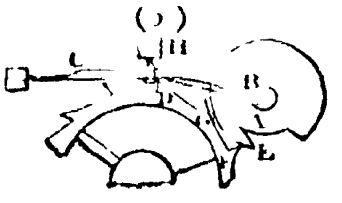
*Duplex Escapement* —This is represented in fig 4 A A is part of the scape-wheel, which is furnished with two sets of teeth, whence probably the name is derived M N R are the teeth of repose, lying in the plane of the wheel, *m n r* are the teeth of impulse, and stand perpendicular to the plane of the wheel B C is the impulse pallet, fixed upon the arbor of the balance just above the plane of the wheel so that its extremity C may be caught by the teeth *m n r* and receive the impulse from them as they successively pass A small ruby roller is also placed upon the arbor, behind the pallet having a notch in one side of it for receiving the teeth M N R When the tooth *m* has passed the claw of the pallet, the tooth M falls upon the ruby roller where it rests until by the returning vibration of the balance the notch is brought to the point of the tooth The tooth then falls into the notch, and thus passes the roller, and the next impulse tooth *n* comes up to the pallet, on the point of which it acts with great advantage in consequence of the long lever As the successive impulses are all given in the same direction the balance necessarily makes two vibrations for each impulse given by the upright tooth The [illegible] great accuracy in the execution of the teeth of the scape-wheel which is indispensable in the case of the escapements already described and also for the lever escapement which in fact is only a modification of the crutch

(4)




*Detached Escapement* — The annexed diagram, fig 5, represents Earnshaw's construction A is the main pallet projecting from the verge or arbor of the balance concentric with which is another small pallet called the *lifting pallet*, which when the balance is vibrating from A towards B, lifts a very slender spring B, and with it the detent spring C so as to set it liberty or unlock the tooth D the point of which rests on a ruby pin projecting from the detent spring C, and forming the detent The point I of the principal pallet having passed the tooth I the wheel moves forward by the action of the main-spring until the next tooth G falls upon the ruby pin and is locked The screw H serves to adjust the position of the detent and the strength of the locking In the return of the balance, the pallet A passes easily by the detent spring by forcing back the slender spring B As in the case of the duplex, the balance here makes two vibrations for each impulse

(5)




*Maintaining Power* — In order that a clock or watch, when perfectly regulated, may continue to indicate true mean time, it is necessary that it have some contrivance for continuing the action while it is wound up Various methods of accomplishing this have been devised One of the simplest consists in the interposition of a spring between the fusee and the wheel impelled by it, a little interior in force to the main-spring (or weight), so as to remain always bent until the pressure of the main-spring is removed by the action of winding, when it begins to act upon a fixed point on one side and the wheel of the fusee on the other so as to propel the work for a short time with a force nearly equal to that of the main-spring

Some of the other parts of the mechanism, as the wheels for moving the minute and seconds hands, the

striking part of a clock in the repeating part of a watch though they form a considerable part of the bulk of the machine, require no great refinement of invention or d[illegible] will be better understood [illegible] nmon clock and repeating watch than from any description which could be given

The history of the invention of clocks is very imperfectly known By some it has been ascribed to Pacificus, archdeacon of Verona in the 9th century, and by others to Boethius in the early part of the 6th The Saracens are supposed to have had clocks which were [illegible] as early as the 11th century, and as [illegible] by Dante to a machine which struck [illegible] must have been known in Italy about the end of the 13th or beginning of the 14th century It is said that the first clock made in England was furnished out of the proceeds of a fine imposed upon the chief justice of the King's Bench in 1288 and that it remained in its original situation, in old Palace Yard, as late as the reign of Elizabeth In the reign of Richard II a large astronomical clock was made by Richard of Wallingford abbot of St Albans which was regulated by a fly But the most ancient clock of which we possess any certain account was erected in a tower of the palace of Charles V, king of France, about the year 1364 by Henry de Wyck or de Vick, a German artist A clock was erected at Strasburg about 1370 at Courtray about the same period, and at Spire in 1395 In the following century public clocks appear to have existed in all the principal towns of Europe, and private ones to have come into very general use

The earliest clocks were doubtless very rude and imperfect instruments, and their present state of excellence must have been attained by slow and successive improvements Wheel work set in motion by springs and weights, was known in the time of Archimedes, and in order to have a timepiece it was only necessary to apply some contrivance to regulate the motion For this purpose recourse was first had to a fly wheel but it would soon be found that the fly, the action of which depends on the resistance of the air, would form a very imperfect regulator The clock of Henry de Wyck, above mentioned was regulated by an alternating balance which was formed by suspending two heavy weights from a horizontal bar fixed at right angles to an upright arbor and the movement was accelerated or retarded by diminishing or increasing the distance of the weights from the arbor It had no regulating spring, and the action may consequently be supposed to have been very irregular, nevertheless [illegible] for astronomical [illegible] Wallingford, Maestlin, the landgrave of Hesse, and others The capital improvement of the pendulum dates from about the middle of the 17th century, but it is very uncertain by whom the application was first made or proposed Galileo was [illegible] remarked, or at least the first who formally announced in his work on mechanics and motion, which was published in 1639, the isochronal property of oscillating bodies suspended by strings of the same length, and it has been pretended that he [illegible] to a clock for the purpose of determining longitudes There is, however, no proof of this fact [illegible] Sanctorius, in his *Commentary* [illegible] an instrument to which he had applied a pendulum in 1612 Richard Harris is said to have constructed, in 1641, a pendulum clock in London for the church of St Paul's Covent Garden Vincenzo Galilei, a son of Galileo, is stated, on the authority of the *Academy del Cimento*, to have applied the pendulum in 1649 It was applied by Huygens in 1656, and by Hooke, for whom the invention has been claimed, about 1670 But to whomsoever the merit may belong of having first made the application Huygens is unquestionably the first who accurately explained the theory of the pendulum, and hence, perhaps, the invention of the pendulum clock has been usually ascribed to him Huygens demonstrated that the vibrations in circular arcs are not independent of the length of the arc, and that in order to obtain perfect isochronism, the ball of the pendulum must move in the arc of a cycloid, and, ingeniously applying a property of the cycloid, of which he was the discoverer namely, that its involute is a curve similar to itself he procured the requisite motion by [illegible] rod wrapped itself in its motion But it was found that no practical advantage could be obtained from this beautiful contrivance, and in fact it was soon rendered unnecessary by the invention of the anchor escapement, which gives the means of rendering the arcs of vibration very small, in which case the error depending on the length of the arc becomes insensible The application of the spiral spring to the balance is the undoubted invention of Hooke

[illegible] which marks an epoch in the history of [illegible] a method of counteracting the effect of changes of temperature on the pendulum rod and balance The mercurial compensation pendulum was invented by Graham about the year 1715 Graham likewise suggested the method of effecting the compensation, by means of the unequal expansions of different metals, an idea which was subsequently realized by Harrison in the construction of the gridiron pendulum, which is now very generally used The compensating apparatus in the watch balance depends upon the same principle, but the mechanical arrangement is necessarily very different *See* BALANCE

For full information on this subject the reader is referred to the following works —Berthoud, *Essai sur l'Horlogerie*, Id, *Histoire de la Mésure du Tems*, *Cumming's Elements of Clock and Watch-Work*, *Derham's Artificial Clockmaker*, *Harrison's Principles of his Timekeeper*, *Earnshaw's Explanations of Timekeepers*, *Reid's Treatise on Clock and Watch-making*, the article 'Horology' in the *Penny Cyclopædia*, &c

HORO'METRY (Gr ὡρα, and μετρον, *measure*) [illegible] hours

HOROSCOPE (Gr ὡρα, and σκοπεω, *I observe*) A representation of the aspect of the heavens and positions of the celestial bodies at a particular moment, drawn according to the rules of the imaginary science of astrology Thus the aspect of the heavens at the moment of the birth of an individual is his horoscope and supposed to indicate his future destinies *See* ASTROLOGY

HO'RPOL *See* URDA

HORRIPILA'TION (Lat horror, and pilus *a hair*) The common expression of the 'hair standing on end," implies the shuddering sensation to which medical writers often apply this term

HORSE *See* EQUUS

HORSE In Nautical affairs a foot rope to support the feet of the seamen while leaning over a yard or boom to furl the sail Also a rod or rope [illegible] which the edge or the corner of a sail traverses [illegible] links

HORSE POWER This term, as applied to steam engines refers to the weight which they are capable of raising to a given height in a given time Watt estimated a single horse power at 32 000 pounds avordupois lifted to the height of one foot per minute, this is, however, nearly double the work of a single horse as usually applied to [illegible]

HORSE RADISH the root of the *Cochlearia armoracia* which when scraped is often eaten as a condiment and an ingredient in sauces, has a place in the *Materia Medica* as a stimulant, and a compound spirit and compound infusion are directed in the *Pharmacopæia* the latter very soon becomes putrid, and neither are useful

HORSE SHOE In Fortification, a work of a round or oval form

HO'RTICULTURE (Lat hortus, *a garden* and colo *I cultivate*) The culture of the kitchen garden and orchard In the kitchen garden are cultivated every description of root, herb flower, and fruit, used in cookery, and in the orchard the more hardy fruits used in cookery, and in the dessert The finer fruits are grown against espaliers, walls hot walls, or under glass The chief difference between horticulture and agriculture is that in the former art the culture is performed by manual labour in a comparatively limited space called a garden, while in the latter it is performed jointly by human and animal labour in fields, or in an extensive tract of ground called a farm *See* GARDENING, AGRICULTURE, and FARMING

HORTUS SICCUS A collection of dried plants preserved in books or papers

HOSANNA (Heb) An exclamation, signifying literally *save now* This Hebrew word occurs only once in the Old Test, viz Psalm cxviii 25 This psalm is the last of those which compose the "great Hallel," and hence perhaps, this invocation was used by those who conducted our Saviour into Jerusalem (Matt xxi, Mark xi, John xii) It was afterwards commonly adopted in [illegible] *Riddle's Christian Antiquities*, p 335)

HOSPITAL (Fr hôpital) In Architecture, a building raised and endowed for the reception of persons incapable of supporting themselves and procuring medical assistance, or as a refuge for the unfortunate or needy Many of the charitable institutions in Great Britain are called hospitals, and are incorporated bodies, possessed of great wealth, which is expended in the support of schools, etc (See *M Culloch's Statistics*, *Low's Charities of London*, *De Gerando, de la Bienfaisance publique*, vol iv book 3)

HOSPITAL GANGRENE A species of ulcerating [illegible] characterized by its infectious nature, [illegible] attack wounds or ulcers in crowded [illegible]

HOSPITALLER, in its original acceptation, was applied to certain religious bodies, who held it their duty to provide lodging and entertainment for those persons engaged in pilgrimages One of the most celebrated institutions of this kind was that at Jerusalem which gave its name and origin to the Knights Hospitallers,—a well-

k [illegible] founded about the end of the 11th c[illegible] got the 24th rule [illegible] afterwards [illegible] England [illegible] wat[illegible] of great wealth and importance unequalled in [illegible] similar bodies They followed the rule of St Austin, and wore a black habit with a white cross upon it At their original institution they were styled Knights of St John of Jerusalem, afterwards Knights of Rhodes, and again Knights of Malta, these two islands having been successively conferred on them by different monarchs *See* ST JOHN OF JERUSALEM KNIGHTS OF

HOSPITIUM (Lat.), signifies in general a place or inn for the reception of strangers, in which sense it is used by old writers, but it is in modern times almost wholly restricted to the celebrated inns on St Bernard and St Gothard, in Switzerland, to which travellers to and from Italy resort

HOSPODAR or WOIWODE The lieutenants appointed by the Porte to govern the two Christian provinces of Moldavia and Wallachia are so called By the treaty of Adrianople between Prussia and Turkey (1829) these officers are to hold their appointments for life, and to pay a fixed annual tribute

HOST (from the Latin hostia, *a victim*) is applied in Theological language to the bread and wine under the appearance of which the Roman Catholics conceive the body and blood of Christ to be present upon the altar The elevation of the Host is a ceremony prevalent in all Catholic countries, in which the consecrated elements are raised a[illegible] procession through a church or even [illegible] city On these occasions the people [illegible] and worship the Host The [illegible] from the 12th century, when, [illegible] necessary to make this public and conspicuous declaration of the Eucharist on the occasion of the promulgation of the opinions of Berengarius [illegible] transubstantiation

HOSTAGE (Lat hospes, *guest*) A person left as surety for the performance of the articles of a treaty The practice of taking hostages is now almost unknown in the mutual relations of civilized communities, but was formerly so common as to have given rise to many questions in the law of nations Hostages were divided into principal and accessary, the latter being where it is expressly stipulated by treaty that the hostage shall be answerable for the event One of the points debated among civilians on this subject was, whether such a hostage could lawfully stake his life and whether in the event of his doing so it was lawful to take it The affirmative was argued from the most ancient example of [illegible] on record,—Reuben's words to Jacob "slay my [illegible] I bring not Benjamin back" According to Philip de Comines the Liegois having given hostages to Charles Duke of Burgundy, with express power to put them to death in the event of an infraction of the treaty, and that event having taken place it was much debated in the council whether the power should not be carried into execution, and after much discussion their lives were spared It has also been questioned whether an hostage can be delivered up against his will Grotius decides in the affirmative The extent of the rights of conquerors over hostages, the events which may dissolve their obligation, the effect of their escape upon the convention between the principals, and other points of the subject are treated at length by writers on national law

HOTCHPOT in Law, is a blending or mixing together of lands given in marriage with lands in fee falling by descent As if A had two daughters, and gives a third part of his lands in marriage with one of them to her husband, and dies seised of the other two thirds in order to acquire any further share of these lands the married daughter must bring the lands first given into hotchpot, that is she must renounce the gift and allow the land to be confounded with the rest, in order that she may inherit her whole share, otherwise her sister will have the remaining two thirds of the lands There is also a rule of hotchpot with respect to the distribution of personal property within the stat 22 & 23 C 2 c 10, as, where a certain sum is to be raised and paid to a daughter for her portion by a marriage settlement, if the daughter would have any further share of her father's personal estate she must bring this money into hotchpot, and allow it to form part of the distributable residue

HOTEL (Fr) signifies, in a general sense, a large inn for the reception of strangers but in a particular sense, especially in France it is applied to the residences of the king, nobility, or other persons of rank or it is used synonymously with hospital, as the *Hotel Dieu*, *Hotel des Invalides*, &c

HOTHOUSE A general term for the glass structures used in gardening, and including stoves, greenhouses, orangeries, and conservatories Pits and frames are garden structures with glass roofs, with the sides and ends of masonry or wood, but they are generally so low as not to admit of being entered and walked in, and this [illegible] the term [illegible] *See* STOVE, GREENHOUSE, PITS AND FRAMES

HOTWALL In Gardening, walls for the growth of fruit trees, which are built with flues or other contrivances for being heated in severe weather, so as to facilitate the ripening of the wood or the maturity of the fruit The most common form of hotwalls is that in which flues or tunnels are conducted through them, into which the smoke and heated air from fires are made to ascend from a furnace at the bottom of the wall to a chimney on the top, but in some cases hotwalls are formed by constructing the entire wall hollow tying the two sides together by cross stones or bricks, and introducing heat by means of pipes of metal containing steam or hot water along the bottom of the vacuity, the heat of which rises to the top of the wall, and heats every part in its progress In all climates north of the meridian of London, hotwalls are of great use for ripening fruits and young shoots, and [illegible] *See* WALL

HOUNDS In Naval Architecture, the projecting parts of the sides of the mast, near its head, which, like shoulders support the rigging, &c

HOUR in its [illegible] denotes the twenty-fourth part of a [illegible] or of the time in which the earth makes a complete revolution in respect of the sun The division of the artificial day or time from sunrise to sunset, into twelve equal parts belongs to the remotest ages of antiquity (see *Goguet, Origine des Loix* &c), the division of the *night* into the same number of parts was introduced at Rome in the time of the Punic wars The Italians make the day commence at sunset, and reckon on to twenty-four hours, or to the succeeding sunset Astronomers also reckon twenty-four hours from mid-day to mid-day, but in the civil reckoning only twelve hours are counted, namely, from midnight to mid-day, and from mid-day to midnight The hours which result from the division of the artificial day into twelve parts are called *temporary hours*, from being of unequal lengths at the different seasons of the year

HOUR CIRCLES, or HORARY CIRCLES The same as meridians, being great circles of the sphere perpendicular to the equator and their planes making with each other angles of fifteen degrees

HOUR GLASS A species of chronometer or clepsydra measuring intervals of time by the running of water or sand from one glass into another

HOURIS The name given by the Europeans to the imaginary beings whose company in the Mohammedan paradise is to form the principal felicity of the *believers* The name is derived from hur al oyun signifying *black-eyed* They are represented in the Koran as most beautiful virgins with complexions like rubies and pearls, and possessed of every intellectual and corporeal charm They are not created of clay as mortal women, but of pure musk, and are endowed with immortal youth, and [illegible] the disease and defects of ordinary beings (See *Koran* chaps 55, 56, Sale's translation, and the Prel Discourse, s 4)

HOURS (Gr Ὧραι) [illegible] in two points of view—as [illegible] hours of the day, and their number is stated in different ways accordingly Their duty was to hold the gates of heaven which they opened to send forth the chariot of the sun in the morning, and receive it again in the evening No classical poet has described them with greater beauty than Shelley [illegible] *Prometheus Unbound* [illegible] ted as forming the train [illegible] *Hymn to Ven* 145, Hes, *Theog* ver 75, and *Hymn ad Apoll* ver 194, see also *Gray's Ode on the Spring*)

HOURS, CANONICAL The seven hours of prayer, observed, it is said, by the Catholic church since the 5th century, chiefly in monasteries The number seems before that time to have varied, although some peculiar seasons of the day and night were always set apart for this observance They became finally fixed at seven by the rule of St Benedict, a number, perhaps, recommended by the literal acceptation of the words of David (Psalm cxix), "Seven times a day will I praise thee" These hours are termed, in the language of the Latin church, matins, prima tertia, nona, vespers, completa or completorium, which last takes place at midnight At the time of the Reformation the canonical hours were reduced in the Lutheran church to two, morning and evening, the "reformed" church never observed them (See *Bingham's Ant Eccl*, *Riddle's Christian Ant*, *Ersch and Gruber's Encycl* Horæ")

HOUSE (German [illegible]) A human habitation, or place of abode of a family Among the eastern nations, and those to the south, houses are flat on the top, with the ascent to the upper story by steps on the outside As we proceed northward a declivity of the roof becomes requisite to throw off the rain and snow, which are of greater [illegible] The [illegible] enclosed [illegible] The part of the [illegible] and *impluvium*, or *cavadium*, and was provided with channels to carry off the waters into the sewers Both the Roman and Greek

house is described by Vitruvius, to whose works we must refer the reader for further information on these heads The word *house* is a term used in various ways, as in [illegible] retired to the lodge connected with the mansion, or to their country seat, it was called "keeping their secret house" (See *Northumberland Household Book*) Every gradation of building for habitation, from the cottage to the palace, is embraced by the word house, so that to give a full account of the requisites of each would occupy more space than could be devoted to the subject in this work indeed to say more would be to write a treatise on [illegible]

HOUSEHOLDER In Law the occupier of a house Where the right of voting for members of parliament is in inhabitant householders, it has been settled by a current of decisions that no one is to be considered as such who does not possess the exclusive right to the use of the outward door of the building He retains the character, however, although by taking inmates he may for a time have relinquished the exercise of that exclusive right The "outward door," to satisfy this description need not be a door opening on the public way, a room or set of rooms having a separate and exclusive outward door (as chambers in one of the Inns of Court) may in the eye of law constitute a house The same principle is followed in criminal law, where to constitute the offence of burglary, it is necessary that a 'house' shall have been broken and entered

HOUSEHOLD, THE KING'S The chief officers of the king's household are —1 The lord chamberlain, under whom are the vice-chamberlain, groom of the stole lords of the bedchamber gentlemen of the privy chamber &c 2 The lord steward in whose office are the treasurer and comptroller of the household, yeomen of the guard, gentlemen pensioners, master of the horse, &c

HOUSEHOLD TROOPS See GUARDS

HOUSE OF CORRECTION A prison for the punishment of idle and disorderly persons vagrants trespassers, &c They are regulated by 4 G 4 c 64 and other statutes See BRIDEWELL, PRISON

HOUSING (From house) In Architecture the space taken out of one solid to admit of the insertion of another

HOVEL An open shed for sheltering cattle for protecting produce or materials of different kinds from the weather, or for performing various country operations during heavy rains, falls of snow or severe frosts

HOWITZER (Germ haufen *to heap*) A species of mortar, or piece of ordnance of iron or brass The iron howitzers used in the British service are four or five feet long, and eight or ten inches diameter

HOY A small vessel hav[illegible] mast

HUBERT, ORDER OF ST [illegible] highest Bavarian order [illegible] founded in 1444

HUE AND CRY In Law, the common process of pursuing a felon This custom is of ancient origin and evidently arose from the practice of pursuing the offender with a loud outcry, that all might try to bring him to justice

HUGUENOTS In French History [illegible] the sixteenth century to the Protestants of France The writers of that time were not acquainted with the true derivation of this popular nickname, to which they assigned various absurd etymologies, as, [illegible] the German "Eidgenossen" [illegible] crates Geneva [illegible] the literary and ecclesiastical metropolis of the French reformed, and consequently they were naturally confounded, in the eye of the Catholic populace with the Swiss who supported that republic by their alliance After a long period during which they increased in numbers under occasional persecution (under Francis I and Henry II) a large party of the Huguenots took part in the conspiracy of Amboise in 1560, and although the free exercise of their [illegible] by the edict of January [illegible] by the violations of that [illegible] government of Francis II in the same year At that period their leaders were of the houses of Bourbon (King of Navarre and Prince of Conde) and Chatillon (the Admiral Coligny) They were powerful in numbers, and still more in wealth and consequence A very large proportion of the higher nobility, of the middle nobility [illegible] especially in the central and south-western [illegible], the whole [illegible] the peasantry in some districts, especially of the south, where the doctrines of the Albigeois were never fully ex[illegible] to their party But during [illegible] 16th century they gradually lost ground under the increasing zeal and fanaticism of the great Catholic body, and after the conversion of Henry IV most of their chiefs among the nobility successively abandoned the faith They sustained two civil wars in the following century against Louis XIII, which cost them the loss of the strongholds which they had held and of many of their [illegible] The history of the Protestant church in France then ceased to be the history of a political party, and the name of Huguenots, [illegible] began to [illegible] ordinary use De Thou, D'Aubigny, Perefixe, and perhaps the most valuable [illegible] contemporary historians of the 16th century Of modern compilations, *Smedley's History of the Religious Wars of France*, Wraxall, Sismondi, vols xvi to xx, *Browning's History of the Hugonots from the Edict of Nantes*, an useful compendium, with references to the best authorities, published in 1839

HUISSIER (From the old word huis, *a door*, whence our *usher*) Executive officers in the French courts of justice whose original function was to keep the door of the tribunal Such officers were styled by the Romans apparitores, cohortales, executores, and by a variety of other names In France the huissiers were originally a subdivision of the general class of *sergents*, *sergens* but afterwards these latter came to be called indiscriminately huissiers Their functions are now numerous and important They give notice on behalf of and execute the processes of the courts to which they are attached both civil and criminal Those of the Court of Cassation [illegible] elt, those of the Cours Royales on [illegible] of those courts, those of courts of commerce by the government The officers termed huissiers priseurs or commissaires-priseurs, are employed [illegible] ublic sales

HUMMING [illegible] In Music, the secondary or superior note in a shake See HARMONY

HULK The name given to an old ship laid by as unfit for further service The hulks at Woolwich consist of old ships to which convicts are sent previously to their departure from the country

HULL The body of a ship, exclusive of the masts, rigging &c

*Hull down* expresses that the hull of the ship is concealed by the convexity of the sea

HUMANITARIAN A term sometimes applied to those who deny the divinity of Christ, and assert him to have been *mere man* This however, is more than the word exactly signifies and the term Psilanthropist, or mere Humanitarian has been [illegible] ying the idea more precisely See [illegible]

HUMANITIES A word employed in modern European schools and colleges of various nations, to signify grammar rhetoric and poetry, including the study of the ancient classics It has the same sense with polite literature A student in humanities (litera humaniores) is termed a *humanist*

HUMBOLDTILITE See MELLILITE

HUMBOLDTINE (so called in honour of Baron A Humboldt) A native oxalate of the protoxide of iron It occurs crystalline and massive and of a yellow colour, the massive variety is earthy and greenish yellow

HUMBOLDTITE A name given to a variety of *Datholite* or borosilicate of lime It occurs crystallized These minerals are named in honour of Humboldt, the celebrated traveller

HUMERUS (Lat) The bone of the arm The first of the radiated system of bones of the interior extremity, articulated with the scapula in the vertebrated animals In Entomology Mr Kirby so calls the third joint of the anterior pair of legs in Hexapod insects

HUMIFUSUS (Lat humus, *the ground* [illegible] *I pour or spread out*) In Botany de[illegible] of plants over the surface of the ground procumbent

HUMIRIACEÆ (Humirium one of the genera) A natural order of arborescent or shrubby Exogens inhabiting Brazil, but not very well understood They differ from *Melaceæ* in their albuminous seeds and their slender embryo, agreeing in the latter respect, and in their balsamic wood with *Styracea* *Humirium floribundum* yields on being wounded a liquid yellow balsam, called Balsam of Umiri resembling the properties of Copaiva and Balsam of Tolu

HUMITE A mineral named in honour of Sir Abraham Hume, in whose celebrated collection it was found It occurs in yellow brown or colourless crystals on Monte Somma It has not been analyzed

HUMMING BIRD See TROCHILUS

HUMOUR See WIT

HUMOURS OF THE EYE See EYE

HUNDRED A hundred is a territorial division, having for its object the more convenient and efficient administration of justice, anciently subsisting in other countries, particularly France and Lombardy, as well as in England and adopted in this country as the subdivision of a county The institution of the hundred, as well as [illegible] the courts and tything is upon no precise [illegible] usually referred to the reign of Alfred, but [illegible] that it was not introduced into all parts of England at the

same time It is certain, at any rate, that the term had not in all parts the same application the meaning usually given to it, namely, the district containing a hundred free families, even if it be reconcilable with what appears to have been in early times the state of the population in the southern counties, is totally inconsistent with any reasonable conjecture as to the population of the north, where the hundred generally includes a much larger district It is probable therefore, that the te
ning st
previously
name of Wapentakes To each hundred belonged a court baron, similar in the nature and extent of its jurisdiction to the county court and also a court leet (*see* LEET), both of which were usually and by the common law, held either by the sheriff, or by a deputy or stew him But in some cases the aron and court leet or of one of them, within the hundred, was by special grant of the crown vested in private persons and exercised by them or their deputies The essential use of the hundred was in the liability of the hundredors when offences were committed within their district, either to produce the offender, or make good the damage This liability much restricted by statute still subsists in certain cases of riotous and wilful mischief The division into hundreds is frequently used in acts of parliament as a convenient mode of reference

HUNDRED WEIGHT A denomination of weight containing 112 pounds It is subdivided into 4 quarters, each of 28 pounds *See* WEIGHTS

HUNTSMAN'S *Tenants* A tribe of spiders so called which are incessantly running or leaping about in the vicinity of their abode to chase and seize their prey

HURDLE A frame usually made of wood but some-
t
l
are fixed five or six horizontal bars and the whole is braced together by one or two diagonal pieces When a fence is to be formed the hurdles are put down end to end, and they are made fast to the ground by the insertion of the lower end of the stakes into it and to one another by a tie fastened round their upper ends, or by a moveable wooden pin passed through them

HURONIA A name given by Mr Charles Stokes to certain radiated articulated bodies formerly referred to the *Polyparia* found in the transition lime stone of Lake Huron (*Geol Trans* vol i New Series)

HURRICANE (Span huracan) A violent storm generally accompanied by thunder and lightning and distinguished from every other kind of tempest by the vehemence of the wind and the sudden changes to which it is subject Hurricanes prevail chiefly in the East and West Indies the Isle of France and in some parts of China The following graphic description of the usual phenomena attending the West Indian hurricanes from the pen of Edmund Burke may be interesting to the reader —'It is in the rainy season principally in the month of August more rarely in July and September that they are assaulted by hurricanes the most terrible calamity to which they are subject from the climate This destroys at one stroke the labour of many years and frustrates the most exalted hopes of the planter and often just at the moment when he thinks himself out of the reach of fortune It is a sudden and violent storm of wind, rain thunder, and lightning attended with a furious swelling of the sea, and sometimes with an earthquake, in short, with every circumstance which the elements can assemble that is terrible and destructive First they see, as a prelude to the ensuing havoc whole fields of sugar canes whirled into the air and scattered over the face of the country The strongest trees of the forest are torn up by the roots and driven about like stubble Their windmills are swept away in a moment Their works their fixtures, the ponderous copper-boilers and stills of several hundred weight, are wrenched from the ground and battered to pieces Their houses are no protection, the roofs are torn off at one blast whilst the rain which in an hour rises five feet rushes in upon them with irresistible violence There are signs which the Indians of these islands taught our planters, by which they can prognosticate the approach of a hurricane It comes on either in the quarters or at the full or change of the moon If it will come on at the full moon, you being at the change observe these signs That day you will see the sky very turbulent You will observe the sun more red than at other times You will perceive a dead calm and the hills clear of all those clouds and mists which usually hover about them In the clefts of the earth, and in the wells, you will hear a
like the rushing of a great wind
much larger than usual, and surburs The north-west sky has a black and menacing look, and the sea emits a strong smell and rises into vast waves, often without any wind The wind itself now forsakes its usual steady easterly stream, and shifts about to the west, from whence it sometimes blows with intermissions violently and irregularly for about two hours at a time You have the
the moon The moon itself is
bur, and sometimes the sun has the same appearance" *See* STORMS, TORNADO

HURST (Sax) A wood, hence the termination of the names of several places in England, particularly in Kent and Sussex

HUSBANDRY A comparatively primitive term, including both agriculture and gardening or all those country occupations which the father of a family is expected to perform in the country The term is very commonly used as synonymous with agriculture The Berwickshire husbandry the convertible husbandry, are terms used in
rotation system which the
kept under

HUSSARS A name given to some well-known equestrian troops used in all the armies of Europe The term is of Hungarian origin (being derived from husz, *twenty*, and ar, *pay*, every *twenty* houses furnishing *one* man), and was first applied to the body of troops raised by the nobles of Hungary on occasion of the appeal made to the latter in 1458 by Mathias Corvin The equipments of such troops are extremely light and elegant and their arms consist of a sabre carbine and a pair of pistols In the British cavalry there are five regiments of Hussars

HUSSITES The followers of John Huss, a Bohemian reformer and divine who was convicted of heresy by the council of Constance and burnt by order of the Emperor of Germany, in 1415 The circumstances attending the rise of this sect are
with a hand there is
writings of Huss and Jerome of Prague were the source from which Luther drew a great part of his opinions and views It is ascertained at the same time that it was from the books of Wiclif that Huss was himself induced to institute his bold innovations into the faith and morals of the church The errors which were charged against him contumacy of the opinions now held by all Protestants, but several of these he himself denied and those for the assertion of which he ultimately suffered have neither been universally held by reformers, nor seem of very great importance They were these —1 That Pope Sylvester and the Emperor Constantine did evil to the church when they enriched it 2 That if any ecclesiastic be in a state of mortal sin he is disqualified for the administration of the sacraments 3 That tithes are not dues but merely eleemosynary On the other hand, he held the Romish doctrine of transubstantiation and the opinion of the necessity of communion in both kinds which became afterwards the most remarkable feature in the doctrines of the Hussites is not reality to be ascribed to their founder The condemnation of Huss is also remarkable, as it is from the circumstances attendant on it that the imputation of not keeping faith with heretics is originally charged upon the Roman church The Emperor Sigismund gave Huss a safe conduct, to secure him from any ill consequences that he might apprehend from delivering himself up voluntarily to be examined by the council Nor did the council assert any right to condemn him They handed him over to the secular arm, to the emperor himself But it is confidently asserted that when the emperor scrupled to violate a promise which was undoubtedly binding upon him, it was at the pressing instance of the pope or cardinals that he allowed the execution to take place The apologists of the Roman Catholics in this matter affirm that this safe conduct imported only that Huss might *go to Constance* without being harmed, the words of the original instrument however, are reported to be, 'Transire, stare, morari, redire liberè permittatis'

After the execution of Huss and of his disciple Jerome in the following year there arose a violent insurrection among their partizans in Bohemia who maintained themselves for many years by force of arms and split into two sects under the denominations of the Calixtines and the Thaborites The former, so called from Latin in the cup in the sacrament were finally reconciled to the church by the concession which they required The latter were so called from the name they gave to the hill on which they pitched their camp in the neighbourhood of Prague, and carried their notions upon the authority of the church and its ministers ceremonies, and all the exterior of religion to the length of an extravagant simplicity The Bohemian Brothers and the Beghards, who gave so great an impulse to the Reformation, were the descendants of this branch of the Hussites (Cochlæus, *Historia Hussitarum Gieseler's Text book*, iii 355 translation)

HUSTINGS (Either from the French hausser, *to lift*, or Sax hus, *house*, and ting, *court* or *judgment*) The principal court of the city of London, held before the lord mayor and aldermen also, in common language, the booth or elevated place on which candidates at a parliamentary election are proposed, and address their constituents

HUTCHINSO'NIANS The name given to those who [illegible] Hutchinson, a well-known [illegible] in the 18th century Though [illegible] have never constituted a sect, they have reckoned among their number several distinguished divines both of the established churches of the United Kingdom and of [illegible] The number of professed Hutc[illegible] creasing through the principle and views of their founder are still entertained by many The characteristics of Hutchinson's philosophy consist in his rejection of Newton's doctrine of gravitation and in his maintaining the existence of a revelation on the authority of the Old Testament, which according to him embraces a complete system of natural philosophy as well as of religion See his works 12 vols 8vo 1748

HY'ACINTH (Gr ) In Mineralogy, one of the names given to the yellow or brown crystals of zircon It occurs in beds of streams and rivers especially in Ceylon, along with rubies, sapphires, &c Its most usual form, when in crystals, is a four-sided prism terminated by four rhombic planes

HYACI'NTHUS In Grecian Mythology, the son of Amyclas king of Laconia, and of the muse Clio accidentally killed by Apollo while they were playing at quoits The story is thus related —Zephyr, enraged at the preference displayed by Hyacinthus for Apollo caused the wind of which he was the god to turn from its course a quoit thrown by Apollo which hitting him on the forehead instantaneously caused his death The latter immortalized his favourite by causing the flower which still bears his name to spring from his blood, and inscribing on its leaves to in[illegible] the [illegible] grief of the god for his loss An annual festival named Hyacinthia was celebrated at Amyclæ in honour of Hyacinthus (*Athen Deipn* iv p 139)

HYACY'NTHINE A brown or greenish mineral in eight-sided prisms, transparent and doubly refractive

HY'ADES (Gr *ὑειν to rain*) In Mythology the name given to the daughters of Atlas and Pleione who overwhelmed with grief at the fate of their brother Hyas, who was torn in pieces by a bull, are said to have wept so [illegible] compassion, took them [illegible] Bull's forehead where they still continue to weep and are thence supposed to presage rain They form a cluster of five stars in the face of Taurus

HYADES *See* TAURUS

HYÆ'NA (Gr *Ὑαινα*) A genus of digitigrade Carnivorous Mammals, separated by Storr from the *Canis* of Linnæus, from which it not only differs in dentition [illegible] *Felis*, the genus *Hyæna* is placed by Cuvier The characters [illegible] smooth, and remarkably large, adapted for breaking the bones of their prey the tongue has a broad patch of cuticular spines on the anterior part of its dorsum the legs are each terminated by four claws, there is a peculiarly large perineal glandular pouch, and the neck and jaws are remarkable for the strength of their muscles The species of hyæna are nocturnal, they prey on dead carcasses An extinct species (*Hyæna spelæa*) was abundant in England and France anterior to the glacier epoch [illegible] verns in both countries

HYALE'A (Gr [illegible]) A genus of beautiful Pteropodous Mollusks, remarkable for the delicacy and transparency of the shell This bears a close resemblance to a bivalve with the two valves unequal and soldered together at the hinge That portion of the shell which corresponds to the ventral aspect of the animal is convex, the dorsal plate is nearly flat, and is longer than the other, the hinder or closed margin of the shell is produced into three sharp points The inhabitant is provided with two large wing-like processes of the mantle, which it protrudes, when swimming, from the anterior open fissure of the shell The species are found floating in the Mediterranean and tropical seas

HY'ALITE (Gr *ὕαλος λίθος, a stone*) A yellow or grey variety of uncleavable quartz or opal, it is commonly concretionary or chalcedonic, of a vitreous fracture and lustre It occurs in trap rocks in grains, filaments, and rhomboidal masses it is silica combined with about 6 per cent of water

HY'ALOID (Gr *ὕαλος*, and *εἶδος form*) A term applied to transparent membranes, and more particularly to that which invests the vitreous humour of the eye

HYBERBO'REANS (Gr *ὑπερ beyond* and *βορέας the north wind*) The name given by the ancients to the unknown [illegible] globe wh[illegible] placed by [illegible] sequently to enjoy a mild and delightful climate The question of the existence and exact situation of the Hyperboreans long formed one of the most intricate in the whole compass of ancient history, but the general opinion now inclines to regard them as synonymous with [illegible] ans, and some other nations of [illegible] he *Encyc des Gens du Monde*)

HYBERNACULUM A term invented by Linnæus to denote a leaf-bud, which he rightly considered the winter quarters of the point of growth in a plant

HYBERNATION (Lat hybernus, *wintry*) The act by, or the state in, [illegible] that season of the ye[illegible], or lack of food prevents their going abroad and performing their customary functions As the state is generally superinduced by the rigours of winter, it has received its denomination from that circumstance, but in the tropics the effects of the hottest and driest weather, in reducing the numbers of the insect world, are such as to render it necessary for many reptiles and some insectivorous mammals as the *Tenrecs*, to pass into a state of inactivity or torpidity, in order to maintain life until the recommencement of the rainy season The condition of hybernation is in fact less the alteration of temperature, than the abstraction of the means of subsistence dependent thereon, [illegible] the [illegible] of insects in the winter season [illegible]

Animals so highly organized as the warm blooded and quick breathing mammalia cannot maintain their complicated organic machinery in action without frequent supplies of food an interruption in this respect of a few days or at most a few weeks, is fatal If, therefore the phenomenon of hybernation had been known only in the cold-blooded classes, an insectivorous mammal in a climate where insects could not subsist for several months in the year would be inconceivable The modification of the vital powers by which a warm-blooded animal is made even temporarily to assume the state and properties of a reptile, is perhaps one of the most striking instances of special adaptations to meet an exceptional case that the history of animals presents When the atmosphere becomes vacant of insect life, and the bat, in its nocturnal flittings would vainly traverse it in search of food, and when the few insects that survive the winter have burrowed too deeply in the earth or concealed themselves in hiding places too secure for the reach of the hedgehog —these species with starvation staring them in the face are preserved by the suspension of those functions the maintaining of which in a state of activity is essentially dependent on an uninterrupted supply of nutriment The bat suspends itself in the innermost recesses of its cave, the hedgehog creeps to its concealed nest, and both resign themselves to deep repose, but the breathing becomes gradually slower than in ordinary sleep, the pulsations of the heart diminish in force and frequency, the supply of stimulating arterial blood to the muscles and the brain is progressively reduced, relaxation of the muscular fibres is converted into stiff inaction and sleep sinks into stupor at length respiration entirely ceases and with it those chemical changes in the capillary circulation on which animal heat mainly depends The preservation of life in its passive or latent state, is now due to the irritable property of the heart's fibre, which is excited to contract by the blood in its present dark or carbonized state and continues to propel it slowly over the torpid frame during the whole period of hybernation This slow circulation of venous blood through both the pulmonic and systemic vessels is the only recognizable vital act during that period, and the material conveyed by the absorbents into the circulating fluid is sufficient to counterbalance the slight waste thus occasioned So long therefore as the state of torpidity continues, the hedgehog and bat are independent of supplies from without but they purchase that independence by a temporary abrogation of their vital faculties cold, senseless motionless and asphyxiated, their entry into death's chamber is prevented only by their being brought to his very door

The hybernation of lizards, snakes, frogs toads, and other cold-blooded reptiles, is accompanied by analogous [illegible] as the heart in [illegible] propel blood imperfectly oxygenated, —as the respiratory or oxygenating apparatus is imperfect, —and as the heat of the body in them rises and falls with the external temperature, a slight deterioration of these lower conditions of the circulating and respiratory functions induces torpidity, with the consequent loss of [illegible] dependence of food Some quadrupeds, as [illegible] and squirrel, which subsist on articles of diet better adapted to be laid up in store than insects, carry a winter provision to their [illegible] ever wholly suspended, the waste of the organism is proportionate to the degree of activity in the working of the machine and they occasionally rouse themselves and take in the requisite supply from their provident store Insectivorous birds, being independent, through their power of traversing space, of the vicissitudes of climate

and their consequences, transport themselves, when their food fails in one country, to [illegible] favourable to its [illegible] of the cuckoo and [illegible] he genial season, and [illegible]

HYBRID [illegible] The produce of a [illegible] een impregnated by a [illegible] genus [illegible] which result from the connection of different varieties of the same species, as the produce of the wild boar and domestic sow, the endless modifications which result from analogous inter breeding from varieties of the rose and other ornamental or useful plants are familiar examples of the principle among vegetables

Specifical hybrids have been produced from the artificial fertilization by Kœlreuter of the *Nicotiana rustica* with the pollen of the *Nicotiana paniculata*, and Schiek has demonstrated, by numerous observations, that a multitude of plants produce specifical hybrids in a state of nature

Hybrids from different species of insects under similar circumstances, have been obtained, as from the connection of *Papilio jurtina* with *P janira*, of *Chrysomela ænea* with *Chr alni*, of *Phalangium cornutum* with *Ph opilio* Specifical hybrids have been obtained in the class of fishes by artificial impregnation between the *Cyprinus carpio* and *Cypr carassius*, and between the *Cypr carpio* and *Cypr gibelio* In birds, hybrids have been bred between the goldfinch and canary, between the reeves and the common pheasant—the pheasant and the common fowl—the swan (*Anas olor*, L.) and the [illegible] L *)—between the *Tetrao tetrix* and [illegible] between the *Corvus corone* and *Corvus cornix*, &c Among Mammals, hybrids have been produced between the lion and tiger, [illegible] and [illegible] the dog and jackal, the dog and fox [illegible] the horse and zebra, the zebra and ass and the horse and ass, the produce of the two last species, as it is the most common and useful of hybrids, being termed *par excellence* "the mule"

But a fruitful connection is not only possible between individuals of different varieties or of distinct species, but also occasionally between animals of different genera Generical hybrids have thus resulted from the union of the goat (*Capra hircus*) with the antelope (*Antilope* [illegible] of the stag with the cow, and of the [illegible] p, notwithstanding their disparity of size Among reptiles between the toad (*Bufo*) and the frog (*Rana*), among insects, between *Cantharis melanura* and *Elater niger*, and between *Melolontha agricola* and *Cetonia hirta* Experiment alone can determine the amount of affinity beyond which fertilization is impracticable, but at present it seems to be restricted to individuals [illegible] to genera of the same natural group

The tendency of all the natural phenomena relating to hybridity is to prevent its taking place, and when it has occurred to arrest the propagation of varieties so produced, and to limit their generative powers so as to admit only of reversion to the original specific forms

It would seem that in most cases the fertilizing particles had a specific power over the ova derived from the same species, or were attracted by them in a peculiar manner, for the milt and roe of different species of fishes are not unfrequently excluded in the same locality, yet hybrids are not met with in consequence Spallanzani was not able to impregnate the ova of the frog with the semen of the newt, nor to produce a fertile combination of those of the toad and newt, nor did the injection of the semen of the dog into the vagina of the cat impregnate any of her ova

The individuals of different species which produce a hybrid offspring do not voluntarily copulate The salacious mare must be blindfolded, [illegible] ass The stallion refuses to mount the she ass, if a mare be in sight Hunter states that, being desirous "to have a she-wolf lined by some dog, she would not allow any dog to come near her, but was held while a greyhound dog lined her, while in conjunction she remained pretty quiet, but when at liberty endeavoured to fly at the [illegible] B [illegible] the wolf, fox, and dog [illegible] each other, but when they were in heat, the females of each species exhibited an insurmountable repugnance to the male of the others, and mortal combats ensued instead of fertile union between the different sexes of the different species (*Annales du Muséum*, t xii p 119)

In a few exceptional cases, serving only to establish the rule of their infertility, specifical hybrids have been known to propagate together, and produce a degenerate intermediate race, which soon becomes extinct it more commonly happens that a hybrid is sterile, or propagates only with an individual of pure breed

On the assumption that a hybrid produced by two individuals of undoubtedly distinct species is sterile, experiments have been made on the breeding powers of hybrids, to determine the nature of doubtful species. Thus Hunter believed that he had obtained absolute proof of the jackal being a dog, and to have equally made out the wolf to be of the same species, and he then proceeds to speculate whether the wolf is from the jackal, or the jackal from the wolf, for he had obtained pups from the connection of a female hybrid jackal dog and a male terrier, and between a female hybrid dog wolf and a male greyhound, and he adds, in respect of the latter fact, that "it would have equally proved the same fact if she had been lined either by a wolf, a dog, or one of the males of her own litter" (*Hunter's Animal Œconomy* by Owen 8vo p 323) But this assertion, that the [illegible] hybrid with an individual of a pure breed proves the fact of the identity of two supposed distinct species equally with the production of offspring from the connection of hybrid with hybrid, cannot be admitted. To prove the identity of two supposed distinct species, on the assumption that the fertility of the hybrids from the two gives the proof required, it should be shown that such hybrids are fertile among themselves, and capable of propagating indefinitely an intermediate variety Hunter's celebrated experiments however, only proved that two nearly allied species will produce a hybrid offspring, and that such hybrid may be impregnated by an individual of the pure breed, but this fact illustrates the general law by which the reversion of the hybrid to the pure breed is provided for, while, on the other hand, the intermixture of distinct species is guarded against by the aversion of two specifically different individuals to sexual union

HYDA'RTHRUS (Gr *υδωρ*, and *ἀρθρον*, *a joint*) The white swelling the joints most subject to it are the knee, elbow, wrist, and ankle It is distinguished from rheumatic swelling of the joints by a fixed and wearing pain preceding the tumefaction and often existing for a long time before [illegible] of this part is perceptible also by the [illegible]

HYDATIDS, [illegible] (Gr [illegible], *a bladder*) A term somewhat vaguely applied both to morbid cysts and true Entozoons of the order *Cystica* Of the latter some are globular with a tunic composed of a double albuminous membrane between which the sporules or ova are developed In the species developed in the human liver, the ova are detached from the internal surface, and it is hence termed *Acephalo-cystis endogena* In a species infesting similar organs in the lower animals the ova are detached from the external surface, and it is called *Acephalo-cystis exogena* In a higher organized genus of Hydatids a slender more or less elongate process is continued from the cyst, and terminates in an extremity provided with suckers and a coronet of recurved hooklets, like the head of a tape-worm this genus is termed *Cysticercus* Another genus has numerous similarly organized [illegible] attached to the cyst, and is accordingly termed *Canurus* It is an hydatid of the last genus which is developed in the brain of [illegible] or "staggers" [illegible] nd, common in Domesday Book and old English charters Its derivation is obscure It is somewhat fancifully drawn from the ancient fable (common to many nations) of the deceit practised by a colonist [illegible] from the owners so much land as he could cover with the hide of an ox, and then dividing it into strips so as to make it extend over a large space Its contents are also uncertain, but are stated by some authorities to amount to 100 Norman or 120 English acres (*Warner's Hist of Hampshire*, *Ellis's Introduction to Domesday*)

HY'DRA In Mythology, a fabulous many-headed monster, which was said to infest the lake Lerna in Peloponnesus According to the fable, on one of its heads being cut off it was immediately succeeded by another, unless the wound was cauterized It was one of the labours of Hercules to destroy this monster, which he is said to have accomplished by the constant application of firebrands to the wounds as the heads were cut off The term *hydra* is sometimes used in a metaphorical sense for any manifold evil

HY'DRA This once dreaded name is restricted in modern Zoology [illegible] of the fresh water Polyps The term *Hydrus* was applied by Linnæus to a genus of water-snakes

HY'DRA One of the ancient constellations in the southern hemisphere

HYDRA'CIDS Acids containing hydrogen as one of their essential elements, such as the hydrochloric or [illegible]

HYDROCELE [illegible] (Gr *υδωρ*, *water*, and *κηλη*, *a rupture*) The [illegible] which [illegible] from the intestines

HYDRA'RGO-CHLORIDES Compounds of the bichloride of mercury with other chlorides, forming a class of haloid salts

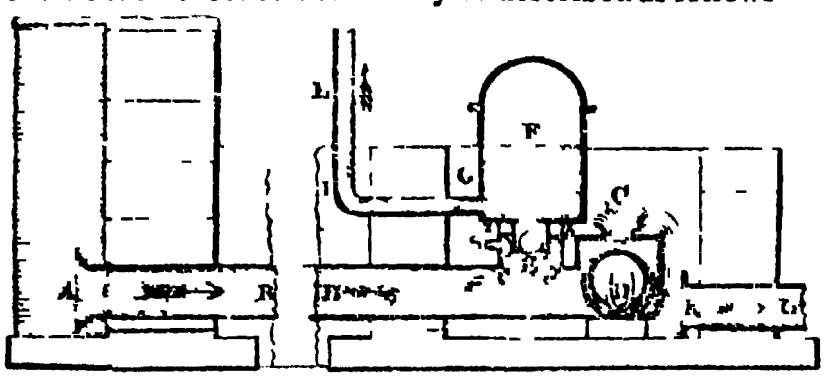
HYDRARGY'LLITE (Gr *υδωρ*, Lat argilla, *clay*) A name given to the native phosphate of alumina, under

the erroneous idea that it consisted of alumina and water

HYDRARGY'RIA (G[illegible]) [illegible] silver, or mercury

HYD[illegible] containing water as one of their proximate elements, and in definite proportion Caustic potash is a *hydrate of potassa*, composed of 1 equivalent of potassa = 48, and 1 of water = 9 Slaked lime, which is an apparently dry white powder, is a *hydrate of lime*

HYDRA'ULIC RAM, or WATER RAM An ingenious hydraulic machine for raising water by means of its own impulse The principle of its action and the mechanism of its construction may be described as follows —




The water arriving at A from the reservoir with the velocity due to the height of the fall passes along the pipe A B, which should have an inclination of at least an inch for every two yards, escapes through an orifice C, which may be shut at pleasure by means of a valve A reservoir F filled with air is attached by means of a cylinder *a b c d* to the pipe A B D, in the middle of the bottom of the reservoir F is a circular orifice, to which there is adapted a short cylindrical tube, of which the extremity L is also furnished with a valve Another valve S serves to supply the air to the space comprised between the cylinder *a b c d* and the tube I G I H is an ascensional tube rising from the reservoir F The water which escapes at C is carried off by the waste pipe K L

T[illegible] ps its mode of [illegible] The pipe A B [illegible] extremity where the valves and the reservoir F are placed is called its *head* Both valves D and E are formed of hollow balls supported on nuzzles and of such a thickness of metal that [illegible] which about twice as much as the quantity of water they displace

We may now consider the effects of the engine when in action The water flowing through the orifice C acquires the velocity due to the height of the fall and raises the ball D from its support till it comes to the orifice C the extremity of this orifice is covered with leather, or with cloth filled with pitch so that when the ball is applied to it the passage of the water is effectually prevented As soon as this orifice is closed the water raises the ball E which had shut the orifice of the reservoir F, and a portion of it introduces itself into this reservoir and into the pipe G I H It thus loses the velocity which it had when the orifice C was shut, and the balls D and E fall down in consequence, the one on its support and the other on the orifice at F When this takes place every thing is in the same state in which it was at first The water begins again to flow through the orifice C, the valve D is again shut, and the same effects are repeated in an interval of time, which, for the same ram, [illegible]

Every time the impulse is renewed a quantity of water is forced up into the reservoir F and the tube H, and as it is prevented from returning, by the action of the valve, it must necessarily be delivered at the extremity of H The use of the air-vessel F is to keep up a continuous motion of the [illegible] mn of water The communication with the [illegible] sphere being cut off, the air within F is compressed by a force proportional to the height of the surface of the water in H above its surface in F, and this compressed air acting by its elasticity on the [illegible] H The air-[illegible] ram, is not [illegible] [illegible] [illegible] ischarge of [illegible] rms of which the [illegible] [illegible] in a single branch On this principle works have been erected at Marly, in France, which raise water in a continuous jet to the height of 57 *metres*, or 187 English feet

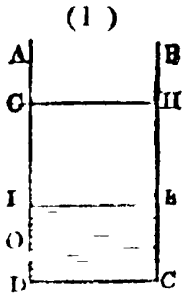
[illegible] of water communicates with the [illegible] this would soon be exhausted if a fresh portion of air were not introduced at each stroke of the ram The little tube S which is stopt by a valve [illegible] rpose At the instant [illegible] takes place, by which the water is thrown back from the head of the ram towards the cistern, and a partial vacuum being thus produced within the cylinder *a b c d*, the pressure of the external atmosphere forces open the valve in the canal S, and a portion of air enters the cylinder, whence it is driven into the reservoir, excepting the small part of it which lodges in the space between the cylinder *a b c d* and the tube E (Hachette, *Traité des Machines*)

The invention of the hydraulic ram, at least in the improved form here described belongs to Montgolfier of Montpelier A machine, however, on the same principle [illegible] by [illegible] in its mode of action, for the orifice C, instead of being opened and shut by the action of the water itself, required to be opened and shut by the hand by means of a stop cock Owing to this circumstance, Whitehurst's machine was of little utility, and appears to have soon been entirely forgotten

HYDRAU[illegible]ICS (Gr[illegible] branch of natural philosophy [illegible] tions of liquids, the laws by which they are regulated and the effects which they produce By some authors the [illegible] to the general sci[illegible], [illegible] *draulics* is more particularly applied to the art of conducting raising and confining water, and to the construction and performance of water-works

There is no part of mechanical science which offers greater difficulties to the mathematician, or where the results of theoretical investigation present so little agreement with experience This arises from the excessively complicated nature of the movements which take place [illegible] the [illegible] liquid mass when its equilibrium [illegible] [illegible] partly from the great number of [illegible] es by which those movements are affected [illegible] principal problem of hydraulics is to determine the velocity with which liquid flows through an aperture in the bottom or sides of the containing vessel

(1)




In order to discover the law of this velocity let A B C D (fig 1) be a vessel filled with water to the height I I and let O be a [illegible] I I from O with a certain velocity depending on the height I I above O I or it therefore is proposed to determine to what height C H the vessel must be filled in [illegible] I [illegible] of hydrostatics it is shown that the force urging a particle of the liquid at O through the orifice is the pressure due to the height of the vertical column above O Now we may consider in the first place that when the velocity of a particle in motion is doubled the momentum, or moving force, must also be doubled and in the second place that if the velocity of the efflux is doubled twice the number of particles will be put in motion in the same interval of time and consequently the momentum or moving force must be doubled on this account also Hence when the velocity of the discharge through O is doubled, the moving force, which in the present case is the pressure must be quadrupled But the pressure is proportional to the height of the fluid above O hence the height must be quadrupled By the same process of reasoning we conclude that to obtain a threefold velocity a ninefold depth would be necessary and so on and, generally that the depths must be increased as rapidly as the squares of the velocities, or in other words, the velocities are proportional to the square roots of the depths of the orifice below the surface

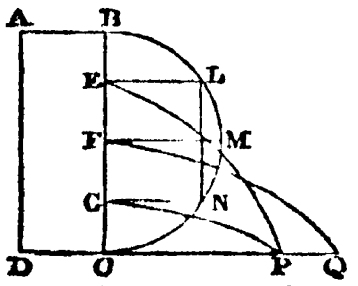
By means of this law the absolute velocity with which water issues from an orifice at any depth under the surface may be ascertained provided we can determine the velocity for any particular depth Now if we suppose the orifice O to be on a level with the surface of the liquid, or if we suppose O to be in the bottom of the vessel covered with an infinitely thin film, there would be no pressure on a particle at O which, therefore, would drop out merely by the effect of its own weight and consequently with the velocity of a heavy body [illegible] fall But the velocity of a falling body is [illegible] to the square root of the [illegible] fallen therefore, since it has been [illegible] the velocity of the discharge through an orifice is also proportional to the square root of the height of the liquid above the orifice, and that the two velocities are the same in one particular case, it follows that they must be the same in all cases, and hence we have this important theorem —"The velocity with which [illegible] a heavy body would acquire by falling from the level of the surface to the level of the orifice

Several consequences [illegible] fundamental theorem In [illegible] is [illegible] with the same [illegible] quantity of water that is [illegible] through an orifice is as the area or section of the orifice multiplied into the square root of the depth Again, if the water is thrown up in a perpen-

dicular jet, it ought to ascend to the height of the reservoir, or if several orifices are made in the same vessel, each presented upwards, the jets escaping from each of them would all rise to the same height But by reason of the resistance of the air, the f[illegible] the orifice, the mutual cohesion of [illegible] which impedes their separation and escape, and the action of opposing currents formed in the interior of the liquid, these conclusions must be received with considerable modifications The effects of the disturbing causes can only be determined by a comparison with experiment

Water [illegible] a hole or pipe in the side of a vessel ke[illegible] other projectiles when the re-

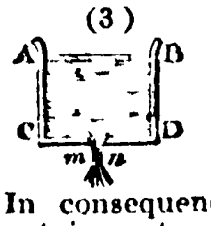
(2)




drical vessel filled with water, and E an orifice in its side, the water will be projected from E with a velocity which would carry it horizontally through double the space B E in the [illegible] B [illegible] L, it escapes at E it begins to descend with an accelerated motion to the level of D C, while it continues its uniform horizontal flight, and thus describes [illegible] P Now, by the [illegible] body moving in a [illegible] through half the [illegible] shown that the velocity at E is equal to 2 B E, therefore the directrix passes through B and consequently 1 B E × 1 C = C P². On B C, as a diameter, let there be described a semicircle B L C, then B E × E C = E L², and consequently C P² = 4 E L², whence C P = 2 E L, or the horizontal range is double the ordinate F L The horizontal range is therefore greatest when the aperture is at F, the middle of B C and is then C Q, which is equal to 2 F M, or to the altitude B C In all other cases there are two apertures, I and G, equidistant from F, which give the same range, for by the nature of the circle there are two equal ordinates, E L and G N

There is a circumstance connected with the efflux of a liquid [illegible] tion W[illegible] ticles continue to descend in vertical lines till they reach within a short distance of the orifice as at C D (fig 3), when those not immediately above it change the direction of their [illegible] which is somewhat without the orifice In consequence of this the vein of water as it issues out is contracted, its breadth at *m n* being less than the width of the orifice This contraction of the jet was first noticed by Sir Isaac Newton, who gave it the name of the *vena contracta*, or the *contracted vein* of the liquid The distance from the orifice at which the contraction is greatest depends in some degree on the magnitude of the orifice, and is e[illegible] when the orifice is circular [illegible] of this contraction is that the discharge of water is not so great as the theory gives it, but is reduced in the proportion of the breadth of the vein where the contraction is greatest to that of the orifice According to Newton this proportion is 5 to 7 nearly, and according to Bossut 5 to 8

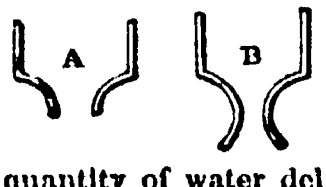
(3)




As the same quantity of liquid must evidently pass through the orifice and the contracted vein in the same interval of time, it follows that the velocity at the latter point must be greater, and therefor[illegible] the theorem re[illegible] the velocity of [illegible] is the velocity at the contracted vein which must be regarded

It is found by experience that if a short tube, about one or two inches long, is inserted in the vessel, and the water be allowed to flow through the tube, the contraction of the vein is very considerably diminished and the quantity of water discharged through the tube is considerably greater in the same time than through an orifice of equal diameter Venturi found that the discharge through a smooth hole in the bottom of a reservoir of tin amounted to 64 quarts in 100 seconds, a short pipe of the same diameter being applied to the bottom of the reservoir, so as to be flat and even with it, the discharge was augmented to 82 quarts in the same time, and on giving the bottom of the vessel the form here represented, leaving the area of the orifice at A (fig 4) the same as before, the discharge was increased to 98 quarts By enlarg[illegible] of the pipe, and [illegible] quantity of water delivered in the same time received a still farther augmentation Such additional pipes are called *adjutages*

(4)




The velocity and other circumstances relative to the motion of water in conduit pipes, and in open canals and rivers, cannot be accurately determined from any theoretical principles, but very numerous experiments have been made on the subject, from which results have been deduced of great value in directing the practice of the engineer W[illegible] horizontal pi[illegible] made in equal times are nearly in the inverse ratio of the square roots of the lengths But this rule applies only within limits which are not very extended, and is not admissible with respect to long pipes It was found by Bossut that water has its celerity [illegible] ng through a tube of one [illegible] In order to obtain the greatest discharge from a pipe, it is necessary that the [illegible] be [illegible] with width uniform, and sudden bend[illegible] The want of evenness of surface impede[illegible] of the fluid, which is further obstructed by any violent change of celerity or direction Whether the channel be contracted or enlarged, the change is unavoidably attended with a proportional loss of impulsion Any sharp flexure of the pipe or conduit will occasion a still [illegible] of the impelling force It is also found that [illegible] pipe discharges less water than a rectilineal one of the same length, and that when the flexures are vertical the quantity discharged is less than when they are horizontal When a large pipe has a number of contrary flexures, the air sometimes mixes with the water, and occupies the highest parts of each flexure, by which means the velocity of the fluid is greatly retarded, and the quantity discharged much diminished

When liquids flow through very small orifices, or capillary tubes, the resi[illegible] is greatly augmented and the rules which apply to [illegible] diameter no longer hold good In this case the celerity depends very considerably on the temperature of the liquid Thus pure water at a temperature near the boiling point is found to flow through a capillary tube five times faster than when the temperature is near the freezing point Alcohol is found to flow six times faster when the temperature is raised 124 degrees Quicksilver is less affected but it endures heat through a wider range

With respect to water running in open channels, or in rivers the resisting forces are so numerous and of so irregular a nature, that it is of little use to attempt to deduce their effect from any general principles In all cases the velocity is increased by the depth of the stream and of the declivity on which it runs to a certain limit; that is, till the resistance, which increases with the velocity, becomes equal to the acceleration, when the motion of the stream becomes uniform The resistance of course depends much on the evenness of the bottom and sides of the channel The greatest velocity of a river is at the surface and in the middle of the stream, from which it diminishes towards the bottom and sides, where it is least. It has been found by experiment that if from the square root of the velocity in the middle of the stream, expressed in inches per second, unity be subtracted, the square of the remainder will be the velocity at the bottom Thus, let $v$ = the velocity at the surface in the middle of the stream, then the velocity at the bottom will be expressed by $(\sqrt{v} - 1)^2 = v - 2\sqrt{v} + 1$ It has also been found by experiment that the mean velocity (or that with which, were the whole stream to move, the discharge would be the same with the real discharge) is equal to half the sum of the greatest and least velocities, as computed by the above formula The mean velocity is therefore $v - \sqrt{v} + \frac{1}{2}$ These formulæ are deduced from the experiments of Du Buat (See *Playfair's Elements of Natural Philosophy*)

When the sections of a river vary the quantity of water remaining the same, the mean velocities are inversely as the areas of the sections, but when the river receives a permanent addition, the velocity is immediately increased The effect of this is to augment the action on the sides and bottom, in consequence of which the width is augmented, and sometimes, though more rarely, the depth This increase of width by [illegible] the points of resistance, again reduces the [illegible] till an equilibrium is established between the velocity and resistance, after which the bed of the river changes only by insensible degrees *See* RIVER

The determination of the force with which a liquid in motion strikes a solid at rest, and the force necessary to propel a solid immersed in a liquid, is another important part of hydraulics, though, of the general principles hitherto deduced [illegible] there are only a very small number which [illegible] approximation to the results of experiment The force of a stream must be [illegible] the force of each particle and that strike in a given time Now the force of each particle is proportional to the velocity with which it impinges, and the number of particles that strike in a given time is also proportional to the velocity of the stream supposing its section to remain the same, hence the whole force of the stream is as the

[illegible] It [illegible] k [illegible] directly on the same plane in the ratio of the cube of the sine of the obliquity to the cube of the radius But it would appear from experiment that this last consequence also holds true when the angle of inclination is greater than 60 degrees It might seem (and it is agreeable to theory to suppose) that the impulse against a liquid at rest with a given velocity would be the same impulse as if the liquid were to move with that velocity and the plane to remain at rest This, however, is not confirmed by experience, which proves that the resistance of a liquid to a body in motion is considerably less than the percussion of the liquid [illegible] velocity with the body at rest The [illegible] from the [illegible] on the hinder part of the moving body by which the resistance is in some degree counteracted But the resistance depends very materially on the figure of the body, and the relation of its length to its breadth A [illegible] its length is considerable, is [illegible] the water with its broad than with its narrow end foremost In general, it is found that whatever tends to diminish the adhesion of the body to the liquid tends also to diminish the resistance A wedge which has its sides rubbed with grease is found to move more freely through the water, hence the great benefit derived from sheathing a ship's bottom with [illegible]

[illegible] the best works on this subject [illegible] *Traité d'Hydrodynamique*, Belidor, *Architecture Hydraulique*, Du Buat *Principes d'Hydraulique* Prony, *Nouvelle Architecture Hydraulique*, and *Recherches Physico Mathématiques sur la Théorie des Eaux courantes*, *Experimental Inquiry concerning the Motion of Fluids*, by J B Venturi translated by W Nicholson, *Ency Brit*, articles Hydrodynamics," "River" &c

HYDRIO'DIC ACID A gaseous compound of hydrogen and iodine, obtained by the mutual decomposition of iodide of phosphorus and water It is composed of 126 iodine + 1 hydrogen and its equivalent therefore is 127 [illegible] this gas is 4 4 One hundred cubic inches weigh 136 grains It is rapidly absorbed by water, furnishing a sour, colourless, and dense liquid which soon becomes brown by exposure to air in consequence of the evolution of a little free iodine It is instantly decomposed by chlorine, which abstracts the hydrogen to form hydrochloric (muriatic) acid, and sets the iodine free

HYDROBRO'MIC ACID A gaseous acid composed of 78 bromine + 1 hydrogen It is obtained by the mutual [illegible] romide of phosphorus and water

HYDROCA'RBON A term applied by chemists to compounds of hydrogen and carbon These elements unite in several proportions and form a variety of curious definite combinations, which are commonly termed *hy* [illegible]

HYDROCARBURETS Compounds of hydrogen and carbon There appear to be several definite combinations of these elements, among them the following deserve especial notice —1 *Light carburetted hydrogen gas*, which is the *firedamp* of coal mines and of marshes 100 cubic inches weigh about 17 4 grains It consists of 2 atoms of hydrogen = 2, and 1 of carbon = 6, its equivalent is 8 It burns with a pale blue flame 2 *Olefiant gas*, which is formed during the distillation of equal measures of alcohol and sulphuric acid 100 cubic inches weigh 30 5 grains It is composed of 2 atoms of hydrogen = 2, and 2 of carbon = 12, and its equivalent, therefore, is 14 It burns with a bright white flame Coal gas consists of a mixture of these two hydrocarbons The term *olefiant gas* is derived from the action [illegible] upon it, which when mixed with the gas over water gradually condenses it into a liquid looking like oil, which is a *hydrochloride of carbon* 3 *Quadricarburetted hydrogen*, which is produced during the destructive distillation of oil (Faraday, *Annals of Philosophy*, xxvii 44) and which is a vapour condensable at 0°, of which 100 cubic inches weigh 61 2 grains It consists of 4 atoms of hydrogen = 4, and 4 of carbon = 24, and its equivalent is 28 It burns with a dense and very smoky flame This compound has also been called *ethene* 1 volume of the vapour of *ether* being constituted of 1 volume of quadrihydrocarbon and 1 of water vapour 4 *Bicarburet of hydrogen*, obtained, like the last from the volatile products formed during the destructive distillation of whale oil When the quadrihydrocarbon has been distilled off from the more volatile portion, that which remains yields a product which congeals at 0° It is a brittle white solid at that temperature 100 cubic inches of its vapour weigh 85 3 grains, and it consists of 3 atoms of hydrogen = 3, and 6 of carbon = 36, its equivalent [illegible] These are the principal forms of hydrocarbon which have been satisfactorily identified they all afford carbonic acid and water when burned in



a sufficiency of oxygen and the proportions in which these are formed together with the specific gravities of [illegible] which their [illegible] and NAPHTHALINE.

HYDROCA'RDIA Dropsy of the pericardium

HY'DROCE'LE (Gr *ὑδωρ*, and *κηλη*, *a tumour*) A collection of watery or serous fluid in the tunica vaginalis testis

HYDROCE'PHALUS (Gr *ὑδωρ*, and *κεφαλη the head*) Dropsy of the brain, or water in the head The acute form of this disease is almost limited to childhood, it is marked by febrile symptoms, pain of the head, and in very young children it The eyes are irregularly directed and [illegible] The eyes are not perfectly closed in sleep and there appears a degree of delirium as far as can be judged of in children coma, convulsions and paralysis are frequent consequences The ventricles of the brain are the chief seat of the watery accumulation [illegible] the temporal artery or jugular vein [illegible] to the head and brisk [illegible] ding remedies

HY'DROCHARYCEÆ (Hydrocharis one of the genera) [illegible] Europe [illegible] loideous flowers with an inferior ovary They agree with *Alismaceæ* in habit and in want of albumen but differ in their carpels being definite in number They are not of any known use, but many of the species are handsome when in flower

HYDROCHLO'RIC ACID A gaseous compound of 1 atom of chlorine = 36 and 1 atom of hydrogen = 1, the equivalent, therefore, of the hydrochloric acid is = 37 *See* MURIATIC ACID

HY'DROCO'RISÆ (Gr *υδωρ* and *κορις*, *a bug*) The name of a tribe of Hemipterous insects, including the water-bugs, these differ from the *Geocorisæ* or land-bugs in having minute antennæ inserted beneath the eyes This tribe includes the water-scorpions (*Nepidæ*), and the boat-men (*Notonectidæ*)

HYDROCYA'NIC ACID (Gr *υδωρ* and *κυανος*, *blue*) This highly noxious compound was first discovered in Prussian blue and hence called *Prussic acid* It is best obtained by gently heating in a small retort a mixture of three parts of cyanuret of mercury and two of hydrochloric acid the evolved vapours should be passed through a tube containing fragments of marble, in order to absorb any hydrochloric acid that may chance to distil over and ultimately condensed in a receiver immersed [illegible] The hydrocyanic acid is a colourless [illegible] very strong odour, resembling that of bitter almonds, its specific gravity at 45° is 0 7 It boils at 80°, and freezes at 0° Dissolved in a large quantity of water it imparts to it the smell and taste of laurel or bitter almond water it is intensely poisonous It consists of 26 cyanogen + 1 hydrogen, or of 14 nitrogen + 12 carbon + 1 hydrogen, and its equivalent is 27

HYDRODYNA'MICS (Gr *υδωρ* and *δυναμις*, *power*) is the science which applies the principles of dynamics to determine the conditions of motion or rest in fluid bodies It is usually divided into two branches, [illegible] which explains the laws of the equilibrium [illegible] cohesion of fluids, and *hydraulics*, which explains the laws of their motion together with the machines in which they are chiefly concerned Though the term *hydrodynamics* is sometimes applied generally to fluids of all kinds it is more usually restricted to the non elastic or incompressible fluids as water, mercury &c, in which case the science which treats of the equilibrium of the compressible and elastic fluids like air is called *aerostatics* and that which treats of their motion *pneumatics*

Hydrodynamics though a science of immense importance in its applications to the various purposes of life, was not cultivated to any extent by the ancients all their knowledge of the doctrine of fluids being limited to a few propositions regarding the pressure and equilibrium of water Archimedes, indeed, established the general principles which serve as the foundation of hydrostatics, in his treatise *De Insidentibus Humido*, and Ctesibius and Hero, who flourished at Alexandria about 120 years after Christ invented the fountain of compression, the syphon and the forcing pump Julius Frontinus who was inspector of the public fountains at Rome in the reigns of Nerva and Trajan, wrote a work on the Roman aqueducts and the modes of distributing water then in use, but he appears to have been unacquainted with the law of the velocities of running water depending on the depth The first modern treatise [illegible] was published in 1639 by Castelli, a [illegible] entitled *Della Misura dell' Acque Correnti*, and contains a satisfactory explanation of various phenomena in the motion of fluids Torricelli discovered the important property that the velocities of fluids issuing through an orifice are as the square roots of the pressures, Mariotte in his *Traité du Mouvement des Eaux*, employed the principle of Torricelli, and explained the

friction Guglielmini was the first who treated of the motion of water in rivers and open canals The subject of the oscillation of waves, one of the most difficult in the whole science, [illegible] who determine thence concluded that the velocities of waves formed on the surface of water are in the subduplicate ratio of their size He was also the first who observed the contraction in the vein of a fluid issuing through an orifice, and regarded the contracted section as the true orifice, by which [illegible] red more conformable to experience [illegible] of Daniel Bernoulli was published in 1738 His theory of the motion of fluids consists in supposing, 1st, that the surface of a fluid in a vessel, while emptying itself by an orifice, remains always horizontal, and 2d, that the fluid mass is conceived to be divided into an infinite number of horizontal strata, all the strata remain parallel and descend vertically with velocities inversely proportional to their breadth, or to the horizontal sections of the reservoir [illegible] and by means of the application [illegible] theory of the motion of fluids was further investigated by John Bernoulli, Maclaurin, and the celebrated D'Alembert, the latter of whom placed it in an entirely new light by the application of Euler's calculus of partial differences One of the best treatises on hydrodynamics which we possess is that of the Abbé Bossut in which are given the results of a very extensive set of experiments performed with great judgment and accuracy Similar experiments, and more extensively varied, were afterwards undertaken by Du Buat whose *Principes d'Hydraulique*, in three volumes, contains a theory founded solely on the results of experiments Du Buat was the first who determined experimentally the influence of heat in promoting fluidity Among other experiments more recently undertaken for the purpose of throwing light on this interesting and difficult subject we may mention those of Coulomb, of Eytelwein of Berlin of Bidone of Turin of General Sabatier of Metz of Mr George Rennie, and of Mr Jardine of Edinburgh from which some valuable results have been obtained relative to the discharge of water from long pipes

The analytical theory of hydrodynamics resolves itself into the integration of equations of partial differences, a branch of the calculus which we owe to the illustrious Euler Euler himself gave the general formulæ for the motion of fluids, founded on the laws of their equilibrium, and thus reduced the whole mechanics of fluid bodies to a single question of analysis If these formulæ could be integrated, we should be able to determine completely in every case all the circumstances of the motion and action of a fluid subjected to the influences of any forces whatever, but such is the difficulty of the subject that the integration, except in a few limited cases has hitherto resisted the efforts of the greatest mathematicians Lagrange, in his *Mécanique Analytique*, has deduced the analytical formulæ of the motion of fluids from the principle of virtual velocities and thus shown that dynamics and hydrodynamics are only branches of one great principle, and results as it were of a single general formula Laplace, in the *Mécanique Celeste*, has also given the general equations of hydrodynamics and applied them to the questions of the figure of the earth and the tides Since the days of those illustrious mathematicians the theory has been illustrated with reference to applications to particular cases by Poisson, Cauchy, Navier, Challis, and others, but it cannot be said to have received any material extension

Treatises on hydrodynamics are very numerous Besides the works of Lagrange and Laplace and the others above mentioned, we would refer the student to *Bossut's H[illegible]*, *Poisson's Mecanique*, *Moseley's Fl[illegible]* *on Hydrostatics and Hydrodynamics* (*See* HYDROSTATICS and HYDRAULICS)

HYDROFLU'ORIC ACID A highly corrosive and very volatile liquid obtained by distilling in leaden or silver vessels a mixture of 1 part of *pure* fluor spar in fine powder with 2 of sulphuric acid This compound acts vehemently upon glass and all siliceous combinations, it is probably a compound of 18 fluorine + 1 [illegible]

HYDROGEN (Gr *υδωρ*, and *γεννατω*, *to generate*) This important element is only known to us in the gaseous or permanently elastic form It was formerly called *inflammable air*, and was sometimes considered as identical with *phlogiston*, or the matter of heat It is usually procured by the action of sulphuric acid and zinc or iron upon water, or by passing the vapour of water over red-hot iron Pure hydrogen is a colourless, tasteless, and inodorous gas 100 cubic inches at mean temperature and pressure weigh 2·13 grains, so that its specific gravity compared with air is as 69 to 1000, and it is exactly 16 times lighter than oxygen It burns in contact with air with a pale blue flame, and when mixed with three or four times its volume of air, or with half its volume of [illegible] rapidly, and in the lat[illegible] The only product of this combustion is *water*, which is thus shown to consist of 1 part by weight of hydrogen with 8 of oxygen, so that upon this datum the number 8 becomes the equivalent of oxygen, and 9 that of water Hydrogen is not absorbed by water, and animals soon die when confined in it

HYDRO'GRAPHY (Gr *ὑδωρ*, and *γραφω*, *I write*) The description of the waters which exist at the surface of the earth, [illegible] to the bearings of the coasts, [illegible] and other circumstances required to be [illegible] of navigation This term implies that regard to the sea that geography has with regard to the land *Hydrographical charts* or *maps* are projections of some part of the ocean, in which the rhumbs, meridians, parallels &c, with the coasts, capes, rocks, shallows, &c, are laid down for the uses of navigation

HYDRO'GURETS, or HY'DURETS Compounds of hydrogen with metals, &c

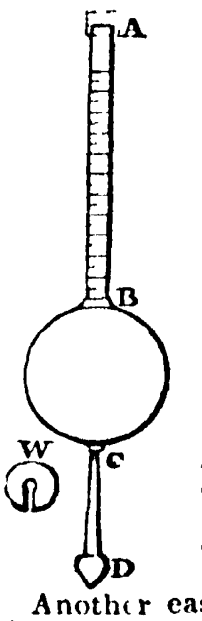
HYDROPHYLLEÆ [illegible] natural order of Monopetalous Exogens, [illegible] *Boraginaceæ* in some respects and *Convolvulaceæ* in others, not, however, climbing like the latter They chiefly inhabit watery places in tropical climates, and have flowers of some beauty, usually belonging to the Cyanic series

HYDRO'LOGY (Gr *υδωρ*, and *λογος*, *discourse*) That part of natural history which treats of water, and of its various properties and modes of existence in nature

HYDROMANCY (Gr [illegible]) Among the [illegible] it was performed in various ways Its origin is ascribed by Varro to the Persians, and Numa is said to have had recourse to it for instruction how he should settle the cere[illegible]

HYDROMEL (Gr *υδωρ* and *μελι*, *honey*) Water sweetened with honey, which, when fermented, forms *mead*

HYDROMETER (Gr *υδωρ*, [illegible]) An instrument for determining the [illegible] liquids, and thence the [illegible], these being inversely as their specific gravities Various instruments of different forms have been proposed for ascertaining readily the specific gravities of fluids, but as Sikes's hydrometer is directed by act of parliament to be used in collecting the revenue of the United Kingdom, it may be considered as more deserving of description than any of the others This instrument is represented




in the annexed figure A B is a flat stem, divided on both sides into eleven equal parts, each of which is again subdivided into two The stem carries a hollow brass ball B C, in which is fixed a conical stalk C D, terminating in a pear shaped bulb D Eight different weights of a circular form, and marked with the numbers 10, 20, 30, 40, 50, 60, 70, and 80, are cut in the manner represented at W [illegible] on the stalk C D When the strength of spirits is to be measured, one of the circular weights is placed on C D, which is found by trial to be capable of sinking the ball so far that the surface of the liquid cuts the stem at one of the divisions between A and B The number of this division is then observed, and also the temperature of the liquid, and the corresponding strength per cent of the spirit is then found in a table which accompanies the instrument

Another easy method of determining the densities of [illegible] ons of a set [illegible] Thrown [illegible] hter float at the surface, but one of them approaching the density of the liquid will be in a state of indifference as to buoyancy, or will float under the surface The number on this ball indicates, in thousandth parts, the specific density of the liquid

HYDROMETRA (Gr *υδωρ*, and *μητρα*, *the womb*) Drop[illegible] of the [illegible]

HYDROMETRIDÆ (Gr *υδωρ*, and *μητρα*, *a birth-place*) A family of *Geocorisæ*, or land-bugs, but of aquatic habits, not, however, living in water, but frequenting the surface

HYDROPERICARDIUM (Gr *ὑδωρ*, and *περικαρδιον*) Dropsy of, or an unnatural accumulation of watery fluid in the sac of the heart

HYDRO[illegible] ACID, or BISULPHURET [illegible] A compound of 2 equivalents of sulphur and 1 of hydrogen its equivalent is 33

HYDROPHANE (Gr *ὑδωρ*, and *φαινω*, *I shine*) A

variety of opal, which is white and opaque when dry, but becomes transparent in water

HYDROPHIDES (Gr ὑδωρ and ὄφις *a serpent*) A name applied to the section of *Ophidians* including the water-snakes These are principally distinguished by having the tail compressed or flattened sideways for the purpose of swimming They are armed with poison fangs, but these are of small size and are associated with a row of minute supplementary teeth

HYDROPHILIDÆ (Gr ὑδωρ and φιλεω *I love*) A family of Pentamerous C species which have short clavate antennæ, long and slender palpi, mandibles bidentate at the tips, body oval and convex, and the legs often ciliated The *Hydrophilidæ*, like the *Dytiscidæ*, are aquatic beetles, and have wings by which they can transport themselves from one piece of water to another, but they are vegetable-feeders, and are less active in their movements than the predatory water-beetles The family includes many genera The typical species *Hydrophilus caraboides*, is common in the stagnant ponds and ditches of this country

HYDROPHOBIA (Gr ὑδωρ, and φοβεομαι, *I fear*) A disease remarkably characterized by alarm at the approach of water and caused by the bite of a mad dog or other rabid animal, but it does not appear capable of being communicated by the human subject At some indefinite period after the bite, and often long after all local injury has healed, itching and pain in the bitten part, heaviness, great restlessness and uneasiness and mental alarm ensue followed by pains about the neck sense of choking, and great irritability and horror at any attempt to drink, although solid food can generally be swallowed Fever vomiting, excessive thirst, spitting of viscid saliva, and difficult respiration then come on with irregular pulse and convulsions under which the sufferer sinks more or less rapidly according to the strength of his constitution Delirium sometimes precedes death but not always, in many instances the judgment appears unaffected It unfortunately happens that nothing in the way of cure and little even as palliation has been successfully effected in this disease, but there appears little doubt that the timely application of preventive measures has been successful and of these the amputation or excision of the bitten part with the application of caustics to it, or both combined are the most efficacious the sooner they are resorted to the better the chance of success but it appears that they may be effective any time before the appearance of symptoms Among caustics the nitric acid is perhaps the most effective It energetically acts upon and decomposes all animal matter and fluids more especially, and if applied very soon after the bite can scarcely fail to be effective it also penetrates the wound and forms a sloughing sore The appearance of madness in dogs in its early stages at least is unfortunately not very well defined nor always easily distinguishable from their other maladies whether the bite is less dangerous before they become evidently rabid than afterwards, seems to be doubtful In general the animal is observed to be unusually dull and unsociable refuses food hangs his head, and appears drowsy he flies at strangers but usually recognizes his master, though with great comparative indifference Afterwards his breathing is quick and heavy, frothy matter runs from his mouth he walks slowly, but occasionally runs and starts forward, at length he forgets his master often falls down flies at every body in his way grows furious, and in four and-twenty or thirty hours dies

HYDROPHYLLIA'CEÆ (Hydrophyllum one of the genera) A natural order of herbaceous Exogens, inhabiting America, very near to *Boraginaceæ* from which they are known by their one-celled, many seeded fruit, and many other characters Some *Polemoniaceæ* have the habit of this order Some of the species of *Nemophila* and *Phacelia* are cultivated on account of their pretty flowers

HY'DROPHYTES (Gr ὑδωρ, and φυτον *a plant*) Plants which thrive in water, a name confined by botanists to Algaceous plants found in fresh water It has been remarked by Mr Lyell (*Principles of Geology*) that the number of hydrophytes is very considerable, and their stations more varied than could have been anticipated, for while some plants are daily covered and uncovered by the tide, others live in abysses of the ocean at the extraordinary depth of 1000 feet, and although in such situations there must reign darkness more profound than night, at least to our organs, many of these vegetables are highly coloured

HY'DROPS (Gr ὑδωρ) Dropsy An unnatural accumulation of fluid in the cellular membrane or cavities of the body

HY'DROPTHA'LMIA (Gr ὑδωρ, and οφθαλμος, *the eye*) Dropsy of the eye

HYDRORACHI'TIS (Gr υδωρ, and ραχις, *the spine*) A tumour upon the spine of infants, at first of a blue colour, but afterwards becoming translucent it is attended with paralysis of the lower limbs, and usually fatal in its consequences

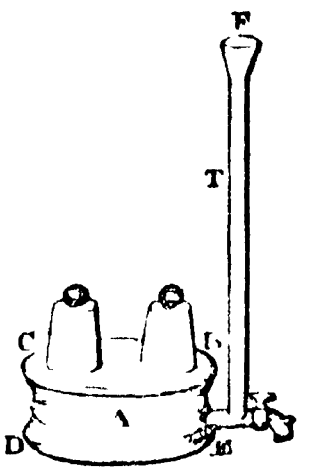
HY'DRO-SALTS Salts formed by hydracids

HY'DROSCOPE (Gr ὑδωρ from ὑδωρ and σκοπεω, *I view*) An instrument anciently used for measuring time by means of the flowing of water through a small orifice [illegible] at the bottom [illegible] water trickled out at the apex [illegible] successively contiguous [illegible] and thereby pointed out the hour

HYDROSTATICA (Gr ὑδωρ and στατικος *I stand*) The name of an order of [illegible] those which have one or more [illegible] their body

HYDROSTA'TIC BALANCE A balance for weighing substances in water, for the purpose of ascertaining their specific gravities *See* BALANCE

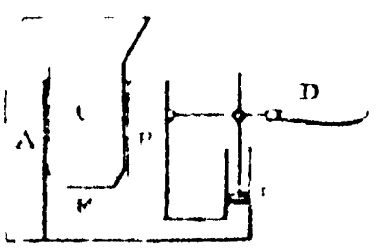
HYDROSTATIC BELLOWS An apparatus for illustrating the *hydrostatic pressure* or the peculiarity of liquids in virtue of which they transmit pressure equally in every direction In the annexed figure B C and D F are two flat boards united by leather or flexible cloth A, water-tight A short tube fitted with a stop-cock communicates with the interior of the bellows by which the liquid may be discharged From the short tube a long tube I rises perpendicularly and terminates in a funnel I The upper board B C is loaded with weights which press it against the lower board D L On pouring water into the funnel F it will descend through the tube T, and enter between the boards, and by continuing the supply a column will be formed in the tube, the weight




of which transmitted through the water in the bellows, will raise and support the weights on the board The load which may be thus raised is easily determined Every portion of the surface of the board B C equal in area to the section of the tube, is pressed upwards by a force equal to the weight of the water in the tube above the level of B C Hence if the section of the tube I is one square inch and the surface of the board B C is 1000 square inches then a column of water in I weighing one pound will sustain a weight on the board of 1000 pounds In this manner a few ounces of water may be made to [illegible] *See* HYDROSTATICS

HYDROSTATIC PARADOX A term frequently employed to designate that principle in hydrostatics according to which any quantity of water however small, may be made to balance any weight, however great *See* HYDROSTATIC BELLOWS

HYDROSTATIC PRESS also called the *Hydraulic Press* and sometimes, from the name of the engineer who gave it the form under which it is now constructed, and brought it into general use *Bramah's Press*, is a machine by means of which an enormous force of pressure is obtained through the medium of water The principle is the same as that of the *hydrostatic bellows*, from which indeed it only differs by the substitution of a strong forcing pump for the long tube and a barrel and piston for the leather and board It consists of a short




and very strong pump barrel A B with a solid piston C of proportionate strength which is pushed upwards against the thing to be compressed by water driven into the barrel beneath it at I from the small forcing pump E If the small pump have only one thousandth of the area of the large barrel and if a man by means of its lever handle D presses its piston down with a force of five hundred pounds, the piston of the great barrel in virtue of the hydrostatic principle of equal pressure in all directions will rise with a force of a thousand times five hundred pounds, or more than 200 tons The hydrostatic press is applied to a great variety of useful purposes, for compressing bales of goods as paper, cotton, wool, tobacco, &c, for expressing oils from seeds, raising weights, uprooting trees &c

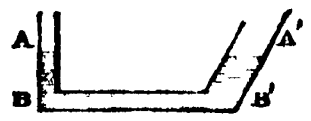
HYDROSTATICS (Gr υδωρ, and στατω, *I stand*), is the science which explains the properties of the equilibrium and pressure of liquids It is the application of statics to the peculiar constitution of water or other bodies existing in the perfectly liquid form

The whole doctrine of the equilibrium and pressure of [illegible] flows from the following fundamental law — "When [illegible] is in equilibrium under the action of forces of any kind, every molecule of the mass sustains an equal pressure in all directions" This law is derived from the very nature of a liquid body, which is such that

all its particles are independent of each other, and perfectly moveable in every direction, whence if any particle sustained a greater pressure in one direction than another, it would necessarily, by reason of the absolute facility of motion with which it is endowed, give way and move towards that part where the resistance is least, and consequently there would not be equilibrium

One of the most obvious consequences of the above law is, that the surface of a liquid when at rest in an open vessel, and acted upon by no other force than gravity, is horizontal, or perpendicular to the direction of gravity If the directions of gravity are parallel, the surface will consequently be a plane, if they converge to a point, the surface of the liquid will be a portion of a sphere Stagnant water at the surface of the earth, therefore, assumes the spherical figure, but by reason of the magnitude of the sphere the curvature of any small portion of it is insensible, and the surface may [illegible] A [illegible] perfect [illegible] eight inches in a mile

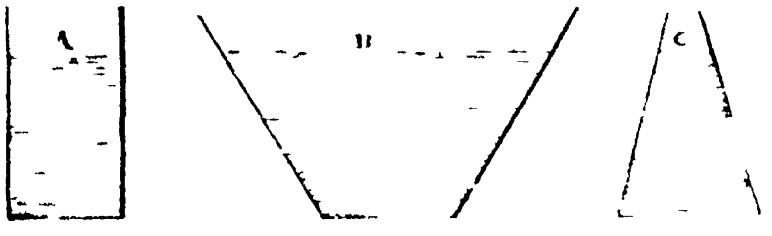
[illegible] made between two or more vessels [illegible] pipes or tubes or otherwise, the [illegible] when in equilibrium will always stand at the same level Let A B A′ B′ be two tubes, united by a third B B′ placed in the horizontal position and suppose water to be poured into one of the tubes at A, it will pass along the tube B B′, and rise in B′ A′ and B A simultaneously, its surfaces at A and A′ always remaining level or at equal vertical heights above B B′ This property is familiarly illustrated in the case of a tea-pot or any vessel having a spout



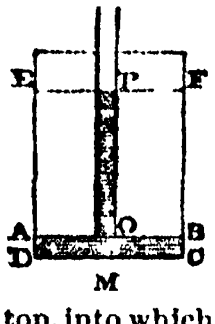

The liquid contained in a vessel being at rest and subjected to the action of gravity only, any particle of it is pressed in all directions (vertically, horizontally, or obliquely) by a force which is equal to the weight of the vertical column of the liquid incumbent on it This important proposition may be demonstrated in the following manner — As the pressure in all directions must necessarily be equal from the supposition of equilibrium, we need attend only to the vertical pressure Now suppose the whole mass of the fluid, with the exception of the vertical [illegible] to the particle in question to become [illegible] ging its place or volume the particle will obviously remain in the same state of compression as before, but as the column alone remains fluid the only pressure on the particle is that produced by the weight of the column Hence the absolute weight of the column forms the measure of the pressure sustained by the particle in all directions when surrounded by the liquid

Instead of a particle of the liquid itself we may consider the column to rest on an indefinitely small portion of the bottom or the sides of the vessel in which it is contained and it will follow that the pressure on an indefinitely small portion of the area at any point of the bottom or sides is perpendicular to the plane of that area and equal to the weight of a vertical column of the liquid standing on it as a base and reaching to the surface Hence the whole pressure sustained by any finite portion of the bottom or sides of the vessel is equal to the weight of a column of the liquid having for its base the surface pressed on (extended into a plane if necessary) and for its altitude the distance of the centre of gravity of that surface from the surface of the liquid

From this proposition it obviously follows that the pressure on the bottom of the vessel depends only on the magnitude of the bottom and the depth of the liquid and is entirely independent of the form of the sides and




of the quantity of liquid in the vessel Suppose the three vessels A, B, and C, to have the areas of their bottoms equal, and that the fluid stands in each to the same depth, then the pressure on the bottom of each vessel is the same, and equal to the weight of the liquid which would be contained in a vessel having an equal bottom and its sides perpendicular




This proposition gives rise to consequences which at first view appear absurd, and has hence been called the hydrostatic paradox Let A B C D be a close vessel with a small hole O in the top, into which a narrow tube O P is screwed water tight Let water be poured into the tube till the vessel A B C D is filled, and the water stands in the tube at the level P



[illegible] pressure [illegible] P M, or in fact equal to the weight of water which would fill a vessel of the magnitude E D C F Now this is the case, however shallow the vessel A B C D, and however narrow the tube P O may be, and hence a very small quantity of water may be made to exercise a pressure of any amount, however great, on the bottom or sides of the vessel containing it

The whole pressure on the top A B of the vessel, and tending to burst it is equal to the weight of the water in the tube P O, increased in the ratio of the area of A B to the area of a section of the tube [illegible] of the tube to be one square inch, and [illegible] A B [illegible] 100 square inches, then a column of water O P, whose weight is one pound, will exert a pressure on A B equal to 100 pounds It is obvious that the pressure in the narrow tube P O may be produced not merely by the addition of water, but by the application of any kind of force, such as the working of a piston, &c, and if the bottom or lid of the vessel A B C D be made moveable, the pressure on either may be brought to bear on one point of an external body and produce an enormous compression It is on this principle that the very useful engine, the *hydrostatic press*, is constructed *See* HYDROSTATIC PRESS and HYDROSTATIC BELLOWS

Many striking phenomena of the natural world are referable to this principle, and [illegible] in engineering If the smaller lodge to a considerable height in the gravel sand, or loose earth behind a wall or [illegible] it would exert a lateral pressure sufficient to push the solid materials from their base Hence a sudden shower often occasions great devastation The same principle also regulates the construction of pipes for the supply of water to cities The pressure acting on the inner surface of the pipe and tending to burst it, being proportional to the depth below the level of the reservoir, the parts of the pipe much below that level must have a greater strength than is necessary at a higher situation A pipe, the diameter of whose bore is 4 inches has an internal circumference of about 1 foot, and the internal surface of 1 foot of such a pipe will be 1 square foot, or 144 square inches If such a pipe were 140 feet below the level of the reservoir, it would sustain a bursting pressure amounting to about 60 pounds on every square inch of its surface, for a column of water the area of whose section is one square inch, and of which the height is 27·727, or nearly 28 inches, weighs one pound, and 28 inches are contained 60 times in 140 feet Hence a piece of the pipe 1 foot long will sustain 144 times this pressure, that is, a bursting pressure of 8640 pounds This exceeds considerably that which is produced in any high-pressure steam engine

*Weight of Bodies immersed in Liquids* — A body immersed in a liquid is pressed upwards by a force equal to the weight of the liquid it displaces, and the difference between the absolute weight of a body and its weight when entirely immersed, is the same with the weight of a quantity of the liquid equal in bulk to the body This proposition which is capable of strict demonstration from the fundamental property of fluids, may be illustrated as follows — Suppose any interior portion of a liquid to become [illegible], it would evidently remain in the same state of indifference or equilibrium as before It must therefore, be borne up by the vertical pressure of the liquid with a force just equal to its weight, or, which is the same thing to the weight of the liquid whose place it occupies And if we conceive this congealed mass to have its weight augmented or diminished, it will be pulled downwards or upwards [illegible] with a new weight and the weight [illegible] in [illegible] liquid Substitute any solid body instead of this block of ice, and the loss of weight it sustains [illegible] will be equal to that of the volume of [illegible]

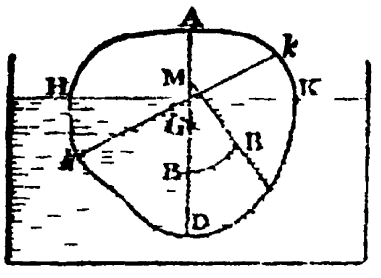
On this principle is founded the method of ascertaining the relative densities or *specific gravities* of different bodies The specific gravity of a body is the ratio of its weight to the weight of an equal bulk of water Let, therefore, W be the [illegible] and W′ its weight in water, the [illegible] quantity of water equal in bulk to the body, and $\frac{W}{W - W'}$ is its specific gravity The specific gravities of bodies are therefore found by weighing them first in air and then in water *See* GRAVITY, SPECIFIC

*Solid Bodies floating on Liquids* — The equilibrium of solid bodies floating on liquids, a subject discussed by Archimedes in his treatise *De Humido Insidentibus*, is an important part of hydrostatics, in consequence of its relation to the construction and stowage of ships A body placed on a fluid specifically heavier than itself, will sink so far that the weight of the fluid displaced is equal to the whole weight of the body, and when it assumes the position of equilibrium, the line which joins the centre of gravity of the body and the centre of buoyancy (which

is the same as the centre of gravity of the immersed part supposed to be homogeneous) is perpendicular to the surface of the water or the horizon

The centre of gravity of a body is a fixed point relatively to the body itself, but the centre of buoyancy, which depends on the figure of the immersed part, will change its place when the figure or relative situation of the immersed part undergoes any alteration It is on the relative situations of the centres of gravity and of buoyancy that the character of the equilibrium of a floating body depends namely whether it is stable or unstable, or indifferent If the figure and position of the body be such that on pulling it a little aside from the situation of rest its centre of gravity takes a higher position than the body has a tendency to redress itself and the equilibrium is stable On the contrary if by a similar change of position the centre of gravity assumes a lower place, the body will not return to its former equilibrium, but will be overturned or upset In this case the equilibrium was unstable But a body may be so constituted (for example, a homogeneous sphere, or a cylinder floating with its axis horizontal) that in every position the centres of gravity and of buoyancy are in the same vertical line In this case the equilibrium cannot be disturbed, and is called the equilibrium of indifference the body having no tendency to maintain one position more than another

To illustrate this and to show at the same time the circumstances on which the stability of the equilibrium depends, let A H D K be a body floating on water and let H K be the line of flotation, also let G be its centre of gravity and B its centre of buoyancy which will be in the same vertical with G when the body is at rest and will obviously be below G The body is now pressed down by its own weight collected at G, and pushed up in the opposite direction by an equal force at B Suppose it to be drawn aside from the position of rest till the water line comes into the position *h k*, the centre of buoyancy B will now be transferred to B', and the line of support will be a line passing through B' perpendicular to the surface of the water Let this line meet the principal axis A D in M, then the equilibrium will be stable or unstable according as M is above or below G the centre of gravity If M coincide with G, the vertical thrust tends to redress the body and restore the equilibrium but if the vertical B' M meets the principal axis below G the body will be pushed more aside till it is overset The point M possesses several remarkable properties Its position in the axis A D remains unaltered when the body is drawn aside from the position of equilibrium, and it limits the greatest elevation which the centre of gravity can have in order that the equilibrium may be stable It was denominated by Bouguer the *metacentre*, and its position may be determined in all cases where the figure and specific gravity of the floating body are given




As the stability of a body depends on the height of the metacentre above the centre of gravity the construction of a ship should be so regulated and its cargo so arranged that the centre of gravity of the whole mass should be at the lowest possible point Hence the heaviest part of the cargo is stowed away nearest the ship's bottom, and vessels having discharged their cargo must be *ballasted*, in order to give them requisite stability When a vessel is without a cargo and empty the weight of the masts and rigging raises the centre of gravity to such a height as to render the equilibrium unstable or at least renders its stability so small that it cannot be safely subjected to the ordinary pressure on the sails necessary to give motion and consequently would be altogether incapable of encountering a gale or a heavy sea

Another important application of the theory of hydrostatics is to the form that ought to be given to the several parts of embankments, dams the flood gates of canals, and other works constructed for the purpose of confining or opposing the course of water This inquiry which is purely mathematical is grounded on the principle that the pressure in any lateral point is directly proportional to its vertical depth under the surface of the water *See* HYDRAULICS and HYDRODYNAMICS

HY'DROSULPHATES, or HY'DROSU'LPHURETS Compounds of hydrosulphuric acid or sulphuretted hydrogen with salifiable bases

HY'DROSULPHURIC ACID Sulphuretted hydrogen This compound was also called *hydrothionic acid* (from hydrogen and Gr θειον *sulphur*)

HY'DROTHO'RAX (Gr ) Dropsy of the chest The symptoms are difficult breathing when in a recumbent posture, paleness, cough, thirst, swelling of the legs and feet, quick and often irregular or intermitting pulse

HY'DRUS (Gr ὑδωρ, *water*) A genus of water snakes, characterized by a compressed or laterally flattened tail adapted for swimming; and by having many maxillary teeth, like non-venomous serpents, but with the first larger than the rest, and grooved for the transmission of a poison duct

The species are confined to the seas of the warmer latitudes

HY'DRUS The Water Snake, a constellation in the southern hemisphere formed by Lacaille *See* CONSTELLATION

HYGEI'A (Gr ὑγιεια, *health*) The Goddess of Health in the Greek Mythology daughter or wife of Æsculapius, according to the different recitals of genealogists Her statues (of which the most celebrated was at Sicyon sometimes represented her attended by a large serpent coiled round her body, and elevating its head above her arm to drink of a cup which she held in her hand Isis in Egyptian monuments appears sometimes in a similar attitude The employment of the serpent as a mythological symbol of life and health has been by some derived from the history contained in the first chapter of Genesis

HY'GEINE That branch of medicine which relates to the means [illegible]

HYGRO'LOGY (Gr υγρος *moist* and λογος, *a discourse*) A medical term, implying the doctrine of the humours or fluids of the body

HYGRO'METER (Gr υγρος, and μετρον, *measure*) An instrument for measuring the degrees of moisture or dryness of the atmosphere

Variations in the state of the atmosphere with respect to moisture and dryness are manifested by a great variety of phenomena and accordingly numerous contrivances have been proposed for ascertaining the amounts of those variations by referring them to some conventional scale All such contrivances are called *hygrometers*, but though the variety of form that may be given to them, or of substances that may be employed is endless, they may all be referred to two classes namely, 1st, those which act on the principle of *absorption*, and, 2d, those which act on the principle of *condensation*

1 *Hygrometers on the Principle of Absorption* — Many substances in each of the three kingdoms of nature absorb moisture from the atmosphere with greater or less avidity, and thereby suffer some change in their dimensions, or weight or some of their physical properties Animal fibre is softened and relaxed and consequently elongated, by the absorption of moisture Cords composed of twisted vegetible substances are swollen, and thereby shortened when penetrated by humidity, and the alternate expansion and shrinking of most kinds of wood, especially when used in cabinet work, and after the natural sap has been evaporated is a phenomenon with which every one is familiar Many mineral substances absorb moisture readily and thereby obtain an increase of weight Now it is evident that any of these changes either of dimension or of weight, may be regarded as the measure of the quantity of moisture absorbed, from which the quantity of water existing in the atmosphere in the state of vapour is inferred but many, indeed the far greater part of them are so small in amount, or take place so slowly that they afford no certain indication of the actual state of the atmosphere at any particular moment

Of the different kinds of hygrometers whose construction depends on change of dimension arising from the absorption of moisture there are two deserving of notice on account of their historical celebrity, though they are now seldom if at all used where accurate meteorological observations are attempted One is the *hair* hygrometer of Saussure, the other the *whalebone* hygrometer of De Luc

Saussure's hygrometer consists of a human hair prepared by boiling it in a caustic ley One extremity of the hair is fastened to a hook or held by pincers the other has a small weight attached to it, by which it is kept stretched The hair is passed over a grooved wheel or pulley the axis of which carries an index which moves over a graduated arch Such is the essential part of the instrument and it is easy to conceive how it acts When the [illegible] more humid the hair absorbs an [illegible] moisture, and is elongated, the counterpoise consequently descends, and turns the pulley, whereby the index is moved towards the one hand or the other On the contrary, when the air becomes drier the hair loses a part of its [illegible] and is shortened The counterpoise is [illegible] the index [illegible] the [illegible] principle that the expansion and contraction of the hair are due to moisture alone, and are not affected by temperature or other changes in the condition of the atmosphere Experiment shows that the influence of temperature is not very great, but after all precautions have been taken in preparing the instrument, it is found to be exceedingly irregular in its movements, and subject to great uncertainties Besides, the substance is soon deteriorated, and will scarcely maintain its properties unimpaired during a single year.

# HYGROMETER

The hygrometer of De Luc consists of a very thin slip of whalebone cut transversely or across the fibres, and stretched by means of a spring between two points One end is fixed to a bar, while the other acts on the shorter arm of the index of a graduated scale When the whalebone absorbs moisture it swells, and its length is increased, as it becomes dry it contracts, and the space over which the index moves by the one or the other of these effects gives the measure of the expansion or contraction of the corresponding state of the atmosphere The hygrometer appears to be more uncertain than that of Saussure

The hygrometers which have been proposed on the principle of a change of weight arising from the absorption of moisture, are liable to still greater objections Changes of weight may indeed be measured with great accuracy by the common or torsion balance, but in the present case they are so small, that the particles of dust which are at all times floating in the atmosphere may produce a great alteration in the results A great variety of substances which attract moisture have been employed such as sponge, cotton, bibulous paper, caustic potash the deliquescent salts, sulphuric acid, &c , but the indications which they give are deserving of very little credit Changes of property indicated by the torsion of cords formed of gut hemp, cotton &c and the torsion of certain vegetable fibres, are still more fallacious

*Hygrometers on the Principle of Condensation* —The hygrometers are of a far more refined nature than those which we have been describing In order to give an idea of the general principle on which they depend, let us conceive a glass jar perfectly clean and transparent to be filled with water and placed on a table in a room where the temperature is for example, 60° the temperature of the water being the same as that of the room Let us next suppose pieces of ice or a freezing mixture to be thrown into the water whereby the water is gradually cooled down to 55 50 45 &c degrees As the process of cooling goes on there is a certain instant at which the jar loses its transparency or becomes dim and on attentively examining the phenomenon it is found to be caused by a very fine dew or deposition of aqueous vapour on the external surface of the vessel The precise temperature of the water and consequently of the vessel at the instant when this deposition begins to be formed is called the *dew point* and is capable of being noted with great precision Now this temperature is evidently that to which if the air were cooled down under the same pressure it would be completely saturated with moisture and ready to deposit dew on any body in the least degree colder than itself The difference, therefore between the temperature of the air and the temperature of the water in the vessel when the dew begins to be formed will afford an indication of the dryness of the air or of its remoteness from the state of complete saturation

But the observation which has now been described is capable of affording far more interesting and precise results than a mere indication of the comparative dryness or moisture of the atmosphere With the help of tables of the elastic force of aqueous vapour at different temperatures, it gives the means of determining the absolute weight of the aqueous vapour diffused through any given volume of air the proportion of vapour existing in that volume to the quantity that would be required to saturate it at [illegible] of evaporation The [illegible] the boiling point of water is evidently equal to the pressure of the atmosphere This may be assumed as [illegible] column of mercury 30 inches in height [illegible] In the fifth volume of the *Manchester Memoirs* has given the details of a most valuable and beautiful set of experiments by which he ascertained the elastic force of vapour from water at every degree between its freezing and boiling points in terms of the column of mercury which it is capable of supporting As the same experiments have since been frequently repeated, and the different results present all the accordance which can be expected in so delicate an investigation the tension of vapour at the different temperatures may be regarded as sufficiently well determined Supposing then we have a table expressing the tension corresponding to every [illegible] the weight of a given volume of vapour, for example a cubic foot, may be determined as follows —

Steam at 212°, and under a pressure of 30 inches of mercury, is 1700 times lighter than an equal bulk of water at its greatest density, or a temperature of about 40°, and a cubic foot of water at that temperature weighs 437272 grains, the weight, therefore, of a cubic foot of steam at that temperature and pressure is 437272 — 1700 = 257 218 grains Hence we may find the weight of an equal bulk of vapour of the same temperature under any other given pressure, suppose 0 56 of an inch, for the density being directly as the pressure, we have 30 in 0 56 in 257 218 grs 4 801 grs, which is the weight required

Having found the weight of a cubic foot of vapour under a pressure of 0 56 of an inch, and at the temperature 212°, we may find its weight under the same pressure at any other temperature as follows It is ascertained by experiment that all the aeriform bodies, whether vapours or gases, expand the 1-480th part of their volume for every accession of temperature equivalent to one degree of Fahrenheit's scale, that is a volume of gas at 32° as unity, its volume at 212° as $1 + \frac{28}{480}$ is to $1 + \frac{180}{480}$, or as 1 058 1 375, and the density and weight being inversely as the volume, we have

1 058 1 375 4 801 grs 6 222 grs

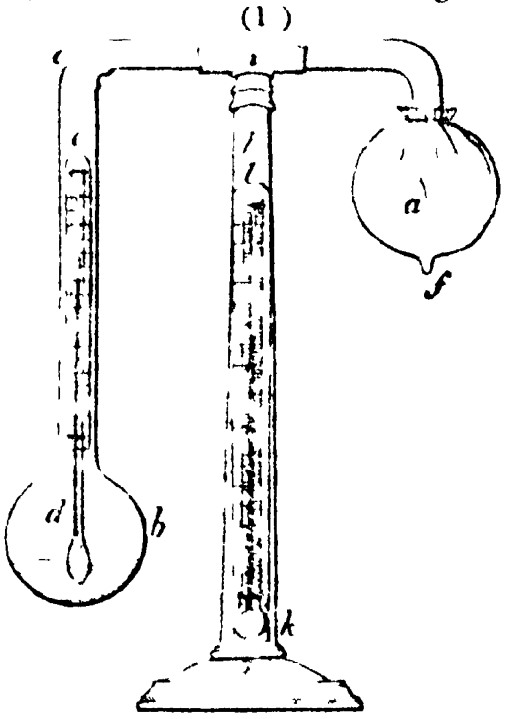
for the weight of a cubic foot of vapour at temperature 60°, and under a pressure of 0 56 of an inch of the mercurial column

The following table, abridged from *Daniell's Meteorological Essays* shows the force or tension, weight, and expansion of aqueous vapour, at different temperatures on Fahrenheit's scale —

| Temp | Force | Weight of a Cubic Foot | Expansion |
|---|---|---|---|
| 0 | 008 | 856 | 9331 |
| 5 | 083 | 1 034 | 9138 |
| 10 | 088 | 1 208 | 9042 |
| 15 | 119 | 1 151 | 9616 |
| 20 | 110 | 1 688 | 9750 |
| 25 | 170 | 2 028 | 9855 |
| 30 | 200 | 2 361 | 9959 |
| 35 | 240 | 2 805 | 1 0062 |
| 40 | 280 | 3 259 | 1 0166 |
| 45 | 340 | 3 803 | 1 0270 |
| 50 | 400 | 4 435 | 1 0375 |
| 55 | 476 | 5 312 | 1 0479 |
| 60 | 560 | 6 222 | 1 0583 |
| 65 | 657 | 7 270 | 1 0687 |
| 70 | 780 | 8 392 | 1 0791 |
| 75 | 906 | 9 780 | 1 0895 |
| 80 | 1 060 | 11 333 | 1 1000 |
| 85 | 1 235 | 13 081 | 1 1104 |
| 90 | 1 450 | 15 005 | 1 1208 |
| 95 | 1 636 | 17 009 | 1 1312 |
| 212 | 30 000 | 257 218 | 1 3714 |

Having thus explained the principle of the condensation hygrometer we will now describe one or two of the forms under which it has been most frequently constructed Daniell's hygrometer is represented in the annexed figure *a* and *b* are two thin glass balls of 1½ inch diameter, connected together by a tube having a bore about 1-8th of an inch The tube is bent at right angles over the two balls, and the arm *b c* contains a small thermometer *d e*, whose bulb, which should be of a lengthened form, descends into the ball *b* This ball having been about two thirds filled with ether, is heated over a lamp till the fluid boils, and the vapour issues from the capillary tube *f* which terminates the ball *a* The vapour having expelled the air from both balls the capillary tube is hermetically closed by the flame of a lamp The other ball *a* is now to be covered with a piece of muslin The stand *g h* is of brass, and the transverse socket *i* is made to hold the glass tube in the manner of a spring allowing it to turn and be taken out with little difficulty A small thermometer *k l* is inserted into the pillar of the stand The manner of using the instrument is this —After having driven out all the ether into the ball *b* by the heat of the hand it is to be placed at an open window, or out of doors with the ball *b* so situated that the surface of the liquid may be on a level with the eye of the observer A little ether is then to be dropped on the covered ball Evaporation immediately takes place, which, producing cold upon the ball *a*, causes a rapid and continuous condensation of the ethereal vapour in the interior of the instrument The consequent evaporation from the naked ether produces a depression of temperature in the ball *b* the degree of which is measured by the thermometer *d e* This action is almost instantaneous, and the thermometer begins to fall in two seconds after the ether has been dropped A depression of 30 or 40 degrees is easily produced, and the ether is sometimes observed to boil and the thermometer to be

(1)

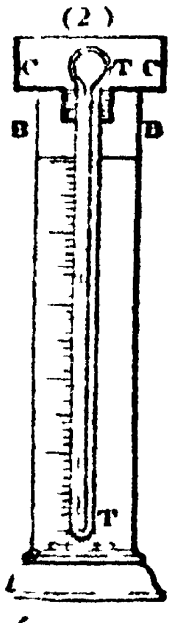


driven below zero of Fahrenheit's scale The artificial cold thus produced causes a condensation of the atmospheric vapour upon the ball *b*, which first makes its appearance in a thin ring of dew coincident with the surface of the ether The degree at which this takes place must be carefully noted In very damp or windy weather the ether should be very slowly dropped upon the ball, otherwise the descent of the thermometer will be so rapid as to render it extremely difficult to be certain of the degree In dry weather, on the contrary the ball requires to be well wetted more than once, to produce the requisite degree of cold (*Daniell's Meteorological Essays*)

The instrument which has now been described is extremely beautiful in principle, but it may be doubted whether, even when the greatest caution is observed the temperature which it indicates is precisely that at which the deposition of dew takes place The deposition first occurs in a narrow ring on a level with the surface of the ether in the ball *b*, thereby indicating that the ether is colder at the surface than a little under it But if the temperature is not uniform throughout the ball, it is evident that only a small part of the bulb of the thermometer can be placed in the point where the greatest cold exists, consequently the temperature indicated by the thermometer will be greater than is necessary for producing the deposition of moisture In other words, the dew point will be given too high

Various attempts have been made to obviate the defects of Daniell's hygrometer but hitherto without much success The apparatus proposed by Pouillet may be described as follows —A small cup C C formed of gold and extremely thin is fixed to a little collar of ivory B B' supported on a stand The stem of an inverted thermometer T T descends through a perforation in the bottom of the cup and is fitted closely into it and sealed the ball of the thermometer being placed at the centre of the cup In order to prevent the mercury from separating a small portion of air is left in the stem When an observation is to be made sulphuric ether is poured into the cup and in consequence of the rapid evaporation which takes place a considerable degree of cold is produced and a deposition takes place on the outside of the cup The degree of the thermometer at the instant the brightness of the metal begins to be dimmed gives the dew point The correctness of the indication depends on the identity of temperature of the ether the metal of the cup and the thermometer Bright gold is found to answer the purpose better than any other metal (Pouillet *Élémens de Physique*)

(2)




**As the** hygrometer is one of the principal instruments in meteorological researches its theory and the best form of its construction have been the subject of frequent discussion in the various scientific journals

**HY'GROMETRIC** This term is commonly applied to substances which readily become moist and dry with corresponding changes in the state of the atmosphere or which readily absorb and retain moisture Sea-weed several saline substances porous clays potash and its carbonate chloride of calcium sulphuric acid are in this sense of the term said to be hygrometric

**HY'GROSCOPE** (Gr *ὑγρο-* and *σκοπεω I view*) An instrument by means of which changes in the condition of the atmosphere with respect to moisture are observed *See* HYGROMETER, by which the same changes are measured

**HY'LÆOSAU'RUS** (Gr *ὕλη a wood* and *σαυρος a lizard*) A name given by Dr Mantell to an extinct gigantic genus of reptiles the fossil remains of which he has discovered in the wealden strata of Sussex

**HYLOBIUS** (Gr *ὕλη*, and *βιος life*) A genus of Tetramerous Coleoptera belonging to the *Curculionidæ* or family of weevils and noted for the ravages committed by one species, *Hylobius abietis* (*Curculio abietis* and *Curculio pini* of Linnæus) upon firs and larches, especially in young plantations This insect varies from five to nine lines in length, is of a pitchy black colour, with numerous yellow spots on the elytra It has been found in the pine woods of Shropshire, the north of England, and Scotland

**HYLOZO'ISM** (Gr *ὕλη*, *wood*, used by ancient philosophers to signify the abstract idea of matter and *ζωη*, *life*) In Philosophy, strictly the doctrine that matter lives Some writers have confined this name to the tenet of the *anima mundi*, or soul of the world, others to the theory of a peculiar life residing in the whole of nature approaching therefore in its sense to pantheism This life is either merely organic or actually sentient the latter notion has been also called *hylopathism* (See the remarks on Cudworth's Intellectual System in *Hallam's Literature of Europe*, iv 188, and *Ersch and Gruber's Encyclopædia*)

**HY'MEN** Among the ancients, the God of Marriage The origin of the worship of this divinity is attributed to the following story —A young Athenian, named Hymenæus in humble circumstances, having become enamoured of a rich and noble lady, from whose presence he was debarred attired himself in female habiliments, and joined a religious procession to Eleusis in which his mistress took part On their way thither the parties who composed it were attacked by pirates who carried them into captivity, but Hymenæus seized the opportunity when they were asleep of putting them to death, returned triumphant to Athens engaged to restore [illegible] to their families on condition of his obtaining permission to marry the object of his affection The Athenians consented, the nuptials of Hymenæus were crowned with happiness, and from that period the Greeks instituted festivals in his honour, and invoked him at the celebration of their marriages The formula employed on these occasions was, 'O Hymenæe Hymen Hymen O Hymenee (*Cat Carm* 61 62) *Hymeneal* is used to signify a song or ode composed in celebration of a marriage

**HYMENIUM** in describing fungi, denotes that part in which the sporules immediately lie It is commonly called the gills in the genus *Agaricus*, but in *Boletus* is a corky or spongy substance pierced full of holes and in other genera represents a variety of peculiar appearances

**HYMENOPTERANS**, *Hymenoptera* (Gr *υμην a membrane*, and *πτερον a wing*) An order of mandibulate insects comprehending those which have four membranous wings with few nervures Latreille divides this order into the following sections and tribes —

1 *Terebrantia* Abdomen of the females furnished with a saw or borer
- *a Securifera* Abdomen sessile, furnished with a saw, larvæ with feet
- *b Pupivora* Abdomen pedunculated furnished with a borer, larvæ toothless

2 *Sedentata* Abdomen of the females armed with a sting
- *a Heteroptera* Females wingless
- *b Fossores* Females winged wings not folded, basal joint of posterior tarsi simple
- *c Diptera* Females winged wings folded
- *d Mellifera* Females winged wings not folded posterior tarsi enlarged and converted into a pollen receptacle or organ

(See to above terms and ARTS and LORMICA)

**HYMN** (Gr *ὑμνος*) An ode in praise of the Deity or of a deified person or event The earliest Greek hymns are those attributed probably without foundation to Homer imitated by Callimachus They are in heroic verse except one of Callimachus in hexameters and pentameters and their contents for the most part are narrations of the events in the mythological history of the respective gods and goddesses to whom they are dedicated related in an encomiastic strain The choric strains of some of the tragedians in honour of deities introduced into their dramas appear also to have the character of hymns especially as dramatic performances among the Greeks had something of a religious solemnity attached to them The Theurgic Hymns were strains of a higher character and intended only for those who were initiated into certain mysteries supposed to have for their object the diffusion of more exalted notions of the divinity Those which are falsely attributed to Orpheus and pass by his name are said to be of this class but except from their obscurity it is difficult to say from what reason Philosophical hymns intended for the use of the followers of a still higher species of worship are mentioned in the division of ancient hymns, but we have no genuine examples of such compositions In modern literature hymns are pieces of sacred poetry intended to be sung in churches of which the Psalms of David the most ancient pieces of poetry properly so called on record (except the book of Job) furnish the chief example and model St Hilary bishop of Poitiers, is said to have been the first who composed hymns to be sung in churches The Latin hymns of the Roman Catholic church are well known from the exquisite music to which they have been united (See *Riddle's Christian Antiquities* p 373 As to the classical hymns and hymnographers, see the *Mem de l'Acad des Inscr* vols xii and xvi)

**HYOSCYA'MIA** The active principle or alkaloid of the common henbane (*Hyoscyamus niger*)

**HYPÆ'THRAL** (Gr *υπο*, *under*, and *αιθηρ*, *the air*) In Architecture a building or temple uncovered by a roof The temples of this class are arranged by Vitruvius under the seventh order having six columns in front and rear, and surrounded by a *dipteral* or double portico The famous temple of Neptune at Paestum, still remaining is an example of this species of building

**HYPA'LLAGE** (Gr *υπαλλασσω*, *I change slightly*) In Grammar and Rhetoric, a species of inversion, in which not only the natural or customary succession of words is changed but [illegible] in which pre[illegible]

subject to another Such examples as "gladium vagina vacuum," *the sword empty of the scabbard*, "in nova fert animus mutatas dicere formas corpora," where the adjective "new" is transferred from "form" to "body," present striking instances of this figure, but although such deviations from the natural sense could not be admitted in modern language, similar locutions are not wholly wanting among ourselves

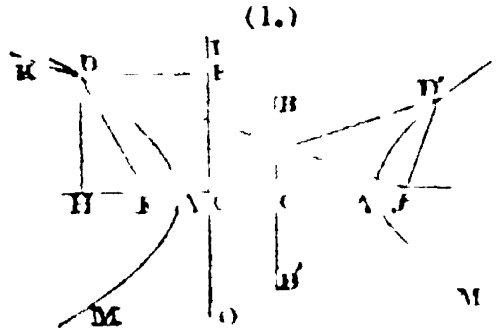
HYPANTHO'DIUM A term given by Link to that form of inflorescence where the receptacle is fleshy and covered with minute flowers but not enclosed within an involucrum, as in *Dorstenia* and *Ficus*

HYPE'RBOLA (Gr υπερβολη, from υπερ *above* and βαλλω, *I throw*) In Geometry, one of the conic sections, formed by cutting a cone by a plane which is so inclined to the axis that when produced it cuts also the opposite cone, or the cone which is the continuation of the former on the opposite side of the vertex The term *hyperbola* was given to this curve by Apollonius on account of its property, that the square of any ordinate is greater than the rectangle under the corresponding abscess and the parameter or differs from that rectangle in *excess*

Like the ellipse and parabola the hyperbola may be defined in various ways, and all its properties investigated without any reference to the cone but considered entirely as a plane curve The definitions most usually adopted are the following —

If two points I and *f* be given in a plane, and a point D be conceived to move round them in such a manner that the difference between the two distances D I and D *f* is always constant the point D will describe on the plane an hyperbola D A M By assuming first one of the given points I and then the other *f* as that to which the moving point is nearest the difference of the lines D I and D *f* in both cases being the same two hyperbolas D A M and D A M will be described opposite to each other, so that the curve consists of two branches The points I and *f* are the *foci* of the hyperbola, and C which bisects the distance between the foci is its *centre* The line A A' is the *major* or *transverse axis* and a straight line B B' passing through the centre perpendicular to A A' and of such a length that the square of its half C B or C B' is equal to the difference between the squares of C I and C A is the *minor* or *conjugate* axis The curve may be described mechanically as follows —Let one end of a string be fastened to I and the other to K the extremity of a ruler *f* D K and let the difference between the length of the ruler and of the string be equal to A *a* Let the other end of the ruler be fixed to the point *f*, and let the ruler be made to revolve about *f* as a centre in the plane in which the axes are situated while the string is stretched by means of a pin D so that the part of it between K and D is applied close to the edge of the ruler the point of the pin will by its motion trace a curve line D A M upon the plane, which is one of the hyperbolas required, and if the ruler be made to revolve about the other focus I while the end of the string is fastened to *f*, the opposite hyperbola will be described by the pin D'

(1.)

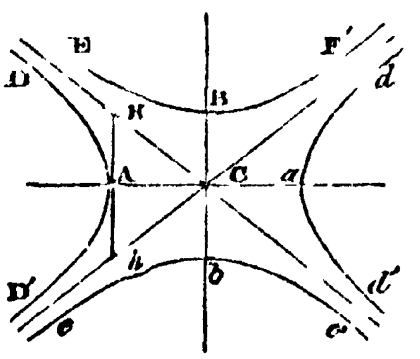


2 The hyperbola may also be defined as follows — Let I be a given point and P Q a straight line given in position, if another point D move in the same plane so that its distance D I from I shall have always to the perpendicular D E or its distance from the given line P Q the constant ratio of two given lines X and Y of which X is greater than Y, the focus of the point D will be a hyperbola The line P Q is called the *directrix* and its distance C G from the centre C is such that C G is a third proportional to C I and C A It is obvious that F A is to A G in the given ratio of X to Y

3 Another distinguishing property of the hyperbola is that the rectangle under A H and H A' is to the square of the ordinate H D in the ratio of the square of C A to the square of C B Let C A = *a* C B = *b*, C H = *x* and H D = *y*, then A H : H A' :: H D² : *a*² : *b*², that is, $(x - a)(x + a) : y^2 :: a^2 : b^2$, or $x^2 - a^2 : y^2 :: a^2 : b^2$, whence $y^2 = \frac{b^2}{a^2}(x^2 - a^2)$ an equation which may be put under this form, $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

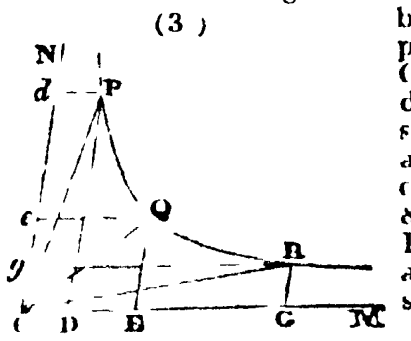
4 Like the ellipse, the hyperbola may also be defined by a polar equation Let F D = *r*, C A = *a*, C I the eccentricity = *e*, and the angle A F D = φ; then $r = \frac{e^2 - a^2}{a + e \cos \phi}$

The hyperbola has two infinite branches, and it has also two asymptotes. Through A, one of the vertices of the transverse axis, let a straight line H A *h* be drawn equal and parallel to B *b*, the conjugate axis, and bisected at A, the straight lines C H, C *h*, drawn through the centre, and the extremities of that parallel, are asymptotes, and if produced indefinitely do not meet the curve, though their distance from it becomes less than any assignable line The asymptotes of two opposite hyperbolas are common to both, and they are likewise the asymptotes of two other hyperbolas, F B F', *e b e'*, whose transverse axis B *b* is the conjugate axis of D A D', and whose conjugate axis is the transverse axis of D A D' These two hyperbolas, E B E' and *e b e'*, [illegible] and, in general, w[illegible] site hyperbolas D A D', *d a d'*, the same belongs also to the conjugate hyperbolas I B F' and *e b e'*



One of the most remarkable properties of the asymptotes is the following —If one of the asymptotes C M be divided in continued proportion in the points D, E, G, &c, and straight lines be drawn from the points of section parallel to the other asymptote, meeting the curve in the points P, Q, R, &c, the spaces D P Q E, E Q R G &c, without the curve, are equal The hyperbolic sections C P Q, C Q R, &c are also equal to each other, and to the spaces D P I Q E Q R G &c Hence from the nature of logarithms the sectors C P Q C P R, &c, or the equal spaces D P Q I D P R G, &c, represent the logarithms of the ratios of C D to C I to C G, &c, and if C D represent the unit of the arithmetical scale, the sector C P Q or the space D P Q I, will express the logarithm of C E in any logarithmic system depending on the angle of the asymptotes From the points P, Q R, &c let P *d* Q *e* R *g* be drawn parallel to C M, the ordinates C *d* C *e* C *g* &c are also in geometrical progression decreasing and wherever the points D L G, &c are situated all the parallelograms C *d* P D, C *e* Q E, C *g* R C &c are equal Hence if C M be taken as the line of the abscissæ and the ordinates be taken parallel to C N and if we make at the same time C E = *a*, C *e* = *b*, the nature of the curve will be expressed by this equation, $x y = a b$ See CONIC SECTIONS

(3)



HYPERBOLE In Rhetoric, a figure by which expressions are used signifying more than it is intended to represent to the hearer or reader, as when thoughts and sentiments are clothed in tumid language or ideas are brought forward which in themselves are incredible, in order to induce a belief of something less than that which is offered Exaggeration is hyperbole applied to narrative when false assertions are added to true in order to increase the impression made by them

HYPERBOLIC LOGARITHMS A system of logarithms so called because the numbers express the areas between the asymptote and curve of the hyperbola, those areas being limited by ordinates parallel to the other asymptote and the ordinates decreasing in geometrical progression But as such areas may be made to denote any system of [illegible] e denomination is not correct [illegible] rithm (from the inventor of the [illegible]) is more frequently used at least by the Continental writers, to denote the same thing The hyperbolic logarithm of any number is to the common logarithm of the same number in the ratio of 2 or 2·3026 to 1, or as 1 to 43429448 See LOGARITHM

HYPERBOLOID or HYPERBOLIC CONOID (Gr υπερβολη and ειδος *form*) A solid formed by the revolution of an hyperbola about its axis *Hyperboloids* also denote hyperbolas of the higher kind, defined, generally, by the equation $x^m y^n = a^{m+n}$ The asymptotic area of any hyperbola of which this is the equation is $\frac{n}{n-m} r y$, and it is very remarkable that this space is always quadrible, except in the case of the common hyperbola, in which *m* and *n* being each 1 the denominator *n* — *m* becomes zero

HYPERCATALECTIC (Gr υπερ *above*, and καταληκτικος, *terminating*) In Greek and Latin poetry, a verse exceeding its proper length by one syllable

HYPERCRITICISM, consists in viewing the works of an author in an ungenerous spirit, exaggerating minor defects, and overlooking or undervaluing such merits or

beauties as might fairly be considered to outweigh the former

HY'PERICA CE Æ (Hypericum, one of the genera) A natural order of Exogenous plants, usually having yellow flowers, with the petals wider on one side than the other, and marked with black dots, while the leaves are in many cases marked with transparent dots They are usually strong-scented and astringent Some of them have coppery red flowers, and yield a resinous substance

HY PERION See TITAN

HY PERMETRE (Gr *pre-eminence*) In Music, an interval nearly equal to one comma and a half

HYPEROXYMURIATES Combinations of the chloric and perchloric acids were formerly so called thus, chlorate of potash was called hyperoxymuriate of potash

HY'PERSTHENE Labrador hornblende It is a [illegible] traces of alumina and of [illegible] massive, it is resplendent, and of a grey green or reddish hue

HY'PERTHYRUM (Gr *υπερ upon* and *θυρα a door*) In Architecture the lintel of a doorway

HYPERTROPHY (Gr *υπερ*, and *τροφη excess of nutrition*) A term frequently applied to the morbid enlargement of any part of the body This term ought to be restricted to cases in which a part though increased in bulk, retains its natural organization and structure (*Cooper's Dictionary*)

HY PHA, in describing *Agaric* denotes the filamentous, fleshy, watery threads of *Byssus*

HY'PHEN (Gr *υφ' ἑν*) In Writing a mark or character thus (-) implying that two words or syllables are to be connected

HYPNO'TICS (Gr *υπνος, sleep*) Medicines which induce sleep

HYPOCAU'STUM (Gr *υπο under* and *καιω I burn*) In Ancient Architecture a vaulted apartment from which the fire's heat is distributed to the rooms above by means of earthen tubes This method first used in baths, was afterwards adopted in private houses and [illegible]

HY'POCHONDRI'ASIS (Gr *υπο under* and *χονδρος, cartilage*) Uneasiness about the region of the stomach and liver or of the hypochondriac region is one of the symptoms of this disease Particular circumstances may induce this disorder in any individual, but it is most commonly met with in persons of sallow or pale complexions spare habit of body, and dark hair and eyes Its mental symptoms are low spirits a groundless apprehension of evil, imaginary local sensations, and erroneous impressions respecting the opinions and sentiments of others with a tendency to misconstrue their actions, aversion to society, want of mental and bodily energy, seeing persons and things and hearing conversations and noises [illegible] symptoms are [illegible] indigestion — costiveness, dimness of sight noises in the ears want of appetite and sleep in most cases in a few severity and drowsiness As this disease is usually connected with imperfect action of the liver and debility of the stomach and bowels mild aperients, small doses of calomel or blue pill, and tonics are to be prescribed, occasionally doses of more powerful purges such as calomel and jalap or scammony with salts and senna must be resorted to where the bowels are foul and overloaded, and where there is much headach a blister to the neck, or the loss of a *little* blood by [illegible]
The regularity of he [illegible]
and it is generally necessary to keep the feet warm

Change of scene and of occupation, cheerful society moderate exercise of all kinds and great kindness and attention on the part of the medical adviser are generally among the essentials in the treatment of this diseased state But every amusement and relaxation must be carefully proposed and pursued, and though it is generally necessary firmly but gently to remonstrate against the *whims* and caprices of hypochondriacs, yet sometimes they must be conceded to When persons are full of evil forebodings and false alarms, it is sometimes well to induce them to keep a diary of their feelings the perusal of which as they recover, or in their happier moments is often comforting proof to them of the utter want of foundation of some of their most inveterate notions Persons who are very irritable and over-anxious, or who, after having been actively engaged in business, retire to a life of ease and idleness, who take no interest in study, amusement, or exercise, and those, again, who have kept bad hours, or who have led debauched lives, or who have studied intensely, — are those in whom some of the worst forms of hypochondriasis occur It is seldom, in the most aggravated cases of this disorder, that well grounded hopes of recovery may not be held out and that its recurrence may not be prevented by timely and firm treatment, but if it be allowed to run its course it often ends in melancholy



HY'POCRATE'RIFORM (Gr *ὑπο, κρατηρ, a cup*, and *φορμη, shape*) That form of a corolla which consists in a cylindrical tube which is longer than the flat spreading limb, as in the flowers of the genus *Phlox* It is called [illegible] salver-shaped

HYPOGE'OUS (Gr *ὑπο*, and *γη, the earth*) Literally subterranean In Botany it denotes all parts in plants which grow beneath the surface of the earth

HY'POGENE (Gr *υπο*, and *γινομαι, I am formed*) A class of rocks which have not assumed their present form and structure at the surface of the earth but are apparently of igneous origin, and thrust up from below See GEOLOGY

HYPO'GYNOUS (Gr *ὑπο*, and *γυνη a female*) In Botany, in describing the situation of plants denotes any thing [illegible] below the base of the ovarium

HYPOMOCHLION (Gr *ὑπο*, and *μοχλος, lever*), in Mechanics, is the fulcrum or support of a lever, or the point against which the pressure is exerted This term is only met with in the old treatises on mechanics, the equivalent term fulcrum being now generally used

HY'PONITROUS ACID An acid intermediate between nitric oxide and nitrous acid, composed of 1 equivalent of nitrogen = 14 and 1 of oxygen = 24 the equivalent of the hyponitrous acid, upon the hydrogen scale, being = 38

HY'POPHO'SPHOROUS ACID An acid composed of 2 atoms of phosphorus and 1 of oxygen, or 32 phosphorus + 8 oxygen

HYPOPHY'LLIUM (Gr *υπο* and *φυλλον, a leaf*) A term invented to denote a petiole that has the form of a small sheath, is destitute of lamina and surrounds the base of certain small branches having the appearance of leaves as in asparagus It is nothing but a rudimentary leaf

HYOPI'UM (Gr *υπο* and *πυον pus*) A disease of the eye in which there is an apparent collection of pus under the transparent cornea, that is in the chamber of the aqueous humour

HYPOSCE'NIUM (Gr *υπο* and *σκηνη a scene*) In ancient Architecture the front wall of a theatre facing the orchestra from the stage

HYPOSTASIS (Gr *υποστασις* from *υπο* and *ιστημι, I stand*) A term invented by the Greek fathers to express the distinct *personality* of the Father Son and Holy Ghost *Προσωπον* in Latin *persona* whence our *person*, signifies properly a face or mask This term however is retained by the Latin fathers who, like ourselves had no word which could exactly represent hypostasis which differs from *ουσια substance* inasmuch as the latter is used for the divine substance essence or [illegible] which is common to each of the hypostases [illegible] individual substances which compose the one Godhead

HY POSULPHURIC ACID An acid intermediate between the sulphurous and sulphuric acids It may be regarded as containing 2 atoms of sulphur ($16 \times 2 = 32$) and 5 of oxygen ($8 \times 5 = 40$), or as constituted of 1 atom of sulphurous acid = 32 and 1 of sulphuric acid = 40 In either case its equivalent is 72

HYPOSULPHUROUS ACID An acid constituted of 2 atoms of sulphur ($16 \times 2 = 32$) and 2 of oxygen ($8 \times 2 = 16$) It is necessary to take this view of composition its equivalent number being 48

HYPOTHECATION (Gr *υποθηκη, that which is subject to a pledge*) In the Civil Law, an engagement by which the debtor assigns his goods in pledge to a creditor as a security for his debt without parting with the immediate possession, differing in this last particular from the simple pledge The term hypothecation is usually applied to things immoveable only (or according to the division of the English law, to things real, things personal savouring of the realty and choses in action) and not to things moveable (or things personal in possession) It answers in general to the English mortgage See MORTGAGE

HYPOTHENUSE (Gr *υπο*, and *τεινω I stretch*), in Geometry denotes the longest side of a right-angled triangle [illegible] The famous [illegible] of *Euclid*, namely that in any right-angled rectilinear triangle the square described on the hypothenuse is equal to the sum of [illegible] two sides, is said to have been discovered by Pythagoras who was so much pleased with it that he sacrificed a hecatomb to the Muses in gratitude Camerer, in the Notes to his edition of the first Six Books of *Euclid*, in Greek and Latin has collected no fewer than seventeen different demonstrations of this celebrated theorem from the principles of elementary geometry

[illegible] *Euclid* [illegible]
a view to draw from it some consequence which establishes the truth or falsehood of a proposition, or gives the solution of a problem In a mathematical proposition there are two things to be considered — the *hypothesis* or the *conclusion*, the hypothesis being that which is granted or supposed, and the conclusion that which follows from

reasoning from the data In the following proposition, 'If two triangles be equiangular their homologous sides are proportional,' the first part *if two triangles be equiangular*, is the hypothesis or *data* from which we are to reason, and the second part, the *homologous sides are proportional*, is the conclusion or consequence at which we arrive by reasoning from that hypothesis

In Physics, the term hypothesis denotes a gratuitous supposition to account for some phenomenon or appearance of the natural world If the hypothesis serves to explain a great number of the circumstances accompanying a phenomenon it acquires a certain degree of probability, and if all the known circumstances can be deduced from it, the probability becomes very great, and in the lapse of time may amount to certainty Thus the hypothesis of the diurnal rotation of the earth and its translation in the ecliptic, imagined by Copernicus to explain the planetary phenomena, has acquired all the characters of certainty from continual astronomical observation In like manner, Kepler's hypothesis that the planets move in elliptic orbits, has been so fully confirmed by subsequent discoveries and computations, that however doubtful it might be at first, no one who is [illegible] can hesitate to receive [illegible] 'A well-imagined hypothesis' says Sir John Herschel "if it have been suggested by a fair inductive consideration of general laws, can hardly fail at least of enabling us to generalize a step further and group together several such laws under a more universal expression But this is taking a very limited view of the value and importance of hypotheses It may happen (and it has happened in the case of the undulatory theory of light) that such a weight of analogy and probability may be accumulated on the side of an hypothesis, that we are compelled to admit one of two things — either that it is an actual statement of what really passes in nature, or that the reality, whatever it be, must run so close a parallel with it as to admit some mode of expression common to both at least in so far as the phenomena actually known are concerned Now this is a very great step not only for its own sake as leading us to a high point in mathematical speculation but for its applications because whatever conclusions we deduce from an hypothesis so supported must have at least a strong presumption in their favour, and we may be thus led to the trial of many curious experiments and to the imagining of many useful and important contrivances which we would never otherwise have thought of, and which, at all events if verified in practice are real additions to our stock of knowledge and to the arts of life" (*Discourse on the Study of Nat Philosophy*)

HYPOTRACHE'LIUM (Greek ὑπο, *under* and τραχηλος *the neck*) In Architecture the slenderest part of the shaft of a column, being that immediately below the neck of the capital

HY'POTYPO'SIS (Gr υποτυπωσις from τυπος *a type*), in Rhetoric signifies an animated representation of a scene or event in descriptive language highly enriched with rhetorical figures

HY'RAX (Gr ὑραξ *a shrew mouse*) This term is now applied to a genus of small Mammalia which rank next the rhinoceros in the order of their affinities and are the most diminutive representatives of the Pachydermatous order The two known species are found in hilly districts at the Cape (*Hyrax capensis*) and in Syria (*Hyrax Syriacus*) the latter species the 'coney' of Scripture

HYSTERAN'THUS, in describing the duration of leaves denotes their appearance after the flowers, as in the almond

HYSTE'RIA (Gr υστερα *the womb*, with which it is supposed that the disease generally connected) It generally attacks unmarried females between the ages of 15 and 35, coming on with low spirits and anxiety sickness, short breath and palpitations, sobbing, and a sense of distension of the bowels which afterwards seems to concentre itself in the stomach and then rise like a ball into the throat, where it produces gasping stupor convulsive motions, crying laughing, hiccough flow of saliva from the mouth, and delirium at length the spasms abate and the person gradually recovers generally with the expulsion of wind from the stomach Some of these symptoms are often much more prevalent than others, so that the disorder assumes many forms it is also very variable in its duration, lasting from an hour or two to one or two days The treatment varies extremely with the apparent causes of the disorder, sometimes bleeding and depletives, at others stimulants and tonics are required, in mild cases [illegible] giving nasal stimulants give [illegible] exciting cause, exercise, moderate and judicious amusements and occupations regular hours, and change of air and scene, are among the best preventives of its recurrence

HYSTERI'TIS Inflammation of the womb This dangerous disease generally occurs the second or third day after delivery, it is attended by fever and pain of the part, [illegible] Energetic treatment

HYSTEROLOGY, or HYSTERON PROTERON (Gr ὑστερος, *the latter of two*, and λογος, *speech*) In Rhetoric, a figure by which the ordinary course of thought is inverted in expression, and the last put first, as, where objects subsequent in order of time are presented before their antecedents, cause before effect, &c Some comprehend the figure usually called antiolimax (*see* CLIMAX) under the name Hysterology

HY'STRICIDÆ (Gr υστριξ, *a porcupine*) The name of the family of Rodent Quadrupeds, of which the porcupine (*Hystrix cristata*) is the type

## I AND J.

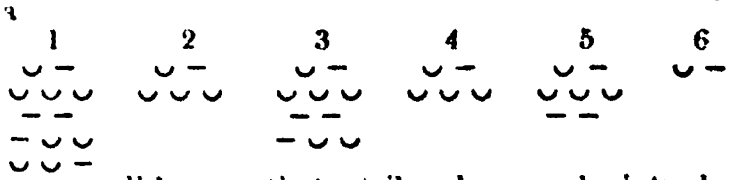
I, the ninth letter of the English and most European alphabets, represents two very different sounds in different languages In England it is equivalent to the French or German sounds of [illegible] and in the German [illegible] we are acquainted, it is identical with the sound of the long English *e* In the Greek language the letter ι is the simplest of the alphabetical characters, being represented by a single stroke thus, ι It is also susceptible of various [illegible] particularly in the Latin, Greek, and [illegible] When two ι's followed in succession, the Romans used to [illegible] one long ī, as *Dī* for *Dii*, *tibicen* [illegible], [illegible] larger than usual, as *ChIus* Shakspeare sometimes substitutes *I* for ay or yes

> Did your letters pierce the queen?
> *I*, sir she took 'em and read 'em in my presence

According to Gebelin the letter ι in hieroglyphic writing represents the human hand the instrument of which man avails himself in all his necessities, the seat of his power and might As a Roman numeral it denotes 1, and if placed before V or X, it diminishes by a unit the number expressed by these two letters The form of J was originally identical with that of I, and it is only within the last century that any distinction was made between them In the English and French languages J has a sibilant sound but the Germans pronounce it exactly as the English *y* before a vowel The Latin sound of this letter is very ambiguous, the question being usually decided by the parties who discuss it according to its pronunciation in the vernacular In the Spanish language J represents a guttural and is frequently substituted for X, which has the same sound

IA'CCHUS See BACCHUS

IA'MBICS A species of verse used by the Greek and Latin poets and especially by the Greek tragic poets The derivation of the word has never been ascertained, but it can boast of an origin nearly coeval with the Greek language The iambics of the Greek tragic poets consisted of three entire metres or six feet, and were thence styled the tragic *trimeter acatalectic* They were composed originally as their name implies, of a succession of iambi (⏑ –) but at a later period various other feet were admitted, of which the subjoined table will convey an idea




Hence it will be seen that a tribrachys may be introduced into all the places except the last, a spondee in the first, third and fifth places a dactyl in the first and third places, and an anapest in the first It was however, long a question of great doubt among grammarians into what places the anapest might be legitimately introduced The discussion at one period ran high particularly between English and German critics but it now seems to be universally admitted that this foot may be used in every odd place of the verse except the last with the general restriction that in the 3d and 5th places it should be contained in a proper name as Antigŏnē, or in a preposition and the word which it governs The comic writers used much greater licence in the iambic trimeter, admitting an anapest, even in common words into every place but the last For a full exposition of this and the other iambic metres employed by the Greek and Latin poets, the reader may consult *Hermann's Elementa Doctrinæ Metricæ*, *Porson's* editions of the *Tragedies of Euripides*, and the article 'Iambic Verse' in *Rees's Cyclopædia* In most modern European languages the verse of five iambic feet is a favourite metre In French it is used almost entirely in lighter poetry, as by La Fontaine and similar writers, the heroic verse being the sixth foot, or alexandrine, but in English German, and Italian, the former is the verse of ordinary use in serious composition The Italians divide it into — 1 The *verso cadente*, in which the line is decasyllabic, consisting of five iambi *e g*

"E come albero in nave si levo" DANTE.

This variety is very much admitted in serious composition and is ill suited to the character of the language Poets have, however, sometimes sportively attempted whole series of versi cadenti as in the set of sonnets of Casti, called *Ite Gauli* 2 The verso rotto, or hendecasyllabic, which is the ordinary one, ending in a short syllable

" Canto l armi pietose, e 'l capitãnð "

3 The verso sdrucciolo, which ends with two short syllables after the fifth iamb

" Passi oziosa, e di tua gloria immēmŏrē "

This also is rarely used in serious writing, but its occasional employment adds a peculiar g r p the hendecasyllabic occasional, and more frequent in blank verse than in rhymes, in consequence of the comparative rarity of trochaic rhymes, the sdrucciolo, also occasionally used by dramatic poets *e g*

" What s Hecuba to him, or he to Hĕcŭbă ? "

The licence is sometimes carried so far as to add three short syllables to the last iamb *e g*

" The senator shall bear contempt herēdĭtārў "

The German language is rich both in iambic and trochaic terminations consequently the decasyllabic and hendecasyllabic are more indiscriminately employed than in either English or Italian, and it is not uncommon to use the elegant variety of alternate iambic and trochaic rhymes like the French masculine and feminine

IBEX (Lat *a wild goat*) The name is restricted to a species of goat, the *Capra ibex* of Linnæus *Bouquetin* of Buffon and the French naturalists It is characterized by having large horns, with a flattened anterior surface and marked with prominent transverse ridges or knots It inhabits the summits of the highest mountain chains in the continents of Europe, Africa, and Asia, but does not exist in the New World

ICEBERG (Germ eis, *ice* and berg *mountain*) The name given to the masses of ice resembling mountains often found floating in the polar seas They are sometimes formed in the sea itself by the accumulation of ice and snow, at other times they seem to be glaciers which have been piling up on shore till quite overgrown and ultimately broken and launched into the ocean by their own weight Masses of this sort abound in Baffin's Bay where they are sometimes two miles long and half or one third as broad Scoresby counted 360 of these bergs drifting along in latitudes 69° and 70° N which rose above the surface from the height of 100 to 200 feet and measured from a few yards to a mile in circumference (*Voyage in* 1822 p 33) Many of them were loaded with beds of earth and rocks of such thickness that the weight was conjectured to be from 90 000 to 100 000 tons and on closer examination the mass was found to be composed among other substances, of granite gneiss mica schist, clayslate, granular felspar, and greenstone Some idea may be formed of the immense depth to which icebergs descend from the fact that the mass of ice below the level of the water is about eight times greater than that above Icebergs have been known to drift from Baffin's Bay to the Azores, and from the South Pole to the immediate neighbourhood of the Cape of Good Hope (See *Lyell's Geology* book ii c 3, *Murray's Image of Geography*)

ICELAND MOSS *Lichen Islandicus Cetraria Islandica* This is a common lichen in the mountainous districts of Europe It contains a bitter principle, and a considerable quantity of starchy matter it is tonic and nutritive, and is often prescribed in disorders of debility, and s consumption

ICELAND SPAR A transparent rhomboidal variety of calcspar, or carbonate of lime This form of crystallized carbonate of lime is particularly valuable for experiments on the double refraction and polarization of light

ICE SPAR A variety of felspar, from Somma near Naples

ICH DIEN (Germ) Literally *I serve*, the motto of the Prince of Wales, which was originally adopted by Edward the Black Prince in proof of his subjection to his father Edward III, and has been continued without interruption down to the present time

ICHNEUMON (Gr *ιχνευμων*, Pharaoh's rat the destroyer of crocodiles, perhaps from *ιχνευω*, because it tracked the foot-prints of the crocodile) A name applied in zoology, in a double sense to a Viverrine genus of quadrupeds, and to a family of Pupivorous Hymenoptera As regards the Mammalia the name is changed for *Herpestes* by Illiger, and the latter has generally adopted by English zoologists (See HERPESTES for the generic characters.) The ichneumon of the Nile (*Herpestes Pharaonis*) was one of the sacred animals of the ancient Egyptians, and although many fabulous feats were narrated of it as the enemy of the crocodile, there is no doubt but that its industrious instinctive searching out of the eggs of [illegible] food tends materially to [illegible] destructive reptile The ichneumon preys, however on the eggs and young of various species of animals Mr Bennett relates that on one occasion a grey ichneumon (*Herpestes griseus*) killed no fewer than a dozen full-grown rats, which were loosed to it in a room sixteen feet square in less than a minute and a half For an account of the insect ichneumons, see PUPIVORA

ICHNOGRAPHY (Gr *ιχνος*, *a model*, and *γραφω*, *I draw*) In Architecture, the representation of the ground plot of a building In perspective it is its representation intersected by a horizontal plane at its base or ground floor

ICHOR (Gr) A thin watery discharge By the Greeks it was applied to the divine fluid that issued from the wounds of the gods

ICHTHIOCOLLA (Gr *ιχθυς a fish*, and *κολλα*, *glue*) See ISINGLASS

ICHTHYOLOGY (Gr *ιχθυς* and *λογος*, *a discourse*) The science which treats of the nature, uses, and classification of fishes

Fishes are those oviparous vertebrate animals which have a heart consisting of one auricle and one ventricle which breathe water, and have the nasal cavity communicating with the external surface only In a few species an air bladder is present, and so organized as to act the part of a lung, but the principal if not exclusive organ of respiration consists throughout the whole class of branchiæ or gills The gills are composed of rows of slender flattened processes suspended by arches attached in general to the hyoid bone and covered with a membrane or tissue of innumerable minute and close set blood-vessels The water which the fish takes in by the mouth instead of being swallowed passes through the interspaces of the gills and escapes by the fissures on each side of the head called gill apertures The air contained in the water acts upon the blood, which is minutely subdivided in the branchial vessels and the bilocular heart serves exclusively to propel the whole of the venous blood to the branchial arteries and is thus analogous in function to the pulmonary auricle and ventricle of the warm blooded classes The blood having been decarbonized in the gills is collected into the dorsal arterial trunk or aorta and is propelled without the influence of a systemic heart to all parts of the body, whence it is again returned by the veins to the branchial auricle and ventricle

The whole structure of a fish is as evidently adapted for swimming as that of a bird for flight Being suspended in a fluid of nearly the same specific gravity as itself it needs not widely-expanded wings for its support Many species moreover have the air bladder organized and developed as, by its contractions and dilatations to vary the specific gravity of the fish and aid in its ascent to the surface or descent into the depths of the water Ordinary progression is effected by the motions of the tail which by the action of powerful muscles displaces the water alternately to the right and left the gills also, in expelling the water backwards may contribute, by the reaction of the current to propel the fish forward The ordinary extremities therefore, being of little use are reduced to a low or rudimental condition, they are chiefly remarkable for the number of parts corresponding to the digital phalanges of the higher classes and which from their disposition are called rays The pieces analogous to the bones of the arms and legs are extremely shortened and often quite concealed, the membrane supported by the diverging rays rudely represents the hands and feet The members thus constructed are called fins those which answer to the anterior extremities are called the pectoral fins, those which answer to the posterior extremities are the ventral fins ' Other rays attached to peculiar bones above or between the extremities of the spinous processes support the vertical fins which are medial and single either above the back beneath the tail or at the extremity of the tail The upper vertical fin or fins are called the *dorsal* the lower ones the *anal* and the terminal one the *caudal* fin The fin-rays are of two kinds Some consist of a single bony piece, usually hard and pointed sometimes flexible and elastic, and divided longitudinally, they are called 'bony or spinous rays " the others are composed of a vast number of little [illegible] generally branched at the extremity, they are called [illegible] jointed or branched rays ' In general the fins, which are placed in pairs and correspond to the ordinary extremities, are four in number, but sometimes there are but two and sometimes they are entirely wanting When both pectoral and ventral fins are present they may have the ordinary relative position, i e the pectoral fins may be considerably in advance of the ventrals—such fishes are said to be abdominal," or the ventrals may be placed below, or on the same or nearly the same transverse line as the pectorals—such fishes are termed ' thoracic, ' or the ventrals may be situated in advance of the pectorals, under the throat of the fish—when the species are called ' jugu

lar" fishes The vertebræ of fishes, when completely ossified, are united, with very few exceptions, by opposite concave surfaces Most fishes have the body covered with scales They are destitute of organs of prehension except the teeth The imperfection of the organ of touch is remedied in some by the development of soft tentacles or feelers

The teeth are very various as to their number, form, and relative size They are either anchylosed to the jaw bones, attached to ligaments or implanted in sockets; when the latter, the tooth has always a single and simple fang The teeth may be placed on the maxillary, intermaxillary, or lower jaw bones, upon the vomer or sphenoid bones, upon the palatine or pterygoid bones, the tongue the branchial arches or the pharyngeal plates, or they may be entirely wanting

Besides the branchial arches, the hyoid bone supports on each side a number of rays, which support the branchial or opercular membrane This membrane is also ge-

bones ' the kind of door thus formed is joined to the tympanic bone, and plays upon a piece called the ' preopercular ' bone

With respect to the subdivision of the class of fishes into orders Cuvier admits the great difficulty which exists in defining them by fixed and easily appreciable characters, and after many attempts adopted the following classification

He first divided the class into two sub classes

Sub class I *Pisces ossei* or fishes properly so called

II *Pisces cartilaginei* or *Chondropterygians* cartilaginous fishes

The first sub class are arranged according to the modifications of their organs of locomotion All the osseous fishes which have the anterior part of the dorsal fin or the first dorsal where there are two supported by bony rays with some bony rays in the anal fin and at least one bony ray in each of the ventrals are collected into an order called *Lanthopterygians*

All those osseous fishes in which with the exception of the anterior dorsal and pectoral rays, all the others are soft constitute the order *Malacopterygians*

The *Malacopterygii* are arranged according to the relative position or absence of the ventral fins into abdominal," jugular or sub brachial' and apodal fishes

Those fishes which have the branchia with form of tufts constitute the order of *Lophobranchii*

Those fishes in which the maxillary and palatine arches are firmly united or as it were soldered to the cranium are called the *Holostomata*

The *Chondropterygian* fishes are divided into the three orders of —

*Sturiones*
*Selacians* and
*Cyclostomes* (See those words)

The chief modification in the arrangement of the class of fishes has been the consequence of a study of the nature and limits of the more remote extinct forms and a comparison of these with existing species

M Agassiz has proved that certain species which stand out as exceptions to the ordinary form and structure of the class among recent fishes are the types of extensive orders which peopled the seas of the ancient world and now characterize particular strata His naturalist has likewise observed more closely than his predecessors the relations which subsist between the external scales and the internal structure and he accordingly proposes to arrange the class of fishes according to the modifications of the scaly covering and divides them into four orders each of which contains fishes having a cartilaginous skeleton and in each there are both Acanthopterygian and Malacopterygian Abdominal and Apodal genera The orders are named *Placoides Ganoides Ctenoides* and *Cycloides* (See those terms)

ICHTHYOPHTHALMITE (Gr *ιχθυς* and *οφθαλμος the eye*) A species of zeolite of a pearly lustre of a fish (whence its name)

ICHTHYOSAURUS (Gr *ιχθυς a fish* and *σαυρος a lizard*) A genus of extinct marine animals which combined the characters of saurian reptiles and of fishes with some of the peculiarities of the Cetaceous Mammalia The vertebræ of the back bone of the *Ichthyosaurs* resemble those of fishes in having their bodies joined by opposite concave surfaces, but the superior arches remain permanently detached, as in reptiles The cranium resembles in structure that of the crocodiles but is characterized by a peculiarly large orbit, in which a circular series of osseous sclerotic plates analogous to those of the crocodile and birds but relatively much larger, has been so frequently found as to prove it to be a generic structure The nostrils are situated, not as in the crocodile, near the point of the snout but close to the anterior part of the orbit

The teeth resemble in structure those of the crocodiles but are lodged, as in some of the Lacertine Saurians, in a groove and not in distinct sockets The locomotive extremities are similar in construction to the paddles of the whale, but they are four instead of two in number, and the anterior paddles are connected by a broad coracoid, a complete clavicle, and a supplementary coracoid bone to a strong sternum, the flattened phalangeal bones supporting the fin are polygonal, and are relatively shorter and more numerous than in the whale tribe The hind paddles are smaller than the fore, and are attached to a pelvis similar to that of the crocodile Small supplemental bones are wedged into the lower part of the joint of the atlas and occiput, and a few of the succeeding vertebral joints, and the tail often presents a fracture at a particular point, whence the existence of a caudal fin has been inferred From the form and position of masses of [illegible] s and scales [illegible] it is concluded that they preyed chiefly on fish, that they had a simple and capacious stomach, and an intestine provided with a spiral valve The geological range of the ichthyosaurus seems, says Dr Buckland, to have begun with the muschelchalk, and to have extended through the whole of the oolitic period into the cretaceous formation The most recent stratum in which any remains of this genus have yet been found is the chalk marl at Dover The chief depository of the bones of the *Ichthyosauri* occurs in the lias at Lyme Regis in Dorsetshire

ICHTHYO'SIS (Gr *ιχθυς*) A roughness and thickening of the skin, portions of which become hard and scaly and occasionally corneous, with a tendency to excrescences Friction, warm bath and occasionally [illegible] been of service in mitigating [illegible] but it seldom yields permanently to any plan of treatment

ICHTHYS (Gr *a fish*) A word found on many seals rings, urns tombstones &c belonging to the early times of Christianity, and supposed to have a mystical meaning from each character forming an initial letter of the word Ιησου, Χριστος, Θεου Υιος Σωτηρ, i e Jesus Christ, the Son of God the Saviour This interpretation is not unlikely, when we consider at once the universal reverence with which the fish was symbolically regarded among most ancient nations, and the many signs and ceremonies adopted by the Christians with some change of meaning from the religious rites of the surrounding nations

ICONOCLASIS (Gr *εικων an image*, and *κλαω, I break*) Literally breakers of images, a title applied to two of the Byzantine emperors Leo the Isaurian and his son Constantine Copronymus who during their reigns, which extended from 726 to 799 persevered in overthrowing the images in the Christian churches and in extirpating their worship The 338 bishops, also, who attended a council at Constantinople in the reign of the latter prince and declared themselves in favour of his views were stigmatized by the orthodox party under the same name In the year 787, however, a general council was assembled at Nicæa by the empress Irene who inclined towards the old superstition, and the images were on this occasion restored to their former honours This council the second of Nice, is the last respecting which the Greek and Latin churches coincide, the practice, however of the Greek church makes a distinction between the use of pictures which it allows and graven images, which it studiously rejects (*Mosheim Eccl Hist* vol i p 262 transl, *Sellosser's History of the Iconoclast Emperors* Frankfort 1812, *Neander*, parts 3 and 4)

ICOSAHEDRON (Gr *εικοσι twenty* and *εδρα, base*) One of the five regular or Platonic bodies bounded by twenty equilateral and equal triangles It may be regarded as formed of twenty equal and similar triangular pyramids whose vertices all meet in the same point, and hence the content of one of these pyramids multiplied by twenty gives the whole content of the icosahedron Let the linear edge of one of its faces be denoted by $a$, then the surface of the icosahedron is $= 5\,a^2\sqrt{3} = 8{\cdot}660254\,a^2$, and the solidity $= \frac{5}{6}a^3\sqrt{\frac{7+3\sqrt{5}}{2}} = 2{\cdot}181695\,a^3$ (See *Hutton's Mensuration* or *Sharpe's Geometry Improved*)

ICOSANDROUS (Gr *εικοσι*, and *ανηρ, a male*) Literally any flower having twenty stamens or thereabouts, but it is usually confined to those flowers in which these stamens are inserted into the calyx

ICTERUS (Gr [illegible] from its resemblance [illegible] form of the word signifies

ICTIDES (Gr *ικτις a weasel*, and *ειδος form*) A genus of nocturnal carnivorous Mammals intermediate between the Plantigrade and Viverrine Digitigrade tribes having the plantigrade walk of the racoons and coatis, and the slender conical snout of the civets and other *Viverridæ* The dental formula of the genus is

Incis $\frac{6}{6}$, can $\frac{1}{1}\,\frac{1}{1}$, præmol $\frac{3}{2}\,\frac{3}{2}$, mol $\frac{3}{3}\,\frac{3}{3} = 38$

The teeth resemble those of the *Paradoxurus* but are thicker and more tuberculous, and thus contribute,

with [illegible] of the feet to indicate the affinities [illegible] Plantigrade *Ferae* Three species of the present genus are recorded, they are all natives of Southern Asia, and are called *Benturongs* The common Indian species (*Ictides albifrons*) is of the size of a domestic cat, but its body is longer and heavier, its legs shorter and its gait lower and more crouching The tail is extremely thick at its commencement, and gradually tapers to its extremity, where it curls upwards The pupil of the eye contracts during daylight into a vertical fissure A benturong, which was kept in captivity many years, was fed on a mixed diet of animal and vegetable substances, and they most probably subsist on similar food in a state of nature

IDEA (Gr ἰδέα from ἰδεῖν, *to see*) Literally, the image or resemblance of any object conceived by the mind There is no word in any language the definition of which, from the obscurity of metaphysical writers is attended with such difficulty as the term *idea*, and the difficulty is enhanced when we consider the vagueness with which its equivalents are expressed in different languages, and the many metaphysical systems that have been constructed on their several significations Like many other terms of mental philosophy the word *idea* is derived from the most eminent of the senses that of sight, and in its most extended acceptation is employed to indicate "every representation of outward objects through the senses and whatever is the object of thought" To give even a cursory glance at the various theories of the origin and nature of ideas would be to write the history of mental philosophy from Plato to Kant, and would far exceed our limits, even if the difficulty of the subject did not deter us from the attempt The reader will find the best exposition of some of the theories alluded to in *Dugald Stewart's Phil Essays* Appendix II, *Kant's Critik der reinen Vernunft Ritter's Geschichte der Philosophie*, *Reid on the Human Mind*, and the *Edin Review*, *Green's Hunterian Oration*, 1840

IDEAL (BEAU), or IDEAL BEAUTY An expression in the Fine Arts used to denote a selection for a particular object of the finest parts from different subjects, united in that one so as to form a more perfect whole than nature usually exhibits in a single specimen of the species or, in other words, the divesting nature of accident in the representation of an individual From the nature of the expression and its definition it is clear that it more immediately attaches to the arts of painting and sculpture in architecture it is susceptible of refinements dependent on the selection of examples upon which however a less universal agreement exists

IDEALISM (Gr ἰδέα *form*) A term applied to several metaphysical systems, varying in its signification according to the meaning attached in each particular scheme to the word *idea*, from which it is derived In England the best known system of idealism is that of Berkeley In reference to this philosopher's doctrines the word is used in its empirical sense for the object of consciousness in sensation (See PERCEPTION) In its Platonic or transcendental sense the term *idealism* has been applied to the doctrines of Kant and Schelling, neither of whom is an idealist in the way in which Berkeley may be so called The system of Berkeley may be thus expressed — The qualities of supposed objects cannot be perceived distinct from the mind that perceives them and these qualities it will be allowed, are all that we can know of such objects If therefore there were external bodies, it is impossible we should ever know it and if there were not, we should have exactly the same reason for believing there were as we have now All, therefore which really exists is spirit, or the thinking principle — ourselves, our fellow men and God What we call ideas are presented to us by God in a certain order of succession which order of successive presentation is what we mean by the laws of nature

IDENTITY PERSONAL denotes the sameness of the conscious subject *I*, through all the various states of which it is the subject The question Wherein consists our identity, and what is its evidence? has been a source of manifold controversy to modern metaphysicians By philosophers of the materialist school the doctrine has been rejected as incompatible with daily and obvious experience But independently of any hypothesis respecting the nature of the soul in itself, it has been argued and with some plausibility that as all our knowledge of a substance is derived from the qualities or phenomena which it presents to our senses, so that all we can mean by a substance being the same with itself is that it possesses the same qualities which it previously did (for if not the substance is changed), so all we can know of the substance *mind* in particular is derived from observation of the changes which it undergoes But we find that what we conceive to be the same individual does, at different periods, assume under the same circumstances widely varying appearances A man shall laugh at what when he was a child would have excited his anger or jealousy This reasoning contains an evident fallacy It does, in fact, like all other reasoning of the same kind, imply that very doctrine which it means to refute Consciousness, it is asserted, is the joint effect of two substances acting one on the other How, then can we affirm that one of these substances is changed, unless by assuming that the other remains the same? How can we show that the phenomenon laughter in the man is different from the phenomenon jealousy or anger in the boy, unless we admit that we who *observe* these phenomena,—*i e* by the premises, on whom these phenomena produce a given effect—remain the same as we were when we were affected previously in a different manner A lump of sugar, as we take it to be, no longer melts in what we take to be water Assuming that the water remains water, we may fairly [illegible] question is not sugar or vice versâ, lest [illegible] we process ourselves equally ignorant of the identity of both substances This [illegible] [illegible] [illegible] ist [illegible] [illegible] Such [illegible] be said to be the *ne-* [illegible] [illegible] positive evidence rests [illegible] [illegible] [illegible] self, is implied in every act of memory *To remember* is to refer a past state of consciousness to the same subject which now at the present moment recals it (See *Bishop Butler's Treatise on Personal Identity*, *Brown's Phil of Human Mind* Lect 12 13, 14 &c &c)

IDENTITY SYSTEM OF In Philosophy (otherwise called Identism) a name which has been given to the metaphysical theory of the German writer Schelling It rests on the principle that [illegible] the objects respectively of [illegible] called by the various terms o[illegible] and subjective real and ideal, &c, are only relatively opposed to one another as different forms of the one *absolute* or *infinite* hence sometimes called the two *poles* of the absolute See SCHELLING, PHILOSOPHY OF

IDEOGRAPHIC CHARACTERS (Gr ἰδέα *an idea* and γράφω *I write*) In Philology, characters used in writing which express figures or notions, instead of the arbitrary signs of the alphabet The Chinese characters are ideographic although the symbols, at first intended to represent distinct objects, have become by use merely conventional The hieroglyphical characters of the ancient Egyptians were of the same description Ideographical writing is opposed to phonetic See PHONETIC

IDEOLOGY (Gr ἰδέα and λόγος *a discourse*), literally the science of mind, is the term applied by the later disciples of Condillac to the history and evolutions of human ideas considered as so many successive modes of certain original or transformed sensations The writings of this school are characterized by an unrivalled simplicity, boldness and subtlety and the different phases of its doctrines are admirably exhibited in the physiological researches of Cabanis the moral dissertations of Garat and Volney and the metaphysical disquisitions of Destutt de Tracy (*Damiron*, *Hist de Phil en France*, tome ii)

IDES (Supposed to be derived from the obsolete verb iduare *to divide*) One of the three epochs or divisions of the ancient Roman month The *calends* were the first days of the different months, the *ides* days near the middle of the months, and the *nones* the ninth day before the ides In the months of March May July and October, the ides fell on the 15th in the other months on the 13th The Romans used a very peculiar method of reckoning the days of the month Instead of employing the ordinal numbers first second third, &c, they distinguished them by the number of days between any given day and the next following [illegible] fixed divisions For example as there were always eight days between the nones and the ides, the day after the nones was called the eighth *before* the ides the next the seventh *before* the ides the next the sixth before the ides and so on In leap years, when February had twenty-nine days the extra day was accounted for by calling both the twenty fourth and twenty-fifth days of that month the sixth day before the calends of March, whence the leap year got the name of bissextile (from bis *twice* and sextus *sixth*) See BISSEXTILE

IDIOM (Gr ἴδιος, *peculiar*) In Philology a mode of speaking or writing foreign from the usages of universal grammar or the general laws of language, and restricted to the genius of some individual tongue Thus, a sentence or phrase consisting of words arranged in a particular manner may be a Latin idiom, the same, arranged in a different manner, an English idiom, &c The use of a particular inflexion of a word may also be an idiom We also use the term idiom in a more general sense, to express the general genius or character of a language We have a number of [illegible] words to express the idioms of particular tongues thus a Latin idiom is a Latinism, a French idiom a Gallicism, &c The word idiom is also not used in the same sense with [illegible] or variety of language *Idiotisme* is the French term ex- [illegible] the English idiom"

IDIOPATHIC (Gr ἴδιος and πάθος *an affection*)

A disease which does not depend upon any other disease and which is thus opposed to those diseases which are

[illegible] (Gr *ιδιος, συν, with* and *κρασις a temperament*) A state of constitution [illegible] ceptibl of certain agent which in general produce no effect, or one peculiar to itself Thus honey and coffee act with some few persons as violent poisons very minute doses of antimony are occasionally followed by powerful emetic effects, and of mercury by salivation, &c

I'DIOT (Gr *ιδιωτης*, originally *a private individual*) In contemplation of Law, one who has been born totally deficient in understanding or has lost it by sickness, so as to have lucid intervals lunatic, properly speaking, one who has lucid intervals The care of idiots and lunatics is a branch of the prerogative of the crown, and exercised ordinarily by the chancellor By the common law persons were found idiots or lunatics by verdict of a jury on a writ de idiotâ or de lunatico inquirendo, but in later times by commissions issued, on petition from near relations, under the great seal Commissions are also frequently issued to determine not specifically whether the party be an idiot, &c, but whether he be under such imbecility as to require protection [illegible] of his affairs, and such is now the practice The custody of an idiot's estate is the [illegible] trusted to the committee of the estate

IDIO'TICON (Gr) A word of frequent use in Germany, signifying a dictionary confined to a particular dialect, or containing words and phrases peculiar to one

[illegible] (Gr *ιδεα, form*, and *κρασις mixture*, indicating that its forms are a mixture of the forms of certain other minerals) The volcanic garnet It is of various colours and is sometimes called volcanic crysolite or hyacinth It occurs in the ejected masses of Vesuvius, and elsewhere It is an alumino-silicate of lime with about 5 per cent of oxide of iron

I'DOL, IDO'LATRY (Gr *ειδωλον a similitud representation, or image*, *λατρεια worship*) The figures of metal, stone, or wood by which Pagans for the most part represent their divinities are termed *idols* and the worship paid to them *idolatry* This practice is expressly forbidden by the second commandment of the Decalogue which says, 'Thou shalt not make unto thyself any graven image Thou shalt not bow down to them nor worship them,' — which must be interpreted to forbid the making of an image for the purpose of worshipping it The absurdity and criminality of idolatry are also clearly pointed out by the light of nature Roman Catholics however are accused of idolatry upon the supposition of their performing acts of adoration to the images of Christ, the Virgin, and Saints the adoration of the Host or consecrated elements is also made a [illegible] which they make that [illegible] spiritual being re[illegible] enlightened heathen in his own case, but does not express the feelings of the multitude, nor was room allowed to the Jews for any such subterfuge

In a wider sense the adoration of any visible objects such as the sun and the host of heaven (Sabianism) is idolatry, and the adoration of animals by the Egyptians But in the more restricted signification of the word, it denotes the adoration by men of the works of their own hands properly as images (*ειδωλα* supposed to represent divine beings Although Grecian idolatry was dignified by all the charms which art could throw around it, it appears that the most popular idols were rude and almost formless images, traditionary representations of the divinities, to many of which the vulgar notion attributed a divine origin, believing them to have fallen from heaven Such were the Hermæ of Athens, the image of Diana (*Διοπετης*) at Ephesus mentioned in the Acts, the sacred 'Ancilia' or shields of the Romans which seem to have commanded more of the veneration of the common people than the Pallas of the Parthenon or the Jupiter Olympius of Elis (See *Vossius De Origine Idololatriæ*, *Graves on the Pentateuch*, *Creuzer Symbolik der alten Volker*, *Spence's Polymetis*, *Mem de l Acad des Inscr* vol xxxviii)

I'DRIALINE A fusible inflammable substance found by Dumas in a mineral from the quicksilver mines of Idria in Carniola

I'DYL (Gr *ειδυλλιον*, the diminutive of *ειδος form*) A short pastoral poem The Greek word is derived from *ειδος, form*, or *visible object*, and hence the object, or at least the necessary accompaniment of this species of poem, has been said to be a vivid and simple representation of ordinary objects in pastoral nature But in common usage the signification of this word is hardly different from that of eclogue The poems of Theocritus are termed Idyls, those of Virgil Eclogues, but it would be difficult to assign a distinction between the two except what arises from the greater simplicity of language and thought which characterizes the former Many critics, however, aver that the eclogue requires something of epic or dramatic action, the idyl only picturesque representation, sentiment, or narrative (*See* ECLOGUE, BUCOLIC) In English poetry among this class may be ranked *The Seasons* of Thomson *Shenstone's Schoolmistress*, *Burns' Cottager s Saturday Night*, *Goldsmith's Deserted Village*, &c &c

IGASU'RIC ACID A name given by Pelletier and Caventou to an acid which is found combined with strychnia in the *Nux vomica* and St Ignatius's bean

IGNA'TIUS'S BEAN The seed of the *Ignatia amara*, used in the Philippine Islands as a cathartic and emetic *See* STRYCHNIA

I'GNIS FA'TUUS (Lat *vain or foolish fire*, a translation of the Fr feu follet) A kind of luminous meteor, which flits about in the air a little above the surface of the earth, and appears chiefly in marshy places, or near stagnant waters, or in churchyards, during the nights of summer There are many instances of travellers having been decoyed by these lights into marshy places, where they perished, and hence the names *Jack-with-a-lantern*, *Will with-a-wisp* the people ascribing the appearance to the agency of evil spirits, who take this mode of alluring men to their destruction The cause of the phenomenon does not seem to be perfectly understood, it is generally [illegible] by the decomposition of animal [illegible] by the evolution of gases which spontaneously inflame in the atmosphere

IGNITION (Lat ignis, *fire*) The act of setting fire to or of taking fire, as opposed to combustion or burning, which is a consequence of ignition The term *spontaneous ignition* is applied to cases in which substances take fire without previous application of heat thus spongy platinum is said to become spontaneously ignited when introduced into a mixture of oxygen and hydrogen gases, and to cause their combustion The particles of steel struck off by collision with flint become ignited on passing through the air, and falling upon gunpowder ignite it, and combustion ensues Iron wire, when red hot is also often said to be *ignited*, or in a state of ignition, and when in that state it is plunged into oxygen gas or into chlorine, it undergoes combustion, and burns in those gases with the further extrication of heat and light

IGNORA'MUS (Lat *we [illegible]*) In Law the endorsement of a grand jury [illegible] equivalent to 'not found' The jury are said to *ignore* a bill when they do not find the evidence such as to make good the presentment

IGUA'NA (Cuvier states, with reference to the derivation of this term that it was originally a St Domingo word, where it was pronounced by the natives *hiuana* or *igoana*, and quotes Hernandes and Scaliger as his authorities He then proceeds to say that Bontius regards it as derived from the Javanese word *leguan* In this case the Portuguese or Spaniards must have transported it to America, where they transformed it into *iguana* They apply this term to the monitor as well as to the *iguana* The *leguan* of Bontius is a monitor The best authorities in erpetology have adopted the Latinized *iguana* as the generic name of the reptiles under consideration) A genus including certain large and beautiful lizards common in the tropical parts of America some of which feed on vegetable substances and are esteemed delicious food The common iguana (*Iguana tuberculata*, Laur) has accordingly received the specific names *delicatissima* and *sapidissima* The generic name *iguana* is now restricted to those species which present the following characters — A large thin fold of skin or dewlap under the chin, cephalic cuticular plates, polygonal, unequal in diameter, flat or carinated, a double row of small palatal teeth, maxillary teeth, with their edges finely dentilated, a crest on the back and tail, toes long and unequal, a single row of femoral pores, tail very long slender, compressed, covered with small, equal, imbricated carinated scales

IGUA'NIDÆ (From *Iguana*) The family of lizards of which the genus *Iguana* [illegible] which is divided, according to [illegible] ing characters of the Iguanas into the subgenera *Iguana* proper, *Corythophanes*, *Basiliscus*, *Aloponotus*, *Amblyrhynchus*, *Metopoceros*, *Cyclura*, *Brachylophus*, *Enyalus*, an[illegible]

[illegible] The *Lézards iguaniens* of French [illegible] extensive tribe of Lacertine Sau[illegible] MM Duméril and Bibron into two groups, *Pleurodontes* and *Acrodontes*

The *Pleurodontes* include the families *Iguanidæ*, *Polychridæ*, *Anolidæ Tr pidolepididæ* and *Opluridæ*

The *Acrodontes* embrace the families *Galeotidæ*, *Agamidæ*, *Phrynocephalidæ* and *Stellionidæ*

A short and thick tongue, with base not retractable in a sheath, and with the extremity free, mobile, and very slightly cleft, is the general character of this extensive tribe

IGUA'NODON (From *Iguana* and Gr *οδους a tooth*) An extinct genus of [illegible] reptiles, dis-

covered by Dr Mantell in the wealden fresh-water formation of the South of England in the localities of Tilgate Forest, Isle of Wight, and Purbeck The chief distinctive character of this genus is the form of the teeth, which are dentilated along the margin of the crown, as in the *iguana*, [illegible] worn down, a broader [illegible] ure by which these teeth [illegible] coarse and tough vegetable food, such as the *Clathrariæ* and similar fossil plants of the wealden strata may be supposed to have afforded the *iguanodon*, is thus described by Dr Buckland — The teeth exhibit two kinds of provisions to maintain sharp edges along the cutting surface, from their first protrusion until they were worn down to the very stump The first of these is a sharp and serrated edge, extending on each side downwards from the point to the broadest portion of the body of the tooth The second provision is one of compensation for the gradual destruction of this serrated edge, by substituting a plate of thin enamel to maintain a cutting power in the anterior portion of the tooth until its entire substance was consumed in the service Whilst the crown of the tooth was thus gradually diminishing above a simultaneous absorption of the root went on below caused by [illegible] rising to replace the old one, [illegible] sumption at both extremities the middle portion of the older tooth was reduced to a hollow stump, which fell from the jaw to make room for a more efficient successor" The anterior surface of the crown of the tooth also, instead of being flat and even, was traversed by alternate longitudinal ridges and furrows, the latter serving 'as ribs or buttresses to strengthen and prevent the enamel from scaling off and forming, together with the furrows an edge slightly wavy, and disposed in a series of minute gouges or fluted chisels, hence the tooth became an instrument of greater power to cut tough vegetables under the action of the jaw than if the enamel had been a continuous straight line By these contrivances also it continued effective during every stage through which it passed from the serrated lancet point of the new tooth to its final consumption'

From the proportions which the bones of the *iguanodon* bear to those of the *iguana* this extinct monster of a former world is calculated to have been 70 feet in length from the snout to the end of the tail the length of the tail alone is calculated to have been 35 feet the circumference of the body 14½ The thigh bone of the full sized *iguanodon* is twenty times the size of that of the *iguana* The snout of the *iguanodon* was armed with a short but strong horn but the long and powerful tail formed probably its most formidable instrument of attack and defence

ILEUM (Gr εἰλέω, *I turn about*) The last portion of the small intestines terminating at the valve of the cæcum

ILIA (Lat) The flanks or the part of the abdomen which includes the small intestines The *os ilium* the haunch bone the upper part of the *os innominatum* which supports the intestines

ILIAC PASSION (Lat *ileus*, *the bowels*) A vomiting of bilious and fecal matter in consequence of obstruction in the intestinal canal

ILIAD (Gr Ἰλιάς) The old Greek poem in existence, commonly attributed to Homer but according to some modern hypotheses the work of several hands The theme of the poem is the siege of Ilium (whence its name) or Troy, or more properly speaking the quarrel of Achilles with Agamemnon general of the Grecian army before that city It consists of twenty four books The first book relates the origin of the quarrel, and the residue of the poem contains an account of the efforts made by Agamemnon and the chief who adhered to his party to conquer the Trojans without the aid of Achilles their defeat the pacification of Achilles, his resumption of arms in the common cause and the death of Hector by his hand Neither the landing of the chieftains, nor the conclusion of the war and capture of Troy, come within its [illegible] See Epic

ILLATIVE CONVERSION in Logic, is that in which the truth of the converse follows from the truth of the exposita or proposition given Thus the proposition 'no virtuous man is a rebel' becomes by illative conversion "no rebel is a virtuous man' Some boasters are cowards," therefore à converso, 'some cowards are boasters'

ILLUMINATI, or THE ENLIGHTENED A secret society, formed in 1776 chiefly under the direction of Adam Weishaupt professor of law at Ingolstadt in Bavaria Its professed object was the attainment of a higher degree of virtue and morality than that reached in the ordinary course of society It numbered at one time 2000 members It was suppressed by the Bavarian government in 1784 It has been supposed that this and some other secret societies were actively engaged in preparing the way for the French revolution, but of this no satisfactory proof has been adduced (See the *Ency von Ersch and Gruber*)

ILLUSTRATION, in Rhetoric, appears to differ from Comparison or Simile in this only, that the latter is [illegible] the expression the [illegible] is, however, sometimes used in a wider sense, in which it seems to comprehend example, which is the recital of a particular fact or instance evincing the truth of a general proposition laid down in the argument and parable, which is a species of symbolical narrative in which the actors and events are intended to represent certain other actors and events in a typical manner See PARABLE

IMAGE (Lat imago) In Rhetoric, a term somewhat loosely used, but which appears generally to denote a metaphor dilated and rendered a more complete picture by the assemblage of various ideas through which the same metaphor continues to run, yet not sufficiently expanded to form an allegory

IMAGE A representation of the Deity in stone, wood, or metal (See art IDOL) The custom of representing Christ, the Virgin and the Saints by images in the churches, which forms a principal feature of Roman Catholic worship is an ancient but not a primitive practice For the principal events in the history of Christian image worship, see art ICONOCLASTS

IMAGE in Optics, is the spectrum or appearance of an object made by reflection or refraction, or the *image* of an object may be more correctly defined as the locus of all the pencils of converging or diverging rays emanating from every point of the object, and received on a surface It is by means of optical images that vision is effected The eye is an assemblage of lenses which con [illegible] object [illegible] where an exact image or representation of the object is formed, and it is this image which is perceived or *felt* by the retina

The brightness of an image depends evidently on the quantity of light concentrated in each point Setting aside the effects of aberration the brightness must therefore be proportional to the apparent magnitude (as seen from the object) of the mirror or lens by which the rays are reflected or refracted multiplied by the area of the object and divided by the area of the image But the apparent magnitude of the lens as seen from the object, is proportional to the square of the diameter of the lens divided by the square of the distance of the object, and the area of the object divided by the area of the image is equal to the square of the distance of the object divided by the square of the distance of the image from the lens therefore the brightness of the image is proportional to the square of the diameter of the lens divided by the square of the distance of the image from the lens that is to say the brightness or degree of illumination of the image depends only on the apparent magnitude of the lens as seen from the image and not in any way on the distance of the object When the object and its image are only physical points and have no apparent magnitude, as stars for example the brightness of the image is simply proportional to the magnitude of the lens or to the square of the diameter of the aperture of the telescope, and for this reason certain stars are rendered visible by large telescopes while their light is too feeble to be perceived by smaller ones

The images of external objects are painted on the retina in a reversed position and from the retina the impressions are transmitted to the sensorium by the optical nerve See EYE OPTICS

IMAGERY may be defined as the generic term for *similes allegories* and *metaphors* or such rhetorical figures as denote similitude or comparison

IMAGINARY QUANTITIES, or IMPOSSIBLE QUANTITIES in Algebra are the even roots of negative quantities, or the imaginary results of some impossible operation The square root of any positive number may be affected indifferently with the positive or negative sign thus $\sqrt{9\,a^2} = \pm 3a$, because $+3a$ or $-3a$, raised to the square equally produce $9a^2$ But if the number or quantity is negative the extraction of its square root is impossible because the square of any quantity, whether positive or negative is essentially positive that is to say a negative quantity cannot be the square of any real quantity whatever The symbolical expressions $\sqrt{-9}$ $\sqrt{-4a^2}$, $\sqrt{-5}$ indicate operations which are impossible, and hence they are designated *imaginary* expressions But though the quantities denoted by these symbols have no real values the symbols themselves may have all the algebraic operations performed on them which can be performed on real quantities Thus, $\sqrt{-9} = \sqrt{9}\ \sqrt{-1} = 3\sqrt{-1}$, and $\sqrt{-4a^2} = \sqrt{4a^2}\ \sqrt{-1} = 2a\sqrt{-1}$ Such expressions are of very frequent occurrence in the higher analysis, and sometimes lead to results of the greatest importance, which it would be difficult, if indeed possible, to obtain in another way (See *Parallax Lemma*)

IMAGINARY ROOTS OF EQUATIONS, are to be

which can only be indicated by imaginary expressions D'Alembert first demonstrated that every imaginary root of an equation can be reduced to the form $a + b\sqrt{-1}$, where $a$ and $b$ are real quantities, and from this it is proved that if an equation have a root of the form $a + b\sqrt{-1}$, it has also another of the form $a - b\sqrt{-1}$, so that imaginary roots always enter an equation by pairs, or their number is always even

IMAGINATION, in Metaphysics may be said in its widest sense, to be synonymous with [illegible] denoting that faculty of the mind by which it either bodies forth the forms of things unknown," or produces original thoughts or new combinations of ideas from materials stored up in the memory It would be vain to enumerate the various definitions of this term, or to attempt to give even an abstract of the diversity of views entertained by philosophers respecting the nature and extent of its operations While some [illegible] Reid and Addison) limit the domain [illegible] so far as to teach that it is nothing more than a *lively conception* of the objects of sight, differing from conception only as a part from the whole, others, like Dugald Stewart place it in the foremost rank of the mental faculties, attributing to its operation the origination and development of the sublimest and boldest thoughts in all the departments of human knowledge Dr Reid's chapter *on the Train of Thought in the Mind* gives a vivid though simple picture of the power of the imagination, while at the same time it exhibits a tolerably faithful specimen of the difficulty of treating this subject, owing to a want of precision in the definition of the term In many philosophical disquisitions imagination is used as nearly synonymous with *fancy* But it should seem that this is an erroneous application of the term, for as Dugald Stewart observes the latter should rather be considered as that peculiar habit of association which presents to our choice all the different materials that are subservient to the efforts of the former and which may therefore be considered as forming its groundwork See ASSOCIATION POLITY

IMAN An inferior order of ministers of religion in the Turkish empire The chief imam of each mosque (Imamul Haikh) performs the ordinary civil functions which in Europe have been in most countries confined to parish priests assisting at the circumcision marriages burials, &c of his parishioners He precedes over the assembly of the faithful at the ordinary prayers, but the solemn noon prayer on Friday is under the superintendence of the Khatib a higher minister (who is also called from that circumstance the *Imamul Djuma* or Friday Imân) The legitimate successor of Mahomet in whom in theory the temporal and ecclesiastical government of Islam should reside is termed *Imam* by way of pre eminence, but the Mussulmans are not agreed among themselves as to the character of this dignity, or as to those who have rightfully borne it The Persians reckon twelve legitimate Imams of whom they believe the last (Mahadi) to be still living (See *Taylor's Hist of Mohammedanism* ch viii)

IMBRICATED In Botany a term used in speaking of the arrangement of bodies to denote that their parts lie over each other in regular order like the tiles upon the roof of a house as the scales upon the cup of some acorns also applied in speaking of the estivation of petals or leaves to denote that they overlap each other at the [illegible] at any involution

IMBROGLIO (A word borrowed from the Italian brogliare *to confound or mix together*, whence the French brouiller and English embroil) In literary language the plot of a romance or a drama, when much perplexed and complicated is said to be an imbroglio The small burlesque theatrical pieces so termed by the Italians derive their ludicrous character from a similar species of absurdity

IMITATION (Lat) In Music a species of composition in which each part is made to imitate the other Sometimes the motion or figure of the notes is only imitated and frequently by a contrary motion making what is called a *retrograde imitation* or *imitazione cancherizzante* Imitation according to M Brossard differs from a *fugue* in that the repetition must be a second third sixth, seventh or ninth, whereas in a fugue the repetition must be in the unison fourth, fifth or octave and the intervals exactly the same in the *comes* and *guide*

IMMERSION (Lat immergo, *I plunge under*) In Astronomy, denotes the disappearance of any celestial object behind another or in its shadow Thus in an eclipse of one of Jupiter's satellites the immersion takes place when the satellite disappears behind the body of the planet, or enters into the planet's shadow, and in an occultation of a planet or fixed star by the moon the immersion is the disappearance of the star or planet behind the body of the moon In like manner, the reappearance of the body is called its emersion The immersions and emersions of fixed stars occulted by the moon, are phenomena of great importance for correcting the lunar tables

IMMERSION, BAPTISM BY, seems to have been the most ancient mode adopted in the Christian church The *trine* immersion in honour of the three persons of the Divinity, is mentioned by Tertullian, and prescribed in the Sacramentary of Gregory the Great, but *single* immersion was held valid by that pope and his decision was confirmed by the fourth council of Toledo, A D 633 (*Riddle's Christian Antiquities* 462)

IMMOLATION (Lat) A ceremony used in the Roman sacrifices, which consisted of throwing upon the head of the victim some sort of corn or frankincense, together with the *mola* or salt cake, and a little wine

IMMUNITY In Jurisprudence, legal freedom from any legal obligation Thus the phrase 'ecclesiastical immunities' comprehends all that portion of the rights of the Church, in different countries, which consists in the freedom of its members, or of its property, from burdens thrown by law on other classes

IMPACT (Lat impingo, *I impinge on any thing*) In Mechanics, the instantaneous action of one body on another to put it in motion If the body moves in the direction of the stroke, the impact was direct, if in a different direction, the impact was oblique

IMPAGES (Lat) In Architecture, a word usually taken to mean the rails of a door

IMPALEMENT In Heraldry, the division of a shield palewise, when the shield is said to be *party per pale* *Impalement per baronet fesse* is the division which takes place on marriage, when the husband's coat is borne on the dexter side of the pale, and the wife's on the sinister Formerly, the husband's and wife's arms were impaled *by dimidiation*, that is, the dexter half of the husband's coat impaled with the sinister half of the wife's and this inconvenient mode of marshalling was pursued in French heraldry down to the period of the Revolution

IMPALEMENT A species of punishment formerly in use among the Turks and some barbarous nations, which consisted in thrusting a stake through the body and thus leaving the victim to a lingering death Instances are on record of persons enduring this horrid torture for several days before death released them from agony (See *Shaw's Travels in Barbary*)

IMPANATION in Theology, otherwise termed *Assumption*, signifies the substantial union of the body and blood of Christ with the elements of the eucharist without a *change* in their nature The word appears to be first used in the controversy about the real presence in the 11th century and to be [illegible] of transubstantiation to the [illegible] Berengarius and his followers It has since been objected by Roman Catholics to the Lutheran theory that it revived the old error of impanation The supporters of the opinion of Berengarius were sometimes termed *Idessenarii* from the word adesse, *to be present*

IMPARLANCE (Fr parler, *to speak*) A mode of delaying proceedings in a civil action by petition to the court for further time General imparlance was to the next term, special imparlance to a specified day, which might be in the same term The practice of imparlance appears to be abolished by 2 W 4 c 39 except as to actions not commenced under the process given by that act

IMPASTATION In Sculpture, the mixture of different matters bound together by means of cements capable of resisting the action of fire or air

IMPEACHMENT (From the Latin impetere *to prosecute*) A species of process against persons accused of treason or high public crimes and misdemeanours of an inferior description The first regular instances of this proceeding appear according to Mr Hatsell on the rolls of parliament in the latter end of the reign of Edward III Before that time the Lords seem to have exercised a high but irregular jurisdiction over state offences, at the prayer of the crown or of private persons But in the case of Richard Lyon 1376 we first find the Commons appearing in their public capacity as prosecutors and several similar instances occur in the course of the following century But from the reign of Henry VI to that of James I impeachments seem to have fallen into disuse, bills of attainder, and prosecutions in the Star Chamber having been prosecuted in their stead In the seventeenth year of James I this form of proceeding was revived against Sir Giles Mompesson for having procured illegal patents, and from that time to the present has been the regular constitutional form of accusation for state offences The form of the accusation exhibited by the Commons is styled *the articles of impeachment* It is an undoubted right of the Commons to exhibit such articles against a peer for treason or any other high crimes and misdemeanours, but it has been doubted whether the Lords have jurisdiction in capital cases over a commoner in this proceeding In one instance (in 1681) they refused to do so, but have in several other instances admitted their competency Managers are appointed by the Commons to conduct the prosecution before the Lords In case of an impeachment of a peer for

treason, it is usual to address the crown to appoint a lord high steward, but the appointment of such an officer does not seem essential to the conduct of an impeachment By 12 & 13 W 3 c 2 it is enacted that a pardon under the great seal shall not be pleadable to an impeachment This however does not deprive the king of his prerogative of pardoning after conviction It was determined, on the impeachment of Warren Hastings, that this proceeding in the Lords is not put an end to by the prorogation or dissolution [illegible] was passed to prevent [illegible] the House of Commons Judgment on impeachment must proceed on the same evidence which would be required in the ordinary courts of justice, in which respect this proceeding differs from that by bill of attainder

IMPE'NETRABILITY In Physics, one of the essential properties of matter or body It is a property inferred from invariable experience, and resting on this incontrovertible fact, that no two [illegible] the same portion of space in the same [illegible] Impenetrability as respects solid bodies, requires no proof, it is obvious to the touch With regard to liquids, the property may be proved by very simple experiments Let a vessel be filled to the brim with water, and a solid incapable of solution in water be plunged into it, a portion of the water will overflow exactly equal in bulk to the body immersed If a cork be rammed hard into the neck of a phial full of water, the phial will burst while its neck remains entire The disposition of air to resist penetration may be illustrated in the following way —Let a tall glass vessel be nearly filled with water, on the surface of which a lighted taper is set to float If over this glass a smaller cylindrical vessel, likewise of glass be inverted and pressed downwards the contained air maintaining its place, the internal body of the water will descend, while the rest will rise up at the sides and the taper will continue to burn for some seconds, encompassed by the whole mass of liquid (*Leslie's Elements of Natural Philosophy*

IMPE'NNATE *Impennes* (Lat in and penna *a wing*) The name of a tribe of swimming birds having short wings covered with feathers resembling scales The penguin (*Aptenodytes*) is a good example of this group

IMPE'RATIVE MOOD (Lat impero, *I command*) That form of the verb which denotes command entreaty or in general, desire *See* GRAMMAR

IMPE'RFECT CADENCE In Music *See* CADENCE

IMPE'RFECT CONCORDS In Music, such as are liable to change from major to minor or the contrary as are thirds and sixths, still, however, not losing their consonancy

IMPE'RFECT NUMBER A perfect number is one whose aliquot parts, added together make a sum equal to the number itself An imperfect number consequently is one such that the sum of its aliquot parts or divisors, is not equal to the number itself Thus 12 is an imperfect number, for the sum of its divisors, 1, 2, 3, 4, 6, is 16 which is greater [illegible]

IMPERFECTIONS In Grammar, that modification of a verb which expresses that the action or event of which we speak was at a certain time to which we refer in an unfinished state This is in English denoted by the auxiliary was joined with the present participle

IMPERIAL (-) In Architecture a species of dome whose profile is pointed towards the top and widens towards the base, thus forming a curve of contrary flexure

IMPE'RSONAL VERBS in Grammar, are those used only in the third person, as *it behoveth it is lawful* It is quite clear that every verb, whether active or passive must have a necessary reference to some noun either expressed or understood for its nominative, and hence the doctrine of impersonal verbs has been justly rejected by the best grammarians, both ancient and modern *See* GRAMMAR

IMPETIGO (Lat impetire, *to infest*) An eruption of small pustules, sometimes called the moist tetter the vesicles discharge an acrid ichor Something of this kind is often produced by particular trades, where irritating substances are applied to the skin Cleanliness, cooling ointments, and occasionally the nitrated mercurial ointment much diluted, are useful Harrowgate water and baths have been recommended, and mild aperients The [illegible] is not contagious

IMPETUS (Lat *force*) In Mechanics, the same with momentum or force *Impetus*, in Gunnery is the altitude through which a heavy body must fall to acquire a velocity equal to that with which the ball is discharged from the piece

IMPLEMENTS, AGRICULTURAL Almost all the operations of agriculture may be performed by the plough, the harrow, the scythe and the flail, and these are the sole implements in the primitive agriculture of all countries With the progress of improvement however, many other implements have been introduced, the more remarkable of which are the drill plough, the horse-hoe, the winnowing machine the threshing machine the hay making machine, and the reaping machine The object of all [illegible] is to abridge human labour [illegible] operations to which they are applied with a greator degree of rapidity and in a more perfect manner than before

IMPLEMENTS HORTICULTURAL The essential implements of horticulture are the spade and the pruning knife The rake might be added, but it can be done without, because if seed be sown on a rough surface, it may be covered by beating that surface smooth with the spade, and if on a smooth surface, it may be covered by scattering with the spade a very thin sprinkling of earth over it Even the pruning knife might be dispensed with, because culinary vegetables might be pulled up by the roots, or cut off at the surface of the ground with the spade, and fruit trees will produce crops without pruning, as by disbudding and thinning with the [illegible] be grown as ever will [illegible] It must be confessed, however that the knife and the rake are very nearly essential instruments of horticulture With the progress of horticulture a great number of implements, instruments utensils, and machines have been brought into use Of these may be mentioned the hoe for stirring the soil and cutting up weeds, and this implement on a larger scale in warm countries is used as a substitute for the spade The watering pot in modern gardening is an important utensil, and the syringe a machine that can scarcely be dispensed with In the forcing department, we have the thermometer [illegible] contrivances for supplying [illegible] or excluding [illegible]

IMPLICATION (Lat implico, *I evolve*) In Law, an inference necessarily arising from something declared Thus contracts are said to be either express or implied *See* CONTRACT

IMPLUVIUM (Lat) In Ancient Architecture the outer part of the court of a house which was exposed to the weather In the summer time it was the practice to stretch [illegible] over it

IMPONDERABLE SUBSTANCES Heat light, electricity, and magnetism are so called being supposed to depend upon very subtle forms of matter of inappreciable weight

IMPORTS AND EXPORTS The articles imported into and exported from a country *See* COMMERCE

IMPOSING (Fr imposer) In Printing, is the arrangement of the pages of a sheet upon the imposing stone in their proper order so that when printed and the sheet folded they will follow each other consecutively, putting the furniture about them with the chase, and so as to be ready to print

IMPOSITION OF HANDS (Lat impono, *I place upon*) is maintained in the English and other churches, as conformable to the apostolic practice and that of the earliest ages in which confirmation and the ordination of priests and deacons are supposed to have been accompanied with the performance of this ceremony In Acts vi the apostles lay their hands on those appointed to be deacons, in Acts viii and xix the converts who had been already baptized by Philip and John are in the same manner confirmed by Paul and the other apostles

IMPOSSIBLE QUANTITY *See* IMAGINARY QUANTITY

IMPOST (Lat impono, *I lay on*) In Architecture, the capital of a pier or pilaster which receives an arch The impost varies with the order whereto it is applied Sometimes the whole of the entablature serves as an impost to an arch The term is applicable to any supporting piece *Impost* is also frequently used as synonymous with tax or public burden

IMPRESSION (Lat imprimo *I press upon*) In the Fine Arts the sensation on the mind which is excited by a work of art The word is also [illegible] of an engraving drawn off from the [illegible] work [illegible]

IMPRESSION The forcible levying of mariners for the king's service at sea The power of impressment is a branch of the king's prerogative It is mentioned in the statute 2 Richard 2 c 4 as a recognized usage Various classes of mariners are exempted from it by particular statutes The officer impressing acts under an impress warrant for that especial purpose, but the regularity of this instrument is carefully watched by the courts and criminal informations have been also granted against officers guilty of unnecessary severity or acts of private malice in carrying it into execution (See, for arguments in favour of [illegible] practice, *Quart. Rev* vol xlix p 496, &c [illegible], *Wealth of Nations*, M'Culloch's ed, note xii)

IMPRIMATUR (Lat *let it (the book) be printed*) The term applied to the privilege which, in countries subjected to the censorship of the press, must be granted by a public functionary appointed for the purpose before

any book can be printed This formula was much used in English books printed in the 16th and 17th centuries, and the privilege is even still vested in some of our own universities especially in Scotland, where it is nothing unusual to find on the title-page of some works recommended to public favour by the senatus academicus the "imprimatur" of the principal

IMPRI'NT (Fr imprimer) The designation of the place where, by whom, and when a book is published, always placed at the bottom of the title Among the early printers it was inserted at the end of the book and is styled the colophon By the act 39 Geo 3 c 79, every printer is obliged to affix his name and residence to each article he shall print, and if it consists of more than one leaf, then upon the first and last leaves, under a heavy penalty [illegible]

IMPRO'MPTU (Lat *in promptu*) In Literature, any short and pointed production supposed to be brought forth on the spur of the moment, generally of an epigrammatic character

IMPRO'PER FRACTION, in Arithmetic and Algebra is a fraction whose numerator is equal to, or greater than its denominator

IMPROPRIA'TION, in Law, is where the tithes glebe, or other ecclesiastical dues of a parish are in the hands of a layman The religious societies having at the time of the Reformation the property of many benefices in their hands, clauses were inserted in the acts by which they were dissolved to give that property absolutely to the king, by whom it was granted out to lay proprietors In common language, such benefices are said to be *impropriated* as are in the hands of laymen, such as are held by spiritual corporations, sole or aggregate are termed *appropriated*

I'MPROVISATO'RI (Lat improviso, *unforeseenly unpremeditatedly*) An Italian word signifying a person who has the talent of composing and reciting a suite of verses on a given subject immediately and without premeditation This peculiar talent, thus restricted appears to belong, almost exclusively to the Italian language and people Much, no doubt of the facility of these improvisatori which appears almost preternatural to one unaccustomed to hear them arises from the peculiar ease and flexibility of their language and its richness in rhymes But this circumstance will not wholly account for so singular a national faculty, for about the time of the revival of letters Italy possessed improvisatori in Latin as well as Italian Many poets have enjoyed considerable celebrity in their day from their success in this mode of composition but we are not aware that any of their p[illegible] often [illegible] the Venetian States have been most famous for the production of improvisatori, especially Sienna and Verona, in which latter city the talent seems to have been perpetuated by succession The chevalier Bernardino Perfetti, the most famous of all these reciters was of Sienna he flourished in the first half of the 17th century He is said to have possessed unbounded erudition and to have been able to pour forth extempore poetical essays on the most abstruse questions of science There have been many distinguished females possessed of this talent (improvisatrici) Corilla, the most celebrated of them was of Pistoia in Tuscany She was the original of Madame de Stael's *Corinne* She received in 1776 the laureate crown at Rome, an honour which had also been accorded to Perfetti Germany is said to have produced one noted improvisatrice, Anna Louisa Karsch There appears no reason why the term improvisation should not also be applied to the delivery of unpremeditated discourses in prose It is the exertion of a very similar faculty, perfected in the same manner by habit to a degree almost inconceivable by those not accustomed to witness its exercise It is, however, much more general The North American Indians are represented to possess it in a high degree In Europe, it is most generally to be found in the pulpit Public secular oratory of this unpremeditated description is far more common in England, and the power much more sedulously cultivated, than in any Continental country (See *Forsyth's Italy, Ed Rev* vol xxii, *Improvisatori*)

INAU'GURA'TION (Lat inaugurare, *to take omens*) was originally applied to the Roman ceremony of admission to the college of augurs or soothsayers, or to the selection of a proper site for the erection of temples or other national edifices, but it afterwards received a more extended signification and is now used in a sense nearly synonymous with the *consecration* of a prelate, or the *coronation* of a king or emperor It means also an introduction to any office with certain ceremonies

INCA, or VNCA A name given by the Indians of ancient Peru to their kings and princes of the blood The empire of the Incas, founded, according to tradition, by the celebrated Manco Capac, extended over the tableland of the Andes, from Pasto to the neighbourhood of Chili, as well as the low lands on the coast It was destroyed by the Spaniards under Pizarro and Almagro The blood royal of the Incas is preserved, or believed to be so, among the Indians of the present day, and Tupac Amaru, who carried on a long and successful insurrection against Spain [illegible] part of the last century professed to be descended from them

IN CŒNA DOMINI (Lat *at the Lord's Supper*) The name of a celebrated papal bull containing a collection of extracts from different constitutions of the popes, comprising those rights which, since the time of Gregory VII, have been uninterruptedly claimed by the Roman see, and a proclamation of anathema against all who violate them It was annually read on Holy Thursday, whence it receives its name but lately on Easter Monday The sects of heretics are cursed in it by their several designations A copy of the bull is hung up at the door of the churches of St Peter and St John Lateran, and all patriarchs, primates, bishops, &c are required to have it read once or more annually in their churches

INCANDI'SCENCE (Lat in, and candere, *to be warm*) The luminosity exhibited by a substance when heated up to a certain point

INCANTA'TION (Lat in, and canto, *I sing*) A form of words combined with certain ceremonies and mixtures of heterogeneous substances used by the ancients for many superstitious purposes They were most commonly resorted to by unsuccessful lovers, in which case they were termed *love potions*, or *philtres*, which see

INCARCERA'TION (Lat) Literally, imprisonment In Surgery, this term is generally applied to ruptures or hernia with the same meaning as *strangulation*, but, according to Scarpa, an *incarcerated* hernia is that in which the course of the intestinal matter is interrupted without any considerable injury of the bowel itself, whereas in *strangulated* hernia the vitality of the bowel is affected or there is organic injury of its coats The functions of the merely incarcerated intestine are healthily resumed upon its return into the abdomen, which is not the case where true strangulation has taken place

INCARNA'TION (Lat caro, *flesh*) A word in common use [illegible] to express the union of the Godhead and the Manhood in Jesus Christ St John says The Word was made flesh, and dwelt among us, a text sufficiently explicit when coupled with other expressions respecting the divine nature of the Word, to maintain the doctrine of the incarnation among the vast majority of the Christian world But the subtle inquiries which men have instituted into the manner and nature of this union have given rise to many varieties of opinion, and to many sects which have incurred the reproach of heresy Not the Socinians only, but the Arians and Sabellians also are led necessarily by their premises into heterodoxy upon this point, the Nestorians, however, and Eutychians, may be considered the principal sects which have joined an orthodox belief as to the relations of the three persons of the Trinity one to the other, with peculiar conceptions of the manner of the union of the two natures in Jesus Christ (See the respective articles)

The real manner of this union or indwelling of the God in the Man is allowed to be a mystery such as cannot be fully apprehended by the human intellect It is easier to point out the errors which beset its investigation than to express in words the true doctrine The phrase, 'The Word was made flesh' cannot imply that the divinity was lost and annihilated in becoming flesh, nor that it changed its own nature and was turned into humanity In either of these cases, Christ would cease to be a divine being while on earth Nor did the Godhead inspire the Manhood after the manner in which the Prophets had been inspired in earlier times, for the terms applied to Christ are of a very different kind Nor on the other hand could the humanity be lost and absorbed in the divinity which would seem to destroy the sympathy with which the m[illegible] regarded mankind, upon which so much of the [illegible] structure [illegible] religion is raised

INCE'NDIARY (Lat incendo *I burn*) Literally, one who sets fire wilfully to a building or stores but it is used also in a metaphorical sense for any political agitator who seeks to inflame the minds of the people See ARSON

INCE'NSE See FRANKINCENSE

INCE'PTIVE (Lat incipio *I begin*) A word used by Dr Wallis to express such *moments* or first principles as, though possessed of no magnitude themselves, have yet the power of producing it by being extended or enlarged Thus a point or a line, though the former has no proper magnitude and the latter no breadth, are both said to be *inceptive* of enlargement In the Latin language *inceptive* or *inchoative* verbs (the latter term being derived from the Lat inchoare, *to begin*) are those which, according to grammarians, are characterized by the termination *sco* or *scor* added to their primitives, and are expressive of a commencement of increase or augmentation of the qualities indicated by the words from which they are derived [illegible] case, *augescere*, to begin to increase *pallere*, [illegible], *pallescere*, to grow pale

INCE'RTUM O'PUS (Lat ) In Ancient Architecture, a [illegible] with [illegible] whose [illegible] exhibits an [illegible] [illegible] [illegible]

INCH A [illegible] enough, the tenth part of a foot

INCH A word used as a prefix to certain small Scottish islands, as Inch-Keith, Inch-Garvie It is derived from the old Irish or Gaelic word [illegible] an island

I'NCIDENCE In [illegible] *Impingement* The meeting of one body with another The term *angle of incidence* is used by writers on mechanics and optics in different senses Thus, in the case of a body striking against a plane the angle of incidence is by some understood to signify the angle formed by the line in which the body moved with a straight line perpendicular to the plane, while others use the term to denote the angle which the line of incidence makes with the plane itself When light or any elastic body is reflected from a surface the angle of incidence is equal to the angle of reflection, and in the case of refraction, the sine of the angle of incidence has to the sine of the angle of refraction a constant ratio

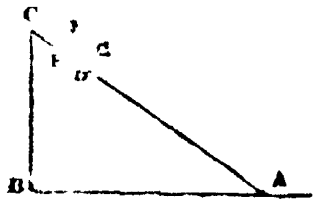
I'NCIDENT In Law something necessarily appertaining to and depending on another, which is termed the principal

INCINERA'TION (Lat incinero *I reduce to ashes* ) The combustion of organic substances for the purpose of obtaining their ashes or incombustible residue

INCI'SORS *Incisores* (Lat incido *I cut* ) The teeth implanted in the intermaxillary bones of the upper jaw and in the corresponding place in the lower jaw and which are generally shaped for the purpose of cutting or coarsely dividing the food

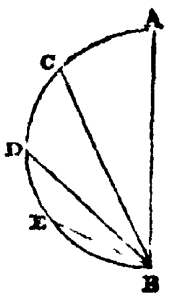
INCLINA'TION (Lat ) A term of frequent occurrence in geometry mechanics physics and astronomy It is in all cases measured by an angle Thus the *inclination of the orbit of a planet* is the angle between the plane of its orbit and the plane of the ecliptic In the history of geometry the *problem of inclinations* is a subject that was treated of by Apollonius in two books which are lost but of which a description has been given by Pappus The problem proposed was this 'To insert a straight line of a given magnitude and tending to a given point between two lines which are given by position' The problem was restored by Marinus Ghetaldus and various other investigations have since been given by the method of the ancient analysts

INCLINED PLANE One of the five simple mechanical powers The theory of the inclined plane is easily deduced from the decomposition of forces Let AC be the position of the plane BC its altitude and AB the horizontal distance of the foot of the plane from the perpendicular BC Suppose a cloud to be placed on the plane at D and let it be required to determine the relation between its whole weight and its tendency to descend along the plane Let DL denote the vertical pressure of the weight and decompose this into DI parallel to the plane and FI perpendicular to it and complete the parallelogram IG Now the part FI is supported by the resistance of the plane there remains therefore only the force represented by FD to urge the descent of the weight along the plane But the triangle DFI is obviously similar to CBA and therefore DI is to DF as CB to CA that is the force of descent along the plane is to the whole weight of the body as the height of the plane to its length or as the sine of its elevation is to radius The force therefore, which is required to raise a body along the plane is less than that which is required to raise it perpendicularly in the same proportion




This fundamental proposition was first demonstrated by Stevinus of Bruges, but by a very different process of reasoning He supposed a chain or chaplet composed of equal links to be thrown over the triangle ABC and the two ends to be united a little below the base AB It is evident that this chain would remain at rest for on altering its position each link would be succeeded by a similar one in the same situation, and if it began to move of itself it would move for ever, a supposition which is absurd But the part below the base being suspended equally at both extremities, is evidently in a state of equilibrium, therefore the part which hangs along the perpendicular BC must balance the part lying along the inclined plane, and the weights of these two parts being as their lengths it follows that a weight placed on the plane is to the force required to sustain it as the length of [illegible] to its height

[illegible] connected with the motion of bodies on inclined planes which deserve to be noticed The first is that the velocity acquired by a body in descending from any altitude to a horizontal plane is the same when it reaches the horizontal plane, whether it has been allowed to fall freely in the vertical, or been constrained to move along an inclined plane at any angle of elevation The second is that the times of descent through all chords of the same circle to the lowest point are equal, and equal to the time the body would take to fall through a height equal to the diameter of the circle Thus, let A B be the diameter, and C B D B, and E B chords of a circle, the time a heavy body would consume in falling vertically through the diameter is the same as that in which it would roll down the inclined plane C B or D B, or F B In other words bodies placed at A, C, D, and F, and abandoned at the same instant to the action of gravity, would arrive at B at the same time In these propositions it is supposed of course, that there is no resistance from friction




INCLO'SURE (Lat includo, *I shut up* ) This term in a general sense is one of the first acts of appropriation since in a new country when any portion of land is purchased or taken possession of, it is inclosed, that is surrounded by a boundary line indicated by certain objects, natural or artificial or of both kinds In a particular sense to inclose land is to divide it into fields and surround these by fences, in order that each field may be devoted to a particular description of culture If nothing farther than the cultivation of plants of different kinds were carried on in the fields of a farm their subdivision by fences would be altogether unnecessary, but as in most cases fields are kept alternately under tillage and pasture it is desirable to have fences to confine the pasturing animals to the field appropriated for their use

INCLU'SA (Lat includo *I inclose* ) The name of a tribe of shell bearing Acephalous Mollusks in the system of Cuvier characterized by the closed state of the mantle which every where surrounds and envelopes the body leaving only a narrow aperture for the passage of the foot and [illegible] mostly into two siphons projecting [illegible] is always open at its two extremities The bivalves of this family are remarkable for their powers of burrowing and excavating clay, sand wood or even stony rocks, and many of the genera secrete in addition to the ordinary valves a calcareous lining to their burrows, which forms a tube surrounding the valves themselves The relative proportions of the tube and valves well illustrate the so called Law of the balance of organs the valves becoming diminished in size as the external sheath is more developed In the shipborer (*Teredo navalis*), which has the longest tube the valves are of the smallest size being reduced to the office of mere boring instrument instead of serving to protect the soft parts of the animal In the watering-pot shell (*Aspergillum* Lam ) they cease to be moveable organs and are blended or confluent with the external tube this is dilated at the anterior extremity which is surrounded with a projecting perforated ridge and closed by a convex plate, perforated like the mouth of a watering-pot

INCLU'SI or RECLU'SI (Lat *shut up* ) In Ecclesiastical History a class of religious persons who lived as hermits in single cells generally attached to monasteries sometimes in the neighbourhood of villages and towns —under the law of not leaving them unless in case of extreme necessity and with the approbation of the bishop whose seal or that of the abbot was impressed on its door The cells are said to have been commonly twelve feet in length and breadth Nuns became sometimes but more rarely recluses

INCOGNITO (Ital *unknown*) abbreviated into *incog* denotes the disguise resorted to by the great when they are unwilling to be recognized It consists either in assuming a different name or title for the nonce or in travelling from one place to another without a retinue or other marks of distinction

INCOMBU'STIBLE CLOTH This term was originally applied to cloth with which asbestus was interwoven on burning away the fibre, the incombustible mineral texture remained

More recently cloth and other materials have been rendered to a great extent incombustible by impregnating them with certain saline substances which, upon the application of fire form a species of glaze upon the goods and prevent them burning with flame by protecting them from the necessary access of air (*See* Combustion ) Borax, alum and phosphate of soda, or ammonia, are the most effectual salts for this purpose, and by properly applying them, with starch, if to muslin dresses curtains or bed furniture, or with size to paper hangings and scenery, these several articles may be rendered incapable of burning with flame, and thus serious accidents by fire prevented Wood may also be rendered comparatively incombustible by soaking it in [illegible] *See* Asbestus

[illegible] Two numbers or homogeneous quantities of any kind are said to be incommensurable when they have no common measure, or when no number or quantity of the same kind can be found which will divide them both without a remainder Thus the numbers 21 and 22 are incommensurable The

side of a square and its diagonal are incommensurable lines as is proved by Euclid in his tenth book Numbers are said to be *incommensurable in power* when their squares or second powers are incommensurable as 2 and 3 the squares of which 4 and 9, have no common measure It is owing to the incommensurability of quantities, that it is found so difficult to explain the doctrine of proportion in the elements of geometry

INCOMPA'TIBLES In Chemistry, salts and other substances are said to be *incompatible* which cannot exist together in solution without mutual decomposition Thus the soluble salts of lead and of baryta are incompatible with sulphuric acid and the sulphates, because the sulphates of lead and of baryta are insoluble, and consequently thrown down in the form of precipitates

INCOMPRE'SSIBILITY That quality of bodies in virtue of which their volumes cannot be diminished There are no substances, perhaps, absolutely incompressible Liquids, however resist compression with great force, but the experiments of Canton have proved that water has its bulk sensibly enlarged by withdrawing the pressure of the atmosphere Nevertheless the extent to which the compression can be carried is very small On enclosing water within an iron cannon the sides of which were three inches in thickness and applying a very great force of pressure the cannon burst before the volume of water had been reduced to 19-20ths of its original dimensions A pressure equal to that of the atmosphere reduces the bulk of water only about 48 parts in one million

I'NCREMENT (Lat *increase*) in the higher Mathematics, denotes a small but finite increase of a variable quantity it is the difference between two successive values of the function of a quantity increasing, according to a determinate law *The method of increments* was the name given by Dr Brook Taylor to a method of analysis invented by him and which has since been extensively cultivated under the appellation of the *calculus of finite differences* It is of great use for the summation of series and furnishes an easy and rapid solution of a great variety of difficult problems to which other means of investigation would hardly apply *Taylor's Methodus Incrementorum* was published in 1715 and contained the celebrated theorem which has since been made the base of the differential calculus (See *Euler's Calculus Differentiaus* Bossut *Calcul Differentiel et Intégral*, Lacroix's large work and Sir J Herschel's Essay in the Appendix to the Cambridge translation of *Lacroix's Differential and Integral Calculus*)

INCREMENT In Rhetoric is a species of climax rising gradually from the lowest to the highest See CLIMAX

INCRUSTATION (Fr) In Architecture and Sculpture a work fixed with cement or cramp irons into notches made to receive it, such as inlaid work and mosaics &c

INCUBATION (Lat incumbo *I brood over*) Hatching or the lying down of an animal upon her own or another's eggs communicating to them and maintaining them at her own temperature a condition essential to their development In many animals the development of the fœtus takes place after the exclusion of the egg and whilst it is maintained in contact with the external surface of the parent's body as in the crab and lobster tribes beneath the caudal plates or agglutinated to the surface of the abdomen as in certain species of pipe fish (*Syngnathus*), or concealed in cutaneous marsupial cavities as in other species of *Syngnathus* and the *Hippocampus*, but in these and other instances from the cold-blooded animals the protection of the ova seems to be the object of their attachment to the parent and not the communication of warmth or any other influence essential to their development It is only in the Oviparous class with warm blood or birds that true incubation takes place and in this class without any exception Another characteristic of true incubation is that the place of the eggs determines that of the incubator which can only perform its office by *lying down upon the eggs*, while in most of the examples of false incubation in the cold blooded animals, the eggs are retained by special contrivances in contact with the parent without occasioning any restraint upon her postures or movements

That a due degree of warmth is the essential object of incubation in birds, is proved by the ancient and well-known practice of substituting artificial heat, by which fertile eggs are hatched in the same period, and the excluded chick is as fully and strongly developed, as when produced by natural incubation (See *infra*)

The mean temperature of incubation is 100° Fah, it may vary from 95° to 105°, and towards the close of the process, may be suspended for one or two hours, or for a longer period, according to the degree of extraneous heat which the eggs may derive from their situation, without fatal consequences to the embryo

The power of communicating the requisite degree of warmth [illegible] the unusual development [illegible] to, a peculiar plexus of vessels distributed over the skin of the abdomen, and which, in most birds, is connected with a derivation of blood from the internal organs of generation, after the subsidence of the menstrual activity of the ovarium and oviduct, to the external integuments The vascular, hot and sensitive condition of the skin of the abdomen is the exciting cause of that uncontrollable propensity to incubate which the Greeks denominated "storge," and which, with its associated phenomena of patience abstinence, and self-denial, forms so remarkable a feature in the economy of birds The egg of the bird presents several peculiarities in relation to the circumstances under which it is to be developed its oval form permits a greater proportion of its surface to be in contact with the heat-communicating skin of the parent than if it had been a spherical body, while the shell, by virtue of its hard calcareous texture, and its arched disposition about the soft contents sufficiently defends them from the superincumbent pressure As warmth is the only essential influence which the egg derives from the parent, the shell is porous, and permeable to air, and the germ is surrounded by an adequate store of nutritious matter This matter is of two kinds the external, called the white of the egg or albumen which wholly disappears during the process of incubation and the internal part, or yolk inclosed in a peculiar membrane, and rendered lighter and of an orange colour by the admixture of a peculiar oil The germ is situated at the superficies of the yolk, beneath the vitelline membrane, in the circular opaque white spot called the "cicatricula" or "tread," and a peculiar mechanism is superadded to the yolk by means of which the germ-bearing surface of the yolk is always kept uppermost and next the warmest surface of the egg, and at the same time is relieved from the pressure against the hard shell to which it must have been subject if the light yolk had not been restrained from rising to absolute contact with that surface Both these purposes are effected by the attachment of two cords of condensed albumen, continued at one end from near the poles of the yolk but a little more distant from the germ bearing side than the line of the transverse axis and expanding at the opposite end which is lost in the layers of albumen near the poles of the egg Thus by their presence and place of attachment these cords, called the 'chalazæ' restrain and regulate the rising of the yolk, so that whichever way an egg be turned the larger proportion of the light yolk always rises above the [illegible] with the cicatricula [illegible] cubation is generally directly as the size of the bird but the degree of development which the chick attains prior to exclusion varies As a general rule it is inferior in birds of flight as the Accipitrine and Passerine orders than in the terrestrial wading and swimming birds and the warmth and complexity of the nest bears relation to this difference of development If the thrush had been forewarned that her young would be excluded from the egg naked and helpless she could not have prepared beforehand a warmer and more comfortable abode than her instinct led her to construct for their accommodation, and if with such a nest we contrast the rude recess of straw in which the hen deposits and incubates her eggs it might be imagined that she knew beforehand that her chickens would come into the world well clothed and strong enough at once to run about and pick up their own food In this case therefore the nest relates only to incubation in the other to incubation and subsequent rearing of the young and according to the degree of development attained during incubation and the associated condition of the nest and habits of the parent birds have been divided into two great groups, the *Aves altrices*, and *Aves præcoces* See AVES

*Artificial incubation* has been practised from a remote period by the Egyptians and Chinese the former indeed, have carried this process to such a high degree of perfection as in many instances to have entirely superseded the use of the hen in hatching It is effected either by means of an oven stove or steam, the principles of which will be found detailed in *Ure's Dictionary of Arts &c* This process has received considerable attention from the French philosophers but perhaps the best exemplification of its results that has been witnessed in Europe is given by the *Eccaleobion*, or egg hatching machine exhibited in London This term recently invented to express the process of artificial incubation is derived from the Gr ἐκκαλέω *I call out* or *produce*, and βίος, *life*.

I'NCUBUS (Lat incubo, *I lie upon*, because the sufferer feels as if something pressed upon his chest) The nightmare The name incubus is derived from imaginary fiends or spectres to whom strange powers are attributed by the writers on dæmoniacal agency Many noble families were supposed to have their origin from the connection of incubi with females as in the well-known instance of Robert of Normandy called *le Diable* (See *Encyc Met*)

INCU'MBENT (Lat incumbo, *I lie upon* or *occupy*) A [illegible] of an ecclesiastical benefice

INCUNABULA (Lat *a cradle*) In Bibliography, a term applied to books printed during the early period

of the art: in general confined to those which appeared before the year 1500

INCURVED (Lat incurvo, *I curve inwards*) In Zoology when applied to [illegible] words

INDECLINABLE In Grammar a word admitting of no declension or inflexion Adverbs, prepositions particles conjunctions, are all indeclinable In classical languages, indeclinable nouns are those few (chiefly borrowed by the Greeks and Latins from foreign languages) of which the termination is not altered in the several cases

INDEFINITE In Botany, when stamens are above twenty in number the word is applied to all other parts when their number is greater than can be readily counted This term always refers in botany to number, and never to form

INDEFINITE PROPOSITION, in Logic, is one which has for its subject a common term, without any sign to indicate whether it is distributed or undistributed *See* PROPOSITION

INDEHISCENT (Lat in and dehisco *I gape*) is said of a fruit the pericarpium of which continues perfectly closed without opening in any degree when ripe

INDEMNITY (Lat in, *without* and damnum, *loss*) In Politics and Jurisprudence, a word of various significations, but applied usually to laws passed to relieve individuals from penalties to which they are liable in consequence of acting in an illegal manner The Act of Indemnity, annually passed by the British parliament for many years prior to the repeal of the Test and Corporation Acts in 1828, was a measure for the relief of persons who had assumed any office without qualifying themselves for it by taking the oaths prescribed by those enactments In Feudal Jurisprudence, the right of the lord to a certain duty payable by religious establishments to compensate him for the loss of those fines on alienation which would probably have accrued from time to time had their property remained in lay hands was termed indemnity In the language of modern politics, compensations paid by a state to other states corporations or individuals for losses sustained through its acts bear the same name Acts of indemnity are also sometimes passed to relieve ministers from the responsibility of measures exceeding their strict constitutional powers, taken by them when parliament was sitting to meet some unforeseen public emergency, or in ignorance, it may be that they had exceeded the powers vested in them by the constitution In 1825 a law of indemnity was passed in France to compensate the losses sustained by the emigrants their families, and those of persons who had been condemned to death for political offences in the course of the Revolution The sum allotted to this purpose was an annual amount of 30 000 000 francs (about 1,200 000*l*) A special commission was appointed to carry it into execution but it appears that its labours were broken off before their completion by the political changes of 1830

INDENTURE In Law a writing or deed comprising some contract between two or more parties The name is derived from the ancient practice according to which the original and counterpart original (to be retained by each party respectively) were written on the same skin of parchment, and then the two parts were separated by a notched or indented cut so that when applied to each other they would appear to match (See DEED)

INDEPENDENCE, DECLARATION OF, in the History of the United States of America The Declaration of Rights was [illegible] by the first general congress of the [illegible] colonies which met at Philadelphia in September, 1775 In this declaration that assembly asserted the right of internal legislation and taxation to be in the provincial legislatures and declared various acts of the mother country to be infringements and violations of the rights of the colonists The second congress, which met in May, 1776, adopted on July 4 of that year a declaration of independence, by which, after a recapitulation of grievances complained of in the former declaration declared the colonies to be free and independent states absolved from all allegiance to Great Britain The first draught of this famous declaration was prepared by a committee of five, consisting of Jefferson and Adams both afterwards [illegible] Franklin and Sherman but Jefferson and Adams were afterwards deputed as a sub-committee to prepare the declaration itself, but, in the shape in which it finally appeared it was in fact the work of the former

INDEPENDENTS A Protestant sect, so called because they maintain that every single congregation of Christians which meet in any one place for public worship forms a church or independent religious society in itself, under [illegible] or [illegible] thing like a national establishment of religion, whether episcopal or presbyterian, and insist that each congregation of Christians has inherent and indefeasible power in itself to exercise ecclesiastical government, to fix their own tenets and form of religious worship, and to adopt their own standard of church discipline, without being responsible to bishops, presbyteries, or synods, or even to the state itself The Independents were not at any time, and are not at this day, remarkable for any peculiarity of religious creed They have always maintained, speaking generally, Calvinistic doctrines their only peculiarity consisting in their maintenance of independent ecclesiastical government

Of the history of this sect it may be proper to give a brief account On the reformation of religion in England the great body of Protestants adopted under the auspices of the government, the episcopal form of church polity, which was in consequence established as the national religion But there were not a few who conscientiously thought that this polity too nearly resembled that which had been supplanted, and objected besides, to the vestments adopted by the clergy in the celebration of divine worship to the liturgy, and above all to the sign of the cross used in baptism, as unscriptural and erroneous These non-conformists or dissentients from the established faith are known in history under the name of *Puritans* as the followers of Novatian had been denominated in the third century They were evidently so called in derision, in consequence of the superior purity and sanctity they assumed and of the greater deference they showed to scripture authority both as to doctrine and the form of religious worship But while they forsook the national church and condemned many of her tenets, they did not agree among themselves They were, in truth unanimous in nothing but in resisting the constitution of the predominant hierarchy Some of them were in favour of presbytery or ecclesiastical government vested in a gradation of church courts such as Calvin had established in Geneva, and as Knox had introduced into Scotland Others were against every form of state religion, or union of churches under the same ecclesiastical government but regarded each congregation of Christians as being *jure divino* a complete and independent church competent to judge decide and act for itself without any external interference or responsibility whatever Of this latter opinion which constitutes the pure principle of English Independency the author and great advocate was Robert Brown who was originally a clergyman of the Protestant episcopal church from which he seceded and avowed his new doctrines about the year 1580 (*Neal's Hist of the Puritans* vol i ch vi London, 1822) Brown is represented by Neal as a vehement and popular declaimer and insinuating in his manners, and hence he succeeded in detaching many from the episcopal faith, and in establishing several separate churches He not only advocated the leading principles of Independency as we have stated them above but taught that the priesthood was neither a distinct order in the Christian church, nor conferred an indelible character, that every person regarded by the majority of a congregation as qualified to teach might be set apart for that office by the election of his brethren and by imposition of their hands, in like manner by their authority he might be discharged from that function and reduced to the rank of a private Christian He also maintained that the right of the pastors to preach was not peculiar to them, on the contrary, that any member who thought proper to exhort or instruct the brethren enjoyed the inherent right of doing so or of 'prophesying' before the whole assembly Hence it happened that after the stated pastor had finished his services the ordinary members were allowed to communicate in public their sentiments on any religious subject (*Ibid*, and *Mosheim's Ch Hist* vol v 355-6 London, 1822) But while Brown enforced these views and claimed liberty of conscience [illegible] called 'did not differ from the Church of England in any articles of faith but were very rigid and narrow in points of discipline They denied the Church of England to be a true church and her ministers to be rightly ordained They maintained the discipline of the Church of England to be popish and anti-Christian and all her ordinances and sacraments invalid Hence they forbade their people to join with them in prayer in hearing, or in any part of public worship, nay they not only renounced communion with the Church of England, but with all other reformed churches except such as should be of their own model' (*Neal*, i 303)

Brown and his followers, as they had imbibed such extreme views, cannot be expected to have been allowed to live undisturbed in the dark times to which we refer He, in truth, suffered severely for his principles, both for some works he published, and for the ecclesiastical doctrines which he travelled throughout England in propagating He was committed, as he afterwards boasted, to no fewer than thirty-two prisons in succession, in some of which he could not see his hand at noonday Nor were his adherents more mercifully treated many of them were fined and imprisoned, and some put to death (*Neal*, i 313) Under these circumstances, a body of the party, with Brown at their head, fled to Holland,

and founded churches at Middelburg Amsterdam and Leyden But these establishments were neither solid nor lasting When the Brownists were delivered from the hands of the bishops their [illegible] and their [illegible] in 1589, and not merely renounced the opinions which he had suffered so much in promulgating, but returned into the bosom of the church which he had abandoned, and which he had so long and so severely calumniated

The Brownists that still remained in Holland, now left to their own discretion, and learning moderation from experience, were not unprepared to modify or reform the severity of the discipline of their founder This judicious [illegible] John Robinson of Norfolk, [illegible] Leyden, "a man who had much of the solemn piety of the times, and who, perceiving the defects that reigned in the discipline of Brown, and in the spirit and temper of his followers, employed his zeal and diligence in correcting them, and in modelling the society in such a manner as to render it less odious to his adversaries, and less liable to the just censure of those true Christians who looked on charity as the end of the commandments" (*Mosheim*, v 359 60) Hitherto the sect had been called Brownists they now renounced that name, and have since been known under the title of Independents, and Robinson, who wrote an "Apology" (*Apologia justa et necessaria pro Exulibus Anglis, qui Brownistæ vulgo appellantur* Lugd Batav 1619 8vo) for them, in which he gave a minute and systematic exposition of their principles was considered as their founder The Independents were much more commendable than the Brownists particularly in the moderation of their sentiments and the order of their discipline They laid aside that hostility to other sects which Brown had inculcated They agreed with the reformed churches generally in articles of faith They wished to maintain communion with them they differed with them only on the subject of church government They were also much more attentive than the Brownists had been to the establishment of a regular ministry in their communities, for while the latter promiscuously allowed all ranks and orders of men to teach in public and to perform the other pastoral functions, the Independents had and still have a certain number of ministers chosen respectively by the congregations where they are fixed Nor is any person among them permitted to speak in public till he has received the sanction of the congregation (*Ib*, and *Mosheim*, ut supra)

Independency thus put on a more rational and Christian footing in Holland was introduced into England by Mr Henry Jacobs in 1616, an individual who constituted the first Independent or (as it is not inappropriately called) Congregational Church in this country For some time however, the sect made but slow progress in England Its members concealed their principles from public view to avoid the penal laws that were in existence against non conformists But during the latter part of the reign of Charles I, when amidst the shock of civil and religious discord, the authority of the Episcopal Church began to decline the Independents assumed greater courage, and publicly avowed their principles with a degree of confidence not previously exhibited by them From this period their progress was rapid a circumstance that may be imputed to a variety of causes, particularly the learning of their teachers the unpopularity and declining state of episcopacy, and the support of Oliver Cromwell who espoused their cause and enrolled himself among the list of their members They probably were, during Cromwell's time the most powerful and important religious body in England, though for a few years previously to the death of Charles I the Presbyterians may be said to have had the ascendency Indeed, presbytery had been established by act of parliament as the national church, and it was chiefly owing to the growing influence of the Independents that this act was rendered inoperative (*Murray's Life of Samuel Rutherford*, chap viii Edinburgh, 1828) Notwithstanding the "Apology" written by Robinson which was regarded as [illegible] standard of faith and discipline, but, in the year 1658, their leading members held a meeting in London, under the [illegible] practised by the Congregational Churches in England, agreed upon and consented unto by the Elders and Messengers at their Meeting at the Savoy, Oct 12 1658" The Confession and Robinson's "Apology," on which it is mainly founded, contain a synopsis of their various tenets, and from these it appears as Mosheim remarks, "that they differed from the Presbyterians or Calvinists in no single point of any consequence, except that of ecclesiastical government" (*Adam's Religious World Displayed* ii 312 13)

Thus matters stood at the date which we have just specified What might have been the issue of the struggle between the Independents and Presbyterians if Cromwell had lived, or if the dynasty which he established had stood [illegible] be told But the restoration of Charles II, and with him the episcopal church, put an end to the influence of both sects The Act of Uniformity was passed in 1662, the object of which was to crush non-conformists, particularly the Independents and Presbyterians The Act required from clergymen a direct [illegible] principle of episcopacy The effect of [illegible] of about 2000 clergymen [illegible] members," or "the Bartholomew worthies" The Independents, however, though proscribed, still subsisted; but in a state of persecution, dejection, and weakness But the Revolution of 1688, and the Act of Toleration, which was passed in the subsequent year, brought them peace and the free exercise of their religion They were now a small body as compared with the Presbyterians, but the two sects, having much in common, and differing only as to church government, entered into an association with each other, under certain heads [illegible] tended to the maintenance of their [illegible] tions (*Whiston's Memoirs of his Life*, vol ii, *Mosheim*, v 361-63)

Since the period of the Revolution, the Independents have greatly increased both in numbers and importance The extraordinary revival of religious zeal which took place about the middle of last century, under the influence of the two Wesleys and Whitfield, was of essential service to the sect of which we are treating Many other persons, awakened to a deeper sense of religion, refusing to unite with any of the three bodies of Methodists, the Wesleyan, the Whitfieldian, or the Countess of Huntingdon's, joined the Independents, and formed numerous churches in connection with that sect The Independents have long ago withdrawn from their association with the Presbyterians, or indeed with any body of Dissenters, and act by themselves They are distinguished from all other Protestant communities chiefly by the two following circumstances —*First* They reject the use of all creeds and confessions (including the Savoy Confession and Declaration) drawn up by fallible men, requiring of their teachers no other test of orthodoxy than a declaration of their belief in the gospel of Jesus and their adherence to the Scriptures as the sole standard of faith and practice *Second*, They attribute no virtue whatever to the rite of ordination, for they declare that the qualifications which constitute a regular minister of the gospel are a firm belief in the Bible, fervent piety, a desire for the glory of God and [illegible] the pastoral charge of [illegible] Christian congregation These two circumstances constitute the distinguishing characteristics of the Independent denomination They do not believe, as may also be mentioned, that an imposition of the hands of bishops or presbyters at ordination confers any new power or prerogative though it is their custom to impose hands in inducting a pastor to a particular charge as a token of recognition in a new relation In point of religious doctrine they vary from the high Calvinism of the Savoy Confession, though moderate Calvinism is maintained, speaking generally by both pastors and people The Independents teach that every point both of doctrine and church discipline is vested exclusively in the congregation and that whatever is supported by a majority must necessarily be law They do not think it imperative to assemble synods, yet if any such be held, which they are periodically, they look on their resolutions as prudential counsels, but not as decisions to which they are obliged to conform (*Adam's Rel World Displayed*, ii 311)

Of the extent and influence of the Independents in England a pretty correct idea may be formed from the number of their colleges or academies, and of their chapels These colleges or academies are exclusively confined to the education of ministers belonging to their own denomination Some of these institutions are wealthy endowments others of them are supported by annual subscriptions Their number is ten, the oldest of which is at Homerton, Middlesex, which was founded in 1730 The last established college is at Manchester, which was instituted in 1837 The others were founded at different intermediate dates The number of Independent chapels in England is upwards of 1700, and appears to be on the increase In Scotland the Independents have upwards of 100 chapels, and in Ireland about 30, but it is reckoned that they have no fewer than 1000 congregations in the United States, and the best authorities concur in stating that their numbers are on the increase

INDETE'RMINATE In Mathematics, quantities which change their values are said to be *indeterminate*, in opposition to those whose values remain fixed and invariable For example, in the equation of the ellipse

$b^2 x^2 + a^2 y^2 = a^2 b^2$, the co-ordinates $x$ and $y$ are indeterminate, while the axes $a$ and $b$ are constant quantities

INDETERMINATE In Botany, when a stem is never terminated by a flower, nor has its growth stopped by any [illegible] example, *Veronica arvensis*

INDETERMINATE ANALYSIS, is a branch of Algebra which has for its object the investigation of problems which admit of an infinite number of different solutions When the enumeration of a problem furnishes a less number of equations than there are unknown quantities, the problem is indeterminate in this sense —that the equations may be satisfied by assigning to the unknown quantities an infinity of different values It happens, however, in the greater number of cases, that the nature of the question requires the values of the unknown quantities to be expressed in whole and positive numbers, a condition which greatly restricts the number of solutions

As in the ordinary algebraic analysis problems belonging to the indeterminate analysis are of the first or second degree, according as the simple powers or squares of the unknown quantities enter into the equations expressing their conditions Every equation of the first degree, containing two unknown quantities may be reduced to the form $a x + b y = c$, and it is plain that if only one equation of this sort is given the values of $x$ and $y$ are wholly indeterminate, for any value whatever may be given to one of these quantities and it will be easy to find a value of the second which will satisfy the equation In the indeterminate analysis the object is to find all the values which $x$ and $y$ can have in whole numbers the constants $a$, $b$ and $c$ denoting whole numbers, either positive or negative

For example let it be proposed to divide the number 159 into two parts one of which is divisible by 8 and the other by 13 If we denote by $x$ and $y$ the quotients of the required parts divided respectively by 8 and 13 these parts themselves must be $8x$ and $13y$ consequently the problem is expressed by this equation

$$8x + 13y = 159 \qquad (1),$$

and it will be solved when $x$ and $y$ are expressed by whole positive numbers

In the first place, this equation gives $x = \frac{159 - 13y}{8}$ or $x = 19 - y + \frac{7 - 5y}{8}$, but as $x$ and $y$ must be whole numbers, it is obviously necessary that $\frac{7 - 5y}{8}$ be also a whole number Suppose this to be $n$, we have then $\frac{7 - 5y}{8} = n$, whence

$$5y + 8n = 7 \qquad (2)$$

an equation of the same form with (1) The value of $y$ deduced from this is $y = \frac{7 - 8n}{5}$ or $y = 1 - n + \frac{2 - 3n}{5}$ Now precisely in the same manner as before since $y$ and $n$ are whole numbers, $\frac{2 - 3n}{5}$ must necessarily be a whole number Suppose this to be $n'$, and we have $\frac{2 - 3n}{5} = n'$, whence

$$3n + 5n' = 2 \qquad (3)$$

From this last equation we get $n = \frac{2 - 5n'}{3}$ or $n = -n' + \frac{2 - 2n'}{3}$ Continuing the same process, we now make $\frac{2 - 2n'}{3} = n''$ (where $n''$ must be a whole number) whence

$$2n' + 3n'' = 2 \qquad (4),$$

from which we obtain $n' = \frac{2 - 3n''}{2}$, or $n' = 1 - n'' - \frac{n''}{2}$ Suppose, next $\frac{n''}{2} = n'''$, and there results

$$n'' = 2n''' \qquad (5)$$

Thus at last an equation has been found which is satisfied by making $n'''$ equal to any whole number whatever, and, on attending to the different steps of the process it will readily be observed that $x$ and $y$, and the indeterminate quantities $n$, $n'$ $n''$, $n'''$, are connected by the following system of equations —

$$\begin{aligned} x &= 19 - y + n \\ y &= 1 - n + n' \\ n &= 0 - n' + n'' \\ n' &= 1 - n'' - n''' \\ n'' &= 2n''' \end{aligned}$$

On deducing from these equations the values of $x$ and $y$ in terms of $n'''$, we find $x = 15 + 13n'''$ and $y = 3 - 8n'''$ Now, on making $n'''$ successively equal to 0, 1, 2 3, &c , or equal to $-1$, $-2$, $-3$, &c , these two equations will give all the values of $x$ and $y$ in whole numbers whether positive or negative, by which the equation $8x + 13y = 159$ can be satisfied But if, as the conditions of the problem require, we take account only of the positive solutions, the values of $n'''$ must be so assumed that the expressions $15 + 13n'''$ and $3 - 8n'''$ are both positive, and it is manifest that this can only be done by assuming $n''' = 0$, or else $n''' = -1$, for all other numbers substituted for $n'''$ render the one or the other of these two expressions negative If we make $n''' = 0$, we obtain $x = 15$, $y = 3$, and if we make $n''' = -1$, $x = 2$, $y = 11$, and either of these two systems of values verifies the proposed equation

The preceding example will show more distinctly than perhaps any rule would do the general methods employed to solve indeterminate algebraic problems of the first degree With regard to equations of the second degree the difficulties of solution are infinitely greater, and in fact involve some of the most abstruse theories of algebraic analysis The subject is discussed at length in *Legendre's Theorie des Nombres*

The oldest treatise on the subject of the indeterminate analysis is the *Arithmetic* of Diophantus of Alexandria the best edition of which is that of Toulouse 1670 with a *Commentary* by Bachet and notes by the celebrated Fermat On the revival of the mathematical sciences, the subject was extensively cultivated by Fermat, Descartes Wallis Lord Brounker and others One of the most luminous elementary treatises on the subject is contained in the second volume of Euler's Algebra

INDETERMINATE COEFFICIENTS A method of analysis invented by Descartes and of very extensive application in the higher mathematics The principle of the method of indeterminate coefficients consists in this, that if we have an equation of this form

$$A + Bx + Cx^2 + Dx^3 + \&c = 0,$$

in which the coefficients A B C are constant quantities and $x$ a variable which may be supposed as small as ever we please each of these coefficients taken separately, is necessarily equal to zero that is to say we must always have $A = 0$ $B = 0$ $C = 0$ &c, whatever may be the number of terms of the given equation

In fact since $x$ may be supposed as small as we please it is always possible to render the sum of all the terms of the given equation which have $x$ for a factor as small as we please that is the sum of all the terms following the first may be rendered as small as we please Hence the first term differs from zero only by a quantity which may be less than any assignable quantity but the first term A being constant its difference from zero cannot be any finite quantity assumed at pleasure for this would suppose it to be variable It follows therefore that A can be nothing else than zero, that is we must have $A = 0$, whence there remains

$$Bx + Cx^2 + Dx^3 + \&c = 0$$

Divide this last equation by $x$ and there results

$$B + Cx + Dx^2 + \&c = 0,$$

and for the same reasons as before it is manifest that we must have $B = 0$ Proceeding in the same manner, we find successively $C = 0$, $D = 0$ &c

The principle here explained is extremely fertile in applications and in fact gives the means of resolving by ordinary algebra all the questions which are considered as belonging to the infinitesimal analysis The respective procedures of both methods when properly simplified are absolutely the same, all the difference consists in the manner of viewing the subject

INDEX In Bibliography, an alphabetical table, containing the principal subjects of a work, or words employed in it, with references to the part of the work in which they are to be found Many independent works containing catalogues of various kinds have been also entitled index

INDEX (Lat indico, *I point out*) A term often applied to the fore finger

INDEX In Music the same as *Direct* which see

INDEX EXPURGATORIUS A catalogue of works, which the church of Rome prohibits the faithful from reading, or condemns as heretical It is annually published at Rome

INDEX OF A QUANTITY, in Arithmetic and Algebra, is used in the same sense with *exponent* Thus, in the expression $(a + b)^3$, 3 is the index, and denotes that the quantity $a + b$ is to be raised to the third power, or cube The index of a logarithm or its *characteristic*, is the figure prefixed to the logarithm for the purpose of indicating the unit's place in the corresponding number *See* LOGARITHM

INDEX OF REFRACTION, in Optics, expresses the constant ratio which exists between the sines of the angles of incidence and refraction Thus, with respect to a ray of [illegible] on the surface of water, the [illegible] is found by experiment to be to the sine of the [illegible] in the constant ratio of 1 336 to 1 Hence 1 336 is the index of refraction in water *See* REFRACTION

INDIAN ARCHITECTURE *See* ARCHITECTURE

INDIAN INK A species of ink used in Europe for the lines and sh [illegible] It is principally manufactured in [illegible] writing From the experiments of Dr Lewis, it appears to be a compound of fine lampblack and animal glue *See* INK

INDIANITE A mineral which occurs in granular masses, associated with garnet, felspar, and hornblende It is hard enough to scratch glass, and of a white or gray colour

INDICATIVE MOOD (Lat indico, *I point out*) That form of a verb which expresses a simple or unconditional judgment *See* GRAMMAR

INDICATOR (Lat indico) A genus of birds belonging to the cuckoo tribe (*Cuculidæ*), characterized by a straight finch like bill with compressed sides and a triangular base, the culmen and gonys being equally inclined towards the tip, and the gonys angulated, wings lengthened pointed, tail moderate, rounded, feet short, middle toe much longer than the tarsus

The species of *Indicator* are remarkable for their habit of indicating the nests of bees, and of guiding men to them by their motions and cries whence both their scientific name and common appellation of honey guides

INDICATOR A muscle of the lower part of the fore-arm which extends the fore finger

INDICAVIT (Lat *he has shown*) In Law a species of the writ of prohibition It lies for a patron of a church, whose incumbent is sued in the spiritual court by another clergyman for tithes amounting to a fourth part of the profits of the advowson, and depends on stats West 2 c 5 13 Ed 1 st 4

INDICTION (Lat indictio, *establishment order*, or *denunciation*) In Chronology a cycle or period of fifteen years the origin of which is involved in obscurity Unlike other cycles the indiction has no reference to any astronomical phenomena, but is supposed to relate to certain judicial acts probably the publication of tariffs of the taxes which took place at stated intervals under the Greek emperors. The Cæsarean indiction fell on the 8th of the calends of October (24th of September), the indiction of Constantinople (beginning A D 312) on the the 1st of September), the pontifical indiction on the calends of January It is a date commonly employed in very ancient charters The commencement of this computation is generally referred to the 1st of January of the year 313 of the common era, hence by counting backwards, it will be found that the first year of our era corresponded to the fourth of one of the cycles of indiction The year of indiction corresponding to any other year of our era is found therefore by this rule — Add 3 to the date divide the sum by 15, and the remainder is the year of the indiction The remainder 0 indicates the 15th of the cycle Thus the year 1800 was the third of the indiction See as to the historical commencement of the era of indictions *Gibbon's Decline and Fall*, ii 223 last ed *Mem de l Acad des Inscr* vol xli

INDICTMENT, PROCESS BY (Lat indico *I proclaim against*) In Law, all persons, without exception are liable to be arrested on a warrant of a justice of peace, if charged with crime, and some officers as the [illegible] liable, have the power of [illegible] without a warrant on some occasions When a party is arrested and brought before a justice of peace he is examined and the information of those who came with him is taken, and the depositions of the witnesses, if taken down in the presence of the prisoner, are evidence against him on the trial If the offence be bailable the justice must then take sufficient bail on the part of the prisoner If otherwise he commits him to prison, and the witnesses are bound over to attend and give evidence the king being in all cases the nominal prosecutor The grand jury being summoned by the sheriff (at every session of the peace commission of oyer and terminer and gaol delivery), consisting of not fewer than twelve nor more than twenty-three of the principal men of the county receives the *indictment* or *presentment* (as it is also termed) preferred against the prisoner, and either *finds* or *ignores* it, returning it into court in the first case, indorsed a *true bill*, in the latter, *not found*

An indictment may be found in the absence of the prisoner, but cannot be tried unless he personally appears The summons, when he is absent, in order to bring him into court, is by *capias*, and if he still abscond he may be further pursued to outlawry When the prisoner appears on this process, or voluntarily, or is brought up in custody, he is *arraigned*, that is called before the bar to answer the indictment If the prisoner refuse to answer (in which event he was subjected in former days, to the famous *peine forte et dure*, by which it was intended to torture him into pleading, in order that the forfeiture of his goods might attach), a plea of not guilty is now recorded, and the trial proceeds, if he plead guilty, judgment is awarded Otherwise he may plead — 1 To the jurisdiction, *i e* that the court before which he is arraigned is not competent to try the offence 2 In abatement for misnomer, but the advantage of this plea is now taken away by 7 G 4 3 He may demur to the sufficiency in law of parts of the indictment 4 He may plead one of the four special pleas in bar (former acquittal, former conviction, former attainder and pardon) 5 He may plead not guilty of the [illegible] prisoner plead not guilty, the fact [illegible] tried on examination of witnesses [illegible] The nobility, it must be observed, are tried by their peers for treason or felony, and misprision of these crimes, but in other cases by a jury The jurors are taken by the panel or list returned by the sheriff, and *criminal offences* are tried by the same common jurymen who try the issue of facts in civil cases in which a *special* jury has not been demanded (*See* JURY) The rules of evidence observed on the trial are mostly the same with those which prevail in civil actions (*See* EVIDENCE) [illegible] liar to this branch of law) [illegible] is considered essential that his testimony should be confirmed by other evidence The verdict of the jury must in all cases be unanimous After trial and conviction follows judgment, unless arrested by motion for that purpose, which it still may be on some exceptions to the indictment in point of law Benefit of clergy, as it was termed, was usually prayed after conviction, and was held in cases where not abolished by statute, to discharge the claimant from the capital part of the punishment But this ancient privilege which had long been founded on a misconception of law, was abolished by 7 G 4 c 30 Forfeiture of real property, absolutely is a consequence of judgment in cases of high treason The forfeiture of goods and chattels relates to, that is takes effect upon conviction, but fraudulent conveyances without consideration in order to escape the forfeiture by the transfer of the property after or in contemplation of indictment are void as against the king The sentence of punishment pronounced or recorded on judgment is in some cases fixed and stated, so that the judges cannot modify the statutory penalty, in others (as in all offences at common law unregulated by statute), it is wholly or partly discretionary

A criminal judgment may be reversed by writ of error for notorious mistakes and irregularities A reprieve suspends the execution of a judgment a pardon avoids the judgment altogether, and a pardon may be conditional on the prisoner's submitting to a substituted punishment, which is the ordinary mode of mitigating the severity of the law in capital felonies

INDIGESTION *See* DYSPEPSIA

INDIGITES The title of a class of Latin divinities, concerning the exact import of which there is some dispute but it is probably most correctly referred to ancient heroes who became tutelary deities after death, according to the ancient mythology — as Romulus The word is of very doubtful etymology

INDIGO A blue substance much used as a dye-stuff The best [illegible] and American plant the [illegible] is used and fermented in vats of water during which it deposits indigo in the form of a blue powder which is collected and dried so as to form the cubic cakes in which it usually occurs in commerce Indigo is quite insoluble in water, when heated it yields a purple vapour which condenses in the form of deep blue or purple acicular crystals When indigo is exposed to the action of certain deoxidizing agents it becomes soluble in alkaline solutions, losing its blue colour and forming a green solution, from which it is precipitated by the acids *white*, but it instantly becomes blue by exposure to air This *white indigo* has been termed *indigogene*, and indigo appears to be its oxide It is best obtained by mixing 3 parts of finely powdered and pure indigo with 4 of green vitriol 3 of slaked quicklime and 100 of water, repeatedly shaking the mixture In about twenty-four hours the supernatant liquor which is transparent, and of a green colour, is to be decanted off, and poured into dilute muriatic acid when the deoxidized indigo is thrown down, but in order to prevent its absorbing oxygen and becoming blue it must be most carefully excluded from the contact of air which may be effected by syphoning it off into the acid collecting it in vessels filled with hydrogen, and washing it with water deprived of air and holding in solution a little sulphate of ammonia In this white state indigogene absorbs between 11 and 12 per cent of oxygen to become blue indigo It would appear from Dumas' experiments that indigogene is a compound of

| | Atoms | | Equivalents |
|---|---|---|---|
| Carbon | 45 | = | 270 |
| Hydrogen | 15 | = | 15 |
| Nitrogen | 3 | = | 42 |
| Oxygen | 4 | = | 32 |
| | 1 | | 359 |

and that indigo consists of 1 atom of indigogene = 359,

and 2 of oxygen = 16 The chemical equivalent of indigo, therefore is 375

When indigo is dissolved in concentrated sulphuric acid, it forms a deep blue liquid, known to the dyers by the name of [illegible] Bengal, and [illegible] of that name, from the 20th to the 30th deg of N lat , but it is also cultivated, though not nearly to the same extent, in the province of Tinnevelly, under the Madras government in Java , in Luconia the chief of the Philippine Islands , and in Guatemala and the Caracas in central America The following remarks, from the *Commercial Dictionary*, will exhibit the history of this now indispensable commodity, and the difficulties with which it had to contend before it obtained a permanent footing in the commerce of Europe "It appears pretty certain that the culture of the indigo plant and the preparation of the drug, have been practised in India from a very remote epoch It has been questioned, indeed whether the *indicum* mentioned by Pliny (*Hist Nat* lib xxxv c 6 ) was indigo , but, as it would seem, without any good reason Pliny states that it was brought from India , that when diluted it produced an admirable mixture of blue and purple colours (*in diluendo misturam purpuræ cæruleique mirabilem reddit*), and he gives tests by which the genuine drug might be discriminated with sufficient precision It is true that Pliny is egregiously mistaken as to the mode in which the drug was produced , but there are many examples in modern as well as ancient times to prove that the possession of an article brought from a distance implies no accurate knowledge of its nature or of the processes followed in its manufacture Beckmann (*Hist of Inventions* vol iv art "Indigo") and Dr Bancroft (*Permanent Colours* vol i pp 241—252 ) have each investigated this subject with great [illegible] sagacity , and agree in the conclusion that the *indicum* Pliny was real indigo and not as has been supposed a drug prepared from the *isatis* or woad At all events there can be no question that indigo was imported into modern Europe by way of Alexandria previously to the discovery of the route to India by the Cape of Good Hope When first introduced it was customary to mix a little of it with woad to heighten and improve the colour of the latter, but by degrees the quantity of indigo was increased , and woad was at last entirely superseded It is worth while however to remark, that indigo did not make its way into general use without [illegible] *woad* prevailed [illegible] of indigo In Germany [illegible] in 1654, prohibiting the use of indigo or *devil's dye* and directing great care to be taken to prevent its clandestine importation , because ' says the edict the trade in woad is lessened, dyed articles injured and money carried out of the country ' The magistrates of Nuremburg went further, and compelled the dyers of that city to take an oath once a year not to use indigo , which practice was continued down to a late period In 1598 upon the representation of the states of Languedoc, at the solicitation of the woad growers the use of indigo was prohibited in that province , and it was not till 1737, that the dyers of France were left at liberty to dye with such articles and in such a way, as they pleased ' (*Beckmann*, vol iv p 142 )

INDI'GOLITE Blue *tourmalin*

INDIGO'TIC A'CID An acid obtained by boiling indigo in nitric acid diluted with an equal weight of water It forms white crystals, very soluble in hot water but very sparingly soluble in cold water It consists, in the 100 parts of 48 25 carbon, [illegible] nitrogen, and 41 28 oxygen , or, [illegible] of 1 atom of indigogene = 359, and 30 atoms of oxygen = 240

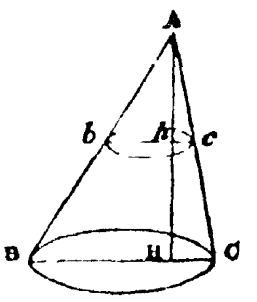
INDIVI'DUAL (Lat individuus ) In the Fine Arts, that which is proper or peculiar to a single object of a species

INDIVI'SIBLES Infinitely small quantities which admit of no further division

In Algebra, the *method of* [illegible] to a peculiar species of calculation [illegible] disciple of Galileo, and much used by mathematicians before the invention of the method of fluxions, or the differential and integral calculus , for which it prepared the way, and of which to a certain extent it supplied the place

In the method of indivisibles lines are considered as composed of an infinite number of points, surfaces as composed of an infinite number of lines, and solids of an infinite number of surfaces These hypotheses are no doubt inconsistent with the rigorous exactness of the ancient geometry, and, taken in the strict sense of the terms, absurd [illegible] can never [illegible] magnitude [illegible] together, compose a solid, or any thing but an area Nevertheless, inaccurate as these ideas are, the conclusions deduced from them are strictly correct, and they afford, in numerous cases, a means of obtaining readily and easily what could only be found by a very long and troublesome process in following the ancient and rigorous method of exhaustions In fact, the objections apply rather to the manner in which the hypotheses are stated than to the method itself, which, in reality, is merely a formula of abbreviation, extremely useful as a means of avoiding the tediousness of the method of exhaustion without diminishing in any way the accuracy of the results Its purpose is to give at once the result of an infinite series of successive approximations , and, as is remarked by Professor Playfair, nothing perhaps more ingenious, and certainly nothing more happy ever was contrived, than to arrive at the conclusion of all these approximations without going through [illegible] approximations themselves

As an example, – Let it be proposed to determine the volume of a cone From A, the vertex of the cone, let a perpendicular A H be drawn to its base Conceive this perpendicular to be divided into an infinite number of equal parts and through each of the points of division a plane to pass parallel to the base of the cone , according to the principles of the method of indivisibles, each of these planes, as *b c*, limited by its intersection with the surface of the cone, will be one of the elements of the volume of the cone, and the whole volume will be the sum of all these elements Now by the properties of the cone these elements are to each other as the squares of their distances from the vertex , therefore, taking A to represent the area of the base of the cone B C, *a* the area of the plane *b c*, H the height A H, and *h* the height A *h*, we have




$A : a :: H^2 : h^2$, whence $a = \frac{A}{H^2} h^2$ Now, if we make V = the sum of these elements or the volume of the cone, it is evident that we have V equal to the constant $\frac{A}{H^2}$ multiplied by the sum of the squares $h^2$ But the distances *h* increase as the series of natural numbers from nothing to H , consequently the quantities $h^2$ represent the squares of those numbers from 0 to H Now it is known that the sum of the squares of the natural numbers, from 0 to $H^2$ inclusive, is

$$\frac{2H^3 + 3H^2 + H}{6},$$

but in the present case the number H being supposed infinite, all the terms in the numerator after the first will be infinitely small in comparison of the first and ought therefore to be rejected whence the sum of all these squares is reduced to $\frac{1}{3} H^3$ Multiply, therefore, this value by the constant $\frac{A}{H^2}$ found above, we have for the volume of the cone $V = \frac{1}{3} A H$ that is to say, the volume of the cone is equal to the product of its base by a third of its altitude

In a similar manner the areas of innumerable curves, and the cubature of many solids are found without difficulty It was in this way that Torricelli, or Roberval, found the quadrature of the cycloid, – a problem of great celebrity among the early mathematicians The work of Cavalieri, *Geometria Indivisibilibus continuorum nova quadam ratione promota* was published at Bologna in 1653 , but he had treated of the subject in a previous work *Exercitationes Geometricæ Sex*, published in 1647

INDU'CEMENT In Law, a term used specially in various cases to signify a statement of facts alleged by way of previous explanation or introduction to other material facts Averments which are mere inducement need not be proved so precisely as others

INDU'CTION (Lat *in*, and duco, *I lead*), the counter-process in scientific method to deduction, implies the raising individuals into generals and those into still higher generalities , deduction being the *bringing down* of universals to lower genera or to individuals Every deduction therefore to be valid, must rest on a prior induction, which, in order that we may obtain logical certainty, must be a *complete* induction , that is to say, must include *all* the individuals which constitute the genus This, it is evident, is impossible, so long as we assume the only power necessary to induction to be the observation of particulars , for these are infinite in number we can never be sure that we have observed them all We are therefore compelled, if we are to admit the possibility of science properly so called, to allow the necessity of some spontaneous action of the understanding in every inductive process , of a faculty, in short, which takes [illegible] from experience [illegible] to arrive at the knowledge of truths not contained in that experience Philosophers differ widely in the language under which they convey their belief of this truth Had the thing itself however, been more distinctly borne in mind, we should have been saved much useless obscurity , in particular, we should

have escaped that altogether false distinction made by logicians between perfect and imperfect induction" All the certainty that can be obtained in physics is a hypothetical certainty, founded on our belief that the course of nature is uniform, but it regards the form of our reasoning, which is all that science contemplates, that remains the same whether the latter be either assumed (See for various observations on the Baconian system of induction, *Playfair's Introductory Essay to the Enc Brit*, and *Hallam on the Literature of Europe*, vol iii)

INDUCTION In Electricity, when one electrified substance is opposed to another, the latter acquires, under certain circumstances, an opposite electric state upon the surface opposed to the inducing body, and is rendered electro-polar *See* ELECTRICITY

INDULGENCE (Lat) A power claimed by the Roman Catholic church of granting to its contrite members remission for a certain term, either on earth or in purgatory, of the penalty incurred by their transgressions The practice was first instituted in the eleventh century by Popes Gregory VII, Victor, and Urban II, as a recompence to those who embarked in the perilous enterprise of the Crusades, but its benefits in process of time extended to all who either by donations or other services [illegible] is the [illegible] for [illegible] although the traffic in indulgences has been reprobated [illegible] minor corruptions have been [illegible] Council of Trent decreed the usefulness and validity of such instruments, and left the whole control of their nature and manner of issuing them entirely in the discretion of the pope for the time being (For an elaborate exposition of this subject see the *Bibliothèque Sacrée*, article 'Indulgence,' also *Mosheim*, iii 83 translation)

INDUMENTUM (Lat induo, *I put on*) In Zoology, the term is restricted in its signification to the plumage of birds This consists of the peculiar epidermic organs called feathers and down, with sometimes a scanty admixture of hair (The description of the component parts of plumage is given under the head of FEATHERS) The plumage is generally more than once changed before it attains that state which is characteristic of the fully mature bird The period during which these mutations are proceeding varies from one to five years, and many birds rear a progeny before they acquire the plumage of maturity When the indumentum of the male bird differs in colour from that of the female the young birds of both sexes resemble the latter in their first plumage, but when both the adult male and female are of the same colour, the young have then a plumage peculiar to themselves In some species the adult birds have a plumage during the breeding season decidedly different in colour from that which they bear in winter in these cases the young birds differ in colour from both parents, and have a plumage which is intermediate in its general tone to that of the two periodical states of the parent birds and bearing indications of the colours to be afterwards attained at either period

The changes in the colour of the plumage of birds are effected either by a total moult of the old and acquisition of new feathers, or by a partial moult and the admixture of new feathers with a certain proportion of the previous plumage or on the [illegible] certain number of new feathers without [illegible] the old ones, or, lastly, by the fully formed feather itself becoming altered in colour the last two changes take place in the adult birds at the approach of the breeding season The change of colour of a fully developed feather is produced either mechanically by the wearing away of the lighter coloured tips, which exposes the brighter tints of the plumage beneath, or by some internal chemical or vital influence upon the colouring matter of the feather itself the latter change begins at that part of the web nearest the body of the bird, and gradually extends outwards till it pervades the whole feather

INDUSIAL LIMESTONE A fresh-water limestone found in Auvergne abounding in the indusiæ or cases of the larvæ of *Phryganea*, great heaps of which have been encrusted by hard travertin and formed into rock

INDUSIUM (Lat induo) A cup that surrounds the stigma of Goodeniaceous and some other plants, it is also the name of the membrane that covers the theca in Dorsiferous ferns

INDUVIÆ (Lat) The withered remains of leaves that not being articulated with the stem cannot fall off, the [illegible] them is said to be *induviate*

INEQUALITY, in Astronomy, is applied to any deviation in the motion of a planet or satellite from its uniform mean motion

INFANGTHEF [illegible] name of an [illegible] Temminck, in [illegible]

INFANT [illegible] This term is used to denote the principle or law of the material world that all bodies are absolutely passive or indifferent to a state of rest or motion, and would continue for ever at rest, or persevere in the same uniform and rectilinear motion, unless disturbed by the action of some extrinsic force The ancients attributed to matter a certain inaptitude, reluctance, or renitency to motion, but that a body in motion required the operation of an extrinsic cause to bring it to rest was first discovered by Galileo Is the disposition of a body to maintain ating an exertion of power, prefixed the word *vis*, and the compound expression, *vis inertia*, though less accurate, has been generally retained Inertia is one of the inherent properties of matter, and unceasingly recalled to our observation in every incident of life

INESCUTCHEON In Heraldry, a species of ordinary, being an escutcheon placed upon the fess point [illegible] and containing, it is said, the third part when charged the fifth when otherwise All escutcheons borne within escutcheons are by some heralds called by this name

INESSE (Lat) A term applied to things actually existing A difference is made by authors between *in esse* and *in posse* the latter being applied to things that are not, but may be, the former being said of things actually apparent and visible

INFANT In Law, a person under twenty-one years of age He is not considered in law as having sufficient ability to contract, and is protected from his own improvidence and the artifices of designing persons by his not being liable for any engagements into which he may have entered, except for necessaries suited to his condition in life His contracts, however are not absolutely void, but only voidable, and though they cannot be enforced against him, yet he may, if he do not choose to avoid them, enforce them against another, and may always confirm them on the termination of his minority He is in general responsible in damages for torts committed by him as for slander or assault His responsibility for crimes varies according to his age and discretion under seven years of age he cannot be guilty of felony, between seven and fourteen a presumption arises that he is doli incapax, but this presumption may be repelled by proof that he could plainly distinguish between good and evil, and he may then suffer death as a felon, and after fourteen he is in general as amenable to punishment as a person of full age

His disabilities many of which are in the nature of privi[illegible]ion, are numerous [illegible] the administration of justice or sit in parliament, he cannot be an executor, nor appear in court by attorney The consent of parents or guardians, or of the Court of Chancery, is requisite to his marriage

INFANTE, INFANTA The titles borne by the younger sons and the daughters of a king of Spain the eldest son being styled Prince of Asturias It is found in a document of the year 999, applied to the sons of King Veremond II It appears however, to have been anciently given to all hidalgos (*Quart Rev* vol lxii p 104, where the reader is referred to the Ley de Partidas, 1, 2) The word "childe" was similarly used in England in the middle ages

INFANTICIDE or CHILD-MURDER, by the law of England is placed upon the same footing with other homicide By 9 G 4 c 41 s 14 a woman indicted for murder of her child may, if acquitted of the murder, be convicted of the misdemeanour of secreting the body of the child to conceal its birth To administer poison, or use other means to procure the miscarriage of a woman great with child, is a capital felony by the same statute (c 14) The exposure of new-born infants, especially females is a common practice among many savage nations at the present day, and especially prevalent among the Chinese According to Lord Macartney, the number of infanticides committed in Pekin alone exceeds 20,000 a year, but it is to be hoped that this calculation is highly exaggerated

INFANTRY The general name for soldiers who serve on foot The term is in all probability derived from the Italian word *fante* signifying a child or young person, and was originally conferred on the young Italian peasantry, who served in the wars on foot, the [illegible] There are, however, various [illegible] origin of the term Among the ancient Greeks and Romans, the infantry constituted the chief strength of an army; and, with the exception of that period in European history [illegible] with the institutions of chivalry prevailed, when the tournament with its gay appendages engaged the attention of all the powerful nobles and otherwise distinguished persons, [illegible] to the cavalry, of little importance, it has generally been regarded as the principal military arm Since the institution of standing armies this has been peculiarly the case From the period of the Conquest down to the reign of Henry VIII, the infantry or

this country consisted of the inferior vassals of the feudal tenants, and from the cause above referred to was neglected both in discipline and accoutrements, but the connection of that monarch with Charles V of Germany and Francis I of France, whose rivalry in arms had introduced great improvements into this arm was the means of directing attention to the defects of the English infantry and paved the way for the introduction of that system of discipline which after the lapse of three centuries has now brought it to perfection The British army comprises exclusively of the militia artillery engineers, and marines, 99 regiments of regular infantry, three regiments of foot guard besides a rifle brigade two West India regiments and the Ceylon rifle regiment *See* Army and the authorities there referred to

INFECTION *See* CONTAGION

INFERIÆ (Lat) Sacrifices offered by the Greeks and Romans to the Dii Manes or the souls of deceased heroes, or any person whose memory was held in veneration These sacrifices consisted of almost every kind of offering, and were instituted on the ninth and thirtieth days after interment They are supposed by some writers to have been the origin of the exequies (quod vide) of the Roman Catholic church

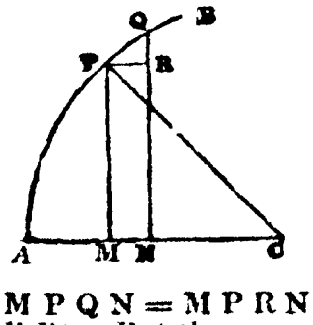
INFERIOR A term given to a calyx that is distinct from the ovarium, as in *silene*, or to an ovary that adheres to the calyx, as in the myrtle It is a bad expression though commonly employed for which the French school have substituted the words nonadherent and adherent

INFERO-BRANCHIATA (Lat inferus, *lower*, and branchiæ *gills*) An order of Gastropods, characterized by the position of the gills which are situated beneath the produced margin of the mantle, they consist of two long series of leaf shaped vascular organs This order comprehends in the system of Cuvier, two genera *Phyllidia* and *Diphyllidia*

INFIDEL (Lat) A term applied to such persons as are not baptized, or do not believe in the Christian religion *See* DEIST

INFINITE (Lat infinitus *boundless*) In Geometry, an infinite quantity is properly that which is greater than any assignable magnitude, and as no such quantities exist in nature, it follows that an infinite quantity is merely an abstraction of the mind formed by excluding the idea of limit or boundary An *infinitely small quantity* is a quantity considered as less than any assignable magnitude There is however, a peculiar signification attached to this expression in mathematical language which has frequently been misunderstood Infinitely small quantities are not absolute zeros or even quantities actually less than certain determinate magnitudes, they are merely quantities which the conditions of the proposed question permit to be regarded as variable until the calculation is entirely completed and as diminishing continually until they become as small as we please, without its being necessary to change the values of those quantities of which they are the differentials It is in this circumstance alone that the character of what are called infinitely small quantities consists, and not in the *littleness* which their denomination seems to imply or in the absolute nullity which may be attributed to them

INFINITESIMAL In Geometry and Analysis an infinitely small quantity that is to say a quantity which is less than any assignable magnitude The *infinitesimal analysis* is that method of finding the relations which exist among the proposed quantities It differs from the differential calculus, or the method of fluxions, only in respect of its metaphysical principles, the analytical processes are precisely the same in both In the theory of infinitesimals a curve is regarded as a polygon of an infinite number of sides, any one of which represents the arc Thus let P Q be one of those sides, then P Q is the hypothenuse of a right angled triangle, of which the sides P R and R Q are the differentials of the co ordinates A M and M P or of $x$ and $y$ Hence making $PQ = dx$ we have $dz^2 = dx^2 + dy^2$ On the same principle, if $s$ denote the area A P Q B, and the area M P Q N, we shall have $ds = y\,dx + \frac{1}{2}\,dy\,dx$ (for M P Q N = M P R N + P Q R = M P × M N + ½ Q R × P R) But the second part of this expression namely, $\frac{1}{2}\,dy\,dx$, is an infinitesimal of the *second order*, being the product of two infinitesimals of the first order The part $\frac{1}{2}\,dy\,dx$ must therefore be omitted being of no value in comparison of the quantity to which it is added and we have consequently $ds = y\,dx$ The elemental triangle P Q R also shows at once the differential values of the trigonometrical lines Thus, supposing the curve A B to be a circle whose centre is C, then the radius C P being unity, and the arc A P being denoted by $z$, we have I cos $z$ P Q Q R $dx$ $d$ sin $z$, whence $d$ sin $z = \cos z\,dz$ Again, I sin $z$ P Q P R $dz$ $= d \cos z$, therefore $d \cos z = -\sin z\,dz$




The theory of infinitesimals affords very great facilities in the application of the calculus to the higher geometry, and especially in the doctrines of physics Whatever view may be taken of the principles, the results, if deduced by correct reasoning, are rigorously accurate, and the mathematician will scarcely be restrained by metaphysical considerations from attempting to reach his object in the shortest way, which, in very numerous applications of the calculus is by the infinitesimal method

INFINITIVE MOOD In Grammar, that inflexion of the verb which expresses the action or passion indefinitely *See* GRAMMAR

INFINITY *See* INFINITE

INFIRMARY (Lat infirmus, *weak*) An hospital for the reception of the sick poor, either supported by the public, or endowed by benevolent persons with funds to defray the necessary expense Establishments bearing this name are not uncommon in all considerable towns of the British empire *See* HOSPITAL

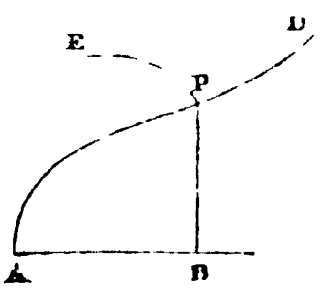
INFLAMMATION In Pathology, this term is applied to redness and heat of some part of the body attended by pain and swelling the vascular action of the part is increased, and if it does not subside or terminate in *resolution* it produces three different effects which, where they take place healthily follow each other in regular order These are, 1 adhesion, 2 suppuration, 3 ulceration

INFLEXED (Lat inflecto, *I bend*) In Zoology, when a part is bent inwards

INFLEXION, in Grammar, in strictness of language is any change which takes place in a word from a modification of its sense between the *root* and the *termination* The inflexion must therefore not be confounded with the termination itself Thus the syllable *am* is the root of all the words employed in the conjugation of the Latin verb amo *I love* in the imperfect tense, the inflexion is the syllable *ab* The termination varies according to the person amabam amabas amabat

INFLEXION In Optics the same as *diffraction*, or that property of light by reason of which, when it passes very near the borders of an opaque body, it is turned from its rectilinear course *See* DIFFRACTION and LIGHT

*Point of inflexion* in Geometry is that point of a curve line where the curvature in relation to the axis changes from concave to convex or from convex to concave The same point is also called the point of *contrary flexure*, and if the direction changes suddenly with relation to the ordinate as well as the abscissa the point becomes a *point of regression* Thus let A P be a curve which from A to P is concave towards the axis A B and from P to D convex towards the axis the point P at which it passes from concave to convex is the *point of inflexion*, and if the curve at P is turned backwards as P E, then P is the point of regression The determination of these points is attended with no difficulty and the method of determining them will be obvious from the following considerations When a curve is concave to the axis, the differential of the ordinate (that of the abscissa being supposed constant) decreases consequently the second differential or $d\,y$ is negative On the contrary, when the curve is convex to the axis $d\,y$ increases, and $d^2y$ is positive At the point therefore at which the curvature changes from concave to convex $d^2y$ changes its sign, but as no variable quantity can change its sign without becoming nothing or infinite in relation to its former magnitude it follows that at the point of inflexion or regression $d\,y = 0$ or infinity Hence to find the point of inflexion in any given curve, it is only necessary to find from the equation of the curve the value of $\frac{d^2y}{dx^2}$, this value made equal to 0 or infinity will give an equation by which $x$ is determined This subject is treated at length in the work of Cramer *Sur les Lignes Courbes*, also in Lacroix's *Calcul Différentiel et Intégral*, and noticed in almost every work on the Differential Calculus




INFLORESCENCE (Lat inflorescere, *to flourish*) The general arrangement of flowers on a stem or branch In botany there are five kinds viz the spike the raceme, the panicle, the capitulum, the umbel, and the cyme, each of which is mentioned in its place

INFLUENZA (As if produced by the influence of [illegible]) often run very high and assume a variety of aspects, [illegible] and other causes The possible [illegible] are highly poisonous and irritating vapour, though in very minute quantity, as the exciting cause of influenza, has been suggested by Dr Prout It may possibly be of volcanic origin, and such a

substance as seleniuretted hydrogen, the effects of which, even in extremely minute quantity, [illegible] might perhaps account for some of [illegible] extraordinary disease

IN FO'RMA PAU'PERIS In Law, a person is said to sue as a pauper, or *in forma pauperis*, when he takes advantage of the stat 11 H 7 c 12, swearing himself not to be worth five pounds, in which case he is entitled to have original writs and subpœnas gratis, and attorney and counsel assigned him without fee, and is excused from paying costs when plaintiff By misconduct, and under certain other circumstances the party is dispaupered, and loses his privilege He is capable of recovering costs though not liable

INFORMATION In Law, an accusation exhibited against a defendant for some criminal offence, not on the oath of jurors but on the special allegation of an officer empowered to exhibit it Criminal informations are either partly at the suit of the king and partly at that of a subject, namely, such as are brought upon certain penal statutes at the suit of common informers, or wholly at the suit of the king These are of two sorts 1 those filed ex officio by the attorney-general, which is a proceeding resorted to in the case of some particular misdemeanours of a public nature, as libels and various other [illegible] public government, and 2 informations [illegible] of the master of the crown office, which lie for some gross and notorious misdemeanours as riots batteries libels &c, not immediately tending to dis

IN FORMERS STELLÆ (Informes Stellæ) in Astronomy are stars not included in any of the constellations See CONSTELLATION

INFRALAPSARIANS In Ecclesiastical History a sect of Presbyterians who maintain that God has created a certain number of human beings only to be damned without allowing them the opportunity of salvation even if they chose to embrace it They are thus designated because they hold that the decrees of God were formed *infra lapsum*, after his knowledge of the fall, and in consequence of it See SUPRALAPSARIANS

INFUSO'RIA (Lat infundo *I pour in*) A name applied by Otho Fr Muller to an assemblage of microscopic animalcules which are for the most part developed in infusions of decayed animal and vegetable substances Some of these minute organized beings were known to Linnæus and were placed by him at the end of the class *Vermes* in a genus which he denominated *Chaos* Muller who made the Infusoria a subject of special study discovered numerous distinct genera and species which he named and classified according to their outward form Gmelin and Lamarck introduced Muller's discoveries and classification of the Infusoria into their systems without any particular modification Cuvier in 1829 observes that 'Naturalists usually close the catalogue of the animal kingdom with beings so extremely minute as to be invisible to the naked eye and which have been discovered only since the invention of the microscope has unveiled to us, as it were a new world Most of them present a gelatinous body of the greatest simplicity and for these this is undoubtedly the situation, but authors have placed among the Infusoria animals apparently much more complicated and which only resemble them in their minuteness and the dwelling in which they are usually found" These higher organized Infusoria were placed by Cuvier at the head of the class in a distinct order under the name of *Rotifères* or *Rotifera*, a name which has subsequently been retained Cuvier attributes to these animalcules a mouth a stomach, an intestine, and an anus, and notices the prominences on the anterior part of the body which some observers had regarded as eyes The anterior lobated organ and its vibratory denticulations the successive action of which gives to the organ the appearance of a swiftly rotating wheel forms the main external character of the order Cuvier includes in the order *Rotatoria* the genera *Furcularia* Lam, *Vaginicola*, Lam *Tubicolaria*, Lam, *Brachionus* Muller

The investigations of Ehrenberg with the aid of a superior microscope to that of his predecessors have brought to light many additional organs and complexities of structure in the *Rotifera* besides several genera and species before unknown, and since these researches naturalists have generally regarded the *Rotifera* as a distinct class of Invertebrata which Professor Grant has placed in the Articulate sub kingdom and Professor Owen in the *Nematoneura*, or higher division of Cuvier's Radiata For the character, subdivision, and organization of the *Rotifera*, see that word

The second order of Infusoria in Cuvier's system is denominated *Homogenea*, a term sufficiently expressive of the inadequate ideas current at that recent period respecting their organization Cuvier says, 'The body of the *Homogenea* presents neither viscera nor other complication, and is frequently destitute of even the appearance of a mouth" Ehrenberg has since shown that they have not only really a mouth, but that the greater part of the *Homogenea* of Cuvier possess a digestive cavity complicated with many cæcal pouches or stomachs, and accordingly proposes to name the order *Polygastrica* Cuvier includes in his second order of Infusoria the genera *Urceolaria*, Lam, *Trichoda*, *Leucophra*, *Kerona*, *Himantopus*, *Cercaria*, *Furcocerca*, *Vibrio*, *Proteus*, *Volvox*, and *Monas* As the polygastric structure has not been detected in any species of *Cercaria*, but as, on the contrary, some species, as *Cercaria lemnæ*, possess a simple alimentary canal, these are together with the cercarial *Spermatozoa*, and the *Ichthydia* which all possess a straight and simple alimentary canal, have been removed from the Infusoria and classed by Mr Owen with the Entozoa

Thus the animals of infusions, although of comparatively simple organization, possessing neither a heart nor respiratory organs, yet manifest at least three distinct types of structure, and are referable to three different classes of animals

Many genera of Infusoria are protected by an external siliceous case The observations which Ehrenberg had made on the modifications of the form and surface of these cases of the existing Infusoria led to his capital discovery of their remains in a fossilized state The mineral called *Polir-schiefer*, used for a long period in the arts for polishing metals and other substances, was first discovered to be composed of myriads of the microscopic flinty cases of polygastric Infusoria belonging to the genera *Gaillonella Bacillaria Diatoma*, &c Whole strata of considerable extent and thickness have since been found to consist almost exclusively of the fossil remains of Infusoria

INGLU'VIES (Lat *a crop*) The crop or dilatation of the œsophagus in which the food is accumulated and macerated but not digested It is largest in the Gallinaceous birds and pigeons but exists in certain birds of prey and also in the flamingo, and others

[illegible] the small masses [illegible] either for coining or exportation

INGRO'SSING See ENGROSSING FORESTALLING

INHA'BITANT In Law a word used in various technical senses Thus a person having lands or tenements in his own possession is an inhabitant for the purpose of repair of bridges wherever he may reside, but for purposes of personal services the 'inhabitant must necessarily be a resident For the purpose of the poor rate the word means a person residing permanently and sleeping in the parish Where the right of voting is in inhabitant" householders a variety of divisions in committees of the House of Commons, in some instances conflicting, have taken place on the point But it appears to be generally understood that an inhabitant is one who keeps a house in his own occupation, either personally residing in it or having it occupied by servants and ready for his residence, having what is termed the 'animus revertendi' or intention to return

INHARMO'NICAL RELATION In Music, that in which a dissonant sound is introduced

INHE'RITANCE In Law an estate or real property which a man has to himself and his heirs, or the heirs of his body &c is termed a freehold of inheritance

INHIBI'TION (Lat inhibeo, *I restrain*) In Scottish Law a species of diligence *i e* process It is a writ in the king's name passing under the signet whereby a debtor is prohibited from contracting any debt which may become a burden on his heritable property in competition with the creditor at whose instance the inhibition is taken out and from granting any deed of alienation, &c to the prejudice of the creditor The heir of the debtor is not affected by the inhibition of his ancestor Other species of inhibition are, that of a husband against his wife, intended to signify that her superintendence over domestic affairs has ceased on which his liability for domestic expenditure contracted by her also ceases, and inhibition of tithes or tends

INHIBITION In Ecclesiastical Law a writ commonly issuing out of a higher court Christian to forbid an inferior judge from further proceeding in a cause before him being analogous to a prohibition issuing out of one of the king's superior courts of justice

INIS An Irish word signifying island, used as a prefix to the names of some islands on the coast of Ireland, and of several towns situated on lakes or rivers in the same country, as Inistallen Inniskilling &c

INITIATIVE (Lat initium *a beginning*) In Politics In legislative assemblies constituted so as to comprise more than one chamber or more than one distinct and co ordinate power that branch of the legislature to which belongs of right the power to propose measures of a particular class is said to have the initiative with respect to those measures Thus in England all propositions for taxing the subject, whether directly or indirectly, must begin in the Commons, a usage which has been adopted in most modern constitutions On the other hand, there are some private bills which by custom originate in the Lords and one bill, that, namely, for a

general pardon, is proposed in the first instance by the crown In France, by the charter of 1830, the three branches of the [illegible] like privileges in proposing laws [illegible] concedes the initiative to the Chamber of Peers, excepting in the case of money bills which must, as in England, originate with the Chamber of Deputies

INJU'NCTION, in Law, is a writ which issues under the seal of a court of equity It is granted in various cases, where the court thinks fit to interfere on equitable grounds with the acts of parties, or with the course of other jurisdictions Thus injunctions are granted under certain circumstances to stay proceedings at common law to restrain the execution of decrees, to other courts, to restrain parties from the commission of waste to preserve property which is in course of litigation, &c Injunctions are also granted to direct parties to quit possession of lands, &c after a decree Disobedience to an injunction is punishable as a contempt of the court from which it issues

INK (German [illegible] The colouring matter of common writing ink is the tannogallate of iron which is suspended in water by gum arabic a little logwood is generally added to [illegible] made [illegible] four ounces of gum [illegible] and six pints of soft water [illegible] then add the other [illegible] together, keep it [illegible] shaking it. In two months' time carefully pour off the ink from the residue into glass bottles, which should be well corked, a few cloves or a drop or two of creosote put into each bottle prevent moulding The addition of a little sugar to ink gives it a gloss, and prevents its drying rapidly and perfectly, so that it is generally used in what is called *copying ink*, from the writing with which copies may be taken by pressure *Indian ink* is a compound of very fine lampblack and size It cannot, like common writing ink, be removed by acids, but as it does not bite or sink into the paper, it may generally be wiped [illegible] *Printing ink* is made with boiled [illegible] lampblack *Red ink* is a solution of alum coloured with brazil wood Boil two ounces of brazil wood, half an ounce of gum arabic, and a quarter of an ounce of alum in a pint of water for ten minutes, strain the decoction, and set it aside to clear *Sympathetic inks* are compounds which when written with will remain invisible till heated solutions of cobalt thus become blue or green, lemon juice turns brown, and a very dilute sulphuric acid blackens *Marking ink* is made as follows — Dissolve one drachm of lunar caustic (fused nitrate of silver) in half an ounce of water previously thickened with a little sap green write with this upon the linen previously prepared for its reception by the application of a weak solution of carbonate of soda [illegible] and [illegible] to dry upon the linen

INULIDANS, *Inlida* [illegible] name of a family of Myriapods having the iulus or gally-worm as the type

INNOCENTS' DAY In the Calendar, a festival celebrated on the 28th of December, in commemoration of the infants murdered by Herod

INNO'MINATUM (Lat in, priv, and nomen, *a name, without a name*) Each of the lower bones of the pelvis is called *os innominatum*, because the three bones of which it [illegible] and the *pubis*, [illegible] share bone, grow afterwards together so as to form what [illegible] which is thus left nameless

INNS [illegible] four corporate societies established in London Every candidate for the rank of barrister-at-law is obliged to be admitted a member of one [illegible] regulations as a student [illegible] Temple, to which three *Inns of Chancery* (Clement's, [illegible]'s, and Clement's) belong, 2. the Middle Temple, with Strand Inn (no longer existing) and New Inn dependent on it 3 Lincoln's Inn (with Furnival's and Thavie's Inns), Gray's Inn (with Staple's Inn and Bernard's Inn)

INNUENDO (Lat *innuendo*, by signification) In Law In the [illegible] was used as a word of reference, when in relating the words of another party it was necessary to describe more particularly the person or thing meant by that party, as, for instance, in a declaration in action for slander, which is the most ordinary modern case of the employment of the innuendo, the plaintiff avers that the defendant said that "he," innuendo (meaning the plaintiff), was a thief, &c Hence the use of the word "an innuendo" in ordinary language to signify a covert allusion

INOCULATION The insertion of poisonous or infectious matter into any part of the body, but in this country the phrase is commonly used to signify the insertion of the virus of the common smallpox the insertion of the virus of the cowpox being called *Vaccination* Inoculation was introduced into general notice by Lady Mary Wortley Montague, whose son was inoculated at Constantinople about the year 1721, and whose daughter was the first who underwent the operation in this country A murder disease is thus protected that when it is received in the natural way Inoculation is performed by inserting the point of a lancet armed with proper matter just under [illegible] ordinary method of turning a ploughed field into a meadow or pasture is by sowing it with grass seeds, but as this part of agriculture has hitherto been very ill understood, and the result of sowing grass seeds has frequently not answered the expectations of the sower, the practice of what is called *inoculation* has of late years been invented, though practised but in very few instances This consists in preparing the soil as if it were to be sown down with grass seeds, but instead of sowing these on the surface, there are distributed over it small fragments of turf taken from the best old pasture land which the neighbourhood affords These fragments may be about two or three inches square, and they are laid down on the surface at the rate of about one in every square foot. After they are deposited grass seeds and [illegible] clover are scattered over the surface and the [illegible] is rolled to press down the the turf and press in the seeds In consequence of the fragments of turf being placed on fresh soil, the grasses and other vegetables which they contain, if of the creeping kind, grow luxuriantly, and their stems cover the intervals between the fragments, but if the grasses which the fragments contain should not be of the creeping or stoloniferous kinds it is evident that the intervals between them must chiefly depend for their grassy surface on the seeds which have been sown On the whole, the inoculation of grass land may be considered as a needlessly expensive process, altogether unscientific, and unsuitable to [illegible] ture

INVERSE PROPORTION, in Geometry, is a proportion in which the terms are placed out of the regular order

INOSCULATION (Lat inosculatio) The union of vessels by conjunction of their extremities This term is sometimes limited to the communication of trunks or [illegible] by [illegible] vessels [illegible] *anastomose*

INQUEST In Law an inquisition of jurors in causes, civil or criminal, when the facts are referred to their trial, being impanelled by the sheriff for that purpose Also the persons to whom the trial of fact in any question, civil or criminal is committed An inquest of office, or inquisition, is an inquiry made by the king's officer, sheriff, coroner, &c, by virtue of their office, or by writ sent them for that purpose or by persons acting under a special commission, to inquire concerning any matter which entitles the king to the possession of lands and tenements, or goods and chattels, as forfeiture for offences, wreck, treasure-trove &c The king's title in general commences on office found

INQUISITION The title given to a court armed with extensive criminal authority in various European countries, especially instituted to inquire into offences against the established religion The first of these tribunals of faith was that established in the south of France after the conquest of the Albigeois in the 13th century They were established in Spain in the middle of the same century not without much opposition on the part of the bishops and secular clergy, who, in Castile, long maintained their exclusive spiritual jurisdiction In 1484, the supreme general inquisition was founded at Seville by Queen Isabella with the aid of the Cardinal Pedro Gonzalez de Mendoza This great court, commonly known by the name of the Holy Office, had far more extensive authority than those local tribunals of the same name which had previously been established Thomas de Torquemada prior of a Dominican convent, was its first president, with the title of inquisitor-general The process of the inquisition was widely different from that of all other courts of justice The kings named the grand inquisitor, who appointed his assessors, some of whom were secular, but the greater part regular ecclesiastics the counsellors were six or seven in number, of whom one, by the ordinance of Philip III, must be a Dominican A party who was brought under cognizance of the court by secret accusation was immediately seized by its officers (termed officials or familiars), and his property put under sequestration If the accused was fortunate enough to absent himself, and did not appear at the third summons, he was excommunicated, and in some cases burnt in effigy. The subsequent process of the court by imprisonment, secret examination, and torture, is well known Penitent offenders were subjected to imprisonment, scourging, confiscation, and legal infamy Those convicted, who were sentenced to death were burnt at the Autos da Fe, which usually [illegible] Advent [illegible] of the inquisitors were for the most part men of intelligence and moderation, and its proceedings chiefly directed against parties guilty of such offences against

decency or religion as would have been punishable in most European countries, although not by an equally arbitrary process But there were exceptions to this general character, and by the provincial courts of inquisition, of which Spain contained sixteen, some acts of barbarous injustice were committed According to a common calculation, 340,000 persons had been punished by the inquisition from 1481 to 1808, of whom nearly 32,000 were burnt In that year it was abolished by Napoleon It was afterwards re-established by Ferdinand III in 1814, but having been again abrogated by the Cortes in 1820, it has not been since reconstituted In Portugal, the supreme court of inquisition was established in 1557 Its history in many respects resembles that of the Spanish court, [illegible] curtailed [illegible] of publicity [illegible] was [illegible] Cortes of 1821 There were courts of inquisition in various southern provinces of France, the principal that of Languedoc, established at Toulouse, which was first founded after the war against the Albigeois, but their power was limited not long after their creation, and fell into desuetude long before their final abolition In several Italian states courts of inquisition have been established, but the institution has never taken much hold on the sentiments or habits of the people of that country It was restored at Rome by Pius VII after the expulsion of the French, but had jurisdiction only over the faith and conduct of the clergy Several well-known histories of the inquisition have been published, particularly that of Limbosch The reader may also consult *Mosheim*, vol iii, *Prescott's Ferdinand and Isabella*, *Quart Rev* vol lv, *Llorente's Hist of the Inquisition*

INSANITY *See* LUNACY

INSCRI'BED FI'GURE In Geometry, a circle is said to be inscribed in a triangle when it touches each of the three sides of the triangle In like manner it is inscribed in a polygon when it touches all the sides of the polygon A triangle or polygon is inscribed in a circle when each of the angles of the figure stands on the periphery of the circle It is a very obvious but remarkable property, that the area of a triangle is equal to the product of the radius of the inscribed circle into half the perim[illegible]

INSCRIPTION In Numismatics, words placed in the middle of the reverse side of some coins and medals *See* NUMISMATICS

INSECTA *See* ENTOMOLOGY

INSECTI'VORA (Lat insecta *insects* and voro *I devour*) The name of a tribe of Zoophagous Mammals, comprehending those which live wholly or chiefly on insects, also of an order of birds in the ornithological system of Temminck

INSE'RTED COLUMN In Architecture, one standing [illegible] all

Botany to denote the manner in which one part grows out of another It was invented at a time when the laws of vegetable structure were unknown, and it was [illegible] that bodies that really grow from each other were inserted into each other Thus stamens said to be inserted into a calyx are in reality stamens that adhere to the sides of a calyx

INSESSO'RES (Lat insideo, *I sit*) A name by which Mr Vigors has designated his second order of birds including the *Passeres* and *Scansores* of Cuvier and which C Bonaparte applies to a primary division of birds in his *Systema Vertebratorum* including the *Passeres Scansores*, and *Accipitres* of Cuvier As the term signifies those birds which perch it is applicable to numerous species belonging to Linnæan and Cuvierian orders not yet included by later innovations under the term of Perchers or *Insessores*

INSOLA'TION, or SCORCHING A local disease of plants, attributable to exposure to too bright a light which causes an excessively rapid evaporation, the effect of which is to kill the part in which the evaporation takes place

INSO'LVENCY In Law the inability of an individual not engaged in trade to pay his debts The insolvency of a trader is called Bankruptcy which see Several statutes have been enacted successively for the relief of insolvent debtors, by releasing them from imprisonment on surrender of the whole of their effects to their creditors Their provisions were consolidated in [illegible] (7 G 4 c 57), and are now [illegible] Act for abolishing Arrest on Mesne Process (1 & 2 Vict c 110) The Insolvent Court consists of four commissioners and other officers, and is a court of record, [illegible] compel attendance, &c [illegible] (Portugal-street), but single commissioners make circuits three times a year through England and Wales The court proceeds upon petition from prisoners in actual custody, or, if the prisoner do not pray, on petition from a creditor An order is then made vesting the prisoner's estate and effects in [illegible] the court, which, however, is [illegible] dismissed

[illegible] court Other assignees are afterwards appointed by the court, in whom the property vests, who must formerly have been creditors, but this appears to be no longer necessary The insolvent delivers into court a schedule, which must contain a full account of his property The petition is then heard, and at the hearing creditors may oppose the discharge, and compel a full investigation of the prisoner's accounts The court may order the discharge either forthwith, or may remand him for a discretionary period, but not exceeding three years, if any frauds or malpractices on his part with reference to the state of his affairs should be detected The insolvent then executes a warrant of attorney for the amount of his debts which the distribution of his property is inadequate to cover, and other modes are provided by which his future property may be made available for his creditors It has long been proposed to unite the bankrupt and insolvent courts The insolvent acts extend only to England and Wales

INSPIRA'TION (Lat in, and spiro, *I breathe*) The act of drawing air into the lungs *See* RESPIRATION

INSPIRA'TION *See* REVELATION

INSTALLA'TION (Modern Lat in, and stallum, *a seat*) A name applied to the ceremony of instating persons in honours or dignities, as a knight of the Garter in the chapel of St George at Windsor, a chancellor in a university, or a [illegible] or other ecclesiastical dignitary, in [illegible] to which he belongs

I'NSTANT (Lat) A part of time or duration in which no succession is perceived There are three kinds [illegible] schoolmen, a *temporary*, [illegible] The first is a part of time immediately preceding another, the second is what is otherwise termed a *priority of nature*, which obtains [illegible] instant, but a point which the understanding conceives to have existed before some other instant, founded on the na[illegible] which cause it to be conceived

IN[illegible]RUCIS In Philosophy, *crucial* instances or examples, a phrase invented by the fancy of Bacon The use of crucial examples or experiments is to facilitate the process of induction For example, A and B two different causes, may produce a certain number of similar effects, find some effect which the one produces and the other does not, and this will point out, as the direction post at a point where two highways meet (crux), which of these causes may have been in operation in any particular instance Thus, for example, many of the symptoms of the oriental plague are common to other diseases, but when the observer discovers the peculiar *bubo* or boil of the complaint, he has an *instantia crucis*, which directs him immediately to its discovery (See, amongst other commentaries on Bacon, *Playfair's Introduction* and *Ed Rev* vol xxxvi)

INSTINCT *See* REASON

I'NSTITUTE The principal philosophical and literary society of France formed in 1795 by the union of four academies (See ACADEMY) *Institute* is applied also to several works embodying the principles of Roman law, of these the chief are those of Justinian and Gaius

INSTITU'TIONS (Lat instituo, *I instruct*) In Literature, a term denoting originally a system of the elements or rules of any art or science, but signifying in a more comprehensive sense all associations formed for the improvement of society at large, or the parties immediately concerned by whatever name they are designated, or to whatever object the labours of the members are directed Institutions formed for the promotion of learning or science have been distinguished by the name of academies or societies, and associations constituted for commercial purposes are usually styled companies, while those formed for other purposes have various designations, or have some epithet prefixed descriptive of their character

I'NSTRUMENT, MUSICAL A musical instrument is one for the production of musical sounds, either by percussion, wind, the drawing a bow across strings, or the production of sound from the vibration of the strings by pulling or pinching them transversely, as in the harp or guitar

I'NSULATED (Lat insula, *an island*) In Architecture, a [illegible] o which it is applied is [illegible] a church is said to be insulated when it adjoins no other building, so also a column is said to be insulated when standing out free from a wall, hence the columns of peripteral temples are insulated

INSULA'TION A body is said to be insulated which, containing a quantity of free caloric, or the electric fluid, is surrounded by [illegible] with other bodies [illegible] *See* ELECTRICITY

INSURANCE A contract of indemnity whereby the insurer, in consideration of a certain premium, undertakes

to indemnify the insured against loss arising by the occurring of a contingent event, such as the destruction of houses by fire, the loss of ships at sea the failure of crops through the inclemency of the seasons

*Insurance* is sometimes synonymously used with *assurance*, but the latter term is now more frequently [illegible] fall other kinds For which life assurances are calculated, see ASSURANCE

In all cases of insurance, the first thing to be determined is the degree of probability that the event under consideration will take place, but it seldom if ever happens that this is known with any moderate degree of precision Even in the commonest cases, it is perhaps altogether impossible to procure the data necessary for the accurate determination of this element Suppose for example, an insurance is to be effected on a ship bound on a voyage to China In what manner is the probability of its reaching its destination in safety to be determined? Even if an accurate account had been kept of all the voyages made during a century, and the number of successful as well as the number of unsuccessful ones were precisely known, the data would still be very insufficient for determining the risk of the loss of any individual vessel The loss of a ship is not a simple event like the turning up of a number on the face of a die The greater or less prevalence of hurricanes at the season of the year when the voyage is to be made, the strength of the ship and sufficiency of its equipment, the skill of the commander, and the character and discipline of the crew —are all elements materially affecting the risk, but which it is impossible to reduce to numerical values and precise calculation All, therefore, that can be done is to adopt certain mean or average values, deduced from observations of the fate of vessels in circumstances not indeed precisely the same but having some degree of similarity To the insurer if he sufficiently multiplies his adventures the result will be the same in the long run as if he had a more accurate appreciation of the separate influences of which the probability of the safe arrival of a vessel at a given port is composed, but the evil which results from this deficient knowledge of facts is, that the owner of a good ship by paying the same premium for insurance as the owner of a bad one, is charged for indemnification against a risk which he really does not run and hence the motives for improving the construction of vessels are not only destroyed, but it even becomes an object of pecuniary interest to expend in their equipment nothing beyond what is necessary to give them that moderate degree of goodness or sea worthiness which suffices to render them insurable on the ordinary terms This system, however much it is to be deprecated, is rather advantageous than otherwise to the underwriters or insurers, because their premiums are charged in proportion, and it renders insurance more necessary the pecuniary loss falls ultimately on the million who consume the merchandise and as to the loss of human life *that* consideration will probably operate as a check to cupidity only in so far as it may tend to raise the wages of seamen

With respect to insurances against fire the exact appreciation of the risk is not less difficult than in the case of marine insurances, but mathematical nicety on this subject is of little importance, for the amount of experience afforded by the general prevalence of the practice and the competition which exists among the numerous rival companies have probably had the effect of adjusting the premium to the average risk with all the accuracy which is practically attainable The premium charged by the London offices for insuring property of the value of 100*l* for a year is one shilling and sixpence, which corresponds to an average annual loss of nearly one in 1300, but it is to be observed that the sum which is charged as premium is presumed to be sufficient not only to cover the losses but also to defray the expenses of the establishment, and to afford an adequate interest on the amount of the capital laid out or risked by the insurance company [illegible] to which the practice of insuring is [illegible] possible that it would be still more general were it not for the circumstance that the government imposes a tax on the transaction of three shillings per annum for each 100*l* insured, which is double the amount of the premium charged by the insurer In 1837, the government duty on insurances amounted to 863,196*l* 12*s* 3*d*, which supposes the value of the property insured in that year to have been upwards of 575 millions

The characteristic property of insurances, of whatever nature, is their tendency to reduce to a certain average value the profits or advantages arising from all speculations of the same kind, however great the number may be The gain which the insurer makes on his successful speculations indemnifies him for the loss he sustains by those which are unsuccessful, and to the insured the result is the same as if they had paid their premiums into a common fund, and agreed to make good to each other their individual losses The insurers are only the intermediate agents of this supposed association, and their profits may be regarded simply as the salary of their functions If other means exist of dividing the risks, insurance becomes unnecessary A mercantile company employing a very great number of ships or taking part in a very great number of enterprises, would derive no benefit from insurance The loss on those which are unsuccessful is compensated by the premiums saved on the whole, in fact the company acts as insurer to itself On this [illegible] insures vessels belonging [illegible] buildings





INTAGLIO (It intagliare, *to cut in*) In Sculpture and Gem Sculpture a stone or gem in which the subject is hollowed out so that an impression from it would present the appearance of a bas relief

INTEGER (Lat *entire*) In Arithmetic a whole number, as opposed to a fractional number, or a mixed number

INTEGRAL CALCULUS The branch of mathematical analysis which treats of the processes by which a function may be found such that its differential shall be a given quantity By English writers this function used to be denominated the *fluent* or *flowing quantity*, and the method of finding it was called the *inverse method of fluxions* Foreign mathematicians who adopted the views and notation of Leibnitz, have called it the *integral* or *sum* of the proposed differential, and this phraseology is now universally adopted by the mathematicians of our own country

The method by which the integral of a proposed differential quantity is to be found is, generally speaking neither obvious nor capable of being reduced to fixed and general rules When an integral is proposed, its differential may always be found by general rules but there is no direct method of returning from the differential to the integral the analyst can only compare the differential expression which is to be integrated with the differentials of known quantities and from such comparison infer the form of the corresponding integral The principal art employed in the integral calculus consists in transforming the proposed functions into expressions which are known to be the differentials of given quantities

In order to denote the integral of a quantity the symbol $\int$ (originally S, the initial letter of the word *sum*) is employed Thus $\int X dx$ denotes the integral of the differential $X dx$

1 To begin with the simplest cases —Let it be proposed to integrate the expression $x^m dx$, or to find the function denoted by $\int x^m dx$ It has been shown, under the term DIFFERENTIAL CALCULUS that the differential of a quantity $x^n$ is $n x^{n-1} dx$, that is to say $dx^n = n x^{n-1} dx$ Let $n = m + 1$, and this becomes $d x^{m+1} = (m+1) x^m dx$, whence we have $x^m dx = \frac{d x^{m+1}}{m+1}$, or, as the constant quantity $(m+1)$ does not affect the differentiation, $x^m dx = d \frac{x^{m+1}}{m+1}$ But as the integral of an expression $dP$ is evidently P the equation gives, on integrating both members $\int x^m dx = \frac{x^{m+1}}{m+1}$ From this we derive the following general rule for integrating a differential of one term —Increase the exponent of the variable quantity by unity, and then divide by the new exponent and by $dx$

It is necessary, however, to remark that the integral thus formed may either be the expression from which the differential $x^m dx$ was derived, or it may be that expression increased or diminished by any constant quantity For the differential of $a x^5$ being $5 a x^4 dx$ and of $a x^5 + b$ being also $5 a x^4 dx$ ($b$ being any constant quantity whatever), it follows that if we have to integrate the expression $5 a x^4 dx$ the integral will be incomplete unless we add to it a quantity which though indeterminate does not change its value with the variation of $x$ We have, therefore, in general, $\int x^m dx = \frac{x^{m+1}}{m+1} + C$, where C is a quantity, positive or negative, the particular value of which remains to be determined by the nature of the problem under consideration This quantity, C, which is necessary in order to complete the integral, was denominated by the older English writers *the correction of the fluent*, in the language of modern analysts, it is *the arbitrary constant*

2 The differential of a polynomial being composed of the sum of the differentials of its terms taken separately, the integral of a polynomial is in like manner formed by adding into one sum the integrals of its component terms

Thus,

$$\int (a\,dx + b\,x\,dx - c\,x^n\,dx) = ax + \tfrac{1}{2}bx^2 - \frac{c\,x^{n-1}}{n-1} + C,$$

and one constant [illegible] for the sum of the constants which [illegible] the separate terms may evidently be represented by a single letter. In the same manner, the integral of a function having the form $(a + b\,x + c\,x^2)^n$ may be found when $n$ is a whole positive number, it being only necessary to raise the root to the power denoted by $n$.

3. By the differential calculus, $d\,\log x = \frac{dx}{x}$. When any differential expression, therefore, can be reduced to this form, its integral will be found by means of a logarithm. Thus, supposing it were required to find the integral of $\frac{a\,dx}{a + bx}$. Suppose $a + bx = z$, and we have $dx = \frac{dz}{b}$. Substitute this in the given expression, and we have $\frac{a\,dx}{a + bx} = \frac{a\,dz}{bz}$. But $\int \frac{a\,dz}{bz} = \frac{a}{b}\int \frac{dz}{z} = \frac{a}{b}\log z + C$, which, on writing for $z$ its value, becomes $\frac{a}{b}\log (a + bx) + C$.

4. An extensive class of differential expressions of very frequent occurrence in the solution of problems, is integrated by means of circular arcs. Let $x$ be the sine of an arc $z$, we have then $x = \sin z$, and by the differential calculus $dx = \cos z\,dz$, whence $dz = \frac{dx}{\cos z}$. But by the properties of the trigonometrical lines $\cos^2 z + \sin^2 z = 1$, whence $\cos z = \sqrt{1 - \sin^2 z}$, or $\cos z = \sqrt{1 - x^2}$, consequently $dz = \frac{dx}{\sqrt{1 - x^2}}$. Transposing the terms of this equation and integrating, we find $\int \frac{dx}{\sqrt{1 - x^2}} = z + C$, $z$ being an arc of which the sine is $x$. Whenever, therefore, an expression occurs of the form $\frac{dx}{\sqrt{1 - x^2}}$, we know that its integral, though it cannot be expressed generally in numbers when a numerical value is given to $x$, is represented by means of an arc of a circle. The expression $\frac{dx}{\sqrt{a^2 - x^2}}$ is reducible to the same form, for on dividing the numerator and denominator by $a$, or $\sqrt{a^2}$, and making $\frac{x}{a} = u$, we get $\frac{dx}{\sqrt{a^2 - x^2}} = \frac{du}{\sqrt{1 - u^2}}$, and $\int \frac{du}{\sqrt{1 - u^2}}$ = arc of which the sine is $u$ or $\frac{x}{a}$. The constant C in the present case is zero, for the arc and its sine both vanish together.

Let us suppose, in the second place, $x = \cos z$. By differentiating we find $dx = -\sin z\,dz$, whence $dz = -\frac{dx}{\sin z} = -\frac{dx}{\sqrt{1 - \cos^2 z}} = -\frac{dx}{\sqrt{1 - x^2}}$. Transposing and integrating as before, $\int -\frac{dx}{\sqrt{1 - x^2}} = z + C$, $z$ being the arc whose cosine is $x$. In this case, the constant C must be determined from this consideration, that when the cosine of an arc is 0 the arc itself is equal to a quadrant. Supposing, then, $x = 0$, and consequently $\frac{dx}{\sqrt{1 - x^2}} = 0$, and denoting the semicircumference as usual by $\pi$, the integral becomes $0 = \frac{1}{2}\pi + C$, whence $C = -\frac{1}{2}\pi$. Substituting this value of $\pi$, we get $\int -\frac{dx}{\sqrt{1 - x^2}} = z - \frac{1}{2}\pi = -(\frac{1}{2}\pi - z)$.

Lastly, let us suppose $x = \tan z$. The differential of the tangent of an arc is equal to the differential of the arc divided by the square of the cosine. Hence $dx = \frac{dz}{\cos^2 z}$, and therefore $dz = dx \cos^2 z$. But $\cos z = \frac{1}{\sec z}$, whence $dz = \frac{dx}{\sec^2 z} = \frac{dx}{1 + \tan^2 z} = \frac{dx}{1 + x^2}$. Transposing and passing to the integral, we have $\int \frac{dx}{1 + x^2} = z + C$. In this case, as the arc and its tangent vanish together, $C = 0$, therefore $\int \frac{dx}{1 + x^2}$ = arc whose tangent is $x$.

To this form we may reduce the expression $\int \frac{dx}{a^2 + x^2}$. Divide the terms by $a^2$, and make $\frac{x}{a} = u$, it then becomes $\int \frac{1}{a}\frac{du}{1 + u^2}$, or $\frac{1}{a}\int \frac{du}{1 + u^2}$, whence $\int \frac{dx}{a^2 + x^2} = \frac{1}{a}$ × arc whose tangent is $\frac{x}{a}$.

5. [illegible] which [illegible] venient [illegible] *tegration by parts*. This consists in making an integral of the form $\int v\,du$ depend on another of the form $\int u\,dv$. Thus, by the differential calculus, $d(uv) = u\,dv + v\,du$, transposing and integrating, we get $\int u\,dv = uv - \int v\,du$, which is the formula by which the artifice in question is accomplished. As an example, let it be proposed to find in this manner the integral $\int x^m\,dx$. Make $x^m = u$, and $dx = dv$, we have then $v = x$, $uv = x^m x = x^{m+1}$, $du = m\,x^{m-1}\,dx$, and $v\,du = m\,x^m\,dx$. Substituting these expressions in the formula $\int u\,dv = uv - \int v\,du$, it becomes $\int x^m\,dx = x^{m+1} - \int m x^m\,dx$, whence (since $\int m\,x^m\,dx = m\int x^m\,dx$) we have by transposing $(1 + m)\int x^m\,dx = x^{m+1}$, and therefore $\int x^m\,dx = \frac{x^{m+1}}{1 + m}$, which is the same expression as was given above. It may be remarked that by the use of this artifice the integral of the expression $x^m\,dx$ has been found by differentiating $x^m$ and making the substitutions ordinarily employed in common algebra.

Another method of integration consists in transforming the given expression into a series, and taking the integrals of the several terms separately. Let it be proposed, for example, to integrate by the method of series the expression $\frac{dx}{a + x}$, which is the differential of the logarithm of $(a + x)$. In the first place, $\frac{dx}{a + x} = \frac{1}{a + x} \times dx$, but on expanding $\frac{1}{a + x}$ into a series by division, we have

$$\frac{1}{a + x} = \frac{1}{a} - \frac{x}{a^2} + \frac{x^2}{a^3} - \frac{x^3}{a^4} + \&c,$$

and multiplying both sides by $dx$ and integrating by the the rules already explained, we find

$$\int \frac{dx}{a + x} = \frac{x}{a} - \frac{x^2}{2a^2} + \frac{x^3}{3a^3} - \&c + C$$

that is to say,

$$\log (a + x) = \frac{x}{a} - \frac{x^2}{2a^2} + \frac{x^3}{3a^3} - \&c + C$$

In order to determine the constant suppose $x = 0$, and the expression becomes $\log a = C$, whence, substituting this value of C,

$$\log (a + x) = \log a + \frac{x}{a} - \frac{x^2}{2a^2} + \frac{x^3}{3a^3} - \&c,$$

a series by which the logarithm of one number may be found from another when the difference between them is small in comparison of the latter number, or, which is the same thing, when the series converges with sufficient rapidity.

As a second example of this method, let the proposed differential be $\frac{dx}{1 + x^2}$, or $\frac{1}{1 + x^2} \times dx$. In this case we have $\frac{1}{1 + x^2} = 1 - x^2 + x^4 - x^6 + \&c$, whence multiplying by $dx$ and integrating the terms,

$$\int \frac{dx}{1 + x^2} = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \&c + C$$

But $\frac{dx}{1 + x^2}$ is the differential of the arc whose tangent is $x$, therefore

$$\text{arc (tan} = x) = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \&c + C$$

and as the arc and its tangent both vanish together, the constant C is in this case $= 0$.

The series which has now been found for the arc in terms of the tangent converges only when the tangent is less than radius, or when $x$ is less than unit, but it may be put under a form which will be convergent when $x$ is greater than unit, or the arc greater than 45°. Thus, the series

$$1 - x^2 + x^4 - x^6 + \&c$$

was obtained by dividing 1 by $1 + x^2$, but if instead of dividing by $1 + x^2$, we divide by its equal $x^2 + 1$, we shall find

$$\frac{1}{x^2+1} = \frac{1}{x^2} - \frac{1}{x^4} + \frac{1}{x^6} - \frac{1}{x^8} + \&c\ ,$$

whence

$$\int \frac{dx}{x^2+1} = \int \left( \frac{1}{x^2} - \frac{1}{x^4} + \frac{1}{x^6} - \frac{1}{x^8} + \&c \right) dx + C\ ,$$

and on multiplying each term of the second member by $dx$ and integrating,

$$\text{arc (tan} = x) = -\frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \&c + C$$

In order to find the constant, we cannot in this case suppose $x = 0$ for on this supposition the second member of the equation is infinite, but if $x = \infty$ the arc becomes a quadrant, or $\frac{1}{2}\pi$, and the equation becomes

$$\tfrac{1}{2}\pi = 0 + C', \text{ or } 0 = -\tfrac{1}{2}\pi + C,$$

and subtracting this equation from the former,

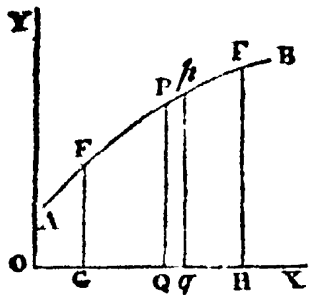
$$\text{arc (tan} = x) = \tfrac{1}{2}\pi - \frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \&c$$

which converges the more rapidly the greater we assume the value of $x$

The preceding examples will give an idea of the method by which the primitive function is obtained from its differential, but the subject is of by far too extensive and abstruse a nature to be entered into at any length in this place We shall therefore content ourselves with indicating some of the applications of the integral calculus to geometry

One of the first objects to which the new calculus was applied by its inventors was the finding the quadrature or areas of curve lines, and their rectification, or the determination of the lengths of their arcs

Let A B be a curve referred to two rectangular coordinates O X and O Y, let E and F be given points in it, and let it be required to find the quadrature of the curvilinear space between E G and F H, the ordinates passing through E and F Through P imagine one of the arc E F draw the ordinate P Q and also $p\,q$ indefinitely near to P Q then the space P Q $q$ $p$ is the differential element of the area G E P Q, and the area itself is equal to the sum of all the differential elements taken between E G and F H But by the principles of the differential calculus the space P Q $q$ $p$ is ultimately (that is, when Q $q$ is less than any assignable quantity) equal to the rectangle under P Q and Q $q$, therefore, making as usual O Q $= x$ P Q $= y$, and $s =$ the area, we have $ds = y\,dx$, and consequently the area $= s = \int y\,dx$ In order to apply this formula it is necessary, in the first place to determine $y$ in terms of $x$ by means of the equation of the given curve




Suppose the given curve to be the common Apollonian parabola, the equation of which is $y^2 = a\,x$, $a$ being a constant From this equation $y = a^{\frac{1}{2}} x^{\frac{1}{2}}$, and consequently $y\,dx = a^{\frac{1}{2}}\, x^{\frac{1}{2}}\, dx$, whence, passing to the integral by means of the formula $\int x^m\,dx = \frac{x^{m+1}}{m+1} + C$, we obtain $\int a^{\frac{1}{2}}\, x^{\frac{1}{2}}\, dx = \frac{2}{3} a^{\frac{1}{2}} x^{\frac{3}{2}} + C$, which on substituting for $a^{\frac{1}{2}}$ its value in terms of $y$, becomes $\frac{2}{3} y\,x + C$ This is the general expression for the area of the parabola, to determine it between the proposed limits we have only to substitute in it the values of $x$ and $y$ at those limits At the point E it becomes $\frac{2}{3}$ O G G E $+ C$, and at the point F it becomes $\frac{2}{3}$ O H H F $+ C$ Subtracting therefore the first of these from the second we have the space G E F H $= \frac{2}{3}$ (O H H F $-$ O G G E), the indeterminate C being eliminated by the subtraction

From this example it is easy to see that the space represented by the integral $\int y\,dx$ is the increment which a certain area receives while the independent variable $x$ passes from one state of magnitude to another, and that the absolute magnitude which represents the integral cannot be known before C is determined or eliminated as above For the purpose of expressing the limits within which the integral is to be taken a particular notation is employed Let O G $= l$, and O H $= k$, then it is usual to write

$$\text{area G E F H} = \int_l^k y\,dx,$$

to express that the integral includes all values of $x$, from $x = l$ to $x = k$ The one of these is the value of $x$ at its commencement, the other at its completion and the integral itself is an indeterminate quantity till the initial and [illegible] is another of the earliest applications of the integral calculus To rectify a curve, signifies to find a straight line equal to its arc According to the principles of the differential calculus, if $z$ denote the arc of a curve then $dz = \sqrt{dx^2 + dy^2}$, consequently if the value of $dy^2$ be found by means of the equation of the curve in terms of $x$ (or that of $dx^2$ in terms of $y$) and substituted in this equation, the radical will contain only one variable and when the expression is capable of being integrated the curve is rectifiable It is, however, only in a comparatively small number of cases that the differential of the arc of a curve can be integrated in finite terms

As an example, let us take the circle, the equation of which is $x^2 + y^2 = a^2$, reckoning the co ordinates from the centre From this equation $y = \sqrt{a^2 - x^2}$, whence $dy = \frac{-x\,dx}{\sqrt{a^2 - x^2}}$, $dx^2 + dy^2 = \frac{a^2\,dx^2}{a^2 - x^2}$, and $dz = \frac{a\,dx}{\sqrt{a^2 - x^2}}$

This expression cannot be integrated otherwise than by an infinite series We have already seen that it is reducible to the form $\frac{dx}{\sqrt{1 - x^2}}$ But the expression $\frac{1}{\sqrt{1 - x^2}}$ expanded by the binomial theorem gives

$$1 + \tfrac{1}{2}x^2 + \frac{1\ 3}{2\ 4}x^4 + \frac{1\ 3\ 5}{2\ 4\ 6}x^6 + \&c\ ,$$

whence, multiplying by $dx$ and integrating the terms separately,

$$\int \frac{dx}{\sqrt{1 - x^2}} = x + \frac{x^3}{2\ 3} + \frac{1\ 3\ x^5}{2\ 4\ 5} + \frac{1\ 3\ 5\ x}{2\ 4\ 6\ 7} + \&c$$

Now if in this series we write $\frac{x}{a}$ for $x$, and multiply the whole by $a$, we shall have

$$\int \frac{a\,dx}{\sqrt{a^2 - x^2}} = x + \frac{x^3}{2\ 3\ a^2} + \frac{1\ 3\ x^5}{2\ 4\ 5\ a^4} + \frac{1\ 3\ 5\ x^7}{2\ 4\ 6\ 7\ a^6} \&c$$

for the length of the arc of the circle whose radius is $a$ and abscissa $x$ Suppose $x = a = 1$, this series gives for the length of the quadrant

$$1 + \frac{1}{2\ 3} + \frac{1\ 3}{2\ 4\ 5} + \frac{1\ 3\ 5}{2\ 4\ 6\ 7} + \&c$$

The quadrature and rectification of the circle are problems which have exercised the ingenuity of mathematicians ever since the invention of the science, but the solution neither of the one nor the other can be obtained in finite terms

The application of the integral calculus to the determination of the volumes and surfaces of solids, is perfectly analogous to the determination of the areas and arcs of plane curves Supposing the solid to be generated by the revolution of a plane curve about its axis, the expression for its volume is $\pi \int y^2\,dx$, where $\pi$ is the semicircumference of the circle whose radius is unit The expression for its surface is $2\pi y \sqrt{dx^2 + dy^2}$ In these expressions the values of $y^2$ $y$ and $dy^2$ must be found in terms of $x$ from the equation of the curve by the revolution of which the solid is formed, and when the values thus found are substituted the formula will contain no other variable than $x$

The integral calculus also affords the readiest and in general, the only means of determining the centres of gravity of oscillation [illegible] and is, in fact the instrument by which mathematicians have succeeded in solving the difficult and important questions of dynamics and physical astronomy, and in ascertaining the laws which regulate the motions of the material world

As the integral calculus with its various applications embodies almost the whole of mathematical science the treatises which have been composed to explain or illustrate its principles are by far too numerous to be mentioned in this place Almost all the improvements of the calculus were first given in the form of Academical Memoirs The great repositories in which it is contained are the writings of Newton, Cotes, Demoivre, the Bernoullis Maclaurin Simpson, Euler, D'Alembert, La[illegible] Gauss Ivory, & [illegible] ler's *Calculus Integralis*, in 4 vols 4to, now very scarce, and Lacroix's *Traité du Calcul Différentiél et du Calcul Intégral*, in 3 vols 4to Of the minor works we may mention Bossut's *Calcul Différentiél et Intégral*, Boucharlat, Lacroix's smaller treatise, translated by Babbage, Herschel, and Peacock, and the treatises which have recently been published at Cambridge, particularly those of Hymer, Peacock, Myers, Hind, &c

INTEGRANT PARTS, in the Corpuscular Philosophy, are the small parts of a body, by the aggregation of which it may be conceived to be formed *Integrant parts* result from the mechanical division of a body, *constituent* [illegible], its chemical decomposition

INTELLECT *See* UNDERSTANDING

INTENDANT (Lat intendo, *I give my mind to any thing*) A title in common use among the French

applied to persons who have the conduct, inspection, and management of any office or function, as intendants of the [illegible], of [illegible] buildings, houses &c which treat of such expressions

INTENTIONS FIRST AND SECOND A distinction drawn by the schoolmen between those acts of thought which relate to an object out of the mind, and those which [illegible] states of consciousness [illegible] *production*, are *first intentions* such terms as *abstraction*, *inference* &c, are the expression of *second intentions* It is to be regretted that this distinction is disused by modern inquirers, or misunderstood by them, as in particular by Whately Great ambiguity might be avoided in philosophical language were it closely kept in view, as in such terms as *cause* and *effect*, which may either allude to a connection between natural phenomena in themselves, or to our [illegible] the essential laws of t[illegible] was first revived in the present century in a learned and acute review of Whately's Logic contained in the 115th Number of the *Edinburgh Review*

INTERCALARY DAY (Lat calo, *I call* *See* CALENDAR) In the Calendar, a day inserted out of the usual order to preserve the account of time Thus every fourth year containing 366 days, while the other years contain only 365 one of the months in that year must have an additional day, which is called the intercalary day The additional day was given to February as being the shortest month, and in the ancient Roman calendar was inserted between the 24th and 25th days In the ecclesiastical calendar it still retains that place, but in the civil calendar it is the 29th *See* BISSEXTILE

INTERCELLULAR PASSAGES in Vegetable Anatomy, are the spaces that exist between the cells, tubes, or vessels of which the tissue of a plant consists As the cells are usually, and the tubes or vessels are always round, it necessarily follows that when pressed together there will be spaces left between their sides

INTERCOLUMNIATION (Lat inter, *between* and columna *a column*) In Architecture the distance between two columns measured at the lower parts of their shafts It is one of the most important elements in architecture and on it depend the effect of the columns themselves, their proportion and the harmony of an edifice Intercolumniations are of five species, viz Pycnostylos, Systylos Diastylos Aræostylos, and Eustylos, under which several terms in this work they are defined, and to them the reader is referred

INTERCOSTAL (Lat inter, and costa, *a rib*) A term applied to muscles and vessels situated between the ribs

INTERDICT (Lat ) In Ecclesiastical History a spiritual weapon by which the Popes used in former times to reduce individuals or whole states to the most abject submission to their power In the middle ages it was the most terrible blow which could be inflicted on the people or the prince When an interdict was laid upon a kingdom all spiritual services ceased, the churches were shut up, the sacraments were no longer administered, no corpses were buried with funeral rites, and all the ministry of the church which was then believed to be the only channel of salvation was forbidden to be exercised The first memorable occasion on which this method of warfare was adopted was the marriage of King Robert of France with Bertha his cousin, when Gregory V in 998 issued interdicts against the whole country, and compelled the sovereign to dissolve his union It had, however, been often used before by bishops, an instance is quoted by Moreri as early as A D 870 (See *Gieseler's Text Book*, ii 117, translation) The ban under which England was laid in the reign of John by Innocent III is well known in the history of this country The latest pretensions to the exercise of this power were assumed by Pius VII, when he issued an inefficient decree against Napoleon in 1809

INTERDICT The technical term in Roman law for a decree of the prætor [illegible] or recovery of prope[illegible] subject see the *Penny Cyclopædia*

INTEREST The premium or sum of money given for the loan or use of another sum of money, generally estimated at so much *per cent*, or per 100*l* The sum lent, and for which the interest is paid, is called the *principal* and the [illegible] interest is called the *rate* The rate will evidently be proportional to the time, for whatever interest is paid for the use of 100*l* for one year, twice that interest will be required for the use of 100*l* for two years The principal added to the interest, or the whole sum paid back to the lender, is called the *amount*

Interest is either *simple* or *compound* *Simple interest* is that which is reckoned and allowed upon the principal only during the whole time of the loan, *compound interest* is reckoned not only on the principal sum lent, but also on the interest as it becomes due It is convenient to treat of these separately

1 *Simple Interest* — Let us assume
$a$ = the amount,
$p$ = the principal sum lent,
$n$ = the number of years for which it is lent,
$r$ = the rate, or interest of 1*l* for one year

Now, the interest of 1*l* for one year being $r$, the interest of $p$ pounds for one year is $p\,r$, and for $n$ years $p\,r\,n$ The amount, therefore, of $p$ pounds for $n$ years, at the rate $r$, is $p + p\,r\,n$, or, $a = p\,(1 + r\,n)$ From this equation we may determine any one of the four quantities in terms of the others The four equations are as follow —

$$a = p\,(1 + r\,n) = \text{the amount},$$
$$p = \frac{a}{1 + r\,n} = \text{the principal},$$
$$n = \frac{a - p}{p\,r} = \text{the time in years},$$
$$r = \frac{a - p}{p\,n} = \text{the rate of interest}$$

These formulæ suffice for the solution of all questions of simple interest It is only necessary to observe, that when the time is less than a year, $n$ is a fraction for example, if the time is seven months, $n = \frac{7}{12}$, and if the time is 100 days, then $n = \frac{100}{365}$ If the rate of interest be 4 *per cent per annum*, then $r = .04$, if the rate be 5 *per cent per annum*, $r = .05$, and so on

2 *Compound Interest* — Though the law does not permit money to be lent at compound interest, yet in [illegible] leases, &c. or effecting [illegible] allowed, the subject is therefore of considerable importance

In order to show the manner in which any given sum increases at compound interest let us suppose 100*l* to be lent at the rate of 5 per cent per annum At the end of the first year this will amount to 105*l* Now this 105*l* may be regarded as a new principal lent out the second year at the same rate, its interest will therefore be 5*l* 5*s*, and consequently the amount at the end of the second year is 110*l* 5*s* This again may be regarded as a new principal, and in the same manner the amount at the end of the third year will be 115*l* 15*s* 3*d*, and so on for any longer period At simple interest the amount at the end of any given time will be greater, as the number of payments or times the interest is added to the principal is greater

As before, let
$a$ = the amount
$p$ = the principal,
$n$ = the number of years,
$r$ = the rate of interest

Therefore, since 1*l* amounts to $1 + r$ at the end of the first year and as every other sum is increased in the same proportion we have $1 \quad 1 + r \quad 1 + r \quad (1 + r)^2 =$ the amount of 1*l* at the end of the second year In like manner we have $1 \quad 1 + r \quad (1 + r)^2 \quad (1 + r)^3 =$ the amount at the end of the third year, and so on In general, the amount of 1*l* at the end

| | |
|---|---|
| of the 1st year | $= 1 + r$ |
| 2d | $= (1 + r)^2$ |
| 3d | $= (1 + r)^3$ |
| 4th | $= (1 + r)^4$ |
| $n$th | $= (1 + r)^n$ |

The amount, therefore, of any principal $p$, at the end of $n$ years is $p\,(1 + r)^n$, and from this we derive the following formulæ for finding any one of the four quantities when the three others are given —

$$a = p\,(1 + r)^n = \text{the amount},$$
$$p = a\,(1 + r)^{-n} = \text{the principal},$$
$$n = \frac{\log a - \log p}{\log (1 + r)} = \text{the number of years},$$
$$r = \left(\frac{a}{p}\right)^{\frac{1}{n}} - 1 = \text{the rate of interest.}$$

As an example suppose it were required to find in how many years a sum of money lent at compound interest, at 5 per cent per annum would double itself Here the quantity to be found is $n$, and we must apply the third formula We have in the present case $a = 2\,p$, and $1 + r = 1.05$, therefore, $n = \frac{\log 2p - \log p}{\log 1.05} = \frac{\log 2}{\log 1.05} = \frac{.3010300}{.0211893} =$ 14.2067 nearly, therefore, at the rate of 5 per cent per annum, any sum of money doubles itself in 14$\frac{1}{5}$ years

In the above formulæ the interest is supposed to be payable yearly, and $r$ denotes the simple interest of 1*l* for one year, but if the payments become due at different intervals from a year, then $r$ will not be the *annual* rate of interest [illegible] yielded by the principal but the nominal rate [illegible] the amount of the first payment For example, suppose the payments due half-yearly, and the nominal interest or simple interest for a year per cent 100*l* principal will produce 2*l* 10*s* of interest the first half year But the interest the second half year being on 102*l*. 10*s*, will be 2*l* 11*s* 3*d*, so that

while the nominal interest is 5 per cent, the interest actually made in a year on 100*l* is 5*l* 1*s* 3*d*

The advantages arising from a sum of money put out to compound interest for shorter periods than a year may be determined as follows Suppose the payments to be made half-yearly then each payment being half of the annual simple interest the amount of 1*l* at the end of the year will be expressed by $\left(1+\frac{r}{2}\right)^2$, which is equal to $1+r+\frac{r^2}{4}$ But the amount at a yearly payment is $1+r$, the advantage, therefore of the half-yearly payment is $\frac{1}{4}$th of the square of $r$ If the payments of interest be supposed to be made quarterly, then the amount of 1*l* at the end of the year will be expressed by $\left(1+\frac{r}{4}\right)^4 = 1+r+\frac{3r^2}{8}+\frac{r^3}{16}+\frac{r^4}{256}$, which exceeds the amount when the payment is yearly, by $\frac{3r^2}{8}+\frac{r^3}{16}+\frac{r^4}{256}$ or by $\frac{3r^2}{8}$ nearly, the remaining terms being very small, and of scarcely any sensible value Generally if the interest is payable $m$ times a year (each payment being the $m$th part of the annual simple interest) the amount of 1*l* at the end of the year will be expressed by

$$\left(1+\frac{r}{m}\right)^m = 1+r+\frac{m-1}{2m}r^2+\frac{(m-1)(m-2)}{2\ 3\ m^2}r^3 + \frac{(m-1)(m-2)(m-3)}{2\ 3\ 4\ m^3}r^4 + \&c$$

As $r$ is a small number, all the terms of this series multiplied by the cube and higher powers of $r$ may be omitted, and the amount becomes $1+r+\frac{m-1}{2m}r^2$, which exceeds the amount when the payment is yearly by $\frac{m-1}{2m}r^2$ If we suppose $m$ to be infinitely great, or the interest to become due and to be added to the principal *momently*, the series becomes

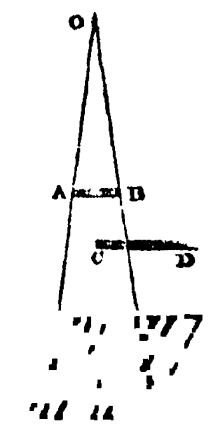
$$1+r+\frac{r^2}{1\ 2}+\frac{r^3}{1\ 2\ 3}+\frac{r^4}{1\ 2\ 3\ 4}+\&c,$$

which is equal to the number whose Napierean logarithm is $r$, or the number whose logarithm is $r \times 1.1513$ in the common tables Suppose the rate to be 5 per cent, we have $.05 \times 1.1513 = .057565$ the natural number corresponding to which is 1.05127, consequently the amount of 100*l* at 5 per cent on the hypothesis of *momently* payments for a year, is 105.127*l* = 105*l* 2*s* 6½*d* nearly, exceeding the amount at simple interest only by 2*s* 6½*d* which differs very little from $\frac{1}{40}r^2$

INTERFERENCE In Optics a term first employed by Dr Young to express certain phenomena which result from the mutual action of the rays of light on each other The phenomena in question are considered of very great importance, and have accordingly been examined with great care, on account of the proof which they are supposed to give of the truth of the undulatory theory of light

The phenomena may be thus explained — Suppose two minute pencils of light from two different luminous points to fall on a screen or piece of paper, and making a small angle with each other If the spot on which both pencils fall is at the same distance from both foci or luminous points the intensity of the illumination is greater than would have been produced by either pencil alone Now it has been found that there is a certain difference between the lengths of the paths at which the intensity of illumination produced by their concourse is the same as when the paths are equal Call this difference $d$, then it is also found by experience that similar bright bands or fringes are produced when the difference between the lengths of the paths of the two pencils is $2d$, or $3d$, or $4d$, &c But it is very remarkable that when the difference between the lengths of the two paths is $\frac{1}{2}d, \frac{3}{2}d, \frac{5}{2}d$, &c, the two pencils, instead of adding to each other's intensity, destroy one another, and produce a black spot or fringe The two pencils thus act on each other, increasing the effect in one case and diminishing it in another, and it is this mutual action which is called *interference*

In order to study the phenomena in detail, Dr Young admitted a pencil of homogeneous light into a darkened [illegible] of a thread or opake disc (the diameter of which did not exceed 1 30th of an inch) placed a little behind the opening Having remarked that the shadow received on a screen was divided by parallel bands, of which that in the middle was always white, he proved that the bands were produced by the interference of the rays passing by the two sides of the thread or disc This was demonstrated by intercepting the light which fell on one of the sides of the dist[illegible]s of a screen placed between the disc and shadow, and allowing it to pass freely by the other side, as represented in the annexed figure, in which O is the hole, A B the disc, E F its shadow, and C D the interposed screen, the border of which receives the shadow of the side B of the disc The instant the screen is brought within the shadow of A B all the fringes of the shadow immediately disappear although the light inflected by the side of the disc A continues to follow the same route as before, which necessarily supposes that it receives some modification from the proximity of that which passes by the side B




The field of inquiry which had thus been opened by the ingenuity of Dr Young was explored to a much greater extent by Arago and Fresnel Instead of the screen C D Arago introduced the edge of a thin plate of glass into the shadow of the disc, and found that the luminous fringes received various modifications, according as the plate of glass was more or less thick When the plate was of a certain thickness, the central fringe M was brought nearer to F and the first dark fringe on the same side occupied the place which had before been occupied by the second, the second took the place of the third and so on On the other side of M the appearance was the reverse, the third fringe took the place of the second, the second of the first and the first was brought into the middle of the spectrum at M On using glass a little thicker the displacement was doubled the first fringe fell upon the place of the third the second on that of the fourth and so on This experiment of Arago proves that the mutual action of the rays does not alone depend on a particular modification which the rays receive at the boundaries of a body which they graze in their course, but also on the different media which they traverse from their source to the point where they interfere

Fresnel adopted a still more ingenious method of performing the experiment Having placed two plane metallic mirrors in a vertical position and so as to make a very obtuse angle with each other he concentrated by means of a lens of small focal length a pencil of homogeneous light directed horizontally to a point so situated before the mirror that part of the diverging cone fell upon the one mirror and part of it upon the other The rays of light reflected from the two surfaces being rendered convergent by the position of the mirrors again met each other at a small angle, and at the point of intersection produced alternations of brilliant and dark fringes These fringes are parallel to the line of intersection of the two mirrors, and on screening one of the mirrors they immediately disappear

In the experiment of Dr Young and Arago it might be supposed that the fringes were produced by some physical action of the interposed body on the light, but in Fresnel's experiment the light is reflected in the usual way, and no question can be raised about the influence of the body by the borders of which it passes The fact is thus established beyond all doubt that two rays of light issuing from a common source and after pursuing a different path meeting again under a small obliquity exercise an influence on each other to the extent of doubling the intensity of the light on the one hand or destroying it altogether on the other The phenomenon of two rays of light neutralizing each other and producing their mutual extinction is one of the most remarkable in the whole range of physical science Though first explained by Dr Young and established by Arago and Fresnel it had formerly been observed and described by Grimaldi

The fact of the interference of the luminous rays having been established it was interesting to determine the constant interval $d$ or difference between the lengths of the paths of the two pencils at which the greatest effect is produced This interval has been very carefully determined both by Fresnel and by Fraunhofer and is found to be different for the different colours The following are values of $d$ found by Fraunhofer for the different colours of the spectrum, expressed in decimals of an English inch —

| | |
|---|---|
| Red - - - | $d = 0.00002582$ |
| Orange yellow - - | $= 0.00002319$ |
| Green - - - | $= 0.00002073$ |
| Blue - - - | $= 0.00001912$ |
| Indigo - - - | $= 0.00001692$ |
| Violet - - - | $= 0.00001572$ |

These values of $d$, being obtained by direct experiments, are independent of any hypothesis respecting the propagation of light they are equally real whether light be supposed to be emitted from a luminous body, or produced by the vibrations of an elastic medium, or rather they are numerical conditions which must be satisfied by any theory of light which may be adopted But the phenomena of interference are scarcely susceptible of probable explanation by the theory of emission, whereas, if

we adopt the undulatory hypothesis, their explanation is remarkably simple Indeed they afford the most decisive reasons yet known for adopting that theory in preference [illegible] undulatory system, the [illegible]

If two luminous waves reach an ethereal molecule at the same instant of [illegible] impulsions, and the [illegible] the diagonal of the parallelogram of which the two sides [illegible] will be nearly equal to their sum and if they are in opposite directions, equal to their difference Let us now suppose, 1st, that two vibratory movements produced by a series of equal and successive undulations indefinitely repeated in an elastic medium are simultaneously experienced at the same point, situated at any distance from their common centre, 2d, that after having followed different paths, their directions at this point are sensibly confounded, 3d, that in consequence of the unequal lengths of the two paths or of their unequal velocities the time which a wave takes to arrive at the point by the first path (A) is shorter than that which it takes to arrive by the second path (B) These suppositions being made it is evident that an ethereal molecule situated at a point common to the two paths A and B will begin to vibrate in consequence of the undulations propagated along A before the undulation which comes by B reaches it, and when this second undulation does take effect the motion of the ethereal particle will be increased or diminished according as the new impulse conspires with or opposes the former Three cases may occur —

1 The difference of the lengths of the paths or the difference of velocities may be such that the wave coming by the path B may reach the molecule at an interval of time after it has been affected by the wave coming by A precisely equal to that of a semi vibration In this case the vibrating molecule having reached its limit of excursion on one side and about to return to the point of repose, would at that instant receive an impulse constraining it to move in the opposite direction with the same velocity The coexistence of the two systems of vibrations would therefore destroy the motion, and the molecule would remain at rest The same thing will take place if the difference of the lengths of the paths or velocities is such that the vibrations propagated along B arrive at the intersection of the paths precisely $3\frac{1}{2}$, $7\frac{1}{2}$ &c of a period of undulation after those which come by A

2 The undulations propagated along B may arrive at the molecule after those coming by A at an interval of time exactly equal to that of a complete vibration or of several vibrations, in which case the molecules would receive the impulse of the [illegible] together and consequently the [illegible] of its excursions would be doubled instead of being destroyed

3 The interval between the two impulses may be neither an odd nor an even multiple of the time of a semi-vibration In this case, the molecule will vibrate with a velocity less than the double of that which it would have if each impulse took place independently of the other (*Herschel's Treatise on Light*, in the *Ency Metropolitana*)

It is a strong presumption in favour of the undulatory theory of light, that it affords not only a complete and satisfactory explanation of the whole of the phenomena of diffraction, but also the means of submitting them to arithmetical calculation See LIGHT

INTERIM (Lat *in the mean time*) In modern European History, the name given to a decree of the Emperor Charles V after the overthrow of the Protestant League of Smalcalde in which he attempted to reduce to harmony the contending opinions of the Protestants and Romanists The use of the cup however and the marriage of the clergy, were the only points which he conceded to the Reformers, and it became a question among them, and gave rise to many serious disputes whether they could conscientiously submit even to a temporary decree of such a nature The enactments of the *interim* were intended only to remain in force till some definitive settlement could be made, whence it derives the name by which it is generally known It received the force of law at the Diet of Augsburg in 1548 Its provisions against the Protestants were however, in most respects set aside by the treaty of Passau, 1552 (See *Mosheim*, vol iv)

INTERJE'CTION In Grammar a part of speech expressing simple emotion without involving any act of conception See GRAMMAR

INTERLO'CUTOR (Lat inter, and loquor, *I speak*) In Literary phraseology, a person who is introduced to take part in dialogue; in Dramatic literature, [illegible] *dramatis personæ* latter name, however, comprehends [illegible] but take no part [illegible] ate personages

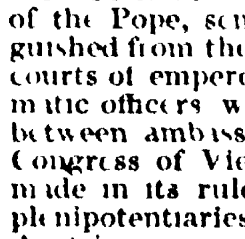
INTERLOCUTORY JUDGMENTS In Law, such as are given in the course of a cause upon any proceeding arising out of it, and do not finally determine it as, the judgment in an action of damages upon which a writ of inquiry issues to assess such damages So a decree in chancery is either final or interlocutory — In Scottish law, a judgment of the court of session, or lord in ordinary, which if allowed to become final will be conclusive is termed interlocutor

INTERLUDE (Lat inter, *between*, and ludo, *I play*) A short dramatic piece, generally accompanied with music properly, such as is represented or performed between the acts [illegible]

INTERMEDE, or INTERMEZZO In Dramatic Literature, nearly the same with interlude A short musical piece, generally of a burlesque character, but many not intended merely for introduction between the acts of a more serious performance, are comprised under these names by the French and Italians

INTERMITTENT Any disease which ceases for a time and again returns, so that the patient is free from it in the intermediate intervals See AGUE

INTERMITTING SPRINGS, are springs which after having run for a certain time stop altogether, and after a time begin to run again and then stop, and so [illegible] the flowings and intermissions generally [illegible] other at pretty regular intervals These phenomena which often excite wonder in the ignorant and have sometimes even been ascribed to the influence of witchcraft are explained on the principle of the siphon Let A be cavern in a mountain, and *a b c* a channel communicating with A, and terminating in the side of the mountain or adjacent plain and let us suppose the cavern to be fed by small streamlets of water, of which the united supply is less than can be discharged by the channel *a b c* Let the cavern be supposed empty The water from the rills or fissures by which it is fed will collect at the bottom and as it rises in the cavern will also rise in the channel *a b* till it reaches the highest level *b*, when it will begin to flow out through *b c*, and by the property of the siphon will continue to flow till the whole cavern is drained to the level of *a* The cavern then begins to fill new and the same series of phenomena is repeated at intervals of which the length depends on the relative capacity of the cavern and channel and the abundance of the supply through the fissures When the supply is constant the intervals of intermission will be equal Some springs of this kind do not cease altogether to flow, but only discharge a much smaller quantity for a certain time and then a greater quantity In this case they are called variable or reciprocating springs They may be caused by the circumstance of a smaller fissure connecting the cavern with the lower part of the channel *c*, through which a portion of water continues to flow while the main discharge is stopt or there may be several siphons all communicating with a common outlet It is easy to imagine a combination of circumstances by which the discharge of water will be greatly increased by the elastic force of air compressed at the top of the cavern A This will take place when the fissures which communicate with the external atmosphere are filled with water and there is in consequence [illegible] which the air in the cavern can escape [illegible] then be propelled through the channel with considerable force, or even raised in a jet by the very same principle as in the fountain of Hero (See *Musschenbroek* Introd t n § 2379, *Desaguliers, Exper Phil* vol ii p 173 *Nicholson's Phil Journ* xxxv p 178, *Ferguson's Lectures on Select Subjects* by Brewster)




INTERMODILLION (Lat inter, *between*, and modillion) In Architecture the space between two modillions which is equal throughout the entablature

INTERNODE (Lat inter and nodus, *a knot*) In Botany the space that intervenes upon a branch between the leaves

INTERNUNTIUS or INTERNUNCIO An envoy of the Pope, sent to small states and republics, distinguished from the nuncio who represents the Pope at the courts of emperors and kings Also a species of diplomatic officers who ranked according to the old practice, between ambassadors and plenipotentiaries Since the Congress of Vienna, as no mention of internuncios is made in its rules they are considered on a level with plenipotentiaries This is (or lately was) the title of the Austrian envoy at Constantinople

INTEROSSEOUS MUSCLES Small muscles between the metacarpal bones of the hand and the metatarsal of the foot the former are concerned in moving the fingers and the latter the toes

INTERPILASTER (Lat inter and pilaster) In Architecture, the space between two pilasters, which depends entirely on the same rules as intercolumniation, and that more especially if both are employed in the same building

INTERPLEADER In Law A [illegible] in equity, is filed by a person who is [illegible] of debt or rent to one of the parties to a suit in equity,

but cannot ascertain, until the determination of the suit, to which of the parties he is indebted, and by this bill he desires to interplead in order that he may save himself harmless in the event of the success of either party In the common law courts, by 1 & 2 W 4 c 58, relief can be given [illegible] adverse claims made on sheriffs [illegible] persons having no interest is the subject of such claims, by a judge's order [illegible]

INTERPOLATION [illegible] terms of which have some determinate relation to each other, and of which the first is called the series of roots, and the second the series of functions, to find the function corresponding to any term in the series of roots from the numbers in the series of functions which precede or follow that which is required Thus, supposing the series of roots to be the natural numbers 101, 102, 104, 105, and the series of functions to be the logarithms of those numbers, then the question may be to find the [illegible] of 103 by means of the logarithms of 101, 102, 104, & 105 In the language of algebraists the problem is to determine the value of $Y_{x+n}$ in a function of the terms which precede or follow $Y_x$

In Astronomy and Physics, interpolation signifies the method of finding a mathematical law which will connect together a number of observed facts Thus, supposing 20 places of a comet have been determined by observation, these places are said to be interpolated when a curve defined by an analytical equation has been found which passes through them all, for by means of this curve the place of the comet at any intermediate time can be found According to this view of the subject, the problem of interpolation is altogether indeterminate, for an infinity of analytic curves of different forms may be found which will pass through 20 given points but in general the circumstances of the question impose such restrictions as render it determinate In the instance now given we know that the curve must be an ellipse, and as an ellipse cannot be made to pass through 20 points taken any how, the question resolves itself into this —To find the ellipse which will *most nearly* pass through the given points, or represent the given observations Another question now arises —what conditions must be fulfilled in order that the observations may be represented *most nearly?* These conditions must be determined from other considerations Suppose the condition to be that the sum of the squares of the errors of observation (that is, of the differences between the observed places of the comet and the corresponding places in the orbit to be found) shall be a minimum, the problem is now quite determinate, though its solution may be sufficiently difficult and laborious

The method of interpolation by differences was first employed by Briggs in the calculation of logarithms, but was afterwards [illegible] way by Wallis, Newton, Cotes, [illegible] the fifth lemma of the third book of the *Principia*, Newton has given a solution of the problem of determining the curve which passes through the extremities of any number of ordinates By modern writers the subject is treated as a branch of the calculus of finite differences It is discussed at length by Laplace in the 2d vol of the *Mécanique Céleste*, and also in the *Theorie Analytique des Probabilités;* by Lagrange, in the *Journal de l'Ecole Polytechnique*, &c See also the Treatise on Differences and Series by Sir John Herschel in the Appendix to the English translation of Lacroix's *Differential and Integral Calculus*, or the 3d vol of Lacroix's large Treatise

INTERREGNUM (Lat ) The period between the death of one king and the accession of another under the Roman monarchy, or under the republic, the space of time when there were by some accident [illegible] trates who could hold the [illegible] (comitia), during which an interrex was appointed *See* INTERREX

INTERREX A person appointed to discharge the royal functions during a vacancy of the throne The Romans first elected an interrex after the death of Romulus, and the custom was continued while the monarchy lasted The manner of their election was this, — the [illegible] whom discharged the functions of royalty [illegible] in an order appointed by lot It has been supposed that these ten senators were not elected, but they were the [illegible] volved on them by virtue of their rank An interrex was also appointed sometimes under the republic to preside over elections of magistrates, &c when the consuls were absent, or their election declared void and no dictator had been created

INTERSCE'NDENT (Lat inter, and scando, *I climb*) In Algebra, a term applied by Leibnitz to quantities when the exponents of their powers are irrational Such expressions are called *interscendent*, as holding a mean as it were between algebraic and transcendental

[illegible] (Lat inter, and seco, *I cut*) In Geometry, the [illegible] of lines or surfaces The intersection of a line, or of a line and a surface, is a point, and the intersection of two surfaces is a line

I'NTERTIE (Lat inter, and tie) In Architecture, an horizontal piece of timber framed between two posts [illegible] together

I'NTERVAL (Lat intervallum) In Music, the [illegible] between sounds as respects their [illegible] by the ancients a *diastem* Intervals are divided into *simple* and *compound*, the former being without parts or divisions, the latter consisting of several smaller intervals

INTERVE'NTION (Lat inter, and venio, *I come*) In Politics the interposition of one state in the domestic affairs of another The right of armed interveniton is one of the most contested portions of the public law of nations, as, although practised frequently enough by the more powerful with reference to the weak, it had never been regarded otherwise than as a permitted abuse of power until the time of the congresses of Vienna, Laybach, &c, when it was publicly recognized by the leading [illegible] Europe

INTESTACY (Lat in the sense of *without* and testor, *I testify*) In Law, the condition of a party who dies without having made a will Freehold lands and tenements in which he has an estate of inheritance descend to his heir, subject to such charges as affect real estate, copyhold lands of inheritance to the heir, by the custom of the manor, chattels must be distributed (subject [illegible] who takes out letters of administration to the estate and effects according to the provisions of the Statute of Distributions

INTESTINALIA *Intestinal Worms* (Lat intestina *an intestine*) The name by which Linnæus and Cuvier have designated the class of animals which infest the interior of other animal bodies and which indicates their most common locality, viz the intestinal tube

The knowledge of the intestinal worms, as a distinct class of invertebrate animals, is of a very late date In the twelfth edition of the *Systema Naturæ*, 1787-8, only eleven species of true Entozoa are enumerated, and of these only six are placed among the *Intestina — Gordius medinensis, Ascaris vermicularis Ascaris lumbricoides, Fasciola hepatica, Fas intestinalis* and *Fas barbata*, the remaining species viz *Hydra hydatula, Tænia solium Tan vulgaris Tan lata*, and *Tæn canina*, are ranged with the *Zoophyta Bloch's Treatise on the Generation of Intestinal Worms* and the succeeding work of Goeze entitled *Versuch einer Naturgeschichte der Eingeweidewürmer Thierischer Körper* 1782, added largely to the number of the described species, and led to the foundation of some accurately defined genera and better ideas of classification Gmelin availed himself of the labours of these authors and combining with them the species described by Redi Pallas, O F Muller, and Werner, was enabled to give two hundred and ninety-nine species of *Intestinalia* in the thirteenth edition of *Linne's Systema Naturæ*, but of this labour it has been justly remarked "Gmelinus, auctorum plurimorum observationes congessit, sed tam judicio et experientia quam sollertia destitutus, plurima miscuit et implicuit, ut in synonimis ab eodem perperam allegatis, extricandis, C A Rudolphi et Zederus multum desudaverint"

The first clear definition of the intestinal worms as a class and their distribution into a system of orders and genera are contained in the great work by Rudolphi, entitled *Entozoorum sive Vermium Intestinalium Historia Naturalis*, 8vo 1808-10 In this work, Rudolphi, after dividing the great class *Vermes*, of Linnæus, into four classes, viz *Mollusca, Gymnodela, Entozoa*, and *Phytozoa*, characterizes the third class as follows — "Entozoa ergo classem, aut si mavis ordinem sistunt peculiarem continentem *alius in animalibus obvia, oculis nudis conspicua, nervis carentia, partibus internis dissimilibus instructa*" Of the class of animals thus characterized, Rudolphi enumerates, in a subsequent work, *Synopsis Entozoorum*, 1819, upwards of eleven hundred species At the present time, nearly double that number of Entozoa are known

Rudolphi distributes the intestinal worms into five orders, which are characterized as follows, —

Order I *Nematoidea* (Round-worms) — Char Body elongated, rounded, elastic, an intestinal canal, with a separate mouth and vent, sexes distinct

Order II *Acanthocephala* (Hooked-worms) — Char Body roundish, utricular, elastic, head with a retractile proboscis, armed with hooks or recurved spines, sexes distinct

Order III *Trematoda* (Fluke-worms) — Char Body soft, rounded, or flattened, suctorial pores; male and female organs in the same individual

Order IV *Cestoidea* (Tape-worms) —Char : Body elongated, flatte [illegible] head either [illegible] (*bothria*), or [illegible] number, me [illegible] vidual

Order V *Cystica* (Hydatids) — Char Body flattened or rounded, continued posteriorly into a cyst, which is sometimes common to many individuals, head provided with two or four pits, or with four suckers, and with a circle of hooklets, or with four unarmed or uncinated tentacles, sexual organs hitherto indiscernible

The Entozoa which are included in the last four orders of Rudolphi have no distinct intestinal canal, and Cuvier considered the presence of this structure in the *Nematoidea* of Rudolphi of sufficient importance to form the character of a primary group, equivalent to all the remaining orders combined, and he observes that the orders thus d [illegible] naturally form two classes

The first order Cuvier terms *Cavitaires*, and he includes in it not only the Nematoid Entozoa, but also the genus *Pentastoma* of Rudolphi, and the Epizoa, or *Vers rigidules*, of Lamarck

The organization of the *Pentastomata*, which were defined, prior to Rudolphi, by Froelich, under the name of *Linguatula*, unquestionably entitles them to rank with the highest organized Entozoa (see *Zoological Trans*, vol i p 381 pl 41), but with respect to the Epizoa, or the external Lernæan parasites of fishes although they agree with the *Nematoidea* and all other Entozoa in the absence of distinct respiratory organs, yet the ciliated natatory extremities which they possess in the young state, and the external ovarian appendages of the adult are characters which raise them above the Entozoa, and indicate their intimate relations with the Siphonostomous Crustaceans

I have, therefore, combined the *Nematoidea* of Rudolphi with the genera *Linguatula*, *Porocephalus* and *Syngamus*, &c, which, under the habit of Cestoid or Trematode worms, mask a higher gr [illegible] to form a class under the name of [illegible] class already embraces the types of three different orders, of which one is formed by the *Nematoidea* of Rudolphi, and a second has been established by Diesing for the *Lin* [illegible] the name [illegible] of the genus *Syngamus* as described by Siebold clearly indicates the type of a third order of *Calelmintha* (See that word)

The four orders of intestinal worms which have no distinct intestine but in which the digestive function is carried on in blind canals, excavated in the parenchymatous substance of the body Cuvier combines into a group, which he terms *Vers intestinaux parenchymateux*, and for which I have proposed the name of *Sterelmintha* (See that word)

This group Cuvier subdivides into three families or orders, the first corresponding to the *Acanthocephala* of Rudolphi, the second to the *Trematoda* and the third being equivalent to the *Cestoidea* and *Cystica* combined with the exception of the genus *Ligula* of Bloch of which Cuvier makes a fourth order restricting to it the application of Rudolphi's term *Cestoidea* To this distinction it must be objected that the passage from the *Læniæ* to the *Ligulæ* is rendered very gradual by the traces of bothria and of generative organs which make their appearance in the higher-organized *Ligulæ* which infest the intestines of certain aquatic birds, and respecting which Rudolphi hazards the following ingenious hypothesis, viz, that these species are actually the more [illegible] developed into a higher grade of [illegible] the warmth and abundant nutriment which they enjoy in the intestines of the birds that have swallowed the fishes so infested To the conjunction of the hydatids with the tapeworms no sound objection can be made the structure of the *Tetrarhynchi* and *Anthocephali*, on the contrary shows how unnatural [illegible] Cestoidea the Cystic Entozoa [illegible] *ides* may be regarded as the point of transition, or of conjunction between the two groups The head in *Cœnurus* and *Echinococcus* presents the form and structure of that of *Tænia*, and the head of the *Tetrarhynchus*, the proboscis excepted, precisely resembles that of the *Echinococcus*, although the *Tetrarhynchi* neither inhabit a vesicle, nor terminate in a vesicle The *Cystica* appear, in fact, to be incomplete *Cestoidea* both consist at first of a simple cyst, like the *Acephalocyst*, but both proceed to develope therefrom a suctorious and uncinated head, from which the *Cestoidea* proceed to develope [illegible] annually shed and reproduced [illegible] worms, as at present known, form two classes, each divisible into three orders

Class I Cœlelmintha

Order 1 [illegible] *Filaria medinensis*, *Filaria oculi*, [illegible] *Ascaris lumbricoides*, *Ascaris vermicularis* *Trichocephalus dispar*, *Spiroptera hominis* *Strongylus gigas*, *Strongylus armatus*, *Trichina spiralis*

Order 2 *Acanthotheca* — Ex *Linguatula tænioides*

Order 3 *Syngamoidea* — Ex *Syngamus trachealis*.

Class II Sterelmintha

Order 1 *Acanthocephali* [illegible]

Order 2 *Trematoda* — Ex *Distoma* [illegible] *stoma pingue*, *Distoma hepaticum*

Order 3 *Tænioidea* — Ex [illegible] *solium*, *Cysticercus* [illegible]

The examples quoted are species which infest man, with the exception of those belonging to the orders *Acanthotheca*, *Syngamoidea*, and *Acanthocephala*, which have no representatives among the human internal parasites For the parts of the body which these latter infest, the

to Entozoa

[illegible] The convoluted membranous and muscular tube extending from the pylorus to the anus It is distinguished into small and large intestines the former including the *duodenum*, the *jejunum*, and the *ileum*, the latter the *cæcum colon*, and *rectum* The small intestines have internal membranous folds, called *valvulæ conniventes*, the large have three parallel muscular bands upon their surface The intestines admit of separation into three coats the external, membranous or peritonæal, the middle coat muscular, and the inner one villous They are attached to the body by the mesentery The structure of the intestinal canal in different animals is wonderfully adapted to its required functions, dependent upon the nature of their food and other circumstances Of these peculiarities the principal are diverted to under the titles of the animals in which they occur

INTONA'TION (Lat in, and tonus, *a tone*) In Music the act of sounding with the voice the consecutive notes of the scale, or in any other given intervals To do this correctly is the first qualification of a good singer It is scarcely practicable without the assistance of a good ear as well as a reference to some common standard such as the key or mode wherein a piece is written From the word *tone*, sometimes used in a sense almost identical with that of [illegible] The musical definition of the [illegible] of *Johnson's Dictionary* is "the accent of a syllable, or the [illegible] of an arch The exterior or upper curve is called the *extrados* See Arch

INTRE'NCHMENT In Fortification, any work that fortifies a post against the attack of an enemy It most usually denotes a ditch or trench with a rampart

I'NTROIT (Lat introitus, *entry*) In Ecclesiastical Antiquities the verses chaunted or repeated at the first entering of the congregation into the church, a custom as old as the fourth century called "ingressa" in the Ambrosian Ritual (*Palmer, Origines Liturgicæ*, ii 19)

INTRO'RSUS (Lat introrsum *inwards*) Turned inwards A term used in describing the direction of bodies to denote their being turned towards the axis to which they appertain, thus, in most plants the anthers are [illegible] towards the style

INTRU'SION (Lat intrudo, *I thrust upon*) In Law a species of injury to freehold property It arises when a stranger intrudes between the death of tenant for life or years and the entry of the heir of a remainderman or reversioner expectant on the estate for life or years who had died previous to the decease of such tenant for life or years Writ of intrusion lies only for a party who has the remainder or reversion in fee remainderman in tail has remedy by formedon *See* Fee-Tail, Formedon

INTUI'TION (Lat intueor, *I look into*) In Philosophy, any act of the mind by which a truth is *immediately* perceived, and as it were *beheld*, without any previous process of analysis or ratiocination Such, according to Kant, are the fundamental propositions of geometry, as, that "two straight lines cannot inclose a space," &c

INTUSSUSCE'PTION (Lat intus within and susceptio) In Anatomy a term [illegible] the folding or passing of one portion of intes [illegible] another

I'NULIN A white powder deposited by a decoction of the roots of the *Inula helenium* or elecampane In its chemical properties it appears intermediate between gum and starch

INU'NDATION (Lat in, and unde, *a wave*) In Agriculture, lands which are overflowed by water from natural causes uncontrolled by art, are said to be inundated when in consequence of the exercise of art and skill, the result is termed irrigation

INVALI'DS (Lat invalidus, *weak*) Those soldiers or sailors who, either on account of wounds or length of service, are admitted into hospitals, and there maintained at the public expense The practice of making provision for soldiers worn out or disabled in the public service dates

from high antiquity The liberality of Pisistratus to the Athenian soldiers is known to every scholar, and the history of ancient Rome is replete with instances of the veterans of the legions being rewarded with grants of land It must be admitted, however, that in ancient times such recompences had not their origin in that high philanthropic feeling by which the moderns are actuated in making provision for military and naval invalids, for they were granted only after victory and emanated more from individual power or favour than from any better established principles of benevolence In modern times there is no civilised country without institutions for the maintenance of invalids, but the most magnificent are, without question the Greenwich and Chelsea hospitals in England, and France the Hotel des Invalides

INVENTION (Lat invenire, *I find*) In the Fine Arts, the choice and production of such objects as are proper to enter into the composition of a work of art "Strictly speaking" says Sir Joshua Reynolds "invention is little more than a new combination of those images which have been previously gathered and deposited in the memory nothing can come of nothing he who has laid up no materials can produce no combinations" Though there be nothing new under the sun, yet novelty in art will be attainable till all the combinations of the same things are exhausted —a circumstance however never come to pass

INVENTION OF THE CROSS A festival celebrated May 3d, in the Roman Catholic church in honour of the finding of the cross on which our Saviour was executed The search was instituted by order of St Helena, mother of the Emperor Constantine A D 326, and the discovery by St Cyril, was found among the ruins M

INVENTORY (Lat invenio *I find*) A catalogue of movables *See* EXECUTOR

INVERSE METHOD OF FLUXIONS The method of finding the *fluents* of given fluxional expressions It is the same with the integral calculus

INVERSE METHOD OF TANGENTS The method of finding tangents are lines drawn law or which fulfil some given condition For example, suppose rays of light issuing from a luminous point to fall on the concave surface of a sphere and to be thence reflected the problem may be proposed to determine the nature of the curve to which all the reflected rays in any given plane are tangents Problems of this kind require the application of the integral calculus and hence the method by which they are solved is called the *inverse* method of tangents as opposed to the *direct* method, viz that of finding the tangent to a curve which is performed by the differential calculus

INVERSE PROPORTION, in Algebra and Arithmetic is the application of the rule of three or proportion in a reverse or contrary order This is usually described by saying that less requires more or more requires less Thus, the question 'if 20 men cut down 3 acres of corn in a given time how many men will be required to cut down 6 acres in the same time?' belongs to the direct rule the quantity of work done being directly proportional to the number of men employed, but the question "if 20 men do a piece of work in 6 days in what time will 40 men perform the same?" is one of inverse proportion for more men will do the work in less time or the number of men required is inversely as the time The question may be stated in this manner, $\frac{1}{20}$ $\frac{1}{40}$ 6, and the answer is 3

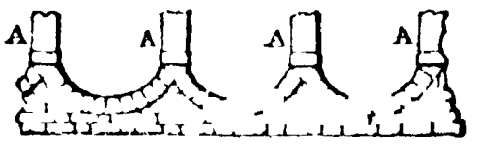
INVERSE RATIO The ratio of the reciprocals of two numbers *See* INVERSE PROPORTION

INVERSION (Lat) In Rhetoric and Philology the transposition of words out of their natural order Every language has a customary arrangement of its own to regulate the order of succession in which words forming part of the same sentence member, or proposition follow each other On the other hand, there is undoubtedly a natural or philosophical order of words following each other in the same analytical succession in which ideas present themselves to the mind varied occasionally by that produced by the succession of sentiments or emotions, and as in every language many customary phrases, if not the general arrangement of the words, are contrary to this primitive order every language has customary inversions of its own Deviations from the *customary* order of words are more commonly called transpositions, but each word has, of course, a relative and somewhat arbitrary signification As an instance of ordinary inversion, it may be observed that, according to the metaphysical or analytical order, the subject of a proposition precedes the predicate, being the first idea which presents itself to the mind Thus in the construction of a sentence expressing a proposition (*see* LOGIC) 'Alexander reigns,' we have the subject of nature But when a substantive and adjective in connection form part of a sentence, i e a subject or predicate, or a part of either, the substantive is that which seems naturally to present itself first to the mind, whereas in most modern languages it follows the adjective, while in the Greek and Latin its ordinary although not its necessary place was before it "Who is a wise man?"—"Vir bonus est quis?" "The end of a long silence"—"Finis silentii diuturni" It is in general to be observed, that modern languages admit far less readily than ancient of transposition, but there are considerable differences in this respect between modern languages themselves German admits much latitude, French very little In our own language we are frequently able to vary the analytical order by following what may be termed the order of emotion, where a French writer could not do so thus in the proposition 'Great is Diana of the Ephesians,' it would be impossible in French to give the force which is added to the expression by the transposition of the predicate to the beginning without violating the habitual rules of construction A similar instance of inversion is to be found in the Swedish and some kindred languages, in which the article follows instead of preceding the noun

INVERSION In Music, the change of place between two notes of an interval, that is placing the lower note an octave the higher note an octave lower

INVERTEBRATA *Invertebrata* (Lat in priv, vertebra *a joint of the back bone*) The animals which are devoid of vertebræ or an internal bony skeleton, and which include the Molluscous Articulate Nematoneurous and Acrite sub kingdoms Lamarck's primary division of the animal kingdom into *Vertebrata* and *Invertebrata* corresponds with that proposed by Aristotle into *Enaima* and *Anaima* It is however subject to the same objection as applies to most of the Dichotomous systems in Zoology viz that the two members of the division are not equivalent to each other The *Invertebrata* for example contain three if not four primary divisions of the animal kingdom, each of which are equivalent to the *Vertebrata*

INVERTED ARCH In Architecture one wherein the lowest stone or brick is the key stone It is used in foundations to distribute the weight of particular points, such as A A A, over the whole extent of the foundation, and hence its employment is frequently of the first importance in constructive architecture




INVESTITURE In Feudal Law the delivery of a fief by a lord to his vassal accompanied by peculiar ceremonies (See FEUDAL SYSTEM) The investiture of a bishop was properly speaking his endowment with the fiefs and temporalties of the see Hence it became a subject of contest between the popes and emperors and one of the principal grounds of the great quarrel of Guelfs and Ghibellines It was conceded by the emperors to the Roman see in 1122, but the question was ended by a substantial compromise which left the nomination in reality in the hands of the temporal prince in European monarchies under the Roman Catholic religion (See *Hallam's Middle Ages*, *Raumer's History of the Hohenstauffen*, *Gieseler's Text Book of Ecclesiastical History*, vol ii *Mosheim's Eccl History*)

INVOCATION (Lat invoco *I call upon*), in Literature signifies in a general sense an address at the commencement of a poem preferred to the Muses or some other Being supposed capable of giving inspiration Thus while the ancient poets generally addressed their invocations to some particular muse or deity Milton invokes the Heavenly Muse 'and the Holy Spirit,' and in his *Henriade* Voltaire calls to his aid 'auguste Verité' For the chief rules of poetical invocation see the *Dict de Richelet* and the *Dict de la Conversation*

INVOCATION OF SAINTS In Theology According to Protestant writers the veneration of saints and martyrs increased rapidly throughout the 4th century, but their *invocation* as intercessors with the Divinity did not generally commence much before the 5th (See *Mosheim*, ii 32 102 ed 1826, transl, *Gieseler* i 283 transl) The followers of Origen are said to have been the first "who apostrophised the martyrs in their sermons, and besought their intercession" Prayers *for* the saints among other departed spirits were discontinued about the 5th century on the principle laid down by Saint Augustine, "Injuria est pro martyre orare, cujus nos debemus orationibus commendari" *See* MARTYRS, SAINTS

INVOICE A list or account of goods or merchandise sent by merchants to their correspondents at home or abroad, in which the peculiar marks of each package, with their value, customs, provision, charges, and other particulars are set forth (See *Com Dict*)

INVOLUCE'LLUM (Lat) In Botany, a secondary involucrum surrounding one of the florets of a umbelliferous flower, or the florets of a capitulum

INVOLU'CRUM (Lat) In Botany, a term having three significations —

1 A ring of bracts surrounding one or many flowers
2 In describing ferns to denote the superincumbent
3 I , to denote the cases of

INVOLUTE, in Geometry, is a curve co extremity of a string unwinding itself from the arc of another curve about which it has been lapped All curves, in which the curvature is neither infinitely great nor infinitely small, may be generated in this way by the evolution of a thread from another curve, which is called the *evolute* of the new curve *See* EVOLUTE

The method of generating curves by evolution is a geometrical theory inverted by Huygens, and given in his *Horologium Oscillatorium*, where he shows that the involute of a cycloid is another cycloid equal to the original one, and he applies this property to the practical purpose of causing a pendulum to vibrate in the arc of a cycloid, in which case, by another remarkable property of that curve, the vibrations are performed in equal times whether the arc of vibration be great or small

INVOLUTION, in Arithmetic and Algebra, is the method of finding any power of an assigned quantity, and is the reverse of *evolution*, which denotes the method of finding the root of any quantity, which is considered as a power of that root

The successive powers of any quantity are found by the continual multiplication of the quantity itself Thus, taking the number 5, we have

$5 = 5^1$ the first power or root
$5 \times 5 = 5^2$ or 25, the second power or square,
$5 \times 5 \times 5 = 5^3$ or 125, the third power or cube

and so on, whence we see that the number of multiplications required to raise a number to any power is one less than the number of the index by which the power is expressed

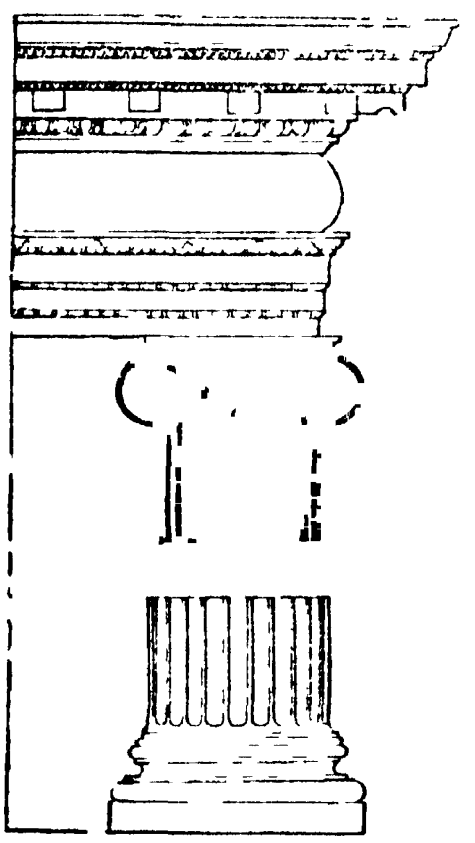
In algebra, simple quantities are involved by multiplying the exponents of the symbols by the index of the power required and raising the coefficients to the same power Thus the cube or third power of $2a^2x$ is $8a^6x^3$ Compound quantities are involved in the same manner as numbers by a continual multiplication of the quantity itself or more generally and expeditiously by means of the binomial theorem

IODINE (Gr ἰώδης, *violet coloured*) A substance discovered in 1812 by M Courtois of Paris In this country it is usually prepared from kelp which is lixiviated with water, and when the crystallizable salts have been separated the mother liquors are mixed with sulphuric acid and black oxide of manganese On the application of heat the iodine rises in the form of a dense violet coloured vapour which by condensation forms steel-grey crystals looking like micaceous iron The specific gravity of iodine is between 4 and 5 when dry it fuses at 227°, and boils and evaporates in purple fumes at 345° When heated with water it distils over at temperatures below 212° The specific gravity of its vapour is about 8 7, so that 100 cubic inches would weigh nearly 270 grams Iodine belongs to the electro-negative supporters of combustion It has an acrid taste, and a peculiar odour somewhat like that of chlorine It is an irritant poison, but in small doses and cautiously administered it has occasionally been of great service in certain forms of glandular disease It is very sparingly soluble in water of which it requires 7000 parts for its solution, the colour of the solution is brown it dissolves copiously in alcohol and in ether, and forms dark brown liquids It possesses strong powers of combination, forming with the metals a class of compounds called *iodides*, with oxygen it forms the *iodic acid*, and perhaps one or more oxides Combined with hydrogen it forms the *hydriodic acid* Its equivalent number is 126, and that of the hydriodic acid 127 Starch is a characteristic test of the presence of free iodine, forming with it a compound of a deep blue colour It is so delicate that a solution of starch dropped into water containing less than a 400,000th part of iodine is tinged blue by it, but the solutions must be cold, for the blue compound is soluble in hot water The great consumption of iodine is in medicine, it is employed in its pure state, and in the form of *iodide of potassium*, which is obtained by dissolving iodine in a solution of pure potash, evaporating to dryness, and fusing the residue

of potash
of a violet
it occurs crystallized, and in

IONIC DIALECT the most euphonious of the the Greek language, was spoken by the inhabitants of the Ionian Islands, and in their colonial possessions in Asia Minor It was originally the same as the Attic dialect, at least they boasted of a common origin, but from the extensive commercial intercourse of the Ionians with the eastern nations, their language gradually imbibed a portion of Asiatic effeminacy which at length became its chief characteristic, forming a striking contrast to that combination of strength and harmony which distinguished the dialect of Attica The chief writers in the Ionic dialect are Herodotus, Hippocrates, and Galen but it is in the writings of the first that to be found

IONIC ORDER of the five orders of architecture, whose distinguishing feature is the volute of its capital In the Grecian Ionic the volutes appear the same in the front and rear be connected on the flanks by a introduced The Romans gave their volutes, and curved the sides of the abacus The Greek volute continues the fillet of the spiral along the face of the abacus, whereas in the Roman its origin is behind the ovolo In some Grecian specimens a neck is added below the echinus, sculptured with flowers and leaves The height of the column is about nine diameters and the base varies considerably in different examples When a pedestal is used it is somewhat higher and more ornamented than the Doric pedestal The Greeks usually made the entablature of this order very simple The architrave has two fasciæ, the frieze plain, and the cornice of few subdivisions, but the modern Ionic is seldom with less than three fasciæ, the frieze is often cushioned, and the cornice is deeper and not unfrequently modillioned its profile being much varied The dentil is also much used in the bed mouldings The shaft is cut with twenty-four flutes separated by fillets Some of the most



celebrated examples of the order are the temple on the Ilyssus of Minerva Polias at Athens and Priene, Bacchus at Teos Apollo Didymæus at Miletus, Fortuna Virilis and the Coliseum at Rome The profile above given is after Palladio

IONIC PHILOSOPHERS The earliest among the Greek schools of philosophy Speculation arose in Greece as elsewhere in the attempt to discover the laws of outward phenomena, and the origin and successive stages of the world's development Such an attempt, it is needless to say, must at first have been extremely rude To the student of philosophical literature, however, no such undertaking however unsuccessful can possibly be otherwise than interesting, and in this instance in particular we are able to discover manifest traces of that liveliness of thought and systematic spirit which distinguish the later Greek speculations The fathers of the Ionic school were Thales and his disciple Anaximenes They were succeeded in the same line of thought by Diogenes of Apollonia and Heraclitus of Ephesus The characteristical mark which distinguishes the speculations of these thinkers is the endeavour to refer all sensible things to one original principle in nature The two first named were satisfied with a very simple solution of the problem Water with the one, and air with the other were made the original materials out of which all things arose, and into which they were finally resolved In their successors the germs of a more philosophical doctrine are apparent They retain, indeed, the simplicity of an original element, but the *air* of Diogenes and the *fire* of Heraclitus are apparently only sensible symbols which they used only in order to present more vividly to the imagination the energy of the one vital principle which is the ground of all outward appearances It philosophers as on between objective and subjective, between a *law* operating in the universe and the corresponding apprehension of that law by reason, however obvious it may seem at the present day, seems to have required the deep meditation of numerous powerful thinkers to bring it into clear consciousness

That the two things were confounded by Heraclitus is evident from his attributing to this universal fire the attributes of a universal reason — the source at once of the order in the world, and of the insight into that order possessed by man Notwithstanding this confusion, the discovery is due to him of the important truth, that "reason is common to all men"—that the ultimate principles of science derive their validity from their univer-

sality, a truth the value of which is not diminished by our finding it combined with the physical hypothesis to which we have alluded

T[illegible] the result of the spontaneous [illegible] ble or power, and all sensible things as modifications of this principle, real only in reference to their ultimate ground But we meet also with a class of thinkers in whom the contrary tendency prevailed Anaximander (B C 590) and Anaxagoras, the master of Pericles, agree in this respect, that they consider the world to be made up of numberless small particles, of different kinds and of various shapes, by the change in whose relative position all phenomena are to be accounted for This hypothesis is combined by Anaxagoras with a Supreme Reason, the author of all that is regular and harmonious in the disposition of these elementary atoms Anaxagoras may indeed be considered as the first philosopher who clearly and broadly stated the leading distinctions between mind and matter For a statement at once luminous and accurate of the leading peculiarities of this philosopher's doctrines and those of his predecessors, the reader is referred to Bishop Thirlwall's admirable *History of Greece* vol ii chap 12 The student who wishes for more minute information may consult Brandis and Ritter's Histories of Philosophy of the latter of which a translation has appeared at Oxford (See especially book iii) See also a collection of the Fragments of Heraclitus in *Wolf and Buttmann's Museum of Antiquities*, Bd I stck 3, and the *Memoires de l'Acad des Inscript* vol xvii

IPECACUANHA The root of the *Cephaelis ipecacuanha* This important article of the *Materia Medica* is the produce of South America, it is in short wrinkled pieces, covered with a grey or brownish grey epidermis and having a central woody fibre surrounded by a pale grey cortical part in which its virtue resides It has a nauseous odour and a repulsive bitterish taste It is difficultly reducible to powder and the dust which it throws off whilst under the process of pulverization is apt to excite great irritation of the respiratory organs From fifteen to twenty grains of powdered ipecacuanha root taken in an ounce of water is one of the safest and surest *emetics*, in doses of from one to three or four grains it is a *nauseant*, and in smaller doses, repeated every four or six hours, as from a fourth of a grain to a grain, it is expectorant and diaphoretic It contains from twelve to sixteen *per cent* of *emetin* to which its medical activity is referable When long boiled with water its emetic power is diminished but the decoction is aperient There are several varieties of ipecacuanha some of which arise from modifications of soil and climate [illegible] to be the roots of distinct plants

IRIDACEÆ (Iris, one of the genera) A natural order of herbaceous Endogens inhabiting the Cape and some other places It differs from *Amaryllidaceæ* essentially in being triandrous with the anthers turned outwards, from *Orchidaceæ* in not being [illegible] from *Zingiberaceæ* [illegible] remarkable for their beautiful flowers than for their utility The substance called saffron is the dried stigmata of the *Crocus sativus* The various species of *Iris*, *Ixia*, *Gladiolus* *Ixgridia* *Crocus*, &c, are among the favourite flowers of the gardener

IRIDIUM (Lat iris, *the rainbow* in consequence of the variety of colours exhibited by its solutions) A metal discovered by Dr Wollaston, associated with the ore of platinum It is grey, brittle very infusible and its specific gravity is about 18 6 It forms several oxides and chlorides, and combines readily with carbon

IRIS (Gr Ἶρις) In Grecian Mythology the personification of the rainbow She also performed the duties of a messenger to Jupiter and Juno

IRIS A name for the rainbow *See* RAINBOW

IRIS In Anatomy, the anterior part of the *choroid* coat of the eye, with its central perforation called the *pupil*, the posterior part or back of the iris is called the *uvea* The term iris is applied to that part of the eye on account of its various colours *See* EYE

IRITIS Inflammation of the iris of the eye

IRON A metal known from remotest antiquity of a peculiar grey colour, and possessing when polished much lustre It is not very malleable, but extremely ductile, and very tenacious At common temperatures it is hard and unyielding, but at a red heat it is soft and pliable and at a high red heat it may be united to another piece equally heated by hammering them together this process is called *welding* The specific gravity of pure iron is about 7 7 Its texture is fibrous, it is very difficult of fusion, requiring for that purpose the highest temperature of a wind furnace It is attracted by the magnet, and is itself susceptible of being rendered magnetic, a property possessed by no other metal except nickel Another remarkable circumstance in the history of iron is, that it has only hitherto been found *native* (that is, in its pure metallic state), in stones and [illegible]ly of *meteoric origin*, for the accounts [illegible] of native iron are doubtful In combination with oxygen and with sulphur, and occasionally with other substances, it is very abundant in the mineral world, and is found in small quantities in many animal and vegetable substances Those minerals which contain iron so combined as to be employed as sources of the metal for the purposes of the arts and manufactures are more exclusively termed the *ores of iron*, and among them the different *oxides of iron*, and the *carbonate* either pure or in combination with various [illegible] the *clay ironstone* of our coal d[illegible] most important The red oxide, and the black oxide (ferrosoferric oxide of Berzelius), are also valuable ores The finest Swedish iron is chiefly procured from the purer oxides, and especially from the native black oxide or *magnetic iron ore* and is reduced by charcoal, in this country clay ironstone is chiefly resorted to, and it is reduced by coke

There are two kinds of iron, known in commerce under the names [illegible] There are also two principal [illegible] distinguished by the terms *white* and *grey* The first is very hard and brittle, and when broken of a radiated texture grey iron is softer and less brittle and may be bored and turned in the lathe The varieties of cast iron are also very different in their chemical composition, some much purer than others they often contain traces of sulphur, phosphorus silicium, calcium manganese, and always more or less oxide of iron and carbon The purer kinds of cast iron which are chiefly carburets of iron may be converted into malleable iron by heating them surrounded by pure oxide of iron by which the carbon is gradually extracted in the form of carbonic oxide it is thus that horse shoes, and other articles such even as knives scissors snuffers, &c are fashioned by casting and afterwards purified by the curious process just noticed The cast iron manufactured in this country is converted into bar or malleable iron chiefly by a process called *puddling*, which consists in subjecting it to the continued action of heat in a reverberatory furnace where as soon as it melts it is stirred about till it gradually becomes less and less fusible and at length grows tough and pulverulent During this part of the process the mass heaves and emits a blue flame in consequence of the burning off of some of its impurities, the fire is then so far increased as to agglutinate the metal into a mass which intensely heated is transferred to a powerful rolling mill, as it passes successively through the rollers a large quantity of impurities, chiefly its earthy ingredients in combination with oxide of iron are squeezed out in the form of a fluid slag and the iron is extended into malleable bars, these are cut into pieces, placed in parcels or faggots in a very hot furnace and again hammered or rolled into bars, they thus become more tough flexible and malleable but much less fusible and may now be considered as nearly pure iron

When iron is heated red hot with the free access of air, it undergoes a slow combustion, that is it combines with the oxygen of the air and is converted into a black fusible substance, as is seen when a bar of white-hot iron is beaten upon the smith's anvil the scales which fly off in brilliant combustion producing the *black oxide of iron* When a thin piece of iron is introduced red hot into oxygen [illegible] becoming rapidly oxidized When this black oxide or when metallic iron is exposed to air and moisture or heated for a long time in contact of air, it becomes converted into a *brown oxide*, familiarly known as *rust of iron* When iron is acted upon by dilute sulphuric acid it decomposes the water of the acid and becomes converted into a *protoxide of iron*, which is taken up by the acid, and yields a green solution, from which, on evaporation, green crystals may be obtained of *protosulphate of iron*, commonly known as *green vitriol*

It appears from the analyses of these compounds that the number 28 may be assumed as the equivalent of iron, and that the protoxide (existing in green vitriol and in the protosalts of iron generally) is constituted of 1 atom of iron = 28 and 1 of oxygen = 8, and is consequently represented by the equivalent number 28 + 8 = 36, that the brown or red oxide, or peroxide of iron, consists of 28 iron and 12 oxygen, and is represented by the equivalent 40, and that many of the native oxides, and, generally speaking, the scales of iron are a definite combination of the above protoxide and peroxide containing 2 atoms of protoxide and 1 of peroxide

The most delicate tests [illegible] and [illegible] produces a purple or dark blue tint in liquids containing very minute proportions of iron, or a black precipitate where the metal is more abundant, and the ferrocyanate of potash, which produces Prussian blue under similar circumstances

Of the combinations of iron, *steel* is, perhaps, the most important It is formed by heating pure iron in contact

with charcoal, and is a compound of iron with a small
*See* STEEL
this valuable metal are too well known to require being pointed out, and no one can doubt that its discovery
thing else to facilitate
career of improvement "It accommodates itself," as Dr Ure has observed, "to all our wants, our desires, and even our caprices, it is equally serviceable to the arts, the sciences, to agriculture and war, the same ore fur-
and the bomb It is a medicine of much virtue, and the only metal friendly to the human frame The ores of iron are scattered over the crust of the globe with a beneficent profusion, proportioned to the utility of the metal, they are found under every latitude, every zone and in every mineral formation and they are disseminated in every soil But though iron is the most common of the metals, it is by far the most difficult to obtain in a state fit for use, and the discovery of the method of working it seems to have been posterior to the use of gold silver, and copper It would be vain to attempt to investigate the steps by which men were at first led to practise the processes required to fuse it and render it malleable, but that the invention of these curious arts is of a very early date is evident from the fact that Tubal Cain but a short time after the creation was "an instructor of every artifice in brass and iron" In most instances the profane historians of antiquity have either attributed the discovery of iron and its uses to their divinities, or they have deified those to whom they supposed they owed the blessings of so valuable a discovery

At what period iron began to be made in this country there is no means of ascertaining, but there is authentic evidence to show that iron works were established by the Romans in the Forest of Dean in Gloucestershire, and in other parts of the kingdom (*Pennant's Wales*, vol i p 89 ed 1810) They were also established at an early period in Kent and Sussex, but it was not till after the celebrated invention of Lord Dudley in 1619 by which pit coal was substituted for timber in the smelting of iron ore, that a great impetus was given to the working of this valuable mineral, an invention which though interrupted and clogged for a time by the devices of an ignorant rabble, at last established for itself a sure footing both in this and in every other European country From 1740 (the period at which Lord Dudley's invention be
manufacture
we have no means of
duced, the subjoined
of the manufacture, and the unexampled rapidity of its growth during the last century In 1740, the quantity amounted, in England and Wales only to 17 000 tons, in 1750, to 22 000, in 1788, to 68 000 in 1796 to 125 00, in 1806 to 250,000, in 1820 to 400,000 in 1827 to 690,000, in 1840, to 1,000 000 and in 1850, to nearly 2 000,000 tons

IRON PYRITES *Yellow sulphuret of iron* A bisulphuret of iron, composed of 28 iron + 32 sulphur It is a very common and abundant ore of the metal, hitherto it has only been used for the production of sulphate of iron, or *green vitriol*, but attention has lately been turned to it as a source of sulphur

IRONY (Gr εἰρωνεία, from εἴρων, *a dissembler*) In Rhetoric, the quality of style and of sentiment which Aristotle designates by the term εἰρωνεία is somewhat different from that which bears the same title in modern phraseology, being, in fact only a subdivision of it Ironia in his sense of the word is an artful representation of qualities or things as less than they really are Thus, among the
of the human mind as given by him, the
who affectedly conceals or depreciates his own good qualities Quintilian gives to rhetorical irony a far more general sense terming it *dissimulatio* or the use of expressions contrary to the thoughts of the speaker He also distinguishes it into
where the
to a few words, a figure of thought where it extends to a whole passage or discourse The Socratic irony is em-
when one speaker affects to take the
for granted in order adroitly to lead him into self-contradiction or obvious absurdity In the ordinary sense, irony is a more delicate species of sarcasm, by which praises are bestowed where it is intended to convey the opposite sense of disapprobation, or assent is notified where the real object is to express dissent

IRRADIATION, in Physics and Astronomy, is the phenomenon of the apparent enlargement of an object strongly illuminated The impression produced by light on the retina appears to be extended, though to an extremely small distance, round the focus of the rays concentrated by the lenses of the eye Hence the image of a star is never a point, but a disc having a sensible diameter, and larger in proportion as the light is more intense, and hence also the luminous part of the moon at her first quarter appears larger than the other This effect which is termed *irradiation*, results evidently from
the organ of vision

In Arithmetic and Algebra, a term or quantities of which the roots are incommensurable with unity, and therefore cannot be accurately extracted Thus, the root $\sqrt{2}$ is irrational, because it cannot be expressed by any finite number If the side of a square = 1, then $\sqrt{2}$ is its diagonal, and it is proved by elementary geometry that the diagonal of a square is incommensurable with its side Irrational quantities are also called *surds*

IRREDUCIBLE CASE In Algebra is that particular case of the solution of a cubic equation in which Cardan's celebrated formula contains an imaginary expression, and therefore fails in its application This circumstance occasioned great embarrassment to the early analysts, and all the efforts of their successors to overcome the difficulty in a direct way have proved unsuccessful In order to show in what it consists, let the proposed cubic equation be $x^3 + ax + c = 0$, then, by Cardan's rule we have

$$x = \left(-\tfrac{1}{2}c + \sqrt{\tfrac{1}{27}a^3 + \tfrac{1}{4}c^2}\right)^{\frac{1}{3}} + \left(-\tfrac{1}{2}c - \sqrt{\tfrac{1}{27}a^3 + \tfrac{1}{4}c^2}\right)^{\frac{1}{3}}$$

Now if in this expression $a$ is negative, and $\frac{1}{27}a^3$ is greater than $\frac{1}{4}c^2$, then $\frac{1}{27}a^3 + \frac{1}{4}c^2$ will be a negative quantity, and consequently the extraction of its square root will be impossible, or the expression $\sqrt{\frac{1}{27}a^3 + \frac{1}{4}c^2}$ will be imaginary But it is known from the theory of equations that every cubic equation must have at least one real root, and it is a circumstance not a little remarkable that those cubic equations in which this imaginary expression occurs have not only one real root, but have all the three roots real

It is possible to disengage the expression for the value of $x$ from the imaginary quantities by expanding it by the binomial theorem, for the imaginary quantities, which will be the same in both the resulting series, will be positive in the one series and negative in the other, and therefore on adding the series together, they will be eliminated But the series which results from this addition will very rarely be convergent, consequently this method is of no use whatever Various indirect methods of finding the roots have been proposed, the following is one of the simplest —

Let $y^3 - qy = r$ be the proposed equation Find in the trigonometrical tables an arc $a$ whose natural cosine is $3r\sqrt{3} - 2q\sqrt{q}$, then the three roots of the proposed equation are,

$$y = 2\sqrt{\tfrac{1}{3}q} \times \cos \tfrac{1}{3}a,$$
$$y = -2\sqrt{\tfrac{1}{3}q} \times \sin \tfrac{1}{3}(90^\circ - a),$$
$$y = -2\sqrt{\tfrac{1}{3}q} \times \sin \tfrac{1}{3}(90^\circ + a)$$

These formulæ apply whether $r$ be positive or negative, but when $r$ is negative, it is more convenient to choose the arc $a$ such that its natural *sine* is $3r\sqrt{3} - 2q\sqrt{q}$, and the three roots are then

$$y = 2\sqrt{\tfrac{1}{3}q} \times \sin \tfrac{1}{3}a,$$
$$y = 2\sqrt{\tfrac{1}{3}q} \times \cos \tfrac{1}{3}(90^\circ + a),$$
$$y = -2\sqrt{\tfrac{1}{3}q} \times \cos \tfrac{1}{3}(90^\circ - a)$$

See the article "Algebra," by Professor Wallace, in the *Ency Britannica*

IRREGULAR CADENCE In Music, one which does not end upon the essential chord of the mode in which a piece is composed *See* CADENCE

IRRIGATION (Lat) The art of watering lands artificially and by means of surface drains or channels, as contr
and
appl
those of Italy Syria, India &c, irrigation is considered as essential to the production of large crops in every description of field and garden culture When any surface is to be irrigated the supply of water which is to be used for this purpose is conducted to the highest part of that surface and from thence it is led over it in open gutters, so as to run very slowly, and sink into the earth as it proceeds As in general no very great extent of surface can be irrigated at once, different parts of a field or farm are irrigated in succession, and in countries where this practice is universal, it often happens that one source of of supply is common to two or more
of which have it on alternate days
and Italy, abundant crops cannot be produced without irrigation Even the potatoe crop and madder are irrigated in the neighbourhood of Avignon, and in Tuscany wheat, maize beans, turnips and every other crop that can be sown in drills in the fields, is watered from artificial channels The practice is as old as human civilization, and some of the first machines which we read of in history are those for raising water from the Nile for irrigating the lands on its banks Water, in short, is to the agriculture of warm climates, what manure is to the

cultivator of temperate regions It is not [illegible] substitute for manure, but as in temperate [illegible] without manure would be of little use, so in [illegible] manure without water cannot be rendered fit for being tak[illegible]

I[illegible] M[illegible] (Fr *loin*) So called from its proximity to the loin It is one of the bones of [illegible] of the *os innominatum* in the

ISCHURIA (Gr *ισχω*, *I retain*, and *ουρον*, *the urine*) Retention of urine

ISINGLASS A very pure form of *gelatine* prepared from certain parts of the entrails of several fish The best is derived from the sturgeon, and is almost exclusively imported from Russia, twisted up in rolls or formed into cakes, which are afterwards torn into shreds or cut into fine shavings in this country Good isinglass should be free from smell and taste, and perfectly soluble in boiling water The name *isinglass* is evidently a corruption of the Ger *Hausingblase*, its correlative term, though it is commonly derived from *ice* and *glass*

ISIS One of the chief deities in the Egyptian Mythology It is difficult amidst the mass of contradictory assertions to ascertain the real origin and attributes of this divinity, for while the Egyptians themselves are said to have confined their worship chiefly to Isis and Osiris [illegible] eek and Latin writers though exceed[illegible] details, assert broadly that these two divinities included, under different names, the whole pagan mythology It would be futile in this place to trace the attempt of the Greeks to identify Isis with Io the daughter of Inachus, whom they represent to have been introduced into Egypt under the form of a cow and [illegible] By the E[illegible] [illegible] sister or sister-wife of Osiris, who concurred with her in the endeavour to polish and civilize their subjects to teach them agriculture, and several other necessary arts of life Among the higher and more philosophical theologians she was made the symbol of Pantheistic divinity see especially the remarkable passage at the end of the *Golden Ass* of Apuleius By the people she was worshipped as the goddess of fecundity, and in her honour an annual festival was instituted which lasted seven days The cow was sacred to her She was represented variously, though most usually as a woman with the horns of a cow, and sometimes with the lotus in her head and the sistrum in her hand Her priests were bound to observe perpetual chastity, but on her worship passing into foreign countries her rites became merely a cloak for sacerdotal licentiousness which at last reached such a pitch that they were prohibited at Rome, and Tiberius, in the ho[illegible] [illegible] for ever ordered the images of [illegible] into the river The worship of Isis, however was afterwards revived, and furnished an ample theme for the indignant pen of Juvenal The *Isiac Table* in the Turin Museum which was so long supposed by the learned to represent the mysteries of Isis, has been judged by Champollion to be the work of an uninitiated artist little acquainted with [illegible] probably of the age of Hadrian [illegible], *Plutarch's Treatise on Isis and Osiris*, &c &c, an Essay by De Montfaucon *Hist de l'Ac des Inscr* vol xvi, which contains a summary of the Grecian learning on the subject, *Mem de l Ac des Inscr* xxxiv, and *Quart Rev*, July 1840)

Isis (*Isidos proclamos*, a marine plant, like coral according to Pliny) The name of a genus of jointed coral in which the joints are composed of substance resembling horn

ISLAM, or ESLAM The religion of Mohammed The body of the faithful, and the countries wherein it is professed, are so termed by the Mohammedans The original word is said to signify *submission to God* All those who professed the true religion and the unity of God, before the arrival of Mohammed, are considered as [illegible] and privileges of Islamism [illegible], chief minister of religion in Turkey, bears the title of Sheikh-ul-Islam

ISLAND (Lat insula) A tract of land encompassed with water, whether of the sea, a river, or a lake, in contradistinction to the *continent* or *terra firma*

ISLANDS OF THE BLESSED (Insulæ Beatorum Fortunatæ Islands Νησοι Μακαρων) According to the Grecian Mythology the Happy Islands [illegible] lie westward in the ocean without [illegible] the virtuous were transported In the early mythology of the Greeks, the Islands of the Blessed, the Elysian fields, and the infernal regions, were generally confounded with each other *See* ELYSIUM

ISMAE'LIANS A Mohammedan sect, who derived their [illegible] of Ishmael, the se[illegible] [illegible] exclusion of Moussa, who was adopted by that saint They consequently rejected the claims of Moussa and the five subsequent Imams The Ismaelians formed a secret asso[illegible] [illegible] of the Christian era by Abdallah [illegible] originated the famous



[illegible] *Tales of Mohammedanism* [illegible] vol xvii, "Secret [illegible] shed in the *Library of Entertaining Knowledge* 1837,

ISOCHROMATIC (Gr *ισος*, *equal* and *χρωμα*, *colour* Having the same colour In certain experiments [illegible] forms, arranged in a certain order, each curve in the one series having one [illegible] both in form and colour in the other [illegible] lines which have the same tint are called *isochromatic* (See Herschel's [illegible] in the *Ency Metropolitana*)

ISOCHRONAL or ISOCHRONOUS (Gr *ισος*, and *χρονος*, *time*, *performed in equal times*) Two pendulums which vibrate in the same time are isochronal, or the vibrations of a pendulum in the curve of a cycloid are so being all performed in the same time, whether the arc be large or small *Isochronal lines* are those along which a heavy body descends with a uniform velocity

ISODOMUM (Gr *ισος* and *δομος*, *structure*) In Ancient Architecture, a species of walling in which all the courses were the same height

ISOLATED (Fr *isole*, from the Ital isola, Lat insula *an island*) In Electricity, a body is said to be isolated when it is surrounded by non conductors, or bodies to which it cannot communicate its electric virtue, except by induction Bodies may be isolated in various ways, by suspending them by means of silken cords, by placing them on a cake of wax resin, or sulphur, or on a stand of glass or dry varnished wood, &c

ISOMERISM (Gr *ισος*, and *μερος*, *part*) Compounds which contain the same elements in the same ratio and yet exhibit distinct chemical qualities are said to be *isomeric* The cyanic and fulminic acids are isomeric compounds of nitrogen oxygen and carbon The distinctions thus arising are probably referible to the different ways in which the same elementary atoms are [illegible] and

ISOMORPHISM (Gr *ισος* and *μορφη*, *form*) Substances which resemble each other in their crystalline forms but differ in their component parts are said to be *isomorphous* Thus the phosphate and biphosphate of soda have the same form, or are *isomorphous*, with the arseniate and biarseniate of soda, and in regard to other bases such as potash and ammonia, each arseniate has a [illegible] the same form In [illegible] nalogy in the atomic constitution of the compounds which are observed to possess the same number of equivalents of acid, alkali, and water of crystallization, and differ in nothing except that the one series contains an atom of arsenic, and the other an atom of phosphorus

ISOPERIMETRICAL FIGURES (Gr *ισος*, and *περιμετρον*, *circumference*) are such as have equal perimeters or circumferences The term isoperimetrical problems in modern analysis designates a very extensive and difficult class of problems, the solution of which re[illegible] [illegible] analysis The general [illegible] curves having the same length to determine that of which some assigned property is a maximum or a minimum, for example among all curves having the same perimeter to find that which has the greatest area This is the simplest question of the kind, and the curve to which the property belongs is proved by elementary geometry to be a circle

In all isoperimetrical problems there are two conditions to be fulfilled according to the first of which a certain property is to remain constant, or to belong to all individuals of the [illegible] and [illegible] to the second in their property is to [illegible] [illegible] possible In the problems of this kind which first attracted the particular attention of mathematicians, the constant quantity was the perimeter of a certain curve, and hence the origin of the term, which is now applied to all problems indifferently in which the question is to find curves having a property of maximum or minimum, with or without the condition of equality of perimeters

James Bernoulli was the first who discovered the true principles on which questions of this kind depend, and the circumstances which render the ordinary methods of [illegible] [illegible] applicable to them The immediate [illegible] [illegible] was the problem of the Brachystochrone (see the term), or curve of quickest descent, celebrated in the early history of the calculus on account of the controversy to which it gave rise between the two brothers, James and John Bernoulli The analysis of the former, *Analysis magni Problematis Isoperimetrici*, was published at Basle in 1701, and in the *Leipsic Acts* of the same year Solutions were afterwards given by Taylor in his *Methodus Incrementorum*, by John Bernoulli in the *Memoirs of the Academy of Sciences* for 1718, and by Euler in the *Petersburg Memoirs* Euler afterwards gave a complete and general solution of the problem in his *Methodus Invenidi Lineas Curvas Maximi Minimive proprietate gaudentes*, a work of which Lagrange has said that there is perhaps no other which can be of more use

to those who wish to exercise themselves in the integral calculus The method, however, which is followed in this work has been superseded by the invention of the *calculus of variations* by Lagrange, a most important branch of analysis, of which the subject of isoperimetrical problems is one of the [illegible] (Lagrange, *Leçons sur le C[illegible]*, Whitehouse, *On Isoperimetrical Problems*, Lacroix, *Traité du Calcul Différentiel et Intégral*, *Airy's Tracts*, &c )

ISOPODA (Gr *ισος*, and *πους*, *a foot*) The name of an order of C[illegible] comprehending those which have the legs [illegible], and adapted only for locomotion and prehension

ISOPO'DIFORM The larvæ of Saprophagous Hexapods are so called which have an oblong body, a distinct thoracic shield, and a vent provided with filaments or laminæ

ISOPYRE (Gr *ισος*, and *πυρ fire*) In Mineralogy a silicate of alumina, lime, and peroxide of iron found near the granite of St Just, near Penzance in Cornwall It is a black amorphous substance, occasionally variegated with grey or red spots or streaks, slightly translucent Its specific gravity is about 3

ISO'SCELES (Gr *ισος*, and *σκελος*, *leg*) In Geometry, an isosceles triangle is that which has two equal sides [illegible] properties of isosceles triangles one is [illegible] the base are equal, and is the de[illegible] f this proposition in *Euclid's* [illegible] the very commencement is somewhat intricate and puzzling to beginners the proposition has been called the *pons asinorum*

ISOSTE'MONOUS (Gr *ισος* and *στημων a stamen*), in Botany, in expressing the proportion that one part bears to another, denotes that the stamens are equal in number to the petals

ISOTHE'RMAL (Gr *ισος* and *θερμη heat*) In Physical Geography, *isothermal lines* are those which pass through those points on the surface of the earth at which the mean annual temperature is the same *Isothermal zones* are spaces on opposite sides of the equator having the same mean temperature, and bounded by corresponding isothermal lines On account of the irregular form and disposition of the continental masses, by which the climate of different places is greatly influenced, the isothermal curves are not parallel to the equator excepting in the very low latitudes According to Humboldt the isothermal line which corresponds to the temperature of 32° of Fahrenheit passes between Ulea in Lapland lat 66°, and Table Bay on the coast of Labrador, lat 51° The isothermal line of 41° passes near Stockholm lat 59½° and St George's Bay Newfoundland lat 48° The line of 50° passes through the Netherlands lat 51° and near Boston in the United States lat 42½° that of 59° between Rome and Florence lat 43° and Raleigh in North Carolina lat 36° In all these cases we see that the isothermal lines in passing from the western side of the continent of Europe to the eastern coast of America deviate very considerably towards the south, the deviation in one case, amounting to 11½° of latitude In passing over the American continent, they again recede to the northward and in California and to the north of that peninsula along the western side of the continent the annual temperature is nearly the same as under similar latitudes in the west of Europe From the western to the eastern side of the old continent, the flexure of the isothermal curves and the diminution of the mean annual temperature under the same parallels are not less conspicuous The isothermal line of 55° passes through Nantes lat 47° and Pekin lat 39½ Edinburgh and Kasan (in the east of Russia) have the same latitude, but the mean annual temperature of the former is 48° while that of the second is below 38° For the different causes which affect the parallelism of the isothermal lines, or which produce the differences of the mean annual temperature of places under the same parallel of latitude, see CLIMATE

Humboldt gives the name of *isotheral lines* (*ισος* and *θερος*, *summer*) to the curves passing through those places at which the mean summer heat is the same, and of *isochimenal* (*ισος*, and *χειμων winter*) to those which pass through the places at which the mean temperature of winter is the same The isotheral and isochimenal curves deviate much more from the parallels of latitude than the isothermal The latitudes of places having the same winter temperature sometimes differ so much as 18° or 20° The winter of Scotland is as mild as that of Milan The mean temperature of the winter months at Edinburgh is about 38½°, of Kasan, under the same parallel, only 2° The winter of Pekin is as rigorous as that of Stockholm (*Humboldt's Fragmens Asiatiques*, *Murray's* [illegible], Introduction)

ISSUANT In Heraldry a charge represented as issuing or coming up from another charge or bearing, also, a lion or other beast represented as rising from the bottom line of a chief

ISSUE In Law, in the most ordinary senses of the word,—1 The points in dispute in a suit at law between two parties, a certain number of which are termed the [illegible], as distinguished from [illegible], to be determined by the court, or in fact, to be ascertained by a jury In each form of action (*see* ACTION, PLEADING) there was formerly a formal traverse, by which the whole or principal part of the allegations of the plaintiff in his declaration might be denied this was termed the general issue Since the adoption of the new rules of pleading (1834) there is now properly speaking no general issue, except in certain cases, where the privilege of giving special matter in evidence under it is [illegible] technical mode of [illegible] imaginary wager [illegible] it is usual to put printed copies of the issues into the hands of t[illegible] 2 Heirs [illegible] ISSUE, [illegible] made by wounding or cutting the skin, and placing a pea upon it, which is pressed upon the part by a bandage

ISTHMIAN GAMES One of the four great national festivals of Greece, so called from their being celebrated on the Isthmus of Corinth They were common to all the states with the exception in this case of the Eleans, against whom a curse had been pronounced should they ever present themselves there They were held near a temple of Neptune, the god who presided over them, and were celebrated every third year, according to some accounts but others assign them a period of one or four years The contests were the same as in the other sacred games (*see* OLYMPIC GAMES) the victors were crowned with [illegible] leaves (See *Potter's Grecian Antiquities*, *Blackmuir's Historical Antiquities*, ii 162 translation)

ISTHMUS In Geography, a narrow neck of land joining two continents or a continent and peninsula Thus, the Isthmus of Darien joining North and South America, the Isthmus of Suez, connecting Africa with Asia

ITALIAN ARCHITECTURE *See* ARCHITECTURE

ITALIC SCHOOL OF PHILOSOPHY, comprehends properly the Pythagorean and Eleatic systems taken together, but sometimes it is used as synonymous merely with the school of Pythagoras Under the several heads will be found the chief features of these philosophical systems which comprising as they do all that can be said in reference to the Italic school, it would seem unnecessary in this place further to advert to The Italic school has been so designated because its founder, Pythagoras, taught in Italy, spreading his doctrine among the people of Tarentum, Metapontum, Heraclea, Naples, &c

ITCH A disease of the skin consisting in an eruption of minute itching vesicles, which are commonly rendered more inflamed and troublesome by scratching They generally make their first appearance between the fingers, or about the bend of the wrist and often spread to other parts of the body especially where cleanliness is neglected The itch is highly contagious, and is supposed to depend upon a minute insect burrowing in the skin, some have regarded the insect as a consequence, and not the cause, of the disease The itch is cured by sulphur, which should be given internally, and applied externally in the form of ointment

ITIHA'SAS The two great heroic poems of the Hindoos the *Ramayana* and *Maha Bharata*, are so called They are of great antiquity, later however, than the *Vedas* Some indeed have attributed the latter poem to a period later than that of Alexander

ITINERARY (Lat *iter a journey*) In Literature, [illegible] as, an Itinerary from Paris to Rome or of the principal places and stations on the great roads throughout a country, as Itinerary of France, Italy, &c The Latin Itineraries which have been preserved to us consist merely of catalogues of stations, and are principally valuable to us because they contain the distance, in Roman miles, from one to another, and thus furnish us with assistance towards determining the actual site of each place mentioned

ITIS This termination, added to the genitive case of the Greek name of an organ or part of the body, implies *inflammation* of that part, as, *gastritis* inflammation of the *stomach*, *pleuritis*, of the *pleura*, &c

ITTNERITE Named after Ittner A rare mineral, which occurs massive and in rhombic dodecaedrons, of a grey or bluish colour It consists chiefly of silica, alumina, and soda, together with some hydrosulphuret

IU'LUS (Lat) A genus of Myriapodous insects, characterized as follows —Antennæ with seven joints, slightly enlarged towards the end, mandibles two, thick, without palps, each divid[illegible] provided with imbricated [illegible] the confluence of two maxillæ, feet attached in double pairs to most of the joints, body long, cylindrical, capable of being contracted into a discoidal spire The common gally-worm (*Iulus terrestris*) is an example of this genus

IVORY The tusk of the male elephant. It is less

brittle than bone, and of a beautifully uniform texture, admitting of turning in the lathe and receiving a high polish It consists of about 24 per cent animal matter [illegible] e of carbonate of lime, and 1 per cent of carbonate of magnesia The principal use of ivory in England is in the manufacture of handles for knives, but it is also extensively used in the manufacture of musical and mathematical instruments, chess-men, billiard-balls, plates for miniatures, toys, &c Ivory articles are said to be manufactured to a greater extent, and with better success, at Dieppe than in any other place in Europe, but the preparation of this beautiful material is much better understood by the Chinese than by any other people No European artist has hitherto succeeded in cutting concentric balls after the manner of the Chinese, and their boxes, chess-men, and other ivory articles, are all far superior to any that are to be met with any where else

The west coast and eastern coasts of Africa, the Cape of Good Hope Colony, India, and the countries to the eastward of the Straits of Malacca, are the great marts whence supplies of ivory are derived, but the most esteemed come from Africa, being of a closer texture and less liable to turn yellow than those from the East Indies The medium weight of a tusk is about 60 lbs, and the average importation for the three years ending 1850 was 6000 cwt, yielding a duty of 1*l* per cwt

IVORY BLACK The mixture of charcoal and phosphate of lime obtained by burning bone is sold under this name, and, like other forms of animal charcoal, is very effective in depriving certain substances of their colour

JABI'RN The name of a Grallatorial or wading bird b[illegible]

JACAMA'R[illegible] [illegible]nsorial birds *See* GALBULA

JACA'NA The wading birds of the genus *Parra* are so called

JA'CCHUS (Gr ἰαχω, *I cry aloud*) A genus of Platyrrhine Quadrumana, or South American monkeys, with thumbs on the hind foot only, all the digits of the fore foot having the same direction, and being armed with narrow, curved, claw like nails The characters of the genus are,—upper middle incisors separated from and larger than the lateral ones, lower incisors elongated, narrow, and vertical, the lateral ones the longest, upper canine teeth conical, and of moderate size but more developed than the lower ones The species of *Jacchus* are [illegible] and not very clearly defined they are all [illegible] The *Jacchus penicillatus*, which is remarkable for the radiated tuft of white hairs which projects in front of each ear, has bred in captivity in this country It is a very delicate little animal, susceptible of cold, and provided with a long and bushy tail, which it wraps round its head and body when asleep or requiring warmth Its food is of a mixed nature, but in the wild state the banana is said to be its principal and favourite nutriment

JACK In Mechanics, an engine for raising heavy weights

*Jack* is also the name given to a machine in common use for turning a spit The common roasting jack, or worm-jack, consists of a double set of wheels, a barrel round which the chain attached to the weight or moving power is wound, a perpetual screw, and a fly which secures a steady uniform motion A multiplying wheel is usually added, in order that the weight may be longer in running down

The *smoke jack* is used for the same purpose as the common jack, and is so called because it appears to be moved by the smoke of the fire It is in fact moved by the ascending current of rarified air, which acts on a fan properly placed in the chimney The motion may be obtained by various contrivances Sometimes spiral [illegible] more [illegible] to the sails of a windmill

JACK, in Nautical language, is a flag or colours used in making signals In the British navy the Jack is a small union flag, composed of red and white crosses, in merchants' ships, this union is bordered by a red field

JACK A common name for the pike

JACK, in Botany, is the name of the *Tsjaca* or *Artocarpus integrifolia* a species of the bread [illegible] in the Indian Archipelago

JACKAL (Ar tschakkal Pers schagal) A wild species of dog, the *Canis aureus* of Linnæus, of gregarious habits, hunting in packs rarely attacking the larger quadrupeds, but supposed to indicate their presence to the lion by the piercing cries which the jackals set up in chorus while scenting the [illegible] feeding on the remnants of the lion's prey, on dead carcasses, and the smaller animals and poultry The jackal interbreeds with the common dog, its period of gestation is the same and the hybrid progeny is fertile The wild jackal emits a highly offensive odour [illegible] tible in the domesticated animal [illegible]

that the 300 animals, called foxes, between whose tails Samson is said to have put firebrands in order to destroy the crops of the Philistines, were jackals The *Canis aureus* is abundant in the warmer parts of India and A[illegible] the new world

JA[illegible] *corvus monedula*, Linn) A comm[illegible] frequents church steeples, old towers, and ruins, in flocks, where they build their nests [illegible] eggs, paler and smaller than [illegible] may be readily tamed, and taught to imitate the sounds of words Like other species of the crow genus, they have the singular habit [illegible] glittering and metallic substances [illegible] wedges used in coal mines

JACK SINKERS Parts of a stocking frame

JACK TIMBERS In Architecture, those in a bay of timbers which, being intercepted by some other piece, are shorter than the rest thus, in a hipped roof, each rafter which is shorter than the side rafters is called a [illegible]

JACOBINS In French History, a political club, which bore a well-known part in the first revolution It was first formed by some distinguished members of the First Assembly, particularly from Britanny, where revolutionary sentiments ran high They took at first the name of Friends of the Revolution, but as at the end of 1789 they held their meetings in the hall of a suppressed Jacobin monastery in the Rue Saint Honore, the name of Jacobins, at first familiarly given them, was finally assumed by themselves The history of the Jacobin club is in effect, the history of the Revolution It contained at one time more than 2500 members, and corresponded with more than 400 affiliated societies in France The club of the Cordeliers, formed by a small [illegible]

The Jacobin club, which had almost controlled the first assembly [illegible] itself divid[illegible] the name [illegible] given to that section which opposed the Girondists or less moderate in the club no less than in the assembly After the destruction of the latter under the Convention, the club was again exclusively governed by the more violent among its own members, until the downfal of Robespierre After that period it became unpopular, and its members having attempted an insurrection on behalf of the subdued Terrorists Nov 11 1794, the meeting was dispersed by force, and the club finally suppressed Some writers, such as Barruel (*Hist du Jacobinisme*), have seen in the first formation of this and similar societies the long-concocted operations of a conspiracy against [illegible]nt and religion throughout Europe [illegible] the other principal clubs of the Revolution adopted all the forms of a legislative assembly In the constitution of 1792, their legal existence was recognized See the historians of the French Revolution, especially Carlyle, Mignet, and Thiers for general views, Messrs Buchez et Roux, *Histoire Parlementaire de la Rev Française*, for the most complete series of details respecting the Jacobins and their meetings which has yet been made public

JACOBINS In Ecclesiastical History the religious of the order of St Dominic were so called in France, from the situation of the principal convent at Paris, near the Rue St Jacques, also called *Frères Prêcheurs*

JA'COBITES In English History, that party which, after the Revolution of [illegible] adhered to the dethroned monarch James II and afterwards to his descendants In Scotland and Ireland where the revolution was not effected except with the assistance of arms, the Jacobite party formed one of the two great divisions of each nation, and although crushed in the latter country by conquest, they continued in the former to comprise a large proportion of the population until long after the last rebellion in 1745 But in England the revolution was effected at first with the consent of all parties, the adherents to the exiled monarch were silenced yet, in a year or two, the Jacobite faction rose into strength, and continued to harass the government of William throughout his reign "It seems undeniable," says Hallam (*Constitutional Hist of Eng* vol iii p 149), "that the strength of the Jacobite party sprung from the want of apparent necessity for the change of government" Its immediate cause however, was to be found in the refusal of a portion of the bishops and clergy to take the oaths to the new government (*see* NONJURORS), which gave, as it were, a certain consistency and tangible ground of opposition to the [illegible] of the dethroned monarch [illegible] At the same time many of William's chief advisers and officers maintained a secret correspondence with James II at the French court, less from any attachment to his cause than with a view to secure their own [illegible] rn After the death of James [illegible] of Anne in England, the efforts of the party languished for

a time; but towards the close of her reign they revived on the [illegible] We have now [illegible] hives, of a fact which had been long suspected, that Bolingbroke and Oxford, with others of Anne's Tory ministers, were in treaty with the son of James II, and either really or in pretence negotiating for his return In 1715, on the arrival of George I, [illegible] first rebellion in Scotland [illegible] proved a [illegible] to t [illegible] B [illegible] the [illegible] ished in 1722 after which time it is probable that no extensive conspiracy took place on their part In Scotland, however, the party maintained its strength unabated, [illegible] of 1745, by its complete failure [illegible] existence It is said t' [illegible] ence with [illegible] The Cardinal of York, his brother, died in 1807, and it has been said that, by his death, the adhesion of the Jacobites, if any existed, was transferred to the reigning family as his next heirs T' [illegible] error, the royal house of Sard [illegible] intervening between the house of Brunswick and the crown of England, according to the strict rules of hereditary descent

JACOBITES In Ecclesiastical History, the monophysite Christians of Syria are so called from Jacob Baradzi, who revived their belief and form of worship in that country and Mesopotamia in the middle of the 6th century Many unsuccessful attempts have been made at various times to unite them with the church of Rome (*Gieseler's Text Book*, Transl, ii 419, iii 414, &c) *See* MONOPHYSITES EUTYCHIANS

JA'COB'S LADDER In Naval affairs, a rope ladder with wooden steps or spokes

JACOB'S STAFF The same as *cross-staff* An instrument used by surveyors in measuring heights and distances where expedition and little accuracy are required

JACQUA'RD A piece of mechanism applicable to silk and muslin looms for the purpose of weaving figured goods The name is that of its inventor (For a description of the loom, see *Ure's Dictionary of Arts and Manufactures*)

JA'CQUERIE [illegible] 1356 *Jacques Bonhomme* was a term of [illegible] applied by the nobles to the peasants, from which this insurrection took its name It began in the Beauvoisis under a chief of the name of Caillet, and desolated Picardy, Artois and Brie where savage reprisals were executed against the nobility for their oppressions It was suppressed after some weeks by the dauphin and Charles the Bad king of Navarre A similar spirit in England produced not many years afterwards the rebellion of Wat Tyler (See Mezeray, iii 838, Froissart, Sismondi, *Hist des Français*, vol x)

JADE In Mineralogy, a synonyme of *nephrite*

JAGUA'R (*Felis onca*, Linn) The largest and most formidable feline quadruped of the new world It is marked with large dark spots in the form of circles, with a dark spot or pupil in the centre of each, it is generally pretty numerous in the neighbourhood of the large rivers where the capibara abounds, and preys chiefly on those large Rodents

JA'LAP So called from Xalapa in Mexico, whence it originally came The dried root of the *Ipomæa jalapa* This root occurs in irregular globular pieces of a dense and resinous texture when reduced to powder it has a very peculiar and nauseous odour and taste In doses of from five to twenty grains, jalap is a drastic purge it is apt to gripe and nauseate

JAMB A Sea term, to squeeze tight The opposite of jamb applied to a rope, is *to render*

JAMBS (Fr jambes) In Architecture, the side or vertical pieces of any opening in a wall which bear the piece that discharges the superincumbent weight of such wall

JA'MESONITE A mineral named after Professor Jameson It occurs crystallized and massive it consists [illegible]

JAMES SAINT [illegible] SWORD, ORDER OF [illegible] der in Spain and Portugal The reigning kings are grand-masters in those countries respectively The orders in the two countries were disunited in 1288

JANISSARIES or JA'NIZARIES (A corruption of [illegible] *yeni tscheri* new troops) A celebrated militia of the Ottoman empire The establishment of this corps has been usually attributed to Sultan Amurath I in 1368, but the researches of Hammer (*History of the Ottoman Empire*, vol i p 92) carry it back to Orchan, the conqueror of Nicæa (1326) This new corps was blessed by a saint of that time, Hadji Bektash by name, who cut off a sleeve of his fur mantle and gave it them as a token whence [illegible] that remained their distinguishing [illegible] irregular infantry long remained [illegible] strength of the empire, and formed [illegible] public within its limits It was long supplied chiefly by the capture of young Christian slaves, and when under Mohammed IV it began to be recruited principally from the children of the soldiers themselves its power and importance gave signs of decay Each regiment or oda of the Janizaries had its own soup kettle, which, in process of time, acquired a sort of prescriptive sanctity, and formed, as it were, the chief standard of the regiment, and the officers and other military functionaries drew their titles from their various supposed employments as cooks or kitchen servants The militia of the Janizaries continued to retain a great influence in the empire itself long after it had ceased to be serviceable in the field against the armies of modern Europe They controlled the sultans themselves, and, as it is alleged, presented a serious obstacle to all improvement, until in the year 1826 the late sultan, on the occasion of a mutiny dissolved the whole corps, after a bloody struggle in his capital in which 20,000 of them were said to have perished, but the number is now thought to have been exaggerated There was an official publication relating to the destruction of the Janizaries which was translated into French (Paris, 1833) See also *Walsh's Residence at Constantinople*, *Duval, Deux Années a Const* (1828), *Quarterly Review*, vol xli, and *Ed Rev* vol l, *Slade's Travels in Germany, &c* (1840)

JANSENISTS A denomination of Roman Catholics in France, who followed the opinions of Jansen, bishop of Ypres and formed a considerable party in the latter half of the 17th century The Jansenists were Calvinistic in many of their sentiments, and in several respects approximated to the Reformed opinions They did not, however separate themselves from the Catholic church, nor did they long survive the decree of Alexander VII, by which certain propositions extracted from their writings are condemned as heretical The Jansenists are chiefly celebrated for the contest they maintained with the Jesuists, by whom they were at last overcome, and subjected to the enmity both of Louis XIV and the Pope (See Leclerc *Bibl Univ* vol xiv, Racine *Histoire du Port Royal*, Fontaine, *Mémoires pour servir à l'Hist du P R*, *Saint Simon's Memoirs*, Palmer, *Essays on the Church*, i 320 &c, *Hallam on the Literature of Europe* vol iii, Schrokh, *Kirchengeschichte, seit der Reformation*, parts iv and vii, *Mosheim*, translation ed 1790, vol v 208 &c)

JANTHI'NA (Gr ἰανθος, *violet colour*) A genus of Gastropodous Testaceous Mollusks, so denominated on account of the beautiful violet colour of the shell There are but a few species [illegible] known all of which are marine and are [illegible] floating on the surface of the ocean in warm and tropical latitudes The shell as in all floating pelagic Testacea, is light and fragile, whence the specific name of the most common species (*Janthina fragilis*), but besides this relation of the shell to the habits and sphere of existence of the animal, each species also possesses a peculiar organ, by which it can as it were suspend itself to the surface of the water, and which has not hitherto been observed in any other molluscous species this organ consists of a congeries of transparent vesicles filled with air, the parietes of the bubble-like cells being composed of a thin colourless condensed mucus and the whole being attached to the posterior part of the foot On account of this place of attachment the vesicular float has been regarded as the analogue of the operculum which otherwise is wanting, but there is an important difference connected with the float viz the power which the animal [illegible] to sink they are also made subservient to the reproductive economy of the janthina, which attaches its egg-cells to the under surface of the float, and when it is thus laden casts it off By this means the ova are preserved in a situation where they may best receive the full influence of heat and light, and the power which the parent possesses of reproducing its float obviates the inconvenience which would otherwise result from this contribution to the well-being of its offspring The following is the process by which the janthina has been observed to repair a mutilation purposely made in its float —The foot was advanced upon the remaining vesicles until about two thirds of that part rose above the surface of the water, it was then expanded to the uttermost, and thrown back upon the water like the foot of a Lymnea when it be[illegible] edges, and [illegible] a globule o[illegible] of the flo[illegible] throughout the foot, and when it was again thrown back to renew the process the globule was found inclosed in its newly made envelope From this it results that the membrane inclosing the cells is secreted by the foot, and

that there is no attachment between the float and the animal other than that arising from the nice adaptation

[illegible] Pectinibranchiate [illegible] is capacious, and contains two pectinated gills Cuvier places the genus [illegible] *Pyrimidella* and *Nerita*, M Rouxe [illegible] *Immutata* and *Turgida*

JA'NUARY [illegible] the first month of the year Rome the name is derived from Janus, a Roman divinity, by others from janua, *a gate* The months of January and February were inserted in the Roman year by Numa Pompilius The Roman feast of the kalends of January seems to have been converted in the 6th century into the Christian festival of the circumcision (Beugnot, *Destr du Paganisme en Occident* vol ii)

JA'NUS [illegible] He was represented with two heads [illegible] and holding a key in one hand and a staff in the other He presided over the commencement of all undertakings, whence the first month in the year was named after him His temple at Rome was kept open in the time of war, and shut in peace The warlike disposition of the Romans is manifest from the fact that this temple was only shut six times in 800 years viz once in the reign of Numa, at the conclusion of the first Punic war, thrice in the reign of Augustus, and once again under Nero

JAPA'NNING The art of covering paper wood, or metal with a thick coat of a hard brilliant varnish it originated in Japan whence articles so prepared were first brought to Europe The material if of wood or papier-machee, is first sized, polished and varnished, it is then coloured, or painted in various devices and afterwards covered with a highly transparent varnish or lacquer, which is ultimately dried at a high temperature and carefully polished

JA'RGOON In Mineralogy, one of the varieties of *zircon*

JARL A word of Scandinavian extraction signifying noble, applied in the early history of the northern European kingdoms to the lieutenants or governors appointed over each province It appears to bear considerable analogy to the English earl (quod vide)

JASMINA'CEÆ (Jasminum one of the genera) A small natural order of Exogenous plants with monopetalous diandrous flowers of a regular figure It contains few species, chiefly inhabiting the warmer parts of the world The only plants of any interest are the jasmines well known for their fragrance

JA'SPER A siliceous mineral of various colours, sometimes spotted, banded or variegated It takes a fine polish, and the variety and richness of its colours render it useful in the ornamental arts

JAU'NDICE A disease characterized by a yellow colour of the eyes and skin, deep coloured urine and pale evacuations from the bowels, it comes on with languor, loss of appetite, dyspeptic symptoms vomiting bitter taste in the mouth, and generally pain in the region of the liver It is apparently caused either by obstruction of the duct that conveys the bile into the intestine by a gall stone, or by a morbid and viscid state of the bile which prevents its flowing freely or by spasm of the gall ducts or by some other pressure the consequence is that the bile, instead of passing off by the bowels is absorbed into the blood and becomes visible upon the skin and especially in the more delicate vessels It is an occasional consequence of pregnancy It sometimes affects infants soon after birth, in which case it usually goes off in a few days, aided by gentle aperients The most common cases of jaundice are probably occasioned by viscidity of bile Aperients and small doses of blue pill with tonics are the most essential remedies, and where it ensues in sedentary habits, moderate walking and horse exercise are requisite It is often a protracted and troublesome complaint, and then indicative of structural derangement Jaundice from gall stones is often attended by excruciating pain and vomiting, owing to the passage of the stone Opiates and such remedies as allay the irritability of the stomach are to be had recourse to, and the warm bath is useful It is the beneficial influence of saline aperients and diluents in this disorder, that has given celebrity to the waters of Cheltenham and similar mineral spring

JA VELIN (Fr javeline) A sort of spear or missile, anciently used both by horse and foot soldiers It was about five feet long, with an iron head hooked and jagged at the end The *pilum* of the Romans was of [illegible]

JAY [illegible] the genus *Garrulus*, separated by Cuvier from the genus *Corvus* of Linnæus on account of the weaker mandibles terminating in a sudden and nearly equal curve The tail is cuneiform, not long, and the slender feathers of the forehead can be erected like a crest The common jay (*Corvus glandarius*, Linn) midificates in woods and builds a simple nest of sticks and slender twigs, the female lays five or six eggs, of a greyish ash-colour mixed with green,





and faintly spotted with brown The young associate with the parents till the following spring, when they separate to form new pairs

JELRS Strong tackles for *swaying up* or raising the lower yards

JE'FFERSONITE In Mineralogy, a species of *pyroxene* It is found in New Jersey

JEHO'VAH The name by which the Deity is represented in the Hebrew Scriptures, in which language it signifies the *Self existent* the *I Am* The word itself was held in peculiar veneration by the Jews, who never allowed themselves to pronounce it in the reading of their sacred books, but substituted for it wherever it occurred the term Adonai, or *Lord* This practice is maintained even to this day, nor will they *write* the word in perfect Hebrew letters And agreeably to this scruple they have left the word Jehovah imperfectly written over the beautiful altar-piece in the recently-erected synagogue in St Helen's Place, making it to resemble that word, but in reality *Beloved*

JEJUNUM [illegible] Lat *jejunus*, *empty*) The second division of the [illegible] ied because when examined after death it is generally found empty or nearly so

JELLY *See* GELATIN

JERBOA *See* DIPUS

JESUATES OF SAINT JEROME A religious order, founded in 1363 by Giovanni Colombino of Sienna of extremely ascetic habits in its origin It was suppressed by Clement IX in 1668

JESUITS DE ROBE, applied to secular persons of high rank bound to the order of Jesuits by vows of obedience, without, however, having taken the spiritual vow

JE'SUITS or THE SOCIETY OF JESUS The most celebrated of all the Romish religious orders, founded by Ignatius Loyola a Spaniard in the year 1534, when he, with Francis Xavier and four or five other students at the University of Paris bound themselves to undertake the conversion of unbelievers The first principle of the society which was then formed was implicit submission to the commands of the Holy See in consideration of which their order was confirmed in 1540 by Pius III, and from that time to the present, though with many alternations of success and reverse the Jesuits have been one of the main bulwarks of the authority of Rome and have exercised immense influence in the destinies of the Christian world The zeal which they manifested at the period immediately succeeding the Reformation when the Dominicans and other orders which had been founded on similar principles and had faithfully executed their mission for many ages had degenerated into luxury and indifference secured for them the favour of the sovereigns and other political partisans of Rome They soon became installed in the confessionals of all the Catholic kings of Europe and throughout the 16th and following century were in fact the directors of their councils and the rulers of their subjects

In Protestant countries they acted as the emissaries and spies of the Pope, and in England, where early in Elizabeth's reign their landing upon our shores was made a capital crime, they persevered nevertheless in keeping alive the spirit of Roman Catholicism among the harassed remnant of the old faith, and passed and repassed the channel year after year devoting their lives, with almost a certainty of eventually suffering, to the maintenance of an illegal, and often a treasonable correspondence with the court of Rome and the enemies of the queen's government At the same time another division of their numerous body employed themselves with [illegible]

[illegible] aries in converting the heathens of Asia and America St Francis Xavier, the Apostle, as he is called of the Indies planted Christianity in Hindostan and Japan, and Ricci introduced it into China In the course of a few years the numbers of professing Christians in these countries became very large, although it cannot be denied both that the means which the missionaries took to increase the number of their conversions were little in accordance [illegible] form of [illegible] their success seems to have been the address with which they obtained the confidence of the ruling powers In Japan and China they became the intimate advisers of the sovereign, and frequently obtained the assistance of the civil power in the furtherance of their missionary system

The Jesuits obtained also, throughout Roman Catholic Europe, the direction of the education of youth they founded many schools and colleges, not only for the instruction of those who were designed for members of their own order but for that of the upper and lower classes generally, in the education of both of which they were eminently successful

As a religious body, the Jesuits differ from their predecessors, inasmuch as, their principle being to conform as much as possible with the manners of the age, they have never adopted the austere observances and exclusive spiritual character upon which all earlier orders had [illegible] to notoriety They are divided [illegible], of which only *the professed* take the religious vows of poverty chastity, and obedience to their superior Among the novices are frequently enrolled influential laymen, as was Louis XIV himself in his latter years, and this is one of the means which the order has employed to extend its efficiency where it would be least liable to observation The Professed are of several ranks, the whole body being under the absolute control of the General whose abode is fixed in Rome, and whose council consists of an admonitor and five assistants or councillors, who represent the five principal Catholic [illegible] communications from the superiors of the different provinces through which its members are distributed

The Pope has conceded to the Jesuits greater indulgence than even to laymen in exempting them from the religious observances which are enjoined to all Roman Catholics, and especially to the religious orders, and hence it is that they have been enabled to devote so great a portion of their time not only to instruction, but to many branches of learning and practice by means of which they have insinuated themselves into the confidence and the concerns of the laity They are remarkable also for the worldly air which when occasion serves they studiously assume, — for the ease with which they dispense with all the outward appearance of their spiritual character in places where their objects seem to be more attainable by a different behaviour, and they have been reproached at all times with allowing themselves on the same principle to make use of mental reservations and other *pious frauds* in pursuance of the peculiar ends of their society Hence, even when their influence in Europe was at its height great distrust was manifested towards them in many quarters In France they were supposed to be implicated in the plots by which Henry III fell and the life of Henry IV was attempted and were indeed banished from that country by royal decree before the end of the 16th century they were re-admitted however and continued in the enjoyment of their full influence in spite of the strong opposition of the Jansenists in the reign of Louis XIV They were banished in the course of the 18th century from France, Spain, Portugal and other Catholic states and in 1773 Clement XIV issued a bull by which he decreed the total abolition of the order The invitation however of Catherine II into Russia and the favour of the successor of Clement restored them in some degree, and they still exist and exercise considerable influence in Italy and Spain From Russia they are at the present moment entirely banished, nor has Portugal re-admitted them since their expulsion in 1759 In France and Germany their presence appears to be connived at though they have never formally been allowed to re-establish themselves in those countries In England they have been allowed to found and maintain the Roman Catholic college at Stonyhurst and their numbers in Ireland are supposed to be considerable By the Roman Catholic Relief Bill, natural born Jesuits resident in the United Kingdom are required to register themselves with the clerk of the peace in every county foreigners must provide themselves with licences from a secretary of state

The history of the order of Jesus has often been written, but with so much exaggeration both of friends and enemies, that it is difficult to point out a fair account The *Historia Jesuitica* of Hospinian a Protestant, carries it down to the end of the 16th century *Orlandi and Sacchetti's History of the Jesuits* was proscribed by the parlement of Paris, a 5th part was added to it by Souvency Coudrette, one of the order, published a history of it just before its dispersion, 6 vols 12mo with Supplement, 1761-4 D'Alembert published an account of the destruction of the order in France, 1765 See also *Georgel's Memoires* Paris 1817 The celebrated *Lettres Provinciales* of Pascal contain a powerful exposure of the errors of the [illegible] 16th and 17th centuries, of which [illegible] Jesuits (See [illegible] was under the management of Jansenists, and contains every charge which hostility could suggest against the Jesuits *Ranke's History of the Popes of the 16th and 17th Centuries* contains much valuable matter relative to that period

JESUITS' BARK *See* CINCHONA, or PERUVIAN BARK

JET A bituminous carbon Some varieties admit of polish, and are used for ornamental purposes

JET D'EAU (Fr) A fountain which throws up water to some height in the air According to the theory of hydrostatics the velocity with which water issues from an orifice is equal to that which would be acquired by a heavy body in falling through a height equal to the difference between the levels of the orifice and the fountain head, whence, if the resistance of the air and other impediments were removed, the height of the jet would be equal to that of the surface of the reservoir Among the causes which prevent the jet from obtaining the height which theory assigns to it, the following are the principal 1st The resistance of the air, which is proportional nearly to the square of the velocity 2d, The friction against the sides of the [illegible] which the water issues 3d, [illegible] diminishing at every instant as they ascend, the lower particles of the ascending column press against those next above them, and the pressure being by the nature of fluids communicated in all directions, the consequence is that the column is enlarged and proportionally shortened 4th, The water at the top of the jet does not fall off instantaneously when its velocity is destroyed, it rests for a moment at the top of the column, where its weight opposes an obstacle to the particles next succeeding which retards their velocity, and this retardation is communicated to the whole column This last obstacle may be avoided by slightly inclining the jet from the vertical, and it is found by experience that a jet so inclined plays higher than one quite upright though the effect is thereby rendered less pleasing It is necessary that the diameter of the adjutage or orifice be considerably less than that of the pipe (See *Desaguliers's Experimental Philosophy*, Mariotte, *Mouvement des Eaux*)

JIPPIRUS A disease of plants where the system becomes affected with a general yellowness

JEW'S HARP An instrument of metal, with a flexible vibratory thin metal tongue fixed to its circular base on which tongue the breath acting in different degrees of force, produces something like a modulated air

Shaped thus,  The outer bars are placed between the teeth and the central piece or tongue is set in vibration by the action of the fingers

JEWSTONE The fossil spine of a large egg-shaped echinus

JEZIDS, or DAVASIN A sect of religionists, long settled in the mountainous country near Mosul said to be disciples of Yezid Ben Anisa, a Mohammedan doctor Their religion, however, is said to be a mixture of the ancient Manichean belief of those [illegible] tenets of Mohammedanism and Zendism [illegible] to be on better terms with the Christian [illegible] neighbouring Turks by whom they are characterized as worshippers of the Devil (Arab *Scheitan*), whose name, it is said no threats of punishment will force them to pronounce and whom they only mention by periphrases as the great sheikh' or "he whom you know of" They live in villages huts and tents, and are dreaded for their ferocity and robber like habits They are noticed at length in a preliminary dissertation to *Sylvestre de Sacy's Description du Pachalik de Bagdad* 1809, said to be the work of Father Garzoni who was eighteen years a missionary in Kurdistan (See the art Yezidee" in *Ersch and Gruber's Encyclopædia*)

JIB A large triangular sail, between the fore-topmast head and the boom (thence called jib-boom), which projects beyond the bowsprit

The effect of this sail would seem to be to lift the ship's head, yet seamen find that as the wind freshens it causes the ship on the contrary to plunge and they either *case it in* (along the boom), or haul it down This anomalous effect may be explained as follows —

Let $x$ and $z$ be the horizontal and vertical co-ordinates of the centre of effort, the centre of gravity of the vessel [illegible] let P be the resultant of the pressures [illegible] may obviously be resolved into three $\delta$ the direct effort along $x$, $\lambda$ the lateral effort along $y$, and $\varrho$ the vertical effort in $z$ The moment to raise the bow is $x\varrho - z\delta$ If $z\delta$ exceed $x\varrho$ the effect is negative, or tends to depress the bow In all vessels $x > z$, also $\delta > \varrho$ generally, hence the effect is not so decided as it may appear at first to be

Let $\varepsilon$ be the angle which P makes with the horizon, and $\varphi$ be the angle between $x$ and the horizontal projection of P, then $\varrho = P \sin \varepsilon$ and $\delta = P \cos \varepsilon \cos \varphi$ hence the effect is

$$P (x \sin \varepsilon - z \cos \varepsilon \cos \varphi)$$

When the wind is aft, $\varphi = 0$, and $\varepsilon = 90 - \varkappa$ (the inclination of the jib stay to the horizon nearly), and the effect is

$$P (x \cos \varkappa - z \sin \varkappa),$$

which, as $\varkappa = 45°$, is positive or lifting

When the wind blows fresh, the vessel being close-hauled and heeling over the stay *sags* to leeward, and the after leech being also slacker than the foot the resultant P may become horizontal or $\varepsilon = 0$, or even negative, in which last case the effect is

$$-P (x \sin \varepsilon + z \cos \varepsilon \cos \varphi)$$

which is altogether depressing If now the jib be eased in, *x* and *z* are diminished Hence, in general, the plunging effect of the jib is owing to the heeling of the [illegible] and to the sheet lead too flat aft The like re[illegible] by hoisting [illegible] staysails

JIB DOOR (Derivation uncertain) In Architecture a door so constructed that it stands flush with the adjoining face of the wall on both sides, and without dressings or architraves Thus it appears part of the wall, the intention being to conceal even the appearance of a door

JO'GGLED JOINTS In Architecture, the joints of stones or other masses indented in such a way that the adjacent stones fitting into the indentations, they are prevented [illegible] shed away from each other by any force [illegible] the pressures by which they are th[illegible]

JOGGLED PIECE (Perhaps from joug, *a yoke*) In Architecture, a truss post whose shoulders and sockets receive the lower ends of the struts

JOHN BULL, the well-known collective name of the English nation, was first used in Arbuthnot's satire, *The History of John Bull* usually published in Swift's works, in which the French are designated as Lewis Baboon the Dutch as Nicholas Frog &c

JOI'NERY (Fr joindre) In Architecture, the art of framing wood-work for the finishing of houses, such as doors, sashes, shutters, &c The term Carpentry is applied to the rough timbering, in which the only tools used are the axe, adze, chisel and saw

JOINT STOCK COMPANY In Mercantile Law a partnership consisting of a large number of members who [illegible] and shares [illegible] peculiar regulations imposed by their [illegible] are continued in an instrument termed a deed of settlement and heretofore in an act of parliament passed for the purpose, but now by 4 & 5 W 4 c 94 [illegible] the necessary powers by letters patent [illegible] constitutes trustees, directors, and other officers, contains the necessary covenants, limits the number of shares &c, and details the rules to be adopted in the management of of the concern By a clause contained in this instrument the shares are rendered transferable by each partner without the consent of the other shareholders subject in general to the approbation of the directors The act of parliament, or letters patent enables the company to sue and be sued in the name of its secretary or other officer, &c It [illegible] there [illegible] partnership

JOINT TE'NANCY, in Law, is where lands and tenements are granted to two or more persons to hold in fee simple, fee-tail, for life, for years, or at will It is created by particular words in a deed or devise Its properties are said to be unity of interest, of title of time and of possession, and it is subject to the right of survivorship in the case of estates for life Joint tenancy may be severed by partition or by the alienation of any party Personal chattels may be the subjects of a joint tenancy

JOINTURE In Law, a settlement of lands and tenements made on a woman in consideration of marriage ordinarily an estate for life A jointure was made a bar of dower, if granted with certain requisites, by 27 H 8 c 10 *See* MARRIAGE LAW OF

JOISTS (Fr joindre) In Architecture the timbers of a floor whereto the boards or laths for the ceiling are nailed They either rest on the walls or on girders, or sometimes on both

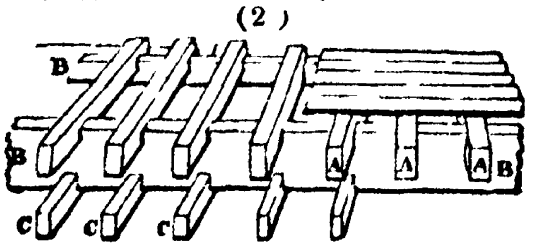
Where only one tier of joists is used, it is called *single flooring* (fig 1), A A A being the joists, and in this sort of flooring such joists should not exceed sixteen feet in length or bearing, and even when the length is more than eight feet they should have stiffening pieces to prevent torsion

(1)



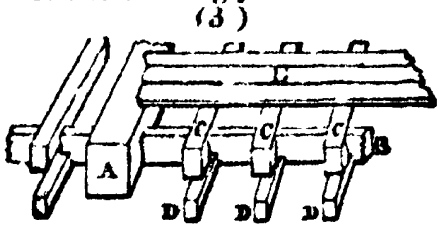

When two sets of joists are used, it is called *double flooring* (fig 2), in which A A are called *floor* or *bridging joists* B B the *binders* C C C the *ceiling* joists

(2)




If the binding joists be framed into girders, the floor is then properly called a *double-framed floor*, of which the subjoined is a diagram (fig 3), wherein A is a girder, B a binding joist, C C C are bridging joists and D D D [illegible] the floor boards of this floor [illegible] girders are the main support

(3)






JOLLY BOAT *See* YAWL

JOURNAL (Ital giornale, *i e* diurnale) Strictly a record or account of daily occurrences It is more extensively employed to signify a narrative periodically or occasionally published of the transactions of a society &c, as by ourselves in the phrase "Journals of the Houses of Parliament," &c It is also used as synonymous with *Magazine*, or other periodical publications of that class

JU'BA (Lat *a mane*) The long and thick-set hairs which adorn the neck, chest, or spine of certain quadrupeds

JUBILA'TE (Lat *rejoice*) A name given to the third Sunday after Easter, so called because in the primitive church divine service was commenced with the words of the 66th Psalm, "Jubilate Deo, omnes terræ," — Sing to the Lord, all ye lands"

JU'BILEE (Lat jubilo, *I rejoice*) The name given among the Jews to the grand sabbatical year, which was celebrated after every seven septennaries of years whether every forty ninth or fiftieth [illegible] the learned The institutic [illegible] in Lev xxv 8—17 This was a year of general release not only of all debts, like the common sabbatical year, but of all slaves and of lands and possessions which had been alienated from their original owners It has been [illegible] that the jubilee was intended to be [illegible] the [illegible] and redemption of mankind under the Gospel dispensation, and it was with this idea that Pope Boniface VIII [illegible] proclaimed a ge[illegible] should visit the tombs of the Apostles at Rome in the secular year 1300 At this period it was intended that the same celebration should take place only every hundredth year In consequence, however, of the enormous afflux of pilgrims which this proclamation brought together and the gain which resulted from it, Clement VI abridged the interval to fifty years, and the solemnity then received the name of the jubilee in imitation of the Jewish custom The second jubilee was accordingly solemnized in 1350 In 1389, Urban V reduced the term to thirty-three years, the number of the life of our Saviour it was [illegible] Nicholas V to fifty, and finally in 1470, [illegible] twenty five, and the jubilee has ever since been solemnized every quarter of a century beginning on Christmas eve, when the Pope opens with great pomp the door of St Peter's, closed except on that occasion (*Mosheim's Eccl Hist*, Transl, ed 1790 iii 263)

JU'DAISM Attachments to the rites of the Jewish law The Judaizing spirit of many of the early Christians is a subject of observation in many of St Paul's Epistles (especially that to the Galatians), and continued for a long period to exercise much influence on the character of the religion (See *Milman's Hist of Christianity* vol i 21 451 &c)

JU'DGES (Lat judex) Certain supreme magistrates who presided over the Israelites from the time of Joshua to the reign of Saul, a period of about 330 years They were so called because they formed at once the civil and the military governors of the people The dignity was retained for life, though it was not always hereditary

JU'DGMENT (Lat judicium) In Law the sentence of the law pronounced by the court upon the matter contained in the record The term judgment, in English legal language is restricted to the decisions of a court of common law those of a court of equity are denominated decrees Judgments are said to be of four sorts —1 Judgments in law (on demurrer where the facts are confessed upon the pleadings) 2 Judgments in fact (on the verdict of a jury), 3 Judgments by confession or default, *i e* where both facts and law are admitted by the defendant, 4 Judgments on a nonsuit or retraxit, where both fact and law are admitted by the plaintiff, who thereupon withdraws his claim Judgments are also said to be either interlocutory on matter arising in the course of the proceeding, or final, on the merits of the case Judgments, when obtained, must be signed by the proper officer, and entered of record, without which they are not judgments Arrest of judgment arises from error appearing upon the face of the record, but such error must now be generally speaking in substantial matter of law, and not on mere matter of form

JU'DGMENT, in Logic, is defined to be the second of the three logical operations of the mind It is the comparing together two of the notions which are the subjects of [illegible] and pronouncing that they agree or [illegible] Judgment, therefore, is either affirmative or negative, and the subjects of judgment are *propositions*, which are expressions of the agreement or disagreement of one term with another

JU'DGMENT In the Fine Arts, the faculty of selecting that which is most suitable to the purpose

JUDICA (Lat *judge*) The fifth Sunday after Lent was so called, because the primitive church began the service on that day with the words of the 43d Psalm, "Judica me Domine —" Judge me O Lord"

JUDI'CIUM DEI (Lat *Judgment of God*) The

term [illegible] all extraordinary trials of secret crime [illegible] ums, single combat, ordeals, &c , in which it was believed that Heaven would miraculously interfere to clear the innocent and confound the guilty (*See* ORDEAL, QUESTION ) Full particulars of the ceremonies instituted on such occasions will be found in *Ducange*

JU'GAL BONE (Lat jugum or Gr ζυγον, *a yoke* ) The cheek bone, so called because it has a *yoke-like* ar[illegible] [illegible] e upper jaw

JU'GATE [illegible] - represented upon a medal side by side or joining each other

JU'GGERNAUT *See* VISHNU

JU'GGLERS (Fr jongleurs ) A general denomination for those persons who practise the arts of legerdemain or who exhibit feats of uncommon strength or dexterity The reader will find in *Beckman's History of Inventions* a learned and curious account of the origin and history of all the feats of this kind exhibited both in ancient and modern times

JUGLANDA'CEÆ (Juglans one of the genera ) A small natural order of Exogenous trees, distributed through the temperate parts of North America and Asia The common walnut *Juglans regia* is well known for its agreeable fruit, and the useful oil it yields by pressure Hickory a very elastic kind of timber, is the wood of *Carya alba*, and that of other species especially *Juglans nigra* and *regia*, is valuable for cabinetmakers' work and similar purposes

JU'GULARS, *Jugulares* (Lat ) The name under which Linnæus comprehended all those fishes which have the ventral fins anterior to the pectorals

JU'GULAR VEINS (Lat jugulum *the throat* ) The [illegible] and *internal* By their union with the subclavian vein they form the superior *vena cava* which terminates in the superior part of the right auricle of the heart

JU'GULUM (Lat *the throat* ) In Mammalogy it is restricted to the fore-part of the neck which intervenes between the throat (gula) and the chest The *fossa jugularis* is the hollow in front of the sternum at the base of the neck

JUJU'BE The fruit of the *Rhamnus zizyphus* it resembles a small plum and is occasionally used as a sweetmeat What is sold under the name of *jujube paste* professes to be the dried jelly of this fruit, but is in fact a mixture of gum arabic and sugar slightly coloured

JU'LIAN ÆRA The commencement of a period invented to correspond with the cycles of the Julian year It coincides with the 710th year before the creation of the world, according to [illegible] chronology

JULIAN CALENDAR The civil calendar introduced at Rome by Julius Cæsar, and used by all the Christian countries of Europe till it was reformed by Pope Gregory XIII in 1582 Before the time of Julius Cæsar the Roman year was lunisolar, and as the pontiffs who had a discretionary power of adjusting the calendar followed no certain rule in their intercalations but sometimes inserted a greater or less number of days for the purpose of prolonging or shortening the period of a particular magistracy the civil year did not long correspond with the astronomical or the course of the seasons, and the reckoning of time fell into great confusion With the advice of the astronomer Sosigenes Cæsar fixed the mean length of the year at 365¼ days, and in order that the year should always commence with the commencement of a day, he decreed that three successive years should contain 365 days, and the fourth 366 and so on for ever He also restored the vernal equinox to the 25th of March the place it occupied in the time of Numa, and thus fixed the correspondence of the civil year with the seasons

In distributing the days of the year among the twelve calendar months Cæsar adopted a very commodious arrangement, which unfortunately was not long suffered to prevail He ordained that the odd months, viz the first third fifth, seventh, ninth, and eleventh, should have each 31 days, and the even months 30 days, with the exception of February which in common years should have only 29 but in the intercalary years 30 days This was as simple and natural a disposition as, perhaps it is possible to make, but the whole arrangement was soon thrown into disorder and confusion to gratify the frivolous vanity of Augustus, by giving to the month which he had named after himself the same number of days as July, which bore the name of the first Cæsar A day was accordingly taken from February and given to August, and lest three months of 30 days might not come together, September and November were reduced to 30 days, and 31 given to October and December Such was the origin of the capricious arrangement which has ever since been adhered to *See* CALENDAR

JULIAN EPOCH In Chronology, the epoch or commencement of the Julian Calendar The first Julian year commenced with the 1st of January of the 46th year before the birth of Christ, and the 708th from the foundation of Rome

JULIAN PERIOD, in Chronology, is a period con[illegible] [illegible] and 15, that is, of the cycle of the sun, the cycle of the moon, and the cycle of indiction The first year of the Christian era had 10 for its number in the cycle of the sun, 2 in the cycle of the moon, and 4 in the indiction Now the only number less than 7980 which, on being divided successively by 28, 19, and 15, leaves the respective remainders 10, 2, and 4, is 4714 Hence the first year of the Christian era corresponded with the year 4714 of the Julian period, and hence also the year of our era corre[illegible] [illegible] ie period, or *vice versâ*, is [illegible] [illegible] nterior to the commencement of the era, subtract the number of the year of the Julian period from 4714, and the remainder is the year before Christ, or subtract the year before Christ from 4714, and the remainder is the corresponding year in the Julian period

2 When the given year is after Christ, subtract 4713 from the year of the period, and the remainder is the year of the era, or add 4713 to the year in the era, and the sum is the corresponding year of the Julian period (*Ency Brit*, art 'Chronology' )

JU'LIAN YEAR The year adopted in the calendar of Julius Cæsar, and equal to 365¼ days The Julian year exceeds the mean solar year, as determined by the best astronomical observations, by 11 minutes and 10·35 seconds which amounts to a day in 129 years In the course of a few centuries this error would become very perceptible, as the equinoxes and solstices would fall back towards the beginning of the year When the Julian calendar was introduced by Cæsar the vernal equinox fell on the 25th of March, at the time of the Council of Nice in 325 it fell on the 21st, and at the reformation of the calendar, in 1582, it had retrograded to the 11th This observation enabled Pope Gregory to fix the length of the year more precisely, and correct the intercalations *See* CALENDAR

JU'LIS (Lat *the name of a fish* ) A genus of [illegible] [illegible] lateral line bent suddenly downward [illegible] opposite the end of the dorsal fin The rainbow [illegible] (*Julis Mediterranea*) has been taken on the coast of Cornwall

JULY, so named by Mark Antony, in honour of Caius Cæsar the dictator, whose gentile name was Julius is at present the seventh month of the year In the Latin calendar it was the fifth, and hence was termed *Quintilis* The Dog-days are supposed to commence on the 3d of this month

JU'MPING HARE [illegible] of the family of the [illegible] the genus *Helamys* [illegible] Cape of Good Hope, and inhabits deep burrows *See* HELAMYS

JUNCA'CEÆ (Juncus one of the genera ) A small obscure natural order of Endogenous plants in most [illegible] [illegible] *Juncus* and [illegible] [illegible] brown or green in colour There are however, species intermediate between the two orders in this respect None of the species are of any importance The common rush is the usual type of this order

JUNCAGINACEÆ A small natural order of Endogenous plants growing in marshes, with minute green flowers They are considered by botanists allied to *Aracæ*, on account of the structure of the embryo, in their general aspect they are something like little rushes

JUNE, so named, according to some, either from the Latin Junius Juno, or Juniores (May, as was alleged, being derived from Majores) At present the sixth month of the year, but in the old Latin calendar the fourth It consisted originally of twenty-six days, to which Romulus is said to have added four Numa afterwards deprived it of one day, which, however, was again restored by Julius Cæsar, and it has ever since remained unaltered

JUNGERMANNIACEÆ (Jungermannia, one of the genera ) A very small natural order of Acrogenous or Cryptogamic plants resembling mosses in appearance, and, like them, growing upon the bark of trees and in damp ground in shady places They bear their seeds in cases containing spiral threads, which, by their elasticity disperse the former when ripe Until lately they were considered to form a part of *Hepaticæ*

JU'NIPER BERRIES The fruit of the *Juniperus communis* They are used in medicine as a diuretic, but their principal consumption is in flavouring gin When distilled with water they yield an essential oil, upon which their peculiar flavour depends The resin of this tree is called juniper gum or sandarach, and is occasionally used in varnishes When powdered it is

used under the name of *pounce*, to prevent ink sinking into paper from which writing has been erased

JUNK A large flat-bottomed vessel, with three masts, and a short bowsprit placed on the starboard bow, used by the Chinese The masts are supported by two or three shrouds, which at times are all carried on the windward side and the fore or main mast carries a sort of lug sail of cane (bamboo)

JU'NO The Latin name of the divinity called by the Greeks Hera ("Hρη) She was the sister and consort of Jupiter, and was held to preside over marriage, and protect married women She was represented as the model of majestic beauty, in royal attire, and attended by her favourite bird the peacock Her principal temples in Greece were at Samos and Argos She was also the patroness of Veii, whence she was invited to Rome on the occasion of the last siege of the former city

JU'NO One of the four small extra-zodiacal planets which circulate between the orbits of Mars and Jupiter Juno was discovered by Professor Harding of Lilienthal (near Bremen) on the 22d of September, 1804, Ceres and Pallas having been discovered previously Juno appears like a star of the eighth or ninth magnitude and is of a whitish colour without nebulosity This planet is distinguished by the great eccentricity of its orbit, exceeding that of any other planet and amounting to 2578, the semi-axis major being taken as unit The effect of this eccentricity on the motion of the planet is such, that the half of the orbit which is bisected by the perihelion is described in about half the time in which the other half is described The sidereal revolution is performed in 1592 66 mean solar days The inclination of the orbit to the ecliptic is 13° 4′ 10″ and the greatest equation of the centre 29° 46′ 19″ The extreme smallness of the planet renders it impossible to determine its apparent diameter, and consequently its magnitude, with any degree of certainty

JU'NTA (Span *an assembly*) A grand Spanish council of state Besides the assembly of the states or *cortes*, there were two juntas one which presided over the commerce, the mint, and the mines, and the other forming a board for regulating the tobacco monopoly The assembling of a junta by Napoleon in 1808 and the part they subsequently played in Spanish history are sufficiently known to the reader In England the term *junto* (evidently of Spanish origin) is used almost synonymously with cabal or faction

JU'PITER In Mythology the Latin name of the deity called by the Greeks Zeus (*Ζευς*) it is derived from that word with the addition Pater *Father* He was the son of Saturn, whom he deposed from his throne, and thence became the supreme monarch of gods and men He married his sister Juno, by whom he had Vulcan, but be- [illegible] demigods by [illegible] The most celebrated of his children were Minerva who had [illegible] her father's forehead, Ba[illegible] and Diana Mercury Pr[illegible] and Minos The most celebrated Grecian temple of this god was at Olympia in Elis, where every fourth year the Olympian games were celebrated in his honour his most revered oracle was among the oak woods of Dodona in Epirus The Romans considered Jupiter as especially the patron of their [illegible] Ol[illegible] columns standing

Jupiter was represented as the model of dignity, grave but mild he is seated on a throne grasping his sceptre and a thunderbolt, and by his side stands his peculiar bird, the eagle

It has been remarked that there is a striking similarity between *Jove* (from *Jovis*, gen of Jupiter) and the Hebrew name of the Supreme Deity, Jehovah

JUPITER In Astronomy, one of the planets and the largest in the system The mean diameter of Jupiter is no less than 87 000 miles, or about eleven times that of the earth, consequently his bulk is about 1300 times greater than that of the earth The distance of Jupiter from the sun is nearly 490 millions of miles, or about 5½ times the radius of the earth's orbit, and he performs his revolution in respect of the stars in 4332 days, 14h 2m 8½ sec, which is nearly 12 years The inclination of the orbit to the plane of the ecliptic was 1° 18′ 51″ at the beginning of the present century and undergoes a diminution of about a fourth of a second in a year

The disc of Jupiter is always observed to be crossed in one certain direction by dark bands or belts These belts are, however, by no means alike at all times, they vary in breadth and in situation on the disc (though never in their general direction) They have even been seen broken up, and distributed over the whole face of the planet, but this phenomenon is extremely rare Branches running out from them, and subdivisions, as well as evident dark spots, like strings of clouds, are by no means uncommon, and from these, attentively watched, it is concluded that the planet revolves in the surprisingly short period of 9h 55m 50 sec (sid time) on a [illegible]

"The [illegible] their occasional variations, and the appearances of spots seen upon them, render it extremely probable that they subsist in the atmosphere of the [illegible] forming tracts of comparatively clear sky, determined by currents analogous to our trade winds, but of a much more steady and decided character, as might indeed be expected from the immense velocity of its rotation That it is the comparatively darker body of the planet which appears in the belts is evident from this — that they do not come up in all their strength to the edge of the disc but fade gradually away before they reach it" (*Herschel's Astronomy, Cabinet Cyclopædia*, p 281)

The radius of Jupiter being 11 times greater than that of the earth, and the rotation on the axis being 2 4 times more rapid, the space passed over by a point on the equator of the planet will be 26 times greater than that described by a point of the terrestrial equator in the same time Hence the centrifugal force is about 26 times greater, and we may therefore conclude that its effect in impressing a flattened form on the planet will be much greater than takes place with regard to the earth Now observation shows this to be the case The disc of Jupiter is evidently not circular, but elliptic, being considerably flattened in the direction of its axis of rotation, and this appearance is no optical illusion, but is authenticated by micrometrical measures, which assign 15 to 14 as the proportion of the equatorial and polar diameters This far exceeds the compression of the earth the ratio of the equatorial to the polar diameter of which is 302 to 301

The annual parallax of Jupiter is less than 12″, consequently the earth as seen from Jupiter will never appear at a greater distance than 12″ from the sun The digressions of Mars will be 17°, those of Venus 8°, and those of Mercury only 4° 16′ An inhabitant of Jupiter would therefore probably be ignorant of the existence of Mercury, which will be almost constantly plunged in the sun's rays and likewise diminished in splendour, on account of the greater distance

The density of Jupiter is very nearly the same as that of the sun and about one fourth of the mean density of the earth The mass of the planet compared with that of the sun taken as unity is 000943, but this is sufficient to produce a very sensible perturbation of the motions of some of the other planets The proportion of light and heat received by Jupiter from the sun, compared with that received by the earth is as 037 to 1

Jupiter through the telescope is observed to be accompanied by four moons or satellites, which revolve about the planet nearly in the plane of its equator, exactly in the same manner as the moon revolves about the earth Their configuration changes at every instant, they appear to oscillate on each side of the planet and their rank or order of distance is determined by the extent of their oscillations In coming between the sun and Jupiter, the satellites throw their shadows on the planet, and produce eclipses of the sun, and when they come to the side of the planet opposite to the sun they are eclipsed in passing through the shadow The beginnings and endings of these eclipses can be observed with great precision, and their observation furnishes the surest means of determining the sidereal and synodic revolutions of the satellites The same observations also afford a means of determining terrestrial longitudes, and it was by means of them that astronomers discovered and measured the velocity of light See PLANET and SATELLITE

JU'RISCONSU'LT (Juris consultus, *learned or skilled in law*) A title given to a class of Roman lawyers, and commonly denoted by the abbreviation *ictus* From what we know of the jurisconsults, they appear to have been a different class from the advocati or causidici who conducted causes, and to have confined themselves to the employment of giving responsa or opinions on cases put to them (See *Mem de l'Ac des Inscr* vol xli) From the recorded opinions of the most learned jurisconsults the *Digest*, the great work of Justinian, was chiefly compiled See ADVOCATE

JU'RISPRU'DENCE The science of right (From the Latin words juris prudens, *skilled in law*) The term *civil jurisprudence* is sometimes restricted to the science of the Roman or civil law For a literally complete list of works on this extensive subject see *Krug's Philosophisches Lexicon*, art "Rechtslehre"

JURY-MAST In Naval affairs, a temporary mast erected in a ship in the room of one that has been carried away by tempest or any other accident Jury-masts are sometimes erected in a new ship to navigate her down a river, or to a neighbouring port, where her proper masts are prepared for her

JURY, TRIAL BY Of the origin and progress of this institution, as far as it has been very [illegible] traced by antiquarians, some account has been [illegible]

the historical review of the Common Law When issue has been taken in fact in a civil suit (*see* PLEADING), the cause stands ready for trial *at bar* of the court itself (*see* LAW, SUPERIOR COURTS), unless by the fiction of *nisi prius* (ib ) it is transferred to the sittings in London and Middlesex, or the assizes in the country (A trial at bar is now c
cases ) The
venire facias to summon jurors
and by a further compulsory pro
he is ordered to distrain them by their lands and goods u
they make default in appearance On motion of either the plaintiff or defendant, the court orders a *special jury* to be summoned The list of persons liable to serve as common jurors is made out by the churchwardens and overseers in each parish, and, after being considered by justices at petty sessions, is copied into a book and delivered to the sheriff On the return of the writs of venire facias, the sheriff annexes a *panel* or list of persons taken from this book, in number from 48 to 72, and the judges are empowered to direct the same panel to attend both for the civil and the criminal sides amounting in all to 144 The twelve jurors who are to try the cause are chosen by ballot out of this list The qualification of a common juror is to be a natural born subject (unless on trial of an alien in which he may if he pleases have a jury *de medietate linguæ* of which one half consists of aliens), to be free from attaint of infamous crime, and to be between the ages of 21 and 60 All such persons (with certain privileged exceptions) possessing 10*l* a year in freehold or copyhold lands and tenements, or 20*l* a year in lands held on lease for 21 years, or rated as householders to the poor's rate in Middlesex for 30*l*, elsewhere 20*l*, or occupying a house with 15 windows are liable to serve In the city of London the juror must be a householder or occupier
property real or personal, to the
ons described in the jurors book as esquires or of a higher degree, or as bankers or merchants are qualified to serve on special juries If on a trial sufficient qualified jurors are not in attendance, a *tales* may be prayed, and bystanders are called in to fill up the number This seldom occurs but in special jury cases, and in these the *talesmen* as they are vulgarly termed are taken from the common jury list

The jury being summoned, the trial proceeds, unless either party *challenge* the jurors *Challenges* are either *to the array* or *to the polls* A challenge to the array is an objection to the whole panel and can only be on account of default or partiality of the sheriff Challenges to the polls are to individual jurors, are said to be of four kinds, *propter honoris respectum*, *propter affectum*, and
is exempted by statute from serving he may challenge himself 2 Insufficient qualification is a ground of challenge by either party 3 On suspicion of partiality as by reason of kindred Challenge to the favour are on a mere suspicion of partiality Legal infamy is the fourth ground of challenge In a criminal case the law of challenges is the same as in a civil one, except that the prisoner for felony has the additional privilege of making *peremptory*
any number of jurors
for cause, if *to the polls*, are tried by the court, except those to the favour, which the court appoints two jurors if sworn, if not two indifferent persons to try Challenges to the array are tried entirely at the discretion of the court

According to the common course of a trial at nisi prius, the counsel for that party on which the affirmative of the issue is thrown by the pleadings (that is, except in occasional cases, the plaintiff) *opens his case* by a statement to the jury and then calls witnesses to prove it The counsel for the other party then replies, and if he also calls witnesses the first speaker has a final reply After the evidence is given and the case closed the jurors are kept together to deliberate of their verdict They must be without meat drink, or fire, unless otherwise ordered by the judge, and as unanimity is necessary to a verdict, it was held at common law that if the jury could not agree, the judge might cause them to be carried round the circuit from town to town in a cart In practice it is usual when they cannot be brought to agreement, to discharge the jury Although the jury in
be judges of the *fact* only, yet
or criminal case ordinarily decides both the facts, and whether the law as stated by the judge is immediately applicable to those facts *e g* a verdict 'guilty' on a charge of murder implies both that the act was committed, and that it was committed under circumstances amounting to murder The jury may, however, find under certain circumstances a *special* verdict, that is, a verdict in which the facts of the case are specially stated, and it is left to the court to apply the law, or they may find a general verdict, subject to a special case as to a point of law In cases of criminal prosecution for libel, much difference of opinion formerly prevailed as to the





effect of a verdict It was held by most lawyers that the only questions for their consideration were the fact of publication, and the truth of what is technically called *the innuendos*, viz that the passages of the libel cited did apply to such or such facts and individuals But by 32 G 3 c 60 (passed through the influence of Mr Fox) it was enacted that on every trial of an indictment or information for libel the jury may find a general verdict of
of
JUST, or JOUST
two persons with lances properly, a mere amicable contest of trial of strength *See* TOURNAMENT

JUSTI MILITU *See* MILITU JUSTE

JUSTICES OF THE PEACE, in Law, are descended from the ancient conservators of the peace, and are appointed
all jointly and separately, to keep the peace, and any two or more of them to inquire of or determine felonies and misdemeanours Some justices, also, are so by act of parliament (namely, a few high ecclesiastical officers), and some by charter or grant, as the mayor and other magistrates in corporate towns Some justices are expressly nominated in the commission, so that certain business cannot be transacted without their presence, these are said to be of the *quorum*, and all the justices are now usually included in the list The qualification of a justice is to have an estate of 100*l* a year free of incumbrance, or a reversion after one or more lives of 300*l* a year, but many privileged persons may act without qualification by estate A justice intending to act under this commission sues out a writ of *dedimus potestatem* from the clerk of the crown in chancery, and takes certain usual oaths

The duties and powers of a justice of the peace are of two kinds, ministerial and judicial In the acts in the former capacity in preserving the peace, hearing charges
examining the informant and his witover the parties
dence, and committing or admi
to the nature of the offence parties who are brought before him The stat 7 & 8 Geo 4 c 64 requires justices to take the most material part of the evidence on examinations before them in writing, to be returned to the assizes both in charges of felony and misdemeanor 2 An extensive jurisdiction, summary and formal, is now exercised by justices of the peace, numerous branches of judicature, both criminal and civil, having been gradually confided to their authority, either exercised by them individually or at the petty sessions and general quarter sessions of the peace The latter court, by 34 Ed 3, has jurisdiction over all felonies and trespasses whatever in practice simple larcenies and many other felonies and small misdemeanors are tried by a jury before it It has also by various statutes jurisdiction over several ot
appellate
vide
trade, and it has one large and exclusive power committed to its care by the legislature, viz the hearing and deciding appeals from orders of magistrates relative to the imposition of the poor's rate, and to the removal of paupers from one parish to another in which they are shown to have a legal settlement (See SETTLEMENT) Justices have either singly or jointly, summary jurisdiction in questions of contract between certain classes of masters
whether
with
freehold, not exceeding 5*l* in value,
batteries not causing injury
the latter case two justices are required), and in certain malicious injuries to property The proceedings are in general on a written charge sometimes termed a complaint, but in proceedings for
an information on receiving which
a summons to cause the appearance of the party charged An appeal to the quarter sessions from the conviction or order of justices is sustainable only where expressly given by statute, and the court of session on hearing the case, is said either to *affirm* or *quash* the conviction or order And the
into the

Other summary remedies afforded by magistrates are in cases of forcible entry and detainer, and some that arise between landlord and tenant

Justices of the peace are liable to actions at the suit of parties injured by them wilfully in the exercise of their authority But it is provided by statute that they shall have notice of any action commenced against them, and the cause of such action, one month before the writ is sued out, and the action must be commenced within six months after the injury complained of Persons recovering a verdict against a justice for any wilful or malicious injury are entitled to double costs These magistrates are also punishable criminally by indictment or information

The police justices of London and its vicinity are stipendiary magistrates, created by act of parliament

JUSTICIARY CHIEF (Lat magnus justiciarius or capitalis justiciarius totius Angliæ) An officer of high power and dignity under the Norman kings of England, who presided over all the courts in the aula regis or king's court so long as it followed the person of the king, and was says Blackstone by virtue of his office guardian of the realm in the king's absence The fundamental power of the chief justiciary was curbed to some extent by the provisions of the great charter, especially that which fixed the trial of common pleas at Westminster, and became altogether obsolete when the various branches of his jurisdiction were broken up into judicature under Edward I *See* [illegible]

JUSTICIARY, THE HIGH COURT OF, IN SCOTLAND, is composed of five of the Lords of Session, added to the Justice-Clerk, the president of the court It is the supreme court of criminal justice, with the power of advocating or suspending all sentences of inferior criminal judges It has circuit courts twice a year, and an additional circuit is now held in Glasgow during the Christmas recess of the Court of Session The sinecure office of Lord Justice-General was in 1831 merged in that of the Lord-President *See* SESSION, COURT OF

JUSTICIES In Law [illegible] sheriff of a county to [illegible]
By means of this writ all personal and many real actions may be tried in the county courts

JUSTIFICATION (Lat transl of the Greek word δικαιωσις) In Theology men are said to be justified when accounted just or righteous in the sight of God, or placed in a state of salvation Justification is used of the state of Christians in the present life only, as in Rom v 9, 'Being justified by his blood we *shall be* saved from wrath through him' The doctrine of justification through faith or rather by faith (εκ πιστεως, διὰ πιστιν *for or by reason of faith*) is set out with peculiar distinctness in the whole Epistle to the Romans According to the eleventh article of the Church of England we are justified 'by faith, and not for our works or deservings' The twelfth declares, that "although good works, which are the fruits of faith and follow after justification cannot put away our sins and endure the severity of God's judgment, yet are they pleasing and acceptable to God in Christ, and spring necessarily out of a true and lively faith, insomuch that by them a lively faith may be as evidently known as a tree is discerned by the fruit" The first of these articles is chiefly directed against the Romanist doctrine of meritorious works, the second, based on the language of St James, that a "man is justified by works, and not by faith only" (c 2 v 24) regards faith and works as inseparably connected and is aimed principally against the doctrine of those who were termed Antinomians or Solifidians For a summary of the opinions [illegible] on this difficult subject, see *Hoskin's Sermon on Justification*, for the views of what is called the High Church party of the present day, *Newman's Lectures on Justification*

# K.

K, a consonant, used in most ancient and modern languages It is derived from the Greek *kappa* or the Hebrew *koph* It has the same sound as C before *a o*, and *u*, and hence it has often been pronounced superfluous In Latin K occurs only in a few words though it was frequently used in the same language as an abbreviation for words beginning with C, as K F for capite tonsus, K R C for cara civitas &c &c In the French alphabet K is only used in words derived from foreign languages As a numeral it was employed to express 250,—

K quoque ducentos et quinquaginta docebit

KA'ABA *See* CAABA

KA'KOXENE (Gr καχος *bad* and οξυς *sharp*, so called probably from the mischief it does to the iron) A mineral occurring in brown or red radiated crystals in the ironstone of Zbiron in Bohemia when heated it emits a green phosphoric light It contains phosphoric and fluoric acids, peroxide of iron and silica

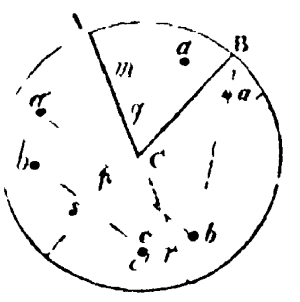
KA'LAND (Germ) A lay fraternity instituted in Germany in the 13th century for the purpose of doing honour to deceased relatives and friends The term is probably derived from kalendæ, *the first day of any month*, as the members of this society chose that day for the observance of their ceremonies These consisted originally of prayers, followed by a slight repast in which all the members participated, but in process of time the religious purposes of the society became wholly merged in the festivities, so that it eventually was found necessary to abolish [illegible] on account of its excesses

KALEIDOSCOPE (Gr καλος, *pretty*, ειδος, *form*, and σκοπεω, *I view*) An [illegible] or revived by Sir David Brewster, [illegible] arrangement of reflecting surfaces, presents to the eye a series of symmetrical images often remarkable for their beauty

The kaleidoscope is formed by two plane mirrors or slips of glass, from six to ten inches in length and from an inch to an inch and a half in breadth at the one end though somewhat narrower at the other, joined together along the edges lengthwise, and inclined to each other in an angle, which must be an exact aliquot part (that is to say, the sixth, eighth, tenth, &c) of four right angles The edges of the mirrors are kept in contact by a strip of black silk glued along the back of the plates, which, if formed of glass, must be coated with black varnish or sealing wax, to prevent reflexion from their posterior surfaces The mirrors being adjusted at the proper angle, are placed within a tin tube, where they are kept in their proper position by pieces of cork or wood wedged in between them and the tube One end of the tube has a small circular aperture in its centre, to which the eye is applied, in the other end two plane glasses are fixed parallel to each other, and perpendicular to the axis of the tube, and about an eighth of an inch apart Between these glasses which form a cell, the objects which produce the images are placed Those which answer the purpose best are small fragments of coloured glass, beads, or other coloured diaphanous matters, of such a size that when the tube is turned round they move freely within the cell and assume new positions In order that the eye may not be disturbed by objects without the tube, the outer glass should be slightly ground, but the inner must be perfectly transparent

On applying the eye to the aperture of the tube the objects within the cell at the other end are seen multiplied by repeated reflexions from the two mirrors and a succession of symmetrical images presented, all arranged round a centre and combined into a perfect whole As the objects are placed loosely in the cell, every motion of the tube changes their relative positions whereby an entirely new image is produced, and it is this constant change and endless variety of new combinations which create the pleasing effect

In order to show how this multiplication of the images is produced let A C represent one of the mirrors and B C the other, and suppose them to make with each other an angle of 60° let *a* also be an object placed between the planes of the two mirrors or one of the diaphanous bodies in the cell between the two parallel glasses at the end of the tube Now when an object is seen reflected from a mirror the image always appears as far behind the mirror (in a perpendicular line) as the object itself is before it, and, with relation to a second mirror, this image will have all the effect of a real object Let therefore *a m* and *a n* be drawn perpendicular to A C and B C and produced till $m a' = m a$, and $n a'' = n a$, then $a'$ and $a''$ will be the two first images of the object *a* Make $a' p$ perpendicular to B C, and $a'' q$ to A C, and let $p b' = a' p$ and $q b'' = a'' q$, then will $b'$ and $b''$ be the images of *a* formed by a second reflexion Again draw $b' c'$ perpendicular to A C and $b'' c''$ perpendicular to B C, and let $c' r = b' r$ and $c'' s = b'' s$, then will $c'$ and $c''$ be the images of *a* formed by the third reflexion But by the geometrical properties of the figure these two points $c'$ and $c''$ coincide or the two images are blended together and the object will be seen in six different places symmetrically arranged in a circular field about the centre C In like manner if A B C had been the 8th part of 360° the object would appear in eight positions, and so on, but if the angle at C, which is the angle of the mirrors be the 5th or 9th, or any odd aliquot part of 360° the images will not coincide, and the symmetrical [illegible] cannot be produced




[illegible] here described was first made known by Sir David Brewster, who took out a patent for it in the year 1817, but by some means or other its properties were discovered and it had acquired great popularity as an agreeable toy, and was in the hands of every body before any number of the patent kaleidoscopes could be prepared for sale It was also very soon remarked that the discovery was by no means new, as an instrument on the same principles [illegible] Porta and Kircher, and also [illegible] England in 1810 under the title of *New Improvements of Planting and Gardening*, by R Bradley, in which it was recommended as useful for assisting to form designs of garden plots and fortifications In fact, the principle, so far as the multiplication of images and their general arrangement are concerned, had been long known, but in order to produce the symmetry which constitutes the principal beauty of the kaleidoscope, it is also necessary that the object and the eye have certain positions with respect to the mirrors, and [illegible] condition seems to belong exclusively to Sir D Brewster See *Brewster's Treatise on the Kaleidoscope*, *Harris's Treatise on Optics*, *Brewster's Optics Cab Cycl*, the *Ency Brit*, &c

KA'LENDERS (From an Arabic word signifying

pure gold) Wandering dervises (See *Lane's Arabian Nights Entertainments*)

KA'LI An Arabic word, signifying the ashes left after the combustion of certain plants, hence the word *alkali* Plants containing *kali*, and potash in *kali-um* the Germans call, hence they

KA'LMIA From Kalm a botanist North American plants, with stamens by their anthers in the same number of niches in its sides The flowers are white or pink, and the leaves evergreen, but the plants are said to be deleterious

KAMI Spirits or divinities, the belief in which appears to have characterized the ancient religion of Japan before it became intermingled with foreign doctrines, and still constitutes These spirits are partly elemental, gods of the sun and moon, and partly the spirits of men, but in fact every natural agent or phenomenon has its spirit or genius The human spirits survive the body, and receive happiness or punishment for the actions of the individual in his Distinguished benefactors of their species, or men renowned for purity of life are deified, and their *kami* rship, like the heroes of antiquity is said at present to be above 3000 They are worshipped in temples in which no images are retained, each pure Deity being merely typified by a mirror, the emblem of purity, and all the rites of the worship appear to be symbolical of purification The priests of these temples are styled Kami-Nusi, *i e* ministers of the spirits (*Klaproth, Annals of Japan*, 1834, *Wiener Jahrbuch* for 1837)

KAMICHI The name of a Rassorial or Gallinaceous bird, remarkable for having its wings armed with two strong spurs and its head with a long slender, cylindrical and nearly straight horn *See* PALAMEDEA

KA'NGAROO The native name of a large indigenous quadruped of New Holland, it belongs to a genus characterized by a strictly herbivorous modification of the marsupial type of the dental organs and by a remarkably long and strong tail and hind legs *See* MACROPUS and MARSUPIALIA

KA'NTIAN PHILOSOPHY (known also by the name of the Critical Philosophy) A system which owes its existence to Immanuel Kant, professor of logic and metaphysics in the university of Konigsberg in the latter half of the 18th century The promulgation of Kant's doctrines forms a very marked era in the history of philosophy Our limits will prevent us from giving an explanation of this system in any degree adequate to its importance We must confine ourselves to a brief outline of its leading features At the time when Kant commenced his metaphysical labours the philosophical world was divided between the sensualism of the French followers of Locke on the one hand and the dogmatic rationalism of the disciples of Wolf and Leibnitz on the other The former, by a species of analytical legerdemain, resolved all our mental powers into modifications of sense, while the latter in an equally indiscriminating spirit, though with far more laudable intentions, sought to construct a system of real truth out of the abstract conceptions of the understanding Against both of these schools Kant declared open warfare Withdrawing himself from all ontological speculation, he sought by a stricter analysis of our intellectual powers to ascertain the possibility and to determine the limits of human knowledge He divides the speculative part of our nature into three great provinces —sense understanding and reason Our perception of the outward world is representative merely of things as they are in themselves it affords us no notices In order to render human experience possible two ground-forms under which all sensible things are contemplated, are assumed —time and space To these he assigns a strictly subjective reality The truth of the fundamental axioms of geometry rests on the necessity and universality of our intuitions of space in its three dimensions —intuitions which are not derived from any one of our senses, or from any combinations of them, but lie at the ground of all of all sensible human experience The understanding or the faculty which combines and elaborates the materials yielded by sense, Kant subjects to a similar analysis All its operations are generalized into four fundamental modes or forms of conception, which, after the example of Aristotle, he names categories (*See* CATEGORY) These are four in number —1 Quantity, including unity, totality, 2 Quality, divided into reality and limitation, 3 Relation, viz substance and accident, cause and effect, action and reaction, and 4 Modality, also subdivided into possibility, existence, and necessity These form, as it were, the moulds in which the rude material of the senses is shaped into conceptions, and becomes knowledge properly so called The categories in themselves are the subject-matter of logic, which is so far forth a pure science, determinable a priori The third and highest faculty, the reason, consists in the power of intelligence, to which the correspondents Out of formed they are to be regarded as regulative only not as constitutive The existence of God, immortality, freedom, are the objects after which the reason is but concerning which it can decide either one way or the other Thus far Kant's system may be regarded as one of pure scepticism The deficiencies of our speculative reason he conceives to be supplied by the moral faculty, to which he has the object of which is what ought to be As the former determines the *form* of our prescribes the form of our *action* feeling, it is a pure form under which the reason is compelled to regard human conduct The personality of man which lies at the ground of speculative knowledge becomes in relation to action freedom of the will It is in our moral nature that we must seek for the only valid foundation of the belief in God, the immortality of the soul, and a future state in which the demands of the practical reason shall be realized (See *Kant's Philosophical Works, Kritik der Reinen Vernunft, Kritik der Practischen Vernunft*, &c)

KA'OLIN The Chinese name for *porcelain clay* A large tract of this useful substance occurs near St Austle in Cornwall, whence our potteries and porcelain manufactories are copiously supplied Its essential component parts are silica and alumina, the former usually preponderates The kaolin of Cornwall, and probably of other countries, is derived from the decomposition of the felspar of granitic rocks

KA'RA A Tartar word, signifying *black*, used in many of the Eastern languages as a prefix to geographical names, as Karamania, *the country of the black people* It has also been employed in the same capacity to signify "tributary," as

KARMA'THIANS a Mohammedan sect which arose in Irak during the 9th century of the Christian era It derived its name from Karmata, its founder, a poor labourer, who assumed the rank of a prophet They maintained bloody wars with the caliphs for nearly a century (*Taylor, Hist of Mohammedanism*, p 223, *Secret Societies of the Middle Ages*, Lib Ent Kn 1837)

KA'RPHOLITE (Gr *καρφω, I dry or shrivel*) A mineral which occurs in stellated crystals of a yellowish colour and silky lustre it is a hydrated silicate of alumina and

KARPHOSIDERITE A mineralogical name of the hydrated phosphate of iron of Labrador

KEEL (Probably from the Gr *κοιλος hollow*) The principal piece of timber in a ship, usually first laid on the blocks in building If we compare the body of a ship to the human skeleton, the keel seems to resemble the back bone and the timbers the ribs It is generally composed of several thick pieces of wood placed lengthways

a ship on coming into port

KEEL In Botany, a name applied in a figurative sense to the two lowest petals of a Papilionaceous corolla which together, have some resemblance to the keel of a boat

KEEL-HAULING A nautical punishment practised chiefly in the Dutch navy by which the culprit is let down on one side of the ship and after passing under the keel is *hauled* up on the other This punishment was formerly not altogether unknown in the British navy, but it is not now resorted to

KEELING A name for the common cod (*Morrhua vulgaris* Cuv) *See* MORRHUA and GADUS

KEEP (Anglo Sax kepan) Applied in ancient Military History to the stronghold of a castle to which in cases of emergency the besieged inmates retreated and there made their last efforts of defence It is almost synonymous with *donjon* (which see)

KEEPER OF THE GREAT SEAL, LORD, or LORD KEEPER An officer of high dignity in the English constitution, whose office is created by the delivery of the king's great seal into his custody He is prolocutor or speaker of the House of Lords by prescription By 5 Eliz c 18 the offices of lord chancellor and lord keeper are declared to be of exactly the same authority, and when there is no chancellor the great seal is put in commission (*See* CHANCELLOR, SEAL *Ill Comm* 17) The keeper of the privy seal is styled lord privy seal

KEEPING (Ang Sax kepan, *to keep*) In Painting, perspective has assigned to it Objects in the nearer parts or foreground of a picture will necessarily receive as they

become more distant, so in the representations of them the colours must be less brilliant and vivid, to direct from the eye towards the distance where they are lost This word must not be confounded with the term *effect*, though effect is doubtless the result of keeping in view that word being more peculiarly applicable to the combination produced by the combination of accidental circumstances in the disposition of light and shade

KELP A common term for sea weed or vraic, which consists of different species of *Fucus* (Lin ) In a strict sense, the term kelp is confined to the produce of sea weeds when burned, which consists of alkaline ashes used in the manufacture of glass and soap It has been recently found, however, that the alkali required for these purposes can be obtained more abundantly from sea-salt, and kelp is at present chiefly used as a manure For this purpose it is eagerly sought after by all farmers on the sea coast, and especially by those who have dry soils, the salt contained in the kelp being a powerful absorbent of moisture from the atmosphere It has lately acquired much importance as a source of *iodine*

KE'NNEL Applied literally to the house in which a pack of hounds is lodged, but used metaphorically also for the pack itself It signifies also the spot to which the fox after his nocturnal depredations retires about the dawn of day Hence, on being found by the hounds in drawing cover he is said to be *unkennelled*

KE'PLER'S LAWS are laws of the planetary motions first discovered and demonstrated by Kepler and which form the basis of the whole theory of [illegible] They are three —1 That every planet moves in an ellipse each of which has one of its foci in the same point namely, the centre of the sun 2 That every planet moves so that the line drawn from it to the sun describes about the sun areas proportional to the times 3 That the squares of the times of the revolutions of the planets are as the cubes of their mean distances from the sun These three laws or general facts were discovered by Kepler from a comparison of astronomical observations, and though it was by means of them that Newton established the more general law of attraction inversely as the square of the distance they are themselves direct consequences of that hypothesis The first law, that of the elliptic motion of the planet was announced by Kepler in his famous work *Physica Cœlestis tradita Commentariis de Motibus Stellæ Martis* 1609 Kepler having computed from the observations of Tycho Brahe the distances of Mars from the sun at different points of his orbit, found that the orbit was not circular [illegible] by astronomers till then, but an ellipse, [illegible] occupies one of the foci of the ellipse He afterwards discovered the same thing to be true of the earth's orbit, and thence extended it by analogy to all the other planets Newton demonstrated in the *Principia* that if a body projected in space is acted upon by a central force varying inversely as the square of the distance the body will necessarily describe one of the three conic sections, but whether the orbit will be an ellipse an hyperbola or a parabola, depends on the intensity of the force with which it is projected

Kepler was led to the discovery of his second law by a comparison of [illegible] *vectores* and [illegible] which he assumed were not rigorously exact, but Newton afterwards demonstrated from the theory of dynamics that the fact is necessarily true of all motions regulated by a central force, whatever the law of that force may be

The history of the discovery of the third law is remarkable, and detailed by Kepler himself in his *Harmonices Mundi* lib v He had long been persuaded that some numerical relation must exist between the periodic times of the planets and their distances from the sun In order to discover this relation he tried successively numerous hypotheses, each of which involved a mass of tedious calculation He began by comparing the intervals between the planetary orbits with the five regular solids, and having failed in this speculation as well as various others, he at length thought of comparing the [illegible] roots and powers of the periods and distances After many attempts and failures, he at last perceived the analogy of which he had been so long in search

> —— "Sera quidem respexit inertem,
> Respexit tamen et longo post tempore venit,

he exclaims, and in the fulness of his delight he has recorded the year and day on which the discovery was made It was the 15th of May, 1618, and, as Professor Playfair has remarked, "perhaps philosophers will agree that there are few days in the scientific history of the world which deserve so well to be remembered" (*Dissertation, Ency Brit* See *Kepler's Harmonices Mundi*, p 189 )

KE'PLER'S PROBLEM The discovery made by Kepler, that the planetary orbits are ellipses having the sun in the focus which is common to each ellipse and that the line which joins the centres of the sun and a planet passes over equal areas in equal times, made it necessary to solve a problem which transcended the geometry of that time —Supposing the semitransverse axis of a planet's orbit to be represented by 1, and the eccentricity by $e$, also the mean anomaly at any given instant of time by $z$, and the eccentric anomaly by $x$, both being reckoned from the perihelion Kepler found the relation between the angles $x$ and $z$ to be expressed by the equation $z = x - e \sin x$ When $x$ is given, $z$ is easily found from the trigonometrical tables, but there is no direct way, unless by infinite series, of finding $x$ when $z$ is given, which is the case that occurs in astronomy The determination of $x$ in terms of $z$ constitutes what is called Kepler's Problem Solutions of this important problem are to be found in most works on astronomy They are generally tentative, depending on a combination of geometrical and trigonometrical principles, but two very elegant ones, purely analytical, are given by Professor Wallace in the *Memoirs of the Royal Astronomical Society* vol ix p 185 The first of these solutions is as follows —

1 Find $z'$, a first approximation to the eccentric anomaly $x$, by this formula,

$$\tan (x' - \tfrac{1}{2} z) = \frac{1 + e}{1 - e} \tan \tfrac{1}{2} z$$

2 Find $y$ such that

$$\tan (\tfrac{1}{2} x' + y) = \frac{1 + e}{1 - e} \tan \tfrac{1}{2} x'$$

3 Find $c$, a correction of $x'$, so that

$$\sin (y - c) = \frac{\sin y}{\sin x'} \frac{\sin 1''}{e} (x' - z)$$

(Here $x' - z$ must be expressed in seconds of a degree )

4 Then the eccentric anomaly $x = x' + c$ The computation of the eccentric anomaly by this method is extremely simple

KE'RATONY'XIS (Gr κέρας, *a horn*, νύξις, *puncture* ) A term applied by the German surgeons to the operation of couching, performed by introducing a needle through the cornea or horny coat of the eye, and depressing the [illegible] lens

KE'RI (CHETIB (Heb ) In Philology the name given to various readings in the Hebrew Bible Keri signifies *that which is read* and Chetib *that which is written* When any such various readings occur the false reading or chetib is written in the text and the true reading or keri is written in the margin, with ק under it These corrections which are about 1000 in number have been generally attributed to Ezra, but as several Keri chetibs are found in the sacred books the produce of his own pen it is more probable that they are of later date (See *Dr Kennicott's Dissertatio Generalis* )

KE'RMES (Arab *little worm* ) An insect found in many parts of Asia and the south of Europe, the *Coccus ilicis* of Linnæus They were long taken for the seeds of the tree on which they live and hence called *grains of kermes* They are used as a red and scarlet dye but very inferior to cochineal Previously to the introduction of cochineal by which it is now nearly wholly superseded kermes had been the most esteemed drug for dyeing scarlet from a remote period of antiquity Cloths dyed with kermes are of a deep red colour, and though much inferior in brilliancy to the scarlet cloths dyed with real Mexican cochineal they retain the colour better and are less liable to stain The tapestries of Brussels and other parts of Flanders which have scarcely lost any thing of their original brilliancy even after a lapse of 200 years, were all dyed with kermes (See *Beckmann's History of Inventions*, and *Bancroft's Permanent Colours* )

KE'RMES MINERAL A name given by the old chemists to the hydrosulphuret of antimony, in consequence of its reddish colour

KE'RODON (Gr κέρας, *a horn*, ὀδους, *a tooth* ) A genus of Herbivorous Rodents, characterized by $\frac{4}{4}\ \frac{4}{4}$ molar teeth each composed of two equal parts, of which the transverse section presents a cordiform or heart-shaped figure the two parts are united on the external side in the upper, and on the internal side in the lower jaw The incisors are two in number in both jaws, and present the form common to the Cavies, to which family the present genus belongs The species are small, scarcely equalling in size the Guinea-pig They are peculiar, with the other Cavies, to the South American continent

KE'RSEY (Probably a corruption of Jersey, whence it originally came ) A kind of coarse cloth, usually ribbed, and woven from long wool It is chiefly manufactured in the North of England *Kerseymere*, on the other hand, is a thin stuff, generally woven plain from the finest wools, and hence it has been inferred that these two terms, whose meaning is so distinct, cannot be referred to the same origin Kerseymere is said to have derived its appellation from Cashmir, a country which

in [illegible] The female makes a simple nest by scraping a hollow in the ground, lining it with grass, and thereon [illegible] The young birds are clothed with down, and soon begin to run about at the approach of danger they squat down, and the parent, by a curious instinct, endeavours to attract the attention of the intruder, and draw him away from the spot, by fluttering about with cries of inquietude, or even running along the ground as if lame In October the lapwings are fat, and in good condition for the table their eggs are considered a great delicacy

LAQUEAR In Architecture *See* LACUNAR

LARA'RIUM (Lat) In Ancient Architecture, the apartment in which the lares or household gods were deposited, it also frequently contained statues of the proprietor's ancestors

LA'RBOARD The left-hand side of a ship to a person whose face is turned towards the head The other side is called the *starboard*

LA'RCENY (Lat latrocenium, *theft*) In Law, a species of [illegible] mixed [illegible] chattels from the person, or from the house to above the value of twelve-pence But this distinction has been abolished by the statute which consolidated the laws relative to this class of offences (7 & 8 G 4 c 29) Larceny is the felonious and fraudulent taking and carrying away of the goods and chattels of another Thefts of things affixed to the freehold, if forming part of what is termed real property, are not larceny at common law, but many offences of this description have been brought within the character of larceny by enactment Robbery, breaking into and stealing in a dwelling-house if in the daytime, [illegible] ceiver of [illegible] felony, or [illegible] 14 Vict c 11, after reciting the provisions of the 7 & 8 Geo 4 c 29 and 9 Geo 4 c 55, declares the punishment of transportation to be abolished in the case of simple larceny save as regards tenants and lodgers stealing from houses to the value of more than 5*l*, and larceny after two previous summary convictions

LA'RES (Lat) Domestic deities of the Italians, who were probably regarded as the souls of the deceased ancestors of a family Their worship, however was not confined to private houses, as there were lares of the city, the country roads &c *See* PENATES

LARGE [illegible] greatest [illegible] ing two longs, one long two breves one breve two semibreves and so on in duple proportion

LARGHE'TTO (Ital dimin of largo) In Music, [illegible]

LARGO [illegible] ALLEGRO

LA'RIDÆ A family of swimming birds, having the gull (*Larus*) as the type

LARK The common name of the native species of [illegible] us, of which one the *Alauda* the sky-lark or lavrock, the other, *Alauda campestris* Linn is called the field lark As the species of the present order differ from most other Insessorial birds in resting, habitually and sleeping upon the ground, their feet present a singular but simple modification, which at the same time beautifully adapts them to their office of supporting the superincumbent body on a flat surface it consists in the extreme elongation in an almost straight line of the claw of the hinder toe, which is, at the same time, proportionally robust, thus the plane of support is extended at the expense of the prehensile faculty, which the habits of the lark render of little or no value to it

The sky-lark is universally admired for the power and melody of its song and for the beautiful associations inspired by the circumstances under which its notes are most richly poured forth—viz while soaring aloft to greet the rising sun It ascends in the air almost perpendicularly, by successive flights, to an elevation at which its song becomes inaudible its descent is generally oblique The female builds her nest on the ground and lays four or five eggs, which are of a greyish brown colour marked with darker spots she sits about fifteen days, and usually rears two broods in the year This [illegible] and in the winter large [illegible] are very fat at this season and are captured in great numbers for the table

LA'RMIER (Fr) In Architecture, the same as *corona*, which see

LA'RUS (Gr λαρος, *a gull*) A Linnæan genus of aquatic birds belonging to the Longipennate division of Palmipedes in the system of Cuvier, and now raised to the rank of [illegible] subgenera The *Laridæ*, or [illegible] their compressed elongated pointed bill, of which the superior mandible is curved downwards near the end, and the interior forms a salient angle beneath The nostrils, placed near its middle, or a little more forwards, are long, narrow, and form a complete transverse perforation, the tarsus ample, and sometimes pointed *Sterna* The gulls are common and numerous on the sea-coast, and feed on the different animal substances which are left on shore or float down with the ebbing tide The black-headed gull (*Larus ridibundus*, Linn) breeds on the marshy edges of rivers or fens, the female makes her nest, among the reeds and rushes, of heath or dried grass, and lays three or four eggs, of an olive brown colour spotted and streaked with dusky red [illegible] the [illegible] species of gulls breed on the most part in the sand or the clefts of rocks

LA'RVA (Lat larva, *a mask*) A Metabolian insect in its first stage after exclusion from the egg so called, because its real form is, as it [illegible] the same term is also applied to those reptiles which undergo a metamorphosis, as the frog, when at a corresponding period of existence

LARVA Spectres of the deceased were so termed by the Romans mere empty forms or phantoms, as their name indicates, yet endowed with a sort of existence resembling life, since they were to be propitiated by libations and sacrifice The larva of Caligula, according to Suetonius, was often seen in his palace after his decease The larvæ are described by Seneca, and often represented in paintings and on gems under the figure of skeleton, sometimes under those of old men, with shorn locks and long beards, carrying an owl on their hands

LARVI'PARA (Lat larva, and pario, *I bring forth*) Those insects are so called which bring forth larva instead of [illegible] the latter being hatched in the oviduct

LARYNGI'TIS Inflammation of the larynx The symptoms are hoarseness, sense of suffocation, great anxiety and restlessness and spasmodic difficulty of deglutition The acute form of the disease sometimes terminates fatally in 24 hours Chronic inflammation of the larynx is not an uncommon complaint, and often a very troublesome one, it is frequently met with among dram drinkers low diet, abstinence from spirituous liquors, and astringent lozenges and gargles generally relieve it, the acute form of the disease requires local and general bleeding and blister on the external throat

LARYNGO'PHONY (Gr λαρυγξ, and φωνη, *the voice*) The sound of the voice as heard by applying the stethoscope over the larynx

LARYNGO'TOMY (Gr λαρυγξ, and τεμνω, *I cut*) The operation of making an opening into the larynx *See* BRONCHOTOMY

LA'RYNX (Gr λαρυγξ) The upper extremity of [illegible] cate, especially in reference to its construction and physiology as the organ of voice

LA'SCARS The name given to the native Indian sailors, many of whom are in the service of our mercantile navy

LA'SER A gum resin greatly esteemed by the ancients, and obtained from the north of Africa It is described by Dioscorides (lib iii c 48), and, under the name of *silphion* by Theophrastus Different names were given to different parts of the plant which affords it, the term *laser* or *lasoon* being exclusively applied to the inspissated juice From the representations of the plant upon the coins of Cyrene it appears to have been one of the *Umbelliferæ* According to Dr Lindley (*Flora Medica* p 52) it was in all probability obtained from *Thapsia asclepium*

LAST In Commerce, a measure of uncertain quantity varying in different countries and with respect to different articles Generally however, a last is estimated at 4000 lbs (See *Commercial Dictionary*)

LATEEN SAIL A peculiar sail having a long yard [illegible]

LATENT HEAT Heat insensible to the thermometer, upon which the liquid and aeriform states of bodies depend, and which becomes *sensible* during the conversion of vapours into liquids and of liquids into solids *See* HEAT

LATERAL OPERATION [illegible] to one of the methods of [illegible]

LATERAN A church [illegible] Peter's see, and the metropolitan of the whole world, dedicated to St John Lateran The name is derived from the Roman family of the Laterani, who possessed a palace on this spot, which was seized by Nero, and became from his time an imperial residence The Lateran palace was given by Constantine to the popes (see *Milman's Hist Christianity*, [illegible] continued to inhabit it [illegible] when it was exchanged [illegible] Vatican The building was then converted [illegible] a church Five councils have been held in the Basilica of the same here called Lateran councils in ecclesiastical history) of which four are considered by

the Roman Catholics to be general The last of these (or the 12th General, according to the sa most celebrated It was held in and is principally famous as establishing the Roman Catholic doctrine of the Eucharist, using for the first time the term transubstantiation for the change of the elements This council was convoked on the occasion of the heresy of the Albigenses, and its exposition of the Catholic faith is directed principally against them for the maintenance of that (omnis utriusque and communion upon

LATERITIOUS er, *a brick*) This term is which is often deposited by the urine

LATIN a rapid vital motion, and containing numerous granules of organizable matter He supposed it to be analogous to the What is usually denominated latex is to be latex

LATH (Sax Lætt) In Architecture, a thin cleft piece of wood used in slating, tiling, and plas There are two sorts of laths, single and pantile, the former being barely a quarter of an inch, whilst the latter are three eighths of an inch thick Pantile laths are long square pieces of fir

LATHE A Sax which the etymology is uncert ty divided into laths of about four or five hundreds Each was originally under the jurisdiction of a lathe-reeve, superior to the county *Lathe* is also the name of a well-known instrument or engine used in turning wood, ivory, or other materials

LATH FLOATED AND SET FAIR In Architecture three-coat plasterer's work, in which the first is called pricking up, the second floating, the third or finishing is done with fine stuff

LATH LAID AND SET In Architecture, two-coated plasterer's work, except that the first is called *laying*, and is executed without scratching unless with a broom When used on walls this sort of work is generally coloured white for ceilings it is white

LATH PLASTERED SET AND COLOURED In Architecture, the same as lath laid set and coloured

LATH PRICKED UP, FLOATED AND SET FOR PAPER The same as lath floated and set for

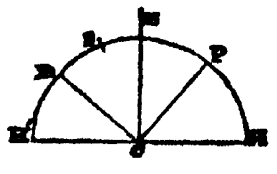
LATICLAVE (Lat laticlavus) The broad stripe which Roman senators and patricians were privileged to wear on their robe

LATISSIMUS DORSI A broad muscle of the back which pulls the os humeri downwards and backwards, and as

LATITUDE (Lat *latitudo*, *breadth*) in Geography signifies the distance of a place from the equator expressed in degrees of the earth's circumference or it is the angle which a line perpendicular to the horizon of any place makes with the plane of the earth's equator term latitude, of the bodies from of the earth's orbit The term declination is applied to denote the angle corresponding to terrestrial latitude, namely, the distance of a star or planet from the plane of the earth's equator This double signification of the term is extremely unfortunate, as it tends to create a confusion of ideas, but having been introduced by the early astronomers, and being ingrafted into every existing work on the science, it is now too late to remedy the evil

Latitude and longitude being the co-ordinates by which the positions of places on the terrestrial surface are defined, their determination forms the most important application of astronomy

In order to give an idea of the methods of finding the latitude of a place, or of a ship at sea, it is necessary to recal some of the elementary properties of the sphere



Let H H′ be the horizon of a spectator placed at C, C P the direction of the axis of the earth's rotation, and C Z the direction of the zenith, or perpendicular to the horizon Let C E to C P, in by the straight lines C P and C Z, or the plane of the meridian, then C E is the intersection of the planes of the equator and meridian, the semidiameter of the earth being neglected as infinitely small in comparison of the distances of the stars, to which C P, C Z and C P are supposed to be prolonged

Now by the P C Z is the latitude of C, and it is which is to be determined The observer always knows his zenith by the direction of the plumb-line, but there is no visible mark in the heavens by which he can at all times determine the place of the equator or the position of E in the meridian, or even the meridian itself But the angles E C P and Z C H being each right angles, E C Z is equal to P C H; that is to say, the latitude of the place is equal to the height of the visible pole in the heavens, and its position in the sphere) is indicated near or *polaris*, which describes within 1° 40′ of it By observing therefore the height of the pole star at any place and making a small correction to the latitude will be obtained, which is the true value But this approximation is very far from being sufficient for any useful purpose

The places of the principal stars being given in the existing catalogues, the observed altitude of any one of them at the time it passes the meridian will give the latitude of the place Let S be a star on the meridian, and S P its polar distance in the catalogue and let its altitude H′ S be observed, then H′ S being known, S Z, the zenith distance, is also known; and S P being also known, we have S P − S Z = Z P, the complement of the latitude In like manner, the latitude may be found by or the be But go some of them give a result affected with much greater uncertainty than others The following are those which are chiefly employed

1 By observing the altitude, or, which comes to the zenith distance of a star on the meridian requiring only a single observation and no other correction than for refraction It is accordingly generally employed for common geographical purposes When the sun or planets are the bodies observed, corrections must also be applied for the semidiameter of the body and for the parallax At sea the bodies selected are the sun and moon, the observation of a star or planet being difficult on account of the motion of the vessel To know when a heavenly body is on the meridian it is necessary to have a pretty accurate knowledge of the time but it may be remarked that near the meridian the altitude varies very slowly, and therefore a small error in respect of the time does not much affect the result

2 By the altitudes of the circumpolar stars (those which never go below the horizon of the place) at their upper and lower transits If the altitude of a star on the meridian is observed both above and below the pole, the sum of the two altitudes is equal evidently to twice the height of the pole, or twice the latitude The only correction required is for refraction, which is not the same in the two observations

3 The latitude may also be found by observing the greatest and least meridian altitudes of the sun in the course of a year The sum of the altitudes of the sun at the summer and winter solstices is equal to twice the height of the equator or twice the complement of the latitude, but this method requiring observations to be made at an interval of six months is seldom had recourse to excepting in fixed observatories

4 to be ders some calculation unnecessary is not indispensable The latitude may be determined by the observed altitude of a body out of the meridian, and indeed with more certainty because several observations may be made successively the mean of which will give a surer result than a single meridional observation Let P be the pole S the place of the star or planet, and S Z its observed zenith distance, or the complement of its observed altitude In the triangle P S Z P S the polar distance of the star, is known, S Z is given by observation and the hour angle Z P S is given, because the time of the observation is supposed to be exactly known, therefore P Z, the co-latitude, may be found by the solution of a spherical triangle This method, however, can only be successfully applied by observing near the meridian, and some artifices of analysis are required to adapt the trigonometrical formulæ to calculation A method has lately been proposed by Professor Littrow of Vienna for determining the latitude by means of observations of the pole star off the meridian, which is found to be of great practical utility



5 The last method which we shall notice for finding the latitude is one that has been proposed by Bessel and consists in observing the eastern and western passages of a star through the prime vertical, that is, the vertical plane at right angles to the meridian When a transit instrument is adjusted to move in this plane, and consequently has its horizontal axis in the direction of the meridian, all the stars which pass the meridian between the zenith and equator will twice enter the field of the telescope Now let $t$ be the time of the eastern transit, $t'$ the time of the western transit, $\delta$ the declination of the star, $\varphi$ the latitude, and P the diurnal arc corresponding

to the time $\frac{1}{2}(t - t')$, then the formula by which the latitude is determined is

$$\tan \phi = \frac{\tan \delta}{\cos P}$$

The advantages of this method are, that the observations may be made with a portable instrument, which can easily be oriented by means of the circumpolar stars; a small error in the altitude will produce no sensible error in the result if the stars observed pass near the zenith, the observations are altogether independent of errors in the division of the instrument, and in determining differences of latitude errors of declination are also eliminated by observing the same stars at all the stations It is therefore a very convenient method for a [illegible] survey

LATITUDINARIANS In English history the name of Latitudinarians was given to a party of English divines in the reign of Charles II who were opposed to the high tenets of the ruling party in the church and who distinguished so many of the doctrines of religion as were of course the objects of much attack, and one of their number, Fowler, Bishop of Gloucester, explained their principles in his treatise entitled "*The Principles and Practice of certain modern Divines of the Church of England, vulgarly called Latitudinarians truly represented and defended by way of Dialogue*" 1671 Henry More, and the other Platonizing divines of the time, were sometimes comprehended under this appellation (See *Mosheim*, vol v p 412, transl, ed 1790) The word has been since very generally used to [illegible] opinions at variance with the [illegible] Scripture and church traditions or merely as a term of party vituperation

LATROBITE A mineral found on the coast of Labrador, and also in Ireland It is translucent, of a pale red colour, and occurs [illegible] It is a silicate of alumina with lime, potash, and traces of manganese

LATTEN (Fr laiton) Brass or bronze Tinned iron is also sometimes known under this name

LATUS RECTUM In the Conic Sections the same with parameter — *Latus transversum*, the same with the transverse axis *See* CONIC SECTIONS

LAUDANUM (Supposed to be derived from Lat. laus *praise*) Different preparations of opium have been so termed the tinctures used formerly to be called *liquid laudanum*

LAUDICOENI (Lat) among the Romans, were persons who (like the modern claqueurs in France or the puffers in England at auctions) attended the performance of plays and the delivery of orations, in order to raise or to join in the acclamation The derivation of the word would indicate that an entertainment was the chief, if not the only reward, which they obtained for their services

LAUDS (Lat laudes, *praises*) In the Roman Catholic Church, the prayers formerly used at daybreak, between those of "matins" and "prime" In later times they have become generally confounded with "matins"

LAUMONITE A variety of zeolite, named in honour of its discoverer, Gillet-Laumont It crumbles when exposed to air in consequence of loss of water It is a silicate of alumina and lime with 16 per cent of water

LAUNCH The putting of a new vessel into the water When the vessel is to be launched, a frame called *cradle* is built under her, thus — At about one third of the extreme half breadth are laid, on each side of the keel and parallel to it, long pieces of timber forming, as it were, two keels under the principal portion of the vessel On these are placed vertical timbers meeting the ship's bottom and inwardly from [illegible] plans or ribband [illegible] on each side upon a platform sloping to the water, these platforms are called *the ways*, and are greased The blocks on which the keel was laid being removed with the shores, the vessel rests on the cradle, which is kept from sliding down by a small piece or bar of wood fixed to it lying nearly horizontal, abutting against a place in the ways called the *dog shore*, which being struck downwards falls, and the vessel slides down into the water When afloat, she is rolled from side to side by the persons on board [illegible]

LAUNCH [illegible] boat, the largest carried by a man-of-war

LAURACEÆ (Laurus, one of the genera) A natural order of [illegible] parts of the [illegible] are distinguished from all other incomplete apetalous Exogens, excepting *Atherospermaceæ*, by the peculiar dehiscence of the anthers, which open in consequence of the face of the valves rolling back, and from that order by the ovules being pendulous, not erect The species are generally tonic and stimulant Cinnamon and cassia are the produce of some, camphor of others, and the common sweet bay is a frequent instance of the order in the northern form A few are so aromatic that their seeds have been used as substitutes for nutmegs

LAUREATE (Lat laureatus) Literally crowned with laurels, applied at present to a well-known officer in the royal household At the Certamina, or gymnastic and other contests celebrated under the Roman emperors, especially at the Quinquennalia, or games of Minerva, poets also contended and the victor was crowned with oak or olive leaves But it was from some traditionary belief respecting the coronation of Virgil and Horace with laurel in the Capitol (of which, however, no record is extant) that the dignity of poet laureate was invented in the 14th century, and conferred on Petrarch at Rome by the senator or supreme magistrate of the city It was intended to confer the same honour on Tasso, who, however, died on the night before the proposed celebration In 1725 and 1776 it was granted to two celebrated improvisatori, the Signor Rufetti and the Signora Morelli, better known by the name of Corilla (*see* IMPROVISATORI) In most European countries the sovereign has assumed the privilege of [illegible] with various titles [illegible] poets laureate, but the imperial poet, or Poeta Cesareo, in Germany, was invested with the laurel This crown, however, was customarily given at the universities in the middle ages to such persons as took degrees in grammar and rhetoric, of which [illegible] Baccalaureus (quod vide) has been derived In England traces of a stipendiary poet royal are found as early as Henry III, and of a poet laureate by that name under Edward IV Skelton, under Hen VII and VIII, was created poet laureate by the universities of Oxford and Cambridge, and appears to have held the same dignity at court, but [illegible] and court honour were distinct until the extinction of the university custom, of which Henry VIII's reign exhibits the last instance

Royal poets laureate are supposed not to have begun to write in English until after the Reformation The office was made patent by Charles I, and the salary fixed at 100*l* annually and a tierce of Spanish Canary wine Under Queen Anne it was placed in the control of the lord chamberlain In the reign of George III the annual tierce of wine was commuted for an increase of salary, and at the close of the same reign the custom of requiring annual odes from the lord chamberlain was discontinued

LAURINE A fatty matter of an acrid taste, contained to the amount of about 1 per cent in the berries of the common laurel

LAVA The substances which flow in a melted state from a volcano They vary considerably in texture and composition *See* GEOLOGY

LAVER (Lat lavo, *to wash*, because washed by the waters of the ocean) A species of *ulva* which is eaten as a delicacy

LAW, in Latin *Lex*, derived from the verb *lego*, I collect or select

*Law collective and particular* — We employ the term "law" to denote a body of rules or all the rules applicable to a given subject, e g the Roman Law, the Law of Nature We employ the term "a law" to denote an individual rule

The idea of law, in its strictest sense, comprehends the notion of two parties, a superior imposing it, and an inferior obeying it

*Laws, improperly or metaphorically so called* — In common [illegible] the word "law" to designate [illegible] can only be thus named by analogy Whenever certain causes invariably or generally produce like effects, this consequence of effect upon cause is popularly termed "a law" Thus we speak of the *law of nature* with reference to inanimate or irrational subjects, of the *law of gravitation*, by which bodies are mutually attracted to each other, of the *laws of motion*, of the *laws* which regulate certain processes in animal and vegetable economy, &c In this sense, laws have been defined to mean "the necessary relations resulting from the nature of things" The analogy is nobly expounded in a well known passage of *Hooker's Ecclesiastical Polity* at the end of the first book

*Laws in their strictest sense* as applied to the voluntary actions of man, comprises the notion of a command issued by a superior imposing an obligation on a subject

*Laws Divine and Human* Laws are divided according to the superior at [illegible] them, into divine and human the law of God, and the law of man

*Divine Law* — The Author of our being has declared his will to mankind at various times through the instrumentality of inspired prophets and teachers There are also certain rules of right and wrong commonly received, which are generally supposed to have their origin in the nature of man and to subsist independently of God's revealed will Thus the term divine law signifies, 1 Revealed law, 2 Natural law

*Revealed Law* — God, as the Lawgiver of the Jewish nation, dictated to Moses a code of laws for that people, comprising both a confirmation of such laws as are

commonly considered [illegible] sanctions, and also various minute ce[illegible] observances Thus the Jewish la[illegible] to consist of, 1 The moral law, 2 The ceremonial law, 3 The civil or political law

*Law of Christianity* — The second branch of revealed law is that which is declared to us in the New Testament

*Law of Nature* — The law of nature, however extensive in its philosophical meaning, is much more confined in that sense in which alone it is within the province of jurisprudence Regard[illegible] relative duties of men [illegible] practical purposes to ob[illegible] principle is the sociability of man, and, consequently that the conservation of society in its actual state whether from the motive of mutual distrust, as Hobbes maintained, or from innate benevolence, as his adversaries contended, is the duty which it imposes on every one

Let us suppose, therefore, that in a community such as our own there could occur at once a suspension of all civil positive law, and that, at the same time the sanctions of God's revealed law could be withdrawn Men would thus be restored to a state of natural liberty The natural law is that code of duties which would then take the place of all other legislation Every act tending to injure our neighbour in person and property every act in any way tending to [illegible] society would then be prohibited by natural law [illegible] now is prohibited by laws human and divine Undoubtedly the natural law in the sense in which it is commonly used comprehends a far wider range of objects The duties of personal holiness the relative duties of the members of a family, the duties of active benevolence, all these are dictated to us by conscience, as much as abstinence from positive injustice But the province of jurisprudence is too limited to admit of the consideration of these higher parts of morality, it is with political society only that she is concerned

*Law of Nations* — The principle of natural law between individuals in a community would thus be the maintenance of the status quo, or actual condition of things, and the insuring to every one the continuance of all his possessions This, therefore is the elementary dogma of that only branch of natural law which can be said to exist as a definite rule of conduct, namely, the law of nations Nations are in a state of natural liberty with reference to other nations For since they have no earthly superior to establish rules for them and since the decrees of Christianity, addressed as they are directly to individuals have been generally discarded in the practice of collective bodies, the only maxims which govern their intercourse are certain conventional arrangements the object of which is the maintenance of the existing society and intercourse between the subjects of distinct sovereign states All the rules of national law have this for their ultimate end The natural law of men to use the phrase of Hobbes teaches the absolute duties subsisting between men and men, the natural law [illegible] between men in societies [illegible] tion) national law is the law of nature applied to independent states as if they were individuals

The law of nations according to the comprehensive arrangement of Mackintosh comprises "the principles of national independence, the intercourse of nations in peace, the privileges of ambassadors and inferior ministers, the commerce of private subjects the grounds of just war, the mutual duties of belligerent and neutral powers, the limits of lawful hostility the rights of conquest the faith to be observed in warfare, the force of an armistice, of safe conducts and of passports the nature and obligation of alliances the means of negotiation, the authority and interpretation of treaties of peace"

But the law of nations, in its practical sense widely differs from this extensive and philosophical compendium of international duties Many of the maxims which relate to [illegible] belong rather to the the hig[illegible] to that of jurisprudence The only punishment of which the sanction can be applied in this species of law is the hostility of other states towards that which violates it Whoever, therefore, is powerful enough, whether from his own strength or from position and alliances, to defy such punishment, is, in a certain sense, above the law Hence, although the law of nations, considered as a branch of that of nature, would lay down absolute rules of conduct in the highest as well as the lowest matters of policy within its reach, it may safely be said that the law of nations as a body of recognized right extends only to a portion, and that the least important, of these matters The only maxims which can be said to subsist as laws are those which are never or rarely violated by European states, because the inconvenience of their general neglect would overbalance the particular inconvenience of adhering to them in a given instance Thus all will acknowledge that there is a wide difference in [illegible] on, between the principles which forbid unjust [illegible] or severity towards the conquered and those which prescribe the privileges of ambassadors and the protection of peaceful aliens

The subjects to which national law is most strictly confined are customary rules respected by the mutual consent of nations, rarely infringed by the voluntary act of a sovereign power, and of which the infringement is considered to require satisfaction and reparation

It is to be observed, that although several of the maxims of national law (such, for example, as the sanctity of the [illegible] of its rules are only recognized and observed by the Christian states of Europe and America in their dealings with each other

National law (from its defective sanction and want of a sovereign legislator as to its details) may, perhaps, be more properly termed the custom than the law of nations

The reduction of the law of nations to a system was first made by Grotius in a work which, as Sir J Mackintosh has well observed, though we now indeed justly deem it imperfect is perhaps the most complete that the world has yet owed at so early a stage in the progress of any science, to the genius and learning of one man To him succeeded Pufendorf, who avoiding the inconvenient and unscientific method of Grotius has, to use the words of the statesman already quoted, without the genius of his master, and with very inferior learning, yet treated the subject with sound sense with clear method with extensive and accurate knowledge, and with a copiousness of detail sometimes indeed tedious, but always instructive and satisfactory But in addition to the works of these illustrious authors, the rules of national law are to be found first in the treatises of several other authors who are usually regarded as authorities, of whom Bynkershoek (*Opera Omnia* fol Lug Bat 1767, Engl Trans fol 1749) Vattel, Wiequefort Rutherforth (*Institutes* 1779) Von Martens, and others, may be cited secondly in the treaties which have been at different times concluded between European states, especially those of Westphalia 1648, Utrecht, 1713 Aix-la-Chapelle 1748, Paris 1763 and Vienna 1814 A pretty complete summary of the bibliography of this subject will be found in the introductory chapter of Mr Manning's work on the *Law of Nations* (1839) (See also Dr Wheaton, on *International Law*, 2 vols 8vo Lond 1836)

[illegible] of letters and until the peace of Nimeguen (1679), the state language ordinarily used was the Latin, but since that period it has chiefly given way to the French which is now commonly used between nations employing different languages in their public acts

*Law Positive or Municipal* — This is the term usually employed to distinguish law in its ordinary sense (the expression of the will of the supreme power in a state), from all the other species of law (improperly so called) with which we have hitherto been occupied It is called *positive* law, because established in the form of direct and definite injunctions, *municipal* from the Latin *municipium* a town possessed of [illegible] and local laws

Positive law is "a rule of civil conduct prescribed by the supreme power in a state" Blackstone adds "commanding what is right and prohibiting what is wrong" [illegible] wrong prohibited acquire the character of right and wrong only from being so commanded and prohibited, the latter half of the definition is evidently comprehended in the first A regulation or body of [illegible] usually adhered to by men in their dealings with each other but not commanded by the civil power nor enforced by lawful punishment is properly called a custom, but when [illegible] whether set by men to each other on [illegible] or by subordinate bodies within the state to individuals, can be enforced by lawful punishment, the sovereign power allowing such punishment, the sovereign power thereby adopts the regulations, and they become laws in the strictest sense of the word

A law is also defined, "a command of a political superior obliging the subject to a particular course of conduct" This definition comprehends most of the civil institutions with which jurisprudence is concerned, but it appears to exclude some which are nevertheless within the province of that science For example,—

1 Many laws are enacted to explain former laws, and also to repeal former laws Neither of these can be said, in strictness, to answer the definition of law which describes it as a command, unless we consider them as [illegible] former [illegible] and [illegible] Roman jurists applied to form laws or imperfect obligations to certain [illegible] of their law prescribing particular conduct but without any penalty being expressed in the event of their violation These were not commands, not being enforced, and could not be said to oblige the subject, who was at liberty to escape the obligation Our laws recog-

nize no such rules as these If a statute enjoins or prohibits an action without adding any express penalty, the courts of justice *presume* that a violation of the statute is punishable Law as the subject matter of jurisprudence, is that which obliges the subject to a particular *course* of conduct by *general* rules of action This excludes —

1 Laws made to permit or restrain the acts of specified individuals Such were called by the Romans *privilegia*, or, under the emperors, private rescripts, in our law, *private acts of parliament* The sovereign body in the state, having the power to repeal and modify its own enactments, can by an expression of its will exempt particular persons from its own injunctions, or can impose new duties on particular persons Such decrees have all the force of law, but they do not form a part of the general law of the country

2 Laws made to suit a particular emergency, occasional or particular commands, which are distinguished from general laws by their *shorter duration* To exemplify this difference, it has been said that should a sovereign command all his subjects to wear black as their ordinary dress, such a command would be a law, but should he order a general mourning for a stated time, such an order would not have sufficient permanence to entitle it to that appellation

Every command given by a political superior is a law in point of force, but it is necessary to establish some distinction between occasional commands, as otherwise every direction every incidental command of a military superior must be considered as a law An act to suspend the collection of a duty for a given time, an order in council to admit bonded goods or to issue any temporary regulations respecting trade and commerce, royal proclamations, all these are familiar instances of the species of occasional or particular commands

Municipal law is commonly divided into two branches, that which concerns the public duties of individuals with reference to the state and that which concerns the private relations of individuals towards each other The division between these branches is not in all systems the same Under the old Germanic institutions for example, most crimes were considered as civil injuries only

Laws, strictly so called and forming the body of public right in each separate state are to be found either in codes sanctioned by the authority of the state, or in decrees issued and made public by such authority, or, finally in certain unwritten customs to which that authority, by

The code is to be found wholly or in part in the Koran, which to Mohammedans bears the character both of revealed and civil law Those of the Hindoos and many other nations have likewise the authority of an imaginary religious sanction

In Western Europe the laws in force in most of its countries, although modified and republished by their several legislatures, are in great measure founded on what is termed the Roman law This body of law is principally declared in the *Pandects*, *Code* and *Institutes* of the Emperor Justinian but these contain only a digest of a small portion of the laws which prevailed in the ancient Roman empire

*The Roman Law* —"Inasmuch," to use the words of our own learned judge Lord Holt, "as the laws of all nations are doubtless raised out of the civil law, as all governments are sprung from the ruins of the Roman empire, it must be owned that the principles of our law are borrowed from the civil law, therefore grounded upon the same reason in many things — The manner in which the Roman law has been introduced into the jurisprudence of modern Europe may be said to have been twofold first, through the prevalence of Roman usages, derived from the times of the empire among the population of various countries, especially that part of it which was collected in towns, secondly through the efforts of the ecclesiastics, who learnt the civil law from the *Codex* of Theodosius, and from the works of Justinian, and introduced it, as far as their authority extended, into such branches of justice as they were permitted to administer, and especially into their canon law, which the various princes of Europe permitted to be binding, to a different extent in different countries, upon their lay as well as clerical subjects Thus the Roman law is in one sense the oldest and fundamental part of public right in many countries, in another sense it was introduced by legislation, altering the character of the received institutions The Roman law comprises what are termed the *Institutes*, *Pandects*, *Code* and *Novels* (See these terms) These have been collected and usually published under the title of *Corpus Juris Civilis*, the best editions being those of Amsterdam (8vo 1664) for the text, and of Gothofred (folio, Paris 1628) for the text and notes The most elaborate modern work on the history of the Roman law is that of Savigny

It would be impossible, within our limits, to give the reader any useful bibliographical notice on a subject which has recently received much attention in Germany and England, and English treatises on the subject are numerous, and of no great value, that law having only existed among ourselves, as we have seen, in certain limited departments

*Civil Law in England* In England while in the way of ancient custom there are fewer vestiges of the civil law than in any other of the provinces of ancient Rome, yet in the way of ecclesiastical jurisdiction it has been wider spread and continued longer in force than almost any where else.

Although Britain was a highly civilized province possessing 140 cities and towns in the time of the Romans, yet the numbers and violence of her invaders, especially the Saxons and the Danes, appear to have extinguished almost every relic of her provincial customs and jurisprudence It is chiefly, therefore, to the clergy that we are to look for the prevalence of the civil law in England, and it has been introduced by them in several ways

1 At the Norman invasion a considerable accession to the numbers and influence of the spiritual body in England took place A century afterwards the discovery of the *Pandects* rendered the study of jurisprudence familiar chiefly among that body, who monopolized most of the learning and intelligence of the age They introduced it into England, and, as the rude and simple justice of the Saxons was inadequate to meet the wants of the people most of the early lawyers, who were themselves chiefly ecclesiastics, sought in the pages of their favourite works for principles to supply the defects as they arose Hence, in the works of Bracton, Britton, and Fleta (written expressly on the common law of England, that is, the customary law of the Saxons modified by extensive introduction of Norman usages), we find constant reference not only in spirit but in words to the civil The time during which the study of this latter was most in vogue among English lawyers appears to have been between the reigns of Stephen and Edward III During the greater part of that period a constant struggle was carried on between the ecclesiastical lawyers, supported in many cases by the crown, and the popular party in favour of the old which was defended by the temporal The victory of the common law, and its establishment as the rule of the land, except in particular cases, may be dated from the reign of Edward I

2 The jurisdiction of the lord chancellor of England is a subject considered elsewhere (*See* CHANCERY) It is sufficient here to observe, that as most of the chancellors under the Plantagenet kings were ecclesiastics and as the matters entrusted to their decision were such as the rules of the common law did not apply to, they generally searched for precedents in that of Rome, which has hence been largely imported into one great branch of modern English law, namely Equity

3 In some particular matters the rules of the civil law have always been allowed by custom to prevail in England These are, such as were taken cognizance of by the courts of in the High Court of Admiralty, the courts of and were ecclesiastical bodies

4 The chief influence of the civil law in England has been through the canon law, which was founded upon it

*Law, Canon* — The rules which were framed by the Christian church for its own spiritual polity may be supposed to have had their origin in the very earliest periods of Christianity itself, but all the authority and force which they possessed could arise only from the mutual consent of the faithful to be bound by them, until the establishment of Christianity as the religion entirely altered the character of The temporal jurisdiction which was naturally conceded to the bishops, together with the legal force given by several emperors, Justinian in particular, to the canons of councils, gradually called into existence a new and independent body of legislation

When the Western Empire had been overthrown, the authority of the popes, as temporal governors, was by the of Rome at the end of the of Western Empire, and the power of the ecclesiastical body was increased and extended in other countries, and the reverence attached to their authority gave to the spiritual censures with which they visited particular offences a greater force than to the sanctions of the national law Thus, besides matters of church government, which were at first the particular subject of the pontifical law, it comprehended within its purview numerous and important branches of the civil law of persons and property

About the year 1150, the various edicts then in force of the several popes, together with the canons of councils, and the authoritative declarations of fathers and doctors of the church, were collected together by the Monk Gratian, and reduced into a volume called the *Decretum*, and considered as the earliest authority in canon law

In the next century Pope Gregory IX published five books of Decretals, collected from the Decretal Epistles of the Popes to which Boniface VIII added a sixth book, about the end of the same century These were added, at subsequent periods to the Clementine Constitutions, a seventh Book of Decretals, and a Book of Institutes The whole of these authorities were collated and published by Gregory XIII in 1580, under the title of *Corpus Juris Canonici*

In matters of evidence, and as far as practicable in the forms of proceeding, the compilers of the canon law founded their system upon that of Rome, with which they were best acquainted In all such matters of civil jurisdiction as their legislation embraced, they likewise assumed it as the basis of their structure By the practice of all ecclesiastical courts the civil law is allowed to come in aid of and to supply the canon law, in all such cases as are there omitted The subjects of the canon law were, 1 The hierarchy and government of the church, 2 All [illegible] 3 The wills of defuncts, [illegible] in most European countries to its full extent Its jurisdiction only subsisted by the toleration of princes, and therefore varied, according as the superstition or piety of these sovereigns, or their jealousy of ecclesiastical usurpation, alternately predominated But, upon the whole, its authority became so deeply rooted that even in countries which have rejected in later times the authority of the pope its rules are still referred to not merely in matters relating to church benefices, but also in some cases of purely civil jurisdiction

Nevertheless, although in early times its authority was asserted by the popes on the ground of their temporal superiority over all earthly sovereigns, its force in every country must now be said to depend upon the will of the state, which gives the force of law to its provisions [illegible] the church [illegible] as A D 60 shortly after the introduction of Christianity among the Saxons, but they were not fully recognized by the state until after the Norman conquest The bishops who held in Saxon times sate with the sheriffs and landed proprietors in the county courts, then withdrew from participation with the execution in civil government From that period the power of the bishops made rapid strides, insomuch that they have succeeded in retaining many branches of jurisdiction of which in other countries the temporal power has deprived them In addition to the general canon law we have in England a particular provincial law—the *constitutions* of the papal legates and councils of this country in 1237 and 1269, and a further body of constitutions framed in provincial synods under the authority of successive archbishops of Canterbury, from Stephen Langton in 1222 to Archbishop Chichele in 1414, and adopted subsequently by the province of York. These constitutions have been illustrated by the commentaries of distinguished ecclesiastics and principally those of Lyndwood, who flourished in the reigns of Henry V and VI The canons of the Protestant church passed in the Convocation of A D 1603, although ratified by King James I for himself and his successors yet do not (as Lord Mansfield finally decided) bind the laity except so far as they declare the older provisions of the law The most standard work [illegible] lesiastical Law is *Gibson's Codex Juris* [illegible] est guides for the student are the treat[illegible], and the recent one of Mr Rogers (1840)

*Law of England Common Law* — This expression is used in two different senses, according to the subject under consideration We speak of the common law in contradistinction to the civil law, or to equity, meaning a certain portion of [illegible] matter, and administe[illegible] rules of evidence and modes of procedure We also by the common law, sometimes mean the unwritten or ancient customary law in this sense it is opposed to the statute law, which is of positive enactment

The constitution and laws of our Anglo-Saxon ancestors have been the subject of innumerable theories and contradictory systems, since the ingenuity of modern times has [illegible] investigation but all the efforts of the learned have gone no farther than to establish the existence of a few principles and customs common, for the most part, to the Germanic tribes in general The leaders of the Saxons emulated each other in assuming the kingly dignity in every district of the island, and endeavoured, as far as the independent spirit of their followers would allow, to adopt the imperial style and legislative powers which the British kings had derived from the provincial tyrants of the empire, and these from the Cæsars [illegible] and rights, and [illegible] the [illegible] But for centuries England was one battle field, between the several clans of Saxons who had usurped her dominion Mercia, Wessex, and Northumberland were divided in law and custom scarce less than in government, and when the island had at last fallen under the dominion of a prevailing Saxon dynasty, the invasion of the Danes [illegible] adulterated her blood and her institu[illegible] the Confessor reduced the customs of the country into something resembling a system of law, and although his enactments are lost, it is to his reign that we must look for the most authentic form of Saxon polity The king was guided and controlled in his deliberations by the witan, or chief men, assembled in the gemote, or meeting, but their relative power and that of the sovereign varied according to the strength or weakness of the latter The body of landholders held their lands by an independent tenure which custom rather than law had rendered hereditary, but there were many who held benefices or enjoyed land under personal grants from the king, or from the great earls who had succeeded the aldermen of the early Saxon times, or from the thanes or inferior nobility Great part of the land was cultivated in common by the people of hamlets and tythings Justice was administered in the county courts, where the *good men* or land owners assembled, and the bishop and sheriff presided Questions of property were decided by ordeal or by a tribunal of sworn witnesses In criminal as well as civil cases the defendant sometimes freed himself by the oath of [illegible] er of law, as it was called when ad[illegible] The inhabitants of every district were mutual guarantees, by the custom of frankpledge which was founded on two principles the one the liability of the lord or superior for the appearance of his vassals, the other, the collective responsibility of the tything or hundred for all its individual members which was not prevalent in all England, and entirely unknown in the northern shires

By the Norman conquest and the division of the better portion of England between Norman proprietors holding in chief of the crown the feudal system of law, as regarded land and its incidents, was early introduced into the country Other portions of Norman jurisprudence were imported at a later period, through the medium of the king's courts, which being at first confined in jurisdiction to the domains of the crown, gradually supplanted the old Saxon courts although these long continued to be governed by their national law

The three great [illegible] from that of other of tenures and their incidents on which the law of real property is founded, and the trial by jury—may perhaps be said to have been founded on Norman jurisprudence but to have become prevalent through their analogy to Saxon institutions See PARLIAMENT

The first consequence of the invasion of the Normans was that different modes of trial were prevalent according to the nation to which the contending parties belonged Compurgation or 'wager of law" was the common mode of decision between Englishmen In criminal cases it was usually by the oath of eleven compurgators chosen out of an array of fourteen In civil suits, the amount of the compurgation required seems to [illegible] value of the property claimed [illegible] mode of trial was added the *wager of battle* which is first named in the laws of the Conqueror, but which either French or English and French might use *Inquest of witnesses* was a Norman mode of trial in civil cases by which witnesses were summoned from the neighbourhood in which the quarrel arose to declare on their oath the truth concerning the matter in question Finally, the ancient proof of *ordeal* subsisted in criminal cases

This diversity in the modes of trial was accompanied by a diversity of judicature The ancient county courts received one blow by the withdrawal of the bishops, who ceased to preside in them becoming chiefly foreigners, and who gradually established, as before shown a separate jurisdiction of their own A still more important wound, in its consequences, was inflicted by the increasing power and influence of the king's courts, at first only confined to causes arising within the royal demesne, in which the Norman law and modes of procedure were adopted, and in which the machine of our own common law was gradually elaborated by judicial ingenuity during successive centuries

Henry the Second is commonly regarded as the founder of the common law His principal contribution towards it consisted in his ordinance of the grand assize, justices in eyre, or circuit justices of the king's courts, being appointed to try causes by inquest of twenty-four witnesses, at the option of the tenant or demandant, if either party preferred to purchase this mode of trial instead of the ordinary trial by battle Shortly after his reign the Fourth Council of Lateran, by abolishing the ordeal (A D 1215), gave a new impulse to the development of the jury system Criminal cases were now tried by a jury of witnesses de vicineto, and the process by which these witnesses, both in civil and criminal cases, became con-

verted into sworn judges of the fact, has never been distinctly traced, but the intermediate steps had certainly all been passed before the reign of Edward III, possibly before the death of the first monarch of that name

If Henry the Second was the founder, Edward I may almost be [illegible] of the common law From his [illegible] ange has taken place in its general principles all that subsequent reforms have effected has been to accommodate those principles to altered circumstances And long may the spirit of these institutions remain unchanged amidst the march of improvement,—holding together, as they now do, the mightiest commercial community of the globe, with no less beneficial authority than they exercised six hundred years ago over the barons, peasants, and burghers of a small feudal monarchy!

The system of real property may be said to have been fixed by the statute *Quia Emptores*, 18 Edw I Before that time we may consider the lands of England as having been subject, in general, to the unrestricted feudal law All land was held, mediately or immediately, of the king The two classes of free proprietors were those who held by the military service (of Norman introduction) and those who held by the old Saxon custom their property in their lands being retained by them, subject only to acknowledgment or fealty to the sovereign,—a less honourable, but probably a less burdensome tenure But either of these tenants might in his turn, create fresh tenants under him, yielding the same homage to him which he yielded to the sovereign Below these, the only two classes of tenants recognized by the law were those who held of the king, or mesne lords, by pure villenage or absolute and base service, and by villein socage, which was also a base service, but restricted to certain specified duties From the tenure of pure villenage have sprung our present copyhold tenures, by which certain lands are held within *manors* (which are the old estates held in early times directly of the king) by the *will of the lord*, as it is expressed in their grant, although by long usage the will of the lord is merely nominal, and the obligations of the tenant consist only in certain specified rents and services

The object of the statute *Quia Emptores* was to restrain the creation of fresh subordinate [illegible] that if any one alienated his land by [illegible] which purported to convey it in perpetuity) the feoffee should hold the same, not of the feoffor, but of the feoffor's lord whether a mesne lord or the king himself Hence all manors must have existed prior to the reign of Edward the First, as it is essential that there should be in them tenants who hold of the lord and such tenancies could not have been created at a later period

When alienation of lands and tenements was made in early Norman times the alienation was either to the donee and his heirs for ever—thus giving him an absolute unrestricted property descendible to his heirs, whether male or female subject only to his homage to the donor, in other words, a *fee simple*, or it was upon condition—as, for instance, a grant to a donee, provided he had issue, under which grant, if the donee died without issue or his issue came to fail, the land would revert to the donor The conditional donees had devised, with the assistance of the king's judges, various ingenious methods of defeating these provisions, as by altering as soon as they had issue, and then repurchasing the fee-simple It was to fix the law of conditional gifts that the statute *De Donis* 13 Edw I, was passed, by which such a donee was absolutely prevented from altering the tenements Hence arose *estates in fee-tail* in other words, estates granted to a man and to certain specified heirs, for example, the heirs male of his body In after times when the restraint on alienation which this statute created began to be repugnant to the more liberal feelings of the people, certain devices were invented (fines and recoveries), whereby the donee in tail was enabled to bar the entail and acquire the fee-simple, as he could have done before this statute was passed

Besides these famous statutes, we find the reign of Edward I distinguished by the confirmation of Magna Charta and the Charter of Forests The first of these great constitutional acts contains few provisions of much importance in legal history, and was far more valuable as an evidence of the spirit of the country in restraining arbitrary usurpations, than as is commonly supposed, by establishing any new franchises or even confirming ancient ones Perhaps its most important legal effect was the fixing to the city of Westminster the court of Common Pleas, which had formerly caused the suitors much inconvenience by following the person of the king in his numerous progresses

It is also to Edward the First's reign that we must refer for the distinct definition of the province of that court, and of the other two superior common law courts of record, the King's Bench and Exchequer The history of these three courts is far too intricate, and requires too much exposition to find a place in these pages I must call [illegible] that the King's Bench [illegible] which the king was supposed, as it [illegible] is, to sit in person, and which followed him in all his progresses, insomuch that in the reign of Edward I it actually sate in Scotland Its jurisdiction consequently extends to all matters which are of the king's prerogative it took cognizance of criminal causes on the crown side, and of civil causes, at first those in the result of which the king was interested and by a fiction all personal actions whatever It was likewise a court of appeal from all inferior courts of records The court of Common Pleas, or Common Bench, had in strictness jurisdiction in all civil causes between subject and subject In this court only real actions, in which the right to land is tried—now nearly fallen into disuse (*see* PLEADING), but anciently the most important part of judicial business—could be adjudicated The court of Exchequer was intended to recover the king's debts, and [illegible] revenues of the crown It acquired in process of time a jurisdiction over common personal actions, by the fiction [illegible] a debtor to the king, and [illegible] similar in form to that of the chancellor's court

The equitable jurisdiction of the chancellor had probably commenced long before the reign of Edward I (*see* CHANCERY), and before his reign the original writs, by which actions were commenced, had been sued out or obtained in the chancery the clerks of which, like the pontifical framers of the *actiones* among the Romans, had the monopoly of drawing up the original instruments In the reign of Edward I (by *Statute of Westminster the Second*, 13 Edw I) an important change was made in this branch of law, by authorizing the clerks to frame writs adapted to particular cases which the old forms did not adequately suit. Hence originate our modern actions of *trespass on the case* *See* PLEADING

From the same statute the modern judges of *assize* and *nisi prius* (*see* NISI PRIUS) are chiefly derived These were originally occasional commissioners, sent down into the counties to deliver the gaol of prisoners, or to try civil causes By this statute the commission was first directed to be given to the king's justices, associated (as they still are in form) with one or two discreet knights of the county The commission of assize is, strictly speaking, a commission to try disputes respecting land wherein the writ of assize (which dates as before stated, from Henry II) was brought,—now fallen into disuse The commission of *nisi* [illegible] be called a legal fiction [illegible] tion in the superior courts (*see* PLEADING) are concluded, and an *issue of fact* is taken between the parties, the issue is appointed, by the entry on the *record* or written proceedings, to be tried by a jury from the county in which the proceedings arise at Westminster, *unless before* the day appointed (*nisi prius*) the judges shall have come to the county in question Besides these commissions, the same judges try criminal cases by virtue of a *commission of the peace* in which they are associated with the justices of the county, a commission of *oyer and terminer*, to hear and determine all treasons felonies and misdemeanors, and a commission of general gaol delivery, to try and deliver every prisoner who shall be in the gaol at their arrival in the county

Having referred to the reign of Edward I as the period under which a general sketch of our old common law might be most advantageously presented, we proceed to notice very briefly the chief alterations which mark its subsequent history These alterations can be easily ascertained where they were caused by the highest legal authority—by the parliament of the nation But far greater changes have been wrought by the silent course of the tribunals—by the discretionary power which our judges have assumed to extend the remedies, which they were authorized to administer, to cases unprovided for by earlier law, which either the ingenuity of practitioners, or in many more instances the increasing wants and more intricate relations of life had called into existence To trace such alterations is as impossible as to note, day by day the increase of stature by which the child grows into the man Often in laboriously investigating the history of our English jurisprudence, we are surprised when we look back, after perusing the events of a generation or a century, to the state of things as it existed at the beginning of that epoch, and find that although we cannot with all our diligence detect in its history the occurrence of any external changes in the subject on which our minds are fixed, yet the same forms, the same modes and circumstances, present themselves to our eyes under a totally different aspect and character

The reigns of Henry II and III are principally remarkable for the gradual substitution of the king's justices of the peace for the various elective magistrates who exercised the several duties of that office before It was in the reign of the latter prince also that the parliament is supposed to have finally acquired its present form Under the successors of the Edwards, and during the wars of the [illegible] [illegible] were made to the general [illegible] law, but during those

times very great changes were silently taking place in the disposition of property by means of the invention of Uses, borrowed from the civil law This extensive and most important subject will be found briefly treated of under the head of CHANCERY

The laws of Henry VII had principally in view the benefit of the exchequer, and hence various more comprehensive modes of enforcing justice against delinquents who might be liable to fine date from his reign methods which in their practice were oppressive and arbitrary, although not without check in the hands of justice Such was the proceeding by information, instead of indictment, in various cases on behalf of the crown The Statute of Fines, passed in this reign confirmed and extended a mode already in use of barring entails Under his successor, whose reign forms so important an epoch in political history, the laws of property were very considerably remodelled by the two statutes of Uses and of Wills (for the former, see CHANCERY) The latter rendered general the power of devising estates by will The system of bankrupt laws also had its commencement under Henry VIII His daughter Elizabeth did not add much to the essential and valuable parts of our statute book, but under her government the acts which restrained the alienation of lands by ecclesiastical bodies were passed and also the celebrated statute respecting the poor, of which the policy forms, even at the present day, a subject of such ardent controversy In the succeeding century, the reign of James I witnessed the first attempt to limit the period at which actions and suits might be commenced, and the first statute of bankruptcy But it is most remarkable for the laborious attempt to systematize our ancient law by Sir E Coke, one of the most acute, if not philosophical jurists of any age or country That of Charles II forms the next marked epoch in the history of our law after those of Edward I and Henry VIII His restoration was distinguished by the abolition of feudal tenures and incidents and the reduction of all the modes by which estates of inheritance might be held (with few exceptions) to two only,—free- The Statute of Frauds, a necessary unwary transactors of business but a source of endless litigation, the statute which regulates the distribution of the effects of intestates, and finally, the celebrated Habeas Corpus Act, which gave or rather confirmed, to every person imprisoned by any authority short of the express [illegible] course of justice, the means of releasing himself — are all productions of this reign

[illegible] gave rise to new views and [illegible] on jurisprudence did not in England produce much substantial alteration by statutory enactment It was rather a period of preparation for change, in [illegible] than of actual reform [illegible] learning and acuteness of several judges who occupied the seats of justice during many years, and introduced by the slow exertion of their own authority a new spirit into institutions of which the forms were preserved

Recent years have introduced some material changes, of which the effect has not yet been fully tried Lord Ellenborough and Lord Eldon had pursued the work of maintaining and embellishing the old institutions, succeeding judges have at last assumed in some degree the character of reformers Sir Robert Peel's criminal statutes conferred a great benefit on the country by removing many of the technical difficulties incident to this branch of law although they did not materially affect its spirit, which, in the article of capital punishments has been [illegible] by a succession of enactments, from [illegible] reign of George III until that of our present sovereign Many of the artificial distinctions, grounded on obsolete reasons, which subsisted between the practice of the different common law courts have been removed The system of pleading (see that article) has been very materially changed And in consequence of the general feeling in favour of local courts of justice to administer redress in trifling disputes between [illegible] has been [illegible] and some local tribunals have been constituted Lastly the ancient usage of imprisonment on mesne process has been abolished, and much additional power given in lieu of it to the Insolvent Court over the property of debtors

The term Common Law is ordinarily employed in two different senses In its legal signification it expresses the old unwritten law, established by precedent and custom, comprising, it has been said, "all recognized doctrines and customs, however introduced, which are neither to be found in the statute book, nor depend on the adjudication of courts of equity For this floating mass of legal principles our ordinary sources are precedents or [illegible], as contained in published [illegible] reference may sometimes be had to more uncertain guides the dicta of legal writers or the general principle and tendency of our laws, for authority in deciding a particular dispute

In its popular sense, common law is opposed to equity and ecclesiastical law; and thus comprises the whole of that law, both criminal and civil, which is administered in courts having trial by jury, and all the other subjects which are within the purview of the common-law courts of Westminster Hall, and of the various local jurisdictions of the country (except so far as some of them exercise equitable authority) It has been defined "the whole of that code, whether founded on statute, usage, or precedent which is administered in the common law courts of Westminster Hall," and this definition will comprehend the law administered in the various local courts in question, as these are bound to act on the decisions of the superior courts Its peculiar characteristic is, that questions of fact arising out of its proceedings are submitted to the decision of a jury

It is, perhaps, not very easy to assign either the history or the theoretical principles of the separation of equity from common law The former was undoubtedly in the first instance a jurisdiction of a remedial character, intended to moderate, according to the conscience of the judge, the rigour of legal judgments, but this is a peculiarity which can scarcely be said to distinguish it in the present day Its rules are as accurately laid down by precedents as those of the common law itself, but there are some subjects (as, trusts) which [illegible] in frustration of the provisions [illegible] out of [illegible] over these courts of equity have an *exclusive* [illegible] There are others over which both equity and law have *concurrent* jurisdiction But the remedies applied by law to injuries committed are subject to certain inflexible rules The power of a jury has limits from the very nature of the institution It can award a debt sought to be recovered, or damages for an injury, but it cannot modify the remedy according to peculiar circumstances Nor has it any means to enforce a course of action other than by imposing damages for neglecting it To take a familiar instance —If A sues B at law for breach of covenant, and judgment passes in favour of A, all that a jury can do is to award damages to A for the breach of contract, but equity can by a process of its own, compel B to a specific performance of the contract under the penalties attached to a contempt of court So, if one of several joint contractors be liable, at law, for penalties or debts incurred in respect of their joint undertaking his only legal remedy is by an action against each, in equity he can compel each of his partners to contribute to the extent of their liability

LAW, MARITIME *See* MARITIME LAW

LAW MARTIAL, is proclaimed by authority of parliament, on an emergency of rebellion, invasion and insurrection It is properly the putting under the cognizance of courts martial a great variety of subjects which by ordinary military law do not appertain to them to be [illegible] Where martial law is proclaimed [illegible] under all circumstances are placed within its jurisdiction even their debts are subject to inquiry before a military tribunal It extends also to a variety of cases not relating to the discipline of the army, and offences committed by non-military persons, as plots against the sovereign intelligence to the enemy, &c The statute for putting into execution martial law usually gives a power to arrest and detain in custody all suspected persons and to cause them to be brought to trial in a summary manner by courts martial, and to execute the sentence of all such courts whether of death or otherwise, and declares, that no act done in consequence of these powers shall be questioned in any of the king's ordinary courts of law and that all who act under the statute shall be responsible for their conduct only to such courts martial

LAW MILITARY, is properly that law which is administered by courts martial, under the authority of parliament and the Mutiny Act [illegible] usually printed together with the Articles of War See COURTS MARTIAL

LAWN (Fr linon) A fine variety of cambric, formerly exclusively manufactured in Flanders Of late the lawn manufacture of Scotland and of the north of Ireland has been brought to rival that of the Flemish weavers

LAWN In Gardening, a surface of grass or turf in pleasure grounds kept smoothly mown

LAXATIVE (Lat laxare *to loosen*), a gentle aperient medicine opposed to *cathartics*, which are drastic purgatives

LAY (Probably the same word with the German lied, *song*) The lyric poems of the old French minstrels, or trouvères, were termed lais, but [illegible] modern usage, to be peculiarly appropriated to [illegible] poems, or serious subjects of moderate length in simple style and light metre

LAY In Agriculture *See* LEA

LAY BROTHERS Persons received into convents of monks, under the three vows, but not in holy orders The introduction of this class of devotees appears to have [illegible] They are dressed somewhat [illegible] monks or *brothers of the choir*, and often employed in the manual exercises necessary for

the uses of the community The Carthusian and Cistercian orders are said to have first recognized the distinction, and their example was followed by the other orders The same distinction exists in monasteries of females between the nuns properly so called and the lay-sisters, or sist rs c nv rs

LAY ELDERS In Presbyterian churches ministers of ecclesiastical jurisdiction, r s who assist the pastor in each BYTERIANS, KIRK ) The divines of that persuasion rest the appointment of lay elders in some measure on that of presbyters "in every city," by Paul and Barnabas, who, they imagine, from the manner in which they are mentioned, could not have been all preachers (See *Hooker Eccl Pol* b vi )

LAYERS In G by laying down s with soil so that the extremity of the shoot is left above ground, and the shoot itself not detached from the plant In order to facilitate the rooting of such layers the portion of the shoot buried in the soil is fractured by twisting or bruising, or cut with a knife immediately under a bud This operation, by obstructing the return of the sap from the leaves, occasions its accumulation at the wounded part, when roots are there produced from the effort of nature to perpetuate life

LAYING In Architecture the first coat on lath of plasterer's two-coat work the surface whereof is roughed by sweeping it with a broom, the difference between laying and *rendering* being that the latter is the first coat upon brick

LAYMAN (Gr λαικος, from λαος, *people*) The appellation by which the rest of the community are distinguished from the clergy (*See* LAITY)—*Layman*, or *lay figure*, among painters signifies a small statue whose joints are so formed that it may be put into any attitude for the purpose of figures

LAZAR HOU (Ital ) A public building in the southern European states, of the nature of an hospital, for the reception of the poor and and those afflicted with contagious disorders In some places lazarettos are set apart for the performance of quarantine, in which case only those are admitted who have arrived from countries infested by the plague, or suspected of being so Howard's well-known account of the principal lazarettos of Europe furnishes the most detailed and interesting particulars of the establishments and to it we refer the reader for full information

LAZARISTS In Ecclesiastical History, a body of missionaries founded by St Vincent de Paule in 1632 so priory of St Lazarus at Paris Their primary object was to dispense religious instruction and assistance among the poorer inhabitants of the rural districts of France They were dispersed at the time of the Revolution but have since re established a congregation at Paris and the French government has lately projected entrusting them with the spiritual care of the colony at

LAZARUS, SAINT ORDER OF of religious persons, originally an association of knights for the purpo Se m lazar houses or hospitals and Being driven out of Palestine in 1253 they followed St Louis to France In 1490, their order was suppressed by Pope Innocent VIII and united with that of St John but the bull was not universally received In 1572 they were united in Italy with the order of St Maurice, in 1608 in France, with that of Our Lady of Mount Carmel The knights of these united orders were allowed to marry

LAZULITE A blue mineral from Styria and the Tyrol, composed of 66 alumina, 10 silica, 18 magnesia, 2 lime 3 oxide of iron

LAZZARO'NI A name given to the poorer classes at Naples, from the Hospital of St Lazarus which served as a refuge for the destitute in that city Forty years ago two large sections of the people were generally comprehended under this name—the fishermen, and the lazzaroni properly so called, who lived in the streets, and performed no other labour but that of errand porters and occasional servants These alone were estimated at 40,000 These Lazzaroni formed a powerful community, which under Masaniello accomplished the revolution of Naples and in later times overthrew the popular government, under the influence of Cardinal Ruffo and the English party But during the French occupation of Naples they ceased to exist as a distinct class, and the name is now only used to designate in general language the mob or populace of that great city

LEA, in Agriculture, is a term applied to lands which are kept under grass or pasturage for a short period For example, in a rotation of fallow, wheat, clover, and rye grass, for three years and rye grass, is said to be land, in lay

LEAD A metal of a blueish-grey colour Its specific gravity is 11 38 It is very soft, flexible, and inelastic, and though ductile and malleable, is possessed of very little tenacity It fuses at about 600°, and if air be carefully excluded, it does not appear to be volatile at a white heat When melted in open vessels, it soon changes into a grey powder, which upon further exposure to heat and air becomes yellow, and is called *massicot*, or, when partially fused, so as to assume a scaly form, *litharge* If massicot be [illegible] and partly converted into a brown powder, which is insoluble, and is a *peroxide of lead* Massicot, or the yellow oxide of lead, is the *protoxide*, and that which forms the salts of this metal it is constituted of 1 atom of lead = 104, and 1 of oxygen = 8, and its equivalent is 112 The brown peroxide consists of 1 atom of lead and 2 of oxygen, and red lead is intermediate between the two extremes, consisting probably of an indefinite mixture of the two oxides The protoxide of lead is soluble in the greater number of the acids and forms a variety of salts, of these the carbonate and the acetate are the most important *Carbonate of lead*, or, as it is commonly called, *white lead*, is the basis of white oil paint, and consequently of a number of other colours [illegible] sheet lead to the fumes of [illegible] corroded, and its surface [illegible] incrustation, which, when scraped off and well levigated, is white lead This article is also made by precipitating a solution of acetate of lead by carbonate of soda, it consists of 112 oxide of lead and 22 carbonic acid *Acetate of lead* is made by dissolving carbonate of lead in acetic [illegible] met with in confused crystalline masses It is soluble in about 4 parts of cold water and the solution has a remarkably sweet taste, whence the term *sugar of lead*, usually [illegible] salt It consists of 112 oxide of lead and [illegible] The crystals include 3 atoms of water, and are therefore represented by the equivalent 190, or 163 dry acetate and 27 water When protoxide of lead is boiled in distilled vinegar, or in a solution of acetate of lead, a dense solution of subacetate or *triacetate* of lead is obtained it is difficultly crystallizable This solution is often used in the chemical laboratory as a test and precipitant and it forms the *extract of lead*, or *Goulard's extract* of pharmacy

The most important native combination, or *ore of lead*, is the *sulphuret*, composed of 104 lead and 16 sulphur It is the *galena* of [illegible] demands for le [illegible] sulphur, and the [illegible] with charcoal The action of water upon lead is curious and interesting in consequence of the universal use of cisterns lined with this metal Perfectly pure water, such as distilled water put into a clean leaden vessel and exposed to air soon oxidizes and corrodes it, and delicate tests discover oxide of lead *in solution* in the water, but river and spring water exert no such solvent power the carbonates and sulphates in such water, though in very minute quantities entirely prevent its solvent power Hence it is that leaden cisterns are used with impunity for the preservation of common water and that the crust which forms upon the metal effectually prevents all further action As this crust partly consists of carbonate of lead, which is very poisonous great care should be taken to prevent its diffusion through the water upon any occasion, as by scraping or cleaning the cistern There is another way in which leaden cisterns sometimes prove injurious, and that is in consequence of galvanic action, where iron or zinc pipes are soldered or let into them the lead is thus rendered electro negative alkaline matter is evolved upon it and small quantities of the oxide or carbonate are thus rendered soluble There are several re-agents by which very minute quantities of lead may be detected, among these solution of sulphuretted hydrogen is perhaps the most effective it produces a brown tint in water containing the minutest trace of lead, and it similarly discolours the greater number of the insoluble salts of the metal A solution of sulphate of soda is also a sensible test of the presence of dissolved oxide of lead, it forms a white cloud in water containing the smallest traces of it a fragment of iodide of pota such water presently occasions in it a sequence of the formation of an iodide of lead

LEAD, BLACK *See* PLUMBAGO

LEAD, for Sounding The common hand lead weighs 11 lbs with about 20 fathoms of line The leadsman stands somewhere on the side of the vessel, leaning against a band for the purpose lets the lead descend near the water, then, swinging it over his head once, or twice if the ship is going fast, throws it forward The line is marked at 5, 7 10, 13, 17, and 20 fathoms The numbers between are called *deeps*, thus, 'by the mark 7," "by the deep nine," indicate 7 and 9 fathoms

When the depth is great, the deep-sea lead of 28 lbs is used The lead is dropped from the fore part of the vessel, the line being passed outside all It is generally necessary to heave the ship to

**LEADING NOTE** In Music, the sharp seventh of the scale

**LEADS, or SPACE LINES**, are pieces of type metal cast to size for the lines of a page, thinner than types, so that they do not take any ink in printing, but leave a white space where placed These pieces are to be placed between the lines of a page already printed, which is considered to look better than when printed solid, and also to branch out the heads of pages and titles

**LEAF** (Sax ) An expansion of the bark at the base of a leaf-bud [illegible] being at once that of respiration and transpiration It is a plate of parenchyma, through which spiral vessels and woody tissue ramify Its surface is covered with stomates, which communicate with minute hollow chambers in the interior It is in the leaf that all the peculiar secretions of a plant are prepared out of the under sap which the roots obtain from the soil

**LEAF-BUDS** Rudiments of young branches, made up of scales imbricated over each other, the outermost being the harder [illegible] minute axis which is [illegible] woody and cellular tissue of the stem When stimulated by light and heat they extend into branches, or if artificially removed from the plant that bears them they are capable of multiplying the individual from which they have been taken

**LEAFLET** A small leaf formed by the petiole of a leaf branching out, and separating the cellular tissue of the lamina into more than one distinct portion, each of which forms a perfect leaf in itself

**LEAGUE** A measure of length, used in reckoning distances by sea The sea league is three nautical or geographical miles or the 1-20th of a degree, and consequently about 3 4 English miles

The common land league is a well-known itinerary measure on the continent of Europe, chiefly in France The French, however, have two distinct leagues the legal posting league (*lieue de poste*), containing 2000 toises, and equal to 2 42 English miles, and a league of [illegible] (frequently the *lieue moyenne*) or equal to [illegible] miles This last, however, can scarcely [illegible] and previous to the [illegible] in the different pro[illegible] ived from the Celtic leach, *stone*, the distances having been marked by stones in the Roman provinces In Gaul alone of those provinces, they were marked in some instances by leagues as well as miles The Gaulish league was considered by the Romans as equal to a mile and a half of their own measure, or as containing 1500 Roman paces It is supposed that the [illegible] or *leuca*, was introduced into England by the Normans where at an early period it came to be reckoned as equivalent to two miles of the time, this being the sense in which the term *leuca* is used by the oldest law writers, and in most of the old English charters *See* MILE

**LEAGUE**, in Politics appears to be in strictness an alliance between two or more powers, in order to execute some common enterprise It is therefore more active, and less durable, than an alliance or a confederacy both of which have some permanent object, while neither necessarily requires active co-operation In the middle ages, the word league was used nearly in the sense now attached to these latter terms hence we read of the Hanseatic league, and of the three leagues still subsisting in the canton of the Grisons in Switzerland, both of which were more properly confederacies The word is of Spanish origin, and it has been said that the period of its commonest use in political language was commensurate [illegible] and [illegible]

**LEAGUE SOLEMN** [illegible]

**LEAGUE THE HOLY** [illegible] **THE LEAGUE** In [illegible] formed by the Roman Catholic party in France under the reign of Henry III The project of the League is said to have been framed by one David an advocate, or, rather, he first conceived the idea of [illegible] tions of the Catholic party in [illegible] confederacy His written scheme bears date 1575 It was ardently received, especially by the [illegible] citizens of Paris and other large towns [illegible] the League was at first only the overthrow of the Protestant power, but the princes of the house of Guise soon placed themselves at its head, and the leaders of the party were not slow [illegible] chang[illegible] [illegible] on the [illegible] citizens, under the impulse of the League, drove Henry III from Paris on the day of the Barricades, and formed the revolutionary government of "the Sixteen" But after the death both of the duke and the king, much division arose in the head quarters of the League at Paris as to the choice of a successor, and in both the popular party, or that of the Sixteen, was put down by the citizens which event in effect destroyed the power of [illegible] ll continued to exis[illegible] [illegible] IV

**LEAKAGE** [illegible] e customs, granted to importers of wine for the waste and damage [illegible] to receive by keeping

**LEAN-TO** [illegible] itecture, a building whose ra[illegible] [illegible] inst or le[illegible] another building

**LEAP YEAR, or BISSEXTILE** A year containing 366 days [illegible] occurs every fourth year, [illegible] centuries, in which cas[illegible] unless the number of the year is divisible by four The term is probably derived from the *leap* or start occasioned by the insertion of the intercalary day, and would have been more appropriate if the year had been deficient by a day instead of being redundant *See* CALENDAR

**LEASE** in Law, is properly a conveyance of lands and tenements (usually in consideration of rent or other annual recompence), made for life, for years, or at will, but always for a less time than the lessor or party letting has in the premises The usual words of operation are, "demise grant, and to farm let" The conveyance by a lessee of part of his interest is properly an under-lease, of the whole [illegible]

**LEASE AND RELEASE** In Law a mode of conveyance appropriate to estates of freehold in lands, tenements or hereditaments Before the Statute of Uses, 27 H 8 c 10, it was customary to give lands to one person for the use of another, or to devise the use of land to one party, while the common law right to the same land descended to another In a court of equity the legal owner of the fee was compelled to cede to the *cestuy que use* or proprietor of the use, the enjoyment of the land, and certain modes of conveyance were employed by which the use was conveyed independent of the legal estate By that statute uses were declared to be executed, i e that if land were conveyed to one party to the use of another, the *cestuy que use* became seised of the legal estate Hence a *bargain and sale*—i e a deed in which for a recited pecuniary sum, technically called a *consideration*, land was conveyed to A to the use of himself or of B—became a good conveyance, because the deed gave the use and the statute immediately added the legal estate To prevent secret conveyances it was consequently enacted in the same reign, that no estate of inheritance or freehold should be conveyed by bargain and sale, unless the deed was enrolled or registered in a certain specified manner But as this statute did not extend to bargains and sales for a less estate than of freehold, the ingenuity of lawyers soon devised a new method of secret conveyance the land was made over to the purchaser by bargain and sale for a year and then the purchaser received a release of all the vendor's remaining interest Thus, by these two deeds (which are now ordinarily comprised in one) a perfect conveyance is created which has almost superseded in general use the older and more solemn modes of alienation for estates in fee-simple

**LEATHER** (Germ leder) The prepared skins of animals The principal object of the art of converting skin into leather is to render it strong and tough, durable, and often water-proof and to prevent its destruction by putrefaction The skins are first cleansed of hair and cuticle and then impregnated either with vegetable tan and extracts in the production of what is called *tanned* leather or with alum and other salts, as for *tawed* leather these processes are sometimes combined and tanned [illegible] results thick sole leather is tanned white kid for gloves is tawed, the upper leather for boots and shoes is tanned and curried, and fine Turkey leather is tawed, and afterwards slightly tanned

*Tanned Leather*—For thin skins which are afterwards curried, the hide is cleansed, and soaked for a day or two in water, it is then *beamed*, or stretched upon a solid half cylinder of stone, where it is cleared of adhering fat and flesh, it is then soaked for several days in a pit of lime and water by which the hair and cuticle are so far loosened as to admit of being scraped off upon the beam, the hide is then washed and put into the *mastering* pit, which is a mixture of water and dung,—that of hens, [illegible] or horse dung not being [illegible] When the hide has here become [illegible] thoroughly cleaned, and submit[illegible] which is at first used very weak, [illegible] from twelve to eighteen months for thick ox and boar hides intended for strong sole leather, and the latter hides, instead of being limed and dunged, are generally, after having been cleaned in water, placed in heaps, where they begin to putrefy, and then the hair may be removed without lime, which would be apt to render the skin hard and harsh The further opening of the texture, so as to prepare it for tanning, is effected by immersion in a sour liquor of fermented rye or barley, or in weak sulphuric acid

The process is called *raising*, and immediately precedes the tanning When fully tanned the goods are drained, stretched upon a convex piece of wood called a *horse*, and [illegible] issed [illegible] it is [illegible] ding [illegible] (Tan and Gelatine) that the principle [illegible] process depends upon the [illegible] the skin with the tanning of the oak bark, or other astringent material which is used, and that great care is [illegible] perfect penetration of the hide [illegible] s thick) by the tanning material hence the necessity of using weak liquors at first, and gradually increasing their strength, for if the hide were in the first instance put into a strong infusion of bark, the exterior surfaces would become so perfectly tanned as to be impervious to the further action of the liquor, and the centre would remain untanned, and consequently soluble and putrescible, so that we judge of the completion of the process by the leather when cut through, being of a uniform brown throughout, anything like a white streak in the centre announcing the imperfection just mentioned

*Tawed Leather, &c* —The skins are first soaked, scraped, and hung in a warm room till they begin to exhale an ammoniacal odour and the wool readily pulls off, they are then scraped and soaked for some weeks in lime water, which checks the putrefaction and hardens the texture, the skin is then again beamed, smoothed, and trimmed, and put into a vat of bran and water, where it is kept for some weeks in a state of gentle fermentation and becomes thin and extensible, and fit for any subsequent operation in this state it is called a *pelt* The method of bringing kid and goat skin to the state of pelt is nearly the same as for lamb skin, except that liming is used before the hair is taken off which is only sold to plasterers, whereas lambs wool is more valuable and would be injured by the lime If the pelts are to be tawed they are worked about in a solution of alum and salt in warm water, which again makes them thick and tough, they are then washed and again fermented in bran and water till the thickening is reduced by the removal of some of the salts, lastly they are stretched on hooks and dried in a stove room when they become a tough flexible white leather, but to give them gloss and suppleness they are again soaked in water and trodden in a large pail containing the yolks of eggs beat up with water, they are then dried in a loft, and smoothed with a warm iron

*Morocco leather* as it is called is chiefly prepared from sheep skins, which after the action of lime water, are brought down by a dung bath and reduced to the state of pelt If intended to be dyed red, they are sewn up in the form of a sack, with the grain side outward, and immersed in a warm cochineal bath, the skin is then tanned in a bath of sumach the skins intended to be blacked are [illegible] with [illegible] [illegible] [illegible] polished [illegible] [illegible] [illegible]

cannot return, as he would do to a book, for farther explanations, and the subsequent part of the lecture may in consequence be rendered nearly useless Hence *perspicuity of statement* is the first and highest quality of a lecturer Perspicuity, indeed, is indispensable to all good writing and speaking but in lecturing especially it is the one thing needful and without it other qualities can avail little or nothing In attaining this essential quality the subjects of the lecture should be arranged that they may follow each other naturally and easily, the sentences should be clear and distinct, neither too long nor too short, the illustrations should be appropriate and of a kind fitted to excite and keep awake the attention of the hearer, and the lecture so composed should be delivered in a plain, distinct, and impressive manner If a lecturer be deficient in these qualities, he can be of little or no use as a teacher, how well soever he may be acquainted with the subject on which he prelects Dr Brown, of Edinburgh, is an instance in point his views with respect to the philosophy of the mind are often original sometimes just, and always ingenious, but the style in which they are expounded is as bad as possible, even in a book made for the closet, and rendered his lectures all but unintelligible to nine tenths of his students It has been the fashion among certain parties who certainly do not owe much to the *belles lettres* to depreciate the lectures of Dr Blair, but they may be safely referred to as all but perfect models of the style and manner in which lectures should be written

When lectures are prepared in the way now stated by parties well versed in the subjects prelected upon and when they are regularly followed up next day by a searching examination of the students on the various subjects treated of, and explanations are given of such difficulties as may have occurred to them, they may perhaps as already stated, be regarded as a pretty unexceptionable method of teaching But lectures got up as they generally are not to instruct the hearer but to exhibit the attainments or prejudices of the lecturer and unaccompanied either by examinations or exercises are about the least profitable exhibitions at which a student can be present

LE'DGER *See* BOOK-KEEPING

LEDGER LINE (Dutch leggen *to lie*) In Music a line either above or below the staff when that is not sufficient in extent to lay the notes upon It is above the staff in ascending progressions, and in descending [illegible] below it

LEDGERS (Fr) In Architecture, horizontal pieces of timber used in scaffolding lying parallel to the wall opposite to which they are erected

LEE, LEEWARD Sea terms denoting generally the side or quarter not directly exposed to the wind The *lee-side* of a ship is the opposite to that on which the wind blows when it crosses her course and which is termed the *weather side* *Leeward* is on the *lee side*, opposed to *windward*, or on the *weather side* A *lee-shore* is the shore on the *lee-side* of the ship or the shore on which the wind blows, and a ship is said to be under the *lee* of the shore when the wind blows from the shore, or when she is in some measure sheltered by the shore The names Leeward and Windward, as applied to the West India Islands, were given to them from their situation in a voyage from the ports of Spain to Carthagena or Portobello The islands which lie to leeward extend from Portorico to Demerara

LEE-BOARD A small platform of planks, which being let down into the water on the lee side of flat-bottomed vessels, opposes the action of the wind to drive them to leeward

LEECH This name is given to those abranchiate red-blooded worms, or anellidans, which are provided with a sucker at both ends of the body (*see* HIRUDO) and of which we possess a few native species, some frequenting the fresh waters, as the horse leeches (*Hæmopis sanguisorba* and *H stagnorum*), others the ocean where they are parasitic upon fishes, as the skate-sucker (*Pontobdella muricata*) The medicinal leech (*Sanguisuga medicinalis*) belongs to that subdivision of the family *Hirudinidæ* which is characterized by having the superior lip of the anterior cup or sucker divided into several segments and the oral [illegible] surrounded by three curved jaws, [illegible] rows of very minute teeth [illegible] to penetrate the skin so as to ensure a ready flow without causing a dangerous wound The upper lip is marked with ten small points considered as eyes The species of the genus *Sanguisuga*, viz *S officinalis* and *S [illegible]* are most common in the south of [illegible] numbers are exported to this country [illegible] of Bretagne drive horses and cows into the ponds, that the leeches may fatten and propagate more abundantly by sucking their blood Children are employed to catch them by the hand, and the grown persons wade into the shallow waters in the spring of the year, and catch the leeches that adhere to their naked legs They are also taken by a sort of net made of twigs and rushes, which is used in the summer when the leeches retire into the deeper waters

The best method of preserving these valuable little animals is stated by the author of the article 'Leech' in the *Penny Cyclopædia* to be that described by Fee It is as follows —

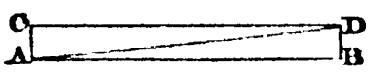
Into a marble or stone trough a layer of seven inches of a mixture of moss, turf, and charcoal is to be put and some small pebbles placed above it, at one extremity of the trough, and midway between the bottom and the top, place a thin plate of marble pierced with numerous small holes, upon which there should rest a stratum of moss, or portions of the *Equisetum palustre* or horse-tail, firmly compressed by a layer of pebbles The trough to be filled with water only so high that the moss and [illegible] charcoal not only aids in keeping the water sweet, but [illegible] leeches being attacked by parasitic [illegible] are very liable The water should be changed about once a week, and more frequently in warm weather

The great importance of ascertaining the best method of preserving the medicinal leech may be inferred from the extent to which the trade is carried on, and the consequent increasing scarcity of these indispensable adjuncts to medicine Four only of the principal dealers in London import 7 200 000 annually

LEE'LITE A pink silico aluminous mineral tinged by oxide of manganese Named from Mr Lee of Cambridge

LEET (Sax leod, Germ leute, *people*) The court leet, or view of frankpledge, was an ancient Saxon institution [illegible] The administration [illegible] and the abatement of nuisances, 2 The preservation of the peace and the prevention of crime by the reception and enrolment of the pledge which each man was obliged to give by becoming a member of some tything The possession of a court leet was the characteristic of the hundred of which the proper leet was distinct from, and subordinate to, that which was held by the sheriff on his tourn The court leet of the hundred was usually held by a bailiff or steward of the sheriff, but it was sometimes granted as well as the leet of a smaller jurisdiction to private lords A court leet also properly belonged to a borough which ranked as a hundred, but such private and borough leets were like the leet of the hundred, subordinate to the county leet of the tourn

LEE-WAY in Navigation is the deviation of the course actually run by a ship from the course steered upon, or it is the angle formed between the line of the ship's keel and the line which she actually describes through the water In consequence of the action of the wind or currents a ship is generally impelled sideways as well as forward whence the direction of her motion is different from that of the keel Suppose the whole force urging the ship to be resolved into two, – one producing motion A B in the direction of the keel, and the other the motion A C in the same time




[illegible] then the ship will move in [illegible] A D and the angle D A B is the *lee way* To obviate the effects of this lateral motion, the ship is laid on a course to the windward of the point to which she is bound

LEGACY *See* WILLS (Lat lego *I bequeath*) A gift by will of personal property as goods and chattels, a testamentary gift of real property being called a devise Legacies are general such as a gift of a sum of money out of the general estate of the deceased, or specific, as a gift of a particular bank note or coin, or of any other individual chattel as a horse or a jewel, or residuary, as a gift of the residue of the estate remaining after all the debts of the deceased and general and specific legacies have been satisfied General legacies are subject to an equal rateable abatement, if the estate is not sufficient for payment of them in full, but a specific legacy is not subject to abatement, unless it be necessary for the payment of debts A specific legacy is, however, subject to what is called ademption, which is the consequence of the subject matter of the legacy being one identical thing in specie thus, if a testator bequeath a particular horse, which he afterwards disposes of in his lifetime, the legacy is said to be adeemed, or taken away, because the horse bequeathed has no longer any existence as part of his property, and the legatee will not be entitled to another horse of the testator's in lieu of it This identity of corpus is so inherent in the notion of a specific legacy, that if a 100*l* in Consols were bequeathed, and the same sum were afterwards transferred by the testator to another stock, the transfer of itself would adeem the legacy The mode of compelling executors to pay a legacy is by suit in equity for the administration of the testator's assets Courts of law have not, in general, any jurisdiction over such mat-

ters Executors cannot be compelled to pay a legacy until the expiration of a year after the testator's death they are allowed that period for ascertaining and discharging his debts, and even after a legacy has been paid the legatee must refund, if it should be necessary, for the payment of creditors who come in, although after the period above mentioned The party to whom a legacy is bequeathed is termed legatee For an account of the legacy duties, see art "Taxation," *Encyc Britannica*, (new edition)

LE'GATE (Lat legatus) A high functionary, in [illegible] whom the pope sends as ambassador [illegible] powers Legates are — 1 A Latere, who possess the highest delegated authority 2 De Latere the former are such as the pope commissions to take his place in councils 3 Legates by office are such as enjoy the titular distinction of legate by virtue of their dignity and rank in the church, but have no special mission

LEGATION *See* AMBASSADOR DIPLOMACY

LEGA'TO (Ital *tied*) In Music, a term used to denote the tying one note to another which is done by placing these marks ⌣ ⌢ above or below the notes intended to be so joined This is also known by the name [illegible]

[illegible] (Ital) In Music *See* DRIVING NOTES

[illegible] (Lat) In Roman History an officer who acted as deputy under a commander-in-chief and whose duty it was to aid the proconsuls and proprætors in the administration of the Roman provinces Of the number of the legati nothing certain is known, though the probability is that there was one to every legion In the absence of the consuls and other magistrates entitled to the *fasces* this honour was conferred on the *legati*

LE'GEND (Lat legenda, *things to be read*) A book originally used at divine service in the Romish churches, in which are recorded the lives of saints and martyrs, portions of which were selected and read for the edification of the people These legends, which contained many ridiculous stories of the lives of the saints, were studiously perused in the refectories of cloisters, and were earnestly recommended to the perusal of the laity, as so many evidences of the truth of the Roman Catholic faith Among these the Golden Legend (the work of Jacobus de Voragine, archbishop of Genoa in the 13th century) which is a collection of the lives of the saints, maintained its ground in the church for two hundred years, though, from the number of ridiculous stories with which it teems, it has now sunk into merited oblivion But although many of the legends consist of tasteless and unmeaning fictions, the offspring of childish credulity which indeed they were intended to feed there are many of them of a highly poetical and romantic character, and hence it is not surprising that this species of literature has often been regarded even by persons of taste, as a verdant oasis amid the desert of imaginative writings in the middle ages There are some sensible remarks as to the value of the early Christian legends in Beugnot, *Hist de la Destruction du Paganisme en Occident*, i 280 In a general sense the term legend is used to denote any fictitious or doubtful narrative, such as the exploits of heroes of the middle ages, or the history of a people or district in which truth is so mixed with fable as to be inseparable from it

LEGEND In Numismatics, that which is written *round* the field of a medal, opposed to *inscription*, which is written across it *See* NUMISMATICS

LEGERDEMAIN (Fr *light of hand*) A term given to some deceptive or sleight-of hand performances, which depend either entirely on dexterity and address, or derive but a small degree of aid from philosophical principles *See* MAGIC

LEGGIA'DRO (Ital) In Music a direction to the performer that the music to which the word is appended is to be performed rather briskly

[illegible] of the Roman army, comprising ten cohorts thirty maniples, or sixty centuries, so that if there had always been one hundred men in each century, as its name imports, the legion would have consisted of six thousand men But the number was in fact variable

There were usually three hundred cavalry joined to each legion, which were divided into ten troops (turmæ), and each of these troops into three bodies of ten men decuriæ) The defensive arms of the legionaries were an oblong shield, a helmet, hauberk, and greaves, their offensive weapons were a sword and two long javelins The legion was drawn up in three lines, the soldiers in each of which were distinguished by the names Hastati, Principes, and Triarii The Hastati, who formed the first line, were young men in the flower of life, and ori[illegible] were, however, afterwards [illegible] the second line, and were men in the [illegible] Triarii were veteran soldiers, and formed [illegible] In each legion there were six military tribunes, who commanded under the consul, each in his turn, usually for about a month This was the early organization of the legion, as it is known to us from the descriptions Livy, at the time of the great Latin war in the 4th century of the Republic It was materially changed in later times, and the three original lines were discontinued probably about the time of the Punic war But it always retained its distinctive character of a separate army, as it were, provided with its complement of cavalry and light infantry, and it has been remarked, as a striking proof of the military genius of the Romans, that after so many ages of additional experience, recent captains, and particularly Napoleon, have found it advantageous to divide their armies into separate corps, each in a similar manner complete, with its own cavalry and artillery, and these, in the French imperial armies, usually averaged from 4000 to 6000 men, or about the number of a Roman legion The organization of the legion is explained in most works on Roman antiquities but has been nowhere so thoroughly treated as by M Le Beau, in a long series of memoirs which [illegible] from time to time in the *Mem de l'Acad des Inscr et Belles Lettres* See particularly vols xxxv xxxvii xxxix. The reader may also now consult *Dr Arnold's History of Rome*, vol ii

LE'GION OF HONOUR An order instituted by Napoleon when first consul of France for merit, both military and civil The order consisted, under the Empire, of grand crosses, grand officers, commanders, officers, and legionaries They were divided into sixteen cohorts, each of 407 members, but the total amount was afterwards much increased Pensions, from 250 to 5000 francs per annum, were attached to these distinctions After the restoration of Louis XVIII the order underwent some modifications [illegible] numbers were limited [illegible] See HONOUR

LEGISLATION *See* LAW

LE'GISLATOR (Lat) [illegible] the laws and polity of a state [illegible] chiefly [illegible] persons of antiquity, such as [illegible] Theseus, Draco, Solon, among the Athenians, Lycurgus among the Spartans, and Numa among the Romans

LEGISLATURE The name given to the body or bodies in a state in whom is vested the power of making laws Thus the king, lords and [illegible] in Britain, whose united consent is indispensable to the framing of a law are styled *the legislature*

LEGITIMACY, in Politics, signifies, in its strictest sense, the accordance of an action or of an institution with the municipal law of the land The principle of obedience to civil authority, in whatever hands the law has placed it, is consecrated by religion as well as by sound philosophy Resistance to or evasion of, the legal commands of a superior, is thus an offence against the law of God as well as of man, in things in themselves indifferent as well as in things commanded by the principles of morality How far they must be obeyed when against the conscience of the subject, is one of those questions of casuistry which never can receive a solution applicable to all cases and circumstances In this sense it is clear that the attribute of legitimacy belongs to no particular form of government, but is equally inherent in all when lawfully established But, looking at the subject from a higher point of view, the question arises, when and how shall a government be taken to be lawfully established? This can only be directly answered by two classes of political philosophers The first attribute the quality of legitimacy only to hereditary monarchical government which they conceive to be peculiarly of divine [illegible] but its advocates have never been able to show any real foundation for it in the language of Scripture, and it is of course impossible to raise it on any other basis (*See* DIVINE RIGHT, NON-RESISTANCE) The second class bases society on the abstract rights of man, attributes all power to the people and considers no government legitimate except such as is founded on their consent This theory also is plain and clear in the abstract, but has the defect of becoming impossible in application For, 1 The principle of the *social contract*, or implied consent of the people, is a mere philosophical fiction 2 The actual consent of the people (*i e* the majority of it) to any existing form of government has never been [illegible] obtained This is notoriously the case in every European country, and even the representative government of the United States of America is chosen by a constituency from which *slaves*, women, and persons under twenty-one years of age (that is, in all, five sixths of the population) are excluded Now the exclusion of any one of these classes can only be justified on grounds of expediency, and similar grounds might equally justify [illegible] other restrictions (e g that of property, as in England and other European countries) which would still further reduce the number of the constituency 3 Supposing a government established by the actual voices of a majority of the whole people, the question would still arise, whether every subsequent act of that

government was largely influenced by that original validity This question was much debated in France at the period of the trial of Louis XVI, when the Convention elected itself by a majority of the people, was assuming the extraordinary power of judging that monarch The Girondists on this occasion, contended that an appeal to the people (i e to the suffrages of a majority of the constituents) was necessary in order to ratify the act, and in practice it has been found that whenever a violent change has taken place the period of the election of the representative body has called for the adoption of extraordinary measures Between these two classes of theoretical politicians, the greater number are content to hold that the only fundamental principle of government is expediency and its only right that given by municipal law or peaceable possession In their view, all government is equally legitimate so soon as it is fairly established, while they fully admit that a question, and often a very difficult one, arises on every violent change of institutions, as to how soon the new government *de facto* has acquired the character of legitimacy In the language of modern politics this word has acquired a peculiar sense, chiefly from its employment about the period of the Congress of Vienna, when the old hereditary dynasties were termed legitimate in contradistinction to those which the French revolution and subsequent wars had founded Hence the principle of legitimacy has been, very incorrectly opposed to that of representative or popular government, a mere abuse of terms but an important one, from the powerful effect which words are able to produce in political discussion

LEGI'TIMACY (Lat legitimus *lawful*) In Jurisprudence the state of a child born in lawful wedlock

LEGITIMA'TION The act by which natural children are rendered legitimate *See* GRETNA GREEN MARRIAGES BASTARD

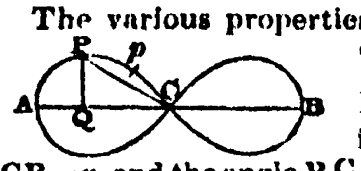
LEGU'MEN (Lat) In Botany, a one celled one or many-seeded, two valved superior fruit, dehiscing by a suture along both its face and its back and bearing its seeds on the ventral suture only It differs from the follicle only in dehiscing by two valves Sometimes it is indehiscent, as in (*cassia fistula*, &c but the line of dehiscence is in such species indicated by the presence of sutures It is very near a drupe, into which it passes in many genera such as *Dipteryx*, &c

LEGU'MINOUS F A very extensive natural order of Polypetalous Exogenous plants found in all parts of the world, forming large trees and huge twiners in the Tropics, and being herbaceous plants or small bushes, rarely trees, in colder countries The order contains a great variety of useful and beautiful species, some of which, like clover, lucern, sainfoin and vetches are cultivated for cattle, others, as peas beans lentils and various other kinds of pulse form part of the food of man Indigo, logwood and many others are well-known dyeing plants, several acacias produce gum arabic, certain *Astragali* yield tragacanth the tamarind and others bear pods whose interior is filled with an agreeable fæculæ or pulp, *Cassia acutifolia* and others yield senna, *Glycyrrhiza* the liquorice root, *Ceratonia* the wild locust fruits of Scripture, finally many are valuable tonics and some are dangerous narcotics, among which the common laburnum is to be named The larger part of this order consists of plants called Papilionaceous, because of a fancied resemblance between their flowers and a butterfly Such plants have one large expanded petal, and four others much smaller which form alæ and carina in front of the vexillum, but in others the more usual form of corolla is observed, and there are even some which like *Ceratonia*, are apetalous The division of the order called *Mimosa* is remarkable for having very small flowers with long stamens, and growing in balls or spikes

LE'MMA (Gr λημμα, from λαμβανω *I take or assume*) In Geometry, a preliminary proposition laid down or the purpose of facilitating or rendering more perspicuous the demonstration of a theorem, or the construction of a problem

LE'MMING A name given to a species of claviculate Rodents (*Georychus lemmus* Ill), very abundant in the north of Europe on the shores of the Arctic ocean It is as large as a rat, with black and yellow fur, and is remarkable for its occasional migrations in innumerable bodies At these periods the lemmings are said to march in a straight line, regardless of rivers or mountains, and, unimpeded by any obstacle, they devastate the country through which they pass *See* GEORYCHUS

LEMNI'SCATA (Gr λημνισκος, *a ribband*) In Geometry, the name given to a curve of the fourth degree, having the form of the figure 8, and of which the equation is $x^2 + y^2 = a\sqrt{x^2 - y^2}$ There are many other curves of the same order but the equations differ from the above [illegible] the enclosing curve is susceptible of quadrature, and its whole area is equal to the square of its semi axis It is a remarkable property of this curve that it is capable of being divided algebraically into equal though dissimilar portions




The various properties of this curve are most easily derived from its polar equation Let C A = $a$, C Q = $x$, and P Q = $y$, the equation of the curve is $x^2+y^2=a\sqrt{x^2-y^2}$ Now let C P = $r$, and the angle P C Q = $u$, we shall have $x = r \cos u$, and $y = r \sin u$ Substituting these values of $x$ and $y$ in the equation of the curve, it becomes, after reduction, $r^2 = a^2 \cos 2u$ But, by the general theory of curves the differential of the area referred to polar co-ordinates is $\frac{1}{2} r^2 du$, hence in the present case it is $\frac{1}{2} a^2 \cos 2u\, du$ and integrating (p P Q = $\int \frac{1}{2} a^2 \cos 2u\, du$ = $\frac{1}{4} a^2 \sin 2u$ + const. At the point Q we have $r = 0$, therefore $\cos 2u = 0$ and consequently $u = 45°$ At this point, therefore, $\sin u = \sqrt{\frac{1}{2}}$, and $\cos u = \sqrt{\frac{1}{2}}$, and at the point A we have $u = 0$, therefore the area comprised between C A and the curve A P p C = $\frac{1}{4} a^2$ Hence the whole area bounded by both branches (the two branches being similar) is equal to $a^2$, or the square of A C, which is $\frac{1}{2}$ A B

Let P be any point in the curve, and $p$ another point related to P by the equation cos A C P × cos A C $p = \sqrt{\frac{1}{2}}$, then the curvilinear arc A P is equal to C $p$ which is the property above alluded to A similar property however belongs also to some other curves (See Legendre, *Exercises de Calcul Integral* tome i)

LEMONS, ESSENTIAL SALT OF The binoxalate of potash is often sold under this name, it is chiefly used for removing iron-moulds and ink-stains from linen

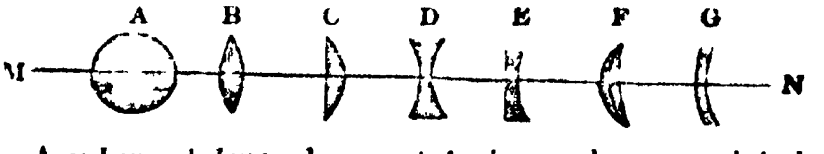
LEMUR (Lat lemur, *a ghost*) This term was applied in the Linnæan system to several of the lower Quadrumanous animals of different structure and habits, it is now restricted to those which have the inferior incisors long compressed, straight and sloping forwards and the lower canines approximated and of similar form and direction differing only in a slight increase of size, whence they have usually been enumerated as incisors the upper incisors are straight and the intermediate ones are separated from each other The long pointed canines of the upper jaw are principally opposed to the trenchant anterior false molars below Each of the four extremities is provided with an opposable thumb but the index digit of the hinder hand has its nail developed into a long, curved sharp pointed claw The use of this claw is to clean or dislodge vermin from the long and thick woolly hair [illegible] and [illegible] gated pointed head and sharp projecting muzzle, the posterior limbs are a little longer than the anterior, the tail is long thick and bushy They are all natives of Madagascar and of some of the smaller islands in its neighbourhood To judge from the nature of their covering it might be supposed that the lemurs were natives of a cold climate, but their fur has relation to the season of their activity They sleep by day and move about in the night season during which time the air is often sufficiently cold in the tropical latitudes Their nutriment is a mixed diet of fruits insects, and small birds, the latter they surprise while at roost

LEMURES Male and female genii or infernal gods, believed by the ancient Romans to haunt solitary rooms and desert places they were propitiated by casting beans to them Their feast was celebrated under the name of Lemuria or Lemuralia

LEMURIDÆ (Lat lemur, *a ghost*) The family of Quadrumanous Mammals of which the genus *Lemur* is the type it includes the genera *Tarsius*, *Otolicnus*, *Stenops Lichanotus* and *Lemur* proper

LENS (Lat) In Optics a thin piece of glass or any other transparent substance bounded on both sides by polished spherical surfaces or on the one side by a spherical and on the other by a plane surface, and having this property that parallel rays of light in passing through it have their direction changed so as to [illegible] point called the *principal focus* of the lens or to diverge as if they proceeded from that point

Lenses receive different denominations according to their different forms Thus,




A *spherical lens*, shown at A, is a sphere or globule of glass

A *double convex lens* shown at B, is a solid formed by two convex spherical surfaces, and is *equally convex*, or *unequally convex*, according as the radii of its two surfaces are equal or unequal

A *plano convex lens*, C, is that of which one of the surfaces is *plane*, and the other *convex*

A *double concave lens*, D, is bounded by two *concave* spherical surfaces, which may have either the same or a different curvature

A *plano concave lens*, E, has one surface *plane*, and the other *concave*

A *meniscus*, F (so called from its resemblance to a

[illegible] which one of the surfaces is *convex* [illegible] *e*, and which meet if continued The radius of the convex surface is consequently smaller than the radius of the concave

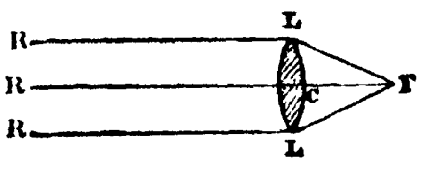
A *concavo convex lens*, G, is that of which one of the surfaces is *concave* and the other *convex*, but in this case the surfaces will not meet though continued, the radius of the concave surface being smaller than that of the convex one

The straight line M N which passes through the centres of all the curved surfaces, or is perpendicular to both surfaces of the same lens, is called the *axis* of the lens, and it is in this line that the focus of the lens is situated

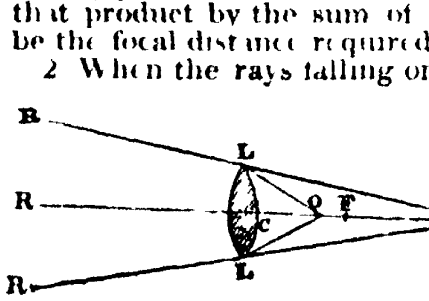
It was observed, at an early period, that a transparent body of a spherical form has the property of collecting at the focus the parallel rays of light which fall on its surface But it was remarked, at the same time, that the illumination at these foci was extremely feeble, in consequence of the thickness of the glass which the light had to pass through This inconvenience is removed by taking only two small segments instead of the entire sphere, by which means, as the refraction takes place only at the surfaces, and not in the interior of the glass, the very same refraction of the rays is produced as when the whole sphere is used, and the thickness of the glass being greatly diminished there passes a much greater number of the rays of the light in the focus is much more considerable

The rules for finding the focal distances of the different sorts of lenses are the following They depend in some measure on the refracting power of the glass We shall here suppose the index of refraction to be 1 500

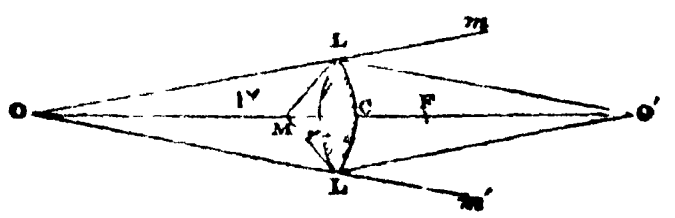
1 Rays of light, R I, R L, falling on a convex lens in directions parallel to the axis, are refracted into the point I, which is called the principal focus In a *double* and *equally* convex lens the distance of I from C, the centre of the lens, is equal to the radius of the spherical surfaces If the lens is *plano-convex* the focal distance is equal to twice the radius of the spherical surface If the lens is unequally convex, its focal distance is found by this rule — Multiply the two radii of its surfaces and divide twice that product by the sum of the radii, the quotient will be the focal distance required



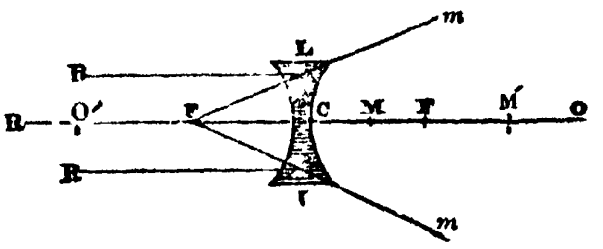

2 When the rays falling on a convex lens whose principal focus is F converge towards a point O their convergency will be hastened, and they will be refracted into a point O′ which is nearer the lens than the principal focus F The two points O and O′ are called *conjugate foci*, and they are related to each other in such a manner that C O′ is a fourth proportional to C O + C F C O and C F Hence when the point O is given the conjugate focus O′ will be found by this rule — Multiply the principal focal distance C F by C O and divide the product by the sum of those numbers It is obvious that as the distance of O becomes greater O′ approaches to F, and when O is at an infinite distance O′ coincides with F




3 Suppose diverging rays issuing from a point O to fall on a double concave lens of which the principal focus is F In this case they will be refracted to a point O′, and the conjugate foci O and O′ are so related that C O′ is a fourth proportional to C O − C F, C O and C F Hence O′ is found by the following rule — Multiply the principal focal distance C F by C O and divide the product by the difference between C O and C F As the point of divergence O recedes from the lens, the point O′ approaches nearer to F, and when O is at an infinite distance, O′ coincides with F As O approaches the lens, O′ recedes from it, when O is at F′ (the focal distance) the refracted rays become parallel to the axis, and when O is between F′ and C, as at M, the refracted rays diverge in the directions L *m*, L *m′*




4 The focal distance of a concave lens is the same as that of a convex one whose surfaces have the same curvature, and the rules for finding the conjugate foci are precisely the same, but the rays, instead of being collected, are scattered by passing through a concave lens, and the principal focus is on the same side as the point from which the rays proceed Parallel rays R L, R C R L, falling on the concave lens L L in the direction of the axis, become divergent as if they proceeded from F′ (the principal focus) When the rays which fall on a concave lens converge towards the point F, they are refracted in the direction parallel to the axis When the incident rays converge to a point O beyond F, the refracted rays [illegible] proceeded from a conjugate point O′ [illegible] than F′ and when the incident rays converge towards a point M, between C and F, the refracted rays will be convergent and meet in a conjugate point M′ on the [illegible] of the lens with M These conjugate foci are determined by the rules which have been given for convex lenses Lastly, when the incident rays diverge from a point O′, farther from the lens than the principal focus, the refracted rays will be more divergent, and proceed as if they emanated from a point between the principal focus and the lens The rule is, in this case, also the same as for convex lenses




5 The effect of a meniscus is the same as that of a convex lens of the same focal distance, and that of a concavo-convex lens the same as that of a concave lens of the same focal distance The principal focal distance is found by this rule — Divide twice the product of the two radii by the difference of the radii

6 The above rules for finding the principal and conjugate foci of the several kinds of lenses may be all expressed by two simple algebraic formulæ Let R denote the radius of the anterior surface (or that at which the light enters), S that of the posterior surface, and let R and S be considered as positive when the surfaces are convex, and negative when concave Also let F denote the distance of the principal focus, and *n* the index of refraction, then, neglecting the thickness of the lens as inconsiderable, the formula which gives the principal focus is

$$\frac{1}{1} = (n-1)\left(\frac{1}{R} + \frac{1}{S}\right) \qquad (1)$$

For reflection [illegible] of convergent and divergent rays, let U [illegible] C O of the focus of the entering rays and V the distance C O′ of the focus of the emerging rays, and let U be considered as negative when the entering rays are *divergent*, and V negative when the emerging rays are *convergent*, then,

$$\frac{1}{U} + \frac{1}{V} = \frac{1}{1}, \text{ or } V = \frac{U F}{U - F} \qquad (2)$$

the point F being determined by the formula (1)

For the [illegible] of these formulæ to the different cases and the correction to be made for the thickness of the lens see *Coddington's Treatise on the Reflexion and Refraction of Light*

In deducing the above rules it has been assumed that the focus into which the rays are refracted is a mathematical point, but this is not strictly true, unless the rays only fall on the lens very near its centre, by reason of the *spherical aberration* (*See* ABERRATION) For the correction of the *chromatic aberration*, arising from the unequal refrangibility of the luminous rays, *see* ACHROMATISM See also LIGHT, OPTICS, and REFRACTION

LENS SHAPED or LENTICULAR, or LENTIFORM A term used in describing the general figure of bodies, to denote their resembling a double convex lens, as the seeds of Amaranthus

LENT A solemn time of fasting in the Christian church, so called from the Anglo-Saxon signifying spring The term of Lent comprises the forty days before Easter, by which it is determined The period of time is intended to commemorate the fasting of our Saviour in the wilderness *See* EASTER

LENTO, or LENTO (Ital) In Music, a direction to the performer that the music to which the word is prefixed is to be performed slowly

LENTIBULA'RIA'CEÆ A very small natural order of Herbaceous Exogens natives of the marshes and waters of all parts of the world They are nearly allied to *Scrophulariaceæ*, but are distinguished by their free central placenta and minute exalbuminous embryo, from *Primulaceæ* by their irregular flowers the [illegible] stamens, and their ovary The beautiful *Pinguicula*, a wild plant in marshes, is one of the genera, and *Utricularia* another. They are of no known use

LENTICELLES, or LENTICULAR GLANDS A term invented by De Candolle to denote certain minute speck-like tubercles on stems Notwithstanding the importance assigned them by this great botanist, his lenticelles appear to be nothing [illegible] roots attempting to spring from [illegible]

LENTIGO A freckle of the skin, so named from its resemblance to a lentil seed

LENZINITE A hydrated silicate of alumina, found

at Eifield in Prussia, it is white, translucent, and falls into small hard grains when put into water

LI'O (Lat *a lion*) One of the zodiacal constellations, situated chiefly on the northern side of the ecliptic The star *Regulus*, called also *Cor Leonis*, belongs to this constellation

LE'O MI'NOR The Little Lion [illegible] the northern hemisphere, between Leo and Ursa Major This constellation has been formed by the moderns, and is not given in Ptolemy's catalogue

LE'ONINE VERSES Latin verses according to the rules of ancient prosody, but rhymed The name is said to be derived from one of the popes Leo or, more probably from a monk called Leoninus The end rhymes to the middle, *i e* to the two last syllables before the cæsura, in hexameters in pentameters, the two divisions are rhymed The following distich may serve as an example —

Dæmon languebat monachus tunc esse volebat
Ast ubi convaluit, mansit ut ante fuit

LE'PADITES, *Lepadita* (Gr λεπας, *a shell-fish*) Goose barnacles, an order of Cirripeds comprehending those which have a long flexible contractile stem fixed by its base to some solid body, and supporting at its extremity the principal parts of the animal, inclosed by a multivalve shell, or coriaceous case

LE'PADOGA'STER (Gr λεπας and γαστηρ, *stomach*) A genus of Discobolous Malacopterygian fishes, having the following characters pectoral fins expanded, with stouter rays at their lower edges which curve slightly forwards, and unite with each other [illegible] means of a transverse membrane directly [illegible] constituting the boundary of an adhesive disk, close to which there is a second, formed by the union of the ventrals, body smooth, and without scales, head broad and depressed, snout salient and protractile, branchiæ slightly cleft, and furnished with four or five rays, and opposite to the anal, which is near to [illegible] genus we possess two native species, one of which called the Cornish sucker (*Lepadogaster connubiensis*) was discovered by Dr Borlase on the coast of Cornwall, the other (*L. jaculatus*) has been taken on different [illegible] Weymouth coast Both species adhere by means of their ventral suckers to rocks stones, &c whence the generic name they feed principally on Crustacea

LE'PALS A term invented to denote stamens that are sterile It is very rarely used

LEPI'CENA A term invented by Richard to denote the two empty bracts situated at the base of the [illegible] usually called glumes

LE'PIDOIDS A family of extinct fossil fishes belonging to the oolitic formation remarkable for their large rhomboidal bony scales Figures of these scales are given in *Dr Buckland's Bridgewater Treatise*

LE'PIDOLITE (Gr λεπις, *a scale* and λιθος *stone*) A mineral of granular and foliated texture, moderately hard of a pinkish colour It contains lithia

LEPIDO'PTERA (Gr λεπις, and πτερον, *a wing*) The third order of insects in the system of Linnæus, and the tenth in that of Latreille, who has given the following concise and comprehensive description of the characters common to the insects of this most interesting, useful, and beautiful group

The wings are four, covered on both sides with minute generally coloured scales, resembling farinaceous dust, which are removed by merely [illegible] [illegible] [illegible]

alatine and pharyngeal bones Of this genus one native pecies is known, called the Scabbard-fish (*Lepidopus gyreus*) It is very rare only four examples are recorded by Mr Yarrell, which were taken on the southern hores

LEPIDO'TUS In P[illegible] ish, distinguished by its large, thick, rhomboidal, enamelled scales, and its hemispherical or obtusely conical eeth its remains are widely diffused through the weallen formation

LEPIDOTUS In Botany, Latin term for leprous

LI'PIS (Gr [illegible] of a thin tra[illegible] nd, owing to the imperfect union towards its circumference of the cellular tissue of which it is composed, having a lacerated irregular margin It gives origin to he adjective Lepidote

LI PI'SMA (Gr λεπισμα, *decortication*) A Linnean genus of Apterous [illegible] first family f Thysanourous insects [illegible] with small which circumstance the most common species has been compared o a little fish The antennæ are setaceous, and usually ery long The feet are short and frequently have very arge and strongly compressed coxæ, resembling scales hese insects run with great velocity some of them, by neans of their caudal appendage are enabled to leap several species conceal themselves in the cracks of the ramework of windows, in wardrobes, under damp boards, c others hide beneath stones

LEPISMA In Botany, a term sometimes applied to the up-shaped disk of *Pæonia* and *Aconitum*, but seldom mployed

LI PI'SMIDÆ The family of Thysanourous insects f which the genus *Lepisma* is the type It includes the [illegible] *Machilis*

LEPIS'TA [illegible] e tribe or the family of Rolents of which the genus *Lepus* is the type

LE'PRA (Gr λεπρος *rough*) The leprosy, a disease f the skin, characterized by scaly patches, nearly of a rcular form The cuticle becomes reddish and scaly, t first upon some one spot, often the knee and thence radually spreads over the body which becomes stiff and incomfortable and most unseemly in appearance Friction warm baths, sulphur baths and afterwards slightly timulating ointments such as pitch ointment or weak itrine ointment with light and moderate diet and careful bstinence from wine and stimulants are the principal eans of cure This disease appears to have been of much more frequent occurrence in ancient than in modern times, but it is generally believed that the *lepers* mentioned in the sacred and profane authors were afflicted with a disease resembling more that known by the name f elephantiasis than leprosy

LEPTOCE'PHALANS *Leptocephalidæ* (Gr λεπτος *slender*, κεφαλη, *a head*) The name of a family of fishes haracterized by the smallness of the head, of which the [illegible] e type

LEPTOCE'PHALUS [illegible] A genus of Apodal Malacopterygian fishes, in the system of Cuvier characterized by a ery small and short head, and a remarkably compressed nd delicate body the pectoral fins and branchial apertures are very small, the dorsal and anal fins are narrow, nd united at the point of the tail One species of this are and singular genus was discovered near Holyhead nd was described by Gronovius under the generic name f *Leptocephalus*, in reference to the diminutive size of he head The *Leptocephali* are more common in the eas of hot climates

LEPTU'RA (Gr λεπτος, *slender* ουρα *a tail*) A linnæan genus of [illegible] beetles now the type of an xtensive family *Leptu'rii* in which the eyes are ounded and entire, or, if slightly emarginate, with the ntennæ inserted before the emargination The head is lways inclined posteriorly behind the eyes, or is abruptly ontracted at its junction with the thorax in the manner f a neck, the thorax is conical or [illegible] nteriorly, the elytra become [illegible] rm *Leptura* is now restricted to those Lepturidans in hich the head is abruptly narrowed immediately behind he eyes, the antennæ inserted near the anterior extremity of the internal emargination of the eyes, the two minences from which they rise being almost confounded one plane The thorax is almost always smooth, or ithout lateral tubercles

LE'PUS (Lat *a hare*) A genus of Rodents peculiarly distinguished by having their superior incisors ouble, *i e* each of them has a smaller one behind it he molar teeth are also more numerous than in most ther Rodentia, there being six on each side of the upper w, and five on each side of the lower jaw the ears are ery long, the tail short and turned up The species of his genus are called hares and rabbits The eyes are rge and prominent, and, with the well developed ears, erve to announce to these timid and defenceless animals emote objects and sounds of peril the strength and proportions of the limbs, of which the hind pair is much longer than the fore, enable them to escape by rapid flight The smaller species, as the rabbit add to their means of safety by burrowing in the soil Among the anatomical characters of the [illegible] rudimental condition [illegible] bony structure of the infra-orbital spaces

LEPUS The Hare In Astronomy one of the forty-eight ancient constellations of Ptolemy situated in the [illegible]

LERNÆOPO'DIDÆ (Lat lernæa, *a parasitic worm*, forma, *form*) The name of a family of Siphonostomous Crustaceans, comprehending those with a long vermiform body

LERNE'A (Gr λερναια, *a name of the hydra*) A Linnæan genus of low-organized crustaceous animals, all of which are external parasites of fishes, and constitute the class *Epizoa* of modern systems

LE ROI LE VEUT (Fr *the sovereign wills it, or assents*) A form of words by which the royal assent is intimated by the clerk of parliament to the passing of public bills To private bills the royal assent is expressed by *Soit fait comme il est desiré* The dissent of the sovereign to the passing of any measure is signified by the words *Le roi s'avisera* *See* PARLIAMENT

LE'SSONS (Lat lego, *I read*) are certain portions of the scriptures read in most Christian churches during divine service, the performance of which in the ancient church devolved [illegible] In the English [illegible] the year at the [illegible], and that of [illegible] the two books of Chronicles, continues through the Old Testament, including portions of the Apocrypha

In the *second* lessons, as they are called, the same course is followed with the New Testament In the Presbyterian church the word *lesson*, in this sense, is unknown, though the practice of reading a portion of scripture is almost universally adopted, but the selection of the passage is left to the choice of the officiating clergyman

LESTRIS (Lat *a robber*) A subgenus of Gulls, separated from the *Larus* proper on account of their large membranous [illegible] edge of the beak, [illegible] They pursue the small gu[illegible] ness to rob them of their food, and hence their name

LETHARGY (Gr ληθη, *forgetfulness*) A heavy unnatural sl[illegible] s[illegible] depending upon apoplexy, from which [illegible] difficulty roused It sometimes arises from a plethoric state of habit, in which case it requires depletion, but it often also is a symptom of over fatigue of mind and then nervous remedies are indicated

LETHE (Gr ληθη) In Greek Mythology, the River of Oblivion one of the streams of the infernal regions Its waters possessed the quality of causing those who drank them to forget the whole of their former existence In the sixth book of *Virgil's Æneid*, the shades of the departed after fulfilling their various destinies in [illegible] thousand years, are brought [illegible] Lethe, as a preparation for their transmigration into new bodies

> Has omnes ubi mille rotam volvêre per annos,
> [illegible]
> Rursus et incipiant in corpora velle revertí

The beautiful verses of Milton are well known —

> Far off from these a slow and silent stream,
> Lethe the river of oblivion, rolls
> Her watery labyrinth whereof whoso drinks
> [illegible]

Nor is the "slow and silent stream" less exquisitely described by Dante —

> Tutte l acque, che son di là più monde,
> [illegible]
> Raggiar non lascia sole ivi, nè luna

Geographers have placed the river Lethe (that is, its supposed issue on the surface of the earth) in Bœotia, near Lebadea, in Crete, and on the coast of Africa There was also a river of oblivion (limia oblivionis) in Spain, now the Lima

LE'TTER (Lat litera) A character used to express one of the simple sounds of the voice Letters properly combined form the visible signs of those sounds by which we communicate our ideas What letters were originally, who first invented them, and among what people they were primarily used, are still questions of profound obscurity Philo, says the *Ency Brit*, attributes this great and noble invention to Abraham, St Irenæus and others to Enoch, Bibliander to Adam, Eusebius, Clemens Alexandrinus Cornelius Agrippa, and others, to Moses, Pomponius Mela, Herodian, Rufus Festus, Pliny, Lucan, and others, to the Phœnicians, St Cyprian to Saturn, Plato and Tacitus to

the Egyptians, some to the Ethiopians, and others to the Chinese, who cannot possibly be entitled to this honour since all the characters are the signs of simple ideas and have nothing in common with letters Various [illegible] are the conjectures concerning the different kinds of letters used in different languages Elias Mon[illegible] supposes the Greeks to have invented the Hebrew letters Annam the Syrian and Cadmus, the Phœnician those of Attica, Nicostrata the Roman, Isis the Egyptian, and Vulfilas those of the Goths All these statements, however, are purely conjectural, and it would be vain to examine the foundation on which they are based Letters are distinguished by grammarians into vowels, [illegible]

GUAGE

LETTER, in Printing is the usual term for an aggregate quantity of types in a printing office, as when a work is put in hand, and there happens to be a great quantity of type of the proper sort unemployed it is usual to say "there is plenty of letter," and, on the contrary, "there is a scarcity of letter"

LETTER OF CREDIT A letter written by one merchant or correspondent to another, requesting him to credit the bearer with a certain sum of money The bearer should be described with as many particulars as possible lest the letter fall improperly into other hands

LETTER OF LICENCE An instrument by which creditors allow a party who has failed in his trade time for payment of debts and [illegible] affairs

LETTER OF ATTORNEY A document by which a party gives another, named therein power to do certain lawful acts in his stead, the party so authorized being called his attorney, such as to give seisin of lands, sue, or receive rents debts and dividends

LETTERS OF MARQUE See MARQUE

LETTERS PATENT or LETTERS OVERT, in Law, are letters of the king open, but sealed at the foot with the great seal of England, conferring some privilege whereby a party is enabled to do or enjoy that which otherwise he could not Such are letters patent to make denizens to protect inventions &c

LEUCIN (Gr [illegible]) A white pulverulent [illegible] of dilute sulphuric acid on muscular fibre It combines with nitric acid, forming the *nitro-leucic acid*

LEUCITE (Gr λευκος) A crystallized mineral of a grey or white colour generally opake and something resembling the garnet in form It usually occurs in lava especially in that of Vesuvius, hence it is also termed *Ves[illegible]*

LEUCOMA [illegible] the cornea of the eye, arising from inflammation

LEUCOPHLEGMATICS In Ecclesiastical History the name of a fanatical sect of Christians which sprang up in the Greek and Eastern churches towards the close of the 12th century The tenets which they embraced were peculiarly strict while they rejected all the outward ceremonies of religion and spent their whole time in prayer and supplication to the Deity They derived their name and origin from an enthusiast, Leucopetrus, of whom little is known beyond his name

LEUCOPHLEGMATIC A pallid flabby state of body

LEVANT (It levante, *rising*), in Geography is applied in a general sense to any country situated to the eastward of us, or in the eastern part of any continent or country but in more contracted signification it is given to that part of the Mediterranean [illegible] bounded by Asia Minor on the north Syria and Palestine on the east, Egypt and Barca on the south, and by the island of Candia and the rest of the Mediterranean on the west

LEVARI FACIAS In Law, a writ of execution directed to the sheriff, whereby he is commanded to levy a sum of money upon the lands and tenements, goods and chattels, of a man who has forfeited his recognizances It is superseded in practice by the writ of elegit, except in cases of outlawry

LEVATOR MUSCLES Those which lift the part to which tney are attached

LEVEE (Fr lever, *to rise*), is the term used in court language for the ceremonial visits which distinguished persons are received in the morning, or, as the word implies at their *rising* It is chiefly applied in this country to the stated public occasions on which her Majesty receives visits from such of her subjects as are entitled by rank or fortune to the honour The difference between a *lévee* and a *drawing-room* consists in this, — that while at the former persons [illegible] appear with the exception of the chief officers of the court [illegible] ladies and gentlemen are admitted [illegible]

LEVIN MASS (Fr literally *an universal rising*) A military expression for the rising of a whole people to defend their country from invasion In Germany it is styled landsturm, in contradistinction to the landwehr or militia (*quod vide*), and there, as in Spain

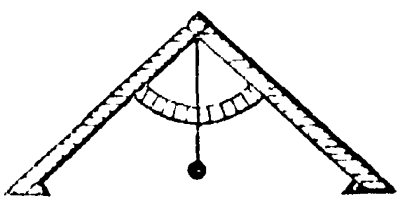
[illegible] instrumental in [illegible]

LEVEL, [illegible] as the direction of a straight line parallel to the plane of the horizon

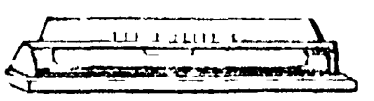
The plane of the sensible horizon is indicated in two ways by the direction of the plummet or plumb line, to which it is perpendicular, and by the surface of a fluid at rest Accordingly, levels are formed either by means of the plumb line or [illegible] and applied in some part [illegible] or [illegible] on the same principle, namely, the action of terrestrial gravity

Levels in which the plumb line forms the essential part are those most usually employed for the common purposes required by bricklayers, masons, carpenters, &c They are constructed under many different forms, but the general principle is as follows —A frame or board is prepared, having one edge perfectly straight, and a straight line is drawn on the frame at right angles to the straight edge To some point of this straight line a thread carrying a plummet is attached [illegible] placed in such a [illegible], hanging freely coincides with the straight line, the straight edge of the frame which is perpendicular to it, must be horizontal See PLUMMET

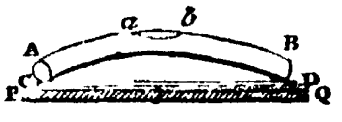
The *Artillery Foot Level*, and the *Gunner's Level*, besides the line and plummet have a scale for showing the inclination of a straight line to the horizon The former has two equal legs or branches placed at right angles, and from their point of junction a thread and plummet hangs, and plays over a quadrant divided into twice 45° from the middle The plane or line on which the two ends rest is horizontal when the thread falls over the zero point of the scale, and when it falls over any other point the degree marked on the scale indicates the inclination of the line to the horizon The gunner's level is on the same principle though differently constructed the thread or plummet being replaced by a solid piece of brass, loaded at the lower end, and the legs, or rather the edges of the brass plate making an angle of 45° It is used in the same manner as the former



*Spirit Level* —By far the most convenient and also the most accurate level is the spirit level represented in the annexed figure, which is nothing more than a glass tube nearly filled with a liquid (spirit of wine being now generally used, on account of its *mobility* and not being liable



when the tube is placed hor[illegible] [illegible]rently in many parts if the tube could be made mathematically straight, but that being impossible to execute, and every tube having some slight curvature if the convex side be placed upwards the bubble will occupy the higher part, as in the figure (where the curvature is purposely exaggerated) Suppose such a tube as A B firmly fastened on a straight bar C D and marked at *a b* two points distant by the length of the bubble, then if the instrument be so placed that the bubble shall occupy this interval it is clear that C D can have no other than one definite inclination to the horizon, because, were it ever so little moved one way or other the bubble would shift its place, and run towards the elevated side Suppose now that we would ascertain whether any given line P Q be horizontal, let the base of the level C D be set upon it, and note the points *a b*, between which the bubble is exactly contained, then turn the level end for end so that C shall rest on Q, and D on P if then the bubble continue to occupy the same place between *a* and *b*, it is evident that P Q can be no otherwise than horizontal, if not, the side towards which the bubble runs is highest, and must be lowered Astronomical levels are furnished with a divided scale, by which the places of the ends of the bubble can be nicely marked" (*Herschel's Astronomy*, p 92)

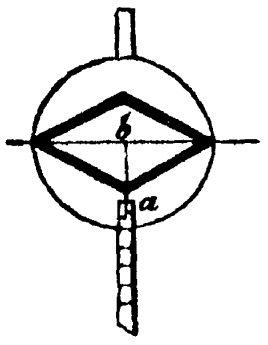



The accuracy of the indications of the level depends in a considerable degree on the regularity of the interior surfaces of the tube They are commonly made of glass tubes in the same state as they are obtained at the glass-[illegible] [illegible] rather spindle form, with a slight spherical curvature The tube and bubble must be of considerable length The larger the bubble the more freely it moves, and consequently the more sensible is the level to a small inclination With proper care they can be executed it is said with such delicacy as to indicate a single second of [illegible] exact horizontality

LEVELLERS In English History, a party which arose in the army of the Long Parliament, about the time when it overawed that assembly, and transferred the king

to Hampton Court in 1647 The levellers as they were called at first implied a determination to level all ranks, and establish an equality in titles and estates throughout the kingdom Several of the officers belonging to this party were cashiered in 1649, and, on Cromwell's departure for Ireland in the end of that year, they raised mutinies in various parts of the country, but were put down by the army, and were put down without bloodshed John Lilburne, one of the chiefs of the party, was said that, "if none but he were left in the world, John would quarrel with himself" His *Manifestation from J Lilburne and others, styled Levellers* (See *Clarendon*, books x and xii, *Godwin's History of the Commonwealth*)

LEVELLING STAVES Instruments used with the spirit level, for supporting a mark, and showing at the same time its height above the ground Mr Adie constructed by Troughton the common levelling staves, rods of mahogany, each about four feet long, and divided into feet and hundredths They carry a vane having at the lower edge a small plane parallel to that which is levelled, and a line on the levelled side denotes the reading of the staff The face of the vane is made of white holly, with an inlaid lozenge of ebony, forming at once a conspicuous object, and one easy of bisection In levelling, the vane must be moved up or down till the horizontal wire of the telescope bisects the acute angle of the lozenge as shown in the figure As the line on the levelled edge at *a* denotes the reading of the staff a piece equal in length to the distance *a b* is cut off from the bottom of the staff, or rather the divisions commence at that number of inches above zero (*Simms's Treatise on Mathematical Instruments* 1834)

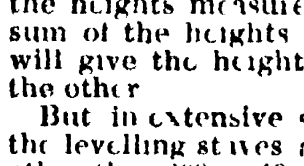



LEVELLING Art of surveying which has for its object to discover how much any assigned point is higher than another assigned point above a level surface or such a surface as water would assume when perfectly at rest

In ordinary cases of levelling (for example, for canals railroads, &c) the instruments commonly employed are a spirit level attached to a telescope and a pair of staves (See LEVELLING STAVES) Suppose that the difference of level between A and B is to be found the staves are placed successively at A, C &c, the intervals not exceeding 400 yards on account of the curvature of the earth and the levelling instrument placed between at equal distances to avoid corrections for refraction It is then directed backwards to the first staff A D and next forward to the second C I and at each observation the division on the staff, or the height at which the visual ray meets it is noted The difference of the heights—that is C I, A D—is the height of the higher station above the lower The hindmost staff, and the levelling instrument are now carried forward to a new position, and the back and fore observations repeated and so on till the operation is completed Then the difference between the sum of the heights measured in the back observations and the sum of the heights measured in the fore observations will give the height of the one extreme station above the other




But in extensive surveys, it is often necessary to place the levelling staves at much greater distances from each other than 300 or 400 yards, in which case allowance must be made for the earth's curvature Let D A D′ represent the arc of a great circle of the earth's surface and A the place of an observer All the points in this arc are in the same level, but the line of sight indicated by the level is a tangent to the circumference at A, and, consequently, objects B B′, in this line, will *appear* in the same level with A, though they are really elevated above it by the distances B D B′ D′ intercepted on the radii between the arc and the tangent Now from the nature of the circle A B′ = B D (2 C D + B D), but, in all cases of actual levelling, the arc A D is very small in comparison of the whole circumference, consequently the square of B D may be neglected, and the arc substituted for the tangent we have then, for the value of B D, this expression, $BD = \frac{AD^2}{2CD}$, that is to say, the depression of the true [illegible] to the square of [illegible] of the curvature of the earth Supposing the diameter of the earth to be 7916 miles, and A D = 1 mile, we shall have B D equal to the 1-7916th of a mile, or 8 004 inches At the distance of 2 miles, the correction will be four times this quantity, or 32 016 inches, and so on, increasing as the square of the distance It is most convenient to reckon both the distances and the corresponding depressions in feet and decimals of a foot, in which case the correction becomes $\frac{1}{7916 \times 5280} A D^2$, to be subtracted from the apparent or observed level, in order to obtain the true The following table shows the depression in feet and decimals of a foot, for the different distances therein stated, the mean diameter of the earth being assumed = 7916 miles —



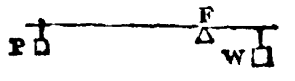

| Distance | Depression | Distance | Depression |
|---|---|---|---|
| *Yards* | *Feet* | *Miles* | *Feet* |
| 100 | 0 00215 | 1 | 0 667 |
| 200 | 0 00861 | 2 | 2 669 |
| 300 | 0 01938 | 3 | 6 006 |
| 400 | 0 03445 | 4 | 10 677 |
| 500 | 0 05383 | 5 | 16 683 |
| 600 | 0 07752 | 6 | 24 024 |
| 700 | 0 10551 | 7 | 32 699 |
| 800 | 0 13781 | 8 | 42 709 |
| 900 | 0 17441 | 9 | 54 054 |
| 1000 | 0 21533 | 10 | 66 733 |
| 1100 | 0 26055 | 11 | 80 747 |
| 1200 | 0 31008 | 12 | 96 095 |
| 1300 | 0 36390 | 13 | 112 779 |
| 1400 | 0 42205 | 14 | 130 796 |
| 1500 | 0 48449 | 15 | 150 150 |
| 1600 | 0 55124 | 16 | 170 836 |

LEVER In Mechanics, an inflexible rod moveable about a *fulcrum* or prop, and having forces applied to two or more points in it The lever is one of the mechanical powers, and, being the simplest of them all, was the first that was attempted to be explained Its properties are treated of by Aristotle, but the first accurate explanation was given by Archimedes, in his Treatise *De Equiponderantibus*

In treating of the lever, it is convenient to distinguish the forces applied to it by different names One is usually called the *power*, the other the *weight* or *resistance*

Levers are commonly divided into three kinds, according to the relative positions of the power, the weight, and the fulcrum In a lever of the first kind (fig 1), the fulcrum F is between the power P and the weight W In a lever of the second kind (fig 2), the weight W is between the fulcrum F and the power P In a lever of [illegible] (fig 3), the power P is between the fulcrum F and the weight W

(1)

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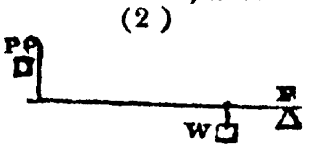
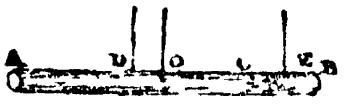



(3)




The general principle of the lever is, that when the power and weight are in equilibrio, they are to each other inversely as their distances from the fulcrum This property is almost an obvious consequence from the principle of virtual velocities, but it may be deduced from more familiar considerations Let A B be a cylinder or bar of homogeneous matter If supported from the middle O the two ends would evidently balance each other, and the pressure at O would be the same as if the whole matter of the bar were concentrated in that point Suppose it to consist of two parts A C and B C these again would be separately supported at their middle points D and E, or the whole of the matter in A C may be conceived to be concentrated at D and the whole of that in B C at E, and the equilibrium would not be disturbed Hence the weight of A C attached at D, and the weight of B C attached at E would balance the inflexible line D E, if supported at O, the centre of the whole bar A B But O D = A O − A D = ½ A B − ½ A C = ½ B C, and O E = O B − E B = ½ A B − ½ C B = ½ A C, consequently O D is to O E as B C to A C, or O D is to O I as the weight concentrated at I to the weight concentrated at D This demonstration is commonly ascribed to Archimedes (*Maclaurin's Account of Newton's Principia*)




This proposition shows the advantage obtained by using the lever as a mechanical engine The arm P F [illegible] W F and consequently, [illegible] exceeds the power The proportion in which the weight exceeds the power is called the *mechanical advantage*, or purchase Suppose P F (figs 1 and 2) = 4 feet and W F = 1 foot, then a power of 1 lb acting at P will overcome a resistance of 4 lbs at W

Suppose the lever with the weights P and W to turn round the fulcrum, the two points to which P and W are attached will describe arcs proportional to the radii F P, F W, consequently the power P is to the weight W as the velocity of the weight to the velocity of the power

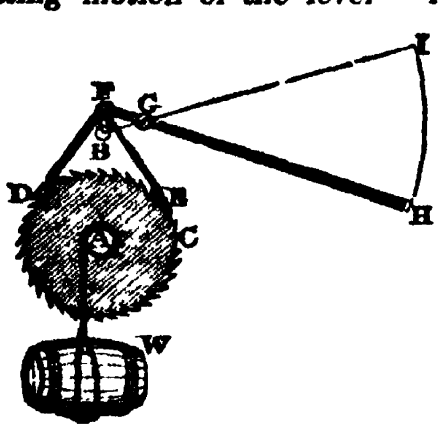
Therefore in this, as in all mechanical engines, when a small power raises a great weight the velocity of the power is much greater than the velocity of the weight, and what is gained in force is therefore said to be lost in time

When the power and the weight do not act on the lever in directions perpendicular to its length, or when the arms of the lever are not in the same straight line or are bent, then the power and the weight are not to each other reciprocally as the arms of the lever, but as the straight lines drawn from the fulcrum perpendicular to the respective directions in which the power and the weight take effect

In [illegible] are of constant occ[illegible] crowbar, the handspike, the poker, scissars, nippers, pincers, &c., are levers of the first kind, the toothed hammer is only a bent lever of this kind The second kind includes the chipping knife nutcrackers, the common door, oars and rudders, the wheelbarrow, &c To levers of the third k[illegible] -shears, the treddle of the turning lathe [illegible] but admit of a prop [illegible] animals are generally levers of this sort The socket of the bone is the fulcrum, a strong muscle attached to it near the socket is the power, and the weight of the limb, with whatever resistance is opposed to its motion, is the weight A very moderate contraction of the muscle thus gives considerable motion to the limb

From the principle of the lever is deduced the distribution of pressure in the case of a pole borne [illegible] between the weight [illegible] the carrier will [illegible] the burden alike, but if a load is [illegible] suffers a greater strain than the other

*Universal Lever* is the name given to a machine formed of a combination of the lever with the wheel and axle [illegible] of which is to give a continued rectilinear motion to a heavy body by means of the reciprocating motion of the lever F G H is a straight line, whose centre of motion is at G At the extremity of its shorter arm hang two bars, the former of which has a hook to catch into the teeth of the wheel A C D, while the latter has its end bent in order to slide over the outer parts of those teeth The axle A has a cord wound round it to the end of which is attached the weight W Now suppose the end H of the lever to be raised from H to I while the other end descends from F to B, the bar F F will then push the tooth F of the wheel to C, while the hook D slides over an equal space on the other side of the wheel On bringing down again the end of the lever from I to H, the other extremity ascends through B F, and the hook D raises up the left-hand side of the wheel through a space equal to E C Thus the reciprocating motion of the lever is made to communicate a continued rotatory motion to the wheel, and, consequently, to lift the weight W suspended from its axle by the cord The universal lever has long been employed in saw mills, for the purpose of drawing along the logs to the saw (*Gregory's Mechanics*, vol ii)




LEVIATHAN The name of a great marine animal in the Book of Job, described in chapter xli, which was covered with close joined or confluent scales and had the jaws, or "doors of the face" armed with terrible teeth round about Some naturalists have supposed that the crocodile might be the subject of the sacred poet's allusions, but the "breath that kindleth coals" could scarcely be suggested by the respiratory actions of a cold-blooded reptile The same objection applies to the opinion that the leviathan of Job was the extinct megalosaurus with this additional difficulty, that the megalosaurus was a terrestrial reptile as the large me[illegible] while of the leviathan [illegible] He maketh the deep to boil like a pot he maketh the sea like a pot of ointment he maketh a path to shine after [illegible] be hoary Upon [illegible] pressions accord [illegible] exertions of a huge cetacean in his native element, and the verse, "Out of his nostrils goeth smoke, as out of a seething-pot or cauldron," does not inaptly figure the "blowing" of a whale The teeth of either the [illegible] of [illegible] exterior [illegible] to the scales of fishes, would have its distinguishing peculiarities correctly defined by the following expressions — "His scales are his pride shut up together as with a close seal One is so near another, that no air can come between them They are joined one to another, *they stick together, they cannot be sundered*" (Verses 15, 16, 17) Many persons must have witnessed the phenomena of the luminosity of the sea on our own coasts, where it is usually [illegible] t produced in the warmer [illegible] or in the tropics The phenomena which naturalists and voyagers have described as being produced by the swimming and blowing of the cetaceous animals in a phosphorescent ocean, during the night might likewise have suggested the description of the fire and sparks that escape from the mouth of the leviathan, and of the shining path that he leaves behind him in the deep

LEVIGA'TION (Lat lævus, *smooth*) The process of [illegible] o a state of fine mechanical division previously powdered, with water or [illegible] rubbing [illegible] smooth slab, with the flat face of [illegible] ler The paste is then often stirred into a large vessel of water where the coarser powder first falls, and the finer remains suspended, and is afterwards collected by pouring it off with the wa[illegible] [illegible] slowly to subside In this way, by [illegible] powders of very different degrees of fineness are obtained

LE'VITES The descendants of Levi, one of the twelve sons of Jacob, to whom no distinct territory was allotted in the land of Canaan, as to the other tribes, but who were set apart for the ministration of the re[illegible] throughout the [illegible] forty [illegible] in the suburbs of Pal[illegible] peculiarly appropriated to their residence The law of Moses commanded the tenth of the vegetable produce of the land, and also of the cattle to be given to them, of this a tenth was set apart for the priests, whose assistants the Levites were When God destroyed the first-born of the Egyptians he appointed that the first born males of the Israelites should be "set apart unto himself" (Exod xiii), in commemoration of the immunity from that visitation which was vouchsafed to the chosen people Afterwards it is recorded that upon the sons of Levi discovering an extraordinary zeal against idolatry in the case of the golden calf (Exod xxxii), the religious offices of the [illegible] [illegible] were [illegible] who with Moses his brother, were both of the tribe of Levi For the classes of which the Levites were composed, their offices privileges &c, see particularly Numb iii viii, also 1 Chron xxiii—xxvi

LE'VYNE (so called from Levy the crystallographer) A crystallized mineral found in Ireland, Faroe, and elsewhere, closely allied to the zeolites It is a hydrated alumino-silicate of lime and soda

LEXICO'LOGY, or LEXIGOGRAPHY (Gr λεξις, *a word or phrase*, and λογος, *description*) A word used by some writers to express that branch of philology which treats of words alone, independently of their grammatical and rhetorical uses, [illegible] composition and their et[illegible] There are two useful papers in the *Quarterly Review* on Greek lexicography, vols xxii xliv

LE'XICON (Gr λεξις) A dictionary of words, or vocabulary, [illegible] usually confined to dictionaries of the Greek or Hebrew tongues The oldest Greek lexicon is the *Onomasticon*, which was written 180 years before Christ the oldest Hebrew lexicon belongs to the 9th century *See* DICTIONARY

LEYDEN JAR *See* ELECTRICITY

LEZE-MAJESTY In Jurisprudence, any crime committed against the sovereign power in a state The name is derived from the Roman phrase, "crimen læsæ majestatis, [illegible] a citizen for [illegible] general misdemeanours of a political character, which were comprehended under the title of injuries to the "majesty of the Roman people" The emperors transferred to all offences against themselves the same criminal character, and offences of leze-majesty were multiplied under their arbitrary governments

LIAS A provincial name, adopted by geologists, for an argillaceous limestone, which, together with its associated beds, is characterized by peculiar fossils *See* GEOLOGY

LIBATION (Lat *libo, I pour*) The solemn pouring of wine and other liquids in religious ceremonies of antiquity, in Greek σπονδαι Libation appears (if our translation is correct) to have been used in the earliest recorded sacrifice for Abel offered milk (Gen iv 4) a daily libation of water was used by the Jews in the Feast of Tabernacles, the burnt offering instituted by Moses was of wine (Numb vi 7) The Grecian libations, in like manner were of unmixed wine, but sacrifices to nymphs, Ceres Proserpine and some other deities, were attended by libations of oil and wine, &c

The wine was poured between the horns of victims, on the altar or on the ground The ancients had also a well-known custom of pouring out a small quantity of wine, by way of [illegible] of their banquets, a [illegible] common under imperial Rome (See this art in the *Enc Met*)

Te multa prece, te prosequitur mero
Defuso pateris HORACE

LIBA'VIUS'S FUMING LIQUOR Bichloride of tin, obtained by distilling a mixture of 1 part of tin filings with 3 of corrosive sublimate It emits dense white vapours when exposed to air

LIBEL In the Spiritual Courts, the original declaration in a civil action is so termed See LAW, ECCLESIASTICAL

LIBEL in Law is applied to almost any malicious publication by writing or printing or by signs, pictures, &c Whatever tends to render a man odious or ridiculous, or to lower him in the esteem and opinion of the world, is a libel [illegible] for compelling [illegible] or, as having a tendency to excite his wrath, and provoke a breach of the peace, may be proceeded against by indictment or criminal information Where it is sought to make a party responsible in damages for a libellous publication, he may set up the truth of the [illegible] answer to the complaint, for the plaintiff [illegible] the misconduct or other thing imputed to him, is not considered to suffer by its disclosure any private injury which can be a legitimate ground of compensation to him, but when the proceeding is by criminal prosecution, the truth is no [illegible] altogether immaterial, for the [illegible] ally provoke a breach of the peace, whether it be true or false The court, however, will, in general, before granting a rule for a criminal information, which supersedes the usual practice of a presentment by the grand jury, require the prosecutor to deny on affidavit the truth of the matters charged against him It will be seen, however, that there is not in any case a legal foundation for the maxim vulgarly ascribed to the law, "The greater the truth the greater the libel" All publications are libels and criminally punishable as such, which have a tendency to disturb the public peace, his majesty's government the established religion, public morals, or the administration of justice Before the 32 Geo 3 c 60 (Fox's Act), on a criminal trial for libel the jury were not allowed to take the whole question into consideration, and return a general verdict of guilty or not guilty, but could only decide upon the fact of publication and whether the libel meant that which it was alleged in the indictment to mean, the court alone taking upon itself to determine the criminality or innocence of such meaning Now, however, in libel, as previously in all other criminal cases it is competent to [illegible] to the whole question, [illegible] not guilty The [illegible] Lord Campbell's act, has made various important changes in the law of libel

Libel is deemed in law a greater offence than slander, inasmuch as written defamation is commonly the result of more deliberate malice than that which is merely spoken, and frequently inflicts greater injury on the object of its attack Many words, such as 'rogue," "swindler," which are not actionable when spoken, are so when written

In an action for libel, a verdict for a farthing damages formerly gave the plaintiff his full costs, until the act of Lord Denman, whereas, in slander if the damages are found under forty shillings, the plaintiff is entitled to no more costs than damages

LIBE'LLULINES A genus of Neuropterous insects, of which the dragon-fly, *Libellula*, is the type

LI'BER (Lat *bark*) In Botany, the interior lining of the bark of Exogenous plants It consists of woody tissue [illegible] very thick-sided, intermixed with [illegible] to be formed annually, at the same time as the concentric zones of wood, and is intended by nature to convey downwards the secretions elaborated in the bark and leaves It is the principal seat of laticiferous vessels

LIBER In Roman Mythology, a surname of Bacchus, in reference, perhaps, to the idea of his being a liberator or deliverer Liber was originally an old divinity, who presided over fertility, and who was worshipped in connexion with [illegible] Proserpine, according to Cicero, *De* [illegible] Ceres

LI'BERAL [illegible] cant name, which has been applied since 1815 to the party in each country which advocates constitutional institutions where they do not exist, or their extension into a more popular character where they do As a party name, this word has been most definitely adopted in Spain where the party of the cortes assumed the title of *liberales*, and nicknamed their adversaries by that of *serviles*

LIBERA'LIA A sacred festival, with games, so called from Liber, a Latin name of Bacchus, in honour of which god they were celebrated at Rome On occasion of this festival that the Roman [illegible] who had attained the age of seventeen assumed the manly dress, or *toga*

LIBE'RTAS, in the mythology of the Greeks and Romans, was a goddess [illegible] Brutus [illegible] called the [illegible] and [illegible] and Italy, statues, temples, and altars were erected in honour of her At Rome, her most famous temple, built by C Gracchus, was situated on the Aventine Mount She was represented under the figure of a woman, holding in one hand a cap the symbol of Liberty and two pon[illegible] in the other In modern times a cap is also used as a symbol of Liberty thus, in France a red cap formed the badge of the Jacobin club In [illegible] cap with a white border is used as a symbol [illegible] titutional freedom of the nation, and Britannia sometimes bears it on the point of her spear

LI'BERTINES In C[illegible] H[illegible] a name given, in [illegible] early [illegible] the middle [illegible] (*Mosheim*, vol iv p 430, transl, ed 1790) See ANABAPTISTS

LI'BERTY In Philosophy *See* NECESSITY

LIBITI'NA An Italian goddess patroness of funerals and undertakers, synonymous with the Venus Infera or Epithumbia of the Greeks She had a temple at Rome in which was deposited a small coin called Libitinarius, for every person who died This custom, which originated in the desire of the Roman authorities to procure a faithful account of the number of deaths, may, perhaps, be regarded as among the first attempts to obtain an accurate census of the population

LI'BRA (Lat *the balance*) One of the zodiacal constellations, the seventh in order, beginning with Aries Libra is one of the forty-eight ancient constellations of Ptolemy

LIBRA denotes also the ancient Roman pound *See* WEIGHTS

LIBRARIES, ITINERATING The name given to a peculiar species of circulating library, instituted a few years ago at Haddington, in Scotland, by Mr Samuel Brown The principle on which [illegible] are formed consists, as the epithet [illegible] in the books being sent from one part or district of a country to another on the following plan —The books are formed into divisions, consisting each of a certain number of volumes, and proportioned in number to the extent of the country intended to be supplied Each division remains for a certain period (in some instances one or two years) in the same place, when it is removed to another locality, and succeeded by a new supply of books of the same number, by which means each locality has a fresh supply of useful reading at short stated intervals In Haddington, which may be called the head-quarters of the [illegible] the books consist of 43 divisions of 50 volumes each, and on the principle above explained each volume, at an average of the 43 divisions, is read [illegible] during two years, the period at which the books [illegible] The system of itinerating libraries has been extended to various other parts of Scotland, to several districts of England, to Ireland, Canada, South Africa, and Jamaica The use of the books is gratuitous, if so wished, and never more than 1*d* per annum has been systematically taken from any reader Voluntary contributions, however, either in books or money, are received (See *Geo Dict*, art "Haddington")

LI'BRARY (Lat liber *book*) The name given neither to a collection of books, or to the apartment or edifice in which they are kept The oldest public library of antiquity of which we have any credible account, is that founded by Pisistratus at Athens, which was carried by Xerxes into Persia, and recovered by Seleucus Nicanor. Whether this was the same library which Sylla (according to Plutarch) carried to Rome, and which was again restored by Hadrian, is not clear, nor is its ultimate destiny known [illegible] the Goths, [illegible] the public libraries [illegible] zens The library of Alexandria was [illegible] of antiquity Its history has been written [illegible] *de l'Ac des Inscr* vol ix), Reinhar[illegible] and many others It was first formed by the Ptolemies Soter, Lagides, Philadelphus, and Euergetes the last of whom resorted to very royal measures for the accomplishment of so laudable an end, for he is said to have seized on books imported from Greece, caused them to be copied, and returned the copies to the proprietors, keeping the original for his library The collection of Soter is said to have been deposited in a suburb called Bruchium, which was burnt by the troops in Cæsar's Egyptian war That of Philadelphus (the smaller of the two) was preserved in [illegible] the nucleus of the lat[illegible] the great library of P[illegible] 200,000 volumes), pre[illegible] by Mark Antony The

narrative of the destruction of this library by the fanatical Arabs in A D 641, is among the popular tales of history and the only circumstance [illegible] that it is substantially, I [illegible] ing the doubts thrown on it by [illegible] The first public library at Rome was founded by Asinius Pollio, A D 716, the second, the Palatine, by Augustus, in 726, great part of it was consumed under Commodus, but much remained even in the time of Constantine Reusch (1734) Fokerman (1764) and Eckhart (1799), have published separate dissertations on the libraries of the Romans The ancient libraries of the West must have wholly perished in the convulsions which attended the overthrow of its empire The history of those of the east is not easy to investigate Constantinople certainly possessed, at the period of its capture, extensive remains of ancient literature, and many, but almost wholly fruitless investigations have been made of late years in the monastic libraries of modern Greece, particularly of Mount Athos, for valuable manuscripts (See *Walpole's Oriental Memoirs*, *Journal of Education*, vol II) The best accounts of ancient libraries, to which we are able to refer the reader, are contained in the work of Petit Radel, *Récherches sur les Bibliotheques Anciennes et Modernes*, Heeren, *History of the Study of Classical Literature*, vol I, *Ersch and Gruber's Encyclopedia*, art "Bibliotheken," *Taylor's History of the Transmission of ancient Books in modern Times*, *Enc Brit*, Suppl, "Library"

Of modern public libraries the greatest and most celebrated is that of Paris (Bibl Nationale) It was commenced by King John, in the middle of the 14th century, with *ten* volumes; and has been augmented by subsequent kings to the enormous number it now possesses (Le Prince, *Essai Historique sur la Bibl du Roi*, Paris, 1787) Next to that of Paris in extent, and possibly in value [illegible] libraries of St Petersburg and Munich In Italy, the Ambrosian at Milan, and the Vatican at Rome, are peculiarly rich in MSS Of British libraries, the greatest are those of the British Museum, of the two English universities, of which that of Oxford (the Bodleian) is peculiarly rich in oriental manuscripts, that of the Advocates, at Edinburgh, and of Trinity College, Dublin Statements of the number of books contained in public libraries will be found in many works, but no statistical information is more imperfect and worthless Some have not scrupled to say that there is no information respecting the great [illegible] ber of printed books, wh [illegible] one half Such scepticism may be exaggerated, but that there is some ground for it may be conjectured from the [illegible] ch we have made between dif- [illegible] M Panizzi is contained in the Appendix to the Report on the Brit Mus, 1838, vol II No 6 The returns in the first column are borrowed from Mr Edwards's elaborate "Statistical View of the Public Libraries of Europe and America" We should premise that the number of printed books belonging to the library of the Brit Mus was actually returned in 1848 at 490 500 and the *volumes* of MSS at the same date were returned at 31,700

| | Edwards, 1848 | | Panizzi, 1836 | | Balbi | | Conv Lexicon, 1828 | | [illegible] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Vols | MSS | Vols | MSS | Vols | MSS | Vols | MSS | Vols | MSS |
| Paris (Nationale) | 824 000 | 80 000 | 650 000 | 80,000 | | - | 350 000 | 70,000 | 350 000 | 70 000 |
| Munich | 800 000 | 24 000 | 500 000 | | - | | 100 000 | 9,000 | 300,000 | 9,000 |
| Petersburg | 500 000 | 21 600 | – | | - | | 300 000 | 11 000 | | |
| Vienna | 453 000 | 16 000 | 300 000 | 16 000 | | | 300 000 | 12,000 | 300,000 | 12,000 |
| Gottingen | 350 000 | 5 000 | 200 000 | 1 500 | | - | 300 000 | - | 200 000 | |
| Dresden | 340,500 | 3 050 | 240 000 | 2 700 | 260 000 | - | 220 000 | 2,700 | 220 000 | 2,700 |
| Copenhagen | 527 000 | 3 000 | 400 000 | 15 000 | | | 130 500 | 3 000 | 200,000 | |
| Berlin | 400,000 | 5 000 | 320 000 | 10 000 | 280 000 | | 250 000 | 1 600 | 200 000 | 2,000 |
| Vatican | 100,000 | 24,000 | - | | | | 30 000 | 40 000 | 30 000 | 40 000 |
| [illegible] | | | [illegible] | | [illegible] | | | | | |
| [illegible] | | | [illegible] | | | | | | | |

LIBRA'TION (Lat libra, *a balance*) In Astronomy a term applied to certain phenomena resulting from the moon's motion, whereby the spots very near the border of the lunar disc alternately disappear and become visible [illegible] as if [illegible]

The [illegible] of three kinds, the libration in longitude, the [illegible] in latitude and the diurnal libration The libration in longitude is occasioned by this circumstance, that the rotatory motion of the moon about her axis is not always precisely equal [illegible] in her orbit If the moon's orbital motion were [illegible] and performed in the same time as her rotation about the axis, the radius vector from the centre of the earth would always intersect the lunar disc in the same point or the moon would always present exactly the same face to the earth But the rotatory motion is sensibly uniform, while the orbital motion, being performed in an ellipse is [illegible] faster than its average [illegible] the eastern and western [illegible] reappear

The libration in latitude is occasioned by the inclination of the moon's axis of rotation to the plane of her orbit Supposing this axis always to have the same direction in space, the angle which it makes with the radius vector of her orbit will [illegible] of her revolution and obtuse [illegible] poles of rotation, and the adjacent parts of the surface, are alternately visible from the earth

The diurnal libration is simply a consequence of the lunar parallax The observer being placed [illegible] of the earth, perceives [illegible] time of her rising which disappears as her elevation is increased, while [illegible] opposite border, that were before invisible, come into view as she descends towards the horizon *See* MOON

The libration in latitude and diurnal vibration were [illegible] Hevelius first observed and ex- [illegible] longitude

[illegible] licet, *it is lawful*) In Law, a power or authority given to a man to do some lawful act, and may be by word or by deed [illegible] other to do it on his ground which would [illegible] would be a trespass and the party [illegible] comes a trespasser *ab initio* Licence is also commonly taken for the admission of an individual, by proper authority, to the right of doing particular acts, practising in professions &c, and for the certificate of such admission

LICENTIATE A degree in some foreign universities [illegible] universities of Paris [illegible] except in [illegible] of Cambridge In the original sense of the word it appears to have been only a title applied to such as had obtained a licence to teach It is said to be of Italian origin [illegible] versity of Bologna Where [illegible] it intervenes between that of bachelor and that of doctor

LI'CHEN (Gr λειχην, *a roughness of the skin*) In Pathology, a papulous eruption of the skin terminating in scurfy exfoliations it is generally symptomatic of disordered stomach and bowels

LICHE'NIC ACID The acid peculiar to some species of lichens It appears to be the *malic acid*

LI'CHENIN A substance closely allied to starch, extracted from the *Cetraria islandica*, or Iceland moss

LI'CHENS Plants of a very low organization, which grow on the bark of trees or rocks, when they form a kind of incrustation, or upon the ground, when they consist of irregular lobes parallel with the earth's surface Occasionally in all situations they are found in a branched state, but their subdivis [illegible] regular and without order Their [illegible] of hard nuclei, called *shields*, which break through the upper surface of the *thallus* or main substance of the lichen, are of a peculiar colour and texture and contain the reproductive particles Lichens abound in the cold and temperate parts of the world The greater part are of no known use, but some, as the reindeer moss (*Cenomyce rangiferina*), the Iceland moss (*Cetraria islandica*), and various species of *Gyrophora*, are capable of sustaining life, either in animals or man The Iceland moss when deprived of its bitterness by boiling, becomes indeed a diet recommended to invalids Others are used as tonic medicines as *Variolaria fagnea*, and *Parmelia parietina* Their principal use is, however, that of furnishing the dyer with brilliant colours, orchall, cudbear, and perolle, with many more, are thus employed

LICKS A term applied in North America to sandy tracts of land, upon which common salt forms an efflorescence, and which almost all graminivorous animals resort to for the purpose of licking the surface

LI'CTORS (Lat ligo, *I bind*) Officers whose duty it was to attend the principal Roman magistrates (such as the consuls, master of the horse, and prators) and the vestal [illegible] their appearance in public and to act as constab [illegible] their command Their insignia were the *fasces* or bunch of rods (originally encircling an axe, which was removed by Publicola, used under the republic only by dictators, and restored under the emperor), and the *virga* or rod, which was used to touch the door of the magistrate on returning home The number of lictors in attendance varied according to the rank of the magistrate, thus the consuls had twelve, the prætors six, and dictators, according to some, twenty-four

LIEGE In the Latin of the middle ages *ligeus*, from *ligare*, to bind A liege lord, in feudal language, is a superior to whom *allegiance* is owed and a *liegeman* he who owes such allegiance Hence all subjects are termed *liege* of the king S new rs derive the word liege from the Teutonic word *leude* (modern German *leute*, people), which was used in the sense of *vassal*

LI'EN (Lat *ligo*, *I bind*) In Law signifies the right which a creditor has to retain the property of his debtor until the debt has been paid, and furnishes one of very few instances in which a party is allowed to take the law, as it were, into his own hands Liens are either general or particular A general lien is the right to retain anything for a general balance of accounts, and not for those demands only which arise in respect of the thing retained This sort of lien is said not to be favoured by law A particular lien, which the law is said to favour, is a right to retain a thing when the claim against the owner of it aris as, where a tailor has to a coat, the tailor is allowed to retain the cloth until he is paid for his labour in making it into a coat The payment of a simple contract debt cannot be enforced by action after six years have elapsed from the time the debt was incurred, but a party who has a lien on property may retain it for an unlimited period, until his claim has been satisfied.

LIE TO *See* LYE-TO

LIEUTE'NANT (Fr ) An officer, who, as the derivation of the word implies, supplies the place and discharges the duty of a superior in his absence

LIEUTENANT IN THE ARMY The officer immediately subordinate to the captain, in whose absence he takes the command of his company In the British service the lieutenants of the Life Guards and Horse Guards and of the three regiments of Foot Guards have the rank of captain In the artillery, engineers, marines, and rifle brigade, of the British service, and in all the regiments of most of the Continental nations there being no cornets or ensigns, the subaltern officers are distinguished as first and second lieutenants The pay of a lieutenant varies, according to the regiment or branch of the service to which he belongs, from 10*s* 4*d* to 6*s* 6*d*, and the price of his commission, according to the pres is, for the Life Guards 1785*l*, Horse Cavalry 1190*l*, Foot Guards, 2050*l*, Infantry 700*l*

LIEUTENANT IN THE NAVY The next rank to that of commander, and co ordinate with that of captain in the army The number of war varies with their rat eight lieutenants besides supernumeraries, and those of the second, third fourth rates &c have respectively one less than the number appointed to the preceding rate The monthly pay of a lieutenant in the British navy varies according to the ship and his duration of service, from 11*l* 10*s* to 4*s*

LIEUTENANT-GENERAL OF THE KINGDOM A dignity equivalent to that of regent which has been occasionally held in France on temporary emergencies The Count d'Artois (afterwards Charles X ) took this title in 1814 on entering France, and held it until the arrival of his brother, Louis XVIII On the expulsion of Charles X, in 1830 the Duke of Orleans was constituted lieutenant general, both by an ordinance of that prince, and by the provisory government of the Hotel de Ville, on July 29, and retained the title until he was proclaimed king, on the 7th August following.

LIFE ANNUITY *See* ANNUITY

LIFE ASSURANCE *See* ASSURANCE

LIFE BOAT A boat originally made at Shields, in 1789, by Mr Greathead, for saving the crews of shipwrecked vessels The following are the general principles — The boat is wide and shallow, the head and stern are alike, for pulling in either direction, and raised to meet the waves, it pulls double banked the oars being fir, for lightness, and fitted with thole pins and grummets, and is steered with an oar The boat is cased round inside on the upper part with cork, in order to secure her buoyancy with as many persons as she can carry, even though full of water, the cork likewise assists in maintaining, or, if equilibrium in emerging from the hollow of the sea It is a curious fact that the smugglers paint their boats white for the contrary reason, because dark-coloured objects alone are discernible

LIFE BUOY A buoy, with a mast to render it conspicuous, thrown into the sea upon a man's falling overboard The one invented by Lieut Cooke, R N, is furnished with a composition which is fired by the act of disengaging the buoy from its place, at night, and burns with a strong light

LIFE GUARDS The body guard of a sovere land they consist of two regiments, comprising each 32 officers, 83 non-commissioned officers, and 351 privates In Germany such troops are styled the *leib garde* (body guard), and in France the *garde du corps* *See* GUARDS

LIFE LINE In a Ship, any rope stretched along for the safety of

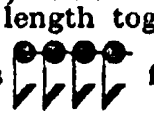
LIFE, MEAN DURATION OF *See* EXPECTATION OF LIFE

LIFE RENT In Scottish Law, the right of enjoyment, either of an heritage or a sum of money, for the life of the life-renter The superior proprietor of the subject, or *fee*, in which this rent subsists, is termed the liar *Terce* (i e dower) and *courtesy* (analogous to the courtesy of England in English law) are instances of legal life rents

LIFTING PUMP *See* PUMP

LIFTS The ropes which support the ends of yards weight of the men upon them

LIGAMENTS (Lat ligo, *I bind*) Strong elastic membranes connecting the extremities of the moveable bones When boiled in water they yield more or less a portion of insoluble albumen

LIGATURE (Lat ligo) In Music, the tie which binds several notes of like length together, by which they appear in groups Thus  four quavers, by means of a ligature at top or bottom, assume the form  , the line connecting them being the ligature

LIGHT (Germ licht ) The cause of those sensations which we refer to the eyes, or that which produces the sense of seeing The phenomena of light and vision have always that they have been examined with such care as to afford grounds for any safe speculation respecting the nature of light and the mode of its propagation through space But the solution of these two questions is involved in very great difficulty, for notwithstanding the splendid discoveries of that immortal philosopher and the long train of interesting and important facts which have been investigated since his time, and more particularly since the beginning of the present century, the true theory of light still remains an enigma This does not arise from any difficulty there is in framing an hypothesis which shall afford a mechanical explanation of the various phenomena, but from the circumstance that more hypotheses than one have been imagined by which all the phenomena can be explained not merely in a general way, but with the precision of numerical calculation

The knowledge of the laws which regulate the phenomena of light constitutes the science of *Optics*, which is divided into a number of subordinate branches An account of the principal phenomena will be found under the terms ABERRATION, CHROMATICS, INTERFERENCE, OPTICS, POLARIZATION REFLECTION, REFRACTION, &c The present article will be confined to a brief enumeration of some of the principal properties of light, and a statement of the two rival theories by which modern philosophers explain its nature and propagation

*Properties of* most familiar from luminous intervenes to intercept the light, they are seen in all situations of the eye Thus, the flame of a lamp is visible from every part of the sphere of which it occupies the centre, and the same is the case with respect to a phosphorescent body, an electric spark, a ball heated red-hot, or light having any other source The sun throws its light, not only on the earth, but on the planets, and comets and every other body in the firmament

Another property of light is, that in a homogeneous medium it is always propagated in straight lines This is evident from various considerations The forms of shadows correctly represent the outlines of the objects which produce them, as seen from the luminous body, which could not be unless the light proceeded in straight lines from the extremities of the objects to the borders of the shadow If three plates of metal, each pierced with a small hole, are placed at some distance behind each other, and in such positions that the three holes are exactly in one straight line, the light will pass freely through them, but if the holes are not exactly in a straight line no light will pass In like manner, if a number of similar objects are placed behind each other in a straight line, the first renders all the others invisible to an eye placed in the same line We cannot see through a bent tube

A third property of light is that it requires time for its propagation The velocity with which it passes from one point to another is, however, so great, that, with respect to any terrestrial distances, the passage may be considered as instantaneous But astronomy furnishes the means, not only of detecting its propagation but of measuring its velocity with great precision Eclipses and emersions of Jupiter's satellites appear to happen later when the earth is at a greater distance from Jupiter, than when it is at its greatest Light, therefore, occupies above a quarter of an hour in passing

through the diameter of the earth's orbit Now, the sun's distance from the earth being nearly 95,000,000 of miles, it follows that light must travel through space with the [illegible] velocity of [illegible] nearly [illegible] time and consequently would pass round the earth in the eighth part of a second Astronomical [illegible] is, no result of science rests [illegible] It is also proved, by the phenomena of aberration, that the light of the sun, planets, and all the fixed stars, travels with one and the same velocity

When light in its progress encounters an obstacle, or enters a [illegible] undergoes certain modifications, depending upon the nature of the body on which it falls, or the [illegible] which it enters When it falls on a smooth polished surface a portion of it is regularly reflected, that is to say, it is returned from the surface at an angle equal to the angle of incidence, and pursues its course in a straight line as before the reflection The quantity of light thus reflected depends on the nature and polish of the surface, and on the angle of incidence, being greatest when that angle is small, but it is calculated that even the brightest and most opaque surfaces, mercury for example, do not reflect more than three fourths of the incident light Another portion of it enters the medium, and there (if the medium is homogeneous) pursues a rectilinear course but differing from its former direction In this case it is said to be refracted The [illegible] medium, [illegible] law of [illegible] the liquids [illegible] whole of the refracted light is bent from its original direction at the same angle In many others, as in most crystallized media, part of the refracted light follows one course, and another part of it a different one, the two portions acquiring at the same time different physical properties In this case the refraction is said to be double A third portion of the light falling on a body is neither reflected nor refracted regularly but is scattered in all directions, and it is this portion which renders bodies visible All bodies on which light falls absorb a certain part of it, more or less in proportion to their opacity In perfectly opake bodies the absorption is total and the light does not penetrate to a sensible depth under the surface In others it penetrates farther but even in the most transparent it is gradually stifled and lost A depth of only seven feet of pure water is required to extinguish one half of the incident light *See* REFLEXION

Solar light, refracted by a prism or other body, is separated into a multitude of rays of different colours, each of which afterwards proceeds in its course independently of all the others These differently coloured rays [illegible] from the variegated hues of natural bodies The investigation of the laws of the dispersion of the coloured rays forms the subject of *chromatics* One of the principal facts connected with it is, that the dispersion of the rays by different refracting substances is not proportioned to the refraction, the dispersive power of some substances being greater than that of others, while their refracting power is less This fact led to the important discovery of the *achromatic telescope* *See* ACHROMATIC CHROMATICS

Light, on being regularly reflected or refracted, undergoes a modification termed *polarization*, in virtue of which it presents, on encountering another medium, different phenomena of reflection and refraction from those presented by light which has not undergone such modification When a ray of light, having acquired this modification, is made to fall on a plane reflecting surface under a certain angle of incidence, no portion of it will be reflected, the whole is transmitted or absorbed But, in the case of ordinary light, some portion is always reflected from a polished surface, whatever be the angle of incidence, the light has therefore acquired the property of being acted upon in a particular way, whence Malus, who first investigated this subject in a philosophical manner, gave the phenomena the name of *polarization*, from its analogy to the effect produced by a magnet [illegible] *See* POLARIZATION

The last property of light which we shall notice as important [illegible] mutual influence on each other [illegible] or modifying each other's effects [illegible] laws This mutual action of [illegible] gives rise to a great [illegible] of the most intricate phenomena of optics, and affords a sufficiently simple explanation of [illegible] ation has [illegible] INTERFERENCE

[illegible] ories have long divided the opinions of philosophers respecting the nature and propagation of light One of these consists in supposing it to be composed of particles of excessive minuteness, projected from the luminous body with a velocity equal to nearly 200,000 miles in a second This hypothesis was adopted by Newton, and, till recently, has been acquiesced in by the greater number of writers on optics The other hypothesis supposes light to be produced by the undulations or undulations of an ethereal fluid of great elasticity, which penetrates all space and permeates all substances, and to which the luminous body communicates an impulse which is propagated with inconceivable velocity in spherical superficies, by a sort of tremor or undulation, as sound is conveyed through the atmosphere, or a wave along the surface of water Both of these hypotheses are rendered probable by the great number of phenomena of which they [illegible] they are both, also, [illegible] Other theories have not met with such general attention from philosophers as to make it necessary to explain them in this place

*Corpuscular Theory of Light* — Sir John Herschel, in his admirable *Essay on Light* in the *Encyclopædia Metropolitana*, states the principles of the Newtonian or Corpuscular theory as follows —

1 "That [illegible] of inertia [illegible] forces, and projected or emitted from all luminous bodies with nearly the same velocity, —about 200,000 miles per second

2 "That these particles differ from each other by the intensity of the attractive and repulsive forces which reside in them, and in their relations to the material world, and also in their actual masses, or inertia

3 "That these particles, impinging on the retina, stimulate and excite vision, the particles whose inertia is greatest producing the sensation of red, those of the least inertia of violet, and those in which it is intermediate the intermediate colours

4 That the molecules of material bodies and those of light exert a mutual action on each other, which consists in attraction and repulsion, according to some law or function of the distance between them, that this law is such as to admit, perhaps of several alternations or changes from repulsive to attractive force, but that when the distance is below a certain very small limit it is always attractive up to actual contact, and that beyond this limit resides at least one sphere of repulsion This repulsive force is that which causes the reflection of light at the external surfaces of dense media, and the interior attraction that which produces the refraction and interior reflection of light

5 "That these forces have different absolute values or intensities, not only for all different material bodies, but for every different species of the luminous molecules, being of a nature analogous to chemical affinities or electric attractions, and that hence arises the different refrangibilities of the rays of light

6 "That the motion of a particle of light, under the influence of these forces and its own velocity, is regulated by the same mechanical laws which govern the motions of ordinary matter, and that therefore each particle describes a trajectory capable of strict calculation as soon as the forces which act on it are assigned

7 "That the distance between the molecules of material bodies is exceedingly small in comparison with the extent of their spheres of attraction and repulsion on the particles of light

8 "That the forces which produce the reflection and refraction of light are, nevertheless, absolutely insensible at all measurable or appreciable distances from the molecules which exert them

9 "That every luminous molecule, during the whole of its progress through space, is continually passing through certain periodically recurring states, called by Newton fits of easy reflection and easy transmission, in virtue of which they are more disposed, when in the former states or phases of their periods, to obey the influence of the repulsive or reflective forces of the molecules of a medium, and when in the latter, of the attractive"

Such are the postulates on which the corpuscular theory of light dep[illegible] Mr [illegible] without difficulty, a[illegible] of mathematical reasoning to the phenomena, which may be investigated by the same sort of analysis with which [illegible] are already familiar in the theories of heat, capillary attraction, and other molecular forces

*Undulatory Theory* — The principles of the undulatory theory are thus stated by Sir J Herschel —

1 "That an excessively rare, subtle, and elastic medium, or *ether*, fills all space, and pervades all material bodies, occupying the intervals between their molecules, and either by passing freely among them, or by its extreme rarity offering no resistance to the motion of the earth, the planets, or comets, in their orbits, appreciable by the most delicate astronomical observations, and [illegible]

2 That the molecules of the ether are susceptible of

being set in motion by the agitation of the particles of ponderable matter, and that when any one is thus set in motion it communicates a similar motion to those adja- [illegible] propagated further and [illegible] according to the same mechanical laws which regulate the propagation of undulations in other elastic media, as air, water, or solids, according to their respective constitutions

3 "That in the interior of refracting media the ether exists in a state of less elasticity, compared with its density, than in vacuo (*i. e.* in space empty of all other matter), and that the more refractive the medium, the less, relatively speaking, is the elasticity of the ether in its interior

4 "That vibrations communicated to the ether in free space are propagated through refractive media by means of the ether in their interior, but with a velocity corresponding to its inferior degree of elasticity

5 "That when regular vibratory motions of a proper kind are propagated through the ether, and, passing through our eyes, reach and agitate the nerves of our retina, they produce in us the sensation of light In a manner bearing a more or less close analogy to that in which the vibrations of the air affect our auditory nerves with that of sound

6 "That as, in the doctrine of sound, the frequency of the aerial pulses, or the number of excursions to and fro from the point of rest made by each molecule of the air, determines the pitch or note, so, in the theory of light, the frequency of the pulses, or number of impulses made on our nerves in a given time by the ethereal molecules next in contact with them, determines the *colour* of the light and that is the absolute extent of the motion to and fro of the particles of air determines the *loudness* of the sound, so the *amplitude* or extent of the excursions of the ethereal molecules from their points of rest determines the brightness or intensity of the light"

That the sensation of light is produced by the vibrations of an extremely rare and subtle fluid is an idea that was maintained by Descartes, Hooke, and some others, but it is to Huyghens that the honour solely belongs of having reduced the hypothesis to a definite shape and rendered it available for the purposes of mechanical explanation Owing to the great success of Newton in applying the corpuscular theory to his splendid discoveries, the speculations of Huyghens were long neglected, indeed, the theory remained in the same state in which it was left by him till it was taken up by our countryman, the late Dr Young By a train of mechanical reasoning which in point of ingenuity has seldom been equalled, Dr Young was conducted by some very remarkable numerical relations among some of the apparently most dissimilar phenomena of optics, to the general laws of diffraction, and to the true principles of the coloration of crystallized substances 'It is a theory' says Herschel, 'which, if not founded in nature, is certainly one of the happiest fictions that the genius of man has yet invented to group together natural phenomena as well as the most fortunate in the support it has received from whole classes of new phenomena, which at their discovery seemed in irreconcilable opposition to it It is, in fact, in all its applications and details one succession of *felicities*, insomuch that we may almost be induced to say if it be not true, it deserves to be so" (*Ency Metr*, "Light" § 595)

*Relations of Light Heat, and Chemical Power* —Light and heat are so intimately related to each other that philosophers have doubted whether they are identical principles or merely coexistent in the solar radiations The chemical property of the sun's rays appears to bear the same relation to light and heat as these do to each other By some the phenomena of chemical change — as shown particularly in all the processes of photography — are considered as the result of luminous power, or the action of light, by others they are regarded as the operation of a distinct principle, and to which the name *Actinism* has been applied

These three principles, or phenomena, possess numer- [illegible] prized according [illegible] during quick [illegible] and when these are studied [illegible] producing chemical change is also developed All bodies, excepting the gases, when heated to a high temperature, become incandescent, and they all begin to give out light at the same temperature, viz about 1000° Fahrenheit Nevertheless there are many circumstances in which they appear to differ

A thin plate of transparent glass interposed between the face and [illegible] sensible portion of the light [illegible] the heat As the intensity of the fire is, however, increased, the heat rays begin to pass through the transparent screen, and the heat rays from a body glowing with an intense whiteness permeate it with but little [illegible] The experiments of Melloni have, however, shown, that certain media which are perfectly transparent to solar light are nearly opaque to heat, and that rock salt and black mica, which are opaque to light allow the passage of the heat rays very freely In a similar manner pale yellow glass through which daylight passes without [illegible] completely stops the dark red rays and a deep cobalt blue glass, or a dense blue fluid which obstructs ninety per cent of the luminous rays, offers no impediment to the permeation of the chemical agency

Light, heat, and actinism, are not, therefore, intercepted alike by the same substances Heat and actinism are also combined in different degrees with the different luminous rays of the spectrum A very remarkable discovery on this subject was made by Sir William Herschel, which would seem to establish the independence of the heating and illuminating effects of the solar rays Having placed thermometers in the several prismatic colours of the solar spectrum he found the heating powers of the rays gradually increased from the violet (where it was least) to the extreme red, and that the maximum temperature existed at some distance beyond the red, out of the visible part of the spectrum The experiments of [illegible] was stretched upon a frame, and blackened upon one side with lamp black, the unblackened side was now placed in such a manner that the prismatic spectrum fell upon it, the image being kept stationary by means of a heliostat The paper was then thoroughly saturated with ether, and the drying of this volatile fluid very distinctly indicated the points of greatest thermic action, by the formation of well defined spots By this means it was shown that the maximum of calorific power existed over the locality indicated by Sir William Herschel, and that the heat gradually diminished through the luminous rays, sinking to its minimum in the violet ray Beyond this, an extension of heating power, or of the calorific spectrum, was detected for a very considerable distance beyond the maximum point, — showing an extension of the thermic action, over a space where there was no light, equal to the length of the luminous spectrum itself In addition to this there has been detected a peculiar class of heat rays [illegible] possess a spe [illegible] have been called *Parathermic* rays, to distinguish them from the true thermic radiations, and it appears probable that they perform very important functions in perfecting the full development of fruits and seeds This discovery of the inequality of the heating power of the different rays led to the inquiry whether the chemical action produced on certain bodies by the solar rays was [illegible] was supported by the experiments of Gouelle, — or owing to some other cause? By a series of delicate experiments, Berard found that this action is not only independent of the heating power, but follows an entirely different law Investigations on this subject have been most ably pursued by Sir John Herschel and others By throwing a prismatic spectrum upon paper carefully prepared with the chloride or iodide of silver, or upon a Daguerreotype plate, — which is of silver, covered with a film of iodine, — the following curious results are obtained No change takes place upon that part of the paper upon which the most luminous rays fall, that space being preserved perfectly white In the green ray chemical change occurs but faintly, but it rapidly increases as we proceed towards the violet end of the spectrum, — the maximum varying slightly between th [illegible] violet rays under varying conditions [illegible] is also found to extend to a considerable space beyond the extreme end of the luminous spectrum, exhibiting an extension quite equal to that discovered to exist at the [illegible] of the spectrum

We [illegible] that the solar rays possess at least three distinct powers, those of heating, illuminating, and effecting chemical combinations and decompositions The actual antagonistic power of light and actinism is shown when by the employment of two prisms we produce two spectra, and so adjust them that the most refrangible rays may fall upon that part of the chemically prepared surface on which the maximum [illegible] Notwithstanding the actinic [illegible] with that of light, the [illegible] energetic to protect the paper or plate from any chemical change, and it is preserved without any alteration of colour This experiment appears to prove the complete independence of these phenomena

The solar rays perform some very important parts in the vegetable economy The experiments of Mr Robert Hunt (see *Reports of the British Association*) prove that the process of germination is mainly dependent upon the action of the chemical rays, or actinism that the growth of the plant — the decomposition of the carbonic acid absorbed by the leaves, in virtue of the excitation of the

vital functions of the living organism, and the colouring matter of the leaves—is entirely the result of luminous power, as distinguished from the other associated powers,
[illegible]
forms of some of the lower classes of animals have also been [illegible] and there are probably many [illegible] the same wonderful agent of which we can at present form no adequate notion. (See Sir J. Herschel's *Treatise on Light*, *Airy's Mathematical Tracts*, *Brewster's Optics*, *Young's Lectures*, Biot, *Traité de Physique*, Pouillet, *Elemens de Physique*, *Hunt's Researches on Light*.)

An account of the principal *Photographic Processes* will be found under the term PHOTOGRAPHY.

LIGHT. In Painting, the medium by which objects are discerned. In a picture it means the part the most illuminated. This may happen from *natural light*, as the sun or moon, or from *artificial light* as a fire, candle &c. The principal light is generally made to fall on the spot where the principal figures are placed, and generally near the centre of the picture. A reflected light is that which a body in shadow receives from a contiguous light object.

LIGHT. The sea term for not laden.

LIGHTER. A strong vessel or barge for transporting [illegible] fly on rivers and canals.

[illegible] An establishment for the exhibition of a light or landmark to direct the mariner. The use of lights for such a purpose is of very high antiquity, but their early history is involved in much obscurity. In the ancient world there were [illegible] Ostia, Ravenna, Puteoli, Capreæ, Rhodes, [illegible] Bosphorus, &c. (*Suetonii Opera* tom. i. p. 755), but by far the most celebrated lighthouse in antiquity was that erected by Ptolemy Soter on the small island of Pharos, opposite to Alexandria, —
vium regens" (*Pliny* [illegible]
height, which some authors have estimated at 600 feet and upwards, procured for it a place among the wonders of the world, and, according to Josephus, its "beaming summit" could be seen at a distance of 300 stadia — about 42 British miles. It is said to have cost 800 talents, and its celebrity was such that Pharos rapidly became, and still continues to be in many countries, a generic term equivalent to *Pharus*.

The most celebrated [illegible] of modern times are, the Tour de Cardouan at the entrance of the Gironde, in France, the Eddystone lighthouse opposite to Plymouth Sound, and that more recently constructed on the Bell Rock opposite to the Frith of Tay. The first of these was begun in 1584, and finished in 1611. It is 186½ feet [illegible] and besides being of the highest importance to the [illegible] so dangerous and frequented a coast, it forms at the same time a splendid specimen of architectural beauty. The Eddystone lighthouse constructed by the celebrated engineer Smeaton was completed in 1759, is regarded as a masterpiece of its kind, and, as has well been observed, bids fair to be little less lasting than the rocks upon which it stands. The Bell [illegible] built by Mr Stevenson on the [illegible] N[illegible] the most dangerous point [illegible] cipal harbours, are now erected in most civilized maritime countries. In the Baltic and the Sound they are particularly abundant, the Dutch have 20 lights on their coast, and in the Zuyder Zee, and on the northern and western coasts of France there are no fewer than 89 excellent lights. (The Admiralty has lately published lists of all the [illegible] The coasts of no [illegible] ithouses is those [illegible] they are under the management of the Brethren of the Trinity House, for Ireland, under that of the Board for the Improvement of the Port of Dublin, and for Scotland, under that of the Commissioners of Northern Lighthouses meeting at Edinburgh. It would swell our pages to too great an extent were we to attempt to give a complete list of the various lighthouses of this country, we must therefore beg to refer the reader to the *Commercial Dictionary* for full particulars upon this subject, and shall devote what remains of our limits to a view of the different principles adopted in the construction of their important machinery.

The ancient mode of exhibiting lights as beacons to the mariner consisted in burning wood or coal in a chauffer on the top of a tower, and till the year 1807, the Eddystone light was [illegible] er than the feeble [illegible] fatuus [illegible] any apparatus for concentrating the light or giving it any particular direction. But as [illegible] [illegible] foci are equally [illegible] which has the focus for its centre, it is evident that without some means of giving the light a horizontal direction, the greater part of it must be wholly lost, for only those rays which are directed in the plane of the horizon, or at least which are depressed only a few degrees below it, can be seen by a ship at a distance. Hence the first object to be attained is to prevent the loss of light by throwing the whole of it forward in the plane of the horizon, in order that its intensity may be increased in the greatest possible degree. Now there are two principles [illegible] principles are combined in the same apparatus.

*Catoptric System*.—The usual mode of applying the catoptric principle is by burning an Argand lamp in the focus of a parabolic mirror. This mode of illumination appears to have been first carried into effect at the [illegible] fleeting mirrors were placed in some of the English lighthouses, under the direction of the Trinity House, and in 1786 the principle was adopted in the only two be[illegible] on the coast of Scotland—viz. the Isle [illegible] Firth of Forth, and the Cumbrae Isle in the Clyde. Soon afterwards it was adopted generally in this country. Borda's reflector was formed of a sheet of copper plated with silver, those applied in Scotland were formed of small facets of mirror glass placed in hollow parabolic moulds of plaster. The mirrors in general use in the British lighthouses at the present time are of copper lined with silver, the focal length is about 3 or 4 inches, and the diameter at the outer edge about 21 inches.

If the curvature of a reflector could be made truly parabolic and it [illegible] point, the rays would [illegible] exactly parallel to the axis of the generating curve, and the beam of projected light would be a cylinder having a diameter equal to that of the mirror. Such a form of the beam would render the light nearly useless, on account of the small portion of the horizon which would be illuminated, and it [illegible] necessary to give the rays a certain degree [illegible] this is practically effected by the size of the flame. The burner of the lamp is usually an inch in diameter, and the origin of the luminous rays being thus at a small distance from the focus, instead of being reflected parallel they are projected in a cone having a divergence of about 14°. The curvature of the mirror may also be so adjusted as to increase the divergence.

In order to produce a light of sufficient intensity, several parabolic mirrors sometimes as many as eight, are placed on a frame with their axes all parallel to each other, so that the light reflected by all of them is blended together in the same beam. To form a revolving light, the frame is attached to a horizontal axis which is turned by means of clock machinery, and in this manner the different quarters of the horizon are successively illuminated. But as a rapid motion would be inconvenient, the frame has usually three or four sides on each of which the same number of mirrors and lights is placed, so that the illumination is repeated three or four times in one revolution. To form a stationary light, a number of reflectors are placed round a circular frame, having their axes on the radii of the circle. This arrangement has one obvious defect, namely that the illumination will not be equally [illegible] the direction of the [illegible] rection of lines bisecting the several angles formed by each pair of contiguous axes. The defect is one which cannot be entirely remedied in a stationary light on the catoptric principle.

*Dioptric System*.—The introduction of lenses for the purpose of giving the light a horizontal direction is of recent date. A project for this purpose is indeed mentioned by Smeaton in his account of the Eddystone lighthouse, and about the end of the last century the method was tried at some lighthouses in the south of England, but from the imperfect figure of the lenses, and the absorption of the light caused by the great thickness of the glass, it did not succeed. But the art of grinding spherical lenses having been since brought to greater perfection, and a means of greatly diminishing the ab-
[illegible]
is to say lenses formed of several pieces separately prepared and afterwards united,—*see* POLYZONAL LENS), the system has been revived of late years, and in many in[illegible] [illegible] [illegible] still into execution. The merit of [illegible] such lenses to lighthouses belongs to the late [illegible] Fresnel, of the Academy of Sciences of Paris. The annular lenses, constructed under the direction of Fresnel for the principal lighthouses in France, are plano convex, having a focal distance of about 3 feet, and they are formed of crown glass, as being less liable to *strike* than flint glass. The effective divergence of the cone of light projected by a lens is generally less than in

the case of a paraboloidal refractor, being only about [illegible] of that portion of the light which falls on the surface of the lens, it must be stopped by the apparatus of this kind would be superior in its effects to a parabolic mirror, but when [illegible] to the imperfections of the [illegible] ting surface, more than one [illegible] s lost in every case, and also [illegible] d more intense flame may be used for [illegible] lens than [illegible] easily appear [illegible] may be on the side of the lens In fact a lens of the largest size used in the French lighthouses projects a cone of equal intensity to that of eight mirrors of the best kind

The construction of a revolving dioptric apparatus of the first order is usually as follows —The revolving frame which carries the principal lenses has eight sides, and there are consequently eight large lenses, so arranged that their axes are all in the same horizontal plane, and meet in the common focus, where the lamp is placed This frame, with its lenses, consequently forms an octagonal prism For the purpose of preventing the loss of the rays which fall above and below the principal lenses, various methods are employed One is to place above the first frame a second frame, whose sides form [illegible] pyramid of 50° of inclination, [illegible] ch is placed a lens having its focus in the flame of the lamp The rays falling on these inclined lenses are refracted into directions parallel to the axis of the lens, and are then reflected into the horizontal direction by plane mirrors placed above the second frame Another method is to place curved reflectors above the frame containing the principal lenses But a third and still more elegant method, proposed by Fresnel, is to substitute for the upper lenses and mirrors a series of triangular prisms [illegible] axes arranged in horizontal [illegible] so that the light falling on the face next the flame is thrown upon the back of the prism, where it suffers a total reflexion, and a second refraction at the third side of the prism gives it [illegible] ection

[illegible] on the dioptric system, it is necessary to increase the number of the lenses, which in fact ought to be infinite, or to form a true cylinder in order to produce an equal diffusion over every point of the horizon In some of the French lighthouses the refracting apparatus consists of a polygonal belt of 32 lenses, but on establishing the Isle of May lighthouse, in 18[illegible] m proposed to form a true cylindric belt, and the task though attended with much difficulty, was successfully executed at a glass-house in Newcastle

The dioptric system is peculiarly adapted for fixed lights, and its advantages are these —1 A light of equal intensity is distributed round every point of the horizon 2 The consumption of oil is less for the same intensity of light, and consequently the expense of maintaining the light is less 3 The trouble attending it is less as there is only one lamp to trim and the lenses are easily kept in order, whereas the reflecting surfaces require much care and attention On the other hand, there is more risk from accident, for the accidental extinction of the lamp leaves the whole horizon in darkness, whereas in a system of reflectors the light would be extinguished over only a small portion of it

Fresnel published his first memoir on the subject in 1822, since that time the dioptric system has been generally adopted for all the principal lighthouses of France and Holland In this country it has as yet been applied only at Inchkeith and the Isle of May in the Firth of Forth, and at the Start Point in Devonshire

*Lamps* —For the lights on the catoptric system the illumination is usually produced by an Argand fountain lamp, having a burner of an inch [illegible] with silver, in order that it may th[illegible] the effect of the heat evolved In the dioptric system a larger flame is requisite, and Fresnel invented a lamp the peculiarity of which consists in its having a series of concentric burners For lights of the first class the number is four and they are protected from the effects of the excessive heat by a superabundant supply of oil, which is thrown up from the cistern below by a clock-work movement, and is kept constantly overflowing the wicks A tall chimney is necessary to supply a sufficiency of air In this country the lamp is fed with spermaceti oil, in France the oil of colza (expressed from the seed of the wild cabbage) is used, and in some parts of the Mediterranean olive oil, but the light obtained from this is comparatively feeble In a few instances coal gas has been used for dioptric lights All attempts to apply the Drummond light, and voltaic lights, have failed, by reason of the great practical difficulties with which those modes of illumination are attended

*Method of dis[illegible]* [illegible] importance in [illegible] the appearances of the different lights so that each may have some distinctive character by which it may be readily recognized, and the mariner be made aware of the part of the coast [illegible] methods adopted for [illegible] —1 The interposition of [illegible] or refractors, so as to give a particular colour to the light red is the only colour which can be used, as shades of any other colour are found to absorb too much light 2 The time of revolution, or the length of the interval between [illegible] appearances of the light this is th[illegible] on the French coasts 3 A *flashing light*, that is a light of which the alternate flashes and eclipses succeed each other so rapidly as to give the appearance of a succession of brilliant scintillations 4 An *intermittent* which consists of a fixed light which [illegible] and after a stated interval as suddenly revealed the appearance of this light is entirely different from that of any revolving light 5 [illegible] which admits of other dis[illegible] be placed vertically above the other, or in the same horizontal plane, or one may be white and the other red Sometimes three lights are necessary to indicate the entrances to harbours, &c

T[illegible] of [illegible] a land [illegible] of a floating light about 1200*l*

(*Encyc Brit*, art "Sea Lights," Smeaton, *Narrative of the Eddystone Lighthouse*, 1793, *Stevenson's Account of the Bell Rock Lighthouse*, 1824, Id, *British Pharos*, 1831, *Brewster's Treatise on Burning Instruments*, 1812; *The Lighthouses of the British Islands*, 1836, *Report of Select Committee of the House of* [illegible] 1839, *Report to the Commissioners* [illegible] *houses* by A Stevenson, 1834, and *on the Inchkeith Dioptric Light*, 1836, [illegible] [illegible] tomene, Peclet, *Tr*[illegible] [illegible] nel, *Memoire sur un* [illegible] *Phares*, 1822, A F[illegible] *Phares et Fanaux allumes sur les Cotés de France*, 1837, &c)

LIGHTNESS (Teut leicht) In the Fine Arts, a quality indicating freedom from weight or clumsiness

LIGHTNING An electric phenomenon, produced by the passage of electricity between one cloud and another or between a cloud and the earth

The identity of [illegible] been previously su[illegible] by the celebrated Dr Franklin, in the year 1749, by the experiment of drawing sparks from the electric kite Since that time the science of electricity has been greatly advanced, nevertheless, the cause of some of the appearances connected with lightning is not well explained even at the present day

There are three phenomena in particular for which theory fails satisfactorily to account The first is the form of the flash which is almost always zigzag, or in broken [illegible] other [illegible] repeatedly to [illegible] the flashes from the [illegible], which often follow each other in quick succession contrary to what takes place in the case of electric conductors, which [illegible] natural state or discharge the [illegible] at a single stroke The third is the length of the flash, which sometimes appears to embrace a large extent of the sky This phenomenon can be best observed from the tops of mountains reaching above the clouds from which the lightning proceeds, and observers in such circumstances agree in stating that they have seen flashes certainly extending several miles in length

The zigzag form of the flash is common to lightning and the electric spark the same explanation should consequently apply to [illegible] been able to give [illegible] the repetition of [illegible] mass of vapours constituting an electric cloud is a less perfect conductor of [illegible] and without knowing [illegible] arranged, so as to be in equilibrium over imperfect conductors, whose surfaces, as in the case of the clouds, often extend many miles, it is easy to see that an instantaneous contact [illegible] an oppo[illegible] a com[illegible] spark [illegible] This we may suppose to be the cause why numerous flashes are darted from the same cloud With respect to the third phenomenon, the great length of the flash may also be a consequence of the feeble conducting power of the clouds, and of the mobility of their constituent parts, or we may suppose parcels of vapour or air, electrified by the influences of two clouds charged with opposite electricities, to be scattered at very small intervals between the clouds, and that, at a given instant, the equilibrium is destroyed, without a transference of the electricity of the one cloud to the other, but merely from parcel to parcel,

along the whole extent of the line in which the flash appears

The theory of an electric fluid, and the well-ascertained differences in the conducting power of different substances suggested the idea of protecting buildings from the destructive effects of lightning by metallic rods It has been disputed whether they have been or can be of use in averting the stroke, but it will not probably be satisfactorily answered until the cause and nature of electric action are better understood *See* ELECTRICITY, THUNDER

LIGHT-ROOM A room in which the light is [illegible]

LIGHTS, NORTHERN *See* AURORA BOREALIS

LIGNEOUS (Lat lignum, *wood*) In Entomology, a part is so called when it is composed of a hard inelastic substance like wood

LIGNIN (Lat lignum) The woody fibre This most important proximate principle of vegetables exists in a variety of forms constituting the entire textures of hard and soft wood and diverse species of plants such as hemp, flax, cotton, &c When by fine mechanical division it is reduced to a pulpy state, it is formed into paper When, by different reagents, all the soluble matters are extracted from wood, the insoluble residue is lignin its ultimate components are charcoal, oxygen, and hydrogen [illegible] in water and according to Dr Prout exposed to [illegible] at a temperature [illegible]

*rot* arising out of the growth of a parasitic fungus, which causes its rapid decay Damp timber, in situations where air has not free access is particularly subject to its attacks, and, when once it has made its appearance the well-seasoned timber in its neighbourhood becomes liable to the same disease The dry rot may be prevented by impregnating the timber with certain saline solutions and of these solution of corrosive sublimate has been found most effectual the chloride combines chemically with the lignin and the compound is very indestructible (*See* DRY ROT) Lignin has also a strong attraction for alumine, and hence linen, cotton, paper, and other forms of this fibre, may be aluminized by steeping them in hydrated alumine diffused through water, or, more effectively, by soaking them in certain aluminous solutions drying them, and afterwards washing out the excess of the salt It is in this way that cotton goods are impregnated with lumine for the purpose of dyed and calico printing Other metallic oxides exhibit similar mordant powers, especially the oxide of iron

The analogy that exists between the composition of sugar, gum starch, and even vinegar and lignin suggests the possibility of the conversion of those proximate elements into each other, and it has accordingly been found that, by carefully roasting pure and fine sawdust, it is rendered partially soluble in water and that a part of it is converted into a nutritious substance probably intermediate between sugar and starch, and which, when mixed with a little flour, yields a palatable bread, not very unlike that made by some of the inhabitants of the northern parts of Europe of the bark of trees Mixed with sulphuric acid, lignin passes into gum, and from this sugar may be obtained by boiling it for some hours in a very dilute sulphuric acid this sugar, when purified, much resembles grape or honey sugar By this process rags may be converted into nearly their own weight of this peculiar saccharine matter

The production of vinegar by the destructive distillation of wood was originally suggested, about the middle of the 17th century, by Glauber, a celebrated German chemist of that time It has lately become a very important branch of manufacture in this country Upon the whole, there are very few natural products equally important with lignin in their applications to the useful and ornamental arts

LIGNIPE'RDOUS (Lat lignum, and perdo, *I destroy*) Insects which destroy wood

LIGNITE (Lat lignum, and ignis, *fire*) Wood [illegible] coal

LIGULA (Lat *ligula*, *a little tongue*, *strap*, or *shoe-tie*) In Botany a membranous appendage at the apex of the sheath of the leaf of grasses, and analogous to the corona of some Asclepiadeous plants The term *ligula* is also applied to the processes proceeding from the base and alternating with the horns, of the organ called the *orbiculus* in Vaginicolæ [illegible]

LIGULA In Entomology, a name applied by Latreille to the lower lip of insects, or *labium* of Linnæus [illegible]

LILALITE A mineral found in a talc rock on the banks of the Sterzing in the Apennines It occurs in yellowish green crystals and massive, cleavable [illegible]

LILIÂ'CEÆ A large natural order of Endogenous plants, with hexapetaloid hexandrous flowers, a superior ovary, and anthers which burst internally They are familiarly known in consequence of the asparagus, the lily the fritillary, the harebell, the star of Bethlehem, and many other [illegible] having a part of the order, which differ [illegible] having a simple style not three-styles, and [illegible] towards the style, not towards [illegible] extremely varied some, [illegible] trees form a tall woody perennial stem, which emulates that of palm trees, others are small bulbous plants, whose stem only lives a few weeks Almost all the order is sought after by cultivators of beautiful plants, and, in the case of the tulip and the hyacinth, innumerable varieties constitute the riches of [illegible] plants to [illegible] which, in different [illegible] gives their active [illegible] garden prod[illegible] and squills

LILIA'CEOUS In Botany, a term invented by Link [illegible] petals of which have their ungues [illegible] limb, and standing side by side It is rarely employed

LI'MA (Lat *a file*) A genus of Lamellibranchiate Bivalves, of the tribe *Ostracea*, characterized by the length of their shells as compared with those of the nearly [illegible] *Pecten*, and their more regular oval form [illegible] the shell are most of them relieved with scales The *Limæ* swim with rapidity by means of their valves but in a young state they secure themselves by means of a byssus

LIMACIDÆ *See* LIMAX

LIMACINA (Latinized form of limax, *a slug*) A genus of [illegible] Pteropodous Mollusks, existing in con-

of the whalebone whale The body terminates in a spirally convoluted tail and is lodged in a very thin shell, formed by one whorl and a half, umbilicated on one side, and flattened on the other The animal uses its light shell as a boat, and its wing-like fins as oars and thus navigates in countless fleets the surface of the tranquil deep

LIMAX (Lat limax *a slug*) The name of a genus of the Linnæan *Vermes Mollusca*, of which the common slug is the type The genus enters into the class *Gasteropoda* and order *Pulmonaria* of the system of Cuvier, and is now raised to the rank of a family (*Limacidæ*), which includes *Limax* proper, *Arion*, Fer, *Stenopus*, Gould, *Vaginulus* Fer *Testacella* Lam, *Parmacella*, Cuv, &c Each of these genera has a small scutiform rudimental shell developed in the substance of the mantle, and protecting the heart The orifice of respiration in the true slugs (*Limax*, Cuv) is on the right side, and not so far forward as in *Arion* The rudimental shell is marked with fine and concentric striæ, and is calcified internally The species of this genus are the pests of gardens and cultivated grounds Young plants may be protected from slugs by having a coarse horsehair rope coiled round their stems or by being plentifully sprinkled with soot, or they may be watered morning and evening with strong and fresh lime water

LIMB in Astronomy, signifies the border or outermost edge of the sun or moon Also the graduated edge of a circle or other astronomical instrument

LIMBERS In Artillery, a sort of advanced train to which the carriage of a cannon is attached on a march It is composed of two shafts wide enough apart to receive a horse between them, joined by two bars of wood, and mounted on a pair of wheels

LIMBO (Lat limbus, *a hem or edge*) A region supposed by some of the school theologians to lie on the edge or neighbourhood of hell This served as a receptacle for the souls of just men, not admitted into purgatory or heaven Such were according to some Christian writers, the patriarchs and other pious ancients who died before the birth of Christ hence the limbo was called Limbus Patrum These, it was believed, would be liberated at Christ's second coming and admitted to the privileges of the blessed in heaven [illegible] when our Saviour went down [illegible] souls, and carried them away with him into heaven This latter idea is probably an adorned representation of the remarkable passage in St Peter's Epistle (i 3 19), where he says that Christ preached to the spirits in prison, and, being held by certain of the later fathers, seems to have given some influence to the growing opinion in favour of a purgatory Limbus puerorum or infantum, was a similar receptacle allotted by some of the schoolmen to the souls of infants who die unbaptized Dante has fixed his limbo, in which the distinguished spirits of antiquity are confined, as the outermost of the circle of his hell The use which Milton has made of the same superstitious belief is well known (*Paradise Lost*, book iii)

LIMBUS [illegible] to denote that portion which [illegible] it is the same organ in a petal as the lamina in a leaf, and is what constitutes the broad, thin, coloured part which renders many [illegible]

[illegible] leim, *glue*) This very useful earth is

obtained by exposing chalk and other kinds of limestone or carbonates of lime to a red heat — an operation generally conducted in kilns constructed for the purpose the carbonic acid is thus expelled and lime more or less pure according to the original purity of the limestone, remains In this state it is usually called *quicklime* When sprinkled with water it becomes very into a dry powder, called *slaked lime* When exposed for some weeks to the air it also falls into powder, in consequence of the absorption of moisture, and of a portion of carbonic acid, so that, in this case, part of the lime reverts to the state of carbonate, and loses its causticity Pure lime may be obtained by heating powdered Carrara marble to whiteness in an open crucible It is white, very infusible, highly luminous when heated to full redness, and of a specific gravity of about 2 3 It requires for solution about 500 parts of water, and is somewhat more soluble in cold than in hot water But, weak as this solution is, it powerfully affects vegetable colours, and is the strongest *alkaline earth* applied to lime It absorbs carbonic acid by exposure to air, and as *carbonate of lime* is insoluble in water, it becomes milky in consequence, so that, from this property, lime-water is a useful test of the presence of carbonic acid The nature of lime was first demonstrated by Davy in 1807 he showed that, like the other alkalies, it was a metallic oxide The metallic base of lime has been termed *calcium* its equivalent is 20, and lime, being a compound of one atom of calcium and one of oxygen, is represented by the equivalent number 28, and hydrate of lime by 28 lime + 9 water = 37 The *salts of lime* are generally obtained by dissolving carbonate of lime in the respective acids several of them exist native *Sulphate of lime*, selenite, or gypsum, is an abundant natural product, and may be formed artificially by adding sulphuric acid, or the soluble sulphates to solutions of the salts of lime It consists of 28 lime + 40 sulphuric acid, and its crystals include two atoms = 18 of water When these crystallized sulphates of lime are heated they part with their water and fall into a white powder called *plaster of Paris*, when this is mixed with water it again combines with it and concretes into a white mass, hence its use for casts busts, &c Sulphate of lime is often contained in spring water, which is thus rendered *hard* and unfit for washing These waters become turbid upon the addition of a spirituous solution of soap *Phosphate of lime* is found *native*, constituting the mineral called *apatite* this is a *subphosphate*, composed of 3 equivalents of lime = 84 and 2 of phosphoric acid = 72 The *earth of bones* is also chiefly a similar phosphate of lime *Oxalate of lime* is very insoluble, and is precipitated whenever oxalic acid or a solution of an oxalate is added to solutions containing lime, hence it is that oxalate of ammonia is so valuable a test of the presence of lime, and is frequently used for the purpose of separating lime in analysis When oxalate of lime is well dried at 500°, it is anhydrous, and consists of 28 lime + 36 oxalic acid = 64 oxalate of lime This substance is occasionally found in the human urine, and sometimes forms calculi these are often of a reddish brown colour and a rough exterior, whence they have been termed *mulberry calculi* When [illegible] is absorbed, and a *chloride of lime* is obtained This article is manufactured upon an extensive scale under the name of *bleaching powder* It evolves chlorine when acted upon by acids, and gives it out very slowly when [illegible] carbonic acid [illegible] and when [illegible] *Carbonate of lime* is thrown down when alkaline carbonates are added to solutions of the salts of lime It is a most abundant natural product, and is found pure in the varieties of calcareous spar and statuary marble Chalk and several varieties of limestone are also nearly pure carbonates of lime It is easily distinguished from other minerals by effervescing in dilute muriatic acid, and by yielding quicklime when a fragment is heated before the blowpipe It is constituted of 28 lime + 22 carbonic acid the equivalent, therefore, of carbonate of lime is 50

The uses of lime are very numerous Its most important application is in the manufacture of mortar and other cements used in building It is also very extensively used in this country, and in some parts of the Continent and North America, as a manure to fertilize land But it is a curious fact that the use of lime as a manure is entirely a European practice, its employment in this way having been never so much as dreamed of by the natives of Asia or Africa (See *Commercial Dict*)

LI'MESTONE A generic term for those varieties of carbonate of lime which are neither crystallized nor earthy, the former being *calcareous spar*, the latter *chalk* When burned they yield quicklime *See* GEOLOGY

LI'MIT, in Geometry, denotes a given or determinate quantity to which some other variable quantity continually approaches so as to [illegible] but which it can never exceed Thus if we suppose a polygon to be inscribed in a circle, by increasing the number of sides of the polygon its area is increased But the area can never exceed that of the circle within which the polygon is inscribed, and it is only when the number of its sides is conceived to be infinitely great that its area becomes equal to that of the circle. The circle is thus said to be the limit of the areas of the inscribed polygon

*Method of Limits*, the same with the *method of prime and ultimate ratios*, a peculiar method of analysis employed by Newton in the *Principia* especially to fluxions or the differential calculus, but preserving the form of the

LIMITATION OF ACTIONS AT LAW The period beyond which personal actions of trespass, or debt on simple contract, cannot be [illegible] stat 21 J 1 c 16 They [illegible] years after the cause of action, with the exception of actions of assault, menace, and imprisonment, which are limited to four But a right of action may be revived by an express acknowledgment on the part of the debtor

Penal actions for forfeitures made by statute must be sued in general, according to the terms of the statutes, within two years or one year

By the recent statute 3 & 4 W 4 c 27, all process for the recovery of land by entry and distress, or by action, whether real or [illegible] years after the [illegible] the disabilities of [illegible] soundness of mind, or absence beyond seas, are allowed ten years after the termination of their disability so that forty years be in all cases the extreme limit This statute extends both to suits in equity and actions at law No advowson can be recovered after one hundred years Money charged upon land, and legacies, are deemed satisfied at the end of twenty years, unless there have been some receipt or acknowledgment Arrears of rent, or interest of money charged on land, cannot be recovered after six years But it has been thought that this limitation has been extended by the subsequent statute 3 & 4 W 4 c 42 which enacts that actions of covenant and debt for rent, &c may be brought at any time within 20 years after the cause of action has accrued

The statutes [illegible] apply [illegible] remedies directly and by [illegible], where the equitable remedy is sought (as it may be in some cases) for a right enforceable at law, and they have been adopted [illegible] those cases where a purely equitable right [illegible] of a legal one, as the right to mesne profits in respect of an equitable ownership, or a debt payable in equity but not in law Where there is not this strict correspondence between the equitable and legal claims, the rule prevails that twenty years' adverse possession, which is in law a bar to the possessory action for land, shall be a bar to all equitable claim, whether the adverse right be merely equitable also or equitable and legal, such period of limitation being, as at law capable of extension from infancy, absence, or disability But time is not a bar to the claim of cestui que trust against his trustee, where the trusteeship was in the origin direct and express, and not coupled with any beneficial interest, as it is in the case of a mortgage, nor does a purchaser, with notice from a trustee, stand in a better situation in respect [illegible] than the trustee himself

LI'MNEA (Gr λιμνη, *a pool*) A genus of freshwater snails, so named from their general location in ponds, ditches, and [illegible] water Many species of this [illegible]

LI'MNING The art of painting in water colours, in which sense it is used to distinguish it from painting in oil colours

LIMO'SA (Lat limus, *mud*) A genus of wading birds, belonging to the *Longirostres* tribe, and characterized by a straight beak longer than that of the snipes (*Scolopax*), and sometimes slightly bent at the extremity, the nasal groove extends [illegible] which is blunt and somewhat depressed, [illegible] or punctation on its surface The external toes are palmated at the base they are longer and slenderer than in the snipes The species of *Limosa* which, with us, are vernacularly termed Godwits, frequent salt marshes and the sea shore

LI'MULUS (Lat limus) A genus of gigantic Entomostracous Crustacea, in which the haunches of the first six pairs of feet are beset with small spines, and are so closely approximated about the mouth as to serve the office of jaws. The œsophagus, instead of proceeding backwards, is continued forwards for a short distance into the anterior part of the shield before it enters the stomach this cavity is lined with a thick rugous cuticle, and terminates in the intestine by a long muscular and valvular projection The heart is elongated, vasiform, and muscular, the branchiæ are supported on a series of closely-packed broad plates beneath the post-abdomen The total number of feet is twenty-two the first ten, with the exception of the two anterior ones in the males of some species, are terminated by a didactyle forceps, and are inserted, with the two following pairs,

beneath a large semilunar shield The species of this genus are found on the shores of the North American and Asiatic continents they are commonly known by the names of king crabs horse shoe or mollusca crabs The tail is long, straight, sharp pointed, and of sufficient strength and size to be used as a spear-head or arrow-point by savages

LINA'CEÆ (Linum, one of the genera ) A small natural order of herbaceous Exogens, principally inhabiting Europe and the North of Africa , allied, according to De Candolle [illegible] *Geraniaceæ* The want of a synadelphic structure the imbricate calyx, the regular flowers and the small quantity of albumen in the seeds, rather point out an affinity with *Cistaceæ* and its allies Their chief characters are the tenacity of their fibre, the mucilage of their seeds and the beauty of their flowers Common flax or lin (whence [illegible] tplx to the order [illegible] what may be called the regular [illegible] from other military corps or establishments Thus all numbered infantry or marching regiments, with the exception of the Foot Guards, are designated by this term, in opposition to the cavalry the artillery the engineers the marines the militia the yeomanry &c

LINE in Fortification is used for a extended ditch as a ditch with [illegible] ions, &c

LINE, in Geography and Navigation is used for the equator, [illegible]

LINE In Geometry having only one dimension [illegible] hat which has length without breadth "

LI'NEAR In Geometry, a linear problem is one that is solved by the intersection of two straight lines, or by an equation of the first degree, and which, consequently, admits only of one solution

*Linear Equations* in the Integral Calculus are those in which the unknown quantities [illegible] Thus $Ax + B = 0$ is a linear equation, when A and B are not functions of $x$, and $Ady + By + C = 0$ is also a linear equation, when A, B, and C do not contain $y$

*Linear Perspective* is that which regards only the positions, magnitudes, and forms of the objects delineated, [illegible] *perspective* in which the variation [illegible] and shade of objects according to their different distances and the quantity of light that falls on them, are also considered and represented

LINEN (Germ. leinwand ) A species of cloth woven with the fibres of the flax plant (*Linum usitatissimum*) The origin of the manufacture of linen is lost in its antiquity In the time of Herodotus linen was an article of export from Egypt, where it had been used from time immemorial , but it is evident that in ancient times its use was limited to the noble and the rich In modern times linen constitutes a staple manufacture in almost all [illegible] ore especially in Germany [illegible] England, Scotland and Ireland [illegible] en prosecuted for a very [illegible] until of late years its progress has been [illegible] compared at least with that made in other branches of manufacture This seems to be partly owing to the attempts to bolster up and encourage the manufacture in Ireland, partly to the absurd restrictions that were for a lengthened period laid on the importation of foreign flax and hemp, and partly to the rapid growth of the cotton manufacture — fabrics of cotton having to a considerable extent superseded those of linen It is only within the last fifty years that any machinery has been used in the production of linen cloth, the first mills for [illegible] about forty [illegible] Scotland, [illegible] principal seat of the manufacture is—in England, Leeds and its immediate vicinity, and in Lancashire, Dorset Durham, and Salop , in Scotland, Dundee which indeed may be regarded as the chief seat of the British manufacture (see *Geo Dict* , art "Dundee"), and in Ireland, the province of Ulster The entire value of the linen manufacture of Great Britain and Ireland is estimated at 8,000,000*l* , and the total number of persons employed in it about 185,000 (*Statist of the Brit Empire* vol [illegible]

LINE OF BATTLE, is the line formed by the ships [illegible] of each other, [illegible] nearly so It [illegible] tack The line is composed of ships of not less than two decks, thence called *line-of battle-ships* The line is also called the *line ahead*

LINE OF BEARING, THE, is formed by the ships of the fleet when ranged on a line six points from the wind, at equal distances, and with their heads in any direction whatever The line is called by the name of that tack upon which if the ships were to haul to the wind together they would form the line ahead For example suppose the wind N , and the ships in a line W N W and E S E of each other, this is the *starboard* line of bearing, whether the ships are going free, or close-hauled upon the *larboard tack*

LINE OF DIP In Geology, the strata which form the crust of the globe are rarely horizontal, but incline to some point of the horizon, and rise to the opposite point , a line drawn through these points is called the line of their *dip*

LI'NGUA (Lat *a tongue* ) In Entomology, the name of an organ situated within the labium or emerging from it, by which insects in many cases, collect their food and pass it down the pharynx, which is situated above its root

LI'NGUA FRA'NCA The dialect spoken chiefly along the European and African coast of the Mediterranean It is a species of corrupt Italian mingled with words of other languages, and may be termed the Creole of the Mediterranean

LI'NGULA (Lat ) A genus of Palliobranchiate Bivalves, with two nearly flat, smooth, oblong, triangular valves, attached between the two apices to a long fleshy pedicle The arms, or labial appendages, are spirally convoluted as in the rest of the class

LI'NIMENT (Lat lino, *I anoint* ) A semifluid ointment or a soapy application, to rub upon painful [illegible] These are usually applied to spirituous and other [illegible] for external use

LINING In Architecture, any covering of an interior surface The linings, for instance or boxings of window shutters, are the pieces [illegible] the recesses into which the shutters [illegible] orways, they are the facings on each side the aperture to sashes, they are the vertical pieces parallel with the surface of the walls

LI'NTEL (Span lintel ) In Architecture an horizontal piece of timber or stone, over a door, window, or other opening, to discharge the superincumbent weight

LION (*Felis leo* Linn ) The largest most formidable, and most noble of the Carnivorous animals, though not the most typical of the genus at which it stands at the head It is chiefly distinguished by the presence of a [illegible] in the male and by a tufted tail and [illegible] the feline markings in both sexes before they arrive at maturity , the colour then being a nearly uniform light fulvous brown, with mane inclining to black especially in the Central and South African races The mane is scantier and lighter coloured in the Asiatic than in the African lions , and there exists a maneless variety in the eastern parts of Hindostan See FELIS

LION In Heraldry, a beast, of which the figure is very commonly borne as a charge The attitudes in which the lion is represented are very various (*See* RAMPANT, PASSANT REGARDANT GARDANT, COUCHANT, SALIENT, SEJANT ) A lion passant is termed, in French heraldic language, a leopard , and hence the common notion that the lions of England were substituted for leopards

LION OF ENGLAND A lion passant regardant or (being the bearing of England), is frequently thus termed in heraldry

LIP A term applied to either of the two divisions of a Monopetalous corolla, where one portion takes a direction upwards and the remainder a direction downwards, as in *Labiatæ* It is the same as *labellum*, which see

LI'PARIS (Gr λιπαρος, *glistening* ) The name of a genus of Lepidopterous insects , [illegible] applied by Pliny to a genus of fishes In Botany, it is the name of a genus of plants

LIPOGRAMMATISTS or WRITINGS (Gr λειπω, *I omit*, and γραμμα, *a letter* ) Compositions in which a particular letter is omitted throughout The ancients produced many ingenious trifles of this description In the *Odyssey* of Tryphiodorus there was no A in the first book, no B in the second and so on There are other pieces of modern invention, such as the *Pugna Porcorum*, in which all the words begin with the letter P Odes in Spanish, containing only one of the vowels, are refinements on the same invention

LIPO'RNA (Gr λιπος, *fat* ) A soft fatty tumour

LIPPITU'DO (Lat lippus, *bleareyed* ) The disease commonly called *bleared eyes*, consisting in a puriform exudation from the margin of the eyelids, which [illegible] of melting or of fusion This term is also used synonymously with *solution*

LI'QUIDS In Grammar, the letters *l*, *m*, *n*, and *r* are so called

LI'QUOR SI'LICUM Liquor of flints A solution of silicated potash

LIRE'LLA In Botany, a term used in describing lichens to denote a linear shield, with a channel along its middle, as found in *Opegrapha*

LIST The enclosed field or ground wherein the ancient knights held their jousts and tournaments , so called from its being encircled with pales, barriers, or

stakes, as with a list Some of these were double, one for each cavalier, which kept them apart, and prevented them from coming nearer each other than a spear's length Hence the expression *to enter the lists* is synonymous with engaging in contest

LIST The name given to the border or selvage of a piece of cloth, &c

LIST, or LISTEL In Architecture, the same as fillet or annulet

LIST, CIVIL *See* CIVIL LIST

LI'STING (Fr leziere ) In Architecture, the cutting away the sappy part from the edge of a board

LI'TANY (Gr λιτανια, *supplicatio*) signifies a general supplication, and was applied by the Eastern church in early ages to a special form of prayer which was introduced [illegible] where the words *rogatio* and *supplicatio* had before been used in the same technical sense It is supposed by Palmer (*Antiq* i 269 ) that the change of term was occasioned by the frequency of processional supplications from the Eastern to the Western churches, beginning in the 4th century It appears that some of the Eastern litanies contain the supplication to saints which forms a [illegible] is mostly translated from the forms of the Western litanies previously used in this country, those of the breviary of Salisbury and York The direction in the Prayer Book is that the litany shall be read on Wednesdays, Fridays, and Sundays on the two former as fast-days in the primitive church, the one as the day in which Christ was sold by Judas, the other as that of the crucifixion, and therefore periods of peculiar humiliation on the Sunday, as the day appointed for the most complete and solemn service in the week (See *Riddle's Christian Antiquities*, p 623, 1839, *Palmer's Origines Liturgicæ*, i 264 )

LITERA'TI (Lat ), denotes, in general learned men, but is applied in China to such persons as are able to read and write their own language and also to a particular sect, consisting chiefly of the most learned men of that country, amongst whom it is called *Jukiao* or learned It is from the class of the literati that the mandarins (*quod vide*) are alone capable of being selected

LI'TERATURE (Lat litera, *letter*), comprises, in the general sense of the word the entire results of knowledge and fancy preserved in writing, but in the narrower use to which ordinary custom restricts it we draw a distinction between literature and positive science, thus exempting from the province of the former one extensive branch of our studies and attainments And, in a still more restricted sense the word literature is sometimes used as synonymous with *polite* literature, or the French *belles lettres* (which see)

The history of literature is a peculiar and distinct subject, comprising several subdivisions, such as histories of the literature of special ages or countries, or histories of separate branches of literature such as poetry For its complete execution it requires an union of bibliographical knowledge with critical acumen It should give the reader a sufficient acquaintance with the titles, contents, and dates of remarkable books and with the general biography of remarkable authors, together with a critical appreciation of the characters and value both of authors and books, and of the dependence, connection, and derivation of literature, that is, the mode in which opinions, taste, and style have been propagated or changed This last, as it is the most difficult part of the subject, so is it that of which the execution has been hitherto most imperfect

Antiquity has left us no relics of this species of history, [illegible] stant references of such writers as [illegible] Quintilian, to earlier authors, accompanied by [illegible] merits, show that the taste [illegible] wanting A remarkable passage of Velleius Paterculus, in which he shows, by historical instances, how many of the great names of antiquity were coeval with each other, in limited periods of time clustering as it were, together in particular seasons and places, is one of the earliest instances we have of that spirit of generalization from literary phenomena which is now so common as to leave little room even for the [illegible]

In the following brief [illegible] works of general literary history which the student has it now in his power to consult, we shall follow in great measure, the criticisms of Mr Hallam, in the Preface to his *Introduction to the Literature of Europe in the Fifteenth, Sixteenth, and Seventeenth Centuries* The oldest work of this description (if such it can be called) is that of Polydore Virgil *De Inventoribus Rerum*, 1499 Conrad Gesner, who has been termed the 'father of literary history,' published his *Bibliotheca Universalis* at Zurich, 1545-55 Notwithstanding these and a few other meagre attempts, Lord Bacon, says Mr Hallam, was justified in denying that, up to his time, any real history of letters had been written [illegible] and [illegible] world wanting this to [illegible] of [illegible] his single eye The next in order of time is *Lamonus Prodromus Historiæ Literariæ*, 1659, a work pursued on a great plan, but scarcely begun But *Morhof's Polyhistor Literarius*, first published in 1688, and much enlarged by subsequent editors, "is still found in every [illegible]" Andrès, a Spanish Jesuit published [illegible] *Progresso, e Stato [illegible]* to 1799, a very extensive, and, in some respects, valuable work, though without much display of taste, and no signs of genius In the present century, no writers, except of Germany, have attempted a field which has become of such enormous extent, but *Eichhorn's Literary History*, in six volumes, 1805, 1811, appears to be now, on the whole, the most complete and valuable work of this kind extant *Wachler's Manual of Literary History*, in four volumes, appeared at Leipsig in 1833

But besides these general compendia, much assistance is to be derived from general biographers Of these the well-known Dictionary of Bayle, first published in 1697, is the earliest of any value It is characterized by Hallam [illegible] That of [illegible] *illustres de la République des Lettres*, 43 vols 12mo 1733, 1745, is extraordinarily copious, and useful in biographies but in other respects of no great value [illegible] *Universelle* (of which the original edition was in 52 volumes, and a supplement is now in course of publication which has reached the letter H) stands incomparably first among this class of works *Chalmers's Biographical Dictionary* scarcely deserves mention as a literary work, but its historical details are sometimes minute and useful, though not unfrequently most so in the obscurest names

Of *partial* works on literary history some of the most remarkable and useful are, 1 According to subjects — History of Philosophy Brucker, Buhle, Tennemann (abridged by Victor Cousin) To these we may add, briefly as they are, the Introductory Essays of Stewart and Playfair to the *Encyclopedia Britannica* Of Belles Lettres, generally, Bouterwek, 12 vols 8vo Poetry, Quadrio, *Storia d'ogni Poesia*, a work of remarkable industry, the [illegible] in point of critical taste [illegible] French Laharpe, *Cours de Litterature Française*, a performance of considerable, but in parts superficial and showy, talent Italian *Tiraboschi, Storia della Letteratura Italiana*, a work of extraordinary value in which the history of Italian literature has been traced, [illegible] the great lines and the most elaborate research, from the earliest times down to the last century It has been abridged, but with some original criticism, by Ginguené in his *Histoire Litteraire de l'Italie*, Corniani's *Storia della Letteratura Italiana dopo il suo risorgimento* 1804,1813 *Sismondi's Literature du Midi de l'Europe* is most valuable, also, in its Italian chapters, although those on Spanish and Portuguese literature touch on subjects less generally known In England, as Mr Hallam observes, "we cannot claim for ourselves a single attempt of the most superficial kind *Warton's History of Poetry* contains much that bears on our general learning, but it leaves us about the accession of Elizabeth" 3 According to ages — The recent work of Mr Hallam, which comprehends the literary history of Europe from 1400 to 1700, a work almost approaching to universal in its character Its peculiar excellences are a philosophical spirit, manliness and candour of judgment great honesty in the execution, and a taste unusually cultivated and correct It is, however, as might [illegible] character, [illegible] different subjects and authors, and in point of execution

The love of literature is, [illegible] remarkable and characteristic form in [illegible] exhibits itself From being the absorbing passion of the learned few, it becomes, with the progress of education, the delight and favourite occupation of numbers, losing, perhaps, in intensity what it gains in universality For, without joining in the views of the indiscriminate eulogisers of past times, it cannot, we think, be fairly denied [illegible] the revival [illegible] of interest now present themselves to the inquiring mind [illegible] of interior character, such, for example, as the establishment of correct rules of classical [illegible] are less appreciated, because we have daily [illegible] topics of much higher interest [illegible] to carry back the faculties to pursuits of special investigation That all this has some disadvantages it were vain to deny Some imagine that not only extent and minuteness of knowledge, but real depth of learning and

power of mind, are more rare among the literati of the present day than heretofore; that we have lost in profundity, to use the common expression, what we have gained in surface. Of that opinion we are not But we imagine ourselves to trace, both in the composition and tone of [illegible] and harmony of tone [illegible] the result of patience, and of that complacent dwelling of the mind on some favourite object of study which was so common in former ages The powers of men of ability are too much dissipated, both by the vast variety of subjects pressing on their attention, and by the temptation to satisfy the cravings of the public by hasty execution

On the other hand, in the four literary countries of the present day — France, Germany, England, Italy, and especially the three former — the number of persons to whom literature furnishes the sole and beloved *recreation* has increased, within the last century, we may add the last generation, to an amount perfectly surprising Were it possible to calculate the number of individuals more than half of whose waking hours are spent in reading, and writing on literary subjects, the result would be startling In Germany the number of books published has nearly trebled since the peace of 1815 The great bulk of the increase belongs to literature specially so called In France and England the accumulation is scarcely less And by the process, common in all these countries, of circulating libraries, the same copy of a book performs an infinitely greater quantity of service, passing under the eyes of many more readers than heretofore It is curious, among ourselves to trace [illegible] vourite amusements of [illegible] almost deserted by the ranks which used to frequent [illegible] The public assembly rooms of the rich [illegible] places of resort for nightly entertainments so common among the middle classes, are also falling into comparative disuse Of the increased infrequency of play, or even games of skill, in society, every one can judge Of wine the consumption has certainly not increased one half in place [illegible] the number of consumers has probably been doubled or sextupled All these things afforded a certain quantity of *occupation*, and the substitute for [illegible] has been the same — literature

It is plain, therefore, how far more important a part than heretofore literature must perform [illegible] the public mind of nations There has been [illegible] it scarcely represented the national [illegible] but merely that of a class by which it was encouraged Any one who were to judge of the social state of England under Charles II by its literature, would pronounce that the nation comprised a learned class of great knowledge, but visionary and unpractical habits of mind, and a frivolous course debauched community Yet, in truth, the great bulk of the nation was sound sober, religious and [illegible] The literature of the latter part of [illegible] is grave decorous, even rigorous in tone, because such was the affectation of the court The people are not represented [illegible] Such anomalies are now impossible The [illegible] rature of the day is and must be the real expression of the popular mind

Now the effect of literature on the moral habits of man is incalculable It is the remark of a [illegible] writer of the present day, that [illegible] rary work without acquiring any positive knowledge at all, or forgetting it as soon as acquired, but very rarely without receiving some moral impression And in this view we regard the predominance of literary habits in a nation as advantageous For, unless public taste is very far corrupted indeed, the tone of morality in the ordinary literature of the day to meet approval must be good not absolutely good perhaps — imperfect it may be, and occasionally false, but still more right than wrong And such a tone of literature, reacting on the minds of the public, will tend to preserve and augment right feelings in the reading classes The more special tendencies of literary habits seem to be to soften the disposition, — to melt down rancorous feelings, — to encourage benevolence of sentiment, and a ready sympathy with generous conduct That they serve essentially to promote self denial and self-devotion, and virtue of the higher order, we do not contend, but we see no ground for the suspicion which some entertain that they are incompatible with the sterner stuff of these more serious qualities or tend to weaken the main springs of thought and action On the other hand although a prevalence of literary habits may render the success of an utterly corrupt style of literature more improbable, yet, when such success does occur, its effects must be infinitely more noxious and destructive Were such a taste as French lighter literature has of late exhibited likely to obtain a real ascendency in that country, there could not be a more powerful cause, as well as decisive symptom, of national degeneracy, but, in truth, it [illegible] temporary evil

One more [illegible] the spread of literary habits remains to be noticed — the enormously increased importance of





what may now be justly termed the literary profession Such fortunes as that of Sir Walter Scott are phenomena belonging to this age alone At this moment (November 1847) the two contending party leaders in France, on whom the eyes of Europe are fixed, are writers by profession, who have risen to their present eminence [illegible] the most noted public [illegible] belong to the same class Spain has had a play-writer for her prime minister In Germany, when a national movement is attempted against an alleged act of usurpation on the part of a sovereign, those who assume the lead are the professors of an university [illegible] the less excitable nature of the people [illegible] influence of wealth and aristocratic [illegible] to in a state of [illegible] attention to the signs of the times will lead us to suspect that, if the frame of our society were shaken by any sudden impulse men of this class would assume a more marked position than they have hitherto occupied This is the brilliant side of the picture On the other hand, the multiplication of a body of men whose employment is essentially precarious, their remuneration irregular, their education high, their tastes luxurious, their wants numerous, their success requiring a constant strain upon the spirits and activity of the brain, is in some respects a thing to be regretted In ill-governed and restless communities they form the [illegible] and flourishing ones [illegible] liancy of society, but at the expense of much of their own peace and happiness We have outlived the days when the ideas of poverty and learning were habitually associated, and the custom of the humiliating dependence of intellect on wealth, —

> Toil, envy, want, the *patron* and the gaol,

but the young aspirant to literary distinction may be usefully reminded of the words of a great writer of our day 'Never' (that is with a free choice before you) 'pursue literature as a profession It would be a sort of irreligion scarcely less than a libel on human nature, to believe that there is any established and respectable profession or employment in which a man may not contrive to act with honesty and honour, and doubtless there is likewise none which [illegible] to the contrary But woefully will that man find himself mistaken who imagines that the profession of literature or, to speak more plainly, the trade of authorship, besets its members with fewer or with less insidious temptations than the church the law, or the different branches of commerce Let literature be an honourable augmentation to your arms, but never fill the escutcheon" (*Coleridge [illegible]*)

LITHIA-GLASS (Gr λιθος, *a stone*, and ξεγυρος, *silver*, probably from its silvery appearance) Fused oxide of lead *See* LEAD

LITHIA (Gr [illegible]) A rare alkaline substance, discovered in [illegible] Arfwedson in a mineral called *petalite*, it has also been found in some other lapideous bodies It is distinguished from potassa and soda by the difficult solubility of its carbonate, from baryta, strontia, and lime, by the solubility of its sulphate and oxalate, and from magnesia by the alkalinity of its carbonate It is the oxide of a white metal which has been named *lithium*, the equivalent of which is 10, and that of lithia 18

LITHI'ASIS (Gr λιθος, *a stone*) The disease of stone in the bladder or kidney

LITHIC ACID (Gr λιθος) The substance generally termed *uric acid* it forms the commonest variety of urinary calculus

LITHODENDRON (Gr λιθος, and δενδρον, *a tree*) Corals have been thus designated, from their frequent

(Gr λιθος, and δερμα, *skin*) A genus of Apodal Echinoderms, in the system of Cuvier, characterized by an oval body compressed posteriorly, of which the surface is covered with a layer of calcareous [illegible] an extremely indurated crust

LITHODOMUS *Lithodoma* (Gr λιθος, and δομεω *I build*) This term [illegible] found in rocks and [illegible] they form for that purpose A particular genus is called *Lythodomus*

LITHO'DOMI (Gr λιθος, and Lat domus, *a house*) Molluscous animals which bore into rocks and lodge themselves [illegible]

LITHOGRAPHY *See* ENGRAVING

LITHOLO'GICAL (Gr λιθος, and λογος, *a discourse*) A term expressing the [illegible] character of a mineral mass We speak of the *lithological* character of a structure, as distinguished from its *zoological* character

LITHOMANCY (Gr [illegible] and μαντεια, *prophecy*) A [illegible] the ancients Their oracular stones appear to have returned audible answers to those who consulted them Modern conjurors have

another species of lithomancy,—the inspection of the surface of smooth agates or crystals Such was the divination of the notorious Dr Dee and his assistant Kelly in the reign of Queen Elizabeth.

LITHOMARGE Stone-marrow A variety of talc of various colours, and generally associated with magnesian minerals

LITHONTRIPTICS (Gr λίθος and τρίβω *I carry away*) Remedies which are supposed to dissolve stone in the bladder, or which prevent the deposition of calculous matter in the urine

LITHONTRIPTOR (Gr λίθος, and θραυστης, *to break*) An instrument for breaking calculi in the bladder, so as to reduce them to small particles which may admit of being passed along with the urine, and thus render the operation of lithotomy unnecessary

LITHOTOMY (Gr λίθος, and τεμνω, *I cut*) The operation of cutting into the bladder for the removal of a stone

LITHOTRITY (Gr λίθος, and τριβω, *I break down*) The operation of breaking a stone in the bladder into small pieces capable of being voided by urine it is effected by the [illegible]

LITMUS In Chemistry a blue pigment obtained from the lichen *Roccella* and [illegible] the Canary Islands it is often called *turnsol*, and yields the dye called *archil* Paper tinged blue by litmus is reddened by the feeblest acids, and hence is used as a *test* of the presence of acids, and litmus paper which has been reddened by an acid has its blue colour restored by an alkali

LITOTES (Gr λιτοτης) In Rhetoric, a figure, according to the Greek and Latin rhetoricians, in which an affirmative is expressed by the negative of the contrary it is, therefore, a species of irony in the ancient sense of the word (*see* IRONY), in which less is expressed than what is intended to be conveyed to the mind of the reader or hearer Thus, "a citizen of no mean city" means "of an illustrious city" It is a figure constantly employed to soften what might otherwise appear obnoxious in self-commendation

LITRE The French standard measure of capacity in the decimal system The litre is a cubic decimetre, that is, a cube, each of the sides of which are 3 937 English inches it contains 61 028 English cubic inches and is therefore rather less than our *quart* Four and a half [illegible]

LITTLE (Sax lytel [illegible] deficient, [illegible] work [illegible] those qualities that tend to [illegible] in contemplating a work of art It is a term always used in a condemnatory sense

LITTORINA (Lat litus the *sea shore*) A genus of Pectinibranchiate Mollusks of the tribe *Trochoida*, characterized by its thick shell, of which the aperture presents a small angle, and is without a ridge The common periwinkle of our coasts (*Turbo littoreus*, Linn) is a species of the present genus

LITURGY (Gr λειτουργια) An office at Athens, by which persons of considerable property were bound to perform certain public duties, or supply the commonwealth with necessaries at their own expense The persons on whom this office was imposed were usually among the richest inhabitants, and if any one selected to fill it could find another more wealthy than himself who was exempt from public duty, he could insist on being released from his charge, which then devolved on the party denounced This obnoxious institution was abolished on the proposition of Demosthenes (See *Boeckh's Pub* [illegible] *ns*) It is from this term that the [illegible] vide), in ecclesiastical meaning has been derived, the sense having been contracted from public *ministry* or service in general to the ceremonies of religious worship

LITURGY The [illegible] services of a church [illegible] the ancients the name is restricted to the service of the Eucharist, which afterwards came to be distinguished in the Western church by the term *missa*, or mass

There still exist in Greek, Latin and some Oriental languages, various rituals by which the Eucharist was celebrated in very early ages Some have supposed that all these may be referred to one original liturgy, which may have been universally adopted in the primitive church Palmer, the latest English writer on this subject (*Antiq* vol i p 8), conceives that the number of original liturgies may be reduced to four, but not lower These he entitles the great Oriental liturgy, the Alexandrian, the Roman, and the Gallican, each of which was extensively used from the apostolic age in the quarters from which he assigns them their names, and became the parents of many other rituals such as were used with constantly diverging variations, in the different patriarchates of the empire

The earliest period at which any liturgical forms were consigned to writing is the end of the third or beginning of the fourth century, at least the liturgy called of St Basil can be traced as high as the latter period This practice, also, seems frequently to have been applied only to certain parts of the service We find, therefore, great differences in the MSS which now exist, and it becomes very difficult to ascertain what the contents of the primitive liturgies were and trace the periods at which many [illegible] were introduced into the service [illegible] of the Eucharist [illegible] the whole of the various services used on ordinary and extraordinary occasions throughout the year For the history of this liturgy, see COMMON PRAYER See also Assemanni, *Codex Liturgicus*, Muratori *Liturgia Romana Vetus*, Bragg's *Collection of Liturgies*, Palmer's *Origines Liturgicæ*, Riddle's *Christian Antiquities*, pp 369 377 As to the reformation in the English liturgy which were seriously contemplated a few years ago by various classes of the church, see *Quart Review*, vols. xlvii 1

LITUUS (Lat) In the geometry of curve lines, the name given by Cotes to a spiral of which the characteristic property is that the squares of any two radii vectores are reciprocally proportional to the angles which they respectively make with a certain straight line given in position, and which is an asymptote to the spiral Let $r$ and $u$ denote any two radii vectores drawn from the pole to the curve, and let $\phi$ and $\psi$ be the measures of the angles they respectively make with the asymptote, then $r^2$ $u^2$ $\psi$ $\phi$ If we take the angle $\psi = 57\ 29578^\circ$ (or such that the arc is equal to the radius), and call $a$ the corresponding value of $u$, the above proportion becomes $r^2$ $a^2$ 1 $\phi$, whence we have for the equation of the curve, $r^2 = a^2\phi^{-1}$

Among the pro [illegible] —1 The radius [illegible] circular arc intercepted between its extremity and the asymptote 2 The area included between the two radii vectores $a$ and $r$ and the curve is equal to $a^2 \log (u-a)$, or proportional to the logarithm of the ratio of $u$ to $a$

For the properties of the lituus see Varignon, *Mem Acad Paris*, 1704, Cotes, *Harmonia Mensurarum*, p 85, *Peacock's Examples to the Diff and Integral Calculus*, p 183

LITUUS Among the Romans, a crooked staff, resembling a crozier, made use of by the augurs in quartering the heavens It is affirmed by Dr E D Clarke that the use of the *augural* lituus, as it was called, is much posterior to that of the *regal* or *quirinal* lituus, which was instituted by Romulus and used as a sceptre by the Roman kings and that they had nothing in common except the name The origin of the word is uncertain (See *Clarke's Observations on the "Lituus," in the Archæolog* xix p 386)

LIVER (Germ leber) The viscus in which bile is secreted It is situated in the right hypochondriac region under the diaphragm, and in the human body is divided into two lobes of which the right lobe is the largest There is between them a smaller lobular process, called the *Lobulus Spigelii* The ultimate arrangement of the different blood-vessels of the liver is very peculiar It has been ably investigated by Mr Kiernan, by whom it is described in the *Philosophical Transactions*

LIVER OF SULPHUR Fused sulphuret of potas [illegible] from its *liver colour*

LIVERY (Fr livrée) A word derived, probably, from the clothes *delivered* by masters to their servants, in which sense it still continues to be used At tournaments the cavaliers used to distinguish themselves by wearing [illegible] badges or liveries, and persons of [illegible] gave liveries to persons unconnected with [illegible] to engage [illegible] The *livery men* [illegible] the [illegible] brace the different trades of the metropolis, and are so called because they are entitled to wear the livery of their respective companies [illegible] sheriffs, [illegible] the city, and, down to the passing of the Reform Bill in 1832, they had the exclusive privilege of voting at the election of members of parliament

LIVERY OF SEISIN In Law, a delivery of possession in lands, tenements, and hereditaments, to one that has a right to the same a ceremony at common law used in the conveyance of lands, whereby an estate of freehold passes by feoffment *See* FEOFFMENT

LIVE STOCK The quadrupeds and other animals kept in a farm [illegible] employed in farm labours, for breeding [illegible] or for other purposes of profit In the farming of Britain and similar climates the principal descriptions of live stock are horses cattle sheep and swine To these are generally added poultry, and sometimes goats, rabbits, fish, and bees In warmer climates the silkworm may be considered as part of the live stock, and under particular circumstances, both in England and on the Continent, deer, and even hares and [illegible] are bred for sale

LIVING [illegible] *See* [illegible]

LIVRE (Lat libra, *a pound*) An ancient French

coin, which appears as early as 810 A D It was at first [illegible] afterwards into 20 *sous* At the [illegible] was substituted for the livre

LIXIVIUM employed by the old chemists to signify an alkaline ley or solution

LIZARD *See* LACERTA

LLOYD'S LIST A well known periodical publication, which contains shipping intelligence It derives its coffee-house, so long celebrated as the resort of all classes connected either with the interest, and its importance in and early maritime information cannot be easily overrated It has been in existence since 1716

LOADSTONE The same with *magnet*, which see

LOAMY SOIL, in the language of practical agriculturists and gardeners, is one in which clay prevails it is called heavy or light, as the clay may be more or less abundant, and sandy, gravelly, or calcareous, according as these earths predominate in the composition In general, loamy soils are more fertile than sand or chalk, but the fertility of any soil is always to a certain extent relative to the nature of the subsoil, and to the local climate

LOBAR (Lat lobus, *a lobe*) A term applied by Linnæus to the feet of those birds, as the grebe which were furnished at their sides with broad-lobed membranes

LOBBY (Ger laube, *an arbour*) In Architecture, a hall or passage serving as an ante apartment for communication to rooms

LOBELIA INFLATA Indian tobacco The leaves of this plant have been used in medicine as an expectorant and emetic it quiets the action of the heart and relaxes the muscles It has been found of great use in allaying the paroxysms of spasmodic asthma, and as a [illegible]

LOCAL PROBLEM (Lat locus) In the ancient Ge[illegible] roblem which admits of an infinite num[illegible] or which can be solved not only by a single point, but by all points situated in some line which may be found *See* LOCUS

LOCH The Scotch term for *lake*, which see See also LOUGH

LOCK, in Internal Navigation, is a part of a canal included between two floodgates, by means of which a vessel is transferred from a higher to a lower level, or [illegible] igher *See* CANAL

[illegible] loc) An instrument composed of springs and bolts, used to fasten doors, drawers chests &c A good lock is the masterpiece in smithery and requires much art and delicacy in contriving and varying the wards, springs, bolts, and other parts whereof it is composed so as to adjust them to the places where they [illegible] to the various occasions of their use [illegible] ocks is so varied and the number of inventions of [illegible] that we cannot attempt to e[illegible] placed on outer doors are called *stock* locks, those on chamber doors spring locks, and such as are hidden in the thickness of [illegible] they are applied are called *mortice* [illegible] is too well known to need description [illegible] the conditions which, to Mr Nicholson, appear necessary in a lock of the most perfect kind —1 That certain parts of the lock should be variable in position through a great number of combinations one only of which shall allow the lock to be opened or shut 2 That this last-mentioned combination should be variable at the pleasure of the possessor 3 That it should not be possible after the lock is closed and the combination disturbed for any one not even the maker of the lock, to discover, by any examination, what may be the proper situations of the parts required to open the lock 4 That trials of this kind shall not be capable of injuring the works 5 That it shall require no key, 6 And be as easily opened in the dark as in the light 7 That the opening and shutting should be done by a process as simple as that of a common lock 8 That it should open with or without a key, or with one, at pleasure 9 That the keyhole be concealed, defended or inaccessible 10 That the key may be used by a stranger without his knowing or being able to discover the adopted combination 11 That the key be capable of adjustment to all the variations of the lock, and yet be simple 12 That the lock should not be liable to be taken off and examined, whether the receptacle be open or shut except by one who knows the adopted combination These considerations involve a mechanical problem of great difficulty, but much towards its accomplishment has been effected in various inventions that have been proposed especially in those of Bramah, [illegible]

LOCO-FOCO The name by which the ultra democratical or the tory party in America has been distinguished since the year 1834 The term originated in the [illegible] at parts having [illegible] meeting at [illegible], in New York, the gas-

accidentally extinguished, and on the hall being relighted with [illegible] (which in America are termed *lo-focos*, [illegible] from the Latin loco foci, *instead of a fire*), the [illegible] appellation, ar[illegible]

LOCOMOTION (Lat *locus*, *a place*, and *motio*, *change of place*) Such motion as is attended by change of place in the body which [illegible] a body [illegible] mill, a lathe moves, but no change of place of the machine is produced such *motion* is not locomotion A steam engine which being fixed in its position, impels other bodies is a stationary engine, but one which travels with the bodies which it drives is called a *locomotive* engine

LOCOMOTIVE ENGINE Any engine which, being employed to draw loads in transport overland, travels with the load which it draws

Since the improvement and extension of iron railways, this term has been exclusively applied to the steam engines, by which loads are drawn upon them Although, strictly speaking the steam engine by which a ship is propelled is a locomotive engine, it is not usual to apply that term to it, such an engine is called a marine engine. (*See* STEAM ENGINE) The term locomotive engine, [illegible] at present used, be understood [illegible] steam engine by which trains are drawn on railways

*History of the Locomotive Engine* —The first practical application of the steam engine as a locomotive power took place in 1804, on a railroad at Merthyr Tydvil, in South Wales The engine was constructed by Messrs Trevithick and Vivian, under a patent obtained by them two years previously This engine, in several respects, resembled in its form and structure those which have been since used for a like purpose

The boiler was a cylinder with flat circular ends, placed upon its side A large tube entered it at one end, and, being carried near the other, was there received and carried back parallel to its first direction, its course through the boiler resembling the letter U The two mouths or openings of this tube were therefore placed at the same end of the boiler One of the mouths of this tube communicated with the chimney, the base of which was flanged upon it, and the other contained the grate and furnace The flame and heated air were drawn through the curved tube and up the chimney The engine was worked by high-pressure steam without condensation the steam [illegible] withdrawn from it, by [illegible] trivance called a four-way cock The cylinder was placed on its side, and in one position of the cock a communication was opened between the boiler and one end of the cylinder, while another communication was opened between the other end of the cylinder and a tube leading to the chimney Steam was thus admitted to act on one side of the piston, and allowed to escape from the other side to the chimney When the piston attained the end of the stroke the position of the cock was reversed, and the steam which had just driven the piston in one direction was allowed to escape to the chimney, while steam from the boiler was admitted on the other side of the piston to impel it in the contrary direction, and in this manner the piston was continually driven backwards and forwards in a horizontal direction, and parallel to the direction of the road The piston rod was moved through a hole corresponding with it in magnitude, in the cover of the cylinder in which it was rendered steam tight by a stuffing box properly lubricated This piston rod acted by means of a connecting rod on a crank which it kept in revolution in the same manner as the crank in a common double acting steam engine is moved (*See* STEAM ENGINE) On the axle of this crank was placed a cogged wheel, which by means of ordinary gearing, conveyed motion to the axle of the hind wheels of the engine, so as to keep that axle in constant revolution The wheels being keyed upon that axle, so as not to be capable, like the wheels of a common carriage, of turning upon it, were necessarily made to revolve with it, and, so long as their pressure upon the road was sufficient to prevent them from slipping, a progressive motion of the carriage was the necessary consequence of their revolution

The early projectors of locomotive engines were all impressed with a notion that the adhesion of the driving wheels to the rails must be insufficient to enable the power applied to these wheels to give progressive motion to the carriage and, without thinking it necessary to ascertain by actual experiment whether such were really the case or not, they expended much [illegible] and capital in devising means of overcoming the difficulty, which, after all, [illegible] Engineers were, it [illegible] if any power compelled the wheels to revolve, they would [illegible] that the carriage or engine [illegible] To provide against this Messrs Trevithick and Vivian proposed to make the external rims of the wheels intended for common roads

rough and uneven by surrounding them with projecting heads of nails or bolts, or by cutting [illegible] in them Seven years afterwards [illegible] Leeds obtained a patent for a method of surmounting this [illegible], by the substitution of a rack rail for the ordinary smooth rail, and constructing teeth on the driving wheels to work in the teeth of this rack. Various other ingenious contrivances were subsequently produced for the same purpose, until about the year 1814, when experience at length [illegible] engineers the [illegible] of the tires of the wheels [illegible] was sufficient to propel the engine, even when drawing after it a great load

In 1814, an engine was constructed at Killingworth colliery, near Newcastle, having two cylinders with a cylindrical boiler, and working two pair of wheels by cranks placed at right angles, so that, when one was in full operation, the other was at its dead points By these means the propelling power was always in action The cranks were maintained in this position by an endless chain, which passed round two cog wheels placed under the engine, and fixed on the same axles on which the wheels were placed The wheels in this case were fixed on the axles, and turned with them

In an engine subsequently constructed by Mr Stephenson for the same railway, the mode adopted of connecting the wheels by an endless chain and cog wheels was abandoned, and the same effect was produced by connecting the two cranks by a straight rod This method is still used in the coupled engines which are applied to draw the trains of merchandise on the present railways

The next stimulus which the progress of this invention received arose from the project of constructing a railway between Liverpool and Manchester, for the purposes of general traffic When this project was undertaken it was not decided what moving power was most eligible—whether horse power, stationary steam engines, or locomotive engines, but the first, for many obvious reasons, was soon rejected, in favour of one or other of the last two

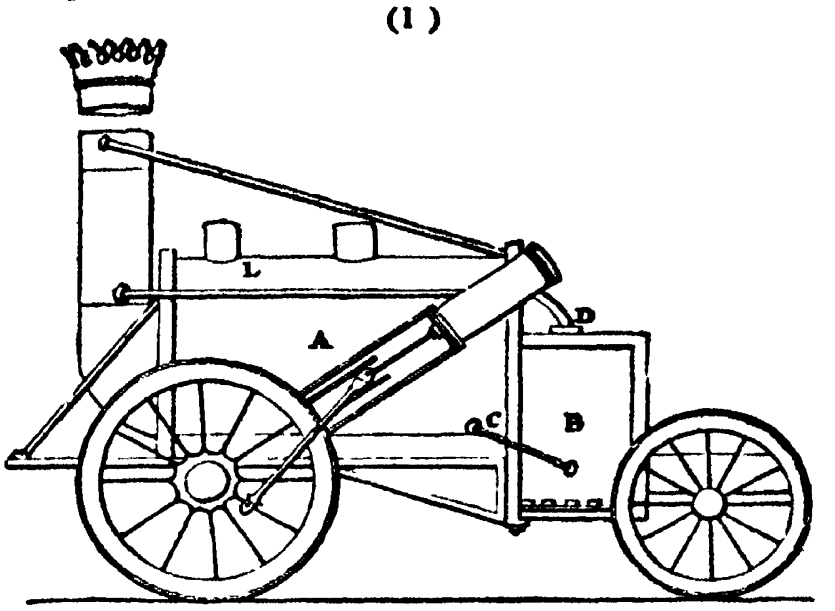
The steam [illegible] a railway by [illegible] is fixed, and draws a train of carriages towards it, by a rope extending the whole length of the road on which the engine works By this method the line of road is divided into a number of short stages, at the extremity of each of which an engine is placed The waggons or carriages, when drawn by any engine to its station are detached, and connected with the extremity of the rope-work to the next stationary engine, and thus the journey is performed from station to station by separate engines For a more detailed account of this method of working a railway, see STATIONARY ENGINE By the other method, each load transported along the line is drawn by an engine which travels with it as horses travel with a carriage on [illegible] road

To enable them to decide which of these two methods of working [illegible] it would be most advisable to adopt, [illegible] the Liverpool and Manchester [illegible] visit the different railways then in operation, to obtain the results of the experience which they afforded as to these two methods of applying steam power to transport and to report their opinion on the relative merits of the two methods After an elaborate inquiry the decision of the directors was given in favour of locomotive power

Until the period to which we now advert railways had been almost exclusively confined to the transport of mineral products from the mines up to the place of shipment, and to this purpose exclusively had the locomotive engine been applied, but the ends to be attained by a railway of thirty miles in length connecting the largest manufacturing town in the greatest manufacturing country in the world, with the greatest, most active, and most opulent commercial port, were of a nature so much more extensive and important, that it was considered that more than ordinary means should be resorted to to obtain a moving power commensurate with the traffic which might be expected under such circumstances Prizes were [illegible] certain stipulations [illegible] most effective [illegible]

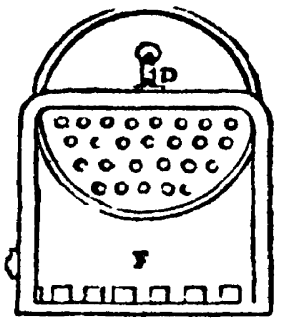
[illegible] wounded body was conveyed, by the same engine, a distance of about fifteen miles in twenty-five minutes, being at the rate of thirty-six miles an hour This engine, which involved in its construction all those mechanical arrangements to which the extraordinary speed and power of the locomotive engine of the present day are due, is represented in elevation in fig 1, and a cross section

(1)




of the boiler and furnace is represented in fig 2 It is supported on four wheels, the weight being principally thrown on the larger pair worked by the engine The boiler is a cylinder 6 feet long, [illegible] at one end, and [illegible] at the other This box is surrounded with a hollow casing, which communicates with the bottom of the boiler by a tube C, and with the top by a tube D The water in the boiler, therefore, flows into the casing and fills it to the same level as that which it has in the boiler When the engine is at work, the boiler is kept about half filled with water, and, consequently, the casing round the furnace is completely filled Steam is abundantly generated in [illegible] as it is on every side to the radiant [illegible] steam rises in bubbles, and passes through the tube D into the boiler The lower part of the boiler is traversed by a number of copper tubes, the [illegible] in fig 2 The flame and heated [illegible] engine burning fuel pass through these tubes, and, after traversing the whole length of the boiler, escape into the chimney [illegible] during their passage, heat to the water in the boiler [illegible] necessary draught [illegible] causing the cylinders [illegible] steam into a pipe, which is presented up the [illegible] is called the blast pipe There are two [illegible] outside the engine, on either side of it, as represented in fig 1 they are placed in a diagonal position and their rods move in guides, the end of the piston rod is connected with one of the spokes of the wheels by a connecting rod, and the piston, as it is driven by the steam in each direction in the cylinder, causes the wheels to revolve

(2)

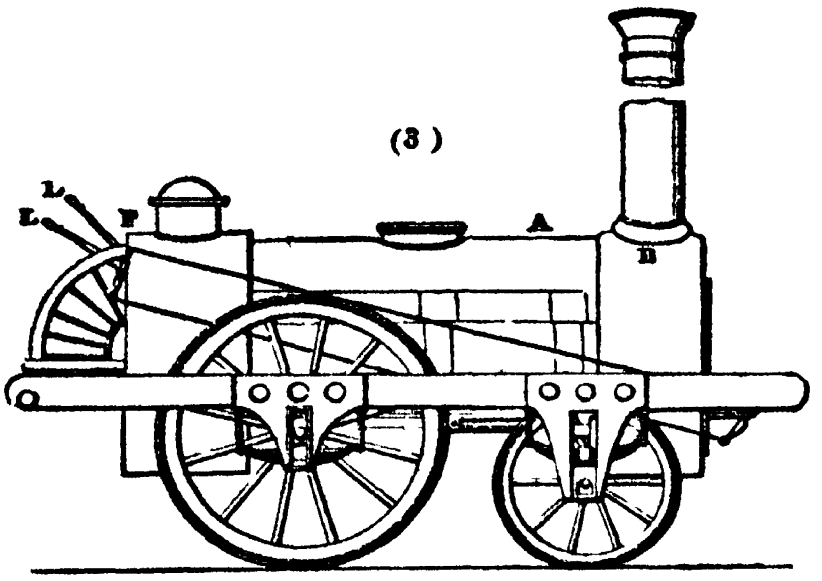



The circumstances in this mechanical arrangement, on which the rapid production of steam depends, are twofold first, the extensive surface exposed to the radiant heat of the fire, by the casing surrounding the fire box, and by the tubes, twenty-five in number and only three inches in diameter by which the flame and heated air are conducted through the boiler from the fire box to the chimney and, secondly by the powerful draught maintained in the furnace by the current of steam constantly discharged up the chimney It has been mainly by bringing these principles more fully into operation, that [illegible] the locomotive engine [illegible]

The railway was not long in operation, when the arrangement of the tubes in the boiler was improved, their number was increased from twenty-five to one hundred and upwards, and their diameters diminished from three inches to an inch and a half This change alone produced an increased efficiency of the fuel, in the proportion of nearly two to one, the consumption of coke in the Rocket having been very nearly 2¾ pounds per ton per mile, while, by the change above mentioned, the consumption of fuel in the new engines was reduced to 1¼ pound per ton per mile The position of the cylinder was also changed Instead of being placed, as in the Rocket, outside the boiler, they were now placed in that part of the engine called the *smoke box*, lying at the bottom of the chimney More recently, however, the [illegible] to view of obviating the necessity of forming cranks in the axles, which was involved by the plan of placing the cylinders between the wheels

The engine, as constructed with the cylinders in the smoke box, is represented in fig 3.

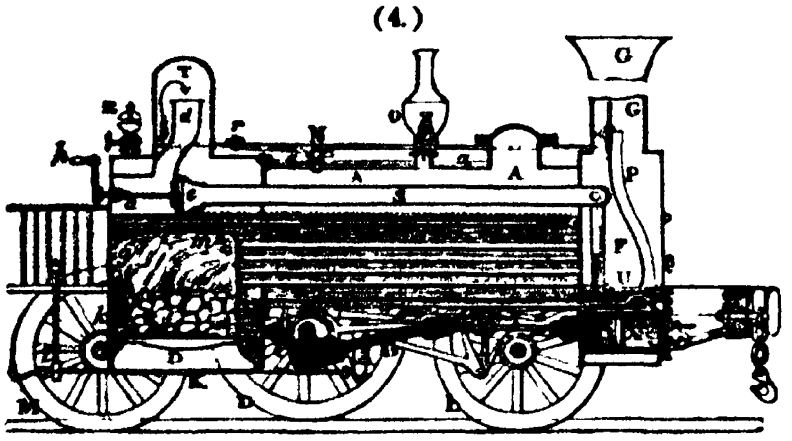
(3.)




The two chief improvements in the locomotive engine, which succeeded those now explained and which brought that machine to its present state of efficiency consisted first, in the substitution of brass for copper tubes, and, secondly, in the addition of another pair of wheels to support the engine It was found, by continued experience, that the copper tubes from the peculiar action of the fire upon them, which has never been explained or understood, were subject to rapid decay, and in the year 1833, after an experience of about three years of the working of these engines, it occurred to Mr Dixon, then one of the superintendents of the engineering department of the Liverpool and Manchester railway, to try the effect of brass tubes The experiment was eminently successful they were found to last six or eight times as long as copper tubes of the same dimensions Having now brought down the history of the locomotive engine to the present time, we shall give a description of one of these machines in one of its most common forms

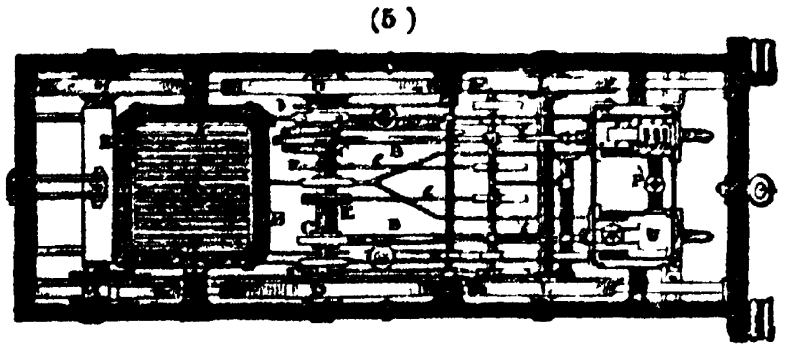
*Description of the Locomotive Engine* —A longitudinal vertical section of a locomotive engine is represented in fig 4, and a plan of the working machinery, including

(4.)




the cylinders, pistons, eccentrics, &c, which are under the boiler, and by the operation of which the engine is driven, is represented in fig 5.

(5.)



The boiler, as has been explained in the engines already described is a cylinder placed upon its side The fire box consists of two casings of metal one within the other, bolted together by stays represented at *k*, the fire grate is represented at D The fire door is represented at *g*, opening upon the platform where the engineer stands It will be perceived in the section fig 4, as well as in the plan fig. 5, that the fire box is on every side surrounded by the water in the boiler The flame and products of combustion, are drawn from the fire box into the smoke box are represented at E, fig 4 The smoke box containing the cylinders and blast pipe, and supporting the chimney is represented at F In the engraving was taken the boiler is feet diameter, it is clothed with a boarding of wood, represented at *a*, and bound round by iron hoops screwed together at the bottom Wood being a slow conductor of heat, this covering has the effect of keeping the boiler warm and checking the condensation of steam

The external casing of the fire box, B B, is nearly square in its plan, as seen in fig 5, being 4 feet wide, and 3 feet 7½ inches long it is constructed of wrought iron plates inches feet below as in fig 1 than that of the boiler, and concentrical with it The inner casing, *k k*, fig 5, is similar in shape to the external, but it is lower and flat at the roof, as seen in fig 4 The space between the two casings is from 3 to 4 inches in width This internal fire box is made of copper plates

As the top of the fire box would be liable to be destroyed by the action of the fire if the level of the water in the boiler were suffered to fall below it, so as to leave it uncovered, a leaden plug *m* is inserted in it, which would melt out before the copper would become injuriously heated, and the steam rushing out at the aperture would cause the fire to be extinguished The tubes E, which serve to conduct the flame through the boiler to the smoke box, are made of the best rolled brass, $\frac{1}{13}$th of an inch thick, and $1\frac{5}{8}$ of an inch in external diameter, they are 121 in number, and the distance between tube and tube is $\frac{3}{4}$ of an inch The tubes act as stays, connecting the ends of the boiler to strengthen them, but besides these there are rods of wrought iron, represented at *o*, fig 4, which extend from end to end of the boiler above the roof of the fire box The smoke box F, containing the cylinders steam pipe, and blast pipe, is 4 feet wide, and feet long it is formed of wrought iron plates, rivetted in the same manner as those of the fire box From the top of the smoke box, which, like the fire box, is semi-cylindrical, rises the chimney G 15 inches diameter, made of ¼-inch iron plates, rivetted and bound round by hoops Near the bottom of the smoke box the working cylinders are placed side by side, in a horizontal position, with the slide valves upwards, as seen in fig 5

At the top of the external fire box, fig 4, a circular aperture is formed 15 inches in diameter, and upon this aperture is placed the steam dome T, 2 feet in height and secured to the aperture by nuts The steam dome is made of brass, nearly half an inch thick A funnel-shaped tube *d*, with its wide end upwards, is flanged upon the side of the great steam pipe S and is carried upwards so that its mouth is near the top of the steam dome T In order to pass into the steam pipe S, the steam which fills the upper part of the boiler A must ascend into the steam dome and enter the funnel *d*, as indicated by the bent arrow in fig 4 This arrangement prevents in a great degree, the effect of priming by which word is expressed technically the spray of water which rises from the water of the boiler, and is mixed with the steam in the upper part of it as the steam ascends into the steam dome this spray falls back, and nothing but pure steam enters the funnel *d* The wider part of the great the hinder end of the fire box, is covered by a circular plate, secured by screws having a stuffing box in its centre, of the same kind as is used for the piston rods of steam cylinders Through this stuffing box the spindle or rod *a'* of the regulator passes, and to its end is attached a winch *h*, by which the spindle *a'* is capable of being turned To the other end of this spindle, at *c*, is attached a plate, which moves upon apertures formed in the cover of the end of the great steam pipe S, so that, by turning the winch *h* more or less, this plate *c* may be removed more or less from over the openings, and thus the steam may be allowed to enter the steam pipe S from the steam dome T or may be shut off altogether enclosed within the boiler, is maintained at the same temperature as the steam in the boiler, and therefore the steam, in passing through it, is not liable to condensation The steam pipe, passing through the tube plate at the front of the boiler is turned down at right angles in the smoke box, where enlarging into wrought inches or is conducted to each of the valve boxes of the cylinders The lower ends of these branches are flanged to the valve boxes at the ends of the cylinders nearest to the boiler by these pipes the steam is conducted into the valve boxes, or steam chests, from which it is admitted by slide On the upper covers, there are valves U, communicating with the passages leading to the top of the cylinder and leading from thence to the blast pipe P to the blast pipe These openings are governed by a slide, so that, when steam is admitted through *m*, the communication shall be opened between *n* and *o* Thus, when steam is admitted to the top of the cylinder, the steam from the bottom will flow from *n*, through *o*, into the blast pipe When the piston reaches the bottom of the cylinder, then the slide opens a com-

munication between *n* and the steam pipe, and between *m* and *o* Thus steam will be admitted to the bottom of the cylinder, while the steam from the top will escape from *m* through *o*, to the blast pipe In this way, by the alternate shifting of the slide, steam is admitted alternately to each end of the cylinder, and allowed to escape from the other end, and the alternate motion of the piston in the cylinder is thereby maintained The pistons used in locomotive engines are of the kind called metallic pistons, and, from their horizontal position, they have a tendency to wear unequally in the cylinders, their weight pressing them on one side only, but, from their small magnitude this effect is found to be imperceptible in practice The cross pipe P', which communicates with the eduction passage *o*, in each of the valve boxes, has an opening in the centre presented upwards, as seen in fig. 5 To this opening is flanged the base of the blast pipe P, fig 4, which rises in a direction slightly curved, and has its mouth presented upwards in the centre of the chimney G The steam which is discharged at each stroke of the pistons from the cylinders passes into this pipe, and escapes up the chimney by puffs When an engine is moving slowly, these puffs are distinctly audible, resembling the coughing of a horse, but when at full speed they succeed each other so rapidly that the ear can scarcely distinguish their intervals It is this stream of waste steam, continually rushing up the chimney, that maintains the necessary draught in the fireplace [illegible] produced in the funnel causes a [illegible] into the smoke box F, through the tubes E, and there is this excellence in the arrangement, that the force of the draught in the chimney being proportional to the quantity of steam produced, it must be therefore proportional to the quantity of fuel necessary to be consumed

The force of [illegible] is communicated [illegible] heads of which move in guides, to the connecting rods B, which are attached to the crank pins of the working axle C, so that, as the piston rods are driven backwards and forwards in the cylinders, the working axle is made to revolve This axle has the driving wheels of the locomotive fixed upon it, and the engine is impelled forward upon the railway as the wheels revolve

The method by which the slides are made to govern the admission and escape of the steam to and from the cylinders is nearly the same as in the steam engine used for the general purposes of manufacture and for a general description of the method, see STEAM ENGINE Meanwhile it may be here briefly stated that this is effected by two circular plates called eccentrics, fixed at F E, fig 5, on the great working axle These eccentrics are circular plates or rings, formed upon or attached to the axle so as to revolve in their own plane, forming, in effect, a part of the axle itself, but they are so placed that their centres do not coincide with the centre of the axle and, consequently as they revolve with the axle, their centres are alternately thrown backwards and forwards, as they pass on the one side or the other of the axle These circular plates are surrounded by rings, within which they revolve but which do not revolve with them These rings are alternately thrown backwards and forwards by the play of the eccentrics, and to these rings are attached rods *e e*, which communicate motion to the arms which drive the rods of the slides Thus the alternate motions of the eccentrics backwards and forwards proceed from [illegible] admission and escape of the steam to and from the cylinders When it is required to reverse the motion of the engine, or to make it move backwards, the motion of the slides, and therefore the positions of the eccentrics on the working axle, must be the contrary of that necessary to produce a progressive motion Sometimes this is effected by shifting the position of the eccentrics on the working axle, but more commonly it is effected by a second pair of eccentrics represented at F F, fig 5, placed on the axle in a position contrary to the others When the engine is driven backwards the eccentrics E F are thrown out of gear, and the eccentrics F I are brought into action

As all the moving parts of the engine require to be constantly lubricated with oil, to diminish the friction and keep them cool, oil cups for this purpose are fixed upon them In some engines these oil cups are attached separately to all the moving parts, in others they are placed near each other in a row on the side of the boiler, and communicate by small tubes with the several parts to be lubricated

The tender is a carriage attached behind the engine, and close to it, carrying coke for the supply of the furnace, and a tank containing water for the boiler The feed for the boiler is conducted through a curved pipe proceeding from the tank, and carried first downwards, and afterwards in a horizontal direction, as [illegible], fig 4, under the boiler It communicates with a forcing pump which is worked by an arm driven by the cross head of the steam piston By this pump water is constantly forced into the boiler so long as the pump is kept [illegible] may be opened and cut off by a cock at the side of the engineer As the feed of the boiler by the introduction of cold water checks the activity of the evaporation, it is the custom not to feed the boiler regularly and constantly, but to throw on the feed when the work on the engine is light and the consumption of steam small, and to shut it off when much steam is required. The circumstances of a railway naturally suggest this When the engine is ascending an incline all the steam which the boiler is capable [illegible], and therefore the activity of [illegible] by shutting off the feed, but in descending [illegible] less power is required, and the feed is put on

Until within the last few years, locomotive engines were supported on only four wheels It is now, however, the general practice to place them on six, and in some cases the driving wheels are in the middle, as represented in fig 4, and, in other cases at the end of the engine Mr Stephenson has been in the practice of constructing the driving wheels without flanges, depending on the flanges of the two pairs of smaller wheels to maintain the engine between the rails In that case the driving wheels must be in the middle The wheels of the engine represented in fig 4 are constructed in this manner But it has been found [illegible] to acquire a pitching [illegible] speeds The driving wheels D are 5 feet in diameter The wheels I are 3 feet 6 in in diameter, and have conical tires with flanges They are placed immediately behind the smoke box The wheels M are precisely similar to L, and are placed immediately behind the fire box

When an engine is required for the transport of very heavy loads, such as those of merchandise, the adhesion of one pair of working wheels is insufficient, and, in such cases, one of the two pairs of wheels L or M is made of the same diameter as [illegible] wheels, and a bar is attached to points on the wheels, at equal distances from their centre, connecting them in such a manner that any force applied to make one pair of wheels revolve must necessarily impart the same motion to the other pair By such means the force of the steam is made to drive both pairs of wheels, and consequently a proportionally increased adhesion is obtained

The pressure of steam in the boiler is usually limited by two safety valves,—one represented at N, under the control of the engineer, and the other at O, which cannot be approached by him The safety valve at N is held down by a lever *r*, which is attached to a spiral spring and which may, by an adjusting screw, be made to press on the valve with any required force The second valve O is pressed by several small elliptical springs, placed one above another over the valve, and held down by a screw, which turns in a frame fixed into the valve seat By this screw the pressure on the valve can be adjusted

In order to give notice of the approach of the train, a steam whistle Z, fig 4, is placed immediately above the fire box at the back of the engine This is an apparatus composed of two small hemispheres of brass, separated one from the other by a small space Steam is made to pass through a hollow space formed in the lower hemisphere and escapes from a very narrow circular opening round the edge of that hemisphere The edge of the upper hemisphere presented downwards encounters this steam, and an effect is produced similar to the action of air in organ pipes A shrill whistle is produced which can be heard at a great distance, and which from all ordinary sounds, never fails to give notice of the approach of a train

*The Link Motion* —One of the most elegant expedients of improvement that has been introduced into the locomotive engine is that known as the link motion It had been the custom previously to its introduction to employ two eccentrics for each engine, of which one was set in the right position for sending the engine forward, and the other was set in the right position for sending the engine backward The two were never in connexion with the valve at the same time, but when the one eccentric was in operation the other was out of gear with the valve, and the two eccentric rods were kept asunder by a link, so that one could not come into gear until the other was disengaged It was suggested, however, that by deriving the valve motion from this link, instead of from the ends of the eccentric rods the engine might be stopped or reversed with [illegible] connecting the ends of the eccentric rods [illegible] must be set nearly opposite to [illegible] be at the extremity of its throw [illegible] other is at the extremity of its throw in the other direction It will therefore follow, that the link connecting the eccentric rods will have nearly the same motion as the beam of a pair of scales, or any other lever controlled in the same manner, and by

raising or lowering the link, so that either its upper or lower end or its centre is situated at the end of the valve rod the valve will be moved in one or the other direction forward or backward or it will be maintained stationary at the middle position This result ensues because the centre of the link is a fulcrum or point of motion, while its ends move in opposite directions A very common form of link is represented in the accompanying figure, and it

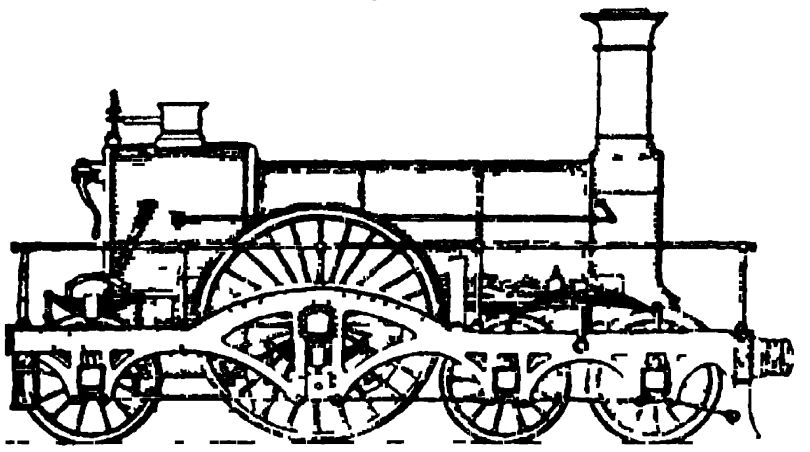
(6.)



is armed with projecting lugs at the ends, to which the eccentric rods are attached The end of the valve-rod is connected with the central slot, and by raising or lowering the link by means of a handle provided for that purpose, the valve-rod may be made to partake of the motion of either end or may be maintained stationary in the intermediate position

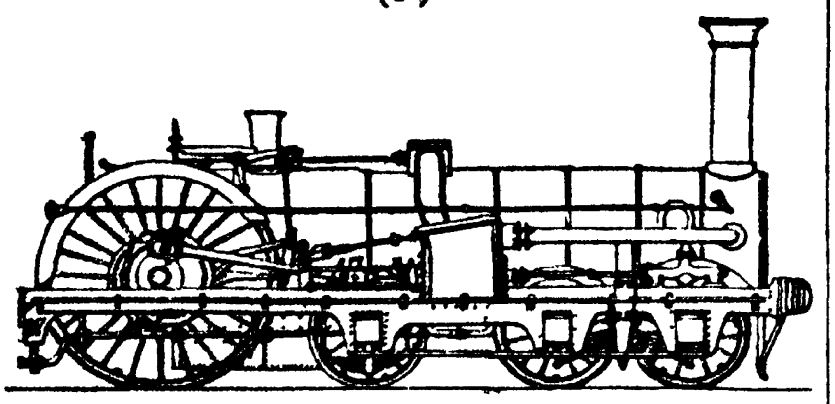
*Express Locomotive Engines* — The exigent demand for speed arising out of the competition of the rival gauges and the establishment of express trains, has caused engines of a much more powerful class to be introduced since the first edition of this work was published Annexed we give the most remarkable examples of this class of engine, being the express engine designed by Mr Gooch for the Great Western railway (fig 7), and Crampton's express engine (fig 8) applicable to the narrow gauge These engines were both displayed at the Great Exhibi-

(7)



tion The cylinders of Gooch's engine are each 18 inches in diameter and 24 inches stroke, the driving-wheels are 8 feet in diameter, the fire-grate contains 21 square feet of area, the heating surface of the fire-box is 153 square feet There are in all 305 tubes of 2 inches diameter, giving a surface in the tubes of 1799 square feet the total heating surface, therefore, is 1952 square feet Mr Gooch states that an engine of this class will evaporate from 300 to 360 cubic feet of water in the hour, and will convey a load of 236 tons at a speed of 40 miles an hour, or a load of 181 tons at a speed of 60 miles an hour The weight of this engine empty is 31 tons, of the tender 8½ tons, and the total weight of the engine when loaded is 50 tons.

(8)



In Crampton's locomotive, the Liverpool, the cylinders are of 24 inches diameter and 18 inches stroke, the driving wheels are 8 feet in diameter, the fire-grate contains 21½ square feet of area, the heating surface of the fire-box is 144 square feet. There are in all 300 tubes of $2\frac{3}{16}$ inches external diameter, and 12½ feet long, giving a surface in the tubes of 2136 square feet the total heating surface, therefore, is 2290 square feet The weight of this engine is stated to be 35 tons when ready to proceed on a journey. Engines of this kind were worked for a short time on the North-Western Railway, but were given up on account of the damage caused to the rails

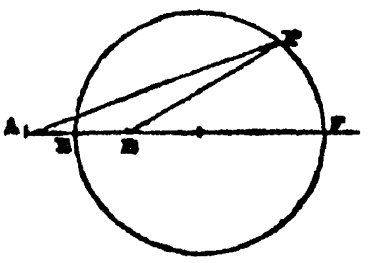
*Traction on Roads and Railways* — The tractive force requisite for drawing carriages over well formed and level [illegible] is about $\frac{1}{150}$th of the load at low speeds [illegible] for drawing [illegible] the load, [illegible] ton at low speeds, but in the case of very well formed railways the force necessary for traction is less than this The resistance, however, increases very rapidly with the speed of the train, and Mr Gooch has ascertained [illegible] it requires a power of 1018 [illegible] cylinders to give to a train weighing 149½ tons a speed of 61·3 miles an hour Of this power 796 horses are expended in propelling the train, and the residue is expended in overcoming the resistance of the blast-pipe, or, in other words, in blowing the fire The evaporative power of a locomotive boiler varies as the fourth root of the speed.

*Indications to be observed in the Construction of Locomotives* — The demand for high rates of speed upon railways and the consequent establishment of express trains for the realisation of that object, have gradually led to such an increase in the length and weight of locomotives as have given rise to various practical evils The width of [illegible] railway which is in most cases only 4 [illegible] the diameter of boiler which can be employed, and as the power of the boiler must be greatly increased to render high speeds possible, the necessary increase in the heating surface has to be obtained by increasing the length of the tubes and diminishing their diameter This alteration, however, renders necessary in its turn a large increase in the force of the blast-pipe, in order that the combustion in the furnace may be maintained with adequate activity, and the back pressure thrown upon the pistons by contracting the blast-pipe, absorbs a large part of the engine power The weight, also, of such engines has a very injurious operation upon the rails, and it appears to be the preferable practice, instead of seeking to accomplish high rates of speed with a single engine to employ two engines with one tender between them so that one stoker and one engine driver may suffice for both Attached to one of the locomotives or to the tender there should be a small engine for replenishing the boiler when the train is standing still Such engines are now very commonly used in steam vessels, and are called donkey engines, but their use in the case of locomotives appears still more important, as the level of the water is liable to speedy subsidence from the smallness of the volume of water which the boiler contains To prevent the alternate action of the pistons from communicating a sinuous motion to the train, a weight should be so applied to each driving-wheel that, when the piston and its appendages are shot back, this weight shall be shot forward It is very desirable that the machinery should be removed from so inconvenient a position as that which it usually occupies beneath the boiler In that class of locomotive engines called Outside Cylinder Engines it is disposed at the sides of the boiler The machinery should be accessible when the train is in motion and the whole of the locomotive above the level of the foot-plate upon which the engine driver stands might be inclosed in a house with glass windows all round In America this has been already done

LOCOMOTIVE POWER, in contradistinction to stationary power, is any kind of moving power applied to the transport of loads on land which travels with the load which it draws [illegible] or carry loads are [illegible] ENGINE

LO'CULICI'DAL In Botany a term applied to the dehiscence of a fruit when it takes place through the back of the cells It is what botanists formerly called a dehiscence with [illegible]

LO'CUS (Lat [illegible] is, is the line traced by a point which varies its position according to some determinate law For example, let this problem be proposed To find a point P such that its distances from two given points, A and B, shall have a given ratio If the line joining A and B be divided in E, so that A E is to E B in [illegible] conditions of the problem But this is not the only




point which has this property, for let F be taken in the [illegible] A F is to B F in the given ratio [illegible] it can be described, then, [illegible] from A and B to any point whatever, P, in [illegible] this circle, A P will have to P B the [illegible] A F to E B, or as A F to F B that is, the [illegible] circle E P F is hence called the *locus* of the point P

When the locus of the variable point is a straight line or a circle, it was called by the ancient geometers a *plane locus*, and when one of the conic sections, a *solid locus*

The *plane loci* formed a branch of the ancient analysis, which, according to the account of Pappus, was treated of by Apollonius in two books which have been lost They were partly restored by Schooten, a Dutch geometer, who flourished in the 17th century, and by Fermat but afterwards in a complete manner by Dr Simson of Glas-

gow, whose treatise, *De Locis Planis*, published in 1749, is a model of geometrical exactness. The principal propositions may be found in Hutton's *Mathematical Analysis*.

Mathematicians have also begun to consider the loci of the equations of three variables; thus $ax + by + cz = o$ is a locus of the first order, $ax^2 + by^2 + cxy + dx + ey + f = o$, a locus of the second order, and so on. The loci of all equations of the second degree are conic sections. (See *Maclaurin's Algebra*.)

LOCUST, the Latin word signifying a crayfish, but now the common name of a species of insects, forming a group or subgenus of the *Gryllus* of Linnæus. They have coloured elytra, and large wings, disposed when at rest in straight fan-like folds, as in other Orthoptera, and frequently exhibiting bright blue, green, or red colours. The thorax is capacious, to afford room for the powerful muscles of the wings, and is marked in many species with one or more crests or wart-like prominences. The locusts fly by starts, but [illegible] in their passage through the air a dense cloud; wherever they alight all signs of vegetation quickly disappear, and cultivated grounds are left a desert. But the mischief does not end here, for when dead the mass of decomposing bodies is so great that the air becomes poisoned by the fetid exhalations. The 2d chapter of Joel gives a powerful description of the devastation committed by these destructive insects.

M. Miot, in his translation of Herodotus, has given it as his opinion that the heaps of bodies of winged serpents which that historian states that he saw in Egypt were nothing more than masses of this species of locust. These insects are eaten in various parts of Africa, where the inhabitants collect them both for home consumption and for commerce. They take away their elytra and wings, and preserve them in brine. One species (*Acridium migratorium*, Latr.) occasionally commits devastations in the south of Europe and Poland, and stragglers have occasionally reached our own coasts. In the United States the term "locust" is applied to a species of *Cicada*, which by their numbers and voracity are almost as destructive as the true locusts of the old world.

LOCU'STA. In Botany. If that form of inflorescence called a spike consist of flowers destitute of calyx and corolla, the place of which is occupied by bracteæ, the rachis is flexuose and toothed, and does not fall to the ground with the flowers, as happens in grasses, each part of the inflorescence so arranged is called a *locusta*, the structure of which is as follows:—At the base are two opposite empty bracteæ called glumes, one of which is attached to the rachis a little above the base of the other, above the glumes are several florets sitting in denticulations of the rachis, each of these consists of one bractea, sometimes with the midrib quitting the lamina a little below the apex, and elongated into a bristle, and of another bractea, facing the first, with its back to the rachis, bifid at the apex, with no dorsal vein, but with its edges inflexed, and a rib on each side at the line of inflexion, and, lastly, within these bracteæ are situated two extremely minute fleshy scales, which are sometimes connate, and stand at the base of the sexual organs.

LODE. A term used by miners, generally synonymously with metallic or mineral *vein*. The lodes containing metallic ores are said to be *alive*, others which [illegible] matters are called *dead lodes*.

LODGE. In Architecture, a small house situated in a park or domain subordinate to the mansion, also, the cottage situated at the gate of the avenue that leads to the mansion.

LODGE. See FREEMASONRY.

LODI'CULA. In Botany, a term given by Palisot de Beauvois to the two minute, colourless, fleshy, hypogynous scales which are situated beneath the ovary of grasses.

LOESS. A German geological term, applied to a tertiary alluvial deposit which occurs in patches between Cologne and Basle. The term is often used by English geologists in reference to that peculiar yellow loam with [illegible]

LOG, LOGLINE. In sea language, the log is a piece of wood, in the form of a sector of a circle (usually a quadrant) of five or six inches radius. It is about a quarter of an inch thick, and so balanced, by means of a plate of lead nailed to the circular part, as to swim perpendicularly in the water, with about two thirds immersed under the surface. The log-line is a small cord, one end of which is fastened to the log, while the other is wound round a reel in the [illegible] ship. The log thus poised keeps its [illegible], while the line is unwound from [illegible] the water, and the length [illegible] time gives the rate of [illegible] lated by *knots* made on the line at certain distances, while the time is measured by a sand-glass of a certain number of seconds. In order to avoid calculation, the length between the knots is so proportioned to the time of the glass that the number of knots unwound while the glass runs down shows the number of miles the ship is sailing per hour. Thus, suppose the glass to be a half minute one: it will run down 120 times in an hour. Now, distances by sea are reckoned by nautical miles of which a degree, so that each mile contains about 6080 feet, the 120th part of which is 51 feet. It, therefore, the knots (which are pieces of coloured cloth) are fastened to the log-line at distances of 51 feet, the number of knots unwound from the reel in half a minute is the number of miles the ship runs in one hour. If the glass runs down in less than half a minute, the intervals between the knots must be diminished in proportion. The first knot is placed about five fathoms from the log, to allow the latter to get clear of the ship before the reckoning commences, and the part of the line between the lead and the first knot is called the *stray line*.

LO'GAN STONES. *See* GEOLOGY, p. 500.

LOGARITHM (Gr. λογος, in the sense of *a proportion* and αριθμος, *number*.) The logarithm of a number is the exponent of the power to which another given invariable number [illegible] first number. [illegible] in which the invariable number is [illegible] the logarithm of 1000 is 3, because 10 raised to [illegible] power is 1000. In general, if $a^x = y$, in which equation $a$ is a given invariable number, then $x$ is the logarithm of $y$. All absolute numbers, whether positive or negative, whole or fractional, may be produced by raising an invariable number to suitable powers. The invariable number is called the *base* of the system of logarithms: it may be any number whatever, greater or less than unity, but, having been once chosen, it must remain the same for the formation of all numbers in the same system. Whatever number may be selected for the base, the logarithm of the base is 1 and the logarithm of 1 is 0. In fact, in the equation $a^x = y$ we make $x = 1$, we shall have $a^1 = a$, whence, by the definition, log $a = 1$, and if we make $x = 0$, we shall have $a^0 = 1$, whence log $1 = 0$.

From the nature of the exponential equation, by which logarithms have been defined, it is easy to discover some of the principal properties and uses of those artificial numbers. Suppose that we have a series of numbers, $y$, $y'$, $y''$, $y'''$ &c. to be multiplied together. Let $a$ be the base of the system of logar[illegible] (to be calculated), and let $x$, $x'$, $x''$, $x'''$ [illegible] of $y$, $y'$, $y''$, $y'''$, &c. respectively. We [illegible], according to the definition, the series of [illegible]

$$y = a^x,\ y' = a^{x'},\ y'' = a^{x''},\ y''' = a^{x'''},\ \&c.$$

Multiplying the corresponding members of these equations into each other, we get

$$y\,y'\,y''\,y'''\ \&c. = a^{x + x' + x'' + x''' + \&c.},$$

whence log $y\,y'\,y''\,y'''$ &c. $= x + x' + x'' + x''' + \&c.$ = log $y$ + log $y'$ + log $y''$ + log $y'''$ + &c. whence we infer this chief property of logarithms, namely, that the logarithm of a product is equal to the sum of the logarithms of its factors.

Again, let [illegible] two numbers $y$ and $y$, to be divided the one by the [illegible] in the [illegible]. We have, as before, the equations $y = a^x$, and $y = a^{x'}$, whence $\frac{y'}{y} = a^{x' - x}$, and therefore log $\frac{y'}{y} = x' - x =$ log $y' -$ log $y$, that is to say, the logarithm of the quotient of a division is equal to the difference between the logarithm of the dividend and the logarithm of the divisor.

These properties of logarithms are of very great importance in facilitating the arithmetical operations of multiplication and division. For if a multiplication is to be effected, it is only necessary to take from the logarithm [illegible] and add them [illegible] the logarithm of the required product, and on finding in the table the number corresponding to this new logarithm, the product itself is obtained. Thus by means of a table of logarithms the operation of multiplication is performed by simple addition. In like manner, if one number is to be divided by another it is only necessary to subtract the logarithm of the divisor from that of the dividend, and to find in the [illegible] corresponding to this difference, which [illegible] the quotient required. Thus the quotient of a division is obtained by [illegible] subtraction.

Logarithms apply with equal advantage to the formation of powers and extraction of roots. Let $y$ be a number to be raised to the power $m$ ($m$ being any number, whole or fractional, positive or negative). As before, we have $y = a^x$, and, on raising both sides of the equation to the power $m$, $y^m = a^{mx}$; whence, by the definition, log $y^m = mx = m$ log $y$, that is the logarithm of the power of a number is equal to the product of the logarithm of the number by the exponent of the power.

If in the equation log $y^m = m$ log $y$ we make $m = \frac{1}{n}$, we shall have log $y^{\frac{1}{n}}$ (or log $\sqrt[n]{y}$) $= \frac{1}{n}$ log $y$, that is to say

[illegible] f any root of a number is equal to the [illegible] mber divided by the index of the root

From these two last results it is obvious that by means of a table of [illegible] bers may be raised to any power by [illegible] and that the roots of numbers may be extracted by simple division

The properties which have now been demonstrated are true of every system of logarithms which may be adopted but their application to numerical computations supposes the construction of a table, including on the one hand the natural numbers, and on the other the logarithms of those numbers calculated for a given base The tables usually employed are those of which the base is 10, and their construction is equivalent to the solution of the algebraic equation $10^x = y$ Hence, making $y$ successively equal to the numbers 1, 2, 3, 4, &c , we have to resolve the equations

$$10^x = 1,\ 10^x = 2,\ 10^x = 3,\ 10^x = 4, \&c$$

The labour of computing the tables is greatly abridged by the circumstance that it is only necessary to calculate the logarithms of the prime numbers, for as all the other numbers may be obtained by the multiplication of prime numbers into each other, their logarithms according to what has been already shown may be found by the addition and subtraction of the logarithms of the prime numbers Hence a table containing merely the logarithms of the prime numbers is all that is strictly necessary for effecting computations by logarithms

When a table of logarithms has been calculated for any given base, it is easy to find by means of it any other system of logarithms corresponding to a different base, without having again recourse to the solution of exponential equations Thus supposing a system of logarithms has been calculated of which the base is $a$ or, which is the same thing that the value of $x$ has been found for every different value of $y$ in the equation $a^x = y$ and that it is required to construct another table of which the base is $b$, or to find the values of $v$ corresponding to every different value of $y$ in the equation $b^v = y$ we may proceed as follows —Taking the logarithms of both members of this last equation from the table supposed already calculated, of which the base is $a$, and recollecting that $\log b^v = v \log b$, we have $v \log b = \log y$, whence $v = \frac{\log y}{\log b}$ But because $b^v = y$, it follows that $v$ is the logarithm of $y$ in the system of which the base is $b$, therefore, denoting the logarithms in this new system by L, we have $L\,y = \frac{\log y}{\log b}$ Hence it appears that, in order to find the logarithm of any given number $y$ in the new system, it is only necessary to multiply its logarithm in the system already calculated by the constant number $\frac{1}{\log b}$ This constant number, by means of which we pass from the one table to the other, is called the *modulus* of the new table with reference to the old

In the common system of logarithms of which the base is 10, those numbers only which are perfect powers of 10 (that is, 100, 1000, &c ) can have commensurable logarithms. The logarithms of all other numbers are incommensurable, and can only be obtained to a certain degree of approximation In general, the approximation will be sufficient if carried to the seventh decimal figure, and accordingly the ordinary tables contain the logarithms only to seven places of decimals, but where very great accuracy is required, as in some astronomical calculations, it may be necessary to use logarithms exact to ten places In Vlacq's tables they are computed to this extent

The relation between a number and its logarithm in the common system being $10^x = y$ (where $y$ is the natural number and $x$ its logarithm), if we make successively

$$x = 0,\ 1,\ 2,\ 3,\ 4\ .\ .\ .\ n,$$

we shall have for the corresponding values of $y$

$$y = 1,\ 10,\ 100,\ 1000,\ 10000\ .\ .\ .\ 10^n,$$

and if we make

$$x = 0 - 1 - 2 - 3 - 4\ .\ .\ .\ - n,$$

we shall have

$$y = 1,\ \frac{1}{10},\ \frac{1}{100},\ \frac{1}{1000},\ \frac{1}{10000}\ .\ .\ .\ \frac{1}{10^n}$$

From these series it is evident that the logarithms of all numbers greater than unity are positive, and that the logarithms of all fractions are negative It is also evi- [illegible] of every number between 0 and [illegible] ry number between 10 and 100 is 1 + a decimal, of every number between 100 and 1000 is 2 + a decimal, and so on But the digits in any number between 10 and 100 are 2, between 100 and 1000 are 3, and so on, [illegible] expressed by [illegible] number [illegible] with a [illegible] added For example, in the number 73594, comprised between 10000 and 100000, or between $10^4$ and $10^5$, [illegible] added This integral part of the [illegible] common to all numbers beween two successive powers of 10 is called the *characteristic* because it shows at once [illegible] number corresponding to the logarithm to which it is prefixed is composed If, then, we know the logarithm of any number, we have [illegible] to have [illegible] or 1000 times, &c as great Thus we have

| | | |
|---|---|---|
| log | 73594 | = 4 8668424 |
| log | 7359 4 | = 3 8668424 |
| log | 73 594 | = 1 8668424 |
| log | 7 3594 | = 0·8668424 |
| log | 73594 | = $\bar{1}$ 8668424 |

In this last example the negative sign is placed over the characteristic, this only being negative But it is more usual and convenient to substitute for the negative characteristics their arithmetical complements, thus,

| | | |
|---|---|---|
| log | 73594 | = 9 8668424 |
| log | 073594 | = 8 8668424 |
| log | 0073594 | = 7 8668424 |

[illegible] carry the decimal point 10 digits to the right or left of its true place — an error which would at once be evident In modern tables the characteristic is properly omitted, the logarithm to which it would be prefixed belonging, in fact not only to one particular number, but also to all multiples or sub-multiples of that number by 10

The methods employed by the first computers of the logarithmic tables were founded on the successive extraction of roots and involved calculations of very great labour, but analysts have since discovered series by which the computations are rendered much more expeditious and easy Let it be required to find the logarithm of any number $x$ by means of a converging series Assume

$$\log (1 + x) = A\,x + B\,x^2 + C\,x^3 + D\,x^4 + \&c \qquad (1),$$

in which A, B, C D &c are coefficients to be determined Taking another number $z$, we shall have, in like manner,

$$\log (1 + z) = A\,z + B\,z^2 + C\,z^3 + D\,z^4 + \&c\ . \qquad (2)$$

Subtracting equation (2) from (1) we get

$$\log (1 + x) - \log (1 + z) = A\,(x - z) + B\,(x^2 - z^2) + C\,(x^3 - z^3) + \&c \qquad (3)$$

But, by the nature of logarithms, $\log (1 + x) - \log (1 + z) = \log \frac{1 + x}{1 + z} = \log \left(1 + \frac{x - z}{1 + z}\right)$, and, on developing this expression in the same manner as $\log (1 + x)$ in the equation (1), we have

$$\log \left(1 + \frac{x - z}{1 + z}\right) = A\,\frac{x - z}{1 + z} + B\left(\frac{x - z}{1 + z}\right)^2 + C\left(\frac{x - z}{1 + z}\right)^3 +, \&c$$

Substituting this development for $\log (1 + x) - \log (1 + z)$ in the equation (3), and dividing both sides by $(x - z)$ there results

$$A\,\frac{1}{1 + z} + B\,\frac{x - z}{(1 + z)^2} + C\,\frac{(x - z)^2}{(1 + z)^3} +, \&c.$$
$$= A + B\,(x + z) + C\,(x^2 + x\,z + z^2) +, \&c$$

Now as this equation is true independently of any particular values of $x$ and $z$, let us suppose $x = z$, and it becomes

$$A\,\frac{1}{1 + x} = A + 2\,B\,x + 3\,C\,x^2 + 4\,D\,x^3 + \&c,$$

which, on expanding the quantity $\frac{1}{1 + x}$ by division, gives $A\,(1 - x + x^2 - x^3 + x^4 -, \&c) = A + 2\,B\,x + 3\,C\,x^2 + 4\,D\,x^3 +, \&c$ Therefore, by the theory of indeterminate coefficients we must have the separate equations $A = A\ -\ A = 2\,B,\ +\ A = 3\,C,\ -\ A = 4\,D, \&c$ , and, on substituting the resulting values of B, C, D, &c , in terms of A in equation (1), we get

$$\log (1 + x) = A\left(\frac{x}{1} - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5} -, \&c\right)$$

The quantity A, which is still indeterminate, is the modulus, and on assigning to it a particular value, we characterize the system which we wish to consider

Let [illegible] A = 1 and [illegible] particular system of [illegible] resulting from [illegible] position by L, we shall then have

$$L\,(1 + x) = x - \tfrac{1}{2}\,x^2 + \tfrac{1}{3}\,x^3 - \tfrac{1}{4}\,x^4 +, \&c$$

This series in its present form is unfit for the calculation of the logarithms of whole numbers, for when $x$ is greater than unity it is divergent, but it may be easily transformed into others having the required properties On substituting $-x$ for $x$, it becomes

$$L\,(1 - x) = -x - \tfrac{1}{2}\,x^2 - \tfrac{1}{3}\,x^3 - \tfrac{1}{4}\,x^4 -, \&c.$$

And on substracting this from the former series, we have, since $L(1+x) - L(1-x) = L\left(\frac{1+x}{1-x}\right)$,

$$L\frac{1+x}{1-x} = 2\left(\frac{x}{1} + \frac{x^3}{3} + \frac{x^5}{5} + \frac{x^7}{7} +, \&c\right)$$

Let us now suppose $\frac{1+x}{1-x} = 1 + \frac{1}{z}$, or $x = \frac{1}{2z+1}$, then, since $L\left(1+\frac{1}{z}\right) = L\frac{z+1}{z} = L(z+1) - Lz$, the last series becomes, by substitution, $L(z+1) - Lz$

$$= 2\left(\frac{1}{2z+1} + \frac{1}{3(2z+1)^3} + \frac{1}{5(2z+1)^5} +, \&c\right)$$

This series gives the difference between the logarithms of two consecutive numbers, and it converges with sufficient rapidity Supposing successively $z = 1, 2, 3, 4$, &c, it gives

$$L2 = 2\left(\frac{1}{3} + \frac{1}{3\,3^3} + \frac{1}{5\,3^5} + \frac{1}{7\,3^7} +, \&c\right)$$

$$L3 - L2 = 2\left(\frac{1}{5} + \frac{1}{3\,5^3} + \frac{1}{5\,5^5} + \frac{1}{7\,5^7} +, \&c\right)$$

$$L4 - L3 = 2\left(\frac{1}{7} + \frac{1}{3\,7^3} + \frac{1}{5\,7^5} + \frac{1}{7\,7^7} +, \&c\right)$$

It will be observed that as the values of $z$ increase the series becomes much more rapidly convergent Suppose, for example, $z = 100$, we have then

$$L101 = L100 + 2\left(\frac{1}{201} + \frac{1}{3\,201^3} + \frac{1}{5\,201^5} +, \&c\right)$$

The logarithm of [illegible] of this series will [illegible] places of decimals

The series now found gives the logarithms of the particular system of which the modulus is 1, and which is called the *Napierian system* because it is that according to which logarithms were first computed by their inventor, Baron Napier But as has already been shown when the logarithms have been found in any one system, they may be transferred into those of any other system by means of a constant factor In the common system the base is 10, and the Napierian logarithm of any number is consequently transformed into the common logarithm of the same number by multiplying by the modulus $\frac{1}{L10}$

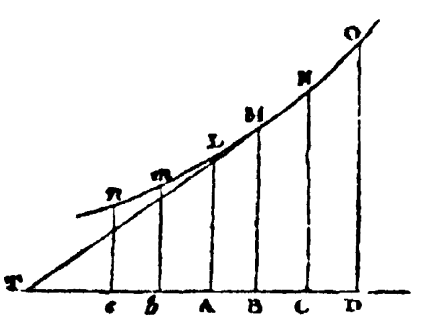
This number which is of great importance in the compu[illegible] ordinary logarithm of the base of the Napierian system, for calling $e$ that we shall have $e^{L10} = 10$, whence taking the ordinary logarithm of both sides of the equation, $L10 \times \log e = \log 10 = 1$, therefore $\log e = \frac{1}{L10}$ $= 0.4342944819$ On passing to numbers we find $e = 2.718281828$

The Napierian logarithms are sometimes called the *natural logarithms*, on account of the modulus of the system being unity, and more frequently *hyperbolic logarithms* because they represent the area of a rectangular hyperbola between its asymptotes

Logarithms were invented by Lord Napier, Baron of Merchiston in Scotland, and made known in a work published [illegible] *Logarithmorum canonis descriptio*, 1614 Henry Briggs, a contemporary of Napier's, professor of geometry in Gresham college, constructed another system, having for its base the number 10 which, corresponding with our system of numeration, is much more convenient for the ordinary purposes of calculation Briggs calculated the logarithms to 14 places, besides the index of all numbers between 1 and 20,000 and between 90,000 and 100,000, and published them in his *Arithmetica Logarithmica* in 1624 Adrian Vlacq, a native of Holland, computed the logarithms of the numbers from 20,000 to 90,000 and thus completed what had been begun and partly accomplished by Briggs, but he reduced the tables to 10 decimal places Vlacq's *Arithmetica Logarithmica* was published at Gouda in 1628, and contained the logarithms of all numbers from 1 to 100,000, calculated to 10 decimals, as also the logarithms of the sines tangents and secants of every minute of the quadrant Vlacq afterwards, in 1633, published another most valuable work, his *Trigonometria Artificialis*, containing the logarithmic sines, cosines, tangents and cotangents for every ten seconds of the quadrant, calculated from the natural sines, &c of the *Opus Palatinum* of Rheticus In the same year another work of the same kind, the *Trigonometria Britannica*, was published at Gouda, containing the logarithmic sines and tangents for the 100th part of every degree of the quadrant, together with a table of natural sines tangents, and secants These had been computed by Briggs

Logarithms being of constant use in astronomical and trigonometrical calculations, the tables which have been published are very numerous The most complete are those of Vlacq, already mentioned, to ten decimals, but they are very scarce, and can with difficulty be procured. There is an edition of them by Vega, in 1797, also scarce *Gardiner's Logarithms*, printed in 1742, in 4to, and another edition of them at Avignon in France in 1[illegible] to seven [illegible] *Gardiner's Logarithms* in 8vo, [illegible] arithmetic sines, &c for every 10 seconds *Taylor's Logarithms*, in 4to, and also *Baguay's* have them to every second *Hutton's Logarithms*, and *Babbage's Logarithms of Numbers* are well known [illegible] and [illegible] *Hülfstafeln* (8vo [illegible] to be mentioned as very [illegible] The above (except Vlacq's and Vega's) are all to seven decimal figures, but for many purposes logarithms to a less number of decimals are sufficiently accurate For navigation and surveying tables to six figures are the most convenient as they give in general the trigonometrical lines [illegible] conds The best tables of this kind [illegible] *of Six-figure Logarithms* (12mo 1840 [illegible] iliary computations in astronomy it is sufficient to have the logarithms to five places The reprint of *Lalande's Five figure Table* by the Useful Knowledge Society (18mo 1[illegible] is convenient, and may be relied on for accuracy

LOGARITHMIC or LOGISTIC CURVE In the higher Geometry, a curve line having this property, that its abscissa are proportional to the logarithms of the corresponding ordinates It is constructed in the following [illegible] O the axis [illegible] A B, A C, A D, &c be taken in arithmetical progression (or such that A B = B C = C D = &c), and from the several points A, B, C, D, &c let the perpendiculars A I, B M, C N, D O, &c be erected, forming a geometrical progression, or such that A L : B M = B M : C N = C N : D O = &c, then their summits I, M, N, O &c will mark the [illegible] The curve is ascending or descendin[illegible] continued from L upwards towards [illegible] towards $m$

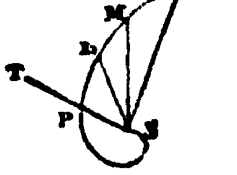



The equation of the curve is $x = a \log y$, and hence its principal properties are easily deduced Taking the differential of the equation, we get $dx = a\frac{dy}{y}$, whence $y\frac{dx}{dy} = a$ Now in any curve $y\frac{dx}{dy}$ is the expression of the subtangent therefore the [illegible] of the logarithmic at different points [illegible] The constant $a$ to which the subtangents are equal is the modulus of the system of logarithms represented by the particular curve When the subtangent (B T for example) is equal to A L, the primary ordinate which represents unity, the curve will exhibit the natural or Napierian logarithms

From the equation $dx = a\frac{dy}{y}$ we have $y\,dx = a\,dy$, but $y\,dx =$ the differential of the area, therefore the area $= \int a\,dy = ay +$ const Making first $y =$ D O, and then $y =$ C N we have the area C N O D $= a$ (D O − C N), that is to say, the area contained between two ordinates is equal to the rectangle under their difference and the constant subtangent

The logarithmic curve was proposed by Gregory of St Vincent soon after the discovery of logarithms, and its leading properties were investigated by Huygens and others Great use is made of it in various applications of physical science, and particularly in exhibiting the relations of elastic fluids (See *Keill's Tract on Logarithms*, *Euler's Introd in Anal Inf*, vol ii, *Leslie's Geometry of Curves* &c)

LOGARITHMIC SPIRAL, or LOGISTIC SPIRAL A curve line, which is generated as follows —Let the line S T revolve uniformly about a fixed point S, while another point P advances or recedes on S T with a velocity always proportional to its distance from the centre S, then the point P will trace out the logarithmic spiral




From this definition of the curve it follows that radiants S L, S M, S N, &c, making equal angles with each other, are continued proportionals, and that the angles about the pole S are the logarithms of the ratios of the successive

radiants whence the curve has its name Let S L = 1, S M = *y*, the angle L S M = *z*; then *z* = *a* log *y*, where *a* is a constant quantity The curve is consequently [illegible] the difference being [illegible] taken as straight lines, whereas in the case of the spiral they may be conceived to be taken as the arcs of a circle

The logarithmic spiral has many remarkable properties. One of them is, that the curve intersects all its radiants at the same angle, and this angle is the modulus of the system of logarithms which the particular spiral represents Another of its properties is that its involute and evolute are the same curve with itself Newton proved that if the force of gravitation had been inversely as the *cube* of the distance instead of the *square*, the planets would have shot off from the sun in logarithmic sp[illegible] (See Appendix)

**LOGEION** (Gr λογειον) In ancient Architecture, the Greek name for *proscenium* (which see) By the Romans it was called the *pulpitum*

**LO'GIC** (Gr λογικη (τεχνη understood, from λογος *speech*, *discourse*, or *calculation*), has been defined the science, and also the art, of reasoning It is a science because it investigates those principles on which reasoning proceeds it has been termed an art, as furnishing rules whereby the formal part of an argument may be constructed Logic was highly valued, perhaps overvalued among ancient philosophers The Stoics, in particular, were celebrated for their application of its principles to their own favourite metaphysical discussions From the abuse of logical knowledge [illegible] fallacies of the Sophists, who according to [illegible] representations of Athenian writers, were hired to furnish their pupils with the means of defending right or wrong positions with equal facility Zeno of Elea is called the father of logic, or dialectics according to the ancient appellation of the science but we are not well acquainted with the discipline which he taught although it can hardly have consisted, as more recent writers have represented, of a mere manual of captious fallacies But it is to the master mind of Aristotle that the science owes, as far as we are able to ascertain not only its first exposition, but its complete development for although logic has been extensively interwoven in later times with the subtleties of metaphysics and of rhetoric yet, as far as the limited province of the pure science extends, little has been done besides placing in a clearer light the discoveries of the Stagyrite When in the middle ages the Aristotelian logic became the foundation of the scholastic philosophy (which was little better than a revival under another form of that of the Athenian sophists) attempts were made especially one by the famous Raymond Lullius, to throw the science into a new form but without success In consequence of the various misapplications and perversions which the system had undergone in the hands of later dialecticians, it fell into great disrepute in modern times, and many of our first metaphysical writers, as Locke for example have treated it with very unmerited contempt Confined to that narrow limit to which alone its rules really extend it is a serviceable exercise for the mind, and affords an accurate insight into the formal part or machinery of reasoning

However multifarious the subjects to which reasoning may be applied and however complicated its details may become, the process by which all reasoning is conducted is one and the same Whoever seeks to prove that because one thing is thus therefore another thing is so [illegible] In analysing the process in question, we find, in the first place, that every truth or apparent truth, arrived at by reasoning, technically termed a conclusion, is deduced from two other propositions, technically termed premises either both expressed, or one expressed and the other implied In many instances it is at once evident to the mind of one capable of reasoning that if the two premises be true, the conclusion must follow Thus, if I wish to prove the mathematical truth that every A is equal to B, I find a third quantity C which is equal to both, and my argument then assumes the following shape — whatever is equal to C is equal to B, but every A is equal to C, therefore every A is equal to B Here the connection between the conclusion and the premises is at once evident and true, but there are many cases in which there is an apparent connection which is in reality false in other words, from two premises a conclusion is deduced, which admitting the truth of those premises, does not in reality follow from them The following, for example, is an instance of a conclusion incorrectly deduced from its premises, which, nevertheless, might at first sight pass current for reasoning "Every rational agent is accountable, brutes are not rational agents therefore brutes are not accountable" To explain the reason why the first of these two arguments is sound, and the latter unsound, requires not the examination of truths in mathematics or in natural religion, but simply of the common process of reasoning, and it is the means of making such an analytical investigation which are afforded by logic

The one of these arguments is a correct, the latter a false or apparent, syllogism (*see* SYLLOGISM); and the validity of the first, and invalidity of the latter, depend upon the necessary or unnecessary connection between the premises and the conclusion, the rules for ascertaining which will be found compendiously given under the head SYLLOGISM A single sentence may often be found to contain, elliptically expressed, and compressed into a narrow compass a whole chain of separate syllogisms [illegible] has been arrived at by this [illegible]

The [illegible] famous maxim termed in the schools of the middle ages the "dictum de omni et nullo,"—viz that "whatever is predicated (*i e* affirmed or denied) universally of any class of things may be predicated, in like manner (*i e* affirmed or denied) of any thing comprehended in that class" Thus, for example in the instance previously given of a valid argument if it can be predicated of the whole class of things which are equal to C that they are also equal to B, if I find any thing equal to C, I may predicate of it that it is equal to B also Hence my second premise A is equal to C, serves to bring me, logically, to the required conclusion — that A is equal to B This therefore, is the general principle on which that process is conducted which takes place in every syllogism

In order that reasoning may be contemplated simply as reasoning without any reference to the essential truth or falsehood of the propositions contained in it, which have nothing to do with the science we are now considering and also with a view of furnishing brief and expressive forms, like those of algebra, instead of words at length a set of arbitrary symbols are employed in logic to denote the qu[illegible] termed of propositions [illegible] or denies a fact every proposition also predicates (*i e* affirms or denies) that a certain attribute belongs either to a whole class or to some members of a class, of objects propositions are therefore in quality, either affirmative or negative, in quantity universal or particular Thus the four symbols of propositions in logical manuals are A universal affirmative, I particular affirmative, E universal negative O particular negative And the form of a [illegible] of the character of each of its premises and of the conclusion, is expressed by three of these letters Thus [illegible] consisting of three univers[illegible] found on examination that each proposition predicates a certain attribute of all the members of a class), will be designated by A A A, a syllogism termed in logical language *barbara* *See* SYLLOGISM

It is also found on farther analysis, that a syllogism embraces three separate objects or notions, two of which are compared with the third and, in consequence of that comparison pronounced to agree or disagree with each other Thus, in the syllogism "No dishonest man is a good citizen Caius is a dishonest man, therefore Caius is not a good citizen" The individual object, 'Caius," and the class of objects 'good citizens," being compared with a third class dishonest men," are found, the one to agree the other to disagree, with that class, and hence it inevitably follows that they disagree with each other — *i e* the conclusion of the syllogism is negative These three objects or terms as they are called in logic, occur in every syllogism The predicate of the conclusion,—*i e* that term which in the conclusion, is predicated of the other, in this instance "good citizen"— is called the major term, the subject of the conclusion—*i e* that term of which the other is predicated (Caius)—is the minor term, and the term with which the other two are respectively compared, "dishonest man," is the middle term

But every word, or combination of words, is not capable of [illegible] — *i e* something which may be predic[illegible] of [illegible] or of which another thing may be [illegible] In the first place adverbs, prepositions nouns in any inflection from the nominative case, &c can only form parts of a term, in logical phrase, [illegible] adjectives, also, have always, [illegible] subjoined, when employed as terms Verbs are mixed words, being resolvable into a term employed as a predicate, united to the *copula* or auxiliary verb (*is* or *is not*) Thus, nouns in the nominative case alone are simple terms or categorematics, these, again, are either the name of an individual or the name of the class the [illegible] terms) may be subjects, but cannot be [illegible] latter may be either Thus, in [illegible] singular term, "C[illegible] dicated that he is rich — *i e* a rich man

A common term, being a word equally applicable to a number of individuals, expresses a notion formed by the faculty of abstraction. When, for example, we contem-

plate several individual oak trees and abstract from each its separate peculiarities of height, growth &c we form the notion of an oak Contemplating a number of trees [illegible] abstracting from each its specific [illegible] we next arrive at the common [illegible] These common notions or terms are then the *predicables* which can be affirmed or denied of other objects

Predicables are divided into several kinds, although the division is, perhaps, strictly rather appertaining to metaphysical than logical science Every predicable is said, according to this division, to express either the genus species difference property or accident belonging to an individual (see these heads and Predicables) But it is to be remembered that a predicable may be referred to one or other of these several kinds, according to the point of view from which it is contemplated If I say of Cæsar that he is a "man," I express his species, considering him in those respects in which he differs from other animals If I say that he was "brave," I express a property If I predicate of him the several circumstances in which he absolutely differed from all other men I express that property or that bundle of united properties which forms his "difference" Every predicable, with a little attention, may be ranged under one or the other of these five classes, although it must be confessed that the distinction seems occasionally arbitrary and unphilosophical

In this hasty outline of some leading features of the art of logic as taught at Oxford (where alone we believe, pure unapplied logic forms a branch of study), we have chiefly made use of the Archbishop of Dublin Dr Whately's valuable *Elements of Logic*

The following passage is cited by Mr Hallam from the *Port Royal Logic*, as giving a juster view of the value of the Aristotelian method than its admirers are wont to entertain —"Cette partie, que nous avons maintenant a traiter, qui comprend les règles du raisonnement, est estimée la plus importante de la logique, et c'est presque l unique qu on y traite avec quelque soin, mais il y a sujet de douter si elle est aussi utile qu'on se l imagine La plupart des erreurs des hommes viennent bien plus de ce qu'ils raisonnent sur de faux principes, que de ce qu ils raisonnent mal suivant leurs principes Il arrive rarement qu'on se laisse tromper par des raisonnemens qui ne soient faux, que parceque la consequence en est mal tirée, et ceux qui ne seraient pas capables d en reconnaitre la fausseté par la seule lumière de la raison ne le seraient pas ordinairement d'entendre les règles que l on en donne, et encore moins de les appliquer Neanmoins quand on ne considéreroit ces règles que comme verités spéculatives, elles serviraient toujours à exercer l esprit" (*Esprit de Penser*, part 3) "To represent this portion of logical science as the whole" adds the same writer, appears [illegible] lar Euclid's axioms and [illegible] metry" (*Introduction to the Literature of Europe*, vol iii p 221) All that can be said in answer is, that the more general meaning of the term logic is undefined, and that it is employed by various writers and schools in the most arbitrary manner, while this portion, though it may be but a small one, is so clearly marked out and forms so distinct a body, that it has occupied in common language the character of the whole science

LOGOGRAPHY Gr λογος, *speech*, γραφω *I write*) A system of taking down the words of an orator without [illegible] which was put in practice [illegible] Twelve or fourteen reporters were seated round a table Each had a long slip of paper, numbered The writer of No 1 took down the first three or four words, and as soon as they were spoken gave notice to his neighbour by touching his elbow, or some other sign No 2 [illegible] No 3, and so on, [illegible], No 1 then began the second line thus all the 12 or 14 slips, when filled, being arranged parallel to each other, formed a single page This mode required great attention and quickness, and was not found to answer well in practice It was introduced in the National Assembly in October, 1790, the expenses being paid by the civil list, and continued until the 10th August, 1792, when Louis XVI and his family, taking refuge from insurrection in the assembly occupied the box of the logographe After that time it was not used (*Dictionnaire de la Conversation*)

*Logography* is also used [illegible] in which whole words [illegible] letters This method was [illegible] the printing of *The Times* newspaper, but after a short trial [illegible] inconvenient

LOGOGRIPH Gr λογος, and γρυφος, *a net*) A [illegible] posed for solution, in order to exercise the mind, is so called The word is used by Ben Jonson

LOGWOOD The wood of the *Hæmatoxylon campechianum*, a tree growing in many parts of the West Indies and on the adjoining continent It is employed in dyeing and calico-printing for the production of reds, blacks, drabs, and several compound colours Its colouring principle has been termed *hæmatine* An extract of logwood is used in medicine as an astringent The price of [illegible] from 10*s* to 7*l* per ton, [illegible] Britain in the three [illegible]

LOIMIC (from λοιμος, *a pestilence*) Relating to the plague or contagious disorders

LOK In Northern Mythology, the name of a malevolent deity, corresponding to the Ahriman of the Persians, who is represented to be at war with both gods and men and originating all the evil with which the universe is desolated In the *Edda* (the great poem of the Norwegian nations) he is described as the great serpent which encircles the earth (supposed to be emblematical of sin or corruption) and as having given birth to Hela, or Death, the queen of the infernal regions

LOLLARDS A class of persons in Germany and the Netherlands who professed, in the 14th century, to undertake spiritual offices in behalf of the sick and dead, and succeeded in attracting the attention and love of the mass of the people who thus were in a great measure alienated from the secular and regular clergy by their general [illegible] The origin of the name has been [illegible] the inquiries of Mosheim seem to lead to the result that it is compounded of the German words *lallen* (identical with the *lallare* of the Romans and the *lull* of our own language, signifying to sing in a murmuring strain) and *hard*, a common affix, as in the somewhat similar word *beghard* A Lollard therefore, meant one in the habit of singing to the praise of God or funeral dirges and the like, as was the custom of the early professors of this holy manner of life The Lollards, however, were accused — probably through the envy and spite of the mendicant friars and others whose neglected duties they so zealously performed — of holding many heretical opinions It is not impossible that there might have been some degree of enthusiasm mixed up with so ardent and unworldly a devotion, but the charges of violent reforming views, still more those of practical vice appear to rest upon no authentic grounds In process of time the name was applied by the partizans of the church to all heretics and schismatics of the day generally, and the followers of Wicliffe in England are frequently stigmatized under the name of Lollards (See *Gieseler's Text-book*, transl, vol iii pp 99 129)

LOMBARD A term anciently used in England for a banker or money-lender The name is derived from the Italian merchants, the great usurers or money-lenders [illegible] of the 13th century, and to have taken up their residence in a street in the city which still bears their name Stowe, in his *Survey of London*, says, "Then have ye Lombarde Street so called of the Longobards and other merchants, strangers of diverse nations assembling there twice every day The meeting of which merchants there continued until the 22d of December, in the year 1568, on the which day the said merchants to make their meetings at the Bursse, a place then new builded for that purpose, in the ward of Cornhill, and was since, by her majesty Queen Elizabeth named the Royal Exchange" (P 202)

LOMENTUM A fruit similar to a legume, excepting that it is contracted in the spaces between each seed and there separates into distinct pieces, or is indehiscent, but divided by internal spurious dissepiments, whence it appears at maturity to consist of many articulations and divisions It occurs in the genera *Ornithopus Hedysarum*, &c

LONG A musical character of this form P, whose length in common time is equal to four semibreves, and consequently eight minims

LONGICORNS [illegible] (Lat longus *long*, cornu, *a horn* The [illegible] coleopterous insects in the system of Latreille so called on account of the length of the antennæ which are rarely shorter than the body and commonly surpass it in length But this conspicuous character is not the only one which the Longicorn beetles possess in common In all of them the under part of the three first joints of the tarsi is furnished with a brush, the second and third are cordiform the fourth is deeply bilobed and there is a little nodule, resembling a joint, at the base of the last The *labella*, placed on a short and transversal *mentum*, is usually membranous, cordiform, emarginate, or bifid, but sometimes is corneous, and forms the segment of a very short and transverse circle The antennæ are either filiform or setaceous they are sometimes simple in both sexes, and sometimes serrate pectinate, or flabelliform in [illegible] males The eyes in some species are rounded and [illegible] but slightly emarginate, and in these species the thorax is trapezoidal [illegible] The [illegible]

As the larvæ of a very great proportion of the Longicorns live in the interior of trees, or under their bark, they are destitute of feet or have but very small ones.

Their body is soft, whitish, thickest anteriorly, and the head spherical and provided with strong mandibles [illegible] particularly, perforating them very deeply, and sometimes killing them in every direction Some of them attack the roots of plants

The abdomen of the female Longicorns is terminated by a tubular and horny ovipositor These insects produce a small sharp sound, by rubbing the pedicle of the base of their abdomen against the interior of the parietes of the thorax

LONGIPALPS *Longipalpi* (Lat longus, *long*, palpus, *feeler*) The name of a family of Brachelytrous Coleopterans, or short-winged beetles, which have the maxillary feelers almost as long as the head

LONGIPENNATES, *Longipennes* (Lat longus, [illegible] *wing*) A family of swimming birds, comprehending those in which the wings reach as far as or beyond the tail, as the tropic bird, albatross, &c They are all denizens of the high seas, and from their powers of flight are to be met with in various latitudes The hind toe is free or wanting The beak is hooked or pointed at the tip

LONGIROSTERS, *Longirostres* (Lat longus, and rostrum, *a beak*) The name of a tribe of Grallæ, or wading birds, including those in which the beak is remarkable for its length and tenuity, and by the high sensibility of its tip is well adapted for searching or probing in mud or soil for worms or insects The different gradations in the form of the bill serve to divide the Longirosters into families and genera

LONGISSIMUS DORSI A muscle of the back, which assists others in keeping the spinal column erect

LONGITUDE, in Astronomy, has two different significations, according as it is applied to a celestial or terrestrial object The longitude of a heavenly body is the arc of the *ecliptic* intercepted between the vernal equinox and a great circle perpendicular to the ecliptic passing through the body It is reckoned eastward all round the sphere from 0 to 360° The longitude and latitude of a celestial object, having reference to the ecliptic, and not to the plane of the earth's diurnal motion, cannot be directly observed The elements necessary for determining a star's place, which are given directly by observation are its right ascension and declination, from which the longitude and latitude must be calculated by the rules of spherical trigonometry In the planetary theory, however, it is convenient to refer the motion of a planet to the plane of the earth's orbit or to make the longitude and latitude the co ordinates of its motion But the places of the stars are always defined, by modern astronomers, by means of their right ascensions and declinations

The longitude of a place on the earth is the arc of the *equator* intercepted between the meridian of the place and some conventional fixed meridian, which is regarded as the origin from which the measures are reckoned Terrestrial longitudes and latitudes correspond to right ascensions and declinations in the heavens with this distinction, however, that the right ascensions are always reckoned from the vernal equinox, or point in which the equator intersects the ecliptic, whereas the longitudes are reckoned by different geographers from different points, selected for some local reason, [illegible] thing connected with the earth's diurnal [illegible] can render one point of the equator more convenient than another [illegible] in the same direction [illegible] ircumference, while geographical longitudes are reckoned both eastward and westward, 180° each way

The parallels of latitude on the earth are distinctly marked out by the diurnal circles described by the stars and consequently latitude can always be determined by direct observation of the heavens but the case is entirely different with respect to longitude, for to observers situated under the same parallel of latitude, but under different meridians, the heavens present exactly the same aspect, and there is nothing whatever to indicate any difference of locality Longitude, therefore, cannot be measured by direct observation, it can only be inferred from the measurement of intervals of time to which it is proportional In the course of a sidereal day the rotation of the earth brings successively every different meridian [illegible] and, the rotation of the earth [illegible] t follows that the angular distance [illegible] will be the same part of 360° that the interval of time which elapses between their coming to the same star is of twenty-four hours For example, if a star pass the meridian of a place A at a certain moment, and that of B exactly one hour of sidereal time later, then the difference of longitude between A and B is the twenty-fourth part of 360°, or 15°, and the longitude of B is 15° west of A The determination of longitudes consequently resolves itself into the measurement of time; and as the time, or the instant of mean noon at any place can always be found without difficulty, if an observer at one place can by any means determine the precise hour it is at any other place *at the same instant*, he has then determined the difference of longitude between the two places

Of the various methods by which differences of longitude may be determined, the simplest and most obvious is that of transferring chronometers from one place to another Suppose [illegible] A and B, each to [illegible] sidereal time of his st[illegible] also regulated to true [illegible] the clock at A, and t[illegible] any change of rate to [illegible] would thus be exhibi[illegible] the time occupied by the equinoctial point or by any star in passing from the meridian of A to that of B, or it is the difference of longitude of the two places expressed in sidereal hours, minutes, and seconds Were chronometers perfect, nothing more complete and convenient could be desired, but this unfortunately is even now very far from being the case, and until within a comparatively very recent time the practical determination of the longitude by means of chronometers could not be attempted

Another method of determining the difference of longitude between two places, independently of astronomical observations is that by telegraphic signals This method though from its nature of the first application is susceptible of great accuracy The explosion of a rocket, the flash of gunpowder in an open dish the extinction of a bright light, &c, are instantaneous phenomena which can be seen at great distances and noted with the utmost precision A signal of this kind made at a station visible from two observatories, must be seen at the same absolute instant of time from both, and the time marked by the clock of each observatory at this instant being noted the difference of their local times, and consequently the difference of their longitudes, becomes known This method is chiefly practised in connection with geodetical operations for measuring degrees of longitude on the earth's surface, and is perhaps the best that can be adopted for determining the difference of longitude between two observatories situated at no very great distance from each other By means of intermediate signals and observers suitably disposed between each, it may also be applied to transfer the time from one place to another when the distance is too great to allow an artificial signal of any kind to be seen from both (See *Phil Trans*, 1826)

When the distance between two places is very considerable, artificial signals cannot be employed, and it becomes necessary to have recourse to the methods furnished by astronomy These are principally the following —

1 *Eclipses of the Moon* — The instant of time at which the moon's disk enters or quits the earth's shadow is independent of the position of the observer, and therefore if the phenomenon could be accurately observed, would give the longitudes of all places from which the eclipse is visible But the penumbra of the earth renders it impossible to determine the precise instant at which the disk enters into the true shadow the observation in fact is uncertain to the amount of a minute of time, which corresponds to a quarter of a degree of longitude, and therefore this method, which was proposed and employed by Ptolemy is now altogether abandoned

2 *Eclipses of Jupiter's Satellites* — These phenomena also occur at the same instant of absolute time to all places on the earth, but they are not susceptible of being observed with much exactness, for the same reason which renders the lunar eclipses uncertain namely, the penumbra of the planet The uncertainty is least in the case of the first satellite on account of its quick motion and as the eclipses of this satellite occur much more frequently than those of the others, the observations are chiefly confined to it The times of the eclipses of the three first satellites are given in the *Nautical Almanac*, so that an observer at any part of the world, who observes one of these eclipses, has only to compare his local time with that assigned to the phenomenon in the almanac in order to determine the distance of his meridian from that of Greenwich But, on account of the uncertainty of the observation, the longitude obtained by this method may be considerably in error

3 *Occultations of Fixed Stars by the Moon* —This method, which is one of the readiest and most useful on land, though it can seldom be practised at sea consists in observing accurately the time at which a certain fixed star disappears behind the disk of the moon, or reappears after having been occulted The first of these phenomena is called the immersion of the star, the second the emersion But, on account of the moon's parallax, the immersion or emersion of a star behind her disk does not take place at the same absolute instant to observers on different parts of the earth, a calculation is therefore necessary to clear the observation of parallax, or to determine the time at which the phenomenon would have occurred [illegible] from the centre of the earth This reduction being made the moon's apparent

semidiameter at that instant must be calculated; by means of which, after applying the proper corrections for parallax, refraction, &c, the exact distance of the star from the moon's centre at the moment of the immersion becomes known. Now, suppose the same occultation to have been observed at another place, and the true distance of the star from the centre of the moon computed in the same manner, or, without a corresponding observation, suppose the time at the second place (Greenwich, for example) to be computed, for which the star's distance from the moon was the same as observed at the first place [illegible] times will show the difference of [illegible] places. The length of the calculat[illegible] gitude is deduced is a disadvantage which attaches to this method. *See* OCCULTATION.

4. *Eclipses of the Sun.* The longitude is deduced from the observation of solar eclipses, in the same manner, and by precisely the same sort of calculations, as from the occultation of fixed stars. An eclipse of the sun is, in fact, an occultation; but these phenomena occur so seldom at any particular place that they afford little assistance in the determination of longitudes. It may be remarked that the irregularities of the border of the moon's disk render the instant of the commencement or end of a solar eclipse, as also of the immersion or emersion of a fixed star, somewhat uncertain. But this uncertainty is corrected, or rather avoided, by measuring with a micrometer the distance between the two cusps, which, shortly after the commencement of the eclipse, [illegible] well defined. Know[illegible] ngth of the chord, and [illegible] bodies, the true distance of their centres at the instant the measure was taken can be calculated without much difficulty. As this measurement can be executed with much precision, and can also be repeated frequently during the progress of the eclipse, the phenomenon of a solar eclipse affords one of the most certain methods of determining a longitude which can be practised. *See* ECLIPSE.

5. *Transits of the Moon.*—This method is founded on the moon's rapid change of place among the stars, which becomes very sensible even in short intervals of time. Suppose an observer at the station A to determine the sidereal time of the transit of the moon's centre over his meridian, and suppose another observer at B, to the west of A, also to note the sidereal time of the same transit. If the moon's right ascension had in the interval undergone no change, the sidereal times marked by the two observers would have been the same; but as the right ascension has increased, while the moon was passing from the meridian of A to that of B the sidereal time of the transit at the latter place will be increased; and, supposing the change of right ascension to be uniform, the difference of the times of transit will be proportional to the difference of meridians. The chief objection to this method is, that any minute error in the adjustment of the transit instrument or rate of the clock is thrown upon the longitude, on which it produces a very sensible effect. The method can, therefore, only be safely practised at fixed observatories with the best instruments.

6. *Moon-culminating Stars.*—This method has been proposed for the sake of [illegible] the effect of minute instrumental errors, which render the method last described so difficult. A star is chosen which *culminates* (that is, comes to the meridian) at nearly the same time with the moon, and which has very nearly the same declination, so that it may be seen in the field of view [illegible] the position of the transit instrume[illegible] star, as well as the transit of the moon's limb, is observed at both stations (or at least observed at the one station, and calculated for the other whose meridian is known), and the difference of sidereal time between the two transits noted at each. This difference, in consequence of the moon's motion in right ascension, is not the same at both stations; and its variation gives the difference of the longitude. By this means any error of the position of the transit instrument affects the star and the moon both alike; but it is erroneous to suppose that the method is independent of accuracy in the adjustment of the transit instrument, for if the instrument is out of the meridian, the resulting longitude will be in error by the amount of the moon's variation in [illegible] the corresponding interval. This [illegible] practised.

7. *Lunar Distances.*—None of the methods which have yet been described (excepting that by chronometers) can be applied to the very important problem of determining the longitude of a ship at sea. In this case, no fixed or meridian instrument can be employed; and the observer can only measure the apparent distance of the moon's limb from a fixed star or planet with a sextant, or some [illegible]. For the purpose of render[illegible] to seamen, the distance of the moon from certain fixed stars is computed (several years previously) for every three hours of Greenwich time, and published in the *Nautical Almanac*. The moon's distance from one of these stars being observed on board a ship, and corrected for refraction and parallax, and the apparent time at the place and moment of observation being determined in the usual manner by the altitude of the sun or a known star, the difference between the apparent time of the observation and the apparent time at Greenwich *corresponding to the same distance*, interpolated from the *Nautical Almanac*, gives the longitude of the ship. *See* LUNAR METHOD.

In the projection of maps and charts it is necessary to assume a point of the equator as the origin of the longitudes. The meridian passing through this point is called the *first meridian*; and as its selection is perfectly arbitrary, it has been placed by different geographers at various parts of the earth; a circumstance which occasions some inconvenience in consulting works of geography. Modern geographers usually assume the meridian of the capital of their own country as the first meridian. English writers generally adopt the meridian of the Greenwich Observatory, for which the *Nautical Almanac* is computed; the French that of the Observatory of Paris. (*See* MERIDIAN.) Ptolemy, and the most celebrated of the ancient geographers, placed the first meridian at the Fortunate Islands (now the Canaries), which they conceived to be the utmost boundary of the habitable earth. The Arabian astronomers also counted the longitude from the Fortunate Islands; and many of the modern geographers have counted from the island of Ferro, one of the most westerly of the Canaries. The reason for fixing on this point was probably that as there was no land known to the west of the first meridian, the longitudes of all places would be reckoned in the same direction, or there would be no west longitude. The discovery of America destroyed the force of this reason. The inconvenience of counting in two directions is not very great; but it might be avoided by reckoning the longitude all round the circle to 360°, which would undoubtedly be an improvement on the present method.

*Degrees of Longitude.*—T[illegible] th being spheroidal, the degrees of [illegible] we proceed from the equator towards either pole. For the law of their variation, and their lengths on the different parallel circles, see DEGREE.

*Geocentric Longitude* is the longitude of a planet as seen from the earth; that is, the point of the ecliptic to which it perpendicularly corresponds as seen from the centre of the earth.

*Heliocentric Longitude* is the longitude of a planet as seen from the sun. See the terms GEOCENTRIC and HELIOCENTRIC.

LONGUS COLLI. The name of a pair of muscles of the neck: when one contracts, it moves the neck to one side; when they both act, the neck is bent forwards.

LOOM. The well-known machine for producing cloth by the interweaving a series of parallel threads which run lengthwise, called the warp or chain, with other threads thrown transversely with the shuttle, called the woof or weft. Under the head WEAVING will be found a notice of the history of the loom, and the numerous improvements that have taken place in its construction from the earliest times down to the invention of Jacquard.

LOO'MING. The indistinct and magnified appearance of objects seen in particular states of the atmosphere. *See* MIRAGE.

LOOPHOLES. In fortification, apertures formerly made in the battlements or in the walls of fortified places, for discharging [illegible] against the assailants. Since the invention of gunpowder, and the substitution of cannon for such missiles, loopholes have necessarily been discontinued in the construction of fortresses, the assailants of which are now sought to be driven back by guns fired through apertures of a different ch[illegible] which see.

[illegible] *Lophobranchii* (Gr. λοφος, *a tuft*, [illegible] *gills*). An order of Osseous fishes, comprehending those in which the gills are in the form of small tufts, and disposed in pairs along the branchial arches, as in the pipe-fish and hippocamp.

LO'PHOTES (Gr. λοφος). A genus of Tænioid fishes, characterized by a short head, surmounted by a high osseous crest, to the summit of which a long and stout spine is attached, bordered behind with a membrane and a low fin, of which the rays are nearly all simple, and which extends from the occipital spine to the point of the tail; this is terminated by a distinct but very small caudal fin.

LOPHY'ROPODS, *Lophyropoda* (Gr. λοφυρος, *crested*, πους, *a foot*). The name of a section of Entomostracous Crustaceans, comprehending those species with cylindrical or conical ciliated or tufted feet.

LO'PPING. Cutting off all the branches of a tree for the sake of the profit to be derived from them; as contrasted with pruning, by which some of the branches are cut off for the [illegible] a tree, however, does [illegible] of the crop or

leading shoot; and hence when timber trees are sold the purchaser bargains to take them either with or without the lop and crop, as the case may be

LORANTHA'CEÆ. (Loranthus, one of the genera) A natural order of parasitical Exogens, principally inhabiting the equinoctial regions of Asia and America. They are distinguished from *Caprifoliaceæ* and all other orders by their parasitical habit, and by the stamens being opposite to the petals. Brown suggests their relation to *Proteaceæ*, and, upon the whole, the structure of this order appears to be rather that of a polypetalous or apetalous than of a monopetalous order. Schleiden has lately made the startling assertion that the [illegible]. The bark is usually astringent. [illegible] their power of rooting in the wood of other plants. They effect this when they first germinate by fixing their root upon the bark, and then by slow degrees introducing it into the tissue till they reach the wood, between the wedges of which they slightly insinuate themselves, thus placing their abortive roots in the line of the current of ascending sap. They are generally beautiful plants, but [illegible]. Mistletoe is the most [illegible].

LORD [illegible], said to be derived from two Saxon words signifying a giver or distributor of bread. It may be said to be either a title of hereditary dignity (as lord of parliament, &c.), or a title expressing certain powers, as lord of a manor, lord chancellor, lord of the treasury, &c. The eldest sons of earls, and all the [illegible].

LORD ADVOCATE [illegible] CATE.

LORD-KEEPER. *See* KEEPER, CHANCELLOR.

LORD-LIEUTENANT OF IRELAND. The chief executive officer of the Irish government, representing in some respects the person of the king. The first viceroy or lieutenant of Ireland appears to have been appointed in the reign of Henry II., and by acts of parliament passed in the reigns of Richard III. and Henry VIII. provision was made for the election of a governor by the chancellor, treasurer, and other high officers of the government, on the death or resignation of a lieutenant until the king's pleasure were known. The chief officer in Ireland has been variously styled at different times, as custos or keeper, justiciary, warden, procurator, seneschal, constable, deputy, and lieutenant. He is appointed by letters patent [illegible] bene placito. He has a council composed of the great officers of the crown in Ireland and others appointed by the crown. He corresponds with the secretary for the home department, but the management of the affairs of the Irish government in London is chiefly entrusted to the secretary for Ireland who is also chief secretary of the lord-lieutenant. He has also a household consisting of a private secretary, steward, [illegible], master of the horse, and [illegible]. His salary has been usually 20,000*l.* per annum.

LORD-LIEUTENANTS OF COUNTIES. In England and Wales, officers appointed by the king, and entrusted by parliament with full power and authority to call together, arm, and array the militia, and cause them to be trained and exercised once every year. Each may appoint twenty or more deputy lieutenants who must have 200*l.* a year freehold estate, except in the Welsh [illegible] the qualification [illegible] nominates officers in the militia and yeomanry; but the names both of deputy-lieutenants and officers must be laid before the king, and if he, within fourteen days, expresses disapprobation, the commissions do not issue.

LORD PRIVY SEAL. *See* SEAL.

LORDSHIP. *See* LEET.

LORE (Lat. lorum, *a strap*), in Ornithology, signifies the space between the bill and the eye, which is bare in some birds, as the great crested grebe, but is generally covered with feathers. In Entomology the term is applied to a corneous angular machine observable in the mouth of some insects, upon the intermediate angle of which the mentum sits, and on the lateral ones the cardines of the maxillare, and by means of which the trophi are pushed forth or retracted, as in the Hymenopterous insects.

LORI'CA (Lat. lorum, *a thong*). A cuirass or crest of mail, made of leather and set with plates of metal in various forms, chiefly in rings like a chain, used by the Roman soldiers.

LO'RICATES, *Loricata* (Lat. lorica, *a coat of mail*). The name given by Merrem to an order of reptiles dismembered from the *Sauria* of Cuvier, and including those species, as the crocodile, which are protected by an armour of bony plates.

LORICA'TION (Lat. loricare, *to crust over*). A term of old chemistry, signifying the application of a lute or coating to glass and other vessels.

LORIS. *See* STENOPS.

LOSS. In Geology. *See* LOSS.

LOTE TREE (of the Ancients). Of this there were two kinds: the one a small plant, from which the *Loto-* [illegible] the other a tree with cut leaves [illegible]. The former was the *Zizyphus* [illegible] *australis*. In the Hindoo mythology, the lote tree is regarded as the symbol of creation. *See* LOTOPHAGI.

LO'THIAN. A name common to that part of Scotland which stretches along a considerable part of the southern shores of the Frith of Forth, and comprehends the three counties Haddingtonshire, Edinburghshire, and [illegible] of the so-called East, Mid, and West Lothian. The etymology of the name is doubtful. Lothian was taken possession of by the Saxon invaders A.D. 450, and became the scene of contest between the Saxon Gaels and Scoto-Irish, and was at length ceded to Malcolm II. in 1020. Lothian was considered as a country wholly distinct from Scotland in the reign of David I., and the period of its incorporation with the rest of the country is assigned to the 11th or 12th century.

LO'TION (Lat. lotum, supine of lavare, *to wash*). A mixture of different ingredients, or a solution of various medicinal substances, in water or other menstrua, designed for external application. Indolent ulcers and tumours require stimulating lotions, whereas sedative and narcotic mixtures are used to alleviate pain.

LOTO'PHAGI (Gr. λωτος, and φαγειν, *to eat*). A name given to a people of ancient Africa who inhabited the Regio Syrtica (*Iber.* iv. 177), so called from the lotus berry forming their principal food. They were represented as a mild hospitable race of men. The food with which they were nourished, among other peculiar qualities is said to have had the power of obliterating all remembrance of one's native country.

LO'TTERY (Germ. loos, *lot*), is defined as a game of hazard in which small sums are ventured for the chance of obtaining a larger value, either in money or other articles. Lotteries are formed on various plans, but in general they consist of a certain number of tickets drawn at the same time, with a corresponding number of blanks and prizes, by which the fate of the tickets is determined. The invention of lotteries has been ascribed to the Romans, by whom, however, they seem to have been resorted to as a means chiefly of amusing and gratifying the people. In modern times this species of gaming has been sanctioned at different periods by most of the European governments, as a means of raising money for public purposes. It would be difficult to give a complete account of the various changes which have taken place in the regulation of lotteries in different countries, but the subjoined summary of their history, from their origin down to [illegible] England may not be uninteresting. [illegible] of which there is an authentic record was drawn in 1569, when 400,000 tickets were sold at 10 shillings each. The prizes consisted chiefly of plate, and the net profits were intended to be appropriated to repairing the harbours of the kingdom and other public works. In the year 1612 a lottery was drawn for the benefit of the English colonies, and, in the course of the same century the desire for embarking in speculations of this kind increased to such a degree, and gave rise to such an infinity of private undertakings, many of which were formed on the most delusive and fraudulent principles, that, in the beginning of Queen Anne's reign, parliament found it necessary to suppress *private* lotteries "as public nuisances." The year 1709 saw the birth of the first state or parliamentary lottery, and from that time down to 1823 they were annually licensed by act of parliament, under a variety of regulations and modifications. In the very early part of last century the prizes were paid in the form of terminable annuities. Thus in 1746 a loan of 3,000,000*l.* was raised on 4 per cent annuities, and a lottery of [illegible] tickets, at 10*l.* each, and in the following year [illegible] was raised by the sale of 100,000 tickets, the prizes in which were founded in perpetual annuities at the rate of 4 per cent per annum. During the same century government constantly availed itself of this means to raise money for various public works, of which the British Museum and Westminster Bridge are well-known examples. But at the commencement of the present century a great repugnance began to be manifested in parliament to this method of raising any part of the public revenue, in consequence of the spirit of gambling which it tended to foster in [illegible] and notwithstanding the [illegible] 1793, which were confessedly attended with much good, the evils to which it gave birth at last became so palpable that, in the year 1823, the legislature at last consented to the entire abolition both of state and private lotteries. It would be superfluous [illegible] nent to point out how prejudicial [illegible] must be to public morals, by giving the countenance of government to systematic gambling, [illegible] by diffusing a spirit of speculation by which the [illegible] is diverted from habits of continued industry to delusive dreams of sudden and enormous wealth, which, in the great majority of instances, must end in poverty and ruin. Those who

wish to see the melancholy results of this system of finance exhibited in its true colours, will find ample information [illegible] to the House [illegible] in 1808, but we cannot refrain from inserting a paragraph from the *Wealth of Nations*, which illustrates their principle and operation with great brevity and effect —

"The world neither ever saw, nor ever will see, a perfectly fair lottery, or one in which the whole gain compensated the whole loss, because the undertaker could make nothing by it In the state lotteries, the tickets are really not worth the price which is paid by the original subscribers, and yet commonly sell in the market for twenty, thirty, and sometimes forty per cent advance The vain hope of gaining some of the great prizes is the sole cause of this demand The soberest people scarce look upon it as a folly to pay a small sum for the chance of gaining 10 or 20,000 pounds, though they know that even that small sum is perhaps 20 or 30 per cent more than the chance is worth In a lottery in which no prize exceeded 20*l*, though in other respects it approached much nearer to a perfectly fair one than the common state lotteries, there would not be the same demand for tickets In order to have a better chance for some of the great prizes, some people purchase several tickets, and others small shares in a still greater number There is not however, a more certain proposition in mathematics, than that the more tickets you adventure upon the more likely you are to be a loser Adventure upon all the tickets in the lottery, and you lose for certain, and the greater the number of your tickets, the nearer you approach to this certainty" (See also *Degerando's Bienfaisance Publique*, l ii ch 6)

State lotteries were abolished in France in 1836, along with the gambling houses, from which a great revenue had been derived They still exist in several of the German states That of Hamburg is established on a comparatively fairer principle than was adopted either in France or England the [illegible] ey for which the tickets are sold [illegible] the buyers, except a deduction of 10 per cent made from the amount of the prizes at the time of their payment See *Penny Cyclo*

LOUGH An Irish term synonymous with the Scotch *loch*, but not with the English *lake*, for loch and lough [illegible] designate [illegible] of the sea, as well as col- [illegible] water, which lake is not

LOUIS D'OR A gold coin under the old system of France, first struck under Louis XIII in 1641, from whom they derived their name The louis d or, says Kelly, coined before 1726, which passed then for 20 livres, were coined at the rate of 36¼ per French mark of gold 22 carats fine From the year 1726 to 178[illegible] louis d ors were coined at the rate of 30 to the mark of gold, and about this period all the gold coins in France were ordered to he brought to the mint to be melted down, and a new coinage then took place at the rate of 32 louis d'ors to the mark of the same degree of fineness, with a remedy of 15 grains in the weight, and $\frac{12}{32}$ of a carat in the allov The intrinsic value of this new coin was 18*s* 9¼*d* sterling Louis d ors were formerly regarded as a current coin in all parts of the Continent, but in England they are sold merely as merchandise, and their value has fluctuated from 18*s* 6*d* to 21*s* sterling The term louis d'or is still given to the gold coinage of the present government of France, though they are also often called 20-franc pieces

LOUIS, SAINT, OF FRANCE A royal military order, founded by Louis XIV in 1693 The badge is a cross of eight points, with fleur de lis, and bearing a circular shield containing the effigy of Saint Louis

LOU'VRE One of the most ancient palaces of France, It existed in the time of Dagobert as a hunting seat, the woods then extending all over the actual site of the northern portion of Paris down to the banks of the Seine The origin of its name has not been satisfactorily ascertained It was formed into a stronghold by Philip Augustus, who surrounded it with towers and fosses, and converted it into a state prison for confining the refractory vassals of the crown It was then without the walls of Paris, but, on their extension in the latter part of the 14th century, it was included within their circuit Charles V made additions to it That part of the palace now called the *Vieux Louvre* was commenced under the reign of Francis I, after the designs of Pierre L'Escot, abbot of Clugny When Charles IX resided in the Louvre, he began the long gallery which connects it with the Tuilleries, and in which is now deposited the celebrated collection of pictures It was finished under Henry IV Louis XIV, from the designs of Lemercier, erected the peristyle which forms the entrance to the Vieux Louvre from the side of the Tuilleries That monarch also gave a beginning to the remainder of the present modern edifice, from the designs of Claude Perrault The edifice has never been finished, though, under the reigns of succeeding monarchs, and especially during that of Napoleon, it has slowly advanced towards completion The eastern front, though not finished even now, exhibits a façade of sur- [illegible] ever equalled. [illegible] square on the plan Three of its sides were from the designs of Perrault above mentioned An [illegible] be necessary to connect the [illegible] to which it is joined at present only on the river side by the great gallery above mentioned but preparations are in progress to effect this object and on the side next the Rue St Honore about 140 feet have been executed Besides the gallery above adverted to, which contains some of the finest pictures in the world, the Louvre contains a museum of sculpture, antiquities, and other specimens of art, equally valuable

LOVE, FAMILY OF A sect of fanatics in the 16th century Holding tenets resembling those of the early Anabaptists There is a proclamation against them by Queen Elizabeth, dated from her manor of Richmond, 1580

LOVE FEASTS A species of religious ordinance held quarterly by the Methodists, to which members of their church alone are admitted, and that only on presenting a ticket or a note from the superintendent They are a relic of the *Agapæ* (which see) held by the early Christians

LOWER CHALK AND GREENSAND *See* GEOLOGY

LOWER EMPIRE The Roman empire, from the removal of the imperial seat to Constantinople, and its successor, the Byzantine empire, down to the capture of that city by the Turks, are frequently joined together under this name by modern historians

LOW SUNDAY In Ecclesiastical Antiquities, the Sunday next after Easter has been popularly so called in England, perhaps by corruption for *close* (Pascha clausum, *close of Easter*, one of the many names by which it was known in the Christian church) (*Riddle's Christ Ant* 640)

LOXIA (Gr λοξος, *crooked*) A genus of Conirostral Passerine birds, characterized by having a compressed beak, and the two mandibles so strongly curved that their points cross each other, sometimes on one side, sometimes on the other The crossbill (*Loxia curvi-* [illegible] of this genus

LOXODROMIC CURVE or SPIRAL (Gr λοξος, [illegible] and δρομος course) A curve spiral [illegible] which it intersects all under the same angle being regarded as the radii of the spiral It is the path which a ship sailing always on the same rhumb, or making the same angle with the meridians, describes on the surface of the terrestrial sphere The properties of the curve are analogous to those of the com [illegible] arithmetical spiral It always approaches the pole, [illegible] ever reaches it so that a ship by following always the same oblique course, would [illegible] approach the pole of the earth without [illegible] find the equation of the loxodromic, let $\varphi$ be the arc of the meridian intercepted between any point of the curve and the pole, and $\lambda$ the longitude of that point, then the infinitely small arc of the parallel of [illegible] corresponding to an increment of the curve is $d\lambda$ [illegible] and the differential of the co latitude is $d\varphi$, but, because the curve cuts all the meridians under the same [illegible] the variation of the parallel of latitude corresponding to an increment of the curve is proportional to the variation of the co-latitude, consequently $a\,d\lambda \sin.\varphi = d\varphi$, or $a\,d\lambda = \frac{d\varphi}{\sin.\varphi}$ which is the differential equation of the loxodromic, $a$ being a constant quantity

LOZENGE An oblique-angled parallelogram, or rhombus, formed by constructing two equal isosceles triangles upon opposite sides of the same straight line

LOZENGE In Heraldry, a bearing in the shape of a parallelogram, with two obtuse and two acute angles. The arms of maidens and widows are borne on shields of this shape

LOZENGE In Pharmacy a medicinal substance made up into a small cake gradually to be dissolved in the mouth Sugar, gum and starch are the usual inert parts of lozenges, and minute quantities of active substances are added, according to the purposes for which they are intended such as ipecacuanha or squills, for pectoral lozenges, extract of poppies or opium, for sedative lozenges, kyan pepper as a stimulant, oil of peppermint [illegible]

LUCANIDÆ (Gr λυκος, *a wolf*, also the name of an insect) A family dismembered from the Linnæan genus *Lucanus*, and including those insects which in addition to the comprehensive characters of the original genus present antennæ strongly geniculate, glabrous or but slightly pilose, the labrum very small, or confounded with the epistome, maxillæ terminated by a membranous or coriaceous, silky penciliform lobe, edentate, or with one tooth, and a ligula either entirely concealed or incorporated with the mentum, or divided into two nar- [illegible] or less beyond [illegible] and between the

elytra. The stag-beetle, *Lucanus cervus*, &c, is the type of this family. The sub genera are *Usalus*, *Lamprima*, *Sinodendrum* &c

LUCA'NUS (Gr λυκος) A Linnæan genus of Coleoptera, forming the type of a tribe of Lamellicorn beetles (*Lucanidæ*, [illegible] of Latreille) it is thus characterised Antennæ [illegible] joints, the first of which is usually much the longest, the antennal club has its leaflets or teeth arranged perpendicularly to its axis, in the manner of a comb The mandibles are always corneous, and most commonly exhibit a sexual superiority of development and peculiarity of form in the males The maxillæ are generally terminated by a narrow, elongated, and silky lobe, but sometimes are entirely corneous and dentated The ligula in most of the *Lucanines* is formed of two small silky pencils, projecting more or less beyond an almost semicircular or square mentum The anterior legs in the greater number are elongated, and their tibiæ dentated along the whole of their outer side The tarsi terminate in two equal and simple hooks, with a little [illegible] between them The elytra [illegible] to the upper part of the abdomen The insects thus characterised were first divided by the immediate successors of Linnæus into two genera, *Lucanus* proper and *Passalus*, both of which are now elevated to the rank of families, and subdivided into numerous subgenera *See* LUCANIDÆ and PASSALIDÆ

LU'CERES (Lat) In Roman antiquities, a body of horse composed of Roman knights, first established by Romulus and Tatius It is said to have received its name either from an Etrurian, who aided the Romans against the Sabines, or from the Lat *lucus*, a grove, where Romulus had instituted an asylum for all fugitives, slaves, and homicides, in order that he might people his infant city but it is difficult to account for the real origin of the word

LUCE'RN (*Medicago sativa*) A well known plant of the Linnæan class Diadelphia, and order Decandria, and of the natural family of the *Leguminosæ* There are many species of the Medicago, but of these the artificial grass, called Lucern, is most deserving of notice This plant was in high estimation among the ancients, and its nutritious qualities, easy cultivation, rapid growth, and luxuriant properties, have placed it in the first rank of vegetable food for cattle, even in the present times Lucern, says an old writer, is commended for an excellent fodder There is not any pulse or other feeding which is more agreeable or more precious for feeding beasts than lucerne so that it may seem to spring out of the earth as a more especial favour from God, not only for nourishing and fattening herds of cattle, but also to serve as a physic for beasts that are sick (*Country Farm*, 3d edit fol 1616, p 364) Those who wish to see the properties of this plant fully developed at once from the author's personal experience, and the concurrent testimony of the best agricultural writers both ancient and modern and its history traced from its discovery during the Persian expedition under Darius to its subsequent introduction successively into Greece, Italy, Spain, France, Germany, and, in fact wherever the art of husbandry has [illegible] down to its arrival in England, will find ample details in the learned *Essays on Husbandry* by the Rev Walter Harte (London, 1770), to which we beg to refer The origin of the term lucern is involved in obscurity Some authors have derived it, naturally enough, from the canton in Switzerland of that name, but from the account given by Mr Harte of the history of this plant, it does not appear either that Switzerland was particularly famous for producing it, or that the northern and western nations of Europe received it thence

LUCERNA'RIA (Lat lucerna, *a lamp*) A genus of fleshy polypi (*Polypi carnosi*) in the system of Cuvier, characterised by a long and slender [illegible] a radiated disc, which sends off numer[illegible] in bundles The *Lucernariæ* Cuvier regards as being nearly allied to the *Actineæ* or *sea-anemones*, but their substance is softer They emit [illegible]

LU'CIFER (Lat lux *light*, and *I bring* The morning star A name given [illegible], when she appears in the morning before sunrise When Venus [illegible] or appears in the evening, she was called *Hesperus* the evening star These names no longer [illegible] except by the old poets

LUCIFERS Matches tipped with a mixture of chlorate of potash and sulphuret of antimony they are inflamed by friction [illegible] piece of emery paper

LUCIFE'RIANS [illegible] and adherents of a sect of heretics, so called from Lucifer, [illegible] 4th century, whose opinions they [illegible] Luciferians considered the soul to be of a carnal nature and to be transmitted from father to child, but the chief occasion of the schism of Lucifer arose from his refusal to hold any communion with those clergy who had conformed to the Arian [illegible] Synod at Alexandria, A D 352 had determined to re admit into the church on condition of an open acknowledgment of their errors. The number of this sect was never considerable, and it was extinct in the time of Theodoret, but it deserves notice from being considered by the Roman Catholics as one of the great schisms in their church *See* SCHISM

LUCI'NA In Roman Mythology, the goddess who presided over the birth of children Her name is derived either from *lucus* or *lux*, according to Ovid's explanation,—

> Gratia Lucinæ, dedit hæc tibi nomina lucus;
> Aut quia principium, tu, Dea, lucis habes.

She is said to be the daughter of Jupiter and Juno, and has frequently been confounded with Diana and Juno, both of whom presided over childbirth She was called Ilithya by the Greeks

LUCU'LLITE A black limestone, often polished for ornamental purposes, to which it is said first to have been applied by Lucullus, the Roman consul

LU'ES (Lat) A poison or pestilence; a plague

LUFF The foremost edge or leach of a fore-and-aft sail *To luff* to bring the ship's head nearer the wind

LU'FFER BOARDING (Fr louvre) In Architecture boards in an aperture placed above each other at regular distances, and inclined to the horizon at an angle of forty-five degrees, so as to admit air without allowing the rain to penetrate

LUG-SAIL A four-sided sail bent to a yard, which is [illegible] about one fourth from the lower end

LU'MACHELLA Shell marble the [illegible] having a pearly lustre, it is sometimes [illegible] *marble*

LUMBAGO *See* RHEUMATISM

LUM'BAR A'BSCESS An abscess of the loins formed upon the psoas muscle it is frequently mistaken for nephritic or rheumatic disease, and, when it forms a swelling [illegible] from [illegible]

LUMBRICAL MUSCLES (Lat lumbricus *an earthworm*) Small muscles of the hand which assist in [illegible]

LUMBRICUS (Lat) A Linnæan genus of Vermes, now the type of a family (*Lumbricinæ*) which ranks as the first of the Setigerous Abranchian Anellidans in the system of Cuvier All the species of this family—the earthworms, as they are commonly called—are characterized by a long cylindrical body, divided by ruga into a great number of rings and by an edentate mouth The common earthworm (*Lumbricus terrestris* Linn) attains nearly a foot in length, and is composed of upwards of one hundred and twenty rings This species is extremely abundant they traverse the soil in every direction swallowing quantities of earth, together with portions of roots and ligneous fibres and other organized substances which they assimilate for their own nutriment Their castings constitute a rich soil

LUNA (Lat *the moon*) In Mythology the daughter of Hyperion and Terra usually confounded with Diana which see The heavenly bodies were favourite objects of worship among the ancients, and as they considered the sun to be sacred to Apollo, whom they worshipped as Sol, so they consigned the moon to the guardianship of his sister Diana [illegible] worshipped under the name of Luna

LUNAR CORNEA Fused chloride of silver, so called from its horn-like appearance, luna being the term by which the old [illegible]

LU'NACY, in Law [illegible] of an insane person who has lucid intervals, which in former times were supposed to depend on the phases of the moon, whence such persons were styled *lunatics* But, for convenience, the term is commonly used as embracing the condition of all those who are under certain legal disabilities on account of mental deficiency such as idiots, fatuous persons, &c, all, in short who are of unsound mind The chief of these disabilities are, incapacity to make contracts either personal or affecting the estate, to sue or defend in courts of justice, to perform offices and duties, to make devises or bequests By ancient legal maxim, the sovereign has the custody of lunatics This is in practice delegated to the keeper of the great seal, by virtue of the sign manual, countersigned by two secretaries of state Applications for a commission of lunacy are consequently directed to him When he determines that such a commission is proper, it issues to certain commissioners, appointed by the same authority They summon a jury to try the fact of lunacy If the party is found lunatic by its inquisition, the inquisition may still be avoided by a traverse, on which the record goes into the King's Bench, which either gives judgment or grants a new trial on it If the lunatic recover, the inquisition may be superseded On the return of the inquisition, the custody of the lunatic's person and estate devolves on the crown, and the chancellor, on petition, appoints *committees* to have the custody [illegible] These may be whoever the [illegible] fit, although next of kin are ordinarily preferred Lunatics are maintained by an allowance out of their own estate when they have none, by statute, in public asylums The custody of lunatics by private individuals is under the control of the provisions of the stat 8 & 9 Vict chaps 100

and 126, by which the powers vested in the Commissioners in Lunacy are placed on [illegible] and a commencement has been made in the management of lunatics which promises to be followed by the best results. Persons of unsound minds who are paupers, and those who have been tried for offences and found insane, and also lunatic convicts, are usually confined in county lunatic asylums, wherever these are established. As to the statistics of lunatic hospitals or asylums, see *Degerando, de la Bienfaisance Publique*, vol. iv. part 3. book 1.

The incapacity of a person of unsound mind to commit a crime depends, it is said, upon his [illegible] moral and legal. The general mode of [illegible] has been to acquit the prisoner, if satisfied that he was incapable of knowing right from wrong, or, as some eminent judges have worded it, if he was unconscious that the act was a crime against the laws of *God and nature*. On acquittal taking place on evidence of lunacy, the jury are now required, by 39 & 40 G. 3. c. 94, to find specially whether the person was insane at the time of committing the offence, and on that finding he is taken into public custody.

LU'NAR BONE. One of the bones of the wrist.

LU'NAR CAUSTIC. Fused nitrate of silver.

LU'NAR CYCLE. The period of time after which the new moons return on the same days of the year. *See* CYCLE.

LU'NAR DI'STANCE. In Navigation, the distance of the moon from the sun or from a fixed star or planet, by means of [illegible] a ship is found.

LU'NAR METHOD. In Astronomy and Navigation, the method of determining the longitude of a place or ship from the observed [illegible] *lunar distances*. This problem, which is of the very highest importance on account of its [illegible] finding the [illegible] into two parts. The first is to ascertain the distance of the moon's centre from one of the principal planets or fixed stars at a given moment, and the second, to find the Greenwich time to which, according to the tables, that distance corresponds. The general method of procedure may be explained as follows. — Six or eight observations of the star's distance from the nearest point of the moon's limb are taken with a sextant as quickly in succession as possible, and the corresponding time at each observation noted. The mean of the observed distances, at the mean time [illegible] distance corresponding to a known instant [illegible]. The true apparent time is here supposed to be given by the chronometer, the rate and error of which are determined by observations of altitude. Contemporaneously with the observations of distance, two assistants are employed in taking the altitudes, both of the moon and star, for the purpose of applying the proper correction for refraction. The remainder of the operation consists in making the requisite calculations. In the first place, the moon's semidiameter is added to the observed distance, whereby the true apparent distance is found. In the next place, the corrections are applied for refraction and parallax, and the apparent distance reduced to the centre of the earth. This part of the [illegible]. The [illegible] which the distances of the moon from some of the principal stars and planets is given for every three hours. Having found in the almanac the distances next less and greater than the true distance deduced from the observations, their difference gives the change of distance in three hours, whence, by interpolation, the Greenwich time is obtained at which the distance was exactly the same, and consequently the Greenwich time corresponding to the apparent time at the instant of the observation.

This method of finding the longitude at sea was first proposed by John Werner of Nuremberg so early as 1514, and recommended by several other astronomers who lived during the same century, but the theory of the lunar motions was then, and for a long time after, by far too imperfect to allow of its practical application. Besides, previously to the invention of Hadley's quadrant, there was no instrument by which the distances could be measured with the requisite precision. The advancement of astronomy, and the perfection of instruments of observation, have obviated [illegible] and the method of lunar distances is now [illegible] the mariners of all countries.

LU'NAR MONTH. The time in which the moon completes a revolution about the earth, and returns to the same position relatively to some celestial body, or point in space, with which her motion is compared. But the moon's period may be determined in relation to several objects, — as the sun, the equinoctial points, a fixed star, the perigee or nodes of her orbit, and accordingly there are as many different lunar months as there are assumed points of comparison, provided these points have different motions in the heavens.

1. The proper *lunar month* is the same as the *lunation* or *synodic month*, and is the time which elapses between two consecutive new or full moons, or in which the moon returns to the same position relatively to the earth and sun.

2. The *periodic month*, or *synodic month*, is the revolution with respect to the moveable equinox.

3. The *sidereal month* is the interval between two successive [illegible] with the same fixed star.

4. The [illegible] *month* is the time in which the moon returns to the same point, for example the perigee or apogee, of her moveable elliptic orbit.

5. The *nodical month* is the time in which the moon accomplishes a revolution with respect to her nodes, the line of which is also moveable.

The exact *mean* lengths of these different lunar months are as follow —

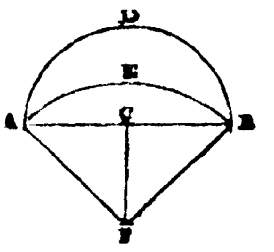
| | days | h | m | sec |
|---|---|---|---|---|
| Synodic month - - | 29 | 12 | 44 | 2 84 |
| Tropical month - - | 27 | 7 | 43 | 4 71 |
| Sidereal month - - | 27 | 7 | 43 | 11 54 |
| Anomalistic month - - | 27 | 13 | 18 | 37 40 |
| Nodical month - - | 27 | 5 | 5 | 35 60 |

These *mean* motions are not uniform, but are subject to periodic and secular variations. *See* MOON.

LU'NAR YEAR is the period of twelve synodic lunar months, and consequently contains 354 days, the lunar months in the calendar [illegible] 29 and 30 days. The exact period [illegible] 354 days, 8 hours, 48 min. 34 sec., so that the lunar year of the calendar requires to be adjusted by intercalation every third year. *See* CALENDAR.

LUNA'TION. The period of a synodic revolution of the moon, or the time from one new moon to the following, being that in which the moon passes through all her phases.

LUNI, or LU'NULA. A geometrical figure in form of a crescent bounded by two arcs of circles intersecting at its extremities. The lunula of Hippocrates, of Chios, is celebrated on account of a remarkable property discovered by that geometer, namely, that it can be exactly squared, though the quadrature of the whole circle has baffled the ingenuity of mathematicians of all ages. Let A D B be a semicircle whose centre is at C, and A E B a quadrant of another circle whose centre is at F (C F being perpendicular to the diameter A B), then the space contained between A D B and A E B is the lune of Hippocrates, and it is equal to the area of the triangle A F B. For the square of A F being equal to the squares of A C and C F, or twice the square of A C, and circles being to one another as the squares of their radii, the whole circle of which A F is the radius is equal to twice the circle of which A C is the radius, and consequently the area of the quadrant A E B F is equal to the semicircle A D B. Take away the common space A E B A, and there remains the triangle A B F, equal to the lune.




LUNE'TTE (Fr.). In Fortification, an enveloped counterguard or elevation of earth, made beyond the second ditch, opposite to the place of arms, differing from the ravelins only in situation. *Lunettes* are also works made on both sides of a ravelin. *See* FORTIFICATION.

LUNETTE. In Architecture, an aperture for the admission of light in a concave ceiling, such are the upper lights to the naves of St Peter's at Rome and of St Paul's at London.

LUNGS (Germ. lungen). The viscera by which respiration is carried on. The right lung is divided into three lobes, the left into two. They are, as it were, suspended in the chest by the *trachea* and separated by the *mediastinum*, they are also attached to the heart by the pulmonary vessels. They are nourished by the bronchial artery, which is a branch of the aorta, and the pulmonary artery carries the venous blood through them from the heart to subject it to the action of the air in their cellular structure; the blood when arterialized returns to the heart by the pulmonary veins, the four trunks of which enter the left auricle. The bronchial veins terminate in the vena azygos. The nerves of the lungs are from the eighth pair and [illegible] intercostal.

LUNISOLAR. [illegible] *moon*, and sol, *the sun*.) Combining the motions of the sun and moon. A lunisolar period is that after which the eclipses again return in the same order. (*See* CYCLE.) The Dyonysian period of 532 years, formed by multiplying together the solar and lunar cycles of 28 and 19 years, has sometimes been called the lunisolar year.

LUPERCALIA. A Pagan festival in honour of Pan [illegible], when the Luperci ran up and down the city naked, having only a girdle of goat's skin round their waist, and thongs of the same in their hands, with which they struck those they met, particularly married women who were thence supposed to be rendered prolific. The name is derived from lupus, *a wolf*, because Pan protected cattle from that animal.

The indecencies and excesses attending the processions of the Lupercals, which had degenerated from high religious rites to vulgar superstitions, provoked the indignation of Christians in the 4th and 5th centuries It is commonly, but erroneously, supposed that pope Gelasius caused them to be abolished (*Gibbon*, vol vi ) Beugnot has shown the contrary (*Destr du Paganisme en Occident* book xix ch 2 )

LUPER'CI The Roman priests of Pan, and most ancient religious order in the state, having been instituted, according to tradition, by Evander king of Pallantium a town that occupied the Palatine Hill before Rome was built There were three [illegible] them; viz the Fabiani, Quintiliani, and [illegible] of whom were founded in honour of Julius Cæsar For the derivation of the word see LUPERCALIA

LU'PININ The bitter substance, extracted from the leaves of the white lupin

LU'PULIN The active principle of the hop, it is more properly called *lupulite*

LU'PUS (Lat ) The wolf One of the southern constellations, situated on the south of Scorpio

LUPUS In Pathology a disease which eats away the parts attacked by it with great rapidity

LUSIAD The name given to the great epic poem of Portugal, written by Camoens, and published in 1571 The subject of this poem is the establishment of the Portuguese empire in India, but whatever of chivalrous great, beautiful, or noble, could be gathered from the traditions of his country, has been interwoven into the story Among all the heroic poets says Schlegel, either of ancient or modern times, there has never, since Homer, been any one so intensely national or so loved or honoured by his countrymen as Camoens It seems as if the national energies of Portugal had centered and reposed themselves in the person of this poet whom they consider as worthy to supply the place of a whole host of poets, and as being in himself a complete literature to his country Of Camoens they say,

Vertere fas aequare nefas aequalia nil est
Est sibi par nemo, nemo secundus erit

The great defects of the *Lusiad* consist in its preposterous mythological machinery, and its clumsy management, but in all the qualities of versification and beauty of language it is perfect, and may be regarded as the "well, pure and undefiled" of the Portuguese language

Few modern poems have been so frequently translated as the *Lusiad* Mr Adamson, whose *Memoirs of the Life and Writings of Camoens* must be familiar to the reader, notices one Hebrew translation of it, five Latin, six Spanish four Italian, three French, four German, and two English Of the two English versions one is that of Sir R Fanshawe written during Cromwell's usurpa [illegible] for its fidelity to the original, [illegible] who unlike the former took great liberties with the original, but whose additions and alterations have met with great approbation from all critics—except as indeed was to be expected, from the Portuguese themselves (See the *Quarterly Review* vol xxv )

LUSTRATION (Lat lustro, *I purify* ) In Roman Antiquities, a sacrifice by which the Romans purified their cities fields, armies or people defiled by any crime or impurity There were various manners of performing [illegible] re of the lustration [illegible] the Roman people he purified them as they were assembled in the Campus Martius by causing a young pig a sheep and a bull just sacrificed, to be paraded round them Before the celebration of the Ludi Seculares, which took place only once in a century, the *populace* was purified by a little sulphur bitumen, and perfume, fixed to a piece of fir called *tæda* which was lighted, and which thus circulated the smoke around them The *army* was purified by [illegible] the soldiers to defile between the two parts of a half-cut victim, while the priest offered up certain prayers The lustration of a funeral pile was effected by making the spectators march round it before the fire was kindled (See *Memoires de l'Ac des Inscriptions* vol xxxvi ) *See* AMBARVALIA

LUSTRUM (Lat ) In Roman Antiquities, a space of about five years at the end of which period the feast called Lustralia was celebrated, in which the censor purified the people by several sacrifices and ceremonies, among others, the *suovetaurilia*, or sacrifice of a hog, sheep, and goat It appears that rather more than five years usually elapsed between one lustralia and the next but the word lustrum is usually employed for the exact quinquennial period The derivation of the word is uncertain Lustrare, in Latin signifies to purify by a sole ceremony and many other lustral ceremonies were in use as for example the *dies lustrales*, or lustral days being the fifth or according to some writers the eighth day after the birth of a child, on which it was purified with certain solemnities, named, and placed under the protection of the gods of the family, the *lustration* of sheep in A[illegible] [illegible] pst May, &c, of which so many are contin[illegible] [illegible] Roman Catholic worship of modern times Sea-water was the most ordinary article used in lustrations. Varro derives the word lustrum from luere, *to pay*, because, according to the custom ordained by Servius Tullius, who first instituted the census (561 B C ) the tribute imposed by the censors was paid at the beginning of every fifth year the last of the lustrum (See an Essay in the *Mémoires de l'Ac des Inscr* vol xxxix , and *Niebuhr's History* )

LU'SUS NATURÆ (Lat *a sport of nature* ) A term applied to any thing unnatural in the physical world

LUTE (It liuto ) A musical stringed instrument of the guitar species and played in a similar way, but in form more resembling the section of a pear, with a back in ribs like those of a melon

LUTES in Chemistry, applications by which the junctions of vessels are rendered tight A glass retort is said to be *luted* when smeared over with clay [illegible] fectly to resist the effects of heat and to [illegible] sion Common lute is a mixture of pipe-clay linseed meal, and water, and is spread upon paper and applied to the joinings of stills and of retorts and receivers *Fat lute* is a mixture of pipe-clay and linseed oil

LU'THERANS or FOLLOWERS OF LUTHER The denomination of Christians who [illegible] this system had its origin in the preaching of Luther In some respects approaches nearer to Romanism than that of any other of the reformed churches The notions of Luther upon the nature of the Eucharist are known under the name of consubstantiation, or the coexistence of the body and bread, the blood and the wine, at the same time It encourages also the private confession of sins makes use of wafers in the administration of the Lord's Supper, and allows of images in churches It insists however, very strongly upon Luther's cardinal doctrine the justification of man by faith and not by any merit in human actions With respect to the divine decrees it holds that God foreknows the dispositions of men whether they will be good or bad, and predetermines their salvation or rejection accordingly, differing therein from the tenet of the Calvinists, which represents the Supreme Being as making his decrees by his own mere will The dogmas of the Lutheran church are carefully set forth in various symbolic books the *Confession of Augsburg*, the *Articles of Smalcald*, the Shorter and Larger Catechisms of Luther, and the *Form of Concord* The principle however, of this church, which considers Christians as accountable to God alone for their religious opinions allows its teachers at the present day, an unbounded liberty of dissenting from these decisions The Lutheran church predominates in the north of Germany in Prussia, Norway Denmark and Sweden there are congregations also of the same denomination in England Holland, Russia and America In the Prussian dominions it has been remodelled under the late king, and is called the Evangelical Church *See* CHRISTIANITY

LUTHERN (Fr ) In Architecture, the same as *dormer* which see

LUTRA (Lat *an otter* ) A genus dismembered by Storr from the Linnæan *Mustela*, and now raised to the rank of a family (*Lutridæ*)

LUXA'TION (Lat luxare, *to put out of joint* ) A dislocation of a bone

LYCAN'THROPY (Gr λυκος, *a wolf*, and ἀνθρωπος, *a man* ) Herodotus relates that the Neurians, a Scythian tribe, were supposed to be changed, for a certain number of days every year, into wolves, and then to resume their former shape, and a similar superstition is noticed by Virgil in his *Eclogues*, by Pliny, Pausanias, and other writers The same superstition, of the power possessed by men of converting themselves into wolves, remained in more modern times, but that which the classical ancients had believed to be effected by the power of herbs or by innate powers, was by Christians considered as a species of sorcery These human wolves were called loup garoux by the French, were-wolves by the Anglo-Saxons, wehrwölfe by the Germans words of the same derivation and bespeaking [illegible] in those countries was of Teutonic [illegible] Lycanthropes were believed to be extremely ferocious, and to devour not only beasts, but human beings, but if they were pursued and wounded, the spell was frequently dissolved, and the sorcerers were found mutilated in those limbs in which they had received the wound in their wolfish shape From the prevalence of these superstitions in the minds of an ignorant peasantry originated the hideous species of madness termed *lycanthropy* in which the patient believed himself to be a wolf, and frequently imitated the actions and howl of that animal In France, in the 16th century, numbers of these unfortunate beings were executed like witches, on their own confession, and in the avowals which they made, of having killed and devoured mankind, they were probably not always under a delusion Some of these men also declared that they were actually wolves, but that in them the hair grew inside or between the skin and the flesh Oribasius, who lived in the fifth century of our era, mentions lycanthropy by its true cha-

racter as a species of madness, and describes the symptoms and the cure This species of insanity seems to have gradually died away along with the superstition which gave it birth (See a curious article in the *Encyclopædia Metropolitana*)

LYCEUM An academy at Athens was so termed, from its situation near the temple of Apollo Lyceus It was frequented, according to tradition, by Aristotle Preparatory schools for the universities, in which the Aristotelian philosophy was formerly taught, hence received the name of Lyceum

LYCHNITES An ancient name of marble, from λυχνος, a lamp, and ειδος, like, by lamp-light

LYCOPODIACEÆ (Lycopodium, one of the genera) A natural order of Acrogens, inhabiting all parts of the world, but abounding chiefly in hot humid situations They are intermediate, as it were, between ferns and coniferæ on the one hand, and ferns and mosses upon the other *Lycopodium rubrum* is a violent cathartic, *clavatum* and *selago* excite vomiting, and the powder contained in the seed-vessels of all the species is so highly inflammable as to be employed occasionally in the manufacture of fireworks They are propagated by spores formed in two-valved cases axillary to the upper leaves

LYCOPODIUM A fine yellow dust or powder, being the seed of the *Lycopodium clavatum* or club moss when thrown into the flame of a candle or of spirit of wine, it burns with a bright flash It is much sought after for producing theatrical lightning and is an excellent substance to sprinkle upon pills to prevent [illegible]

LYCOSA (Gr λυκος, *a wolf*) A genus of spiders in which the eyes form a quadrilateral group as long as or longer than it is wide the two posterior eyes not placed on an elevation The first pair of legs is evidently longer than the second but shorter than the fourth which is the shortest of all The internal extremity of the jaws is obliquely truncated Almost all the *Lycosæ* keep on the ground where they run with great swiftness They inhabit holes in the ground which they line with silk and enlarge in proportion to their growth Some establish their domicile in chinks and cavities in walls where they form a silken tube covered externally with particles of earth or sand In these retreats they change their tegument, and, as it appears, after closing the opening pass the winter in a state of torpidity The females, when they go abroad carry with them their eggs enveloped in a cocoon attached to the abdomen by threads On issuing from the egg the young ones cling to the body of the mother, and remain there until they are able to provide for themselves The *Lycosæ* are extremely voracious, and courageously defend their dwelling The famous Tarantula spider is a species of this genus

LYDIAN STONE A silicious slate, used by the ancients as a touchstone from Lydia

LYING PANELS In Architecture those in which the fibres of the wood lie in an horizontal direction

LYING-TO A nautical term denoting the state of a ship when the sails are so disposed as to counteract each other, and thereby retard or destroy the progressive motion of the vessel The fore and main staysails and mizen trysail serve very well for this purpose as they cause but little way and have sufficient power to keep the ship heeled over, and therefore steady, with her decks turned from the sea When the sea runs very high the lower sails are liable to be becalmed by the waves and therefore to suffer the ship to roll to windward, the maintopsail is then used

LYMPH (Lat lympha *water*) The liquid contained in the lymphatics

LYMPHATICS Absorbent vessels which carry lymph from all parts of the body, and terminate in the thoracic duct

LYNCH LAW The irregular and revengeful species of justice administered by the populace in some parts of the United States, is said to have been so called from a Virginian farmer of the name of Lynch, who took the law into his hands on some occasion, by chasing a thief, tying him to a tree, and flogging him with his own hands Some observers have thought that this barbarous system was, to a certain extent, palliated by the difficulty of e[illegible] which Captain Maryat (*Diary in [illegible]* with what justice we know not, to the inadequate pay of the judicial establishment in the newly settled districts, and the bad character of many of the judges raised to the bench by electioneering politics He instances the case of a single town in Georgia with 3000 inhabitants, in which there were in one year fifty-nine assassinations, as a proof of the occasional utility of some irregular acts of justice on the desperadoes of such a population But it must surely contribute to brutalize and occasion crime, far more than to repress it One of the most signal and violent acts of popular resentment, under the show of summary justice, was the mock trial and execution of a number of professed gamblers, at Vicksburg, on the Mississippi, four years ago Miss Martineau's work on America contains some fearful pictures of the persecution carried on, under the same pretences, against missionaries or supposed missionaries of the anti-slavery party, in the southern states Indeed, she received a hint that she ran herself some danger of being "Lynched," if she visited them, which however, did not affect her resolution Lynch law may be called a democratic imitation of the old feudal Vehmgerichte or self constituted tribunals in Westphalia and elsewhere which assumed the right of controlling the violent actions of the nobles, and have been the subject of so much romantic fiction

LYNX A constellation of the northern hemisphere, formed by Hevelius

LYNX A name given to the different species of a group of the *Cats* (*Felidæ*), distinguished by short tails, [illegible] ears The lynxes have been long [illegible] sight,—a quality which in all probability they derived together with their name, from Lynceus one of the Argonauts to whom on their perilous expedition, his quick sight was of essential service in enabling them to steer clear of rocks and sand-banks The lynx was consecrated to Bacchus

LYRA (Lat) The Harp one of the forty-eight constellations of Ptolemy It is situated in the northern hemisphere

LYRA A portion of the brain, the medullary fibres of which are so arranged as to give it somewhat of the appearance of a lyre

LYRE A musical instrument of the greatest antiquity among the Egyptians and Greeks Tradition attributes its invention to the accident of finding on the banks of the Nile a tortoise, whose flesh was entirely decomposed but whose tendons [illegible] dried and stretched by the sun's rays and [illegible] struck, of yielding musical sounds Hermes the finder of this tortoise, having made an instrument in imitation of it is supposed thus to have been the inventor of the lyre The Greeks attribute the invention to their Hermes (Mercury) the son of Jupiter and Maia It is generally considered that the original Egyptian lyre was only of three strings and that the Greek Mercury improved upon the invention, that the Muses clubbed together to add one string Orpheus Linus and Thamyris adding one each, thus forming it altogether into an heptachord, or seven-stringed lyre At a later period the lyre consisted of eleven strings, which were made of the sinews of animals, its body was hollow to increase the volume of tone, and it was played with the *plectrum* or lyre stick of ivory or polished wood, and sometimes with the fingers like the harp It went by the different names of lyra phorminx, chalys, barbitos, barbiton, cithara

LYRE BIRD or LYRE PHEASANT *See* MENURA

LYRIC *See* ODE

LYTHRACEÆ (Lythrum one of the genera) A natural order of Polypetalous Exogenous plants, with long tubular striated calyxes, at the [illegible] of which are inserted the petals while the stamens grow nearly at the base They are little known in cultivation, but some of [illegible] *Lagerstræmia Indica* [illegible] The rosewood of the cabinetmaker is the trunk of *Physocalymna floribunda* and the henna employed in the toilet of oriental ladies, is obtained from *Lawsonia inermis*

# M.

M The labial letter of the liquid series It is susceptible of various interchanges, more especially in the Greek and Latin languages (See *Penny Cyclo*) In writing two Ms successively the Germans frequently drop one, and replace it by a stroke over that which they retain, thus m As an abbreviation M stands for Marcus, Manlius, Martius and Murcus M A for Master Artium, MS for Manuscript and MSS for Manuscripts M, or, more properly a symbol somewhat resembling it, was used by the Romans to denote 1000, and the moderns have also adopted that letter

MAB The name given by the English poets of the 15th and succeeding centuries to the imaginary queen of the fairies The passage in *Romeo and Juliet*, in which her qualities and attributes are so beautifully set forth, is familiar to all

MAC A Scotch term, signifying son, prefixed to many surnames, as *Mac* Donald, &c It is synonymous with *Fitz* in England and *O* in Ireland

MACACUS A genus of Catarrhine or Old World monkeys characterized by having a fifth tubercle on their last molars ischial callosities and cheek pouches; comparatively short and thick limbs a projecting muzzle and prominent superciliary arches They have generally a

pendant tail, but in some it is short, as in the pig tailed baboon (*Macacus rhesus*) When they cry out, they inflate a membranous sac, which communicates with the [illegible]

MACARONIC VERSE Verse in which the words of a modern language are ludicrously distorted into Greek or Latin inflections and metre Theophilo Folengo, who wrote under the name of Merlinus Coccaius, in Italy, in the 16th century, and calls himself the inventor of this sort of burlesque composition, informs us that its name is derived from the Italian macaroni eatables composed of flour, cheese, and butter, and that it expresses the gross and rustic characters appropriate to its words and sentiments *Drummond's Polemo Middinia*, a Scottish burlesque, is perhaps the best known macaronic form of our language

MACCABEES, BOOKS OF THE The two last books in the arrangement of the Apocryphal writings enumerated by our church The first is a Greek translation (as is supposed) from a Chaldaic original The second appears to be a compilation from various sources The two books are not connected the former comprehends the events of Jewish history for nearly 40 years B C 176 to 139, the second begins about B C 187 and extends over about 16 years Neither has ever been reckoned by the Jews in their catalogue of sacred writings, but they are received into the canon of Scripture by the church of Rome, with the title of *3d and 4th Chronicles* There are two other books, commonly called *3d and 4th Maccabees*, which were never received by any church

MACE A word of doubtful etymology signifying sometimes a club of metal and sometimes a military weapon appropriated to [illegible] About the period of Edward II maces were used in England both in battles and tournaments, and they remained so till the time of Elizabeth, when they were displaced by the pistol Maces are still used by the Turkish cavalry The mace is an ensign of authority, is often borne before magistrates By the old English writers it is used synonymously with sceptre

Mace, the external envelop of the seed of the nutmeg, is a particular form of what botanists call *arillus* It is aromatic but less so than the nutmeg and is chiefly used in cookery or in pickles, and not, like the latter in confectionary

MACEDONIANS In Ecclesiastical History a sect which derives its name from a bishop of Constantinople who, in the 4th century denied the distinct existence and Godhead of the Holy Spirit which he conceived to be merely "a divine energy diffused throughout the universe," "while the Father and Son together constitute the one existing Deity These opinions were condemned at the second general council held at Constantinople in 381 *See* PNEUMATOMACHI

MACERATION The steeping of substances in any cold liquor

MACHAIRODUS (Gr μαχαιρα *a sabre*, and οδους, *a tooth*) An extinct mammal allied to the bear

MACHE'TES (Gr μαχητης *a combatant*) The generic name under which Cuvier has distinguished the ruffs and reeves from the sandpipers godwits and other allied Grallæ The ruffs have the bill and carriage of the genus *Totanus*, but the membrane between their external toes is nearly as extensive as in *Limosa* Our native species (*Machetes pugnax* Cuv) is somewhat smaller than a snipe and celebrated for the furious combats that take place among the males in their nuptial season At this period the head is partly covered with red papillæ, the neck is surrounded with a thick collar of feathers, which often varies in different individuals

MACHIAVELISM A name given to the system of governing which is propounded in the general writings of Machiavelli and particularly in his treatise called *The Prince* The term is still used in a disparaging sense notwithstanding the different construction which has of late been given to the motives and purposes for which Machiavelli wrote his work

MACHICOLATED (Fr machicoulis) In Gothic and castellated Architecture a building whose parapets project beyond the faces of the walls, and are supported by [illegible] large corbels or consoles

MACHINE (Gr μαχανη), in a general sense signifies any thing which serves to increase or regulate the effect of a given force Machines are either *simple* or *compound* The simple machines, otherwise called the *simple mechanical powers* are usually reckoned six in number, namely, the *lever*, the *wheel and axle* the *pulley*, the *wedge*, the *screw*, and the *funicular machine* See the respective terms

Compound machines are formed by combining two or more simple machines They are classed under different denominations, according to forces by which they are put in motion, as *hydraulic* machines, *pneumatic* machines, *electrical* machines &c, or the purposes they are intended to serve, as *military* machines, *architectural* machines &c

Although there are no limits to the combinations and adaptations of machinery [illegible] ciples which may be appli[illegible] any machine whatever When a machine attains its state of uniform motion, the momentum of the power is equal to that of the resistance and is the same that would be *in equilibrio* with the resistance if there were no motion at all From this principle and from the consideration that in all machines the work done is to be estimated not merely from the quantity of resistance which is overcome, but from the quantity overcome in a given time, we can ascertain the relation that ought to subsist between the velocity and the load or resistance in order that the effect of the machine may be a maximum This maximum effect is produced when the two following conditions are fulfilled 1 When the load, or resistance, is about four ninths of that which the power when fully exerted, is just able to balance, or that which would keep the machine at rest altogether, and, 2 when the velocity of that part of the machine to which the power is applied is one third of the [illegible] These conditions are ded[illegible] expression which is adopted by Euler and other writers to represent the law of the moving power Let P = the power applied (or weight which the power when fully exerted is just able to overcome), R = the resistance or load or weight to be overcome, $c$ the greatest velocity or that at which the power ceases to act, $v$ = any other velocity then the law of the moving power is

$$R = P\left(1 - \frac{v}{c}\right)^2$$

The variables in this expression are R and $v$ and the effect is represented by the product $Rv$, on making which a maximum the rules of the differential calculus give $v = \frac{1}{3}c$, whence the formula becomes $R = \frac{4}{9}P$

From these expressions it follows, that when the moving power and the resistance are both given if a machine be so constructed that the velocity of the part to which the power is applied is to the velocity of the part to which the resistance is applied in the ratio of 9 R to 4 P the effect of the machine will be a maximum or it will work to the greatest possible advantage The above conditions apply equally to machines impelled by animal force and the agents of [illegible] steam the force of gravity &c [illegible] to the greatest advantage or performs the greatest quantity of work in the least time when it moves with about one third of the utmost speed with which it is capable of moving and is loaded with four ninths of the greatest load which it is capable of putting in motion It has been supposed in the above remarks that the friction of the parts of the machine is included in the resistance (See Coriolis *Du Calcul des Machines*, Navier *Leçons sur l'Application de la Mecanique* Belidor *Architecture Hydraulique*, Gregory's *Mechanics*, Moseley's *Mechanics applied to the Arts* &c)

MACHINERY A general term by which the works of the complex machines are designated

MACIGNO (Ital) A hard siliceous sandstone

MACLE A mineral, called also *chiastolite* It forms prismatic crystals white externally and grey within which are found embedded in clay slate Its principal component parts are silica and alumina, with a little oxide of iron

MACLURITE A mineral named after Dr Maclure from New York and New Jersey It occurs in roundish embedded masses imperfectly crystalline It is a silicate of magnesia, with traces of potash, oxide of iron, and fluorine

MACMILLANITES A religious sect in Scotland the successors and representatives of the Covenanters in the 17th century and more recently denominated the Reformed Presbytery On the first settlement of presbytery as the established church of Scotland at the Revolution in 1688 a small body of the people the remnant of the Covenanters condemned the principles on which that act was founded as Erastian They insisted not only that the church though endowed by the state, should be entirely independent of civil authority, and uncontrollable and supreme in itself but that the revolution government should not be recognized inasmuch as it was not founded on the Solemn League and Covenant, and did not restore presbytery as it had obtained [illegible] Second Reformation," or be[illegible] [illegible] Church[illegible] This [illegible] to a very small [illegible] [illegible] Relief[illegible] [illegible] [illegible] [

state of matters throughout the body at large and to cultivate a better understanding with each other

Thus they continued without any formal separation for several years, and as they were at all times regarded as a fanatical and illiberal sect, enemies equally to the ecclesiastical and civil authorities Meanwhile, Mr John M'Millan, who had been ordained parochial minister of Balmaghie, in the stewartry of Kirkcudbright, in 1701 adopted and publicly avowed their principles, and was, in consequence, deposed in 1704 from the office of the ministry He did not, however, renounce his ministerial character, but continued to officiate both among his former people who almost to a man adhered to him, and others who favoured his views In 1706, having received a unanimous call from the scattered societies to be their minister, he accepted the invitation, and in a short time he was joined by Mr John M'Neil, a licentiate of the established church, who, like himself, had been deprived of all connection with that church The high veneration which Mr M'Millan and Mr M'Neil entertained for presby[illegible] prevented any attempt being made [illegible] for the latter in an irregular way Neither would they compromise their principles to gain the co-operation of other ministers who, like themselves, but for somewhat different opinions, had been expelled from the establishment They renewed the Covenant in 1712 and never ceased to bear public testimony against what they regarded the defections and corruptions of the church of Scotland

On the death of Mr M'Neil which took place not long afterwards, Mr M'Millan was joined by the Rev Thomas Nairn who had been driven from the church and had for some time been connected with the Secession The prospects of the *M'Millanites* as this sect had long been called in honour of their eminent leader now began to brighten The [illegible] and some lay elders (formerly ord[illegible] presbytery, in 1743 at Braehead near Carnwath Lanarkshire and gave their body the name of the Reformed Presbytery, — a designation which has superseded in a great measure, that of M'Millanites They are also called Mountain or Hill people, because having at first no chapels they conducted public worship, in imitation of their persecuted ancestors in the reigns of Charles II and his brother, in the open air generally on the side of a hill

From the time they were constituted into a presbytery their number has gradually but slowly increased In 1809 they had sixteen congregations, but their highest ecclesiastical court was a presbytery They now form a synod, consisting of six presbyteries the number of congregations [illegible] five In the days of persecution, [illegible] of the [illegible] took refuge in the north of Ireland, and the M'Millanites there form four presbyteries [illegible] The sect prevails [illegible] extent of eight or ten congregations Some of their congregations in Scotland are very small, and none of them are large They have a professor of divinity belonging to their own body In doctrine they profess the highest Calvinism and may be characterized as the strictest sect of Presbyterians They still hold substantially the same sentiments as the alleged Erastianism of the established church or what they regard as her unscriptural subjection to the civil power Some of their extreme opinions however on the subjects of the covenant and presbytery have of late been somewhat modified They generally, if not universally, use public prayers for the sovereign and for civil magistrates, an act which they from conscience avoided for about a century after their organization under Mr M'Millan Wherever their numbers are sufficiently large, they have built chapels, and public worship in any circumstances rarely takes place out of doors They have not thought it expedient to renew the Covenant since 1715 In short they have become a comparatively liberal and enlightened sect of Christians, and are eminently characterized by piety and moral strictness (See *Adam's Religious World Displayed*, vol iii 157—169, *The Testimony of the Reformed Presbyterian Church*, Paisley, 1837, *Historical Part of the Testimony*, Glasgow, 1830, *A short Acc of the Old Presbyterian Dissenters* Glasgow 1824, *Acts of Gen Assembly apud Ann* 1704 1708, 1715 also the articles CAMERONIANS and COVENANTERS in this work)

MACRODACTYLI (Gr *μακρος, long*, *δακτυλος finger*) A tribe of wading birds comprehending those in which the toes are remarkable for their extreme length as the jacanas

MACROPUS (Gr *μακρος long*, *πους, foot*) The generic name of the kangaroo, also applied to a genus of beetles

MACROURANS, *Macroura* (Gr *μακρος, long*, and *ουρα, a tail*) A section of Decapod Crustaceans including all those which have the tail, or post abdomen, as long or longer than the body

MACULÆ (Lat *spots*) Dark spots on the surfaces of the sun and moon, and on some of the planets The solar spots are very variable as to their number and continuance They were first observed by Galileo in Italy and Harriot in England soon after the invention of the telescope and unknown to each other The spots on the moon are permanent, and are caused by the shadows of its mountains, and the unequally reflecting materials of which parts of it are composed The planets have some permanent maculæ, as the belts of Jupiter and some variable especially Mars and Venus, and frequently also Jupiter These maculæ have led to many fanciful conjectures respecting the constitution and atmospheres of the bodies of *See* SUN, MOON

MADDER (Fr *garance*) The prepared root of the *Rubia tinctorum* It is extensively used as a red dye stuff, its infusion is of a dirty red colour, but it is rendered bright and permanent by an aluminous mordant Its colouring principle has been termed *alizarine*

MADIA (Gr *μαδος, bald*) A genus of Composite plants, inhabiting South America and California, and important because of the utility of the fruit as a source of vegetable oil From some German reports it appears that it is the most productive of all oil plants

MADONNA (Engl *my lady*) An Italian term applied to the Virgin Mary Hence pictures of the Italian school representing the Virgin are generally designated as Madonnas

MADREPORA (A hybrid compound of the French madre, *spotted*, and the Latin porus *a pore*) The word appears to have been first used by Imperati to designate a genus of Lithophytes in which the calcareous axis has its whole surface beset with small lamellate and stellate depressions

The genus was adopted by Linnæus, who placed it among his *Vermes Zoophyta* and characterized it as follows — *animal* resembling a medusa, *coral* with lamellate star-shaped cavities It is scarcely necessary to observe that the animal, especially in the larger madrepores, as the *Fungia* most closely resembles the *Actinia* in its general organization Cuvier places the madrepores in the tribe *Lithophyta*, of the family of *Polypiers nuds* The Lithophytes having the common character of the Linnæan genus are now subdivided into the genera *Fungia* Lam, *Turbinolia*, Lam, *Cyclolythus*, Lam, *Caryophyllæa*, Lam, *Oculina* Lam, *Faviopora*, Lam, *Serialopora* Lam, *Astræa Explanaria*, *Pontes*, *Meandrina*, Cuv, *Porcma* Cuv, *Hydrophora*, Fischer, *Agaricina*, Cuv, *Sarcinula*, Lam, *Stylina*, Cuv, and *Madrepora* proper

MADREPORITE A species of columnar carbonate of lime found in Norway and Greenland

MADRIER In Military Engineering, a thick plank covered with plates of iron and having a cavity sufficient to receive the mouth of a petard with which it is applied against a gate or any other obstacle intended to be broken down Also the flat beams laid in the bottom of a moat or ditch to support the wall There are also madriers lined with tin and covered with earth to form roofs over certain portions of military works, in order to afford protection against fires in ledgments, &c

MADRIGAL One of the lesser kind of poems, usually consisting of fewer verses than the sonnet or roundelay, In its composition the fancy and convenience of the poet are not subjected to very strict rules rhymes and verses of different species being often intermixed The subjects are mostly of a tender and gallant nature the character often quaint the expressions marked with great simplicity Sometimes however, a loftier and sublimer train of thought finds its way into these compositions, especially among those of the English school, as in the following celebrated specimen, set to music, and perhaps written, by Orlando Gibbons, in 1612 —

> Oh! that the learned poets of this time,
> Which can so lovesick lines so well contrive,
> Would not consume good wits in hateful rhyme,
> But with deep care some better subject find
> [illegible]

Of a lighter and more regular sort, the following may serve for a specimen —

> When Thoralis delights to walk,
> The fairies do attend her
> They sweetly sing, and sweetly talk,
> And sweetly recommend her
> The satyrs leap and dance around,
> And make their conges to the ground
> [illegible]

Grassineau in his *Musical Dictionary* describes the madrigal as "a little piece of poetry, the verses whereof were free and easy usually unequal it borders on a sonnet and an epigram, but has not the briskness of the one, nor the pungency of the other"

It is extraordinary that the etymology of this word, though introduced but little more than three centuries ago, is now altogether lost We subjoin the conjectures that have been raised upon it Bengilo (*Arte Poetica*) says that it is corrupted from the word mandrial, *a sheepfold* Cardinal Bembo seems to think with the last-named

author, and defines it as a pastoral love-song, adding, moreover that it is of Provençal origin Huet brings it from *Martegaux* the name of a people of Provence "Ces martegalles et madrigaux," he observes, ont pris leur noms des Martegaux, peuple Montagnards de Provence de mesme que les Gavots, peuple Montagnards du pays de Gass, ont donné le nom à celle que nous appellons gavotte" (*Traite des Romans*, p 124) Covarruvias (*Trésor de la Langue Castellan*) derives it from *mandra* So that there is much testimony in favour of its pastoral origin But the most curious, perhaps of all the etymologies is that of Ferrari in his *Origine de la Langue Italienne*, who derives the word from the Spanish verb madrugar, *to rise in the morning*, which Menage in his *Dict Ety* says is naught This last-named author throws out a suggestion that it may have had its origin [illegible] Vallee de Vire [illegible] 464) Others supposing that the earliest specimens of this sort of poetry were addressed to the Virgin *Calla madre* have thence derived madrialle and madrigale and go on to say that having afterwards been applied to poems of love and gallantry, the original meaning was lost The words of a very large proportion of the madrigals of the sixteenth century, a period when they were most in favour, are certainly opposed to [illegible] the mother of [illegible] rather than to the Virgin Many of the composers called their pieces *madrigali spirituali* We regret that we cannot [illegible] with any certainty upon this subject in which we must leave him to a choice among the etymologies here set down or to find one of his own that he may think more germane to the matter

We will now endeavour to define this word in a musical sense, and we do not think we can better accomplish that object than in the quaint language of old Charles Butler (*Principles of Music* London 1636) He says The madrigal is a chromatic mode in discant whose notes do often exceed the number of the syllables of the ditty sometimes in duple sometimes in triple proportion with quick and sweet reports and repeats and all pleasing varieties of art, in four five or six parts having in one or more of them one or more rests, especially in the beginning to bring in the points begun in another part Choron calls it a species of composition resembling the fugue, but the style of which being less dry, is susceptible of every kind of expression The simple madrigal is for voices only the accompanied madrigal as its name imports is with an accompaniment of one or more instruments, mostly the organ Jo Arcadelt a Flemish composer, has, but without foundation been attributed the honour of composing the first madrigals They however exist by more ancient composers even by those of the Flemish school and to our readers who are at all conversant with the subject the name of Adrian Willaert will doubtless occur as one of the composers alluded to The fact is, that simple madrigals appeared about the beginning of the 16th century during which and the whole of that following the style was particularly cultivated and encouraged and may be considered to have now passed away unless we are allowed to consider the English glee an offset from it The first madrigals were a style of music very much resembling that of the church, but they afterwards assumed a character peculiar to themselves which is strikingly exemplified in those of Luca Marenzio (soon after the time that Palestrina flourished) and after him in the works of Gesualdo, the Prince of Venosa, Monteverde, and Mazocchi It is in their madrigals that the restraints which laboured counterpoint imposed were abandoned to make way for imitations, canons and fugues The style was indeed that of the age, but the subjects were free, and the tender and impassioned poetry adopted was well expressed in the inflections of the harmonies employed The original character gradually became more free, and was carried to its utmost limit in the compositions of the celebrated Alessandro Scarlatti In England during the reign of Elizabeth the composition of the madrigal attained [illegible] degree of excellence, perhaps the highest Our composers were in no respect interior to those of Italy and the Netherlands It is hardly necessary to observe that among them are to be found the names of Orlando Gibbons Dowland, Wilbye, Ward, Bennett and Morley

MAESTO'SO (Ital) In Music, a direction to the performer that the music to which the word is prefixed is to be performed slowly and with grandeur

MAGAZINE (Fr magazin) A receptacle for military stores, but especially for gunpowder, in a fortress

MAGAZINE An apartment below, in the after part of the ship, in which the powder is kept As lights are not allowed to be burnt here, the light is received from another apartment, called the light-room

MAGAZINE In Literature, the general designation for the periodical literature of a country, exclusive of the newspaper and review The peculiar province of the two latter seems to be to communicate information—the one on politics and passing events the other on literary and scientific subjects, while that of the magazine is of a more miscellaneous character, embracing all the features of the newspaper and review, but at the same time containing, in the form of tales, sketches, and poetry, &c, a great variety of what may be peculiarly termed *original* matter, the introduction of which would be foreign to the purposes of the others The earliest publication of this kind in England was the *Gentleman's Magazine*, which still exists It appeared in 1731, and the success which so deservedly followed its establishment immediately called into the field a host of competitors, which have so increased in number and variety as to form an era in literary history See PERIODICALS, REVIEW

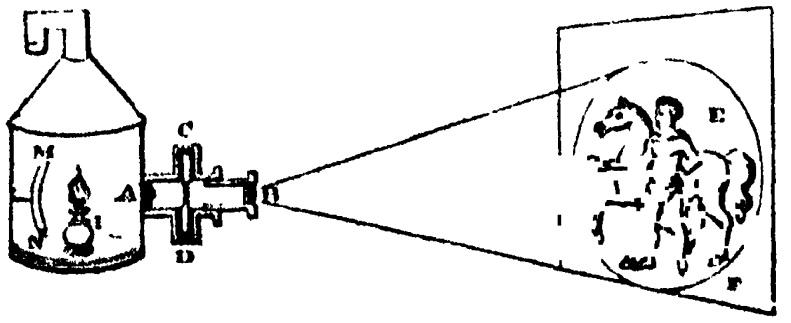
MAGELLA'NIC CLOUDS Three nebulæ in the southern hemisphere, first recorded by the navigator Magellan, and named after him, two of them about 12° or 13° from the south pole, and the third more distant Whether they be resolvable into stars by means of the larger telescopes, has not been yet ascertained, but, from their distinctness as nebula they probably are

MAGIANS The caste of priests (hereditary) among the Persians and Medians are so termed by ancient Greek historians The name [illegible] cutists from *mog* or [illegible] Zend language Zoroaster is designated as the great reformer of the order, but the history and the very existence of that celebrated character are enveloped in complete obscurity He is generally supposed to have lived at no long period before the age of Cyrus The most remarkable feature of his doctrine consisted in the two principles of Good and Evil (Oromasdes and Arimanes) who were held to divide the dominion of the world in alternate periods during its whole predestined duration of 12000 years The books termed the *Zendavesta*, brought to Europe in the last century by Anquetil du Perron, are supposed by some to contain the essential doctrines of this religion but their authenticity has been the subject of much discussion The fire-worshippers of Persia and India still hold them in reverence (See ZENDAVESTA, CUBRIS) Our amplest resources for the study of the religion and character of the ancient magi are to be found in the learned researches of Anquetil (See especially *Memoires de l'Acad des Inscriptions* vol xxxix)

MAGIC (Ital *arte magica*, *the art of the Magi* because those Persian philosophers were ranked by the Romans among the highest professors of supernatural powers through intercourse with the genii or intelligences with which their universe was peopled) Common is the superstitious belief in the possession of such powers has been among all nations hitherto discovered on the globe the Romans were perhaps the most superstitious in this and other respects of all people No American tribe has a more implicit faith in its rude "medicines or mysteries than this great and civilised people had in its auguries and divinations, and it is a remarkable feature in their character that while their religion prescribed these rites the popular imagination was always searching after fresh excitement from others which were not only unauthorized but condemned by their laws—the practices of the Thessalian witches the magi the sorcerers of Egypt and Phrygia and the numberless other foreign nations with which their dominion brought them in contact [illegible] he emperors were continually renewing [illegible] edicts, and it seems to have been mainly from this circumstance that the idea of magic, as a black and forbidden art, became rooted in the minds of the people of modern Europe For the northern conquerors held such supernatural power in high respect, and in the East the favourite land of sorcery and magic, the professors have from time immemorial been regarded rather as venerable than as hateful As to ancient magic, see *Mém de l'Acad des Inscr* vol xxxix Hence, if any systematic account can be attempted of matters which have their foundation in the strange caprices of popular credulity it may be thought that in the superstition of the middle ages *white* magic or *celestial* magic according to Cornelius Agrippa's division, originated in the North or East, *superstitious* or *diabolical* magic from Roman notions engrafted on Christianity, while *natural* magic arose merely from the disposition among the scientific of those days to take advantage of the vulgar propensity to attribute every thing [illegible] auses It is to be observed [illegible] other [illegible] garded [illegible] with [illegible] was peopled by their imagination with enchanted castles and spectral illusions (see *Scott's Dæmonology and Witchcraft*, letter v), and Froissart gives a most picturesque account of the spells which were resorted to by Mahometan warriors in their conflicts with the soldiers of the cross In the romances founded on these historical encounters there are usually a good magician or witch (not the degraded witch of vulgar superstition, but the French fee Italian fata) enlisted in the Christian party, evil necromancers in that of the infidels Thus,

in *Ariosto*, Malagigi and Melissa aid the one side, and Atlas the other The notion of *white witches*, or beneficent wizards, was assiduously kept up by those impostors who wished to profit by the public credulity, and yet avoid the penalties awarded by the church, and in the church itself there was a contest continually maintained, whether magic, practised through laborious research and study of the celestial influences or intermediate spirits, was lawful But the public opinion always inclined the other way, and the magicians of highest pretensions were always in danger of being classed with the hated necromancers who derived their power from compact with the devil Among the earliest fables respecting the higher order of European magicians is that of Virgil, the Latin poet turned into a wizard by popular belief, which dates as high as the 11th or 12th century Robert of Lincoln (Grosseteste) Michael Scot Albertus Magnus, and the famous Roger Bacon all lived in the 13th Of these the first was a church reformer, who seems to have lain under the imputation of magic merely on account of the displeasure with which he was regarded by the orthodox Michael Scot is almost wholly a traditional personage, that is, his real history is scarcely known the European reputation which he had achieved as a wizard is proved by the high mention of him in the *Inferno* of Dante, who condemns all magicians indiscriminately to eternal punishment It is difficult to say that Roger Bacon ever gave any cause by pretensions of his own like so many other eminent natural philosophers of early time, to those charges of magic to which his high genius subjected him Perhaps Sir F Palgrave, in his amusing fiction (*The Merchant and Friar*) is not far wrong in representing him as partly dazzled by an inability to comprehend the real extent of those extraordinary discoveries which were opening upon him, and partly owing his magical reputation to the impostures practised by his servants in his name Albertus Magnus a Dominican and a celebrated magician in his time has more justly open to the charge of quackery It seems to have been after this time, about the 14th century that magic rose for a season into high repute as a lawful art and sovereigns had professed magicians and astrologers attached to them The extraordinary tales related of some of these point evidently to results effected by means of legerdemain the feats of Zito sorcerer to Wenceslas, king of Bohemia (Godwin *Lives of the Necromancers*, p 273) are exactly a counterpart of what Tavernier saw at the court of the Great Mogul The heads of magicians maintained their pretensions with diminished after the revival of letters Yet the three most famous of all belong to the commencement of that era Doctor Faustus (if that personage be [illegible] Cornelius Agrippa and Paracelsus It will be evident to any one who reads their history that the belief in *celestial* magic was with difficulty maintained in their days while that in *necromancy* and *witchcraft* was becoming more prevalent than ever There is a good deal of mystery about the character of the famous Dr Dee, and it does not appear distinctly how far he pretended to those powers which are ascribed to him in that dreary work entitled *A true Relation of what passed between Dr Dee and some Spirits* published by Meric Casaubon in 1659 In 1631 the French curate, Urbain Grandier was burnt for sorcery at Loudun, in 1640 the pretender Dr Lamb was murdered by the London mob and these are nearly the latest instances of distinguished magicians while the degraded belief in witchcraft lasted much longer As to *natural magic* or the production of singular phenomena by natural means see *Brewster's Letters on Nat Magic*, *Quart Jour* vols xlviii lix

MAGIC LANTERN An optical instrument, by means of which small figures painted with transparent varnish on slides of glass are represented on a wall or screen considerably magnified It is generally used as a toy, and affords amusement from the grotesque character of the figures, but is also employed to enlarge the diagrams employed in astronomical lectures so as to be seen by an audience for which purpose it is well adapted both by its portability and the small cost of the whole apparatus The principle of its construction is very simple A lamp L, with a powerful Argand burner is placed within a closed lantern, and in the focus of a concave




mirror M N At the opposite side of the lantern is fixed a tube A B containing a hemispherical illuminating lens A, and a convex lens B, and between A and B is a slit C D, through which the sliders of painted glass are introduced In this manner the picture is placed in the axis of the tube and strongly illuminated, in consequence of the light being concentrated upon it by the mirror The picture being also in one of the conjugate foci of the lens B an enlarged image of it is formed upon a wall or screen E F at some distance behind The tube A B is made to pull out so that the distance of the lens B from the slider can be increased or diminished at pleasure, and consequently an image formed of any size within moderate limits The magic lantern was invented by Athanasius Kircher

MAGIC SQUARE A term used to denote a series of numbers in arithmetical progression, arranged in the equal cells of a square in such a manner that the vertical, horizontal and diagonal columns give the same sum For example, let the first sixteen numbers be arranged as in the annexed table, and a magic square will be produced, for the numbers in each vertical column, in each horizontal column, and in the two diagonal columns, being added together, give the same sum, namely 34 This is, however, only one of a great number of ways in which the same numbers may be arranged so as to fulfil the conditions Frenicle *Des Combats*, Paris, 1693) has proved that there are 878 such arrangements Emanuel Moscopolus, a Greek author of the 14th or 15th century, is the first who is known to have treated of magic squares and to have given rules for their construction The principal authors who have written on the subject are Stifels Leibnitz, Bachet Poignard Lahire, Ozanam, Franklin &c For the history of the subject see *Montucla*, vol i p 346, or *Hutton's Dictionary*, and for the methods of constructing them, *Ozanam's* or *Hutton's Mathematical Recreations*

| | | | |
|---|---|---|---|
| 1 | 16 | 11 | 6 |
| 13 | 4 | 7 | 10 |
| 8 | 9 | 14 | 3 |
| 12 | 5 | 2 | 15 |

MAGILP When linseed oil and mastic varnish are mixed together they produce a gelatinous compound known under the above name and used by artists as a vehicle for colours

MAGILUS A name given by Montfort to a genus of Tubulibranchiate Gastropods in the system of Cuvier chiefly remarkable for the form length and solidity of their shell The modifications of this dermal production are due in the present instance in great measure to the accidental circumstances of the locality in which the growth of the individual proceeds The young *Magilus* commences its career in a bed of lithophytous coral and during the early and rapid stages of its development secretes its calcareous covering in the ordinary form of a spiral univalve but soon the growth of the surrounding madrepore surpasses its own and it is compelled to bring its oral and respiratory orifices by the most direct route to the level of the surrounding coral While this change of place is being effected the mollusk continues to secrete fresh layers of shell coextensive with its own advance and to fill up the deserted part of the shell with a solid deposit of a dense semivitreous and subtransparent carbonate [illegible] the form of a spiral univalve and the opposite end excavated for a certain depth for the lodgment of the animal The tube is characterized by being longitudinally carinated

MAGISTER (contracted Mister or Mr) An appellation given in the middle ages to those persons who had attained some degree of literary or scientific eminence — in scientia aliquâ præsertim literariâ It was equivalent to the modern title of doctor

MAGISTER EQUITUM An officer among the Romans subordinate to the dictator, by whom he was usually elected See DICTATOR

MAGISTERY The old chemists generally applied this term to *precipitates* produced by the dilution of certain solutions with water such as magistery of *bismuth*, which is an insoluble subnitrate, obtained by pouring nitrate of bismuth into water

MAGISTRATE (Lat) A general designation of those public officers to whom the executive power of the law is committed, either wholly or in part It is almost impracticable to give any definition of this term so comprehensive as to include within it all the offices both in ancient and modern times to which this appellation has been given Under the various heads, the reader will find a notice of the principal magistrates of all ages and countries

MAGMA (Gr μάσσω, *I blend together*) A thick

MAGNAGHAI [illegible] Charles Magna

MAGNALIS [illegible] [illegible] [illegible]

barons of the kingdom to the second The title is of Latin derivation

MAGNESIA A white, tasteless, earthy substance, usually obtained by exposing its hydrated carbonate to a red heat Its specific gravity is 2 3 It is almost insoluble, but when moistened and put upon turmeric paper it reddens it this sometimes depends upon a trace of lime It is an oxide of a brilliant white metal, which has been called *magnesium* and which may be obtained by heating chloride of magnesium with potassium The vapour of the two upon each other, chloride of potassium is formed, and magnesium separates it may be washed with water and dried Heated to redness in the air, it burns with great brilliancy into magnesia, 12 parts of the metal combining with 8 of oxygen to form 20 of magnesia In commerce, pure magnesia is generally distinguished by the term *calcined magnesia*, and the hydrated carbonate of magnesia, obtained by precipitating a solution of sulphate of magnesia by carbonate of soda and washing and drying [illegible] medicine *Sulphate* [illegible] vaporating the residue of sea-w [illegible] It has been separated, or by adding sulphuric acid to *bittern* and evaporating, so as to obtain the resulting sulphate of magnesia The [illegible] the action of dilute sulphuric [illegible] and it is not uncommon in mineral waters it was formerly procured from certain springs near Epsom in Surrey, and was hence termed *Epsom salt* It crystallizes in four-sided prisms with dihedral summits Its crystals are soluble in their weight of water at 60°, and in three fourths their weight at 212° They melt when heated, and gradually lose their water of crystallization They consist of 20 magnesia, 40 sulphuric acid and 63 water This salt is a useful purgative in medicine, and is the chief source of the other forms of magnesia All the magnesian salts have a peculiar bitterish flavour Magnesia is found native in the state of hydrate and carbonate it exists as a component part of several minerals, and many of them are soft or soapy to the touch

MAGNESIAN LIMESTONE An extensive series of beds lying in geological position immediately above the coal measures, so called because the *limestone*, which is the principal member of the series, contains *magnesia* See GEOLOGY

MAGNESITE Native magnesia

MAGNESIUM The metallic base of magnesia, which see

MAGNETIC COMPASSES See COMPASS

MAGNETIC COMPENSATOR A contrivance devised by Mr Barlow for eliminating the influence of a ship's guns and other iron in deranging the bearings of the compass It consists of a plate or combination of plates of iron placed near the binnacle so as to counteract, by an equal and opposite attraction, that of the rest of the iron on board the vessel Mr Airy (*Phil Trans* 1839) has investigated the law of disturbance in the case of vessels built of iron, and shown that the disturbing force consists of a very large force of permanent magnetism in the rolled and hardened plates employed in the construction of the vessel, and a very small force of induced magnetism which changes with the place of the ship, or rather with the varying circumstances of terrestrial magnetism by which it is produced Mr Airy has given a set of practical rules for correcting the disturbing forces by means of two powerful magnets placed at right angles to each other below the compass, and a box of small iron chain, which is used instead of Barlow's correcting plate

MAGNET, NATURAL One of the numerous oxides of iron, possessed, however, of properties peculiar to itself, if we except the metals nickel and cobalt which possess it also in a very slight degree The magnet consists chiefly of two oxides, together with a small portion of quartz and alumine Its colour varies in different specimens, according to minute differences in the ratios of the two oxides, and the nature of the foreign substances with which they are found united, but it is usually of a dark-grey hue, and has a dull metallic lustre It is found in considerable masses in the iron mines of Sweden and Norway, in the Isle of Elba, in different parts of Arabia, China Siam and the Philippine Islands Small magnets are also occasionally though rarely, met with among the iron ores of this country The properties are,—

1 It attracts iron in all its states except the oxides

2 If formed into a bar, and suspended freely by a hair, or on a pivot passing through its centre, it will turn itself round and after a few pendulous vibrations settle to some one position which it will return to if left undisturbed or if disturbed will, after a few similar vibrations, return to [illegible] as before

3 By rubbing on a bar of steel it will give the bar the same properties, and a bar of soft iron will, while contiguous to it, even when not touched by it obtain the same properties, which however, the iron does not, like the steel, retain upon removal

4 The position of rest is different at different places, and different at the same place at distant periods of time

A great number of amusing toys have been formed of this substance, and the phenomena are often at first sight very surprising, but its application to the purposes of navigation renders it one of the most important discoveries ever made The earlier navigators believed that it pointed always to the north pole of the world, and that therefore by means of it they could always at once tell the direction of their meridian and consequently in what [illegible] of navigation has long been laid aside, as *artificial magnets* can be constructed having a much greater intensity of directive power See MAGNETISM

MAGNETIC NEEDLE An instrument suspended by its centre, and magnetized which shows the direction of the resultant of the magnetic forces at the place of observation See COMPASS and DIPPING NEEDLE

MAGNETIC PYRITES Native black sulphuret of iron it attracts the magnetic needle

MAGNETISM The science which investigates the phenomena presented by natural and artificial magnets and the laws by which they are connected The following brief explanation of it under both aspects will serve to render the subject generally intelligible, but it is impossible to give more than the essential phenomena and the general laws without descending to the detail of particular cases For further information reference may be made to the excellent compendium of Dr Roget in the *Library of Useful Knowledge*, to *Mr Barlow's Magnetic Attractions* (2d ed) and *Treatise on Magnetism* in the *Encyclopædia Metropolitana*, *Sir D Brewster's Treatise on Magnetism* in the *Encyc Britannica*, Gilbert *De Magnete* 1600 folio, *Robison's Mechanical Philosophy*, Biot *Traité de Physique*, tom iii Pouillet *Elemens de Physique*, Becquerel *Traité d'Electricité et du Magnétisme*, and various papers in the *Transactions of the Royal Society of London and Edinburgh* To the work of Dr Roget we have been under great obligations in drawing up the present abstract

*Phenomena of* [illegible] Pl 1 If a nicely balanced [illegible] suspended by a piece of untwisted silk or allowed to rest upon a pivot, free to turn in all directions both horizontally and vertically and if it be then magnetized by any of the methods hereafter described it will turn itself into one particular position and if disturbed by any means it will return invariably to the same as its position of repose The horizontal angle which it makes with the meridian is called its *variation*, or its *declination*, and the vertical angle which it makes with the horizon its *dip* or *inclination*

Phenomenon 2 Both these angles (dip and variation) continually change at the same place of observation sometimes the latter very rapidly, the former so far as has yet been observed very slowly at all places Thus about 1659 at London the needle pointed in the direction of the geographical meridian before that time it had pointed east of it but from that time till about 1818 it had continually made an angle more and more westward till it arrived at a variation of 24½° Since then its motion has again been retrograde and it is now little more than 23½° west (See COMPASS) The dip has also undergone similar variations at London in 1773 it was 72° 15′ and in 1830 it was 69° 38′

Phenomenon 3 The observation of navigators shows that there is a curve line on the surface of the earth at every point of which the needle will take a horizontal position This is called the *magnetic equator* It seems to cross the geographical equator in four points, and its form and position are also undergoing continual changes M Morlet and M Hansteen have investigated this subject with great care, and the former thinks it changes only its position not its form which is contrary to what theory would lead us to expect

The lines at which the dip is the same number of degrees are called *magnetic parallels* of that degree or more properly *lines of equal dip*, and the points at which the needle takes a vertical position the *poles*, *poles of convergency*, or more properly *poles of verticity* The points at which the variation is any given number of degrees constitute lines on the earth's surface, called *lines of equal variation*, or (after Dr Halley, who made a considerable number of observations on them) *Halleyan lines*, and the vertical circle whose plane coincides with the needle in its free position at any place is called, though improperly, the *magnetic meridian* of that place

Phenomenon 4 If the [illegible] needle whether compelled by its form or by loading one end of it with a weight sliding as an armature to keep a horizontal position, or free to take its own proper dip at each place successively, be made to vibrate by being drawn from its natural position, and then liberated, it will perform its vibrations more rapidly in some places than in others, and in the same place at different distant periods Its

places of most rapid horizontal vibration are not to be considered as those at which the most rapid vibrations of the freely suspended needle take place Hansteen has very laboriously investigated, from observations made by himself and others, the curves where the horizontal vibrations are the same, and he thinks there are four poles at which it is more rapid than at any points immediately near them But the rate of vibration of the free needle has as yet been observed at very few places with sufficient care to justify any general conclusion respecting such poles of vibration The velocity of vibration marks at the variation of the *intensity* of the vibrating force, the needle itself being a pendulum

Phenomenon 5 The intensity itself varies at different times of the day and under all variations of temperature in the surrounding medium, the place of observation being the same This was first observed more than a century ago, but its laws and circumstances have been only recently investigated by Mr Christie and subsequently by M Kupffer (See *Phil Trans* 1821 *Annals de Chimie*, 1826, and *Mr Christie's Report on the Present State of our Knowledge concerning Terrestrial Magnetism* in the *Reports of the British Association* The variation also undergoes similar changes and it is believed the dip also, but this has not been well established by observation

It is the opinion of Mr Christie Sir David Brewster, and others that the places on the earth where the temperature is lowest are precisely those where the magnetic intensity is the greatest accordant with what Mr Christie's experiments on the influence of temperature would lead us to expect but till we have more certain knowledge of the state of magnetic intensity at those places we cannot affirm this to be the case, probable as it may seem to be

In the following phenomena the place is supposed to be chosen and the dip variation and intensity to be fixed thereby It may be any place whatever on the surface of the earth We shall suppose it to be London (and there is comparatively little variation of these elements in the British Isles) The point of the needle which dips below the horizon and points to the westward of the meridian is called the *north pole* of the needle and the elevated one the *south pole* When the horizontal needle is used these same terms apply the end which varies westward being the north pole and the other the south pole

Phenomenon 6 If either pole of a magnet be brought near any small piece of soft unmagnetized iron it will be found to attract it Iron filings for instance are immediately collected together when a magnet is placed among them and they adhere to it when lifted up and more especially about the poles of the magnet in thick clusters About the intermediate parts the number that adhere is much less than near the ends and in every magnet there is a part to which the filings have no tendency to adhere at all It thus appears that the magnetic forces whatever be their nature are situated near the extremities of the magnet but it has been long questioned whether they be resident in two isolated points or diffused for considerable distances round those points but in a state of less intensity as they recede from those centres

Phenomenon 7 When instead of fragments of iron we substitute a rectangular or cylindrical bar of soft unmagnetized iron the magnet and the iron will be mutually attracted towards each other The best mode of exhibiting this is to suspend them by threads of untwisted silk at the appropriate distances as the friction they would undergo in sliding on a table is thus removed It will be found that the ends which are nearest to each other will tend to coalesce and that the other ends will tend to coalesce or recede according as the remote end of the iron happens to be situated with respect to the body of the magnet

If another iron body be brought near the former in this state of the apparatus the first iron will be found to be converted into a *temporary* magnet also and in like manner the second piece of iron may be proved to have become also a temporary magnet and then the third and so on The intensity of attraction and repulsion is however weaker in each in succession till it at length becomes insensible This is prettily exhibited by attaching a key to a magnet, a nail to the key a smaller nail to that a sewing needle to the smaller nail and so on as long as there is sufficient magnetic force developed to sustain the concatenation in a state of suspension Some magnets will sustain a considerable weight, others, of course, are capable of exerting very little force

The iron is said to be converted into a magnet, or, more briefly to be *magnetized by induction*, or, to use the French term, to be *magnetized by influence*

Phenomenon 8 If two magnets be suspended, as in the last experiment it will be found that the two north poles repel each other and the two south poles repel each other but the north pole of the one and south pole of the other mutually attract each other They will, in consequence of this mutual action upon each other, take positions *generally* different from those which they would each take in the absence of each other

Phenomenon 9 If the poles of the successive induced magnets spoken of in Phen 8 be examined as to their nature, by means of their action on the poles of a small magnetic needle, it will be found that each of them is a distinct magnet, each consecutive pair of them having their dissimilar poles in contact This is known at once by observing which end of the needle is attracted before the next piece of iron is put on, and which after it is added, the needle being applied near the untouched end of the iron

If, moreover, the pieces of iron be laid on a table, and not in contact, the same phenomena will be observed on the application of the trial needle near their extremities

When two or more magnets are employed to act by influence on the same piece of iron the phenomena become more complex, and the operation is called *complex induction* The phenomena are very curious and interesting

Phenomenon 10 If the iron be removed it instantly ceases to be magnetic, and may have its position reversed with precisely the same effect as before, each phenomenon taking place now at the end opposite to that where it was exhibited before, and this will be the case, however long the apparatus has been allowed to remain in the position spoken of If, however pieces of steel be employed the inductive influence is less than in the iron whilst instead of [illegible] instantaneously as the iron did it requires a sensible time and becomes itself a permanent magnet There are indeed few, if any pieces of iron and steel in which the magnetic force is wholly lost or wholly returned upon removal, but we here speak of the sensible and approximate circumstances of the phenomena

Phenomenon 11 If a magnet be broken or any way severed it is converted into two separate magnets, the two ends of the fragments at which the fracture was made being of opposite kinds to the two ends of the whole bar respectively as if they had been but two magnets united by opposite poles

Phenomenon 12 If two magnets be brought near each other their intensity of action on the vibrations of a needle are affected according to the relative positions of the poles indicating not only that the direction of the quiescent state of the needle is affected (Phen 8) but that the intensity of the magnetic force is also altered This shows that the magnetized bar itself is affected by the inductive power of the other bar as soft iron is

Phenomenon 13 If a mass of soft iron be brought into the vicinity of a magnetic needle the needle will be *generally* deflected from its natural position in various degrees and directions, according to the form and position of the needle and the mass When an iron sphere is employed as a common ball the investigation of the order of the phenomena becomes more simple and easy and it was by remarking that in this case there was a certain plane in any point of which the needle may be placed with respect to the sphere where the needle would not be at all deflected, that Mr Barlow was led to prosecute his celebrated experiments on this subject Mr Christie remarked that this plane was the plane passing through the centre of the ball perpendicular to the *dip* direction of the needle itself

There are also lines on the iron sphere in which if the needle is placed the deflection will be a given quantity

The same phenomena however, are exhibited whatever be the form of the mass Mr Barlow experimented on a gun 58 cwt and found it so He also found that the action did not depend upon the mass itself but upon the surface of the mass, as the same effects were produced by a ten inch ball a ten inch shell and a globe of sheet iron of the same diameter If, however, the sheet iron was less than $\frac{1}{10}$th of an inch in thickness the effects were diminished but up to that degree of thinness they did not seem to vary whilst after they varied very rapidly, and soon became insensible

Phenomenon 14 If disks of various metals be put into rapid rotation they will also deflect the magnetic needle from its natural position That this is not owing to vibration or vorticity produced in the air is rendered evident by the same effects taking place in a more intense degree in vacuo than in the open air The phenomenon itself was first observed by Arago in France, but it has been chiefly [illegible] by Messrs Herschel Babbage Christie Barlow Faraday and Harris, to whose memoirs on the subject in the *Philosophical Transactions* the reader is especially referred

Phenomenon 15 Bars that have long stood in a vertical [illegible], &c are found to have become [illegible] A bar of soft iron, placed [illegible] the magnetic needle, acquires temporary [illegible] a bar of steel be left there for [illegible] a permanent magnet These facts show that the earth itself is a great magnet and converts the others into magnets by induction This was

observed so far back as the time of Dr Gilbert, and it is remarkable that, whilst his great cotemporary Lord Bacon was precipitively urging the new organon in philosophy, Gilbert was actually putting it into the most careful practice The doctrine of terrestrial induction, as taught by Gilbert, is the doctrine of the present hour, and with scarcely a single improvement in the whole range of the theory

The foregoing contain the most important phenomena of magnetism which depend upon terrestrial influence merely those which depend upon electrical influence will be found under the head ELECTRO-MAGNETISM

*Laws of Magnetic Action* — Law 1 The intensity of the attractive force exercised by the north pole of one magnet on the south pole of another, and its repulsive force on the north pole of the second, varies inversely as the square of the distance of those poles, and the like occurs when we consider the action of the south pole of the first magnet on the north and south poles respectively of the other The same law precisely holds with respect to the attraction of a corpuscle of unmagnetized iron

This is the fundamental law of the science and may be considered as the source from which the others flow by mathematical reasoning It has been determined with great care by several philosophers but especially Michell and Coulomb by means of the torsion balance Other laws were, in the earlier state of the science, conjectured to obtain, as for instance Newton supposed the forces to vary as the cubes of the distances and some recent inquirers have contended for the simple inverse of the distances, but Newton's opinion was founded upon insufficient experiments, and that of the authors referred to upon an oversight in their mode of estimating the intensity of the forces Not the slightest doubt however now remains upon the minds of those who are competent to form an opinion of the truth of the law stated above

Law 2 When the needle is very short in comparison with the distance and length of the magnet and has its centre fixed immoveably but is otherwise at liberty to take any directive position it will so arrange itself that its line of direction will be in the plane drawn through the two poles of the magnet and its own (the needle's) centre of rotation, and the line of the needle's direction being produced to meet the magnetic line (or line drawn through the poles) will divide the latter into [illegible] which are in the ratios [illegible] poles from the centre of the needle When the needle is not small in comparison, as above the law becomes more complicated

Law 3 If two magnetic needles be made to vibrate the intensities of their magnetic forces are as the squares of their number of vibrations made in the same time This is true whatever be the planes in which they vibrate, so far as the force is effective in that plane, but for a direct comparison of the ratio of the intensities without further computation the vibrations of both needles must in both cases be made in the *same plane* The planes most commonly used for vibration are — the horizontal plane the plane which has been called the magnetic meridian or that vertical plane which passes through the natural direction of the needle at the place of observation and the vertical plane at right angles to this

Law 4 If the needle be allowed to move vertically in a plane making any angle with the magnetic meridian the dip in that case is equal to the dip in the magnetic meridian multiplied by the cosine of the inclination of the two planes, and if [illegible] in which the dip is observed [illegible] of the natural dip at that place is equal to the sum of the squares of the cotangents of the observed dips

Law 5 The intensity of the horizontal force is equal to the intensity of the whole force multiplied by the cosine of the dip If, therefore, the same needle be used in all the experiments and observations be made to determine the dip and horizontal intensity at several different places, the relative intensities of the terrestrial magnetic force can be deduced from those observations by the three last laws for each of the places

The laws according to which magnetic force is influenced by temperature have been chiefly investigated by Coulomb, Kupffer Barlow and Christie It appears generally, that between the temperature of — 5 and + 17 of Fahrenheit, the intensity of magnets decreases as the temperature increases, and that at temperatures above 100° a part of the power of the magnet is permanently destroyed The effects produced on soft iron by changes of temperature appear to be directly the reverse of those produced on magnets, an increase of temperature causing an increase of magnetic force

*On the Formation of Artificial Magnets* — 1 If a steel bar be held in the natural direction of the dip [illegible] or three smart blows be given at the upper end with a hammer, it will become a permanent magnet

2 If the end of a steel bar be placed in contact with one of the poles of a magnet, it will become permanently magnetic by induction A better plan is to place the needle in a line between the opposite poles of two magnets of equal intensity

3 Lay the bar flat on a table, and draw another magnet (placed upright upon it) several times from one end to the other, always the same way Or take two magnets, and lay them horizontally upon the bar to be impregnated, having their dissimilar ends in contact over its middle, and slide each towards the end of the bar This must be repeated several times Or, again, instead of laying them horizontally, hold them in any angle of inclination (each in the same angle, estimated from the perpendicular to the middle of the bar) and draw them several times along towards the ends without varying their inclinations

The above methods were those originally employed, but when the principles of magnetic induction came to be better understood, more complicated but more effective processes were invented, for the explanation of which reference must be made to works expressly on the subject (See *Brewster's Treatise on Magnetism*) Those more complicated processes may be greatly simplified by the substitution of a magnet in the form of a horseshoe for the compound magnets If placed at once in the middle of the needle to be magnetized, with the poles turned in a direction the reverse of the poles intended to be given to the needle, and then moved backwards and forwards along the surface of the needle, taking care to pass over each half of it an equal number of times and repeating the same operation on the other side the needle is speedily and effectually rendered magnetic This is by far the simplest [illegible] and it may be considered as a method [illegible] induction being accelerated by the friction

On the subject of terrestrial magnetism which at the present time is occupying so much of the attention of scientific men reference may be made in addition to the works above cited to the following — Hansteen, *Untersuchungen über der Magnetismus der Erde* 4to Christiania 1817, Barlow *Phil. Trans.* 1833, *Allgemeine Theorie des Magnetischen Vereins im Jahre* 1838 by Gauss and Weber Leipzig 1839 (a translation of which will be found in *Taylor's Scientific Memoirs*), *Intensitas Vis Magneticæ Terrestris ad Mensuram Absolutam revocata* Auctore C. F. Gauss, Gottingæ, 1833 *Major Sabine's Report to the Seventh Meeting of the British Association* 1838 *The Report of the President and Council of the Royal Society on the Objects of Scientific Inquiry*, 1840, and to an excellent popular abstract of the present state of our knowledge on the subject in the *Quarterly Review* for June 1840

MAGNETISM ANIMAL This pretended influence or agent had its origin in Vienna about the year 1776 when a person of the name of Anthony Mesmer published a thesis *On the Influence of the Planets on the Human Body* About the same time a Jesuit called Father Hehl imagined that by the help of a loadstone and certain steel plates rendered magnetic he had cured several diseases and being struck with the analogy of Mesmer's views to his own they entered into a kind of partnership as joint practitioners and attracted considerable notice, so that although they soon quarrelled, their system of treatment had acquired some notoriety and many powerful advocates Hehl continued to practise this new and occult science in Germany, and Mesmer in 1778 went to Paris and in the course of a short time performed such wonderful cures and took care to have them so satisfactorily attested that his apartments were daily thronged with patients of all ranks and fees and reputation poured in from all quarters He here however unluckily associated himself with a M. d'Eslon, a medical man who being more skilful in the art of pleasing patients than his master, contrived to gain the ascendency, and so to disgust Mesmer that he was induced to quit Paris for Spa, where he soon contrived, under the pretence of initiating others in the secrets of his trade, to raise about 14000*l* with which he retired to his native place (Mersburg in Suabia) and left magnetism and the magnetizers to their own resources

As the jargon of Mesmer has been revived in our own days it may be worth while to give his own definition of his art which is quite as intelligible as some of the later versions of it which have recently appeared in London, for in this "hotbed of quackery" Mesmerism, as it is called, has occasionally taken root and at one time, but for an accident, which we shall presently notice, threatened to thrive and prosper

'Animal magnetism says Mesmer, "is a fluid universally diffused, it is the medium of a mutual influence between the heavenly bodies, the earth, and animated bodies, it is continuous, so as to leave no void, its subtilty admits of no comparison, it is capable of receiving, propagating [illegible] the impressions of motion, it [illegible] of reflux The animal body [illegible] of the magnet by insinuating itself [illegible] effects them immediately There are observed, [illegible] in the human body, properties analogous [illegible] mag-

net, and in it are discerned poles equally different and opposite The action and the virtues of animal magnetism may be communicated from one body to other bodies, animate and inanimate This action takes place at a remote distance, without the aid of any intermediate body, it is increased and reflected by mirrors, communicated, propagated, augmented, by sound, its virtues may be accumulated, concentrated, transported Although this fluid is universal, all animal bodies are not equally susceptible of it, there are even some, though a very small number, which have properties so opposite that their very presence destroys all the effects of this fluid on other bodies

"Animal magnetism is capable of healing diseases of the nerves immediately and of a mediate It perfects the action of medicines, it excites salutary effects salutary crises in such a manner that the physician may render himself master of them, by its means he knows the state of health of each individual and judges with certainty of the origin, the nature, and the progress of the most complicated diseases, he prevents their increase and succeeds in healing them without at any time exposing his patient to dangerous effects or troublesome consequences whatever be the age, the temperament, and the sex In animal magnetism nature presents a universal method of healing and preserving mankind"

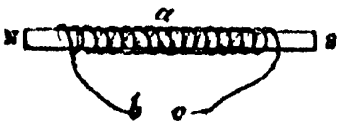
Many of our readers have probably witnessed the silly and disgraceful exhibitions in this line of practice which some years ago were displayed in London and are therefore aware of the means by which the magnetized are brought under the 'influence' It is always necessary that the magnetizer himself should be charged with the fluid and [illegible] its influence, [illegible], nor can all persons be magnetizers some want power, and others faith, in short there must be a due share of folly or of imposture or both, on the one hand and of credulity, cunning or morbid irritability on the other and then all goes right The magnetizer with his wand of office performs certain antics before the patient, and the patient either falls asleep or into a fit or is dumb or deaf or garrulous and painfully sensitive to sounds as the case may be But it is by no means necessary that the doctor and the person magnetized should see each other a skilful artist, well charged can magnetize a fit subject in another room house street or town and can moreover tell by his own sensations to what extent the influence is communicated and how the persons receive it

Mesmer availed himself of certain aids which our modern practitioners have rejected, such as boxes of steel bars magnetized water and musical instruments imbued with the magnetic influence he also frequently tied his customers together or made them link their thumbs when several were to be magnetized at once When patients are in the crisis or under the full influence of the power they can be immmediately roused out of it by certain looks, gestures and touches of the adept

To ascertain how far the pretensions of the animal magnetizers were cut [illegible] French government [illegible] of scientific and unprejudiced persons to investigate its merits among whom were Bailly Franklin and Lavoisier, and it is curious that their report, which was translated into English, and published here in 1785 is not more often quoted 'This pretended agent say they, "is not magnetism, for on examining the grand reservoir of the fluid by a needle and electrometer neither magnetism nor electricity could be detected We tried it upon ourselves and others without effect and on blindfolding those who professed great susceptibility of its influence, all its ordinary effects were produced when nothing was done but when they imagined they were magnetized while none of its effects were produced when they were really magnetized but imagined nothing was done So also when brought under a magnetized tree, nothing happened if they thought they were at a distance from it while they immediately went into violent convulsions when [illegible] were near the tree though really not so [illegible] Therefore' say the commissioners 'are purely imaginary, and although they have wrought some cures, they are not without danger for the convulsions sometimes spread among the feeble of body and mind, and especially among women And finally there are parts of the operations which may readily be turned to vicious purposes, and in fact immoral practices have already actually grown out of them"

Some years ago a great animal magnetizer arose in this country called Perkins, who invented what he called "metallic tractors, for collecting condensing, and applying animal magnetism, but Dr Falconer and Dr Haygarth of Bath soon put an end to his pretensions, by performing all manner of cures and wonders with a pair of wooden tractors, and as those cases were well attested, they proved, as every person of common sense before knew, that all Perkins's results were imaginary or assumed, and so animal magnetism fell into oblivion A few years ago some lamentable attempts were made to revive it in London, not by quacks and impostors, but by [illegible] and even by persons who enjoyed a considerable share of public respect and favour The [illegible] of their credulity and folly, but the mania has spread into the provinces, where it still rages with unabated fury

MAGNE'TO ELECTRICITY Under the term ELECTRO MAGNETISM will be found the description of certain magnetic phenomena produced by electricity It has been demonstrated by Faraday that electric phenomena may be produced by magnetism and to these the term *magneto-electricity* has been applied Let *a* represent a hollow helix of copper wire covered by silk, the ends *b c* of which are connected with a delicate galvanometer, and N S a powerful bar magnet, which can easily be thrust into and withdrawn from the spiral or helix it will then be found that every time the magnet is pushed into the helix the galvanometer is deflected in one direction, and each time it is withdrawn it is deflected in the opposite direction On repeatedly threading the helix with the magnet, the deflection also takes place Now as the deflection of the galvanometer can only be produced by the motion of electricity in the helix, it is obvious that an electric current is produced each time that the magnet moves through it hence as, on the one hand electricity in motion produces magnetism so, here, magnetism in motion produces electricity By causing the pole of a powerful magnet to revolve before a coil of wire, or, what amounts to the same thing, if the coil be made to revolve opposite to the pole of a magnet, an electric current will be established in the coil which may be made sensible by sparks shocks and chemical effects




MAGNETOMETER An instrument for measuring the intensity of terrestrial magnetism The three elements sought to be deduced from magnetic observations are the declination the inclination or dip, and the absolute intensity, together with the variations to which they are subject and each of these elements requires for its determination a peculiar apparatus A detailed account of the construction and various adjustments of the instruments made use of in the magnetic observatories recently established and of the methods of observing, will be found in the *Report of the President and Council of the Royal Society on the Objects of Scientific Inquiry in Physics and Meteorology* 1840 The first accurate measurements of magnetic force were made by Coulomb with the torsion balance, but the more precise method which is now generally adopted and which depends on the dynamical principle of observing the number of vibrations made by a needle in a given time, was proposed by Graham so long ago as 1722

MAGNETOMO'TOR (Lat lit *magnet-mover*) A term applied to a voltaic series of two or more large plates which producing a great quantity of electricity of low tension is well adapted to the exhibition of electromagnetic phenomena

MAGNITUDE (Lat) Size, extent quantity This term was originally employed to designate the space occupied by any figure, or, in other words, 'was applied to objects strictly termed geometrical, and to the three dimensions —length, breadth, and thickness then it was extended to designate the quantity of any one of these, and also of angular space, or the inclination of two lines to one another, or again the compound idea of a solid angle formed by any number of planes meeting in a point The amount of any one of these, taken in reference to some standard of the same kind of quantity as that spoken of, was called its magnitude The term was gradually enlarged in its signification, so as to apply to every kind of quantity that admits of exhibition or mensuration, or of which greater or less can be predicated, and in this sense it was used by Euclid

MAGNITUDE, APPARENT The angular space (plane or solid) under which a body appears when viewed from some distant point The term is chiefly used in speaking of the celestial bodies, and is then employed to express the plane angle subtended by the diameter of the visual disc of the body It is also used in many branches of optical science, but always with the same *general* meaning

MAGNOLIA'CEÆ (Magnolia, one of the genera) A natural order of Exogenous plants, consisting of trees or shrubs of great beauty usually with evergreen leaves, and large fragrant flowers They inhabit the temperate parts of America and Asia, as well as the tropics, and are universal objects of cultivation The bark of the tulip tree, and of some of the true magnolias, has the reputation of being a good febrifuge

MAGPIE A common species of the Crow tribe *Corvus pica* of Linnæus now the type of a distinct genus, *Pica caudata* They continue in pairs throughout the year, and prey on a variety of food, chiefly animal, as the young of hares, rabbits, and feathered game, young poultry, eggs, carrion, and insects, lastly, fruit and grain

The magpie is celebrated for its crafty instincts its power of imitating words, and the propensity which it has in common with other species of the crow tribe to purloin and secrete glittering articles The nest of the magpie is admirably constructed for strength and warmth, and is commonly defended by a dome It lays six or seven eggs early in spring, of a yellowish white spotted with brown and cinereous In winter magpies will assemble in great numbers to roost in some coppice towards the [illegible] on the approach of day

MAHABA'RATA The name of one of the great Indian epic poems, the subject of which is a long civil war between two dynasties of ancient India the Kurus and Pandus This poem embraces the whole circle of Indian mythology, but it is still more valuable as embodying an immense number of historical fragments which will be of great importance to the future historian of India Many episodes from the *Mahabarata* have been ably translated by some of our most celebrated orientalists, and parts of the original have been published at different periods in Germany The period at which the *Mahabarata* was written is wholly unknown, and it has no less baffled all the researches of the learned to discover the date at which it assumed its present methodical form The *Penny Cyclop* [illegible] of this poem See RAMAYANA

MA'HADO A name of one of the Indian deities from whom the sacred Ganges is fabled to spring He is incorrectly used in Goethe's well known poem *Der Gott und die Bajadere* which begins Mahado, du Herr der Erde' (Lord of Earth), as synonymous with Siva

MAHOMEDANISM *See* MOHAMMEDANISM

MAI'A In Grecian Mythology — 1 The daughter of Atlas and Pleione one of the Pleiads who became mother of Mercury by Jupiter 2 A daughter of the god Faunus and wife of Vulcan, frequently confounded by mythologists with the former personage

MAI'DÆ A family of crabs (Brachyurous Crustaceans) of which the genus *Maia* is the type The form of the shell is ovoid the manus and the preceding joint are nearly of the same length The species called *Maia squinado* is occasionally taken on our own coasts as well as those of France and of the Mediterranean it is commonly called the "sea spider"

MAI'DEN The name given in Scotland to a sharp edged instrument, formerly used for the beheading of criminals It resembles in its construction the *guillotine* of the French See GUILLOTINE

MAIDEN HAIR The *Adiantum capillus veneris* a fern found in many parts of Europe on damp shaded rocks It formed an ingredient in the syrup of capillaire of old pharmacy

MAIL (Fr maille) A small piece of metal or money but used collectively to defensive armour formed of iron rings or round meshes See HAUBERK

MAIL signified originally the bag which contains letters forwarded by government for the public convenience but it was soon afterwards extended to the letters themselves, and it is now used also for the conveyance in which they are forwarded See POST OFFICE

MAILS, or MAILIS In Scottish Law the rents of an estate (Silver halfpence in England were recently called mailes) In the northern counties of England and in Scotland, payments made by the occupiers or owners of lands to persons in league with the various classes of freebooters who infested the country were termed *black mail* To take it was made a capital felony by stat 43 Hen 7 c 13

MAIM, or MAYHEM In old English Jurisprudence a wound by which any one was so disabled as to be less fit to defend himself [illegible] from an injury which [illegible] hem was abolished, with other criminal appeals, by 59 G 3 c 46 Cutting and stabbing, "with intent to murder and with intent to maim or disfigure, are now distinct offences, under 9 G 4 c 31 s 11 and 12 The latter was thereby made a capital felony only in such cases in which if death had ensued it would have been murder

MAI'NTENANCE, in Law is defined to be an officious intermeddling in a suit that in no way belongs to one by maintaining and assisting either party with money or otherwise to prosecute or defend it The punishment by common law is fine and imprisonment, and by 32 H 8 c 9 a forfeiture of ten pounds

MAI'NTENANCE, CAP OF A cap of dignity anciently belonging to the rank of a duke, termed by the French *bonnet ducal* The lord mayor's fur cap is also called a cap of maintenance

MAIZE (Mais, the American name), a kind of corn extensively cultivated for food, is the grain of the plant named by Linnæus *Zea mays* Like other corn, it is a species of grass, whose albumen is sufficiently large and farinaceous to be ground into flour In this plant the grains are unusually large, compressed, and packed closely in *regular parallel lines along the sides of a receptacle* many inches long In the young state each grain is tipped with a long slender style as fine as a thread of silk, and many hundreds of such styles being collected together from each receptacle, the whole resemble a silken tassel hanging down from the orifice of the sheathing leaves in which [illegible] When ripe the corn is [illegible] leaves and is only to be [illegible] stripped back The male or barren flowers grow in a loose panicle at the end of the stem There are many varieties of maize, some with stems seven or eight feet high, others not exceeding the stature of two feet, some requiring a long summer to ripen their grain, others coming to perfection in a couple of months The colour of the grain is also variable, chocolate-coloured, red, crimson, yellow, white, and variegated are all known to the American planter This kind of corn is not grown exclusively for the sake of the ripe grain, the young female inflorescence, which is sweet and tender, is boiled or cooked in other ways as a delicate vegetable, and the young stems are occasionally given to cattle Many attempts have been made to cultivate maize in England as a field crop but without success It does not thrive north of the basin of the Mediterranean, and requires a [illegible] heat than we experience in these islands

MAJESTY This title of honour is derived from the Romans among whom it stood for the collective power and dignity of the sovereign body, as majestas populi Romani Hence treason was termed crimen lasæ majestatis an injury offered to majesty Majesty was the attribute of consuls prætors &c only as representing the public and hence in later times when it was transferred to the emperors along with the sovereign power, inferior magistrates were entitled, in ceremonial language by the appellation of dignitas Majesty is now the conventional title of European emperors and kings (The Sultan of Turkey has no more elevated title in our ceremonial than Highness) It appears to have been first assumed by the German emperors who were considered as representing the imperial dignity of Rome then by the French kings Henry II in England by Elizabeth The Emperor of Austria has the title Majesty with the prefix K K (Kaiserliche Königliche or Imperial Royal)

*Apostolical Majesty* — A title bestowed on Stephen duke of Hungary about A D 1000 by Pope Sylvester II Re conferred on the empress-queen Maria Theresa in 1758

*Catholic Majesty* — A title bestowed on Ferdinand and Isabella of Spain by Pope Alexander VI in 1491 in memory of the conquest of the Moors it had, however, been borne by earlier Spanish monarchs

*Most Christian Majesty* — A title borne by the kings of France, first solemnly conferred on Louis XI in 1469 by Pope Paul II

*Most Faithful Majesty* — The title of the kings of Portugal bestowed by Benedict XIV on John V

MAJOR In the art Military a field officer next in rank above a captain and immediately inferior to a lieutenant colonel His chief duties consist in superintending the exercises of his regiment or battalion and of putting in execution the commands of his superior officer This class of field officers did not exist till the beginning of the 17th century The prices of a major's commission and his pay in the British army are as follow — In the regiments of the line, 3200*l* pay 16*s* per diem in the dragoons 1787*l* pay 19*s* 3*d* per diem in the life and royal horse guards 5380*l* pay 1*l* 4*s* 5*d* per diem and in the foot guards (with the rank of colonel) 8300*l* pay 1*l* 3*s* This appellation of major does not exist either in the artillery or engineers *Brigade major* is a staff officer, who performs for a brigade or in a garrison duties equivalent to those of a major in a regiment or battalion *Major general* is an officer next in rank below a lieu- [illegible] whose functions he has to discharge in [illegible] his superior officer

MAJOR AND MINOR In Music terms applied to imperfect concords differing from each other by a semitone *minor* They are used in the same sense when applied to discords

MAJORA'T In modern legal phraseology as employed by several Continental nations, the right of succession to property according to age It is defined "a fidei-commissum gradual successive perpetual, indivisible made with a view to preserve the name, arms, and dignity of a family and destined for ever to the eldest member of it" In the German empire and in Spain this species of entails is of great antiquity *See* MAYORAZGO

MAJORAT In the French Law expresses the property, landed or funded, which by virtue of several decrees of the empire might be reserved by individuals enjoying hereditary titles of honour and attached to the title so as to descend with it The German and Spanish laws of majorat had no exact equivalent in old France, but a species of majorat existed in the case of the Duches-Pairies, abolished at the Revolution, with other feudal institutions The general rule of French law that children succeed equally to their parents' property, is only modified by the regulations respecting what is termed a "portion disponible" (*Cod Civil*, art 913 &c) A per-

son who leaves one child only can dispose, by will or donation, of half his property; one who leaves two one third, and so on a person who dies without descendants, but leaving "ascendants," one half or three fourths, according to certain rules, if he leaves only collaterals, he [illegible] whole

MAJOR DOMO (Lat major domus *greater officer of the house*) In the courts of those kingdoms which were formed out of the fragments of the Western Empire, three different offices seem to be designated by this title —1 The maître d'hôtel, or chief officer of the prince's table, præfectus mensæ, architriclinus, dapifer, &c, 2 The mayor of the palace (æconomus, *steward*), 3 The first minister, prefect of the palace, count of the palace, &c Charles Martel is termed major domus by some ancient historians This title became in later times confounded with that of seneschal In Germany, under the Othos and the house of Swabia, the dapifer was an officer of high rank, who bore among other duties, the standard of his sovereign The corresponding office was dapifer of the empire the elector of Bavaria, arch dapifer In England he was a personage of less distinction and his subscription generally appears last among the attesting witnesses to ancient charters

MAJORITY In Politics the age at which the sovereign in hereditary monarchies becomes capable of exercising supreme authority See MINORITY REGENT

MAJOR TERM in Logic, is in a syllogism the predicate of the conclusion The major premise is that which contains the major term In hypothetical syllogisms the first premise is called the major

MAJUSCULE CAPITALS LETTERS In Diplomatics, capital letters The Latin manuscripts of the classical age which we possess (those found at Pompeii and a few parchment MSS of very early date) are written in capital letters Few instruments or books of later date than the sixth century are in capital letters

MALACHITE (Gr μαλαχη *the mallow flower*, or μαλακος *soft*, hence also called *soft* or *fibrous* copper ore) The *blue* and *green* varieties of copper

MALACIA (Gr μαλακια *a nauseous fish*) A depraved appetite

MALACODERMS, *Malacodermi* (Gr μαλακος and δερμα *skin*) The name of a tribe of Serricorn beetles including those with a soft and flexible body

MALACOLITE (Gr μαλακος) A variety of *augite* of a dark green colour

MALACOLOGY (Gr μαλακια the Aristotelian name of the Mollusca of the moderns, and λογος *a discourse*) The science of the Mollusks (See that word for their general characters) Cuvier the great reviver of this branch of natural history divides the Mollusks into six classes

I *Cephalopoda* — Mantle in form of a sac open anteriorly containing the branchiæ and abdominal viscera, head protruding from the mantle well developed and crowned by fleshy productions, by means of which they crawl and seize various objects

II *Pteropoda* — Mantle closed appendages of the head either wanting or extremely reduced The principal organs of locomotion are two membranous fins, like wings situated on the sides of the neck

III *Gasteropoda* — These crawl by means of a fleshy disk on their belly The mouth is supported by a head

IV *Acephala* — The mantle encloses the branchiæ and viscera the mouth opens within its cavity and is not supported by a distinct head The mantle may be open throughout its length, at both ends, or at one extremity only

V *Brachiopoda* — These are also enclosed in a mantle without an apparent head, but have a pair of long, fleshy, ciliated arms which are spiral when retracted

VI *Cirrhopoda* — This class Cuvier defines as being similar to the other Mollusks in the mantle branchiæ &c, but as differing from them in having numerous horny and articulated limbs, and a nervous system more nearly resembling that of the Articulata

Since the early form and metamorphoses of the *Cirrhopoda* or more properly *Cirripedia* were known, most zoologists have regarded them as members of the Articulate sub kingdom

The classification of the Mollusca has been much perfected by those zoologists who have been attracted to the study of this department of the animal kingdom by the beautiful and diversified coverings of the testaceous species Among these Lamarck ranks deservedly the chief, and his system is still that which mainly guides the conchologist in the arrangement of his shells

The following is the outline of the Lamarckian system —

In the system of Lamarck the natural primary group of animals to which the science of malacology relates constitutes the 11th and 12th classes of his Invertebrata The first of these classes, under the name of *Conchifera*, is equivalent to the Testaceous *Acephala* and *Brachiopoda* of Cuvier, and these low-organized headless Mollusca have their external shelly defensive covering rendered the more complete by way of compensation for the slight development of the nervous centres to which the impressions of external objects or [illegible] which the acts of [illegible] are therefore provided with and generally completely covered by two shells, which are technically called "valves," and the *Conchifera* of Lamarck thus include the Mollusks with bivalve shells These are divided into two orders, *Dimyaria* and *Monomyaria*

### Class I CONCHIFERA

Order 1 *Conchifera Dimyaria* — Char Two muscles of attachment at least, shell internally with two muscular impressions, which are separate and lateral

(1) Shell regular generally equivalve

(A) Shell gaping in general at the lateral extremities, its valves being approximated

(*) *Crassipede Conchifers* — Mantle with its lobes united anteriorly, either entirely or partially, foot thick gape of the shell wide

Family 1 *Tubicolidæ* — Shell either contained in a tubular sheath distinct from its valves, or entirely or partially incrusted in the wall of its sheath, or projecting externally (*Aspergillum, Clavagella, Teredo* &c)

Family 2 *Pholadidæ* — Shell without a tubular sheath, either furnished with accessory pieces or gaping very much anteriorly (*Pholas, Gastrochæna*)

Family 3 *Solenidæ* — Shell without accessory pieces, and gaping at the lateral extremities only, ligament external (*Solen, Panopæa Glycymeris*)

Family 4 *Myadæ* — The same characters of the shell, with the ligament internal (*Mya Anatina*)

(**) *Inæquipede Conchifers* — Mantle with its lobes not united or hardly united anteriorly foot small, compressed, gaping of the shell often considerable

Family 5 *Mactridæ*

a Ligament internal only (*Mactra, Crassatella, Lyonsia Lutraria*)

b Ligament partly internal partly external (*Ungulina Solemya Amphidesma*)

Family 6 *Corbulidæ* — Shell inequivalve, ligament internal (*Corbula Pandora*)

Family 7 *Lithophagidæ* — Ligament partly external partly internal, shells without accessory pieces or any particular sheath more or less gaping at their anterior side (*Saxicava Petricola Venerupis*)

Family 8 *Nymphæ* — Two cardinal teeth at most in the same valve, shell often gaping a little at the lateral extremities, ligament external, nymphæ [illegible] *Psammobia* [illegible] *Crassina*) See CONCHOLOGY

(B) Shell closed at the lateral extremities when the valves are shut

(***) *Lamellipede Conchifers* — Foot flattened, lamelliform not posterior

Family 9 *Conchidæ* — Three cardinal teeth at least in one valve with as many or less in the other, lateral teeth sometimes

1 *Fluviatile Conchidæ* — Shell with lateral teeth and covered with a false epiderm (*Cyclas, Cyrena, Galathea*)

2 *Marine Conchacea* — No lateral teeth in the greater number, rarely an epidermis, which covers the whole shell except the umbones (*Cypræa, Cytherea, Venus, Venericardia*)

Family 10 *Cardiadæ* — Cardinal teeth irregular either in their form or situation, and accompanied in general by one or two lateral teeth (*Cardium, Cardita, Isocardia* &c)

Family 11 *Arcadæ* — Cardinal teeth small numerous, intrant and disposed in each valve on a line which is [illegible] straight or arched (*Cucullæa, Arca, Pectunculus Nucula Trigonia* and *Castalia*)

Family [illegible] [illegible] which is simple or divided, and with a longitudinal tooth which is prolonged under the corselet, and sometimes without any tooth at all or is furnished along its length with irregular granulous tubercles Umbones with the epidermis peeled off, and frequently eroded (*Unio, Hyria, Anodon*, and *Iridina*)

Family 13 *Chamidæ* — Shell irregular, inequivale, a [illegible] pressions distant, lateral, external ligament depressed (*Diceras, Chama, Etheria*)

Order 2 — *Conchifera Monomyaria* — Only one muscle of attachment which seems to traverse their body Shell with an internal subcentral muscular impression

(*) Ligament marginal, elongated on the border, sublinear
Family 14 *Tridacnidæ* — Shell transverse, equivalve, with an elongated muscular impression bordering the upper limb (*Tridacna Hippopus*)
Family 15 *Mytilidæ* — Shell longitudinal or subtransverse, with a muscular impression contracted into an isolated space without bordering the limb, hinge with a subinternal ligament, which is marginal, linear, very entire (*Modiola, Mytilus, Pinna*)
Family 16 *Malleidæ* — Ligament sublinear either interrupted by serial teeth or simple, shell subinequivalve foliated (*Crenatula Perna, Malleus, Avicula*)
(**) Ligament not marginal, contracted into a short space under the umbones, and not forming a tendinous tube under the shell
Family 17 *Pectinidæ* — Shell regular, compact not foliated (*Pedum, Lima, Plagiostoma, Pecten, Plicatula, Spondylus, Podopsis*)
Family 18 *Ostreidæ*
*a* Ligament partly external, shell foliated but nevertheless often acquiring great thickness (*Gryphæa, Ostrea Vulsella*)
*b* Ligament internal, shell delicate, papyraceous (*Placuna, Anomia*)
(***) Ligament either wanting or represented by a tendinous chord which sustains the shell
Family 19 *Rudista* — Shell very inequivalve (*Sphærulites, Radiolites, Calceola, Birostrites Discina Crania*)
Family 20 *Brachiopoda* — Shell adherent either immediately or by a tendinous chord mantle bilobate, the lobes separated anteriorly enveloping the body, two opposed, elongated, fringed arms near the mouth, rolled spirally when retracted (*Orbicula, Terebratula, Lingula*)

## Class II Mollusca

Order 1 *Pteropoda* — Char No foot for creeping nor arms for progress or seizing the prey, two fins opposed and similar, proper for natation, body free and floating, some naked, others with thin semitransparent symmetrical shell (*Hyalæa Cleo Cleodora, Limacina, Cymbulia, Pneumodermon*)
Order 2 *Gasteropoda* — Animals with a straight body never spiral, nor enveloped in a shell which can contain the entire body, a foot or muscular disc along the whole length of the under part of the body serving for creeping, some naked, others protected by a dorsal shell [illegible] or less [illegible]
Section 1 *Hydrobranchiata* — Branchiæ whatever be their position, developed either in the form of a network, in laminæ, in a pectinated form, or in a ribbon-like shape The Gastropods of this section breathe water only
Family 21 *Tritonidæ* — Branchiæ external placed above the mantle, either on the back or on the sides and not being in any particular cavity (*Glaucus Eolis Tritonia Scyllæa Tethys Doris*)
Family 22 *Phyllidiadæ* — Branchiæ placed under the border of the mantle, and disposed in a longitudinal series around the body or on one side only not being in any particular cavity (*Phyllidia, Chitonellus Chiton, Patella*)
Family 23 *Semiphyllidiadæ* — Branchiæ placed under the border of the mantle, and disposed in a longitudinal series on the right side of the body only (*Pleurobranchus, Umbrella*)
Family 24 [illegible] — Branchiæ placed in a particular cavity [illegible] anteriorly near the neck, shell always external and covering the soft parts (*Parmophorus Emarginula Fissurella Pileopsis, Calyptræa, Crepidula Ancylus*)
Family 25 *Bullidæ* — Branchiæ placed in a particular cavity towards the posterior part of the back and covered either by the mantle or by an opercular escutcheon (*Bulla, Aplysia, Dolabella*)
Section 2 *Pneumobranchiata* — Branchiæ creeping, in in the form of a vascular network, on the wall of a particular cavity, the aperture of which is small, and can be contracted or dilated at will The Gastropods of this section breathe the [illegible] air
Family *Limnidæ* (See Limax)
Order 3 *Trachelipoda* — Body spiral in its posterior part, which is separated from the foot, and always lodged in a shell, the foot free, flattened, attached to the lower base of the neck or to the anterior part of the body, and serving for creeping, shell spirivalve and sheathing
Section 1 *Phytiphaga* — Trachelipods without a projecting siphon, and respiring in general by means of a hole, the greater part phytiphagous, and furnished with jaws, shell with the aperture entire, having at its base neither dorsal subascending notch nor canal
(*) Breathing air only, shell spirivalve unarmed, not distinctly nacreous
Family 26 *Helicidæ*
*a* Four tentacles (*Helix, Bulimus, Achatina*, &c)
*b* Two tentacles (*Auricula Cyclostoma*)
Family 27 *Limnæidæ* — Amphibious living in the water but coming to the surface to breathe shell with a sharp edged lip (*Planorbis, Physa Limnæa*)
(**) Breathing water only, branchiæ projecting in form of filaments laminæ, or tufts in the branchial cavity, shell often nacreous, and often also having protuberant parts on the surface
(*a*) Shell fluviatile, operculated the left border of which does not resemble a demi partition
Family 28 *Melanidæ* — Shell with disunited borders (*Melania, Melanopsis, Pirena*)
Family 29 *Peristomidæ* — Shell with united borders (*Valvata, Paludina, Ampullariæ*)
(*b*) Shell fluviatile or marine, the left border resembling a demi-partition
Family 30 *Neritidæ* — *Navicella, Neritina* (fluviatile), *Nerita Natica* (marine)
(*c*) Shell marine, the left border not resembling a demi partition
Family 31 *Janthinidæ* — Shell floating at the surface of the water (*Janthina*)
Family 32 *Macrostomidæ* Shell not floating having the aperture very wide no columella (*Siphonatus, Stomatella Haliotis*)
Family 33 *Plicacidæ* — Aperture of shell not very wide, plaits on the columella (*Tornatella Pyramidella*)
Family 34 *Scalaridæ* — Borders of the aperture united circularly, no plaits on the columella (*Vermetus, Scalariæ, Delphinula*)
Family 35 *Turbinidæ* — Borders of the aperture disunited (*Solarium Rotella, Trochus, Monodonta, Turbo Planaxis Phasianella, Turritella*)
Section 2 *Zoophaga* — Trachelipods with a projecting siphon and which only breathe water, which reaches the branchiæ by means of this siphon These feed on animal substances only are marine have no jaws, and are furnished with a retractile proboscis Shell spirivalve sheathing the soft parts with an aperture which is either canaliculated or notched, or turned up at its base
(*a*) Shell with a canal more or less long at the base of its aperture and the right border of whose lip does not change with age
Family 36 *Canalifera*
1 No constant process on the right lip of the shell (*Cerithium Pleurotoma Turbinella, Cancellaria Fasciolaria, Fusus Pyrula*)
2 A constant process on the right lip in all the species
α No processes on the spire (*Struthiolaria*)
β Processes on the spire (*Rancila Murex Triton*)
(*b*) Shell with a canal more or less long at the base of its aperture and the right border of whose lip changes its form with age, and has a sinus inferiorly
Family 37 *Alata* — Wing shells (*Rostellaria, Pterocera Strombus*)
(*c*) Shell with a short canal ascending posteriorly or with an oblique notch at the base of its aperture, this demicanal being directed towards the back
Family 38 *Purpurifera*
1 Canal ascending or recurved towards the back (*Cassis Cassidaria*)
2 An oblique notch directed backwards (*Purpura, Ricinula Monoceras, Concholepas Harpa, Dolium, Buccinum Eburna Terebra*)
(*d*) No canal at the base of the aperture but a subdorsal notch and plaits on the columella
Family 39 *Columellidæ* — *Columbella, Mitra, Voluta, Marginella Volvaria*
(*e*) Shell without a canal but having the base of its aperture notched or versant, and the whorls of its spire large compressed and enrolled in such a manner that the last whorl nearly entirely covers the others
Family 40 *Convolutidæ* — *Ovula, Cypræa, Terebellum, Ancillaria, Oliva, Conus*
Order 4 *Cephalopoda* — Mantle in form of a sac containing the lower part of the body, head projecting from the sac, surrounded by arms, which are not articulated [but furnished with suckers, and which environ the mouth, two sessile eyes, two horny mandibles to the mouth, three hearts*], sexes separate
Division 1 *Polythalamous Cephalopods* — Shell multilocular, enveloped completely or partially and which is inclosed in the posterior part of the animal, often with adherence
Family 41 *Orthoceratidæ* — Shell straight, or nearly so, with simple or not sinuous chambers (*Belemnites, Orthoceros, Nodosaria, Hippurites, Conulites*)
Family 42 *Lituolidæ* — Shell partially spiral; last

* The characters included within brackets apply only to the 4d division of Lamarck's order

whorl continued in a straight line (*Spirula, Spirulina, Lituola*)

Family 43 [illegible] re eccentric [illegible]

Family 44 [illegible] roidal, or oval, with [illegible] whorls or partitions united *en tunique* (*Miliola, Cyclolina, Vermia*)

Family 45 *Radiolidæ* — Shell discoid with a central spire, and partitions radiating from the centre to the circumference (*Orbitolina, Lenticulina, Placentula*)

Family 46 *Nautilidæ* — Shell discoid, with a central spire, and partitions which do not extend from the centre to the circumference (*Discorbis, Siderolites, Polystomella, Nautilus, Nummulites, Nonionites*)

Family 47 *Ammonitidæ* — Shell [illegible] with chambers sinuous at the edges (*Ammonites, Orbulites, Ammonoceras, Turrilites, Baculites*)

[From regard being only had to the characters afforded by the shell the Polythalamous Cephalopods of Lamarck form the least natural of his groups Many of the genera, especially the microscopic species belong to a different primary division of the animal kingdom, and one genus, *Gyrogona*, to another kingdom of nature, it being a fossil seed The genera *Belemnite* and *Spirula* which are true Cephalopods have been removed to the higher-organized or Dibranchiate order of Cephalopods]

Division 2 *Monothalamous Cephalopods* — Shell unilocular, entirely external, and enveloping the animal

Family 48 Genus *Argonauta*

Division 3 *Sepiary Cephalopods* — No shell either internal or external, a solid free cretaceous or horny body contained in the interior of the greater part of the animals

Family 49 Genera *Octopus, Loligopsis, Loligo, Sepia*

Order 5 *Heteropoda* — Body free elongated, swimming horizontally, head distinct, two eyes, no arms surrounding the head, no feet under the belly or under the throat for creeping, one or more fins without any regular order, and not disposed by pairs

Family 50 Genera *Carinaria, Pterotrachea, Phyllirœ*

Modifications of more or less importance in the classification of the Mollusca have been proposed by Oken [illegible], 1816) Ferussac (1819) De Blainville [illegible] J E Gray (*London Medical Repository*) Dr Hayes, Ring and others For an account of the structure and growth of shells see CONCHOLOGY

MALACOPTERYGIANS, *Malacopterygii* (Gr μαλακος and πτερυξ *a wing*) The name of a division of the class of fishes comprehending all those which with an internal osseous skeleton have the rays supporting the fins soft, except the first ray of the dorsal and pectoral fins

MALACOSTRACANS (Gr μαλακος, οστρακον, *a shell*) The name of a division of the class Crustaceans including those which are covered with a crust softer than the shell of the Mollusks but firmer than the covering of the Entomostracans (See that word) The term *Malacostraca* was first applied by Aristotle to the *Crustacea* of the moderns, being used by him in a comparative sense, as contrasted with the *Ostracoderma*, which are the modern *Testacea*

MALÆIC ACID An acid obtained by distilling malic acid at a temperature of about 160° When malic acid is exposed for a longer time to a moderate heat, it becomes modified into *paramalaic acid*

MALAGMA (Gr μαλασσειν *to soften*) A poultice

MALARIA (Ital mal aria, *a bad air*) The exhalation of marshy districts which produces intermittent fevers This term has now become of general application, but it was long restricted to that district of Italy extending from Leghorn to Terracina in one direction and from the sea to the Apennines in another Even in the time of Horace Rome was deserted two months in the year on account of the dangers of the malaria

MALIC ACID [illegible] A peculiar acid contained in the [illegible] several other fruits it may be obtained also from the berries of the *Sorbus aucuparia*, or mountain ash, and has hence been called *sorbic acid*

MALICE (Lat malitia), in the English Law, does not necessarily bear the signification of particular ill feeling towards an individual, but is a term directly importing wickedness in the commission of an act, and excluding a just cause or excuse (See MURDER) Malicious injury to property is in some instances a felony, in others a misdemeanour, punishable, in some on summary conviction the law respecting which is consolidated in one of the statutes commonly called Peel's Acts (7 & 8 G 4 c 30) By sect 25 of this act it is expressly declared that the word malice, in relation to these injuries, bears its legal and not its popular signification, it being there declared that the act applies, whether the offence shall be committed from malice conceived against the owner of the property, or otherwise" In civil actions for injuries to which malice is essential, *e g* slander, libel &c, the question of the existence of malice is one, in general, for the jury, but under certain circumstances, it may be implied by the court from the absence of reasonable and probable cause In actions for malicious prosecution

MALLEABILITY (Lat *malleus, a hammer*) The property of being susceptible of extension under the blows of a hammer It is especially characteristic of some of the metals, and in this quality gold exceeds all the others common gold leaf is not more than a two hundred thousandth part of an inch in thickness, five grains may be thus extended so as to cover a surface of more than 270 square inches *See* DUCTILITY

MALLEUS (Lat *a hammer*) One of the small bones of the internal ear, attached to the *membrana tympani*, somewhat in shape resembling a hammer

MALLEUS A genus of Ostracean Bivalves, characterized by having, in addition to the simple pit for the ligament, a notch on the side of the ligament for the passage of a byssus The species of this genus are called "hammer-oysters" The most noted is the *Ostrea malleus* of Linnæus which has the cardinal region of the shell [illegible] nothing like the head of a hammer, of which the [illegible] valves, extended transversely, represent the handle It is a native of the Indian archipelago, and still ranks among the number of rare and high priced shells

MALLOW (Lat malva), is a weed common by hedgerows and waysides in Europe It has mucilaginous properties, and has been employed in the preparation of emollient poultices, in the same way as the marsh mallow Its fruit is a depressed disk, and is called by the country people "cheeses" (Fr *Fromageon*)

MALLUM The public assembly or meeting of the people according to the usage of the old Teutonic nations Under the Carlovingian monarchs the mallum appears to have been summoned by the missus, or deputy of the sovereign There is a separate mallum for every leading state or kingdom which composed the empire, and it was attended by the notables of all the various races of inhabitants (Roman Frankish, Gothic, &c), and in some instances by the Scabini or Echevins, who represented the communities of the towns

MALMSEY A strong and fine flavoured sweet wine, made in Madeira of grapes which have been allowed to shrivel upon the vine, it is of a deep golden hue It contains between 16 and 17 per cent of alcohol

MALT, is used to designate grain which has become sweet in consequence of incipient germination Malt forms the principal ingredient in the manufacture of beer and is not used for any other purpose Three different kinds are employed 1 pale or amber malt, which yields the saccharine or fermentable extract, 2 brown or blown malt which is not fermentable, but is used to impart flavour, 3 roasted or black, or as it is sometimes called patent malt, which is employed instead of burnt sugar merely as a colouring matter The process followed in the manufacture of malt is very simple, and has been carried on for a very long period nearly in the same manner in which it is conducted at present (See *Thomson's Chemistry*)

The manufacture of malt has been carried on in England to a great extent from a very early period, but it is singular that notwithstanding the products obtained from it have always formed the principal beverage of the great bulk of the people the consumption of malt varied very little from the beginning of the last century till within the last half dozen years This extraordinary result so different from what would have been *a priori* anticipated is ascribable partly to the increased duties laid on malt but still more to the greater increase of those laid on beer, its principal product No doubt however it has been partly, also, occasioned by the change that has taken place in the mode of living by the introduction and universal use of tea, coffee and other articles substituted in the place of beer But the increase that has taken place in the consumption of malt since the reduction of the duty on it in 1822, and the repeal of the beer duty in 1830, seems to prove that the duties were at least quite as instrumental in checking the consumption as the introduction of the articles alluded to Malt was first made to contribute to the public revenue in England in 1667 in Scotland in 1713, and in Ireland in 1785 From the period at which the duty was first levied on malt down to the present time, it has been subject to numerous changes, a succinct account of which will be found in the *Penny Cyclopædia* The present duty on malt from barley is 2*s* 7*d* per bushel, and from bere or bigg 2*s* The quantity of malt charged with duty in the United Kingdom during the three years ending 1830, averaged nearly 500,000,000 bushels, and the revenue derived from it averaged, in the same period, [illegible]

MALTHA A mineralogical term applied to *mineral pitch*, an inflammable bituminous product probably de-

rived from the exsiccation of mineral tar A cement containing mineral pitch was used by the ancients for plastering their walls, and was composed of pitch wax, plaster, and grease Another sort, with which the Romans used to plaster the interior of their aqueducts, was made of lime incorporated with melted pitch The various bituminous pavements which have lately come into use are similar combinations

MALVACEÆ (Malva one of the genera) A natural order of monopetalous Exogenous plants, with polypetalous flowers and monadelphous stamens The species are herbs, bushes, or trees, and are found all over the [illegible] parts of the world, especially the [illegible] are in many cases large and handsome, but the order is chiefly interesting from the *Gossypium*, or true cotton plant, forming a part of it Another species is the mârsh mallow, or *Althæa officinalis*, and some yield a fibre fit for manufacture into [illegible]

MAMELUKE (Arabic, memalik, *a slave*) A name applied to the male slaves imported from Circassia into Egypt by the master of that country In the 13th century, when the countries in the vicinity of Mount Caucasus were ravaged by Gengis Khan, Nojmedden, sultan of Egypt purchased several thousands of the natives of those regions, especially Turks, and formed them into an armed body of guards These guards, or Mamelukes in the sequel, seized on all the power of the country murdered the sultan Touran Shah, A D 1258, and made Ibeg, one of their own number, his successor After that period the Mamelukes, whose numbers were continually enriched by importations from their own country governed Egypt 263 years (See *Gibbon*, vol xi) This military sovereignty was destroyed by Selim I the Turkish sultan, who took Cairo 1517 Nevertheless the Mamelukes under their 24 beys continued for 200 years more to exercise a power scarcely inferior to that of the Turkish pachas, whom, in the 18th century they reduced to mere ciphers in the government Their power was again considerably broken by the French invasion under Buonaparte, to which they offered a determined opposition After the abandonment of Egypt by the French, the struggle between the beys and the pachas was renewed finally, in 1811, the present pacha Mohammed Ali, having invited the principal leaders of the Mamelukes to a banquet, slew 470 of them by treachery, and compelled the remainder to submission

MAMERTINE PRISONS *See* PRISONS

MAMMA'LIA (Lat mamma *a teat*) The most highly organized class of animals, at the head of the great scale of organized nature They possess mammary glands and such [illegible] is developed in the womb Their external distinguishing marks are a covering of hair and teats or nipples but to the manifestation of these two characters there are a few exceptions The principal anatomical character is the condition of the lungs which are suspended freely in a thoracic cavity separated by a perfect diaphragm from the abdomen The entire tissue of the lungs is occupied by extremely minute air-cells, with highly vascular parietes so that the air inspired is rapidly decomposed and breathing can be safely suspended only for a short time The whole mass of circulating blood is transmitted to the lungs by the mechanism of a pulmonary auricle and ventricle equally perfect, and inferior only in power to the systemic auricle and ventricle, which subsequently propel the aerated blood to the general system the heart consequently consists of four distinct cavities

The upper jaw of the Mammalia is fixed the two rami of the lower jaw consist each of a single bony piece and are articulated by a convex or flat condyle to the base of the zygomatic process and not the tympanic element of the temporal bone With a few exceptions the jaws of the Mammalia are armed with teeth these are arranged in a single row, are lodged in sockets, sometimes by two or more fangs, and are never anchylosed to the substance of the jaw A deciduous tooth is never succeeded by more than one corresponding tooth in the vertical direction The tongue is fleshy, well developed, with the apex more or less free The posterior openings of the nasal passages are protected by the 'soft palate' and the larynx or opening of the wind-pipe, by an 'epiglottis" The alimentary canal varies with the nature of the food, but the 'cæcum coli" is usually single The rectum commonly terminates by a distinct aperture behind the urinary and generative orifices

The bodies of the vertebræ have their articular surfaces more or less flattened, and always joined together by a series of concentric ligaments with interposed glairy fluid The cervical vertebræ, with one or two exceptions are seven in number The atlas is articulated by two surfaces to two occipital condyles, developed from the ex-occipital elements With two exceptions, the coracoid bone appears as a small process or appendage of the scapula The sternum is narrow, and consists of a simple longitudinal series of bones

The brain presents its highest state of development in the Mammalia it consists of a cerebrum which is generally [illegible] with laminæ [illegible] tubercula quadrigemina, hence called 'bigeminal bodies" they are situated on the upper part of the crura cerebri and are generally concealed by the overlapping posterior cerebral lobes The rudiment of the "corpus callosum," or great cerebral commissure, first begins to be distinctly recognizable in the Implacental Mammalia; and in a state of normal development, or where it bears a direct proportion to the size of the corpora striata or hemispheres of the brain, it is peculiar to the Placental Mammalia

The eyes of the Mammalia are never complicated with a pecten or marsupium, a choroid gland, or sclerotic bony plates

The organ of hearing acquires in the Mammalia a fully developed cochlea with a "lamina spiralis" there are three distinct ossicles in the tympanum, the drum, or membrana tympani, is usually concave towards the meatus which generally commences with a more or less complicated external ear supported by a distinct fibro-cartilage

The Mammalia without exception bring forth their young alive hence they were termed by Aristotle *Zootoca* This phenomenon is however by no means peculiar to the present class but it was supposed that they differed from other viviparous animals as the viper in the development of the germ by means of a placenta Such however is not the case with the marsupial animals and probably not with the Monotremes, and as the absence of the placenta is associated with several important modifications of structure in the species so developed by which they approximate to the characters of the oviparous classes the class Mammalia may be primarily divided into two great sub classes, called *Placentalia* and *Implacentalia*

Before however the subdivisions of these groups are characterized it may be advantageous to trace the principal steps by which the present views of the affinities and classification of the Mammalia have been acquired

Aristotle although he has left no evidence of a systematic arrangement of the Mammalia in which the succession and subordination of the orders and families are methodically laid down was nevertheless the first who indicated the larger groups into which the Mammalia resolved themselves, according to their natural affinities

We may infer e g from one part of the *Historia Animalium* that the *Zootoca* would be divided according to the nature of their locomotive organs into three sections —1st *Dipoda* or bipeds, 2d *Tetrapoda* or quadrupeds and 3d *Apoda* or impeds Man is cited as the type of the first and the whole tribe is included in the last of these primary groups, the second embraces all the rest of the class which in common language are called quadrupeds These Aristotle subdivides into two great natural groups according to the modifications of the organs of touch In the first a part of the digits is left free for the exercise of the tactile faculty the nail or claw being placed upon one side only, in the second group the extremities of the digits are enclosed in hoofs

The first of these subdivisions is acknowledged to be natural and has been retained by modern mammalogists under the name of *Unguiculata* The following families were characterized in it by Aristotle —1st, those which have the front teeth trenchant and the back teeth flattened as the *Pitheconda* or apes and the *Dermaptera* or bats, 2d those with acuminated trenchant or carnivorous teeth which Aristotle calls *Karcharadonta*, 3d, the Rodent quadrupeds, which are indicated by a negative dental character With respect to the hoofed or ungulate quadrupeds Aristotle points out subordinate groups and characterizes them by modifications of the feet Thus, the 1st are the *Polyschidæ* or multungulate quadrupeds as the elephant, the 2d are the *Dischidæ* or bisulcate quadrupeds, as the Ruminants and hog, the 3d are the *Aschidæ*, or solidungulate quadrupeds as the horse and ass From the imperfect mode in which the zoological writings of the Stagyrite have been handed down we have not the means of knowing whether Aristotle viewed any of the groups thus defined in their relation of subordination to each other or in the spirit of modern classification, for although they agree in relative value with those termed *Classes*, *Orders*, *Families*, *Genera* yet Aristotle applies to each of them the same denomination, viz *genos*, or genus

The honour of having formed an original scheme for the classification of quadrupeds, in which the subordination of characters and of groups is attended to, is due to our great countryman Ray From Aristotle to his time the classification of the Mammalia received no improvement worthy of notice Ray's arrangement is given in a tabular form, in his *Synopsis Methodica Animalium Quadrupedum*, and is as follows —

# MAMMALIA

*A Table of Viviparous Four-footed Animals*

Viviparous hairy animals or quadrupeds are, —

- *Ungulate*, and these either
  - *Solidipedous* as the Horse, Ass, Zebra
  - *Bisulcate*, which are
    - *Ruminants* with horns, that are
      - Persistent, as in the Ox, Sheep, Goat,
      - or
      - Deciduous as in the Stag
    - *Not Ruminants* as the Hog
  - *Quadrisulcate*, as the Rhinoceros, Hippopotamus
- *Unguiculate*, whose feet are either
  - *Bifid* as in the Camel, or
  - *Multifid*, which are
    - With *digits* adhering together, and covered with a common integument, so that the extremities alone are visible at the margin of the foot, and are covered with obtuse nails as in the Elephant
    - With *digits* in some measure distinct, and separable from each other, the nails being
      - *Depressed*, as in Apes,
      - or
      - *Compressed* where the incisor teeth are
        - *Many*, in which group all the animals are carnivorous and rapacious, or at least insectivorous, or subsist on insects, with vegetable matter
          - *The larger ones* with the
            - *Muzzle short* and head rounded, as the Feline tribe, or with the
            - *Muzzle long*, as the Canine tribe
          - *T* [illegible] tribe
        - *Two very large* of which tribe all the species are phytivorous, as the Hare

The anomalous species he afterwards observes among the viviparous quadrupeds with a multifid foot are the hedgehog the armadillo the mole the shrew the tamandua, the bat and the sloth The first five of these species agree with the *canine* and *vermine genera* in their elongated muzzle but differ from them in the form and disposition of the teeth the tamandua indeed is altogether destitute of teeth the remaining two anomalous species have the muzzle shortened

Linnæus defines the class Mammalia as follows — *Heart* with two auricles and two ventricles, blood warm *lungs* respiring reciprocally (*pulmones respirantes reciproce*), *jaws* incumbent covered armed with teeth in most penis intrans, generation viviparous Lutterous, *senses* tongue nostrils eyes ears tactile papillæ, *covering* hairs few in tropical very sparing in aquatic mammals, *support* four feet except in those which are entirely aquatic in which the posterior feet are bound together in the fin of the tail *Anal* in most

Linnæus like Aristotle and Ray founds his primary divisions of the class Mammalia on the locomotive organs, but his secondary divisions or orders are taken chiefly from modifications of the dentary system The following is the scheme of his arrangement —

*Mammalia*

| | | |
|---|---|---|
| *Unguiculate* | [illegible] lower jaw | *Bruta* |
| | [illegible] incisors 0 | *Cete* |
| | [illegible] incisors 1 | *Primates* |
| | [illegible] 10) incisors 1 | *Feræ* |
| *Ungulate* | Front teeth in both upper and lower jaw | *Pecora* |
| | Front teeth none in the upper jaw | *Jumenta* |
| *Multicuspidate* | Teeth variable | *Glires* |

(From the *Systema Naturæ* ed 16 Holmiæ p 24)

On comparing the three preceding systems it will be found that the most important errors of arrangement have been committed not by Aristotle but by the modern naturalists Both Ray and Linnæus have mistaken the character of the horny parts enveloping the toes of the elephant which do not defend the upper part merely as is the case with claws but embrace the under parts also, forming a complete case or hoof

With respect to Linnæus however it must be observed that although he has followed Ray in placing the elephant in the unguiculate [illegible] upeds he has not overlooked the great [illegible] which the latter naturalist adopted from Aristotle as is evident from the table above quoted He erred, perhaps in not giving names to those primary divisions

From the manner in which Linnæus has arranged his orders in this table, it would seem that he had the circular progression of affinities in view The walrus among *Bruta* connects the commencement of the chain with *Cete* which forms the last link, but whether or not he had perceived the affinity of *Elephas* to the *Glires* and intended it as the transitional genus to that order, as Cuvier has subsequently shown, is less certain

Pallas, in his great posthumous work entitled *Zoographia Rosso Asiatica*, has given the following outline of a *Systema Mammalium* —

Classis I ACTANTIA

Ordo I *Feræ* — 1 Felis, 2 Canis, 3 Ursus, 4 Meles, 5 Viverra, 6 Mustela, 7 Phoca

Ordo II *Semiferæ* — 1 Simia 2 Lemur 3 Didelphys, 4 Vespertilio, 5 Talpa, 6 Sorex, 7 Erinaceus

III *Glires* — 1 Hystrix, 2 Castor, 3 Lepus, 4 Arctomys, 5 Spalax 6 Cricetus, 7 Mus, 8 Myoxus 9 Myoxus 10 Dipus 11 Sciurus

IV *Ruminantia* — 1 Camelus, 2 Moschus, 3 Cervus, 4 Capreolus 5 Bos, 6 Antilopes

V *Anomalopoda* — 1 Equus, 2 Sus, 3 Rhinoceros, 4 Hippopotamus

VI *Belluæ* — 1 Elephas 2 Rosmarus

VII *Cetacea* — 1 Manatus, 2 Delphinus, 3 Physeter 4 Balæna 5 Ceratodon

We shall now proceed to the arrangement of the Mammalia proposed by Cuvier in the last edition of the *Regne Animal* and this is the more interesting as in giving the outline of this method Cuvier develops the principles on which his divisions are founded

The characters by which Mammalia differ most essentially one from another are derived from the organs of touch from which results their degree of dexterity, and from the organs of mastication which determine the nature of their food and upon these very closely depends not only every thing which is connected with the digestive functions but a variety of other circumstances relative even to their degrees of intelligence

The perfection of the organs of touch is estimated by the number and mobility of the digits and the extent to which they are enclosed in a claw or in a hoof A hoof which completely encloses that part of the digit which touches the ground precludes the exercise of it as an organ of touch or of prehension The opposite extreme is where the nail in the form of a simple lamina covers only one side of the end of the digit leaving the other side in possession of all its delicacy of tact

The kind of food is indicated by the molar teeth to the form of which the articulation of the jaws invariably corresponds

For cutting flesh the molar teeth must be trenchant and serrated, and the jaws fitted together so as to move like the blades of a pair of scissars, simply opening and closing in the vertical direction

For bruising grains and roots the molar teeth must have flattened crowns and the jaws a horizontal motion and further that the grinding surface may be always unequal like a millstone, the teeth must be composed of substances of different degrees of density and consequently wearing down in different proportions

The unguiculate quadrupeds are all of necessity herbivorous or with flat crowned molares because the conformation of their feet does not permit them to seize living prey

"The unguiculate animals are susceptible of more variety They are not limited to one kind of food, and besides the consequent variation in the form of their molares they differ materially from each other in the mobility and sensibility of their digits There is, moreover a characteristic which prodigiously influences their dexterity, and gives variety to their modes of action it is the faculty of opposing a thumb to the other fingers, so as to seize the smallest objects, which constitutes a

* Genus *Vermineum*, from their wormlike form

*hand*, properly so called This faculty is carried to its highest degree of perfection in man, in whom the whole anterior extremity is free, and can be exclusively employed in prehension These different combinations, which strictly determine the nature of the several mammiferous animals, have formed the grounds for their distribution into the following orders —

"Amongst the unguiculate animals the first is man, who in addition to his peculiar privileges in every other respect is distinguished zoologically by possessing hands on the anterior extremities alone, the posterior extremities being destined to sustain him in an erect position

"The order which comes nearest to man — that termed *Quadrumana* — has hands on the four extremities

"Another order, termed *Carnivora*, has not the thumb free and opposable on the anterior extremities

These three orders possess, likewise, severally, the three kinds of teeth, viz molars, lanaries, and incisors

"The quadrupeds of the fourth order, viz the *Rodentia*, have the digits differing little from those of the *Carnivora*, but they want the lanary teeth and have the incisors of a form and disposition altogether peculiar to themselves

"To these succeed the animals whose digits now become much cramped being sunk deep in large and, most commonly crooked claws They are further defective in the absence of incisor teeth, some of them even want the lanaries, and others are altogether destitute of dentary organs We shall comprehend them under the term *Edentata*

"This distribution of unguiculate animals would be perfect, and would form a very regular chain if New Holland had not lately furnished us with a small collateral chain, composed of the *Marsupial* animals all the genera of which, while they are connected by a general [illegible] at the same time correspond in their dentition and diet some to the *Carnivora*, others to the *Rodentia*, and a third tribe to the *Edentata*

"The ungulate animals are less numerous and present [illegible] form

The *Ruminantia* by their cloven feet, their want of upper incisors, and their complicated stomach, form a very distinct order

"All the other quadrupeds with hoofs might be united into a single order, which I would call *Pachydermata* or *Jumenta*, the elephant excepted, which might form an order of itself, having some remote affinities to the order *Rodentia*

"Last of all come the Mammalia which have no hinder extremities, and whose fish-like form and aquatic life would induce us to form them into a separate class, if their economy was not in every other respect the same as in the class in which we shall leave them They are the warm blooded fishes of the ancients, or the *Cetacea* which, combining the powers of other Mammalia with the advantage of being sustained upon the watery element [illegible] to be found in the whole animal creation *Règne Animal*, 2d ed p 65)

The proofs that this small collateral chain of mammals which New Holland has lately furnished forms a distinct primary group in that class, have been successively established in the memoirs by Mr Owen on the Generation the Structure of the Brain the Osteology and the Classification of the Marsupial Animals and on the Mammary Glands the Ovum and the Young of the Ornithorhynchus, published in the *Philosophical* and *Zoological Transactions* In the latest classifications of the Mammalia (Charles Lucien Buonaparte *Systema Vertebratorum*, Martin, *History of Mammalia*) the binary division of the class Mammalia founded on the anatomical and physiological facts detailed in those memoirs has been adopted

The first of these divisions, which we have proposed to call subclass PLACENTALIA, includes the following orders —

| | | |
|---|---|---|
| I | *Bimana* — Ex | Man |
| II | *Quadrumana* — Ex | Ape, Monkey, Lemur |
| III | *Cheiroptera* — Ex | Bat |
| IV | *Insectivora* — Ex | Shrew Mole, Hedgehog |
| V | *Carnivora* — Ex | Dog, Civet, Cat, Weasel, Bear, Seal |
| VI | *Cetacea* — Ex | Porpoise, Whale |
| VII | *Pachyderma* — Ex | Manatee, Hippopotamus Elephant, Hog, Horse |
| VIII | *Ruminantia* — Ex | Camel, Deer, Antilope, Ox |
| IX | *Edentata* — Ex | Sloth, Anteater, Manis, Armadillo |
| X | *Rodentia* — Ex | Rat, Squirrel, Rabbit, Guinea-pig |

The second division, or the subclass IMPLACENTALIA, in- [illegible]

| | | |
|---|---|---|
| XI | [illegible] — Ex | Wombat, Kangaroo, Opossum |
| XII | [illegible] — Ex | Ornithorhynchus |

[illegible] introduced into the Cuvierian system in the binary subdivision of the class, there are a few minor differences in the above classification on some explanation is requisite

From Pallas's great group of *Semiferæ*, the families of which he conceived to be linked together by an uninterrupted series of affinities the *Simiæ* and *Opossums* [illegible] the Cuvierian system to form the types [illegible] orders we conceive that the modification of the locomotive system, by which the bat is enabled to fly, is as cogent [illegible] the type of an order, as [illegible] of the ape and lemur The *Insectivora*, also, in their continuous dental series, comparatively feeble canines, and generally perfect clavicles, seem to claim equivalency of rank with the remaining *Carnassiers* of the Cuvierian system, which will thus correspond with the *Feræ* of Pallas From the seals, with their largely developed brains, acuminated teeth, and rudimental hind fins, the transition seems most natural to the piscivorous *Cetacea* The herbivorous *Cetacea*, for reasons given at length in the *Proceedings of the Zoological Society* 1838, we propose to remove to [illegible] true *Cetacea* they [illegible] No linear arrangement of the orders of a class can ever express more than a part of their mutual affinities If we were to place them according to their natural relations, the *Quadrumana* would occupy the centre of the class, as from these the greatest number and variety of affinities seem to radiate Thus the genus *Galeopithecus* leads to the *Cheiroptera* the *Lemurs* to the *Carnivora* the *Loris* to the sloths among the *Edentata*, while with the *Rodentia* the *Lemurs* claim close alliance through the *Cheiromys* or *Aye-aye* The *Insectivora* closely approximate the extreme of the implacental group while [illegible] join the other The *Rodentia* approach still more closely to the marsupial wombat The *Rodentia* again by the *Capybara* and the extinct *Toxodon* evidently merge into the *Pachyderma* and the Patagonian hare seems to lead them to the small musk-deer among the *Ruminantia* The *Edentata* have lost in the mailed *Glyptodon* a transitional step to the thick and tubercular-hided rhinoceros The twofold affinity of the *Cetacea* to the seals on the one hand and to the manatee and the hippopotamus on other has been already alluded to

In this reticulate interweaving of affinities under which image the true relations of the Mammalia as at present known can alone be impartially and [illegible] it will be observed that as the series [illegible] *Quadrumana* they likewise descend, so that the scheme may be likened to a cone, of which Man is the culminating point

From different points at the base of this cone the connection may be traced with the inferior classes the most direct transition appears to be made by the Monotremes to the class of Reptiles The extinct *Enaliosauria* once formed a transition, perhaps not less close, from the crocodiles to the *Cetacea* The *Pterodactyles* seem to have connected the *Cheiroptera* with the flying oviparа The Mammalia which present the closest relations to birds are the marsupial *Petaurists* and the arboreal *Rodents*, but the hiatus is great Between mammals and fishes, the reptiles interpose at all points, the extinct *Ichthyosaurus* seems to have been the transitional step from the *Cetacea* to the true fishes

MAMMA'LOGY (Lat mamma, *a teat*, Gr λογος, *a discourse*) The science of Mammals the doctrine of their organization, habits, properties, and classification See MAMMALIA

MA'MMIFERS *Mammifera* (Lat mamma, *a teat*, fero *I bear*) A term synonimous with Mammals, or Mammalia

MAMMI'LLARY (Lat dim mammilla) In Geology a surface studded over with rounded projections

MA'MMON (Syr) used in scripture to signify either riches or the god thereof By poetic licence Milton makes Mammon one of the fallen angels and has pourtrayed his character in some admirable lines which are too well known to be cited here

MA'MMOTH A word of Tartar origin, applied in Si- [illegible]

[illegible] the newer tertiary deposits in England, the continent of Europe and Asia In Siberia an entire animal has been discovered, with the soft parts preserved in the frozen soil of the banks of a Siberian river The particulars of [illegible] discovery are as follow In 1799, a Tungusian, named Semonoff, usually went to hunt and fish at the peninsula at Tamut, after the fishing season of the Lena was over had constructed for his wife some cabins on the banks of the lake Oncoul, and had embarked to seek along the coasts for mammoth horns (tusks) One day he saw among the blocks of ice a shapeless mass but did not then discover what it was In 1800 he perceived that this object was more disengaged from the ice, and that it had two projecting parts, and, towards the end of the summer 1801, the entire side of the animal and one of his tusks were quite free from ice

The summer of 1802 was cold, but, in 1803, part of the ice between the earth and the mammoth for such was the object, having melted more rapidly than the rest the plane of its support became inclined, and the enormous mass fell by its own weight on the bank of sand In March, 1804, Schumarhoff came to his mammoth, and, [illegible] with a merchant [illegible] Adams gives the [illegible] "Two [illegible] overy of the mammoth, I fortunately traversed these distant and desert regions, and I congratulate myself in being able to prove a fact which appears so improbable I found the mammoth still in the same place but altogether muti-lated [illegible] the Tun-gusian chief had recovered, there was no obstacle to pre-vent approach to the carcass of the mammoth, the pro-prietor was content with his profit from the tusks and the Jalutski of the neighbourhood had cut off the flesh, with which they fed their dogs during the scarcity Wild beasts, such as white bears, wolves, wolverines, and foxes, also fed upon it, and the traces of their footsteps were seen around The skeleton, almost entirely cleared of its flesh, remained whole, with the exception of one fore-leg, the spine, from the head to the os coccygis, one scapula the bones of the other three extremities were still held together by the ligaments and by parts of the skin The head was covered with a dry skin one of the ears, well preserved, was furnished with a tuft of hairs All these parts have necessarily been injured in trans-porting them a distance of 11 000 wersts (7330 miles), yet the eyes have been preserved and the pupil of the eye can still be distinguished This mammoth was a male, with a long mane on the neck but without tail or proboscis (The places of the insertion of the muscles of the proboscis are it is asserted visible on the skull, and it was probably devoured, as well as the end of the tail) "The skin, of which I possess three fourths is of a dark-grey colour, covered with a reddish wool and black hairs The dampness of the spot where the animal had lain so long had in some degree destroyed the hair The entire carcass, of which I collected the bones on the spot is 4 archines (9 feet 4 inches) high and 7 archines (16 feet 4 inches) long from the point of the nose to the end of the tail, without including the tusks which are a toise and a half (9 feet 6 inches) measuring along the curve the distance from the base or root of the tusk to the point is 3 feet 7 inches in length, the two together weighed 360 lbs avoirdupois, the head alone with the tusks weighs 11 poods and a half (414 lbs avoirdupois) The principal object of my care was to separate the bones, to arrange them, and put them up safely which was done with particular attention I had the satisfaction to find the other scapula, which had remained not far off I next detached the skin of the side on which the animal had lain, which was well preserved This skin was of such extraordinary weight that ten persons found great difficulty in transporting it to the shore After this I dug the ground in different places to ascertain whether any of its bones were buried but principally to collect all the hairs which the white bears had trod into the ground while devouring the flesh Although this was difficult from the want of proper instruments I suc-ceeded in collecting more than a pood (36 pounds) of hair In a few days the task was completed, and I found myself in possession of a treasure which amply recompensed me for the fatigues and dangers of the journey, and the considerable expenses of the enterprise The place where I found the mammoth is about 60 paces distant from the shore and nearly a hundred paces from the escarpment of the ice from which it had fallen The escarpment occupies exactly the middle between the two points of the peninsula, and is three wersts long (two miles), and in the place where the mammoth was found this rock has a perpendicular elevation of 30 or 40 toises Its substance is a clear pure ice, it inclines towards the sea its top is covered with a layer of moss and friable earth, half an archine (14 inches) in thick-ness During the heat of the month of July, a part of this crust is melted but the rest remains frozen Cu-riosity induced me to ascend two other hills at some dis-tance from the sea they were of the same substance, and less covered with moss In various places were seen enormous pieces of wood of all kinds produced in Siberia, and also mammoths horns [illegible] ap-peared between the hollows of the rocks [illegible] astonishing freshness How [illegible] collected is as curious as difficult to resolve The in-habitants of the coast call this kind of wood *adamcina*, and distinguish it from the floating pieces of wood which are brought down by the large rivers to the ocean, and collect in masses on the shores of the Frozen Sea the latter are called *macheina* I have seen, when the ice melts, large lumps of earth detached from the hills mix with the water, and form thick muddy torrents, which roll slowly towards the sea The earth forms wedges which fill up the spaces between the blocks of ice The [illegible] of the ice was [illegible] high and ac-cording to [illegible] the animal was, [illegible] below the surface of the ice, &c On arriving with the mammoth at Bos-chaya, our first care was to separate the remaining flesh and ligaments from the bones, which were then packed up When I arrived at Jakutsk I had the good fortune to repurchase the tusks and from thence expedited them to St Petersburg [illegible] of the academy, and the skin [illegible] head and feet" A part of the skin and some of the hair of this animal, were sent by Mr Adams to Sir Joseph Banks, who presented them to the museum of the Royal College of Surgeons The hair is entirely separated from the skin, excepting in one very small part, where it still remains attached It consists of two sorts — common hair and bristles, that remaining fixed on the skin is of the colour of the camel, an inch and a half long very thick set and curled in locks it is interspersed with a few bristles, about three inches long, of a dark reddish colour The skin when first brought to the museum was offensive, it is now quite dry and hard, and where most compact is half an inch thick Its colour is the dull black of the living elephant's skin

MAN (Germ mann, probably from the Lat *humanus* or *mens*) Of all living beings on the surface of this planet the first is man, who, in addition to his peculiar privileges in every other respect, is distinguished zoolo-gically by possessing a hand on the anterior extremities only the posterior or lower limbs being destined to sustain him in an erect position He is, however, naked, and without natural defensive or destructive weapons It is the modifications of the bones and muscles of the lower extremities and especially of the feet, that constitute the most striking anatomical characters of the human species but with these are associated many other cha-racteristic conditions of the general frame-work of the body which as they have been nowhere so accurately, truly and eloquently set forth as in the lectures of Pro-fessor Green, we shall take the liberty to give in the words of that philosophic anatomist and accomplished writer

In a comparison of the frame and capabilities of man with those of the inferior animals, if we take the human frame as the ideal standard of form it will be found that all others present so many declensions from the idea by exaggeration or defect, and it will be found from this survey that man is unquestionably endowed with that structure, the perfection of which is revealed in such a balanced relation of the parts to a whole as may best fit it for a being exercising intelligent choice, and destined for moral freedom It is not therefore, an absolute per-fection of the constituents singly, but the proportional development of all, and their harmonious constitution to One for which we contend, — a constitution which im-plies in a far higher degree than in any other animal a ba-lanced relation of the living powers and faculties, and which requires therefore in man pre-eminently the en-dowment of rational will as necessary for the control and adjustment of the balance Man has not the quick hearing of the timid herbivorous animals but it was not intended that he should catch the sound of distant danger, and be governed by his fears he has not the piercing sigh[illegible] of prey, but [illegible] or a [illegible] the perfect proportion of man which we observe in the inferior animals may be regarded as deformities by ex-aggeration or defect, dependent upon a preponderance of a part that necessitates a particular use or the absence of a part that deprives the animal of a power, and in both instances alike abrogates that freedom for which provi-sion is made in the balanced relation of the constituents of the human fabric, which permits the free choice of means and the adaptation to any purpose determined by an intelligent free-will Dilate the head, and you have a symptom of disease, protrude the jaws, you have a vo-racious animal, lengthen the ears, timidity is expressed, let the nose project and the animal is governed by its scent, enlarge the belly and you are reminded of the animal appetites long arms may fit him for an inhabitant of the trees and a fit companion for the ape, and pre-dominant length of legs are infallibly associated with the habits of the wading or leaping animals In all, regarding man's form with reference to his destination as the ideal standard the means become ends, deformity prevails, and becomes the badge of unintelligent slavery to the mere animal nature

'This may be further illustrated by a general and brief comparison of the components of the skeleton in the vertebrated animals with that of man In considering the skull, it will be found that man, of all animals, has the largest and roundest cranium From the ape to the fish the brain-case decreases in capacity in correspond-ence with a proportionably diminishing development but in the same ratio the parts allotted to the senses, and the parts merely subservient to the preparation of the food, increase in size In looking at the head of the

horse and the dog, it will be readily observed how much the cranium recedes and the jaws protrude, but in birds, reptiles and fish, the proportions are so altered by the diminution of the cranium that the whole head appears almost to consist of the jaws witness the mandibles of the stork and pelican and the enormous jaws of the crocodile and shark And we may add, that man is the only animal that has a prominent chin This distinguishing character of the human skull is found in the proportion of the brain-case to the jaws when compared with the same in the inferior animals, the ingenious Camper devised the method of more accurately determining by means of what has been called the 'facial angle' It consists in drawing one line from the most prominent part of the forehead to the sockets of the upper incisor teeth, and a second, which describes the ground plane of the cranium, through the external *meatus* of the ear and lower edge of the nose and which cutting the first forms with it a determinate angle and it asserts that this angle will be greater in proportion to the development of the forehead and recession of the superior *maxilla*, less or more acute [illegible] jaw and recession of the [illegible] angle must be [illegible] it is worthy of notice that the Greek sculptors who were careful to mark strongly, or even exaggerate those circumstances which peculiarly mark the human character, have often exceeded the right angle in the ideal anatomy of their deities, though at the same time with the discriminative taste which prevented them from exceeding the limit beyond which the form would have become a symptom of disease It follows, then that the size of the brain-case in man, proportionate to the development of the brain, indicates the predominance of this organ over those of the senses, which may be regarded as the measure of the subserviency of the animal to the outward excitants and over the organs for the preparation of the food the preponderance of which marks the subjugation of the creature to the mere animal needs — that the predominant development of the cranium, I say is the mark, symbol and condition of man's characteristic excellence as pre-eminently gifted with mind"

"If we compare the lower limbs of man with the hinder extremities of quadrupeds we find the peculiar character and perfection of the former in their adaptation and appropriation to maintain the balance of the body in the erect posture In some indeed, the hinder limbs are so formed as to permit the creature to obtain for a time the free use of the fore extremities, but the endowment serves but to mark as in the monkey that it was intended for a climbing animal and the extraordinary length and strength of the legs of the kangaroo show only its aptitude to leap And if, in birds the support of the body is effected by two legs it leaves the interior extremities free only for the purpose of aiding in, and of executing, a different mode of locomotion In man alone the lower extremities, providing wholly the means of support and progression, leave the upper limbs as instruments the use of which is entirely at the choice of the agent And, in aid of this purpose we find in man the most perfect upper extremity From the ape to the fish the different components diminish in number development, and variety of motion This is especially noticeable in the hand, which, in consequence of the length of the fingers, the number of articulations and the multiplicity of their movements, especially in consequence of the capability of opposing the thumb to the fingers becomes an instrument fitted for the most delicate and varied operations directed by the skill and intellect of man Compare in this respect, this flexible and modifiable apparatus with the single digit of the extremity of the horse, on the horny tip of which the weight of the animal (by an admirable mechanism indeed) is supported and carried, or with the abortive hand of the whale, sufficiently like the human to be so called, but retracted, enveloped in skin, and degenerated into a fin, that merely serves as an oar in propelling the animal through the water It might be said perhaps, that the hand of the monkey claims the praise of a great perfection as that of man, but the dwindled thumb marks its imperfection for handling and for touch and the arms even of the anthropoeid orang outan lengthened to deformity irresistibly prove their use to be little else than for grasping and climbing

"In the contemplation of the human skeleton its most striking characteristic, however, and that which contradistinguishes it from the bony fabric of all other animals, is its adaptation to the erect position an attribute not only peculiar to man, but without which his structure could not correspond to his spiritual endowments, since it is at once the need and symbol of a being raised above the servile condition of the mere animal nature

"Thus the skull is poised, with only a slight preponderance anteriorly, at the top of the vertebral column, and a plumb-line dropped from the point of its support falls through the centre of gravity between the feet, which present the base of support to the whole towering fabric We remark, however, that the supporting parts do not range with this line.

The spine is set like an italic *S*: it recedes at the chest, in order to give room to its cavity; and at the same time is harmoniously inflected forwards at the loins and neck in order to facilitate its balance over the points of support and it cannot be doubted that these curves contribute to the capability of bending and changing the position of the trunk, without endangering the loss of balance But the balance of the body is also greatly aided by the breadth of the human pelvis, which supplying a broad base of support, permits the inclinations of the trunk without the necessity of [illegible] position of the lower limbs The lateral [illegible] pelvis, however, throws the heads of the thigh bones, upon which the weight of the body is transmitted, to some distance on each side of the line that falls through the centre of gravity, and in order to provide compensating adjustment the thigh bones are placed obliquely inclining towards each other, so that in the upright posture with the feet together they touch at the knees, and the weight is then received upon the heads of the leg bones or *tibiæ*, which stand perpendicularly under the centre of gravity and these again are planted upon the arch of the foot or instep, on which the whole weight of the body securely rests Then, in order to secure in the foot the requisite firmness in standing we find that it is articulated with the leg at right angles, so that both the heel and toes touch the ground, and the joint is placed nearer the posterior than the anterior part of the foot, so as to increase the base of support in that direction towards which the body tends most to fall besides which, the weight is here received on the inner side of the foot where it is most arched thereby offering not only the advantage of a strong support but one which is highly elastic yielding without injurious action upon the foot and acting as a spring in [illegible] This the main column of the human form is raised and built up upon its pedestal, and the living pillar readily maintaining its equipoise, bears aloft its capital, whilst the upper limbs are left free to ad-libitative motion Thus the place of the head, as the corporeal representative of that which perceives and wills, the disposition of the senses therein as the *media* of intelligence and of the organs of speech as the interpreters of thought, and the arrangement of the upper limbs as instruments of volition, no longer subservient to mere animal needs — all impress us with the conviction that even the skeleton cannot be intelligible to us without admitting that the human body frame was designed for the instrument and dwelling of a being contradistinguished from, and elevated above, all other animals —

A creature, who not prone
[illegible]
[illegible]
[illegible]

"Man alone is erect It is to this posture that the body of a man owes the character, impressed on the whole frame, of its emancipation from subserviency to the mere animal needs and becomes expressive of mind and of free and intelligent action It will be seen that the lower limbs answering the purposes of support and locomotion have alone any obvious or necessitated utility, while the upper extremities are in consequence, left at liberty as the ready and facile instruments of his will Hence too, the senses are best freed from their servitude to the bodily wants, and the countenance is raised as the expressive exponent of thoughts and feelings, which the mouth declares and interprets by words And thus, as the stem bears the corolla, the head is carried on high as the most noble part of the frame which it surmounts, all the rest of the body seems as if intended to carry it, and when considered in its fitness for expression, it may be said to be the representative of the whole man

"If principally connected with erect posture the body is admirable, and acquires its human character, we shall no less find in directing our attention to the organs of motion in man the aptitude and capabilities of a being designed for intelligent freedom We find in man the organic structure adapted for the greatest variety of motion It is true, indeed, that many of the Mammalia are so constituted as greatly to excel man in particular kinds of locomotion, but we shall in vain look for the same combination and mastery of his powers which the erect posture implies The monkey climbs and jumps with a [illegible]ry extraordinary, but it is with difficulty, or only for a short time, that he raises himself into the erect position Dogs, horses, deer, excel man in swiftness, but they cannot climb nor walk erect The otter, the beaver, and the seal swim well, but it is their only boast above creatures of their own kind And whales, or other cetaceous animals, though admirably adapted for swimming, have no other means of locomotion Man, on the other hand, stands and walks erect; runs jumps climbs, swims Man alone can so modify his frame that it is in his power to waive the high privilege of

the harmony and balance of his faculties, and by concentering [illegible] we have reason to [illegible] he bears most characteristic [illegible] — [illegible] ever, outstrip the [illegible] In short, man has the most modifiable organs of motion, an [illegible] of [illegible]

"The capability of varied motion in man depends greatly upon the facility with which the different parts of the body, especially the limbs move at the joints in opposite directions, — a power which not only permits variety of movement, and confers an aptitude of expressive action, but likewise gives pre-eminently a character of [illegible] and freedom to the total motion [illegible] his body, in connection with the erect position, which gives the unity to any totality of movement, and determines the attitude or carriage necessary to preserve its balance In order to balance the body whether at rest or in motion, it is necessary that the man should exert an incomparably greater number of muscles than the inferior animals, and for the same reason a far greater effort of his volition is required for adjusting the proportional action of each and for combining and harmonizing the actions of all, in short, of all animals, man must be the master of his own body

"It is further deserving of notice, that the inflections of the trunk, the motions of the limbs, and the play of the several joints, all tend to the circular and curvilineal in their movements, a circumstance which mainly tends to confer on human motion the character of beauty And it may be safely affirmed that, under all the varieties of expressive movement, the very structure and mechanism of the body tend to reduce its motions to the form of the beautiful, or resolve them into grace, a fact of which we may convince ourselves in watching the sinuous movements of the dance, wherein, aided by the totality of motion in the dancer, they present a harmony by continuity — a problem of grace which is ever solving, and ever beginning anew

"Beauty of attitude and grace of carriage are however, intimately connected with the maintenance and equipoise of the body No attitude can be beautiful in which the idea of rest is not conveyed by that permanence and security which result from a perfectly felt balance Grace of carriage requires not only a perfect freedom of motion but also a firmness of step arising from a constant bearing of the centre of gravity over the base of support" (*Arnott's Physics* p 128) It includes ease and security And in both, whether it be motion becoming fixed in attitudes, or attitudes presenting themselves in the shaping flow of motion beauty and grace reveal themselves in self-command, and in freedom made manifest by self-control In short look at the body in any position or attitude in any of the incidental or casual forms arising out of the free and unconstrained movements of man healthy in frame and unshackled by conventional usages and the truth will force itself on your conviction Pass in review the ponderous strength of the Hercules the agile Mercury, the graceful ease of the Antinous the reclining Ilyssus, all the animated forms of the frieze of the Parthenon — whatever Greek art has signalized or modern genius realized witness the sports of children or go even to the wild denizens of the American forest and proof will no longer be needed that grace and beauty are inherent in, not accidents of the human body as the fit instrument of human freedom and intelligence, and the translucent medium, as it were of man's proper and spiritual being" (*Green's Vital Dynamics* 1840, p 60)

The main points of internal anatomy in which man differs from or excels the lower animals are the following — First of all in the magnitude of the brain which is relatively greater than the spinal chord and nerves in him than in any other animal This superiority is chiefly due to the great development of the hemispheres of the cerebrum, which are likewise characterized in man by the number and depth of the convolutions by which the cineritious and vascular surface is augmented The parts which are most evidently superadded to the human brain are the posterior lobes of the cerebrum, the corresponding horn of the lateral ventricle, and the lesser hippocampus

Of the external senses, that of smell is the least developed, but both this and the other organs are well balanced, and in their [illegible] most delicate and perfect The two eyes are [illegible] forward, and thus, though man does not see on two sides at once, like many quadrupeds, there is more unity in the result of his vision, and he can concentrate his [illegible] closely on the objects of his [illegible] The [illegible] ear, having little mobility or extent, does not increase the intensity of sounds; notwithstanding which, Cuvier well remarks that man best distinguishes their intonation So also with respect to the organ of smell though most animals excel man in their power of scent for particular objects, there are none perhaps which can distinguish so many varieties of or which are so uniformly affected by, unpleasant, odours In the discrimination and delicacy of taste man has unquestionably the advantage over the lower animals, and [illegible] hand so framed, or the tactile extremities [illegible] so expanded, or endowed with such an exquisitely sensitive and discriminative integument, as in man

"Man," says Cuvier, "has a particular pre-eminence in his organs of voice he is the only mammal that can articulate sounds, probably on account of the form of his mouth and the great mobility of his lips He receives results his most valuable mode of communication, for of all signs that can be conveniently employed for the transmission of ideas, varied sounds are those which can be perceived at the greatest distance, and in most directions simultaneously

[illegible] of the heart, which rests obliquely on the diaphragm, and on which depends the absence of the [illegible] [illegible] [illegible] ha, — relates to man's erect position

The alimentary organs of man indicate his natural destination for a mixed diet of animal and vegetable substances, but the prehensile faculty of his hands, and the intelligence which [illegible] permitted the teeth to remain of [illegible] proportions as might simply serve to divide and crush the food which the hands carry to the mouth Thus the canine teeth, though present and with crowns shaped for piercing, do not exceed the adjoining teeth in size, and no interval in the dental series of one jaw is required to receive a produced tusk of the opposite jaw when the mouth is closed thus [illegible] but unbroken [illegible], the back-teeth have flat and tuberculate crowns for bruising the short and [illegible] admit of the mastication [illegible] of flesh that has not been previously prepared by cooking

The organs of digestion conform with those of manducation, the stomach is simple, the intestinal canal of mean length, the small intestines are provided with numerous transverse folds of the secreting and absorbing mucous membrane called *valvulæ conniventes* the large intestines are well marked, they commence by a short and wide cæcum provided with a long, slender, and vermiform appendage

The period of gestation is nine months In general there is only one child at a birth, twins are born once in about five hundred cases of parturition, and more than that number is extremely rare The fœtus of seven months is eleven inches in length, that of nine months eighteen inches Those which are born prior to the seventh month usually die The first, or milk teeth, begin to appear a few months after birth, commencing with the incisors, at two years the entire deciduous series twenty in number is attained These are shed successively from about the seventh year, to be replaced by others The eight deciduous incisors are succeeded by eight permanent ones, the four deciduous canines by four permanent ones, the eight deciduous molares by the eight bicuspides Of the twelve true or posterior molars which are permanent, there are four — one on each side of both jaws — that make their appearance at four years and a half, four more at nine years, the last four being frequently not cut until the twentieth year The fœtus presents one fourth of the adult stature when born, it has attained one half of it at two years and a half and three fourths at nine or ten years Between the seventeenth and twenty first years the growth almost entirely ceases Man rarely exceeds [illegible] and seldom remains under five Woman is [illegible] inches shorter When the full stature is attained the body generally begins to [illegible] [illegible] accumulated in the cellular tissue, [illegible] becomes rigid, the fat is commonly absorbed, the before smoothly-filled integument falls in wrinkles, and old age arrives, with decrepitude, decay, and death Man rarely lives beyond a hundred years, and most of the species, either from disease, accidents, or merely old age, perish before that term

"The child," says Cuvier, "needs the assistance of its mother much longer than her milk, whence results an education intellectual as well as physical and a durable mutual attachment From the long period of infantile weakness results domestic subordination, and, consequen [illegible] persons [illegible] with their parents those tender [illegible] ch they have been so long accustomed [illegible] to mutual assistance multiplies to an [illegible] extent those advantages previously derived by isolated man from his intelligence it has assisted him to tame or repulse other animals, to defend himself from the effects of climate, and thus enabled him to cover the earth with his species Circumstances, more or less favourable, have restrained the social condition within limited degrees, or

[illegible] [illegible] [illegible] [

have promoted its development The glacial climates of the north of both continents and the impenetrable forests of America, are still inhabited by the savage hunter or fisherman, the immense sandy or salt plains of Central Asia and Africa are covered with a pastoral people and innumerable herds these half civilized hordes assemble at the call of every enthusiastic chief and overrun the cultivated countries that surround them in which they establish themselves but to become enervated, and to be subjected in their turn to the next invaders This is the true cause of that despotism which, in every age, has crushed the industry called forth under the fine climates of Persia, India, and China Mild climates, soils naturally irrigated and rich in vegetables, are the natural cradles of agriculture and civilization, and when their position is such as to afford shelter from the incursions of barbarians, talents of every kind are [illegible] Such were formerly (the [illegible] Greece and Italy, and such is at present nearly all the happy portion of the earth's surface"

The influences of climate, and of the different habits and social conditions thence resulting, are associated with differences of form, stature, features and colour of the skin, not greater however, than the corresponding differences which indicate varieties of a species in the lower Mammalia and accordingly naturalists have distinguished and have [illegible] more or less successfully the [illegible] varieties in As the races and varieties of the domesticated quadrupeds so also those of the human species, blend imperceptibly with each other, and the absence of well defined boundaries depends not only on the gradual subsidence and change of those physical causes which probably gave rise to the original varieties but also to the faculty common to the individuals of different varieties of the same species to produce by their union, individuals capable of propagating the intermediate variety Hence has arisen the difficulty of defining the primary races of man, and the discrepancy which exists in the conclusions of those naturalists who have devoted the greatest attention to this important and most interesting branch of zoology Cuvier considers that *three* varieties are eminently distinct, — the white, or *Caucasian*, the yellow, or *Mongolian*, the black or *Æthiopian*

"The Caucasian," he observes "to which we belong is distinguished by the beauty of the oval which forms the head, and it is this one which has given rise to the most civilized nations — to those which have generally held the rest in subjection it varies in complexion and in the colour of the hair

"The Mongolian is known by his projecting cheek-bones, flat visage, narrow and oblique eyebrows scanty beard, and olive complexion Great empires have been established by this race in China and Japan and its conquests have sometimes extended to this side of the Great Desert, but its civilization has always remained stationary

"The Negro or Æthiopian race is confined to the southward of the Atlas chain of mountains, its colour is black its hair crisped the cranium is contracted and the nose flattened The projecting muzzle and thick lips [illegible] to the apes the hordes of [illegible] always continued barbarous [illegible] races characterized by Cuvier Blumenbach adds the *Malayan* and *American* races Of the Malays, however, Cuvier asks, "Can they be clearly distinguished on the [illegible] both sides, the Caucasian [illegible] the Mongolian Chinese?" And with regard to the Americans, he states "They have [illegible] character which can entitle them to [illegible] a particular race Their copper-coloured complexion is not sufficient Their general black hair and scanty beard would induce us to approximate them to the Mongols, if their defined features their nose as projecting as ours, their large and open eyes did not oppose such a theory, and correspond with the features of the European" Dr Pritchard however, considers that there are seven classes of nations which may be separated from each other by strongly marked lines

The *first* class corresponds with Cuvier's Caucasian variety, but which Dr Pritchard prefers to call *Iranian*

The *second*, which he terms *Turanian*, is equivalent to the Mongolian variety

The *third* class are the native American races, excluding the Esquimaux and some tribes which resemble them more than the majority of inhabitants of the new world

The *fourth* class comprises only the Hottentot and Bushman races

A *fifth* class includes the Negros

The *sixth* class consists of the Papuans, or woolly-ha[illegible]

[illegible] races

A study of the resemblances and differences of human speech in various regions and various ages has added much and will contribute more to the true knowledge and definition of the primitive races of the human species It has already led to the establishment of the [illegible] The Semitic which [illegible] Chaldean, Syriac, Phœnician, and Ethiopian, the *Indo-Europæan*, which includes Sanskrit, Persian, Greek, Latin, German, and Celtic, the *Monosyllabic* languages, as Chinese, Thibetan, Birman, Siamese, the *Polysynthetic* languages, a class including most of the American Indian dialects The combination of [illegible] glossological characters, is [illegible] exact characters of the human races

MANATI [illegible] herbivorous Cetacean, forming the type of a distinct genus *Manatus* See that word

MANA'TUS (Lat manus, *a hand*) The name given by Cuvier to a genus of his herbivorous Cetaceans, including the species usually called sea-cows They have an oblong body terminated by a lengthened oval fin, their grinders, which are eight on each side of both jaws, have square crowns marked by two transverse ridges There are no incisors or canines in the adult, but when very young there are two very small pointed teeth in the intermaxillary bones, which soon disappear Vestiges of nails are visible on the edge of their swimming paws, which they employ with some address in carrying their young, hence the comparison of these organs with hands, and the name *Manatee* and *Manatus* applied to the animal There are two species of Manatee in America, and one in Africa, they inhabit the mouths of the great rivers, and browse on the herbage that clothes the banks

MANCHINEEL (Mancinella the Spanish name) A tree inhabiting the West India islands and celebrated for its poisonous qualities It is asserted that to sleep beneath its shade is to poison, and that the land-crabs found in the groves of manchineel become poisonous from feeding on its seeds Although there is doubtless much exaggeration in these stories no doubt exists of the deadly effects of manchineel juice when introduced into the system

MANDA'MUS In Law a prerogative writ in the form of a command issuing from the Court of King's Bench directed to any person corporation, or inferior court of judicature within the king's dominions requiring them to perform various duties It is grounded on the suggestion of a party injured by the acts or omissions of such persons or bodies, and lies for instance, to compel the admission or restoration of a party applying to an office or franchise which has been illegally withheld, for the production of public papers, to compel the holding of courts &c

MANDARIN The [illegible] of the official order of [illegible] either civil or military of the former there are nine classes of the latter five Although the mandarins are inferior in dignity to the higher class of nobility, whose dignity partakes of a personal character, they form the effective ministry and magistracy of the country The Chinese equivalent of *mandarin* is *kouon*, which signifies literally *a public character*

MA'NDIBLE *Mandibula* (Lat mandibula *a jaw*) In Zoology, this term is applied to the lower jaw of mammals and to both jaws of birds (except by Illiger, who restricts its appellation to the lower jaw in this class also) In insects it is applied to the upper or anterior pair of jaws

MANDI'BULATES, *Mandibulata* (Lat. mandibula, *a jaw*) The name of a grand section of insects, including all those which preserve their organs of mastication in [illegible] state of metamorphosis

MANDIOC [illegible] can name of the plant which is otherwise called *cassava*, and which is most extensively cultivated within the tropics of America, for the sake of the nutritive fæcula contained in its stems It is the *Jatropha manihot* of botanists The substance called tapioca is one of its products In its raw state the whole plant is poisonous, but by the preparation and torrefaction of the fæcula the poisonous principle, which is volatile, is driven off

MA'NDRAKE, or MANDRAGORA A herb of fabulous character, concerning which there existed many singular superstitions The herb mentioned in Genesis, ch xxx, which our translation renders mandrake, was, probably, some flower or root to which common belief attached value as a philter The mandrake of modern as well as classical superstition is a herb supposed to have a resemblance to the shape of a man Those who [illegible] from the ground are obliged to do so with peculiar [illegible] according to some dogs must be employed to do so, which die instantly after) shrieks and groans are heard to issue from it, which have the power of injuring the unwary person who hears them Its favourite habitat was believed to be the ground under a gallows on which a criminal was hanging When plucked, it was said to be useful in conjurations, for the transformation of men or beasts, and was also believed to enable the

possessor to acquire riches at play, and to discover hidden treasures (*Encyc Metropol*)

MA'NDREL (Fr *mandrin*) In Machinery, a revolving shaft or axle to which turners affix their work in the lathe

MA'NDRILL (*Eng man*, and *drill*) A baboon The name of the Catarrhinæ or apes of the genus *Papio* Cuv They are the largest and most formidable of the baboons The mandrill proper is the great blue-faced baboon of our menageries — *Simia mormon* and *maimon* of Linnæus It is of a greyish-brown, inclining to olive above, with the cheeks blue and furrowed The nose in the adult male becomes red and even inclines to a fine scarlet at the end It is difficult, says Cuvier, to imagine a more hideous or extraordinary animal The male attains the size of a man, and is a terror to the negroes of Guinea and the other parts of Africa, of which this species is a native

MANE'GE (Fr from the Ital maneggio), is used in England to signify either the art of horsemanship or of training horses

MA'NES A word of uncertain etymology, applied generally by the Romans to souls separated from the dead There is some obscurity, however, about the precise meaning of this term According to Apuleius the Manes were originally called Lemures, and consisted of two classes, — the *Lares* and the *Larvæ*, the former of whom were the souls of those who had led virtuous lives, and the latter of those who had lived improperly, and, at a later period, the term *Manes* came to be a general designation for both On the other hand, St Augustin maintains that *Manes* was, from the first a term applied to the spirits of deceased men when no definite opinion could be formed of their merits — Animas hominum dæmones esse, et ex hominibus fieri Lares si meriti boni sint, Lemures sive Larvas si mali, manes autem cum incertum est bonorum eos sive malorum esse meritorum" In the month of February annually the Manes were propitiated at their sepulchres during twelve days It was the duty of the pontifex maximus to see that proper ceremonies were observed The stones in the Roman burial places, and their funereal urns, were generally inscribed with the letters D M S (*Dis Manibus Sacrum*)

MANGANE'SE This name is generally given to a black mineral originally described in the year 1771 by Scheele as a peculiar earth, and which was afterwards shown by Gahn to be the oxide of a metallic substance which he called *magnesium* This term however having been applied to the metallic base of magnesia the word *manganese* [illegible] the metal, and the ore above [illegible] black or peroxide of manganese The metal itself has a specific gravity of about 8 It is grey, hard brittle and very difficult of fusion, and has not been applied to any use The black oxide, on the contrary is largely employed as a source of oxygen, and is especially important from the use which is made of it in the decomposition of common salt for the production of chlorine Manganese may be represented by the equivalent 28, and the black oxide being a compound of 1 atom of manganese and 2 of oxygen, has the equivalent 44 (28 + 16) There is also a protoxide of manganese, composed of 28 metal + 8 oxygen, which is the basis of the salts of this metal When hydrate or carbonate of potassa, or nitre are fused with peroxide of manganese in an open vessel a dark-coloured compound is obtained, long known under the name of *chameleon mineral*, in consequence of its yielding in cold water a solution which is at first green then blue, purple, red, brown, and ultimately deposits a brown powder, and becomes colourless This substance has since been termed *manganate of potash* and has been proved to contain a compound of 1 atom of manganese and 3 of oxygen which has been called *manganic acid* and is represented by the equivalent 52 In the pink solution, which is produced at once by the action of hot water manganese exists in a still higher state of oxidizement forming the [illegible] *acid*, in which 2 atoms of manganese are [illegible] 7 of oxygen Both these compounds are very easy of decomposition Some of the proto-salts of manganese have lately been used in calico printing as the source of brown colours, and occasionally as deoxidizing agents

MANGE An eruptive disease which attacks several domestic animals, especially the dog It is said to resemble the itch, and, like that disease to be produced by a minute species of acarus which burrows beneath the cuticle It is stated that the fluid discharged from the eruption of mange, in horses and dogs, has produced the itch upon the human skin It is commonly produced by confinement and want of cleanliness, and bad or insufficient food

MA'NGEL WURZEL The root of the *Beta hybrida* This German name is translated *root of scarcity*, the root being large, and used as a substitute for bread [illegible] of cattle

MA'NGER [illegible] in which is placed the corn or other short food given to live stock, and more especially to horses *See* RACK

MA'NGER The space near the hawse holes bounded on the upper side by a partition across the bows called the *manger board* to receive the water while it enters the hawse holes and prevent it from flooding the deck

MA'NGO (Mangos maruma in the Tamul language of India), is a very large tree inhabiting the tropical parts of Asia throughout all which it is as extensively cultivated as the apple and pear trees are in Europe Old specimens have been seen with a trunk from ten to fifteen feet in diameter The fruit is something like a nectarine, but more compressed, longer, and more curved It contains a large stone covered with coarse fibres which lose themselves in the succulent flesh The wild and inferior varieties of this fruit have so much of turpentine as to be wholly unfit for eating, but in the fine varieties this flavour is replaced by a rich sugary quality, which renders it very delicious In this country the mango has rarely ripened its fruit, but it is common in the shops in a pickled state The fruit of the *Mangifera Indica*, a tree cultivated in Asia, is also called "[illegible]"

MANGOSTEEN The fruit of the *Garcinia mangostana*, growing in Java and the Molucca Islands it is of the size of an orange, and of a delicious flavour

MANGROVE (probably an abbreviation of *mangle* grove, the former being the Malay name), is a tree inhabiting the shores of the tropical parts of the world in either hemisphere, and well known to navigators on account of the dense groves it forms even down into the water itself It belongs to the genus *Rhisophora*, and is principally remarkable for its seeds germinating before they leave the case in which they were generated on the branches The young radicle grows downwards through the humid air till it reaches the mud, in which it fixes itself and then the leaves and new stem unfold at the opposite end The *white* of the tropics, is *Avicenn* genus from the genuine plants of that name

MA'NIA (Gr *μαινομαι*, *I rage*) Madness It is defined to be delirium unattended by fever, in which both judgment and memory are impaired and the irritability of the body diminished so as to resist many morbid causes There is a false perception of things, marked by incoherence or raving and resentment of restraint It is divided into melancholic and furious the former marked by dejection of spirits, the latter by violent exertion of strength, malice to particular individuals, and repugnance to scenes and places before agreeable Dissection has shown that in cases of madness there is usually effusion of water into the cavities of the brain, or appearances of previous inflammation of its membranes, or hardness of its substance, or peculiar thickness of the skull, and it has lately been stated that chemical analysis has shown an excess or deficiency of phosphorus in the composition of the brain in cases of madness and idiotcy

MANICHEISTS The followers of Manes, an oriental heretic of the 3d century, who having been ordained a Christian presbyter, attempted to effect a combination between the religion which he was appointed to preach and the current philosophical system of the East He pursued herein the same course as the Valentinians, Basilidians, and many others, whose leading ideas may be denominated Gnostic He maintained a dualism of principles governing the world, and a succession of dualisms generated from them, like the Gnostic æons All things were effected by the combination or repulsion of the good and the bad, men had a double soul good and evil, even their bodies were supposed to be formed the upper half by God the lower by the Devil The Old Testament was referred to the inspiration of the evil principle, the New to that of the good In the latter, however, Manes proposed many alterations, and maintained also the authenticity of various apocryphal scriptures A great part of his system related to cosmogony and psychology, in which fields of speculation he expatiated with the most arbitrary freedom Like most other oriental systems, the Manichean heresy was celebrated alike for the austerities which it enjoined, and for the scandalous excesses which were attributed to its most zealous votaries The charge of Manicheism, which in later times becomes scarcely intelligible, was frequently brought against the early reforming sects, such as the Albigenses, Waldenses, Picards, &c (See Mosheim (transl), ed 1790, i 303 &c, Beausobre, *Hist Critique de Manichée et du Manichéisme*, Amst 1734, Gieseler, vol i 190 (transl), ii 151, iii 340, Milman, *Hist of Christianity*, ii 322)

MANIFESTO In Politics, a declaration of motives publicly issued by a belligerent state, or by a general acting with full powers, previously to the commencement of hostilities They are in the form of letters, with a superscription or [illegible] addressed to the public in general, and signed by the [illegible] sovereign who sends them forth The usage of issuing manifestos is said to date so far back as the 14th century The term is probably derived from the Latin words "manifestum est," with which such documents usually commenced

**MA'NIOC** The Indian name of amylaceous products

**MA[illegible]**, embraces the manual and mechanical operations of the laboratory, and in the delicate details of analysis, as well as in the exhibition of class experiments, great skill and practice in manipulation are required to ensure success The processes of weighing, measuring, filtering, distilling, precipitating, dissolving, using the blowpipe, &c all come within the meaning of manipulation Mr Faraday has published an excellent treatise upon this subject

**MANIPULUS** (Lat manus, *hand*) In Roman Military Antiquities, a subdivision of the cohort so called from the handful of grass, straw &c which formed its original standard A maniple of triarii consisted of 60 men, one of hastati and principes of 120, when the number of the legion was 300 (See M le Beau's Eighth Dissertation on the Roman Legion, *Mem de l'Ac des Inscr* vol xxxii)

**MA'NIS** The name of a genus of Edentate Mammals, singularly characterized by being covered with large, strong, imbricated, horny scales, like the Lacertine reptiles, and hence commonly called scaly lizards, and [illegible] Their [illegible] blooded mammals, and rank in the system of Cuvier among the Edentate order, of which they may be regarded as typical forms, being wholly destitute of teeth, and provided with a tongue of extraordinary length with associated glands for preparing an abundance of adhesive lubricous mucous By this organization they are peculiarly adapted to prey on ants termites &c and certain of their claws are extraordinarily developed, to enable them to break through the walls of the habitations of these social insects The manises are confined to the warmest regions of Asia and Africa, where they play a corresponding part with that assigned to the true anteaters (*Myrmecophaga*) in South America

**MANITRUNK** *Mantruncus* in Entomology is a term given to the anterior segment of the trunk, in which the head inosculates, or on which it turns

**MA'NNA** (Syrian mano *a gift*, it being a term applied to the food given by God to the children of Israel in the wilderness) What we now call *manna* is a saccharine substance which exudes from the bark of the *Fraxinus ornus* and some other species of ash natives of the south of Europe especially Sicily and Calabria Manna is used in medicine as a mild aperient It differs remarkably from common sugar in not being susceptible of vinous fermentation, so that if mixed with common sugar and yeast and subjected to the process of fermentation, the sugar becomes converted into alcohol but the manna remains unaltered in the liquor When manna is dissolved in boiling alcohol, the solution as it cools deposits it in flaky and acicular crystals often arranged in concentric groups Manna thus purified, has been chemically designated by the term *mannite*

Various opinions have been entertained respecting the precise nature of the manna on which the Israelites were sustained, and attempts have been made at various times to account for its miraculous appearance on natural causes, but in our opinion, without any success The Syriac word *mano* [illegible] to this circumstance, and is no doubt Hebrew *man hu*, the Scripture explanation of which is certainly the best The word asks a question and signifies *What is this?* for they wist not what it was' (Exodus xvi 15) And if they did not know *then* 'what it was,' it is not likely we should know now They could see that it was a little round grain, or something like a grain, of the size of coriander-seed, and white as the hoar frost on the ground, but it had no component parts such as they could describe And even admitting, as has been frequently maintained, that it exuded from the bark of the ash, or some other tree, it is incredible that it could be supplied in such abundance in the deserts of Arabia as to give sustenance to 50[illegible],000 Israelites for 40 years, without the miraculous intervention of Providence

**MA'NNER** (Fr maniere) In the Fine Arts, a peculiarity of treating a subject or of execution, by which individual artists are distinguished the latter arising out of a particular mode of using the media and implements of art, the former out of a singular method of observing nature (See *Sir J Reynolds's Sixth Discourse*)

**MAN-OF-WAR, MERCHANT MAN** The common terms for ship-of-war, merchant-ship

**MANO'METER, or MA'NOSCOPE** (Gr *μανος*, *rare*, and *μετρον*, *a measure*, or *σκοπεω*, *I view*) An instrument for measuring the *density* of the air, or rather its *elastic force*, to which the density is supposed to be proportional See PNEUMATICS

**MA'NOR** (Lat maneo, *I reside*, from the residence of the lord) signifies a district subject to the jurisdiction of a court baron In the feudal ages, a grant of lands from the king carried with it a right of dominion, and the grantee or baron had power to make laws, and hold a court of justice for his dependents within the territory, which was called a manor The baron might also by subinfeudation parcel out the land so granted to others, to hold of him, as he held of the king, by military service or other tenure These again further subdivided the land by grants to others, and so on, increasing manors by this process *ad infinitum* The services due to the lord of the fee were, in consequence, very negligently performed, and, to meet this inconvenience, the statute of Ed I, called Quia Emptores, was passed, which enacted that the buyers of lands should hold them by the same services, and of the same lord, as they were before held by when in the hands of the seller This put a stop to the increase of manors, and every manor, therefore, now in existence, must have existed in the time of Ed I, and [illegible]

**MANSARD** [illegible] from the name of its inventor, a celebrated architect) In Architecture, the [illegible] which see

**MANTELET** A moveable parapet, constructed of boards covered with tin, iron, or leather, to serve as a protection to the miners in carrying a sap or a trench towards a besieged place Mantelets are of various forms, adapted to the peculiar circumstances of the approach

**MA'NTIS** (Gr *μαντις*, applied by Hesychius (*Hyl* x 18) to the cicada) A Linnæan genus of Orthopterous insects, characterized by having the head exposed, and the body narrow and elongated, the palpi short, and terminating in a point, the ligula quadrifid, the tarsi five-jointed, and the [illegible] and not ray-wise like [illegible] times called *praying insects*, on account of the position of the anterior pair of legs, which differ from the rest,—are found only in tropical and temperate climates they are diurnal and remain almost stationary on plants and trees, frequently resembling, in a remarkable degree, their leaves and branches in both the form and colour of the wings and body, and thus they deceive the smaller insects on which they prey Their eggs are usually enclosed in a capsule formed of some glutinous substance, which hardens by exposure to the air and is divided internally into several cells It is curious to trace the correspondence with the vegetable kingdom already noticed in the wings and body continued into the form of the egg capsules which in many species closely resemble a seed receptacle of a plant presenting regularly disposed ridges and angles or even being bristled with little spines The female attaches it by an adhesive secretion generally to the stem of a plant

A second group of mantises characterized by having the anterior legs like the following ones now form a distinct subgenus *Spectrum* and are generally called *spectre insects* they feed exclusively on vegetables, of which they singularly resemble the dried twigs The progress of entomology has required further subdivisions of both the above groups

**MANTISSA** The decimal part of a logarithm is sometimes called the *mantissa* of the [illegible] the integral part being the *characteristic* Thus in log 900 = 2·95424, the characteristic of the logarithm of the number is 2 and ·95424 is the mantissa, which belongs equally to the numbers 9·90 900, 9 &c

**MANTLE** (Fr manteau) In Architecture, the piece lying horizontally across from one jamb of a chimney to the other In Malacology, the external fold of the skin of the mollusks

**MANUAL** (Lat manus *the hand*), was applied originally to the Roman Catholic service book from its convenient size (being [illegible] carried in the hand), but it now signifies a small work used chiefly for the purpose of reference

**MANUFACTURE** (Lat manus, *a hand*, and facio, *I make*) In Political Economy a term employed to designate the changes or modifications made by art and industry in the form or substance of material articles, in the view of rendering them capable of satisfying some want or desire of man Hence the perfection of manufacturing consists in the being able to effect the wished-for changes in the raw material with the least expenditure of labour, or at the least cost

With the exception of fishing, hunting, mining, and such branches of industry as have for their object to obtain possession of material products in the state in which they are fashioned by nature, all other branches may, in fact, be comprised under the term manufacture Generally, indeed, it is applied only to those departments of industry in which the raw material is fashioned into desirable articles by art and labour without the aid of the soil But there is no really good foundation for any such limitation, which, unless explained, is apt to make it be supposed that businesses which are substantially identical not only differ from, but are opposed to, each other It is obvious, indeed, on the slightest consideration, that agriculture in nothing but a manufacture, for the business of the agriculturist is so to dispose of the soil, seed, manure, and other materials, that they may supply him with other and more desirable products Manufacturing industry consists, in fact, in

the *application of art, science, and labour to bring about* [illegible] *modifications of already existing ma-* [illegible] varieties depend wholly on the modes in whic[illegible] is made The manufacture of any [illegible] usually derives its name from the raw material manufactured modified, or wrought up into a new shape Thus the terms woollen, cotton, and hardware manufacture, mean the working up of wool, cotton or metals into useful or desirable articles, shipbuilding is the manufacture of timber and iron into ships, agriculture (*ager* and *colo*) is the production of corn, beef, and other products, by the adaptation of the soil and the vegetative powers of nature to their manufacture, and so on The knowledge of the means by which art and labour may be most successfully employed in each of these departments forms the peculiar business of the woollen, cotton, and hardware manufacturers, ship-builders [illegible] &c

It would far exceed our limits to attempt to enter into any details with respect to the application of labour in the separate departments of manufacturing industry, but considering the vast importance of manufactures to mankind, and especially to the British nation, we may, perhaps, be excused for endeavouring shortly to state some of those conditions and circumstances that seem, in a general point of view, most essential to success in manufactures

These are partly of a moral and political, and partly of a physical description Of the former class the most important seem to be the security and free disposal of property, the absence of monopolies, and the non interference of government in industrious undertakings, the diffusion of knowledge amongst the people, the cordial reception of foreigners and the emulation and energy inspired by inequality of fortune, and by the gradual increase of taxation Among the more prominent of the physical circumstances conducive to the progress of manufactures are supplies of the raw materials to be manufactured, with the command of power, that is of coals water falls &c A good deal also of the progress of manufactures seems to depend on the advantageous situation of a country for commerce, and on the nature of its climate We shall briefly notice some of the more prominent of these circumstances

1 *Moral Circumstances contributing to the Progress of Manufactures* — It is unnecessary to take up the reader's time by enlarging on the necessity of security and of the free disposal of property to success in manufacturing industry or indeed in any laborious undertaking Without security there can be neither industry nor invention No man will engage in any employment, or exert either his bodily or mental powers unless he be well convinced that he will be allowed to reap all the advantages accruing from his labour skill or genius Any doubt as to this is sure to paralyse his exertions And if, owing to the weakness or ignorance of government the prevalence of a revolutionary spirit or any other cause, the security of property were materially impaired all sorts of industrious undertakings that did not promise an immediate return would be forthwith abandoned and every person possessed of property would endeavour to convey it out of the country The want of security is in fact the greatest of public calamities In its absence we find nothing but the most abject poverty and barbarism, and supposing other things to be equal the wealth and civilization of nations will be pretty nearly proportioned to the security of property they respectively enjoy Every other circumstance conducive to the advancement of industry may exist in a country, but without security these can be of no material service A high degree of security will compensate for many deficiences but nothing can make up for its want it is a *sine qua non* of manufacturing and national prosperity

2 The absence of monopolies and the non-interference of government in industrious undertakings undoubtedly conduce in no ordinary degree to the progress of industry Every man is always exerting himself to find out how he may best extend his command over the necessaries and conveniences of life, and sound policy requires that he should so long as he does not interfere with the rights and privileges of others, be allowed to pursue his own interest in his own way That individuals are, generally speaking, the best judges of what is most beneficial for themselves is now universally admitted to be the only principle that can be safely relied on It is the duty of governments to preserve order, to prevent one individual from injuring another, to maintain, in short, the equal rights and privileges of all But it is not possible for them to go one step further without receding from the principle of non interference, and laying themselves open to the charge of acting partially by some and unjustly by others

The most comprehensive experience corroborates the truth of this statement [illegible] the famous act of James I in 1624, for [illegible] monopolies, full scope has been given in Great Britain to the competition of the home producers, and though the various resources of talent and genius have not been so fully perhaps or at least so early developed, as they would have been had there been no restrictions on our intercourse with foreigners, they have been stimulated in a degree unknown in most other countries France, previously to the Revolution, was divided into provinces, having each peculiar privileges and separate codes of revenue laws, and, in consequence, the intercourse between them was subject to the most oppressive restrictions In Germany and Spain the same miserable system prevailed, so that they were not only deprived of the freedom of foreign, but even of internal commerce The inhabitants of each province being in a great measure isolated from the rest, there was comparatively little competition, and, instead of invention and active exertion there was nothing but routine and sluggish indifference Holland and the United States have been almost the only countries that have enjoyed the same degree of internal freedom as Great Britain, and the former, notwithstanding the unfavourable physical circumstances under which [illegible] placed has long been, and still is, the richest [illegible] while the latter, whose condition is in other respects more favourable, is advancing with giant steps in the career of improvement

It is sometimes said that restrictions on industry and commerce cannot be [illegible], seeing the progress [illegible] have always existed [illegible] show the weight to be attached to this allegation The restrictions referred to have been confined to some branches of foreign trade, and, luckily, the freedom allowed to all sorts of industry at home would have insured our advance even had our [illegible] been a good deal more fettered and restrained [illegible] been But to imagine, as many have done, that these restrictions contributed to accelerate our progress, is the climax of folly Their influence is, in every case, distinctly and completely the reverse, but though considerable even in Great Britain, it has been insufficient to counteract the advantages resulting from the freedom we otherwise enjoyed

3 The ability to read and the diffusion of instruction among all ranks and orders of the people by the general circulation of books and journals the establishment of mechanics institutes, &c, have had a material influence over the advancement of arts and industry They have had the double advantage of multiplying the means and chances [illegible] or discovering [illegible] a few [illegible] the means and capacities required for the manufacture of commodities and the accumulation of riches, being unable to apply them, are necessarily poor and destitute, but an intelligent people though placed in a comparatively unfavourable situation never fail by availing themselves of the powers and energies of nature and making them subservient to their purposes, to attain to distinction as manufacturers and so become rich and prosperous That knowledge is power is true in manufactures as well as in morals The more familiar our acquaintance with and the more complete our command over natural agents the greater of course, must be our ability to modify rude products, and to make them minister to our wants and the gratification of our desires In tracing the causes of our success in manufactures and industry, it is not possible to appropriate to each circumstance the portion belonging to it of a result which is the joint effect of the whole, but if this could be done it would be found that no inconsiderable share is fairly ascribable to the extraordinary diffusion amongst us of scientific information

4 For a lengthened period the reception given to foreigners in England was any thing but cordial In most countries indeed not in an advanced state of civilization, strangers are uniformly the objects of popular dislike, and this feeling seems at one time to have prevailed quite as much in England as any where else But notwithstanding the various legal disabilities laid on foreigners, and the ill-treatment they often experienced, their settlement here has been productive of the most advantageous results The Flemings, invited over and protected by Edward III, gave the [illegible] to the woollen manufacture, and the [illegible] the Low Countries during the persecution [illegible] Duke of Alva and from France subsequently to the revocation of the Edict of Nantes, materially forwarded our commerce and many branches of manufactures During the last century the prejudice against aliens lost much of its force, and several of the disabilities under which they formerly laboured have been removed But in all that respects [illegible] our policy has been less [illegible] of the Dutch In Holland they have always been received with open arms, and a short residence in the country and a small payment to the state, have entitled them to all the privileges

enjoyed by natives The highest authorities agree that this was one of the main causes of the extraordinary progress made by the republic in commerce and wealth "It has always been our constant policy to make Holland a perpetual safe and secure asylum for all persecuted and oppressed [illegible] for [illegible] at any time been able to weaken or destroy, or make the state recede from protecting, those who have fled to it for their own security and self-preservation Throughout the whole course of all the persecutions and oppressions that have occurred in other countries, the steady adherence of the republic to this fundamental law has been the cause that many people have not only fled thither for refuge with their ample stock [illegible] most valuable [illegible] many trades, fabrics, manufactures arts and sciences, in this country, notwithstanding the first materials for the said fabrics and manufactures were almost wholly wanting in it, and not to be procured but at a great expense from foreign parts" (Memorial by Dutch Merchants presented to the Prince of Orange in 1751)

5 We incline to think that the great inequality of fortune that has always prevailed in this country has powerfully contributed to excite a spirit of invention and industry among the less opulent classes It is not always because a man is absolutely poor that he is perseveringly industrious and economical, he may have already amassed considerable wealth but he continues with unabated energy to avail himself of every means by which he may hope to add to his fortune that he may place himself on a level with the great landed proprietors and those who give the tone to society in all that regards expense No successful manufacturer or merchant ever considers that he has enough till he be able to live in something like the same style as the most opulent landlords Those immediately below the highest become, as it were a standard to which the class next to them endeavour to elevate themselves, the impulse extending in this way to the very lowest classes, individuals belonging to which are always raising themselves by industry address and good fortune to the highest places in society Had there been less inequality of fortune amongst us there would have been less emulation and industry would not have been so successfully prosecuted It is true that the desire to emulate the great and the affluent by embarking in a lavish course of expenditure is often prematurely indulged in, and carried to a culpable excess, but the evils thence arising make but a trifling deduction from the beneficial influence of that powerful stimulus which it gives to the inventive faculties, and to that desire to improve our condition and to mount in the scale of society which is the source of all that is great and elevated Hence we should disapprove of any system which like that of the law of equal inheritance established in France had any tendency artificially to equalize fortunes To the absence of any such law, and the prevalence of customs of a totally different character we are inclined to attribute a considerable portion of our superior manufactures, wealth, and industry

6 We are also disposed to believe, how paradoxical soever such a notion may appear, that the taxation to which we are subject has hitherto at least been favourable to the progress of industry It is not enough that a man has the means of rising in the world within his command he must be placed in such a situation that unless he avail himself of them, and put forth all his energies, he will be cast down to a lower station Now this is what our taxation has effected to the desire of rising in the world, implanted in the breast of every man it superadded the fear of being thrown down to a lower place in society, and the two principles combined produced results [illegible] separately [illegible] it would not have had this effect But though considerable, its increase was not such as to make the contributors despair of being able to meet the sacrifices it imposed by increased skill and economy, and the efforts they made in this view were far more than sufficient for their object, and consequently occasioned a large addition to the public industry and wealth, that would not otherwise have existed

II *Physical Circumstances [illegible] contributing to the Progress of Manufactures* [illegible] raw material may [illegible] of this description of circumstances Those who reflect on the value and importance of our manufactures of wool, of the useful metals such as iron, tin, lead, copper, &c, of leather, flax, and so on,—will readily admit that our success in them has been materially facilitated by our possessing [illegible] It is of less consequence [illegible] manufacture possesses considerable value in small bulk, whether it be furnished from native sources or be imported from abroad, though even in that case, the advantage of having an internal supply which cannot be withdrawn through the jealousy or hostility of others is far from immaterial But no nation can make any considerable progress in the manufacture of bulky and heavy articles, the conveyance of which to a distance necessarily occasions a large expense, unless she have supplies of the raw material within herself Had we been destitute of iron ore lead and tin, we could never have distinguished ourselves by the magnitude and value of our manufactures of these articles, and any one who reflects on the signal advantage resulting to every branch of manufacturing industry from being able to procure abundant supplies of iron at the cheapest rate, will be convinced that we are under any thing but slight obligations to our exhaustless stores of this mineral

2 But of all the physical circumstances that have contributed to our extraordinary progress in manufactures and industry none have had so much influence as our possession of the most valuable coal mines These have conferred advantages on us, not enjoyed in an equal degree by any other country Our extraordinary success in the manufacture of iron, copper, &c is not owing so much to our p[illegible] the ores as to our possessing the coal by the aid of which they have been smelted and refined The paramount importance of coal as a manufacturing [illegible] principally manifested since the [illegible] engine Without a cheap and abundant supply of fuel, the engine, as now constructed would be of comparatively little use It is, as it were the hands by which the most gigantic results are effected, but coal is the muscle by which the hands are set in motion and without which their all but illimitable power and dexterity could not be called into action or made subservient to any useful purpose Our coal mines may thus in truth be regarded as vast magazines of hoarded or warehoused power, and unless some such radical change should be made on the steam engine as should very decidedly lessen the quantity of fuel required to keep it in motion or some equally serviceable machine, but moved by different means be introduced, it is not at all likely that any nation should come into successful competition with us in those departments of manufacturing industry in which steam-engines, or machinery moved by steam may be advantageously employed

3 The advantageous situation of a country for commerce and the nature of its climate, have also a powerful influence over manufacturing industry Owing to the facilities afforded by the insular situation of Great Britain for maintaining an intercourse with all parts of the world our manufacturers have been able to obtain supplies of foreign raw materials on the easiest terms, and to forward their own products wherever there was a demand for them Had we occupied a central or internal situation in any quarter of the world our facilities for dealing with foreigners being so much the less, our progress would have been comparatively slow, but being surrounded on all sides by the sea that is by the great highway of nations we have been able to deal with the most distant as well as with the nearest people and to profit by the peculiar capacities of production enjoyed by each Under such circumstances it would have been singular had we not shot ahead of most of our competitors in the race of improvement, and it will require some powerful counteracting agency to neutralize or overcome these advantages

4 Our climate is peculiarly favourable for all sorts of exertion and enterprise without being too severe, it is sufficiently so to render comfortable clothing and lodging indispensable, and consequently gives rise to wants that are either unknown or less sensibly felt, in more genial regions Its inequality too by requiring incessant care and attention on the part of the husbandmen, or manufacturers of corn makes them [illegible] as well as industrious and the qualit[illegible] naturally impressed on this great class are, through their example, universally diffused

The author of a valuable article on English statistics in the *Edinburgh Encyclopædia* when enumerating the causes of our extraordinary success in manufactures, lays the greatest stress on the superiority of our machinery, [illegible] our capital, and the extent to which [illegible] labour is carried amongst us But this is to mistake effects for causes These, in fact are the means and instruments by which manufacturing industry is immediately carried on, and the real inquiry is what are the circumstances that have rendered us so abundantly supplied with these means? We have endeavoured briefly to answer this inquiry by stating what appear to be the most prominent causes of that extraordinary accumulation of capital, and of that universal employment of improved and powerful machinery and subdivided labour, which mark our eminence as a manufacturing people Still, however, we are inclined to think that a good deal must in these matters be ascribed to chance or to some lucky contingency, that could not *a priori* be looked for Had Hargreaves, Arkwright, Watt, or Wedgwood not existed, or been born abroad, it is impossible to say how much it might have affected the state of industry here, but there seem to be sufficient grounds for thinking that it

would have been, at this moment, materially different from what it actually is A good deal too, depends on priority A country, town or district that has already established and made a considerable progress in any manufacture, acquires, in consequence, a a van ta a enable it successfully to contend pla l under what are naturally more favourable circumstances, its merchants are already in possession of the markets, its inhabitants, being trained to the business, have acquired that peculiar sleight of hand that is necessary to form expert workmen, and they are in this way frequently able to preserve their ascendency for a lengthened period, and sometimes even to drive those from the field who have a preponderance of natural advantages on their side

It seems to be the peculiar good fortune of England that, as respects all the great branches of manufacture, priority and of acquired - well as the natural advantages already noticed of abundant supplies of the raw material, of inexhaustible beds of coal, and of situation Cotton is not an exception, for though the raw material be the product of other countries, the freight upon it is not very considerable, and is but a trifling deduction from the other circumstances that seem to insure our superiority in this department To excel in machine-making is to excel in what is certainly the most important branch of manufacturing industry Superiority in any single branch, except this, may exist simultaneously with great inferiority in many others, but eminence in the manufacture of machinery is almost sure to lead to eminence in every other department

Considerable, though not, as it appears to us, too much stress, has been laid on the practice generally adopted in Great Britain of paying workmen wherever it is practicable, by the piece, or by the work done and not by the day This system gives the workmen an interest in being industrious, and makes them exert themselves to execute the greatest quantity of work in the least space of time, and in consequence of its prevalence, this practice materially influences even the day labourers, who, to avoid invidious comparisons, make exertions unknown in other countries Hence a given number of hands in Great Britain perform much more work than is executed by the same number of hands almost any where else, in fact, if we regard wages in their proper light, that is, if we look upon them as a compensation for work done, and not for the time spent in doing it they will we believe, be found to be cheaper in Great Britain than in most other countries (For farther particulars, see the section on Manufactures in the *Statistical Account of the British Empire*, whence this article has been partly abstracted )

MANUMISSION, or ENFRANCHISEMENT (Lat manus, and mitto *I send away* ) The grant of liberty to a slave Ancient charters containing such grants were frequently termed chartæ ingenuitatis (See a law of William the Conqueror, *Lamb Archai* 126 ) The term manumission is derived from a practice adopted by the ancient Romans in enfranchising their slaves The master seized the hand of the slave and dismissed him with the words "hunc hominem liberum esse volo" Among the Romans there were two classes of manumission, called perfect and imperfect the former of which were effected in three different ways The enfranchisement was perfect — 1 Per censum, by which the name of the slave was, at the master's request, placed in the register of free citizens 2 Per vindictam, when the slave was led before the prætor, and, the master having demanded his liberty, that magistrate laid the vindicta (or rod of office) on his head with the words "aio te liberum esse more quiritium" 3 Per testamentum, by will It was imperfect when the slave was enfranchised at private entertainments or by letter See CLIENT

MANURES Substances added to the soil, with a view of accelerating vegetation and increasing the production of the crops Animal, vegetable, and mineral substances are used for this purpose Decomposing animal matter of any kind forms one of the most powerful manures, and in many instances accelerates the decay and decomposition of inert vegetable matters mixed with it, as in the mixture of dung and straw which forms the common offal of stables All animal excrements are also powerful manures, and, when duly applied to the soil, soon exhibit their influence by the luxuriance of the crop It, however, often happens in respect to esculent vegetables that their quality is deteriorated, and that they acquire a coarse and rank flavour, if over-manured, as is the case with much of the produce of the market-gardens near London, where, in consequence of the vicinity of the metropolis, manure is abundant, and luxuriant and fine-looking vegetables in great request for the table

In all cases where animal manures are used care should be taken that they are brought into action upon the soil as soon as they begin to decompose, or as soon as possible afterwards, and not suffered to rot, and exhale their best constituent parts whilst lying in the farm-yard The drainings and the exhalations of a common dung heap contain its most effective ingredients and these are often suffered to go to waste or to contaminate the air and collect in pools of filth The fresh and the old manure of this decomposition are known to farmers under the - . short dung the advantages and economy when properly applied cannot be doubted Those animal manures which are slow of decomposition are most durable, and generally most effective in their operation Of these the best is ground bones, the animal part of which is very gradually dissolved out by moisture, so that their effect is long-continued, and their earthy matter is also probably beneficial, at least to many crops Vegetable manures are often very effective, especially as in the case of ploughing in a green crop, where all the soluble matters are brought into action, and inert vegetable substances may be rendered active by mixture with those which easily putrefy, or with animal matter Some vegetables, such as cabbages and many other cruciform plants approximate to animal matter in their composition, and are proportionately good manures Mineral manures act in two ways either by their causticity, as is the case with quicklime, by which they decompose roots fibres, &c, and render to the growing crop, or they alter the texture of the soil Thus, sand may be called a manure for clayey lands, and clay and loam for those that are sandy Upon the same principle, stiff soils are improved by paring and burning, by which a superficial sandiness is produced, and the texture of the soil rendered more appropriate for vegetation

MANUSCRIPTS (Lat manu scriptum, *written by the hand* ) Literally writings of any kind, whether on paper or any other material in contradistinction to such as are printed Books were generally written upon vellum after the papyrus had ... obsolete, until the ... introduction of paper made from rags, about the 13th century after Christ, and the finest and whitest vellum is generally indicative of great age in a manuscript The dearness of this material gave rise to the practice of using old manuscript books on which the writing had been erased (*see* PALIMPSEST) and also to that of abbreviations These were carried to excess in the 12th century, and from that time until the invention of printing, and for a long period subsequent to that invention abbreviations were still in common use in Greek printing they were usual until within the last fifty years Of Latin MSS those prior to the reign of Charlemagne (A D 800) are considered ancient Manuscripts of the early classical age were written on sheets rolled together *Illuminated manuscripts* are such as are embellished with ornaments, drawings emblematical figures, &c illustrative of the text This practice was introduced at a very early period, for we find the works of Varro Pomponius Atticus, and others adorned by illuminations But ... and prayer book ... colours most employed for this purpose were gold and azure Illuminations were in a high state of perfection between the 5th and 10th centuries, after which they seem to have partaken of the barbarism of the middle ages, which threw their chilling influence over every description of art On the revival of the arts in the 15th and 16th centuries many excellent performances were produced, but the art did not take deep root, and we believe the last specimen of illumination executed in this country was Cardinal Wolsey *Lectionary* at Christ Church, Oxford See CODEX, DIPLOMATICS, PALÆOGRAPHY

MAP (Lat mappa ) A delineation of some portion of the surface of the sphere (terrestrial or celestial) on a plane Terrestrial maps are *geographic* or *hydrographic*, according as they denote a portion of the land or of the sea, the latter, however, are usually called *charts* (See CHART ) A map representing a small extent of country is a terrestrial map is to exhibit the boundaries of countries and the relative positions of their several parts A perfect representation of a country should present all its parts, not only in their true relative positions, but also in their just proportions This may be accurately done on a globe, but as the earth's surface is spherical it is impossible to represent any considerable portion of it on a plane so that the distances of places shall retain the same proportions which they have ... and geographers have accordingly had recourse to various methods ... all of which ... particular cases

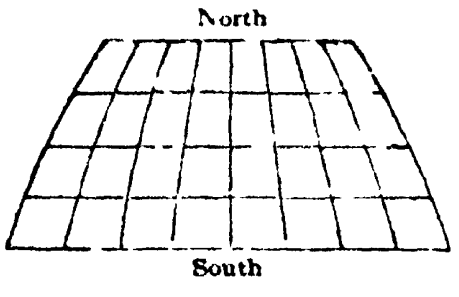
One method ... to represent the points and lines of the sphere according to the rules of perspective, or as they would appear to the eye, having some assigned position relative to the sphere and the plane of representation This method gives rise to the different modes of *projecting* the sphere, of which the three principal are the orthographic, the stereographic, and the central The method of projection answers very well when the surface to be represented is small and the eye is placed perpendicularly over it, but when it embraces a considerable

portion of the sphere, the parts near the extremities of the map are much distorted *See* PROJECTION

A second method is to suppose the surface to be represented to be a portion of the surface of a cone, whose vertex is somewhere in the polar axis produced, and which either touches the sphere at the middle latitude of the surface to be represented or falls within the sphere at the middle latitude and without it at the extreme parallels The conical surface is then supposed to be developed on a plane (which it admits of being); whence this method is called the method of development Of this method there are various modifications as that of Murdoch, who supposes the side of the cone to be parallel to the tangent of the meridian at the middle latitude but to penetrate the surface of the sphere between the middle latitude and the extremities of the projected arc, that of De Lisle, who assumed the cone such as to intersect the sphere in the two parallels equally distant from the extreme and middle latitudes, that of Euler, who placed the apex of the cone at a determinate distance beyond the pole

A third method is to lay down the points on the map according to [illegible] law, the condition to be observed being that [illegible] of the spherical surface to be represented, and their representations on the map, shall be similar in their small elements Of such methods the best known is *Mercator's Chart* (which nowever, may be [illegible] which the meridians are equidistant, parallels and the parallels [illegible] are also straight lines perpendicular to the meridians, but of which the distances from each other increase in going from the equator in such a proportion as always to show the true bearings of places from one another *See* MERCATOR'S CHART

*Celestial Maps* — For the construction of his maps of the stars the astronomer Flamsteed adopted the following method — All the parallels on the sphere are represented by straight lines, and likewise one of the meridians, namely, that which passes through the middle of the map, as in the annexed diagram The parallels which are all perpendicular to this meridian have the same relative lengths as on the sphere and consequently the degrees of longitude are represented in their just proportions, that is are proportional to the cosine of the latitude If therefore the parallels be each divided into the same number of equal parts, a curve line drawn through the points of division will represent the meridians By this method any distance in the direction of the parallels is equal to the corresponding distance on the sphere, but it is evident that the map is much distorted towards the extremities, in consequence of the oblique directions of the meridians Flamsteed's method is sometimes used in geography for representing countries which lie on both sides of the equator in which case the distortion is less A modification of it which consists in substituting arcs of circles for the curved [illegible] whereby their obliquity [illegible] employed in the construction of maps The Society for the Diffusion of Useful Knowledge has adopted the gnomonic projection for laying down their maps of the stars




For details respecting the general construction of maps, we refer the reader to the work of Mr Jameson on the subject, *Malte Brun's Geography*, *Malte Brun's and Balbi's Systems of Geography Abridged*, *Murray's Encyclopedia of Geography*, *De Morgan's Explanation of the Gnomonic Projection of the Sphere*, and particularly the *Traité de Topographie d' Arpentage et de Nivellement* of Puissant

MARANA'THA (Syr) A form of anathematizing among the Jews which was viewed as a tremendous denunciation (See 1 Cor xvi 22) It signifies "the Lord will come," [illegible]

MARANTA'CEÆ Maranta (one of the genera) form the natural order of Endogenous plants, from which the most genuine kind of arrow-root is prepared This substance is the starch contained in the tubers of *Maranta*, *Arundinacea*, and some other species, and of certain kinds of canna *Marantaceæ* are very nearly the same as *Zingiberaceæ*, from which they differ in the flowers being more irregular, and the anther having but one lobe instead of two

MARA'SMUS (Gr *μαραινω*, *I waste away*) Emaciation atrophy

MA'RBLE (Fr marbre) A term limited by mineralogists and geologists to the several varieties of carbonate of lime which have more or less of a granular and crystalline texture In sculpture, the term is applied to several compact or granular kinds of stone susceptible of a very fine polish The varieties of it are extremely numerous The most valuable sorts used by the ancients were the *Pentelican*, which was white, and obtained from Mount Pentiles in Attica; the *Parian*, also called *Marpessian*, obtained from the island of Paros, was of a white colour as was that from Mount Hymettus in Attica Thasus and Teïos also produced white marbles, which were in much repute A place called Luna, in Etruria, produced a marble whose whiteness exceeded that from Paros Of the white marbles were those from Mount Phelleus, from the neighbourhood of Coralios, in Phrygia, from Cyzicus, in Asia Minor, and the Marmor Phrygium, found near Synnada in Phrygia The black marbles most used were from Tænarus, and the Numidian The Chium Marmor, from the island of Chios was of a black transparent chequered colour The Obsidianum, procured from Ethiopia, was black The Proconesian marble was with black veins Mount Taygetes afforded the Marmor Laconicum, which was green, and is better known by the name of Verde Antique A marble of mingled green was obtained from Carystus The Atrician marble, from Mount Atrax in Thessaly, was a mixture of black, white, blue, and green The Tiberian and Augustan marbles were green, and brought from Egypt The Marmor Memphites was green, and is what we call serpentine Corinth produced a yellow marble The Marmor Phengites was white, with yellow spots, the Rhodian was marked with spots of a golden colour and that of Milos yellow In modern times the quarries of Carrara almost supply the world with white marble Of variegated marbles there are many sorts found in this country of singular beauty *See* ELGIN MARBLES see also GEOLOGY

MARCH The first month of the Roman year, and the third of the English In the ecclesiastical calendar used in England till the change of style in 1752 this was also the first month as it was in the Roman It is named Martius in honour of Mars the reputed father of Romulus There is an old proverb still prevalent in Scotland, which represents March as borrowing three days from April, which have thence come to be designated the borrowed days They will be found noticed in the *Complaint of Scotland* Upon this subject Dr Jamieson observes, "Those who are much addicted to superstition will neither borrow nor lend on any of these days If any one would propose to borrow of them, they would consider it as an evidence that the person wished to employ the article for the purpose of witchcraft against the lenders"

MARCH In Music a military air played by inflatile and pulsatile instruments to regulate the steps and to animate the minds of soldiers The march, however, has long been adapted to every species of musical instrument and some of the most celebrated compositions of [illegible], as the March of the [illegible] Peasant's March in Weber's *Freischutz* and above all Beethoven's Funeral Marches In the Supplement to the First Edition of the *Encyclopædia* it is truly said that a march should be always composed in common time with an odd crotchet or quaver at the beginning It is usually quick for ordinary marching and slow for grand occasions, but no general rules can be laid down for its composition

MARCH, in Military Language signifies the motion of a body of troops from one place to another It consists of three measures 1 ordinary time in which about 75 paces are taken in a minute, 2 quick time, in which about 108 steps are taken in a minute, 3 the quickest, or as it is called *wheeling* time, at the rate of 300 feet in the same space

MARCHES The name given to the borders or frontiers of any district, but more especially applied to the boundaries between England and Wales, and England and Scotland The term is derived from an old Anglo-Saxon word signifying a mark, and is to be found in every language of Teutonic descent Several titles of dignity both in this and other countries derive their origin from their possessors having been appointed governors of the *marches* or frontiers of their respective countries, of these marquis [illegible] and markgraf in Germany are the most [illegible] The Earl of March now enjoyed by the Duke of Richmond was originally bestowed on Mortimer, a member of the family so celebrated in English history, because he was the governor or superintendent of the Welch marches In the middle ages the name *marchers* was given to the noblemen who lived on the marches of Wales and Scotland. According to Camden they had once their own laws, and even the "power of life and death like petty kings" but these privileges were abolished by Henry VIII There was formerly a court of the marches of Wales in existence, where pleas of debt, or damages not above the value [illegible] tried and determined

MARCIONITES The followers of Marcion, a heretic of the 2d century, who adopted the Oriental notion of the two contending principles, and imagined that between them there existed a third power, neither wholly good nor evil the Creator of the world and the God of the Jewish dispensation The object of the Good Principle, or Supreme God, is to restrain the ambition of

these two powers, which wage a constant war against each other as well as himself. For this purpose it was that he sent his son Jesus Christ to destroy the Evil Principle on the one hand and to counteract and coerce the power of the Jewish Deity on the other The Marcionites were a branch of the great Gnostic heresy Their opinions are found in the writings of Irenæus, Epiphani[illegible]

M[illegible] of Christians, a branch of the Gnostics who derived their name from an Egyptian called Marcus, and reputed a magician The Marcosians had a great number of apocryphal books which they held to be canonical, and many of their fables are still in use and credit among the Gre[illegible]

MA'RIKANITE is a variety of [illegible], found at Marekan in Siberia in small spherules

MARGA'RIC ACID (Gr *μαργαριτη, a pearl*) The substance into which the margarine, or concrete portion of certain oils, is converted by the action of alkalies It has a pearly lustre, and is insoluble in water, but readily soluble in hot alcohol, which deposits it as the solution cools It fuses at 140°, and reddens betimes It closely resembles stearic acid

MA'RGARINE The solid fatty matter of certain vegetable oils has been thus termed by Lecanu, from its pearly lustre The purest margarine is obtained from the concrete portion of olive oil

MARGARI'FIC ACID A distinctive term applied to one of the fatty acids which result from the saponification of castor oil By the same process this oil also yields the œnic and the elaodic acids

MARGARO'NE When margaric acid is mixed with quicklime and distilled, a peculiar fatty product which crystallizes in pearly scales is obtained, which has been distinguished by the above term from other analogous substances

MA'RGIN (Fr marge) in Printing is the arrangement of the pages in a sheet at proper distances from each other according to the size of the paper, so that when the sheet is printed and folded the border of white paper round them shall be regular and uniform in every leaf of the book

MA'RGIN OF A COURSE In Architecture, that part of the upper side of a course of slates which appears uncovered by the next superior course

MARGI'TES The title of a satirical poem attributed, but with little probability of truth to Homer, it by him is meant the author of the *Iliad* or *Odyssey* The subject of the poem, which has not come down to us was the character of a silly empty-headed m[illegible]

MA'RGRAVE or more properly MARKGRAVE A title of rank formerly used in Germany, and equivalent to the English marquis Both words spring from a common origin See Marquess

MARI'A THERE'SA, ORDER OF A military order of M[illegible] and knights founded in 17[illegible]

MARI'NES A corps of men enlisted to serve as soldiers on board of ships of war in naval engagements and on shore under certain circumstances They sometimes assist, particularly in the British service in performing some naval duties on board of ship The period at which a distinct corps was embodied for this department of the British service is unknown In 1684 mention is made of the Duke of York's maritime regiment of foot and in the reign of Will III several regiments were placed on the establishment these, however, were subsequently disbanded In the beginning of Queen Anne's reign six regiments of marine soldiers were raised, and though these were again disbanded in 1749, six years afterwards 130 companies were raised on the recommendation of Lord Anson consisting in all of above 5000 men Since the commencement of the present century great additions have been made to this corps, and at present its strength amounts to 9000 men The men are clothed and armed in the same manner as the infantry of the line The corps is commanded by a lieutenant-general and a major-general, who are naval officers, holding in addition to their rank as such these military titles there are also four colonels commandants of divisions, besides four colonels and second commandants No commissions in the corps are obtained by purchase, and the officers of marines rise in it by seniority, without however, being able to obtain a higher rank than that of colonels commandant (See *Penny Cyclopædia*)

MARIOTTE'S LAW In Pneumatics, a general property of elastic fluids, first established by Mariotte, namely, that the elasticity or pressure is directly proportional to the density, or, which is the same thing inversely proportional to the space which the fluid occupies See PNEUMATICS

MA'RITIME LAW, signifies the laws relating to harbours, ships, and sailors It forms an important branch of the commercial law of all trading nations, and embraces an infinite variety of subjects, most of which have been defined under their respective heads The most celebrated codes of maritime law have been, in classical times, that of Rhodes; in modern times, the *Consolato del Mare*, a compilation supposed to have been framed at Barcelona as early as the 9th century, the laws of the Isle of Oleron, in the time of Richard I of England, the laws of Wisby in the island of Gothland, to which some northern jurists have assigned an earlier origin than the laws of Oleron, but which there can be little doubt were merely a compilation from those above specified But by far the most complete and well-digested system of maritime jurisprudence that has ever appeared is that comprised in the *Ordonnance de la Marine*, issued by Louis XIV in 1681, by which maritime law was elevated to the rank of a regular system, and has formed the basis of many of the subsequent decisions of English, American, and other [illegible] courts This excellent code was compiled under the direction of M Colbert, by individuals of great talent and learning, after a careful revision of all the ancient sea laws of France and other countries, and upon consultation with the different parliaments, the courts of admiralty, and the chambers of commerce of the different towns It combines whatever experience and the wisdom of ages had shown to be best in the Roman laws, and in the institutions of the modern maritime states of Europe In the preface to his treatise on the *Law of Shipping* Lord Tenterden says, — "If the reader should be offended at the frequent references to this ordinance, I must request him to recollect that those references are made to [illegible] code of a great commercial nation, which [illegible] prosperity to that code a code composed in the reign of a politic prince, under the auspices of a wise and enlightened minister, by laborious and learned persons, who selected the most valuable principles of all the maritime laws then existing, and which, in matter, method, and style, is one of the most finished acts of legislation that ever was promulgated" The ordinance of 1681 was published in 1760, with a detailed and most elaborate commentary by M Valin, in 2 vols 4to *See* ADMIRALTY, COURT OF (See also the *Commercial Dict*)

MARK An old coin current in England and Scotland valued 13*s* 4*d* A piece of money so called is at present used in Hamburgh, it is equal to 1*s* 4*d* sterling

MA'RKET (Mod Lat mercheta, from merx) In Law, the liberty or franchise whereby a town is enabled to set up and open shops, &c, at a certain place within its limits, for buying and selling, and better provision of such victuals as the subject wanteth The establishment of a market, with the grant of the tolls thereunto belonging is one of the king's prerogatives, and can only be effected by virtue of the king's grant, or supported on long and immemorial usage and prescription which presuppose such a grant The general rule of law is that all sales and contracts of any thing vendible in fairs or markets overt (or open) shall not only be good between the parties but valid against all claim by others having any right or property in the subject

MA'RKING INK An indelible ink used for marking linen, it effectively resists washing and almost all chemical agents its basis is oxide of silver, which has a strong affinity for the fibre of linen and cotton, and acquires by exposure a black colour A good marking ink is prepared by dissolving a drachm of fused nitrate of silver in half an ounce of distilled water and colouring it with a little sap green, but a thick gum to thicken it written with upon the unprepared linen, the place to be written upon is commonly prepared for its reception by the previous application of *liquid pounce*, which is made by dissolving two drachms of carbonate of soda and two drachms of gum arabic in four ounces of water this also effectively precipitates the oxide of silver upon the vegetable fibre, and prevents any injury from the corrosive action of the salt of silver A solution of ammonio nitrate of silver, thickened by a little gum, forms a marking ink which may be used without any previous preparation

MARKING NUT, in Botany, is the seed or nut of the *Semicarpus anacardium* a tropical tree, related to the cashew nut It derives its name from the juice contained in its fruits staining linen of a deep and indelible black colour

MARK, ORDER OF SAINT A Venetian order of knighthood, St Mark the Evangelist having been the patron of that republic The knights were elected by the doge and senate

MARL, is composed of carbonate of lime and clay in various proportions, and in different degrees of compactness and friability In some marls the proportion of clay is small, in which case the marl, as a manure, acts on soils much in the same manner as lime, but where clay is the predominant ingredient of marl, it acts on the soil partly as lime, but principally by altering the texture of the soil Hence all sandy soils are improved by marl, in consequence of its increasing their compactness and capacity for retaining moisture, while argillaceous marls applied to clays are of little or no use From these long-established facts has arisen the old adage, —

Who marls sand shall bury land,
Who marls clay throws all away

Marl is found in almost every country; not like limestone, in protruding rocks, but, from its friable nature, which moulders down into a comparatively earthy mass, under or near the surface of the soil, whence it is dug out and spread on the surface Hence, while limestone is quarried, chalk and marl are dug out of pits Marl has been in use in Europe since the time of the Romans it is very generally employed as a manure in France and Germany and in England it is most employed in Norfolk

MA'RLINGSPIKE An iron bolt tapering to a point [illegible]

MARLY MACHINE A celebrated piece of mechanism, one of the most complex perhaps ever constructed, for [illegible] Seine to supply the town of Mar[illegible] and Trianon Its mean produce was from 30,000 to 40,000 gallons per hour, and was attended with an expense of about a farthing for 15 gallons It was erected in 1682 by Runnequin, upon very unscientific principles, but still with considerable skill in its details It was, as such complicated machines always are, often out of repair, and Hachette reports of it that, after 128 years, it fell into total ruin Details of its construction may be seen in Belidor, *Arch Hydraulique*, *Gregory's Mechanics*, vol ii, and other places

MARMORATUM (Lat) In Architecture a cement formed of pounded marble and lime well beaten [illegible]

MARMOT The Rodent animal so called is the type of a genus (*Arctomys*) nearly allied to the squirrels being characterized by having five molar teeth on each side of the upper and four on each side of the lower jaw all bristled with points and indicative of a somewhat mixed diet The marmots however, in their general form are nearly the reverse of the squirrels [illegible] heavy, with short legs, a middle-sized or [illegible] and large flat head They pass the winter in a state of torpor, concealed in deep holes, the entrance of which they close with a heap of dried grass They are natives of Europe and North America live in societies, and are easily tamed

MA'RONITES The followers of Maro inhabitants of the mountains Libanus and Antilibanus in Syria who adopted in the 7th century the opinions of the Monothelites, they continued to form a separate sect until the 12th century, when they became reconciled to the see of Rome The Maronite writers, however have always maintained their freedom from the errors imputed to them, and declare themselves to have been uniformly attached to the doctrines of the Catholic church (See MONOTHELITES (*Mosheim*, transl ed 1790 ii 1 6)

MAROO'NS (Supposed to be derived from a word used in Spanish America, signifying *hog-hunters*) A name given in Jamaica to runaway negroes When Jamaica was conquered from the Spaniards a number of negroes, abandoned by their former masters occupied some of the mountainous parts of the island and caused great trouble to the colonists About 1730 they became extremely formidable, but after a war of eight years at length submitted to a capitulation by which they were allowed to retain their free settlements in the heart of the island, in 1795 a portion of them again rose in arms but were speedily put down, and transported to a new settlement in Nova Scotia (See *Dallas's History of the Maroons*)

MARQUE, LETTER OF [illegible] time of war to a private person [illegible] cruise at sea and make prize of the enemy's ships and merchandise the ship so commissioned is sometimes called by the same name (See REPRISALS, LETTER OF) The word is derived from mark (Germ *frontier*) as being a right of capturing property beyond the limits or frontiers of another prince

MA'RQUESS (Germ mark *a limit* or *frontier*) A title of dignity in England, France, and Italy next in rank to that of duke It is of German origin, those military chieftains in the Teutonic kingdoms and empires which arose on the fall of the Western empire who were entrusted with the defence of districts on the frontiers, having been styled mark-grafen, counts of the marches or frontiers (in Latin, marchiones) Many of these officers were appointed by Charlemagne, although he was not probably the first creator of the office According to the ordinary course of the development of feudal institutions, these chiefs, from military governors appointed for life, became territorial potentates, holding their lands by hereditary right, and, on the decay of that system, this honour, like others, became merely titular In England, the first marquess was Robert de Vere, Earl of Oxford, created by Richard II, in 1387, Marquess of Dublin for life The next creation was of John de Beaufort, Earl of Somerset, raised to the rank of marquess in 1397, which dignity he afterwards refused to bear, as a strange and novel one (See Nicolas, *Introduction to the Peerage*, lxxvi) After that period the title [illegible] until the reign of Edward VI

MARQUETRY (Fr marquetrie) In Architecture, inlaid work consisting of different pieces of divers coloured woods of small thickness glued on to a ground usually of oak or fir, well dried and seasoned, which, to [illegible] is composed of several thick [illegible] builders used it in cabinet work, and John of Vienna and others of his period by it means represented figures and landscapes, but in the present day it is chiefly confined in its use to floors, in which the various pieces of wood are usually disposed in regular geometrical figures, and are rarely of more than three or four species

MA'RRIAGE LAW OF Marriage, in its legal sense is a civil contract binding parties to certain reciprocal obligations, and the general principle of law respecting this, as well as other contracts, is, that it is to be held valid according to the usage of the country wherein it is made Thus a marriage between English subjects in Scotland according to the formalities of Scottish law is binding, and the children of such parents are legitimate in England A marriage between English subjects in France according to the ceremonies in the church of England would not be valid, according to the principles of general law unless registered before the civil magistrate according to the provisions of the French code But, by the statute 4 G 4 c 91 marriages between English subjects, solemnized abroad by ministers of the church of England in the chapel of a British ambassador or British factory are valid in the United Kingdom

Previous to the passing of the first Marriage Act in 1754 the law of England was governed by the canon law and consequently, an agreement to marry, followed by consummation, formed as it now forms in Scotland, a sufficient union That statute first rendered necessary the preliminaries of the publication of banns, or the obtaining a licence It was amended by 4 G 4 c 17 But that act imposed so many additional restrictions on parties wishing to become husband and wife that it was found necessary to repeal it in all haste, and another statute was passed (4 G 4 c 76), by which English marriages were next regulated

By this act the banns of marriage are to be published three Sundays in a parish church or public chapel of the establishment in the parish wherein both or the parish wherein each, of the parties dwell A licence is a dispensation by virtue of which marriage may be solemnized without the publication of banns It is granted by [illegible] persons having authority from the bishop [illegible] cannot now be obtained unless upon affidavit that the parish or district in which the marriage is to be solemnized has been the usual place of residence of one of the parties for fifteen days immediately preceding the granting of the licence The affidavit must also declare that there is no impediment of kindred or alliance nor any other lawful cause of hinderance

By the last marriage act, 6 & 7 W 4 c 85, a superintendant registrar of marriages was appointed, who is required to register marriages, and empowered to give licences &c either himself, or by inferior registrars Places of worship, certified according to law, may be registered for the solemnization of marriages, or they may be celebrated before the superintendant registrar himself thus entirely removing the contract from ecclesiastical control But all parties may, if they please, still marry in the parish church An extensive registration [illegible] provided by the same act

A special [illegible] with all restrictions as to time and place of marriage By a regulation of Archbishop Secker it is not to be granted except to persons of a specified rank, but in practice the privilege is extended as a matter of favour

The power of parents and guardians, in restricting the [illegible] of their minor [illegible], is now confined [illegible] the following [illegible] The publication of banns is void, if the parent or guardian of either party declare, or cause to be declared, their dissent in public at the time of the proclamation In case of marriage of a minor by licence, the father or guardian, or if none, the mother or the guardian appointed by the court of chancery, must give consent, and such consent must be notified in the affidavit on application for the licence. If consent be unreasonably withheld, the only resource of lovers against the flinty hearts of parents or guardians is by petition to the lord chancellor, who may, if he pleases, interpose his judicial authority in favour of their union

Marriages are void if solemnized in a wrong name They are also void where there is a prior existing marriage, and in case of lunac[illegible]

Proof of a marriage is [illegible] a party who was present at the celebration, or by production of the parish register, and showing the identity of the parties

The ecclesiastical courts have the direct cognizance of questions respecting [illegible] but as the common law courts [illegible] operty, and others in which the fact of marriage may be incidentally called in question, they can require proof of it without resorting to the assistance of the former

Marriage is voidable by suit in the ecclesiastical court, where such marriage has been contracted under a ca-

nonical impediment, namely, consanguinity or affinity, or bodily incapacity of either of the parties Marriages solemnized by force are also voidable, and such as are contracted in error under certain circumstances A voidable marriage is good to all intents until rendered void by a sentence of the court

Other matrimonial causes in these courts are—1 Jactitation of marriage When one party gives out or reports that he or she is married to another, the party is [illegible] (see Ecclesiastical Courts, under the head of Law) in the spiritual court, and unless the defendant proves marriage, silence is enjoined, which is the only remedy the spiritual court can give

1 Adultery, as a public crime, is left to the cognizance of the spiritual courts as a civil injury, it is pursued by the husband in an action of trespass for damages against the adulterer in those of common law

2 In suits on the ground of adultery in the spiritual court the remedy prayed is a separation or divorce *à mensa et thoro*, from bed and board And it may be obtained by either party, but will be refused in case the other party recriminates and mutual unfaithfulness is proved, or in case other circumstances are shown which, in the opinion of the court, disentitle the complainant to the remedy he prays for

A divorce *à vinculo matrimonii*, that is, the annulment of marriage, can only be conferred by act of parliament Evidence must be given on applying for the bill that there was judgment for the plaintiff on an action for damages against the seducer, or sufficient cause shown why such action was not brought or such judgment obtained

3 Another ground on which the spiritual courts will grant a separation is cruelty, but the cruelty for which such relief can be granted is only such as directly endangers the life or health of the injured party

4 A suit for restitution of conjugal rights is to compel mutual cohabitation And no deed of separation or mutual agreement, nothing short of a sentence by the court, can bar the complainant of his or her right to promote this suit, but cruelty or adultery may be pleaded in reply as constituting lawful grounds for separation

5 Alimony is that legal proportion of the husband's estate which by the decree of the ecclesiastical court, is allotted to the wife for her maintenance during the pendency of a suit between them, or after a sentence of divorce *à mensa et thoro* by reason of the cruelty or adultery of the husband, the permanent allowance to be paid to the wife during their separation The quantum of alimony is decided by the court on a statement of the husband's property (called *an allegation of facultics*) and his answer thereto

*Marriage, its Effect on Property* — The consideration of the legal effect produced by marriage on the property of the parties [illegible] relates to —

1 The [illegible] wife, as it respects property acquired by either before marriage

2 As it respects property acquired by either after marriage

3 As its dispositions are affected by separation or divorce

(1, 2) As to real property If the wife is seised of lands or tenements in an estate of inheritance and dies having had issue born living the husband is entitled to the lands or tenements for his life, being tenant as it is termed by the courtesy of England and this, whether the lands be held by a legal or equitable title

Dower is now, since the statute 3 & 4 W 4 c 115, the wife's right to one third part, for life of all estates of inheritance which her husband dies entitled to or seised of in possession It formerly attached to all estates of inheritance of which he was at any time possessed, so that he could not defeat her title by alienation but to legal estates only Since the 1st January 1834, the period on which the above-mentioned act came into operation equitable estates are also subject to it It has long been customary to bar this right to dower by various complicated processes, which the law has permitted to defeat the wife's claim, and especially by settlements before marriage, giving a jointure or provision in lieu of dower It may now be barred by the husband's alienation in his lifetime, or by his will, or by a declaration in the deed of conveyance of the land to the husband Anciently a *feme covert* could only alienate real property by the public solemnity of a *fine*, now, by a deed executed after her examination by commissioners, to show that no control is exercised by the husband

All the *personal* property to which a woman is entitled vests in her husband by marriage Her *chattels real*, that is, leasehold property for a term of years, will revert to her if she survive him, and although the husband may alienate them in his lifetime, he cannot dispose of them by will But should he survive her, they are his absolutely Her *chattels personal* — money and goods — are his without restriction, to give or bequeath as he pleases even in her lifetime Her *choses in action* (that is, property of which there is no immediate occupation, as debts due to her, money in the funds, &c) are the husband's property *conditionally*, that is, if he reduce them into possession by exercising his rights over them during her life If not they survive to her absolutely, and should she die first, he only takes them as her administrator, which he is by right

If the husband die intestate, the wife is entitled to half his personal property if there be no issue, and to one third if there be issue

The husband is liable for all his wife's debts and engagements made while unmarried, but not for such as she may have contracted during a former marriage But he is relieved from all debts by her decease, and if he die first, she only is responsible For debts contracted by the wife during marriage the husband is not liable unless they have been contracted with his consent, express or implied, and this implied assent gives rise, as may well be supposed, to numberless questions in courts of law

As to the acts of husband and wife before marriage — The will of a bachelor or widower not having children is revoked by his subsequent marriage and birth of issue A warrant of attorney given by an unmarried woman is revoked by her marriage So is her will, in every case, but there are others of her acts — such as the grant of a lease at will — which are not revoked, but merely revocable

Settlements or articles, made in contemplation of marriage, are contrivances to modify the effects which would be produced by the mere act of law on the rights of the respective parties, and also to ensure an alienable provision for issue It is usual to vest the property of both parties in trustees, generally for the benefit of the husband during their joint lives, then for the benefit of the survivor, after his or her death for the benefit of the children, in such proportions as the nature of the property or circumstances of the family may dictate But it is usual to give authority to the parents by means of a *power* to vary these relative proportions A jointure, although, in the strict sense of the word a joint estate to husband and wife, is in practice a separate estate to the wife in lands and tenements, to take effect immediately on the husband's death and to secure a competent provision for her during her life at least it is usually provided by settlement, and bars dower Pin-money is an annual income settled [illegible] before marriage by the husband on the intended wife, usually by means of trustees

But in other cases, and especially when the casualties of a trade render it desirable to secure a certain protection the wife is provided for in the settlements by vesting her own property, or a portion of it, in trustees for her sole and separate use In this case the sums so secured are wholly independent of her husband's control Where bequests are made to a married woman for her separate use and no trustees are named to protect them a court of equity will consider her husband a trustee for her She may sue him, or any other person, in those courts, in respect of such property Her savings out of it are likewise hers in separate right But savings made by a wife out of an allowance for her private expenditure are not in every case her separate property

A married woman has also a claim, in a court of equity, to a provision out of her own property in several cases, especially where the husband deserts or ill-treats her, or where being a ward of chancery, she is clandestinely married

(3) On a divorce *a vinculo matrimonii* dower is gone and if such divorce be on account of pre-contract consanguinity or affinity the children are illegitimate and the wife's property is restored to her But a divorce *a mensa et thoro* does not bastardize the children or bar dower

Adultery during a voluntary separation entitles the aggrieved party to a divorce *a mensa et thoro* as much as during cohabitation, and frees the husband from all debts of his wife or claims by reason of her

A husband is not held liable for debts contracted by his wife, even for necessaries, if he have turned her out of doors for adultery, or if after being turned out, she commit adultery, or if she depart from him without his consent, or if she elope with an adulterer, or if the husband and wife separate by mutual agreement In cases where the wife has separate means, or is provided for by separate maintenance

Bigamy or polygamy, is a felonious offence, punishable by transportation for seven years, and is now (since the statute 9 G 4 c 31) equally punishable, although the second marriage took place out of the jurisdiction of English law

A wife committing any felony except murder or manslaughter [illegible] with her husband is not responsible for the offence but she is indictable for high treason so committed

In both civil and criminal cases (with the exception of treason), husband and wife are not allowed, except under particular circumstances, to give evidence for or against each other

**MARS** In the Solar System, one of the old planets, and the fourth in the order of distance from the sun The mean distance of Mars from the sun is 1 5236923, the mean distance of the earth from the sun being 1 it is, consequently, about 142,000,000 of miles Mars performs his mean sidereal revolution in 686 '7964458 mean solar days, and his synodical revolution (that is, returns to the same position in respect of the earth and sun) in 779 936 days His orbit, at the beginning of the present century was inclined to the ecliptic in an angle of 1° 51′ 6″, and its eccentricity is 093307, half the major axis being unit His apparent diameter varies from 3 6″ at his greatest, to 18 28″ at his least distance from the earth At his mean distance the apparent diameter is 6 29″, whence the true diameter is found equal to 517, that of the earth being unit, or about 4108 miles Mars has a rotation about his axis which is performed in 24 h 39 m 21 sec The inclination of the axis to the ecliptic is 58° 18′ When the opposition of Mars takes place at the time he is near the aphelion of his orbit he is then at his least distance from the earth, and presents an interesting appearance when seen [illegible] 'In this planet," says Sir [illegible] with perfect distinctness, the outlines of what may be continents and seas Of these the former are distinguished by that ruddy colour which characterizes the light of this planet which always appears reddish and indicates, no doubt an ochreous hue in the general soil like what the red sandstone districts of our own country may possibly offer to the inhabitants of Mars, only more decided Contrasted with this (by a general law in optics) the seas, as we may call them, appear greenish These spots, however, are not always to be seen equally distinct, though, when seen, they offer always the same appearance This may arise from the planet not being entirely destitute of atmosphere and clouds, and what adds greatly to the probability of this is the appearance of brilliant white spots at its poles which have been conjectured, with a great deal of probability, to be snow, as they disappear when they have been long exposed to the sun, and are greatest when just emerging from the long night of their polar winter" (*Astronomy, Cab Cyc*) *See* PLANET

**MARS, or MAVORS** The Latin names of the deity called by the Greeks Ares He was fabled to be the son of Juno, conceived by means of the virtue of a certain plant, and was worshipped as the God of War At Rome he was honoured as the progenitor of Romulus the founder of the city, of which he was held to be the protector, and it was to the honour of this divinity that the Latin husbandmen used to offer up a peculiar sacrifice, called *suovetaurilia* which as the derivation of the word implies, consisted of a pig a sheep and a bull The priests of Mars were called *salii* and to their care was intrusted the sacred shield (*ancile*) which was said to have fallen from heaven during the reign of Numa *See* SALII, ANCILE

**MARSEILLAISE HYMN** The name popularly [illegible] even to the national anthem of the French The origin of this song which has played so important a part in the revolutions not only of France but of other continental states was long involved in obscurity, and we scarcely think it will be considered out of place to embody in our pages the following statement [illegible] which may be relied on as authentic

The Marseillaise Hymn was the production of Rouget de Lille, a French officer of engineers, who was quartered at Strasburg in the year 1791, when Marshal Luckner commanded the army, at that time entirely composed of young conscripts The marshal was to march the following morning of a certain day, and, late in the evening previous, he inquired if there were any men of a musical or poetical genius in the army who could compose a *soul-inspiring* song to animate his young soldiers Some one mentioned Captain Rouget de Lille who was immediately ordered into the presence of the marshal to receive his commands on the subject, which having been given, and a promise made by De Lille that a song would be ready the following morning he went to his quarters, and during the night he not only wrote the song in question, but also set it to music, and next morning the army marched to its tune, and carried every thing before it with an enthusiasm only to be equalled by absolute frenzy

The song is said to have been styled the *Marseillaise Hymn* from a body of troops, on their march from Marseilles, having entered Paris playing that tune at a time when it was little known in the capital The *original* of the *Marseillaise* is said to be in the possession of the family of Louis Philippe

**MARSH.** A flat surface, the soil of which is so far saturated with water throughout the year as to be unfit for culture by the spade or plough, but not so much as to prevent it from producing coarse grasses, and other kinds of herbage Marshes are generally situated in bottoms, where they are kept moist by the water which descends from the surrounding lands, or along the banks of rivers or lakes, [illegible] being nearly on the [illegible] Where a marsh is situated so as to be occasionally overflowed by the sea, or by a river up which the tide flows it is called a salt marsh; and the herbage produced by such lands is found highly conducive to the health of animals which pasture on them for a certain portion of the year, from the alterative effect of its saline properties

**MA'RSHAL** A title of honour in many European countries, applied [illegible] derivation of [illegible] uncertain The [illegible] hereditary in the family of the Dukes of Norfolk William Fitz-Osborn and Roger de Montgomery are said to have been marshals to William the Conqueror their successors for some time are not accurately known, but the office was held in 1138, in fee, by the family of Clare and thence descended to the Earls of Pembroke, and thence to Roger de Bigod, Earl of Norfolk, who surrendered it to Edward I After being granted for life and during pleasure, to several successive marshals, the dignity, with the title of Earl Marshal, was given to Mowbray, afterwards Duke of Norfolk, in whose family the dignity subsisted until it reverted to the crown in the reign of Edward IV Richard III granted it to his favourite, Howard, Duke of Norfolk, after whose death and attainder it passed through many hands, but was by Charles I granted for life to his descendant, Thomas Howard Earl of Arundel, and finally his grandson Henry Howard Earl of Norwich, was constituted hereditary earl marshal of England in 1672, with remainder to the issue male of the Earl of Arundel aforesaid, in which latter line it now subsists The earl marshal is eighth in rank among the great officers of state in England He has the same jurisdiction over the court of chivalry which was formerly exercised by the constable and marshal jointly

*Marshal of the King's Household or Knight Marshal* – An officer whose office is said to be to hear and determine pleas of the crown and suits between those of the king's household and other persons within the verge The marshal of the King's Bench has the custody of the King's Bench prison in Southwark

*Marshal of France* is the highest military rank in the French army This officer appears first in history under the reign of Philip Augustus as commander-in-chief of the royal armies The number of marshals was increased by several successive sovereigns in the reign of Henry IV the states of Blois limited it to four, but this restriction was not observed, and, in the reign of Louis XIV there were at one period no less than twenty In the same reign officers of the navy as well as the army received the rank of marshal The marshals bore two batons or marshal's staffs — azure semé of fleur de lys or saltier wise — as the token of their dignity After the deposition of Louis XVI the dignity of marshal ceased but was revived by Napoleon, with the title of Marshal of the Empire

**MA'RSHALLING** In Heraldry the arrangement and distribution of coats in a shield so as to denote the several matches and alliances of the family *See* BLAZONRY

**MA'RSHALSEA** In Law, the court or seat of a marshal The King's Bench prison in Southwark, is said to be so called because the marshal of the king's house was wont to sit there or to keep his prison The Marshalsea or Knight-marshal's Court, commonly called the Palace Court was created by Charles I, and had jurisdiction of personal actions within a circuit of twelve miles round Whitehall, but it was abolished in 1849

**MARSH MIASMA** The infectious vapours which rise from certain marshes and marshy soils, and which tend to the production of intermittent and remittent fevers

**MARSU'PIALS** *Marsupialia*, or *Marsupiata* (Lat. marsupium, *a pouch*) An order of Implacental Mammiferous quadrupeds, of which the females have a portion of the abdominal integument folded inwards, forming either a depression containing the mammæ, or a pouch serving also as a temporary abode for the young, and the males have a corresponding portion of the abdominal integument extended outwards, forming a scrotum or pedunculate bag for the testes In both sexes two supplementary trochlear bones are developed in the internal pillars of the abdominal rings, and are articulated to the anterior part of the brim of the pelvis, around which bones plays the [illegible] testes in the [illegible] the trochlear ossicles, from [illegible] these muscles with the [illegible]"

The quadrupeds associated together by the common [illegible] characters above defined so far [illegible] that a placenta is not [illegible] of the fœtus contracts no adhesion with the parietes of the uterus The fœtus is prematurely born after a gestation of only thirty-eigh

days in the great kangaroo, in which it does not exceed an inch in length. It is then received into the pouch, and adheres to the nipple for [illegible] pouch. The generative organs [illegible] and [illegible] striking peculiarities common to all [illegible] by which they differ from the ordinary [illegible]. Cuvier accordingly, in 1816, separated the marsupial from the other unguiculate quadrupeds, to form a distinct group, which he describes as forming with the Monotremes a small collateral chain, all the genera of which, while they are connected together by the peculiarities of the generative system, at the same time correspond in their dentition and diet, some to the Carnivora, others to the Rodentia, and a third tribe to the Insectivora. M. de Blainville, in the Tables of the Animal Kingdom which he published in the same year, 1816, constituted a distinct subclass of Cuvier's "small collateral chain" of mammals, and gave to the subclass the name of *Didelphe* [illegible] *Metatheles*, by which he distinguished the Placental Mammalia.

Many acute and sound-thinking naturalists refused their assent to these views, which, as they were supported by a knowledge of the conformity of organization of only the generative system in the Marsupials, were unquestionably defective in the evidence essential to enforce conviction. The best argument for returning to the older views of classification and for distributing the marsupial genera, according to the affinities indicated by their dental and [illegible] among the different orders of the [illegible] were advanced by Mr Bennett, the accomplished author of *The Gardens and Menagerie of the Zoological Society delineated* (vol. i. p. 265), and these have been repeated with approbation [illegible] later classificators, as Mr Swainson. [illegible] of the true affinities of the Marsupialia could only flow from an [illegible] organization, and the question [illegible] proposes with reference to the genus *Phascolomys*. What is there of importance in the structure of the wombat except this solitary character of the marsupium to separate it from the Rodent order?"—a question which he might in 1831, have asked with equal force in reference to any other marsupial genus—could only be answered satisfactorily by the anatomist who had submitted the Marsupialia in question to a thorough dissection.

Although the Marsupials present modifications of the dental system corresponding with the carnivorous, omnivorous, and herbivorous types, yet they agree with each other and differ from the analogous Placental Mammalia in having four instead of three true molars, or four molars which are not displaced and succeeded by others, in the vertical direction.

In the locomotive organs it is true that we see some of the Marsupials [illegible] like the Placental Quadrumana [illegible] with falculate claws, like the Placental Feræ, a third, as the wombat, has the feet adapted for burrowing, a fourth, like the Cheiromeles, is aquatic, and has webbed feet, yet all these Marsupials agree with each other in having a rotatory movement of the hind foot, analogous to the pronation and supination, which, in the placental quadrupeds, are limited, when enjoyed at all, to the fore feet, and they manifest moreover a peculiar modification of the muscles of the [illegible] in relation to these rotatory movements. In those Marsupials as the kangaroos, potoroos, and perameles, in which the offices of support and locomotion are devolved exclusively or in great part upon the hind legs, these are strengthened at the expense of the loss of the rotatory movements of the feet, but in the enormous development of the two outer toes, and the conversion of the two inner ones into unguiculate appendages useful only in [illegible] the fur, these Marsupials differ from all Placentals, whilst the same peculiar condition of the toes may be [illegible] Pedimanous group of Marsupials [illegible] organs notwithstanding their adaptation to different kinds of progression, testify to the unity of the marsupial group in the two remarkable peculiarities of structure above cited.

The vascular system gives evidence to the same effect. All the Marsupials present the following peculiarities in the structure of the heart, viz. the right auricle manifests no trace of either *fossa ovalis* or *annulus ovalis*, and receives the two *venæ cavæ superiores* by two separate [illegible] r, less urgent in [illegible] because the modification, as regards the separate entry of the superior *venæ cavæ* obtains in a few placental species, as the elephant and certain Rodents, but as the first-cited cardiac character is common and peculiar to the Marsupial Mammalia, and as the second, while it is universal in the Marsupials, occurs only as an exceptional condition in the placental series, the arguments which they afford to the unity of the marsupial group cannot be overlooked in a philosophical consideration of the affinities of the Mammalia.

With respect to the nervous system, it has been shown that, in the structure of the brain, the Marsupialia exhibit a close correspondence with the Ovipara in the rudimental state of the *corpus callosum*; the difference which the most closely analogous placental species offer in this respect is broadly marked (*Owen on the Brain of the Marsupial Animals, Phil. Trans.* 1837, p. 89, pl. vi.).

These coincidences in the Marsupialia of important organic modifications of the dental, locomotive, vascular, cerebral, and reproductive systems, establish the fact that they constitute a natural group, inferior, on the whole, in organization to the Placental Mammalia.

The following is a tabular view of the subordinate divisions of the Marsupialia regarded as an order of the Implacental subclass of Mammalia:—

*Classification of the Marsupialia*

| Tribes | Families | Genera | Subgenera. |
|---|---|---|---|
| **Sarcophaga** | | | |
| Three kinds of teeth, canines long in both jaws, a simple stomach, no *intestinum cæcum* | *Dasyuridæ* - | Thylacinus<br>Dasyurus<br>Phascogale | |
| Extinct transitional forms - - - - - - | | Phascolotherium<br>Thylacotherium | Fossil |
| **Entomophaga** | | | |
| Three kinds of teeth in both jaws, a simple stomach, a moderately long *intestinum cæcum* | *Ambulatoria* - | Myrmecobius | |
| | *Saltatoria* - | Charopus<br>Perameles | |
| | *Scansoria* - | Didelphys - - | Didelphys<br>Cheironectes |
| **Sarcophaga** | | | |
| Anterior incisors large and long in both jaws, canines inconstant, stomach simple or with a special gland, a very long *intestinum cæcum* | *Phalangistidæ* - | Phalangista - - | Cuscus<br>Pseudocheirus<br>Tapoa |
| | | Petaurus - - | Petaurista<br>Belidia<br>Acrobata |
| | *Phascolarctidæ* - | Phascolarctus | |
| **Poephaga** | | | |
| Anterior incisors large and long in both jaws, canines present in the upper jaw only, or wanting, a complex stomach, a long *intestinum cæcum* | *Macropodidæ* - | Hypsiprymnus<br>Macropus | |
| **Rhizophaga** | | | |
| Two scalpriform incisors in both jaws, no canines, stomach with a special gland, *cæcum* short, wide, with a vermiform appendage | *Phascolomyidæ* | Phascolomys<br>Diprotodon - | Fossil |

MART. *See* Fair and Market.

MARTELLO TOWERS. The name given to the [illegible] were erected along [illegible] B[illegible] at the commencement of the present century, intended as a defence against the meditated invasion of Napoleon. The [illegible] is usually supposed to be derived from [illegible] (Myrtle) Bay, Corsica, which, after a determined resistance, was at last captured by the British in 1794. These towers were provided with vaulted roofs, and consisted of two stories,—the lower for the reception of stores, the upper, which was shell-proof for the casement of troops, and the wall of the building terminated in a parapet, which secured the men in working the pieces of artillery,

which besides were constructed on moving pivots, so as to be fired in any direction In most places of England these towers have been dismantled, those that remain either serve as stations for the use of the coast blockade force, or, like that near Leith, are not employed for any purpose

MARTINE'T A cant phrase for a severe military disciplinarian probably derived from a certain Colonel Martinet, who served in the French army under Louis XIV, who was the inventor of a peculiar whip, called by his name for the purpose of [illegible] and also (if Voltaire may be believed) [illegible]

MARTINGALE In Naval affairs, a rope leading downwards from the jib-boom end, to keep the jib-boom down against the force of the sail and stay In the manége, martingale is applied to a thong of leather fastened at the end of the girths under the belly of a horse, and at the other end to the musrol, passing between the legs to keep him from rearing

MARTLET In Heraldry, a fanciful bird, shaped like a martin or swallow, but depicted with short tufts of feathers in the place of legs It is the difference or distinction of a fourth son

MA'RTYR (Gr *μαρτυς*, or *μαρτυς witness* in which sense the word is used by the writers of the N Test when speaking of the apostles, in reference to the testimony they bore to the resurrection of Christ) When the members of the Christian church were subjected to persecution under the Roman emperors the persons accused were questioned as to their belief, and in undergoing punishments and death, were said to bear witness of their master before the world A distinction was also made between those who, although they boldly asserted their belief, were yet not visited with extreme punishment who were designated under the name of *confessors*, and those who actually suffered death who alone were dignified with the title of martyrs, and said to obtain the crown of martyrdom Martyr, in its ordinary signification, denotes a person who suffers death or persecution on account of his belief (See *Mosheim's Eccl History* (transl), ed 1790, i 77, *Giesler* (transl), c 8 14 71 &c As to the numbers of martyrs, *Ib* 109 162)

MARTYROLOGY (Gr *μαρτυς* and *λογος a description*) The name given to that department of ecclesiastical history which relates to the acts and deaths of martyrs It also signifies a calendar or register kept in religious houses, wherein were inserted the names and donations of their benefactors and the days of their death As specimens of this species of works we may mention the *Martyrology* of Eusebius, which was so celebrated in the early church but which is lost, and *Fox's Book of Martyrs* the most valuable record of the sufferings of the English reformers Many of the accounts in the early martyrologies are purely fabulous See *Ruinart's Acta Martyrum*, Baronii *Martyrologium Romanum*, and *Middleton's Free Inquiry* Gallonius *De Sanctorum Martyrum Cruciatibus*, 1598 and subsequent editions is a book of [illegible] popularity on the Continent

MASCAGNIN [illegible] of the native sulphate of ammonia o[illegible], named after Mascagni who first discovered it

MA'SCLE In Heraldry, a bearing in the form of a lozenge perforated, supposed to represent the meshes of a net

MA'SONRY (Fr) The science of combining and joining stones for the formation of walls and other parts in constructing buildings The science when applied in the construction of domes, groins, and circular arches, is difficult and complicated, depending on a thorough knowledge of descriptive geometry Hence the various methods of obtaining the requisite lines for the artificer would require a space and diagrams which cannot be given here, but the reader who desires acquaintance with that part of the subject may consult Rondelet *Traité Théorique et Pratique de l'Art de Batir* Paris 1829 30, 4to, with the certainty of finding all the information he requires Vitruvius mentions several kinds of masonry among the ancients, which were distinguished from a [illegible] different modes of arranging the stones [illegible] are 1 The *Reticulatum*, which is arranged in diagonal courses, like the meshes of a net, whence its name 2 The *Incertum*, wherein the rising courses are so laid, without any certain size of stones as that the vertical joint above always falls over the middle of the joint below The appearance of this work is not perhaps so pleasing as that of the first, but the work itself is stronger 3 The *Isodomum*, in which all the courses are of equal height, as its name imports 4 The *Pseudisodomum* which received its name from the [illegible] in height 5 The *Emplecton* in [illegible] work were wrought and the centre of the wall filled up with rubble work in which species of work the Greeks employed *diatoni* or bond stones, running in one piece through the thickness of the wall to tie it together The first principles to be attended to in building stone walls are, that the vertical joints in any course should not fall over the vertical joints in the course immediately below it; and that where the thickness of the wall consists of two or more pieces of stone, bond stones or blocks which run through the whole wall transversely, if possible in one piece, should be introduced as frequently as possible for the purpose of binding the whole mass together The different species of masonry in present use may be reduced to four — 1 *Bond masonry* wherein the stones of each succeeding course are laid so that the joint that mounts and separates two stones always falls directly over the middle of the stone below 2 That of *brickwork*, where the bodies and projections of the stones enclose square spaces or parts &c formed with bricks 3 That called by the French *de moilon*, or small work, wherein the courses are equal, well squared, and their edges or beds rusticated 4 That wherein the courses are unequal, and filled up in the middle with small stones and mortar

MASONRY *See* FREEMASONRY

MASQUE, or MASK A species of drama It originated from the custom in processions, and other solemn occasions, of introducing personages in masks to represent imaginary characters Many of these characters, even in the religious shows of Italy, &c, were of a grotesque description, and the performance often intermixed with dancing and buffoonery By degrees in England, something of a dramatic character was added to these exhibitions At first, as in the well-known progresses of Queen Elizabeth monologues or dialogues in verse were put into the mouths of the masked performers, and in the reign of James I, they had ripened into regular dramatic performances sometimes as in the *Tempest* of Shakspeare, introduced by way of interlude in regular plays, at other times acted as separate pieces, with much machinery and decoration Ben Jonson was the first, and indeed almost the only classical English writer (with the exception of Milton in the solitary and noble specimen of *Comus*) who devoted much labour and taste to this department of the drama His masques were represented at court the queen of James I, and after her the accomplished Queen Henrietta Maria did not disdain to take part at least as silent dramatis personæ, in some of these pageants The taste for them died away in the reign of Charles I, and after the interruption given to the progress of dramatic art and literature by the civil wars, they were not again brought into fashion

MASQUERADE (Ital mascherata) An amusement practised in almost every civilized country of modern times consisting of a ball and other festivities, in which only those who are masked or disguised can participate This species of amusement had its origin in Italy where according to *Hall's Chronicle*, they had become fashionable so early as the beginning of the 16th century Of its introduction into England Hall thus speaks — On the date of the Epiphaine, at night (A D 1512-13) the king (Henry VIII with xii others were disguised after the manner of Italy called a maske a thing not seen afore in England, they were apareled in garmentes long and brode wrought all with golde, with visers and cappes of golde, and after the banket doen, these maskers came in with the six gentlemen disguised in silke (in all probability the *domino* of more recent times), "baryngе staffe torches, and desired the ladies to daunce some were content, and some that knew the fashion [illegible] commonly seen [illegible] daunced together as the fashion of the maskes is, thei toke their leave and departed and so did the quene and all the ladies" The invention of masquerades is ascribed to Granacci, who died in 1543

MASS (Lat missa) The name by which the Roman Catholics designate the celebration of the Lord's Supper after the forms of their church The term is derived from the phrase "Ite, missa est, concio" (i e *Go, the assembly is dissolved*), by which the priest in the primitive ages, signified to the catechumens that all that part of the service of the church was concluded which it was allowed to all believers indiscriminately to attend The communion of the eucharist was extended only to the [illegible] the *fideles* who had completed the period [illegible] instruction and, after the pronunciation of these words, the offering of the body and blood was made It was to this offering itself that the term missa [illegible] The service of the mass, as it is still [illegible] throughout Catholic countries, was the work of Gregory I in the 6th century It consists of three parts the offertorium, or offering of the elements upon the altar, the consecration, by which they are supposed to undergo the transubstantiation into the real body and blood of Christ, and the sumption, or actual participation in them by the communicants These ceremonies are accompanied by the recitation of various prayers, and the priests go through numerous evolutions which are supposed to represent the circumstances attending the passion of our Lord High mass is the performance of this service accompanied with music

MASS (Germ masse) The quantity of matter of which any body is composed The mass is directly as

the product of the volume of the body into its density The mass multiplied into the constant force of gravity constitutes the weight, and hence the mass of any body is rightly estimated by its weight *See* MECHANICS

MASS In the Fine Arts a large quantity of matter of light or shade It is generally applied in painting to light and shade brought upon objects proper for their [illegible] so as to give repose and [illegible] each without [illegible] and the other without being scattered

MASSALIANS *See* EUCHITES

MASSETER (Gr *μασσασθαι, I chew*) A short thick muscle which raises the lower jaw, and assists in [illegible] forwards in the act of chewing

MASSICOT Yellow oxide of *lead*

MASSORA, or MASORA A critical work among the Jews [illegible] two portions of Hebrew B As the sacred books were originally written without any breaks or divisions into chapters or verses or even words the Jews found it necessary to establish a canon to fix and ascertain the reading of the Hebrew text This rule or canon is designated *Massora*, or tradition, in which the verses, letters, words &c are all numbered, and by this means the slightest variations can be detected The Jewish rabbis who drew up this work are styled Massorites *See* BIBLICAL HISTORY, &c

MAST A long piece or system of pieces of timber, placed nearly perpendicularly to the keel of a vessel to support the yards or gaffs on which the sails are extended When a mast is one entire piece it is called a *pole-mast*, but in all large vessels it is composed of several lengths called *lower*, *top* and *top gallant* masts sometimes a fourth, called a *royal* mast

The method of supporting each mast on the one next below it is peculiar On the sides of the lower mast, some feet below the head are placed cheeks on these are fixed horizontally two short pieces of wood fore and aft, called *trestle trees* Across these at right angles are laid, before and abaft the mast two or more longer and lighter pieces called *cross trees*, which give the name to the entire system On the mast head itself is a *cap*

The topmast being placed up and down the fore side of the lower mast is *swayed up* between the trestle trees and through the round or foremost hole in the cap When raised so high that the *heel* of the topmast is nearly up to the surface of the cross trees a piece of iron, called the *fid* is put through the hole in the heel for the purpose and on this fid, of which the ends are supported on the trestle trees, the topmast rests When fidded the topmast is *stayed* and the rigging or shrouds *set up* to the *dead eyes* in the ends of the cross trees These dead eyes pull from the lower rigging below and thus the cross trees serve merely to extend the rigging The topgallant is supported in the same manner on the topmast When the mast is to be taken down it is first raised to relieve the fid which being drawn out the mast is lowered

The masts are supported by a strong rope leading forward called the *stay* by others leading aft on each side of the ship called in general *backstays*, and by others abreast called *shrouds* and also *breast backstays*

Large lower masts are composed of pieces and have for some years been made of several lengths about a foot or so square, and the whole supported merely by hoops at intervals

The *main-mast* is near the middle of the vessel the *fore-mast* is that which is nearest the fore part and the *mizen-mast* is abaft the mainmast

The old rule for the length of the main lower mast is to take ½ the sum of the length of the lower deck and extreme breadth the fore mast is $\frac{8}{9}$ths of the main-mast the mizen-mast considerably smaller The top-mast is about $\frac{3}{5}$ths of the lower mast These rules, as well as others for the thicknesses, &c, are merely for convenience, based on no mechanical principle, and are by no means strictly followed

MA'STER (Lat magister) A title frequent among the Romans as [illegible] (master of the horse the lieutenant or [illegible] command to a dictator), magister peditum, magister census &c Magister militiæ (master of the army, or of military affairs) was a title under the later Roman emperors *Grand master*, in modern times is the common title of the chief of the orders of knighthood, and of some fraternities as the Freemasons The eldest sons of some noble landed proprietors are designated as masters in Scotland, as the master of Gray, master of Douglas, &c

MASTER In the Universities, a degree in arts, the most ancient of all the academical titles In the university of Paris, where this as well as the other learned distinctions appears to have originated it was originally a mere title belonging to [illegible] in the schools (magistri, doctores) Thus every master was, of necessity, a lecturer In process of time (and probably about the middle of the 13th century) the title became a degree, attainable by all after a certain amount of residence and proficiency, while the duty of lecturing was confined only to a certain number of masters, termed *regents* About the same period the separation of the degrees of master and doctor took place In the English universities, the degree of master of arts follows that of bachelor A master becomes a regent after a short period, and, according to the old academical constitution, is supposed to read lectures during the year of his regency On becoming a regent, he becomes a member of the governing body of the university, having a vote in [illegible] Oxford, in the senate at [illegible] the degree of master is the highest in the faculty of arts, but subordinate to that of bachelor of divinity Elsewhere the faculty of arts is synonymous with that of philosophy, in which the degree of doctorate is conferred, superior to that of master

MASTER, otherwise called Captain, in Commercial Navigation, the person entrusted with the care and navigation of a ship His duties are very important In some countries [illegible] this office who has not been [illegible] constituted board, but in this country the owners are left to their own discretion as to the skill and honesty of the master, and although he is bound to make good any damage that may happen to the ship and cargo by his negligence or unskilfulness, he cannot be punished as a criminal for mere incompetence No one is qualified to be the master of a British ship unless he be a natural-born British subject, or naturalized by act of parliament, or have become a subject to his majesty by conquest, cession, &c, and have taken the oaths of allegiance, or a foreign seaman who has served three years in time of war on board of his majesty's ships

MASTER In the Royal Navy, the officer who has the charge of the navigation of the ship, with other duties his rank is next to lieutenant

MASTER ATTENDANT The officer next in rank to the superintendent of the royal dock-yard

MASTER AT ARMS A petty officer of the navy, who is in fact, the head of the police of the ship his assistants are called ship's corporals

MASTER OF THE CEREMONIES An officer attached to all European courts whose duty consists in regulating all matters of etiquette and state ceremony (*See* CEREMONIES &c) The name is also applied to any individual who is appointed by general consent to preside over the arrangements of a public ball, with the power of deciding all disputes that may arise therein

MASTER OF THE HORSE The third great officer in the British court When not put in commission this office is always filled by a nobleman He has the management of all the royal stables and bred horses with authority over all the equerries and pages coachmen, footmen, grooms &c In solemn cavalcades he rides in the same carriage with the sovereign Salary, 1276*l* 13*s* 4*d* per annum

MASTER OF THE HOUSEHOLD An officer employed under the treasurer of the household to survey accounts Salary 800*l* per annum

MASTER OF THE MINT *See* MINT

MASTER OF THE ROBES An officer of the royal household in the lord chamberlain's department His salary is 800*l* per annum

MASTER OF THE ROLLS *See* MASTERS IN CHANCERY

MASTERS IN CHANCERY are assistants to the lord chancellor The masters in ordinary are twelve in number, of whom the master of the rolls is chief To them are referred interlocutory orders for stating accounts, computing damages, &c They also administer oaths, take affidavits and acknowledgments, and examine bills in chancery with reference to their propriety The masters are also employed by the house of peers in carrying messages to the commons Masters extraordinary are appointed to act in the country beyond twenty miles from London By 3 & 4 W 4 c 94 s 16, the appointment of masters in ordinary is taken from the lord chancellor and vested in the crown

MA'STER-SINGERS A class of poets who flourished in Germany during the 15th and part of the 16th century They were confined to a few imperial towns, and their chief seat was the city of Nuremberg They were generally of burgher extraction, and formed regular corporations, into which proficients were admitted by the ordinary course of apprenticeship Their poetry (generally confined to devotional or scriptural pieces, legendary tales with some admixture of satire and of amatory lyrics) was subjected to a peculiar and pedantic code of laws both composition and versification, and a board of judges (styled merker) assembled [illegible] criticised and *mark* the faults which [illegible] in either particular he who had the fewest faults received the prize. Hans Sachs, the famous cobbler of Nuremberg, was a member of these societies, although his genius was of too independent a character to submit to the trammels of their poetical regulations

MA'STIC (Gr *μαστιχη, a species of gum*) In Architecture, a cement of recent introduction into England,

employed for plastering walls. It is used with a consi- [illegible] of linseed oil, and sets hard in a few days [illegible] on account of its substance, and from its being fit for the reception of paint at an early period, it is much used in works where great expedition is requisite

MASTIC A peculiar resin which exudes from the *Pistacia lentiscus* Its chief use is in varnishes

MA'STICOT (Fr massicot) In Painting, a yellow colour being an oxide of lead

MASTI'TIS (Gr *μαστος*, *the breast*) Inflammation of the breast in women it commonly terminates in suppuration

MA'STODON (Gr *μαστος*, *a nipple*, and *οδους*, *tooth*) A genus of extinct fossil quadrupeds allied to the elephant, so called from the conical projections upon the surfaces of the molar teeth

MA'STOID (Gr *μαστος*, and *ειδος*, *form*) Certain *nipple like* processes of the bones

MASTOTHECA (Gr *μαστος*, and *θηκη*, *a receptacle*) A name sometimes used for Marsupium and applied to the abdominal pouch of the marsupial animals

MATE In a Merchant Ship, the deputy of the master, taking in his absence the command There are sometimes [illegible] wo, three, or four mates in a [illegible] her size, denominated 1st, 2d, 3d, &c mates The law, however, recognizes only two descriptions of persons in a merchantman — the master and mariners, the mates being included in the latter, and the captain being responsible for their proceedings

In men-of-war, the officers immediately subordinate to the captain are called lieutenants But the *master* or officer whose peculiar duty it is to take charge of the navigation of the ship, has certain mates under him, selected from the midshipmen The boatswain gunner, carpenter, &c have each their mates or deputies, taken from the crew

The officers [illegible] in the ships belonging to the East India Company are called 1st 2d 3d, &c officers East Indiamen had no sailing masters the commanders performing that duty (*Falconer's Marine Dictionary*, &c)

MATE The Paraguay name of a plant called *Ilex paraguensis* by botanists, whose leaves are used extensively in that country as a substitute for tea It has the property of turning milk blackish when mixed with it

MATE'RIAL Any thing composed of matter or possessing the fundamental properties of matter See MATTER

MATE'RIALISM That metaphysical theory which is founded on the hypothesis that all existence may be resolved into a modification of matter, including of course the conscious subject Materialists, of one sort or other, have abounded in every stage of philosophical thought They have consisted in the main, of persons accustomed to the exclusive pursuit of merely physical or empirical science, who have transferred the habits and prejudices thus engendered to the higher sciences of metaphysics and physiology The most celebrated materialists were among the ancients, Democritus and his later disciples Epicurus and his sect, to whom may be added though in a somewhat different sense, the Stoics among the moderns, Gassendi, Hobbes Hartley and Dr Priestley Most schemes of materialism rest on the assumption that all that is real in nature consists in the minute particles from the juxtaposition of which all sensible objects arise This is what is variously designated as the atomic, the mechanical, or the mechanico corpuscular theory and has met with supporters chiefly in France Among ourselves, in very recent times Dr Thomas Brown has eloquently maintained that part of this system which relates to physical phenomena, though he has combatted, with the utmost [illegible] portion of it which includes the [illegible] (Compare sect v ix with sect xii xiii Sect i) *Priestley's Disquisitions on Matter and Spirit*, 1777, and his *Three Dissertations on the Doctrine of Materialism and Philosophical Necessity* Also *Price's Letters on Materialism and Philosophical Necessity*) The latest and boldest defence of materialism that has appeared in England is to be found in the celebrated lectures of Mr Lawrence, who maintained that the brain is to be considered as secreting thought in the same sense in which the liver secretes bile or the [illegible]

MATE'RIA MEDICA [illegible] substances, natural and artificial, which are used in the cure of disease, and which are usually called *medicines* They are frequently arranged into classes dependent upon their virtues or effects, or upon their constituent parts but perhaps the most convenient arrangement is the alphabetical

MATHEMA'TICS (Gr *μαθησις*, *learning*) The science which [illegible] the consequences which are logically [illegible] from any given or admitted relations between magnitudes or numbers It is usually divided into two parts *pure*, where geometrical magnitude or numbers are the subject of investigation; and *mixed*, where the deductions thus made are from relations which are obtained by observation and experiment from the phenomena of material nature, and which constitutes [illegible] physical science [illegible] science was geometry and this received its highest degree of cultivation amongst the Greeks Several of their works are come down to our own times but all have undergone more or [illegible] and some of the most interesting are [illegible] as the *Porisms* of Euclid, or known [illegible] of Arabic translations, as [illegible] *See* GEOMETRY

The next object of research that comes under the denomination of pure mathematics is number, the science of which constitutes arithmetic By reason of their defective system of notation, the Greek geometers were under the necessity, in very complicated methods [illegible] ordinary numerical calculations and for [illegible] to abstruse properties and relations of numbers they had recourse to geometrical constructions The moderns have, however, discovered a much more simple and direct system of processes, constituting *algebra*, and this has also been applied with great success to the solution even of geometrical problems and theorems which by purely geometrical methods had never been effected The differential calculus and the calculus of functions are also branches of algebra *See* ARITHMETIC and ALGEBRA

Of the various branches of the mixed mathematics or applied mathematics, astronomy is by far the most advanced towards perfection, and next to it the doctrine of optics, which has been cultivated as subservient to astronomy This has depended chiefly on the simplicity of the *laws* which connect the phenomena, and the consequent simplicity of the mathematical investigations which are necessary for a development of their consequences Nevertheless simple as those laws are, and relatively simple as the investigations to which they lead also are, their perfect development is beyond the present powers of mathematical science, which in numerous cases can only furnish approximate results

MA'TINS In the Roman Catholic church the earliest of the canonical hours of prayer *See* HOURS

MATRASS A chemical vessel employed in sublimations and in digesting solutions in a sand heat It is superseded in the modern laboratory by a flask

MATRICULA (Lat *mater mother*) A register kept of the admission of persons into any body of society of which a list is made In the Romish church there was a *matricula clericorum* a list or catalogue of the officiating clergy, and *matricula pauperum*, a list of poor persons to be relieved Hence when a student is entered in the [illegible] universities he is said to be *matriculated*

MATRIMONY See MARRIAGE

MA'TRIX (Lat) In Metallurgy the stony substance in which crystalline minerals and metals are embedded is frequently termed their *matrix* or *gangue* In dyesinking the *matrix* is the indented mould from which impressions are taken in relief [illegible] the term to the iron moulds in which [illegible]

MA'TTER (Lat materies) Substance Of the intimate nature of matter the human faculties cannot take cognizance, nor can data be furnished, by observation or experiment on which to [illegible] All we know, or ever can know [illegible] *properties* Some of these are the foundation of physical science others of the different subordinate sciences, as, for instance, of chemistry

Matter is divisible by abrasion and other means into small fragments which, when the division is carried to any considerable extent, are called particles It is supposed however, and many reasons appear to justify the hypothesis, that it is capable of reduction into particles (called atoms) of particular forms, and each class having its own proper magnitude and peculiar properties, that determinate numbers of atoms of one kind admit of combination with some determinate number of another kind, or of several kinds, and of thereby forming compounded atoms having properties peculiar to that combination, and different from the *known* properties of their elemental atoms These solutions and combinations result from properties inherent in the atoms themselves, but whether the simple classes of atoms that are believed to exist are themselves really primary and elemental is not known, and probably never can be with certainty

In larger masses, or in masses of aggregated atoms, so classed that their peculiar properties are mutually neutralized, phenomena are exhibited which bear a great resemblance to one another through considerable classes of such compounds, whose elements we have reason to [illegible] and under [illegible] are [illegible] and [illegible] degree or intensity These last are the objects of *physical* investigation they are called emphatically the properties of matter; and the laws of their mutual influences are the foundation of *mechanical philosophy* These properties

may be regarded as either essential or accident The essential properties of matter are usually reckoned the following —

1 *Divisibility*, or the property which every known substance possesses of being separable into parts, and these again into smaller parts, and so on until the parts become inappreciable to our senses, nor can any limit be placed to the subdivision

2 *Impenetrability*, or a resistance exerted by every body to the occupation of its place by another This resistance is of various degrees of intensity dependent on the state and atomic constitution of the bodies, but no two bodies can simultaneously occupy the same place

3 *Porosity*, or the separation of the particles or atoms from each other by intervals or pores Every substance with which we are acquainted is more or less porous

4 *Compressibility*, or the property in virtue of which the volume of every body may be contracted into smaller dimensions

Among the essential properties of matter may also be included *extension* and *figure*, but these belong also to space, and form the subject of geometry

The contingent properties of matter are *mobility* and *weight* Matter in every form is capable of being moved from one place to another, and every substance gravitates towards the centre of the earth But motion has reference to space, and weight to the attraction of other matter

The above are the general properties of matter, upon which physical investigations depend There are however various other qualities belonging to particular substances or to matter in particular states the consideration of which is important in mechanical philosophy Among these the principal are *elasticity*, *fluidity*, *hardness*, *rigidity*, *solidity*, — for which see the respective terms

MAUNDRIL In Coal Mines a pick with two shanks

MAUNDY THURSDAY The Thursday preceding Easter on which the sovereign of England distributes alms to a certain number of poor persons at Whitehall, so named from the maunds or baskets in which the gifts were formerly contained This custom is of very great antiquity, and according to Ducange, it derives its origin from St Augustine Maundy Thursday is also called Shere Thursday (See *Nare's Glossary*, *Fosbrooke's Encyc of Antiquities*, p 702)

**MAUR, SAINT, CONGREGATION OF** A learned body of religious of the Benedictine order so called from a village near Paris where they were established in 1618 On the request of Louis XIII Gregory XV gave this order his approval by an apostolical brief dated 17th of May 1621, and it obtained new privileges from Urban VIII by a bull dated 21st of June 1627 The fame of this body attracted the attention of many other religious orders, several of which were induced to submit to its rules, and at last it numbered upwards of a hundred religious houses The literary world owes to them a series of very valuable editions of ancient Greek authors chiefly fathers during the 17th century Among the most eminent of its members during that period may be mentioned Jean Mabillon Thierri Ruinart, Hugh Menard and Bernard de Montfaucon, &c &c (See Mosheim, *Eccl Hist* vol v)

MAUSOLE'UM A sepulchral building, so called from Mausolus king of Caria to whose memory it was raised by his wife Artemisia about 353 B C hence all sepulchral structures of importance have obtained the name of mausolea From its extraordinary magnificence it was esteemed the seventh wonder of the world According to Pliny it was one hundred and eleven feet in circumference, and one hundred and forty feet high It is said to have been encompassed by thirty-six columns, and [illegible] enriched with sculpture

MAXILLA (Lat maxilla *a jaw*) In Anatomy this term is applied to the bones supporting the teeth of both jaws In Zoology, it is restricted to the upper jaw in Mammalia, and to the inferior pair of horizontal jaws in articulate animals

MA'XIM Synonymous with *axiom* which see

MA'XIMA AND MINIMA Terms employed in analysis to signify not the absolute greatest and least values of a variable quantity, but the values it has at the instant when it ceases to increase and begins to decrease, or *vice versâ* A variable quantity may therefore have several maxima and minima The theory of maxima and minima forms a part of the differential calculus, and is treated as given in all works on that subject

MAY The fifth month of our year, but the third of the Roman The name is supposed to be derived from Maia, the mother of Mercury, to whom the Romans offered sacrifices on the first day of the month, but various other derivations have been assigned to it *See* CALENDAR

**MAY DAY** The 1st of May is usually so called in England, by way of eminence, in commemoration of the festivities which from a very early period were till recently, and in many parts of the country are still observed on that day It would be out of place in this work to give any detailed account of them, as they are universally known, but a few words as to their origin may not be out of place In looking at the nature of these rites, which are to a certain extent common to every place in which they are observed, it is evident that they had their origin in the observances practised in honour of the Latin [illegible], but it is impossible to fix with accuracy the precise period at which they were introduced into England The earliest notice of the celebration of May-day may be traced to the Druids, who on May-eve were accustomed to light large fires on eminences in gratitude and joy for the return of spring At a later period the observance of this day appears not to have been peculiar to any class of society, for the most exalted as well as the lowest persons took part in it In his *Court of Love* Chaucer says, that on this day "forth goeth all the court, most and least, to fetch the flowres fresh, and braunch and bloom," and it is well known that Henry VIII and Katherine and all their court partook in the diversion The *maypole*, which is still visible in many of the English villages, and *Jack in the green* are still relics of this custom (Some interesting remarks on this subject are to be found in *Grimm's Deutsche Mythologie*, pp 448—451)

MAYOR (Lat major meaning the first or senior alderman) The title of the chief municipal officer of a borough, to whom it appears to have been first given by charters granted some time after the Conquest But the title and office of portreeve or boroughreeve still continued, in some few places to the exclusion of, and in some [illegible] Municipal Reform Act, 5 & 6 Will IV, by which latter title was applied universally and exclusively to every borough The chief magistrates of London and Dublin are designated Lord Mayor

MAYOR (Maire) In France, the first municipal officer of each commune, according to a general system established by the law of 14th Dec 1789, which created municipalities Since 1831 they are selected by the government out of the municipal council, which is chosen by the electoral body The maire has one or more *adjuncts* or assessors, according to the population of the commune chosen in [illegible] The maire keeps the registers of births marriages, &c of the commune, he acts as a magistrate in the prevention and commitment of offenders, he has a judicial power over certain minor offences He is also the principal agent of the general administration for his commune, and the executive authority to carry into effect the ordinances of the municipal council

MAYORAZGO (Span from Lat magistratus *See* MAJORAT) Strictly, the right possessed by the eldest born in noble families to inherit certain property on condition of transmitting it entire to those possessed of the same right on his decease Five distinct species of mayorazgo, or right of hereditary succession, are now known in Spanish law Property held in virtue of the right cannot be alienated or disposed of The mischievous effects of this strict system of entail on agriculture and national wealth and on the character of the higher classes of Spain, have been long insisted on by political philosophers

MAYOR OF THE PALACE (Lat major domus regia) In early French History the title of the chief officer of state under the Merovingian kings After the death of Dagobert I, A D 638 and in the subsequent decay of the royal authority, these functionaries by degrees usurped almost the entire power of the state The first of those mayors who exercised this kind of sovereignty was Grimoald under Sigebert III, king of Austraria Pepin, son of Charles Martel having succeeded his father in the office of mayor of the palace, afterwards ascended the throne in 752, after which time the office lost its importance, or was [illegible] (See Turner, *Hist of England during the Middle Ages*, vol i p 8)

MEAD (Dutch, mede) A vinous liquor made by dissolving one part of honey in three of boiling water, flavouring it with [illegible] portion of ground malt and a piece [illegible] and suffering the whole to ferment [illegible] mead is flavoured with primrose blossoms Mead formed the ancient, and for centuries the favourite beverage, of the northern nations It is frequently mentioned in *Ossian*

MEADOW A flat surface under grass, generally on the banks of a river or lake, but so far above the surface of the water as to be considerably drier than marsh [illegible] to produce grass and herbage of [illegible] The soil of meadow lands is generally alluvial [illegible] more or less mixed with sand, and it is kept in a state [illegible] by the deposition of matter on its surface, in consequence of being occasionally overflowed by the adjoining river or lake The produce of meadows is generally made into hay which though not equal in quality to that produced on drier grass lands, is yet superior to what is obtained from marshes

**MEAN.** In Mathematics, a quantity having an inter-

mediate value between several others which are formed according to any *assigned law* of succession

The *arithmetical mean* of several quantities is simply the *average* formed by dividing the sum of all the quantities by their number In physical inquiries, where a great number of values of a quantity have been determined by observation or experiments, of which the error is as likely to be in excess as defect, the average or arithmetical mean is the most probable result

The *geometrical mean* between two quantities or the *mean proportional*, is a quantity which forms the middle term of a duplicate ratio, or continued proportion of three terms viz such that the first given term is to the quantity sought as that quantity is to the other given term In arithmetic it is the square root of the product of the two given terms

The *harmonical mean* is such a number that, the first and third terms being given, the first is to the third as the difference of the first and second is to the difference of the second and third or, if $a$, $b$, $c$ be the numbers, $b$ being the mean,—

$$b = \frac{2ac}{a+c}, \text{ or } \frac{2}{b} = \frac{1}{a} + \frac{1}{c}$$

ME'ASLES *See* RUBEOLA

MEA'SURE (Lat mensura) In Geometry, a magnitude or quantity taken as unit and employed to express the relations of other magnitudes or quantities of the same kind Euclid defines the measure of a quantity to be that which, being repeated a certain number of times becomes equal to the quantity measured Thus in Arithmetic, the *measure of a number* is any number which divides the given number without leaving a remainder, but this definition rather corresponds to the notion of *aliquot part*

In a more extended sense the term measure is applied to that by which any thing is compared in respect of quantity Thus, we have measures of extension of weight time force, resistance temperature &c, in short of every thing of which greater and less can be predicated and it frequently happens that the unit or measure is not taken in the thing or property which is the immediate subject of consideration, but in something else which depends on it, or is proportional to it Angular space for example, is measured by an arc of a circle time by the rotation of the earth about its axis or its revolution about the sun, force, by the quantity of motion it impresses on a body, degrees of heat by the expansion of metals or other substances, muscular strength by the resistance of a spring &c *See* ANGLE, CHRONOLOGY, GRAVITY THERMOMETER DYNAMOMETER, &c

By measure, in an absolute sense is understood the unit or standard by which we measure extension We have, therefore, measures of length, of superficies and of volume or capacity, but as the two latter may be deduced in all cases from the former it is only necessary to establish a unit, or standard of length The choice of such a standard, and the different multiples and parts of it taken for the uses of society, form a metrical system or system of metrology

*Standards of Measure* —As no precise notion can be formed of the magnitude of a line in any other way than by comparing it with one of a known length the [illegible] the interchange of ideas to measures not entirely arbitrary, but fixed by nature and intelligible alike to all mankind, seems to have been perceived in the earliest ages Hence originated the *foot*, the *cubit*, the *span*, the *fathom* the *barleycorn*, the *hand-breadth* and other denominations of measure taken from parts of the human body, or from natural objects, which though not of an absolute and invariable length, have a certain mean value sufficiently definite to answer all the purposes required in a rude state of society But, as civilization advanced, the necessity of adopting more precise standards would be felt, and the inadequacy of such measures as the foot, the cubit, &c (referred only to the human body) to convey accurate notions, would be rendered most apparent in their application to itinerary measures or the estimation of great distances, where differences of the fundamental measure, of no account when one or two units only are taken into consideration, would amount, by repeated multiplication, to enormous quantities In order to avoid this inconvenience, recourse was had to other methods of estimation, but which, in fact, amounted only to descriptions more or less vague, and not to measures Thus, in ancient authors we [illegible] of a day's journey, a day's sail, and so forth, and in many parts of the continent of Europe even at the present time it is the custom of the peasantry to reckon itinerary distances by hours

On looking among the objects of nature for a standard of measure perfectly definite, and, at the same time, invariable, and accessible to all mankind, a very slender acquaintance with geometry and natural philosophy will suffice to show that the subject is beset with innumerable difficulties In fact, nature presents only two or three elements which, with the aid of profound science and a refined knowledge of the arts, can be made subservient to the purpose, and even all of these are applicable without such aid The [illegible] and its form and absolute magnitude are presumed to remain the same in all ages hence the distance between the equator and the pole is an invariable quantity, and any assigned part of that distance as the 90th or 360th of the meridian, is constant, and will furnish a precise and unalterable standard of measures, fit for the purposes of metrology, provided we [illegible] with the proper scales [illegible] The force of gravity at the [illegible] at any given place, and very nearly the same at all places under the same parallel of latitude and at the same height above the level of the sea, hence the length of a pendulum which makes a given number of oscillations in a day is also constant at a given place, and, with proper skill and precautions, may be determined in terms of any assumed scale These two elements the length of a degree of the meridian, and the length of the seconds' pendulum, are the only ones furnished by nature which have yet been used as the basis of a system of measures One or two others have been suggested, as the height through which a heavy body falls in a second of time, determined, like the length of the pendulum, by the force of gravity, or the perpendicular height through which a barometer must be carried till the mercurial column sinks a determinate part—for example a 30th of its own length, but, for reasons which it is unnecessary here to state, these distances are not so susceptible of being accurately determined as the terrestrial degree, or the length of the seconds pendulum

It has been [illegible] Prony's *Metrologie*, Bailly *Histoire de l'Astronomie ancienne* that several nations referred their measures of length to a unit chosen from an aliquot part of the earth's circumference, and that the different *stadia* were only different aliquot parts of the same great unit, but the supposition is altogether improbable for the ancients had no means of determining the magnitude of the earth with any tolerable precision, and do not themselves make any reference to such a standard Mouton an astronomer of Lyons about 1670, proposed as a universal standard of measure a *geometrical foot* of which a degree of the earth's circumference should contain 600,000, and remarked that a pendulum of this length would make 3959½ vibrations in a half hour In 1671 Picard proposed a similar idea, and Huygens first suggested the pendulum as the unit or standard of measures Condamine one of the French academicians engaged in the measurement of the terrestrial arc in Peru, proposed that the equatorial pendulum ought to be adopted, as being the most natural measure and independent of the pretensions of different countries No attempt however was made to establish a regular system of measures on any of these standards until the time of the French revolution when a system of weights and measures referred to the terrestrial degree, and accommodated to our arithmetical scale, was adopted in that country

*English Standard Measures* —The unit of lineal measure in this country is the yard all other denominations being either multiples or aliquot parts of the yard But as this is an entirely arbitrary measure, and until the year 1824, was never strictly defined by the legislature, great perplexity has often arisen in attempting to ascertain the exact portion of space it was meant to represent For the purpose of preserving some degree of uniformity among the ordinary measures of the kingdom, certain standards were preserved in the exchequer, with which all rods were required to be compared before they were stamped as legal measures The oldest of these standards in existence dates from the reign of Henry VII, but it has long been disused, and that which, till the year 1824, [illegible] brass rod, of the [illegible] placed there in the time of Elizabeth There was another similar rod of the same date, called an *ell* The ell however, does not appear ever to have been established as a legal measure, but was conventionally considered as equal to a yard and a quarter To these rods belonged a brass bar, on one edge of which was a hollow bed or matrix fitted to receive the square rod of a yard, and on another a like bed fitted to receive that of an ell, and into these beds were fitted the yard and ell measures brought to be examined and stamped with the standard marks All rods so stamped became standard measures It is abundantly obvious that measures determined in this coarse manner could have no strict claim to be considered as *accurate* copies of the original standard, but it would seem that the standard itself was incapable of affording any definite or correct measure. It is thus described by Mr Baily, in his Report on the new Standard Scale of the Royal Astronomical Society —"I have had an opportunity of seeing this curious instrument, of which it is impossible at the present day to speak too much in derision or contempt A common kitchen poker, filed at the ends in the rudest manner by the most bungling

workmen, would make as good a standard It has been broken asunder, and the two pieces been dovetailed together, but so badly that the joint is nearly as loose as that of a pair of tongs and yet within the last ten years, to the disgrace of this country copies of this measure have been circulated all over Europe and America, with a parchment document accompanying them certifying that they are true copies of the English standard" (*Phil Trans Roy Soc* vol ix)

Such being the condition of the legal standard, it was obviously impossible that any measure could be found in terms of it, where great accuracy and minuteness were necessary, for instance, that of the seconds' pendulum, [illegible] It was utterly inadequate [illegible] In the year 171[illegible] and Members of the Academy of Sciences at Paris proposed to have accurate standards of the measures and weights of both nations made and carefully examined, in order that a means might be provided of comparing the results of scientific experiments in England and France The committee who undertook the matter besides the legal standard in the Exchequer, found some others which were considered of good if not equal authority At Guildhall they found two standards of long measure, which were only two beds or matrices one of a yard, and the other of an ell, cut out of the edges of a substantial brass bar, like that at the Exchequer Another, preserved in the Tower of London, was a solid brass rod, about 7-10ths of an inch square, and 41 inches long, on one side of which was the measure of a yard divided into inches Another, belonging to the clockmakers company delivered to that corporation by indenture from the Exchequer in 1671, was a brass rod of eight sides nearly half an inch thick, on which the length of the yard was expressed by the distance between two upright pins, or small checks, filed away to the proper quantity The committee selected the standard in the Tower as being the best defined, and consequently the best adapted to their purpose, and Mr George Graham (a celebrated clockmaker) at their desire, laid off from it with great care, the length of the yard on two brass rods which were then sent to the Academy of Sciences at Paris, who in like manner set off thereon the measure of the Paris half toise One of these was kept at Paris the other was returned to the Royal Society where it still remains but unfortunately it was not stated at what temperature the toise was set off, and, consequently, the comparison is now of little or no value

In 1758 a committee of the House of Commons was appointed to inquire into the original standards of weights and measures in the kingdom The committee entered very fully into the subject and presented to the house an elaborate report in which they recommended that a rod which at their order had been made by Mr Bird from that of the Royal Society and marked 'Standard Yard 1758' should be declared the legal standard of all measures of length This rod consisted of a solid brass bar 1 01 inch square and 39 08 inches long At about 1⅛ inch from each end a gold pin or stud is inserted, in which pins, at the distance of 36 inches are two points intended to designate the length of the yard It was proposed that this rod should be carefully laid up in safe custody to be used only occasionally, and, for the ordinary sizing of yards another rod was prepared by the same artist furnished with checks and divided into inches and parts, for the easier adjusting of any comparative measure

In the following year another committee was formed on the subject It concurred in the recommendation of the former committee, that Bird's standard yard should be the only unit of lineal measure and at the same time recommended that a copy of it should be made, for security [illegible] ed in some public office [illegible] was constructed by Bird, in 1760, similar to the former of which indeed it was intended to be a copy This last standard (of 1760) was declared by the act of 1824 to be the legal standard of [illegible]

Notwithstanding these two parliamentary reports, no legislative enactment was passed and the subject remained for a long time in the same state of uncertainty In 1796 a scale was constructed by the celebrated Troughton, for Sir George Shuckburgh, which has been much referred to in scientific treatises, in consequence of its [illegible] experiments made by Captain [illegible] length of the pendulum, and also carefully compared with all the other standards, and with the French mètre Troughton at several times made various other measures, but, as they never possessed any legal authority, it is unnecessary to allude to them farther than to state that they were all copies, as nearly as could be made, of a scale that had been constructed by Bird, and had belonged to Mr Harris, assay-master at the Mint

In 1814 the subject of standard measures and weights was again brought under the consideration of parliament, and a committee of the House of Commons made a report, which, however, was attended by no result In 1819 a commission was named by the prince regent consisting of Sir Joseph Banks Sir George Clerk Mr Davies Gilbert, Dr Wollaston Dr Young and Captain Kater, who first recommended that, for the legal determination of the standard yard, the yard which had been employed by General Roy in the measurement of a base on Hounslow Heath as a foundation of the trigonometrical survey, should be adopted, but in a subsequent report, made the following year (1820), they proposed the standard which had been made by Bird in 1760, on account of its being, as they stated, "both laid down in the most accurate manner, and as best agreeing with the most extensive comparisons which have been hitherto executed by various observers and circulated throughout Europe, and in particular with the scale employed by the late Sir George Shuckburgh" This last report having been approved by a committee of the Commons, an act was at length passed, in June 1824 in which the unit of measure was for the first time defined, and in the following terms —

'The straight line or distance between the centres of the two points in the gold studs in the brass rod, now in the custody of the clerk of the House of Commons, whereon the words and figures *Standard Yard*, 1760, are engraved, shall be, and the same is hereby declared to be, the original and genuine standard of that measure of length or lineal extension called a yard, and that the same straight line or distance between the centres of the said two points in the said gold studs in the said brass rod the brass being at the temperature of 62° of Fahrenheit's thermometer shall be and is hereby denominated the *Imperial Standard Yard*, and, shall be and is hereby declared to be, the *unit* or only standard measure of extension' And the act further declared that if at any time hereafter the said imperial standard yard shall be lost, or shall be in any manner destroyed, defaced, or otherwise injured, it shall be restored by making under the directions of the lords of the treasury, a new standard yard, bearing the proportion to a pendulum vibrating seconds of mean time, in the latitude of London in a vacuum, and at the level of the sea, as 36 inches to 39 1393 inches

The recommendation of the commissioners, on which this enactment was founded, has been severely criticised, and, in point of fact so far as the exact length of the yard is concerned, the subject remained in the same doubtful state in which it was before the act was passed That the standard which was adopted was not an original measure (it was in fact a copy of Bird's standard of 1758, which was a copy of that of the Royal Society which again was a copy of that in the Tower) was of little consequence provided the measure had been laid down on it with such precision as to leave no doubt as to its exact length, but so far was this from being the case, that when it came to be compared with a new standard scale made for the Royal Astronomical Society, it was found to be utterly impossible to ascertain the centres of the points in the gold [illegible] and lines [illegible] perfectly applicable by the method [illegible] Mr Baily, in his report above cited says the mean diameter of each of the holes was nearly 100th of an inch, and they by no means [illegible] like a circular shape In fact, not only [illegible] sons differ in their estimate of the centres [illegible] times accor[illegible] that impinged on the sides of the holes And he adds, "How the legislature of the present day, when the art of making mathematical instruments has arrived at such a state of perfection, could have sanctioned the adoption of such an imperfect and undefinable measure as this for a standard, must always be a matter of astonishment, more especially when we consider that the French had recently set us a laudable example, in the great pains and labour taken in the execution of a new set of standard [illegible] perior accuracy and precision" (*Mem R A S* vol viii)

This scale was destroyed by the fire which consumed the two houses of parliament in 1834, so that the country is at the present time without a legal standard, for the provision of the act relative to its restoration by comparison with the seconds' pendulum is perfectly nugatory Its restoration could not be thus effected with any tolerable certainty The length of the seconds' pendulum is one of those constants of nature which it is possible to determine only within certain limits, very narrow indeed, but still too wide for the purpose in question Besides, the standard adopted by the legislature had never been directly compared with the pendulum, and the relation between them assigned in the act, namely, 36 to 39 1393, is now known to be incorrect, on account of the neglect of certain precautions in the determination of the [illegible] pendulum which subsequent experiments have shown to be indispensable [illegible] has however, [illegible] what the legislative enactment [illegible] Early

In the year 1834 a most laborious and minute comparison of the different standard measures was made with a new scale constructed for the Royal Astronomical Society The length of the legal standard, as nearly as it could be determined, is known in terms of this scale, and may therefore be recovered; but, as a new act is necessary in any case, the legislature may probably be advised to do now what ought to have been done in the first instance namely, cause a standard to be made in a more skilful manner, and authenticated copies of it, or rather other measures having ascertained relations to it, to be deposited in several public places, and only to be used in cases of emergency The evil in this, as in many other instances, has arisen from legislating too much All that is required is that two very fine points be struck in a strong rod of platinum or a block of cast iron at any convenient distance, and to declare that the distance between these points at a certain temperature of the metal shall be the standard of measure and that so many parts of this standard shall constitute the yard or unit all the rest may be safely left to experimental philosophers and mathematical-instrument makers

*English System of Linear Measures* —The unit of measure, as already stated is the yard The yard is divided into 3 feet, and the foot subdivided into 12 inches The multiples of the yard are the pole or perch the furlong and the mile, 5½ yards being a pole 40 poles a furlong and 8 furlongs a mile But the pole and furlong are now scarcely ever used itinerary distances being reckoned in miles and yards The relations of these different denominations are exhibited in the following table —

| In | Feet | Yards | Poles | Furlongs | Miles |
|---|---|---|---|---|---|
| 1 | 0 083 | 0·028 | 0 00 5 | 0 0001 [illegible] | 0 000 01 [illegible] 8 |
| 12 | 1 | 0 333 | 0 0606 | 0 001 [illegible] | 0 0001 [illegible] 9 |
| 36 | 3 | 1 | 0 1818 | 0 0013 [illegible] | 0 [illegible] 1818 |
| 198 | 16 5 | 5 5 | 1 | 0 025 | 0 0 [illegible] 3125 |
| 7920 | 660 | 220 | 40 | 1 | 0 125 |
| 63360 | 5280 | 1760 | 320 | 8 | 1 |

*Measures of Superficies* —In square measure the yard is subdivided as in general measure into *feet* and *inches*, 144 square inches being equal to a square foot and 9 square feet to a square yard For land measure the multiples of the yard are the *pole* the *rood* and the *acre*, 30¼ (the square of 5½) square yards being a pole 40 poles a rood and 4 roods an acre Very large surfaces as of whole countries are expressed in square miles The following are the relations of square measure —

| Sq Feet | Sq Yards | Poles | Rood | Acres |
|---|---|---|---|---|
| 1 | 0 1111 | 0 00 [illegible] 7709 | 0 0 [illegible] 1827 | 0 00 [illegible] 7 |
| 9 | 1 | 0 0330579 | 0 0082644 | 0 0 [illegible] 12 |
| 272 25 | 30 25 | 1 | 0 025 | 0 00 [illegible] |
| 10890 | 1210 | 40 | 1 | 0 [illegible] |
| 43560 | 4840 | 160 | 4 | 1 |

*Measures of Volume* —Solids are measured by cubic yards, feet and inches 1728 cubic inches making a cubic foot and 27 cubic feet a cubic yard For all sorts of liquids corn and other dry goods the standard measure is declared by the act of 1824 to be the *imperial gallon* the capacity of which is determined immediately by weight, and remotely by the standard of length in the following manner —According to the act the imperial standard gallon contains 10 pounds avoirdupois weight of distilled water, weighed in air at the temperature of 62° Fahrenheit's thermometer the barometer being at 30 inches The pound avoirdupois contains 7000 troy grains, and it is declared that a cubic inch of distilled water (temperature 62° barometer 30 inches) weighs 252 458 grains Hence the contents of the imperial standard gallon are 277 274 cubic inches The parts of the gallon are *quarts* and *pints*, 2 pints being a quart, and 4 quarts a gallon Its multiples are the *peck* the *bushel* and the *quarter*, the peck being 2 gallons the bushel 4 pecks, and the quarter 8 bushels The following are the relations —

| Pints | Quarts | Gallons | Pecks | Bushels | Quarters |
|---|---|---|---|---|---|
| 1 | 0 5 | 0 125 | 0 0625 | 0 0156 25 | 0 0019 [illegible] |
| 2 | 1 | 0·25 | 0 125 | 0 03125 | 0 003906 25 |
| 8 | 4 | 1 | 0 5 | 0 125 | 0 0156 25 |
| 16 | 8 | 2 | 1 | 0 25 | 0 03125 |
| 64 | 32 | 8 | 4 | 1 | 0 125 |
| 512 | 256 | 64 | 32 | 8 | 1 |

For an account of the various other measures used in commerce, see the *Commercial Dictionary*, or *Colonel Pasley's Observations on the Measures, Weights, and Money used in this Country* (London, 1834), where a full description is given

*French System of Measures* —The French system of measures, introduced during the Revolution, has for its standard the length of a quadrant of the earth's meridian The unit of measures of length is the *mètre*, which is taken as the ten-millionth part of the quadrant This length, deduced from the great trigonometrical measurement of the meridian from Dunkirk to Barcelona, is marked by two very fine parallel lines drawn on a bar of platinum, and preserved in the archives of the Academy of Sciences [illegible] accepted the mètre, or rod of the standards of [illegible] with a copy of the mètre, one of the Pavillon [illegible] Kater found the length of the mètre to be 39 37079 inches of the English standard (*Phil Trans* 1818) Mr Baily found the length of the mètre to be 3 [illegible] inches of the Royal Astronomical Society's (*Mem R A S*, vol ix p 133), from which, by reducing to [illegible] the imperial yard The comparison is, however, attended with some degree of uncertainty, from the circumstance that a reduction must be made for the expansion of the metals, the standard temperature of the English measures being 62° Fahrenheit and that of the French measures 32° or the temperature of melting ice

In the French system the unit of superficial measure is the *are*, a surface of 10 mètres each way or 100 square mètres The unit of measures of capacity is the *litre* a vessel containing the cube of a tenth part of the mètre and equivalent to 0 220097 parts of the British imperial gallon The standard temperature is that of melting ice All the divisions and multiples of the units are decimal, and the principle of nomenclature adopted was to prefix the Greek numerals to the decimal multiples, and the Roman numerals to the decimal subdivisions

The measures of length are,

| | | |
|---|---|---|
| Myriametre | = | 10000 mètres |
| Kilometre | = | 1000 |
| Hectometre | = | 100 |
| Metre | = | 1 |
| Decimetre | = | 0 1 |
| Centimetre | = | 0 01 |
| Millimetre | = | 0 001 |

The measures of surface are,

| | | |
|---|---|---|
| Hectare | = | 10000 sq metres |
| Are | = | 100 |
| Centiare | = | 1 |

The measures of capacity are,

| | | |
|---|---|---|
| Kilolitre | = | 1000 litres. |
| Hectolitre | = | 100 |
| Decalitre | = | 10 |
| Litre | = | 1 |
| Decilitre | = | 0 1 |
| Centilitre | = | 0 01 |

The unit of solid measure is the *stere* or cube of the metre equal to 35 3168 English cubic feet

No system of metrology hitherto invented can be compared with this of the French in scientific point of view, nevertheless the decimal subdivisions have been found unsuited to the purposes of retail traffic to which in fact only a binary system or the division of the unit into halves and quarters seems applicable Accordingly, it has been found necessary to permit a modified system for such purposes so that there are in fact at present in France three different systems of measures the ancient which was never wholly abandoned, the decimal system and a binary system or *système usuel* having the decimal standards for its basis with binary divisions to which the names of the ancient weights and measures are given, the word *usuel* being annexed to prevent confusion

Of the different measures of length used in European countries the foot is the most universally prevalent We subjoin the relation between the foot of different countries and the English foot —

| | English foot |
|---|---|
| Russian foot - - | = 1 |
| Paris foot - - | = 1 065765 |
| Prussian and Danish foot - | = 1 029722 |
| Bavarian foot - - | = 0 957561 |
| Hanoverian foot - - | = 0 958333 |
| Saxon foot - - | = 0 929118 |
| Austrian foot - - | = 1 037128 |

Comparative tables of the measures used in different countries are given in various works one of the most complete and convenient will be found in *Hulsse's Sammlung Mathematischer Tafeln*, Leipzig 1840 For further information on the subject of this article, see *Pauctons Metrologie ou Traité des Mésures*, Paris, 1780, *Kelly's Universal Cambist*, 1821 See also LEAGUE, MILE and on the subject of weights, see WEIGHT

MEA'SURE In Music, the interval or space of time between raising and depressing the hand in a movement, being the same as *bar* The measure is regulated according to the different values of the notes of a piece, by which [illegible] Semibreves [illegible], one perpendicular stroke tall, called a whole measure

MEA'SURES In Geology, sometimes used as synonymous with beds or strata *coal measures*

MECHANICAL CURVE A curve of such a nature that the relation between the abscissa and the ordinate cannot be expressed by [illegible] equation Such curves are now more [illegible] *transcendental curves* See CURVE

**MECHA'NICAL PHILOSOPHY** The science of [illegible] to physical inquiries

**MECHA'NICAL POWERS** *See* MACHINE

**MECHA'NICAL SOLUTION OF A GEOMETRICAL PROBLEM** In the constructions of pure geometry only the ruler and compasses are allowed to be used, or, in other words, the constructions are required to be effected by means of straight lines and circles only The ancient geometers observed that there were many problems (as the duplication of the cube and the trisection of an angle, for instance) which could not be constructed by these means They hence had recourse to other instruments (*machinæ*) to effect this purpose, and such solutions were distinguished from the geometrical ones by the term *mechanical*

**MECHA'NICS** (Gr *μηχανη*, *machine*), in Natural Philosophy, is the science which treats of forces and powers, and their action on bodies, either directly or by the intervention of machinery

The theory of mechanics, which is a branch of mixed mathematics, is founded on an axiom or principle called the *law of inertia*, or Newton's *first law of motion*, namely, that a body must remain for ever in a state of rest, or in a state of uniform and rectilineal motion if it be not disturbed by the action of an external cause Theoretical mechanics is therefore divided into two parts *statics*, which treats of the equilibrium of forces, and *dynamics*, which is the science of accelerating or [illegible] the actions they produce When [illegible] leration are in the fluid state these become respectively *hydrostatics* and *hydrodynamics* which are comprehended under *hydraulics*, and sometimes the terms *ærostatics* and *aerodynamics* are used to denote the corresponding divisions of pneumatics, but all these divisions are more frequently included under the general term *mechanics*

Practical mechanics or a knowledge of the effects of some of the mechanical powers must have existed to some extent from the earliest ages of the world but of the machines used by the ancients in their constructions the oldest account which we possess is contained in the *Architecture* of Vitruvius Archimedes in his *Treatise De Æquiponderantibus* first investigated theoretically the principles of equilibrium, and the same philosopher is celebrated for the mechanical contrivances by which in the siege of Syracuse he so long frustrated the efforts of the Roman army under Marcellus During the eighteen centuries which succeeded the age of Archimedes the theory of mechanics remained in the same state Galileo laid the foundations of modern dynamics by his discovery of the law of accelerating force and by reducing the propositions of that science to mathematical formulæ In the hands of Newton mechanics assumed a new form, and the discovery of the new analysis enabled mathematicians to complete what had been begun by Galileo and to express all the effects of the actions of bodies on each other by analytical equations

For points connected with the theory see ACCELERATION, DYNAMICS, FORCE, STATICS &c, and for details LEVER PULLEY WHEEL AND AXLE &c The best treatise on the subject is that of Poisson, *Traité de Mecanique*, 2d ed 1833

**MECHA'NICS' INSTITUTES** The name given to the means by which instruction is communicated to tradesmen and mechanics in large towns throughout the British empire These institutes may be safely said to owe their origin to Dr Birkbeck who in 1800 delivered a course of lectures on natural philosophy and its application to the arts to an audience composed entirely of the mechanics of Glasgow though it was not until after the lapse of twenty years that his idea was followed up Institutions of this sort are at present established in almost every town in England whose population amounts to 10,000, and in some of much smaller number They are supported partly by contributions, and partly by the subscription of the members Short courses of lectures illustrated with experiments are given on the most popular and different branches of natural philosophy and occasionally on departments of literature, moral philosophy political economy &c Reading rooms are attached to the greater number of these institutions, which, speaking generally, are well attended On the whole we believe these establishments have been productive of considerable advantage The instruction they supply is, no doubt, very flimsy and superficial, but it notwithstanding serves to expand and inform the minds of the auditors, and is probably the most suitable for them An improvement in the system of school education by qualifying the members of mechanics' institutes the better to appreciate accurate scientific discussions, would be the most likely, or rather perhaps the only means by which to improve the lectures given at the institutions [illegible] (See *Stat of Brit Empire*, vol ii p 369)

**MECHANISTS** Those philosophers who refer all the changes in the universe to the effect of merely *mechanical* forces, such as *impact*, *weight*, and the like They are opposed to the dynamical philosophers, or those who assume a living and spontaneous power in nature, antecedent to and different from the phenomena present to the senses *See* MATERIALISM

**MECHLO'IC ACID** A compound of meconia and chlorine

**MECHO'ACAN** (From the province of Mexico, whence it is brought) The root of the *Convolvulus mechoacauna* it is a purgative, and was formerly used [illegible]

**MECONIC ACID** (Gr *μηκων*, *the poppy*) The peculiar acid with whi [illegible] When pure, it forms [illegible] solution forms a deep [illegible] which therefore are ge [illegible] bined The salts of this acid are termed *meconates*, those of lime, baryta, lead, and silver are white, and soluble in nitric acid Meconic acid is constituted of 7 atoms of carbon = 42, 2 of hydrogen = 2, and 7 of oxygen = 56 its equivalent therefore is 100

**ME'CONIN** (Gr *μηκων*) A white fusible substance, procured from opium and supposed to be a distinct principle It is said that more than from two to three grains of it are contained in a pound of opium, it seems doubtful whether it be an educt or a product

**MECO'NIUM** (Gr *μηκων*) Opium The term is also applied to the excrement found in the lower part of the fœtal intestines

**MEDAL** (Fr medaille) A piece of metal, in the shape of a coin, engraven with figures or devices, struck and distributed in memory of some person or event Ancient coins although intended for the purpose of circulation, are also commonly termed medals *See* NUMISMATICS

**MEDA'LLION** (Fr) In Numismatics, this name is appropriated to coins struck in Rome, and the provinces under the empire, which, in gold or silver, exceed in size the largest coins of which the name and value are known in those respective metals, viz the aureus in gold, and the denarius in silver It has been doubted whether they were intended for the purpose of circulation, or merely struck like modern medals, to commemorate persons or events *See* NUMISMATICS

**MEDALLURGY** (Fr medaille and Gr *εργον work*) The art of making and striking medals and coins *See* NUMISMATICS

**MEDIE** (Gr *μεσος middle*) The three letters *b*, *g* and *d* (beta, gamma, delta) are so called in the Greek alphabet as holding respectively a middle place between their several *tenues* *p*, *k*, *t* (pi, kappa, tau), and aspirates, *ph ch th* (phi, chi, theta)

**MEDIANT** (Lat medius) In Music, the chord which is a major or minor third higher than the key note according as the mode is major or minor

**MEDIASTINUM** The duplicature of the pleura, which divides the cavity of the thorax into two parts

**MEDIATISATION** The annexation of the smaller German sovereignties to larger contiguous states, which took place on a large scale, after the dissolution of the German empire in 1806 The same thing had been done [illegible] to be made mediately instead of immediately dependent on the empire The term was retained when the abolition of the German union had rendered it in strictness inappropriate A few more were mediatised after the peace of 1815 See *Conv Lex*, and *Hawkins's Germany*, 1838, which contains a chapter on this subject

**MEDIATOR** A term applied to Jesus Christ, as interceding between God and man and obtaining for the latter the remission of the punishment due to original and contracted sin The divinity of our Saviour is argued from his mediatorial character it seeming impossible to conceive that a mere man could efficaciously intercede by the sacrifice of himself for the sins of his fellow men Those reasoners, therefore who have arrived at the conclusion of the mere humanity of Christ, either expressly deny or essentially modify the idea of his mediatorial character

**MEDIUM** In Physics, the substance or matter in which bodies exist, or through which they move in passing from one point to another The resistance which different mediums oppose to bodies in motion is proportional to the respective densities of the mediums Newton supposed the existence of a universal medium, or ether, infinitely more rare and subtile than air and diffused through the whole creation The modern discoveries of the propagation of light by undulation, and of the acceleration of some of the small comets, give great probability to this supposition

**MEDLAR** (Corruption of Mespilar?) The fruit of the *Mespilus germanica*, a plant found wild in several parts of Central Europe It is remarkable for the austerity of its fruit when first gathered, and for its total loss of that quality after a few weeks, when it becomes soft brown, and sweet,—a condition which the French call *blessé* Of [illegible] finest as to [illegible]

in flavour In the eyes of a botanist the medlar is only a hawthorn berry of large size

MEDU'LLARY RAYS (Lat medulla, *marrow*) The vertical plates of cellular tissue which radiate from the centre of the stem of Exogenous plants, through the wood to the bark

MEDU'LLARY SHEATH

MEDU'LLARY SUBSTANCE The interior white portion of the brain The *medulla oblongata* is a part of the brain lying in front of the occipital bone and formed by the junction of the crura of the brain and cerebellum It terminates in the spinal marrow

MEDULLIN

MEDU'SA

MEDU'SA In Zoology a name given by Linnæus to a genus of marine animals now forming an extensive tribe (*Medusaria*) in the class *Acalepha* of the Cuvierian system The body is in the form of a

and more or less elongated, whence the resemblance to the fabled monster which suggested the original generic term The *Medusæ* are commonly known by the name of "sea-blubber" "jelly-fish" &c They have a stomach or digestive cavity excavated in the centre of the disk and opening externally either by a central and inferior crucial mouth, or continued into branched appendages and receiving the nutriment by innumerable minute pores, analogous to the "stomata" of plants or those root-like appendages The digested fluid is conveyed by vessels from the stomach to an exquisite network or plexus situated on the under surface of the border of the disk where it receives the influence of the atmosphere and is fitted for assimilation Some species as the *Medusa aurita* have also intestinal canals leading from the stomach to separate anal outlets Traces of a nervous system and rudimental organs of vision have been discerned in some of the *Medusæ* They swim by muscular contraction of the margins of the disk They are of distinct sexes which congregate together chiefly in the autumnal month The male and female organs much resemble each other and are situated in both sexes in

generally four in number on the

The ova are received when impregnated in marsupial sacs appended to the arms (in *Medusa aurita*) whence they escape in the form of ciliated infusoria afterwards assume the structure of eight armed polypes pass the winter in this state, and undergo their final transformation in spring Notwithstanding the complication of the organic machinery functions

of the *Medusæ* their solids form

their frame that of a Medusa of ten pounds weight, what remains upon the filter through which its fluid parts chiefly sea-water have escaped does not exceed two drachms A great number of the *Medusæ* are phosphorescent shining in the gloom of night like globes of fire, but the nature and the agents of this wonderful property remain to be discovered Most of the *Medusæ* at certain seasons sting and inflame the hand that touches them, but the cause of this property is equally unknown

MEE'RSCHAUM (Germ

magnesian mineral found

chiefly in some parts of Greece and Turkey It is light and soft, and is employed in the Turkish dominions as fuller's earth In Germany it is extensively used in the manufacture of tobacco pipes, which are prepared for sale by being soaked first in tallow, then in wax and finally by being polished with shave grass Imitation meerschaum pipes are sold in large quantities and the greatest caution is necessary to guard against deception To the connoisseur, the best criterion is the beautiful brown colour which the genuine meerschaum assumes after being smoked some time

MEGALE'SIAN GAMES (Gr *μεγας*, *great*) One of the most magnificent of the Roman exhibitions of the circus in honour of Cybele, the mother of the gods

MEGALI'CHTHYS (Gr *μεγας*, and *ιχθυς*, *a fish*) An extinct genus of fishes including species of great size, one of which the *Megalichthys Hibberti* has left its teeth and other parts in the channel coal of Lanarkshire, and the Lothians

MEGALO'NYX (Gr *μεγας*, and *ονυξ*, *a claw*) A large fossil quadruped the remains of which were found in a cavern in the limestone of Virginia in America

MEGALOPTERANS, *Megalopteres* (Gr *μεγας*, and *πτερον*, *a wing*) A name given by Latreille to a family of Pubescent Neuropterous insects comprehending those which have large wings horizontally folded

MEGALOSAURUS (Gr *μεγας* and *σαυρος*, *a lizard*) The generic name applied by Dr Buckland to an extinct genus of gigantic Saurians discovered in the oolite slate of Stonesfield near Oxford The species on which the genus is founded included individuals measuring from forty to fifty feet in length, they partook

The entire

The femur and tibia measure nearly three feet each, and a metatarsal bone has been found of the length of thirteen inches The bones of the extremities have large medullary cavities The

the teeth, which Dr Buckland has described as — "In the structure of these teeth we find a combination of mechanical contrivances analogous to those which are adopted in the construction of the knife, the sabre, and the saw When first protruded above the gum the apex of each tooth presented a double cutting edge of serrated enamel In this stage its position and line of action were nearly vertical, and its form like that of the two edged point of a sabre cutting equally on each side As the tooth advanced in growth, it became curved backwards in form of a pruning knife and the edge of serrated enamel was continued downwards to the base of the inner and cutting side of the tooth whilst on the outer side a similar edge descended but to a short distance from the point and the convex portion of the tooth became blunt and thick as the back of a knife is made thick for the purpose of producing strength In a tooth thus formed for cutting along its concave edge each movement of the jaw combined the power of the knife and saw, whilst the apex, in making the first incision, acted like the two edged sabre The backward curvature of the full grown teeth enabled them to retain like barbs the prey which they had penetrated (*Bridgewater Treatise*, i p 238) The entire teeth which sufficiently bespeak the carnivorous and predatory nature of the extinct monster were arranged in a pretty close series in sockets along the alveolar border of the jaws

MEGANYCTERANS (Gr *μεγας* and *νυκτερις a bat*) The first division or tribe of the order *Cheiroptera*, including the largest species of

which however are exclusively vegetable eaters living mostly on soft fruits and having

to that kind of food by their broad simple crowns The tribe is also distinguished from the animal feeding bats, whether bloodsuckers or insect catchers by having the two innermost fingers armed with hook shaped claws, and by the simple structure of the nose and ears The alimentary canal and especially the stomach of the great frugivorous bats are likewise more complicated than in the other tribes The meganycterans are distributed over the warmer parts of Asia Africa and the Polynesian Isles, but do not exist in America

MEGA'RIAN SCHOOL OF GREEK PHILOSOPHY founded at Megara by the disciples of Socrates, who retired thither after his death and distinguished in later times by its logical subtlety Its most celebrated names were those of Euclides Eubulides and Stilpo

MEGASCOPE (Gr *μεγας* and *σκοπειν* *I view*) An optical instrument proposed by M Charles of the French Academy of Sciences for the examination of bodies of considerable dimensions It is a modification of the solar microscope and has been used for determining the curvature of the different parts of the eye See MICROSCOPE

MEGASTOMES *Megastoma* (Gr *μεγας*, and *στομα* *mouth*) The name of a family of Univalve shells comprehending those which are not symmetrical, and which have

MEGATHE'RIUM (Gr *μεγας*, and *θηριον*, *beast*) The name given by Cuvier to a genus of extinct Edentate quadrupeds including and represented by one of the most gigantic of terrestrial mammalia The haunches of the *Megatherium Cuvieri* were more than five feet wide and its body twelve feet long and eight feet high, its feet were a yard in length, and terminated by formidable compressed claws of immense size its tail was of great length and probably much larger than that of any other extinct or

The head of the megatherium

cranium presents many of the peculiarities of that of the sloth The upper jaw was armed with five teeth on each side, the lower jaw with four on each side all the eighteen teeth belong to the molar series They were perpetually

like those of the Rodents, but had their

and

transverse ridges and

their

composed as in the teeth of the sloth, of a central body of coarse ivory, a thick outer coating of cementum, and a thin intermediate layer of fine and dense ivory, which forms the prominent terminating ridges of the crown

Nothing certain is known of the nature of the integuments of this singular and enormous animal; but the

fossil bony armour which has been conjectured to have appertained to the megatherium unquestionably belongs to another species of gigantic Edentate, more nearly allied to the armadillos See GLYPTODON

MI'GRIM (Fr megrim, probably from Gr ἡμι, *half*, and κρανιον, *the skull*) A violent intermitting pain affecting one side of the head

MELLONITE found in grains or small shining crystals, chiefly at Mount Somma near Vesuvius The name is from μειων, *less*, implying that the terminating pyramids of the crystals are the consequent shortness of the axis of the primitive form

MELÆ'NA (Gr μελας, *black*) The black vomit When blood is thrown up from the stomach it is generally black, in consequence of

ME'LAM A substance formed of a mixture of sal ammoniac and sulphocyanuret of potassium It is said to consist of 12 equivalents of carbon, 11 of nitrogen, and 10 of hydrogen

MELANCHOLY (Gr μελας, *black* and χολη, *bile*) A disease of the mind, chiefly characterized by ungrounded fear and apprehension of evil

MELA'NIA (Gr μελας) A genus of fluviatile Pectinibranchiate Gastropods, having a moderately thick shell, with an aperture longer than it is wide, enlarging opposite the spire, and the columella without folds or umbilicus the length of the spire is various They have the eyes with their external side, and about one third of their length from the base

MELANITE (Gr μελας) The black garnet

MELANO'SIS (Gr μελας) A morbid state characterized by deposition of a black matter in various parts of the body

MELANTERITE (Gr μελας) A mineralogical name of the native sulphate of iron

MELANTHIUM (Melanthium, one of the genera) A genus of plants, with a regular six-parted inferior perianth, and six stamens with the anthers [illegible] The number of species included in it is [illegible] but among them are the *Veratrum* or white hellebore, and *Colchicum* or meadow saffron the poisonous qualities of which indicate the general properties of the order

ME'LAS (Gr μελας) A disease endemial in Arabia It consists in the formation of dark brown or black spots upon the skin

MELAS'MA (Gr μελας) A disease of aged persons, in which a black spot appears upon the skin, which soon forms a foul ulcer

ME'LASOMES *Melasoma* (Gr μελας, and σωμα *body*) A tribe of Heteromerous Coleopterous insects comprising those which are of a uniform black or grey colour

MELASTOMACEÆ (Melastoma one of the genera) A natural order of Exogenous plants with polypetalous flowers and strongly ribbed leaves inhabiting tropical countries in great numbers but unknown in Europe in a wild state, and only occurring very sparingly in the temperate parts of America In the equatorial regions of this continent they are extremely numerous and some of the species bear berries the juice of which stains the mouth black, whence their name (μελας, and στομα *a mouth*) Their most characteristic mark is to have the anthers bent downwards and prolonged into a horn which is held fast in sockets of the ovary before the flower expands Many of the species are ornamental none are useful

MELCHISEDE'CIANS In Ecclesiastical History several sects of early heretics have been so termed from the opinions entertained by them respecting the character and office of Melchisedec arising from the language of St Paul in the Epistle to the Hebrews The Theodotians, in the 3d century are said to have regarded him as superior to Christ A sect of visionaries in Phrygia who appear to have been a branch of the Manichæans, are reported to have made Melchisedec an object of adoration Many divines of later times have entertained the belief that the Son of God appeared to Abraham under the form of Melchisedec (Cuneus, *De Rep Hebræorum*)

MELCHITES (Syr malek *king*) In Ecclesiastical History the Eutychians, when condemned by the council of Chalcedon gave this name (royalists, imperialists) to the orthodox who endeavoured to put the order of the Emperor Marcian into execution against them Among Oriental Christians it now designates in a general manner all those who are neither Jacobites [illegible] Catholic Greeks, [illegible] Eastern patriarchates (Mosheim *Eccl Hist* vol ii)

MELEAGRIS (Gr *a guinea-hen*) A term employed by Linnæus to designate the genus of which the turkey is the type The head and upper part of the neck is invested with a plumeless and caruncullated skin there is a cutaneous appendage of a similar construction under the throat, and another of a conical form on the forehead, which in the male, when under excitement, can be distended and elongated so as to hang over the point of the beak From the lower part of the neck of the adult male hangs a tuft or tassel of stiff hairs The coverts of the tail are shorter and stiffer than in the peacock, but can be erected and displayed in the same way The tarsi of the male are armed with weak spurs The common turkey (M. [illegible] L.) was introduced into Europe in the [illegible] size, and the excellence of its flesh led to its being cultivated with great care is now common, and widely dispersed [illegible] of the American woods is of a greenish colour with a copper gloss A second, and much more beautiful species (*Meleagris* [illegible]) has been discovered in Honduras [illegible] is greatly to be desired

MELES (Gr μελι, *a badger*) A genus separated by Storr from the Linnæan *Ursus*, and characterized by Mr Bell as follows — Second incisor in the lower jaw placed behind the others, molars $\frac{5-5}{6-6}$, arranged in an uninterrupted series, feet plantigrade, a glandular pouch underneath the tail, having a transverse orifice Since the extirpation of the common bear the badger, *Ursus meles* of Linnæus, which is a typical species of the present genus is the sole representative of the Ursine family in our indigenous zoology The habits of this quadruped are nocturnal, inoffensive, and slothful, its food consists of roots, earthnuts, fruits, the eggs of birds, insects reptiles, and the smaller quadrupeds its noxious qualities are consequently few and of slight moment, and by no means justify the exterminating war unintermittingly waged against it The muscular strength of the badger is great, its bite proverbially powerful, and a dog must be trained and encouraged to enter willingly into a combat with this species The long claws of the fore feet enable the badger to dig with effect, and he habitually dwells in burrows, which he digs by choice in declivities covered by thick coppice, or concealed in the recesses of woods The female prepares a nest of moss and grass, and brings forth her litter of three or four blind young in the summer season

MELE'TIANS In Ecclesiastical History the partisans of Meletius bishop [illegible], deposed in a synod at Alexandria about 306, on the charge of having sacrificed to idols during the persecution by Diocletian He was supported by numerous adherents, and thus a schism [illegible], which was partially concluded by the submission of Arsenius chief of the party, to Athanasius in 333, but does not seem to have been wholly extinct for 100 years (*Mosheim*, vol i)

MELICE'RIS (Gr μελι, *honey*, and κηρος, *wax*) An encysted tumour the contents of which resemble honey

MELILO'TUS (Lat mel *honey*, and lotus, *a leguminous plant*) A honey scented, [illegible] with erect stem and long erect racemes of small yellow or white flowers, resembling those of clover, of which it was formerly regarded as a species In some parts of Europe two or three species are cultivated as annual fodder plants

MELINGA or MELINGEA (From Μελιταια, a state in Thessaly, or Μελιτηεια a name of Venus, derived from μελι *honey*) In Zoology, a genus of beautiful corals and also a genus of butterflies

MELIPHAGANS [illegible] Gr μελι *honey*, φαγω, *I eat*) A family [illegible], comprising the birds which feed on the nectar of flowers

MELLITE, or MELILITE (Gr μελι, and λιθος, *a stone*) A yellow crystallized mineral, composed of mellitic acid and alumine It is very rare, and was first observed in the beds of brown coal in Thuringia The term *melilite* has also been applied to a yellow mineral which occurs in very minute crystals in the fissures and cavities of lava It fuses into a glass before the blowpipe but its composition has not been determined

MELLITIC ACID The peculiar acid of the mellite or honeystone of Thuringia According to Liebig the ultimate elements of this acid are 4 equivalents of carbon = 24 4 of oxygen = 32 and 1 of hydrogen = 1

MELLON A lemon-yellow substance composed of 6 equivalents of carbon and 4 of nitrogen, obtained by heating dry bisulphuret of cyanogen

MELOCA'CTUS (Melon-cactus) Round stemmed, ribbed succulent plants covered with spines on the ridge of the ribs, and producing the flowers among wool, on a hairy head or cap, which is protruded from the top of the stem They were included by Linnæus in his genus *Cactus*, and they [illegible] distinguished from [illegible] to which the modern [illegible] Cereus [illegible] are applied For the sake of their grotesque form, [illegible] are cultivated by persons curious in col[illegible]

MELODRA'MA (from [illegible]) A short drama in which [illegible] ing from the opera, as the [illegible] of the words are recited, and not sung In Germany melodrama is a short dramatic piece in lyrical verse themselves, and in France, its character [illegible] a vehicle for gorgeous decoration [illegible] insignificant plot, usually of a serious or romantic description

MELODY (Gr μελωδια, from μελος, *a song*) In Music, the arrangement in succession of different sounds

for a single voice or instrument, being distinguished from harmony, which is the result of the union of two or more concording musical sounds

ME'LOË (Gr *μελω a probe*) A genus of Coleopterous insects, of the section *Heteromera* tribe *Trachelides* and family *Cantharidæ*, in the system of Latreille In this genus the antennæ are composed of short and rounded joints the intermediate of which are the largest, and sometimes so disposed that these organs present in this point, in several males, an emargination or crescent The wings are wanting, and the elytra, oval or triangular, with a portion of the inner margin cross each other, only partially cover the abdomen particularly in the females, in which this segment of the body is extremely voluminous The meloes crawl along the ground or upon low plants, on the leaves of which they feed A yellowish or reddish oleaginous liquid exudes from the articulations of their legs In some districts of Spain these insects are used in the place of the true blister-flies (*Cantharides*), they are also employed by the farriers Latreille is of opinion that the modern meloes were the *Buprestes* of the ancients —insects to which they attributed very noxious properties supposing them to be fatal to the oxen that swallowed them

MELOLON'THIDANS *Melolonthidæ* The family of Coleopterous insects, of which the May-chafer (*Melolontha vulgaris*) is the type

MELPO'MENE (Gr *μελπομαι, I sing*) The muse who presides over tragedy, represented usually with a mask in one hand, a club or dagger in the other, and with buskins [illegible] et

MELUSINE In the mediæval Mythology of France, a beautiful nymph or fairy whose history occupies a large space in the popular superstitions of that country She is represented as the daughter of Helmas king of Albania, and the fairy Persine, [illegible] Raymund, count of Toulouse [illegible] ncent castle of Lusignan (originally called Lusinem the *anagram* of Melusine) Like most of the fairies of that period, she was doomed to a periodical metamorphosis during which the lower part of her body assumed the form of a fish or a serpent On these occasions she exerted all her ingenuity to escape observation, but having been once accidentally seen by her husband in this condition, she swooned away, and soon afterwards disappeared, none knew whither But her form is said to be seen from time to time on the tower of Lusignan clad in mourning and uttering deep lamentations, and her appearance is universally believed to indicate an impending calamity to the royal family of France

MELYRIS (Gr *μελυρις* an insect mentioned by Nicander) A Fabrician genus of Coleopterous insects, belonging to the section *Pentamera* subsection *Serricornes* tribe *Malacoderma* and constituting the family *Melyridæ* in the system of Latreille in which it is characterized as follows —Palpi commonly short and filiform, mandibles emarginated at the point, body usually narrow and elongated, head covered at the base by a flat or slightly convex thorax, joint of the tarsi entire and the terminal hooks unidentate or bordered with a membrane, antennæ usually serrate, and in the males of some species even pectinate

MEMBRA'NA TYMPANI The membrane which separates the internal from the external ear The drum of the ear

MEMBRANE The expansion of any of the tissues of the body into a thin layer Anatomists generally enumerate three kinds of membrane, namely the *mucous* the *serous*, and the *fibrous* The mucous membranes are those which line the canals of the body which are exposed to the action of air or foreign matters, —such as the lining of the nose, trachea, æsophagus, stomach intestines, &c The serous membranes form the lining of the sacs or closed cavities, as of the chest abdomen &c The fibrous membranes are tough inelastic and [illegible] such as the dura mater, the periosteum [illegible] of joints, &c

MEMNON In Greek Mythology, a fabulous king of Ethiopia, son of the goddess Aurora who is said to have assisted the Trojans in the siege of Troy, and to have been slain by Achilles Several Egyptian kings of this name are also mentioned by different Greek writers But the name is, in fact, supposed to be a general appellation or epithet (Mei-amun, *beloved of Ammon*) borrowed by the Greeks from the Egyptian language, and erroneously applied by them to particular individuals The famous statue called by the Greeks Memnon at Thebes in Upper Egypt, which possessed the real or imaginary property of emitting a sound like that of a harp, at the rising of the sun, is supposed to have been in the building called by M Champollion the Rhamesseion, from its founder Rhamesses, or Sesostris, of which the stupendous ruins are still seen between Medinet Habou and Kournah (See Champollion, *Lettres écrites d'Egypte et de Nubie*, p 261) The statue of black granite in the British Museum, already styled the brother of the younger Memnon, was found in the Rhamesseion The real Memnonium was, however, probably the temple erected by Amenoph, or [illegible] (Champollion, *ib* p 303)

MEMOIR In Literature, two different species of composition are popularly designated by the terms Memoir and Memoirs A short biographical notice of an individual, or a short essay on a particular subject (especially to accompany and explain a map, view, facsimile, or other representation of [illegible] called Memoir In architectural [illegible] to a [illegible] account, [illegible] with narratives and remarks respecting the personages and events of the times in which he lived, is termed his Memoirs, being supposed, as the name denotes, to have been drawn up with the object of assisting his memory in reflecting on past events In modern but incorrect diction the life of a person by another is also termed his Memoirs if drawn up with a somewhat less regular arrangement and containing more matter not immediately connected with the subject than the species of narration which we term a Life The French were the earliest, and have always been by far the most successful writers, in this branch of literature Their historical memoirs, partly autobiographical, and partly the works of authors who had access to the papers and memorials of those whose lives they illustrated, form a complete series from the 16th century to the present time and throw the greatest light on some portions of history, while their memoirs of celebrated individuals in the ranks of literature and fashion are still more numerous and interesting In the last century this branch of literature became so popular that any distinguished individual who did not leave authentic memoirs of himself was sure to become the subject after his death of fabricated memoirs published under his name and this species of falsification of which Voltaire then complained appears to be now carried on as extensively as at any former period The collections of historical memoirs recently edited in Paris contain three series of historical memoirs relating to French history and one of English memoirs translated illustrating the period of our great civil war and revolution The latter undertaking was conducted by M Guizot

MEMORIAL In Diplomacy a species of informal state paper much used in negotiation Memorials are said to be of three classes 1 Memorials in the form of letters subscribed by the writer and speaking in the second person as addressed to another 2 Memorials proper or written representations subscribed by the writer and with an address but not speaking in the second person 3 Notes in which there is neither subscription nor address Specimens of the first class of memorials are circulars from the bureau of foreign affairs sent to foreign agents answers to the memorials of ambassadors and notes to foreign cabinets and ambassadors

MEMORY (Lat *memini I remember*), is defined to be the power or capacity [illegible] to the senses or the mind accompanied by a distinct consciousness of past existence The term is also employed though more rarely to denote the act or operation of remembering, or the peculiar state of the mind when it exercises this faculty in contradistinction to the faculty itself Various opinions have been propounded by metaphysicians respecting the nature and origin of the faculty of memory Upon this point, however it is not our intention to enter into any details as this question is so mixed up with that of other faculties of the mind such as perception and association and such metaphysical questions as personal identity &c, as to be inseparable from them, and to these heads we must refer the reader for information We may however remark that the ancient Platonists and Peripatetics ascribed the faculty of memory to the common theory of ideas, that is of images in the brain or in the mind of all the objects of thought, and in this opinion they were supported, with slight modifications by many other philosophers of antiquity But Dr Reid who has examined this question with great acuteness has satisfactorily demonstrated the theory of the ancients to be very defective The more modern theories of Locke, Hume, and other philosophers also meet with little consideration from the same acute metaphysician, who, after exposing their fallacies, sums up in these words —"Thus, when philosophers have piled one supposition on another as the giants piled the mountains in order to scale the heavens it is all to no purpose — memory remains unaccountable, and we know as little how we remember things past as how we are conscious of the pres[illegible] (*Essays on the Human Mind* p 159 185)

MENACHANITE [illegible] oxide of titanium, found in the [illegible] of Menachan [illegible]

MENDICANT FRIARS *See* ORDERS, MENDICANT

MENDICITY (Lat mendico, *I beg*) The condition of habitual beggars One of the greatest curses which can afflict a civilized society is the prevalence of mendicity, and it is very much to be regretted that the prejudices of excellent and humane persons have so constantly interposed, and still interpose, difficulties in the

w of the adoption and enforce nent of correct principles [illegible] ... [illegible] ... [illegible] ... seeing in mendicity only the natural expression of that indige ce into which numbers are unhappily thrown by the inequality of property and uncertainty of employment prevailing in almost all communities and who forget [illegible] ... [illegible] ... [illegible] ... poor laws, and far more than either the activity of En- [illegible] ... [illegible] ... [illegible] ... And, owing to that very circumstance, it is perhaps worse in England than in any other country, that is, the established mendicants are more connected with the criminal part of the population (See the reports of the Constabulary Force Commission) Ireland has long been unhappily celebrated for the prevalence of mendicity The number of destitute persons" in the island was estimated by Mr Stanley in 1837 at about 80,000 (*Mr Nicholl's Report on Poor Laws in Ireland*) the number of street mendicants in Dublin at nearly 1000 or almost *one twentieth* of the population Mr Lewis following the evidence adduced before the Irish Poor Law Commission, divides the habitual mendicants into —1 Wandering beggars chiefly cripples blind maimed &c 2 Professional strolling beggars who have no fixed domicile, and live constantly by mendicancy 3 Town beggars who live by mendicancy but have a fixed domicile these he says are generally known by those who relieve them and their character is not on the whole very bad" 4 Poor housekeepers who are relieved by three or four neighbours, to whom their wants are known but who would not resort to general begging (*On Local Disturbances in Ireland* 1835) Mendicancy and wretchedness,' says Mr Nicholl, have become too comm [illegible] ... truth [illegible] ... giving in Ireland to those of indiscriminate legal relief in England What effect the new system of poor laws may have on this and other evils of that country time must show In France, *depots de mendicite* were first founded in 1767, a kind of half way between prisons and hospitals for mendicants Their situation was rendered dependent on their good behaviour These receptacles held 6000 or 8000 persons in 1789 In 1808 by a new law vagabonds mere vagrants, were distinguished from beggars —the disabled persons, or other persons begging within their own [illegible] ... the former were sent to maisons de [illegible] ... here are now two giol depots for Paris [illegible] ... and Villers Cotterets and all authorities concur in the statement that they had manifestly diminished mendicity at Paris (Degerando *De la Bienfaisance Publique* iii part 3 b 1) "The road to mendicity," says M Sismondi "is now too wide and too easy, instead of calling on religion to smooth it, we should multiply as far as possible the resources of the poor, in order to prevent their being dragged into it"

MENILITE A mineral somewhat resembling semi-opal, found at Menil Montant near Paris

MENISCUS A lens convex on one side and concave on the other *See* LENS

MENISPERMIC ACID An acid contained in the berries of the *Menispermum cocculus* (*Cocculus indicus*) where it exists in combination with the vegetable alkali called *picrotoxia*

MENNONITES The title by which the Anabaptists of Holland came to be distinguished after they had put themselves under the guidance of Menno a native of Friesland, who undertook to moderate the extraordinary fanaticism of those sectarians (*Mosheim* transl, ed 1790 v 490) *See* BAPTISTS ANABAPTISTS

MENOBRANCHUS (Gr *μενω I remain* *βραγχια, gills*) A Perennibranchiate amphibian, which retains the external gills

MENOPOMÆ, *Menopoma* (Gr *μενω* and *πωμα a lid*) A Perennibranchiate amphibian which retains the opercular aperture, but not the external gills

MENORRHAGIA (Gr *μην a month*, and *ρεω, I flow*) Flooding, immoderate menstrual discharge, hæmorrhage from the uterus

MENSTRUUM (Lat mensis, *a month*) signified, in the language of the old chemists some preparation or drug which could only operate effectually at a particular period of the [illegible] ... used for any fluid sub [illegible] ...

MENSURATION Though this term literally signifies the act of measuring, it is usually employed to denote the branch of practical geometry which teaches the methods of calculating the dimensions and areas of figures the volumes of solids &c from the measurement of certain lines or angles of the figures or solids, which supply the requisite data

Every rectilineal plane figure may be decomposed into triangles; and hence the mensuration of such figures resolves itself into the determination of the sides or area of a triangle (*See* TRIGONOMETRY) [illegible] ... planes may in like manner be [illegible] ... and their contents consequently determined by the methods of elementary geometry (*See* PYRAMID) The determination of the lengths of curve lines, the areas of figures bounded by curves, and of solids bounded by curve surfaces, requires the application of the integral calculus (*See* QUADRATURE, RECTIFICATION) For the areas and volumes of the most usual geometrical figures, see the respective terms as CIRCLE ELLIPSE &c

MENTUM (Lat *the chin*) In Mammalogy the term is applied to the outer [illegible] ... of the mouth, or lower jaw The *mentum prominulum* is that which [illegible] ... from the upper margin of the lower jaw, the *mentum absconditum* is that which [illegible] ...

MENU INSTITUTES OF The [illegible] ... most celebrated code of [illegible] ... law called from Menu, Men [illegible] ... by whom it is supposed to have been revealed The Hindoos themselves ascribe to this system the highest antiquity, and many of the most learned Europeans are of opinion that of all known works there is none which carries with it more convincing proofs of high antiquity and perfect integrity Sir W Jones assigns the date of its origin somewhere between Homer and the Twelve Tables of the Romans, and Schlegel asserts it as his belief that it was seen by Alexander the Great in a state not materially different from that in which we possess it The Institutes of Menu [illegible] ... ture they embrace all [illegible] ... history of the creation of the world and man, the nature of God and spirits and a complete system of morals, government and religion The work, says Sir W Jones, contains abundance of curious matter, interesting both to speculative lawyers and antiquaries, with many beauties which need not to be pointed out, and with many blemishes which cannot be justified or palliated it is a system of despotism and priestcraft, both, indeed, limited by law but artfully conspiring to give mutual support But notwithstanding these and other defects, as has frequently been remarked the most striking features by which the code of Menu is distinguished are the rigour and purity of its morals Many of its maxims have all the sublimity of the precepts of Christianity, to which, in fact, they bear a close resemblance, not only in the style of [illegible] ... but of expression Thus, "Let not a man complain even though in pain, let him not injure another in deed or in thought, let him not even utter a word by which his fellow-creatures may suffer uneasiness" Again, "Let him bear a reproachful speech with patience, let him speak reproachfully to no man, with an angry man let him not in return be angry, abused, let him answer mildly" The inspired words of the Psalmist, "The fool hath said in his heart there is no God," are thus almost verbally rendered The wicked have said in their hearts no one sees us yes the gods distinctly see them, and so does the spirit within their breasts" The Institutes of Menu have been translated into the English and French languages into the former by Sir W Jones in 1794, the latter by Des Longchamps in 1830 (Strasburg) An edition of the original Sanscrit, together with Sir W Jones's translation was published at Calcutta in 1822-25 by Sir Graves Haughton

MENURA (Gr *μενος, strength*, and *ουρα, a tail*) A name invented by Dr Shaw for a genus of birds peculiar to Australia, the true affinities of which have been the subject of [illegible] ... ornithologists [illegible] ... the *Menura* [illegible] ... pheasants evidently belong to the order *Passeræ*, and approach the thrushes in their beak, which is triangular at the base, elongated, slightly compressed, and emarginate at the point Only one species is at present known, and this is chiefly peculiar for an extraordinary sexual development of the tail feathers of the male Of these there are three kinds the twelve common ones, with very fine and widely separated barbs, two more in the middle, of which only one side is furnished with thickly-set barbs, and two external ones, curved in the figure of an S, or like the arms of a lyre, whose internal barbs, large and thickly set, form a kind of broad riband, while [illegible] ... become longer only near [illegible] ... the twelve ordinary quills.

MENYANTHES (Gr [illegible] ... A genus of Gentianaceous plants [illegible] ... pro- [illegible] ... in which [illegible] ...

MENYNGES (Gr *μηνιγξ, a membrane*) The membranes which cover the brain are so called

MEPHITIS (Lat) Any noxious exhalation, but more [illegible] ... applied to carbonic acid gas Mephitis was [illegible] ... goddess who was invoked by the [illegible] ... noxious vapours

MERCAPTAN [illegible] ... posed of sulphur, car

bon, and hydrogen, which has received the above name from its energetic action on mercury — *corpus mercurium cupiens* (*Voir Annales de Chimie et Physique* lv 87)

MERCATOR'S CHART, or PROJECTION A representation of the sphere on a plane, in which the meridians are represented by equidistant parallel straight lines and the parallels of latitude also by straight lines perpendicular to the meridians This projection, which is universally adopted for nautical charts, by reason of the facilities which it affords in navigation from the circumstance that the rhumb, or sailing course between two points, is represented by a straight line, was invented by Gerard Mercator (his true name was *Kauffman*, of which Mercator is the Latin equivalent), a native of Rupelmonde, in East Flanders, born in the year 1512 But, though Mercator gave his [illegible] not appear that he knew t[illegible] distance of the parallels fr[illegible] true principles [illegible] Edward Wright of Ca[illegible] explained them in his tr[illegible] *f certain Errors in Navigation*, published in 1599, and are as follows —Suppose one of the meridians on the globe to be d[illegible] one of these, taken at any parallel of latitude, w[illegible] a minute of longitude taken on that parallel, as the radius of the equator to the radius of the parallel, that is, as radius to the cosine of the latitude, or as the secant of the latitude to radius This proportion holds true on the map in this sense that if a minute of the equator be taken as the unit of a scale, and that unit be considered as the radius of the tables, then the representation of a minute of latitude will be expressed by the number in the trigonometrical tables which is the secant of that latitude Hence on the map while the degrees of longitude are all equal, the degrees of latitude marked on the meridian form a scale of which the distances go on increasing from the equator towards the poles, each being approximately the sum of the secants of all the minutes of latitude in the degree The numbers resulting from the addition of the secants of the successive minutes reckoned from the equator form a scale of meridional parts, which is given in all books of navigation The very remarkable property of this projection, namely that the divisions of the meridian are analogous to the excesses of the logarithmic tangents of half the respective [illegible] y 45° above the logarithm of the [illegible] by Bond about the year 1645, but was first demonstrated by James Gregory, in his *Exercitationes Mathematicæ* published in 1668 (See the *Scriptores Logarithmici* vols ii and iv)

MERCURIA'LE The first Wednesday after the great vacation of the parliaments under the old French régime On that day they met to discuss grievances and deficiencies, and to reprimand members for misconduct Hence an harangue of reproof is popularly termed in French a *mercuriale*

ME'RCURY (Probably from the Lat merx *merchandise*) The Latin name of the Grecian Hermes He was the son of Jupiter and Maia, and discharged the office of the messenger of the gods Part of his duty was also to conduct the shades of the dead to the infernal regions He presides over eloquence, profit, good fortune, and theft, in which he was himself so great a proficient that, on the day of his birth he stole fifty kine from the herds of Apollo whom he repaid by the gift of his invention, the lyre (See the Hymn ascribed to Homer with the beautiful translation of it by Shelley) His attributes, exploits, and insignia are briefly enumerated by Horace (Ode I 10) —

> Mercuri facunde, nepos Atlantis
> [illegible]
> Fortis Pelasgi [illegible] deorum
> Mercurius,
> [illegible]
> [illegible]
> *Condere furto*

Between which passage and the lines of Ovid (*Fasti*, v 663—669) a curious coincidence will be found Mercury was represented as a youth lightly clad, with the *petasus* or winged hat, and wings at his heels In his hand he bears the emblem of his heraldic office the *caduceus* [illegible] with two serpents twined about it The more ancient statues of Mercury were square blocks of stone, with a rudely carved head on them They were set up in great numbers in the streets of Athens

ME'RCURY In the Solar System, the planet nearest the sun The mean distance of Mercury from the [illegible] 0 387098, the radius of the earth being taken as unity it is consequently little more than a third of the earth's distance from the sun [illegible] His mean sidereal revolution [illegible] solar days and his successive oppositions or conjunctions take place at intervals of 115 877 mean solar days The orbit is inclined to the ecliptic in an angle of [illegible] and its eccentricity is greater than that of any other of the old planets being 0 2056, the major axis being unity Mercury being an inferior planet always appears in the neighbourhood of the sun his greatest elongation or angular distance from the sun amounts only to 29° 48′ so that he is very seldom visible to the naked eye His apparent diameter varies from 5″ at his superior conjunction when at his greatest distance from the earth, to 12″ at his inferior conjunction when nearest the earth At a distance equal to the mean distance of the sun from the earth, the apparent diameter is 6 9″ His true diameter, compared with that of the earth taken as unity, is 398, or about 3140 miles On account of the smallness [illegible] and, in a good telescope, exhibits phases, and the planet is supposed to revolve about its axis in the space of 24 h 5 m 28 sec Mercury is sometimes seen to pass over the sun's disk This occurs only when he is in one of his nodes nearly at the time he is at his inferior conjunction The phenomena are of more frequent occurrence than the transits of Venus, but of far less astronomical importance The three next transits will be visible in this country, and will occur at the following dates —1861, Nov 11, 1868, Nov 4, 1878, May 6 *See* PLANET

ME'RCURY This metal is found chiefly in the state of *sulphuret* which is decomposed by distillation with iron or lime It is also found *native* Mercury is the only metal which is liquid at common temperatures, it is white and very brilliant It freezes and assumes a crystalline texture at 40° below zero Its specific gravity is 13 5 It boils at 660° and its vapour condenses upon cool surfaces in minute brilliant globules It is not altered by exposure to air at common temperatures but when kept in vessels to which air has access, at a temperature near its boiling point, it gradually becomes converted into a deep red crystalline substance, which is the *peroxide*, or *red oxide of mercury* When mercury is dissolved in cold dilute nitric acid the pure alkalis throw it down in the form of *black protoxide* The same oxide is also [illegible] with solution of caustic po[illegible] oxides of mercury The equivalent of this metal is about 200 and the oxides consisting respectively of 1 atom of mercury and 1 of oxygen and 1 and 2, are represented by 200 + 8 = 208 and 200 + 16 = 216 Mercury is represented in chemical formulæ by *hg* from the Latin *hydrargyrum*, literally signifying *water silver* The symbol of the protoxide will then be (*hg* + *o*) and of the peroxide (*hg* + 2 *o*) Each of these oxides combines with the acids, and produces the *protosalts* and *persalts* of mercury

*Mercury and Chlorine* — There are two *chlorides of mercury*, a *protochloride* or *calomel*, and a *perchloride* or *corrosive sublimate* Calomel may be obtained by mixing 60 parts (1 equivalent) of common salt or chloride of sodium with 248 parts (1 equivalent) of protosulphate of mercury and exposing the mixture in a proper subliming vessel to a red heat, the chlorine of the salt combines with the mercury of the sulphate to form protochloride of mercury [illegible] of 200 mercury and 36 chlorine) and the [illegible] salt uniting with the oxygen of the oxide of mercury becomes soda which, with the sulphuric acid forms sulphate of soda Calomel may also be obtained by mixing 200 parts of mercury with 272 of corrosive sublimate and subliming the mixture When thoroughly washed and levigated calomel is a tasteless white powder, its specific gravity is 7 2 When heated it acquires a yellow colour, and at a temperature below redness it rises in dense white fumes, which are deposited in the form of a white powder upon cold surfaces It is insoluble in water When hastily sublimed it often becomes a crystalline horny mass and occasionally forms beautiful prismatic crystals It is sometimes found native, forming however, a very rare ore called from its appearance *horn quicksilver*

Perchloride of mercury or corrosive sublimate is obtained by sublimation from a mixture of 120 parts of common salt (or 2 equivalents), and 296 (or 1 equivalent) of persulphate of mercury It rises in the form of a white crystalline substance of an acrid metallic taste, highly poisonous soluble in 20 parts of cold and in 2 of boiling water Its specific gravity is 5 2 When heated it evaporates in acrid fumes at a temperature below that required for the volatilization of calomel Corrosive sublimate is a compound of 1 equivalent of mercury and 2 of chlorine In the above process [illegible] chlorine is furnished by the chloride [illegible] phate of soda is the other product

*Bisulphuret of Mercury*, known also by the name of cinnabar or vermilion, is prepared artificially by heating together 100 parts of mercury with about 20 of sulphur, they form a black compound, which when strongly heated, rises in the form of a deep crimson-coloured sublimate, this, reduced by long trituration into a fine powder, ac[illegible] tasteless, and insoluble [illegible] and 32 sulphur, or (*hg* + 2 *s*) A black *protosulphuret of mercury* (*hg* + *s*) is precipitated by sulphuretted hydrogen from a solution of the protonitrate When a mixture of equal weights of

finely-powdered peroxide of mercury and Prussian blue is boiled in water till the blue colour disappears, the solution yields, when filtered and evaporated, a crop of straw-coloured prismatic crystals, which are *bicyanuret of mercury* $2\,cy + hg$

Mercury is found in various parts of the world Among the principal mines are those of Almaden near Cordova in Spain, Idria in Carniola, Wolstein and Moschel in the Palatinate, Guancavelica, in Peru It is stated by Dr A T Thomson, in his *Dispensatory*, that most of the mercury used in this country is brought from Germany But, whatever may have been the case formerly, it is certainly true at present Of the 34 hundredweights of quicksilver imported in 1831, 1832, and 1833, from Germany, 269,558 lbs were brought from Spain 13,714 lbs from Gibraltar, the rest principally from Carniola, and a part from Spain, 31,014 lbs were brought from Italy Only 192 310 lbs were retained for home consumption in 1833 *Pol Jo*, No 550 Sess 1834 Quicksilver is found in the provinces of Chuquisaca, Potosi, and Oruro, between Europe and America was interrupted, the price of quicksilver rose to such a height in the latter that it answered to import it from China, but after the peace it was regularly exported to the latter, and at an average of the 14 years ending with 1828 the imports of quicksilver by the English and Americans into Canton amounted to 618 085 lbs a year, worth 340 262 dollars Besides its uses in medicine, mercury is extensively employed in the amalgamation of the noble metals in water gilding, the making of vermilion, the silvering of looking-glasses, the making of barometers and thermometers, and many other scientific instruments

MERGER, in Law is the destruction of a lesser estate in lands and tenements by the acquisition of a greater estate in the same immediately succeeding by the same party and in the same right Thus an estate for years is said to merge or sink in an estate for life if there be no other estate vested in another person intervening between the two and an estate for life in an estate of inheritance There is no merger of an estate tail

MERGUS (Lat mergus the name of a sea bird, supposed to apply to the cormorant) A numerous genus of Anserine birds characterized by a beak thinner and more cylindrical than that of the ducks and with each mandible armed at its margins with small pointed teeth directed backwards, like those of a saw the upper mandible is curved downwards at its extremity The goosander (*Mergus serrator*) and the merganser (*Mergus merganser*) are examples of this genus

MERIDIAN (Lat meridies *mid-day*) In Astronomy a great circle of the sphere passing through the earth's axis and the zenith of the spectator It is the circle on which the latitudes of places are reckoned commencing from the equator which it intersects at right angles The terrestrial meridian is the great circle (or rather ellipse) formed by the intersection of the surface of the earth with the plane passing through the poles and the place of the spectator See DEGREE

MERIDIAN ALTITUDE The altitude or height above the horizon &c in degrees of any celestial object, when it crosses the meridian of a place

MERIDIAN, FIRST The meridian from which longitudes are reckoned The choice of the first meridian is entirely arbitrary, and most nations reckon the longitudes from their capital, or meridian passing through their principal observatories Thus in English works the longitude is reckoned from Greenwich, in French, from Paris in Russian from St Petersburg, &c Ptolemy employed the Canary Islands, the French formerly reckoned from Ferro, and the Dutch from the Peak of Teneriffe Mercator chose the island Del Corvo See LONGITUDE

MERIDIAN LINE A line traced on the surface of [illegible] the meridian [illegible]

MERIDIAN OF A GLOBE, OR BRASS MERIDIAN, is a graduated circular ring, within which the globe is suspended and revolves, and by means of which it is connected with the frame bearing the horizontal scale Meridian lines are also traced on the globe itself, usually at 15° distance, or a difference of longitude corresponding to one hour of time It is probable that these, with the parallels of latitude, suggested to Descartes the idea of *co ordinates* which he applied so successfully to [illegible] with geometry

MERINO SHEEP A breed of sheep till lately peculiar to Spain, but now reared in Saxony, England, and more particularly in Australia chiefly for the superior fineness of their wool The word *merino* signifies an overseer of pasture lands and is applied to this breed of sheep, because, in Spain [illegible] migratory flocks, under a system of [illegible] as a head, and with a general right of pasturage all over the kingdom The best flocks of Spanish merinos are found in Leon and Castille of the Saxon variety, at Stolpen and Rochsburg, but merinos are to be found in North America, the Cape of Good Hope, and above all in New South Wales, which promises to be one of the principal [illegible] the world *See* SHEEP

MERLON In Fortification, the part of the parapet or epaulement included between two embrasures

MERMAID (Germ meer, *sea*, and magd, *maid*) A fabulous creature, the fore part woman, the hinder half fish The species of [illegible] still existing have been viewed at a distance in the sea by persons who have excited the idea of mermen and mermaids, are the cetaceous *dugong* and *manatee* these have their teats placed [illegible] like arms and hands, and terminate behind [illegible] like tail The nipples are pectoral, and they are often seen ascending to the surface to breathe, clasping their suckling young to the breast

MEROPIDANS, *Meropidæ* The family of Insessorial birds of which the bee-eater (*Merops*) is the type.

MEROS (Gr) In Architecture, the plane face between the channels in the triglyphs of the Doric order

MERULIDANS, *Merulidæ* The family of Dentirostral passerine birds of which the thrush (*Merula*) is the type

MESEMBRYANTHEMUM (Gr μεσος, *the middle*, βρυω *I grow*, and ανθος, *a flower*), is a very large genus of [illegible] Cape plants, of which many species are conspicuous for the beauty of their flowers, which expand in sunshine and close up in gloomy weather They are chiefly interesting on account of the hygrometical quality of their fruit, which when wetted opens out into numerous radiating valves and when dry contracts with force into a compact and apparently solid body This fruit is sometimes called the fig-marigold

MESENTERY (Gr μεσος, and εντερον, *an intestine*) The membrane by which the intestines are attached to the vertebræ, it is formed of a duplicature of the peritonæum, and supports the nerves and vessels of the intestines

MESMERISM *See* MAGNETISM, ANIMAL

MESNE PROCESS Such process as intervenes between the beginning and end of a suit It is opposed to final process or that which takes place by way of execution after judgment Imprisonment for debt on mesne process was effected by the bare affidavit of one person, stating that another owes him 20*l* It is abolished, under certain exceptions by 1 & 2 Vict c 110 *See* ARREST

MESOCOLON (Gr μεσος, and κωλον *the colon*) The mesentery of the colon it is an extensive duplicature of the peritonæum

MESOLABE (Gr μεσος, and λαμβανω, *I take*) An instrument employed by the ancients for finding two mean proportionals between two given lines, which were required in the problem of the duplication of the cube (See *Eutocius on the Works of Archimedes*, and the 3d Book of *Pappus*)

MESOLYTE (Gr μεσος and λιθος *a stone*) A hydrated silicate of alumina, lime, and soda It is also called *needle stone*

MESOPHYLLUM (Gr μεσος, and φυλλον, *a leaf*), is the parenchymatous tissue forming the fleshy part of a leaf between the upper and lower integuments

MESOTHORAX (Gr μεσος, and θωραξ *the chest*), in Entomology is the posterior segment of the thorax, which bears the posterior pair of wings and the third or posterior pair of legs

MESOTYPE (Gr μεσος and τυπος *form*) A hydrated silicate of alumina and soda It has also been called natrolite It occurs in trap rocks and in the ancient lava of Vesuvius

MESS in Military Language signifies the public dinner prepared either for the officers of the same regiment, or for those of different regiments if in garrison, and to the support of which they are bound to contribute a portion of their pay General [illegible] only married officers are exempted from [illegible] and dining at the mess, the rest preside over it in rotation, without respect to military rank

MESSENGER In Naval Language, a hawser or small cable of about sixty fathoms in length, wound round the capstan, and having its two ends lashed together When the anchor is to be weighed this rope is attached to the cable by the *nippers*, and thus acts as an endless rope [illegible]

MESSENGERS [illegible] employed in the [illegible] to convey despatches, either at home or abroad They were formerly employed in serving the secretaries' warrants for the apprehension of parties charged with high treason, or other grave offences, and in such cases it was not unusual for them to detain their prisoners at their own houses In the year 1713 the ambassador of the [illegible] of Morocco was taken into custody by a [illegible] messenger, and released only after a lapse of six months

MESSIAD The name given to the only modern epic poem of Germany, the subject of which is, as the name implies the sufferings and triumph of the Messiah It is written in hexameter verse [illegible] as elsewhere observed, the German [illegible] modern language, and consists of 20 books. The publication of this poem procured for its author unbounded

high praise must be understood as referring chiefly to its having been among the first productions in which the power and resources of the German language were developed, rather than to its innate merits as an epic poem, or to the influence it has exercised over the national poetry of Germany The reputation of Klopstock among his own countrymen rests chiefly on his Odes, and it must be admitted that in all those parts of his epic poem into which [illegible] words whenever the [illegible] excited,—there are few poets, either ancient or modern, to whom he deserves to be postponed But on the other hand the dignity and simplicity of his sentiments are not unfrequently disfigured by the pedantry and affectation of his style and the tediousness of his episodes

MESSIAH An old Hebrew word signifying the anointed or sacred corresponding with the Greek word χριστος, and in this sense applied to the Saviour as it was [illegible] the Jews to their prophets, priests and kings It was customary to anoint all these high personages when they assumed their office We read in Psalm ii 2, "The kings of the earth set themselves against the Lord and against his *anointed*" (i e his Messiah), and in Psalm xlv 7, "Therefore God even thy God, hath *anointed* thee with the oil of gladness above thy fellows" This *anointing*, therefore was not a sensible unction with external oil or ointment but a symbol of it, a spiritual, an internal unction of grace given by the Holy Ghost—"And God gave not the spirit by measure unto him" St Luke tells us that our Saviour applied this *anointing* to himself when [illegible] synagogue of Nazareth [illegible] is a pause for any one to speak or read who can enlighten or instruct the people when this period came our Saviour stept forward, took up the Hebrew roll and opened it at the book of the prophet Isaiah and read aloud this passage —"The spirit of the Lord is upon me because he hath *anointed* me to preach the gospel to the poor &c, and he closed the book and he gave it to the minister and sat down The eyes of all them that were in the synagogue were fastened on him and he said, "This day is this scripture fulfilled in your ears, and all bare him witness and wondered at the gracious words which proceeded out of his mouth" (Luke iv 17 &c)

MESSUAGE (modern Lat messuagium) in Law is said to be properly a dwelling-house with a small portion of land adjacent or the site of the manor It is now one of the general words used in the legal description of dwelling-houses with the land attached

MESTINO In Spanish America, the child of a [illegible]

METAMORPHOSIS [illegible] morphosis

METACARPAL (Gr μετα, *between*, and καρπος, in the sense of *the wrist*) Belonging to the metacarpus or that part of the hand which is between the wrist and fingers

METACENTRE (Gr μετα, and κεντρον, *centre*) A term first applied by Bouguer to that point of a floating body in which, when the body is disturbed from the position of equilibrium, the vertical line passing through the centre of buoyancy meets the line which when the body is at rest passes through the centre of buoyancy and centre of gravity In order that the body may float with stability the position of the metacentre must be above that of the centre of gravity *See* HYDROSTATICS

METAGALLIC ACID When gallic acid is rapidly heated up to about 480°, carbonic acid and water are evolved, and a black product remains soluble in the alkalies and forming insoluble compounds with many of the metallic oxides This product has been termed *metagallic acid*, its ultimate elements are 12 atoms of carbon = 72, 3 atoms of oxygen = 24 and 3 atoms of hydrogen = 3, making its equivalent = 99

METALLOIDS (Gr μεταλλον, *a metal*, and ειδος, *form*) A term sometimes applied by chemists to the inflammable non metallic bodies such as sulphur phosphorus &c The metallic bases of the fixed alkalies and alkaline earths have also been by some called metalloids, in consequence probably of their low specific

METALLURGY (Gr μεταλλον and εργαζομαι) The art of separating metals [illegible] The principal metallurgic processes are described under the respective metals

METALS (Gr μεταλλον) are distinguished by their [illegible] out of their opacity and reflec- [illegible] They conduct electricity and heat and they have not been resolved into other forms of matter so that they are regarded as simple or elementary substances When their compounds are electrolysed the metals appear at the negative surface and are hence considered as electro positive bodies They are enumerated in the following table, together with the names of the chemists by whom they were discovered the date of the discovery their specific gravities melting points, equivalent or atomic weights and symbolic abbreviations For their individual distinctive characters see the respective metals Tantalum is omitted inasmuch as its properties and combining weight have not been accurately examined

| | Names of Metals | Authors, and Dates of their Discovery | Specific Gravity | Melting Points | Equivalent Weights | Abbreviations or Symbols |
|---|---|---|---|---|---|---|
| | | | | *Fahr* | | |
| 1 | Gold | (Known to the ancients and represented by the annexed symbol, with which they were supposed to be mysteriously connected) | 19 25 | 2016° | 200 | au |
| 2 | Silver | | 10 47 | 1873 | 110 | ag |
| 3 | Iron | | 7 78 | 2800° s f * | 28 | fe |
| 4 | Copper | | 8 89 | 1996 | 64 | cu |
| 5 | Mercury | | 13 60 | 39 | 200 | hg |
| 6 | Lead | | 11 35 | 612 | 104 | pl |
| 7 | Tin | | 7 29 | 442 | 58 | sta |
| 8 | Antimony | Basil Valentine 1490 | 6 70 | | 65 | an |
| 9 | Bismuth | Agricola 1530 | 9 80 | 497 | 72 | bi |
| 10 | Zinc | Paracelsus? 1530 | 7 00 | 773 | 32 | zn |
| 11 | Arsenic | Brandt 1733 | 5 88 | | 38 | ar |
| 12 | Cobalt | | 8 53 | 2810° † | 30 | cob |
| 13 | Platinum | Wood 1741 | 20 98 | oh bp † | 96 | pla |
| 14 | Nickel | Cronstedt 1751 | 8 27 | 2810° | 28 | nic |
| 15 | Manganese | Gahn 1774 | 6 85 | s f | 28 | mn |
| 16 | Tungsten | D'Elhuyart 1781 | 17 60 | | 100 | tu |
| 17 | Tellurium | Müller 1782 | 6 11 | 620° | 32 | tel |
| 18 | Molybdenum | Hielm 1782 | 7 40 | oh bp | 48 | mol |
| 19 | Uranium | Klaproth 1789 | 9 00 | oh bp | 217 | ur |
| 20 | Titanium | Gregor 1791 | 5 30 | oh bp | 24 | ti |
| 21 | Chromium | Vauquelin 1797 | | oh bp | 28 | chr |
| 22 | Columbium | Hatchett 1802 | | oh bp | 185 | col |
| 23 | Palladium | Wollaston 1803 | 11 50 | - - | 54 | pal |
| 24 | Rhodium | | | oh bp | 45 | rh |
| 25 | Iridium | Tennant 1803 | | oh bp | 96 | ir |
| 26 | Osmium | | | oh bp | 100 | os |
| 27 | Cerium | Hisinger 1804 | | | 48 | ce |
| 28 | Potassium | Davy 1807 | 0 86 | 136 | 40 | po |
| 29 | Sodium | | 0 97 | 190 | 24 | so |
| 30 | Barium | | | | 70 | ba |
| 31 | Strontium | | | - | 44 | str |
| 32 | Calcium | | | - - | 20 | cal |
| 33 | Cadmium | Stromeyer 1818 | 8 60 | 442 | 56 | cad |
| 34 | Lithium | Arfwedson 1818 | | | 10 | li |
| 35 | Silicium | Berzelius 1824 | | - | 8 | si |
| 36 | Zirconium | | | - | 30 | zir |
| 37 | Aluminum | | | | 10 | al |
| 38 | Glucinum | Wöhler 1828 | | - - | 18 | gl |
| 39 | Yttrium | | | - | 32 | yt |
| 40 | Thorium | Berzelius 1829 | - | - | 60 | th |
| 41 | Magnesium | Busey 1829 | - - | - - | 12 | mag |
| 42 | Vanadium | Sefström 1830 | - | - - | 68 | va |

METAMECONIC ACID, is produced by boiling the aqueous solution of meconic acid It evolves carbonic acid, and becomes brown Two atoms of meconic acid are thus resolved into 1 of metameconic acid and 2

* Smith's forge. † Oxyhydrogen blowpipe.

of carbonic acid It is represented by 12 *car* + 4 *h* + 10 *ox*

METAMORPHOSIS (Gr μετα, indicating *change*, and μορφωσις Transformation The heroic poem of Ovid in which he recounts the most celebrated mythological narratives respecting the gods of Greece and Rome, and the changes wrought by supernatural power In Entomology the change of form which insects and some other animals undergo in passing from one stage of existence to another, in each of which they manifest different habits, and have a different organization The three states of a fly, or perfect insect are *larva*, *pupa*, and *imago*

METAPHOR (Gr μεταφερω, *I transfer* indicating the substitution of one word for another of similar meaning) In Rhetoric, a figure by which a word is transferred from the subject to which it properly belongs and applied to another which has some similitude to its proper subject, with a view to give energy to the expression of the former A comparison or simile (*see* COMPARISON) appears to be only a metaphor with the addition of a sign denoting that it has been thus transferred Thus "the silver moon" is a metaphorical expression for the [illegible] objects by names to the expression of the feelings and wants of a complicated mode of life, it becomes more and more metaphysical in character until it is found that a very large proportion of the words in common use are either metaphors, or are words derived from foreign languages, and whose primary sense as derivatives is the same with their secondary or metaphorical sense in the language from which they came Thus, the English word 'character" used a few lines above is drawn from the metaphysical use of the Greek χαρακτηρ which in its primary signification denoted [illegible] on a hard substance Metaphors have been divided by writers on rhetoric, into several classes, but the most appropriate are those which are termed analogical and which derive their force not from any actual resemblance between two objects, but from a resemblance between the relations which they bear respectively to certain other objects Thus the 'sea of life' is a common and appropriate metaphor, not from any resemblance between the idea of the visible sea and the complex notion of that abstraction which we term human life but because there is a fancied similarity between the position of navigators in an uncertain voyage and that of human beings [illegible] manifold scenes of life

METAPHOSPHORIC ACID A term by which some chemists designate the dry flaky acid obtained by burning [illegible] under a bell glass of air or oxygen

METAPHYSICS (Gr μετα *after* and φυσις *nature*) A word employed in popular usage to denote all those inquiries which are conversant about objects other than merely physical and sensible It is an observation of Sir James Mackintosh that the term *metaphysics* affords a specimen of all the faults which the name of a science can combine To those who know only their own language it must at their entrance on the study convey no meaning It points their attention to nothing If they examine the language in which its parts are significant they will be misled into the pernicious error of believing that it seeks something more than the interpretation of nature It is only by examining the history of ancient philosophy that the probable origin of this name will be found, in the application of it as the running title of several essays of Aristotle which were placed in a collection of the manuscripts of that great philosopher *after* his treatise on physics The censure thus conveyed we cannot with all deference for so eminent an authority regard as more than partially correct Though the account of the origin of the word is as far as it goes, the true one, it does not comprehend the whole truth

If Sir James Mackintosh had examined the contents of those treatises of Aristotle to which he adverts, he would have found that the title *metaphysics* was prefixed to them, not, as his words imply merely because they [illegible] the compiler, because there was the best possible reason for their being so placed in the fact that the inquiries which compose them were conceived by Aristotle himself to admit of a general distinction from that department of inquiry which he included under the name of physics The first few chapters of [illegible] are devoted to the elucidation of [illegible] to the endeavour to clear up the [illegible] once [illegible] whereby they were to be apprehended Admitting, therefore, as we most readily do, that great misapprehensions are popularly entertained with regard to the nature of metaphysics, we shall endeavour, as far as the limits of the present article will permit us, to remove such mistakes, by distinguishing the science of metaphysics from other sciences, with which as they are closely connected with it it has too frequently been confounded

Metaphysics we understand to be the science which regards the ultimate grounds of being, as distinguished from its phenomenal modifications As a means of attaining this end, it considers the correlative of being, knowledge, and knowledge, not merely in reference to its *form*, as it is capable of law and regulation, for that is the province of logic — nor in regard to its history, and the successive stages of its development, which are the objects of psychology, or mental philosophy — but knowledge as it is in relation to being, or objective reality Philosophers have not been satisfied with marking the [illegible] in nature, and the order whether those appearances were outward and sensible, or internal and revived by observation of their own mental processes, they have not even been content with the discovery that their knowledge of phenomena was self-consistent, and obeyed certain determined or determinable canons or forms, they have felt that the highest end of science could then only be attained when all knowledge was perceived to depend on a one ultimate principle, which should demonstrate at once its consistency with itself and its absolute foundation in reality That the science of this ultimate unity is that to which the greatest philosophers have with more or less distinctness assigned the name of metaphysics [illegible] to the history of philosophy for [illegible]

Whether the object thus proposed were one which the human faculties are capable of reaching is itself the first problem of metaphysics, and enters not, therefore, into that with which we have at present to do,—a definition of the word We may indeed with Hume and his followers reject all such attempts as chimerical, and endeavour to resolve the speculations to which they have led into the delusions of association or caprice, or we may with Kant, confine ourselves to the *critique* of our mental laws and as the result of our investigation pronounce that we possess no faculty capable of reaching outward reality In the first case, if we have been careful to ascertain that our analysis has at every step been legitimate we are bound to admit, not that metaphysics is an impossible science but that it does not yet exist *as* a science In the second instance, we are constrained to allow that all reality is subjective only, and that we can only know things in relation to our own modes of knowing, and this is itself a metaphysical principle, preclusive of further inquiry In defiance, however, alike of the sneers of the sceptic, and the yet profounder scepticism of the critical philosophy our own days have witnessed the rise in Germany and France, of more than one professed system of metaphysical science The frequency of such endeavours as these undertaken as they are, by men of such [illegible] eness and philosophical insight as [illegible] Hegel even if they inspire us with no hope of a nearer approximation to the objects which they pursue may at least serve to convince us that the propensity to such speculations constitutes an inalienable and indestructible instinct of our intellectual and moral nature

METAPLASM (Gr prep μετα signifying *change*, and πλασσω *I form*) In Grammar, a general term comprehending all those figures of diction which consist in alterations of the letters or syllables of a word, taking place in three ways,—by augmentation diminution, or immutation 1 Augmentation at the beginning *prosthesis*, in the middle *epenthesis*, at the end *paragoge*, to which may be the number of syllables by their [illegible] 2 Diminution at the beginning *aphæresis*, in the middle *syncope*, at the end, *apocope*, by contraction of two vowels *synæresis* or *crasis* 3 Immutation, *antithesis* signifying the change of one letter for another, *metathesis*, transposition of the order of letters (See those respective heads)

METASTASIS (Gr μετα and στασις, *station*.) The transference or translation of a disease from one part of the body to another

METATARSUS (Gr μετα and ταρσος, *heel*) The instep is so called by surgical writers

METATHESIS (Gr μετα, and θεσις, *position*) In Grammar, the transposition of the letters of a word, a figure of uncommon occurrence in modern orthography, but which very ordinarily takes place in the gradual formation of the dialects of a language *e g* German, ross, English horse *See* METAPLASM

METAUOMI (Gr μετα, and τεμνω, *I cut*) In Architecture, the space between [illegible] and the next

METAYER (Fr, in [illegible] mezzaiuolo, Lat colonus medietarius) In France and Italy, a farmer holding land on condition of yielding half the produce to the proprietor, from whom he receives tools and stock Land thus occupied is said to be held in *metairie* The conditions of the contract, however, vary essentially in different countries and districts The antiquity of this mode of letting land is very great it is probably the same which was called by the Romans *locatio in partibus* (see

*Plin. Epist*); and the farmer thus holding was also termed *colonus partiarius* It now prevails extensively in the south and middle of France throughout Italy in parts of Spain, and, it is said in the East For a very valuable summary of the character and effects of this agricultural system, the reader may be referred to Mr Jones's *Essay on Wealth*, and for a highly coloured view of the state of the peasantry under it in some parts of Italy to M Sismondi's *Etudes sur l'Economie Politique*

METEMPSYCHOSIS (Gr *μετα change* and ψυχη *soul*) A Greek word denoting the migrations of the soul [illegible] successive bodies The doctrine of [illegible] of souls has existed in the belief of various religious and philosophical sects from the remotest antiquity It formed the leading doctrine of one of the most celebrated schools of philosophy in the whole heathen world (*see* PYTHAGOREAN PHILOSOPHY), it was said too to have found numerous adherents in Egypt, but it is chiefly among the Indians that this doctrine has taken deep and permanent root With them it appears to have been an article of faith from the period at which we can first perceive any trace of their existence as a nation, and it is not going too far to say that not only all the opinions, but even all the manners of the Indians, are at this hour built upon this doctrine The Indian doctrine of *metempsychosis* rests on the supposition that all beings derive their origin from God and are placed in this world in an altogether degraded condition, from which they all but more particularly the human race, must either decline into still lower degradation [illegible] with their [illegible] the vicious or the virtuous [illegible] of their nature It must be remarked, however, that the Indians make a wide distinction between the future destiny of those who have passed through life tainted by the usual vices and infirmities of human nature, and those whose lives have been spent in the constant discharge of religious duties In the latter case, the soul does not pass through the [illegible] stages of existence, 'but proceeds directly [illegible] with the Supreme Being with which it is identified as a river at its confluence with the sea merges therein altogether His vital faculties and the elements of which his body consists are absorbed completely and absolutely both name and form cease, and he becomes immortal, without parts or members' (See Mr Colebrooke's translation of Extracts from the *Brahma Sutras*, in the *Transac of the Roy As Soc* vol ix)

METEMPTOSIS See PROEMPTOSIS

METEOROLOGY (Gr *μετεωρος aerial* and λογος, *discourse*) The science of meteors or the science which explains the various phenomena which have their origin in the atmosphere Under the term meteorology it is now usual to include not merely the observation of the accidental phenomena to which the name of meteor is applied but every terrestrial as well as atmospherical phenomenon whether accidental or permanent depending on the action of heat light electricity and magnetism In this extended signification meteorology comprehends climatology and the greater part of physical geography, and its object is to determine the diversified and incessantly changing influences of the four great agents of nature now named, on land in the sea and in the atmosphere See ATMOSPHERE CLIMATE, and the various terms referred to under METEORS

METEORS (Gr *μετεωρα*) A name given to any phenomena of a transitory nature which have their origin in the atmosphere Meteors are of various kinds Some are produced simply by a disturbance of the equilibrium of the atmospheric fluid, and are called *aerial meteors* (*See* WINDS WHIRLWINDS) A second class arise from the deposition of the aqueous particles which the atmosphere holds in solution and which are precipitated in consequence of a diminution of pressure or temperature sometimes in a fluid and sometimes in a concrete form These are called *aqueous meteors* (*See* DEW, FOGS, HAIL, RAIN, SNOW, VAPOUR, &c) A third class of meteors, or atmospherical phenomena, are caused by the action of the aqueous particles dispersed in the atmosphere on the rays of light These are called *luminous meteors* (*See* FATA MORGANA, HALO MIRAGE, PARHELIA, RAINBOW) A fourth class are the *igneous meteors* comprehending those which present the phenomena distinctive of combustion *See* AEROLITE AURORA BOREALIS, FIRE BALLS LIGHTNING, SHOOTING STARS, &c

METHEGLIN (Germ meth, *mead*) A beverage made of honey and water, fermented by the addition of yeast

METHOD From the Greek word *μεθοδος* which signifies a journey undertaken in quest of any object, or a way of attaining a [illegible] hence, [illegible] mode of investigating [illegible] Thus [illegible] method the [illegible] method, the analytical method, &c *See* DIALECTICS INDUCTION, ANALYSIS

METHODISTS The body of Christians to whom this name is chiefly applied are the followers of the late John Wesley, the founder of this numerous sect, hence called Wesleyan Methodists But the term bears a more extensive meaning being [illegible] sections of Christians wh[illegible] from the Wesleyan denomination

The origin of the Methodist society took place at Oxford in 1729 After the Revolution when the principles of religious toleration were recognised amidst the progress of free inquiry the clergy of the established church were [illegible] comparative [illegible] was observed with pain by John Wesley and his brother Charles, when students at the University of Oxford, and being joined by a few of their fellow-students who were intended for the ministry in the established church, they formed the most rigid and severe rules for the regulation of their time and studies, for reading the scriptures, for self-examination, and other religious exercises The ardent piety and rigid observance of system in every thing connected with the new opinions displayed by the Wesleys and their adherents as well as in their college studies, which they never neglected, attracted the notice and excited the jeers of the various members of the university, [illegible] *Methodists*, in allu[illegible]sicians at Rome who practised only by theory (Celsus *in Præfat de Medicina*)

In the mean time Wesley took orders in the established church, and acted for a few months as assistant to his father who was rector of Epworth, in Lincolnshire After the death of the latter he was induced (1735), in company with his brother Charles and two other friends, to accept of an offer to go to Georgia in North America, to preach the gospel to the Indians On his return to England in 1737 Wesley officiated in several churches of the establishment But the higher ranks were offended at his declamatory and enthusiastic mode of preaching, and the clergy having disclaimed some of his doctrines the churches in general were soon shut against him It was his desire however to be allowed to officiate in the pulpit of his native church His object, in truth was to effect a reformation in the church not to recede from connection with it, and the rules he observed himself and imposed upon his followers, were designed as supplementary to the established ritual not as superseding it But the circumstances to which we have referred threw his labours into a different and ultimately an opposite channel, and in short without having at first intended it, he became the founder of the most numerous class of Dissenters in Great Britain

Being thus virtually expelled from the established church he preached in Dissenting chapels in London and other places where he could obtain admission In course of time and owing to the vast multitudes that crowded to listen to his ministrations, he adopted the expedient of officiating in the open air, and commenced field preacher He first formed his followers into a separate society in 1738 the year after his return from America though he referred the establishment of Methodism to a prior date (See *Wesley's Eccles Hist* vol iv p 175) Wesley, from this date devoted his time and his great talents exclusively to the propagation of what he regarded the doctrines of the gospel and to the extension of that sect of which he was the founder His labours were chiefly confined to England but he also paid visits to Scotland and Ireland — in the former of which his success was inconsiderable (*Sir H Moncreiff's Life of Dr Erskine* cap vii) But while he confined his own labours to Great Britain and Ireland, he was not inattentive to the spiritual necessities of other countries, and by means of a succession of missionaries propagated his doctrines to a very great extent in America and many of the West India islands

The unparalleled success which attended his great missionary exertions was not gained without much obloquy and persecution, particularly in the United Kingdom Owing to the intelligence and liberality of the age, neither himself nor any of his missionaries were exposed to stripes and imprisonment, but all of them met with violent opposition on the part not merely of clergymen, both established and dissenting, and the wealthier classes, but also of the people, and some of them were beset with mobs assailed by showers of stones and other missiles, and sometimes dragged through the streets as raving enthusiasts and as disturbers of the public peace It must, at the same time, be confessed that the imprudence of some of his followers contributed somewhat to the reproach which they experienced

Finding his societies rapidly increasing, and having been refused assistance from the established clergy, Wesley was induced to have recourse to lay preachers, an expedient which he was at first exceedingly averse to adopt, but which he afterwards found most efficient in promoting the triumph of his views He was thus enabled to exercise superintendence over all his followers, and greatly to extend his sphere of action

Though Wesley objected to his adherents being called Dissenters, and required them to attend the established church when they had no opportunity of hearing their own preachers, yet his creed is professed Arminianism,

and differs, therefore, in many points from what is generally understood to be the doctrine of the Thirty-nine Articles He denied the doctrine of election, though he admitted that *certain* persons and churches have been elected, and that *great* events have been foreordained He differed from the system of Calvin in regard to the extent of the atonement, which he maintained was for all men He held that repentance preceded faith He taught that, by virtue of the blood of Christ, and the operation of the Holy Spirit, it was the privilege of Christians to arrive at that maturity in grace and participation of the divine nature which excludes sin from the heart, and fills it with perfect love to God and men (*Wesley's Plain Acc of Christian Perfection*) These and other minor opinions in which he differed, or seemed to differ, from the creed of the established church, are still retained by the Methodists (In addition to Wesley's works, particularly his *Sermons*, see *Benson's Apology for the Methodists*, and *Myles's Chronol Hist of the Methodists*) Wesley and his followers, we may here observe continued long after their separation from the church to read the service of that church, nay the practice was continued in a few instances, after his death The great body of the Wesleyans, though they are now classed among Dissenters, are in favour of a national establishment of religion, and give the benefit of their support to the established church of England There is, in truth, a pretty large body who fluctuate between Methodism and the national creed

But while this is the case, the Methodists have adopted a system of church discipline and government quite distinct from those of the establishment and which seems to partake as much of presbytery as of any other polity Of this system which is considerably complicated, the following are the leading features — Each society or congregation is divided into smaller bodies, called *classes* each class embracing from twelve to twenty persons one of whom is styled the *leader* Each society has also a body of men called *stewards*, whose office is similar to that of deacon in the established church The duties of leaders — namely visiting the sick and holding religious intercourse with the members belonging to their class — are in many respects, akin to those of lay elders in the Presbyterian Church of Scotland The leaders, stewards and minister meet once a week (and this is called a *leaders meeting*) on the religious business of the society, and to account for the funds received from the members in support of schools or of the gospel

A number of these societies united constitutes a *circuit* which is large or small as the circumstances of each locality require One of the ministers within the district is termed the *superintendent* The ministers officiating in the circuit meet all the classes quarterly, and speak personally to each member Those whose conduct is devoid of reproach receive a ticket the chief use of which is to prevent imposture After the conference with the classes another meeting (called a *quarterly meeting*) is held consisting of all the ministers leaders and stewards in the circuit On this occasion the stewards deliver their collections to a *circuit steward*, and every thing relating to secular matters is publicly settled At this meeting, also, the candidates for the ministry are proposed, and the stewards, after a definite period of service are changed

From five to ten or fifteen of the circuits according to their extent, form a *district* the ministers in which meet annually, the meeting being termed a *district meeting* This assembly has authority 'to try and suspend ministers who are found immoral, erroneous in doctrine, or deficient in ability, to decide concerning the building of chapels, to examine the demands from the circuits respecting the support of clergymen, and to elect a representative to attend and form a committee, four days before the meeting of the annual conference, in order to prepare a draught of the stations for the ensuing year (*Myles, ut supra*) The circuit stewards are present at this meeting during the settlement of all financial matters The judgment of the assembly is conclusive until the meeting of the conference, to which an appeal is allowed in all cases

The *conference*, which is the supreme judicatory, and whose decisions are final, consists, strictly speaking only of a hundred of the senior itinerant preachers, in terms of a deed of declaration executed by Wesley and enrolled in chancery In this deed the meeting is termed 'the Conference of the people called Methodists" But the conference is generally composed of the preachers elected at the previous district meetings to be their representatives, of the superintendents of the circuits, and of every minister who chooses to attend all of them being allowed the same right of voting as the hundred, or legal conference From this body all authority emanates, and by them all regulations to be observed throughout the whole Methodist connection are framed In their name are levied all the funds required for carrying on the operations of the body Ministers are by th[illegible] to the stations they are respectively to [illegible]

nominate the superintendents of the various districts; they decide on all cases of appeal, and, generally speaking, the whole state of the connection comes under their review and controul All their deliberations are carried on with closed doors, so that the people have no check over their proceedings But the results of their discussions are annually published for each meeting, under the title of *Minutes of Conference*, which embody the laws of the society The gradation of courts, and the supreme authority being vested in the conference, are somewhat similar in spirit and operation to the various judicatories of the Church of Scotland, in which, like the conference of the Methodists, the general assembly is supreme; the chief exception being that the latter judicatory is composed of certain relative proportions of lay elders and clergymen, while the Methodist conference is confined exclusively to ministers (*General Rules of the Methodist Society, Adam's Religious World*, vol iii pp 113—119)

At the death of Wesley, in 1791, there were, in Great Britain and Ireland, about 300 itinerant preachers in connection with the new sect, and 1000 of what are called local preachers, — some of them, however, having very small congregations, — and 80 000 members But the Wesleyan Methodists have established foreign stations in Australia, Van Diemen's Land, &c, and so rapidly have they increased that the number of Wesleyan Methodists in 1850, both at home and abroad, amounted to upwards of two millions, and the total number of preachers, regular and supernumerary, was 6000

Various schisms have taken place from the Wesleyan Methodists at various times among the most important of which may be reckoned the followers of Whitfield, formerly the coadjutor and afterwards the most powerful and eloquent opponent of Wesley, and supporter of Calvinism, [illegible] in whose [illegible] ritual of [illegible] Methodists, the Primitive Methodists, or Ranters (which see), the New Connection Methodists (which see), the Independent Methodists, Bryanites, Warrenites, &c Some of these sects, particularly the Whitfieldians, are nearly allied in church [illegible] Independents, and it is [illegible] take place between them and this latter denomination (In addition to the works already quoted, see *Journal of John* [illegible] by Coke, Moore, &c, but [illegible], *Nightingale's Portraiture of Methodism*, *Mosheim's Church History*, vol vi pp 281—288)

METHYLENE (Gr *μεθυ*, *wine*, and *υλη*, *wood*) When wood is subjected to destructive distillation there is formed along with the tar acetic acid and other products, a highly volatile and inflammable liquid, which, when purified by distillation off quicklime, was called spirit or alcohol of wood or pyroxilic spirit The hydrocarbon which forms the basis of this form of alcohol, and to which the term *methylene* has been applied, is presumed to consist of 1 atom of carbon = 6, and 1 atom of hydrogen = 1 its density (in reference to hydrogen) being just half that of olifiant gas, or = 7 The alcohol of wood is a *hydrate* of this hydrocarbon, or a compound of 1 atom of methylene = 7 and 1 atom of water = 9 the equivalent therefore of the alcohol of wood is 7 + 9 = 16

METOCHE (Probably from *μετεχω Ipartion*) In Architecture the space between two dentils

METOICI (Gr *μετοικοι sojourners*) The resident aliens who formed a large class of the inhabitants of Athens They were distinguished from the few full citizens by many [illegible] burdens They had no share in the administration of the state and were precluded from the power of possessing landed estates Each was compelled to purchase the shelter he received from the state by the payment of a small annual sum (*μετοικιον*), and to place himself under the guardianship of a citizen (*προστατης*), who was his formal representative in the courts of law They were generally engaged in mercantile and mechanical business

METONIC CYCLE So called from Meton, its inventor (B C 432) A cycle of nineteen years, or, more accurately, of 6940 days, at the end of which time the new moons fall on the same days of the year, and the eclipses return in nearly the same order The reason of this is, that in 19 solar years there are 235 lunations (with a difference of a few hours), and very nearly one complete [illegible] The cycle was corrected by [illegible] Callippic Cycle

METONYMY (Gr [illegible], derived from the preposition [illegible] and [illegible] toric and C [illegible] idea or thing is substituted for that of another, to which it has a certain relation Thus the effect is frequently substituted for the cause — "grey hairs" stands for old age" the abstract for the concrete — "What doth gravity" (*i e* the grave person) "out of his bed at midnight?" — substance for quality, precedent for subsequent, &c

The term *Metonomasia* (of the same origin as metonomy) was invented during last century by the French [illegible] and prevailed to a [illegible] extent [illegible] [illegible]

MET'OPA (Gr *μετα between*, and *οπη a hole*) In Architecture, the [illegible] triglyphs of the Doric order It is left either plain or decorated, according to the taste of the architect In the most ancient examples of this order, the metopa was left quite open, as is manifest from a passage alluded to in the art ARCHITECTURE

METOPO'SCOPY (Gr *μετωπον, a forehead*, and *σκοπεω, I view*) The art of divination by inspecting the forehead, treated of especially by the famous Cardanus The signs of the forehead are chiefly its lines, but moles and spots are also supposed to have their particular meaning The lines are under the dominion of their several planets

METRE (Gr *μετρον, measure*) In the classical sense of the word, a subdivision of a verse The Greeks measured some species of verses (the dactylic, choriambic antispastic, Ionic, &c) by considering each foot as a metre, in others (the iambic, trochaic, and anapæstic) each *dipodia*, or two feet, formed a metre Thus the dactylic hexameter (the heroic verse) contains six dactyls and spondees the iambic anapæstic and trochaic *trimeter*, six of those feet respectively A line is said to be *acatalectic* when the last syllable of the last foot is wanting, *brachycatalectic*, when two syllables are cut off in the same way, *hypercataleptic*, when there is one superfluous syllable

METRONOME (Gr *μετρον*, and *νομος a law*) An instrument for measuring musical time It is contrived on the principle of a clock having a short pendulum whose bob being moveable up and down on the rod is thus capable of increasing or decreasing the length of a note or bar as required by the character of the music The length or duration of a note is often expressed at the head of a piece of music by [illegible] that a pendulum of a given length in inches will [illegible] minim, crotchet or other note as the case may be

METRO'POLIS (Gr *μητηρ mother* and *πολις city* or *state*) 1 A parent state from which colonies have sprung, in which sense the word is uniformly employed by ancient Greek writers 2 The chief city of a province in the later ages of the Roman empire The Christian church having adopted the secular division of the Roman empire into provinces, the episcopal seat established in every such city, and the bishop of it himself were termed metropolitan 3 In modern usage, the chief or capital city of an independent state

METROPO'LITAN, in early Ecclesiastical History, [illegible] tropolitans took place at the end of the third century and was confirmed by the council of Nice In some of the Protestant states of Germany the title exists to the present time, and the person in possession of it has rank equivalent to the bishops of the English church

MEZZANINE (Lat mezzano, *middle*) In Architecture, a story of small height introduced between two higher ones

MEZZO SOPRA'NO (Ital) In Music a high counter tenor having the *C sol ut* clef on the second line

MEZZOTI'NTO (Ital *half tinted*) A particular method of engraving on copper *See* ENGRAVING

MIA'SMA (Gr *μιαινω, I infect*) Infectious or contagious matter The term is generally applied under the name of *marsh miasma* (malaria of the Italians) to the infectious emanations from marshy lands and stagnant waters, which are peculiarly characterized by producing [illegible]

MICA (Lat mica *I shine*) [illegible] found in thin *elastic* laminæ, soft, smooth, and of various colours and degrees of transparency Silica, alumina potash, and oxide of iron are its principal components It is one of the constituents of granite In some parts of Siberia and elsewhere it forms an article of trade, often known under the name of *Muscovy glass*

MI'CA SLATE One of the lowest of the stratified rocks [illegible] quartz and mica *See* GEOLOGY

MICHAELMAS The feast of St Michael the Archangel It falls on the 29th of September, and is supposed to have been established towards the close of the fifth century, Brady says in 487 In England, Michaelmas is one of the regular periods for settling rents, and an old custom is still in use of having a roast goose to dinner on that day, probably because geese are at that period most plentiful, and in the highest perfection (See *Brand's Pop Ant*)

MICHAEL [illegible] The order of knighthood, [illegible] by Louis XI [illegible] of St Michael, [illegible] The motto of this order was "Immensi tremor oceani" It was at first and for some time after its institution in high repute, but under Catherine of Medicis, who lavished it indiscriminately, it came to be held of no account, from which state it never recovered

MI'CROCOSM (Gr *μικρος κοσμος, little universe*) Man has been called so by some fanciful writers on natural philosophy and metaphysics, by reason of a supposed correspondence between the different parts and qualities of his nature and those of the universe

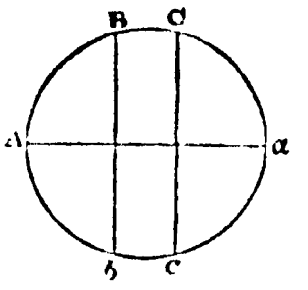
MICRODA'CTYLUS (Gr *μικρος* and *δακτυλος a digit*) A name proposed by M Geoffroy for the short toed genus of wading birds called by Illiger *Dichelophus* See that word

MI'CRODON (Gr *μικρος*, and *οδους, a tooth*) The name of a genus of extinct fishes, belonging to the thick toothed or Pycnodont family, in the Ichthyological system of Agassiz

MICROMETER (Gr *μικρος*, and *μετρον, measure*) An instrument applied to telescopes and microscopes for measuring very small distances, or the diameters of objects which subtend very small angles A great number of contrivances of various kinds and depending on different principles, have been employed for this purpose, but it will be sufficient to give a general description of some of the most useful or remarkable ones

*Wire Micrometer* — This instrument, when placed in the tube of a telescope, at the focus of the object glass presents the appearance represented in the annexed figure (fig 1) A *a* is a spider's web line, or very fine wire fixed to the diaphragm and B *b* and C *c* are similar wires stretched across two forks each connected with a milled-headed screw By means of these screws the two wires, B *b* and C *c*, which are exactly parallel to each other are moveable in the direction perpendicular to A *a*, and in order that the wire A *a* may be placed in any direction relatively to the meridian there is an adjusting screw, which works into an interior toothed wheel, and turns the apparatus round in its own plane perpendicular to the axis of the telescope

(1)




The method of using the micrometer is as follows — Suppose the object to be accomplished were the measurement of the *angle of position* and distance of two very close stars the telescope being set and kept on the objects the micrometer is turned by its [illegible] screw until the spider line A *a* coincides with the [illegible] the two stars or *threads* them both at the same moment The milled heads of the screws which carry the two moveable wires, are then turned until B *b* bisects one of the two stars, and C *c* bisects the other The observation is now completed and it only remains to ascertain the position and distance indicated by the micrometer For the first of these purposes the circumference of the micrometer is divided into degrees and minutes and read by two verniers this reading gives the position of A *a* in respect of the horizontal and vertical planes, and consequently the position of the two stars To find [illegible] of the screw which carries one of the moveable wires, for instance C *c* is turned until C *c* coincides with B *b*, and the number of revolutions and parts of a revolution required to effect the coincidence, gives the distance of the stars when the value of the *scale* of the micrometer is known, that is to say, when the number of seconds of space which correspond to one revolution of the screw is known The screws must be made with great accuracy, and their heads are usually divided into 60 equal parts representing seconds

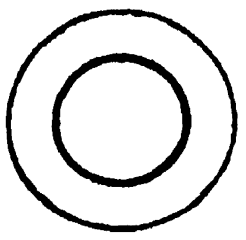
The value of the scale or of a revolution of the screw, is obtained in the following manner — Set the two wires, B *b* and C *c* apart to a certain number of revolutions, and place them in the direction of the meridian Observe the transits of several stars of known declination over the wires then multiply each interval of seconds by 15, and by the cosine of the star's declination, and, taking the mean you have the seconds of space which correspond to a known number of revolutions of the screw (See Appendix, by the Rev R Sheepshanks, to *Professor De Morgan's Explanation of the Gnomonic Projection of the Sphere*)

*Circular Micrometer* — This instrument, which differs entirely from the above, was first suggested by Boscovich, in the *Leipzic Acts* for 1740, and used by Lacaille in observing a comet in 1742, but seems afterwards to have fallen into disuse, until it was revived by Dr Olbers, about 1798 The principle may be explained as follows If the field of a telescope be perfectly circular (which may be effected by means of a diaphragm turned in a lathe), and if its diameter be determined from observation, the paths of two celestial bodies across the field may be considered as two parallel chords which are given in terms of a circle of any diameter The differences of the [illegible] positive [illegible] the middle of the parallel wires [illegible] differences and the distance between the chords, which is readily computed

from their lengths, gives the difference of the declinations of the two bodies

The most improved construction of the annular micrometer is that of Fraunhofer. It consists of a [illegible] glass (fig. 2), having in its centre a round hole of about half an inch in diameter, to the edges of which a ring of steel is cemented, and afterwards truly turned in a lathe. The disc being mounted in a brass tube, so [illegible] adjusted in [illegible] and applied to a telescope, the steel ring is alone visible, and appears as if suspended in the atmosphere, whence the instrument is called the *suspended annular micrometer*. The advantage of this construction consists in the accuracy with which the moment of ingress or egress is determined, from the body being seen in the field of view before it comes up to the edge of the steel ring. The annular micrometer is conveniently used for comparing the place of a small star or a comet with that of a known star in nearly the same parallel of declination. (*Astronomische Nachrichten*, b. iv.)

(2)



*Divided Object Glass, or Double Image Micrometer.* — This instrument is formed by dividing the object glass of a telescope or microscope into two halves, the straight edges being ground smooth, so that they may easily slide by one another. A double image of an object in the field of view is produced by the separation of the segments, and, by bringing the opposite edges of the two images into contact, a measure of the diameter of the object is obtained in terms of the extent of the separation. From its being used to measure the diameter of the sun, this is usually called the *heliometer* (*see* HELIOMETER). Instead of a divided object glass, Ramsden preferred a divided lens in the eye-tube, which form of the instrument is called the *dioptric micrometer*. The double image micrometer was suggested by Roemer about 1678, but first brought into use by Bouguer, about 1748.

*Micrometer by Double Refraction.* — The Abbé Rochon conceived the ingenious idea of applying the principle of double refraction to micrometrical measurement. Conceive two prisms, A B C and B C D (fig. 3), formed of the same crystal, and so disposed that the face A B of the first is perpendicular to the axis of the crystal, while in the second the axis is parallel to the line of the intersection of the two faces C B and C D, so that the axes of crystallization of the two prisms are at right angles to each other. The prisms are placed in perfect contact, and cemented by mastic, and together form a plate of which the opposite sides are parallel. Now suppose a ray of light M I to fall perpendicularly on the face A B, it will proceed through the prism A C B, in the same straight line I O without being separated, because I O is parallel to the axis of the crystal. But when it arrives at O, and enters the second prism B C D it will be separated into two, the ordinary ray will continue to follow the same direction I O N P, because the refracting powers of the two prisms are the same, but the extraordinary ray will take a different direction O R (towards B D, if the crystal is attractive as rock crystal, but towards A C, if the crystal is repulsive as Iceland spar), and, on emerging from the prism at R will be refracted in the line R S. The angle P I S of the inclination of the two rays after their emergence from the prism is constant for the same crystal, and must be determined by experiment.

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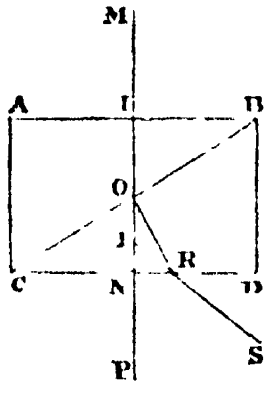


Let us now conceive this apparatus to be placed in the tube of a telescope, of which O (fig. 4) is the object glass and I the focus, and the telescope directed upon a distant object at D (as a planet), the diameter of which, *m n* is to be measured. Suppose the double prism at I' two images will be formed, the ordinary image at *a*, and the extraordinary image at *b'*. By sliding the prisms along the tube towards O the distance between the images will be increased, and by sliding them towards the focus F, it will be diminished, and if placed exactly in the focus, the two images will coincide. Let V denote the visual angle or apparent magnitude of the object, *f* the focal distance F O of the telescope, U [illegible] I' *b* depending on the prism, and D [illegible] we shall then have the diameter of the image = *f* tan V, [illegible]. Now, if the apparatus [illegible], where the two images [illegible] of the image will be

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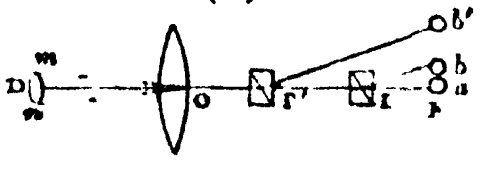


equal to the distance *a b*, and we have, consequently, *f* tan V = D tan U. Here the quantities *f* and U are found by experiment, whence V, the angular magnitude of the object, becomes known in terms of D.

The prism micrometer, when constructed in the manner now described, has this important defect, that the extraordinary image is accompanied by the prismatic colours, especially if the angle to be measured exceeds a few minutes, and hence Rochon found that he could not use it for measuring the [illegible] and moon. But this defect has been [illegible] by simply altering the arrangement of [illegible] and giving the double prism a fixed position [illegible] and before the eye glass. By this disposition two images are formed at the focus, the centres of which are fixed points, whose distance depends on the refracting power of the crystal, and the contact of the images is produced [illegible] visual angle subtended by the diameter of the observed object.

Various modifications of the three principles now explained have been proposed, for details respecting which we refer to *Brewster's Treatise on New Philosophical Instruments*, or to the article "Micrometer," in the *Ency. Brit.*, by the same author, and to *Dr Pearson's Introduction to Practical Astronomy*.

The micrometer is an instrument of the utmost importance in astronomy, and one, in fact, to which that science is as much indebted as to the telescope itself. From a paper by Mr Townley, in the *Phil. Trans.* for 1667, it appears certain that a micrometer with a moveable wire was first constructed by our countryman Gascoigne, [illegible] and used by him for measuring [illegible] one of the planets, but as Gascoigne, who was killed in the civil wars in 1644, published no account of his invention, the instrument was entirely forgotten, and the merit of reinventing it, and bringing it into general use, belongs to the French astronomer Azout, who published a description of it in 1667. Huygens, a few years previously had contrived to measure the diameter of a planet by inserting in the tube of a telescope at the focus of the object glass and eye-glass a slip of metal which covered exactly the image of the planet, and then deducing the diameter from the breadth of the slip, compared with the diameter of the field; and Malvasia had employed for the same purpose a reticle or network of fine silver wires crossing each other at right angles, and dividing the field of the telescope into a number of equal squares. (For the history of the invention and successive improvements of the micrometer, see the notes by Mathieu to *Delambre's Histoire de l'Astronomie au 18me Siecle*, pp. 616 and 617.)

MI'CROPHONE (Gr. *μικρος*, and *φωνη*, *a voice*). An instrument for increasing the intensity of low sounds, by subjecting a more sonorous body than that which emits the sound to be affected by the vibrations of that body, and thereby also [illegible].

MI'CROPYLE (Gr. *μικρος*, and *πυλη*, *a gate*), in Botany is a perforation through the skin of a seed over against the apex of the nucleus. It is what was the foramen or exostome of the ovule.

MI'CROSCOPE (Gr. *μικρος*, and *σκοπεω*, *I view*). An optical instrument which enables us to see and examine objects which are too minute to be seen by the naked eye. Microscopes are single or compound, according to the nature of their construction, a single microscope being one through which whether it consists of a single lens or a combination of lenses, the object is viewed directly, and a compound microscope one in which two or more lenses are so arranged that an enlarged image of the object formed by one of them is magnified by the second, or by the others if there are more than two, and seen as if it were the object itself.

*Single Microscope.* — This instrument is, for the most part simply a lens or sphere of any transparent substance, which refracts the rays of light [illegible] from a small body placed in its focus, and gives them such a degree of convergency as is necessary for distinct vision. In order that the rays of light issuing from the several points of a very small body may produce a sensible impression on the retina of the eye, it is necessary that the object be brought very near the eye, but when this is done, the rays coming from its different points are so divergent as to produce only a confused image. Now, if a convex lens be interposed between the object and the eye, and so placed that its distance from the object is a little less than its focal distance, the diverging rays issuing from the object are refracted by the lens, and enter the eye placed behind it, either parallel, or so nearly parallel as to afford distinct vision. The object is then seen in the direction of the refracted rays, and at the distance at which it could be distinctly seen by the naked eye, and consequently magnified in the ratio of the distance of distinct vision to the focal distance of the lens. This

ratio is called the *magnifying power* of the lens, hence, for single microscopes, the magnifying power is equal to the distance at which a small object can be seen distinctly by the naked eye, divided by the focal distance of the lens, and, as the distance of distinct vision is constant (at least for the same individual), the magnifying power is inversely as the focal distance. If we suppose the distance which limits distinct vision in respect of minute objects, to be 5 inches (which is about the average for good eyes) and the focal distance of the lens to be 1 inch, the object will be magnified 5 times in linear dimensions, and 25 times in superficial. If the focal distance is one tenth of an inch, the object will be 50 in linear extent, and [illegible].

A single microscope may be obtained very easily by piercing a small circular hole in a slip of metal, and introducing into it a drop of water, which will assume a spherical form on each side of the metal. The substance commonly used for microscopic lenses is plate glass, but they are sometimes formed of rock crystal, which is better. Flint glass, by reason of its great dispersive power, is unfitted for the purpose. The precious stones, as the garnet, ruby, sapphire, and diamond, have been proposed, but the numerous and skilful attempts of Mr Varley and Mr Pritchard have proved that the advantages arising from the greater refractive power of those substances are more than counterbalanced by their colour, reflective power, double refraction and heterogeneous structure. The crystalline lenses of minnows and other small fishes give a very perfect image of minute objects.

When the object to be examined is of such magnitude as to subtend an angle of some degrees, the requisite distinctness cannot be given to its whole surface by an ordinary lens, in consequence of the confusion occasioned by the lateral rays, unless, indeed, the rays are only permitted to enter the lens through a very small aperture whereby the quantity of light is greatly diminished. In order to remedy this inconvenience, Dr Wollaston contrived a form of lens to which he gave the name of *periscopic lens*. Its construction is as follows: two plano convex lenses or hemispheres are ground to the same radius, and between their plane surfaces a thin plate of metal, with a circular aperture, is introduced. The aperture which appeared to give the most distinct image was about 1-50th of the focal length in diameter, and when the aperture was well centered, the visible field was as much as 20° in diameter. A lens of this kind possesses the double advantage of having a very short focal distance and very little spherical aberration. Dr Wollaston's contrivance may, however, be improved upon in various ways, for example, by filling up the central aperture with a cement of the same refractive power as the lenses whereby the loss of light from the double number of surfaces is avoided, or by grinding away the equatorial parts of a sphere of glass, so as to leave a deep groove all round it in the plane of a great circle perpendicular to the axis of vision, and filling the groove with opake matter. This last construction is called the *Coddington lens* (from the name of its proposer), and when executed in garnet and used in homogeneous light it is considered by Sir David Brewster to be the most perfect of all lenses either for single microscopes, or the object lenses of compound ones.

In using a single lens as a magnifier, it is always necessary that the light be made to pass through a very small aperture in order that the object may be seen distinctly and without distortion. This necessity arises, both from the spherical aberration and the chromatic dispersion of the light falling on the surface of the lens under an angle of considerable obliquity, and the consequence is that the pencils of light admitted to the eyes is so much diminished that the object cannot be clearly seen. To remedy this inconvenience, Dr Wollaston proposed a combination of two lenses, called, in consequence, *a microscopic doublet*, the optical part of which may be described as follows. — M and N (fig. 1) are two plano convex lenses whose focal lengths are in the ratio of 3 to 1, or nearly so, and placed one over the other, so that their plane sides are towards the object. The adjustment of the distance between the lenses is best accomplished by trial, and they must, accordingly, be mounted so that the distance can be varied at pleasure. A B is a diaphragm or stop for limiting the aperture. Though it does not appear that the stop was contemplated by Dr Wollaston, who makes no allusion to it, the [illegible] of the microscope depends much on its [illegible]. It is obvious that as each of the pencils of light [illegible] the extremities of the object is rendered eccentric by the stop and made to pass through the two lenses on opposite sides of the common axis, they are affected by opposite errors, which, in some degree, serve

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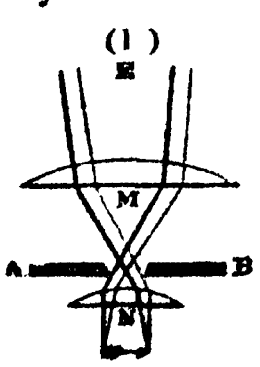
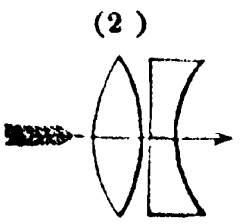



to counteract each other. This doublet, when correctly made, is infinitely superior to any single lens, and will transmit a pencil of from 35° to 50° without any very sensible errors. The original description, by Dr Wollaston, is given in the *Philosophical Transactions* for 1829.

The above construction has been improved upon by substituting two plano-convex lenses for N in the doublet, the plane side of the one being in contact with the convex side of the other, and the stop being retained between them and the third. This combination is called a *triplet*, and its advantage is, that the errors of the doublet are still further reduced by the greater approximation to the object, in consequence of which the refractions take place nearer the axis.

Another form of doublet, proposed by Sir John Herschel, is represented in the annexed figure (2). It consists of a double convex lens whose radii of curvature are as 1 to 6, and of a plano-concave, whose focal length is to that of the other as 13 to 5, placed in contact with the flatter surface of the former and having its concavity turned towards the object. Many other combinations have been proposed, but those which ha[illegible]e the most useful. [illegible] lens is considerable, and consequently its focal distance very small, it requires to be placed at the proper distance from the object with [illegible] as it cannot be held in the hand with [illegible] for any length of time, it requires to be mounted in a frame having a rack and screw, by means of which its distance from the object can be adjusted with accuracy. Mirrors for collecting the light and throwing it upon the object are also necessary for many purposes.

(2)



*Compound Microscope.* — The simplest kind of compound microscope is formed by the combination of two converging lenses, whose axes are placed in the same straight line. The arrangement of the lenses and the path of the rays will be readily understood from the annexed diagram (fig. 3.) M N is the object glass which has a very short focal distance, and P Q the eye glass. A small object *a b* being placed before the object glass a little farther from it than the focus of parallel rays, a reversed and enlarged image *a' b'* will be formed at some distance behind M N. The lens P Q is placed at such a distance from M N that its principal focus is in the line at *a' b'*, consequently the rays of light from every point of the image *a' b'* emerge nearly parallel from P Q, and to the eye all the image *a' b'* is magnified as if it were a real object into *a'' b''*, and appears at a distance equal to the limits of distinct vision, which, as stated above, is about 5 inches.

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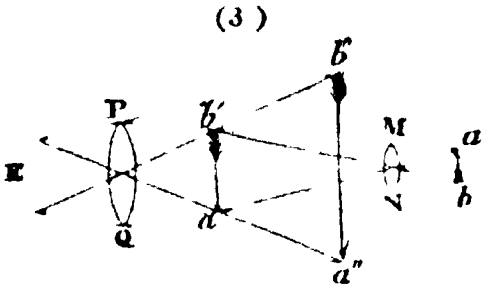


The magnifying power of this microscope, or the ratio of *a'' b''* to *a b*, is found as follows. — In the first place, if we assume *d* to denote the distance of the first image *a' b'* from M N, and *f* the distance of *a b* from M N, or the focal distance of M N, we have this proportion, *a b' : a b :: d : f*. In the second place, if *l* denote the limit of distinct vision, or distance of the second image *a'' b''* from P Q, and *f'* the focal distance of P Q (or distance of *a' b'* from P Q), we shall also have *a' b'' : a' b' :: l : f'*. These two proportions, being multiplied together, give $\frac{a'' b''}{a b} = \frac{d}{f} \cdot \frac{l}{f'}$, which, therefore, is the magnifying power of the microscope. It thus appears that the magnifying power is inversely as the product of the focal distances of the two lenses, and directly as the distance between them. The magnifying power will therefore be increased by increasing the distance between the object-glass and eye-glass, but a limit is soon placed to this increase by the indistinctness of the image, and, in practice, it is not advisable to make the distance of *a' b'* from M N more than from 5 to 7 inches. Suppose the focal distance of M N to be $\frac{1}{4}$th of an inch, and the distance of *a' b'* from M N to be 5 inches, then *a' b'* will be 20 times greater than *a b*, and if the focal distance of P Q be half an inch, and the distance of *a'' b''* from P Q be 5 inches, then *a'' b''* will be 10 times greater than *a' b'*, and, consequently, 200 times greater than *a b*, or the magnifying power is 200.

The great defects of the microscope, when constructed in the manner now described, consist in the smallness of the field of view, and want of achromatism in the object-[illegible] *b'* and *a'' b''* are [illegible]. For the sake of [illegible] than either

of the others, and called the field glass, is usually inter- [illegible] *a' b'* and the object-glass [illegible] —The principle of the reflecting microscope is very simple, and easily conceived Suppose M N (fig 4 ) to be a concave speculum, and a small object to be placed before it at *f* A reflected image of the object will be formed at F, where the rays issuing from each point of the object intersect each other, and magnified in the proportion of F M to *f* M If the image at F is viewed with the naked eye the instrument is a single reflecting microscope, but if the image is viewed through a refracting lens P Q (or a combination of lenses forming an [illegible] which the rays are made to converge [illegible] at F, it becomes a compound reflecting microscope

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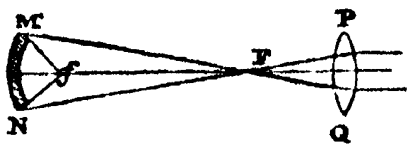


The reflecting microscope was first proposed by Sir Isaac Newton in the form now described, but on account of the impracticability of illuminating the object, it was long disused It has, however, been recently revived, under a modified form, by Professor Amici of Modena, who places the object outside the tube of the microscope, below the line N F, and, in order that an image may be formed in the speculum the rays issuing from the object fall upon a small plane mirror placed at *f*, inclined to the axis of the speculum in an angle of 45°, whereby they are thrown upon the speculum in the same manner as if the object itself were placed at *f* By this means the object can be illuminated with perfect facility The concave speculum M N is ground into an ellipsoidal surface, the diagonal mirror is placed at the nearest focus *f* and the image is consequently formed at the other focus I The image at I is viewed with a single or double eye-piece, as in other microscopes

*Solar and Oxyhydrogen Microscopes* — The solar microscope is composed essentially of a mirror and two converging lenses The plane metallic mirror C D (fig 5 ), reflects the sun's rays upon the lens M N, by

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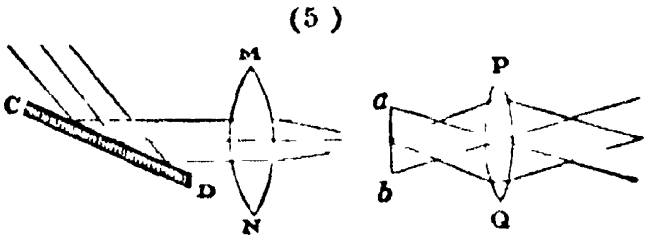



which they are concentrated upon the object *a b* placed in its focus The object being thus strongly illuminated is placed before a second lens P Q (a little before the principal focus), by which the rays are rendered still more convergent and produce a magnified image of the object upon a screen suitably placed at a distance of some feet behind the lens The object is here supposed to be transparent, if opake the light must be thrown upon it in such a manner as to be reflected by it to P Q The mirror and lens M N are placed in the hole of a window shutter in a darkened room and the mirror must be moveable in order that the sun's rays may always fall upon it under a proper angle to be reflected to the lenses But the solar microscope is now almost entirely superseded by the *oxyhydrogen microscope*, so called because the illumination, instead of being produced by the sun's rays is produced by burning a small piece of lime or marble in a stream of oxyhydrogen gas In this case the plane mirror C D becomes unnecessary, and instead of the lens M N a concave speculum is employed in front of which the ball of lime is placed and an intense light thus thrown upon the object *a b* the rays from which are brought to foci upon the screen by the lens P Q For full details respecting the management of this apparatus which forms a very popular exhibition the reader is referred to *Goring and Pritchard's Micrographia* For descriptions of the various kinds of microscopes, see *Brewster's Treatise on New Philosophical Instruments*, or the *Ency Brit* art "Microscope"

MI'DDLE AGES (In French, *moyen age*) A term usually employed to denote somewhat vaguely, a space of several centuries in European annals, intervening between what are called the ancient and modern periods of history The centuries between the ninth or tenth and the end of the fifteenth after Christ are generally comprehended under this loose denomination In the work of Mr Hallam on the *Middle Ages*, that historian has assumed as his period of commencement the conquest of Gaul by the Franks, about A D 500, and, for his conclusion, the invasion of Italy by Charles VIII, about 1500, and with reference to the affairs of the Greeks and their oriental neighbours, he places, as the most convenient limit between ancient and modern history, the era of Mohammed

MI'DDLE CADENCE In Music *See* CADENCE

MI'DDLE LATITUDE SAILING In Navigation, is a method of converting the departure into difference of longitude, and the difference of longitude into departure, when the ship's course is oblique to the meridian It is founded on this principle, which however is in many case, and not even a [illegible] when there is also considerable difference between the latitudes left and arrived at, namely, that the departure may be accounted an arc of a parallel of latitude midway between the two extreme latitudes Its rules are,—

radius cos middl lat diff longitude departure,
cos middl lat tan course diff lat diff long

*See* NAVIGATION

MI'DDLE RAIL In Architecture, the rail of a door level with the hand on which the lock is usually fixed

MI'DDLE TERM [illegible] is that with which [illegible] are separately compared *See* SYLLOGISM

MI'DSHIPMAN In the Navy, the step next above volunteer of the first class, which is generally the commencement At nineteen years of age the midshipman passes one examination in seamanship, and another in navigation, when he becomes eligible for a lieutenant's commission

MIDSHIPS The middle of the ship, with reference to length or breadth

MI'LKMILK A [illegible] carbonate of lime of a green colour from M [illegible] Tuscany

MIGRA'TION (Lat *migro*, *I migrate*) This word is used in Zoology to signify the transit of a species of animals from one locality or latitude to another The passage is usually to and fro between a temperate and a cold climate, or a temperate and a warm climate, and this periodical change of abode is most general in the arctic species of animals and least prevalent in the tropical species The most remarkable, rapid, and extensive migrations are performed by birds, in virtue of their preeminent locomotive powers, and of their ability to maintain a long and rapid flight through a medium which offers the least opposition to their progress The inequalities and alternations of land and water upon the surface of the earth and the presence of enemies and other dangers, would appear to form insurmountable obstacles to any general or extensive migration of quadrupeds, yet the musk-ox the rein-deer, the arctic fox, &c, are driven southward by the rigours of the polar winter, and return to the extreme latitudes in the summer season Less regular but not less general migrations, take place among the quadrupeds which range the tropical continents in seasons of unusual drought Countless herds of oxen goaded by intolerable thirst, are thus impelled in an irresistible course over vast tracts of the South American Pampas in quest of water The valleys of the warmer parts of Africa are occasionally traversed by numerous assemblages of the wild quadrupeds of that continent, migrating under the same stimulus Lions and other carnivora have on these occasions been seen mingled with, and absolutely hemmed in by the countless assemblage of antelopes gnus, and other herbivorous species which constitute their prey The Scandinavian lemming, however, is the species of quadruped that is most remarkable for its migration [illegible] to return In this respect the migration of the lemmings [illegible] dence [illegible] of the [illegible] appear to be the shores of the arctic ocean Here whether numbers exceed the means of subsistence, they congregate together and commence a migratory course southward, moving [illegible] climbing mountains, and when [illegible] obstacle impedes their progress they devastate the country through which they pass The migration of birds appears to be influenced mainly by the necessity of providing sufficient food for their young and by the temporary continuance of such food in the climates best suited [illegible]

The arctic and northern seas, which [illegible] during the long unbroken day that constitutes the summer season of such latitudes, are resorted to by numerous aquatic [illegible] season, and these birds regularly [illegible] when the severities of winter set in In temperate latitudes, as those of England certain spring and summer months are peculiarly favourable to the production of insects in their different stages, and our island is accordingly frequented by many insectivorous birds, which leave warmer latitudes during these months to breed and rear their young with us As a general rule, it may be stated that birds migrate southward in the northern hemisphere for food principally, but that they migrate northward both to feed and breed The most remarkable summer immigrants that visit [illegible] the south and breed in this island are the [illegible] swallows, cuckoo, nightingale, and many other insectivorous Passerine birds, and it is remarkable that the males of the song birds always precede the other sex in their vernal flight.

The winter immigrants from the north are the species of wild swan, many species of wild duck, the smews, merganser, and other aquatic birds, the woodcock, &c. It occasionally happens that a winter immigrant remains with us the whole summer, and breeds. Thus the woodcock's eggs and young have occasionally been taken in our woods, but this is an exceptional or individual case. It is a rare occurrence when [illegible] its sojourn into the winter. It is a thing only when by late hatching, or debility produced by accident or disease a swallow or martin has been prevented from joining the main body of autumnal emigrants of its own species, and is seen flying about when an unusually mild day may have called some insects abroad in the months of November or December.

The season of migration is that of association, both in birds and other animals. The swifts congregate for their departure about the middle of August, the swallows assemble together for the same purpose in September. Their powers of flight are more than equivalent to the extent of space they have to traverse to reach the warmer latitudes, as the Mediterranean shores of Africa where they have been seen in those months when they have disappeared from us. Yet there have not been wanting naturalists who have believed that the life of the swallow was maintained during the absence of its insect food in England by the same torpidity which enables the bat and hedgehog to exist through the winter and resume their vital functions in spring. The burrows of the sand-martin have been explored in winter with this view, but neither there nor in any other hiding place has a torpid martin or swift been ever found. It was next conjectured that these birds went under water in autumn, and passed the winter not only torpid but submerged. The [illegible] how the [illegible] body of a swallow float upon water was overcome, nor how the extravascular plumage was preserved undecomposed and fit for use after six months soaking in water.

The short migrations of the cuckoo and nightingale are unquestionable. Why should the longer migrations of summer breeding birds of greater powers of flight be doubted? The direct observation of swallows in the act of migrating, and the slowly acquired but certain knowledge of their winter resort, have finally put to rest the scepticism as to the migration of the swallow tribe which only the authority of such eminent naturalists as White of Selborne could have so long rendered excusable in works of Zoology.

MI'LDEW. This term is generally applied to a particular mouldy appearance on the leaves of plants which is produced by innumerable minute fungi which if not checked in their growth will occasion the decay and death of the parts on which they grow, and sometimes of the entire plant. In [illegible] the [illegible] is termed rust, and some [illegible]. It [illegible] wheat, and on the hop, and in gardens on the leaves of the peach, the nectarine, and other fruit trees. The causes favourable to the production of mildew are a rich soil and a moist atmosphere without a free circulation of air or sunshine. In agriculture this parasitical disease is generally considered without remedy; but in gardening, it may be checked by the application of powdered sulphur to the leaves covered with the fungi, which is found to destroy them without greatly injuring the leaf. Dry-rot is only mildew of a more formidable kind.

MILE (Lat. mille passuum, *a thousand paces*). The Roman pace being 5 feet and a Roman foot being equal to 11·62 modern English inches, it follows that the ancient Roman mile was equivalent to 1614 English yards, or very nearly 11-12ths of an English statute mile.

The English statute mile was defined (incidentally, it would seem) by an act passed in the 35th year of the reign of Queen Elizabeth, by which persons were forbidden to build within three *miles* of London, and the mile was declared to be 8 furlongs of 40 perches of 16½ feet each. The statute mile is, therefore, 1760 yards or 5280 feet. *See* MEASURES.

The mile is used as an itinerary measure in almost all countries of Europe, particularly those which were formerly under the sway of the Romans, but it is very difficult to conjecture the causes which have given rise to the great diversity of its values. It has been supposed that in some countries the Roman mile was confounded with the ancient Celtic league.

The following table, given on the authority of *Kelly's Cambist*, shows the length of the modern mile and also the league, of various countries, and their relation to the English statute mile:

| | Yds. | Stat. Miles. |
|---|---|---|
| Modern Roman mile | 1628 | 0·924 |
| English statute mile | 1760 | 1·000 |
| Tuscan mile | 1808 | 1·027 |
| Ancient Scottish mile | 1984 | 1·127 |
| Irish mile | 2240 | 1·273 |
| French posting league | 4263 | 2·422 |
| Spanish judicial league | 4635 | 2·634 |
| Portugal league | 6760 | 3·841 |
| German short mile | 6859 | 3·897 |
| Flanders league | 6864 | 3·900 |
| Spanish common league | 7416 | 4·214 |
| Prussian mile | 8237 | 4·680 |
| Danish mile | 8244 | 4·684 |
| Dantzic mile | 8475 | 4·815 |
| Hungarian mile | 9113 | 5·178 |
| Swiss mile | 9153 | 5·201 |
| German long mile | 10126 | 5·753 |
| Hanoverian mile | 11559 | 6·568 |
| Swedish mile | 11700 | 6·648 |

According to the same authority the Arabian mile is [illegible]. Persian parasang 6086 yards, the Russian werst 1167 yards, and the Turkish berri 1826 yards. The English geographical mile is 1-60th of a degree of latitude, or about 2026 yards; the geographical league of England and France is 3 such miles, or 6078 yards; and the German geographical mile is equal to 4 English geographical miles or 8106 yards. See an excellent disquisition on the history of the English mile in the *Penny Cyclopædia*.

MILIA'RIA (Lat. milium *millet seed*). A disease attended by an eruption resembling millet seed. Miliary fever.

MILIEU (JUSTE)—PARTY OF THE. A French party nickname arising, it is said, out of a casual expression of King Louis Philippe, but which has obtained a notoriety rather greater than such ephemeral phrases usually acquire. It has served to denote the great party opposed to the Carlists, or Legitimists on the one hand, and to the extreme left section of the Chamber of Deputies with its allies the Republicans on the other. After the overthrow of the feeble ministry of Laffitte in March 1831, Casimir Perier was authorized to form a new cabinet, and his administration seems to have realized more than any other the ideal of a government of the Juste Milieu. Under its rule the hereditary peerage was abolished, the continual street disturbances which had almost controlled the will of the previous ministry quelled, Ancona seized, and the foundation of the successful intervention of France in the Holland-Belgic quarrel laid. Perier died of cholera on the 16th of May 1832. After a short interval he was succeeded by Soult, who was perhaps afterwards, more identified with this party than any other minister. Molé, Guizot, Dupin, Thiers, Barrot, the most eminent statesmen of France, during the reign of Louis Philippe, having each of them adopted a line, and formed to a certain extent a party of his own, alternately aided and opposed by the great body of the partisans of the Juste Milieu.

MILIOLA (Lat. milium *a millet-seed*). The generic name applied by Lamarck to an extinct mollusk or zoophyte which has left its small foraminiferous multilocular shell in great numbers in the strata of many quarries in the neighbourhood of Paris.

MILITIA. A body composed of citizens regularly enrolled and trained to the exercises of war, but not permanently organized in time of peace, or, in general, liable to serve out of the country in time of war. Such an establishment exists in most European countries under different names. (*See* GUARD, NATIONAL.) In Austria and Prussia it is called Landwehr, and in the latter country receives full pay during a certain part of every year when it is in exercise. Various and unsuccessful efforts were made by Germans [illegible] wars of the last century to organ[illegible], which should be as cheaply raised as militia and yet be serviceable in foreign war. Frederick the Great used such troops for garrison service. The militia of England and Scotland now consists of a certain number of men in every county, drawn by lot to serve for five years, and liable to be called out and embodied on danger of rebellion or invasion by proclamation of the king in council, and with notification to parliament if that body is sitting. During the late war, the militia was kept constantly on foot and might be sent to any part of the kingdom, so that it differed little from the regular army, except that it could not be sent abroad, and that it was recruited by ballot. But in addition to the above a militia called local or fencibles in many instances raised and supported entirely at the expense of some great landed proprietor was established in every county. After the peace of 1815 the militia was disembodied, but as we remarked above it is still liable if it be considered necessary to be called out. In Prussia every man who has served his three years, or a single year in certain cases, of lawful service in the standing army, belongs to the first class of the landwehr until his thirtieth year, and from that time until his fortieth to the second class.

MILK (Germ. milch). A fluid secreted by peculiar glands in the breasts of the class of animals called *Mammalia*, and destined for the nourishment of their young.

The obvious components of milk are cream, curd, and

[illegible] cream (of cow's milk), of the sp[illegible], according to Berzelius, of

| | |
|---|---|
| Butter | 45 |
| Curd | 35 |
| Whey | 920 |
| | 1000 |

The remaining skim milk has a specific gravity of about 1033, and consists of

| | |
|---|---|
| Water | 929 |
| Curd with a trace of butter | 28 |
| Sugar of milk | 35 |
| Lactic acid, lactate of potash, and a trace of lactate of iron | 6 |
| Muriate and phosphate of potash and earthy phosphates | 2 |
| | 1000 |

If we subtract the curd, the remaining substances constitute whey The *curd* of milk, or *caseous matter*, partakes in many of its chemical properties of the nature of albumen, in others it resembles vegetable gluten more especially in the fermentation which it undergoes when kept in a moist state *Sugar of milk* is obtained by evaporating whey When purified it has a sweet taste and requires 7 of cold and 4 of boiling water for solution, and is insoluble in alcohol when digested with nitric acid it is partially converted into mucous or *saccholactic acid*, and not, like common sugar into oxalic acid This therefore though an animal product, closely resembles the vegetable proximate principles and milk may hence be considered as partaking of the nature of [illegible] as animal food See DAIRY

MILK FEVER See PUERPERAL FEVER

MILK TREE, so called from its trunk yielding a milky fluid when wounded is a name applied more particularly to those species in which the fluid is harmless and fit for food, an uncommon circumstance among lactescent plants whose secretions are generally dangerous In the Caraccas there is one sort the *palo de vaca* or cow tree of Humboldt whose milk is a common article of diet among the natives, this is the *Galactodendron utile* In that and other countries plants of the Sapotaceous order especially species of Achras also furnish such a secretion In Ceylon has been found the Kirriagum plant or *Tabernæmontana utilis*, which is used by the Cingalese in a similar manner

MILK VESSELS in Plants are the anastomosing tubes lying in the bark or near the surface of plants in which a white turbid fluid is secreted They are one of the forms of the *vital veins* of Schultz which see

MILKY WAY or VIA LACTEA or CALAXY A broad and irregular zone of stars that surround the heavens, so distant that their united light gives but an indistinct and undefined whitishness to the whole appearance —whence its name See GALAXY

MILL (Gr μυλη, Lat mola) This term seems to have signified originally an engine for grinding corn but it is now used in a general sense to denote a great variety of machines whose action depends chiefly on circular motion The particular purpose is usually indicated by a prefix, thus bark-mill, cotton-mill, flour-mill, oil mill saw-mill, spinning-mill, &c

The machinery by which it is necessary to accomplish the ultimate objects of the mill must obviously vary almost indefinitely Many voluminous works on this subject have been published as well as separate accounts of particular structures See Brewster's edition of *Ferguson's Lectures*, *Gray's Experienced Millwright*, *Buchanan on Millwork*, by Rennie, *Banks on Mills*, *The Repository of Arts* &c A catalogue of the principal works on the subject of mills is given in *Gregory's Mechanics* vol ii

MILL, BARKER'S See CENTRIPETAL MACHINE

MILLENNIUM (Lat mille annum *a thousand years*) The reign of Christ with his saints upon earth for the space of a thousand years an idea derived from a passage in the 20th chap of the Apocalypse, and not uncommonly entertained by Christians in all ages but especially in the times of the primitive church The opinion seems to be traced as far back as to Papias a father of the second century It is the subject of much discussion among the writers of that and the succeeding ages, was maintained by Justin Martyr, Irenæus, Tertullian and many others and powerfully refuted by Origen (See the work of *Alstedius* translated by Bruton, 1643, *Gibbon*, ch xv, with Milman's notes, Bertholdt, *Christologia Judæorum*, Eisenmenger, *Das Entdeckte Judenthum*, *Lightfoot*, *Mosheim*, vol i)

MILLEPORA *Millepora* (Lat mille, *a thousand*, porus, *a pore*) A tribe of Lithophytous Polypes, including those in which the calcareous axis is perforated by extremely numerous pores

MILLET (Lat millium, Fr millet) A plant classed by botanists among the grasses, though some of its species attain a height of from 16 to 20 feet in favourable situations There are many species of this plant; of which the principal are the Polish, the common or German, and the Indian millet In several parts of Europe it is cultivated as a grain, and is sometimes employed as a substitute for rice or sago by the poorer classes, [illegible] and dor[illegible] extent in France, Switzerland, Southern Germany, and most extensively in Egypt, Syria, Nubia, China, and Hindostan, but the climate of England is not sufficiently dry and warm to allow of its being cultivated here

MILLION A thousand thousand, or, as often defined, ten hundred thousand *See* NUMERATION

MILLSTONE GRIT A geological term applied to a group of strata which occur between the mountain limestone and the superincumbent coal formations, it is a [illegible] quartzose sandstone

MILVINES, *Milvini* A family of Raptorial birds, of which the kite (*Milvus*) is the type

MIME (Lat mimus, Gr μιμος, from μιμεομαι, *I imitate*) The name given by the ancient Greeks and Romans at once to a species of dramatic entertainment, and to the authors and actors by whom it was respectively composed and performed It consisted chiefly of a rude representation of common life, and resembled the modern farce or vaudeville in its character and accompaniments Sophron of Syracuse, who lived about 400 years before the Christian era is considered the inventor of this species of composition His pieces were read even with pleasure by Plato who is said to have introduced this kind of dramatic entertainment into Athens (The *Museum Criticum* No 7, contains several fragments of mimes by Sophron) At what period mimography was first practised at Rome cannot be precisely ascertained, but in the time of the emperors and even under Augustus this species of entertainment had attained a high degree of popularity Among the Romans, it was of a still more farcical character than among the Greeks, from whom it was borrowed, and bordered more upon such mountebank representations as *Punch and Judy* among ourselves and the *Fantoccini* of the Italians Mimes originally formed a part of the usual theatrical exhibitions, but they were soon introduced by the wealthy Romans into their private entertainments to divert their guests At Rome they also held a prominent place at funerals on which occasions their duty consisted in praising the virtues and exposing the defects of the deceased It is however very probable that less licence of caricature was then admissible, but the highest rank was not exempt from the practice Thus Suetonius tells us that the archmime Favo was present at the funeral of Vespasian — 'Sedet in funere Favo archimimus, personam ejus referens, imitansque, ut mos est, facta et dicta vivi

MIMUS (Lat *a mimic*) A genus of Passerine birds separated by Boie from the thrushes (*Turdus* of Linnæus) on account of the more elongated form of the body and particularly of the tail the shorter wings and more curved upper mandible The type of this genus is th[illegible] See that word

[illegible], right and common in use among the Greeks, but which was d[illegible] the Attic mina, which is that most frequently mentioned was heavier than the Roman pound by about four drachmæ Each mina contained 100 drachmæ and was itself contained 60 times in an Attic talent The coin was worth a little more than 3*l* of our money

MINARET (Arab menarah *a lantern*) A slender and lofty turret in the mosques of Mohammedan countries, used for the purpose of summoning the people to prayers and consequently answering the purpose of the belfry in Christian churches They are usually surrounded with projecting balconies, and are crowned with spires surmounted by a crescent Before the hour of prayer the criers of the mosques ascend the minarets, whence they summon the people to prayers with the words, "Come ye people, to the place of rest and in[illegible] asylum of safety"

MINDERERUS'S SPIRIT Solution of acetate of ammonia, first recommended as a febrifuge by Raymond Minderer us a physician of Augsburg

MINE The name given generally to every system of subterraneous work or excavation which has for its object the discovery and extraction of the metallic ores or other mineral produce But in addition to the underground works which constitute the mine properly so called, the term usually comprehends also the ground on [illegible] with wheels, and other machinery for drainage the extraction of the ores, and their mechanical preparation, with various buildings and erections The subject of mines is one of the most important within the whole range of human knowledge their contents constitute the main-springs of civilization, and the means employed to obtain them are to be ranked among the most extraordinary instances of human enter-

prise patience and ingenuity The art of mining has been practised from the earliest antiquity and has formed a branch of industry to the most barbarous as well as the most civilized communities It is true that we can scarcely dignify by the name of mining the operation by which the savage merely collects grains of gold in the sands of rivers, or extracts it by pounding, when mechanically combined with other substances, but even this simple operation becomes interesting when viewed as the first link in the chain of those elaborate and scientific processes now employed in the extraction of metallic and other mineral substances from the bowels of the earth In England, mining had a very early origin, compared with the progress of other arts in the country It was, in all probability, the first source of trade to these islands, and so celebrated was British tin over the whole of the then known world, that the Phœnicians traded to Cornwall for this metal At that early period, however, and indeed for centuries afterwards, the art of mining was necessarily in a comparatively rude and imperfect state arising from the want of an effective means of drainage and of blasting implements, and it was not until hydraulic machines were applied to raise the waters which accumulated in mines of every description that metals could be followed to any considerable depth and not until gunpowder had furnished the means of splitting the hardest rock that the miner was enabled to surmount the obstacles which the most indurated strata opposed to his progress These inventions, therefore may be regarded as most important epochs in the history of mining but the *present* comparatively perfect state of the art is mainly owing to the invention of the *steam engine* and the improved manufacture of iron which took place in the latter part of last century The former gave to the miner a power capable of universal application and of an effect that added, as it were, new regions of subterranean country to his control, while the latter has proved no less important in contributing to the same result by the improved machinery and apparatus it has placed within his reach

The art of mining embraces a multiplicity of topics and processes, differing in their character in proportion to the difference of the locality of the lodes, the habits of the population, and the character and the resources of the country in which it is practised, many of which, besides, are of so abstruse and complicated a nature as to be utterly unintelligible without the most lengthened details, and the introduction of numerous diagrams that would have been foreign to the object of this work, that we shall refrain from entering upon a subject which it would be impossible for us to treat satisfactorily in this place We must therefore refer the reader to *Ure's Dict of Arts, &c*, which contains full details upon the numerous processes connected with this most important art and content ourselves with subjoining the following tables the one made up from the *Geo Dict*, containing an estimate of the mineral produce of Great Britain on an average of years and prices, the other being a Comparative Table of celebrated Mines in Europe and America, which we have borrowed from the *Quarterly Mining Review* for July, 1835, p 60 (The various mining terms, as *shaft lode*, &c will be found defined under their respective heads, and the different metallurgical processes explained under the separate metals)

Estimate of the Mineral Produce of Great Britain, on an Average of Years and Prices

| | Quantity | Value |
|---|---|---|
| Silver - | 10 000 lbs troy - | £ 30,000 |
| Copper - | 13 000 tons | - 1 300 000 |
| Tin - | 5 500 - | - 550 000 |
| Lead - | 46 000 | - 950 000 |
| Iron - | 1 250 000 - | - 10 000 000 |
| Coal - | 32 000 000 | - 12,000,000 |
| Salt alum and other minor produce more than - - | | 1,000,000 |
| Total value probably exceeds - | | £ 25 830 000 |

COMPARATIVE TABLE of celebrated Mines in Europe and America By F Burr, Esq

| | Consolidated and United Mines (At present the richest mines in Cornwall) | Veta Grande Mines (At present the richest mines in Mexico) | Mine of Valenciana (Richest of the Mexican mine at the beginning of the present century | Mine of Himmelsfurst (Richest of the Saxon mines at the beginning of the present century |
|---|---|---|---|---|
| Situation - - | Two miles east of Redruth | Four miles north of Zacatecas | One mile north of Guanaxuato | Two miles south east of Freyberg |
| Elevation - | Elevation of the surface above the level of the sea from 200 to 300 ft Depth of the bottom of the mine below the level of the sea, about 1370 feet | Elevation of the surface above the level of the sea supposed to be about 6000 feet Elevation of the bottom of the mine above the level of the sea probably near 5000 feet | [illegible] bottom of the mine above the level of the sea, 5730 feet | Elevation of the surface [illegible] the bottom of the mine above the level of the sea, 263 feet |
| Nature of the rock | Primary clay slate resting immediately on granite a short distance westward of the mines The clay slate is intersected by numerous channels of porphyry which have nearly the same direction as the mineral veins and are often of considerable width The porphyry sometimes appears also to form large irregular masses in the clay slate Both rocks are traversed by veins of quartz and clay intersecting the metalliferous veins | Transition clay slate, alternating with dolomite and occasionally with grey wacke This clay slate is sometimes decomposed it rests on syenitic rocks and is in some places covered with porphyry | The *Veta Madre* of Guanaxuato upon which this mine is worked traverses both clay slate and porphyry, but it is most productive in the former rock The clay slate is considered by Humboldt to belong to the transition class but situate near the limits of primary formations This rock in depth passes into chlorite slate, and talc slate It contains subordinate beds [illegible] phyry rests upon the clay slate and is conformable to it both in direction and stratification | The rock prevailing in the neighbourhood of Freyberg in which this and most of the other mines are situate, is a formation of primary gneiss. |
| Nature of the metaliferous deposits - | In the consolidated mines, the eight following lodes are extensively worked — Wheal Fortune lode, Cusvoose Treasure lode, Wheal Unity lode, Wheal Treasure lode, Gonning's lode, Martin's lode, and Glover's lode In the United mines the principal metal is upon the Old lode, and about five or six others are more or less productive Numerous smaller lodes or "branches occur also in both mines The principal lodes are from 2 or 3 to 7 or 8 feet wide, the "branches are generally 12 or 18 inches wide The direction of the lodes varies from nearly east and west to about 20 degrees north of east and south of west The underlie of the principal lodes is from 2 to 3 feet per fathom north, that of the smaller ones about the same south | One principal vein of the Veta Grande [illegible] separated into 3 branches and sometimes into four When ramified the width extends to 60 or 70 feet when united, it varies from 8 or 10 to 20 or 30 feet The branches are generally about 10 or 12 feet wide, and the upper one is most productive The direction of the Veta Grande [illegible] 30 degrees [illegible] east, and north of west and its underlie from two to three [illegible] other veins cut the principal vein of the Veta Grande, which cross it at an acute angle One of these appears to heave the vein for about 700 feet being the most remarkable derangement of the kind on record | One principal vein of the Veta (the *Veta Madre*), which is often separated into three branches, extending from 130 to 160 feet in width When not ramified its width varies from 20 or 30 to 60 or 70 feet [illegible] from 1 to 3 feet The direction of the vein is north west and south east, its underlie is south, and about 5 or 6 feet per fathom | There are five veins worked in this mine The principal vein (*Teich flache*) is from 1 foot 6 inches to 3 feet in width the others are from 6 to 12 inches wide The direction of this vein is nearly north and south, its underlie is west, and about 3 feet per fathom Some of the other veins intersect it |

TABLE — *continued*

| | Consolidated and United Mines (At present the richest mines of Cornwall) | Veta Grande Mines (At present the richest mines in Mexico) | Mine of Valenciana. (Richest of the Mexican mines at the beginning of the present century) | Mine of Himmelfurst (Richest of the Saxon mines at the beginning of the present century) |
|---|---|---|---|---|
| Ores | Chiefly copper ore, occasion [illegible] occurs, but not in very great abundance | Chiefly red silver, native silver, sulphuret of silver, and arsenical iron pyrites | Sulphuret of silver, native [illegible] black silver, [illegible] | [illegible] ret of silver, red silver |
| Produce of the ores | 9½ per cent of fine copper, average produce in 100 parts of ore | 3½ oz per quintal | Four ounces of silver per quintal of 100 lbs Equivalent to 2½ parts of metal in 1000 of ore, or ¼ per cent. | Six to seven ounces [illegible] 100 parts of metal [illegible] of ore, or from 3 8ths to nearly ½ per cent. |
| Veinstone | Chiefly quartz, of which many varieties occur | Chiefly quartz, occasionally [illegible] of lime, and heavy spar | [illegible] hornstone | Quartz [illegible] calcareous spar |
| Mineral substances accompanying the ores | The ores are generally accompanied by 'gossan *' in the backs of the lodes, by blende, and by iron, and | The ores are generally accompanied by blende, sulphuret of antimony, and iron pyrites | The ores are accompanied by blende, spathose iron, copper and iron pyrites | The ores are accompanied by blende, spathose iron and a little iron and arsenical pyrites. |
| Depth of the principal shafts | [illegible] *shaft*, 275 fathoms Some of the other engine shafts are scarcely inferior in depth | *Tiro General*, 182 fathoms *Gallega* shaft, 138 fathoms. | *Tiro General*, 310 fathoms | *Frankenschacht*, 180 fathoms. |
| Depth of adit at the principal shafts | At Woolf's engine shaft 13 fathoms The average depth of the adit at the other engine shafts is about 30 or 40 fathoms | There is no adit to this mine | There is no adit to this mine | The adit at the shaft called *Frankenschacht* is 47 fathoms in depth |
| Quantity of water | Varies from 2000 to 3000 gallons per minute | About 80 gallons per minute | The Valenciana was a dry [illegible] it first became troubled with water, in consequence of some of the workings being inadvertently communicated with the adjoining mine of Tepevac which although upon the same vein, was extremely wet The quantity of water raised during the late working appears to have been about 110 gallons per minute but the regular influx was much less | 50 gallons per minute |
| Height to which the water is raised | About 230 fathoms at the [illegible] fathoms | On an average about 150 fathoms | 310 fathoms | 133 fathoms. |
| Power employed in drainage | 9 steam engines 3 of 90 inch cylinder 3 of 80 1 of 80 and 2 of 60 A water wheel 18 feet in diameter | Usually 10 malacates † | A steam engine of 30 inch cylinder, and 7 malacates | Two water wheels, each 42 feet in diameter |
| Probable equivalent in actual horse power | 1500 constantly at work, or a total number of above 4500 | 32 horses constantly working, or a total number of about 100 horses | 65 horses constantly at work, or a total number of about 200 | 16 horses constantly at work, or a total number of about 50 |
| Average annual expense in drainage | 12 700*l*, taking the average of the last ten years | 20,000*l* per annum | About 40 000*l* per annum | Cannot be ascertained, but evidently very small |
| Quantity of ore and [illegible] raised | 16,400 tons of copper ore, a few tons of tin ore | 21 380 tons of silver ore | 32,500 tons of silver ore | 630 tons of silver ore |
| Produce in metal | 1517 tons of fine copper, a little tin | 153 000 lbs troy of silver | 221,900 lbs troy silver | 6160 lbs troy of silver |
| Total returns, or value of the above | 119,800*l* | 423,100*l* per annum | About 600,000*l* | About 18,000*l* |
| Total costs of the mine | 93,500*l* exclusive of lord's dues 98 500*l* including lord's dues | 252,170*l* per annum | 197,900*l* per annum | 9500*l* per annum |
| Clear profit to the proprietors | 21,800*l* per annum | 171,210*l* per annum | 118,750*l* per annum | 3560*l* per annum |
| Amount of capital invested | 75,000*l* | 130,000*l* | Cannot be ascertained, but known to have been very small | Cannot be ascertained, but probably very small |
| Interest on capital invested | 280 per cent after paying back the original capital | Nearly 700 per cent after paying back the original capital | Not known, but certainly many hundred per cent | Not known, but probably very high |
| Proportion of costs to returns | Costs exclusive of lord's dues, 78 per cent | About 59½ per cent. | Costs 60 per cent. In the nine years following the proportion was 80 per cent , at the end of that time the working of the mine was stopped by the revolution in the year 1809 | Costs 73 per cent. |
| Number of men employed | About 2500 persons, of whom about 1450 are employed under ground | About 900, of whom nearly 600 are employed under ground | 3100 Indians and Mestizoes, of whom 1800 are employed under ground | 700 miners, of whom 510 are employed under ground |
| Wages of the miners per day | Probably about 3 shillings on an average | About 8 or 9 shillings per day | From 4 to 5 shillings | About 1*s* 6*d* per day |
| Quantity and [illegible] of ore | | | 1420 cwt , value 15,830*l* | 240 cwt ; value 1070*l* |
| Manner in which the ores are disposed of | Sold to the smelting companies, and smelted by them at Swansea, in South Wales. | Chiefly reduced by the company at the Hacienda of Sanceda, by smelting and amalgamation | Sold to the *Rescatadores*, and reduced by smelting and [illegible] | Delivered to the Government reduction works in the neighbourhood of Freyburg, where they are partly smelted, and partly amalgamated |

Average of the last Ten Years. — Average of the last Six Years. — Average year at the end of the Eighteenth Century. — Average at the end of the Eighteenth Century

* Gossan, or Gozzan, oxide of iron and quartz

† Malacate, a horse whim

MINES AND MINERALS In England all minerals are [illegible] which they are found, with the exception of gold and silver, which are said to belong to the crown But, by 1 W & M c 30, no mine of copper or lead is adjudged [illegible] be extracted A lease of land [illegible] conveys, it is said, the right to carry on open mines only, and not open new ones, unless expressly reserved, but that, if there are no open mines, the lessee may then dig new ones, as otherwise the grant would be of none effect But, unless the lessee be authorized, to dig mines is waste Mines are not rateable to the relief of the poor with the exception of coal mines, the latter being expressed in the statute of Eliz, the former are held to be excluded by implication But quarries are rateable, and the distinction between a mine and a quarry is taken to be not the nature of the mineral extracted but the mode of working thus, a mine of limestone worked by a shaft is not rateable The law of mines and minerals is subject to a variety of local customs of which those of Devon and Cornwall are the most remarkable *See* STANNARIES

MINE In Fortification, a subterraneous passage leading to a chamber underneath any place intended to be blown up by gunpowder *See Müller's Art of War*, and other works on military engineering of subsequent date

MINERAL ADIPOCERE A greasy bitumen found in the argillaceous ores of iron *See* HATCHETINE

MINERAL CAOUTCHOUC The elastic bitumen found at Castleton in Derbyshire

MINERAL CHAMÆLEON *See* MANGANESE A manganesate of potash obtained by fusing a mixture of nitre and black oxide of manganese So called from the variety of colours which its aqueous solution successively exhibits

MINERAL GREEN Carbonate of copper, obtained by precipitating a hot solution of sulphate of copper by carbonate of soda

MINERALIZERS The substances with which metals are combined in their ores Thus in the native oxides, oxygen is called the mineralizer, sulphur is also a very common mineralizer, as in the ores of copper, lead &c

MINERALOGY A branch of physico-chemical science which teaches the properties composition and relations of mineral bodies, and the art of distinguishing and describing them

"There is no branch of science," says Sir J Herschel, which presents so many points of contact with other departments of physical research and serves as the connecting link between so many distant points of philosophical speculation, as this To the geologist the chemist, the optician, the crystallographer it offers specially the very elements of their knowledge and a field for many of their most curious and important inquiries, nor with the exception of chemistry is there any which has undergone more revolutions or been exhibited in a greater variety of forms To the ancients it could scarcely be said to be at all known and up to a comparatively recent period nothing could be more imperfect than its descriptions, or more artificial and unnatural than its classifications The more important minerals in the arts, indeed,—those used for economical purposes, and those from which metals were extracted, had a certain degree of attention paid to them for the sake of their utility and commercial value and the precious stones for that of ornament but until their *crystalline forms* were attentively observed, and shown to be determinate characters, on which dependence could be placed no mineralogist could give any correct account of the real distinction between one mineral and another It was only, however when chemical analysis had acquired a certain degree of precision and universal applicability, that the importance of mineralogy as a science began to be recognized, and the connection between the external characters of a stone and its ingredient constituents brought into distinct notice"

In the above quotation the two characters of minerals upon which their classification is founded are adverted to, namely, their *structure* and their *composition*, and pursuing these as their leading objects, mineralogists have of late discarded a number of other qualities upon which much stress was formerly laid, but which are so variable and indefinite as to be really of little value, such, for instance, as weight, colour touch, and other sensible qualities, which often vary in different specimens of the same mineral

There are so many disadvantages belonging to any mineralogical arrangement founded exclusively on crystalline form, or on chemical composition, that, for all practical purposes, it is necessary to blend the two, but since the chemical theory of definite proportionals, or, as it is commonly called, the atomic theory, has been known to be applicable to the greater number of mineral combinations, the chemical arrangement of mineral substances has assumed a new and important aspect it [illegible] a mineral, that its [illegible] should in all cases form an essential part of such description, where at least it can be attained, for it must be recollected that there are many cases in which minerals do not occur crystallized and where that characteristic, therefore, would be totally at fault It has been well observed by Dr Thomson (*System of Chemistry*, Part III, Introduction), "that if mineralogy were to be confined to mere crystallized bodies, it would be divested of the greatest part of its utility, for a very great proportion of those minerals that are of the greatest utility to man, and which, therefore, it is peculiarly important to be able to distinguish from others, are seldom found in the state of regular crystals How often do the ores of copper tin, lead and iron occur in an amorphous state? And were a mineralogist incapable of distinguishing them from each other, and from other minerals, except in the rare cases when they assume a regularly crystallized form his knowledge would be useless as far as the important arts of mining and metallurgy are concerned"

Mineralogical analysis, as connected with the atomic theory has made no inconsiderable progress in the skilful and industrious hands of Berzelius, but it is still quite in its infancy as regards the [illegible] of mineral arrangement, and before it can be [illegible] adopted as such, many new analyses and much laborious revision of former researches will be requisite One of the latest authors on mineralogy who has adopted an arrangement founded upon the chemical composition of minerals is Dr Thomas Thomson He divides minerals into three classes —

Class I *Acid Bases* (Those bodies which become acids when combined with oxygen)

| | | Species |
|---|---|---|
| Genus I | Carbon | 11 |
| II | Boron | 1 |
| III | Silicon | 7 |
| IV | Phosphorus | |
| V | Sulphur | 1 |
| VI | Selenium | |
| VII | Tellurium | 1 |
| VIII | Arsenic | 5 |
| IX | Antimony | 5 |
| X | Chromium | |
| XI | Molybdenum | 1 |
| XII | Tungsten | |
| XIII | Columbium | |
| XIV | Titanium | |
| XV | Vanadium | |

Class II *Alkaline Bases*

| | | |
|---|---|---|
| I | Ammonia | 2 |
| II | Potassium | 1 |
| III | Sodium | 7 |
| IV | Lithium | |
| V | Barium | 5 |
| VI | Strontium | 6 |
| VII | Calcium | 30 |
| VIII | Magnesium | 37 |
| IX | Aluminum | |
| | 1 Pure, or combined with bases | 7 |
| | 2 Simple salts | 24 |
| | 3 Double anhydrous salts | 39 |
| | 4 Double hydrous salts, soluble in water | 3 |
| | 5 Double, insoluble in water, and phosphates | 4 |
| | 6 Double hydrous aluminous silicates or zeolites | 39 |
| | 7 Triple aluminous salts | 15 |
| | 8 Quadruple aluminous salts | 12 |
| X | Glucinum | 4 |
| XI | Yttrium | 6 |
| XII | Cerium | 8 |
| XIII | Zirconium | 5 |
| XIV | Thorinum | 1 |
| XV | Iron | |
| | 1 Uncombined, or united to a simple substance | 13 |
| | 2 Oxygen salts of iron | 22 |
| | Double ditto | 19 |
| | Triple ditto | 6 |
| | 3 Sulphur salts of iron | 2 |
| XVI | Manganese | |
| | 1 Combined with simple bodies | 11 |
| | 2 Simple oxygen salts | 5 |
| | 3 Double oxygen salts | 5 |
| | 4 Triple oxygen salts | 1 |
| XVII | Nickel | |
| | 1 Combined with simple bodies | 5 |
| | 2 Oxygen salts | 1 |
| | 3 Sulphur salts | 2 |
| XVIII | Cobalt | |
| | 1 Combined with simple bodies | 5 |
| | 2 Oxygen salts | 2 |
| | 3 Sulphur salts | 1 |

| | | Species |
|---|---|---|
| XIX | Zinc | |
| | 1 United to simple bodies | 4 |
| | 2 Oxygen salts | 6 |
| | 3 Sulphur salts | 1 |
| XX | Lead | |
| | 1 Native, or united to simple bodies | 7 |
| | 2 Oxygen salts of lead | |
| | *a* Simple | 7 |
| | *b* Double | 10 |
| | *c* Triple | 2 |
| | 3 Sulphur salts | 5 |
| XXI | Tin | 2 |
| XXII | Bismuth | |
| | 1 Native, or combined with simple bodies | 6 |
| | 2 Oxygen salts | 2 |
| | 3 Sulphur salts | 1 |
| XXIII | Copper | |
| | 1 Native, or combined with simple bodies | 6 |
| | 2 Oxygen salts | 19 |
| | 3 Chlorine salts | 1 |
| | 4 Sulphur salts | 5 |
| | 5 Selenium salts | 1 |
| XXIV | Mercury | 5 |
| XXV | Silver | |
| | 1 Native, or combined with simple bodies | 10 |
| | 2 Oxygen salts | 1 |
| | 3 Sulphur salts | 6 |
| XXVI | Uranium | 5 |
| XXVII | Palladium | 2 |

### Class III *Neutral Bases*

| | | |
|---|---|---|
| I | Gold | 3 |
| II | Platinum | 1 |
| III | Iridium | 1 |

We have given the above as a specimen of a chemical mineralogical arrangement, and except, perhaps, that the last class is unnecessarily separated from the preceding, it is sufficiently simple and explicit The individual characters of each species, such as colour, fracture, hardness specific gravity and crystalline forms constitute, of course, a necessary part of their description

One of the most useful *practical* works on Mineralogy and, in our language at least the most available for the use of the student, is Mr Allan's edition of the elementary introduction to that science of the late Mr William Phillips In this work the following order of arrangement is adopted, and the annexed tables give the distinctive constituents of the respective species

N B —The proportions are indicated by figures, where ascertained when doubtful, are marked thus —

### EARTHY MINERALS

| *Silica* | Silica | Alumina | Lime | Water | Iron | Manganese |
|---|---|---|---|---|---|---|
| Quartz | 100 | | | | | |
| Opal | — | | | | | |
| Flint | 98 | 2 | | | | |
| Calcedony | 84 | 16 | | | Iron | |
| Jasper | — | — | | | — | |
| Hornstone | 74 | 16 | | | 10 | |
| | | | Lime | Water | | Manganese |
| Leelite | 75 | 22 | | | | 3 |
| Kirpholite | 37 | 29 | | 11 | 3 | 20 |
| Alumo-calcite | 86 | 3 | 7 | 4 | | |
| Garnet | 43 | 16 | 20 | | 21 | |
| Cinnamon stone | 40 | 23 | 32 | | 5 | |
| Idocrase | 40 | 33 | 22 | | 5 | |
| Gehlenite | 29 | 24 | 35 | 5 | 7 | |
| Prehnite | 44 | 28 | 20 | 5 | 3 | |
| Stilbite | 58 | 17 | 9 | 16 | | |
| Heulandite | 59 | 15 | 12 | 14 | | |
| Dipyre | 62 | 25 | 11 | 2 | | |
| Davyne | 45 | 34 | 13 | 8 | | |
| Laumonite | 50 | 22 | 12 | 16 | | |
| Zoisite | 43 | 31 | 22 | | 4 | |
| Epidote | 40 | 28 | 15 | | 17 | |
| Axinite | 50 | 16 | 17 | | 9 | 8 |
| Isopyre | 48 | 14 | 16 | | 22 | |
| Indianite | 43 | 38 | 15 | | 4 | |
| Xanthite | 55 | 14 | 38 | | 13 | |
| | | | | | | Magnesia |
| Anthophyllite | 63 | 14 | 4 | 2 | 13 | 4 |
| Amphodelite | 46 | 36 | 10 | 2 | 1 | 5 |
| Smaragdite | 50 | 21 | 13 | | 13 | 3 |
| Anorthite | 45 | 34 | 15 | | 1 | 5 |
| Clava | 75 | 10 | 5 | | 3 | 2 |
| Kerolite | 39 | 13 | | 31 | | 17 |
| Pyrophyllite | 60 | 30 | | 5 | 1 | 4 |
| Fahlunite | 48 | 29 | | 13 | 5 | 5 |
| Chiastolite | 67 | 30 | | | | 3 |
| Iolite | 50 | 34 | | | 5 | 11 |
| Sordawalite | 50 | 15 | | 5 | 19 | 11 |
| | | | Barytes and Strontia | | | |
| Harmotome | 47 | 18 | 20 | 15 | | |
| Brewsterite | 54 | 17 | 15 | 13 | 1 | |
| | | | Lithia | | | |
| Petalite | 78 | 17 | 5 | | | |
| Spodumene | 66 | 25 | 8 | | 1 | |

### EARTHY MINERALS — *continued.*

| | Silica. | Alumina | Lime | Water | Iron | Manganese |
|---|---|---|---|---|---|---|
| Jeffersonite | 58 | 2 | 16 | | 10 | 14 |
| Tabular spar | 52 | | 46 | | 2 | |
| Okenite | 57 | | 27 | 16 | | |
| | | | | | | Magnesia |
| | | | | Titan | | |
| Melilite | 40 | 3 | 20 | 4 | 14 | 19 |
| Gismondine | 43 | 3 | 48 | | 4 | 2 |
| Augite | 53 | | 22 | | 17 | 8 |
| Diopside | 58 | | 17 | | 6 | 19 |
| Babingtonite | | | | | | |
| Bucklandite | | | | | | |
| Hornblende | 59 | | 14 | | 7 | 20 |
| Arfwedsonite | | | | | | |
| Hypersthene | 56 | 3 | 1 | | 26 | 14 |
| | | | | Water | | |
| Schiller spar | 43 | | 1 | 13 | 14 | 29 |
| Bronzite | 60 | | | | 8 | 32 |
| Thulite | 47 | 28 | 23 | | | 2 |
| *Alumina* | Alumina | Water | Silica | Iron | | |
| Corundum | 98 | | | 2 | | |
| Diaspose | 85 | 14 | | 1 | | |
| Gibbsite | 65 | 35 | | | | |
| Calaite | 74 | 19 | | 7 | | |
| Hydrate of alumina | 45 | 40 | 15 | | | |
| Allophane | 34 | 42 | 24 | | | |
| Scarbroite | 43 | 48 | 8 | 1 | | |
| Halloysite | 34 | 26 | 40 | | | |
| Worthite | 54 | 5 | 41 | | | |
| Fibrolite | 58 | | 38 | 4 | | |
| Sillimanite | 55 | | 43 | 2 | | |
| Kyanite | 64 | | 34 | 2 | | |
| Staurolite | 52 | | 30 | 18 | | |
| | | Magnesia | | | Fluor A | Ox of Zinc |
| Automalite | 60 | 3 | 4 | 9 | | 24 |
| Fluellite | — | | | | — | |
| Topaz | 58 | | 35 | | 7 | |
| Chrysoberyl | 81 | | 19 | | | |
| Spinel | 74 | 8 | 15 | 3 | | |
| Sapphirine | 64 | 17 | 15 | 4 | | |
| Ceonaste | 67 | 14 | 3 | 16 | | |
| | | | | | | Lime |
| Turnerite | — | — | | — | | — |
| *Magnesia* | Magnesia | Water | | | | |
| Hydrate of magnesia | 70 | 30 | | | | |
| Chrysolite | 43 | | 38 | 19 | | |
| Olivine | 38 | | 50 | 12 | | |
| Figurite | | | | | | |
| Fersterite | — | | — | — | | |
| Condrodite | 56 | | 38 | 6 | | |
| Humite | | | | | | |
| Tautolite | — | | — | — | Alumina | |
| Serpentine | 40 | 15 | 42 | 3 | 9 | |
| Soapstone | 25 | 19 | 46 | 1 | | |
| Steatite | 32 | 7 | 59 | 2 | | |
| Potstone | 30 | 3 | 49 | 12 | 6 | |
| Nephrite | 31 | 3 | 50 | 6 | 10 | |
| Nemalite | 52 | 20 | 13 | 6 | | |
| Marmolite | 42 | 15 | 42 | 1 | | |
| Picrolite | 38 | 12 | 41 | 9 | | |
| Picrosmine | 35 | 8 | 55 | 2 | | |
| *Zirconia* | Zirconia | | | | | |
| Zircon | 69 | | 29 | 2 | | |
| Ostranite | | | | | | |
| *Glucina* | Glucina | | | | | |
| Euclase | 42 | | 44 | 3 | 31 | |
| Emerald | 15 | | 68 | 1 | 16 | |
| *Yttria* | Yttria | Glucina | | | Cerium | |
| Gadolinite | 38 | 5 | 25 | 16 | 16 | |
| *Thorina* | Thorina | Lime | | Iron, &c | Water | |
| Thorite | 58 | 3 | 20 | 9 | 10 | |

### ALKALINO-EARTHY MINERALS

| *Potash* | [illegible] | [illegible] | Alumina | Water | Magnesia | Iron |
|---|---|---|---|---|---|---|
| Mica | 8 | 48 | 25 | 4 | 10 | 20 |
| | | | | | Lime | |
| Rubellane | 10 | 45 | 10 | 5 | 10 | 20 |
| Margarite | 2 | 40 | 42 | 1 | 10 | 5 |
| Leucite | 21 | 56 | 23 | | | |
| Herschellite | | | | | | |
| Andalusite | 4 | 36 | 55 | | | 5 |
| Bucholzite | 2 | 46 | 50 | | | 2 |
| Phillipsite | 7 | 48 | 23 | 16 | 6 | |
| Apophyllite | 5 | 52 | | 18 | 25 | |
| Dysclasite | 2 | 58 | | 14 | 26 | |
| | | | | | Magnesia | |
| Nacrite | 18 | 50 | 26 | | 1 | 5 |
| | | | | Sulp A | | |
| Hauyne | 16 | 38 | 19 | 13 | 12 | 2 |
| | | | | Water | | |
| Weissite | 6 | 55 | 23 | 4 | 9 | 3 |
| Pearlstone | 4 | 76 | 12 | | 5 | 3 |
| Gieseckite | 7 | 48 | 36 | 5 | | 4 |
| Pinite | 9 | 56 | 25 | | | 10 |
| Pyrargyllite | 3 | 44 | 29 | 16 | 3 | 5 |
| Felspar | 14 | 67 | 19 | | | |

## ALKALINO EARTHY MINERALS — *continued*

| | | | | | | |
|---|---|---|---|---|---|---|
| *Potash* | Potash | Silica | Alumina | Water | Lime | |
| Latrobite | — | 4 | 3 | 4 | | Iron 1 |
| Agalmatolite | — | | 2 | 5 | 2 | |
| | | | | | Magnesia | |
| Chlorite | 7 | 52 | 10 | 6 | 12 | 13 |
| Killinite | 6 | 56 | 27 | 8 | | 3 |
| | | | | | Lime | |
| Couzeranite | 10 | 53 | 24 | | 13 | |
| Glaucolite | 5 | 52 | 29 | | 14 | |
| | | | | and Flu A | Lithia | |
| Lepidolite | 9 | 50 | 29 | 5 | 5 | 2 |
| *Soda* | Soda | | | Water | Lime | |
| Mesotype | 16 | 48 | 27 | 9 | | |
| Thomsonite | 5 | 38 | 30 | 13 | 14 | |
| Mesole | 8 | 42 | 28 | 11 | 11 | |
| Needlestone | 6 | 47 | 26 | 12 | 9 | |
| Brevicite | 10 | 44 | 29 | 10 | 7 | |
| Gmelinite | 5 | 50 | 20 | 21 | 4 | |
| Comptonite | | | | | | |
| | | | Magnesia | | | Phos A |
| Ledererite | 4 | 50 | 22 | 9 | 12 | 3 |
| | | | Alumina | | | |
| Hypostilbite | 2 | 53 | 18 | 19 | 8 | |
| Epistilbite | 2 | 59 | 17 | 14 | 8 | |
| Spherostilbite | 1 | 56 | 17 | 17 | 9 | |
| | and Potash | | | Magnesia | | |
| Friamite | 3 | 54 | 15 | 5 | 15 | 8 |
| Humboldtilite | 5 | 44 | 11 | 6 | 31 | 3 |
| Lapis lazuli | 9 | 51 | 12 | 6 | 17 | 5 |
| Nepheline | 20 | 44 | 34 | | 2 | |
| | | | | Water | | |
| Ittnerite | 14 | 34 | 30 | 12 | 10 | |
| Flaolite | 21 | 46 | 32 | | | 1 |
| Nuttalite | 8 | 38 | 26 | 8 | 19 | 1 |
| | Soda | | | Mur A | | |
| Sodalite | 26 | 36 | 32 | 6 | | |
| Cancrinite | 26 | 41 | 33 | | | |
| | | | | | | Iron &c |
| | | | | Sul A | | |
| Spinellane | 18 | 41 | 29 | 5 | 2 | 5 |
| Pericline | 10 | 70 | 20 | | | |
| Labradorite | 4 | 56 | 27 | | 11 | 2 |
| Albite | 11 | 70 | 19 | | | |
| | | | | Water | | |
| Analcime | 14 | 55 | 23 | 8 | | |
| Sarcolite | | | | | | |
| Pitchstone | 3 | 73 | 12 | 8 | 1 | 3 |
| Pumice | 3 | 77 | 18 | | | 2 |
| Obsidian | 10 | 75 | 12 | | | 3 |
| Spherulite | 4 | 79 | 12 | 2 | | 3 |
| | | | | Magnesia | | |
| Saussurite | 6 | 49 | 24 | 3 | 10 | 8 |
| | | | | Water | | |
| Scapolite | 1 | 45 | 35 | 2 | 17 | |
| Fkebergite | 5 | 47 | 29 | 3 | 14 | 2 |
| Pectolite | 10 | 51 | 1 | 4 | 34 | |
| Chabasie | 2 | 51 | 18 | 19 | 10 | |
| Levyne | | | | | | |
| | | | | | Magnesia | |
| | | | | Bor A | | |
| Tourmaline | 3 | 36 | 35 | 4 | 6 | 16 |
| | | | | | Lime | |
| Meionite | 2 | 40 | 32 | | 21 | 2 |
| Edingtonite | 3 | 54 | 14 | | 21 | 8 |
| | | | | | Magnesia | |
| | | | | Water | | |
| Krokydolite | 8 | 51 | | 4 | 3 | 34 |
| Achmite | 11 | 56 | | | | 33 |
| Cummingtonite | 9 | 59 | | 2 | | 30 |
| | | | Zirconia | | Lime | |
| Eudyalite | 14 | 54 | 11 | 3 | 10 | 8 |

## ACIDS

| | | |
|---|---|---|
| Sulphuric acid | Sulphur 40 | Oxygen (60) |
| Boracic acid | Boron 26 | Oxygen 74 |

## ACIDIFEROUS EARTHY MINERALS

| | | | | | | |
|---|---|---|---|---|---|---|
| *Alumina* | Sul A | Alumina | Water | | | |
| Subsulphate of alumina | 24 | 30 | 46 | | | |
| Sulphate of alumina | 36 | 16 | 48 | | | |
| | Phos. A | | | | | |
| Wavellite | 35 | 37 | 28 | | | |
| Kakoxene | 18 | 10 | 26 | Silica. 10 | Iron 36 | |
| | | | | | | Lithia |
| Amblygonite | 54 | 39 | | | | 7 |
| Childrenite | — | — | | | — | |
| | | | | | | Magnesia |
| Azurite | 43 | 35 | 6 | 3 | 3 | 10 |
| | Carb A | Lime | | | | |
| *Lime* | | | | | | |
| Carbonate of lime | 44 | 56 | | | | |
| | | | | | | Strontia |
| Arragonite | 44 | 54 | 1 | | | 1 |

## ACIDIFEROUS EARTHY MINERALS — *continued*

| | | | | | | |
|---|---|---|---|---|---|---|
| *Lime* | Carb A | Lime | Water | | | Magnesia |
| Bitter spar | 50 | 34 | 2 | | Iron 3 | 14 |
| Ankerite | 35 | 50 | | | | 12 |
| Plumbo calcite | 43 | 54 | | | | Lead 3 |
| | Phos A | | | | | |
| Apatite | 44 | 56 | | | | |
| Herderite | | | | | | |
| | Fluor A | | | | | |
| Fluor spar | 28 | 72 | | | | |
| | Sul A | | | | | |
| Anhydrite | 58 | 42 | | | | |
| Gypsum | 46 | 33 | 21 | | | |
| | Nit A | | | | | |
| Nitrate of lime | 66 | 34 | | | | |
| | Bor A | | | Silica | | |
| Datholite | 22 | 36 | 5 | 37 | | |
| | Arsen A | | | | | |
| Pharmacolite | 50 | 26 | 24 | | | |
| Haidingerite | 57 | 29 | 14 | | | |
| | Tung A | | | | | |
| Tungstate of lime | 80 | 20 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| *Magnesia* | Carb A | Magnesia | Water | | |
| Carbonate of magnesia | 50 | 48 | 2 | | |
| Brcunnerite | 49 | 42 | | Iron 9 | |
| Conite | 49 | 33 | | 3 | Lime 15 |
| | Sul A | | | | |
| Sulphate of magnesia | 33 | 16 | 51 | | |
| | Nit A | | | | |
| Nitrate of magnesia | 72 | 28 | | | |
| | Phos A | | | | Fluor 7 |
| Wagnerite | 12 | 47 | | 4 | |
| | Borac A | | | | |
| Boracite | 69 | 31 | | | |
| | | | | | Lime |
| Hydro boracite | 50 | 11 | 26 | | 13 |
| | Carb A | Baryta | | | |
| *Baryta* | | | | | |
| Witherite | 22 | 78 | | | |
| Baryto calcite | 31 | 51 | | | 18 |
| | Sul A | | | | |
| Barytes | 34 | 66 | | | |
| | Carb A | Strontia | | | |
| *Strontia* | | | | | |
| Strontites | 30 | 70 | | | |
| | | | Sul A | Baryta | Lime Ka |
| Barystrontianite | 22 | 48 | 9 | 18 | 3 |
| | Sul A | | | | |
| Celestine | 44 | 56 | | | |
| | Phos A | Yttria | | | Iron |
| *Yttria* | | | | | |
| Phosphate of yttria | 37 | 63 | | | 2 |

## ACIDIFEROUS ALKALINE MINERALS

| | | | |
|---|---|---|---|
| *Potash* | Nitric Acid | Potash | |
| Nitre of potash | 54 | 46 | |
| | Sulp Acid | | |
| Sulphate of potash | 46 | 54 | |
| *Soda* | Carbon Acid | Soda | Water |
| Carbonate of soda | 37 | 50 | 13 |
| Trona | 37 | 38 | 25 |
| | Sulph A | | |
| Sulphate of soda | 45 | 35 | 20 |
| | Nitric A | | |
| Nitrate of soda | 63 | 37 | |
| | Boracic A | | |
| Borate of soda | 37 | 15 | 48 |
| | Muriatic A | | |
| Muriate of soda | 47 | 53 | |
| *Ammonia* | Sulph A | Ammonia | |
| Sulphate of ammonia | 53 | 23 | 24 |
| | Muriatic A | | |
| Muriate of ammonia | 51 | 32 | 17 |

## ACIDIFEROUS ALKALINO EARTHY MINERALS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Potash* | Sul A | Potash | Alumina | | Water | | |
| Alum | 24 | 11 | 11 | | 45 | | |
| Alum stone | 36 | 10 | 40 | | 14 | | |
| | | | | | | | Magnesia |
| Polyhallite | 53 | 15 | | Lime 19 | 6 | | 7 |
| | Fluor A | | | | | | |
| *Soda* | | | | | | | |
| Cryolite | 44 | 32 | 24 | | | | |
| | Sul A | | | | | | |
| Glauberite | 57 | 22 | | 21 | | | |

## ACIDIFEROUS ALKALINO EARTHY MINERALS—*continued.*

| | | | | | | |
|---|---|---|---|---|---|---|
| *Soda* | Sul A | Potash | | | Mur A | Mag nesia |
| Reussite | 57 | 29 | | | 2 | 12 |
| | | | Alu mina | | Water | |
| Soda alum | 38 | 8 | 12 | | 42 | |
| | Carb. A | | | Lime | | |
| Gaylussite | 29 | 20 | 1 | 18 | 32 | |
| | | | | | | Iron, &c |
| Native carbonate of lime and soda | 37 | 9 | | 39 | 10 | 5 |
| *Ammonia* | | Ammo | | | | Mag |
| Sulphuret of alu mina and ammo nia | Sul A | nia | | | | nesia |
| | 37 | 5 | 12 | | 45 | 1 |

## METALLIFEROUS MINERALS

| | | | | | | |
|---|---|---|---|---|---|---|
| *Iron* | Iron | Sul phur | | | | Nickel |
| Native iron | 97 | | | | | 3 |
| Iron pyrites | 47 | 53 | | | | |
| White iron pyrites | 46 | 54 | | | | |
| Magnetic iron pyrites | 61 | 39 | | | | |
| Arsenical iron | 36 | 21 | | | | Arsen 43 |
| | | Oxygen | | | | |
| Oxydulated iron | 72 | 28 | | | | |
| Specular iron | 69 | 31 | | | | |
| | | | Water | Silica | Lime | |
| Red hæma tite | 65 | 29 | 3 | 2 | 1 | |
| | | | | | Man gan | Zinc |
| Franklinite | 46 | 30 | | | 10 | 14 |
| Hydrous ox ide of iron | 57 | 26 | 14 | 2 | 1 | |
| Goethite | 61 | 28 | 11 | | | |
| Brown ha matite | — | — | — | | | |
| Stilpnosider ite | 56 | 25 | 16 | 3 | | |
| | | | | | | Mag nesia |
| Cronstedtite | 42 | 18 | 11 | 22 | 2 | 5 |
| Pinguite | 25 | 11 | 26 | 37 | | 1 |
| Anhydrous silicate of iron | 51 | 19 | | 29 | 1 | |
| | | | | | | Alu mina |
| Chloropal | 24 | 11 | 18 | 44 | 2 | 1 |
| Chamosite | 42 | 19 | 17 | 14 | | 8 |
| Siderochiso lite | 53 | 20 | 7 | 16 | | 4 |
| Hisingerite | 37 | 15 | 12 | 29 | 1 | 6 |
| | | | | | | Lime |
| Yenite | 39 | 16 | 1 | 30 | 2 | 12 |
| | | | | Sulph A | | Arsen A |
| Pitchy iron ore | 24 | 11 | 29 | | 10 | 26 |
| | | | | | Mur A | Man gan |
| Pyrosmalite | 24 | 10 | | 36 | 7 | 16 |
| | | | | | Carb A | |
| Spathose iron | 46 | 14 | | | 40 | |
| | | | | | Phos A | |
| Phosphate of iron | 32 | 10 | 27 | | 31 | |
| Hetéposite | 32 | 11 | — | | 15 | 9 |
| Karphosi derite | — | — | — | | — | |
| | | | | | Sulph A | |
| Sulphate of iron | 19 | 7 | 45 | | 29 | |
| Botryogene | 25 | 10 | 33 | | 32 | |
| Misy | — | — | — | | — | |
| | | | | | Arsen A | |
| Arseniate of iron | 29 | 15 | 20 | | 38 | |
| | | | | | Oxal A | |
| Oxalate of iron | 41 | 13 | | | 46 | |
| | | | | | Tung A | |
| Tungstate of iron | 14 | 9 | | 2 | 71 | 4 |
| | Man gan | | | | | |
| *Manganese* | | | | | | |
| Hausmannite | 78 | 22 | | | | Baryta |
| Braunite | 68 | 29 | 1 | | | 2 |
| Pyrolusite | 66 | 31 | 2 | 1 | | |
| Grey oxide of manganese | 68 | 22 | 10 | | | |
| Psilomelane | 55 | 23 | 6 | | | 16 |
| | | | | Silica, &c | Iron | |
| Wad | 48 | 21 | 17 | 10 | 4 | |
| Cupreous mangan | 53 | 23 | 20 | 1 | Copper 3 | |
| | | | Sulph A | | Iron | Glu cina |
| Helvine | 34 | 8 | 5 | 39 | 6 | 9 |
| Bitticiferous oxide of manganese | 36 | 17 | Water 8 | 40 | 4 | |

## METALLIFEROUS MINERALS—*continued*

| | | | | | | |
|---|---|---|---|---|---|---|
| *Manganese* Hydrate of manganese | Man gan | Oxygen | Water | Silica. | | |
| | — | — | — | — | Iron | |
| Knebelite | 27 | 15 | | 33 | 25 | |
| | | | | | | Lime 15 |
| Bustamite | 28 | 8 | | 49 | | Carb A 11 |
| Sulphuret of manganese | 66 | 18 | | Sul-phur 5 | | |
| Carbonate of manganese | 39 | 17 | | 1 | 38 | Lime 5 |
| Pelokonite | — | — | — | | | |
| | | | | | Iron. | Phos A |
| Huraulite | 24 | 14 | 16 | | 8 | 38 |
| Phosphate of manganese | 25 | 14 | | Lime 2 | 25 | 34 |
| *Molybdena* | Molybd | Sulph | | | | |
| Sulphuret of molybdena | 60 | 40 | | | | |
| Oxide of mo lybdena | 85 | Oxygen 15 | | | | |
| *Tin* | Tin | | | | | |
| Oxide of tin | 79 | 21 | | | | |
| Sulphuret of tin | 36 | Sulph 26 | Copper 36 | Iron 2 | | |
| *Tungsten* | Tungst | Oxygen | | | | |
| Oxide of tungsten | 86 | 14 | | | | |
| *Titanium* | Titan | | Iron | Silica | | |
| Anatase | — | — | | | | |
| Rutile | — | — | | | | |
| Iserine | 45 | 16 | 36 | 3 | | |
| Brookite | — | — | — | | | |
| Crichtonite | — | — | — | | | |
| | | | | | | Man gan 1 |
| Ilmenite | 59 | 10 | 30 | | | |
| Mohsite | — | — | — | | | |
| | | | | | Lime | |
| Sphene | 33 | | | 34 | 33 | |
| | Tit A | | Water | Cerium | | Uran |
| Pyrochlore | 63 | 10 | 4 | 5 | 13 | 5 |
| | | | Iron, &c | | | Zircon |
| Æschynite | 56 | 4 | 4 | 12 and Yttria | 4 | 20 |
| Polymignite | 53 | | 12 | 16 | 4 | 15 |
| *Cerium* | Cerium | | Silica | Water | | Iron |
| Cerite | 51 | 15 | 18 | 10 | 2 | 1 |
| Silicate of cerium | — | — | — | | | |
| | | | | | and Alum | |
| Allanite | 19 | 15 | 33 | 3 | 26 | 4 |
| Lorrehte | 11 | 8 | 33 | 4 | 28 | 16 |
| | | | | | and Yttria | |
| Orthite | 16 | 6 | 36 | 8 | 24 | 10 |
| | | | | | | and Carbon |
| Pyrorthite | 12 | 4 | 11 | 27 | 5 | 41 |
| | | | | | Carb A | |
| Carbonate of cerium | 60 | 16 | | 13 | 11 | |
| | | | | | Fluor A | |
| | | | Lime | | | Yttria |
| Yttro-cerite | 14 | 4 | 47 | | 25 | 10 |
| Fluate of ce rium | 66 | 17 | | | 16 | 1 |
| | | | | | | Sulp Lead |
| *Uranium* | Uran | | Silica | Iron | | 5 |
| Pitchblende | 82 | 5 | 5 | 3 | | |
| | | | Lime, &c | | Water | Phos A |
| Uranite | 55 | 7 | 7 | 1 | 15 | 15 |
| | | | | Copper | | |
| Chalkolite | 55 | 8 | | 6 | 15 | 16 |
| | | Carb A | | | | |
| Carbonate of uranium | — | — | | | | |
| | | Sulp A | | | | |
| Johannite | — | — | | | — | |
| | | | | Man | | |
| *Tantalum* | Tantal | Oxygen | Iron | gan | Yttria | |
| Tantalite | 81 | 10 | 4 | 5 | | |
| | | | | | | Lime |
| Yttrotanta lite | 51 | 4 | 4 | | 37 | 4 |
| | | | | Tin, &c | | Zir conia |
| | | | Cerium | | | |
| Fergusonite | 44 | 5 | 3 | 3 | 42 | 3 |
| *Chrome* | Chr | | Iron | | | |
| Oxide of chrome | 70 | 30 | | | | |
| | | | | | | Alu mina |
| Chromate of iron | 39 | 28 | 26 | | | 7 |
| | Bis | Sul | | | | |
| *Bismuth* | muth | phur | Copper | Lead. | | |
| Native bis muth | 100 | | | | | |
| Sulphuret of bismuth | 81 | 19 | | | | |
| Cupreous bismuth | 49 | 13 | 38 | | | |
| Needle ore | 43 | 15 | 12 | 30 | | |
| Oxide of bis muth | 90 | Oxygen 10 | | | | |

## METALLIFEROUS MINERALS — *continued*

| | | | | | | |
|---|---|---|---|---|---|---|
| *Bismuth* | | | | | | |
| Bismuth-blende | Bismuth 62 | Oxygen 9 | Silica 23 | Iron 2 | | Phos. A 4 |
| Telluric bismuth | 64 | | | Tellur 31 | Sulphur & Selen 3 | Silver 2 |
| *Arsenic* | Arsenic | | Iron | | | Antimony |
| Native arsenic | 96 | | 1 | | | 3 |
| Oxide of arsenic | 76 | 24 | | | | |
| Sulphuret of arsenic | 70 | Sulph 30 | | | | |
| Arsenical pyrites | 65 | 5 | 28 | | | Nickel 2 |
| *Cobalt* | Cobalt | Arsenic | Sulphur | | Iron. | |
| Bright white cobalt | 34 | 44 | 20 | | 2 | |
| Tin white cobalt | 22 | 75 | | | 3 | |
| Bismuth cobalt ore | 10 | 78 | 3 | | 5 | Bismuth 1 |
| Sulphuret of cobalt | 44 | | 39 | | 4 | Copper 13 |
| Earthy cobalt | 61 | Oxygen 16 | | Water 23 | | |
| | | | Arsen A | | | |
| Cobalt bloom | 31 | 9 | 38 | 22 | | Magnesia |
| | | | | | Lime | |
| Roselite | — | — | — | — | — | — |
| | | | Sulph A | | | |
| Sulphate of cobalt | 23 | 6 | 30 | 41 | | |
| *Nickel* | Nickel | Sulph | | | | |
| Sulphuret of nickel | 65 | 35 | | | | |
| | | | Antimony | | | |
| Antimonial nickel | 28 | 16 | 56 | | | |
| | | | Arsenic | | | |
| Arsenical nickel | 44 | 1 | 55 | | | |
| | | | Arsen A | | | |
| Nickel ochre | 30 | Oxygen 8 | 37 | 25 | Alumia | Lime, &c |
| Pimelite | 13 | 3 | Silica 35 | 38 | 6 | 5 |
| *Silver* | Silver | | | | | |
| Native silver | 100 | | | | | |
| | | | Antimony | | | |
| Antimonial silver | 84 | | 16 | | | |
| | | | Tellur | | | |
| Telluric silver | 63 | | 37 | | | |
| | | Sulphur | | | | |
| Sulphuret of silver | 87 | 13 | | | | |
| Flexible sulphuret of silver | — | — | | Iron — | | |
| Sternbergite | 33 | 33 | | 34 | | |
| Brittle sulphuret of silver | 68 | 16 | Antim 11 | 2 | | |
| Sulphuret of silver and antimony | | | | | Copper | Arsenic |
| Polybasite | 65 | 17 | 5 | | 9 | 4 |
| Red silver | 60 / 68 | 23 / 20 | 17 | | | 15 |
| Miargyrite | 37 | 22 | 40 | | 1 | |
| Sulphuret of silver and copper | 53 | 16 | | | 31 | |
| | | | Bismuth | | | Lead |
| Bismuthic silver | 15 | 17 | 28 | 6 | | 34 |
| | | Selenium | | | | |
| Seleniuret of silver | 69 | 26 | | | | 5 |
| Seleniuret of silver and copper | 39 | 28 | | | 24 | Carb A &c 9 |
| | | Iodine | | | | |
| Iodic silver | — | — | | | | |
| | | | Antimony | | | Carb A |
| Carbonate of silver | 73 | | 15 | | | 12 |
| | | | | | | Mur A |
| Muriate of silver | 72 | | | 6 | | 22 |
| | | | | | | Arsen A |
| Gänsekötthigerz | — | | | — | | — |
| *Copper* | Copper | | | | | |
| Native copper | 100 | | | | | |
| | | Sulphur | Iron | | | |
| Sulphuret of copper | 78 | 19 | 3 | | | |
| Kupferindig | 65 | 33 | 2 | | | |
| Bisulphuret of copper | 67 | 33 | | | | |
| | | | | Arsenic | | |
| Purple copper | 62 | 23 | 15 | 14 | | |
| Grey copper | 48 | 13 | 25 | | | |

## METALLIFEROUS MINERALS — *continued*

| | | | | | | |
|---|---|---|---|---|---|---|
| *Copper* | | | | | | |
| Copper pyrites | Copper 33 | Sulphur 36 | Iron 31 | | Selen | |
| Seleniuret of copper | 60 | | | | 40 | |
| | | Oxygen | | | | |
| Red oxide of copper | 89 | 11 | | | | |
| Black copper | 80 | 20 | | | | |
| | | | | | Carb A | |
| Blue carbonate of copper | 55 | 14 | | | 26 | Water 5 |
| Green carbonate of copper | 57 | 15 | | | 19 | 9 |
| Chrysocolla | 35 | 9 | | | | 20 |
| Dioptase | 38 | 11 | | | | 14 |
| | | | | | Sulph A | |
| Sulphate of copper | 25 | 7 | | | 32 | 36 |
| Brochantite | 53 | 15 | | | 17 | 12 |
| Kupfer samintera | — | — | — | | — | |
| Muriate of copper | 57 | 15 | | | Mur A 11 | 17 |
| | | | | | Phos A | |
| Phosphate of copper | 51 | 14 | | | 28 | 7 |
| Hydrous phosphate of copper | 50 | 13 | | | 22 | 15 |
| | | | | | Arsen A | |
| Arseniate of copper | 29 | 8 | | | 28 | 35 |
| Fuchroite | 38 | 10 | | | 33 | 19 |
| Kupfer schaum | 37 | 9 | | | 26 | 18 |
| Erinite | 47 | 12 | | | 34 | 5 |
| Skorodite | 18 | 10 | 21 | | 32 | 19 |
| *Gold* | Gold | | | | | |
| Native gold | 100 | | | | | |
| *Platina* | Platina | | | | | |
| Native platina | 100 | | | | | |
| | Palla | | | | | |
| *Palladium* | dium | | | | | |
| Native palladium | 100 | | | | | |
| | Iri | | | | | |
| *Iridium* | dium | | | | | |
| Native iridium | 100 | | | | | |
| | | | Osmium | Rhodium | Iron | |
| Iridium and osmium | 47 | 19 | 3 | | 1 | |
| | Tellu | | | | | |
| *Tellurium* | rium | Gold | Silver | | | |
| Native tellurium | 92 | 1 | | | 7 | |
| Graphic tellurium | 58 | 28 | 12 | | Lead 2 | |
| Yellow tellurium | 13 | 27 | 8 | | 20 | |
| Black tellurium | 16 | 6 | | | 63 | Sulph 11 |
| | | | | | | Antim 4 |
| *Antimony* | Antimony | Sulph | Iron | | | |
| Native antimony | 100 | | | | | |
| Berthierite | 53 | 31 | 16 | | | |
| Sulphuret of antimony | 71 | 26 | | | | |
| Jamesonite | 35 | 23 | 2 | | 40 | |
| Heteromite | 38 | 22 | | | 40 | |
| Zinkenite | 45 | 23 | | | 32 | |
| Red antimony | 75 | 20 | | | | Oxygen 5 |
| Oxide of antimony | 84 | | | | | 16 |
| Antimonial ochre | — | | | | | Water — |
| Antimonphyllite | — | | | | | |
| *Lead* | Lead | | | | | |
| Native lead | | | | | | |
| Sulphuret of lead | 84 | 16 | | | | |
| | | | | | | Antim |
| Bournonite | 41 | 20 | | | | 26 |
| | | | | | Arsen & | |
| Prism copper glance | 33 | 10 | | | 18 | 19 |
| Native minium | | | | | | |
| Seleniuret of lead | 70 | Selen 28 | | | Cobalt 2 | |
| | | | | | Alumina | |
| Plumbgomme | 40 | Oxygen 3 | Water 19 | | 38 | |
| | | | | | | Carb A |
| Carbonate of lead | 74 | 10 | | | | 16 |

METALLIFEROUS MINERALS — *continued*

| | | | | | | |
|---|---|---|---|---|---|---|
| *Lead* | | | | | Carb A | Sulp A |
| Sulphato carbonate of lead | Lead 82 | | | | 4 | 14 |
| Sulphato tri carbonate of lead | 88 | | | | 5 | 7 |
| Cup sul carbonate of lead | 72 | | | Copper 7 | 6 | 15 Mur A |
| Muriate of lead - | — | | | | — | — |
| Co unnite - | 75 | Oxygen | | | | 25 |
| Murio carbonate of lead | 80 | 6 | | | 6 | 8 |
| Phosphate of lead | 76 | 6 | | | 16 | 2 Magnesia |
| Polysphärite | — | — | Water — | — | — | — |
| Arseniate of lead | 72 | 6 | | Arsen A 13 | 7 Sulph A | Mur A 2 |
| Sulphate of lead | 65 | 7 | 2 | | 26 | |
| Cupreous sulphate of lead | 56 | 4 | 5 | Copper 15 | 20 Molyb A | |
| Molybdate of lead | 57 | 4 | | | 31 Chrom A | |
| Chromate of lead | 63 | 5 | | | 32 | |
| Melano chrote | 71 | 6 | | | 23 | |
| Vauquelinite | 57 | 6 | | 9 | 28 Tung A | |
| Tungstate of lead | 44 | 4 | | | 32 Vanid A | |
| Vanadiate of lead | — | | | | — | — |
| *Zinc* | Zinc | Sulph | Iron | Silica | | |
| Sulphuret of zinc | 63 | 33 Oxygen | 4 | | | |
| Red oxide of zinc | 74 | 18 | 8 | | | |

METALLIFEROUS MINERALS — *continued*

| | | | | | | |
|---|---|---|---|---|---|---|
| *Zinc* | Zinc | Oxygen | | Silica. | Water | |
| Siliceous oxide of zinc | 54 | 13 | Iron 25 | | 8 | |
| Carbonate of zinc | — | — | — | Carb A 35 | | |
| Willelmine | 52 | 13 | | Sulph A 30 | 42 | |
| Sulphate of zinc - | 22 | 6 | | | | |
| Hopeite - | — | | | | — | |
| *Mercury* | Mercury | Silver | | | | |
| Native silver | 100 | | | | | |
| Native amalgam | 85 | 15 Chlorine | | | | |
| Muriate of mercury | 85 | 15 | | | | |
| Iodic mercury | — | Iodine — | | | | |

COMBUSTIBLE MINERAIS

| | | | | |
|---|---|---|---|---|
| Sulphur - - | Sulphur 100 | | | |
| Diamond | Carbon 100 | Iron | | |
| Plumbago | 92 | 8 | Silica | |
| Anthracite | 72 | 4 | 24 | |
| Naphtha - | 88 | Hydrogen 12 | Oxygen | |
| Bitumen | 53 | 7 | 40 | Azote |
| Coal - | 75 | 6 | 5 | 14 |
| Dysodile | — | — | | |
| Amber - | 81 | 12 | 7 | |
| Hatchetine | — | — | | |
| Scherérite | 76 | 24 | | |
| Ozokerite | — | — | | |
| Mellite | Mel A 41 | Alumin 15 | Water 44 | |
| Retinasphalt | | | | |
| Fossil copal | | | | |

MINERAL PITCH, *Maltha* A solid, softish bitumen Sp gr about 1 5

MINERAL TAR The bituminous substance called *petroleum* It is brown viscid, and unctuous Its specific gravity is 0 88 It is found in Britain, and on the continent of Europe, in the West Indies (Barbadoes tar), and in Persia It may be resolved by distillation into naphtha and petroleum

MINERAL WATERS This term is applied to certain spring waters containing so large a proportion of foreign matter as to be unfit for ordinary use

Mineral waters may, in most cases, be artificially prepared by the skilful application of the knowledge derived from analyses with such precision as to imitate very closely the native springs When the various earthy or metallic constituents are held in solution by carbonic acid or sulphuretted, they should be placed along with their due proportions of water in the receiver of the aerating machine and then the proper quantity of gas should be injected into the water Sufficient agitation will be given by the action of the forcing-pump to promote their solution (See *Ure's Dict of Arts, &c*)

The following table shows the composition of several of the principal mineral springs of Europe

TABULAR VIEW of the Composition of the Principal Mineral Waters of England.

One Pint (Wine Measure) contains the following Ingredients —

| Waters | Gases: Nitrogen, C I | Gases: Carbonic Acid, C I | Gases: Sulphuretted Hydrogen, C I | Carbonates: Carbonate of Soda | Carbonates: Carbonate of Magnesia | Carbonates: Carbonate of Lime | Sulphates: Sulphate of Soda | Sulphates: Sulphate of Magnesia | Sulphates: Sulphate of Lime | Muriates: Muriat of Soda | Muriates: Muriate of Magnesia | Muriates: Muriate of Lime | Oxide of Iron | Silica | Temperature | Total of Saline Contents | Authority |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Sulphurous* | | | | grs | grs | grs | grs | grs | grs | grs | grs | | | | | | |
| Harrowgate | 0 8 | 1 | 2 3 | | 0 7 | 2 | | 1 3 | - | 7 | 11 | 1 5 | - | - | cold | 91 | Garnet |
| Moffat | 0 5 | 0 6 | 1 2 | | | | | | - | 4 5 | | | - | - | do | 4 5 | Ditto |
| Cheltenham sulphur spring | | - | 1 5 | | | | 23 5 | 5 | 1 2 | 35 | | | 0 3 | | do | 65 | Parkes & Brande |
| *Saline* | | | | | | | | | | | | | | | | | |
| Cheltenham pure saline | | | | | | | 15 | 11 | 4 5 | 50 | | | - | | do | 80 5 | Ditto |
| Bristol | | 3 5 | - | | | 1 5 | 1 5 | | 1 5 | 0 5 | 1 | | | | 74° | 6 | Carrick |
| Buxton | 0 2 | | | | | 1 3 | | - | 0 3 | 0 2 | | - | 0 03 | | 82° | 1 83 | Pearson |
| Bath | | 1 2 | | | | 0 8 | 1 5 | - | 9 | 3 3 | | | a trace | 0 2 | 116° | 14 6 | Phillips |
| Scarborough | | | | | | a trace | 20 | | 9 | | | - | ditto | | cold | 2 9 | Saunders |
| Kilburn | | 3 5 | 8 5 ? | | 0 5 | 1 | 12 | 37 | 5 5 | 2 5 | 5 5 | 0 2 | ditto | | do | 64 2 | Schmeisser |
| Leamington New Bath | 0 1 | a trace | a trace | | | | 19 | | 14 | 53 | 1 5 | | 0 8 | | do | 88 3 | Lambe |
| Leamington Old Bath | 0 3 | - | ditto | | | - | 7 5 | 7 | 18 | 41 | - | | | | do | 73 5 | Ditto |
| *Chalybeate* | | | | | | | | | | | | | | | | | |
| Tunbridge | 0 59 | 1 | { a trace of oxygen } | | | 0 03 | | - | 0 17 | 0 30 | 0 03 | 0 05 | 0 28 | | do. | 0 56 | Scudamore |
| Cheltenham chalybeate | | 2 5 | - | 0 5 | - | - | 22 7 | 6 | 2 5 | 41 3 | - | | 0 8 | - | do | 73 8 | Parkes & Brande. |
| Brighton | | 2 2 | - | - | - | - | | - | 4 | 3 | 0 75 | | 1 4 | 0 14 | do | 9·29 | Marcet |

# MINERAL WATERS.

## TABULAR VIEW of the Composition of the Principal Mineral Waters of Germany

| Ingredients found in 16 oz of Water in a dry state, in grains | Carlsbad | Ems | [illegible] | [illegible] | [illegible] | [illegible] | Spa | Geilnau | Selters | Seidschutz | Pulina |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Carbonate of soda | 9 695 | 10 750 | 8 26 | 6 197 | 5 00 | - | 0 7375 | 6 6210 | 6 155 | | |
| Sulphate of soda | 19 695 | - | 39 72 | 22 544 | 25 50 | 2 14566 | 0 0375 | 0 0420 | - | 23 4960 | 123 8 |
| Muriate of soda | 7 975 | 7 654 | 12 45 | 8 996 | 7 96 | - | 0 44949 | 0 5430 | 17 292 | | |
| Sulphate of potash | - | 0 540 | 0·93 | - | 0 93 | 0 04194 | 0 07909 | 0 2872 | 0 397 | 4 8940 | 4 8 |
| Muriate of potash | - | 0 045 | - | - | - | - | - | | 0 358 | | |
| Carbonate of lime | 2 37 | 1 1407 | 4 1300 | 4 016 | 1 847 | 5·98824 | 0 9850 | 2 9705 | 2 1870 | 6 8060 | 0 77 |
| Sulphate of lime | - | - | - | - | - | 7 22132 | - | - | - | 1 5050 | 2 6 |
| Sub phosphate of lime | 0 0017 | - | - | - | 0 014 | - | 0 01366 | - | | 0 0156 | 0 0035 |
| Fluate of lime | 0 024 | 0 00192 | - | - | | - | | - | 0 0018 | | |
| Carbonate of magnesia | 1 369 | 0 7887 | 3·0560 | 2 4 | 0 600 | 0 32352 | 1 12275 | 2 1709 | 1 3780 | 1 0980 | 6 406 |
| Sulphate of magnesia | - | - | - | - | - | 2 69752 | - | - | | 83 1380 | 93 086 |
| Muriate of magnesia | - | - | - | - | - | 1 12664 | - | - | - | 1 6300 | 19 666 |
| Nitrate of magnesia | - | - | - | - | - | - | - | | - | 7 9070 | |
| Alumina | - | - | 0·0075 | | - | - | - | 0 0247 | | | |
| Sub phosphate of alum | 0 0024 | 0 0018 | - | - | - | 0 01478 | 0 00851 | - | 0 0027 | 0 0117 | |
| Carbonate of strontian | 0 007 | 0 0107 | - | - | | - | - | - | 0 0192 | | |
| Sulphate of strontian | - | - | - | - | - | 0 02063 | | - | - | 0 0168 | |
| Carbonate of barytes | - | 0 0029 | - | | | | | | 0 0019 | | |
| Silica | 0 577 | 0 4139 | 0 8800 | 0 669 | 0 568 | 0 19689 | 0 4985 | 0 2695 | 0 302 | 0 1200 | 0 176 |
| Carbonate of iron | 0 0278 | 0 026 | 0 1760 | 0 4 | 0 350 | 0 12816 | 0 3751 | - | - | 0 0147 | |
| Carbonate of manganese | 0 006 | 0 0037 | 0 0065 | 0 092 | 0 006 | 0 01852 | 0 0519 | - | - | 0 0042 | |
| Total | 41 9239 | 21 35932 | 69 616 | 45 311 | 42 775 | 20 55412 | 13 903 | 12 9288 | 28 0946 | 130 6845 | 251 3075 |
| Carbonic acid gas in 100 cubic inches | 58 | 51 | 125 | 119 56 | 154 | 160 | 136 | 163 3 | 130 | 6 4 | 6 9 |
| Temperature (Fahr.) | Sprud 165° Neub 138° Mühl 128° Ther 122° | Kess 117° Krän 84° | 53° | 49° | 53° | 56° | 50° | 51° | 58° | 58° | 58° |
| Analyzed by | Berzelius. | Struve | Struve | Steinmann | Struve | Struve | Struve | Struve | Struve | Struve | Struve |

MI'NERAL YELLOW, or PATENT YELLOW A compound of oxide and chloride of lead obtained by digesting powdered litharge in a solution of common salt washing drying, and fusing the product It is used as a pigment

MINE'RVA The Latin goddess [illegible] to and confounded with the Grecian Pallas Athene or Athena (Ἀθήνη) She was fabled to have sprung in full armour from the forehead of her father Jupiter Minerva was worshipped as the goddess of wisdom and the patroness of industry and the arts Athens the city to which she gave name was her favourite spot and there her worship was celebrated with great splendour and the magnificent temple the Parthenon erected to her honour But she was also worshipped at Rome with peculiar veneration There she had three temples one on the Capitol, which she shared with Jupiter and Juno a second on the Aventine and a third on the Celian mount in which she was worshipped as *Minerva Capta* an epithet said to [illegible] statue was transported from [illegible] that city by Camillus At Rome there were also two great festivals celebrated annually in her honour, the one called Quinquatrus or Quinquatria, the other Quinquatria Minora (See these words) The origin of the name of Minerva has long puzzled etymologists Cicero says she is called "Minerva, quia minuit or minatur," but it has been also fancied that the word is a shortened form of Meminerva (from memini, *I remember*) she being the goddess of memory It is possibly from the same root as the Lat mens, *mind* which is expressed so clearly in many languages wholly unallied, of which the German (whence the English *man*), and the Hindostan mena, may serve as examples But the Tuscan name of the goddess is Menrfa, which seems the immediate source She was represented as a young woman, with a grave and noble countenance clothed in armour *See* PALLAS

MI'NIATURE (Fr) A representation of nature on a very small scale *Miniature Painting* is generally executed on ivory, and is, as to composition, drawing, and finishing, subject to the same laws as Painting (which see) The outline is traced upon with a silver point or pencil, and must be [illegible] light and delicate This is afterwards drawn in with thin carmine as correctly as possible the corrections being made with finely powdered pumice stone, rubbed on with a paper or leather stump The dead colouring then proceeds, wherein the shadows are left delicate and the lights strong the full effect being afterwards produced by dotting The artist usually begins the shades with vermilion and carmine giving the strongest touches to the most prominent parts and to those where separations are marked out in shades that are obscure Indigo is afterwards used for the bluish shades on such parts as recede from the light Yellow tints, composed of ochre and vermilion are usually employed on the sides of the nose towards the bottom under the eyebrows underneath the cheeks and on other parts rising towards the light The backgrounds if dark, are commonly composed of bistre umber or Cologne earth, with black and white others of a yellow cast by the use of ochre The grey back grounds are formed by black white, and a little indigo When of a green or olive hue Dutch pink, white, and black are the ingredients The back-grounds are formed in two coats, first laying on a light thin tint, and afterwards a darker one of the same colour, evenly and smooth The dotting is performed by separate dots, or by short notching strokes crossing each other every way so as to have the appearance of being dotted

MI'NIM (Lat minimus) In Music, a character 𝅗𝅥 equal in duration to two crotchets or half a semibreve

MI'NIM The smallest liquid measure generally regarded as about equal to one drop The fluid drachm is divided into sixty minims

MI'NIMS, or MINIMI, ORDER OF THE A religious order instituted by St Francis De Paulo in the fifteenth century The name is derived from the Lat minimus *the least*, by which the founder meant to indicate that humility should be the distinguishing feature of the order In conformity with this design the rules he prescribed were of the strictest kind Besides the three usual vows of poverty, continence, and obedience, the most rigid abstinence was inculcated Except in cases of illness, the members were prohibited not only from animal food but even butter, milk, or cheese, any kind of sustenance in the composition of

which such materials were used Their dress was of the coarsest and meanest kind, the colour being black, like that of the Franciscans Long before the death of its founder, this order had attained so high a degree of celebrity that it could boast of monasteries in [illegible] and Germany, and at no very distant period fewer than 450 religious houses scattered throughout Europe and Asia (See the *Dict de la Conversation*)

MINISTER In Politics, a servant of the sovereign executive power in a state generally speaking, the head of a department or branch of government Usage, in different countries, fixes very differently the limits of that higher class of servants to which the term is applied In the British empire, none but the heads of administrative departments are termed ministers part of whom belong to the cabinet, and part are not included in it The cabinet ministers have varied under different administrations, and as our government is of mixed organization, partly to serve the actual necessities of state, and partly retaining ancient distinctions of office founded on usage only some of the ministers hold merely sinecure appointments In France where the forms of [illegible] are established more on the principle of utility [illegible] eight ministers so called 1 of the interior, 2 of finance, 3 of justice, 4 of public instruction and ecclesiastical affairs, 5 of commerce and public works, 6 of the marine and colonies, 7 of war, 8 of foreign affairs In [illegible] in either house of parliament [illegible] peers, as representatives only, of commoners In France the same regulation prevails, but ministers have also, by virtue of their office a right to sit and take part in the debates in either chamber In the United States, no minister (or secretary, in the language of that government) can be chosen either representative or senator In some European countries (as Russia) a distinction is established between the private affairs of the sovereign and foreign affairs on the one hand, which form the combined duties of the cabinet ministers and the affairs of the interior, which are entrusted to ministers of state There are also in some governments honorary or *conference* ministers without any real department of duty The representatives of minor sovereigns at foreign courts are usually styled *ministers*, instead of *ambassadors* The term *minister* is also frequently used in a sense synonymous with *clergyman*

MINIUM (Lat) In Painting a red colour being a calx of lead according to Pliny it was the common red lead See LEAD

MINNEHOFF (Germ, literally *courts of love*) The name given by the Germans to the cours d'amour so famous in the history of chivalry The subjects brought before these courts were chiefly connected with the Romantic gallantry of the period and consisted either of questions proposed with the view to entrap the judges into some awkward decision, or of serious complaints resulting from affaires du cœur which were discussed and decided upon with all the formality of a court of law These minnehofe were for a long period looked upon as forming an indispensable part in all chivalrous exercises Knights, ladies, and poets participated alike in their proceedings, and large collections of their decisions are still extant A certain number of ladies remarkable at once for personal and mental attractions, acted as judges in these courts the fair sex also conducted the proceedings as counsel attorneys general and solicitors general, &c and they were attended by a numerous train of nobles, knights, and others who were invested by the court with gradations of rank and precedency analogous to those conferred by the sovereign These courts were held periodically at Signes Avignon Lille, and Pierrefeu The last regular court of this kind was celebrated by Charles VI and his wife Isabella of Bavaria, but they were now and then renewed at irregular intervals and the last on record took place as late as the reign of Louis XIV at Ruelle at which the princess Maria of Gonzaga presided, and Mademoiselle de Scudery represented the advocate-general We subjoin a few specimens of the questions proposed at these courts for [illegible] from which it will be seen that at the present day there would be little difficulty in deciding upon them, they could not fail at that romantic era to excite considerable discussion 1 Which is harder to bear,—the infidelity or the death of the beloved? 2 Whether does a man whose wife, or a lover whose betrothed is unfaithful, suffer most? 3 Who is more culpable,—the man who boasts of favours from a lady which he never received, or he who having really received them makes it known? (See the *Damen Lexicon*, Adorf, 1837)

MINNESÆNGERS The most ancient school of German poets, whose name is derived from the old German word minne (*love*) The songs and fame of the Provençal troubadours appear to have penetrated into Germany under the first emperors of the house of Hohenstauffen, in whose time the crusades and the frequent Italian wars combined to bring their nation, seated as it is in the centre of Europe, in closer communication with those surrounding it The minnesængers imitated in German the strains of those early poets, and, like them, made love their principal subject, which was celebrated with [illegible] concerns but at the [illegible] The verses of the minnesængers are in the old Swabian dialect of the High German, which, under the Hohenstauffens, themselves of Swabian race, was the court language As was the case with the troubadours, the minnesængers belonged to two different classes there were among [illegible] and even sovereigns, while [illegible] more professional poets—wandering minstrels, who attached themselves to the persons of distinguished chiefs or wandered from court to court The oldest of the [illegible] known is Henry of Veldeck, about [illegible] During the latter part of the 12th and first half of the 13th century this school of poets flourished, after which it gradually declined and was succeeded by the [illegible] and the school of the master-singers We possess the names of more than 300 poets and pieces of the composition of a large proportion of them, who sang during the short period in question The German amatory poets had their high and low minne like the celestial and popular Venus of the ancients, the former an abstract and chivalric devotion to a beloved object, the latter a less elevated passion The ancient German national epic, called the *Nebelungen-Lied*, and the heroic poetry of the *Heldenbuch*, belong to the same period and dialect, and were works of the same race of poets, as were also other poetical romances, founded on the foreign traditions of [illegible] and classical antiquity

MINNOW or MINIM (Lat minimus, *least*) The name of a species of Cyprinoid fish (*Leuciscus phoxinus*, Cuv), and the smallest of the British species of that family It inhabits many of the fresh water streams and canals in England, and spawns in June, when each female is attended by two males

MINOR In Music *See* MAJOR

MINORITY In Politics, the period during which the sovereign in an hereditary monarchy is incapacitated from exercising the supreme authority by reason of not having attained the age prescribed by law, also the state of such incapacity The royal authority in hereditary monarchies, never dies and when a sovereign deceases leaving a successor below age it passes immediately to the person or persons whom the constitution has invested with the authority of regent, as [illegible] when the king becomes subject to any other incapacity The term of royal minority is variously regulated by the constitution of different countries The legal majority of a king of France was fixed at fourteen by an ordinance of Charles V, which has been since followed in that country, but, as a year commenced is reckoned as accomplished, the actual period at which a king of France begins to govern is the age of thirteen years and a day The same period is fixed by the laws of Spain and Portugal By the constitution of Great Britain the sovereign is of full age at eighteen years as far as can be collected from the statutes passed at several times to empower the king to name a regent whenever it has been apprehended that the crown was in danger of devolving on a prince under age

MINORITY In Law the state of an individual of either sex who has not attained the age prescribed by law at which civil rights can be exercised In England and in France majority is attained on the completion of the 21st year, in Germany on the 25th The distinctions made by the Roman law between different periods of minority are unknown to our law

MINOR TERM of a Categorical Syllogism, in Logic, is the subject of the conclusion The minor premise is that which contains the minor term In hypothetical syllogisms the categorical premise is called the minor

MINOS, in Mythological History, was son of Jupiter and Europa and king of Crete, and so celebrated as a lawgiver on earth that after his death he was appointed judge of the infernal regions, in which office he was associated with Æacus and Rhadamanthus

MINOTAUR (Gr Μινως, and ταυρος, *a bull*) A fabled monster of classical antiquity, half man and half bull frequently mentioned by the poets He was said to be the son of Pasiphae wife of Minos II king of Crete, by a bull (ταυρος), hence the term Minotaur He lived on human flesh, hence Minos shut him up in the famous labyrinth of Dædalus feeding him with criminals, and afterwards with youths and maidens sent from Athens As is well known Theseus, by the assistance of Ariadne, succeeded in destroying him, and thereby rescued the Athenians from the obligation of sending their children to be devoured The *Dict de la Conversation* gives an [illegible] See also [illegible]

MINSTER (Germ) was [illegible] applied only to the church of a monastery or convent, and forms the

termination of the name of many places in England in which such churches formerly existed, as Westminster, Leominster, &c It is sometimes, but incorrectly, used in common language to signify a cathedral church

MINSTRELS (Fr ménestral or old Germ minne, *love*) Defined by Percy as an order of men in the middle ages who subsisted by the arts of poetry and music, and sang to the harp verses composed by themselves or others They appear to have been the successors of the minnesingers, scalds and bards of different European nations, who, even after the age of chivalry had passed, attempted to gain a subsistence by practising those arts which at an earlier period had procured fame and honour for their predecessors The origin, character, and decline of the minstrels, are thus ably traced in vol lxxxii of the *Edin Review* [illegible] "*omnis luxuriæ inventor*" [illegible] sang of mimic war to the dull barons of dungeon castles, who had ears, although they could not read — who, doubly steeped in the crime of wealth and want of occupation, listened greedily like other great men, to their own praises Minstrelsy supplied the lack of a more refined intellectual entertainment and of rational conversation, as professional gentlemen do now at civic banquets their harpings lulled the rude Saul to sleep, which is now done by quarto epics The person of the minstrel was sacred, his profession was a passport, he was high placed in hall a welcome guest" the assumption of his character became the disguise of lovers of adventure These advantages raised pseudo laureates, 'idle vagabonds," according to the act of Edward I, "who went about the country under the colour of minstrelsy" men who cared more about the supper than the song, who, for base lucre, divorced the arts of writing and reciting and stole other men's thunder Their social degeneracy may be traced in the dictionary the chanter of the *gests of kings, gesta ducum regumque* — dwindled into a "gesticulator" a jester, the honoured joglar of Provence into the mountebank, the juggler, 'the jockie,' or doggrel balladmonger

> Beggars they are by one consent,
> And rogues by act of parliament

They descended by the usual stages of things of mere fashion at first the observed of all observers and therefore then imitated, until they became common — vulgar, which is but one step, and the test at once of merit universal acceptance, and the forerunner of disgrace no sooner taken up by the *οι πολλοι* than rejected by the exclusive In Spain, particularly this occurred very soon The really good clergy were shocked at their abuses, while the interested grudged the money earned by rivals who interfered with their monopoly of instructing the people in pious prose, or of amusing them with alexandrine legends Their Latin synonyme for 'scald rhymers"—*scurra mimus*, &c — will outlive their sculptured caricatures, when mendicant monks, minstrels fools, monkeys and beasties are pilloried on pinnacle and gargoyle, in cloister and cathedral The itinerant monks and mountebanks repaid all this, like Falstaff by showing up the irregularities of regulars and seculars "in ballads to be sung to filthy tunes" They undermined their influence Preachings and songs take part in all national changes, for doctrines precede actions They were the popular press of the time, opposed by the privileged orders, and watched by statesmen, as Burleigh afterwards [illegible] — the thermometer of the people's [illegible] alterations for the worse, the primitive principle 'to entertain" remained unchanged To this the original ballad was sacrificed, passing from one to another each minstrel begged borrowed, or stole from all quarters The originals were corrupted and remodelled, they got their bread by plying — '*magister artis ingeniique largitor venter*" As late as the beginning of last century the houses of many leading families, especially in the northern parts of the empire, were provided with minstrels, who were employed in various duties, all of them, however, in some degree connected with their original occupation *See* BARD, SCALD, MINNESINGERS BALLAD

MINT (Germ muntze) The place in which the coin of the realm is manufactured The whole of the British coin is issued from and manufactured in the Royal Mint in London The general details of the business of the Mint are briefly stated under the article COINAGE

The Royal Mint received its constitution of superior officers in the 18th year of the reign of Edward II, and continued nearly as then established to carry on its operations within the Tower of London

Between the years 1810 and 1815 the present magnificent and commodious building was erected on Tower Hill at the suggestion of a committee of the [illegible] council appointed in 1798 "[illegible] state of the coins of the king [illegible] and constitution of the Mint," and in 1815 a new constitution was introduced founded upon a report drawn up by the present Lord Marlborough who was then master

The chief officers of the mint are the master, the deputy master, the [illegible] the king's (or queen's) assay masters, [illegible] the clerk of the irons and superintendent of machinery these constitute "the mint board," and meet every Wednesday, or as often as may be required, [illegible] business of the establishment The actual [illegible] is carried on under the direction of the company of moneyers The other officers are the master's assayer, the melter, the chief engraver, the weigher and teller, the surveyor of the meltings, and the solicitor The duties of these officers are fully set forth in the "mint indenture" As relates to the general history of the coinage the reader is referred to the new edition of *Ruding's Annals of the Coinage* The article "Coinage," in the *Encyclopædia Britannica*, gives an abstract of the duties of the respective officers and is especially valuable as containing the only extant account, illustrated by engravings, of the machinery employed in the mint this account [illegible] A [illegible] respecting the whole establishment will be found in the *Parliamentary Report of the Select Committee on the Royal Mint*, and its Appendix, published by order of the House of Commons, 30th June 1837

MINT (Lat mentha) A name given to several herbaceous aromatic plants belonging to the natural order *Labiatæ* and genus *Mentha* Spearmint, or *Mentha viridis* is that which is so generally used in this country, mixed with vinegar and sugar as a sauce Peppermint, or *Mentha piperita*, yields the stimulating oil of the same name Horsemint and others are also species of the same genus

MINT, MASTER OF THE An officer in the English administration, generally till lately removeable with a change of ministry His salary is 2000*l* a year

MINUET (Fr) A species of dance performed in slow time and with measured steps formerly of great celebrity but now rarely if ever met with

MINUTE (Lat minutum) The sixtieth part of an hour of time and the sixtieth part of a degree of angular space In modern astronomical works minutes of time are denoted by the initial letter *m* and minutes of space by the dash or acute accent, which was first used by Ptolemy

MINUTE In Architecture, the sixtieth part of the diameter of a column, by which subdivision architects measure the smaller parts of an order

MINUTE GUNS Guns fired at intervals of a minute, as a signal from a vessel in distress Also fired [illegible] great persons

MINUTES Originally the rough draft of a public instrument drawn up by a notary, so termed because usually written in a smaller character than the instrument itself The term is now applied to a brief report of the proceedings of a society drawn up by the clerk or secretary in which sense it is nearly synonymous with *protocol* which see

MIOCENE (Gr *μειων minor*, and *καινος, recent*) A term applied by Mr Lyell in his *Elements of Geology*, to geological formations containing a *minority of fossil shells of recent species*

MIQUELETS In Modern History, a species of partisan troops raised in the north of Spain, and chiefly in Catalonia The Miquelets became first known in the wars between Spain and France in the 17th century At several periods (in 1689, 1789, and again in the wars of Napoleon) the French have endeavoured to organize similar corps to oppose to the Miquelets in the mountain warfare of those districts

MIRACLE (Lat miror *I wonder*) According to the definition of Dr Johnson, "something beyond human power," which though in itself evidently vague and insufficient, may be explained by the addition of "a deviation from the established laws of nature" A miracle must be not only superhuman, but preternatural Some writers add the 'immediate interference of God" as another condition of a miracle, but this assumes a point which is open to [illegible] inasmuch as it precludes the agency of [illegible] such interruptions of the course of nature, which is still a question among theologians With respect to the credibility of miracles, the most popular argument against them is that of Hume, who considers no weight of particular testimony credible when balanced against our universal experience of the constancy of the laws of nature "No testimony," he says, "is sufficient to establish a miracle, unless the testimony be of such a kind that its falsehood would be more miraculous than the fact it endeavours to establish" If the words *incredible* or *contrary to experience* be substituted for *miraculous* in this passage, the startling effect of this statement of the argument, in which its efficacy resides, will disappear, and the question will be left upon the very grounds which the believer would choose for his own position Hume was answered by Dr Campbell, in his [illegible] (See also *Rutherford's Discourse* [illegible] *Criterion*,

*Locke's Discourse on Miracles*, *Lardner's Credibility*; *Middleton's Free Inquiry*, *Price's Nature of Miracles*, some very valuable remarks of Paley, in his *Evidences of Christianity*, *Hooker's Eccl Polity*, b viii on Miracles as the Tests of a Supernatural Mission," *Bentham's Rationale of Evidence*)

MIRAGE (Fr) An optical illusion very common at sea, and especially in high latitudes, and sometimes also witnessed on land, particularly in Egypt and Persia, and on the margin of rivers and lakes, or on the seashore It arises from unequal refraction in the lower strata of the atmosphere, and causes remote objects to be seen double, as if reflected in a mirror, or to appear as if suspended in the air When the effect is confined to apparent elevation the English sailors call it *looming*, when inverted as the Italians give it the name of *Fata* (a term) Ships in the [illegible] horizon by its inverted image in the air, though he did not previously know that it was cruising in that part of the fishery The mathematical theory of the phenomenon is given by Biot, in the *Memoires de l Institut* for 1809 [illegible] *Biot's Traite de Physique*, [illegible] (*Cabinet Cyclopedia*)

MIRROR (Fr miroir) A speculum or looking-glass, or any other polished body capable of reflecting the images of objects, rays of light from which fall upon them Silver is considered to be the most powerful reflector, but the speculum metal as now prepared is scarcely inferior, if at all so and in some cases even better In the very early ages of the world polished metallic specula were employed as mirrors by the Jewish and Egyptian women especially of brass, but in modern times, quicksilvered plates of glass are alone used as mirrors

*Concave mirrors* are used to concentrate the rays of the sun in a single point and thereby produce intense heat The surfaces formed by the revolution of the ellipse parabola and hyperbola, are such as reflect them accurately to one point, provided they emanate from one point are parallel to one another (as the solar rays) or would converge to a more remote point than the one which it is desirable to use The great difficulty of constructing these has led to the employment of spherical segments which, though not accurate, yet under proper restrictions are approximately so For the mathematical theory, see REFLECTION, see also BURNING GLASS, SPECULUM TELESCOPE

MIRZA (A corruption of the Persian title Emir-Zadeh *sons of the prince*) The common style of honour in Persia when it precedes the surname of an individual When appended to the surname it signifies prince

MISANTHROPY (Gr μισος *hatred* and ανθρωπος, *a man*) signifies a general dislike or aversion to man and mankind, in contradistinction to *philanthropy*, which means the love of our species

MISCELLANY (Lat misceo *I mix*) A word usually applied to a collection of literary works or treatises The most celebrated collection of works known by this name is *Constable's Miscellany*

MISCHNA The text of the Jewish Talmud on which the *Gemara*, or second part is a commentary It consists of traditions and explanations of scripture The former are supposed by the Jews to have been delivered to Moses on the mount, and from him to have passed through the keeping of a succession of prophets and sages to Rabbi Juda of Tiberias, who committed them to writing Their compilation is supposed by modern commentators to have taken place about A C 150 or 190 (See Prideaux *Connexion* vol ii, and Lardner, *Collection of Jewish and Heathen Testimonies* vol i)

MISDEMEANOR, in Law is any offence which is the subject of indictment and punishment not of a felonious character, such are seditious acts perjury, battery, libels, conspiracies, attempts and solicitations to commit felonies, &c Over these offences the justices of the peace at quarter sessions have a general jurisdiction, although they may be removed by certiorari to the King's Bench, and in the trial the defendant has had for a long period of time one remarkable privilege, viz that his counsel might address the jury which was equally the case in treason, but not until the year 1837 in any sort of felony The ordinary punishment of mis- [illegible] sometimes by [illegible] been sometimes termed *misprisions*, although this word in its more restricted signification, is applied to concealments of felony or treason

MISTLETOE, or MISSELTO A parasitical plant inhabiting the branches of many kinds of trees in the north of Europe It is the *Viscum album* of botanists Its connection with Druidical ceremonies is well known, but, as tradition tells us that the priests of that superstition only employed the misseltoe of the oak, some doubt has been entertained of the plant now so called being really that of our ancient chronicles, because it had not been found upon the oak for many centuries It has, however, been recently discovered upon that tree in the west of England, and this leaves no doubt upon the subject The powder of the leaves or shoots of the misseltoe has been used in epilepsy

MISERERE The 50th Psalm, 4th of the Penitential Psalms, is that designated by the Roman Catholic church under this word, on account of its first words (in the Vulgate translation, "miserere mei Deus, secundum magnam misericordiam tuam") It is the usual psalm [illegible] and more solemn modification

MISERICORD [illegible] given to the third passion

MISERICORDIA A narrow-bladed dagger so [illegible] was the weapon used by [illegible] when he enforced him to cry for mercy

MISNOMER In Law, the description of a person by a wrong name In grants by deed such mistakes may, in some instances, be corrected by the courts, if the party be sufficiently pointed out in the instrument itself In grants by will such construction will be more liberally exercised It is said that the law is not so precise as to surnames as with respect to Christian names The proper mode for the defendant to avail himself of a misnomer in an action was formerly by plea of abatement, but now the court will amend on motion (3 & 4 W 4 c 42) In criminal cases, the court had the power to amend still earlier (6 G 4 c 64) where the defendant was misnamed But if the prosecutor be misnamed in an indictment the variance is fatal, and the defendant must be acquitted It is to be observed that mere misspelling is no misnomer, if the name have the same sound with the real one

MISPRISION (From the Fr mespris *contempt* or *negligence*) In Criminal Law, in its larger sense, it is used to signify every considerable misdemeanor which has not a certain name given to it in the law, and it is said that the offence of misprision is involved in every treason or felony whatsoever Generally, however, by the word misprision is understood the contempt or neglect that is the non-disclosure or concealment, of any treason or felony, committed or to be committed, which a man is cognizant of but has never assented to, for if he expressly assented, this makes him, in a case of treason, a principal and in a case of felony either a principal or accessory, according to circumstances Misprision of treason is punished by loss of the profits of lands during life forfeiture of goods, and imprisonment for life Misprision of felony in a public officer is punished by imprisonment for a year and a day in a common person, by imprisonment for a less discretionary time, and in both by fine

MISSAL The book containing the ritual for the celebration of the various masses of the Roman communion The missals in use in different churches are not identical in all respects but the most important part of them, the canon of the mass as delivered in the Sacramentary of Gregory the Great, which was taken from that of Pope Gelasius in the 5th century and which is affirmed by Roman Catholics to be a faithful representation of the ritual of the primitive church, is common to all

MISSIONARIES In ordinary language, ministers who go abroad to preach the gospel to infidel nations The following table of the present condition of some of the more remarkable missionary societies now existing in England is taken from the *Penny Cyclopedia* —1. Society for the Propagation of the Gospel in Foreign Parts receipts 1837, 43,000*l*, expenditure, 56,000*l*; subscribers about 12,000 This society is conducted on the principles of the Church of England, and was incorporated in 1701, chiefly with a view to our then American possessions 2 Baptist Missionary Society, founded 1786 receipts 1837-8, 22,000*l*, expenditure, 20 000*l* The operations of this society are chiefly carried on in the East and West Indies 3 London Missionary Society founded 1795 now [illegible] dependents receipts 1838, [illegible] Much connected with the East Indies and the South Seas 4 Church Missionary Society founded 1814 for Africa and the East" but [illegible] missionaries extensively to [illegible] expenditure 91,000*l* 5 Wesleyan Missionary [illegible] 1817 receipts, 85,000*l*, expenditure, [illegible] extensive field of labour is in the West Indies 6 Missions of the Church of Scotland chiefly India 7 Missions of the United Brethren, or Moravians, who have been distinguished in this line of exertion since 1731 The Danish missions are among the oldest Protestant; those of the United States are now among the most extensive The history of Roman Catholic missions in the East is detailed in many works See *Duhalde*, for China The rise and fall of Christianity in Japan is narrated by Charlevoix (1715), those in America are slightly noticed in the article immediately following this

**MISSIONS** Stations of missionaries in infidel countries In Geography, the extensive districts formerly under the control of missionaries of the church of Rome, on the borders of the Spanish and Portuguese settlements in America, were so called These missionaries chiefly [illegible] ch they governed with [illegible] they had also extensive districts under their control The downfal of the order was followed by the destruction of these settlements those of Paraguay were wholly ruined, those of Brazil, by regulations of the Marquis de Pombal, taken from their spiritual [illegible] placed on a new footing The missions of the order [illegible] continue to subsist on the banks of the Upper Amazon and Orinoco, and in California, but they have undergone severe losses from the revolutionary wars The success of the experiment of governing the American Indians by missionaries has been the subject of much controversy It is certain that the Jesuits succeeded better than any other governors have done in rendering them industrious, and subjecting them to discipline But it is contended that this was only effected by an artificial system which rendered them the servile and childish dependents of their spiritual masters and that this slavish state was injurious to them not only in a moral but a physical [illegible] remature decay, insomuch that [illegible] of all the missions was continually decreasing, although endeavours were made to keep it up by violent seizures of free natives who were brought by force within their boundaries See Charlevoix, *Hist du Paraguay*, the *Lettres Edifiantes*, Raynal, *Histoire des Indes*, and *Southey's History of Brazil* the two last writers especially for philosophical views on the subject, although the latter is perhaps too favourable, *Humboldt's Personal Narrative*, for those on the Orinoco, *Forbes's California* for a very unfavourable view of the condition of those in the latter country American missionaries have established a government somewhat similar to those of the Roman Catholic orders in some of the South Sea Islands See *Ellis's Polynesian Researches*, the *Voyages* of Capt Beechey Capt Fitzroy and others

**MITES** A tribe of minute Acaridan Condylopes, which do not suck their food See Acarus

**MITHRAS** The grand deity of the Persians supposed to be the sun or the god of fire to which they paid adoration as the purest emblem of the divine essence The Romans also raised altars to the honour of this divinity, with the inscriptions *Deo Soli Mithræ*, or *Soli Deo invicto Mithrae* As to the introduction of this oriental worship in Rome, see *Mem de l Ac des Inscr* vol xvi p 270 It was one of those which resisted Christianity the longest See Beugnot, *Destruction du Paganisme en Occident*, *Milman's Hist of Christianity*

**MITHRIDATE** A celebrated medicinal confection invented by Damocrates, physician to Mithridates king of Pontus, and supposed to be an antidote to all effects of poison and contagion, [illegible] vis opium

**MITRAL VALVES** The valves of the left ventricle of the *heart*

**MITRE** (Gr *μιτρα, a head band, or diadem*) The pontifical ornament worn on the head by the pope cardinals and in some instances by abbots in the Roman catholic church, and in the Protestant episcopal church by archbishops and bishops upon solemn occasions It appears to have been a hierarchal head covering from the earliest ages of antiquity Pellerin says it was that worn by the regal pontiffs of the Hebrews, and with a few slight modifications, was afterwards adopted by the oriental kings and pagan high priests under the name of *cidaris* Among the Romans the mitre was originally a sort of head-dress worn by ladies, and Servius makes it a matter of reproach to the Phrygians that they were dressed like women, inasmuch as they wore mitres There is every reason for supposing that in England the mitre was worn by the bishops on the first introduction of Christianity into the island, and it is supposed in *Gough's Sepulchral Monuments* (vol i p 153) that the practice was borrowed from the apex or tutulus of the Flamen Dialis in ancient Rome As an heraldic ornament the mitre of a bishop is surrounded by a fillet set with precious stones the archbishop's mitre on the other hand, issues from a ducal coronet.

**Mitre** In Architecture, a junction of two pieces of wood or other material at an interior or exterior angle by diagonal fitting

**MITTIMUS** (Lat *we send*) In Law,—1 a writ for transferring records from one court to another, 2 a precept under the hand and seal of a justice of peace committing an offender to his charge *See* Commitment

**MIXED CADENCE** In Music *See* Cadence

**MIXED FEVER** A fever intermediate between inflammatory and low or typhus fever

**MIZZEN MAST** The name given to the mast which supports the after sails, being nearest the stern of the ship

**MNEMONICS** (Gr [illegible] The art of [illegible] tory of [illegible] by artificial [illegible] processes of tying a knot in a handkerchief, &c, will exemplify the simplest species of mnemonics, in which we endeavour to connect certain arbitrary acts with peculiar associations, so that the memory of the former may call up the latter Some persons have taken the precaution, before delivering an address by heart, of entering the room in which it was to be spoken, and connecting in their own minds particular portions of their intended language with certain visible objects in the room The well known solemnities observed on the perambulation of parish boundaries, &c, form another instance of practical mnemonics, the object being to fix the memory of particular spots in the mind of those present For the purpose of facilitating the remembrance of dates, names, &c various methods have been devised by different writers (especially Feinagle and Gray in England) under the names of Memoria Technica or Artificial Memory

**MNEMOSYNE** (Gr *μνημοσυνη*) In Classical Mythology, the goddess of memory [illegible] the genealogists of Uranus (Heav [illegible] and mother by Jupiter, of the Nine Muses Her statues usually have the figure enveloped in long and ample drapery and the right hand raised towards the chin

**MOAT** A ditch made round the old castles and filled with water In some cases this still remains, as at Lickhill Castle, whilst in others they are drained and planted as at the palace of the Black Prince at Eltham For the most part, however, all traces of them have disappeared

The moat surrounding a military fortress of modern construction (or the *ditch*) is left dry but where it is capable of inundation at pleasure this circumstance is considered an advantage to the system of defence

**MOBILITY** (Lat *moveo I move*) One of the general properties of matter, in virtue of which every body at rest can be put in motion by the action of a force adequate to overcome its inertia See Matter

**MOCHA STONE** A species of agate

**MOCKING BIRD** A name given to one of the family of thrushes, the *Turdus polyglottus* of Linnæus on account of the surprising facility and accuracy with which it can imitate almost any sound, it is also the finest of natural song-birds and the vocal organs which are well developed in all the thrush tribe find their highest perfection and complication in the mocking bird

This species in modern ornithological systems, forms the type of a genus (*Mimus* of Boie) it includes other species besides the *M polyglottus*, all of which are natives of America

**MODE** (Lat modus) A term used by Locke to denote 'such complex ideas which however compounded, contain not in them the supposition of subsisting by themselves but are considered as dependences on or affections of substances' Of these modes there are two kinds—*simple* and *mixed* Simple modes are only variations or different combinations of the same simple idea without the mixture of any other as *a dozen* or *a score* which are nothing but the ideas of so many distinct units added together' *Mixed modes* are those "compounded of simple ideas of several kinds put together to make one complex one,—e g *beauty*, and consisting of a certain *composition of colour and figure* [illegible] beholder" It need hardly be said that [illegible] is founded on a very imperfect and false analysis The term is now universally laid aside by writers on mental philosophy

**Mode** In Music the melodious constitution of the octave as consisting of seven essential and natural sounds besides the key or fundamental It is not any single note or sound, but the order of the concinous degrees of an octave the fundamental note whereof may in another sense, be called the key, as it signifies the principal note which regulates the rest The difference between a mode and a key is, that an octave with its natural concinous degrees is called a mode with respect to the manner of dividing it whilst as regards its place in the scale of music or pitch it is called a key

**MODEL** (Lat modulus) In Mechanics, a small or miniature representation of the structure of a machine so as to exhibit its mode of working &c Owing to the effect of increased mass in making the machine itself, the results obtained from the model exceed those of the machine in a greater ratio than the linear dimensions of the two works

**Model** In the Fine Arts, that which is an object of imitation In Painting and Sculpture, it is the individual whom the artist procures for getting up his proportions, details, play of the muscles &c Also in Sculpture, it is a term applied to the small sketch in wax or clay for a work of art In Architecture it is a small pattern in relief either of wood plaster or other material of the building proposed to be executed

**MO'DELLING** In the Fine Arts, the art of making a mould from which works in plaster are to be cast, also used for the forming and display of the design itself

**MODERATORS SENIOR and JUNIOR** In the University of Cambridge, two public officers appointed annually to perform various duties They are ex officio examiners in the senate house Their name is derived from another of their duties, viz presiding in the opponencies, or ex formed in the schools between undergraduates candidates for the degree of bachelor of arts These disputations, relics of the old university system, are now reduced to little more than matters of form *Moderator* is also the name applied to the president for the time being of the General Assembly of the Church of Scotland, and of the other superior church courts of the synod and presbytery

**MODILLION** (Fr modillon) In Architecture, an ornament sometimes square on its profile, and sometimes scroll-shaped, thus  , with the intervention of one or two small horizontal members placed at intervals under the corona in the richer orders They should stand centrally over columns when the latter are employed They are simplest in the Ionic and Composite orders, more carving being bestowed on them in the Corinthian order The mutule of the Doric order, which should always stand over the centre of a triglyph, is the same sort of thing, and occupies the same place in the entablature as the modillion

**MO'DULATION** (Lat modulor) In Music the act of moving through the sounds in the harmony of any particular key to those of another, or the transition from one key to another

**MO'DULES** (Lat modulus) In Architecture a measure equal to the semidiameter of a Doric column It is a term only applied in the Doric order and consists of thirty minutes

**MODULUS** In Analysis, the constant coefficient or multiplier in a function of a variable quantity by means of which the function is accommodated to a particular system or base Thus in the theory of *logarithms* it is the number by which all the logarithms in one scale of notation must be multiplied to adapt them to the same number in another scale The only scales or bases actually Napier- modulus lasticity,

see ELASTICITY

**MO'DUS** (Modus decimandi or special manner of tithing), in Law, is when lands tenements or some certain annual sum or other profit hath been given time out of mind to a parson and his successors in full satisfaction and discharge of all tithes in kind It is in some cases a pecuniary compensation in others compensation in work and labour See TITHES

**MOGRVBIANS, or MEN OF THE WEST** A name formerly given to a species of Turkish infantry composed of the peasants of the northern parts of Africa who sought to ameliorate their condition by entering into foreign service

**MOGUL GREAT** The name by which the chief of the empire so called, founded in Hindostan by Baber in the 15th century was known in Europe The last person to whom this title of right belonged was Shah Allum, and the Mogul empire having terminated at his death in 1806, his vast possessions fell chiefly into the hands of the East India Company

**MOHAIR** (Gr mohr, Fr moire, It moerro, Sp muc, muer) The hair of a variety of the common goat famous for being soft and fine as silk, and of a silvery whiteness It is not produced any where but in the vicinity of Angora in Asia Minor The exportation of this valuable and beautiful article, unless in the shape of yarn was formerly prohibited, but it may now be exported unspun The production preparation and sale of mohair have long engrossed the principal attention of the inhabitants of Angora, and it used to form an important article of Venetian commerce It is manufactured into camlets and other expensive stuffs Hitherto but little has been imported into England

**MOHA'MMEDANISM** One of the most celebrated systems of religion in the world, so called from Mohammed, its author and founder, who was born at Mecca in Arabia, in May, 571 This founder of a new religion and of a political power, which even in his lifetime extended over his native country, and which under his successors threatened to embrace the empire of the world, traced his [illegible] descents from Kor[illegible] that bore his name, and who again was affirmed to be in direct descent from Ishmael, the son of Abraham The future prophet sprung therefore, from the noblest tribe of the Is[illegible] His paternal father was at the time of [illegible] Mecca and [illegible] the *Caaba* which from [illegible] memorials had become identified in the minds of the Arabs with every sacred feeling), consequently, from the sanctity of his territory and his office, a prince of great power and influence But though descended from so powerful a family Mohammed's early life was spent in [illegible] dence His father was a younger son [illegible] and having in his early infancy lost both his parents, his only inheritance was five camels and a female slave On his paternal grandfather was devolved the guardianship of the future prophet, but of this protector he was deprived by death when only eight years of age In a dying charge Motalleb confided this tender plant of the ancient stock of the Koreish to the hands of Abu Taleb, his eldest son, and the successor of his authority, who amply redeemed the trust reposed in him by continuing throughout life the steadfast friend of his ward amid all the difficulties and dangers to which the latter was exposed in the promulgation of his doctrines His education however, is said to have been extremely scanty, and at the early age of thirteen, being intended for a commercial life, he accompanied his uncle's trading caravan into Syria He afterwards entered into the service of Khadijah, a rich widow of Mecca, to whom his skill in commerce or his other accomplishments so far endeared him that at the end of three years she bestowed upon him her hand and fortune, — an alliance which restored him to the station of his family At this period he was twenty-five, and his wife forty years of age

During the first thirteen years of his marriage little or nothing is known of his history, but at the termination of that period he withdrew from society, — resorted to a cave in the neighbourhood of Mecca, where he gave himself up to contemplation, and laid the foundation of that bold and hazardous project which afterwards raised him to glory and dominion It was in this retirement he gave out that for two years he was in daily communication with the Deity

In his 40th year he assumed the prophetic office, and displayed his views and principles to his domestic circle His first convert was Khadijah, whom he always regarded with affection and even reverence, and whom he placed, after her death, among the only *four* perfect women the world ever saw, the other three being Miriam the sister of Moses, the Virgin Mary, and Fatima, the youngest of his own daughters The progress of the new sect was at first very slow Three years were silently employed in the conversion of fourteen (some say nine) proselytes, but in the fourth year he extended the theatre of his preaching and proclaimed his doctrines publicly to his fellow citizens The faith which under the name of Islam (the salvation), he preached, was compounded substantially of two great principles, which as Gibbon says involves an eternal truth and a necessary fiction, namely that there is only one God, and that Mohammed is his prophet — the last and greatest of the prophets He did not, however aim so much at founding a new religion as reforming the old, as declared by the former prophets, Adam Noah, Abraham Moses, and Christ by putting an end to those superstitions and idolatries by which the true faith had been corrupted Being urged to confirm the reality of his divine mission by miracles he wisely declined the attempt, appealing to the internal evidence of his doctrines, and declaring that miracles would depreciate the merit of faith The only miracle which he professed to have accomplished is a nocturnal journey from Mecca to Jerusalem, and thence through the heavens, on an imaginary animal called Borack like lightning, but the words of the *Koran* are often regarded as figurative and allegorical He persevered with assiduity in the public exercise of his mission The citizens of Mecca listened to the exposition of his principles with patience till he attacked the idols of the Caaba This, however, raised such a storm against him particularly on the part of the Koreishites, that notwithstanding the protection of Abu Taleb who, though not converted to Islamism, continued the warm and steadfast protector of his nephew, many of his followers fled to other countries, chiefly to Ethiopia This happened in the sixth year of his mission, and is called the *first Hegira* or flight

In the tenth year of his mission he lost both his wife Khadijah and his uncle Abu Taleb The death of the latter being the severest blow that the new faith had yet sustained, this year is known in the Mohammedan annals as "the year of mourning" The death of Abu-Taleb removed the only check to the virulent enmity of the Koreishites [illegible] succeeded to the sovereignty of Me[illegible] [illegible] three years, marked, however, by the accession of many proselytes Mohammed, on the invitation of a deputation from Medina fled to that city, and instantly, as if by magic, the proscribed and condemned exile became a powerful, and, as it soon appeared, an all but invincible monarch The flight from Mecca to Medina, which is called the *second Hegira* or *par excellence* THE HEGIRA, is the epoch from which the Mohammedans date their æra It occurred in the 53d year of Mohammed's age, and 13th of his mission, and coincides with the 16th July, A D 622

Hitherto Mohammed had [illegible] persuasion and argument in propagating [illegible] Throughout the eighty-five chapters of the Koran [illegible] lished at Mecca, so far from the use of any species of coercion being recommend[illegible] his faith, he exhorts his [illegible] the injuries to which their principles might expose them, declaring that he had no authority to compel any one to embrace his creed In the eighteen chapters published at Medina, on the contrary, he taught a very different doctrine, and announced that God had commanded him to extirpate idolatry by force of arms and to force universal submission to his authority The enjoyments of paradise were promised to 'those who fight for the cause of God, whether they be slain or not" (Sur 11 4 9) Nor were those mere words of course, they were soon reduced to practice Mohammed, soon after his arrival in Medina assumed the exercise both of the sacerdotal and regal office The option of friendship, or submission, or battle, was proposed to the enemies of Islamism His petty excursions for the defence or attack of a caravan prepared his troops for the conquest of Arabia But what established his power and laid the foundation of future conquests was the issue of the battle of Bedr, near Medina, fought in the second year of the Hegira between the troops of Abu Sophian the new sovereign of Mecca, and his own, in which the latter, though only a third of the number of the enemy gained a complete victory with the loss of only forty men [illegible] an example of perhaps the most rapid success on record, and at the lapse of six years in the eighth Hegira his victorious troops entered the city of Mecca — an epoch from which may be dated the final establishment of the Mohammedan faith in Arabia The few contests that followed were merely the last struggles of an expiring opposition, and were mostly terminated by Mohammed's generals, while the prophet himself was employed in destroying the idols enshrined in the Caaba and in consecrating the temple to the worship of the sole God The year following is known in Mussulman history as the "year of embassies," because missions were sent to the prophet from a majority of the Arabian tribes giving in their adhesion to his creed, and recognizing his authority, both sacred and civil

But while his religion was thus triumphant and was destined still farther to spread and to remain the prophet's own days were drawing to a close About three years before his death his health had been declining, in consequence of poison that had been administered to him by a Jewess of Chaibor in order to test the validity of his divine knowledge But his death was occasioned by a fever of fourteen days on the 6th June, 632 in the 10th Hegira in the 63d year of his age His remains were buried in Medina in the very room in which he breathed his last and though the house itself has long since disappeared a simple unadorned monument marks the spot where his body reposes [illegible] way to Mecca increases the worth of his pilgrimage if he turn aside to visit also the city which contains the ashes of Mohammed

Dur[illegible] life of Khadijah, Mohammed did not avail himself [illegible] right of polygamy after her death however, the restraints which policy or conjugal affection had imposed on him were laid aside, and the utmost license marked his subsequent career While he limited the number of wives to four in the case of others he claimed an exemption to himself on divine authority and married no fewer than seventeen according to some authorities, and nine according to others strangely enough, all widows except one, — Ayesha, the daughter of Abu Beker By Khadijah he had four sons and as many daughters, and by an Egyptian concubine a fifth son but his sons all died in infancy, and of ten daughters none survived him except Fatima, who was married to her cousin Ali From this marriage sprang an illustrious offspring, the ancestors of the numerous existing scherifs, or sons of the prophet

The religion of the [illegible] in the Koran [illegible] to Mohammedan belief, are uncreated and eternal, subsisting in the essence of the Deity, and inscribed with a pen of light on the table of the everlasting decrees and communicated at different times to Mohammed by the angel Gabriel The *Koran*, which is written in the purest Arabic, is, with some exceptions, a work characterized by great richness and sublimity To the beauty of its style, indeed, its author appeals as a proof of its inspiration, but Gibbon has remarked, that "his loftiest strains must yield to the sublime simplicity of the book of Job" (chap iv) Its boldest flights, and its general scope are borrowed from the sacred volume Indeed, the object of Mohammed seems to have been to recal the inhabitants of the populous country of Arabia to the worship of the only God, and to unite idolaters, Jews, and Christians in the same creed He taught that the chain of inspiration was prolonged from Adam to the promulgation of the *Koran*, that Christ did not die on the cross, but that a phantom, or a criminal, was substituted in his place, and that he was translated to the seventh heaven, that Christ rejoiced in the assurance of a future prophet more illustrious than himself, and that the promise of the *Paraclete*, or Holy Ghost, was prefigured in the name, and accomplished in the person, of Mohammed, the last and greatest of the prophets He taught the existence of angels, good and bad, and of the Devil or *Eblis*, describing the latter as having been expelled from heaven without hope of recovery, for refusing to pay homage to Adam at the divine command As to the inspired writings, he acknowledged the Pentateuch, the Psalms, and the Gospel The doctrine of the resurrection and the day of judgment formed part of his faith He taught that every man shall be judged according to his works, but that the believers in Islamism shall not be subjected (like the wicked idolaters or infidels) to eternal condemnation, but that, after undergoing a purifying punishment, they shall be translated into the regions of bliss He inculcated the absolute and unalterable predestination of all things He called prayer "the pillar of religion," and the key of Paradise,' and he prescribed five different stated periods of prayer duly accompanied with as many ablutions or purifications of the body During prayer he first insisted that the face should be turned to Jerusalem, in compliment to the Jews, but afterwards bestowed that honour on Mecca Alms, fasting, and pilgrimage to Mecca are the remaining duties of practical religion enjoined on all good Mussulmans Of the last the most holy was that of Ramadan instituted in honour of the month in which Gabriel appeared to him in Mecca Friday was ordained as the Moslem sabbath because it was on that day he made his flight to Medina He continued the rite of circumcision in compliment to the prejudices of his countrymen He condemned usury, and forbade the drinking of wine

The grossly sensual character of Mohammed's paradise constitutes perhaps the greatest blemish in his religious system and has exerted a debasing influence over all the countries where it has acquired an ascendency

To the history of Islamism after the death of its illustrious founder we cannot do more than allude The rival pretensions of Abu Beker and Ali the latter of whom called himself the first believer,' to succeed Mohammed in the empire he had founded both gave a temporary check to the progress of the religion, and produced a schism which exists till the present day *See* SONNITES, SCHIITES

Notwithstanding the high pretensions of his competitor, Abu Beker was elected to the office of supreme head of the Mussulman religion and power, under the title of Caliph or Khalif *i e* successor of the prophet Under his sway and that of his two immediate successors the most brilliant success attended the Arab arms Indeed by the 20th Hegira or within ten years of the death of the prophet Syria, Persia and Egypt being conquered, adopted the new faith Ali was chosen the fourth khalif, but achieved nothing very memorable At his death which took place by the hands of an assassin the throne was usurped by a son of Abu Sophian whose descendants are called the Ommiyade race of khalifs They held the sovereignty for nearly 100 years during which time the whole of Africa was overrun and so far colonized by tribes of Bedouins that it has since remained as to language manners and religion an Arab country The Islam faith prospered nearly as rapidly in the East at least within 80 years from Mohammed's death it embraced all the countries between the Indus and the Atlantic and from the Indian Ocean to the steppes of Central Asia It has since penetrated even into China and found its way into many of the islands in the Indian Archipelago Spain was taken in 711 The Arabs were for a short time masters of the South of France but were finally driven across the Pyrenees in 732 The Ommiyade khalifs were, in the 133d Hegira (A D 750), superseded by the descendants of Abbas one of the uncles of Mohammed This last dynasty is known in history as that of the Abbasside khalifs

Meanwhile the seat of the khalifat was removed from Medina to Damascus and latterly to Bagdad Nor was the khalifate itself of very long standing It had been tottering for years, but it fell in the 656th Hegira (A D 1258), a Tartar army having taken Bagdad, and put an end to the nominal, sacerdotal and regal power of the khalifs, the real power having for a long time, resided in the Turkish sultans of Asia Minor The title of khalif is now recognized as one of the attributes of the grand segnior as successor of Mohammed, and of the sophi of Persia as successor of Ali, but it no longer imp[illegible] the d[illegible]charge [o]f any religious [illegible]

B[illegible] the foreign conquests of [illegible] nor the downfall of the khalifat, made any essential change in the political state of Arabia The people adhere to Mohammedanism as the true faith, but otherwise

are divided into petty tribes and communities, as before the birth of the pretended prophet Of two attempts made in Arabia to reform the Moslem faith, all traces of the first (A D 890), the object of which was to rescind the prohibition of [illegible] the holy ashes [illegible] in more recent times, namely in the beginning of last century It was made by Addul Waheb, who proclaimed himself a prophet sent by God to reform the abuses [illegible] Mohammed, or any created being (*See* WAHABEEISM) But while these doctrines were rapidly spreading, and while the cities of Mecca and Medina had fallen into the hands of the new sect, Mehemet Ali in the name of the sultan, gave an effectual check (1813) to their farther progress, and restored the holy cities to the nominal authority of the Porte The Wahabee tenets have since been at a stand, or are on the decline, even in Nedsjed, the native province of the founder (See *Abulfeda in vita Mohammed*, *Prideaux Life of Mohammed*, 8vo 1710, *Adam's Relig World Displayed*, *D Herbelot*, *Bibliotheque Orient*, *Greens Life of Mahomet*, the *Travels* of Niebuhr and others, *Burckhardt's Notes on Bedouins and Wahabees*, *Rycaut's Present State of the Ottoman Empire*, *Lives of Mohammed by Boulainvillier and Gagnier*, *Mill's Hist of Moham*, *Forster's Moham Unveiled*, and especially *M Culloch's Geog Dict*, art Arabia")

MOIDORE A Portuguese gold coin, value 27*s* sterling

MOI'NTAU (Fr) A small flat bastion raised in front of an intended fortification to defend it from the approaches by means of small arms

MOIRE'E METALLIQUE called in this country crystallized tin plate, is a variegated primrose appearance produced upon the surface of tin plate by applying to it in a heated state some dilute nitro muriatic acid for a few seconds then washing it with water drying, and coating it with lacquer The figures are more or less beautiful and diversified according to the degree of heat and relative dilution of the acid This mode of ornamenting tin plate is much less in vogue now than it was a few years [illegible] *Dict of Arts* &c)

MOLARES *Molares* (Lat mola *a mill*) Teeth generally having a flattened triturating surface and situated behind the incisors and canines when these are also present In some Mammals as the Cape ant eater, all the teeth are molars They are generally of two kinds viz those which are liable to be displaced and succeeded by others in the vertical direction, and those which are succeeded and sometimes as in the elephant and kangaroo displaced by others developed at the back of the mouth, and advancing forwards horizontally the first are termed false molars the second kind true molars

MOLA'SSE A provincial name used in Switzerland for a soft green sandstone belonging to the Miocene tertiary period *See* GEOLOGY

MOLA'SSES (Port melasses) A brown viscid uncrystallizable sugar (See SUGAR) It is sometimes used in England in preparing the coarser sort of preserves and on the Continent extensively in the manufacture of tobacco It has a burned but not a disagreeable taste

MOLE A species of the genus *Talpa* (which see) common in this country and other parts of Europe This quadruped exhibits in perfection that modification of structure by which the Mammiferous animal is adapted to a subterranean life Its head is long conical and tapering to the snout which is strengthened by a bone and by strong gristles worked by powerful muscles The body is almost cylindrical thickest behind the head and gradually diminishes to the tail There is no outward indication of a neck, that part being enlarged to the size of the chest by the massive muscles which act upon the head and fore-legs These, which are the principal instruments by which the mole excavates its long and intricate burrows are the shortest broadest and strongest in proportion to the size of the animal, which are to be met with in the Mammiferous class The rapidity with which the mole can make its way through a favourable soil is such, that it may be said to swim in the earth and, since it must displace matter so much denser than water, so do its fore limbs display a mechanism correspondingly superior in strength to the analogous extremities or pectoral fins of the dolphin The food of the mole consists of worms and insects its voracity is great, and it soon perishes if food be scarce or wanting The ardour of the sexual appetite is not less intense and characteristic of this curious quadruped The sense of sight is very feeble, the eyes being minute and rudimental, but the other faculties of smell and hearing, as being more serviceable in its dark retreat, are extremely acute

The female prepares a nest of dry herbage, roots, and leaves, in a chamber commonly formed by excavating and enlarging the point of intersection of three or four passages The young are brought forth to the number of four or five in April, and sometimes later

The farmer views the operations of the mole as destructive to his crops not only exposing and destroying their roots, or by [illegible] of the mole-hills, his burrows, moreover, become the haunts and hiding places of the field mouse and other noxious animals The mole is also accused of carrying off quantities of young corn to form its nest Hence every means are devised to capture and destroy it, and men gain a livelihood exclusively by this occupation Some naturalists, however, plead that the injury which it perpetrates is slight, and that it is more than counterbalanced by the benefit which it produces by turning up and lightening the soil and especially by its immense destruction of earth worms, and many other noxious animals which inhabit the superficial layer of the ground, and occasion great injury to the roots of grass, corn, and many other plants The soundest practical conclusion lies probably in the mean of these opinions, and the enlightened agriculturist while he takes prompt measures to prevent the undue increase of the mole would do well to reflect on the disadvantages which might follow its total extermination

MOLE In Engineering, a massive work formed of large stones placed in the sea by means of coffer-dams, extended either in a right line or an arch of a circle before a port, which it serves to close and to defend the vessels in it from the impetuosity of the waves, &c It is sometimes used synonymously with *harbour*

MO'LECULE (Lat molecula) A corpuscle or atom, single or compound Molecules are the elementary particles into which all bodies are supposed to be resolvable

MO'LINISM In Roman Catholic Theology a system of opinions on the subjects of grace and predestination somewhat resembling that advocated by the Arminian party among Protestants It derived its name from the Jesuit Louis Molina, professor of theology in the university of Evora in Portugal, who laid down a series of propositions on these debated questions in his work, entitled *Liberi arbitrii cum gratiæ donis &c*, *concordia*, which appeared in 1588 It was attacked by the Dominicans on the charge of having advocated in it Pelagian or Semi Pelagian sentiments, and accused before the Inquisition he appealed to Rome, and the cause was debated for twenty years in the congregations, and left at last undecided by a decree of Paul V in 1687 Since that period Molinism has been taught as an opinion which believers are free to embrace in Roman Catholic schools and generally supported by the Jesuit and attacked by the Jansenist party It must not be confounded with *Molinosism* — a name which the doctrine of the Quietists has received from the work of a Spanish enthusiast (Molinos) on Mystical Life, condemned in 1687 by Innocent XI The French Quietists professed to abjure and oppose the errors of Molinos (*Mosheim*, 17th Cent II 2 part 1) See QUIETISTS

MO'LISITE A mineralogical name of the crystallized titanate of iron of Dauphiny

MO'LLAH The title of the higher order of judges in the Turkish empire After the three first magistrates of the empire (the two cadil-askers of Roumi and Anatolia, and the istambol-cadissy or chief ordinary judge of the capital) follow fourteen mollahs, who preside over the fourteen principal seats of justice in the empire, among these, the mollahs of Mecca and Medina have the highest rank The place of a mollah, like all others in the Turkish empire is held only at the will of the sovereign, and is now granted annually (see *D Ohsson*, *Tableau de l'Empire Ottoman* vol iv), but displaced mollahs preserve their rank in the Ulema above their successors The Turkish mollah must not be confounded with the Tartar *mulla*, which see

MO'LLE (Ital) In Music, a sound that is flat as compared to another half a tone higher, thence called sharp

MOLLUSKS *Mollusca* (Lat mollis, *soft*) The name applied by Cuvier to the great primary division of the animal kingdom which includes all those species having a ganglionated nervous system, with the ganglions or medullary masses dispersed more or less irregularly in different parts of the body which is soft and inarticulate The pulmonary or branchial circulation is separate and distinct but is aided by the direct propulsion of a heart in one class only There is always a heart for the systemic circulation, and it mostly consists of one ventricle and one auricle Some of the mollusks breathe air but the greater part respire through the medium of salt or fresh water The blood of the mollusks is white or blueish In one class only is there a rudiment of an internal skeleton giving attachment to a part of the muscular system, in the rest it is absent, and the muscles are attached to various points of the skin Their contractions produce inflexions and extensions of their different parts, and, alternating with relaxations, enable the species to creep climb swim burrow and seize upon various objects, according as the form of these parts may

permit, but as the locomotive organs are not supported by articulated and solid levers the mollusks cannot leap or advance rapidly on dry land Many of the aquatic species are encumbered with a heavy shell Nearly all the mollusks have an extensive fold of the skin reflected over their body which it covers like a mantle, it is sometimes produced into a breathing pipe or extended and divided in the form of fins When the locomotive organs simply membranous or fleshy, or when a horny or testaceous rudiment of a shell is developed, but remains concealed in the substance of the mantle, the mollusk is said to be *naked* When the shell is so much enlarged that the contracted animal finds shelter beneath or within it, the species is said to be *testaceous* (*See* CONCHOLOGY) The masticatory or oral organs present all the various modifications for predatory, omnivorous, or herbivorous habits, and the stomach may be simple, multiple, or complicated with a peculiar armature Some of the mollusks are unisexual, others androgynous a few dioecious

With few exceptions, their habits and economy present comparati they are only preserved ity *See* MALACOLOGY

MO'LOCH The name of the chief God of the Phœnicians, frequently mentioned in Scripture as the God of the Ammonites and probably the same as the Saturn of the Syrians and Carthaginians Human sacrifices were offered at the shrine of this deity and it was chiefly in the valley of Tophet to the east of Jerusalem that this brutal worship Solomon built a temple to Moloch on the Mount of Olives and Manasseh long after his son pass through the horrid king

Milton has described the character of Moloch in the following well-known lines —

> First Moloch horrid king besmear'd with blood
> Of human sacrifice and parents tears
> Their children
> Wisest
> Of
> And black Gehenna call'd, the type of Hell

MOLOSSUS In Greek and Latin poetry, a foot consisting of three long syllables as χαιρουσαι γεγηθασι It is said to derive its name either from a favourite dance of the Molossi, a people of Epirus, or from Jupiter Molossus, in whose honour odes were composed in which this

MOLYBDENUM (Gr μολυβδος *lead*) This name was originally applied to the native sulphuret of molybdenum, which was considered to be an ore of lead it was afterwards shown to be the ore of a peculiar metal to which the name molybdenum was given It is white brittle, very infusible, and of a specific gravity about 8·6 It forms two oxides and an acid The equivalent of the metal is about 48, and the *molybdic acid* consists of 1 atom of molybdenum and 3 of oxygen and is represented by the equivalent 72 The compounds of this acid are called *molybdates* The molybdate of lead has been found native

MO'MENT (Lat movere *to move*) A small but indefinite period of time Sometimes the word *instant* is used synonymously with moment

MOMENT MOMENTUM These terms have been used by writers on mechanics in various senses Galileo in his *Dialogues* uses the phrase *momentum of a power* or *of a weight*, applied to a machine to denote the action, energy, or impetus of the power to move the machine, so that an equilibrium subsists between two powers when their moments to move the machine in opposite directions are equal and he shows that the *momentum* is proportional to the power multiplied into the virtual velocity This notion of momentum was also adopted by Wallis, in his *Mechanics*, published in 1669 and when the term is used with respect to a weight, it is synonymous with the phrase *quantity of motion*, that is, the product of the mass by the velocity

The product of the mass by the *square* of the velocity or the *living force* (*see* FORCE) is sometimes called the *moment of the moving force*, or the *moment of activity*, and the product of the mass by the velocity and by a line (or, which is the same by the square of the velocity and by a time) is called the *moment of the quantity of motion*, or *quantity of action* (Carnot, *Principes de l'Equilibre et du Mouvement*)

Modern writers use the phrase *moment of a force with respect to a point*, to denote the product of the force into the perpendicular let fall from the point upon the line of its direction, and *moment of a force with respect to a plane*, to denote the product of the force into the perpendicular drawn from its point of application to the plane These two moments are entirely distinct The first depends upon the direction of the force, and is independent of its point of application, the latter depends upon the point of application, and is independent of the direction (See Poisson, *Traité de Mécanique*)

MOMENT OF INERTIA, in Dynamics denotes the sum of the products of all the material elements of a revolving body each multiplied into the square of its distance from the axis of rotation It is the integral of the expression $\int r^2 dm$, in which $dm$ is the element of the mass, and $r$ its distance from the axis *See* ROTATION

MO'MIERS (Lat the Irregular Verb *mamincrv*) The name by which the rural population of the so-called Evangelical party have been designated in Switzerland, and some parts of France and Germany, since 1818 They appear originally to have borne a considerable resemblance to the Methodists of our own country, for, like the latter they at first embraced no tenets distinct from those of the established church, and were only distinguished from its members by a more habitual indulgence in devotional contemplation and religious exercises But

party in a pamphlet published in 1818, accused the latter of denying the divinity of our Saviour and of a thorough backsliding from the doctrines of Calvinism, and the Geneva clergy (*la venerable compagnie*) having in the view of allaying asperities passed a resolution prohibiting any theories of the doctrinal points of religion from being propounded in the pulpit and having counselled the clergy to avoid disputed points as much as possible in their discourses the smouldering embers of their hostility to the established church burst into a flame They now began to attack the clergy in the pulpit and in pamphlets, accusing them of having abandoned all gospel truth and denying their right to be regarded as ministers of the establishment But all their efforts to bring the latter into contempt were unsuccessful the Genevese remained faithful to their pastors, and in the year 1831 the Momiers possessed only about 200 adherents

In other parts of Switzerland however and more especially in the canton de Vaud, the zeal of these sectaries was attended with more success After a few years toleration of their preaching and proselytizing, during which it was said the Momiers had sown the greatest discord and hatred among the inhabitants of the canton, the government at last saw the necessity of interference, and in the year 1824 promulgated some vigorous ordinances to put them down These enactments as might have been expected failed of their effect The enthusiasm of the Momiers was redoubled they were now surrounded with the glory of martyrdom and many who before had viewed their zeal with indifference or contempt now deeply sympathized in what they could not but regard as an unprovoked attack upon the liberty of conscience In consequence of this their promulgation was relaxed, then suffered to lie dormant, and at last repealed in 1831 Since that period the number of the Momiers has gradually diminished and in 1839 the clergy of this canton resolved by a large majority to revert to the ancient *régime* of the church (See the *Conversations Lexicon der Gegenwart* See also the *Edin Review*, vol xlii, which contains an interesting account of the rigorous enactments passed against this sect with some severe remarks on their violence and absurdity)

MO'MUS (Gr μωμος *derision*) The god of raillery and ridicule, and said by Hesiod to have been the progeny of night

MO'NACHISM MONK MONASTERY (All derived from the Gr μονος *alone*) Words indicative of certain important features in ecclesiastical history Monachus, or monk, properly signifies one who lives a solitary life and was applied in the first instance to the numerous individuals who began in the second and third centuries to retire from the occupations of the world and devote themselves in the deserts of Egypt and Syria to a contemplative and religious life It was not till the middle of the third century that the monkish system, properly so called was established by which many persons were congregated bound by vows to the performance of duties and abstinence from worldly enjoyments These monks are distinguished by the appellation of Canobites, or Associates, from the ascetics anchorites, and hermits, who lived apart not from the world only but from each other The monkish system originated in Egypt where St Anthony founded several associations of this kind The inmates of the primitive monasteries were bound by the profession of four objects solitude labour, fasting, and prayers They renounced all temporal possessions, and supported themselves entirely with their own hands Fasting was practised in moderation only, nor do the early monks appear to have affected piety or regularity by the extravagant austerities of later times For an useful list of books on the subject, see this article in the *Penny Cyclopædia*

For an account of the progress of this practice, and the

rules to which the professors of Monachism were subjected in later times see ORDERS (RELIGIOUS)

MONAD (Gr *μονας an unit*) In Metaphysics this [illegible] his works, I find myself quite incompetent to annex any precise idea to the word as he employed it" He then quotes the following a [illegible] tempts to explain his [illegible] has no parts a compound substance is an aggregate of simple substances, [illegible] parts, are neither [illegible] are the real atoms of nature, in other words, the elements of things" "Every monad is a living mirror, representing the universe, according to its particular point of view, and subject to no regular laws, as the universe itself" "Every monad with a particular body makes a [illegible]" (*Enc Brit*, Preliminary Dissertation, [illegible] The groundwork of the monadic theory is to be found in the different physical systems of Zeno, Leucippus, Democritus, and Epicurus, but Leibnitz was the first who reduced it to a system, and its chief supporters since his death have been M Wolf and Madame Duchâtelet

MONADELPHOUS (Gr *μονος* and *αδελφια, a fraternity*) A botanical term applied to stamens the filaments of which are combined into a single mass as in the common mallow It is the name of some of the classes in the Linnæan system

MONANDROUS (Gr *μονος* and *ανηρ a man*), is a flower having but one stamen It is the name of the first class in the Linnæan system

MONARCHY (Gr *μοναρχια*, derived from *μονος single*, and *αρχειν to rule*) The government of a single person Monarch and monarchy are equivalent in common speech to king and kingdom so that we often read of the Spartan monarchs &c although the government of Sparta was under a double race of kings reigning at the same time Monarchies are usually said to be of four kinds —*absolute*, *limited hereditary* and *elective* which are self-explanatory terms The only elective monarchy in Europe was that of Poland All absolute and limited monarchies have adopted the hereditary principle

MONAS (Gr *μονας*) A genus of extremely minute polygastric Infusores

MONASTERY (Gr *μονη*) The general name for those religious houses appropriated to the reception and maintenance of monks and nuns but especially of the former (*See* NUNNERY) For an account of the origin and object of monasteries see MONACHISM, and the authorities there referred to, and for the habits, rules and peculiarities of the different orders of monks and nuns, see the respective articles but more especially ORDERS RELIGIOUS The English term *monastery* was variously rendered by the Greek fathers, thus we find it expressed not only by *μοναστηριον* and *μονη* but by *σεμνειον a holy place*, *μαυδρα, an inclosure* *φροντιστηριον a place of meditation* &c The suppression of monasteries was one of the first consequences of the Reformation in all the countries that abandoned the Popish faith But even in Roman Catholic states, with the exception of Italy they have long been on the decline, and though since the relaxation of the penal laws several nunneries have been established in various parts of Great Britain there is no reason to suppose that these establishments will ever attain even an approximation to their pristine vigour

MONDAY The second day of the week is so called, and means, literally the *day of the moon* Its equivalents in Fr and Germ are respectively Lundi and Montag, signifying also *day of the moon*

MONEY * In Political Economy the name given to the commodity adopted to serve as the *marchandise bannale* or universal equivalent of all other commodities, and for which individuals readily exchange their surplus products or services

Without the use of money of some sort or other exchanges must have been greatly embarrassed and the division of employments never could have been carried to any considerable extent Innumerable difficulties would occur in attempting to carry on trade by barter A, for example, has a quantity of corn which he wishes to exchange for cloth belonging to B but the latter [illegible] with corn, no exchange [illegible] A must therefore, [illegible] session of the cloth, learn what commodity B will accept in exchange for it, and having learned this, he must seek out some third person willing to part with the equivalent demanded by B in exchange for corn It might not, perhaps, be possible for A to get his purpose effected so easily as has here been supposed, or without negotiating several subsidiary exchanges, but what has now been stated is sufficient to evince the extreme difficulty of carrying on commerce in this way

Individuals so placed would naturally endeavour, in seeking their own advantage, to obviate, in as far as practicable, such inconveniences, and it would require but little sagacity to perceive that the best way of accomplishing this would be to acquire some portion of that article, whatever it might be, which was observed to be most in demand, or which passed most readily from hand to hand in exchange for others, because, when possessed of it, one would be able, with comparatively little difficulty, to get whatever else he wanted Now, this generally desirable article, whether it be corn, salt, cowries, hides, or whatever else, is in fact money But though this grand instrument of exchange may be one thing in one country and one state of society, and another thing in another country and another state of society it is never the result of invention or contrivance It originates in the circumstances natural to society, and is changed, improved, and perfected, according as experience serves to make individuals better acquainted with its nature and functions

An article that has been adopted from a sense of its suitableness to serve as the ordinary equivalent for other things, or as the common medium of exchange, comes in the course of time to be used also as a *measure of value*, or as a standard by which to compare and estimate the values of other things Thus, instead of saying that an individual is worth 1000 sheep, 1000 quarters of wheat or 1000 acres of land, these are rated or estimated at their value in money, and it is said that their owners are worth certain amounts of the latter Not only therefore does the introduction of money contribute in the most effectual manner to the facilitating of exchanges but it also gives precision to statements as to values that would otherwise be all but unintelligible The statement for example, that an individual was worth 1000 head of cattle, or 1000 packs of wool would convey no clear idea even to dealers in these articles, as their qualities differ so very widely, and supposing these to be ascertained there are very few individuals who know anything of the value either of cattle or wool But by rating them in money all these difficulties and ambiguities vanish in an instant, reference is then made to a measure with which every body is familiar and every one has a distinct idea and full knowledge of the value of the articles, or wealth of the parties referred to

*Qualities required in a Commodity fitted to serve as Money* —An immense variety of commodities have been adopted to serve as money in different countries and states of society, but, in the course of no very long period it is ascertained that no commodity can be advantageously employed as money unless it possess certain properties First it should be easy of transportation, and therefore should possess great value in small bulk 2d it should admit of being rubbed and carried about without losing much from the wear, and it should admit of being hoarded or kept for an indefinite period without loss 3d as the products to be exchanged for money are of very different value, it should also admit [illegible] homogeneous, that is a given quantity of money in London should be precisely identical with the same quantity in Edinburgh Dublin and every where else and 5th, the value of mon[illegible] other things [illegible] change only [illegible] lities most essential to any commodity adopted to serve as money, and the money of any country may be said to be good or bad according to the degree in which it possesses or wants these qualities

Now, it will be found that the precious metals possess all the qualities enumerated above in a far higher degree than any other products with which we are acquainted, and this has doubtless formed the irresistible reason that has led all civilized communities to adopt them as money The cost of their production, especially of gold, is so very considerable that they possess great value in small bulk, their firm and compact texture makes them difficult to wear and they may be kept for any length of time without deteriorating, they are divisible into any number of parts and have the valuable property of being easily reunited by means of fusion without loss, they are perfectly identical, the physical qualities of an ounce of pure gold or silver taken from the mines in any part of the world being precisely the same with those of an ounce taken from the mines in any other quarter; and though their value be not invariable, it changes, speaking generally, only by slow degrees, and is less susceptible of fluctuation than that of most other articles No wonder, therefore, when almost all the qualities necessary to constitute money are possessed in so eminent a

* Etymologists differ respecting the derivation of the word money Some contend that it comes from the Latin *admonish*, *reform* because the stamp impressed on coin indicates its weight and fineness. Others contend [illegible]

degree by the precious metals, that they have been used as such in civilized societies from a very remote æra They became universally money, to use the words of Mr Turgot, "not in consequence of any arbitrary agreement among men, or of the intervention of any law, but by the nature and force of things"

*Introduction of Coined Money* —When first brought to market, gold and silver, like copper, iron, or any other metal, were in the shape of bars or ingots, and were exchanged or bartered for other commodities exactly as these would have been bartered for anything else The parties having agreed upon the quantity of the precious metals to be given for certain goods the quantity was next delivered by weight Nor is this mere conjectural statement, advanced in a later age to explain appearances, and resting on probability only Aristotle (*Polit* lib i cap 9) and Pliny (*Hist Nat* lib xxxiii cap 3) tell us that such was, in fact the method by which the precious metals were originally exchanged for other things in Greece and Italy, [illegible] furnish a striking example of [illegible] primitive practice in the East It is there stated that Abraham weighed 400 shekels of silver, and gave them in exchange for a piece of ground he had purchased from the sons of Heth (Genesis, xxiii 16) It is also mentioned that this silver was "current money with the merchant" an expression which evidently refers to its quality only, for, had the silver been coined it would have been unnecessary to have weighed it But the weighing of gold and silver whenever they happened to be exchanged for commodities and their adjustment to the agreed on weight must have been a very difficult and troublesome process There can however be no doubt that the greatest obstacle to the use of the precious metals as money would at first be found in the difficulty of determining their purity or fineness with sufficient facility and accuracy It is indeed most probable that when they originally began to be used as money their quality would be inferred from their weight and colour But the extreme inexactness of the conclusions derived from such loose and unsatisfactory data would soon become obvious, and the devising of some method by which the weighing of the metals in exchanges might be dispensed with and their quality be easily and accurately determined would be seen to be indispensable to their general use as money Luckily such a method was not long a desideratum It was early discovered that to ascertain its purity and to obviate the trouble and expense of weighing the metal all that was necessary was to form it into *coins*, that is to mark each piece with a public stamp or authoritative impress declaring its weight and fineness Such appear to have been the steps that led to the formation and introduction of gold and silver coins (*Goguet De l'Origine des Lois* i 269 Hood), the employment of which has been of the very greatest utility and has perhaps contributed more than anything else to facilitate commerce and to accelerate the progress of civilization and the arts *

"Without some article of known exchangeable value such as coin, readily received as an equivalent for other things the interchange of commodities must have been very limited, and consequently the divisions of labour very imperfectly established Now money obviates these evils, and by a twofold operation
In the first place it saves all that t[illegible]
while the intercourse between man and man is carried on by barter, must frequently intervene before a person can be supplied with the quantity of the commodity which he wants, in the second place and in consequence of its saving the time and labour which must otherwise be spent in effecting exchanges it multiplies the transactions of mercantile industry, and thus allows the divisions of employment to be more thoroughly established By the first operation it disengages a very considerable portion of labour from an unproductive occupation, and enables it to receive a more useful direction, by the second it increases in a very high degree the productive powers of the labour already usefully employed It assists every man in availing himself of the skill and dexterity which he may have acquired in any particular calling and [illegible] in a manner suitable to the climate [illegible] districts and different countries And by both these operations coins increase to an extent, not easy to be calculated, the wealth of civilized communities" (*Torrens on the Production of Wealth* p 305)

But, however great and obvious the advantages attending the use of the precious metals in the shape of coin, it is necessary to bear in mind that the nature of exchanges and the principle on which they are made, are not [illegible] affected Equivalents are still given [illegible] a quarter of corn for an ounce of pure unfashioned gold bullion is as much a barter as if it were exchanged for an ox, or a barrel of beer, and supposing the metal to be formed into a coin, or marked with a stamp declaring its weight and fineness, that circumstance could, it is obvious, make no change in the terms of the barter The coinage would save the trouble of weighing and assaying the bullion, but it would do nothing more A coin is merely a piece of metal of a known weight and fineness, and the commodities exchanged for it are uniformly held by the parties to be of equal value, and yet these obvious considerations have been very generally overlooked The notion was [illegible] that coins were merely the *signs* of value [illegible] that they have no more claim to this designation than bars of iron or copper, sacks of wheat, or any other article Coins exchange for other things because they are desirable articles which having been produced by an expenditure of capital and labour possess real intrinsic worth A draft, cheque, or bill may not improperly perhaps be regarded as the sign of the money or coin to be given for it but that coin is itself a valuable commodity A sovereign is not a sign —it is the thing signified

*Privilege of Coining Legal Tender* —In order to obviate the endless confusion and inconvenience that could not fail to [illegible] from the [illegible] purity the [illegible] prohibited the issue of coins by private parties, and has itself supplied those in circulation Generally also very severe penalties have been inflicted on the forgers of coin, or on those who fabricate counterfeit coins or coins of less weight than the standard or made up in whole or in part of some baser or less valuable metal It is obvious indeed that the extensive practice of this offence by necessarily generating a feeling of insecurity and suspicion would check the circulation even of genuine coins and would consequently in so far deprive society of the advantages resulting from their employment It is found however that the improvement of the fabric of the coins by the perfecting of the dyes and otherwise is a more effectual means than even the utmost severity of punishment for the prevention of forgery though some very considerable degree of the latter is of course always indispensable

Where the use of coins has once been adopted all values in contracts and other engagements are rated or estimated in money and it is usual in almost all countries to enact that coins of the legal or standard weight and purity shall be *legal tender* and to declare that no legal proceedings of any kind shall be instituted on account of any debt or pecuniary obligation against any individual who has offered to liquidate the same by payment of an equivalent amount of the recognized coin of the country A pound troy or 12 oz of the metal of which English silver coins are made contains 11 oz 2 dwts pure silver and 18 dwts alloy This pound is coined into 66 shillings, so that each shilling contains 80 727 grains fine silver and 87 27 grains standard silver, and the money pound [illegible] contains 1014 54 grains pure silver and [illegible] standard silver From 1600 down to 1816 the pound weight of standard silver bullion was coined into 62 shillings All the English silver coins have been coined out of silver of 11 oz 2 dwts fine from the Conquest to this moment except for the short period of sixteen years from the 34th Henry VIII to the 2d Elizabeth

The fineness of gold is estimated by carat grains equivalent to 4½ dwts troy, gold of the highest degree of fineness or pure being said to be 24 carats fine The purity of our present gold coins is 11 parts fine gold and one part alloy The sovereign or twenty shilling piece, contains 113 001 grains fine gold and 123 274 grains standard gold The pound troy of standard gold is coined into 46 sovereigns and $\frac{80}{720}$ths of a sovereign, or into 46*l* 14*s* 6*d* The mint or standard price of gold is therefore said to be 46*l* 14*s* 6*d* per pound troy, or 3*l* 17*s* 10½*d* an ounce The alloy in coins is reckoned of no value, it is allowed in order to save the trouble and expense that would be incurred in refining the metals to their highest degree of purity and because when its quantity is small it renders the coins harder, and less liable to be worn or rubbed Were the quantity of alloy considerable, it would lessen the splendour and ductility of the metals, and would add too much to the weight of the coins

Before the art of metallurgy was well understood, the baser metals were frequently used as money Iron was the primitive money of the Lacedæmonians, and copper of the Romans But both iron and copper deteriorate by being kept, and, besides this defect, the rapid improvement of the arts, by lowering their price, rendered their bulk too great in proportion to their value to permit of their continuing to be used as money Copper, indeed,

* The Roman jurists have given a clear and concise account of the circumstances that led to the use of money, and of its functions — "*Origo emendi vendendique a permutationibus cœpit Olim enim non ita erat numerata neque aliud merx, aliud pretium vocabatur sed unusquisque, secundum necessitatem temporum ac rerum, utilibus inutilia permutabat, quando plerumque evenit ut quod alteri superest alteri desit Sed quia non semper, nec facile concurrebat, ut cum tu haberes quod ego [illegible] electa materia [illegible] permutationum æqualitate quantitatis subveniret [illegible] publicâ percussa, usum dominiumque, non tam ex substantia præbet quam ex quantitate nec ultra merx utrumque, sed alterum pretium vocatur*" (*Digest*, lib. xviii tit. 1 de Contr Empt)

is still used in the form of tokens, convertible into silver in very small payments In this country, copper pence and halfpence are rated at about 72 per cent above their real value, but as their issue is exclusively in the hands [illegible] they are only legal tender to the [illegible] any one payment, this over- [illegible] of any bad effect The use of copper in other countries is limited in much the same [illegible] everywhere the only metals [illegible] to the coins used in considerable [illegible]

*Varying the Standard* — The value of all sorts of property being estimated and the stipulations in almost all contracts for its purchase sale, or hire being made in money or coins, it is plain that no change can take place in the value of such money or coins without virtually subverting these estimates and contracts and enriching the debtor portion of society at the expense of the creditor portion, or *vice versa* As the cost of producing all commodities is liable to vary from improvements in the arts the exhaustion of the present or the discovery of new sources of supply none can be selected to serve as money or coin that may not vary in its *cost* or real value It is believed, however, that the precious metals vary less than any material that could be suggested, and, with the exception of the extraordinary fall in their value caused by the discovery of the American mines, it seems to have been remarkably constant at other periods

But, in addition to the fluctuations naturally inherent in the value of coins arising from variations in the cost of the metal of which they are made, their standard has been repeatedly changed Notwithstanding that money or coin, from its being universally used as a scale by which to compute the value of all commodities and as the equivalent for which they are commonly exchanged is by far the most important of all the measures used in society and should consequently, be preserved as invariable as possible there is none that has been so frequently altered The necessities or extravagance of governments have forced them to borrow and, to relieve themselves of the incumbrances thus contracted they have almost universally had recourse to the disgraceful expedient of degrading the coin, that is of *cheating* those who lent them money to the extent of the degradation and of enabling every other debtor in their dominions to do the same

The ignorance of the public in remote ages facilitated this species of fraud Had the names of the coins been changed when the quantity of metal contained in them was diminished there would have been no room for misapprehension But although the weight of the coins was undergoing perpetual and their purity occasional reductions their ancient denominations were almost uniformly preserved, and the people who saw the same names still remaining after the substance was diminished — who saw coins of a certain weight and fineness circulate under the names of florins, livres or francs and pounds — and who saw them continue to circulate as such after both their weight and the degree of their fineness had been lessened began to think that they derived their value more from the *stamp* affixed to them by authority of government than from the quantity of the precious metals they contained This was long a very prevalent opinion, but the rise of prices which invariably followed every reduction of the standard and the derangement that was thereby occasioned in every pecuniary transaction undeceived the public and taught them and their rulers the expediency of preserving the standard of money inviolate

The standard may be reduced by simply raising the denomination of the coin, by ordering for example that a half-sovereign should pass for a sovereign and the latter for a double sovereign &c It injustice be resolved upon this is the least mischievous way in which it can be perpetrated inasmuch as it saves all the trouble and expense of a recoinage But as it renders the fraud obvious and glaring it has rarely been resorted to, and most reductions have been effected either by diminishing the weight of the coins or by increasing the proportion of alloy in the metal of which they are made, or both

Originally the coins of all countries seem to have had the same denominations as the weights commonly used in them, and contained the exact quantity of the precious metals indicated by their name Thus, the *talent* was a weight used in the earliest period by the Greeks the *as* or *pondo* by the Romans the *livre* by the French, and the *pound* by the English and Scotch, and the coins originally in use in Greece, Italy, France and England bore the same names, and weighed precisely a talent a pondo a livre, and a pound The standard has not, however, been preserved inviolate, either in modern or ancient times It has been less degraded in England than anywhere else, but even here the quantity of silver in a pound sterling is less than the *third* part of a pound weight, the quantity it contained in 1300 In France, the livre current in 1789 contained less than *one sixty-sixth* part of the silver implied in its name, and which it had actually contained previously to 1103 In Spain and some other countries [illegible] been carried still further From 12[illegible] of England and Scotland were of the same weight and purity, but at the last-mentioned epoch the standard of Scotch money was, for the first time, sunk below that of England, and by successive degradations the value of Scotch money, at the union of the crowns in 1600, was only a *twelfth* part of the value of the [illegible] of the kingdoms [illegible] Scotland

The gold and silver coins of Ireland have been for a considerable period the same as those of Great Britain, but until 1825 they were nominally rated 8⅓ per cent higher This difference of valuation, which was attended with considerable inconveniences, was put an end to by the act 6 Geo 4 c 79, which assimilated the currency throughout the empire

*Mint or Government Valuation of Gold and Silver Coins* — If both gold and silver coins be made legal tender it is obviously indispensable that their value with [illegible] or that [illegible] entitled to discharge the claims upon them by payments either of gold or silver coins according to some regulated proportion — a practice which was long adopted in England

But the value of each of the precious metals is liable to perpetual changes, and hence, however accurately soever their proportional [illegible] may correspond with [illegible] bear to each other in the market when the regulation is made the chances are ten to one that it will speedily cease to express their relation to each other The moment however, that such a change takes place, it becomes the obvious interest of every one who has a payment to make to make it in the *overvalued* metal, which, consequently becomes the sole, or nearly the sole, currency of the country Hence the reason why the coins of some countries are almost wholly of silver, and others almost wholly of gold It is estimated for example, that when it was fixed in 1717, that the guinea should exchange for 21 shillings gold was overvalued as compared with silver to the extent of $1\frac{19}{31}$ per cent (*Liverpool on Coins*, p 85), and as the real value of silver with respect to gold continued to increase during the greater part of last century the advantage of paying in gold in preference to silver became more decided, and ultimately led to the universal use of gold in all large payments and to the fusion or exportation of all silver coins of full weight (*Liverpool loco cit*)

In France a different valuation of the metals has had a different effect Previously to the recoinage in 1785, the *Louis d or* was rated in the mint proportion at only 24 livres when it was really worth 25 livres 10 sols Those therefore who should have discharged the obligations they had contracted by payments of gold coin instead of silver would plainly have lost 1 livre 10 sols on every sum of 24 livres In consequence very few such payments were made, gold was almost entirely banished from circulation and silver became almost the only species of metallic money used in France (*Say, Traité d Economie Politique* tom i p 393)

In 1816 a new system was adopted in this country, it being then enacted (56 Geo 3 c 68 [illegible] *should be legal tender in all payments* [illegible] *shillings* The pound of silver bullion that had previously been coined into 62 shillings was then also coined into 66 shillings the additional *four* shillings being retained by government as a *seignorage* or duty (amounting to $6\frac{14}{31}$ per cent) upon the coinage To prevent the silver coins from becoming redundant, government has retained the power to issue them in its own hands Under these regulations, silver has ceased to be a standard of value, and forms merely a subordinate or subsidiary species of currency or change, occupying the same place in relation to gold that copper occupies in relation to itself This system has been found to answer exceedingly well

A good deal of difference of opinion has existed as to whether gold or silver coins are best fitted for being made a legal tender It does not seem that the one possesses any very striking advantage over the other, none, certainly that would justify a change, after a selection has been made and acted upon for any considerable period

Down to 1626 a seignorage or duty upon the coinage was usually charged upon [illegible] coins issued by the mint, and it may be [illegible] that the imposition of such a duty, when it is not carried to an undue height is advantageous A coin is more useful than a piece of uncoined bullion of the same weight and purity; the coinage fitting it for [illegible] while it does not unfit it for being [illegible] purpose When, therefore, a duty or seignorage is laid upon coin equal to the expense of coinage, it circulates at its real value, but when the charge is defrayed by the public, it circulates at *less* than its real value, and is consequently

either melted down or exported whenever there is any demand for bullion in the arts, or any fall in the exchange It is, indeed true that were a seignorage to be laid on gold coins, it would be necessary, to prevent an enhancement of the value of the currency, that their weight should be proportionally reduced, and it is on this account better perhaps, to let them remain on the present footing But when a seignorage was laid on the silver coins, in 1816, it was not necessary to take the circumstance now alluded to into consideration, for as they were made subordinate to gold, and were intended to serve as change merely, its imposition had no tendency to raise the value of the currency, at the same time that it was calculated effectually to prevent the fusion of the coins, and to yield a small revenue to government

*The exportation and importation of gold and silver coins* was formerly prohibited, but in 1819 it was enacted (59 Geo 3 c 49) that they might be freely exported and imported, without being liable to any charge or duty whatever, and they may be imported without being either reported or entered at the custom house This regulation has rendered it next to impossible to ascertain the value of the bullion imported

*Paper Money* —[illegible] resulting from the [illegible] money we are not to suppose that these are obtained gratuitously The use of a metallic currency is accompanied by a heavy expense, and there is a much greater difficulty in effecting payments by the agency of coins than one might at first be disposed to believe If the currency of the United Kingdom consisted wholly of gold, it would certainly amount to at least 60 millions sterling, the expense of which allowing ¼th per cent for the wear and tear and loss of coins, could hardly be estimated at less than *three* millions a year But this heavy expense is really a far less serious obstacle to the exclusive use of the precious metals as money than their weight, and the trouble and expense attending the carrying them about The weight of 1000 sovereigns exceeds 21 lbs troy, so that it would be necessary to employ a waggon to make a large payment even in gold It is also very difficult to employ them for small payments, provided they have to be made at a considerable distance, inasmuch as the expense of sending gold by post, and the premium to guarantee it against loss, amount to a considerable sum Hence it is that all commercial nations endeavour to fabricate a portion of their money of some less valuable and more portable material than bullion, and hence also the origin of bills of exchange, cheques, and other devices for economising the use of money

Of the substitutes that have been resorted to instead of gold and silver coins, *paper notes*, payable on demand, have been by far the most generally adopted, and are in all respects the most eligible Intrinsically they are almost destitute of value, so that their employment and their loss costs next to nothing *, and they may be carried about or transmitted by post with the utmost facility But though in these respects the employment of pieces of paper instead of coins leaves nothing to be desired, it is plain that [illegible] value must depend [illegible] They are commonly issued as a substitute for or representative of coin, the issuer being bound to pay their value, or the sums they profess to represent, in coin of the standard weight and purity the moment it is demanded, and so long as this regulation is really and *bona fide* complied with, no inconvenience can result from their employment Practically however, it is found no easy matter to carry these regulations into effect, and this, and indeed every country in which paper money has been issued, has repeatedly sustained the greatest injury from its being issued in excess or on unsound principles Paper money, in fact, can never be either securely or beneficially employed unless the quantity of it in circulation vary exactly as the quantity of gold or silver coins to be substituted in its stead would do were it withdrawn But having elsewhere inquired into the means by which this identity between the value of coins and paper notes may be best maintained we beg to refer the reader to the article Banks in this Dictionary for a farther discussion of this important branch of the subject

I ENGLISH COINS — Account of the English Silver and Gold Coins, showing their Value, the Seignorage or Profit upon the Coinage, and the Price of the Pound Troy of Standard Gold and Silver, from the Conquest to the present Time

| A D | Anno Regni | Silver 1 Fineness of the Silver | Silver 2 Pound Weight of | Silver 3 Profit or [illegible] on the Coinage | Silver 4 Equal to the Mint Price for Standard 11oz 2dwts fine Troy Weight | Gold 5 Fineness of the Gold in the Coins | Gold 6 Pound Weight of such Gold coined into | Gold 7 Profit or [illegible] | Gold 8 Equal to the Mint Price for Standard [illegible] Troy Weight |
|---|---|---|---|---|---|---|---|---|---|
| | | Oz dwts | L s d | L s d | L s d | Crts Gs | L s d | L s d | L s d |
| 1066 | Conquest | 11 2 | 1 0 0 | | | | | | |
| 1280 | 8 Edward I | — — | 1 0 0 | 0 1 0 | 1 0 3½ | | | | |
| 1300 | 28 —— | — — | 1 0 3 | 0 1 2½ | | | | | |
| 1344 | 18 Edward III | — — | 1 0 3 | 0 1 3 | 1 0 3½ | 23 3½ | 13 3 4 | 0 8 1 | 12 10 8 |
| 1349 | 23 —— | — — | 1 2 6 | 0 1 3 | 1 2 8 | — — | 14 0 0 | 0 11 8 | 13 3 9 |
| 1356 | 30 —— | — — | 1 3 0 | 0 0 10 | 1 5 9½ | — — | 15 0 0 | 0 6 8 | 14 8 4 |
| 1394 | 18 Richard II | — — | 1 3 0 | 0 0 10 | 1 5 9½ | — — | 15 0 0 | 0 5 0 | 14 9 11 |
| 1401 | 3 Henry IV | — — | 1 3 0 | 0 0 10 | 1 5 9½ | — — | 15 0 0 | 0 5 0 | 14 9 11 |
| 1421 | 9 Henry V | — — | 1 10 0 | 0 1 0 | 1 10 11½ | — — | 16 13 4 | 0 5 0 | 16 2 9 |
| 1425 | 4 Henry VI | — — | 1 10 0 | 0 1 0 | 1 10 11½ | — — | 16 13 4 | 0 5 10 | 16 1 11 |
| 1464 | 4 Edward IV | — — | 1 17 6 | 0 4 6 | 1 15 2½ | — — | 20 16 8 | 2 10 0 | 18 0 5 |
| 1465 | 5 —— | — — | 1 17 6 | 0 4 6 | 1 15 2½ | — — | 22 10 0 | 1 0 10 | 21 1 10 |
| 1470 | 49 Henry VI | — — | 1 17 6 | 0 2 0 | 1 17 10½ | — — | 22 10 0 | 0 13 0 | 21 9 7 |
| 1482 | 22 Edward IV | — — | 1 17 6 | 0 1 6 | 1 18 4½ | — — | 22 10 0 | 0 7 6 | 21 15 0 |
| 1483 | 1 Richard III | — — | 1 17 6 | 0 1 6 | 1 18 4½ | — — | 22 10 0 | 0 7 6 | 21 15 0 |
| 1485 | 1 Henry VII | — — | 1 17 6 | 0 1 6 | 1 18 4½ | — — | 22 10 0 | 0 7 6 | 21 15 0 |
| 1509 | 1 Henry VIII | — — | 1 17 6 | 0 1 0 | 1 18 11½ | — — | 22 10 0 | 0 2 6 | 22 0 0 |
| †1527 | 18 —— | — — | 2 0 0 | 0 1 0¾ | 1 18 11¼ | — — | 22 0 0 | 0 2 8 | 22 0 0 |
| —— | —— | — — | 2 5 0 | 0 1 0 | 2 1 0 | — — | 27 0 0 | 0 2 9 | |
| —— | —— | | | | | 22 0 | 29 2 6 | 0 3 0 | 21 19 6 |
| 1543 | 34 —— | 10 0 | 2 8 0 | 0 8 0 | 2 4 4½ | 23 0 | 28 16 0 | 1 4 0 | 26 8 0 |
| 1545 | 36 —— | 6 0 | 2 8 0 | 2 0 0 | 2 11 9½ | 22 0 | 30 0 0 | 2 10 0 | 27 10 0 |
| 1546 | 37 —— | 4 0 | 2 8 0 | 4 4 0 | 2 15 6 | 20 0 | 30 0 0 | 5 0 0 | 27 10 0 |
| 1547 | 1 Edward VI | 4 0 | 2 8 0 | 4 1 0 | 2 15 6 | 20 0 | 30 0 0 | 1 10 0 | 31 7 0 |
| 1549 | 3 —— | 6 0 | 3 12 0 | 4 0 0 | 2 19 2½ | 22 0 | 34 0 0 | 1 0 0 | 33 0 0 |
| 1551 | 5 —— | 3 0 | 3 12 0 | | | | | | |
| —— | —— | 11 0 | 3 0 0 | | | 23 3½ | 36 0 0 | | |
| —— | —— | | | | | 22 0 | 33 0 0 | | |
| 1552 | 6 —— | 11 1 | 3 0 0 | 0 1 0 | 2 19 3½ | 23 3½ | 36 0 0 | 0 2 9 | |
| —— | —— | | | | | 22 0 | 33 0 0 | 0 3 0 | 32 17 8 |
| 1553 | 1 Mary | 11 0 | 3 0 0 | 0 1 0 | 2 19 6½ | 23 3½ | 36 0 0 | 6 3 0 | 33 0 8 |
| 1560 | 2 Elizabeth | 11 2 | 3 0 0 | 0 1 6 | 2 18 6 | 23 3½ | 36 0 0 | 0 3 0 | |
| —— | —— | | | | | 22 0 | 33 0 0 | 0 4 0 | 32 16 0 |
| 1600 | 43 —— | — — | 3 2 0 | 0 2 0 | 3 0 0 | 23 3½ | 36 10 0 | 0 10 0 | |
| —— | —— | | | | | 22 0 | 33 10 0 | 0 10 0 | 33 0 0 |
| 1604 | 2 James I | — — | 3 2 0 | 0 2 6 | 2 19 6 | 22 0 | 37 1 0 | 1 10 0 | 35 14 0 |
| 1626 | 2 Charles I | — — | 3 2 0 | 0 2 0 | 3 0 0 | — — | 41 0 0 | 1 1 5 | 39 18 7 |
| ‡1666 | 18 Charles II | — — | 3 2 0 | 0 0 0 | 3 2 0 | — — | 44 10 0 | - | 41 10 0 |
| 1717 | 3 George I | — — | 3 2 0 | 0 0 0 | 3 2 0 | — — | 46 14 6 | - - | 46 14 6 |
| 1816 | 56 George III | — — | 3 6 0 | 0 4 0 | - | — — | 46 14 6 | - | 46 14 6 |

* The use of a note is no doubt in several [illegible] an equivalent amount of coin but as the issuer of the note is [illegible] the occurrence [illegible] — Henry VIII [illegible] was substituted in its stead The 1 weight was but 11oz 2dwts troy as at present, [illegible] tale were exactly a pound weight

‡ [illegible] Charles II The seignorage on the coinage was at this time given up, and the gold bullion brought to the mint has ever since been coined free of expense A seignorage of $6\frac{14}{31}$ per cent was imposed on the coinage of silver by 56 Geo 3

II Account of the Contents or Weight, and of the Value in Sterling of the principal Gold Coins of different Countries

| Coins | Contents in pure Gold | Value in Sterling |
|---|---|---|
| | *grains* | *s* *d* |
| Austrian Dominions | | |
| Sovereign | 78 6 | 13 10 92 |
| Double ducat | 106 4 | 18 9 97 |
| Bavaria | | |
| Max d'or, or Maximilian | 77 | 13 7 44 |
| Ducat | 52 8 | 9 4 12 |
| Cologne | | |
| Ducat | 52 6 | 9 3 70 |
| Denmark | | |
| Christian d'or | 93 3 | 16 6 14 |
| England | | |
| Sovereign | 113 1 | 20 0 |
| Half sovereign | 56 55 | 0 10 |
| France | | |
| Louis, or piece of 20 francs | 89 7 | 15 10 5 |
| Hamburgh | | |
| Ducat (double in proportion) | 52 9 | 9 4 35 |
| Hanover | | |
| George d'or | 92 6 | 16 4 66 |
| Ducat | 53 3 | 9 5 19 |
| Holland | | |
| Ducat | 52 8 | 9 4 13 |
| Malta | | |
| Louis | 108 | 19 1 37 |
| Milan | | |
| Sequin | 53 2 | 9 4 98 |
| Doppia or pistole | 88 4 | 15 7 74 |
| 40 Lire piece of 1808 | 179 7 | 13 9 64 |
| Naples | | |
| Six ducat piece of 1783 | 121 9 | 21 6 89 |
| Three ducat piece, or oncetta, of 1818 | 58 1 | 10 3 10 |
| Netherlands | | |
| Gold lion, or 14 florin piece | 117 1 | 20 8 69 |
| Ten florin piece (1820) | 93 2 | 16 5 93 |
| Portugal | | |
| Dobraon of 24 000 rees | 7 9 | 134 3 96 |
| Dobra of 12 800 rees | 401 5 | 71 0 70 |
| Moidore or Lisbonnine (½, &c in prop) | 152 2 | 26 11 21 |
| Prussia | | |
| Frederick (double) of 1800 | 184 5 | 32 7 64 |
| Frederick (single) of 1800 | 92 2 | 16 3 12 |
| Rome | | |
| Scudo | 367 | 64 11 43 |
| Russia | | |
| Ducat | 53 2 | 9 4 98 |
| Imperial | 181 9 | 32 2 51 |
| [illegible] | 219 8 | 30 8 10 |
| Saxony | | |
| Ducat | 52 9 | 9 4 31 |
| Spain | | |
| Pistole | 90 1 | 15 11 35 |
| Sweden | | |
| Ducat | 51 9 | 9 2 22 |
| Switzerland | | |
| Pistole | 105 9 | 18 8 91 |
| Tuscany | | |
| Zecchino or sequin | 53 6 | 9 5 83 |
| [illegible] | 246 1 | 43 6 66 |
| Venice | | |
| Zecchino or sequin (½ and ¼ in prop) | 53 6 | 9 5 83 |
| East Indies | | |
| Mohur of 1770 | 186 8 | 33 0 72 |
| Mohur proportion | 94 | 16 7 64 |
| Mohur | 189 8 | 30 1 04 |
| Rupee | 104 7 | 29 1 78 |
| Rupee | 165 | 29 2 12 |
| Pagoda star | 41 8 | 7 4 77 |

III Account of the Contents or Weight and of the Value in British Standard Silver at 5*s* 2*d* an ounce, of the principal Silver Coins of different Countries

| Coins | Contents in pure Silver | Value in Sterling |
|---|---|---|
| | *grains* | *s* *d* |
| Austria | | |
| Rixdollar or florin *Convention* | 179 6 | 2 1 07 |
| Copfstuck, or 20 creutzer piece | 89 8 | 0 8 29 |
| Halbe copf, or 10 creutzer piece | 28 8 | 0 1 01 |
| Baden | | |
| Rixdollar | 358 1 | 4 2 |
| Bavaria | | |
| Rixdollar of 1800 (½ in proportion) | 34 6 | 1 0 25 |
| Copfstuck | 89 8 | 0 8 29 |
| Brunswick | | |
| Rixdollar *Convention* | 359 2 | 4 2 15 |
| Half rixdollar | 179 6 | 2 1 07 |
| Denmark | | |
| Rykdaler | 368 4 | 4 6 23 |
| Half rykdaler | 194 2 | 2 3 11 |
| Mark, specie, or ¼ rykdaler | 64 4 | 0 7 59 |
| England | | |
| Crown (*old*) | 429 7 | 5 0 |
| Half crown | 214 8 | 2 6 |
| Shilling | 85 9 | 1 0 |
| Sixpence | 42 9 | 0 6 |
| Crown (*new*) | 403 6 | 4 8 36 |
| Half crown | 201 8 | 2 4 18 |
| Shilling | 80 7 | 0 11 27 |
| Sixpence | 40 3 | 0 5 63 |
| France | | |
| Franc | 69 4 | 0 9 69 |
| Demi franc | 34 7 | 0 4 84 |

* This value of the American eagle is taken from average assays of the coins of twelve years

SILVER COINS — *continued*

| Coins | Contents in pure Silver | Value in Sterling |
|---|---|---|
| | *grains* | *s* *d* |
| Genoa | | |
| Scudo of silver | 457 4 | 5 3 87 |
| Hamburgh | | |
| Rixdollar specie | 397 5 | 4 7 49 |
| Double mark or 32 schilling piece (single in proportion) | 210 3 | 2 5 36 |
| Piece of 8 schillings | 50 1 | 0 6 99 |
| Hanover | | |
| Rixdollar, *Constitution* | 400 3 | 4 7 89 |
| Florin, or piece of ⅔, fine | 200 3 | 2 3 96 |
| Holland | | |
| Florin or guilder (½ in proportion) | 146 8 | 1 8 49 |
| 12 Stiver piece | 92 4 | 1 0 90 |
| Florin of Batavia | 141 6 | 1 7 77 |
| Lubec | | |
| Rixdollar, specie | 391 9 | 4 6 72 |
| Mark | 105 1 | 1 2 67 |
| Lucca | | |
| Scudo | 372 3 | 4 3 98 |
| Malta | | |
| Ounce of 30 tari of Emmanuel Pinto | 337 4 | 3 11 11 |
| 2 Tari piece | 17 7 | 0 2 41 |
| Milan | | |
| Scudo of 6 lire (½ in proportion) | 319 6 | 3 8 62 |
| Lira | 54 8 | 0 7 37 |
| Modena | | |
| Scudo | 287 4 | 3 4 13 |
| Naples | | |
| Ducat new (½ in proportion) | 295 4 | 3 5 24 |
| Piece of [illegible] | 295 1 | 3 5 20 |
| [illegible] | 148 4 | 1 8 72 |
| [illegible] (proportion) | 75 | 0 10 46 |
| Poland | | |
| Florin, or gulden | 84 | 0 11 72 |
| Portugal | | |
| [illegible] | 198 2 | 2 4 67 |
| Seis vintems, or piece of 120 rees | 46 6 | 0 6 50 |
| Testoon | 42 5 | 0 5 93 |
| [illegible] | 23 3 | 0 3 25 |
| | 20 4 | 0 2 84 |
| Portuguese Colonies | | |
| Piece of 8 macutes, of Portuguese Africa | 159 8 | 1 10 31 |
| Ditto of 4 ditto | 78 1 | 0 10 90 |
| Prussia | | |
| Rixdollar Convention | 359 | 4 2 13 |
| Florin, or piece of ⅔ | 198 4 | 2 3 70 |
| Rome | | |
| Scudo or crown | 371 5 | 4 3 87 |
| Mezzo scudo, or half crown | 185 7 | 2 1 93 |
| Paolo | 37 2 | 0 5 19 |
| Russia | | |
| Rouble | 312 1 | 3 7 58 |
| Rouble (Alexander 1805) | 278 1 | 3 2 83 |
| 20 Copeck piece | 62 6 | 0 8 74 |
| 5 Copeck piece | 15 3 | 0 2 13 |
| Sardinia | | |
| Scudo, or crown (½ and ¼ in prop) | 324 7 | 3 9 34 |
| Saxony | | |
| Rixdollar, *Convention* (½ and ¼ in prop) | 358 2 | 4 2 01 |
| Sicily | | |
| Scudo (½ in proportion) | 348 2 | 4 0 62 |
| Spain | | |
| † Dollar of late coinage | 370 9 | 4 3 79 |
| Half dollar, ditto | 185 4 | 2 1 88 |
| Sweden | | |
| Rixdollar | 388 5 | 4 6 28 |
| Switzerland | | |
| Ecu of 1 franken | 407 6 | 4 9 18 |
| Turkey | | |
| Piastre (1818) | 67 7 | 0 9 15 |
| Tuscany | | |
| Lira | 53 4 | 0 7 45 |
| United States | | |
| Dollar | 370 1 | 4 3 68 |
| [illegible] | 559 1 | 4 2 14 |
| Copfstuck | 59 8 | 0 8 35 |
| East Indies | | |
| Rupee Sicca, coined by the East India Company | 175 8 | 2 0 54 |
| [illegible] | 175 9 | 2 0 56 |
| [illegible] | 164 7 | 1 11 01 |
| [illegible] | 165 | 1 11 |
| Fanam Cananore | 32 9 | 0 4 5 |
| Bombay old | 35 | 0 4 88 |
| Pondicherry | 22 8 | 0 3 18 |
| Ditto double | 39 | 0 5 44 |
| Gulden of the Dutch E I Co (1820) | 118 4 | 1 8 72 |

*Ancient Coins* — We subjoin, for the convenience of such of our readers as may have occasion to consult works in which reference is made to ancient coins, the following tables of those that were principally current among the Jews, Greeks, and Romans They were calculated by Dr Arbuthnot (*Tables of Ancient Coins, Weights &c*, 4to ed Lond 1754), and do not differ materially from the tables of Paucton, whose *Metrologie* (4to, Paris, 1780) is the most complete and elaborate work that has ever been published with respect to ancient monies, weights, and measures At the same time we confess we should not be disposed to place much reliance on these tables, and we have elsewhere stated our reasons [illegible] — (Art "Money," New Edit *Encyc Britannica*)

† This is the coin which is universally circulated under the name of the Spanish dollar

### Jewish Coins

| Names and Proportions | | | | | | Value in Sterling £ | s | d |
|---|---|---|---|---|---|---|---|---|
| Gerah | | | | | | 0 | 0 | 1 49/160 |
| 10 | Bekah | | | | | 0 | 1 | 1 11/16 |
| 20 | 2 | Shekel | | | | 0 | 2 | 3 3/8 |
| 1,200 | 120 | 50 | Maneh Mina Hebraica | | | 5 | 14 | 0½ |
| 60,000 | 6,000 | 3,000 | 60 | Talent | | 342 | 3 | 9 |
| Solidus aureus, or sextula, worth | | | | | | 0 | 12 | 0½ |
| Siclus aureus, worth | | | | | | 1 | 16 | 6 |
| A talent of gold, worth | | | | | | 5475 | 0 | 0 |

### Grecian Coins

| | | | | | | | | Value in Sterling £ | s | d | qrs |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lepton | | | | | | | | 0 | 0 | 0 31/336 | |
| 7 | Chalcus | | | | | | | 0 | 0 | 0 31/48 | |
| 14 | 2 | Dichalcus | | | | | | 0 | 0 | 1 7/24 | |
| 28 | 4 | 2 | Hemiobolum | | | | | 0 | 0 | 2 7/12 | |
| 56 | 8 | 4 | 2 | Obolus | | | | 0 | 1 | 1 1/6 | |
| 112 | 16 | 8 | 4 | 2 | Diobolum | | | 0 | 2 | 2 1/3 | |
| 224 | 32 | 16 | 8 | 4 | 2 | Tetrobolum | | 0 | 5 | 0 2/3 | |
| 336 | 48 | 24 | 12 | 6 | 3 | 1½ | Drachma | 0 | 7 | 3 | |
| 662 | 96 | 48 | 24 | 12 | 6 | 3 | 2 Didrachma | 1 | 3 | 2 | |
| 1,324 | 112 | 96 | 48 | 24 | 12 | 6 | 4 2 Tetradrachma | 2 | 7 | 0 | |
| 1,660 | 384 | 120 | 60 | 30 | 15 | 7½ | 5 2½ 1¼ Pentadrachma | 3 | 2 | 3 | |

Of these, the drachma and didrachma were of silver the rest for the most part, of brass

The drachma is here with the generality of authors, supposed equal to the denarius though there is reason to believe that the drachma was somewhat the weightier

| | Value in Sterling £ | s | d |
|---|---|---|---|
| The Grecian gold [illegible] ing 2 Attic drachmas [illegible] teus and exchanging usually for 25 Attic drachmas of silver | 0 | 16 | 1¾ |
| But according to our proportion of gold to silver it was worth | 1 | 0 | 9 |
| [illegible] for Attic [illegible] of the same value | 0 | 18 | 1 |
| Stater Daricus, according to Josephus, worth 50 Attic drachmas, or | 1 | 12 | 3½ |
| Stater Crœsius, of the same value | | | |

### Value and Proportion of the Roman Coins

| | | | | | | Sterling £ | s | d | qrs |
|---|---|---|---|---|---|---|---|---|---|
| Teruncius | | | | | | 0 | 0 | 0 775/1000 | |
| 2 | Sembella | | | | | 0 | 0 | 1 5/100 | |
| 4 | 2 | Libella As | | | | 0 | 0 | 3 1/10 | |
| 10 | 5 | 2½ | Sestertius | | | 0 | 1 | 3¼ | |
| 20 | 10 | 5 | 2 | Quinarius Victoriatus | | 0 | 3 | 3½ | |
| 40 | 20 | 10 | 4 | 2 | Denarius | 0 | 7 | 3 | |

| | £ | s | d |
|---|---|---|---|
| The Roman [illegible] | 1 | 4 | 3¾ |
| [illegible] | 1 | 0 | 9 |
| [illegible] proportion mentioned by [illegible] | 0 | 12 | 11 |
| According to the [illegible] which the aure is [illegible] its value | 0 | 16 | 1¾ |

MO'NEYERS, COMPANY OF This company, which is of very ancient origin, are officers of the Royal Mint, under whose superintendence and responsibility the various moneys of the realm are manufactured They receive the bars of standard metal from the *melter*, and under their direction these are rolled down, cut into blanks, and coined these processes are described under the word Coinage The connection of the Company of Moneyers with the other officers of the mint will be evident from the duties of the other officers, which are stated under the word Mint (See also Mr Atkinson's account of the origin and constitution of the Company of





Moneyers, in the Parliamentary Report of the Select Committee on the Royal Mint, 1837, p 119)

MONOCARPONS (Gr *μονος*, *single*, and *καρπος fruit*), is a term invented by De Candolle to designate what gardeners call annuals and flowers which like the Agave die after they have once borne fruit though they may live for many years We perish as soon as they have once borne fruit

MO'NOCHORD (Gr *μονος*, and *χορδη string*) In Music, an instrument consisting of a single string stretched between two bridges standing on a graduated rule, for the purpose of measuring the variety and proportion of musical sounds The monochord is called the harmonical canon or the canonical rule

MONOCHROMA'TIC LAMP When a solution of common salt is added to spirit of wine, the mixture burns with a flame in which yellow predominates almost to the [illegible] The consequence is, [illegible] either yellow or black, and deficient in the tints which they exhibit when seen by solar light, or by that of our ordinary combustibles (See Sir David Brewster, in the volume of the *Family Library* on "Natural Magic") The term *Monochromatic* is of the same origin as —

MO'NOCHROME (Gr *μονος*, and *χρωμα*, *colour*) A painting executed in a single colour See Painting

MONOCOTYLEDONS (Gr *μονος*, and *κοτυληδων a lobe*) A class of plants having but one cotyledon or seed-lobe in the embryo They are now more generally called [illegible] see

MONODELPHIANS (Gr *μονος* and *δελφυς*, *a womb*) A name given by De Blainville to the first sub-class in his binary division of Mammalia, comprehending those which have no supplementary external pouch or marsupium but which bring forth the young in a state sufficiently mature not to require such additional protection It is antithetical to *Didelphs*

MO'NODON (Gr *μονος* and *οδους*, *a tooth*) The generic name of the narwhal signifying its upper peculiarity of having but one tooth, which projects like a horn from the fore part of the head, a second tooth, however is always to be found concealed in the adjoining jaw where it remains in a rudimental state In the female both tusks are rudimental

MONODY (Gr *μονος*, and *ωδη*, *a song*) A species of poem of a mournful character in which a single mourner is supposed to bewail himself This differs from those pastoral elegies (like the *Daphnis* of Virgil) which are in the form of dialogues

MONŒCIA (Gr *μονος* and *οικος a house*) In Botany, the twenty-first class in the system of Linnæus, comprising the Androgynous plants, or those whose structure is both male and female

MO'NOGRAM (Gr *μονος* and *γραμμα*, *letter* or *writing*) An abbreviation of a name by means of a cipher composed of two or more letters intertwined with each other Monograms were used on coins in very ancient times, being found on Greek medals of the age of Philip and Alexander of Macedon The Greek monogram of the name of Christ which resembles P placed perpendicularly in the middle of an X thus ☧, is found on coins of the age of Constantine By far the greater number of the ancient monograms are still unintelligible, though the labour and research which have been expended in endeavouring to decipher their meaning have in many instances been rewarded with success Among others whose researches on the ancient monograms may be consulted with advantage are, Montfaucon *Palæographia Græca*, Frœlich, *Annal Reg Syr*, Combe *Museum Hunterianum*, Torremuzza *Descriptio des Monnaies de Sicile*, Pellerin, *Recueil des Villes des Peuples, et des Rois*, Mionnet *Traité de la Numismatique* Monograms are frequently found on coins and maps of the middle ages, and they are also to be met with as a substitute for the signature of the princes of that period This class of monograms is of great importance in illustrating the monuments of antiquity, and their investigation constitutes a distinct and peculiar branch of diplomatics In later times monograms were frequently employed by printers and engravers to record their names at the end or on the title page of a book, or in some portion of an engraving A great deal of attention has likewise been bestowed upon this branch of [illegible] writing, and with considerably more success The Abbé de Marolles, in 1667, was the first who directed attention to this subject, and to him succeeded Florent Le Comte (*Cabinet des Singularités d'Architecture, &c*), Orlandi (*Abecedario Pittorico*), Le Chrut (*Anzeige und Auslegung der Monogrammatum*), De Virloy (*Dictionnaire d'Architecture*), and Bartsch ([illegible] a work [illegible] arch) complete [illegible] on this class of monograms is to be found in the *editio optima* of Brulliot (*Dictionnaire des Monogrammes, &c, avec lesquels les Peintres, &c, ont designé leurs Noms*, 2 tom 4to Munich, 1832; a work which is founded on the principle of considering

the *first* letter of the monogram as the key to its explanation

A monogram is said to be *perfect* when it contains all the letters of the word it is intended to represent (*Dict de* [illegible]

MO'NOGRAPH (Gr *μονος*, and *γραφω*, *I write*) A treatise or memoir on a single subject of a limited description Such, for example, are the greater part of the memoirs which are read before learned societies

MONOGY'NIA (Gr *μονος*, and *γυνη*, *a female*) In Botany, the name given by Linnæus in his system to the first order or subdivision in each of the first thirteen classes of plants, comprising such as have one pistil or [illegible] a flower

MO'NOLITH (Fr monolithe, from Gr *μονος*, and *λιθος a stone*) A term recently introduced into England, to signify a pillar or other large substance consisting of a single stone Herodotus speaks of a huge rock of this sort in front of the temple of Minerva at Sais, which was scooped out, and contained an apartment 18 cubits in length, 12 in breadth, and 5 in height It was said to have been transported from the town of Elephantine by order of king Amasis, and to have occupied 3000 men for three years in conveying it Some remarkable monoliths have been found in Egypt, of these the zodiac of Dendereh, and the obelisk of the Luxor, both of which have been removed to Paris, are well known examples

MO'NOLOGUE (Gr *μονος* and *λογος*, *a discourse*), or SOLILOQUY (Lat solus, *alone*, and loquor, *I speak*), is, as its name imports a speech uttered by one of the dramatis personæ of a play when alone or, as it is vulgarly termed, speaking to himself The introduction of the soliloquy is obviously a very unnatural contrivance in the dramatic art, yet its obvious necessity reconciles the spectator to it In the drama of ancient Greece soliloquies are rare, for the passages at the commencement, or "prologues" of plays, where the first actor comes forward and explains his own character and something of the subject of the piece to the audience can hardly be termed soliloquies The speech of Ajax before his death is a celebrated exception

MO'NOMA'NIA (Gr *μονος* and *μανια Rage*) Insanity upon one particular subject the mind being in a sound state in reference to other matters

MO'NOMIAL or MONOMIAL (Gr *μονος* and *νομη*, *a part*) In Algebra an expression composed of a single term or a series of factors all which are single terms

MONOMI'RANS [illegible] (Gr [illegible] *limb*) A section of [illegible] which the tarsus [illegible] ned of a single joint

MO'NOMYARIAN [illegible] (Gr *μονος* and *μυων muscle*) All those bivalves or conchifers which have only one adductor muscle, and consequently but one muscular impression on each valve

MONONEU'RANS *Mononeura* (Gr *μονος*, *νευρον*, *nerve*) A term applied by Rudolphi to the series or primary division comprehending the animals which he believed to have only the ganglionic system of nerves, as the Mollusks and Insects

MONOPE'TALOUS (Gr *μονο* and *πεταλον a petal*), in Botany, is applied to a corolla, the petals of which cohere [illegible] to form a tube

MONO[illegible]PHYLLOUS [illegible] (Gr [illegible] *φυλλον a leaf*), in Botany is applied to calyx the sepals of which cohere by their [illegible] into a kind of tube or cup

MONOPHYSITES (Gr *μονος* and *φυσις*, *nature*) A name given in the 5th century to certain heretics who in the language of the Athanasian creed, 'confounded the substance,' that is the divine and human substance which are united in Christ but neither absorbed into the other *See* INCARNATION, EUTYCHIANS NESTORIANS (Mosheim, *Eccl Hist* vol ii)

MO'NOPLEURO BRA'NCHIANS (Gr *μονος* and *πλευρα a side*, *βραγχια gills*) A name given by De Blainville to an order of his class *Paracephalophora*, comprehending those species which leave the branchiæ more or less completely covered by a part of the mantle, and situated on the right side of the body

MONO'POLY (Gr *μονος* and *πωλεω*, *I sell*), in Law, is defined by Sir E Coke (3 *Inst* 181 c 5) 'an institution or allowance by the king, by his grant commission, or otherwise, to any person or persons bodies politic and corporate of or for the sole buying selling, making, working or using of any thing, whereby any person or persons, bodies politic or corporate are sought to be restrained of any freedom or liberty that they had before, or hindered in their lawful trade" The practice of granting monopolies, giving to one or a few individuals the sole privilege of producing importing, or dealing in certain articles has been acted on to a greater or less extent in all countries, and was carried to an oppressive and ruinous extent in England in the reign of Elizabeth and [illegible] the strenuous opposition of the crown it was [illegible] by the famous statute of the 21 Jas I cap 3 Its provisions did not extend to patents for new inventions, nor to grants by act of parliament to corporations &c But it suppressed all private monopolies, and by giving full freedom to industry and invention, contributed more perhaps than any other act to the progress of improvement than all other act [illegible] e statute book

MONOPOLYLOGUE (Gr *μονος*, *πολυς*, *many*, and *λογος a discourse*) A term recently invented to designate an entertainment in which a single actor sustains many characters

MONO'PTERAL (Gr *μονος*, and *πτερον*, *a wing*) In Architecture, a temple or circular enclosure of columns without a cell

MO'NORHYME (Gr *μονος*, and *ῥυθμος*, *measure*) A composition in verse, in which all the lines end with the same rhyme This species of composition is said to owe its invention to Benin, who wrote in Latin, and de [illegible] Pope Alexander III

MONOS[illegible]TA (Gr [illegible] *ονος*, and *στομα*, *a mouth*) The name of a genus of Trematode Entozoa, including those which have only a single pore, serving at once for nutrition and adhesion

MONOTHA'LAMANS (Gr *μονος*, and *θαλαμος*, *a chamber*) This term is applied to those univalve shells which have only one chamber

MO'NOTHEISM (Gr *μονο*, and *θεος a god*) The doctrine of or the belief in the existence of one God in contradistinction to Polytheism, the belief in a plurality of Gods The Jewish, Christian, and Mohammedan systems of religion are the only pure specimens of Monotheism in existence It has often been supposed that the Jews alone of all the nations of antiquity, had conceived the truth of there being only one God, but there can be little doubt that there are no well-founded reasons for this opinion In the arcane theology of Egypt, not only was the unity of the Deity acknowledged but he was even adored, not as the God of any particular religion but as the eternal and omnipotent Governor of the Universe In support of this assertion the testimony of various heathen writers might be cited, but the following passage from Jablonski may supersede the necessity of adducing any other authority "Those men" he observes, 'who were most distinguished for wisdom among the Egyptians acknowledged God to be a certain unbegotten Eternal Spirit, prior to all things which exist, who created, preserves contains pervades, and vivifies everything who is the Spirit of the Universe, but the Guardian and Protector of men' That many of the priests and poets and philosophers of Greece were not ignorant of the same truth is not less evident In one of the *Orphic Fragments* preserved by Proclus we find it expressly declared, that 'there is One Power, One Deity the great Governor of all things" The verses which, according to Bishop Warburton were sung in the Eleusinian Mysteries contained the following passage —"Pursue thy path [illegible] the temple the King of the world He is One [illegible] himself alone and to that One all things have owed their being He encompasses them No mortal hath beheld him, but he sees everything" In some verses which have been often cited by the fathers from a tragedy now lost Sophocles has said, "There is in reality only One God who made the heavens and the remote earth the blue waves of the ocean and the strength of the winds' That Pythagoras admitted the unity of the Deity must be evident to all who have considered his philosophy, and his monotheism is further attested not only by the eclectic philosophy, but in distinct terms by St Justin and St Cyril Euclid of Megara and Socrates were both Monotheists Plato was in all probability one likewise His Trinity, like that of the Magi and the Egyptians, was not a trinity of beings but of modes of being in the Divine Nature 'When" says he, "I speak fully in my epistles I commence with *God*, —when I do not, my letters begin with *gods*" But if any further proof were wanting in support of this opinion, the following passage from Origen must be held to be conclusive —

Many of the old philosophers have said that there is one God, who created all things, and in this they agree with the law but some say in addition, that God hath made and governs all things by his Word, and that it is the Word of God by which all things are regulated In this they write consonantly not only with the law, but with the Gospel' (*Edin Review*, vol vii pp 97 98)

MONO'THELITES (Gr *μονος* and *θελω I will*) A sect of heretics, who, while they avoided the error of the Eutychians, and allowed the two natures of Christ to coexist distinctly in the unity of the person, conceived the influence of the divine will so to predominate over the human substance as to leave to the latter no action or efficiency of its own

[illegible] his doctrine is ascribed to the emperor [illegible] in [illegible] reconcile [illegible] church by a middle course of this nature, and published an edict under the advice of some theologians of the day in assertion of it This opinion was condemned by some provincial and one general council, and, on the other

hand, was maintained in the elect of several succeeding emperors Now the question finally settled though silence was frequently commanded upon it, until it was forgotten in the louder disputes of the [illegible] opponents (Combefis, *Monothelit* [illegible]

MONO'TONY (Gr *μονος* and *τονος a sound*) An [illegible] ing or composition

MONOTR[illegible] (Gr *μονος* and *τρημα a hole*) A tribe of ovo-viviparous Mammalia, of which only two genera are known to exist, viz the *Platypus* or *Ornithorhynchus*, and the *Echidna*, both peculiar to Australia The term is indicative of the common cloacal outlet for the excremental and generative products

MO'NOTRIGLYPH (Gr *μονος* and *τριγλυπτος*, *a* [illegible] In Architecture, such an intercolumniation [illegible] Doric [illegible] as brings only one triglyph over it

MONSEIGNEUR A title of courtesy in France, which was prefixed to the titles of dukes and peers, archbishops, bishops, and some other exalted personages, and used in addressing them *Monseigneur* simply was, before the Revolution the title given to the dauphin *Monsieur* is now the common title of courtesy and respect in France, and previously to the revolution in 1830 *Monsieur* simply was the title of the eldest brother of the king

MONSOO'NS (From a Malayan word signifying *seasons*) In Physical Geography, the name given to a certain modification or disturbance of the regular course of the trade winds which take place in the Arabian and Indian seas Between the parallels of 10° and 30° south latitude the eastern trade wind blows regularly, but from the former parallel northwards the course is reversed for half the year, and from April to October the wind blows constantly from the south-west During the other [illegible] of the year the regular north-east trade wind prevails The south-west monsoon is supposed to be occasioned by the great rarefaction of the atmosphere over the extensive regions of Eastern Asia during the summer months *See* TRADE WINDS

MO'NSTER (Lat monstrum) Any thing out of the common order of nature is occasionally designated by this term, but it is physiologically employed under a more [illegible] which one or [illegible] genital malformation [illegible] then must amount [illegible] deformity, or it may be confined to internal organs Buffon, Blumenbach and Meckle have treated on monstrosity classifying its modifications under three heads the first including cases in which parts of the body are increased in number, the second those where certain organs are deficient, and the third including cases in which size, situation, and structure are concerned Other writers such as Geoffroy St Hilaire (*Histoire des Anomalies*), have adopted more comprehensive arrangements, arising however out of the general subdivision of monsters into simple and compound the former including all cases in which the elements of a single individual only are concerned, the latter those in which the constituent parts of two or more individuals are united Simple monsters have again been distributed into three classes The first including such varieties of malformation as chiefly affect one organ or system of organs without [illegible] anomalies [illegible] subdivided into cases where size form or structure is affected and those in which the malformation affects the arrangement, connection, or number of parts The second class in this arrangement includes cases of extensive malformation attended by great deformity and by disturbance of vital functions The third class is limited to [illegible] anomalies [illegible]

The history of individual cases of monstrosity would be here misplaced, several of the most remarkable are detailed in various volumes of the *Philosophical Transactions*, in the *Transactions of the Medico Chirurgical Society*, and in the *Penny Cyclopædia*, art "Monster"

MO'NSTERS, or CHIMERICAL FIGURES In Heraldry, a species of bearings, of which some are very common in English coats of arms and others common in foreign, although not often used in our own The sagittary or centaur, man tiger, sphinx, harpy, triton, and mermaid, are monsters compounded of the human and bestial shape Of monstrous beasts, the most common in armorial bearings are [illegible] griffin (a compound of the eagle and the [illegible] (a two-legged dragon) besides these, there are the unicorn, the heraldic antelope, tiger, and ibex (which are chimerical figures, but representing the natural beast), the musimon (an animal between the goat and the sheep), and the salamander Monstrous birds are the phœnix, camel [illegible] allerion cockatrice, &c

MONTA'NISTS Heretics of the second century, who derive their name from their founder Montanus, a Phrygian, who pretended to inspiration, and declared himself to be a prophet sent from God to complete the Christian scheme, and advance it to its highest state of perfection He affirmed himself to be the Paraclite or Comforter, whose mission was supposed by various sectarians of the early centuries to be distinct from that of the Holy Spirit, which was promised to the apostles, and was expected to put the finishing stroke to the revelation of Jesus Christ The characteristics of this sect were similar to those which are known by the general name of Gnostic, and consisted principally in great austerity of manners and a belief in the possibility of an advance from the obvious and literal interpretation of the word of God to a state of interior and spiritual knowledge coincident with a participation in the divine nature itself

MO'NTANT (Fr) In Architecture, any upright piece in a system of framing

MONT DE PIÉTÉ (Ital Monte di Pieta) The name given on some parts of the Continent to certain benevolent institutions, established for the purpose of lending money to the poor at a moderate rate of interest They originated under the papal government in the 15th century and were intended to countervail the exorbitant usurious practices of the Jews, who formed at that period the great money-lenders of Europe These institutions were afterwards introduced into many of the Continental states, and similar establishments existed, and in some cases still exist, at Paris, Madrid, Brussels, Ghent Antwerp, &c *Monti frumentarii* are public granaries, from which corn is sold to the necessitous Italians on a principle somewhat analogous to that on which sums are lent by the Mont de Piété

MO'NTEM The name given to an ancient custom till lately prevalent among the scholars of Eton, which consisted in their proceeding every third year on Whit Tuesday to a tumulus (Lat *ad montem*, whence the name), near the Bath road, and exacting money for *salt*, as it was called, from all persons present or passers by The sum so collected was given to the *captain*, or senior scholar of the school, and was intended to assist in defraying the expenses of his residence at the university, to which he was about to proceed The origin of this ceremony dated from the establishment of the foundation of Eton College, but it was at first held on the 6th of December, the festival of St Nicholas, the patron of children, and it is only since 1779 that the present was substituted for the original period of its celebration It was the almost invariable practice of the sovereign, the court, and a large portion of the nobility to honour this festivity with their presence, and so liberal were their contributions that the *salt money* has been known to approach nearly 1000*l* (See *Huggett's MS Collections*, for a history of Windsor and Eton colleges, in the British Museum, and *Brand's Popular Antiquities*)

MONTH (Germ monat) The twelfth part of our calendar year It is so called from its being the period of the moon's revolution round the earth *See* CALENDAR

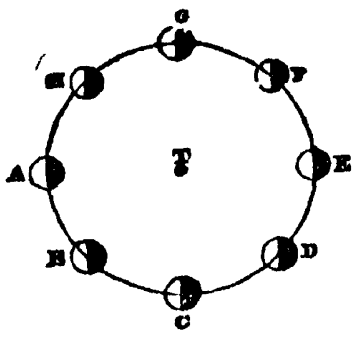
MO'NUMENT (Lat) A memorial for perpetuating the remembrance of an event, also a cenotaph in memory of the dead The productions of architecture and sculpture intended to transmit to posterity the memory of individuals and events [illegible] called monuments Among [illegible] are tombs and sepulchral edifices or columns The most ancient are the obelisks and pyramids of Egypt, and perhaps, contemporary with these the tombs of the Persian kings still visible in the ruins of Persepolis Greece abounded with monuments of this nature Buildings in that country were frequently raised in commemoration of distinguished persons or events and of this class were the Choragic monuments in honour of those who had received the prize [illegible] games Of these [illegible] monument of Lysicrates vulgarly called the Lantern of Demosthenes Among the monuments of this class of the Romans, the triumphal arches are in the first rank The column called the Monument of London and the Duke of York's monument, illustrate respectively the definition above given

MOOD (Lat modus) In Grammar, the designation by the form of the verb of the manner of our conception of an event, or fact, whether as certain, contingent, possible desirable, or the like *See* GRAMMAR

MOOD OF A CATEGORICAL SYLLOGISM, in Logic, is the designation of its three propositions in the order in which they stand, according to their quantity and quality

MOON (Gr *μηνη*, Germ mond) The satellite of the earth The moon after the sun, is not only the most conspicuous but in an astronomical point of view, the most interesting of the celestial bodies The variety of her phases, her eclipses, and the rapidity with which she changes her place among the fixed stars, drew the attention of the earliest observers of the heavens, and in modern times [illegible] of the theory of her motions [illegible] the determination of terrestrial longitudes, has given the *Lunar Theory* the first rank among the objects of astronomical science

*Phases of the Moon* The different phases of the moon were probably the first celestial phenomena that received a correct explanation By observing them attentively during the course of a single revolution, it would be inferred that they are occasioned by the reflection of the sun's light from the spherical surface the moon, and accordingly the fact was recognised by the earliest astronomers Let I be the earth, and A B C D E F G H successive portions of the moon in her orbit, the sun being supposed to be situated in the straight line T A, and at so great a distance that lines drawn from it to every part of the moon's orbit may be regarded as parallel When the moon is at A, she is in *conjunction* with the sun, and passes the meridian at the same time, and her illuminated hemisphere being then turned directly away from the earth, no portion of her disk is visible A few days after the conjunction the moon begins to appear on the eastern side of the sun at B, having the form of a crescent the horns of which are turned *eastward* or away from the sun When she arrives at C or 90° from her conjunction the earth is in the plane of the great circle of her orb, which forms the boundary between her dark and illuminated hemispheres, and consequently half the disk is visible The moon is then in her *first quarter* At D more of the illuminated hemisphere is turned towards the earth and she appears gibbous At F she is in opposition to the sun, the illuminated side is turned directly to the earth and the disk appears round or *full* After passing [illegible] to wane, and [illegible] to appear [illegible] When [illegible] or 270° from the [illegible] From this point to the conjunction the moon again appears as a crescent becoming narrower as she approaches to A, but the horns of the crescent are now turned *westward* still away from the sun The straight line which joins A and F is called the line of the *syzygies*, that which joins C G is the line of the *quadratures*, and the points B D F H situated at equal distances from those lines, are called the *octants* The magnitude of the illuminated portion of the disk is thus seen to depend on the position of the moon relatively to the sun and the earth, and is easily determined by a geometrical construction The mean period of time in which a revolution of the phases is completed or in which she passes from one conjunction to the following, is 29 days, 12 h 44 m 2 8 sec

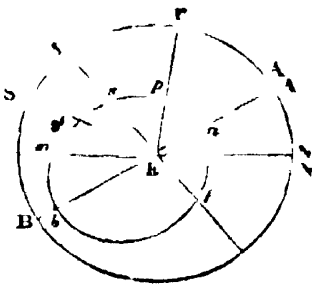



*Distance and Magnitude of the Moon* — The moon's distance from the earth is found from her horizontal parallax, which may be determined either by simultaneous observations at stations very distant from each other or by means of the occultations of fixed stars by the moon From such observations it is found that the amount of the parallax varies considerably at different times Its mean value gives the average distance of the moon from the earth equal to 59 9 of the earth's equatorial semidiameters, or about 237 000 miles which is upwards of 400 times less than the distance of the sun Combining this result with the apparent magnitude (31 20″) of the moon's diameter, when at her mean distance it results that the diameter of the moon is to that of the earth in the proportion nearly of 3 to 11, whence the volume of the moon is only about 1 49th of the volume of the earth

*Inclination and Nodes of the Lunar Orbit* — The moon's orbit is inclined to the ecliptic under an angle of 5° 8′ 47″ 9, but the line in which it intersects the ecliptic, or the *line of the nodes* does not maintain a fixed position on the plane of the ecliptic It is observed that the moon passes from one of the nodes to the opposite one in less time than is required to pass through 180° of longitude, hence the line of the nodes has a retrograde motion on the ecliptic, and its motion is so considerable that it completes a revolution, or returns to its former position, in a period of 6798 28 days, or about 18 6 years This period is remarkable, as being that after which the eclipses of the sun and moon again return nearly in the same order The cause of the regression of the line of the nodes is the attractive power of the sun which is always tending to draw the moon into the plane of the ecliptic, and which would at length cause her orbit to coincide with that plane, were the tendency not counteracted by the angular motion of the moon round the earth By reason of the angular motion the mean inclination remains the same, and the resulting effect is the retrograde motion of the nodes But as the sun's distance from the earth is a variable quantity the effect of the solar action in displacing the nodes of her orbit is also variable Hence, and also on various other accounts, the motion of the nodes, and the inclination of the lunar orbit to the ecliptic, are subject to certain periodical changes, all which must be accurately appreciated and computed in the formation of the lunar tables *See* PERTURBATIONS

*Eccentricity of the Lunar Orbit* — The general orbit of the moon is an ellipse, having the earth at one of its foci, but on account of the disturbing force of the sun, and the difference of the intensities of this force when the moon is differently situated relatively to the earth and sun, the ellipse is constantly changing its form and position on the plane of the orbit, and hence the numerical values assigned to all its elements are to be considered only [illegible] mean values The distance of the moon [illegible] when in *apogee* or at her greatest distance, is 63 842 semidiameters of the earth, and when in *perigee*, or at her least distance, 55 916 semidiameters, whence the eccentricity, or distance of the focus form the centre, is about 0 066, half the major axis [illegible] in the best tables, it is [illegible] in respect of the fixed stars, it is found to have a rapid motion eastward, completing a whole circuit in 3232 57 mean solar days, or nearly nine years But this mean motion is subject to inequalities of considerable magnitude The different situations of the line of the apsides with respect to the line of the syzygies gives rise to the inequality of the lunar motion, called the *evection* *See* EVECTION

*Different Species of Lunar Months* — As the principal [illegible] the lunar orbit — the syzygies the nodes the [illegible] and in different directions, it follows, that the period of time in which the moon completes a revolution with respect to any of these points, or to the fixed stars, will be different in each case These periods which are called lunar *months*, may be explained as follows — Let E be the centre of the earth, *a s b t* the orbit of the moon, *a b* the transverse axis or line of the apsides, *s t* the line of the syzygies, *n m* the line of the nodes and A S B N the great circle of the sphere in the plane of the ecliptic Also, let P be a fixed point on this circle, and suppose the moon to be at *p*, or seen in the direction F P The time which elapses while the moon passes from *p* and returns to the same point of the ecliptic, is called the *tropical* revolution and differs only about seven seconds from the time in which the moon returns to the same fixed star, or performs a *sidereal* revolution Suppose now the moon to be at *s* in the line of the syzygies when the moon advancing from *s*, in the direction *m b n*, has again come round to the same point of the ecliptic, she will not now be in conjunction, for, in the interval, the sun has advanced from S to S′ (nearly a twelfth of the circumference) and consequently the moon must go on to *s*, till she overtakes the sun, before she returns to her conjunction The interval from conjunction to conjunction is the *synodic period*, and exceeds the tropical period by two days and about five hours Next suppose the moon to be at her perigee *a*, or seen in the direction E A, while the moon, after leaving *a* is describing her orbit, the line of the apsides E A revolves through the angle A E A′, and consequently the moon, after coming into the line E A, must continue to advance till she comes to *a′* before she arrives again at her perigee The interval from perigee to perigee is called the *anomalistic period*, and it is also longer than the tropical period, though much shorter than the synodic, inasmuch as the line of the apsides requires about nine years to complete its revolution, while that of the syzygies is completed in one year Lastly, suppose the moon at *n* in the line of the nodes While the moon is advancing round her orbit, the line of the nodes, I N, moves backward into the direction E N′, consequently the moon will have come up to her node at *n′* before she has completed a revolution on the ecliptic The interval from node to node is called the *nodical period* and is shorter than any of the other periods The following table exhibits in mean solar days the mean lengths of the different lunar periods or months —




| | Days. |
|---|---|
| Synodic revolution | 29 53059 |
| Sidereal | 27 32166 |
| Tropical | 27 32158 |
| Anomalistic | 27 55460 |
| Nodical | 27 21222 |

*Acceleration of the Moon's mean Motion* — On comparing observations of the moon made at distant times, it has been discovered that her mean motion has been undergoing a constant acceleration since the earliest times This acceleration is, however, extremely small, amounting only to 10″ in a century, and therefore is in-

sensible for any moderate interval of time, though it becomes considerable after a few centuries Being measured by centuries it is called the *secular acceleration* of the mean motion Its physical cause was found by Laplace to be [illegible] but

*Eclipse of the Moon* [illegible] much greater than that of the earth the earth must project behind it in space a conical shadow the axis of which is in the plane of the ecliptic, and in the straight line joining the earth and sun On computing from the relative magnitudes of the earth and sun and the distance of the two bodies the length of this shadow, it is found to be reckoned to about 216 of the radius of the earth, and consequently far beyond the orbit of the moon It is found also that the [illegible] shadow at the mean distance [illegible] But the greatest apparent [illegible] 33' 3" or about 1/4 of [illegible] the moon appears to be still [illegible] when she is full or in opposition with the sun the whole lunar disk will be enveloped in the earth's shadow, and as the moon requires about an hour to pass over a space equal to her own breadth, the whole disk may be involved in the shadow, and the moon remain invisible during a space of about two hours This phenomenon is a *total eclipse* of the moon, and it is evident that if the moon's orbit coincided with the ecliptic, a total eclipse would take place every lunation In consequence however of the inclination of the orbit to the ecliptic the moon at the time of her opposition in general so far from the ecliptic that her disk does not come into contact with the earth's shadow, and consequently no eclipse takes place The occurrence of the eclipse, therefore depends on the distance of the moon from her node at the time of the opposition, and it results from the computation of the [illegible] the eclipse may take [illegible] If the node and must take place [illegible] the node is not greater than 7°

*Eclipses of the Sun by the Moon* — A solar eclipse is occasioned by the moon's body coming between the spectator and the sun and the [illegible] rays coming from the whole or a [illegible] This phenomenon, like an eclipse of the moon can only happen when the moon is near one of her nodes but a total obscuration does not necessarily take place even when the moon is in the ecliptic at the time of her conjunction for the magnitude and distance of the moon are so related that the apex of her conical shadow sometimes falls short of the earth's surface though at other times it would reach as far as the earth's centre When the umbra extends beyond the earth's surface, its intersection with the surface marks out a circular spot within which no part of the sun's disc is visible and there is a total eclipse For some distance around this spot that is to say within the *penumbra* a part only of the sun will be visible or there will be a partial eclipse When the apex of the shadow does not extend to the earth there will be no total eclipse at any part of the earth but a spectator situated in or nearly in the prolongation of the axis of the cone, will see the whole of the moon on the sun, though not large enough to cover it, that is to say he will witness an *annular* eclipse For the method of calculating eclipses of the sun and moon, see ECLIPSE

*Rotation and Libration of the Moon* — From the observation of the lunar spots, it is ascertained that the moon has a motion of rotation about an axis nearly perpendicular to the plane of her orbit, and, what is very remarkable, the period of rotation is *exactly* equal to that of her sidereal revolution about the earth Hence, the same hemisphere of the moon is always turned towards the earth, but as the rotation is uniform, while the motion of revolution about the earth is sometimes faster and sometimes slower than the mean the line which joins the centres of the earth and moon does not intersect the lunar surface always at the same point but fluctuates a little to the eastward and westward of its mean place whence the spots near the eastern and western borders of the disk alternately disappear and are brought into view This phenomena is called the *libration in longitude* Moreover, as the moon's orbit is inclined to the ecliptic in an angle of 5° 8' 47 9", while the plane of her equator makes with the ecliptic an angle of 1° 30', the axis of rotation is not exactly perpendicular to the plane of the orbit, whence her poles come alternately into view for a small space round the northern and southern borders of the disk This is the *libration in latitude* There is also a *diurnal libration*, occasioned by [illegible] from the surface instead of the [illegible] LIBRATION

*Appearance and Physical Constitution of the Moon* — On looking at the moon with the naked eye, her disk appears diversified [illegible] on being examined with a [illegible] to be mountains and valleys That the whole surface of the moon is covered by such inequalities is evident from the circumstance that the line of separation between the illuminated and dark hemispheres, which, if the surface were even would be a perfect ellipse is at all times extremely ragged, and indented with deep recesses and prominent points The mountains near this line cast behind them long black shadows (like mountains on the earth when the sun is in [illegible] the micrometrical measurement of [illegible] the mountains may be calculated [illegible] Herschel, some of the highest of them exceed 1¾ English miles in perpendicular altitude Tycho, the bright spot in the south-east quarter from which the rays seem to run, is apparently a volcanic crater, 50 miles in diameter and 16,000 feet deep surrounded by broad terraces within, and with a central mountain about 5000 feet high Schroeter has estimated the average height of the lunar mountains to be upwards of 5 English miles, but it is easy to see that the measurement is not susceptible of much accuracy

"The generality of the lunar mountains" says Sir J Herschel, "present a striking uniformity and singularity of aspect They are wonderfully numerous occupying by far the larger portion of the surface, and almost universally of an exactly circular or cup-shaped form, foreshortened, however, into ellipses towards the limb, but the larger have for the most part flat bottoms within, from which rises centrally a small, steep conical hill They offer, in short, in its highest perfection, the true volcanic character as it may be seen in the crater of Vesuvius and in some of the principal ones, decisive marks of volcanic stratification, arising from successive deposits of ejected matter may be clearly traced with powerful telescopes What is moreover, extremely singular in the geology of the moon is, that although nothing having the character of seas can be traced (for the dusky spots which are commonly called seas, when closely examined present appearances incompatible with the supposition of deep water) yet there are large regions perfectly level and apparently of a decided alluvial character" (Astronomy *Cabinet Cyclopædia* p 229)

The moon has no atmosphere, or at least none of sufficient density to refract the rays of light in their passage through it There is consequently no water on her surface and no animal similarly constituted to those which inhabit the earth could subsist there Her surface presents no appearance of vegetation or of variation which can be ascribed to a change of seasons Every thing appears solid desolate and unfit for the support of animal or vegetable life Whether the materials of which the lunar substance is composed are of the same nature as those which compose the earth there are no means of knowing From the effect of the moon's gravitation in producing the nutation of the earth's axis, the mass of the moon is determined to be very nearly 1-80th of the mass of the earth whence as her volume is only 1-49th of the earth's volume it results that her density as compared with the mean density of the earth, is 615, or a little more than one half

MOON'STONE A variety of *adularia*, or resplendent felspar, it occurs massive and crystallized Select specimens are sometimes cut into ring and brooch stones

MOOR An uncultivated surface without trees, and with few grasses or other herbage fit for pasture, and generally containing scattered plants of heath, with a dark peaty soil Moor lands are generally the least fitted for culture of any description of surface not rocky or mountainous Moors are covered with a very thin layer of soft black sterile soil, and the subsoil is generally gravel or retentive ferruginous clay By the destruction of the heath or other bad herbage, and by sowing down with grass seeds they may be improved In many cases, also trees will grow on drained moors, in which case the soil ultimately becomes ameliorated by the fall and decay of the leaves

MOOR in Navigation [illegible] a vessel by two anchors in nearly [illegible] that she rides by either in certain [illegible] by [illegible] in other winds Also to secure a vessel to weights or chains sunk in harbours for the purpose These weights are called [illegible] whole apparatus *moorings*

[illegible] LECTURE See ARCHITECTURE.

MOPLAHS The Mahometan inhabitants of Malabar, descended from Moors and Arabians who have settled on that coast and married Malabar women They are said to form a fourth of the population They are commercial and industrious on the coast, but a furious race in the interior (Forbes, *Oriental Memoirs* p 258)

MORAINE The name given in Switzerland and Savoy to the longitudinal deposits of stony detritus which are found at the bases and along the edges of all the great glaciers The formation of these deposits are explained by Professor Agassiz as follows — The glaciers, it is well known, are continually moving downwards, in consequence, probably, of the introduction of water into their fissures, which, in freezing, expands the mass, and the ice being thus loosened or detached from the rocks below, is continually pressed forward by its own weight

In consequence of this motion the gravel and fragments of rocks which fall upon the glaciers from the sides of the adjacent mountains are accumulated in longitudinal ridges or *moraines* From the existence of such deposits in many places where there are now no glaciers, combined with the polished appearance of the surfaces of the rocks on the sides of valleys, supposed to have been produced by the friction of moving glaciers, Professor Agassiz infers that the extent of glaciers was formerly much greater than it now is, and that they covered the great valley of Switzerland, with the whole chain of the Jura (Agassiz *Etudes sur les Glaciers de la Suisse, Reports 4th British Association for* 1840)

MORAINS See Glaciers

MORANA The old Bohemian goddess of winter and of death the Marzana of Scandinavia A grand yearly festival was celebrated in honour of this goddess in the month of March Her image was conveyed solemnly to the nearest brook or rivulet, and thrown into it amid the rejoicings of the people This festival was called "Das Joden-Austreiben, " and as the words imply, was held of the end of winter and the return of spring (See *Grimm's Deutsche Mythologie* p 116)

MORASS Moor lands saturated with water to such an extent as not to bear the tread of cattle A morass is to a moor what a marsh is to a meadow It is evident that the drainage of morasses and moors, by lessening the evaporation of water from their surfaces, must tend to improve the local climate

MORAVIAN BRETHREN See Herrnhut

MORBIDE'ZZA (Ital) In Painting softness and delicacy of style Its opposite is a style whose lines are harsh and [illegible]

MORDANT A substance used to fix colouring matters upon different stuffs (See Dyeing) Alumina and oxide of iron are the most important mordants

MORDI'LLA (Lat mordeo, *I bite*) A Linnæan genus of Coleopterous insects, the type of a family (*Mordellidæ*) of Latreille's *Heteromerans* distinguished by the general form of the body which is elevated and arched, with the head low, the thorax trapezoid or semicircular, the elytra very short or narrow and pointed at the tips, as well as the abdomen They are distinguished from their [illegible] *Pyrochroidæ* by their extreme [illegible] of their integuments and their tenacious and painful bite The subgenera of the *Mordellidæ* are *Ripiphorus*, *Myodites* *Pelecotoma* *Anaspis*, and *Mordella* proper to the last subgenus are now restricted the species of the present family which have the antennæ of equal thickness throughout and slightly serrated in the males, the eyes not emarginate, and the abdomen terminated by a long point

MORDE'NTI (Ital) In Music a grace in use by the Italian school, which is effected by turning upon a note without using the note below

MO'REL (Germ morchel) The *Morchella esculenta* is one of the few fungi found in this country which may be used as food with safety It occasionally occurs in woods and orchards, whence it finds its way to the markets, but it is of comparatively rare occurrence It has a hollow stalk an inch or two high and a yellowish or greyish ribbed head two or three inches deep

MORE'SQUE (Fr) In Painting, a species of ornamental painting, in which foliage fruits flowers &c are combined, by springing out of each other without the introduction of the human figure, or that of any animals, and receiving its name from having been much used by the Moors, who however, were not the inventors of it

MORGANA'TIC MARRIAGE, or LEFT-HANDED MARRIAGE (Said to be derived from the Gothic word morgjan *to shorten*) A marriage between a man of superior and a woman of inferior rank in which it is stipulated that the latter and her children shall not enjoy the rank or inherit the possessions of her husband Such marriages are not uncommon in the families of sovereign princes, and of the higher nobility in Germany but they are restricted to persons of the most exalted classes

MORGUE (Fr) The name given to a place in many French towns where the bodies of persons found dead are exposed in order to be recognized and owned by their friends The clothes in which they were found are placed near the bodies, for their better identification The Parisian morgue is built on the left bank of the Seine, in one of the most populous [illegible] of the city, and presents one of the [illegible] spectacles to be witnessed anywhere

MORMONS (Gr *μορμων, a mask*) The generic name for the short-winged web footed birds, usually called Puffins, the singular beak of which gives the head the appearance of a grotesque mask The depth of the base of the bill equals that of the entire head, and frequently the length of the bill itself the mandibles are compressed, arched, obliquely channelled, and notched towards the tip The eggs and young birds are sought after and taken in great numbers in the Orkneys and Faroe Isles

MORMYRUS (Gr *μορμυρος* a name given by the Greeks to a fish frequenting lakes and rivers, and probably the *Sparus mormyrus* of Linnæus The name was applied by Latreille to a genus of malacopterygian fishes placed in the Malacopterygian order between the *Esocini* and *Salmonidæ* by Cuvier The *Mormyri* differ from the pikes in little else save in the small size of their mouth, of which the angles are formed by the maxillary bones, and a corresponding modification of the alimentary canal, the intestines being longer, and complicated by two cæca The *Mormyri* are confined to the rivers of Africa, and are reckoned the best-flavoured fishes that are caught in the Nile

MOROCCO (Fr maroquin) A species of goatskin leather, originally imported from the Levant and Barbary states It is extensively used in the binding of books *See* Leather

MO'ROXITE (Lat morus, *the mulberry tree*) A mineralogical name applied to one of the varieties of native phosphate of lime of a mulberry colour

MOROXYLIC ACID An acid discovered by Blaproth combined with lime, in the bark of the *Morus alba*, or white mulberry tree

MO'RPHEUS In Ancient Mythology, the god of dreams, the son of Υπνος or Somnus, who presided over sleep, with whom he is frequently confounded The chief distinction between them appears to be this — Morpheus had the power of assuming only the human shape, while the transformations of Somnus were unlimited He is generally represented as a beautiful youth, with a bunch of poppies in his hand

MO'RPHIA (Lat Morpheus, the god of dreams) The narcotic principle of opium It may be separated from opium in the form of white prismatic crystals almost insoluble in water, but soluble in boiling alcohol, it combines with the acids and forms salts, all of which are powerful sedatives, and have proved of great value as medicines Of these the muriate of morphia is perhaps the best It is composed of about 288 morphia (which is its equivalent) and 37 muriatic acid One of the most characteristic chemical properties of morphia and its salts is that they decompose iodic acid and consequently immediately discolour its aqueous solution The ultimate elements of morphia are carbon, oxygen, hydrogen, and nitrogen

MO'RPHNUS (Gr *μορφνος*, a name applied by Aristotle to the osprey) This term is restricted by Cuvier to a genus of *Accipitres* called eagle-hawks, having wings shorter than the tail but with long and slender tarsi and comparatively feeble toes Some species have the tarsi naked and scutellated, as the *Morphnus guianensis*

MORPHO'LOGY (Gr *μορφη, form*, and *λογος, description*) That department or division of the science of botany which treats of the metamorphosis of organs [illegible] from the comparison of one kind of organ [illegible] that notwithstanding the differences between them there are so many close analogies, and so much identity of structure, as to render it probable that they are all formed upon one common plan, modified according to the purposes for which they are severally destined The leaf which is the most universal of the external organs is taken as the best representation of this type, and with the more reason, because all the other parts are found to have a tendency to assume the organization of a leaf when any disturbing cause interferes with their development According to morphological writers the scale of a leafbud is a rudimentary leaf, the petal is a leaf reduced in size and thinned or coloured, or both, the stamen is a leaf, whose petiole is represented by the filament while the two lobes of the anther are the two sides of its lamina, and the pollen is the disintegrated mesophyll, and so on These conclusions [illegible] At the present day the question is indeed no longer speculative but is decided by the evidence of our eyes, for all those transformations the necessity of which morphologists assumed by mere force of reasoning, have now been witnessed by Schleiden and many others, who have traced the development of the [illegible] from their earliest condition, through all [illegible], up to the period of complete development, and have found that they are all deviations from a common type subsequent to the [illegible]

MORRIS DANCE A peculiar kind of dance practised in the middle ages [illegible] supposed to have been first introduced [illegible] Spain by Edward III, when John of Gaunt returned from that country but few traces of it are found earlier than the times of Henry VIII [illegible] though it was borrowed either from the French or the Flemings In the morris dance bells were fixed to the feet of the performer, and the great art consisted in so ordering the feet as to produce something like concord from the various bells

MORS In Ancient Mythology the daughter of Night without a father, and goddess of death. The most sub-

lime representation of death personified is to be found in the *Paradise Lost*

**MORTA'LITY, BILLS OF** Bills of Mortality are extracts from pa sh register showing the numbers who have died in some fixed period of tim as a year, a month or a week, and hence they are called yearly, monthly, or weekly bills In general, they also contain the numbers of baptisms, and sometimes the numbers of marriages

The keeping of parish registers was begun in England in the year 1538, in consequence of an injunction issued by Lord Cromwell the king's vicegerent in ecclesiastical affairs after the abolition of the papal authority in the kingdom In Germany they appear to have been introduced at a somewhat earlier period, for Sussmilch has given extracts from the Augsburg bills which go back to the year 1501, and they were established in most countries of Europe about the beginning of the seventeenth century

The London bills containing the records of the baptisms and deaths were begun in the year 1592 but were not kept regularly till after the plague which prevailed in 1603, since which time they have continued weekly, and an annual bill has been also regularly published Their value, however, was very little understood nor do they seem to have attracted much notice until 1662, when Graunt published his *Natural and Political Observations on the Bills of Mortality*, a work of great merit, considering the time at which it was written The ages at which the deaths took place were not inserted in the bills till 1728 Throughout the country the registers were kept, generally speaking, with very little care, but the recent act for the registration of births, marriages, and deaths which came into operation in 1836 has introduced an incomparably better system, and as the sex, ages, and causes of death are now recorded the public will soon be in possession of far more authentic information than has yet existed on some of the most in- [illegible] social statistics (See article Mortality [illegible] *Brit*, Preface to the *Population Returns for* 1831, *Annual Reports of the Registrar General of Births, Deaths, and Marriages in England*, 1839, *et seq*)

**MORTA'LITY LAW OF** By this term is usually understood a mathematical relation subsisting among the numbers of persons living at the different ages of life, such that, having given the number of persons living at any assigned age the number of them who remain alive at every subsequent age and consequently the mortality which takes place in the interval will be expressible by that relation It must be obvious that in speaking of a law of this kind we can only have regard to the averages of large numbers In respect of a single individual, or a small number of persons the uncertainty of the duration of life is proverbial, but the case is entirely changed when multitudes are concerned, and there are few classes of contingent events of which the results can be predicted with so little risk of departure from the truth as the average age to which the lives of a considerable number of persons will be prolonged

The circumstances which affect the mean duration of human life depend upon a great number of different causes, as climate, the facility of obtaining subsistence the state of civilization the manner of living progress of medical science, &c all of which vary in different countries and at different times The law of mortality therefore, must vary with these circumstances and consequently, if expressible by any mathematical function it must be one affected by numerical coefficients depending on the particular circumstances and of which the values can only be determined by observation The simplest expression which has been proposed for representing the course of mortality is that which is derived from the celebrated hypothesis of Demoivre, namely that, if a number of individuals be taken in any given year of age the number of deaths which take place among them will be the same every year until the whole are extinct In this hypothesis only one numerical quantity requires to be determined, which is the average extreme age De moivre adopted 86, and his hypothesis may therefore be simply enunciated as follows —Out of 86 infants born 85 will be alive at the end of the first year 84 at the end of the second, and so on to the extremity of life, the decre- [illegible] a considerable number [illegible] life, this hypothesis of equal decrements represents the observed facts with tolerable accuracy and as it affords considerable facilities in various [illegible] it was formerly much used in the computation of life contingencies

If we suppose a straight line to be divided into a number of equal parts representing the ages of human life, and perpendiculars to be drawn through the points of division proportional to the number of survivors at each age out of a given number taken at a previous age a curve line drawn through the extremities of all those perpendiculars will represent the law of mortality as indicated by the observations, and the equation of the curve will be the relation between the [illegible] Now it is possible to draw a [illegible] curve through any number of points, but in the present case this method of proceeding is attended with no advantage, for if the number of points be great, as it necessarily must, the equation is of a high order, and its numerical computation impracticable Lambert, of Berlin who appears to have been the first who exhibited the law of mortality by a curve line constructed a somewhat complicated empirical formula, which represented the mortality observed in London during some part of the last century with considerable accuracy, and which may be adapted to any other set of observations by giving suitable values to its numerical coefficients But the most ingenious attempt which has been made to deduce a formula from *à priori* considerations is contained in a paper by Mr Benjamin Gompertz published in the *Philosophical Transactions for* 1825 Mr Gompertz assumes as a principle that there is a power in human life to resist the effects of disease, or oppose destruction which loses equal proportions of its intensity in successive equal small intervals of time, and from this he derives an expression which gives the number of survivors ($y$) of any number of individuals, taken at any given age, at the end of any number of years ($x$) counted from that age in terms of three constants, which may be determined from observations The formula may be given under this form —

$$\log y = \log l + \text{No whose log is } (\log \log p + x \log q),$$

$l$ $p$, and $q$ being the constants to be determined On [illegible] king the corresponding values [illegible] table, and determining the constants by means of the three equations so formed, the formula is found to agree with the table through all the ages within limits which may be fairly supposed not to exceed the errors of the observations

On account of the multitude of causes which influence the rate of mortality among the inhabitants of a country, it is plain that any formula deduced from *a priori* considerations can only be trusted so far as it is found to agree with experience and therefore for all practical purposes recourse is had to a table showing for each year of age the number of deaths which are observed to take place out of a large number of persons who enter upon that age The ratio of those two numbers is the measure of the probability that an individual entering upon that age will not survive the year and may be assumed as the law of mortality in respect of that age The table may be exhibited under different forms the most usual is a table of decrements which is constructed by supposing a large number of persons as 10 000 for example to start together in the same year of age (the year of birth is usually assumed) and to write down in the same column the number of them who remain alive at the end of each successive year From this the number who die in each year and the chances of surviving a year or any number of years are easily found For some purposes a table of the probabilities of living over a year at each age, or of dying in the course of the year is more convenient, but either form can be readily reduced to the other

The oldest table of mortality we possess is published in the *Philosophical Transactions for* 1693 and was constructed by Halley from the mortuary registers of the town of Breslaw, in Silesia This town was selected, because the number of births having been nearly equal to the number of deaths for some years it might be assumed that the population had remained in a nearly stationary state during that time —an assumption which affords the means of determining the ratio of the number who die at each age to the number who entered upon that age, for it is evident that in a place so circumstanced and supposing also there is no migration the number who survive or complete any year of age within a given period is equal to the sum of the deaths at all the greater ages during the same period For the sake of facilitating calculations from the table he reduced the numbers proportionally to 1000, by which number he represented the infants of one year of age

This method of determining the mortality from the mortuary registers or *bills of mortality*, has been frequently adopted, particularly by Dr Smart, in the formation of a table showing the mortality in the city of London about the middle of the last century, by St Maur, in respect of Paris, and by Dr Price, for the celebrated Northampton table, presently to be described But it is evident that as the population of a large town or district of country can never be absolutely stationary, and as migration must be constantly taking place to a greater or less extent the method is not absolutely correct, and, in fact, the results to which it leads must be attended with great uncertainty In order to obtain accurate results, it is necessary to know the numbers who actually enter upon each year of age, as well as the numbers who die in that age during the period included in the observation, and hence in addition to the mortuary register, an enumeration in each year, or at short intervals,

of the community in the several ages of life, is requisite for the accurate solution of the problem But, although great attention has been given of late years to the statistics of life, in various countries of Europe, it is only in a very few instances that sufficiently accurate data for the construction of a mortality table have been ons embracing indiscriminately the inhabitants Of these few, the principal (if not the only) instances are the observations made in Sweden and Norway, those of Dr Heysham at Carlisle, and more recently by Dr Cleland, at Glasgow

In consequence of the migration which is constantly going on among the inhabitants it is very difficult to obtain with certainty the data necessary for determining the mortality of any town or district, but there are various associations of individuals with respect to which precise data exist Such, for example are the religious houses in Catholic countries, the tontines which were established in different countries of Europe during the last century, the annuitants of the British government, and especially the life assurance companies now become so numerous In all such associations, the numbers who enter upon and die in each year of age can be ascertained with precision from the records of the association, which therefore afford the data requisite for determining the rate of mortality at the different ages, without hypothesis of any kind Tables were thus constructed by Kersseboom from Dutch registers of annuitants, by De Parcieux, from the lists of the nominees in the French tontine, chiefly of 1689 and 1696, and from the mortuary register of the Benedictines, and of the nuns in several convents in Paris, and by Mr Finlaison from six different classes of annuitants in English and Irish tontine Of the assurance offices the Equitable Society and the Amicable Society have published their experience separately, and in 1843 a series of tables was published under the superintendence of a committee of Actuaries exhibiting the law of mortality deduced from the combined experience of seventeen offices, including the two above named

We shall now give a comparative view of the mean duration of life at the different ages computed from some of the best known tables premising a short account of each table

1 *Northampton Table* — This table, which perhaps is better known in this country than any other, on account of its having been adopted by the greater number of the assurance offices as the basis of their tables of premiums was constructed by Dr Price from the bills of mortality from 1735 to 1780 of the parish of All Saints in the city of Northampton It cannot be considered as possessing much authority either on account of the accuracy of the data or the number of lives of which it embraces the history, and the hypotheses made use of in its formation — namely that the number of the inhabitants, and the number of annual deaths remained the same during the forty six years included in the observations, and also that the migrations all took place at the age of twenty years, — tend further to render it of doubtful value It differs from the modern tables in giving a much lower expectation of life at the younger and middle ages, a circumstance which may be in part owing to the improved condition of the labouring classes of the people but probably in a much greater degree to the inaccuracy of the observations (*Price on Reversionary Payments* 4th ed 1783)

2 *Carlisle Table* — This was constructed by Mr Milne, from registers kept by Dr Heysham of the births and deaths which took place in the city of Carlisle and its environs in the nine years from 1779 to 1787, the number of inhabitants having been determined by two enumerations which were made during that interval On account of the accuracy of the data and the skilful manner in which they were made use of this table is of considerable authority, though it probably gives a somewhat too favourable view of the duration of life as experienced of England generally (*Milne's* &c 1815)

3 *Government Tables* — These tables as already mentioned, were computed by Mr Finlaison, from observations of the mortality among the nominees of life annuities granted by the British government Mr Finlaison has given twenty-one tables of the probabilities of life but the recorded facts are contained in only six of them, the by combinations of these six The two subjoined table, for males and females respectively, are deduced from the rate of mortality adopted by the government for determining the values of life annuities (*Finlaison's Report to the Lords of the Treasury* published by order of the House of Commons 1829)

4 *Equitable Society's Table* — This table which was prepared by Mr Arthur Morgan, and published in 1834, exhibits the mortality which took place in the society from its establishment in 1760 to the end of the year 1829 By reason of the great number of lives contained in it, and the certainty of the data, this is a document of great importance It will be seen from the subjoined table that, for ages under fifty, it gives a rather more favourable expectation of life than the government table for males, and agrees nearly with the Carlisle table, but for ages above fifty it gives a less favourable expectation than either of those tables The observations com-

*Table* This table is described *and Sixth Annual Reports of the Registrar General* (1843 and 1845) It is constructed from the returns to parliament of the ages of the population of England in 1841, and of the deaths registered at different ages in that year, and is probably a close approximation to the mean duration of life in this country

For the sake of avoiding decimal points, the numbers in the subjoined table show the mean duration of life for ten individuals or the number of years enjoyed by ten individuals collectively In respect of a single individual, the mean duration of life is the tenth part of the number given in the table

| Age | Northampton | Carlisle | Government (Males) | Government (Females) | Equitable Society | English Life Table |
|---|---|---|---|---|---|---|
| 0 | 252 | 387 | 502 | 555 | | 411 |
| 5 | 408 | 513 | 489 | 542 | | 500 |
| 10 | 398 | 488 | 456 | 511 | 483 | 474 |
| 15 | 365 | 450 | 418 | 472 | 450 | 437 |
| 20 | 334 | 415 | 384 | 440 | 417 | 403 |
| 25 | 309 | 379 | 359 | 408 | 381 | 370 |
| 30 | 283 | 343 | 332 | 376 | 345 | 337 |
| 35 | 257 | 310 | 302 | 343 | 309 | 301 |
| 40 | 231 | 276 | 270 | 311 | 274 | 271 |
| 45 | 205 | 242 | 238 | 278 | 239 | 239 |
| 50 | 180 | 211 | 203 | 244 | 204 | 206 |
| 55 | 156 | 176 | 172 | 208 | 170 | 172 |
| 60 | 132 | 143 | 144 | 173 | 139 | 140 |
| 65 | 109 | 118 | 116 | 140 | 111 | 112 |
| 70 | 86 | 92 | 92 | 110 | 87 | 88 |
| 75 | 65 | 70 | 71 | 85 | 66 | 67 |
| 80 | 48 | 55 | 49 | 65 | 48 | 51 |
| 85 | 34 | 41 | 31 | 48 | 34 | 38 |
| 90 | 24 | 33 | 20 | 28 | 26 | 28 |
| 95 | 8 | 30 | 12 | 16 | 11 | 20 |

There are many questions of great interest respecting the law of mortality which cannot yet be satisfactorily answered from the want of sufficient data The Carlisle table gives only an indication of local mortality, but it may be asked whether the mortality is the same in different parts even of the same country or the same in cities as in rural districts? Now, the government annuitants resided in all different parts of the kingdom, and the same may be said of the members of the Equitable Society though perhaps a majority of the latter were resident in London But the three tables—namely, the Carlisle table the table computed from the government male annuitants and the Equitable Society's table — present a remarkable agreement and so far as their evidence goes, we cannot draw any positive conclusion either in favour of a particular district or a select class of individuals

It seems to be established beyond doubt that the rate of mortality at least in England has undergone a very sensible diminution within a century especially in respect of children and aged people This may be ascribed in some degree to the discovery of vaccination, but more especially to the general diffusion of comfort and the improved mode of living, among the labouring classes of the community

Another question of great importance is, whether the law of mortality is the same for both sexes? In the above table it will be seen that there is a remarkable disparity between the male and female annuitants in favour of the latter This indication of the greater longevity of females is confirmed by the observations of De Parcieux on the monks and nuns in the French convents, of Kersseboom on the Dutch annuitants, of Dr Price, on the mortality at Chester, and also by the tables constructed from the mortality in Sweden, at Montpellier in France and in the cities of Amsterdam and Brussels It is still however, open to doubt whether the superiority shown in the above instances holds generally true Over the whole population of Belgium, the greater part consisting of peasantry and labourers, it is found that the lives of females are shorter than those of males while in the towns the advantage is on the side of the females The combined experience of the seventeen life assurance offices above referred to shows no superiority in the duration of female life

The following table, showing the proportion of deaths to the population in the principal states of Europe, according to the latest observations, is extracted from a paper in the *Revue Encyclopédique* for July and August, 1833 We cannot vouch for its accuracy, but it is probably not far from the truth

| Countries. | Periods or Epochs. | Ratio of Mortality to Population |
|---|---|---|
| Sweden and Norway | 1821–1825 | 1 in 47 |
| [illegible] | 1819 | 1 45 |
| [illegible] | 1826 | 1 44 |
| [illegible] | 1829 | 1 44 |
| [illegible] | 1818—1821 | 1 55 |
| [illegible] | 1827—1828 | 1 38 |
| [illegible] | 1825—1828 | 1 45 |
| Prussia | 1821—1826 | 1 39 |
| Austrian Empire | 1828 | 1 40 |
| France | 1825—1827 | 1 39 |
| Switzerland | 1827—1828 | 1 40 |
| Portugal | 1815—1819 | 1 40 |
| Spain | 1801—1826 | 1 40 |
| Italy | 1822 1828 | 1 30 |
| Greece | 1828 | 1 30 |
| Turkey in Europe | 1828 | 1 30 |
| Northern Europe | | 1 44 |
| Southern Europe | | 1 36 |
| The whole of Europe | | 1 40 |

For an accurate description of the various mortality tables up to the date of its publication the reader is referred to the [illegible] article on the subject, by Mr Milne, in the *Ency Britannica*

MO'RTAR (Dut mortar) In Architecture a cement for the junction of stones and bricks, made of lime sand, and water In the composition of it stone lime is preferable to that burnt from chalk, and river to pit or road sand

MORTAR A short wide piece of ordnance for throwing shells bombs, grape-shot, &c It is the most ancient kind of cannon

MORTAR In Pharmacy a vessel made either of iron stone ware, or glass, &c according to the use to which it is applied in which substances are either pulverized or dissolved by means of a pestle In fine chemical processes recourse is often had to mortars made of agate flint, or porphyry

MO'RTGAGE In Law a mortgage-deed is in effect a conveyance by which a party grants his interest or a portion of it to another with a condition that if a sum of money is paid by a stipulated day the grant shall be void T[illegible] whether of fee s[illegible] rms of the conveyance D[illegible] this estate the mortgagor though in possession is in contemplation of law only tenant-at-will to the mortgagee, and on failure of payment the estate of the mortgagee would become absolute at law But in equity the mortgagee's estate is subject to an *equity of redemption* or right to redeem on the part of the mortgagor and a mortgage is thus redeemable so long as the relation of debtor or creditor appears to subsist between the parties and for twenty years after the last acknowledgment of that relation by the mortgagee unless upon his application the right be previously foreclosed by a decree of the court

MORTIER (Fr) The name given to a cap of state of great antiquity worn by the first kings of France and the form of which is still preserved in the cap worn by the president *de la cour* of Paris

MORTIFICA'TION (Lat mors *death* and facio *I cause*) Local death gangrene When any portion of the body loses its vitality a process of separation takes place between it and the living parts that surround it, and when [illegible] in parts or organs it is necessarily fa[illegible] that attend mortification of the viscera are generally loss of pain, diminution of fever, small sinking pulse hiccup, delirium, cold sweat, and fainting which precedes death

MORTIFICATION in Scottish Law, is nearly synonymous with mortmain in English By an act of 1587 land vested in the church was declared to be given for superstitious purposes, and to belong to the crown, and thus the spoliation of the richly endowed church of that country prior to the Reformation was finally legalized

MO'RTISE (Fr mortaise), in Architecture is the junction of two pieces of wood or other material the cavity cut in one piece being the receiving corresponding portion of the wood of the other, which is called a tenon

MO'RTMAIN In Law, an alienation of lands, tenements, or hereditaments, to any corporation, sole or aggregate, guild, or fraternity The foundation of the statutes of mortmain is Magna Charta, by which it was rendered unlawful for any one to give his lands to a religious house &c in order to take them back again to hold of the same house, which was extended, by interpretation, so as to annul gifts of lands which religious houses did not give back to the donor to his own use, but kept in their own hands after taking A great number of statutes were afterwards passed in order to restrict alienations to religious persons and houses, and various devices formed for the purpose of eluding them, of which the system of uses, which has become in some sort the foundation of our law of real property was one (See REAL PROPERTY, IRISH) But during the whole of this time the king had the power of dispensing with the statutes of mortmain by granting licences of alienation, and this power was confirmed to the crown by stat 7 & 8 W 3 c 37 Alienation to charitable uses are exempted from the statutes of mortmain, but they are subjected to particular forms and solemnities by the last mortmain act, 9 G 2 c 36 The term mortmain is derived from the Latin words mortua manus (*dead hand*), because the lands so alienated are said to fall into a dead hand, i e one incapable of performing the usual services required of tenants

MO'RTUARY In Law, a fee paid to the incumbent of a parish, by custom peculiar to some places, on the death of a parishioner It appears to have been a very ancient usage to present the priest on the solemnization of a funeral, with some personal chattel of the deceased, or a sum of money in lieu of it under the various titles of pecunia sepulchralis, sedatium, in Saxon *soul shot*, &c It had become a legal custom as early as the reign of Henry III, when the reservation of a mortuary appears to have been essential to the validity of a testament of chattels The amount was fixed by 21 H 8 c 6 according to an *ad valorem* taxation of the goods of the deceased Mortuaries (where due by custom) are recoverable in the ecclesiastical courts, and it should appear, since the statute at common law, although such actions have not hitherto been brought

MO'RUS (Lat *the mulberry tree*, Celtic mor, *black*), is a [illegible] genus of plants containing some species valuable [illegible] and others for their fruit The latter is our mulberry tree, *Morus nigra*, whose well known black juicy berries are a favourite autumn production, the former are *M alba philippensis*, and others which constitute the best of all food for silkworms The latter are found occasionally in plantations, but they are too tender to bear our climate well, and cannot be usefully cultivated even in the midland country of England

MOSAIC or MUSAIC (Gr μουσαικον, *polished, elegant*, from μουσα as being *fine or ingenious?*) In Paint[illegible] carefully inlaid upon a ground generally of metal In St Peters at Rome are to be seen some works of this sort on a magnificent scale This art was practised at a very early period and was reintroduced to Italy by the Byzantine Greeks

MOSAIC GOLD Bisulphuret of tin, a yellow flaky substance sometimes employed in ornamental japan work This term has lately been applied to a superior kind of brass and to a yellow alloy of copper, zinc, and gold

MOSAIC WORK In Architecture the inlaying pavements walls &c with small dies of different-coloured stones or glass in regular figures, or to represent historical or other subjects

MOSLEM *See* MUSSULMAN

MOSQUE (Arab medsched) A Mohammedan place of religious worship The principal interior decoration of mosques consists in the lamps which are numerous, [illegible] the floor is covered with carpets [illegible] M[illegible] is denoted by a niche, or by a tablet inscribed with verses of the Koran called the Kebla The principal Arabian and Syrian mosques are most remarkable for their vast quadrangles surrounded with numerous columns, those of the Turks for the elegance of their cupolas The original places of worship of the Arabians were the temples dedicated to the religion of the different nations whom they subdued such, for instance as the temple of Jerusalem the temple of Minerva at Athens and innumerable others in Spain, Asia and Egypt It was not until they had consolidated their power that the Arabians devoted themselves to the cultivation of the arts and gave any indication of that original architectural genius which afterwards displayed itself in the structure of mosques At the entrance of almost every mosque there is a large court planted with bushy trees in the centre of which or under a vestibule paved with marble, are fountains for the prescribed ablutions of the Mussulmans, and to these courts is usually attached a small gallery, on which the apartments of the ministers of religion, &c abut But besides mosques for public worship there are others set apart for the instruction of young men in the science of legislation, and the doctrines of the Koran, and to this class belong the so called *royal* mosques, or *jamis*, of Constantinople Most of these mosques have hospitals for poor, the sick, or deranged persons attached to them Their revenues are often considerable, and are derived chiefly from endowments in landed property The term *mosque* is found, with slight variation, in all European languages The Turkish equivalent is meschit, which is supposed to be [illegible] *foundation*, and [illegible] Ir mosquee, the Germ moschee, the Span mequita, the Ital maschetta, and the Eng mosque *See* MINARET

MO'SSES, in common language, are any minute,

small-leaved Cryptogamic plants Thus club moss is a lycopodium, Iceland and reindeer mosses are lichens, and the numerous species of Jungermannia are all comprehended under the same term But in systematical botany no plants are considered mosses except such as belong to the natural order *Bryaceæ* or *Musci* Such plants are simple-leaved, without spiral vessels or sto- [illegible] or thecæ, covered by a cup or calyptra The structure of the sporangia is as complex as that of the stems and leaves is simple Each sporangium is closed by a lid or operculum, below which is a transverse membrane, closing up the urn left after the fall of the operculum The edge of the urn is furnished with one or more rows of teeth, in all cases some multiple of 4, in the centre is a columella or column, and between the latter and the sides of the urn are the spores It is not a little singular that such plants should have cases called staminidia containing powdery matter, among which are found animalcules, not distinguishable from such as are called spermatic and which swim about freely in water None of [illegible] known use

[illegible] Land abounding in peat moss but not so much saturated with water as to become peat bog, or morass

MOSS-TROOPERS In English and Scottish History those inhabitants of the borders of the respective countries who were banded together in clans and lived by rapine received this denomination from the character of the country over which they 'trooped' in their excursions, These banditti were little heard of after the union of the two crowns but not absolutely suppressed until the union of the kingdoms a century afterwards

MOTES, among the Anglo-Saxons were public courts or conventions of the people assembled for municipal or legislative purposes They were of various kinds, as Wittenagemote Folkmote Burgemote, &c (See these separate articles) *Mote* was a customary service or payment at the mote or court of the lord from which certain persons alone were exempted by charter or other privilege

MOTTET (Ital motetto) In Music a composition consisting of from one to eight parts of a sacred character

MO'THER OF PEARL (Fr nacre de perles Germ perlen mutter) is the hard silvery brilliant internal layer of several kinds of shells particularly oysters which is often variegated with changing purple and azure colours The [illegible] Indian seas alone secrete this coat of [illegible] to render their shells available to the purposes of manufactures The genus of shell fish called *Pentadina* furnishes the finest pearl as well as mother of pearl, it is found in greatest perfection round the coasts of Ceylon near Ormus in the Persian Gulf at Cape Comorin and among some of the Australian seas The brilliant hues of mother of pearl do not depend upon the nature of the substance but upon its structure The microscopic wrinkles or furrows which run across the surface of every shell act upon the reflected light in such a way as to produce the chromatic effect, for Sir David Brewster has shown that if we take with very fine black wax or with the fusible alloy of D Arcet, an impression of mother of pearl it will possess the iridescent appearance Mother of pearl is very delicate to work, but it may be fashioned by saws files, and drills with the aid sometimes of a corrosive acid such as the dilute sulphuric or muriatic and it is polished by colcothar of vitriol (*Ure's Dictionary of Arts &c*)

MO'THER WATER A term applied by chemists to saline solutions from which crystals have been deposited and which when poured off and re evaporated furnish a second crop

MO'TION (Lat motio) In Mechanical Philosophy motion is the change of place, that is of the part of space which the body occupies, or in which it is extended Motion is *real* or *absolute* when the moving body changes its place in absolute space, it is *relative* when the body changes its place only with relation to surrounding bodies, and it [illegible] en the body changes its situation with [illegible] bodies that appear to us to be at rest All the phenomena of motion are derived by mathematical deductions from the three following laws of motion of Newton —

1 A body must continue for ever in a state of rest, or of uniform motion in a straight line, if it be not disturbed by the action of an external cause

2 Every change of motion produced by any external force is proportional to the force impressed and in the direction of the straight line in which the force acts

3 Action and reaction are equal and in contrary directions, that is, equal and contrary changes of motion are produced on bodies which mutually act on each other

For the formula which express the relations between the moving force the spaces passed over, and the times when bodies move in straight lines or curves, with uniform or accelerated velocities, see FORCE AND VELOCITY For elementary illustrations of these laws we refer to Maclaurin's Account of Newton's *Principia*

MOTION (Lat motio) In Painting and Sculpture, the change of place or position which from certain attitudes a figure seems to be making in its representation in a picture It can be only implied from the attitude which prepares the animal for the given change, and differs from *action*, which see Upon motion, in art, depends that life which seems to pervade a picture when executed by a master

MOTION In Music, the manner of beating the measure so as to hasten or retard the pronunciation of the words or notes

MO'TION IN COURT In Law, an occasional application to the court by the parties or their counsel, for the purpose of obtaining some rule or order of court which becomes necessary in the progress of a cause Motions are either of a criminal nature, as motions for an attachment for a misbehaviour, or of a civil nature A motion in the courts of common law is either for a rule absolute, *i e* to take effect immediately, or it is for what is termed a rule nisi or a rule to show cause—*i e* a rule to take effect unless cause be shown against it by a certain day, when, if no cause be shown the rule is made absolute on a second motion Motions are accompanied by affidavits stating the facts on which they are grounded, and generally preceded by a notice to the opposite party

MOTION, QUANTITY OF This term is used by writers on mechanics to denote the product of the mass or moving body by the velocity *See* MOMENTUM

MOTIVE FORCE The force which tends to produce motion It is the same with momentum

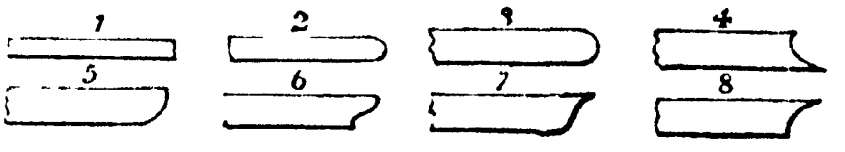
MO'TOR MOVER A term applied by anatomists to certain muscles &c

MO'TTO (Ital) is used to signify a word or sentence added to a device, and when put upon a scroll it is commonly employed as an external ornament of coat armour The use of mottos for this purpose is very ancient The term motto is also applied as a sentence or quotation prefixed to any writing or publication

MOULD Soil composed of decayed vegetable matter in a state of minute division more or less mixed with garden earth The kinds of mould most in use in horticulture are leaf mould formed from the decayed leaves of trees rich mould formed [illegible] dung heath mould found on [illegible] and peat mould, formed of thoroughly decomposed peat In general moulds are distinguished from soils by containing a much greater portion of vegetable matters than of earths

MOULD (Span molde) In Sculpture the matrix or hollowed wrought form into which the liquid or plaster, wax or metal is run in casting works of art

MOU'LDING (Fr moule) In Architecture, the members of an order which are shaped into various curved or flat forms of which there are eight sorts The fillet which is square in profile (1), the astragal (2),




the torus (3) being larger than the astragal, the scotia (4), the echinus (5), or quarter round, the inverted cyma talon, or ogee (6) the cyma, cyma recta, or cymatium (7), and the cavetto or hollow (8)

MOULDING-LOFT A large room in a dockyard in which the several parts of the ship are drawn out in their proper dimensions

MOU'LTING The fall of the plumage of birds It may be either partial or total the complete moult generally takes place annually, the partial moult occurs at the change of plumage to which some species of birds are subject at the breeding season The moult is always accompanied by the development of a new plumage, which may be of a different colour from that which is lost See INDUMENTUM

MOU'NTAIN LIMESTONE A series of limestone strata, the geological position of which is immediately below the coal measures with which they also sometimes alternate See GEOLOGY

MOU'NTAIN MILK A very soft spongy variety of carbonate of lime

MOUNTAIN (Lat mons) In Geography, the term applied to designate the principal elevations on the earth's surface Mountains and hills, say Bakewell, are relative terms with respect to each other, the highest elevations being denominated mountains, and the lower hills In the case of Mont Blanc and Mont Rosa, which are more than 5000 yards high the mountains in Cumberland and North Wales would be called hills, though Snowdon rises more than 1100 yards and Skiddaw and Helvellyn more than 1000 above the level of the sea In England, if hills rise abruptly, [illegible] than 100

yards above the surrounding country, they are generally called mountains *See* GEOLOGY

*Arrangement of Mountains* — Mountains are seldom found insulated or detached sometimes though rarely, they exist in aggregate groups, branching from a common centre, and not externally connected, but most commonly they are extended in ranges or mountain chains, traversing extensive regions A single continuous chain is of rare occurrence in general a number of chains is associated, though there does not seem to be any predominating form of aggregation or direction, at least with reference to the whole surface of the globe In some instances there is a principal or central chain, with secondary groups branching off from it, in others, several chains are associated to no one of which the rest can be said to be subordinate and in others again, as the Cor[illegible] each other, all running [illegible] been surmised that the direction of the principal mountain chains is that of the line of greatest length of the continent or region to which they belong, but this idea, though rendered plausible by some remarkable instances, can scarcely be said to be borne out by the facts In a very general view it may be stated that the predominating direction of the great mountain chains of the old world is from west to east, while those of America range from north to south *See* GEOGRAPHY

Another generalization which seems to be liable to fewer exceptions, is that mountain chains or ranges present the steepest acclivities on the sides nearest the sea Thus [illegible] the shores [illegible] present their precipitous sides to the Euxine and those of Caucasus and Mozanderan to the Caspian The western Ghauts face the Indian ocean and the whole range of the Cordilleras, with their prolongation to the Arctic ocean presents its escarpments to the great Pacific On the hypothesis that the continents and mountain masses have been upheaved by a force acting in the interior of the earth these peculiarities of configuration afford scope for curious speculation respecting the prodigious efficacy of the subterranean agencies through which the crust of the earth has assumed its actual form

*Altitude of Mountains* — On taking a general view of the surface of the earth the elevation of the loftiest mountain chains, enormous as it appears to be is insignificant in comparison of the dimensions of the globe The radius of the earth is nearly 4000 miles, while the height of the highest peaks above the mean level scarcely exceeds 5 miles [illegible] to 800, so that on a 16-inch globe the corresponding inequality would only amount to the hundredth part of an inch Mountains, however, exercise a very great influence on the climate of a country and hence it is of great importance in geography to ascertain their altitude and configuration The methods by which the measurement is effected have been explained under the term HEIGHTS, MEASUREMENT OF

The following are the altitudes of a few of the most elevated peaks in the four quarters of the world The most extensive list which we have seen is given in *Gehler's Physicalisches Lexicon* art 'Hohenpunckte' where the authorities for the different measures are also stated

*Europe* — Mont Blanc, Alps, 15 781 ft Mont Rosa, 15 555 ft, Ortler Spitze, Tyrol [illegible] 13,720 ft, St Gothard Pass, [illegible] St Bernard 8,040 ft, Mont Perdu, Pyrenees 11 283 ft, Le Pic Blanc, do, 10,205 ft, Monte Corno, Appennines 9,523 ft Lomnitz, Peak of Carpathians [illegible] Parnassus, 8,000 ft, Mulahacen Sierra Nevada Spain 11 673 ft, Ætna Sicily, 10 963 ft, Snechattan Norway 8,115 ft, Snaefell Iceland 6,860 ft, Helvellyn, England, 3,055 ft, Ben Macdui, Scotland, 4,418 ft, Macgillicuddy's Reeks, Ireland, 3 410

*Asia* — Dhawalagiri Himalaya, 26 862 ft, Jamautri, do [illegible], [illegible], Caucasus, 18 500 ft, Mouna Kaah, Sandwich Islands, 18,400 ft, Demavend, Mazanderan, 14,700 ft, Soomoonang Thibet, 14 500 ft, Ophir, Sumatra, 13 842 ft, Italitzkoi, Altai, 10,735 ft, Ararat [illegible], Lebanon, 9520 ft, Sinai, 5 000 ft, [illegible]

*Africa* — [illegible] Geesh 15,000 ft, Peak of Teneriffe [illegible] 11,400 ft, Niewveldt, Cape of [illegible], [illegible] Gros Morne, Isle of Bourbon, 9,600 ft, Trigo, Canaries, 7,400 ft, Tuivo, Madeira, 5,162

*America* — Sorata [illegible] Illimani, Peru, 21 490 ft, Chimborazo [illegible] ft, Antisana, 19,150 ft, Catopaxi, [illegible] ft, [illegible] de Popocatepti, Mexico, 17,716 ft, Pos[illegible], [illegible] Nevado de Mexico, 15 700 ft, Lake of [illegible], City of Rio Bamba, 10,800 ft, White Mountains, Massachusetts, 6,230 ft

MOURNING may be defined generally as an external indication or manifestation of grief for the death of a friend or relative Certain usages in regard to mourning [illegible] nations, barbarous and [illegible] but except in the grief of which they are intended to be the symbol [illegible] flowers marks of uncleanliness Thus the Chinese mourn in white, the Turks blue or in violet, the Egyptians in yellow, the Ethiopians in grey In ancient Rome and Lacedæmon the ladies mourned in white In Eastern countries it was regarded as a peculiar mark of affliction to cut the hair, and at Rome, on the contrary, to let it grow The Greeks adopted the Eastern practice, and bestrewed the tombs of those for whom they mourned with their hair The peculiarities of the ancient Jews in time of mourning are well known, and the various customs of which so minute an account is contained in the Pentateuch are still maintained on these occasions by their descendants From the commencement of the Christian era the general colour adopted for mourning throughout Europe has been, with very few exceptions, black The kings of France mourn in violet Tue duration of the period of mourning differs in different countries but in all is usually regulated by the nearness of relationship between the survivors and the deceased Thus in France the period prescribed by usage is, for a husband, one year and six weeks, for a father, mother, wife, or child, six months, for a grandchild four months and a half, for a brother or sister two months, for an uncle or aunt three weeks, for a cousin-german fifteen days, &c The rules that determine the forms and duration of *court mourning* emanate from the sovereign, but these do not extend beyond the court, and though on the demise of the crown or a relation it is expected, in the language of the *Gazette*, that the people "put themselves into decent mourning," this is seldom generally complied with except when the character of the deceased has been such as to secure wide popularity (The art 'Deuil' in the *Encyclopédie des Gens du Monde*, gives a very complete view of the chief modes of mourning in use in ancient and modern times) *See* SEPULTURE RITES OF

MOUSE (Lat mus probably from the Greek *μυειν, to hide*) The pretty but annoying little Rodent quadruped which infests human dwellings and granaries is usually understood by this word, the other small species of the genus *Mus* being distinguished by some prefix as harvest mouse field mouse, and the larger species of the same genus being termed rats (For the generic characters of the mouse see MUS) The common mouse, like the rest of the genus and indeed the whole of its order is remarkable for its fecundity, it produces ordinarily five or six young ones at a birth and this several times in the course of the year In a fortnight the young are able to leave the mother and assume an independent existence and these are soon [illegible] able to reproduce The harvest mouse (*Mus messorius*) is the smallest of known mammals the length of the head and body is two inches and a half Its nest is beautifully and elaborately constructed of the panicles and leaves of three stems of the common reed interwoven [illegible] forming a roundish ball suspended on the [illegible] at a height of about five inches from the ground The field mouse is about the size of the house mouse but is distinguished by its larger eyes and ears Many small mouse-like quadrupeds are commonly termed 'mice' which really belong to a different genus, or even order, as the dormouse the field vole, the shrew, &c

MOUSE In Naval Affairs a hump or knot worked on a rope to prevent a noose from slipping

MOUTH (Sax muð) In Architecture, the same as cavetto which see

MOVEABLE FEASTS Certain festivals held in commemoration of different events recorded in the Gospels and the Acts of the Apostles and connected with the personal circumstances of Christ during the last year of his earthly life and after his death As they are reckoned backward and forward from his resurrection and as the celebration of that day depends on the time of new moon which varies at different times through the space of a month, these dependent festivals also vary in the same way Easter is always the first Sunday after the first new moon after the 21st of March, and from this all the others are reckoned for each year

MOVEMENT The train of wheel work of a clock or watch *See* HOROLOGY

MOVEMENT In Politics, an expression that has been adopted of late years into the political vocabulary of most European nations, signifying that party in a state whose principles consist in a restless endeavour to obtain such concessions in favour of popular rights as will ultimately place the chief functions of government in the hands of the people It is opposed to the Conservative party or the *parti de resistance*

MOW A mass of corn in the sheaf, built up in one end of the barn preparatory to being threshed

MOWING The act of cutting down grass herbage, or corn with a scythe Mown grass, or herbage, is either given to horses and cattle in a green state, or dried and

stack [illegible] they [illegible] for separating the corn or pulse from the straw or haum by threshing

MO'XA A soft woolly substance made in Japan from the leaves of the *Artemisia Chinensis*, or Chinese mugworts It is used as an actual [illegible] a small cone of it upon the skin and [illegible] when it burns down to the part and makes a sore, which is kept open if requisite

MOYA Mud poured out from volcanos

MUCI'VORA (Lat *mucus*, and *voro, I devour*) A name applied to [illegible] insects, comprehending those which feed on the mucus or other juices of plants or [illegible] bodies

MUCK, [illegible] A vulgar phrase which has been adopted into the English language to signify an indiscriminate attack upon friends and enemies, as in the well-known verse,

Who runs a *muck*, and tilts at all he meets

This expression is derived from the Javan word amok, which means *to kill*, the inhabitants of Java and many other of the Asiatic islands being remarkable for an irresistible phrenzy resulting from a desire of vengeance, which leads them to aim at indiscriminate destruction and thus to subject themselves to be treated like wild beasts which it is impossible to take alive These fits of desperation were long considered peculiar to the class of slaves in the islands above mentioned but there are many instances on record where whole villages and even armies, have under the influence of a *mok* devoted themselves to inevitable destruction to avenge an injury or an insult The accounts of the wars of the Javans says Raffles, in his *History of Java* as well as of the Malays abound with instances of warriors running *amok*, of combatants giving up all idea of preserving their own lives rushing on the enemy committing indiscriminate slaughter and never surrendering themselves alive The cause of these fits of desperation has been attributed to an intemperate indulgence in opium-eating

MU'COUS MEMBRANE The membranous lining of the canals and cavities of the body which are exposed to the contact of air or other inorganic substances The basis of this membrane is compact cellular tissue not gelatinous or adipose and having a peculiar cuticular covering beset in some cases with abundant nervous papillæ in others with the orifices of secretory glands

MU'CUS (Lat) The secretion of the mucous membranes the most characteristic of which is that from the nasal membrane Mucus is viscid and acquires apparent fluidity in water without being actually dissolved, but gives a ropiness to it when present to a less amount than 1 per cent With pure water of the temperature of 95° [illegible] in a few hours, but if the apparatus [illegible] the mucus remains upon the paper and gradually thickens It may be repeatedly dried and moistened without material change of properties, it, however, becomes less transparent, yellow [illegible] and on cooling is found to retain its former characters When dried it is yellow and translucent, and subjected to distillation it yields carbonate of ammonia and empyreumatic oil, and phosphate and carbonate of lime and carbonate of soda are found in the ash It is soluble in dilute sulphuric acid, and blackened by the concentrated acid, it is not soluble in acetic acid, but yields but a trace of albumen According to Henle mucus consists of the scales of the epithelium which covers the open cavities of the body This epithelium or cuticle consists of minute cells of various forms, which are continually wearing off and being renovated, it thus yields scales which mix with the watery secretion and constitute mucus

MU'DAR The Indian name of *Calotropis gigantea* a plant of the Asclepiadaceous order, a substance used medicinally in that country, [illegible] ofulous cases but not admitted into [illegible] of Europe It gives its name to *mudarine* a peculiar chemical principle, having the singular property of softening by [illegible]

MUEZZIN Muezzin [illegible] general appellation of those officers, or clerks of the mosques whose duty it is to proclaim the ezan or summons to prayers, at the five canonical hours viz at dawn, noon 4 o'clock P M, sunset, and nightfall

MUFFLE An arched vessel with a flat bottom in which substances may be exposed to a red heat without coming [illegible] the fuel *See* ASSAYING

MUFTI The Turkish title of a doctor of the law of the Koran, derived from *fetvas*, a rescript or answer to a question of law addressed to the competent authority, which fetvas it is the province of the mufti to issue The mufti of Constantinople, or Sheikh ul-Islam, is the chief functionary of the Turkish church and represents the sultan in spiritual matters, as the grand vizier does in temporal

MUGGLETO'NIANS A sect of Christians who sprung up in England in 1561, and derived their name from Muggleton with an associate [illegible] the two last and [illegible] asserted that they had power to save or to ruin in a future state whomsoever they pleased Notwithstanding the absurdity of their pretensions they obtained many adherents and the belief in their inspiration has been maintained though by a comparatively insignificant number from the period of their first promulgating their opinions down to the present time A collection of the works of Muggleton and Reeves, together with some Muggletonian tracts, was published in 3 vols 4to in 1764 In these the reader will find the singular doctrines of this sect fully, but, as appears to us very unintelligibly set forth In the religious controversy to which the promulgation of their doctrines gave rise their chief opponents were the Quakers and amongst these were George Fox and William Penn.

MUGILOIDS [illegible] *a mullet*) A family of Acanthopterygian fishes in the system of Cuvier, characterized by having an almost cylindrical body covered with large scales, and furnished with two separate dorsals, the first of which has but four spinous rays The mouth is either edentulous, or is provided with teeth of extremely minute size This family includes the genera *Mugil* [illegible] it is included in the Cyclostomiz

MULA'TTO A term in general use in American countries, in which there exists a mixed population of different races and colours, for the offspring of a union between a white and a negro

In our West Indian possessions the offspring of a white and a mulatto is called a *quadroon*, or one quarter black, of a white and quadroon a *muster*, or one eighth black, of a white and muster a *mustafina* or one sixteenth black, after which they are said to be *whitewashed* and are considered as Europeans On the other hand the offspring of a mulatto and a negro is called a *cabre*, of a cabre and negro a *griffe*, and generally speaking after this there is no distinctive appellation but negro All this is sufficiently simple, but in the Spanish and Portuguese colonial possessions the intermixture of Europeans with negroes mulattoes &c, and these again with other classes, has given rise to a multiplicity of denominations sufficiently vague and indefinite even in these languages, but wholly untranslateable into English It must be admitted, however that great ingenuity has been displayed in tracing the amount of European and negro blood that flows in the veins of the mixed races, as the following list of terms (which might be considerably augmented) will prove —*Zambi*, quatralvi, tresalvi, saltatras, coyote zambaigi cambusos giveros, puchuelos albarassados barrinos &c All these again may be multiplied in arithmetical progression, thus forming a host of modifications, each, however, retaining more or less his original characteristics in proportion to the relation in which he stands to his original stock

In Spain, the term Mulatto has been employed to designate persons having a tincture of Moorish blood

MU'LBERRY The so called paper mulberry is the *Broussonetia papyrifera* and not a morus, its tenacious pliable inner bark forming a valuable material for the dress of the South Sea Islanders and Chinese The yellow dye wood called fustick is the produce of another species of this genus, the *Broussonetia tinctoria* *See* MORUS

MU'LBERRY CALCULUS An urinary concretion consisting chiefly or entirely of oxalate of lime Many of these calculi in form and colour somewhat resemble the fruit of the mulberry

MULCH Straw or litter half rotten In Horticulture when this material is applied round the roots or stems of plants to protect them from the drought or from frost, they are said to be mulched

MULL A term used in Scotland almost synonymously with Cape which see, and [illegible] promontories projecting portions of the island, as the Mull of Galloway, of Cantyre &c

MU'LLAS The priests of Tartary are so called They form one of the three grand classes into which the Tartars are divided, the other two being the *murzas* or nobility and the peasantry Their chief duty consists in reading the Koran but their stock of knowledge is generally so scanty, that they are seldom able to interpret the Arabic in which the office of the mosque is performed The village mullas are generally decently behaved and respectable men, a little too much given to sell charms for the ague but living for the most part among their neighbours a quiet and charitable life, the arbitrators as well as curates of their sequestered valleys, and frequently possessing, in addition to these weighty charges, the sinecure office of parish schoolmaster" (*Quart Rev* vol xxix p 129) The Tartar *mulla* and the Persian *mollah* (which see) have evidently a common origin, but the [illegible] wholly distinct

MU'LLET, in Heraldry, represents the rowel of a

spur In English blazonry it is depicted of five points in French of six It is used as the filial distinction of the third son *See* DIFFERENCE

MULLET The name of the fishes of the genus *Mugil*, which in addition to the family characters of the Mugiloids, have the middle of the under jaw produced into an elevated angular point, adapted, when the mouth is closed, to a corresponding groove in the upper jaw, the number of the branchiostegous rays is six Of this genus there are three British species, viz the grey mullet (*Mugil capito* Cuv ) the thick lipped mullet (*Mugil chelo* Cuv ) and the short mullet *Mugil curtus* Yarrell of these the first species is the least rare The red mullets (*Mullus surmuletus*, Cuv , and *Mullus barbatus*, Linn ) belong to a different family of fishes the former of these species was in high repute [illegible] by the ancient Romans and on occasions of extravagant prices were given when it had attained an unusually large size

MU'LLION, or MANNON In Architecture, the upright post or bar dividing the lights in a window

MULTANGULAR FIGURES or POLYGONS MULTILATERAL FIGURES Rectilinear figures of more than four sides, so called from the number of its angular points, as a pentagon, hexagon decagon &c which have five, six, ten sides or angles respectively

MU'LTIARTI'CULATE (Lat multus articulus *a joint*) in Zoology, is applied to the antennæ of insects, and to the legs of Crustaceans and Cirripeds when they are composed of a great number of joints, also to bivalve shells which have numerous teeth in the hinge

MULTICARI'NATE (Lat multus carina *a keel*) in Conchology, is applied to a shell which is traversed by many keel like ridges as the *Fusus multicarinatus*, *Turbinella multicarinata*

MULTIDE'NTATE (Lat multus, dens *a tooth*) In Zoology, when a part is armed with many teeth or tooth-like processes A family of Nereids is hence termed *Multidentatæ* by De Blainville, on account of the structure of their horny jaws

MULTILO'CULAR (Lat multus, loculus *a lodge*) In Conchology this term is applied to those shells which, like the nautilus, have their cavity divided into many chambers

MULTINO'MIAL (Lat multus nomen *name*) In Algebra, an expression consisting of several terms (more than two) which are connected by the signs of addition or subtraction, + or — Sometimes it is called a polynomial, and in modern works, after the French writers, a *polynom*

MULTINOMIAL THEOREM A theorem discovered by Demoivre for forming the numeral co-efficients which arise in raising any multinomial to any given power without the trouble of actual involution The binomial theorem of Newton is a particular case of this, viz that in which the number of terms is only two

MU'LTIPLE (Lat multiplex) Any quantity which contains another an exact number of times without a remainder is a *multiple* of the latter, and the latter is a *submultiple* or part of the former

MULTIPLE POINTS In Analytical Geometry when two or more branches of a curve pass through the same point it is called a multiple point

MULTIPLE VALUES, in Algebra signify symbols which fulfil the algebraical conditions of a problem when several different values are given them, as the roots of an equation certain functions of an arc or angle &c

MU'LTIPLICA'ND, in Multiplication is the number or quantity that is to be repeated the number of times denoted by the multiplier

MULTIPLICA'TION In Arithmetic, an abbreviated process by which, when a number is to be repeated several times, a result equal to the sum arising from all the repetitions is obtained (*See* ARITHMETIC and FRACTIONS ) A considerable abbreviation of this is effected by the use of logarithms (*see* LOGARITHMS), and other methods of shortening the work or lessening the degree of attention requisite in performing it have at different times been devised, as Napier's rods and the logarithmic slide rule of Gunter *See* NAPIER'S RODS

MULTISPI'RAL (Lat multus, spira *a spiral turn*) In Conchology, this term is applied to those operculs of univalve shells which exhibit very numerous and narrow spirals from the centre

MULTISTRIATE (Lat multus, stria *a streak*) In Zoology, when an animal or part is marked with many streaks

MULTIVA'LVE (Lat multus, valva, *a valve*) In Conchology, when a shell consists of several calcareous pieces as that of the chiton or barnacle

MU'LTOCA The name given to the code of laws by which the Turkish empire is governed, consisting of the precepts contained in the Koran, the oral injunctions of Mohammed, and the decisions of the early caliphs and doctors It relates to every subject of life, and comprises various matters appertaining to government, the sultan being the sole judge of its application to particular cases (*See* SULTAN, VIZIR See also *Edin Review*, vol x p 259 )

MULTU'NGULATE (Lat multus, ungula, *a hoof*) In Mammalogy, when a quadruped has the hoof divided into more than two parts corresponding with three or more digits, as the elephant, rhinoceros, &c Ray so denominated a family of hooted quadrupeds corresponding with the *Polyschides* of Aristotle

MUMMIFORM (Lat mumia, *a mummy*, forma, *form* In Entomology the nymphs of certain Lepidoptera are so called which resemble an Egyptian mummy

MU'MMY (Arab mumia, from mum, *wax*) The name given to the dead bodies of men or animals which are by any means preserved in a dry state from the process of putrefaction Mummies have usually been divided into classes — the natural produced by burying in peculiar dry soils or atmosphere, which permit the drying of the animal tissues to be effected with such rapidity that the body is preserved, the latter embracing the various means that have been employed from the earliest ages to preserve dead bodies from corruption Of the former or natural class of mummies some well known instances are to be found in the vaults of several Continental churches, particularly at Strasburg, Toulouse and Bordeaux

The *art* of embalming owes its origin to the extreme veneration with which the ancient Egyptians regarded the corpses of their relatives and was practised with such success that at the lapse of 3000 years the mummies found in the numerous catacombs of Egypt are still objects of admiration But it was not to the dead bodies of the human species alone that the ancient Egyptians restricted their reverence, they practised embalming also on all the animals which their religion held sacred and of these upwards of fifty different species have been found embalmed

The art of embalming was practised also to a considerable extent by the ancient Jews, Greeks, and Romans though it never attained such celebrity or perfection among them as among the people from whom it was borrowed It was also adopted as a national custom by the Guanches the ancient inhabitants of the Canary Islands a full account of which is to be found in the *Essai sur les Isles Fortunées* by M Bory de St Vincent

The account which Herodotus has left us of the Egyptian process of embalming is so minute and has besides been so amply confirmed in the most essential particulars not only by the subsequent writers of antiquity, but in still more recent times (see the *Memoir* of M de Rouyer) that we cannot refrain from embodying it in our pages There are says he, persons resident in Egypt who make this art their profession When a dead body is brought to them they show the bearers three wooden models of mummies imitated in painting, the most elaborate of which are said to be of him (Osiris) whose name I do not think it right to mention on this occasion The second which they show is simpler and less expensive, and the third is the cheapest of all They then demand of the bearers which model they wish to be adopted, and the latter having decided upon the price, depart The most expensive preparation is as follows — First they extract the brain through the nostrils by means of a hooked iron instrument — partly by pulling it out, and partly by the infusion of drugs They then with a sharp Ethiopian stone make an incision in the side in order to extract all the viscera which they wash with palm wine and purify with pulverized perfumes Having next filled the belly with pure ground myrrh cassia, and all other odoriferous herbs except frankincense, they sew it up, and rubbing the whole corpse with natron bury it for 70 days — a longer period not being admissible At the expiration of the 70 days they wrap the whole corpse in bandages of fine linen and smear it all over with gum, which the Egyptians are in the habit of using instead of glue The friends of the deceased, on again receiving the body have a wooden case made in the form of a human figure, in which they place it, and having shut it up deposit it in a sepulchral building, setting it upright against the wall

For those again who, on account of the great expense of this mode of embalming, adopt the middle course the bodies are thus prepared — They fill all the intestines with cedar oil, without either cutting into the body or extracting the viscera, and, taking measures to prevent the egress of the injected liquid they salt the body for the prescribed number of days The cedar oil is then taken out, and such is the power with which it operates that it brings with it the bowels and all the viscera in a state of dissolution The natron also destroys the flesh of the body, leaving only the skin and the bones The body is then returned

The third mode of embalming is that practised on the poor In this case they inject into the body a mixture of salt and water, wrap it up in natron for 70 days and then deliver it to the relatives (*Herod* b 2 c 186 )

It was long a matter of uncertainty what became of the intestines after they had been removed from the body of those embalmed according to the first process Porphyry and Plutarch have both asserted that they were thrown into the Nile, but modern discoveries in the tombs leave no doubt of the fact that they were embalmed separately, and deposited in four vases in the coffin (See *Sir G Wilkinson's Manners and Customs of the Ancient Egyptians*, vol ii p 467 2d Series)

Diodorus mentions three different classes of persons who assisted in preparing the body for the funeral the scribe, who regulated the incision in the side, the *paraschistes** or cutter, and the embalmers To these may be added the undertakers who wrapped the body in bandages, and who had workmen in their employment to make the cases in which it was deposited Many different trades and branches of art were constantly called upon to supply the undertakers with those things required for funereal purposes as the painters of mummy cases, those who made images of stone, porcelain, wood, and other materials, the manufacturers of alabaster, earthenware, and bronze vases, those who worked in ivory, the leather cutters, and many others

With regard to the question, when the custom of embalming the body ceased in Egypt some are of opinion that it ceased at an early time, when Egypt became a Roman province But this has been fully disproved by modern discoveries, and it not only appears that the early Christians embalmed their dead, but according to St Augustine, mummies were made in his time at the end of the 5th century The origin of this opinion is perhaps to be sought for in the circumstance that at the period of the Roman invasion of Egypt the custom may not have been universal, and Sir G Wilkinson maintains that it in all probability gradually fell into disuse rather than that it was suddenly abandoned from any accidental cause connected with change of custom, or from religious scruple

Since the commencement of the present century the attention of the learned in the chief countries of Europe has been particularly directed to the subject of embalming the dead and the researches of numerous travellers from Belzoni downwards to Sir G Wilkinson aided by the scientific manipulations of Pettigrew and others have cleared up many points that were formerly obscure in reference to this art, which was so general in ancient, though wholly unknown in modern Egypt The following observations, borrowed from *Dr Nuttall's Classical and [illegible] Dictionary* &c, will at once exhibit briefly the state in which the mummies are found at the present day and serve as an appropriate commentary on the description of the process of embalming as detailed above The practice of embalming upon the immense scale of the population of a country such as Egypt involves a problem of the highest interest If to those numberless pits and catacombs of human corpses are also conjoined the mummies of the ibis dog ape cat and crocodile, the bull Mnevis Apis and Isis, the ram the fox and horned asp, in short of every reptile of the land, — we are lost in surprise and amazement how such a process could be established, and if by resins drugs or spices, from whence such profuse quantities could be procured and supplied These bodies also are often enveloped in silks and bandages of stained linen of surprising [illegible] 1000 yards in length [illegible] nted with gilding as fresh as when first laid on, with pieces of coloured glass imitative of the finest gems evidencing their knowledge of staining and cutting them in a manner which merits notice, as well as their enamels also All these ornaments found around the mummies are highly preserved, and as well as the sycamore chests resist all the injuries of time, and subsist fresh and perfect for the examination of the curious They usually have the Nubian cast of countenance, the outline figure traced in black, and the colours, four in number — blue red yellow and green — laid on without any mixture of shading but altogether forming a composition of very considerable interest These chests usually have within them small scarabæi or the idols of Isis and other deities in clay and coloured glass and beautiful enamels One scarabeus mentioned in *Greaves's Pyramidographia*, was of magnet which although 3000 years since it was taken from the rock, its natural bed, still retained its attractive magnetic virtue The recent discoveries of M Belzoni add also to our stock of information upon the articles of the wrappers and prove in this also the science and the labour of their embalming, by evincing that there were distinct modes of preservation and of envelopes for every caste, — that of the priesthood particularly with a scrupulosity of minute detail that astonishes and marks their high privileges Upon examining mummies that have been brought to Europe, a decided similarity of ornament is observable: the better-conditioned being covered with glass ornaments, cut as precious stones, and disposed with the [illegible] of colours, and offering the same [illegible] other mummies that are painted, [illegible] ornaments which were costly were preserved for principal personages, while the inferior classes contented themselves with tracing the decorations in paintings

It has been frequently maintained that the doctrine of metempsychosis formed part of the ancient Egyptian creed, but it would seem that the practice of embalming the dead is wholly irreconcileable with such a doctrine. Others have explained this Egyptian usage as if it proceeded from a belief in materialism, but it can surely never be argued that unbelievers in the immortality of the soul would be most anxious to guard against the dissolution of the body On the contrary, as Schlegel has well observed, this usage seems rather to set forth an indistinct feeling that this apparently dead matter is still important, — some mistaken and imperfect presentiment that the bond between the soul and matter is not altogether dissolved, and shall yet one day be restored, — and that even this matter shall have its portion in immortality and [illegible]

MUMPS [illegible] applied to inflammation of the [illegible] the [illegible] by fever or constitutional symptoms, but is occasionally translated to other glandular parts A gentle dose of physic and the application of a piece of flannel dipped in warm salt water or in solution of acetate of ammonia, is generally all the treatment required From the way in which this complaint sometimes spreads in families or schools, there is some reason to believe it to be contagious or infectious

MUNDIC A Cornish name for iron pyrites

MUNDIFICANT (Lat mundare *to cleanse*) A term applied in old pharmacy to certain healing and [illegible] ointments and plasters

MUNICIPAL, MUNICIPALITY The word *municeps*, in the language of early Roman jurisprudence, signified a person capable of holding an office or dignity (from munus or munium, *an office*, and capio, *I take*) It was appropriated in its more particular meaning to those who by the constitution of Rome, were admissible to certain privileges and honours, but not to the right of suffrage or magistracy, in consequence of not being full citizens These were the strangers who in various ways became incorporated with the Roman people without acquiring the right of citizenship The jurisconsult Paulus (as cited by Festus) notices three sorts of municipes — 1 Free strangers settled in Rome, 2. Citizens of commonwealths which became absorbed in that of Rome by conquest or submission (quarum civitas universa in civitatem Romanam venit) such were Aricia, Cere, Anagnia, 3 Citizens of allied commonwealths, who retained their citizenship at home while at the same time they became municipes of Rome such were Tibur, Pisa, Arpinum It is plain that this last is the sense in which the citizen of one state was said to be municeps of another Towns of the last two descriptions (if the passage of Paulus is correctly understood) were probably comprehended by the Romans under the title of *municipia*, *i e* towns which possessed their own rights, and the burgesses of which were also municipes of Rome Such burgesses often acquired full Roman citizenship and even dignity but seem to have been always (in the republican times) regarded as of recent and comparatively ignoble franchise as in the passage of Juvenal respecting Cicero (ignobilis et modo Romæ municipalis eques), *i e* one coming from the municipium of Arpinum By later writers, municipia are sometimes confounded with colonies The word municipal and its derivatives have passed into modern usage in two different senses 1 The local government of a small district especially of a town and particularly if elective, is termed a [illegible] such are municipal corporations in England Every Latin municipium had its own customary law (*jus municipale*). Hence with later jurists municipal law came to signify the law of particular towns, districts, and provinces In this latter sense the customs of the French cities and provinces were called municipal laws And among modern publicists the word has received a still greater extension, the positive law of [illegible] country (in opposition both to natural or moral law and to the law of nations) being often called its municipal law The same term is also sometimes used rather vaguely in contradistinction to the constitutional or political law of a state, as where crimes are divided into offences against the state and municipal offences

MUNIMENTS A common name, in legal phraseology, for deeds, charters, &c, chiefly those belonging to public bodies [illegible] ecclesiastical corporations have generally a "muniment room" in which these are kept

* The office of *paraschistes*, or dissector, was held in infamy "As [illegible]

Derived from Lat murena *an eel*, because, as it is said, they [illegible]

MURÆNOIDS (Lat murena *a species of eel*) The name of a family of Apodal fishes, including the true eels (*Anguilla*) and the eels without pectoral fins (*Muræna*) The fishes of the latter genus are more voracious and have their jaws armed with more formidable teeth than the *Anguillæ* One species (*Muræna Helena*) was much esteemed by the ancients, who fattened it in ponds expressly constructed for the purpose The history of Vædius Pollio, who caused his transgressing slaves to be flung into these ponds as food for the *Murænæ*, is well known

MURAL ARC, or ARCH In [illegible] segment of a large circle fixed [illegible] wall of an observatory for the measurement of the meridional altitudes or zenith distances of the heavenly bodies

MURAL CIRCLE, MURAL QUADRANT, in Astronomy, is an instrument, generally of a large size attached to a stone wall or pier of solid masonry and fixed in the meridian for the purpose of measuring the distances of stars from the pole or the zenith The first mural quadrant, or rather arch, used at Greenwich, was erected by Flamsteed in 1689, and divided by Abraham Sharp There are still two quadrants in the Observa[illegible] one of them was erected by Graham [illegible] rvations of Halley, and was redivided by Bird in 1753, the other was constructed by Bird in 1750 and is the instrument with which Bradley and Maskelyne made their most important observations Experience having shown that entire circles are susceptible of much more accurate division and much less liable to derangement than quadrants, a mural circle was constructed by Troughton and placed in the Observatory in 1812 Since that time the advantages of this construction have been fully appreciated and a mural circle is now regarded as the principal fixed instrument in all the great public observatories

Troughton's mural circle is six feet in diameter It is formed of brass, and fixed by means of sixteen conical radii, concentric to and at right angles with a conical axis nearly four feet long seven inches in diameter at the extremity at which the circle is fixed but only half as much at the other extremity The axis rests and turns in two collars one towards each end of the cone fixed at the front and back of a stone pier about four feet in depth The degrees are cut into five spaces on a narrow ring of white metal composed of gold and palladium The divisions are read by six micrometers placed at equal distances round the circle and securely fixed to the stone pier The telescope is fixed at right angles to an axis which works within the conical axis of the circle It consequently moves in the plane of the circle, and can be clamped in any position so that the readings may be made on different parts of the circle In order that the circle may move easily round its axis and that the lower side of the front socket may be relieved from the load of the instrument, two large friction wheels are suspended in front of the pier from the arms of two levers which by means of counterpoises, may be made to support the whole or any part of the weight The details of construction, however, admit of being varied in many different ways

The use of the mural circle is to measure angular distances in the meridian The axis must therefore be placed exactly horizontal, and the plane of the circle vertical and in the meridian, and the line of sight at right angles to the axis and parallel to the plane of the circle Small errors, however, in the adjustments scarcely affect the results The advantages of the mural above all other astronomical circles consist in the permanence of the microscopes, and the facilities for observing stars by reflection (For a detailed description of this instrument see *Pearson's Practical Astronomy*, also *Dr Robinson's* [illegible] *Armagh Observatory* [illegible] *yal Astron Society*)

MURCHISONITE A variety of crystallized felspar found in the new red sandstone near Exeter its component parts are silica 686, potash 148, alumina 166 [illegible] its discoverer, Mr Murchison

MURDER, in the English law, is defined to be the killing any person under the king's peace, with malice prepense or aforethought, either express or implied by law The word is of the same origin with the German *mord*, Fr *meurtre*, in law Latin, *murdrare* —to which word [illegible] an indictment [illegible] was taken by a prisoner in the reign of W [illegible] ng of good Latinity, which was overruled with contempt The malice prepense is the chief characteristic which distinguishes murder from other species of homicide, and it is the great office of the jury [illegible] malice has been shown [illegible] outward circumstances or *implied*, as where one deliberately kills another without provocation the law implies malice Malice is also *implied* where persons having authority to arrest or imprison using the proper means for that purpose are resisted in so doing, and killed, which offence is murder Killing in the prosecution of an unlawful act, when the act is done deliberately and with intention of mischief either indiscriminately or to particular individuals is likewise murder, whether or not there was a premeditated design of killing the individual slain So where particular malice against an individual is wreaked, by mistake, against another Whenever, also, death ensues on an unlawful act done in prosecution of a *felonious* intention, it is murder, as where a man is killed by a shot discharged at an animal with intent to kill and steal it, or where the intent is only to do some great bodily harm, and death ensues When several assemble to commit a breach of the peace forcefully, and happen to kill a man in the prosecution of such intention, they are all guilty of murder In some cases also, murder may be the consequence of a lawful act criminally or improperly performed, as by duress in a gaol

The execution in cases of murder, by 25 G 2 c 37, was to take place the next day but one after sentence, unless staid by the discretion of the judge, with an exception for Sunday by 9 G 4 c 31 and it was usual to sentence on Friday in order that the Sunday might intervene before execution But by 6 & 7 W 4 c 30 the time before execution was made the same as in other capital offences It happened at a trial for murder at the Devonshire assizes only a few days after the passing of this act when two men were convicted, that during the interval which elapsed sufficient doubt was raised as to the identity of one of the prisoners to prevent the execution

By the French code penal of 1810, the several kinds of homicide are accurately defined, and the crimes of "assassinat parricide infanticide and empoisonnement" are capital But the power given to the jury by the code of 1808 of pronouncing *under what circumstances* a criminal act has been committed materially modifies the severity of the law If extenuating circumstances are found by the jury the punishment is diminished

MUREX (Lat murex *a shell fish*) A name applied by Linnæus to a genus of the Vermes Testacea having a univalve spiral shell, with an oval aperture [illegible] nature, straight or slightly ascending canal [illegible] thus characterized form a family (*Muricidæ* or rock shells) in the Buccinoid tribe of Pectinibranchiate Gastropods of the system of Cuvier and include the following genera proper *Brontes*, Montf, *Typhis* [illegible] Montf, *Aquilla*, Montf *Fotorium* Mart, *Tritonium* Montf, *Trophona*, Montf *Ranella* Lam *Apollon* Montf, *Lusus*, Lam, *Pathna* Mart, *Struthiolaria* Lam *Pleurotoma* Lam, *Clavatula* Lam *Typula* Lam, *Fulgur*, Montf, *Fasciolaria* Lam *Turbinella* Lam

MURIACITE An anhydrous sulphate of lime, containing a little common salt

MURIATIC ACID, or HYDROCHLORIC ACID This acid was originally discovered by Glauber and called by him *spirit of salt* In its pure or gaseous form it was first obtained by Priestley in 1774 and its true composition was shown by Davy in 1809 who proved it to be a compound of hydrogen and chlorine, hence it has been termed *hydrochloric acid* Muriatic acid gas is procured by acting upon common salt (which is a chloride of sodium) by concentrated sulphuric acid the water of the acid is decomposed, and its hydrogen combines with the chlorine of the salt to form muriatic acid, whilst the oxygen is transferred to the sodium which is thus converted into soda, and this unites to the sulphuric acid to form sulphate of soda 60 parts of common salt, and 49 parts of concentrated sulphuric acid afford by this mutual action 37 parts of muriatic acid and 72 of sulphate of soda Muriatic acid gas may also be formed by passing an electric spark through a mixture of equal volumes of chlorine and hydrogen, or by exposing such mixture to the sun's rays, or inflaming them by a taper they burn with explosion and form a volume of muriatic acid equal to the united volumes of the gases As the specific gravity of hydrogen is to that of chlorine as 1 to 36, the specific gravity of the resulting muriatic acid gas compared with hydrogen will be 18 5, and 100 cubic inches of it will weigh 39 3 grains Muriatic acid gas is rendered liquid under a pressure of 40 atmospheres of the temperature of 50°, it extinguishes flame and is intensely sour, powerfully reddening vegetable blues Water absorbs it with much violence taking up about 480 times its volume This is the state in which muriatic acid is generally used Its specific gravity is about 1 19 and it is commonly obtained by distilling a mixture [illegible] sulphuric acid, and water When [illegible] happens that a mutual decomposition [illegible] acid ensues [illegible] the oxide unites to the hydrogen of the water, and the metal to the chlorine to form a metallic chloride Thus it is that soda and muriatic acid form a chloride of sodium or common salt The most effective test of the presence of muriatic acid is nitrate of silver, which forms an insoluble chloride

of silver in all solutions containing muriatic acid or muriates

MURICATE (Lat muricatus, *thorny*) In Zoology, where a surface is armed with short, but not close-set cones, having a sharp apex

MURIDÆ (Lat mus, *a mouse*) The family of Rodents of which the genus *Mus* is the type by some naturalists it is restricted to the genera *Mus Hesperomys, Dendromys, Ge* [illegible] *Pseudomys*, by other [illegible] the *Lib* [illegible] *Castoridæ*

MURINES (Lat mus, *a mouse*) The name of a tribe of Rodent quadrupeds, of which the genus *Mus* is the type it includes the families *Muridæ Arvicolidæ*, and *Sciuridæ*, and is the most widely distributed of all the Rodent tribes

MURRAIN (Fr), is the popular term of a malignant epizootic influenza to which cattle are subject, and which has at various times made terrible havoc among them It appears to have been long known, and, from the accounts handed down does not seem to have changed its characters materially

This disease extensively raged on the Continent from 1710 to 1746 (Lancisi *Disputatio Historica de Bovilla Peste*), and serious visitations of the malady were also witnessed during the years 1730 and 1731 and from 1744 to 1746 at that time many written descriptions were produced of this pest among which the work of Sauvages, the celebrated professor of medicine at Montpelier stands pre-eminent It produced, in 1757 an extreme fatality among the cattle of this country, an account of which was published in an excellent work by Dr Layard, a physician of London

This disease as it is met with in England may be characterized as an extremely malignant inflammatory œdema attacking and indeed confining itself for the most part to one of the hind quarters of the animal It is most common in the seasons of spring and autumn and affects principally young cows The most prominent features are tumefaction and a discolouring of the side affected with consequent lameness and inability to move, a peculiar emphysema of different parts of the body but particularly over the region of the spine and all the symptoms of putrid fever present in diseases of a typhoid character It speedily runs on to gangrene and few animals survive an attack of this kind more than ten or a dozen hours

Although the English murrain is somewhat modified in its virulence by season locality and the condition of the sufferer it is nevertheless generally looked upon as incurable When however, remedial measures are had recourse to, extensive scarification or rather incisions of the affected side, fomentations and purgatives are most likely to effect the desired object

It may be necessary also to remark that this malady is known to farmers and others in the different counties of England by a variety of terms none of which are either elegant or expressive, and, on the other hand that diseases different altogether from the one under consideration have received the same name indeed the word murrain is often used to denote any epizootic affection in cattle The one just described may, however be looked upon as the true murrain of this country

The murrain which broke out in England about two years ago, and has ever since committed such havoc among the cattle is travelling steadily northwards, but the disease has lost much of its original virulence as almost always happens in the case of epidemics travelling from one country to another Accidental circumstances aggravate the complaint, but in a general way it runs its course now in a few days, and to all appearance condition lessened, or "taking-on" stayed exceeds not from a fortnight to three weeks Much depends upon the condition of the animal, and in numerous instances the distemper touches rather than skuthes The doctoring process has been generally discontinued, and the best of all recipes is the warmth communicated by sheltered fields or sheds, rest, and the absence of disturbing influences

The prevention of this disease is even perhaps more important than the medical treatment and consists in allowing a free access of air to all the buildings stalls &c, with daily fumigation of them by chlorine or chloride of lime Care should be taken to examine three or four times a day the cattle on every farm so as to remove as speedily as possible the healthy ones from those that are affected

MURRHINE (Lat murrhina vasa, Gr μυρρίνες) Murrhine vases were a species of ware often mentioned by writers of the Roman empire, the material of which has been much disputed by modern antiquaries They came from the East, and, according to Pliny, were made of some precious stone found chiefly in Parthia, but some have conjectured that this was an erroneous opinion prevalent among the Romans, and that they were in reality of porcelain, of which the manufacture was unknown to the western nations (See *Plin Hist Nat* l 37, and a memoir in the 43d vol of the *Mem de l'Ac des Inscr*; and *Maurice's Indian Antiquities* vol vii)

MURRY or SANGUINE In Heraldry a dark red, one of the colours or tinctures employed in blazonry It is expressed in engraving by opposite diagonal lines crossing each other reckoned a dishonourable colour, rarely to be met with in [illegible]

MURZAS The name [illegible] of the Tartars, or, more strictly perhaps, to the second class of their nobility, the first or principal class being [illegible] the latter are looked upon as upstarts by the older nobility and regarded as an inferior race The Murzas have from the earliest ages been distinguished for their bold and refractory character, and the peculiar privileges they formerly possessed supplied them with the means of giving effect to their turbulent dispositions Since the conquest of Tartary, they have sunk into comparative insignificance, though many of them retain a large share of their former property, and have considerable influence among their own countrymen (See *Quart Rev* vol xxix p 128) The Tartar *murza* is evidently of the same origin with the Persian *mirza*, with which, however it must not be confounded *See* MIRZA

MUSACEÆ (Musa one of the genera), constitute a small but very important natural order of plants, related to the orders yielding ginger arrow-root and similar substances, but [illegible] having several stamens instead of one only The plantain (*Musa sapientum*), the most valuable product of the vegetable kingdom in hot countries in consequence of the abundance of nutritious food yielded by its fruit, and the application of its leaves to the purposes of thatching and of thread obtained from its petioles in the manufacture of the finest muslins, is the representative of the order Another species is the *Musa paradisiaca* or banana, and the singular plants called Strelitzias with their orange and blue flowers, are also members of *Musaceæ*

MUSCA (Lat *a fly*) A Linnæan genus of Dipterous insects now expanded into a family (*Muscidæ*) of the fifth tribe (*Athericera*) of the order *Diptera* in Latreille's system It is distinguished by a proboscis always very apparent membranous, and bilabiate generally having two palpi, and capable of being entirely withdrawn into the oral cavity, and a sucker of two pieces [illegible] terminate in a plate with a lateral s[illegible] are divided into the subfamilies *Creophila* which includes the meat-fly (*Musca vomitoria*) and the common house fly (*Musca domestica*), the *Anthomyzæ* the *Hydromyzæ* the *Scatomyzæ* the *Dolichocera*, the *Leptopodidæ*, the *Capromyzæ*, the *Gymnomyzæ* and the *Hypocera*

MUSCHELKALK [illegible] stone This name [illegible] to a limestone formation belonging to the red sandstone group it has not yet been found in England

MUSCI See MOSSES

MUSCICAPA (Lat musca *a fly*, capio, *I take*) A genus of Dentirostral Passerine birds characterized by a depressed beak furnished with hairs at its base and with the point more or less hooked and emarginate The genus is now split into various subgenera, as *Tyrannus, Gymnocephalus Muscipeta* and *Muscicapa* proper, &c, included in the family name of *Muscicapidæ* Their general habits are cruel and predatory, like those of the shrikes, and according to their size and strength, they live on small birds or insects The smallest and weakest of the *Muscicapidæ* gradually approach the form of the wagtails

MUSCIDÆ The family of Dipterous insects, of which the fly (*Musca*) is the type

MUSCHIFORMES (Lat musca *a fly*, forma, *form*) The name of a tribe of *Tipulariæ*, or crane flies, comprehending those which have a stout body and short legs, [illegible] flies

MUSCLE BAND In Coal-mines, the black shale containing embedded muscle shells

MUSCLE (Lat musculus, diminutive of mus, *a mouse* from its resemblance to a flayed mouse) Fleshy fibres [illegible] the m[illegible] *voluntary*, others such as the heart, are independent of the will, or *involuntary*, and others, as the diaphragm and muscles of respiration generally have a *mixed* action, being to a certain extent only dependent upon the will Muscles are aggregates of minute muscular fibres, which appear to be composed of small globules, but we are, in fact, ignorant of the ultimate structure of the muscles, and of the causes on which their wonderful powers depend They are enveloped in and penetrated by cellular membrane, and abundantly supplied by nerves, blood-vessels and lymphatics

Their principal constituent or proximate elementary structure consists of fibrin with some albumen, besides which gelatine and fat are derived from their cellular membrane, and hæmatosin, osmazome, and other con-

stituents of the blood are also found in them they therefore constitute the most nutritious species of animal food *See* ALBUMEN and CREATINE

All the muscles are under the immediate influence of the brain and nerves; and consequently when this influence is abstracted, as by the division of the nervous trunks by which they are supplied, the powers and functions of the muscle whether voluntary or involuntary, are in the first instance disturbed, and afterwards cease altogether Electricity is capable to a certain extent of recalling the action of the muscles, provided it be applied before rigidity ensues, hence the supposed analogy that power of matter and certain properties of the nerves The arrangement of the fibres of muscles is infinitely various, and adapted to the particular purposes which each has to fulfil In the voluntary muscles the fibres are generally parallel, or nearly so, but in the involuntary muscles they are more or less interwoven and interlaced When muscles contract, they become shorter, harder, and thicker and their bundles of fibres are thrown into undulated lines with a tremulous or vibratory motion most rapid where the contraction is most powerful, and producing a distinct sound, which may be most easily heard when the tip of the finger is put into the ear, it occasions a noise like that of carriages rumbling over a distant pavement (Wollaston, *Philos Trans*, 1809) The number of these vibrations amount to between twenty or thirty in a second these muscular sounds are importantly concerned in the diagnosis of certain diseases by the medium of the stethoscope

MUSCOVADO The name given to unrefined or moist sugar

MUSES (Gr Μοῦσαι, Lat *Musæ*) In the Greek and Roman Mythology nymphs or inferior divinities distinguished as the peculiar protectresses of poetry, painting, rhetoric, music, and generally of the *belles lettres* and liberal arts, with which indeed they are sometimes identified — *Quis est omnium qui modo cum Musis, id est cum humanitate et cum doctrina habeat aliquod commercium qui* &c (Cicero, *Tusculan* lib v cap 23) Helicon and the region round Parnassus was the favourite seat of the Muses where they were supposed, under the presidency of Apollo to be perpetually engaged in song and dance and in elevating the style and conceptions of their favoured votaries It appears probable that the early Grecian poets struck with the beauty and sublimity of the scenery in this part of Greece, ascribed the humanizing influence it was so well fitted to exercise over the mind to the agency of the nymphs and other tutelary deities of the place to whom they gave the name of Muses Originally there appear to have been only three of these divinities* and their names — *Mneme Melete* and *Aoide* or Memory Reflection, and Song — sufficiently show the nature of the faculties over which they were supposed to preside According as the fine and liberal arts were cultivated and expanded the province of each muse seems to have been more restricted, and additions were made to their number which ultimately was fixed at nine Their names and functions are succinctly stated in the following verses of Ausonius —

[illegible]

MUSETTE A name sometimes given by the Continental nations to the bagpipe The itinerant performers on the musette, who were formerly very numerous in many European countries, were called *musars*

MUSEUM (Gr μουσεῖον, from μοῦσα, *a muse*) A collection of curious objects in nature and art, but, in most instances, the former The name denotes a temple or place sacred to the Muses, and is said to have been first given by Ptolemy Philadelphus to that part of the royal palace at Alexandria in which he placed the famous library In England the museum at Oxford is the most ancient institution bearing the name It was founded in 1679, and enriched in the first instance chiefly by the contributions of Elias Ashmole but want of room and of funds has prevented it from affording an adequate exhibition of the various classes of objects for which it was originally destined, and which modern discoveries have so greatly augmented The foundation of the British Museum, in London was laid by Sir Richard Cotton's presenting to it his collection of manuscripts Since that period the library has been increased by the addition of the Harleian, Lansdowne, Egerton, and several other [illegible] extensive purchases out of funds [illegible], by the deposit of copies of newly published works, according to the legal right conferred on it by [illegible] and by the donations of George III and IV the latter of whom presented to it his father's library In sculpture, the British Museum possesses the [illegible] of marbles from Lord Elgin from Greece, [illegible] the Lycian marbles, an assemblage of Egyptian, and the Layard or Nineveh works of art It contains also the Hamilton vases, and the famous Barberini or Portland vase In several departments of natural history, especially in mineralogy it is extremely rich It was founded by Sir Hans Sloane in 1733, and fills the mansion known by the name of Montague House, together with adjoining buildings more recently erected The most celebrated museum in Italy is the Vatican, at Rome, next to it, that of Florence, and the Museo Borbonico, at Naples In France, as well as in Italy, galleries of pictures are considered as within the meaning of the general term 'musee," and the museum of the Louvre is chiefly remarkable for its contents of this description

MUSHROOM (Fr mousseron, a kind of agaric used in sauces), is, properly speaking, the *Agaricus campestris*, or eatable agaric, — a species common in pastures and well known for its excellence as an ingredient in sauces, but the term is generally used in a more extended sense, and applied indiscriminately to all firm fleshy species of the genus *Agaricus*, whether eatable or not

MUSIC (Gr μουσική) The art of combining sounds agreeable to the ear This art becomes a profound science when we investigate the principles on which its combinations are founded and the causes of the emotions it produces

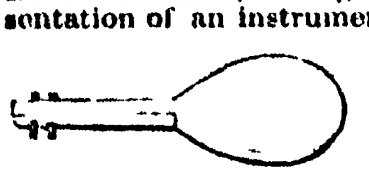
*Hebrew Music* — Notwithstanding the great labours of the early fathers of the church and of many other learned men there are few materials even in the Scriptures themselves for a very satisfactory account of the music of the Jewish nation whose restricted intercourse with other nations prevents our receiving any illustration of it from contemporary writers All that can be done is to cite a few passages from holy writ relative to the first ages of the world from which it will be seen that from a very early period, the art constantly ministered to the religious ceremonies of the Hebrews Moses (*Gen* iv 21) tells us that Jubal sixth in descent from Cain, was "the father of all such as handle the harp and organ" The organ here mentioned according to the commentators was the syrinx, or a species of Pan's pipes This must have been but a short period after the deluge Six hundred years after this period Laban reproaches Jacob thus "Wherefore didst thou flee away secretly and steal away from me? and didst not tell me that I might have sent thee away with mirth and with songs with tabret and with harp" So that at this time vocal and instrumental music was not unusual For two hundred and fifty years after this period nothing occurs relative to music when we find Moses after the passage of the Red Sea, singing with the Israelites on the occasion Miriam Aaron's sister, 'took a timbrel in her hand and all the women went out after her with timbrels and with dances' There seems ground [illegible] that Miriam by birth an Egyptian and [illegible], might have learnt the use of the timbrel and the dance in that country The instruments mentioned during the administration of Moses appear to have been confined to the trumpet and tambourine After the siege of Jericho where the rams horns that were blown were rather military signals than instruments of music, we have no record of music till the appearance of the canticle of Barak and Deborah which seems to have been sung in dialogue without instruments, excepting the timbrel and the trumpet before mentioned From several passages music appears to have been united with prophecy Samuel (b I ch x v 5) says to Saul, "Thou shalt meet a company of prophets coming down from the high place with a psaltery and a tabret, and a pipe and a harp before them" These prophets were doubtless poets or psalmodists improvisatori of verses which they sung to the accompaniment of an instrument, and many of the fathers have supposed that the Jews had a college or school of prophets which was also a school of music, for they almost universally accompanied themselves, or were accompanied by others, with musical instruments David, who had cultivated music from his infancy, seems to have been destined by his family to the profession of a prophet, and Saint Ambrose says that he was chosen by God, above all the other prophets, to compose the Psalms The power that the harp of David had upon Saul, when he was tormented with the evil spirit, is an example, among many others, of the influence of music on the maladies of the mind, and especially in cases of melancholy Under the reign of David music was much esteemed He [illegible] a regular corps of musicians for the celebration of the [illegible] ceremonies, and his patronage necessarily extended its influence David, on all occasions seems to have been interested in the solemnities of his time we find him continually dancing and

* [illegible] says four *De Nat Deorum* i cap 21 but in this he is at variance with [illegible]

playing before the Lord, with songs, harps, psalteries, timbrels cymbals, corners and trumpets As in Egypt, the musicians were confined to one family that of Levi, which was exclusively consecrated to the service of the Lord and the cultivation of music When Solomon was made king, four thousand were the number "which praised the Lord with instruments" Dr Burney calls the reign of Solomon the Augustan age of the Jews, and though Solomon, unlike his father, was not himself a performer, and ranked "men-singers and women-singers, and the delights of the sons of men, such as musical instruments," among the vanities of the world, yet he continued the priests and Levites in his employ In the reign of Jehoshaphat the Levites were useful in the field of battle, and were, by their songs, the cause of the victory that was gained, and indeed this was not the only instance in which they were similarly serviceable Some time before the destruction of the temple and the first Babylonish captivity, music and the sacred rites had met with interruption both on account of war, and by their intercourse with foreign [illegible] The captivity was a mortal blow [illegible] had made to recover their music, and sixty-six years, the period of its duration was sufficient to efface all from their remembrance [illegible] Psalm [illegible] land Re[illegible] cond time, again delivered, and then conquered by the Egyptians Persians, and Romans successively —the unfortunate Jews had no leisure to cultivate the arts and it appears probable that their music which scarcely deserved the name till the reign of David even at its best epoch depended for effect more upon the number of the performers than upon any refined knowledge of the art

Among the modern Jews instrumental as well as vocal music was excluded from the synagogue from the time of the destruction of Jerusalem The singing they allow at the present day is a modern innovation for according to a passage of their prophets the Jews consider it contrary to their law or at least improper, to sing or rejoice until the coming of the Messiah The Germans are the only Jews in the present day who have a regular musical establishment in their synagogue They sing in parts and have preserved traditional melodies which are considered very ancient At Prague an organ is used [illegible]

[illegible] opinion of the ancients was pretty general Pythagoras was indebted to the Egyptian priests for nearly all the science he possessed and especially that of music Though Diodorus Siculus assures us that the Egyptians were not allowed to cultivate music and that they considered it useless and even injurious to society and the cause of effeminacy, yet Plato who had visited Egypt observes in one of his Dialogues that none but excellent music was allowed where the youth were assembled Though he admits others of their habits were bad he excepts the music Strabo tells us that the youth were instructed at the earliest age in music that the songs were fixed by law, and that the sort of music used was established by the government exclusive of every other sort The Greeks even attributed the invention of some of their musical instruments to the Egyptians, such as the triangular lyre, the single flute the drum and the systrum Herodotus says the Dorians were of Egyptian extraction and as the three most ancient modes of Grecian music were the Dorian, the Phrygian and the Lydian it is probable that the Egyptian colony that peopled that province carried thither the music and instruments of their country Like all other professions in Egypt that of music was hereditary A similar custom as we have above stated prevailed among the Jews, and Herodotus tells us that the inhabitants of Lacedæmonia who were Dorians resembled their ancestors, the Egyptians in this that their musicians were all of the same family, and that their priests, like those of Egypt were taught medicine and the art of playing upon stringed instruments when they were initiated into the mysteries of religion The same author mentions that in the processions of Osiris the Egyptians carried statues of the god singing his praises, and were preceded by a flute There is a singular proof of the antiquity of this art to be met with at Rome on the Guglia Rotta, which Augustus brought to Rome, being one of the largest obelisks that was removed from Egypt and which was thrown down and broken at the sacking of the city, in 1527 by the constable of Bourbon It is, among other hieroglyphics, the representation of an instrument, as here given, very like the colacsione (a species of guitar) still in use in Naples From the pegs it is evident two strings were employed, and the length of the finger board, if the strings were tuned at a great interval from each other, would afford a very considerable scale of notes This instrument alone proves to what extent music was cultivated



in Egypt, and that its inhabitants were acquainted with the method of repeating the scale Hermes [illegible] or the ancient Mercury Trismegistus to whom is ascribed the invention of writing astronomy religious rites and ceremonies, has the credit also of having invented the lyre with three strings, which, it is pleasantly said, were types of the three seasons of the year, there being a fourth season neither in Egypt nor among the ancient Greeks The lowest chord, say they, was the type of winter, the [illegible] the highest of summer The [illegible] ollodorus, was the origin of the [illegible] its inundation on one occasion, left on retiring a quantity of dead animals, and among the rest a tortoise The flesh soon perished and dried up, from the heat of the sun, nothing but the shell and the cartilages were left, and from their contraction they had been [illegible] Mercury [illegible] of [illegible] the bank of the river [illegible] his [illegible] tortoise shell and was [illegible] [illegible] the first [illegible] produced [illegible] the [illegible] [illegible] the [illegible] of a lyre He [illegible] [illegible] [illegible] [illegible] [illegible] shell [illegible] [illegible] [illegible] [illegible] [illegible]

the Turks themselves, the enemies of art, will pass whole nights in listening

*Grecian Music* - The fables of mythology are so mixed [illegible] of all the arts that it is difficult [illegible] Hence the most celebrated authors of the history of music, after delivering faithfully what the ancients have recorded on the subject, have left the reader to shift for himself in analyzing the mass Burney, of whose history in the two previous articles we have largely made ourselves, we propose to follow in the following short account of Grecian music The Phœnicians came into Greece with Cadmus, the son of Agenor amongst them were a class of men well versed in the arts and sciences of their country, who were called Curetes These established themselves in Phrygia where they were called Corybantes, in Crete, where they received the name of Dactyli they spread also into Rhodes, Samothracia, and other places In these places writing and music were the arts principally taught by them Cadmus, in Samothracia, took to wife Harmonia (sister of Jasius and Dardanus), who was so skilled in music that the Greeks gave her name to the art Diodorus in describing the marriage feast of the parties, makes the gods themselves guests Mercury came with his lyre, Apollo brought a similar instrument, Minerva assisted with a flute and the Muses also [illegible] Electra, the mother of the bride, celebrated the mysteries of Cybele with dancing, tambourines, and cymbals How Diodorus was informed of these particulars he does not condescend to tell his readers, but it seems probable that the story was founded on ceremonies which the priests at certain festivals, performed in honour of Harmonia and Cadmus Jupiter, they say was born at the epoch of the arrival of the Phœnicians, and the Curetes, it appears brought him up At that time they were not acquainted with any musical instruments save those of percussion they could not therefore have taught the Greeks more than the use of these, and they could convey no musical notions except those of rhythm The inferior divinities — Minerva, Mercury Apollo, and the Muses — afterwards became the protectors of the art, and invented wind and stringed instruments

These two circumstances are as the reader will perceive irreconcileable, and Diodorus committed an anachronism, which may be accounted for if his description was taken from some religious spectacle The flute with holes by stopping which many notes were produced was certainly a more [illegible] than the pipes of Pan This was the invention of Minerva who performed upon it until she was derided by Juno and Venus for the grimace and wry faces consequent on playing it, when she renounced it in favour of the lyre The employments assigned to Mercury by the Greeks may be learnt from the pleasantry of Lucian The same personage is the Hermes of the Egyptians, he had the credit of having invented music, and in those days its principal instrument the lyre In Greece the lyre he invented had seven strings, whereas that which he gave the Egyptians had three only Apollo was another of the Grecian deities whose origin was in Egypt He was a performer on the lyre, and there is no necessity to repeat in this place his contest with Pan, and the decision of Midas under whose form the silly king of Phrygia was represented by some neglected poet Marsyas was another of Apollo's unfortunate victims, upon him he wreaked his vengeance with such cruelty that he himself was afterwards ashamed of his conduct, and actually threw aside his lyre for a considerable period, which it is said retarded the progress and perfection of that instrument Fortunio Liceti a modern writer thus explains the story of the flaying Marsyas alive by Apollo Before the invention of the lyre, the flute was considered the most important instrument, and its practice enriched the performers on it As soon as the lyre [illegible] that nobody listened to flut[illegible] credit and were ruined Now the money of those days, being made from leather hides, gave rise to the story that Apol[illegible] ripped [illegible] his hide The priestess of Apollo at Delphi [illegible] Plutarch, her oracles to the sound of the flute Afterwards, when her oracle was in the greatest renown there were [illegible] instruments, and dancing and singing [illegible] were nothing more than a band of singers and musicians in the service of Osiris, or the Egyptian Bacchus, under the superintendence of his son Osiris The Greeks made them the daughters of Mnemosyne by Jupiter Those who make them the daughters of Pierus, king of Thrace, do not alter the first account, for the female musicians of Osiris, before they were taken into his service, had been celebrated in Thrace under the name of Muses, and the daughters of that Pierus who initiated them became celebrated under the same name Bacchus has been so celebrated in the musical world that we cannot leave him out Diodorus makes him the inventor of theatrical representations and schools of music, in which those who excelled were exempt from military service Hence the author says that musical societies have since enjoyed many privileges Certain it is that the Dionysiacs, or [illegible] Grecian representations [illegible] are as old as the world [illegible] In Attica [illegible] Rome all persons who appeared on the stage singing dancing, or reciting verses for the amusement of the people were called servants of Bacchus, and at all the processions, triumphs, and ceremonies instituted by the ancients in honour of the god music entered largely into the programme This is constantly seen in the bas-reliefs that have come down to us, for wherever there are fauns, satyrs and bacchanals we always find a certain set of musicians of some sort or other dancing

Pan seems to enjoy the [illegible] in the second class of divinities who patronised music The Egyptians, however, ranked him higher than did the Greeks Pan, say some, was the inventor of the flute called the syrinx The fable is pretty which gave rise to the invention Syrinx, a nymph, being pursued by Pan, flies to the banks of a river, whose nymphs she implores to save her Pan thinks to catch her, but embraces only the reeds Under this new form, Syrinx, shaken by the winds, emits certain melodious tones The god, pleased with the sound, makes an instrument from the reeds, to which he gives the name of Syrinx Pan is the companion and counsellor of Bacchus Shepherd, musician, dancer, hunter, and warrior he directs the movements of the bacchanals, but the perfection with which he plays the flute is such that Bacchus is never happy without him The satyrs follow in Pan's train Silenus was the inventor of several instruments Like Marsyas, he was bold enough to challenge Apollo, with better fortune, however, as regards the result

Such was the state of music in Greece under the gods and demi-gods, that is to say in those primitive times when every one who had signalized himself by a useful invention was deified after his death and considered the protector of the art he had invented The heroic age followed this, and, divesting the subject of fable as much as possible we shall now proceed to the music of that period Amphion Chiron Orpheus, Linus, were at once the first poets and the first civilizers of Greece Amphion is the first Theban musician mentioned in the history of the art Homer however is silent on his wonderful skill in music and of his having erected the walls of Thebes by the aid of the lyre Pausanias thinks his musical reputation was acquired by his alliance with Niobe and Pliny is of the same opinion Both of them allege that Amphion learnt the art in Lydia and that, having brought it into Greece, he was thence accounted the inventor of the Lydian mode Chiron, whom Plutarch calls the wise centaur accounted the son of Saturn and Philyra was born among the centaurs in Thessaly, that is among the people of Greece who first trained and rode the horse With the reputation of inventor of medicine botany and surgery, he lived at the foot of Mount Pelion, in a cavern which his science made the principal and most frequented school of Greece Plutarch makes him the instructor of Hercules in music, medicine and law, though Diodorous says that Linus was his master And here let it be observed that ancient authors [illegible] accomplishments [illegible] nature was anciently a reproach to any one above the commonest class Achilles was the most renowned pupil of Chiron who bestowed much of his time to instruct him in this art, as the means of not only softening the impetuosity of his character but of exciting him to heroic actions [illegible] Herculaneum represents [illegible] the young Achilles to play upon the lyre After Chiron, Linus and Orpheus appear to have been the first poets and musicians of Greece, but it is difficult to decide which was the pupil of the other Diodorus says that Linus has the priority, and that he added the chord hehanos to the lyre of Mercury, and invented rhythm and melody The majority of the ancients make him the instructor of Hercules, whom, say they he found so stupid and obstinate, that having on one occasion given him a blow the young hero seized his preceptor's instrument and beat his brains out with it Orpheus, however, whether before or after Linus, acquired the greatest name in Greece His reputation was fully established at the time of the Argonautic expedition, in which he was one of the adventurers Apollonius Rhodius observes, that he not only excited his comrades by the sound of his lyre, but that he also silenced the syrens by the superiority of his singing The fables universally say that Orpheus travelled in Egypt, where he was instructed in the mysteries of religion, theology, and poetry, and that he was the first who transplanted them to the Grecian shores According to the custom of the time, he united with the knowledge of music that of the sublime sciences Preferring the lyre to all other instruments, of which before him the flute seems to have been the principal [illegible] his imitators [illegible] his wife, the [illegible] god of the infernal regions, as known to every reader.

**The instrument that produced these effects was but a seven-stringed lyre, two strings having been added by himself, by which addition the second tetrachord was completed**

**Obloquitur numero septem discrimina vocum — VIRG**

From the little power which such an instrument possessed, compared with those of modern times, we may infer that it must have been the novelty of the art or the beauty of the poetry which produced such extraordinary impressions, or perhaps both acted upon a very susceptible race of people The mastery which Orpheus possessed over the Thracians made the women of that country jealous of him, and by them history relates he was murdered In the time of Plutarch the females of Thrace were said to be reproached with this barbarity The head, it is said, that his lyre, at the time of his murder, fell into the river Hebrus, down which it floated to Lesbos, where it was deposited in the temple of Apollo Neanthus, who afterwards purchased it of the priests of the temple, thought, like the nobleman who bought Punchinello, that the possession of it would inspire him no sooner had he begun to use it than the dogs of his neighbourhood tore him to pieces After the Argonautic expedition, the most important event in Grecian history is that of the siege of Troy Homer [illegible] is the only historian [illegible] ledge respecting the art He has preserved the names of several musicians, and these are the only ones known from the time of Orpheus up to the time of celebrating the Olympic games

The instruments mentioned by Homer, in the *Iliad* and *Odyssey*, are the lyre, the flute, the syrinx, or Pan's pipes The lyre is by him called *φορμιγξ*, *κιθαρις*, and *χελυς*, Aristophanes [illegible] poet who calls it *λυρα* [illegible] trumpet, it is thought that this instrument, though common in his time was unknown to the Greeks at the siege of Troy With Homer music and poetry are inseparable *αοιδος*, *a singer*, is the word used by him to express a poet By him Achilles and Paris are both exhibited as playing the lyre, but the former does it to console himself for the insult that had been offered to him, whilst the latter exercises his skill to forget the disgrace of having sought safety in flight Achilles sings the deeds of heroes The song of Paris was more [illegible] to the lyre [illegible] in recounting tales of love [illegible] music with his art was Tiresias he was also gifted with prophecy, and was a priest Thamyris receives from Homer the appellation *κιθαριστης one who sang to the lyre* Plutarch, in his Dialogue on Music, says that he was born in Thrace, the country of Orpheus that his voice, though loud, possessed the quality of softness, but that [illegible] with [illegible] punishment was [illegible] talent of touching the lyre This circumstance is mentioned in the catalogue of the ships (Lib II v 594) According to Diodorus Thamyris was of the school of Linus, and Suidas places him eighth of the epic poets who preceded Homer Clemens of Alexandria says he was the inventor of the Dorian mode, but he is probably wrong, inasmuch as this had before his time been imported into Greece by the Egyptians, who invaded that part of Greece which bore the name of Doria In the eighth book of the *Odyssey* Homer gives an eminent place to Demodocus whom he describes in his character of poet and singer as the glory of the human race Some have thought that under this name the poet was painting his own portrait He places him on a throne a herald announces him, and he has a private table, and in every circumstance speaks of the honours that were paid to him Like Tiresias and Thamyris he paints him blind, which it will be recollected was his own case The blind [illegible] likeness he bestows on him [illegible] accurately similar The last musician celebrated [illegible], who, according to Eustathius, had been his master He is immortalized in the *Odyssey* The poets and musicians of Greece appear to have much resembled the Celtic bards They wandered about, singing their works in great cities, and usually found admission to the palaces of princes, where they were treated as though endued with inspiration [illegible] pus were also celebrated, before [illegible] their musical talents the first, according to the Arundelian marbles, flourished 1506 years B C He was the inventor of the Phrygian flute and the airs or *nomes* that were sung to [illegible] the gods, to Pan, Bacchus, and other divinities of the country The second is honoured [illegible] by the Greek writers Two musicians [illegible] Olympus The most ancient was the most celebrated He was a native of Mysia and the disciple of Marsyas Burney has taken notice of Dr Burn's remarks that relate to the [illegible] to any system of music, and he conjectures that the airs that were sung in the temples in the time of Plutarch were then of the same relative antiquity as [illegible] Dr Burney has taken notice of Dr Burn's remarks that relate to the [illegible] Plato Polybius, Athenæus, [illegible] speak [illegible] Herodotus and Homer [illegible] [illegible] [illegible]

words were so suited to the circumstances of the battle of Mantinea, that the audience immediately turned their eyes to Philopœmen, who was present and interrupted the singer by shouts and acclamations of applause Timotheus, born at Miletus, 446 B C , was one of the most [illegible] tenth and the eleventh the consequence whereof was that for the innovation he was banished from Sparta, and ordered to cut off the additional strings, that he might not corrupt the ears of the youth with too great a variety of notes We have above stated that the Spartans behaved in an equally barbarous manner to Terpander This Timotheus, who died two years before the birth of Alexander, must not be confounded with the celebrated flute-player who was so great a favourite with that prince, and whose tones animated him to arms The Isthmian did not differ from the games already described they received their name from being celebrated on the Isthmus of Corinth Other games existed in different cities as for instance the Panathenaic at Athens Music was cultivated at all, and held in much esteem

At Athens, in the time of Pericles music was considered so necessary a part of education that not to understand it nor play any instrument was considered a disgrace Pericles was especially zealous in his patronage of music Besides regulating the form and increasing the number of musical competitions at the Panathenaic festivals, he built an edifice called the Odeum for the express purpose of rehearsals previous to performance in the theatre It was during his era that Antigonides and Dorion, the two most eminent flute-players flourished So great appears to have been the passion for flute-playing that as much as three talents (upwards of 600*l* ) were given for a single flute, fortunes were realized in manufacturing them and the performers lived in splendid and [illegible] style Even the women were performers on the flute Of these the most renowned was Lamia, to whom for the benefits she had prevailed on Demetrius to confer upon the city the Athenians rendered divine honours and dedicated a temple to her, under the name of Venus Lamia It seems that execution on this instrument was carried to a great extent, for Aristotle cries out against the difficult passages that used to be practised, and even against music generally The people however, who as a mass are never disposed to give up the pleasures of sense for those of the mind, continued to encourage these novelties and their authors, and from being the handmaid music became the mistress of poetry The justice of the complaints of Plato and Aristotle on this point is confirmed by Aristoxenus himself well skilled in the art, and Plutarch frequently laments that the theatre had ruined music though what the latter says must be taken with some allowance, seeing that he was a priest of Apollo and anxious doubtless, to confine music to the service of [illegible] After the complete subjugation of the Greeks like [illegible] rest of the arts, music fell to decay They continued, indeed to cultivate music under the Roman emperors, and under their own even afterwards under the Turks, it was one of their amusements but so barbarous is it in the present day that it is difficult to conceive that the same nation ever possessed a music which drew down the [illegible] T [illegible] of the ancient [illegible] upon which we could judge have long since passed away, but we will add, in conclusion to this section the opinion of M Ginguené on the subject "We see in the poetical works of the Greeks the variety and liveliness of their passions, and these same passions could not be expressed in music without an equal variety of air and modulation I do not mean by that to say that Greek music was entirely similar to our own to decide that point it would be necessary to hear and compare the one with the other I maintain only that Greek music was full of harmony, that it admitted that variety of modulation which alone can give pleasure to cultivated minds, and that to suppose that the Greeks were pleased with a music that comprehended but four notes is one of the greatest follies that can be imagined"

*Roman Music* —It is scarcely possible for any nation to exist without some sort of music and it appears that at a very remote period, such was not the case with the Romans A [illegible] rude and barbarous, their intercourse with the Etruscans who were much farther advanced in the arts than themselves, would soon have had effect upon it Strabo and Livy affirm that public music, as used at sacrifices, was especially learnt by this nation of the Etruscans Servius Tullius, 660 years before Christ, in his division of the people into classes or centuries, directed that two entire centuries should consist of [illegible] the charge, which proves at least the [illegible] musicians One hundred and fifty years afterwards, the [illegible] at funerals was by the laws of the twelve tables, directed to [illegible] six flute players Among the Romans, as was also the case with the Greek music (see above), music and the drama were inseparable In the end these exhibitions became offensive but the further notice of these is unnecessary in this place Music, however, was for a [illegible] sacred uses, and it was only after [illegible] the Great that the Asiatic custom was introduced of having female musicians, — *psaltriæ*, — to play at festivals and private banquets The Etruscan music, which we have already slightly mentioned, was cultivated with success, for all the instruments of the Greeks, which are known to us from their bas-reliefs, are to be found in paintings on Etruscan vases so that it may be safely assumed that the Romans were accustomed to the best music that the age afforded Under Augustus, who was not a great patron of the art, music was not much esteemed it is possible he might not have had much taste for it, and yet, when he was getting into years, he engaged a musician to regulate the intonation of his voice Tiberius banished musicians from the city, which under him became as sad as in the days of Augustus it had been lively Caligula, however, recalled them Claudius, though he patronized gladiatorial fights in preference to music, still encouraged the art, but under Nero it shone in all its ancient splendour Such was this emperor's delight in it, that he passed a great portion of his time in taking lessons of Torpus, the most skilful harpist and lyrist of his day We have before stated his ardour in the pursuit of the art to have been so great that he contended at the Grecian games Nero's successors were patrons of the public games, and of dramatic and musical exhibitions throughout the empire Adrian had always been attached to the arts of Greece He instituted new games, which his successor Antonine continued Commodus whose disposition was similar to Nero's in cruelty, resembled him also in an intense passion for [illegible] the arts, and music, of course, among [illegible] with them —with them to [illegible] its former glory, after centuries had passed away, and all art seemed to have been lost for ever

*Italian Music* — Italy has been to the rest of Europe in modern times what ancient Greece was to Rome Though we cannot so well trace the art of music in its early restoration as we can the arts of design, we know that to the religion and church which brought them forward we are indebted for the foundation of all that is good in the musical art The plain chant of the Catholic church the foundation to which we allude, is said to owe its origin to Ambrosius, archbishop of Milan, in the fourth century He it is generally understood, brought it into form and based it upon rules Two centuries afterwards Pope Gregory carried it to such perfection that up to the present hour it has needed no improvement, indeed seems incapable of improvement and remains one of the noblest monuments that the art has produced The music of Italy aided by a language which Metastasio called *musica stessa* notwithstanding the revolutions it at first underwent, at length became the guide for the rest of Europe Even out of the church as early as the 13th century music was cultivated, for Prince Conrad in 1268 went out against Charles I of Sicily with a female choir singing accompanied by cymbals, drums, flutes, violins, and other instruments and it is known that all the courts of Italy were filled with musicians for the amusement of their sovereigns At Florence is still in existence a manuscript collection of sacred songs entitled *Laudi Spirituali* in honour of God, the Virgin, saints and martyrs which as early as 1310 used to be sung by a society called the *Laudisti* A society of this sort existed when Dr Burney was at Florence in 1770, and he states that he often heard them singing about the streets in three parts, accompanied by a portable organ When Petrarch was crowned with laurel at Rome in 1341, music was introduced to grace the ceremony, and from the account of that ceremony, printed at Padua in 1549, it appears that it consisted of instrumental as well as vocal music To return back a little, it appears that, in 1022, Guido, a Benedictine monk of Arezzo, was the first who imagined the scheme of designating by [illegible] spaces, the different sou [illegible] have claimed for Hubald and Odo the credit of this invention a century before the time of Guido, but we do not think the claim established

Guido gave to the notes the names ut, re, mi, fa, sol, la taking them from the first syllables of the hymn of St John the Baptist, in which they are certainly found —

[illegible]
*Mi*[illegible]*fa*[illegible]
*Solve* [illegible]

The syllable si was [illegible] by a [illegible] In Mr [illegible] manuscript in the Vatican [illegible] Gaffurius [illegible] Marchetto of Padua had improved [illegible] proves that he was acquainted [illegible]

matic counterpoint That the science was making vast strides from the old plain chant is clear from the bull of Pope John XXII in the early part of the 14th century, wherein complaint is made of what he was pleased to call the abuse of descant, whereby the principles of the antiphonal and gradual had fallen into such contempt [illegible] when melody was cultivated as an art exceeded the bounds which the ecclesiastical tones prescribed Without particularizing the steps by which it continued to advance the *Ars contrapuncti* of John de Muris, in 1330, laid down laws of harmony, some of which are observed in composition at the present hour He says that, in the scale of the octave, there are six species of consonances,—three perfect and three imperfect Of the first sort are the unison, the octave, and the fifth, of the second sort, the two thirds, major and minor, and the sixth major It is curious that he did not place the minor sixth among the number of consonances, since it is but an inversion of the major third, which he admits to be a consonance Prosdoscimus, in 1412, speaks of the fourth of which no mention is made by De Muris, and treats it as a dissonance, though, he says, it is less so than the second and the seventh, and that it may be placed in a middle class, between consonances and dissonances Advanced, however, as the science became at this period, it was not until the middle of the 15th century that the laws of harmony were fixed on that foundation that still bears the superstructure of the refined combinations of even modern music The first treatise on music that was printed in Italy was towards the end of the 15th century by John Tinctor, but that published a few years afterwards, by Franchino Gafforio (printed in 1496 at Milan), excelled its precursor The claim of the Italians to the invention of counterpoint has been disputed in favour of the Flemings, and also of the English There is no doubt that the former contributed much to its advancement and perfection but the works that are extant, if we are to judge from them, satisfy us that the claim cannot be maintained In the compositions of this period there is a want of melody which all the display of science and curious combinations they contain could not atone for, but in the 16th century melody and counterpoint were united by the splendid genius of Palestrina and some of his contemporaries and disciples, and the art was enriched by the treatises of Peter Aaron Zarlino Artusi of Bologna the Venetian Zacconi, and many others, which spread throughout Europe and left scarcely more to be desired on the first principles of music as a science Palestrina, the principal cause of this revolution began his career by a diligent study of the masters who had preceded him making himself familiar with their difficulties and with their styles Applying himself to the simplification and purification of harmony, and to the discovery of more flowing and natural melodies he nevertheless paid a degree of homage to the preceding school whose pedantry and obscurity he knew how to correct

The Gothic style of composing masses and motetts on a canto fermo which he practised in his early compositions he entirely abandoned after 1570 His style upon which he was continually refining became at last the model of the age and after his time for a considerable period the best ecclesiastical compositions were honoured by being called *alla Palestrina* Nanino his fellow student and intimate friend Cifra his disciple Luca Marenzio and many other masters of the Roman school, gloried to tread in his steps, whilst Zarlino at Venice Costanzo Porta at Padua Orazio Vecchi and Monteverde at Mantua, Bottrigari and Orturi at Bologna endeavoured, and with considerable success, to build their counterpoint with the clearness purity, and elegance of the great master of modern music Among these, Monteverde is particularly to be noticed, for his passing beyond the master whom he followed He was the first who used double discords, such as the ninth and fourth the seventh and ninth, and the seventh and second, as also the unprepared false fifth and seventh This at the time created great disputes in the republic of music Monteverde in prefaces and letters, defended his practice, but his best defence was to be found in the progress he made The licences he took, far from being offensive to the ear, were soon adopted by others who had abused them The passion for fugues, canons and other difficult compositions of that nature, requiring the highest degree of science, continued in the 17th century which produced many learned musicians One of the most extraordinary of these was Francesco Soriano who published 110 canons upon the [illegible] five six, seven, and eight [illegible], but Fra. Vicentino went far beyond him, and has left, it is to be apprehended, all future canonists in a hopeless condition He wrote one to the words *Illos tuos misericordes oculos* &c resolved in more than two hundred different ways, for two, three, four, and five voices, another for ninety-six voices a third for twenty voices only, but with four different subjects going at the same time Other masters employed themselves in a similar manner Of the Roman school, also, Luca Marenzio merits special mention here though great in church music, he is best known and admired in the exquisite madrigals he composed, which still continue to be performed in this country Marenzio died at Rome, in 1599 At the head of the Venetian school, the Italians themselves place Adrian Willaert, a Fleming To him Zarlino attrib[illegible] than one choi[illegible] of St Mark at V[illegible] his disciples w[illegible] Porta The N[illegible] brated in Italy, and was established in the 15th century, under the reign of [illegible] of Milan, the patron of all the arts It was at N[illegible] whom we have before alluded to, Guarnerio, and many others, distinguished themselves Church and madrigal music there flourished In the latter branch, Carlo Gesualdo, Prince of Venosa, showed in an eminent degree the powers of that style of writing The Lombard school registers the names of Costanzo Porta, its head, Gastoldi, Guiseppe Biffi, and Paola Cima, of Milan, Pietro Ponzio of Parma, Orazio Vecchi of Modena, and Claudio Monteverde, before alluded to The most celebrated disciples of Porta were Balbi and Piccioli Orazio Vecchi was among the first composers of dramatic music, and for a considerable time maestro di capella at Mantua The Bolognese school comprises few writers in the 16th century, though in that following its professors equalled those of the first rank [illegible] Andrea Rota may be considered the [illegible] here in music seems to take no distinguished place we know of Alessandro Striggio and Francesco Cortuccia only who enjoyed much reputation

Dramatic music appeared in Italy in the 15th century a musical tragedy having [illegible] Peri, [illegible] the real epoch of the music of the drama can scarcely be dated [illegible] and first appearance was at Florence Ottavio [illegible] assisted at the post, and Peri the musician, both Florentines, and the name of the piece *Daphne* This priority is however, disputed in favour of Vincenzo Galileo, the father of the celebrated astronomer, who, desirous of recovering the musical declamation of the Greeks, [illegible] the episode of Ugolino [illegible] Upon the [illegible] of the seventeenth century the drama was principally recitative, when in 1649, Cavalli began to introduce more airs than had hitherto been used, which practice was further extended in the *Dorna* of Cesti, composed in 1663, after which, for some time, it degenerated so much into *spectacle*, that, in the works represented about the end of the 17th century, neither poet, composer, nor singers are recorded but the machinist and decorator only Among the composers were, however men of great knowledge and genius such as Gasparini Perti, Colonna, Lotti, and Alexander Scarlatti, who is said to have been the inventor of the obligato recitative Great improvements were introduced in the beginning of the 18th century by the pupils of Scarlatti, viz Leo, Vinci, Sarro, Hasse Porpora Feo, Abos and particularly Pergolese About the middle of the century appeared Jomelli, Piccini Sacchini Guglielmi Traetta, Anfossi, and others, whose names are not less celebrated than their predecessors and the century closes with Paisiello and Cimarosa It remained however, for a Bohemian, Gluck to accomplish the revolution which has brought the opera to its present state in Europe The great improvement in instrumental music towards the end of the last century induced operatic accompaniments with all the richness of the symphony which under Haydn Mozart, Cherubini, Spohr, Weber and many others, seems to have reached almost the height of power and effect that music can give

Europe is as much indebted to Italy for the introduction of instrumental as for that of vocal music the Italians have been the instructors in both Violin music was cultivated by Corelli and Tartini, and their pupils, before other nations had thought of it, and the same may be said of the harpsichord from Frescobaldi to Clementi So, in concerted pieces, Boccherini introduced the quintett, and indeed short of the symphony, which we owe to the Germans their early superiority cannot be disputed In our time a sensible decay is visible in Italian music, the art seems to have left its ancient seat to abide in Germany, where it has been cultivated with an ardour and success perfectly astonishing

*German Music*.—Like all other nations, the Germans owe their music to the Italians They received the Gregorian chant from Italy, [illegible] not have equalled their masters in [illegible] have greatly surpassed them in instrum[illegible] At the beginning of the 17th century, the music of Germany was greatly inferior to that of Italy, and it was not till the end of this century that the Germans began to evince [illegible] We are not acquainted with [illegible] the German church,—similar character we mean, to that produced by the school of Palestrina in Italy, but in later times the

writings for that church, by Graun, Haydn, and Mozart, have never been surpassed nor equalled, and though these very much partake of the symphony and drama, there is a pathos and sublimity about them calculated in the highest degree to inspire devotion In the madrigal style we believe they exhibit no specimens, which is the more remarkable, from the circumstance of the German school having been considered by some to have been of as early an origin as the Flemish Their oratorios possess the greatest beauties we need only name the *Ascension* and the *Israelites*, by Bach the *Death of Jesus* by Graun, and the *Messiah*, by Handel Though not so old as that of Italy, the German theatre is [illegible] but until Keyser appeared to compose for the [illegible] century, it was without [illegible] the last century, the German composers bred in the Neapolitan school carried their style into Germany, where it became predominant, and the model of the country John Adolphus Hasse had the principal share in the transference of this style, which improved by Graun Neumann, Gluck, and carried still further by Haydn and Mozart, has travelled back to Italy, to shine second hand in Rossini and others, but without the lustre of the Germans Gluck, of whom we have spoken above though by birth a German belongs properly to France, for, strange to say he was not properly appreciated by his own countrymen though in later years they found out their error, and acknowledge it still by the rapture with which his works are now received Germany derives its greatest reputation from the success with which it has cultivated instrumental music In harpsichord and piano-forte music, it may be safely said they have surpassed all other nations, for it would be difficult to place names that rest on equal reputation by those of J S Bach and his children of Haydn, Kozebech, Mozart, Dussek Cramer and a host of others The music of wind instruments seems to belong now almost exclusively to Germany their organists are excellent, and their orchestras well regulated In musical literature they are superior to every other nation witness the works of Mattheson, Marpurg Kirberger J Bach, Albrechtsberger Forkel Koch, and a host of others, most of them of the 18th century In the present day, it is by no means surprising that the success of the Germans should be so extraordinary seeing that there is no school *for the education of youth in the country* at which music is not taught and cultivated even down to those where children receive gratuitous instruction

*Flemish Music* — The Flemish have been frequently confounded with French musicians, so that it is rather difficult to separate at times, the one from the other Louis Guicciardini (*Descrizione di tutti i paesi bassi* published 1556) gives a list of all the musicians born in the Low Countries, who were then dispersed in different parts of Europe, which robs the French catalogue of some of its most distinguished names From the 15th century Flanders from its commerce and wealth, and superfluous riches, was enabled to patronise the fine arts and most especially was that the case in the times of Charles V and Francis I Upon these monarchs, who lived less in their own capitals than elsewhere the arts seem everywhere to have been attendant, and when we recollect their frequent sojourn at Brussels Antwerp and other cities of Flanders, we are not surprised at the number of excellent musicians that Flanders produced The John Tinctor of whom we have heretofore spoken flourished about 1474 he was a native of Flanders, and maestro di capella to Ferdinand of Arragon King of Sicily and Naples He is the earliest theoretician whose name has reached us Soon after, or contemporary with him, was John Okenheim, the first composer of music in parts From the fragments which have been preserved by Glareanus, he appears to have been a learned writer, whose works seem more calculated to please the eye than the ear, and from the authors of the following century who notice him, we learn that he was the writer of a motett in 36 parts Josquin, or, as the Italians call him Josquino del Prato, was Okenheim's most celebrated scholar The laws and difficulties of canon, fugue augmentation, diminution, inversion, and other practices of church music, were by him observed and overcome in the most felicitous manner, and he has by some been dignified with the title of father of [illegible] which as his era is nearly a century before that of Palestrina, Orlando di Lasso, &c It is proper to state that Guicciardini claims Josquin as an Italian, and, at least, there can be no doubt he was educated in Italy inasmuch as he was a singer in the chapel of Sixtus IV His [illegible] numerous and as often executed in the beginning of the 16th century as those of Handel were in England fifty or sixty years ago His death took place at Brussels, and his monument is still to be seen in the church of St Gudula Hobrect, or Obrect, was a good composer of this period and adds to his fame the honour of having been selected by Erasmus to instruct him in the principles of his art We must pass shortly over the names of Pierre de la Rue or Petrus Platensis as he was sometimes called Jean Mouton Verdelot Nicolas Gombert master di capella of Charles V, Jacques de Wert Pierre and Jean Waelrant or Wardelant Verdonk, Arkadelt, and others, many of whom are still known to the musical antiquary by [illegible] compositions, though they were called [illegible] parts in Flanders Between 1544 and [illegible] more than twenty collections of these *chansons* or madrigals published at Antwerp and Louvain, by Tylman, Susaro, and Pierre Phalaise, who were themselves good [illegible] as were in the same century, the publishers [illegible] Wechlin Gardano and Scotto at Venice, Ballard [illegible], and Tallis and Bird in England After Clemens (non papa), an elegant and exquisite, though not voluminous writer, and Cypriano Rore, a pupil of Adrian Willaert, must be recorded the name of Orlando di Lasso, one of the most diligent and celebrated writers of the 16th century He was born at Mons in 1520, and died at Munich in 1593 Living to a great age, the number of his works exceed those even of Palestrina Fifty collections of his different works are still extant, consisting of masses, motetts passions, psalms, and songs or madrigals, printed in Italy, Germany, France, and the Low Countries Such was his reputation, that the following verse was written for his epitaph —

Hic ille Orlandus Lassum, qui recreat orbem

M Ginguene, to whom we are much indebted for the account of the restoration of music speaking of Cypriano Rore and Orlando di Lasso, says, "These two Flemings, having passed the greater portion of their lives in the courts of princes had acquired a lighter style, and a species of melody more appropriate to secular music, than that of Palestrina who residing at Rome, and writing principally for the church, exhibits in all his productions a [illegible]" And again, 'They were the church excepted, they prepared the colours and set the palettes of musicians with many new tints of harmony and modulation, which were exceedingly serviceable to those who came after them' These were the two first masters who ventured upon chromatic passages and upon accidental flats and sharps From the epoch of these men Flanders ceased to have a school of music especially belonging to itself

*French Music* —We have stated in another place, that Hubald de St Amand and Eudes de Clugni have been named by the French writers as having preceded Guido in the knowledge of the scale, but as we are not in a condition to decide between the claimants, we shall content ourselves with the declaration of our conviction, from all that we have read, that France, as respects the art and science of music, was much advanced at a very early period, and that the country certainly boasted of many church musicians between the 8th and 11th centuries, for, besides the two we have named we have Remi, a monk of St Germain d Auxerre Gerbert le Scholastique, and others whose knowledge is well authenticated In the 14th century Philippe de Vitry archbishop of Meaux, applied himself to music and poetry with considerable success A manuscript preserved in the Vatican proves him to have been well informed upon counterpoint as far as it was then known and practised he not only applied himself to church music but wrote motetts, but these are lost and perhaps would if we had them, be now difficult to decipher Belonging to this century also, we have by the assiduity of the Abbe le Beuf the account of a manuscript by Guillaume de Machau This MS consists of two volumes of French and Latin poems and a great number of *lays virelays ballades* and *rondeaux*, all set to music, some for a single voice, others in three and four parts, — triplum, tenor, contra-tenor, and a part without title In the second volume is an entire mass, including the *Credo* in four parts, which it is believed was sung at the coronation of Charles V in 1364

During the 15th and 16th centuries the art made but little progress in France Under Francis the First not near so many musicians were to be found in France as in Italy Germany, England, and the Low Countries The works of Claude de Jeune, who probably ought to be placed with the Flemish school, and of Orlando di Lasso, seem to have been admired and performed at this period in the country in which Josquin was also a favourite The dearth of writers on the science at this period is no less remarkable [illegible] work of this period, by Clement Janequin, [illegible] *la Bataille ou Defaite des Suisses a la* [illegible] imitations of the sounds of [illegible] collection in 1544, called *Inventions Musicales a quatre et cinq Parties* The masters about this period were [illegible] Jambe-de fer, [illegible] sufficient to say that some [illegible] patrons of music [illegible] VIII may be [illegible] Charles IX whom were constantly good musicians Of them, Claude Goudimel did not escape in the massacre of the Protestants at Lyons in 1572 At the end of the 16th century were some minor

artists, such as Jean de Castre Louis Bisson Nicholas Duchemin, Francois Roussel Jean Perotn and others by whom are collections of madrigals Francois Eustache de Caurroy, born in 1549, called, by his cotemporaries, "le prince des professeurs de musique," was maestro di capella to Charles IX, Henry III, and Henry IV, and [illegible] however, are [illegible] was a similar [illegible] He composed the requiem for the funeral of [illegible] Ronsard, which was afterwards performed at that of Henry IV, whose reign [illegible] peace to make much pro[illegible] came to the throne at the early age of six years, was a great friend to music, and appears to have kept up what might be called a considerable band [illegible] During the reign of Louis XIII Jean Baptiste Boesset wrote several [illegible] songs, as they were called About the middle of the 17th century Michael Lambert, who died in 1696, appears to have attracted many scholars by his skill in composition Dramatic music was introduced into France about 1645 In 1660, at the celebration of the marriage of Louis XIV, the opera of *Ercole Amanti* was produced, and the foundation of the French opera was thus laid At this period Lulli, of Florentine birth, had been patronised by the Chevalier de Guise, through whose offices he was put under the best masters of the time Till the year 1686, in which his last opera was brought out, he seems to have been the idol of the court, and to have been considered in France the *ne plus ultra* of composers Compared, however, with the Italian opera of the same epoch his compositions are not far behind, though it was a misfortune for the country that, for so long a period every thing which was not an imitation of the style of Lulli was considered an inferior production Instrumental music made but little progress in the 17th [illegible] organists were the three [illegible] Couperins, Charbonieres who died in 1670, Dumont a good composer of church music who first introduced violin accompaniments into France, the Abbe de la Barre, and, lastly Lalande, the most celebrated French composer of ecclesiastical music, at the end of the 17th and beginning of the 18th century Rameau, born at Dijon in 1683 was destined to rouse the French nation which seemed to have slept since their loss of Lulli In the space of twenty-seven years after 1733 he produced 22 operas and became so great a favourite with the people that it was dangerous to criticise his works The time has however, passed in which his operas would be listened to and but for his theoretical works the only solid base of his glory he would long since have been forgotten Rameau died in 1767 His school lasted till about 1775 though since 1750 the comic opera has been on the Italian model Under this with Dauvergne le Borde Floquet J J Rousseau Duni and Philidor, French melody has regenerated and Monsigny, Gossec and Gretry completed its improvements The reform thus effected prepared the French for the reception of the *Iphigenie* of Gluck, in 1774 at which time he had Piccini and Lucchini for rivals These musicians have been succeeded by a school which comprises the names of Berton, Mehul, Boildieu Kreutzer and others, [illegible] their ranks are found [illegible] Winter In instrumental composition the French have not been so original, though latterly they have considerably advanced France is considered deficient in musical literature and does not attend to its cultivation with that ardour that is so manifest in Italy and Germany Their conservatory, however, is an establishment likely to do honour to the nation, and the work of Choron, — entitled *Principes de Composition des Ecoles d Italie, adoptes par le Gouvernement Français, pour servir à l Instruction des Eleves des Maitrises de Cathedrales Ouvrage classique formé de la Reunion des Modeles les plus parfaites en tout genre*, in 3 vols fol, — is alone sufficient to redeem the French from the accusation of wanting musical literature

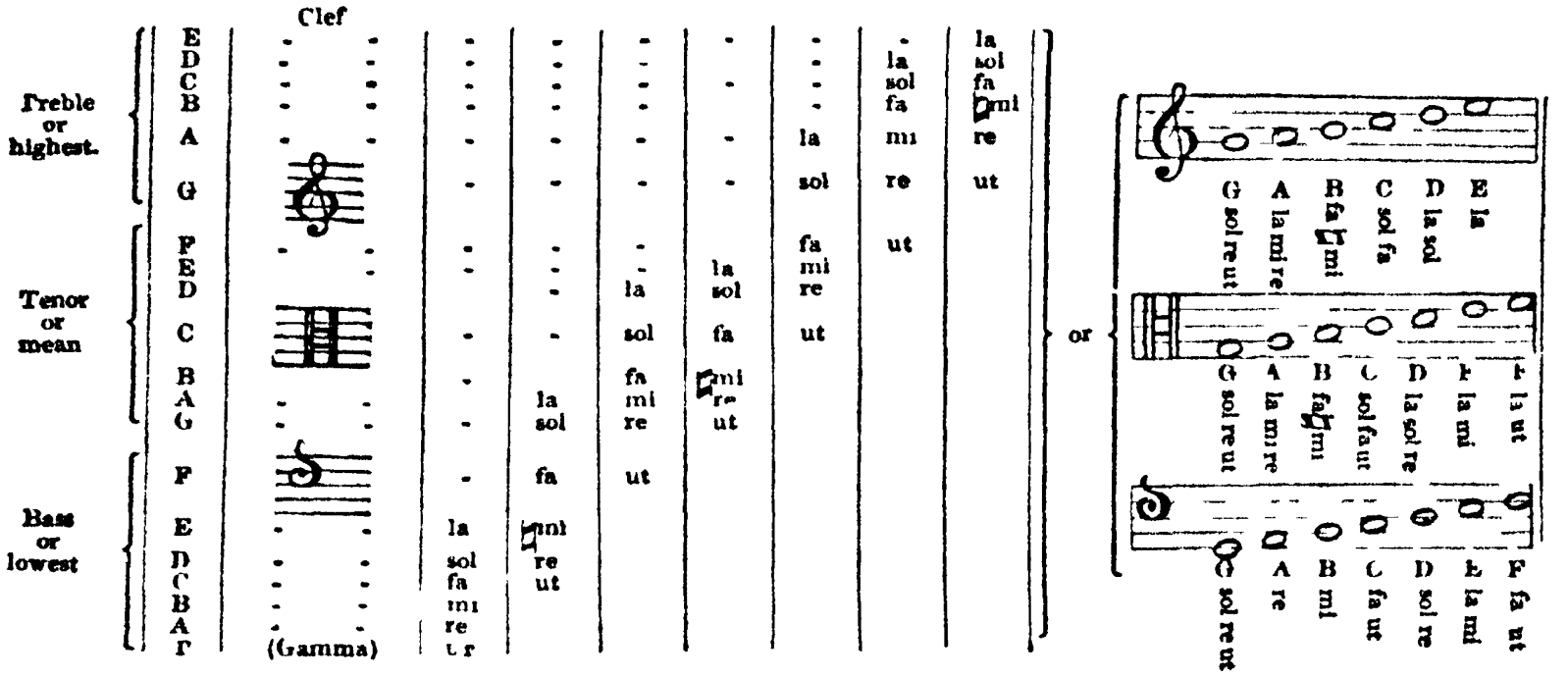
*English music* — We are not acquainted with writers in this country of earlier date than those of Italy, but for the honour of this country, however much we may have been behind Italy in the restoration of other arts in that of music we were formerly quite on a par with the Continent, and it is singular that in later years we should have lost our character, and we fear deservedly, among other nations It is certain that England can boast masses in four, five, and six parts written by natives, as ancient as those of the Italians themselves, we have also secular music in two and three parts and good counterpoint, in the latter end of the [illegible] and beginning of the 16th century, about which period to the English musician the names of William of Newark, Sheryngham, Turges, Tudor, Banester, Browne, and others, are familiar The first named was one of the musicians of Henry VI, and the compositions of Tudor are known from Prince Henry s (Hen VIII) music-book Henry VIII is known as a composer, from a beautiful anthem in Boyce's collection of cathedral music, and his patronage of Christopher Tye, the composer of *Laudate Nomen Domini* a motett frequently sung at madrigal meetings [illegible] the present day, shows that good music was [illegible] as it ought to be Marbeck in 1550, published the whole of the reformed cathedral service to musical [illegible] he had nearly be[illegible] reign of Elizabeth the talents displayed by our countrymen appear to have been surpassed in no other country, and music here was then indeed in its palmy state Tallis, Bird, Morley, Dowland, and Bull, were the principal composers of the reign Elizabeth herself could have been no mean per[illegible] she was able to play the pieces in her virginal [illegible] though it does not appear that James I took [illegible] in music it nevertheless continued to prosper during his sway, indeed, the compositions of Gibbons were, as pieces of church music, perhaps never surpassed in any age or nation neither are his secular pieces of inferior character This reign as well as the preceding was fruitful in madrigal writers as well as composers for the church, among the former of whom were Michael and Thomas Este, Bateson, Ward, Litchfield, Pilkington, Wilbye, Bennett, Farmer, Ford, and others, and among the last Tomkins, Elway Bevin, and Dr Nathaniel Gyles In the time of Charles I instrumental music was coming into vogue, the monarch was a pupil of Cooper (who was wont to be called Coperario), and used to practise the viol di-gamba He had a band of performers, eighteen of whom are known, including Nicholas Laniere, who was the master of it The most celebrated men of this reign were Dr Wilson, William and Henry Lawes, and Dr Child, who died in 1697 aged 90 after having been organist of St George's chapel, Windsor, during the extraordinary period of sixty-five years So intent was Charles upon advancing music, that he granted a charter to the most eminent musicians of that day, with many great privileges The art had been sinking for some years, but its fall was accele[illegible] of the cathedral service in 1643, [illegible] whom we hear during the time of Cromwell were William and Henry Lawes Though these men were favourites of Milton, and the subject of some of his verses they were sadly inferior to Tallis, Bird, and Gibbons During the interregnum the musical flame was chiefly fed at Oxford, but even there, from the year 1646, in which the king was forced to leave the city after the battle of Naseby until 1660 it was nearly extinguished At the Restoration it appeared again to flourish Child, Christopher Gibbons, Rogers, and Wilson, were made doctors of Oxford, the choirs again obtained good masters, and the organs, which had been destroyed by the fiend like rage of the Puritans, were again set up though with difficulty, from the scanty supply of organ builders Among the musicians who were attached to the court of Charles II was Henry Purcell of whom Dr Burney says that he, 'during a short life and in an age almost barbarous for every species of music but that of the church manifested more original genius than any musician under similar circumstances that any inquiries into [illegible] have yet discovered in any part of Europe This truly great man died Nov 21 1695 in the thirty seventh year of his age, his principal contemporaries were Dr Blow his master Pelham Humphreys, and John Weldon After Purcell s death some skilful men appeared as amateurs in the service of the church, namely, Doctors Holder, Aldrich and Creyghton among the professors were Jeremiah Clarke, Goldwin, and Doctors Croft Green, Boyce, and Nares Croft of all these was undoubtedly the greatest he like Purcell was a disciple of Blow always elegant and simple in his strains frequently grand and masterly he has not left a composition that does not exhibit great learning His death occurred in 1727, in the fiftieth year of his age Dr Boyce occupied the void which Croft s death had created, he was a good musician always pleasing but rarely grand in his compositions His contemporary Jonathan Battishill, wrote some fine compositions for the church and prepared the way in glee writing for a race of English musicians who are an honour to their country The reader will recognize the truth of this assertion when he glances at the names of Alcock Arne, Attwood W Beale Callcott, Dr Cooke, Robert Cooke, Crotch [illegible] Elliott, Harington Horsley, Thomas Linley the Earl of Mornington, Shield, Stafford Smith, Spofforth, the Wesleys, &c In dramatic and symphony writing, we regret to say England is still in her infancy

*Chinese Music* — The Chinese have had a system of music from a most remote period, and in its scale it seems to have more resemblance to the Grecian than any other to which it could be compared From the time of Yao and Chun which their chronology would carry back [illegible] centuries before Christ, they have had [illegible] eight species of sounds 1st, The sound of dried skins, such as drums, 2d, The sound emanating from stone, called *king*, 3d, That of metal, as bells, 4th That of baked earth, called *hiuen*, 5th, That from silk, called *kin* and *che*, 6th, That from wood,

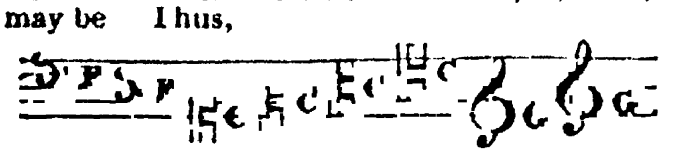
called *ya* and *thou*, 7th, That from bamboo, such as flutes, called *koan*, 8th, That from the gourd, called *cheng* Their scale consists of 14 notes, of which the seven middle notes correspond to our gamut from *f* upwards They seem unacquainted with harmony and we ought, perhaps to apologise for saying so much of it

*Hungarian Music* — About the 9th century the Hungarians left Asia to settle in Europe, when they conquered the country that bears their name Like all the Asiatics, they were attached to music and at first doubtless, used only Asiatic instruments These were nearly all wind instruments, and consisted of the trumpet, the flute, the cymbal, and several others Till the time of Mathias Corvin it was in a state of mediocrity, he incited the Hungarians to [illegible] and arts, of which [illegible] Under Ladislas and Louis II music was cultivated with great care, their national songs were, however, the only vocal music they possessed till the time of Stephen, king of Hungary, when the ecclesiastical chant appears to have been introduced In a diploma of Bela III, A D 1192, it appears that prince sent an envoy to Paris to be instructed in melody, perhaps induced to do so by his second wife Margaret, who was daughter of Louis VII of France

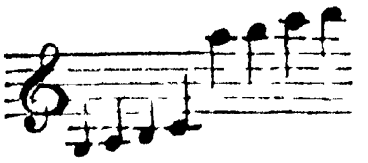
All musical ideas are expressed by means of *notes* on a *staff*, that is, five equidistant horizontal lines on or between which the notes are placed The *gamut* is a table whereon these notes are placed; and their relative situations as to acuteness or gravity of tone is ascertained by *clefs* The names of the notes, which are six in number, are *ut re, mi, fa, sol, la*, the lowest of these being the gamma of the scale Modern musicians have used as equivalents the first seven letters of the alphabet The arrangement in question is exhibited in the diagram below, a note having been added by the moderns to complete the octave



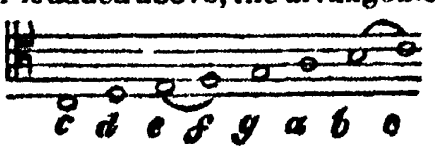

From this diagram it will be seen that the bass clef also called the F fa ut clef on whatever lines placed makes the notes on the line between the dots F or fa ut, whence reckoning is made upwards or downwards, that the tenor or C sol fa ut clef makes all the notes on the line between the cross or horizontal bars or sol fa ut, and that the treble or G sol re ut clef makes all the notes on the line round which the character turns G sol re ut, and it is to be observed that these several clefs may be put on any lines of the staff notes which then take the name F, C, or G, as the case may be Thus,



One of the most important ends gained by the use of these clefs is the avoidance of notes running off the staff which they otherwise would do, and what are called *ledger* lines would be wanted, thus,



where the ledger lines are those upon which the notes out of the staff are placed The lines of a staff are reckoned upwards, thus the lowest line is called the first the lowest but one the second, and so on When the F clef is placed on the third line, it is called the *baritone* clef, when on the fourth, the *bass* clef When the C clef is placed on the first line, it takes the name of the *soprano* clef, when on the second the *mezzo soprano*, when on the third, the *alto* or *countertenor* clef and when on the fourth, the *tenor* clef The G clef is rarely or never now placed on any but the second line, and is then called the *treble* clef It may be sometimes seen in old books placed on the first line, when so found, it is called the *high treble* clef In keyed instruments the C next to the middle of the instrument is the note of the tenor or C clef, the G above it to the right is the treble or G clef, and the F below to the left is the F or bass clef note When to the seven primary notes (see diagram) another is added above, the arrangement is called an octave, thus,

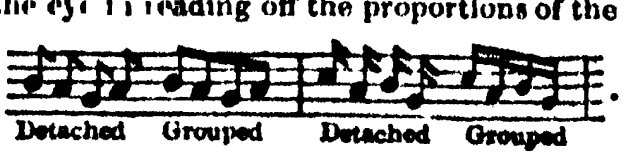



After which, if more be added either upwards or downwards, it will be but a return to similar notes either more acute or more grave in pitch, that is an octave above or below them respectively This which is called the *scale* has between its notes seven intervals of which those between *c* and *d*, *d* and *e* *f* and *g* *g* and *a* and *a* and *b* are equal and are called *tones* or *whole tones*, whilst those between *e* and *f* and *b* and *c* are *semitones* To inquire how nature has implanted on the ear dissatisfaction from any other position of these semitones in the scale of the octave is not the object of this treatise That it is so is certain, and the most uneducated whistler could not avoid it without exertion The scale is also divided into two *tetrachords*, from *c* to *f* and from *g* to *c* each of these consists of two tones and a semitone There is not a strict mathematical equality between these fourths, but for our purpose here — and the difference indeed is imperceptible except to the finest ear — that equality may be assumed As all *melody* or *air* which is an artful succession of tones, depends on a right perception of the places of the semitones, the above preliminaries must be well understood by the student

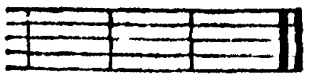
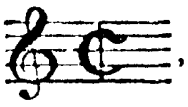
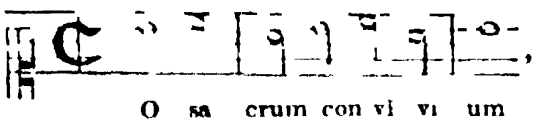
By the particular form of a note its duration, or length of time it is to be held on is known There are nine of these forms, which are exhibited in the subjoined table, in which the two first are now rarely used though in old ecclesiastical music they are constantly met with

| | | | |
|---|---|---|---|
| The large | equal to two longs | | |
| The long | — two breves | | |
| The breve | — two semibreves | | |
| The semibreve | — two minims | | |
| The minim | — two crotchets | | |
| The crotchet | — two quavers | | |
| The quaver | — two semiquavers | | |
| The semiquaver | — two demisemiquavers | | |
| The demisemiquaver | | | |

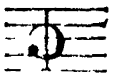
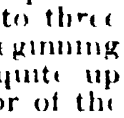
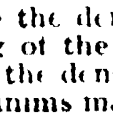
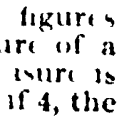
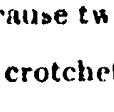
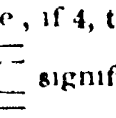
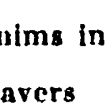
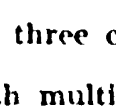
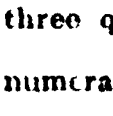
The notes with hooks appended to their tails are frequently [illegible] together this does not alter their value, but assists the eye in reading off the proportions of the notes Thus,



If a dot be added to the right hand of any note, thus ♩., it increases its duration exactly one half The duration of a note is measured by the musician from habit, and is regulated by *beating time*, that is, by the elevation and depression of the hand or foot quicker or slower according to the nature of the music performed A musical piece is divided into *measures*, which are equal portions of time, and the vertical lines which so divide it are called *bars*, single lines taking merely that name, and the two thick ones at the end of a strain *double bars*

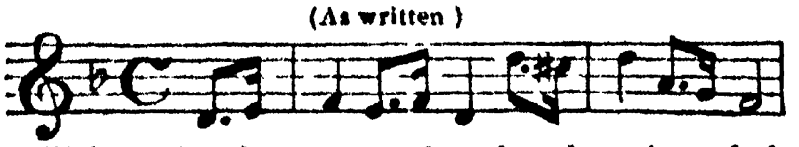
Thus,  Every measure must contain a certain number of notes according to the time marked at the [illegible] is of two sorts,— [illegible] two all others originate The first is of two sorts 1st, that in which each bar is equal to a semibreve in duration, 2d, that in which a minim in duration is equal to a bar Those common times in which a semibreve is the measure are marked by a C after the clef at the beginning of the staff, thus,  When the C has a bar through it, thus  , it denotes a quicker measure, thus  , and

O sa crum con vi vi um

is called *alla breve* but it is now usually written by dividing the breve into halves There is another sort of movement now very rarely used, it is very quick, and it is thus marked,  The other characters of common time are  , signifying that there are two crotchets in the bar of which (the denominator) four make a semibreve Triple time is so called from the bars being divisible into three parts it is beat with the hand down at the beginning of the bar raised a little in the middle and quite up at the close of it In this time the denominator of the figures placed at the beginning of the staff is a measure of a semibreve thus if 2 be the denominator the measure is a minim, because two minims make a semibreve, if 4, the measure is a crotchet, and so on Hence  signifies three minims in a bar,  three crotchets,  three quavers So again with multiples of 3 for the numerator  signifies three crotchets,  six quavers,  nine quavers,  nine semiquavers,  twelve quavers Other sorts of triple time are used, but if the reader keep in mind that the denominator always expresses the division of the semibreve, and the numerator the number of those divisions in each bar, no mistake can ever arise

There is a certain stress laid on some part or parts of every bar, which is called *accent*, hence each bar or measure is divided into accented and unaccented parts the accented are the principal and those on which the pathos and spirit mainly depend The beginning and the middle, or the beginning of the first half of the bar and the beginning of the latter half in common time and the beginning or first of three notes in triple time, are universally accented parts of the measure, so the first and third crotchet of the bar are on the accented part of the measure in common time In triple time, where the notes as we have explained go by threes, the note in the middle is unaccented and the first and last accented, the accent, however on the first is so preponderant, that the last is almost accounted as though it had none It is on account of accent that it is frequently necessary to begin a movement with only part of a measure Thus in the Welsh tune *Griffith ap Cynan*, —

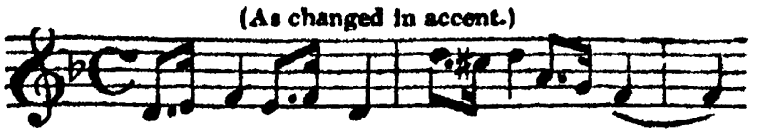
(As written)



it will immediately be seen that the alteration of the accent entirely changes

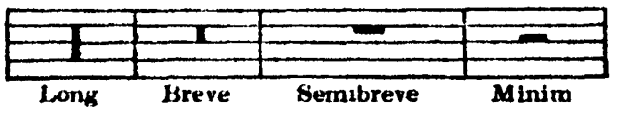


(As changed in accent.)

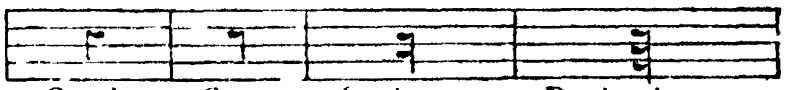


the character of the air When the last note of a bar (as in the last bar of the lower example) is connected with [illegible] as to make only one note [illegible] This is also sometimes used in the middle of a measure, also when a note of one part ends in the middle of a note of the other: the latter, however, is called *binding* or *legature*

A *rest* is a pause or interval inserted when silence is required in the part to which it is written, which silence is [illegible] of [illegible] —

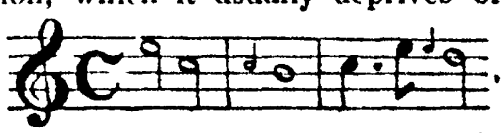
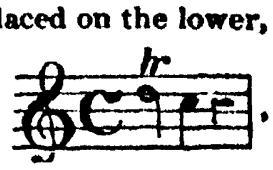
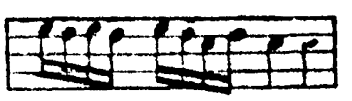
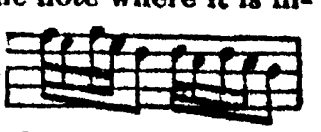


Long Breve Semibreve Minim

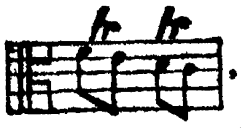
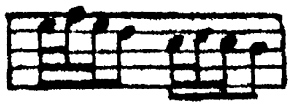


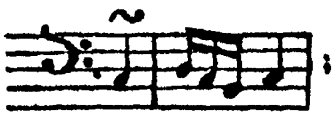
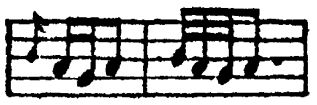
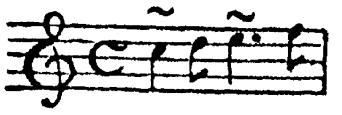
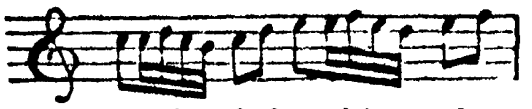
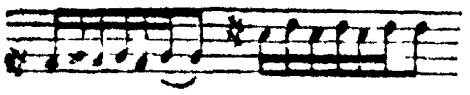
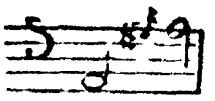
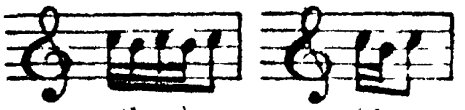
Crotchet Quaver Semiquaver Demisemiquaver

It has been already noticed that in the ascent of a note to an octave there are between the third and the fourth note, and between the seventh and the octave, semitones instead of whole tones, and this is what is called the *diatonic scale* It must therefore be evident, from this inequality, that supposing it were necessary, for the sake of the voice's compass or any other cause, to commence a piece of music higher or lower than it was originally written, the mere shifting the notes higher or lower on the lines and spaces would not represent the same relative proportions in all the intervals, because the places of the semitones would remain the same on the staff whilst their position with respect to the notes would be altered An expedient is therefore wanted by which the places of the notes may be raised or depressed the value of a semitone The former, that is raising them, is effected by placing sharps before them, thus ♯, and the latter by means of flats, thus ♭ If we want to restore any note that has been thus treated to its original place it is effected by means of a natural thus ♮ Two other characters are also used — the double sharp, thus ×, which raises a note two semitones, and the double flat 𝄫 which equally depresses it Upon keyed instruments such as the pianoforte and organ, these sharps and flats are represented by the short black keys, and there is no distinction between D♯ and E♭, and such want of distinction is an imperfection in the instrument, for as we have before hinted, there is not a strict mathematical equality between the semitones of the diatonic scale The number of these flats and sharps at the beginning of a staff affect all the notes of the line or space on which they are placed, and are termed the *signature* If in addition to these in the course of a movement any other occur, they are termed *accidental*, and only affect the notes which they immediately precede and those also in the same bar but if in the same bar any note after having been accidentally raised, on being repeated is preceded by a natural, such natural restores it to its original place

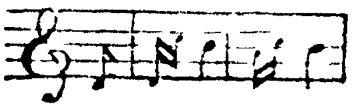
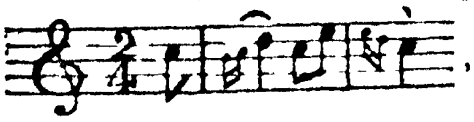
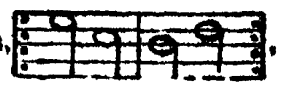
The ornaments of musical melody are called *graces*, the principal of which are the *appoggiatura*, the *shake*, the *turn*, and the *beat*, with the *mordente*, *beat*, *slide*, and *spring* peculiar to the Germans those of musical harmony are the *arpeggio*, the *tremando*, &c The appoggiatura which always occurs on the accented part of the measure is a small note placed before a large one of longer duration, which it usually deprives of half its value, thus,  , wherein the small notes are appoggiaturas Occasionally, the appoggiatura is only one quarter of the note it precedes The shake is a quick alternate repetition of a note with the note above it, the mark *tr* being placed on the lower, and the upper one not expressed, thus  , performed  When there are a series of [illegible] Italians call it *una ca* [illegible] the *passing shake* is thus marked ≈ over the note where it is intended, thus  , performed 

The mordente of the Italian school is used similarly;

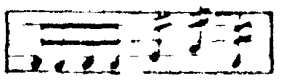
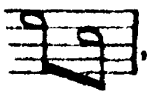
thus  , performed 

The turn employs the note above and that below in the following way,  ; performed  The inverted turn, thus marked ∽, turns from the note below that marked instead of above it Turns on dotted notes are very frequently used, they are written as follows  performed  The beat is the reverse of the shake without the turn, and is generally made at the distance of the semitone below, hence all the natural notes, except C and F, require the note below them to be accidentally sharpened for the beat, thus  , performed  The half-beat is most frequently used in the bass and is very similar to the acciacatura of the Italians The inferior note is struck only once, and at the same time with the principal note, but is immediately quitted, as  The Italians use the degree above The German mordente is a beat commencing with the note itself and is either long or short, thus, 

(long) (short)

This differs from the mordente we have already described by being made with the next degree below The Italians use the degree above The German beat consists of two small notes, forming a skip, descending one degree upon the principal note, written thus  performed  Naumberger calls this grace a double appoggiatura The German slide consists of two small notes, which move by degrees, written thus  , performed  The German spring, like the Italian mordente, consists of two small notes, sounded distinctly, thus  , performed  It is the practice of the composer to mark, where necessary, the occasional alteration of these graces by sharps, flats or naturals The graces that belong to harmony are, the *tremolo*, or reiteration of one of a chord, the *tremando*, or general trembling of the whole chord, and the *arpeggio*, which is an imitation of the harp, the notes of the chord being struck in quick and repeated succession The following characters are also used in Music —the *pause* 𝄐, which, placed over a note, signifies that a long continuance of the sound is to be made on that part of the measure, and is equally effective when placed over a rest, the *repeat* 𝄇, which is a sign placed to show where the performer must return to repeat the passage, — the Italians call it *il segno*, the *direct* w always placed at the end of the staff on the line or space which the following note occupies The dots which are found in the inner side of bars show that the measures or bars included by them are to be repeated; thus,  , shows that these two bars are to be played twice over, the same object being sometimes effected by writing the word *bis* over them

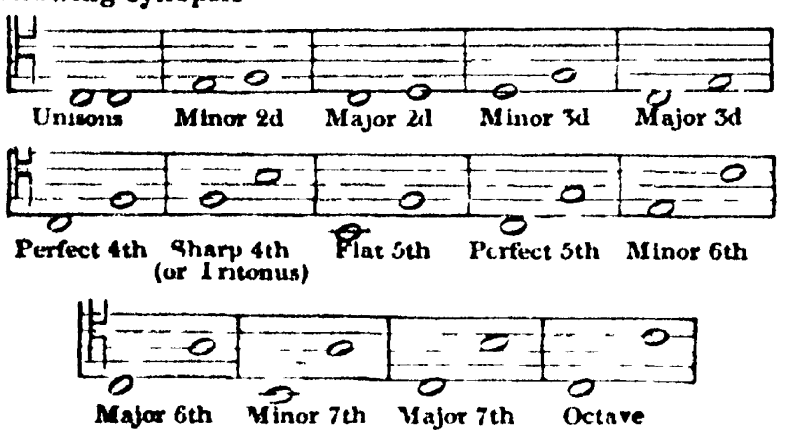
We have already treated these [illegible] all that we have to add on them here is, that as every bar or measure contains a certain number of notes, so every *strain* consists of a certain number of measures, which are terminated by the double bar

*Expression* in music is indicated by the following marks — The *tye* which is a convex line over ⁀ or a concave line under ‿ two notes [illegible] ing them into one It is also [illegible] notes where the bar divides the [illegible] line, used over notes not on the same lines or spaces, showing that such notes are to be played smoothly; and in vocal [illegible] stroke [illegible] Sometimes [illegible] mostly [illegible] an interme[illegible] yet uniting the one and the other, thus,  The other marks of expression are the *crescendo* <, by which the sound is to be increased from soft to loud, the *diminuendo* >, which is exactly the converse of the last,—the union of these two <> indicating that the first part is gradually increased from soft to loud in the middle, and the [illegible] and the *rinforzando* for which smaller [illegible] sort are used >< , which increase or diminish the sound so marked In order to save time in writing and copying music the following abbreviations are used —A single stroke placed over or under a semibreve or through the stem of a minim or crotchet, divides it into quavers a double stroke into semiquavers and a triple stroke into demisemiquavers, thus,  The other kind of abbreviation is much used in modern music, and is effected by grouping the stems of minims like those of quavers, thus  , performed 

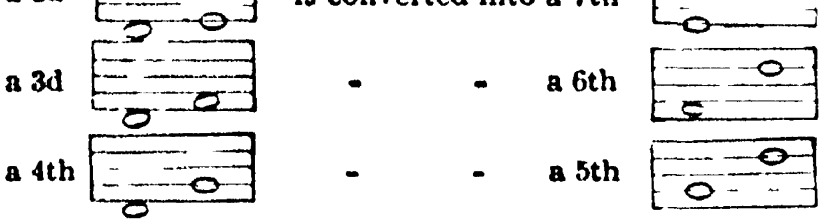
*Melody*, which will be perhaps better understood by the term *a tune* is a particular succession of sounds in a single part and is produced by the voice or an instrument The artful manner of introducing the notes of different lengths and succeeding one another at intervals pleasing to the ear is one of the desiderata of the musician the other being the successful accompaniment of these single sounds by others according to the laws of harmony As respects tune or air melody has two motions,—either by degrees or by skips by the former when it moves to the line or space immediately above or below it, and by [illegible] the [illegible] shows each motion 

The distance between any two notes is called an interval, and it is customary to measure it from the lower of the two notes which by their names indicate the number of degrees whereof the interval [illegible] in the diatonic scale whole [illegible] tones It may be as well to explain here the term *diatonic* It is derived from two Greek words *δια through* and *τονος a tone*, because, through [illegible] in this scale, it proceeds by whole tones, five out of the seven being of that description, and the other two being semitones And again, that the notion of an interval between sounds may be properly acquired and felt, we would hint that it may be comprehended by stretching a string between two fixed points so that upon being struck its vibrations are free and will yield a sound Now a string half the leng[illegible] etched will yield a sound exactly one [illegible] the intermediate lengths, therefore, between 1, which we will assume the first string to have been, and ½, the length of the second at a certain place, according to a certain ratio, will yield the different sounds of the octave thus we may acquire a distinct notion of intervals of sound by absolute intervals of length To return, then, to different intervals in the octave If we count from the lower note to its octave, there will be found the following intervals —First, the *unison*, which in harmony is

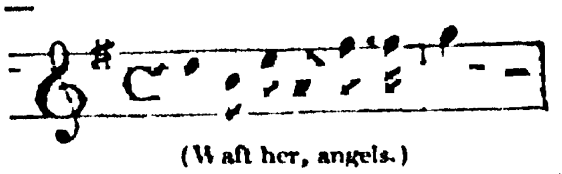
accounted an interval, though it be the same identical sound Second, the *minor second*, sometimes called the *flat second*, is the interval formed by two sounds at the distance of a diatonic semitone from each other Third, the *major second*, consisting of a whole tone Fourth, the *minor third*, containing a whole tone and a diatonic semitone Fifth, the *major third*, consisting of two whole tones Sixth, the *perfect fourth* containing two tones and a diatonic semitone Seventh the *sharp fourth*, containing three whole tones, and called thence by the ancients the *tritonus* Eighth, the *flat fifth*, containing two tones and two semitones, which, however, are not equal to three whole tones, but rather to two minor thirds Ninth the *perfect fifth* containing three tones and one semitone, equal to a major and a minor third Tenth, the *minor sixth*, consisting of three tones and two semitones Eleventh, the *major sixth*, which consists of four tones and one semitone Twelfth, the *minor seventh*, containing four tones and two semitones, or ten semitones Thirteenth, the *major* or *sharp seventh*, composed of five tones and one semitone, or eleven semitones Fourteenth and last, the *octave*, consisting of eight degrees The above fourteen intervals are given in the following synopsis —




By inserting the semitones between these intervals, the number which we have above stated in each will be easily discovered When the lower note of any interval is placed an octave higher, or the higher note an octave lower, it is called *inversion* Thus,

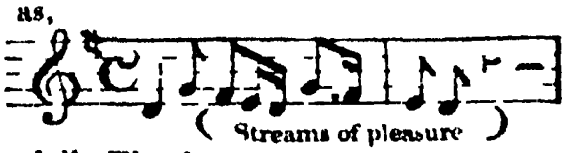



By this operation major are converted into minor intervals, and the converse, for instance the sharp fourth becomes a flat fifth and the unison becomes an octave We will here mention an ancient division of melodies, which at least ought to be understood by a student — namely into that of *authentic* and *plagal* melodies The former are those whose principal notes are between the key note and its octave, of which the following is the example given by Calcott, in his Grammar, from Handel's *Jephtha*, —



(Waft her, angels.)

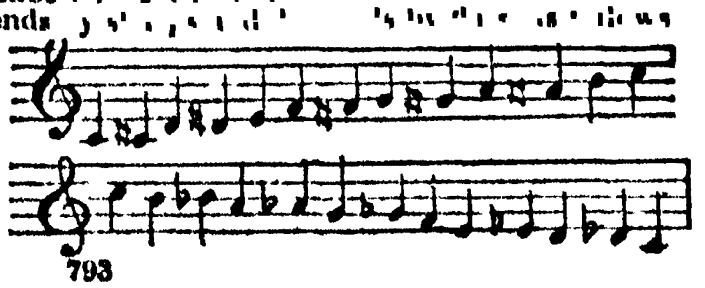
The latter, on the contrary, have their principal notes contained between the fifth of the key and its octave, or twelfth, as,



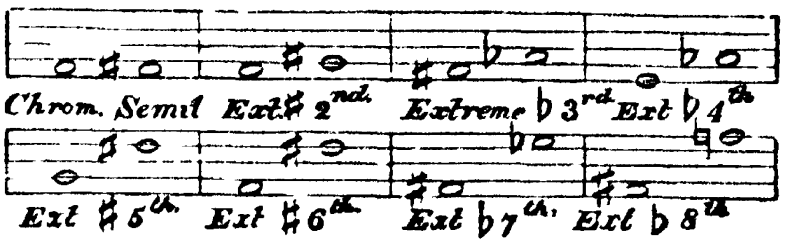
(Streams of pleasure)

from Handel's *Theodora*

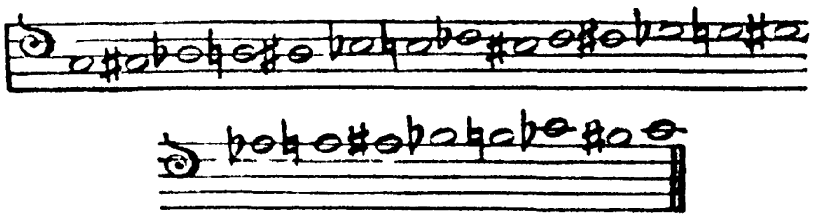
There are three scales occasionally used in music the *diatonic*, which has already been explained, and the *enharmonic* The chromatic — which, to some, takes its name from the Greek word *colour*, because they suppose the Greek [illegible] by different-coloured characters, according to others because holding the mean place between the diatonic and enharmonic system, it was like colour between black and white; [illegible] it embe[illegible] ascends [illegible]



From this it appears that the chromatic scale consists of thirteen tones, with twelve intervals between them, whereof we have already, among the diatonic intervals, described seven, the other five form a distinct species of intervals called *chromatic* First, the *chromatic semitone* is the interval between any note and the same depressed by a flat or raised by a sharp Second, the *extreme sharp second*, which consists of a tone and a chromatic semitone, being composed of two degrees Third, the *extreme flat third*, which contains two diatonic semitones, consisting of three degrees, or it is the minor third diminished by a [illegible] Fourth the *extreme flat fourth*, [illegible] and consisting of four degrees, or it is the perfect fourth diminished by the chromatic semitone Fifth, the *extreme sharp fifth* which is the perfect fifth increased by the chromatic semitone Sixth, the *extreme sharp sixth*, or the major sixth increased by the chromatic semitone, consisting of five degrees [illegible] divisible into a major third and sharp fourth Seventh the *extreme flat seventh*, or the minor seventh diminished by a chromatic semitone, it is composed of four tones and two diatonic semitones, and [illegible] three minor thirds Eighth, the *extreme flat eighth*, or octave diminished by the chromatic semitone This is never used in melody The above intervals are exhibited in the subjoined synopsis

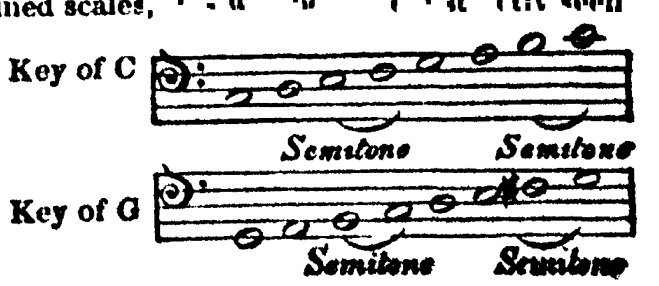



The enharmonic scale, so called from the augment *en*, and signifying extremely harmonious, or well knit together is a series formed by uniting the ascending and descending scale of the chromatic genus It contains intervals smaller than the semitone not, indeed, exactly half the semitone, but, [illegible] there [illegible] small [illegible] to it, called the *diesis*, a [illegible] We have before hinted that there is not a strict mathematical equality between the tones in an octave Our limits do not permit to pursue that question further than to say, that that tone which is between the fourth and fifth of the scale is divided into nine small parts, called *commas*, whilst that between the fifth and sixth of the major scale contains only eight commas The diatonic semitone contains five commas, and the chromatic semitone three or four, according to the magnitude of the tone Now the enharmonic scale divides each tone into two chromatic semitones and a quarter tone, but we subjoin a diagram of it

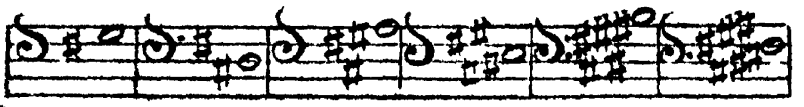


In this scale we have inserted the intervals E♭ and and E♯, also C♭ and B♯, but they do not properly belong to the scale, as their distance is less than a quarter tone We have omitted above to state that there is another interval, which, by calculation, is found to be a comma and a half and is called *hyperoche*, or an *excess*

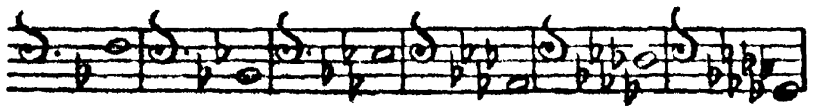
As in oratory there is a principal subject whereon the speaker constantly dwells, and to which, after diverging from it, he always returns, so in music there is one sound in which the piece begins and ends, which regulates the rest, and to which regard must be had in all the other sounds of the piece, and this sound is called the *key*, and the principal note the *key note*, or *tonic*. From the diatonic scale we have seen that the semitones lie between E and F, and B and C, the key note being C Now if we wish to make G the key note, it is clear that without some contrivance the writing the notes from G to its octave will throw one of the semitones out of its place, namely, that between F and F which, instead of being, as it ought to be, between the seventh and the octave, is between the sixth and the seventh It is obvious, then if [illegible] of a ♯, we shall [illegible] to that which it [illegible] By comparing the subjoined scales, [illegible]



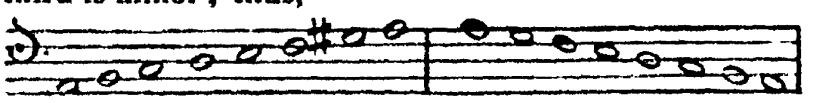
Now if D be taken as the key note, we shall find it will be necessary to sharpen the C as well as the F, in order to bring the semitones into the places they ought to occupy in the octave, and we shall have two sharps In order to save the constant repetition of these sharps, it is usual to put them at the beginning of the staff, where they are called *signatures*, thus,



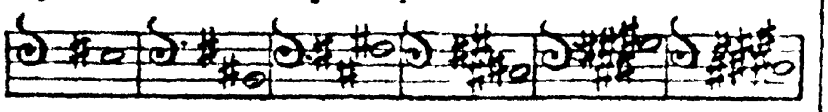
In the same way the keys bearing flats are marked, saving that the seventh of the original key bears the first flat, as follows.—



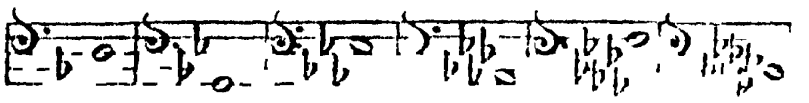
Besides these scales, which are all constructed with the major third, and are therefore called major keys, there is a scale constructed from the natural notes whose third is minor, thus,



In which it must be observed, first that the places of the semitones are different, and second that the ascending scale always [illegible] it is not sha[illegible] in question is, however, always omitted in the signature, and marked accidentally where the melody requires it It must be here noted, that between the [illegible] and G♯ a harsh chromatic interval called an *extreme sharp second*, occurs, to avoid which the sixth is sharpened by which the scale of the minor mode has two notes different from the signature, but in the descending scale no accidentals are required The minor modes, whether proceeding by sharps or flats, have exactly the same signatures as the major mode Thus by sharps we have



and by flats,

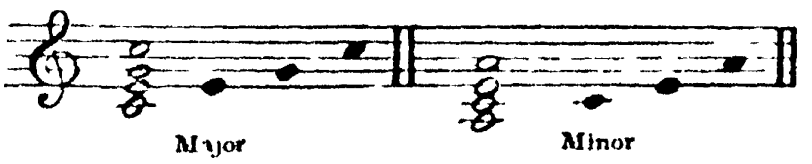


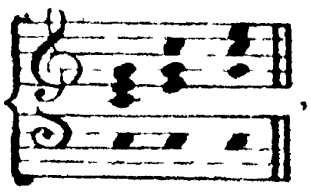
Major and minor scales which have the same signatures are denominated *relative* Thus the relative minor keys of A is E♯, in which case the tonic or key note of the minor mode is found to be the sixth note ascending of the major scale bearing the signature and the tonics are always one degree below the last sharp of the signature but in flat signatures always the third degree above the last flat

The change of a melody from its original to a higher or lower pitch is called *transposition* and this may be effected by altering the signature according to the pitch of the new tonic or key note This alteration may be also accomplished in every minor melody If a melody is performed in the relative or tonic minor being originally major, the change is not called transposition but *variation* *Modulation* is the motion of the melody on the key in which it has commenced and the alteration by new flats and sharps of the original scale Modulation comprehends the regular progression of several parts through the sounds that are in the harmony of any particular key, as well as the proceeding naturally and regularly from one key to another Every scale is immediately connected with two others oneon the fifth above which adds a sharp to the signature, the other on the fifth below or fourth above by which a new flat is added to the signature These were called by Dr Boyce *attendant keys* Minor scales have in like manner their attendant keys

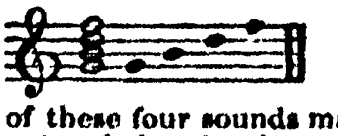
We here subjoin, from the late Dr Callcott's excellent Musical Grammar, the names given to certain notes in the scale as peculiarly marking their character, though we do not intend to use them in the following part of this short essay 1st, The *tonic*, or key note is the chief sound upon which all regular melodies depend and with which they all terminate All its octaves above and below are called by the same name 2d, The *dominant*, or fifth above the key note, is that sound which from its immediate connection with the tonic is said to *govern it*, that is, to require the tonic to be heard after it, at the final cadence in the bass 3d, The *sub-dominant*, or fifth below the key note, is also a species of governing note, as it requires the tonic to be heard after it [illegible] It is the fourth in the regular ascending scale of seven notes and is a tone below the dominant, but the term arises from its relation to the tonic, as the fifth below These three principal sounds are the radical parts of every scale, of the minor as well as the major, and all melodies are derived from them. 4th, The leading note, or sharp seventh of the scale, is in Germany called the *subsemitone* of the mode, it is always the major third above the dominant, and therefore in the minor scales [illegible] sharp or natural whenever it oc- [illegible] *mut*, or middle note between the tonic and the dominant ascending, varies according to the mode, being the greater third in the major scale, and the lesser third in the minor scale 6th, The *submediant*, or middle note between the tonic and subdominant descending, varies also according to the mode, being the greater sixth in the major scale, and the lesser sixth in the minor scale 7th, The *supertonic*, or second above the key note, has seldom been distinguished in England by this or any other appellation In theory it is considered as a *variable* sound, being a comma higher in the major scale than when the mode changes to the relative minor

Harmony consists in the combination of two or more sounds or melodies heard at the same moment, the intervals between such sounds having been already defined A *concord* is an agreeable relation of two sounds as respects the ear, such sounds which are agreeable compounds singly being [illegible] also in succession, subject to certain laws Concord is therefore included under the term harmony though more properly applied to the agreeable effect of two sounds in consonance, whereas harmony involves the agreement of a greater number of sounds than two When two sounds either in consonance or succession are disagreeable to the ear, the relation between them is called a *discord* The concord then may be called a harmonical interval and the discord an inharmonical one, yet by the proper interposition of discords the harmonies of a passage receive a lustre and value from the contrast They must however as we shall presently show be properly *prepared* and *resolved*, as it is technically called The union of any sound with its third (major or minor) and its perfect fifth is called a *common chord*, to which if the octave to the sound be added, we have a combination of four sounds in the harmony, thus,

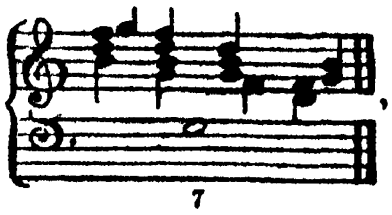



So long as in these chords the C or the A remain the lower note the chord is called the common chord of C or A respectively, but the moment the position of the lower note is [illegible] of the chord also changes Thus [illegible] C be used as the lowest or bass note, thus  , the chord is called a *sixth*, because the key note is then the interval of a sixth upwards from the bass note and that sixth has for its accompaniment a minor third from E to G

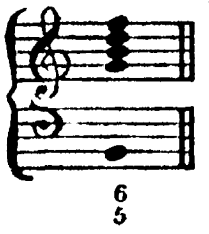
If G be now placed at the bottom and used as the bass note, thus  , the key note is an interval of a fourth above the bass and the chord is called a *fourth* and as the example shows is accompanied by a sixth From this it is manifest that the sixth and fourth are no more than inversions of the common chord having the same note C for their expressed or understood bass, which is called the *fundamental bass*, because it is that on which they are founded, and the same arrangement equally exists in the common chord with a minor third The common chord is expressed shortly thus, $\frac{5}{3}$, or $\frac{8}{3}$; but $\frac{8}{5}$ they are frequently omitted The second example or chord of the sixth is merely figured with a 6 and the third example, where G is the lowest note, is denoted by the figure $\frac{6}{4}$

Of discords the most simple is the minor seventh, or, as some call it the *dominant seventh*; because it occurs only on the fifth or dominant of the key, and requires that part in which it occurs always to descend one degree We here give its full accompaniment of four real parts  As in the common chord either of these four sounds may be placed as the bass or lower note of the chord, yet as with C in the common chord the fundamental note of it will be G, B being a

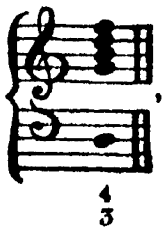
third, D a perfect fifth, and F a minor seventh; thus,



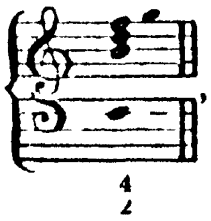
, in each of which cases it would carry the figure 7 below it Sometimes, however, it is figured below, $\begin{matrix}5&7&5&3\\5&5&3&7\\7&3&7&5\\&8&&\end{matrix}$, such positions containing the tenth, twelfth, and fourteenth of the root, when the octave is removed When B becomes the bass note, as



the chord by inversion consists of a minor third, an imperfect flat or false fifth, and a minor sixth, and is, as in the example, figured $\frac{6}{5}$ If D be next taken as the bass note, thus



, the chord consists of a minor third, perfect fourth, and major sixth, and is, as in the example, figured thereunder $\frac{4}{3}$ If F be used for the lower or bass note, thus

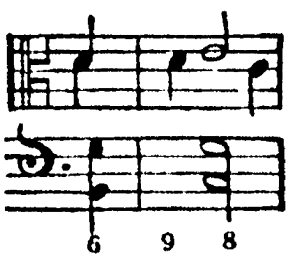


, the chord is composed of a major second, sharp fourth, and major sixth, and is figured $\frac{4}{2}$

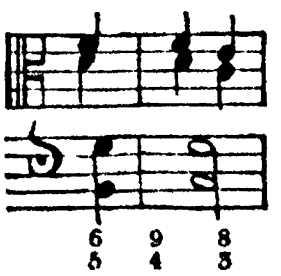
From these observations it appears, therefore that the three last chords are properly called derivatives of the minor seventh when accompanied with a major third and perfect fifth By some authors these three chords are called the syncopated fifth, the syncopated third and the syncopated second respectively Besides the chords within the compass of the octave, there is the *ninth*, which is usually accompanied with a third and fifth, thus,



When used in a composition of four parts, and marked by a single 9, it has the accompaniment of a third and fifth, thus,

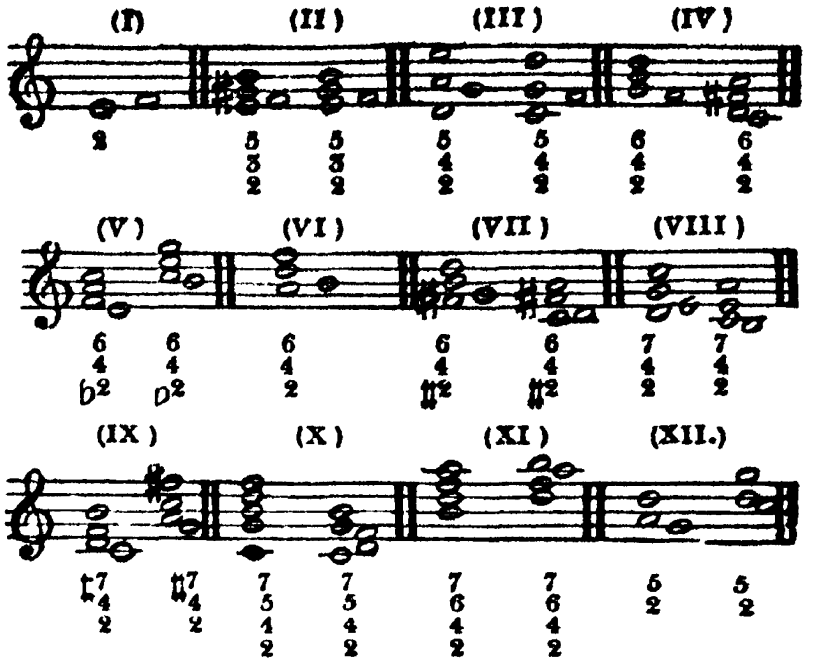


Frequently, however, it is accompanied by a fourth and fifth, and then is marked with a double row of figures, thus,

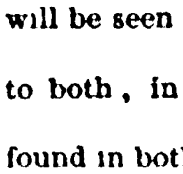


When the composition is in only three parts, the fifth is not used With the third and fifth as an accompaniment the ninth becomes then an appoggiatura to the octave in the place of the eighth The ninth has two inversions one of them figured with a seventh on the third of the fundamental note, the other figured with a fifth and a sixth on the fifth of the fundamental note

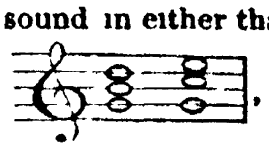
When the figures 4 and 6 are dashed, thus $\not{4}\not{6}$, it indicates that they represent a sharp fourth and a sharp sixth It will perhaps be useful, in this place, to place before the reader a synopsis of all the discords from the seventh upwards they are all inversions of the seventh sharp or flat, with major or minor thirds



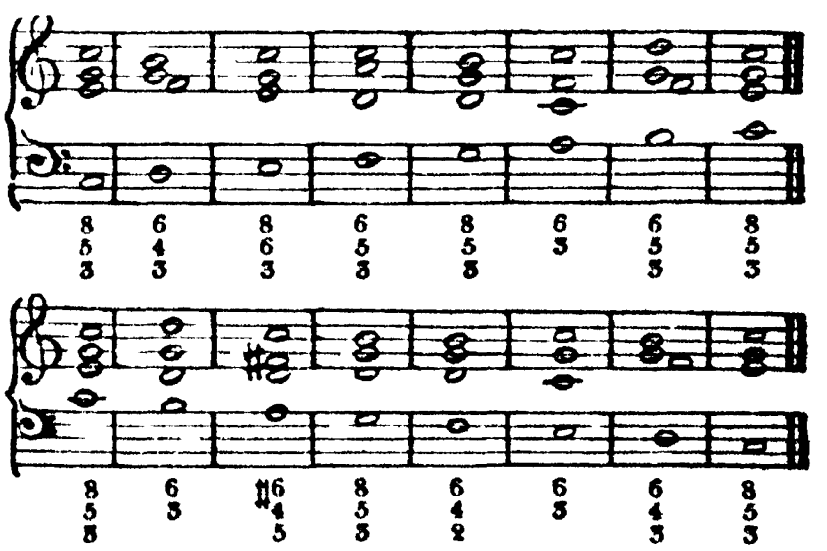

In the above table I is the second, and it is the lower note which is the discord, II contains four real parts without octaves or unisons, and its use is to retard the $\frac{6}{4}$ or $\frac{6}{5}$, IV is also with four real parts, three of which form a common chord above the bass, which note is the discord, VI is the imperfect common chord, with a whole tone added below, VII is the major second, perfect fourth, and minor seventh, and is used to retard the [illegible] in the bass, X is [illegible] which the figure 4 is the [illegible] sharp seventh, XI is the chord of the thirteenth,—the sixth may be either major or minor, in XII the fifth must be perfect, the second either major or minor, and either the one or the other may be doubled The above is a concise view of the *figured* or *thorough bass*, called by the Italians *basso continuo*, and the reader will recollect that all chords may be reduced to the fundamental bass by bring- [illegible] or to that of the [illegible] ing as a sound is or is not



, these two chords, which are irrelative, it will be seen there is no sound in either that is common to both, in the chords



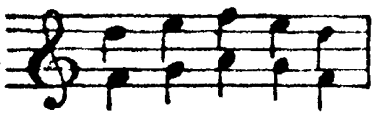
, the G being found in both chords, they are relative If in proceeding from one chord to another any note of the previous chord is kept in that which follows, the process will produce correct harmony The discords, where they appear, must of course be *prepared* and *resolved*, whereof we shall hereafter speak, and care must be taken to avoid progressions of fifths and octaves between the extreme parts when both move the same way Before leaving this part of the subject, we subjoin, as properly belonging to it, what is called the harmony of the scale, that is, the accompaniment which it carries in ascending and descending —



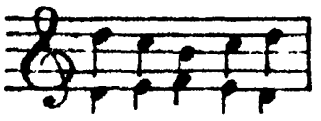
*Composition* is the art of joining and combining concords and discords [illegible] that their succession and progress [illegible] may be agreeable to the ear It may be here mentioned that melody being chiefly the business of the imagination, its rules serve only to prescribe limits to it, beyond which the imagination in searching out the variety and beauty of the airs ought not to go But harmony is the work of the judgment; and its rules are more certain and extensive, and more difficult in

practice A person, indeed, unskilled in music may by chance make a piece of good melody, but a person of judgment does it with certainty In harmony the invention has not so much to do, for the composition is conducted from a nice observation of its rules, assisted also by the imagination It is not to be expected that in the compass of this article space can be afforded for a complete treatise on this part of the subject, all that we propose is to present to the reader some of the leading rules of the science

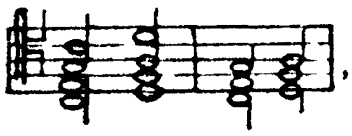
The different motions of the parts which constitute harmony are *direct* and *contrary* In the former the parts move the same way, ascending or descending There is also a third motion, according to some, called *oblique motion*, but that may be classed under contrary motion In direct motion, the parts move the same way, ascending or descending,



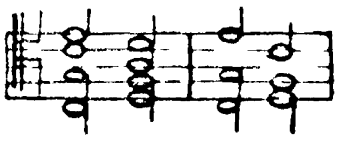
In contrary motion, one of the parts rises whilst the other falls,



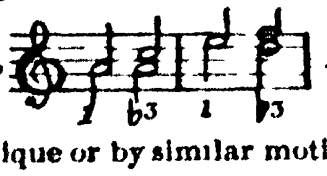
The use of these motions enables the composer to avoid harmonical irregularities in the use of octaves and fifths and in other points The following are the leading rules of harmony, as regards the motions and successions of concords — First, octaves and fifths must not be consecutive in direct motion For instance,



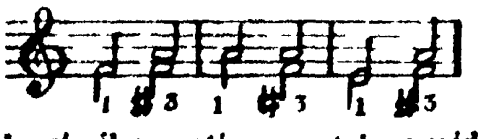
, where the motion is direct, may be avoided by giving the passage contrary motion, thus,



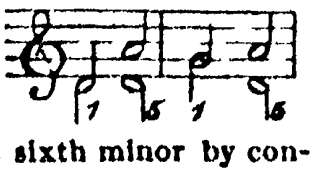
Second, unnecessary and distant skips must be avoided as much as possible, and the chords should be kept as close and as much connected as may be Third false relations such as the extreme sharp second, must be avoided, unless the same be required for the purpose of expressing some particular effect Fourth, the regular motion of the different sharp intervals minor or flat intervals must descend after the flat In observing this rule, however, that of avoiding consecutive octaves and fifths must nevertheless be observed neither is to be strictly observed where certain effects are required It is customary for compositions to begin with one of the perfect concords of its key note, namely the octave or fifth, and it should end in the key note with its common chord for the harmony It should not begin or end with a sixth, though it sometimes may with a third To these we may add, that you must not go from an imperfect concord to a perfect concord by similar motion, such passages being said to contain *hidden* octaves or fifths, which will be seen by filling up the diatonic degrees through which one of the parts is conceived to pass With these prefatory remarks we shall now proceed to some few details of the laws of harmony In proceeding from the unison, when both parts move, it is better to go from it to the third minor than the third major We may go to the minor either by oblique or contrary motion,



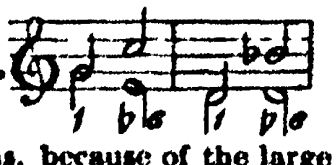
, but to the major it must be by oblique or by similar motion, the first being the best,



A fifth after a unison by similar motion must be avoided it is good in oblique motion, and is allowed in contrary motion, one part moving a single degree,

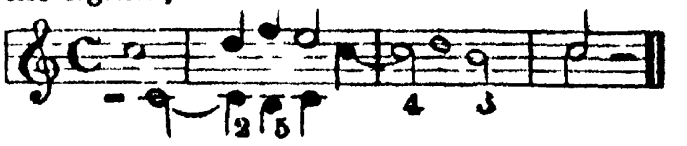


From the unison we may go to the sixth minor by contrary motion,



it is not good by the other motions, because of the large leap But from the unison to the sixth major is forbidden An octave after a unison except by oblique motion must be avoided, inasmuch as in two unisons or two octaves it is but the division of a large note into smaller

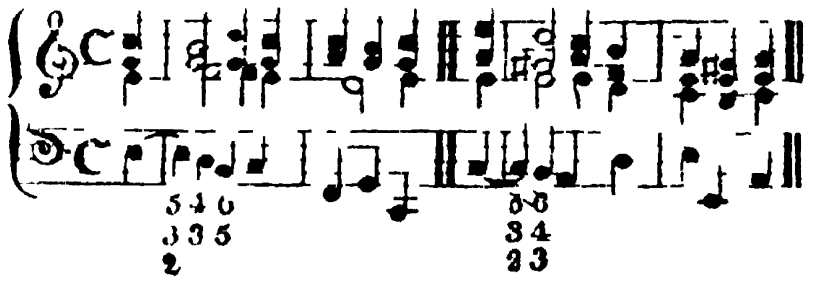
In the *second*, the lowest note is the discord It may be *prepared* in any concord, and *resolved* in any but the eighth; it must therefore descend to the resolution,



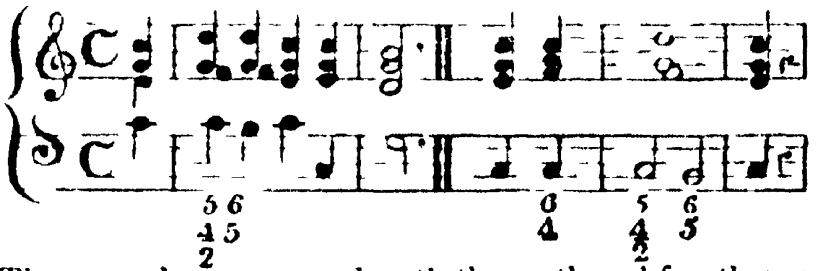
The *preparation of a discord* is effected by taking care that the note which is the discord is heard in the preceding harmony, its resolution being its descent either a tone or a semitone according to the mode, after it has been struck Those seconds are called *transient* which are introduced without preparation on the accented part of the bar, thus



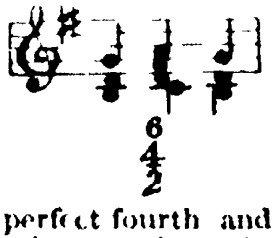
, and if these transient seconds be removed to the accented part of the bar, they then become appoggiaturas When the second is attended by the fifth and third, it becomes a chord of four real parts, and retards the chord of $\frac{6}{4}_{3}$ or the $\frac{6}{5}$, and if the third be sharp, the minor mode is indicated



A chord is said to have four real parts when it contains four sounds without octaves or unisons A concord can only have three real parts When the second is attended by the fourth and fifth either the fifth or the fourth must be prepared, and it becomes the chord of the fifth and sixth at the resolution of the second by the bass



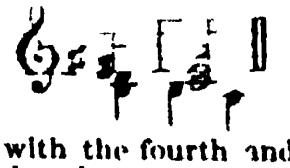
The second accompanied with the sixth and fourth is a chord of four real parts, three of them forming a common chord above the bass which being the discord must be resolved by a descent to the next degree the sharp fourth usually ascends, but it sometimes remains stationary,



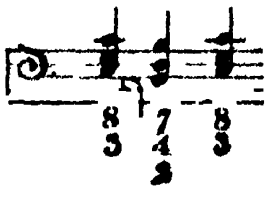
This chord with the minor second, perfect fourth and minor sixth is produced by adding a minor semitone below any common chord with a major third and also by placing a note one tone below the imperfect common chord a major second perfect fourth, and minor sixth, but in all these the second is resolved by descent The extreme sharp second with the sharp fourth and major sixth is a tone and major semitone below the imperfect common chord The second major with a perfect fourth and minor seventh retards the common chord with a major third by an appoggiatura in the bass, thus,



The minor second, perfect fourth and minor seventh retard the common chord with a minor third in a similar manner,

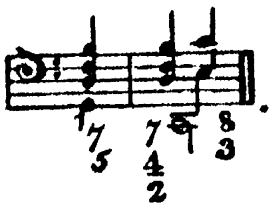


The second is also accompanied with the fourth and sharp seventh which, when introduced upon a resting bass, allow all the intervals when struck to ascend,

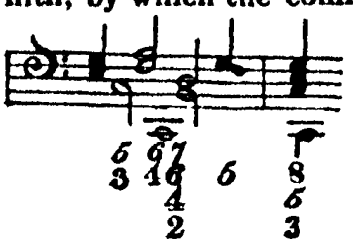


When, however, the

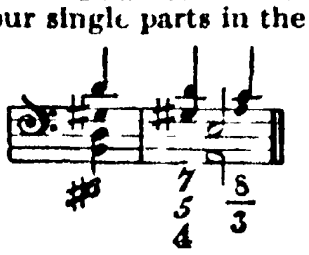
bass moves, it is usual to prepare the upper parts,



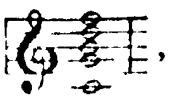
. The fourth may indeed be used without preparation, but it falls to the resolution Both the major and minor sixth are used in the chord with or without preparation, but they fall to the fifth, by which the common chord preserves its fulness,



The second may or may not fill up the chord If the fifth is taken in the chord for the fifth part, it is suspended, and may or may not be in the preceding chord You obtain the last sixth perfect by it, and retain four single parts in the places where the second is omitted,



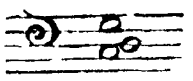
The second accompanied with the fourth, fifth, and seventh,



, by some is called the chord of the eleventh the fourth being the representative of that interval which is always perfect as well as the fifth, but the second and seventh are major Accompanied by the seventh, sixth and fourth, the second is called the chord of the thirteenth, in which the thirteenth is figured by the sixth, which may be either major or minor,

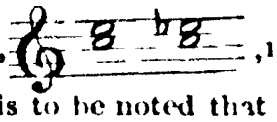


When the second is accompanied by the fifth,



, the latter must be always perfect, but the second may be either major or minor

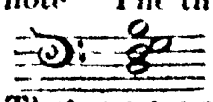
The third major or minor,



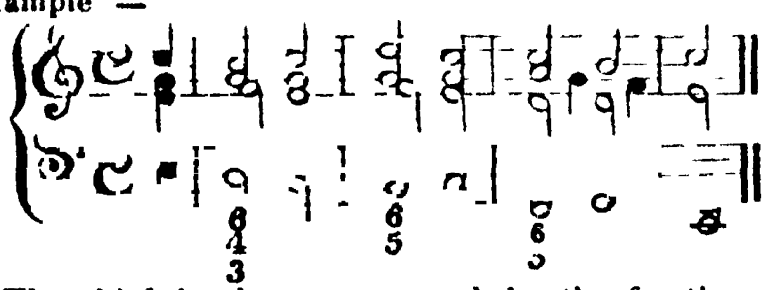
, is an agreeable concord, of which it is to be noted that two minor thirds in succession are better than two majors but mixed thirds in succession are most pleasant to the ear, indeed an octave of major thirds is extremely unpleasant It is best to begin a regular ascent with a major third, and a descent with a minor,



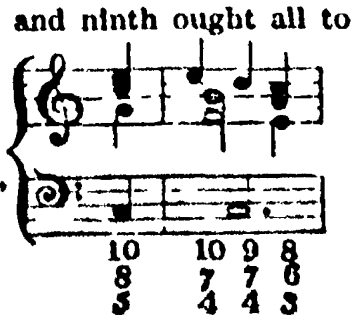
, and in two parts it is not well to end in a third above the key note The third is accompanied by a fourth and sixth,



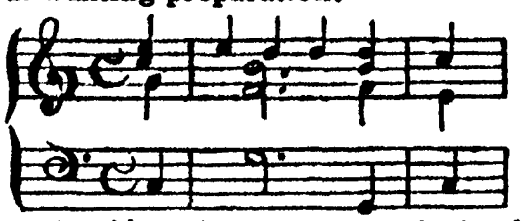
, and is generally called the small sixth That species of it wherein the third is minor the fourth perfect, and the sixth major is elegant in effect, as the seventh, from which it is derived The following is an example —



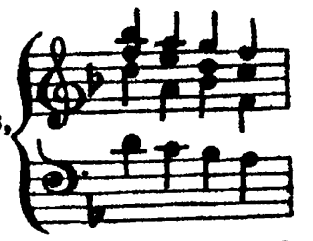
The third is also accompanied by the fourth and seventh, but when the third or the tenth is at the top of the chord, it is generally followed by the 9 7 4, which fourth, seventh, and ninth ought all to descend to the resolution, thus,



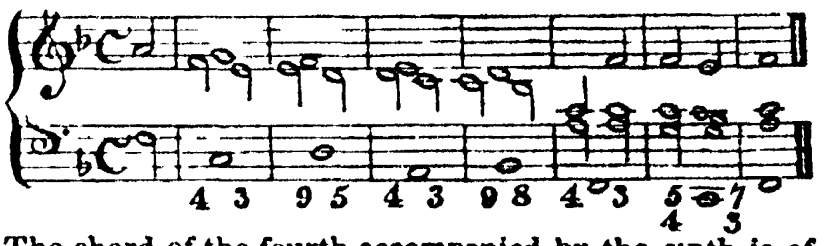
The third accompanied by the sixth and seventh is generally followed by the chord of the seventh, hence the sixth is the only interval wanting preparation.



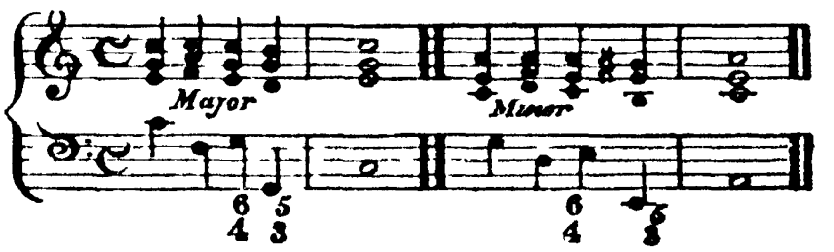
The fourth should not be used alone it should be associated with the sixth and octave; thus,



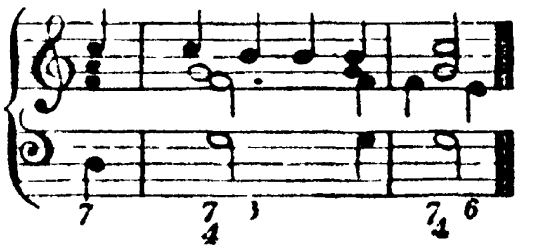
Accompanied by the fifth, the fourth is a discord much used When introduced on a resting bass, it resolves into the third, and its effect is so similar to that of the ninth, that they are frequently introduced alternately



The chord of the fourth accompanied by the sixth is of [illegible] and when preceded [illegible] the key note and fourth of the key, and succeeded by the common chords to the fifth of the key and the key note, forms one of the terminations to a musical period called the fourth and sixth cadence, thus,

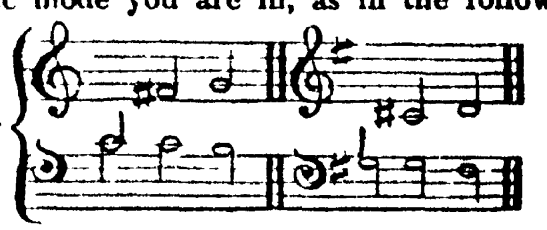



When the seventh accompanies the fourth, and that is followed by the chord of the third, fifth, and seventh, either the fourth or seventh or both should be in some part of the chord preceding it In the following example both the fourth and seventh are prepared and resolved —



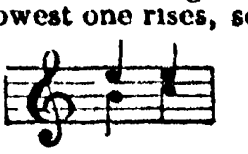
When, however, the chord of the fourth and seventh is followed by the fourth sixth and eighth, it is frequently used without preparation in either of the positions The fourth and seventh descend to the resolution, and generally resolve after each other

The interval of the sharp fourth, which has been before mentioned is a minor semitone more than the perfect fourth, and a major semitone less than the perfect fifth Its natural resolution is that the bass shall fall a degree, and the upper part rise one, by which the two parts meet in a minor sixth It is of very great use in modulation, as you can by introducing it upon the key note, always change the mode you are in, as in the following examples —



In four parts the sixth and second are taken with it

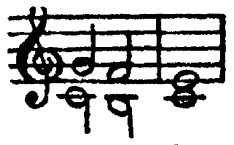
The interval of the imperfect fifth is a minor semitone less than the perfect fifth and a major semitone more than the perfect fourth In using this chord the highest note falls and the lowest one rises, so that they meet in a major third, thus,



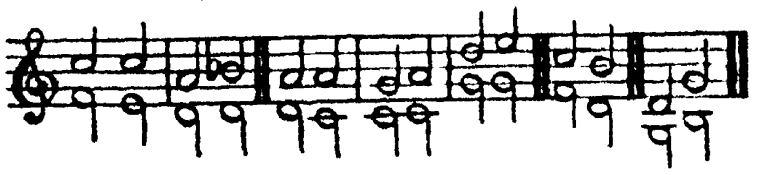
In four parts it is accompanied by a third and sixth,



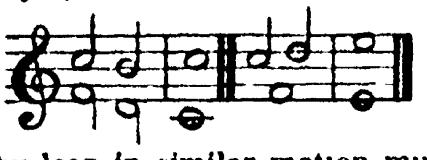
The fifth is the next interval which we have to consider; of this we have already said that two fifths cannot follow each other, except by contrary motion From the fifth to the unison is good by oblique motion, and also by contrary motion one part moving a single degree, but by similar motion it is bad From a fifth to either of the thirds is allowed by all the motions, but it is best by the oblique, next to the oblique the best way to the third minor is by contrary motion, and to the third major by similar motion, and both by single degrees A false [illegible] provided it be also im- [illegible] and by contrary motion,



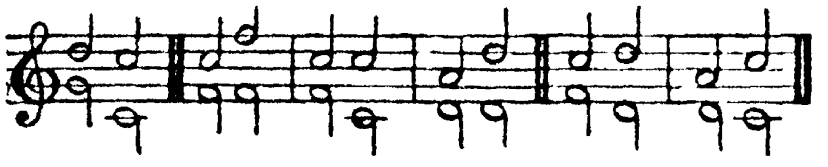
From the fifth to either sixth is best by oblique motion, but it is allowed by similar motion if one part move a single degree it is also allowed ascending, but not descending, to go by leap from the fifth to the sixth minor, but not to the major



In passing from the fifth to the octave through a sixth, the sixth must be major, never minor; and it must be by contrary motion,



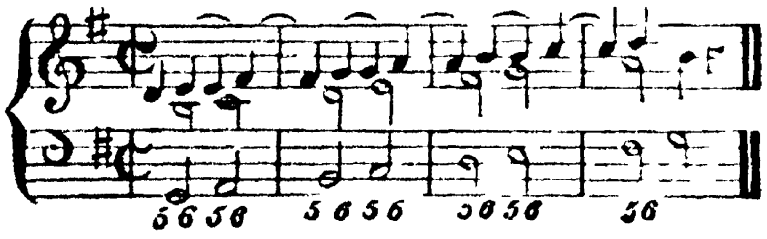
An octave after a fifth by leap in similar motion must be avoided By oblique and contrary motion, it is good and allowable by similar motion, one part moving a single degree, as follows —

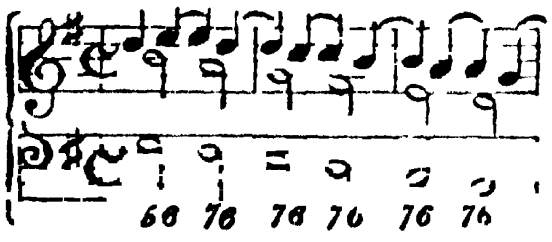


When a third or a sixth moves to a fifth in similar motion, there is said to be a *hidden fifth* in the passage The reader will, in the following example, see by the dots where these lie

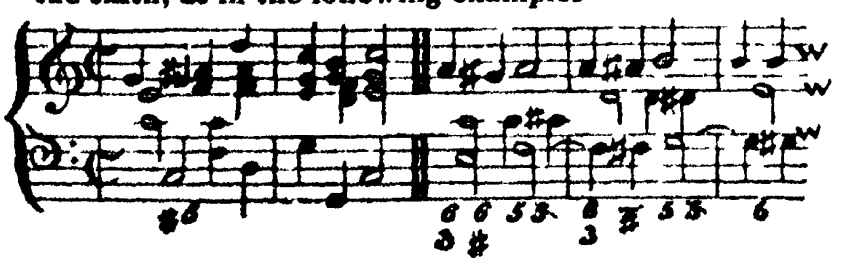


In a regular ascent, it is common for a fifth to be succeeded by a sixth, as in a descent it is for the seventh to be succeeded by a sixth Of both these, which are termed *sequences*, the following are examples —



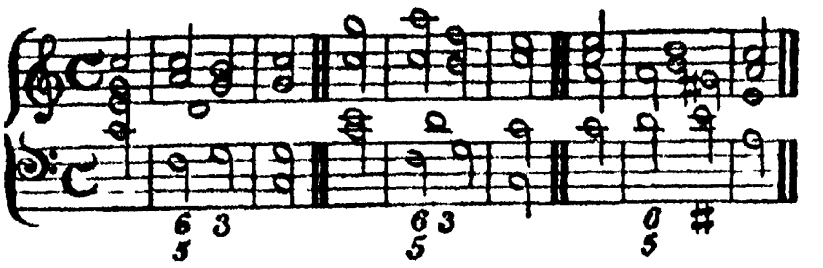


The chord of the extreme sharp fifth, which consists of two major thirds placed above each other, is generally preceded and succeeded by a common chord, or that of the sixth, as in the following examples —



It is here seen that the extreme sharp fifth to the bass, whether it be in the middle or at the top of the chord, always rises to the resolution It is called a *transient chord*

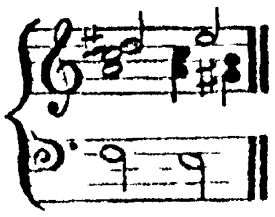
The sixth, by inversion, becomes a third, and it often happens that the bass which accompanies sixths will harmonize equally well with thirds When accompanied with the fifth, the fifth is treated as a discord, which we will illustrate by two or three instances



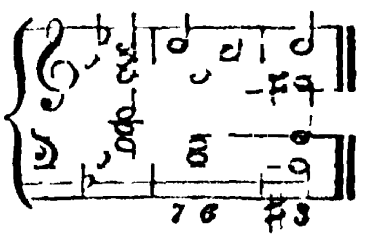
Some have given the name of the *great sixth* to this chord when the sixth is major and the fifth perfect If the fifth is imperfect and the sixth minor, it is called the *chord of the false fifth* It will be seen above that the chord of the great sixth is used on bass notes which ascend a tone to the perfect chord, and that of the false fifth to those which ascend a semitone,



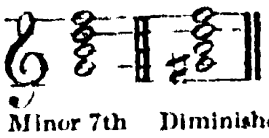
The species of this chord chiefly used in minor keys consists of a perfect fifth, an extreme sharp sixth, and major third, and the bass of it generally descends,



The minor seventh accompanied with a third major and perfect fifth is one of the most agreeable of the discords, it should be heard in the chord which precedes it when used with a minor third and perfect fifth,

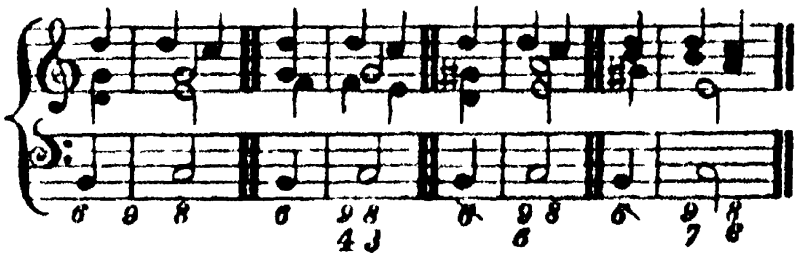


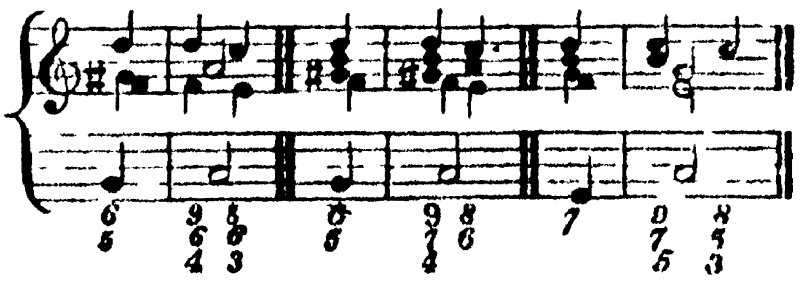
By raising the lower note of a minor seventh a minor semitone the chord of the diminished or extreme flat seventh, also called the *equivocal chord*, is produced,



Minor 7th Diminished 7th

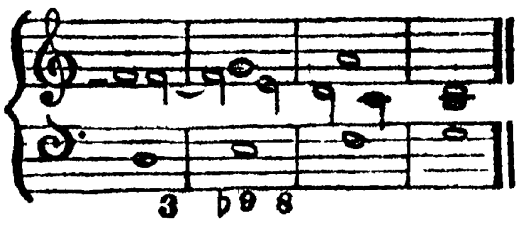
This is called the [illegible] uncertainty of the key note into [illegible] preparation of a major seventh is a third a fifth a sixth or an eighth, its resolution is a third a sixth and a fifth from the concords in which it is prepared The ninth major consists of a whole ton and the minor ninth a semitone major above the octave The major ninth is prepared by a third a fifth, and occasionally by a sixth never by an eighth and is resolved by a third a sixth or an eighth from each of the concords in which it is prepared When the ninth is used in four parts the third and fifth must be taken with it Besides the above resolutions of the ninth, it may be resolved by the fifth if the bass rise a fourth or fall a fifth when the upper part falls one degree for its resolution It must be accompanied at the resolution by an eighth if the piece be in four parts We subjoin a few examples —





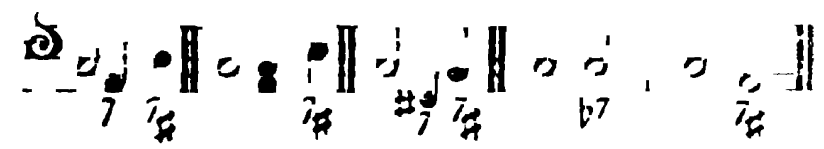
The [illegible] prepared [illegible]

but it is resolved in the third if the bass descend a third on the resolution,

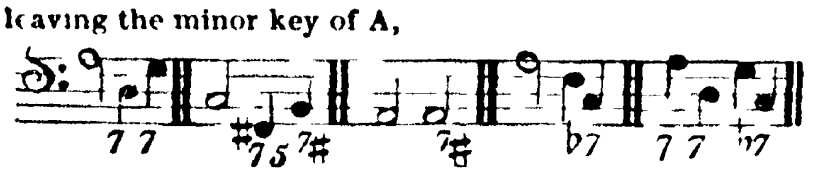


The ninth may have other discords mixed with it, as the fourth, in which case the fourth must be prepared and resolved as a discord The seventh may be also mixed with it, in which case the seventh must be also separately prepared and resolved

We have before defined the word *modulation* our intention here is to add a few observations on the mode in which it is accomplished, premising that the laws of modulation are dependent on those of harmony If you desire to keep in the key you are to use all the sounds of the scale as much as possible, uniting them in good melody, and dwelling chiefly on those which carry the essential chords, that is, the chords of the seventh and key notes will be frequently wanted varied so as to avoid monotony You must take cadences or pauses on these two chords only, or at furthest on that of the fourth of the key You are never to alter the scale because the introduction of a flat or a sharp not belonging to it indicates that the key is abandoned To modulate into other keys formal cadences are not required, if they are, they are usually made at the end or in the middle of a piece We subjoin the methods for passing from one key to another, which are five in number for the major and four for the minor keys, and these alone can be considered legitimate, unless through the medium of enharmonic modulation leaving the major key of C,



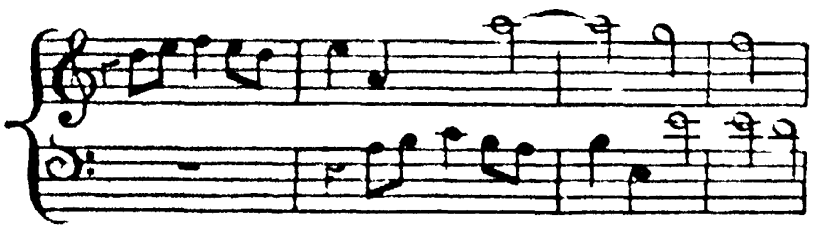
leaving the minor key of A,



Our limits prevent extending this part of the subject to greater length than we would wish on this point are recommended to *Frike's Guide to Harmony* London 1793

A *fugue* consists in the repetition of a melody in the different parts at different intervals of time each repeating according to certain rules what the preceding one has performed the part which leads being called the *guide* and that which repeats the *answer* The answer is conducted by the same intervals as the guide

*Imitation* differs from fugue says Brossard because in the former the repetition must be a second third, sixth, seventh, or ninth, or indeed any interval above or below the first voice or guide whereas in fugue the repetition must be in the unison, fourth, fifth or octave —



The principal rules in writing fugues are —First to prefer the key note and its fifth before any other for the first and last notes of the fugue; in which case the melody is to be contained within the octave to the key Second, if one part begin or end with the key note, the other begins and ends with the fifth, taking care that the different relative intervals between the notes be regularly preserved Thirdly, as in diatonic progression either ascending from the key note to its fifth, and [illegible], there is one note difference, you are at liberty to make one of those two notes in conjoint degree of that progression that contains the greater number to agree with the progression which is unavoidably used, wherein there is one note less, and that in the middle of the melody These are the leading rules of the fugue

The *canon* is a species of fugue, which may be infinitely repeated, it is taken up at the fifth and at the ourth When this is done, the whole of the melody must be arranged, and accidental sharps and flats added to those notes where the use of the natural degrees would prevent the air from being exactly similar, whence its difficulty The well known canon of *Non Nobis Domine* is a fine specimen of canon composition

*Time* [illegible] the accurate division of the long and short notes to the syllables to which the music is set in such a manner as to separate the words properly, and to make the accented syllables of each word so conspicuous that what is sung may be clearly comprehended In instrumental music, it is the adaptation of the expression to the sentiment It is mostly used to signify the duration of several sounds heard in succession, whether musical by voices and instruments, or without inflexion of tone, as by the beating of a drum, &c Here we have only to [illegible] nearly the beginning of this article, and we do not think it necessary to add to it in this place further than to state that in the beating of time by the hand or foot, as there mentioned, the elevation of the hand is called by the technical name *arsis*, a Greek word signifying a lifting up and the depression of it by the term *thesis*, signifying the action of laying down expressions, —which are also applicable in another sense as, for instance, when a point or passage is inverted or turned, that is, rises in one part and falls in another, or the converse, it is said to move *per arsin et thesin* Emphasis is frequently obtained for particular expressions by throwing the accent on the weak part of the measure, or by the different grouping of the quavers semiquavers, &c, and also by the mark of emphasis, RF (signifying rinforzando) placed over a note where the composer desires to [illegible] the weak part of a measure with more than its share of importance Of this the following passage from a favourite symphony of Haydn is an example —



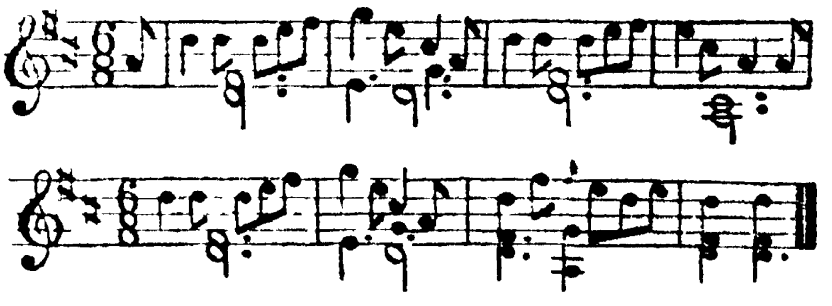
(Emphasis.)

on the note marked with a dash over it Dr Callcott thus distinguishes between accent and emphasis —"Accent always requires pressure (on a pianoforte) immediately after the note is struck and emphasis requires force at the very time of striking the note" A phrase is a short melody usually formed of two measures in simple time, though with the ancient writers it is often contained within the bar Of the common phrase the following is an example —



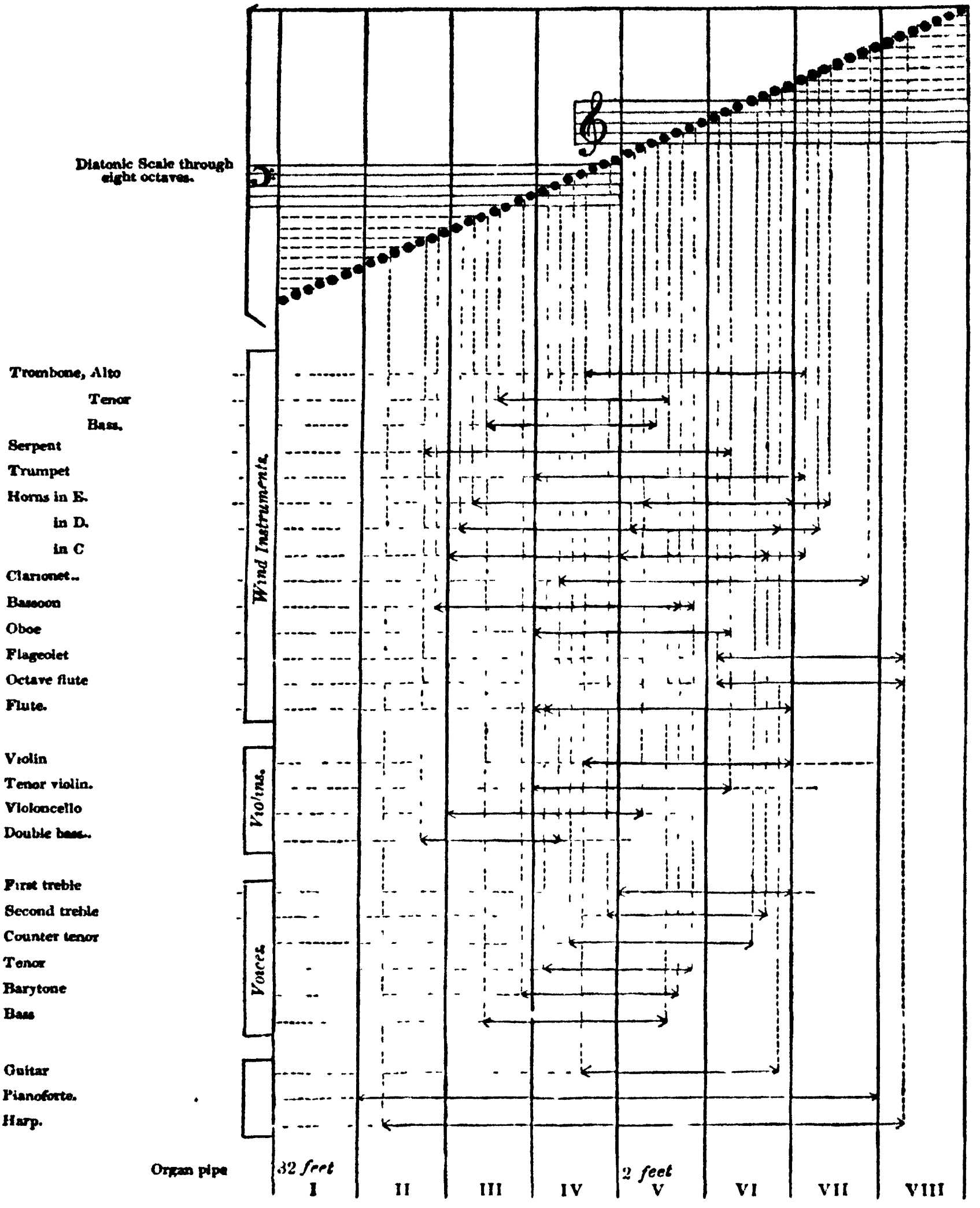
Andante Phrase Phrase

Phrases in melody are formed by air, in harmony they are formed by sequences of chords and discords terminating with a cadence which is more or less perfect as the passage is more or less finished The well weaving together of the phrases whereof a strain is composed, so that their proportions may be symmetrical and form a beautiful whole is one of the tests of a fine composer Though musical punctuation, unlike that in writing, is without visible characters to mark the ends of phrases, and the periods whereof phrases are composed, yet such division does actually exist, and as an example of punctuation will better than words assist the reader in understanding it we present to his notice the following well-known passage from the opera of *Don Giovanni*, by Mozart —



In the four distinct parts into which this melody is divided three of them belong to the chord of the dominant or fifth of the key, and the other, which is the last, to the tonic or key note The seventh of the dominant is upon the three first parts, but to [illegible] punctuate the first part, he has [illegible] at the end of the second part In the other two he has a pedal point (or holding on of the bass) of the key note, on which the chord of the seventh of the dominant is struck. [illegible] regular phrases, the last [illegible] a *section*, and one or more of these sections constitutes a *period* When a period or more than one is terminated by a double bar, the whole is called a *strain* We close this article with a synoptical view of the different pitches of the instruments of an orchestra, and of the human voice, from Choron's celebrated work to which our acknowledgments are due, as [illegible] Mr Mainzer's *Musical Grammar*, the admirable [illegible] the *Encyc Methodique*, and to Shield's *Introduction to Harmony*

**SYNOPTICAL VIEW of the different Pitches of the Instruments of an Orchestra, and of the Human Voice.**




MU'SICAL GLASSES A musical instrument consisting of a number of glass goblets, resembling finger glasses, which are tuned by filling them more or less with water, and played upon with the end of a finger damped There are few persons at a dinner table who have not tried their skill in producing the sound which the vibration of a finger glass will yield in the way above described The less the quantity of water in glasses of similar forms and equal capacity the lower will be the tone of the scale, hence the facility of forming a complete scale by the quantity of water contained in each

The skill or rather knack of operating upon the sets of glasses for the production of melodies and harmonies, is that of producing instantly the required vibration by a gentle and rapid action of the finger upon their edges, and so quickly from one to another as to be able to introduce harmonies to the sounds of the air or melody before the vibrations of its glasses have ceased A touch of the finger on the edge of a glass puts of course a stop to its vibration, and thus prevents confusion

MUSK A peculiar concrete substance, the produce of the *Moschus moschiferus*, or musk deer, an animal which inhabits the mountains of eastern Asia Behind the navel is a bag, which in the adult animal is filled with musk These bags are imported from China, Bengal, and Russia Musk is originally a viscid fluid, but dries into a brown pulverulent substance, of a strong, peculiar, and highly diffusible odour Its chief use is as a perfume it has been employed in medicine as a stimulant antispasmodic, but much difference of opinion exists as to its efficacy, and its high price, and extreme liability to adulteration, are circumstances against its use

MUSKAT A rich sweet wine made in the south of France of [illegible] grapes

MUSK DEER (*Moschus moschiferus*, Linn.) The [illegible] the large preputial glandular pouch which secretes the well-known substance called musk

MUSKET (Fr. *mousquet*) The fire-arm used by the regiments of the line (*See* GUN) A great number of very curious ones, of various dates and countries, from

the earliest period of their use, may be seen in the repository of the Royal Artillery at Woolwich

MU'SKETOON A species of musket, shorter but thicker and wider in the bore than the ordinary musket The musketoon or *mousquetton* was of French invention and is described by De Gheyn, in 1688 (*Traité des Armes*) as differing from the carabine in being furnished with a fire lock instead of a wheel-lock

MU'SLIN A fine thin kind of cotton cloth with a downy nap on the surface The name is derived from the town Mosul, in Asia, where it was originally manufactured The first muslin was imported from India into England in 1670; and twenty years later [illegible] manufactured in considerable quantities in England and England Muslins are now manufactured in immense quantities at Manchester and Glasgow, in France, Germany, and Switzerland, of a fineness and durability that rival those of India, at the same time that they are considerably cheaper The fineness of some Indian muslins is such that when laid on grass upon which a little dew has fallen, they are scarcely visible *See* COTTON

MUSOPHAGA (Gr *μουσα*, the generic name of the banana, and *φαγω*, *I eat*) A genus of Scansorial birds, characterized by the base of the beak forming a disk which partly covers the forehead The species of this genus are called "plantain eaters," because their principal food is the fruit of the banana

MUSQUI'TO The American name for the species of gnat (*Culex*) They abound in damp situations, both in the warmer climates and during the summer months in high northern latitudes They pierce the skin with a lancetted proboscis, and discharge a venomous liquor into the wound, they can only be guarded against at night by enclosing the bed with a musquito curtain The Laplanders drive them away by fire, and by coating the naked parts of the body with grease

MUSSEL *See* MYTILUS

MU'SSITE A pale green mineral from Mussa in Piedmont, it is a variety of *augite*

MU'SSULMAN The general appellation for all who embrace the faith of Mohammed The term signifies "resigned to God," and is the dual number of the singular *moslem*, of which *muslimim* is the plural The appellation is said to have been first given to the Saracens

MUST The expressed juice of the grape before its conversion into wine by the process of fermentation

MU'STARD (Fr moutarde) The seed of the *Sinapis alba* and *nigra*, ground into powder and freed from the husks it is the well known condiment of the shops or at least a part of it for, in order to reduce the strength of the pure mustard there is generally a considerable quantity of wheaten flour added Brown mustard should be the flour of *Sinapis nigra* exclusively which is much more pungent than the other A dessert spoonful of coarsely powdered mustard-seed taken in a glass of water generally operates as an emetic, it is also aperient A mustard poultice, or *sinapism*, is sometimes a useful stimulant

MUSTE'LA (Lat mustela, *a weasel*) The generic name under which Linnæus comprehended the Vermine or Vermiform quadrupeds of Ray or the carnivorous Mammalia, which are distinguished by the length and slenderness of their bodies and are thus enabled to wind like worms, into very small crevices and openings whither they easily follow the little animals that serve them for food The otters, skunks polecats and weasels were included in this genus, and still constitute the natural family *Mustelidæ*, and the genus *Mustela* is now restricted to the true weasels, which differ from the polecats in having an additional false molar above and below and in the existence of a small internal tubercle on the lower "carnassial" or sectorial tooth, two characters which, Cuvier observes, somewhat diminish the cruelty of their nature

MUSTER-ROLL A specific list of the officers and men in every regiment, troop, or company, made out by the adjutant, and delivered to the inspecting field officer or paymaster, &c, by which they are paid, and their [illegible] known

MUTE [illegible]r, a vowel (or consonant) is said to be mute when written but not pronounced, as the vowel *e* at the end of many English words, in some of which it effects a change in the pronunciation of the preceding vowel, as in *wife*, *life*, *place*, &c, rendering it long, in others it has no effect, as after a diphthong—*house*, *pronounce*. In old English, the mute *e* was very generally added at the end of words especially nouns, and in versification the *e* often ceased to be mute, as is constantly the case in the poems of Chaucer

MUTE in Law is said of a person who refuses to plead to an indictment for felony &c By stat 12 Geo 3 c [illegible] such a person is to be considered as pleading guilty and to be punished as upon conviction; but formerly a plea was extorted from him by the inhuman and disgusting process *peine forte et dure*, which see.

MUTE A dumb officer of the Seraglio whose duty it is to act as executioner of persons of exalted rank who have incurred the grand seignior's displeasure The term mute is also applied to persons employed by undertakers to stand before the door of a house in which there is a corpse for a short time previously to the funeral

MUTICA Linnæus [illegible] A name applied by Linnæus to one of his primary divisions of Mammalia, including the whale tribe, as being maimed, or deprived of the hinder pair of extremities, also given by Storr to an order of quadrupeds comprehending those which want either a certain kind of teeth, or are wholly [illegible]

MUTINY, in Law is the offence, in a person under [illegible] of resisting or refusing obe- [illegible] Mutiny Act is a table annually passed since the reign of William and Mary (April, 1689), by which the crown is vested with power to form articles of war, and to constitute military courts martial *See* COURTS MARTIAL

MUTULE *See* MODILLION

MU'ZARAB (Ar [illegible] being under the government of the Moors in Spain, so called it is said, from an Arabic word signifying imitators or followers of the Arabs The denomination is now chiefly remembered in consequence of the celebrated disputes between the supporters of the Muzarabic liturgy, which was preserved by the Christians of Spain during their subjection to the Mahometans, and those of the Roman, introduced by the see of Rome about the 10th century During the following age this dispute was warmly carried on, and well-known [illegible] of miracles operated in favour of the [illegible] long current in Spain It was, however, gradually superseded by the Catholic It is said that mass is still celebrated according to the Muzarabic ritual in one chapel at Toledo A brief but excellent account of the different phases of the Muzarabic controversy is to be found in the *Dict de la Conversation* See also the *Penny Cyclopædia*, and the authorities there referred to

MU'ZZLE LASHING The lashing by which the muzzle of a gun in a ship is secured to the upper part of the port

MYA (Gr *μυα a muscle*) A name applied by Linnæus to a genus of the *Vermes testacea*, including those having a bivalve shell, characterized by a hinge with broad, thick and strong teeth, seldom more than one and not inserted [illegible] shell gene- [illegible] Mya is characterized [illegible] the [illegible] *Lutraria* among the Acephalous Testacea of Cuvier [illegible] divided into the genera *Mya* proper, *Lutraria*, Lam, *Anatina*, Lam, *Solemya* Lam *Glycimeris*, Lam, *Panopæa*, Lam *Pandora* Lam The true *Myæ* include that species of the genus *Unio*, Brug, which is celebrated by Tacitus for producing pearls, and which is indigenous in some of the rivers of Scotland and England

MYCE'LIA (Gr *μυκης*, *a fungus*) The young flocculent filaments of fungi

MYDRI'ASIS (Gr) A paralytic affection of the iris of the eye

MY'ELENCE'PHALA (Gr *μυελος*, *marrow*, and *εγκεφαλον brain*) The name indicative of the condition of the nervous system of the primary division of animals, [illegible] which the cerebral and spinal chord [illegible] is synonymous with *Vertebrata*

MY'ELONEU'RA (Gr *μυελος marrow*, and *νευρον*, *nerve*) A name given by Rudolphi to a group of animals corresponding to the Articulata of Cuvier, viz Crustacea, Insects, and Anellides which have a gangliated nervous system, forming a chord considered to be analogous to the spinal marrow of Vertebrates

MY'LO (Gr *μυλη*, *a grinder tooth*) Names compounded of this word are applied to certain muscles attached near the grinder teeth, as *mylohyoideus*, *mylopharyngeus*, &c

MYO'LOGY (Gr *μυων*, *a muscle*, *λογος*, *a discourse*) The doctrine of the muscles In [illegible] this term is applied to a description of the muscles of animals

MY'OPS (Gr *μυωψ*, from *μυω*, *I wink*, and *ωψ*, *the eye*) A person who is purblind or near-sighted This defect usually arises from too great convexity of the cornea causing the rays to come to a focus before they arrive at the retina It is corrected by the use of glasses which increase the divergency of the rays before they enter the cornea, and thereby throw their focus further back, so as to fall on the retina

MY'RIAD (Gr *μυριας*) Ten thousand Often used as expressive of an indefinite multitude

MYRIAMETRE A French measure equal to ten thousand meters, it is the equivalent of two leagues of the old measure *See* MEASURES

MYRIAPODS, *Myriapoda* (Gr *μυριας*, *ten thousand*, and *πους*, *foot*) The name of a class of Articulate [illegible] which have an indeterminate [illegible] that of the articulations of the body

MYRICIN That portion [illegible] in alcohol The wax of the M[illegible]

MYRIOLITRE A French measure of capacity equal [illegible] litres or 610240 cubic inches

MY[illegible] (Myristica, one of the genera) A natural order of arborescent Exogens inhabiting the tropics This has been placed, on account of its apetalous flowers, in *Lauraceæ*, from which it is distinguished by the structure of the calyx, anthers, and fruit Brown places it between *Proteaceæ* and *Lauraceæ*, but the order appears rather to be an apetalous form of *Annonaceæ*, with which the trimerous flowers [illegible] arillate seed, [illegible] embryo, and peculiar pro[illegible] bark generally abounds in an acrid juice, which is viscid and stains red The rind of the fruit is caustic, the aril and albumen of *Myristica moschata*, the former known under the name of *mace* and the latter of *nutmeg*, are important aromatics, abounding [illegible] to fat, which [illegible] tous as [illegible]

MYRMECOBIUS [illegible] genus of Marsupial quadrupeds which feed on ants The only known species, *Myrmecobius fasciatus*, is a native of Australia

MYRMECOPHAGA (Gr μυρμηξ and φαγω *I eat*) The name of a genus of Edentate quadrupeds which feed on ants and are called *ant-eaters* They are peculiar to the continent of South America

MYRMELEO'NIDES (Gr μυρμηξ and λεων *lion*) The family of insects commonly called *ant-lions*, having the [illegible] the type

M[illegible] Classical Mythology, a people on the southern borders of Thessaly, who accompanied Achilles to the Trojan war Their name is derived by the mythologists from μυρμηξ *an ant*, and they were said to have arisen from ants or pismires in answer to a prayer of Œacus, king of the country, to Jupiter after his k[illegible] by a pestilence

MYRMILLONES [illegible] Antiquity a species of gladiators who fought completely armed against the Retiarii Their arms consisted of a sword headpiece and shield On the top of the headpiece they wore a fish embossed, called μορμυρος whence in all probability their name is derived The Myrmillones were also termed *Galli*, from their wearing Gallic armour and *Scutatores*, from the shield by which they were defended

MYRO'BALANS (Gr μυρον *an ointment* and βαλανος, *a nut*, because formerly used in the preparation of unguents) A bitterish austere fruit brought from India, the produce of several species of *Myrobalanus* Myrobalans are used by the Hindoos in calico printing and medicine, they were also formerly employed in Europe (though to a comparatively trifling extent) in the arts and pharmacy

MYRRH This gum resin is imported from Turkey it is in irregular tears and lumps, of a reddish brown colour [illegible] but bitter taste It is [illegible] of *Imyris* said to be a native of Abyssinia and Arabia Felix It is a good stimulating tonic medicine, and is given in doses of from five to twenty grains

MYRTACEÆ (Lat myrtus) are an important natural order of Polypetalous Exogenous plants, of a woody texture, and frequently forming small trees found in all tropical and temperate countries where they are often cultivated for the sake of their valuable aromatic properties The spices *cloves* and *pimento* are produced by some species, the agreeable fruits called *guava jam rosade*, and *rose-apples* are yielded by others while the enormous *gum-trees*, or *Eucalypti* of New Holland, and the *Melæuca*, which furnishes the stimulating green oil of *cajeput*, also belong to the order *Myrtaceæ* are nearly related to the Onagraceous order from which they differ in having an indefinite number of stamens, and to *Melastomaceæ*, which have rostrate inflected anthers and ribbed leaves Their most essential characters are to have [illegible] flowers, indefinite stamens [illegible] fruit, and dotted leaves with an intra-marginal [illegible]

MYRTLE (*Murt*, the Persian name whence μυρτος) An evergreen fragrant bush inhabiting all the warmer parts of the basin [illegible] of the west of Asia. It was [illegible] and is at this day regarded with superstitious reverence by the Persian peasant In the latitude of London the myrtle will endure the climate only in the warmest and most sheltered spots

MYSTACINÆ (Gr μυστραξ *moustache*) The name of a family of Infusories of the tribe *Trichoda*, including those which have [illegible] four hair-like processes, disposed in [illegible] species of animals derive their trivial name from the same root, as the *Vesperilio mystacinus* or whiskered bat the *Caprimulgus mysticalis*, or bearded goat-sucker the *Cypselus mysticeus* or bearded swift, &c

MYSTERIES, SACRED (The word mystery has been by some traced to the Hebrew סתר, to hide, whence *mystar*, a thing concealed, formed from which is the Gr μυστηριον and [illegible] *mystery*, and [illegible] the learning of which was something occult and mysterious, but the [illegible] from the Gr μυεω) [illegible] in speaking of certain truths set forth in the Old and New Testament, to the full understanding of which human reason cannot attain This is all the [illegible] prophecies were mysteries [illegible] ws, until they received their accomplishment in Christ Among the mysteries set forth in the New Testament the most prominent are, the doctrine of the satisfaction of Christ, the forgiveness of sins for the sake of his sufferings, and eternal life in a future w[illegible] between Christ and his church, [illegible] peration on our hearts and the resurrection from the dead.

But the greatest of sacred or scripture mysteries is doubtless the incarnation of the Son of God —the advent of Christ in the fulness of time, of the seed of Israel, and his participation in our nature, according to the flesh, "being in the likeness of man," and "found in fashion as a man,' but "very God of very God," "God over all, blessed for ever" 'The Word was *with* God and *was* God says John, "and the Word was made flesh" This is the mystery, and "without controversy, great is the mystery of godlin[illegible] God, manifest in the flesh," or [illegible] the flesh," as the [illegible] [illegible] [illegible]

celebration of the greater mysteries occupied nine days, chiefly devoted to sacrifices, processions, and other acts of worship, and during this period the judicial tribunals were closed; an armistice was proclaimed, private enmities were hushed, and death was decreed by the Athenian senate against any one, how high soever in rank, who should disturb the sanctity of the rites. The ceremonies of initiation into both the lesser and greater mysteries were conducted by four priests of the most illustrious families of Greece, called Hierophant, Dadouchos, Hierokeryx, and Epoptes; and these [illegible] were assisted by numerous inferior functionaries, to whom various appellations were given indicative of their several duties. The examination of those who had been initiated by the lesser mysteries, and who were preparing for the greater, was apparently rigorous. All foreigners, all who had even involuntarily committed homicide, who had been declared infamous by the laws or had been guilty of a notorious crime, were excluded; but these regulations were not immutable, for various instances might be produced to show that homicides and robbers were sometimes initiated.* Women and children were admissible, and a child, styled *the child of holiness*, whose innocence, it was believed, of itself endowed him with capacity to fulfil the requirements of the mysteries, was selected to conciliate the deity in the name of the initiated.

Of the ceremonies which attended the initiation we know little, since every postulant was required, under the most dreadful oaths, to conceal whatever he saw or heard within the hallowed precincts, and he who violated the oath was not only put to death, but devoted to the [illegible] Yet the priests of ancient, like the [illegible] of modern times, could not prevent the disclosure of *some* facts. Crowned with myrtle, and enveloped in robes, which from this day were preserved as sacred relics, the novices were conducted beyond the boundary impassable to the rest of men. The hierophant, with his symbols of supreme deity, and his three assistants, representing the three other gods, were carefully visible. Lest any should have been introduced not sufficiently prepared for the rites, the herald exclaimed 'Far from hence the profane, the impious, all who are polluted by sin!' If any such were present, and did not instantly depart, death was the never failing doom. The skins of new-slain victims were now placed under the feet of the novices, the ritual of initiation was read, and hymns were chanted in honour of Ceres. The novices moved on, while a deep sound rose from beneath as if the earth itself were complaining; the thunder pealed, the lightning flashed, and spectres glided through the vast obscurity, moaning, sighing [illegible] shades, the messengers of the [illegible] Madness, Famine, Diseases, [illegible], and the explanations of the hierophant delivered in a solemn voice, added to the horrors of the scene. This was intended as a representation of the infernal regions where misery had its seat. As they advanced amidst the groans which issued from the darkness were distinguished those of the suicides — thus punished for cowardly deserting the post which [illegible] this world. But the scenes beheld seemed to be a sort of purgatory where penal fires and dire anguish, and the unutterable horrors of darkness, were believed after countless ages of suffering, to purify from the guilt acquired in this mortal life. Suddenly the bursting open of two vast gates with a terrific sound dimly displayed to their sight, and faintly bore to their ears, the torments of those whose state was everlasting — who had passed the bounds beyond which there is no hope. On the horrors of this abode of anguish and despair a curtain may be dropped, the subject is unutterable. Onwards proceeded the novices, and were soon conducted into another region, that of everlasting bliss, the sojourn of the just — of those whose hearts had been purified and whose minds had been enlightened by 'the holy doctrine.' This was Elysium — the joys of which were equally unutterable, equally incomprehensible, to mortals not admitted into these mysteries. Here a veil was in like manner thrown over *this* scene. (*Cab. Cyclop.*, vol. 61.)

Like most other questions of this nature, the origin and purpose of these religious institutions are involved in the deepest obscurity, and all the efforts of the learned that have been directed to the elucidation of this question in all ages, but more particularly in modern times, have ended only in [illegible]. Referring to the dissertations [illegible] and Dr. Leland for the chief views that have been entertained respecting them, we may here briefly observe, that though the mysteries seem to have been instituted for the purpose of enlightening the initiated as to the hidden meaning of religious doctrines and usages of which the great mass of the people were kept in ignorance, there are no means of [illegible] even to a conjecture as to the real nature [illegible] taught in the mysteries, or the advantages of initiation. Were this the place for such discussions, we think it might be satisfactorily proved that mysteries must form an indispensable part in the religious ceremonies of every people who have attained to a certain degree of civilization. The [illegible] of antiquity were composed too senseless, to be believed by any one into whose mind the light of philosophy had dawned, and accordingly we find that many of the most distinguished persons embraced and inculcated in private (*see* MONO[illegible]) opinions respecting the [illegible] were well known to the priests, many of whom were too enlightened to credit the delusions of which they were the ministers, and who might well tremble for the further spread of doctrines which must inevitably prove fatal to their influence. It became, therefore, a matter of state policy to divert into another channel those feelings of religious infidelity which, if communicated to the vulgar, might have ended in popular disturbances, and hence, in all probability, mysteries were instituted, which, while they ministered to the pride and vanity of human reason by elevating the initiated above the prejudices of ordinary persons, and gave as it were the sanction of the state to the entertainment of heterodoxical opinions, no less gratified the vulgar by the splendid shows and ceremonies of which they were the vehicle, at the same time that they held out the prospect of initiation to all who might be deemed worthy of the honour. (In addition to the works already quoted, see *Sir G. Wilkinson's Ancient Egyptians*, vol. ii. pp. 322—332, 2d Series, and the authorities there referred to.)

MYSTERIES. In Modern Literature, a species of dramatic composition, with characters and events drawn from sacred history. Saint Gregory Nazianzen composed the earliest sacred drama extant on the model of the Greek tragedies, but with Christian hymns substituted for the ancient chorus. The mysteries of the middle ages are thought by some to have been first introduced by pilgrims returning from the Holy Land. They originated among, and were probably first performed by, ecclesiastics. However serious and solemn the events which were represented in these singular compositions, there were invariably, in the later mysteries, two characters introduced to make sport for the multitude, namely, the Devil and the Vice — a personage accoutred in a long jerkin, a cap with ass's ears, and a dagger of lath. He is now best remembered by the allusions to his character and office in the plays of Shakspeare. Miracles, or miracle plays, were a species of mystery; they are usually said to have represented the martyrdoms of saints. In the 16th century, the mysteries were succeeded by moralities, which were much in vogue about the time when the Reformation made its chief progress in England. The characters in moralities were allegorical personages. Several of these performances, some by no means destitute of poetical merit, remain to us. They may be considered as the last step in the progress made by the dramatic art in modern Europe before it reached the station and character which it has ever since retained.

MYSTICISM. In Religion, a word of very vague signification, applied for the most part indiscriminately to all those views or tendencies in religion which aspire towards a more direct communication between man and God, not through the medium of the senses, but through the inward perception of the mind, than that which is af[illegible]. Thus, the Pantheism of the modern religionists, which [illegible] supposed a God existing in all space and matter, and revealed to us in the outward manifestations of things, the Quietism of Madame Guyon, Fenelon, &c., who sought for direct revelation from the Divinity to the believer in a species of ecstasy, the Pietism of Molinos, &c., the doctrines of the Illuminati in Germany, the visions of Swedenborg, and some of the notions prevalent among the Methodists and other [illegible] all approximate to mysticism [illegible]. (On the mystics of the East, the first volume of *Mosheim*, as to those of the West, the third (transl. ed. 1790, p. 352.)

MYTHOLOGY. (Gr. μυθος, *fable*, and λογος, *discourse*.) By the mythology of a people, we understand the collective body of its traditions respecting its gods and other fabulous preternatural beings. The classical mythology, i. e. that of ancient Greece and Rome, being the best known, is most frequently intended when the word is used without any distinctive addition; but the mythologies of the ancient Egyptians, of the Hindoos, and of the northern nations of Europe have also been sedulously examined by modern scholars, and reduced into systems pretty generally known. The learned although singular work of Bryant, *Analysis of Ancient Mythology*,

* It has been said that the [illegible] Mysteries in the manner and [illegible] [illegible] [illegible]

is a rich repertory of traditions and doctrines, though arranged with a view to the author's own far-fetched theory *Keightley's Mythology of Ancient Greece and Italy* is perhaps the most useful manual of those subjects The work of Creuzer, *Symbolik der Alten Volker, besonders der Griechen*, may be considered among the most erudite and valuable of all books on classical antiquities An ot[illegible] of antiquity will [illegible] to which we beg to refer, and the chief mythological personages are noticed under their particular heads

MYTILACEANS, *Mytilacea* (Gr *μυτιλος, a mussel*) The name of the family of Lamellibranchiate Mollusks, having the genus *Mytilus* or common mussel, for its type and characterized by the mantle being open anteriorly and by having a foot either sufficiently developed for the office of progressive motion, or serving to draw out, direct and fix the byssus

MYTILUS (Gr *μυτιλος, a mussel*) A name applied by Linnæus to all those testaceous Vermes having a bivalve shell rough [illegible] fixed by a byssus, with a hinge mostly without teeth [illegible] with a subulate, excavated long and [illegible] The species comprehended under the above phrase are placed by Cuvier in the Testaceous order of Acephalous Mollusks, and have been subdivided into the genus *Mytilus* proper, of which the common edible mussel (*Mytilus edulis*) is an example, *Modiolus*, Lam, *Lithodomus* Cuv, *Anodonta* Brug, *Avicula* Brug, *Meleagrina*, Lam which produces the most precious pearls Extensive establishments are maintained at Ceylon and other places for the express purpose of collecting the *Meleagrina margaritifera*, or pearl oyster

MYXINE (Gr *μυξα, mucus*) The name of a genus of Cyclostomous fishes remarkable for their mucous slippery integument the species called glutinous hag (*Myxine glutinosa*) is a native of the British seas Its habits are parasitic and it is most commonly met with in the interior of a cod upon whose flesh it has been preying

## N.

N One of the liquid series of letters It is common to all known languages, and is interchangeable more particularly in the Latin and Greek languages and those derived from them, with a variety of letters As an abbreviation N is used for *north numero* &c, N B for *nota bene*, N L for *non liquet* (i e the cause is not clear enough to pass sentence on), N P for *notarius publicus*, &c

NA'BLUM One of the most famous musical instruments among the Hebrews, but one whose form and nature are so little known that Calmet thinks it was a harp, Kircher a psaltery or stringed instrument of percussion played on by sticks and Harmer (*Observations on Scripture*) hints at its being a bagpipe Bythner (*Lyra*) says the *nebel* (נבל) was like a leathern bottle, explaining his meaning to be that it bore a resemblance to the ancient Greek and Roman lyre, whose body was made of the shell of the tortoise. The authority of Josephus (*Ant Jud* lib vii c 12), if to be relied upon, distinctly shows it was not an instrument of percussion but played upon with the fingers, his words are, "Ὁς ναβλα δωδεκα φθογγους εχουσα, τοις δακτυλοις κρουεται Its having twelve sounds without telling how those sounds were produced, whether by strings or wind leaves the matter so doubtful that the reader must decide for himself

NABOB (A corruption of nawáb, from naib, *a deputy*) The title of the governor of a province or commander of an army in India under the domination of the Moguls The nabob was properly speaking a subordinate provincial governor under the subah or [illegible] governor of a subah, or larger province In the decay of the Mogul empire many of the nabobs became virtually [illegible] dominions were reduced by the [illegible] The term nabob is vulgarly applied to those Europeans who have amassed a large fortune in the East [illegible] in eastern splendour

NACARAT (Span nacar, *mother of pearl*) A term [illegible], a pale red colour with an orange cast The *nacarat* of Portugal is a crape or fine linen fabric, dyed fugitively of this tint, which is used by ladies to give their countenances a roseate hue The brightest reddest *nacarat* of this kind are manufactured by the Turks of Constantinople (*Ure's Dictionary*) *See* ROUGE

NACREOUS [illegible] In Zoology, when the surface of a shell or [illegible] reflects iridescent light

NACRITE (Fr nacré) A mineral of a pearly lustre, found crystallized in granite It is a silicate of alumina and potassa

NADIR (Arab nazeer *opposite*) In Astronomy and Geography, the point of the heavens diametrically opposite to the zenith The zenith and nadir are the two poles of the horizon

NÆNIA In [illegible] sung to the music of fl[illegible] Roman goddess who presided over lamentations

NAEVUS A natural spot or mark upon the skin of children at birth

NAIADS (Gr *ναω, I inhabit*, or *νασω, I flow*) In the ancient Roman and Greek Mythology female deities who presided over fountains, rivers brooks &c The number of these goddesses was indefinit In his *Georgics* (book iv) Virgil enumerates 16, and Ovid, in his *Elegies* (book ii 64) speaks of at least 100 in the river Anio The most beautiful of the Naiads is said to have been Aigle (*Eng*, Fc 6) Many of the Homeric heroes are represented to have been the offspring of these deities

NAILS (Germ nagel) This term is given to the terminal horny appendages of the fingers and toes when they are in the form of flattened or depressed plates, serving to support a broad tactile surface, as in the human fingers When these appendages are compressed, curved pointed, and extended beyond the digit, they are called 'talons" or 'claws,' when they encase the extremity of a digit like a box they are called "hoofs"

NAIS (Gr *ναις, a naiad*) The name of a genus of minute Abranchiate Anellides, or red blooded worms, remarkable for their powers of reproducing parts of the body when mutilated, and for procreating their kind by spontaneous separation of the hinder segments of the trunk

NAIVETÉ (Fr) is applied to a certain indescribable grace in the female [illegible] of great natural shrewd[illegible], to a certain extent a disregard of the conventional forms and usages of society

NAKED FLOORING In Architecture, the timber work of a floor, which supports the boarding or ceiling, or both

NAME (Lat nomen, Germ nome, Fr nom) The designation by which any individual is known The custom adopted in personal nomenclature has been based on some uniform principle since the earliest ages, modified however by the varying circumstances of different countries and according to the more or less advanced state of civilization of every people Thus in the early state of society of the Jews Egyptians, Persians Greeks, Romans Germans Gauls Britons, and indeed of every nation no individual had more than one name, but in a more advanced or refined period one or more additional names were given in order to mark the different families to which individuals belonged as well as to distinguish members of the same family from each other To effect these objects the ancient Romans at least those of good family generally used three names,—the *prænomen*, the *nomen* and the *cognomen*, the first, which was given on the assumption of the *toga virilis* marked the individual, like our Christian name, the second distinguished the *gens* (which see) and the third the *familia* (which see), to which he belonged To these however was sometimes added a fourth name called the *agnomen*, which was derived from some distinguishing peculiarities in each individual's character or condition, thus Publius Cornelius Scipio was named *Africanus* from his exploits in Africa The mode of designation adopted in all the countries of modern Europe is founded on a principle [illegible] pellation intervenes between the *prænomen* (or Christian name) and the *cognomen* (or surname) It would be difficult to give any satisfactory reasons for the adoption of the Christian and surnames most commonly met with among ourselves Those who are inclined to prosecute inquiry into this comparatively untouched subject will find some ingenious hints for their guidance in the *Penny Cyclopædia* (art "Names, Proper"), to which we beg to refer *See* SURNAME

NA'NDU The name of the American ostrich (*Rhea Americana*) *See* RHEA

NANKEEN A yellowish or buff-coloured cotton cloth largely manufactured at Nankin, in China Its colour is that of the cotton wool of which it is manufactured They are sometimes bleached, and then are called *white nankeens* Imitation nankeens are manufactured at Manchester, but it is admitted these are of an inferior quality to the Chinese, neither lasting so long, nor [illegible] the colour so well

NANTES EDICT OF *See* EDICT

NA'OS, or NAVE (Gr *ναος, a temple*, or *ναῦς, a vessel*) In Architecture, that part of a temple enclosed by the walls The part in front of it was called *pronaos*, and that in the rear *posticum* In modern architecture, it is the middle part or alley of a church, between the aisles or wings

NAPHTHA A limpid bitumen, which exudes from the earth upon the shores of the Caspian and some other Eastern countries Near the village of Amiano, in the state of Parma, there exists a spring which yields this

substance in sufficient quantity to illuminate the city of Genoa, for which purpose it is employed It has a peculiar odour, and generally a yellow colour, but may be rendered colourless by distillation Its specific gravity is about 0 75 It boils at about 160° It is highly [illegible] white smoky flame It appears to consist of 10 carbon with 5 of hydrogen, and is therefore a pure hydro-carbon A liquid very similar to mineral naphtha is obtained by the distillation of coal tar It has sometimes been used in lamps, but is apt to smoke This variety of naphtha is in great request for [illegible] chouc

[illegible] A compound obtained by distilling naphthalate of ammonia

NAPHTHALIC ACID A crystalline product, resembling in appearance benzoic acid, obtained by Laurent from naphthaline

NAPHTHALINE A substance formed during the destructive distillation of pit-coal for the production of gas It is obtained by re distilling the coal tar It is a [illegible] than water, and of a [illegible] remely volatile, fusing at 180°, and its vapour condenses in large white flaky crystals It burns with much smoke, and dissolves in alcohol and ether It consists of 60 carbon, 4 hydrogen, and is therefore a hydro-carbon It combines with sulphuric acid to form the *sulpho-naphthalic acid*

NAPIER'S RODS, or BONES An instrument contrived by the celebrated Lord Napier, the inventor of the logarithms, for the purpose of performing mechanically the arithmetical operations of multiplication and division Napier's rods consist of small squared pieces of bone or ivory, box or silver about 3 inches long and 3 10ths of an inch in breadth the faces of which are divided into nine little squares or cells, each of which is parted by a diagonal into two triangles On these cells are engraved the successive columns of the common multiplication table, in such a manner that the units or right hand figures are [illegible] ns or left-hand [illegible] —

| 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 0 |
| 3 | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 0 |
| 4 | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 0 |
| 5 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 0 |
| 6 | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 | 54 | 0 |
| 7 | 7 | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 | 0 |
| 8 | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 | 0 |
| 9 | 9 | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 81 | 0 |

As an example of the manner in which the rods are used let it be required to multiply the numbers 6795 by 4876 Select the rods which have the figures of the multiplicand inscribed at the top and place them in their order, with the index rod before them when they will stand as in the table annexed Then opposite to the several figures of the multiplier 4876 on the index but proceeding backwards, take the numbers in each horizontal column, add the pair of digits in each rhombus formed by the adjacent triangles of two contiguous cells, and, finally, collect into one sum the rows of the products corresponding to each digit of the multiplier, transcribed and properly disposed, as under —

| 1 | 6 | 7 | 9 | 5 |
|---|---|---|---|---|
| 2 | 12 | 14 | 18 | 10 |
| 3 | 18 | 21 | 27 | 15 |
| 4 | 24 | 28 | 36 | 20 |
| 5 | 30 | 35 | 45 | 25 |
| 6 | 36 | 42 | 54 | 30 |
| 7 | 42 | 49 | 63 | 35 |
| 8 | 48 | 56 | 72 | 40 |
| 9 | 54 | 63 | 81 | 45 |

| | |
|---|---|
| 40770 | 6 |
| 47565 | 7 |
| 54360 | 8 |
| 27180 | 4 |
| 33132420 | |

[illegible] the last digit of the multiplier, and [illegible] right along the horizontal column, there occur the figures — first, 0, then 3 and 4, or 7; 5 and 2, or 7, 4 and 6, or 10, and lastly, writing down the cipher [illegible] 4 These [illegible] together [illegible] 5 [illegible] In same manner the other rows are [illegible] added in the usual manner, the product of [illegible] numbers is obtained It is obvious that this method of calculation is much too tedious to be of any real use

NAPLES YELLOW A celebrated yellow pigment, formerly made by a secret process at Naples, and used not only in oil painting, but as an enamel colour, it is said to be a mixture of the oxides of antimony, lead, and zinc

NAPOLEON, CODE OF It was in 1802, during the temporary calm of the Peace of Amiens, that Napoleon, then First Consul, undertook the great task of forming a civil code It was entrusted to a commission [illegible] of state, of which Tronchet, Rœderer, Portalis, Thibaudeau, Cambacérès, Lebrun, were the leading members "Tronchet" (said Napoleon himself to Las Casas) "was the soul of the code" (*Memoirs*, part 3 234) And Portalis has also the credit of a very important share in its composition but Napoleon himself took great interest in the subject, and mingled eagerly in the discussions of [illegible] by the procès-verbal of those [illegible] allowances made for the unparalleled flatteries of the Napoleonists, his observations are said to show great intuitive sagacity much readiness, and a peculiarly inquiring disposition, which often led him to the principles of things while men of less natural power and trained in a different school were busying themselves unprofitably with the matters on the surface "I had at first fancied," he says, "it would be possible to reduce all laws to simple geometrical demonstrations, so that every man who could read and connect his ideas together would be able to decide for himself, but I became convinced almost immediately after that this idea was absurd" (*Las Casas, Mem* part 6 263) Still, according to himself, he continued to cherish the scarcely less absurd idea that no other laws might be necessary than those inserted in the code The second volume of the work of Thibaudeau (*Sur le Consulat et l'Empire*) is perhaps the most useful to consult for the history of these discussions According to him the secretary Locre did not in any degree improve the speeches of the First Consul in his report Although the ideas of Napoleon himself are said to have entered largely into the composition of the code, it does not appear clearly in what important particulars this was the case, except in one singular instance, that of the law of divorce (book 1 title 6), the liberty of which he is said to have greatly promoted The Code Civil is composed of a great number of laws, dated from the "14 Ventose, an 11 (March 1803) to 24 Ventose an 12 (March, 1804), in which latter month they were united in a single code, and which was republished under the empire in 1807 The "Code de Procedure Civile" was put in force on the 1st January, 1807, the Code of Commerce dates from the same year, the "Code d'Instruction Criminelle" from November 1808, the "Code Penal" from February, 1810, which last is a revision of the "Code Penal" and "Code des Delits et des Peines" of the Revolution But the Code Civil is that to which the term "Code Napoleon" is in common language particularly applied It consists of three books, the first 'of persons,' subdivided under eleven titles, the second 'of goods (biens), and the different modifications of property,' comprising four titles the third 'of the different manners in which property is acquired,' with twenty titles These last are again subdivided into chapters and sections, and the whole code consists of articles numbered in arithmetical order through the whole, in all 2281 The most important provisions of the code as to the civil state of persons are those relating to marriage and divorce With regard to property its fundamental law is that of equal succession by heirs the abolition of most distinctions between landed and moveable property, and the restraint imposed by it on the testamentary power making in all a system 'fundamentally at variance with that of all the other states of Europe and of which the ultimate consequences are destined to be more important than any of [illegible] which [illegible] about by the Revolution" (*Alison's History of the French Revolution*, vol vi) But in this respect the Code Napoleon merely consolidated the revolutionary laws already existing *See* CODE

NAPOLITE A blue mineral from Vesuvius

NARCEIA (Gr ναρκη, *torpor*) A vegeto-alkaline base, contained in opium, and discovered by Pelletier in 1832 Its salts have the peculiarity of being blue in a certain degree of concentration, and on adding successive quantities of water to them the colour changes to violet and red and lastly disappears By this character, and by its easy fusibility [illegible] it is distinguished from the other principles with which it is associated Its medical virtues have not been ascertained, nor has its equivalent number been determined

**NARCI'SSUS** In Mythology, the beautiful son of Cephesus and the nymph Liriope, whose history formed one of the most favourite topics with the poets of classical antiquity Though beloved by all the Grecian nymphs he treated them with contemptuous indifference; but having accidentally seen his own image reflected in a fountain, he became so enamoured of it that he languished till he died, and thus realized the prophecy of Tiresias, that he should live until he saw himself After his death the gods, moved with compassion for his fate, changed him into the flower which bears his name

NARCISSUS In Botany a genus of Endogens belonging to the natural order of *Amaryllidaceæ*, "among which it is known by its flowers growing upon a scape, and having a cup at their mouth," the stamens opposite the sepals being longer than the others The species are very numerous, and from their delicate shape soft and various colour, and sweet scent, have long been favourite objects of cultivation, especially the daffodils, jonquils, and tazzettas Some of the more hardy species grow wild in our woods and under our hedges, but the finer sorts are natives of more southern latitudes

NARCO'TICS (Gr ναρκη, *torpor*) Medicines which produce drowsiness, sleep, and stupor They appear, in the first instance, to act as stimulants, quickening the pulse and rousing the energies of the nervous system and, in every instance, this is their most obvious operation In larger doses these effects are followed by a tranquil state of mind, torpor, and even coma Considerable skill and experience are required in the successful administration of these medicines both as regards the cases in which they are to be prescribed the doses in which they are to be given and the peculiarities of habit which often interfere with and modify their usual effects They are to be distinguished from sedatives, which do not produce preliminary excitement Opium is a narcotic, henbane a sedative

NARCO'TINE (Gr ναρκη) A crystallized substance, obtained by digesting the aqueous extract of opium in ether, and evaporating the ethereal solution It was discovered in 1803 by Derosne and supposed to be the narcotic principle of opium but this has since been shown to reside more exclusively in *morphia* and narcotine is possessed rather of stimulant qualities and is the cause perhaps of the excitement which opium occasions It consists of 65 carbon, 5 50 hydrogen, 2 50 nitrogen and 27 oxygen

NARRA'TION (Lat narro *I tell*) In Rhetoric the term usually applied to the second division of an oratorical discourse in which the facts of the case are set forth from which the orator intends to draw his conclusions This part of a discourse should be characterized by the greatest simplicity of style, as well as by absence of all rhetorical ornaments

NARWHAL The common name of the species of Cetacean which has a single long protruded tusk See MONODON

NA'SAL (Lat nasus *nose*) A nasal pronunciation is given in some languages to particular letters as in French to the letters *n* and *m* in certain positions The only sound approaching to nasal in English is that of the double consonant *ng*, as *sing, ring*, &c

NASALIS See SYNOTUS

NASCENT STATE Chemists generally apply this term to gaseous bodies at the moment of their evolution as it were, from liquids or solids and before they have assumed the aeriform state There are numerous cases in which bodies having no tendency to combine under ordinary circumstances readily unite when presented to each other in their nascent states Hydrogen and nitrogen gases, for instance when mixed together show no disposition to combine, but when certain organic bodies containing those elements are heated, they are evolved in their nascent states and combine so as to form ammonia, it is in this way that ammonia is abundantly produced during the destructive distillation of many kind of animal matter, and of pit coal

NASSIUM (Lat), among the ancient Romans signified *freight*, whence it was used for a piece of money put into the mouths of deceased persons to enable them to pay Charon for ferrying them over the Styx A similar custom prevailed among the Greeks

NA'SUA (Lat nasus, *a nose*) A genus of Plantigrade Mammalia, so called from the remarkable elongation and upward curve of the nose The species of this genus, *N rufa*, or red coati, and *N fusca*, or brown coati, are both natives of South America They climb trees in pursuit of birds, and to rob their nests, they burrow for shelter at the foot of large trees and often undermine them to such an extent that they are liable to be overturned even by a slight wind

NASUTA (Lat nasus) A term in Zoology, signifying the prolongation of the muzzle into the form of a nose, as in the *Perameles nasuta*, *Pleuronectes nasutus*, *Trygala nasutus*, or the development of the integument of the face above the muzzle forming a true nose, as in the proboscis monkey *Simia nasuta* Ti-



liger called a family of Multungulate quadrupeds with the nose prolonged beyond the jaws, and moveable, as in the tapir, *Nasuta*

NATA'LITIES, *Birthday* A day celebrated with much ceremony by the ancients. Of these there were four, which all Roman citizens were bound to observe, viz those of the gods, of their emperors, of distinguished persons, and their own On such occasions every Roman was arrayed in white, and in all his ornaments; among which a ring, called by way of eminence the *annulus natalis* was conspicuous Sacrifices were offered to the *genius* which presided over the person and the day concluded with a sumptuous entertainment, to which friends and kindred were invited

NATATORES (Lat nato, *I swim*) Swimming birds The name of the order of birds including those in which the toes are united by a membrane whence the order is also termed *Palmipedes* The legs are placed behind the equilibrium and the body is covered with a a thick coat of down beneath the feathers

NATATORY (Lat nato) In Zoology, when a locomotive extremity, or other part, is provided with a membrane or with close-set hairs, by which it is adapted for impelling water

NATION (Lat) A collective appellation for a people inhabiting a certain extent of territory under the same government The word is also used in some universities, by way of distinguishing students of different districts or countries, as the case may be This latter meaning is borrowed from the custom that was adopted in the University of Paris previously to the institution of faculties, when those who resorted to it from different countries lived under the same institutions and masters a [illegible] being the only bond of union

NATIONAL DEBT In Political Economy and Finance the amount of the sums or obligations owing by a nation or state

In modern times it has been customary in most countries on the occurrence of any circumstances that occasion any considerable increase of expense to borrow either the whole or some portion thereof paying a certain stipulated interest for the same In this country the practice of borrowing money in order to defray part of the war expenditure was introduced in the reign of William III And how much soever opinions may differ as to the policy of [illegible] in ordinary times it could not at its first [illegible] in Britain, be dispensed with The Revolution involved us in a bloody and expensive contest with Louis XIV, then in the zenith of his power who espoused the cause of the exiled family of Stuart But though great and imminent the danger from without was inferior to that from within A numerous and powerful party were favourable to the views of the Pretender, and the imposition of such additional taxes as would have been required to defray the heavy cost of the contest we were forced to wage for our liberties and religion would have given a violent shock to industry and afforded the Jacobites the means of traducing the new government fomenting popular discontent and most probably of overturning the revolutionary establishment Under such circumstances, the contraction of debt was not really a matter of choice, but of necessity The error if there have been any consisted in continuing the system of loans after the new government was firmly established and when either the whole or a larger portion of the war expenditure might have been defrayed by taxes raised within the year

In the infancy of the funding system it was customary to borrow upon the security of some tax or portion of a tax set apart as a fund for discharging the principal and interest of the sum borrowed This discharge was however very rarely effected The public exigencies still continuing the loans were in most cases either continued or the taxes were again mortgaged for fresh ones At length the practice of borrowing for a fixed period, or as it is commonly called upon *terminable* annuities, was almost entirely abandoned, and most loans were made upon *interminable* annuities, that is, government undertake to pay the lenders of any given sum a certain annuity in all time to come or till they find it convenient to pay off the principal, but the lenders have no right or title to demand payment of the latter, that being a matter entirely at the option of government, who may either pay it or not, as they think fit

In the beginning of the funding system, the term fund meant the taxes or funds appropriated to the discharge of the principal and interest of loans, those who held government securities, and sold them to others, selling of course, a corresponding claim upon some special fund But after the debt began to grow large, and the practice of borrowing upon interminable annuities had been introduced, the meaning attached to the term fund was gradually changed, and instead of signifying the security upon which loans were advanced, it has for a long time signified the principal of the loans themselves

During the reigns of William III and Anne the interest stipulated for loans was very various But in

the reign of George II a differe[illegible] practice was [illegible] Instead of varying the interest [illegible] to the state of the money marke[illegible] interest was generally fixed at 3 or 3½ per cent , the necessary variation being made in the principal funded Thus, suppose government were anxious to borrow, that they preferred borrowing in a 3 per cent stock, and that they could not negotiate a loan for less than 4½ per cent , they effected their object by giving the lender, in return for every 100*l* advanced, 150*l* of 3*l* per cent stock; that is, they bound the country to pay him or his assignees 4*l* 10*s* a year in all time to come, or otherwise to extinguish the debt by a payment of 150*l* In consequence of the prevalence of this practice, the principal of the debt now existing amounts to nearly 2-5ths more tha[illegible] by the lenders

T[illegible] been in the last degree injurious, though some advantages are either derivable or supposed to be derivable from it No doubt it renders the [illegible] of [illegible] bt, and its transfer, more simple and [illegible] than it would be, did it consist of a number of funds bearing different rates of interest , and it is contended that the greater field for speculation afforded to the dealers in stocks bearing a low rate of interest has enabled government to borrow, by funding additional capitals, for a considerably less payment, on account of interest than would have been necessary had such increase of capital not been made

In point of fact, however, these advantages are inconsiderable, while the disadvantages inseparable from the practice of funding a large amount of stock at a low rate of interest are great and signal During war especially if any considerable portion of its expenditure be defrayed by means of loans the rate of interest uniformly rises, and is usually much higher than during peace If therefore, loans were funded in stocks bearing a rate of interest equivalent to the market rate when they were contracted for, the charge on their account might be reduced soon after the return of peace according to the fall in the rate of interest , whereas when loans are funded in stocks bearing a low rate of interest, with a corresponding increase of capital, it becomes impossible to take advantage of the fall of interest at the return of peace and the country is burthened with the war interest in all time to come ! It is not easy to exaggerate the injury we have sustained by overlooking this plain principle In 181[illegible] to specify only one of many similar instances government bargained for a loan of 27 000 000*l* it being stipulated that every subscriber of 100*l* should be entitled to 174*l* 3 per cent stock and 10*l* 4 per cent stock, making the interest paid on the loan 5*l* 12*s* 4*d* per cent The great improvidence of this transaction is obvious Had from 5*l* 15*s* to 6*l* per cent of interest been paid for the loan it might have been obtained without funding any additional capital , and had that been done, we should have been able within two or three years in consequence of the fall of interest after the peace, to reduce the charge on account of the loan to 3 or 3½ per cent , but, owing to the way in which the contract was made, we have not had and will not have any means of reducing the exorbitant charge on account of this loan, so long as the market rate of interest is above 3 per cent except by paying 174*l* for every 100*l* originally received exclusive of the 10*l* of 4 per cent stock ! But this, as already stated is only one instance out of many of the same sort We believe indeed that we are within the mark, when we affirm that, owing to this erroneous method of funding, the country is at present paying from 6,000 000*l* to 7 000 000*l* a year on account of the public debt more than it would have had to pay had the same sums been borrowed and funded without any increase of capital

We have said that an interest of from 5*l* 15*s* to 6*l* per cent , instead of the stipulated interest of 5*l* 12*s* 4*d* per cent , would have enabled the loan of 181[illegible] to be funded without any increase of capital Now, this is not a hypothetical statement In the year in question 11 000 000*l* of exchequer bills were funded in a 5 per cent stock, at the rate of 117*l* stock for every 100*l* exchequer bills This was equivalent to an interest of 5*l* 17*s* per cent , being only 4*s* 8*d* more than the interest paid on the loan, though the subscribers to the latter had 84*l* of artificial capital created for every 100*l* advanced and the holders of the bills only 17*l* of artificial capital But in point of fact, the differences in the rates of interest, after allowing for certain circumstances connected with the loans, amounted to only 2*s* 3*d* per cent This shows how little the saving in the charge on account of interest, by funding increased capitals, deserves to be considered as at all de[illegible] (For a further dis-cussion of this subject, see the *Edinburgh Review* No 93 art iii )

That this improvident system should have been so extensively acted upon by our finance ministers during the American and French war is the more surprising, seeing [illegible] had [illegible] capitals at a comparatively high rate of interest Owing partly to the scarcity of capital, but much more to the supposed instability of the revolutionary establishment, the loans during the reigns of William III and Anne were mostly contracted at a very high rate of interest The stock created was the exact amount of the loans, the interest on it being increased according to the supposed insecurity of the government the scarcity of floating capital, &c Now, mark the consequences of this so early as 1716, Sir Robert Walpole, availing himself of the greater facility with which money was procured after the treaty of Utrecht, and of the greater stability of the government, was able, by offering to pay off the creditors, to reduce the charge on account of the debt from 1,598,602*l* to 1,274,146*l* , being a saving of 324,456*l* , or about one fifth part of the entire charge. And in 1749, during the administration of Mr Pelham, the interest was again reduced from 4 to 3 per cent , a measure which produced a fresh saving of 565,000*l* a year

Happily the practice of funding in a 5 per cent stock was not entirely abandoned during the late war In 1822, the total British and Irish 5 per cent stock amounted to about 150,000 000*l* , and, by offering to pay it off, a reduction of interest was then effected to the extent of about 1,200,000*l* a year And since that period, further savings have been effected by the reduction of the interest [illegible] tely, the far [illegible] the late war, and that with the American colonies, was funded in the 3 per cents , and, as already stated, the charge on that portion has, in consequence, been hitherto, and will most probably continue to be, unsusceptible of diminution

*Payment of National Debt Sinking Fund* — The payment of the national debt can be effected only by applying to that purpose such surplus revenues as the treasury may have to dispose of But it was contended by the founders of the sinking fund established in 1716, and still more strongly by Dr Price and Mr Pitt, the founders of the sinking fund of 1786, that if a sinking fund were formed, by applying a certain amount of revenue to buy up stock, and if the dividends on the stock so bought up were afterwards uniformly applied to the same object, such sinking fund would increase at *compound interest*, so that the largest amount of debt might be defrayed almost without an effort Dr Price illustrated the operation of this principle by calculating the number of *globes of gold* to which a penny, laid out at compound interest at the birth of Jesus Christ, would now amount to ! But though a calculation of this sort be theoretically true, it is practically false and absurd The truth is, that no sinking fund, even though it consisted of a clear surplus revenue ever really operates at compound interest It is true that by constantly applying the same original amount of free revenue and the dividends accruing on the stock purchased by it to buy up fresh stock, the reduction of the debt is effected in the *same way* as if the free surplus revenue had been increasing, by an inherent energy of its own, at compound interest , but it is essential to know that though the *modus operandi* be the same, the means are radically and totally different The debt is reduced because a portion of the produce of the taxes is systematically applied to pay it off and it can never be reduced by any other means To make capital increase at compound interest, it must be employed in some sort of productive industry , and the profits, instead of being consumed as income, must be regularly added to the principal, to form a new capital It is unnecessary to say that no such sinking fund has ever existed Those that have been set on foot in this and other countries have all been supported either by loans or by the produce of taxes, and have never paid off a single farthing of debt by their own agency

It is clear, from this statement, that when there is no surplus revenue there can be no sinking fund Dr Price, however, did not scruple to lay it down broadly, that to suspend the sinking fund during war, though the expenditure might then greatly exceed the income, would be [illegible] folly (*Appeal to the Public on the Subject of the National Debt*, [illegible] 1771 ) And inconceivable as it may now appear all parties in parliament concurred in the soundness of this opinion, and approved the policy of keeping up the sinking fund machinery during the whole of last war Hence the loans for the service of the year had to be increased by the entire amount of the sums placed at the disposal of the sinking fund commissioners , so that for every shilling's worth of stock transferred to them by this futile proceeding, an equal amount of *new debt* had to be contracted, exclusive of the loss incurred through the expense of management, &c

For [illegible] delusive juggle was kept u[illegible] n believing, notwithstanding [illegible] rience to the contrary, that it w[illegible] the public debt. Dr. Hamilto[illegible] merit of having dissipated this delusion, the grossest, certainly, that ever im-

posed on any people He showed, in his work on the National Debt, published in 1813, that the sinking fund, instead of diminishing, had really added to the debt, and he proved to demonstration that the *excess of revenue above expenditure* is the only sinking fund by which any part of the national debt can be discharged "The increase of revenue," he observes, "or the diminution of expense, are the only means by which the sinking fund can be enlarged, and its operations rendered more effectual, and all the schemes for discharging the national debt, by sinking funds operating at compound interest, or in any other manner, unless in so far as they are founded upon this principle, are completely illusory"

The entire amount of the debt contracted from 1792 to 1816, both inclusive, amounted to 584,874,557*l*, but of this no less than 188,522,350*l* was made over to the commissioners of the sinking fund to be laid out in the paying off debt But it must not be supposed that the influence [illegible] that it was [illegible] money be borrowed with the one hand that it might be paid off with the other It is clear that a process of this sort could not take an atom from the public debt, but in point of fact, it added considerably to its amount Had the sinking fund not existed, the amount of the loans contracted during the war would have been fully a third less than they really were, and, as the rate of interest is always greater on large than on smaller loans it follows, had this miserable juggle not been kept up, that the money borrowed from 1792 to 1816 would have been obtained at a reduced charge, at the same time that the expenses of its management would have been saved The sinking fund has, therefore, been a costly as well as a delusive piece of quackery The loss it entailed on the country during the war has been estimated, apparently on reasonable grounds, at above 600,000*l*

At length the folly of contracting debt for no other purpose but to pay it off, became obvious to every one, and the nominal amount of the sinking fund began to be diminished after the close of the war In 1819 it was attempted to form a real sinking fund of 5,000,000*l*, that is, to maintain a real surplus revenue of that extent. But as this could not always be done after various modifications an end was put to the [illegible] the act 10 Geo 4 c 27 having [illegible] the sum applicable in future to the reduction of the national debt should be the surplus if any of the total revenue beyond the total expenditure of the kingdom

*Distribution of the Dividends, or Interest on the National Debt* — It appears from the subjoined account of the number of dividend warrants issued during the half year ending the 5th of January, 1843, that they amounted in all to about 280,000 and the number has not materially varied in the interval The large number (87,176) of holders of stock not producing above 5*l* of half yearly dividend is principally, we believe, ascribable to the circumstance of the Bank of England and the London private banks not allowing interest on deposits

We may observe, by the way, that the number of persons having a direct interest in the funds is much greater than it would appear to be from this account The dividends upon the funded property belonging to the Bank of England and other banks, to the Equitable and other insurance companies, &c, are paid upon single warrants, as if they were due to so many private individuals, whereas they are really paid to these individuals only because they act as factors or trustees for a vast number more It is, consequently quite absurd to pretend, as is sometimes done that any interference with funded property would affect only 280,000 individuals out of a population of 25,000,000 Any attack upon the dividends would really be destructive, not merely of the interests of those to whom dividend warrants are issued, but of all who depend on them it would destroy our whole system of banking and insurance, and overspread the country with bankruptcy and ruin Not only, therefore, is every proposal for an invasion of the property of the fundholders bottomed on injustice and robbery, but it would were it acted upon be little less ruinous to the community than to the peculiar class intended to be plundered

1 STATE of the Public Funded and Unfunded Debt of Great Britain and Ireland, and the Charge thereon, on the 5th January 1850

| PRINCIPAL | | | | ANNUAL CHARGE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Capitals Unredeemed | | | | In Great Britain | | | In Ireland | | | Total Annual Charge |
| GREAT BRITAIN | £ | s | d | *Due to the Public Creditor* | £ | s | d | £ | s | d | £ s d |
| Debt due to the South Sea Company at 3 per ct | 3,662,784 | 8 | 6½ | Annuities per 1 Geo 4 c 22 expire 1867 | 585,740 | 0 | 0 | | | | |
| Old South Sea Annuities at 3 per ct. | 3,195,160 | 17 | 9 | Annuities for limited term of years per 22 Geo 3 c 31 10 Geo 4 c 21 and Will 4 c 11 which expire at various periods viz | | | | | | | |
| New South Sea Annuities, at 3 per ct | 2,195,720 | 6 | 9 | Granted up to 5 Jan 1849 £1,190,956 19 0 | | | | | | | |
| South Sea Annuities, 1751 at 3 per ct | 500,780 | 11 | 9 | Deduct expired and unclaimed up to ditto including 100*l* Waterloo Annuities 59 Geo 3 c 31 772,109 9 10 | | | | | | | |
| Debt due to the Bank of England at 3 per ct | 11,015,100 | 0 | 0 | | 918,847 | 9 | 2 viz | 869,097 | 9 | 2 | 49,750 0 0 |
| Bank Annuities created in 1726 | 750,313 | 19 | 0 | *Payable at the National Debt Office* | | | | | | | |
| Consolidated Annuities at 3 per ct | 374,313,317 | 14 | 8½ | Life Annuities per 48 Geo 3 c 142 10 Geo 4 c 24, and 3 Will 4 c 14 viz | | | | | | | |
| Reduced Annuities, at 3 per ct. | 121,679,816 | 11 | 8 | Granted up to 5 Jan 1849 £2,230,776 14 0 | | | | | | | |
| Total at 3 per ct | 517,313,051 | 10 | 1½ | Deduct expired and unclaimed up to ditto 1,350,777 16 0 | | | | | | | |
| [illegible] | 214,780,836 | 4 | 6 | | 886,038 | 18 | 0 | | | | |
| [illegible] | 423,151 | 8 | 2 | Tontine and other Life Annuities, per various Acts — English | 17,792 | 12 | 6 | | | | |
| Total, Great Britain | 732,523,342 | 2 | 9½ | Tontine and other Life Annuities, per various Acts — Irish | 31,250 | 8 | 7 | 6,524 | 2 | 3 | |
| IN IRELAND | | | | | 26,161,891 | 13 | 3½ | 1,443,107 | 4 | 10 | |
| Irish Consolidated Annuities at 3 per ct | 5,620,886 | 14 | 5 | Management | 91,751 | 7 | 4 | | | | |
| Irish reduced Annuities, at 3 per ct | 120,295 | 16 | 9 | [illegible] | 26,256,623 | 0 | 7½ | 1,443,107 | 4 | 10 | |
| Annuities at 3½ per ct | 33,123,671 | 2 | 3 | Interest on [illegible] | 421,882 | 10 | 0 | | | | |
| Debt due to the Bank of Ireland, at 3½ per ct | 2,630,769 | 4 | 8 | Total Annual Charge, exclusive of 76,145*l* 17*s* 9*d*, the [illegible] commissioners on account of Stock unclaimed 10 years or upwards, and of unclaimed Dividends, and also on account of Donations and Bequests | 26,678,505 | 10 | 7½ | 1,443,107 | 4 | 10 | 28,121,612 15 5½ |
| New 3 per ct Annuities | 3,673 | 11 | 2 | | | | | | | | |
| Total, Ireland | 41,499,296 | 9 | 3 | | | | | | | | |
| Total, United Kingdom | 774,022,638 | 12 | 0½ | | | | | | | | |
| Exchequer Bills outstanding 5th Jan 1849 | 17,786,700 | 0 | 0 | | | | | | | | |
| Total Funded and Unfunded Debt, 5th Jan 1849 | 791,809,338 | 12 | 0½ | | | | | | | | |

# NATIONAL DEBT.

II. Account of the Principal and Annual Charge of the Public Debt at different Periods since the Revolution.*

| | Principal, Funded and Unfunded | Interest and Management. |
|---|---|---|
| | *L* | *L* |
| Debt at the Revolution, in 1689 | 664,263 | 39,855 |
| Excess of debt contracted during the reign of William III above debt paid off | 15,730,439 | 1,271,087 |
| Debt at the accession of Queen Anne, in 1702 | 16,394,702 | 1,310,942 |
| Debt contracted during Queen Anne's reign | 37,750,661 | 2,040,416 |
| Debt at the accession of George I | 54,145,363 | 3,351,358 |
| Debt paid off [illegible] above debt contracted | 2,053,125 | 1,133,807 |
| Debt at the accession of George II | 52,092,238 | 2,217,551 |
| Debt contracted from the accession of George II to the peace of Paris in 1763, three years after the accession of George III | 86,773,192 | 2,634,500 |
| [illegible] | 138,865,430 | 4,852,051 |
| [illegible] | 10,281,795 | 380,480 |
| Debt at the commencement of the American war, in 1775 | 128,583,635 | 4,471,571 |
| Debt contracted during the American war | 121,267,993 | 4,980,201 |
| Debt at the commencement of the war in 1793 | 249,851,628 | 9,451,772 |
| Paid off [illegible] | 10,501,380 | 243,277 |
| Debt at the commencement of the war, in 1797 | 239,350,148 | 9,208,495 |
| Debt contracted during the war | 601,500,343 | 22,829,679 |
| Total funded and unfunded debt on the 1st of February, 1817, when the English and Irish exchequers were consolidated | 840,850,491 | 32,038,174 |
| Debt cancelled from the 1st of February, 1817, to 5th of January, 1850 | 49,041,153 | 3,916,562 |
| Debt, and charge thereon, 5th of January 1850 | 791,809,338 | 28,121,612 |

* This account has been [illegible] partly from the table in Dr Hamilton's work on the National Debt [illegible] partly from the *Parl Paper*, No. 165 Sess 1851 and partly from the *Annual Finance Book* for the year [illegible]

III. An Account of the Total Number of Persons to whom a Half Year's Dividend [illegible] on the 5th of January last, and the Yearly Payment thereof, on each Description of Public Stock and on each Description [illegible], distinguishing the Number respectively of those whose Dividends for the Half Year did not exceed 5*l* 10*l*, 50*l*, 100*l*, 200*l*, 300*l* 500*l*, 1,000*l*, 2,000*l*, 3,000*l* 4,000*l* 5,000*l*, and the Number of those whose Dividends exceed 5,000*l*, distinguishing also, in those above 1,000*l*, the Dividends due to any Public Company, or to more than a single Name —

| | Not exceeding | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5*l* | 10*l* | 50*l* | 100*l* | 200*l* | 300*l* | 500*l* | 1,000*l* | 2,000*l* | Co & Joint Accts ,3,000*l* | 3,000*l* | Co & Joint Accts ,3,000*l* | 4,000*l* | Co & Joint Accts ,4,000*l* | 5,000*l* and upwards | Total |
| Number to whom dividends were payable | | | | | | | | | | | | | | | | |
| On 3*l* per cent. reduced annuities | 10 317 | 4,745 | 11,681 | 3,473 | 2 17 › | 742 | 453 | 231 | 53 | 24 | 9 | 5 | 5 | 3 | 12 | 33,958 |
| On 3*l* 10*s* per cent reduced annuities | 7,019 | 4,36 2 | 10,17 3 | 2,909 | 1 561 | 411 | 251 | 112 | 15 | 21 | 5 | 4 | nil | 1 | 5 | 26,849 |
| On 3*l* 10*s* per cent annuities 1818 † | 198 | 162 | 399 | 211 | 127 | 57 | 38 | 30 | 3 | 3 | nil | nil | nil | 1 | 3 | 1,232 |
| On 4*l* per cent annuities, 1826 | 1 601 | 903 | 2 014 | 512 | 312 | 92 | 59 | 15 | 4 | 1 | 2 | 1 | n | [illegible] | | 5,636 |
| On long annuities | 9 078 | 4,212 | 8 361 | 1,>16 | 72› | 187 | 99 | 34 | 4 | 1 | 1 | 1 | 1 | 1 | m | 24 221 |
| [illegible] | 1,519 | 787 | 1,632 | 351 | 178 | 56 | 32 | 20 | 4 | nil | 2 | | n | | 2 | 4,583 |
| On 3 per [illegible] an nuities | 28 722 | 13 719 | 32 601 | 9,612 | 6,286 | 2,141 | 1,424 | 709 | 153 | 18 | 16 | 20 | 7 | 13 | 21 | 95,555 |
| [illegible] ‡ | 120 | 71 | 180 | 40 | 27 | 4 | 2 | nil | nil | nil | nil | | nil | n | | 447 |
| On new 3*l* 10*s* per cent annuities | 26 881 | 14 698 | 29 370 | 6 648 | 3,129 | 765 | 431 | 204 | 28 | 20 | 4 | 1 | 2 | 4 | 9 | 82,194 |
| On new 3*l* per cent annuities | 3› | 31 | 107 | 36 | 20 | 3 | 4 | nil | 1 | nil | nil | nil | nil | nil | nil | 2 7 |
| On annuities for terms of years | 1 656 | 833 | 1 ›57 | 333 | 161 | 37 | 34 | 12 | 1 | nil | 1 | 3 | nil | 1 | 8 | 4,839 |
| Totals | 87,176 | 14 618 | 98 30› | 25 641 | 14,701 | 4,495 | 2 827 | 1,367 | 266 | 151 | 40 | 35 | 15 | 24 | 60 | 279,571 |

† Dividends payable 10th of October

‡ Dividends payable on 5th of January

NATIONS LAW OF *See* Law

NATIVITY A word used by way of eminence to signify the birthday of our Saviour and of saints and other canonized persons In Astrology the word nativity [illegible] *scope* which see

NATRIX [illegible] the Linnæan *Coluber* of which our common harmless snake, *Coluber natrix*, Linn, is the type

NATROLITE A mineral which occurs in small rounded fibrous masses of a yellowish colour, it is by some called *prismatic zeolite* It is chiefly found in Suabia in amygdaloidal basalt It is a hydrated silicate of soda and [illegible]

NATRON The German [illegible] soda hence, also, the German chemists call sodium *natrium* It is probably from the ancient term νίτρον, *nitron*, or fossil alkali, hence *nitre* It is found in sandy soils of various countries, but more especially in Egypt, where it was anciently [illegible] in the art of embalming [illegible]

NATURAL [illegible] marked thus ♮, whose office is to contradict the flats or sharps placed at the beginning of a stave or elsewhere, and by the use of which the note to which it is prefixed returns to the diatonic scale

NATURALIZATION In Law, the process by which an alien is placed in the same civil condition as if he had been born under the dominion of the state In England, this can only take place by act of parliament, and it is provided by stat 1 G 1 c 4 that no bill for naturalization can be received without certain clauses incapacitating the party from sitting in parliament or being a member of the privy council, &c *See* Alien

NATURAL HISTORY, may be defined to be the history and description of the natural products of the earth, [illegible] vegetables or animals together with [illegible] and effects The [illegible] all the branches of this wide and interesting subject treated at considerable length under their respective heads

NATURAL ORDERS OF PLANTS are groups of genera which are supposed to bear a greater resemblance to each other than [illegible] These may be said to be coeval with our knowledge of plants for the old ideas of grasses trees, herbs, corn fruit trees, indicate a natural perception of the existence of some such groups When systematical botany first assumed the semblance of science we find the Umbelliferous, Leguminous, Liliaceous, Labiate, and Composite orders, more or less distinctly defined It is, however, chiefly by the labours of botanists posterior to the days of Linnæus, especially to Jussieu and his followers, that the present improved limitation of natural orders is owing It must, however, be confessed that they are still in great need of regulation, which can scarcely, however, be anticipated until something precise shall have been settled concerning the relative value of differences in organization. The most

complete account of them in English is that in *Lindley's Natural System of Botany*, ed 2, in which 289 natural orders are enumerated

NA'TURAL PHILOSO'PHY, or PHYSICS, is the science which treats of the properties of natural bodies, and their actions on each other See Physics

NATURE, LAW OF See Law

NAU'CA In Botany a seed in which the scar of the hilum occupies one third part of the external surface, as in the horse chesnut

NAUMA'CHIA (Gr *ναυς a ship* and *μαχη a fight*) Among the Romans, a representation of a naval engagement, which took place most usually in theatres (called also naumachiæ) made especially for the purpose These exhibitions were originally instituted for purposes of naval discipline, but, in process of time, only malefactors or captives whose lives had been forfeited participated in them They appear to have been conducted on a scale of such magnificence as almost to exceed belief Within the places set apart for them whole fleets went through their evolutions without inconvenience or confusion, and all the artifices of human ingenuity were put in play to give an air of reality to the representation We are told by Suetonius that in an exhibition of this sort given by Nero sea monsters were seen swimming about in the artificial lake, and in the sea-fight on the lake Fucinus, given by Claudius, there are said to have been no fewer than 19,000 combatants Julius Cæsar appears to have first given a naumachia on an extensive scale his example was followed by many of his successors on the imperial throne, and at last they were frequently exhibited at the expense of private individuals as a means of increasing their popularity The seats for the convenience of spectators were arranged in a manner somewhat similar to those in the amphitheatres See AMPHITHEATRE

NAU'SEA (Gr *ναυς a ship*) A sensation of sickness, similar to that produced by the motion of a ship at sea An inclination to vomit

NAUTILI'DÆ (Gr *ναυτιλος*, the name of the argonaut in Aristotle) The family of Cephalopods with siphoniferous shells, of which the *nautilus* is the type

NAU'TILUS (Gr *ναυτιλος*) The name of a genus of Tetrabranchiate Cephalopods including those which have a chambered shell with simple septa perforated in the centre concave towards the outlet of the shell and with the last chamber the largest, and containing the body of the animal

NA'VAL ARCHITECTURE In the small space we can assign to this subject we shall merely endeavour to convey a general notion of the principles and process of construction

Ships are built in different forms, according to the service they are intended for and the burdens they have to carry It is in men-of-war, which besides possessing in an eminent degree the general qualities of a ship have to support a heavy armament of cannon, and which are destined to severe and long-continued service that the principles of construction have been carried to the greatest perfection The form of the ship her strength, or the scantling necessary for the services required of her, are, from our imperfect knowledge of hydrodynamics, the results of experience alone

When a ship is to be built, her form is projected in three different planes perpendicular to each other

1st The *sheer draught* which is the side view, or projection on the plane of the keel On this are laid off the length, the heights of all the parts from the keel the position and rake of the stem and sternpost the principal frames or timbers of the sides, the ports decks channels place of the greatest breadth or midship frame, stations of the masts, &c

The frames before the midship frame are distinguished by letters, abaft it by numbers

The midship frame is not exactly in the middle of the length but rather before it

2d The *body plan*, or end view This shows the contour of the sides of the ship at certain points of her length, and since the two sides are exactly alike, the left half represents the vertical sections in the after part of the body, and the right hand half those in the fore part The base of the projection is the midship, or largest section, called also the *dead flat*, within which the other sections are delineated. On this are exhibited also the beams of the decks

3d The horizontal or floor plane, called also the *half breadth plan* The base of this is the section made by the horizontal surface of the water and the outside surface of the ship and is called the *upper water line*, or *load water line* If the ship now be supposed to be lightened uniformly, she will exhibit another water line, and thus any number of like parallel sections at equal distances down to the keel

On this projection the water lines appear as curves, on the sheer draught as straight lines parallel to the keel

These three sections correspond [illegible] the same scale, and any point in [illegible] ferable to the other two projections.





The several parts are drawn from these plans at their full size on the floor of the mould loft, and worked from the moulds or models so taken

The place in which the ship is built is called a *slip* In the middle and leading to the water, is a row of piles of stout pieces of wood called the *blocks*, having a declivity towards the water of about 1 inch in 1 foot On these the keel, which is of elm, is laid, and its component lengths scarfed together Under the keel is placed the false keel for defence At the end furthest from the water is raised the *stem*, which is in fact the keel continued upwards Inside the stem and just above the keel, is the *apron*, a curved timber connecting both On each side of the upper part of the stem is fixed an upright timber, these are called the *knight heads*, and the bowsprit lies between them At the other end of the keel is the sternpost at which the planking finishes abaft, and on which the rudder is hung Inside (or before this) are the *inner post* and other pieces for strength Upon the keel is fixed a layer of timber of the same breadth and rising forward and aft, called the *dead wood*, on this are placed the *floor timbers* these consist of one which crosses the keel to which it is bolted, and the two parts of a like timber firmly joining it, and projecting beyond its ends The several pieces are got into their places by shifting shears

The *frames* consist of pairs of timbers composed of pieces of different lengths joining the floor timbers, and carried upwards The length joining the floors is called the first futtock the next the second futtock, and so on, ending in the *top timbers* The pairs are bolted by iron bolts and of late adjacent pairs have been thus connected The frames are supported temporarily by being fixed to the *cross spalls* — long fir planks laid horizontally about the height of the gun deck

Those frames whose planes are perpendicular to the keel are called *square frames*, at the head and stern these planes incline towards the extremities, and are called *cant frames* These divisions of the ship are called accordingly *square* and *cant bodies*

When the framing has assumed its form the *ribands* are fixed these are thick narrow planks at wide intervals extending the length of the vessel marking the direction of the planks, they are firmly shored and removed when the planking comes on The *riband lines* appear on the half breadth plan as diagonal lines

Upon the keel and over the floor timbers to which it is scored is laid the *kelson*, which is, in fact, a second keel over the first

The stern of square sterned ships is formed upon the *wing transom*, the uppermost of the horizontal pieces of timber called *transoms* crossing the sternpost inside

The wing transom is secured to the timbers of the side by a strong horizontal knee

When the framing is complete the outside planking is laid on The *wales* thick planks above the water are first secured to the ribs The *clamps* are thick planks inside to support the ends of the beams of the decks

The *beams* support the decks rest on the clamps, and are secured to the side by *knees*

The *breast hooks* are strong curved pieces of timber crossing the stem and joining the bows The *deck hooks* are the same, being at the decks The *crutches* answer a like purpose below in the after part

The *port sills* are the upper and lower edges of the ports

The *spirketting* is the plank of the side between the water way and the port sill

The *chain wales* are thick planks of the outside to receive the chains and preventer bolts for the support of the rigging

The *foot waling*, or *ceiling*, is the plank lining the inside of the ship below

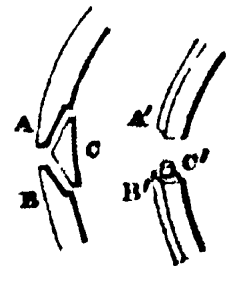
The *limber boards* are short thick pieces of wood resting against the kelson for the convenience of keeping a clear passage to the well

The *knee of the head*, also called the *cutwater*, is the projecting part of the head, it is secured to the bows by knees called *checks*

In order to bend wood into the necessary curvature it is steamed in places for the purpose When the planking is all complete, the ship is caulked and painted

The fastenings of timber are effected by bolts, treenails or oaks The present method of framing ships of war is chiefly due to Sir Robert Seppings We shall describe it here generally for particulars, see the *Phil Trans* 1814, and the published reports on the subject

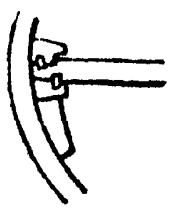
As the timbers or ribs cannot be procured entire, or of the proper curvature, various methods have been used for joining the [illegible] C, fastened by treenails to the ends A B of the timbers [illegible] upon the joint, in [illegible] falls on the treenails, and when the chock decays, no support is afforded in any sense whatever.



At present the square ends A' B', are brought together, while a *coak* C', or small oak cylinder, is let into each

By this plan the two faces resist any effort by pressure from without to close the timbers, and the coak itself resists the effort (the last) to make one timber slide past the other, the whole force necessary to cut it off flush with the section In the single case of lifting one face exactly perpendicularly off the other, the coak offers no resistance, this effort, which is that produced by the strain of the rigging on the sides, is opposed by other numerous connections The method is very ancient, being used in the construction of the pillars in the temple at Balbec, the advantage of its application to shipbuilding is seen in the frames which undergo no change of form while hoisted into their places The efficiency of the plan however, does not appear in a single length, but in the system of frames each joining of which is placed near the middle of the next piece

A *shelf piece*, coaked and bolted to the timbers or ribs,



and resting on short vertical pieces of timber called *chocks*, and sometimes scored to the ribs, is carried like a hoop entirely round the ship On this the beam ends are coaked, and over these again is laid a strong water way scored to the beams, and coaked Besides these the beam end is clasped by two arms of an iron knee, of which the third, which is vertical, is bolted to the chock

The shelf binds firmly the ends and sides of the ship together, and resists like an arch all external pressure

The spaces between the timbers below are filled up by dry wood driven in tight and caulked, thus rendering the bottom solid and water tight, independently of the planking

One of the most important improvements is the diagonal framework below Instead of the former planking in the hold are placed *braces*, crossing the ribs to which they are coaked, at an angle of 45°, those in the fore body incline (or rake) aft, and those in the after body forward They butt against the kelson, and extend nearly to the water, they are in general placed under every other beam, but closer at the extremities

Longitudinal pieces of timbers are laid nearly parallel to the keel over the heads or joinings of the timbers and bolted through, these, crossing the diagonals form a series of rhomboidal figures across which inside are firmly driven *trusses*, lying the opposite way from the diagonals these are bolted through, and when necessary are further tightened by driving in thin iron plates at the ends The diagonals act by the *tension* of the fibres, the trusses by the *thrust* and the whole thus resists every effort to change the figure of the ship

The system was first put into complete practice in the Tremendous, 74, in 1810, which ship evinced in several severe trials, a firmness and dryness not known before

M C Dupin has shown (*Phil Trans* 1817) that the principle of diagonal framing had suggested itself and been tried by several French engineers, but is often abandoned The merit, therefore of Sir R Seppings, in reducing to practice a system which to others had been attended with insuperable difficulties more than compensates the want of novelty in the idea itself

The ancient square massive but weak sterns, have been replaced by Sir R Seppings by round sterns corresponding in construction and therefore in strength to the bow These have again undergone various alterations, tending to combine the strength of the new with the imposing

It is only no immoveable frame with the former weak and unconnected structure, that we can fully perceive the inefficiency of the ancient construction The timbers, instead of forming an independent system were often supported in part by the planking itself, as is the case in boats The masts resting only upon their steps, instead of strong platforms which diffuse the pressure on all sides, and pressed downwards by their weight and by the enormous strain of the rigging, arising from the wind on the sails, forced the keel down, and made the ship leaky The timbers and framework, being at right angles, without mutual support, the whole stress of the ship came on the fastenings, and, lastly, the safety of the ship depended entirely upon that of the outside plank, the part most exposed to injury

The planks of the decks have also sometimes been placed diagonally, and lately iron diagonal straps have be

It

droop, or the ship *hogs*, a three-decker formerly drooped at once, on being launched, 9 inches at each end, which increased with her length of service, at present, such a ship droops only 3½ inches, which, when the materials are set, suffers little or no increase

Within the last changes have been made by Sir W raising the beam of the ships, and therefore their stability, and otherwise in the forms Several improvements have also been introduced by Sir O Lang

Exposure to moisture being a cause of the decay of timber, building under cover has long been practised This also protects the men from the weather

The wood usually employed in shipbuilding is oak Elm, which does not split readily, is employed for the keel, and for the caps Fast India teak, a very heavy durable wood, which does not shrink, nor is liable to splinter from shot is now very much used African teak is also much used Fir is used for light works, masts, &c

The bottoms of ships are liable to become covered with weeds and shells, and to be eaten through by worms To prevent these evils, the bottoms were formerly covered with a thin sheathing of wood, which was replaced when worn Lead has also been used Ships are now sheathed almost universally with thin sheets of copper

For further information on this subject, reference may be made to the following works —Bouguer, *Traité du Navire*, Clairbois, *Traité Elementaire, &c*, *Chapman's Naval Archit*, with Notes by Dr Inman, *Steel's Elements*, with an Appendix by J Knowles, F R S, *Fincham's Outlines of Shipbuilding*, the article "Shipbuilding" in the new edition of the *Ency Britannica*

NAVAL CROWN Among the Romans, a crown of gold or silver, resembling the prow of a ship, awarded to him who first boarded a hostile vessel *See* CROWN

NAVL *See* NAOS

NAVE In Mechanics, the middle part of the wheel, from which the spokes radiate

NAVIGATION (Lat navis, *a ship*), is that branch of science by which the mariner is taught to conduct his ship from one part or place to another

To understand the principles of navigation and their practical application it is necessary that the mariner should be acquainted with the form and magnitude of the earth the relative situations of the lines conceived to be drawn on its surface, and have charts of the coasts and maps of the harbours which he may have occasion to visit He must also understand the use of the instruments by which the direction in which a ship is steered and the distance which she sails are ascertained, and be able to deduce from the data supplied by such instruments the situation of his ship at any time, and to find the direction and distance of any place to which it may be required that the ship should be taken

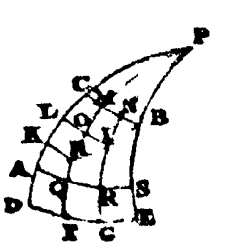
A curve passing through any two places on the earth, and cutting every intervening meridian at the same angle is called a *rhumb line*, the angle which such a curve makes with each meridian is called the *course* between any two places through which the curve passes, and the arc of that curve intercepted between any two places is called their *nautical distance* This distance is more than that measured on the arc of a great circle passing through the two places, unless both places are on the same meridian, or both on the equator, when the rhumb line and great circle coincide

*latitude* between any two places is an arc intercepted between the parallels of latitude on which the places are situated, and the *difference of longitude* is the arc of the equator, or the angle at the pole included between the meridians of the places. Hence when the latitudes or the longitudes of two places are of the same denomination with respect to *north* or *south east* or *west* the difference is found by subtracting the less from the greater, but when of different denominations what is called their difference is found by taking their sum *See* LATITUDE, LONGITUDE

When a ship has sailed on a rhumb line from one meridian to another the arc of the parallel at which the ship has arrived, intercepted between the two meridians, is called the

and the sum computed, computed on the supposition that the distance sailed on the rhumb line is divided indefinitely small equal parts, is called the *departure*

In the annexed diagram, let P represent the north pole; D I an arc of the equator, P D, P F, P G, and P E meridians, and A B a rhumb line passing through A and B, A S, K H, L I, and B C, arcs of parallels of latitude at the points A, H, I and B respectively, and let A H, H I, I B, &c be so small and so numerous that neither they nor A K, K H, H O, I O, &c may differ sensibly



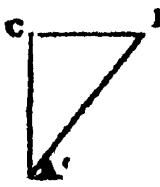

Then if a ship sail from A to B, B C

if from B to A, A S is

in either case the sum of K H O I, N B is called the *departure*, and A K + O H + I N, &c, which is always equal to A C or B S, is the *difference* of latitude.

Now, A K H, O H I, N I B, &c, may be considered as identical right angled plane triangles; and if in the an-

nexed plane triangle, right-angled at C′, A′ B′ be taken equal to A B in the preceding figure, A′ C′ to A C, or to its equal A K + H O + I N, and the angle B′ A′ C′ to B A C, or O H I, or N I B, then C′ B′ in this figure would accurately represent K H + O I + N B, &c in the preceding one That is, in the plane triangle A′ B′ C′, right-angled at C′, if A′ represent the course from one place to another, A′ B′ the distance of the two places measured on the rhumb line passing through them, then A′ C′ will be their *difference of latitude*, and C′ B′ the *departure* made in sailing from the one to the other




On these principles depend what is called *plane sailing*, and it is evident that if any two of the four elements, *course*, *distance*, *difference of latitude*, and *departure*, be given, the others may be found by the resolution of a right-angled plane triangle The formulæ are,

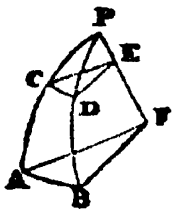
$$\begin{aligned} \text{dep} &= \text{dist} \times \sin \text{course}, \\ \text{diff lat} &= \text{dist} \times \cos \text{course}, \\ \text{dist} &= \text{dep} \times \text{cosec course}, \\ \text{dist} &= \text{diff lat} \times \sec \text{course}, \end{aligned} \qquad (A)$$

$$\tan \text{course} = \frac{\text{dep}}{\text{diff lat}}$$

When a ship sails on a meridian, the diff lat is the same as the nautical distance and the *latitude* only not the longitude is changed, and when she sails on a parallel of latitude the departure is the same as the nautical distance and the *longitude* only, not the latitude is changed but in sailing in any other direction, both the latitude and longitude are changed

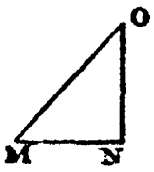
For finding the change of latitude corresponding to any course and distance, the principles of plane sailing already explained, are sufficient, but to find the change of longitude corresponding to any given change of place requires considerations of a different kind

Let a ship sail on a parallel of latitude as from C to D and let P C A, P D B be two meridians passing through C and D, and meeting the equator in A and B, then A B or the angle A P B, is the difference of longitude corresponding to the distance C D sailed on the parallel in the latitude A C or D B And if F be the centre of the sphere, A F B, C E D portions of the planes of the equator and parallel respectively, we have, by similar sectors




C D A B D E B F cos lat rad 1 secant of lat, therefore A B = C D sec lat

Hence again, if in the annexed plane triangle M N O, right angled at N the angle M be made equal to the number of degrees and minutes of the latitude of the parallel on which the ship is sailing and M N be equal to C D M O in this figure will be equal to the arc A B in the preceding one, and will consequently represent the difference of longitude, for




$$\text{M O} = \text{M N} \sec \text{M} = \text{C D} \sec \text{lat}$$

Therefore, in sailing on a parallel, the properties which connect the latitude of the parallel the distance sailed upon it, and the corresponding diff long are all found in a right angled plane triangle, the base representing the distance sailed on the parallel the hypothenuse the diff long, and the included angle the latitude of the parallel

When a ship sails on an oblique rhumb two methods have been proposed
with the diff long
and the other, from the name of its inventor, *Mercator's sailing*

*Middle latitude sailing* is a compound of plane and parallel sailing Referring to the first figure in this article, it is evident that K H is greater than C M, but less than A Q, that O I is greater than M N but less than Q R, and that K H + O I + N B will not differ greatly from the meridian distance midway between the parallels C B and A S

The departure corresponding to course $c$, and distance $d$, being therefore found from dep $= d \sin c$, and this being taken as a meridian distance in the latitude $\frac{1}{2}(l + l')$, the middle latitude between the latitude sailed from and that $l$ arrived at the diff long is found approximately from the principles of parallel sailing, from the formula,

$$\text{diff long} = \text{dep} \sec \tfrac{1}{2}(l + l')$$

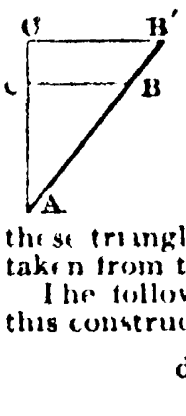
From this, and from the first and last of the formulæ (A), we immediately deduce the following for middle latitude sailing, viz —

$$\begin{aligned} \text{diff long} &= \frac{\text{dist} \times \sin \text{course}}{\cos \text{mid lat}} \\ \tan \text{course} &= \frac{\text{diff long} \times \cos \text{mid lat}}{\text{diff lat}} \\ \text{dep} &= \text{diff long} \times \cos \text{mid lat} \end{aligned} \qquad (B)$$

In *Mercator's sailing* the globe is conceived to be extended from the equator towards the poles, so as to form a cylinder whose diameter is that of the equator; the corresponding elementary parts of the meridians and parallels as projected on the cylindric surface bearing the same proportion to each other as the like corresponding parts do on the spherical surface the projected rhumb lines being straight lines and the poles vanishing in infinite distance Such a cylinder unrolled on a plane is called a *Mercator's chart* Now, considering the earth as a sphere the meridians and the equator are equal great circles, and therefore any small portion of a parallel is to a like portion of the meridian in the same proportion as the radius of the parallel to the radius of the equator, that is, as the cosine of the latitude to the radius of the tables, or as radius to the secant of the latitude If, therefore, $m$ [illegible] of the [illegible], and $m'$ its projection, of $m$ on Mercator's chart, then, generally, $m' = m \sec l$.

It follows from this that in Mercator's projection the degrees of latitude, which at the equator are equal to those of longitude increase with the distance of the parallel from the equator proportionally to the secants of the latitudes The parts of the meridian thus increased are called *meridional parts*, and it is a property of the projection that the meridional parts of any given latitude are equal to the sum of the secants of the minutes in that latitude (See MERCATOR'S CHART) The sum of the secants being computed for every minute up to any latitude $l$, and [illegible] of $m$ *meridional parts*, [illegible] latitudes of any two places, is called [illegible] lat of those places, the *difference* being taken when the latitudes are of the *same*, and the *sum* when of *different* denominations

It is likewise a remarkable property of Mercator's projection that any small triangle on the sphere is represented on the chart by a similar triangle, the angles of the original triangle and its representation being equal Hence the ship's path on the sphere and its projection on the chart cut the meridians under the same angle If, therefore A B C be a triangle on the sphere, A C being a portion of the meridian and A B′ C′ its projection, then A B′ and A C′ will be in the same direction with A B and A C, and B′ C′ will be parallel to B C In these triangles therefore the course A is an angle common to both A C is the diff lat, A C′ the meridional diff lat, C B the departure, C′ B′ the diff long A B the distance run and A B′ the distance as projected on the chart, the same scale being used for measuring all the lines in the diagram Hence from such parts of these triangles as may be determined by observation, or taken from tables, the others may be computed




The following formulæ are obvious consequences of this construction —

$$\begin{aligned} \text{diff long} &= \frac{\text{dep} \times \text{mer diff lat}}{\text{diff lat}} \\ \tan \text{course} &= \frac{\text{diff long}}{\text{mer diff lat}} \\ \text{distance} &= \text{diff lat} \times \sec \text{course} \end{aligned} \qquad (C)$$

The course of a ship at sea is determined by the *compass* (for the description of which *see* COMPASS) The needle generally rests in a position pointing northerly and southerly, and the angle which its direction makes with the true north and south line is called the *variation of the compass*, the variation being denominated *easterly* or *westerly* according as the north end of the needle is to the east or west of the true north The amount of this deviation differs greatly in different situations and it is by no means a constant quantity even at the same place There are, however, simple astronomical means of finding it at any place, so that, by applying a correction for the variation either the true course may be gained from an observed compass one, or the compass course from a computed true one

Besides the general *variation* to which we have here adverted it is found that in ships which have large masses of iron on board the compass is sensibly attracted, and the effect varies with the direction of the ship's head Mr Barlow has devised a remedy for this cause of derangement, which consists in placing a small disk of iron in such a situation behind the compass that its single effect exactly counterbalances the combined force of the [illegible] masses *See* MAGNETIC COMPENSATOR

The velocity of the ship, or the *rate* of sailing is determined experimentally, at the end of every hour, by heaving the *log* (*See* LOG) For changes of velocity between the times of heaving the log, the officer on duty makes the best estimate he can

When the wind is adverse or changeable, it is often requisite to sail on different courses, and the crooked line which the ship then describes is called a *traverse*, and the method of finding a single course and distance equivalent to such a compound one is called *resolving a traverse*

This may be done by a geometrical projection but it [illegible] in practice by the aid of the traverse [illegible] ble the *diff lat* and *dep* corresponding to each course and distance is taken and entered in an appropriate table, having columns headed N S E W, namely N and S for diff lat, and E W for departure The difference between the sums under N and S shows the diff lat, as does the difference between the sums under E and W the departure, and in either case the difference is of the same denomination as the larger sum The course and distance required are then either found by inspection in a traverse table, or by the formulæ (A)

When a ship makes considerable way through the water, and the wind is on the beam, abaft it, or even a little before the beam, she moves forward in the direction of her keel, but in rough weather, with the wind forward, she will generally be driven more or less to leeward, as will be shown by the direction of the wake, or the ripple formed by the waves closing behind her The angle this ripple makes with the direction of the keel is the *leeway*, and it must be applied as a correction to the course shown by the compass, and always allowed *from* the wind, — that is to the left, if the wind is on the right hand side of the ship, and to the right, if on the left *See* LEEWAY

All matters relating to the navigation of a ship are entered in a systematically ruled book called the *log-book*, and what day after day is so recorded is called the ship's journal The principal columns in the log book are for the hour of the day, the course, rate of sailing, leeway, and winds, one for general remarks and for entering the particulars and results of celestial observations, for notes on the weather and memoranda as to all important points of duty in the ship the sails set and the manner in which the crew are employed To this is duly appended the latitude and longitude of the ship at noon, both as deduced from celestial observations and as computed from the course and distance since the time when the place was last ascertained The place determined from the course and distance is called the place by *dead reckoning* The bearing and distance of the land first expected to be seen and the course and distance made on the whole, during the day, are also added

If the course and distance could always be accurately determined the place of the ship could be computed with corresponding exactness from the principles of which we have above given a concise account But these data can only be obtained in a roughly approximative form The effect of unknown currents unavoidable imperfections in steering, and numberless other sources of error render [illegible] very [illegible] d to rely for several days on these data only he often finds that his expected and his true place are considerably distant from each other

In the modern practice of navigation therefore the course and distance are only used to enable the seaman to assign approximately the place of his ship between the times at which it is determined, independently by celestial observations

This branch of nautical knowledge which is generally and properly included in every system of navigation is called *nautical astronomy*, and the improvements which have been introduced in its modern application constitute the chief difference between navigation as practised in our own and former times

For a minute explanation of the processes by which the place of a ship on the wide ocean may be determined from the observed situation of celestial objects with respect to each other and to the horizon, we must refer to works expressly devoted to the subject But we shall give a short account of the most useful practical methods of finding the *latitude* the *longitude*, and the *variation of the compass*, which are the three principal problems in nautical astronomy

*Reduction of Altitudes* — Before the altitudes of celestial objects as observed at sea can be employed in the solution of astronomical problems they must be corrected for the effects of dip and parallax, and for semidiameter, when the altitude of the upper or lower border, instead of that of the central, has been observed, as in the case of the sun or moon

[illegible] through which the sea horizon appears depressed in consequence of the elevation of the observer [illegible] corresponding to the altitude A and the horizontal parallax taken from the *Nautical Almanac* for the time of observation, and A′ = the true altitude then

$$A' = A - d + s + p\cos(A - d + s) - r$$

In practice, the corrections to be applied to A to obtain A′ are taken from tables, and the process of reduction is short and simple

*To find the latitude from the observed meridian altitude of a known celestial object*

Let z be the complement of the true altitude, as deduced from the observed one, D the object's declination, and L the latitude, and call z north when the zenith is north, and south when it is south of the object then $L = z \pm D$, a formula in which D is + when z and D are of the same, and — when of different denominations, and L is of the same denomination as the greater of z and D

*To find the latitude from two observed altitudes of the sun, with the time elapsed between the observations* —

Let $t$ = the half elapsed time in degrees, $p$ the sun's polar distance at the middle instant between the observations, $s$ = half the sum, and $d$ = half the difference of the two corrected altitudes, then compute the angles A, B, C, D, and E, in succession, from the following formulæ —

$$\sin A = \sin t \sin p$$
$$\cos B = \sec A \cos p$$
$$\sin C = \operatorname{cosec} A \cos s \sin d$$
$$\cos D = \sin A \sin s \cos d \sec C$$
$$E = B + D$$

And the expression for the latitude is,

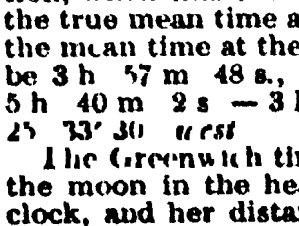
$$\sin \text{lat} = \cos D \cos E$$

There are many other methods by which the latitude may be found, but the two which we have given are those most generally used by seamen

We pass on to a consideration of the principles on which the methods of finding the longitude astronomically at sea are founded

*The longitude* is found by comparing the *time* at the first meridian with the same *denomination* at the place of observation, allowing 15° of longitude for every hour in the *difference* of the times

In the annexed diagram, let P A represent the meridian passing over the first point of *Aries*, P S that passing over the true and P M that passing over the mean place of the sun, and P X that passing over any other celestial object X Let also P G be the meridian of Greenwich, P N the meridian of *west* longitude, and P O a meridian in *east* longitude




Then, for that instant of absolute time, A P G represents the *sidereal*, S P G the *apparent*, and M P G the *mean* time at Greenwich, twenty four hours of time being represented by four right angles A P N, S P N, and M P N, are the [illegible] mean time at the meridian P N, and A P O, S P O, and M P O, the like times at the meridian P O

Now N P G, the longitude of the meridian P N, = A P G − A P N = S P G − S P N = M P G − M P N, and G P O the longitude of P O = A P O − A P G = S P O − S P G = M P O − M P G

Therefore the longitude of any place represented in time is equal to the difference of the relative times at the first meridian and the meridian of the place, the times being both sidereal, both apparent, or both mean time, and both reckoned from the same noon, — *west* when the Greenwich time is *greater* and *east* when it is *less* than the time at the place of observation

The angle X P G reckoned westerly from P G, is called the meridian distance of the object X from the meridian P G and X P N its meridian distance from the meridian P N A P X is its right ascension, A P S the right ascension of the sun, and S P M the *equation of time*, or the difference between mean and apparent time

Now if $a$ be the altitude of an object X as observed in a given latitude $l$ say on the meridian P N, and $p$ = P X, its polar distance, then, if we put $s = \frac{1}{2}(a + l + p)$, the angle X P N may be determined from this expression,

$$\sin^2 \tfrac{1}{2}(\text{X P N}) = \sqrt{[\sin(s - a) \cos s \sec l \operatorname{cosec} p]}$$

And X P N + A P X − A P S + S P M = M P N, the mean time at the meridian P N

P X, A P X, A P S and S P M are furnished by the *Nautical Almanac*, and it is evident, therefore, that from an observed altitude of a celestial object, with the data supplied by the *Nautical Almanac*, the *mean time* at the place of observation may be found

With respect to the corresponding Greenwich time, it may be found by means of a chronometer, whose error and rate are ascertained before it is taken to sea For example if on May 4th the chronometer be 4 m fast for Greenwich time, and on May 14th 4 m 50 s fast for Greenwich time, then, if on May 30th, at sea, an altitude be observed to determine time at the place of observation, when this chronometer shows 5 h 46 m 12 s, then the true mean time at Greenwich is 5 h 40 m 2 s, and if the mean time at the place deduced from the observation be 3 h 57 m 48 s., the longitude of the place will be 5 h 40 m 2 s − 3 h 57 m 48 s = 1 h 42 m 14 s = 25° 33′ 30″ *west*

The Greenwich time may also be found by considering the moon in the heavens as the pointer of a Greenwich clock, and her distances from the sun and certain stars as indicating the Greenwich times to which they cor-

respond. These distances are computed, and published beforehand in the *Nautical Almanac*, for every third hour of Greenwich time, so that if at any moment we ascertain the moon's distance from some such celestial object the Greenwich time may be found by comparing [illegible] in the *Nautical Almanac* [illegible] given, however, are the distances of the objects as seen from the centre of the earth, and therefore before a distance observed on the surface can be made available for finding the Greenwich time it must be reduced to what it would have been if the observation had been made at the centre. Many formulæ have been devised, and numerous and extensive collections of tables have been formed, to assist in making this reduction, but perhaps the following is as convenient as any other that has been proposed.

Let $m$ be the moon's app. zenith dist., $s$ the sun's, M the moon's true zenith dist., S the sun's, $d$ the app. dist. of the centres of the objects, and D the required or the true distance, and put

$$A = \tfrac{1}{2}(M + S),\ B = \tfrac{1}{2}(m + s + d) - d,$$
$$\sin X = \sqrt{(\operatorname{cosec} s \operatorname{cosec} m \sin M \sin S \sin A \sin B)}$$
$$\text{then } \sin \tfrac{1}{2} D = \sqrt{[\sin (A + X) \sin (A - X)]}$$

*To compute the bearing of the sun, the altitude, polar distance, and latitude being known* —

Let $a$ = the altitude, $l$ = the latitude, $p$ = the polar distance, $S = \frac{1}{2}(a + l + p)$ and B the required bearing or azimuth — estimated from the east and west towards the north, and from the north when the latitude is south, towards the east when the altitude is increasing, and towards the west when it is decreasing, then

$$\sin \tfrac{1}{2} B = \sqrt{[\sec a \sec l \cos S \cos (S - p)]}$$

If the compass bearing of the object be observed when the altitude is taken, the variation of the compass may hence be found, for let B′ = the compass bearing, then the variation is B + B′ or B − B′ the sign + being used when one bearing is eastward and the other westward, and − when both are on the same side of the meridian, and the variation is *west* when B is to the *left*, and eastward when it is to the right of B′.

For an account of the history of navigation, the reader is referred to the Introduction to *Robertson's Elements of Navigation*. Of modern works on this subject in general use among British seamen, we may notice those by Dr Inman, and particularly those of Mr Riddle and of Lieut. Raper, treating both of the theory and practice. The Epitomes of Moore, Mackay and Norie are also very useful compilations, and have long had an extensive circulation.

NAVIGATION ACTS. Several statutes of our early kings were passed with a view to confine particular branches of the English carrying trade to English merchants, but as they were generally enacted merely for some temporary object, they produced little effect. In 1650 the first navigation act was framed under the republican government, partly with a view to punish the inhabitants of the sugar islands, who were chiefly loyalists, partly in hostility to the Dutch. It prohibited foreign vessels from trading to the English colonies (a prohibition extended, in 1651, to the mother country) without a licence from the council of state. In 1660 the government of Charles II. re-enacted these prohibitions on a more extended scale. The chief articles of the act 12 Car. 2. c. 18 are, that no goods be carried to or from any English colonies but in vessels built within the English dominions, or really the property of Englishmen, and whose masters and at least three fourths of the crew, are English, that no goods of foreign growth or manufacture (with specified exceptions), be imported in English vessels, except from the country where they are grown and manufactured, that sugar, tobacco, and other colonial commodities (thence called in trade enumerated), be imported into no part of Europe but England and her dominions. The history of these acts, so much extolled by British politicians, and termed by some the charta maritima of England, and of the modifications which their provisions have undergone down to their repeal in 1850, is [illegible] of M'Culloch's edition of the *Com. Dict.*

NAVIRE (Fr.). An order of knighthood [illegible] St Louis king of France [illegible] of France to undertake the expedition to Holy Land. After having fallen into decay [illegible] with renewed lustre [illegible] under the auspices of the order of the crescent. This order derived its [illegible] the circumstance that the collars [illegible] to and ship appendant from them or less [illegible] were ordered to bear in their arms a ship argent in chief.

NAVY (Lat. *navis*, *a ship*), in its most extended signification is applied both to the mercantile and military marine of a nation, but it is more commonly restricted to vessels of *war* only, all others being said to belong to the merchant service. In treating of the navy, it is usual to consider it under two distinct heads the *materiel* and *personnel*: the former comprising all that relates to the construction, armament, and equipment of ships; the latter including all who receive rank, pay, or [illegible] in the service of the navy, and whatever concerns the appointment, station, and duties of officers, sailors, and marines. Under the different heads the reader will find a notice of the chief subjects included in the *materiel* of the navy, and we shall in the present article restrict ourselves to some general remarks respecting its history, management, and present state, which may serve to give a coup d'œil of the whole subject, and which could not well be comprised under separate heads.

The naval history of England is usually divided into three eras, the first comprising all the period that preceded the reign of Henry VIII., the second ending with the restoration of Charles II., and the third from the Restoration down to the present time. Omitting all that period of English naval history that intervened between the Conquest and the reign of Henry VIII. as too unimportant to be dwelt upon in a sketch of this nature, we may state, before passing to the second period, that the first ship, properly so called, of the British navy, was built by Henry VII. in the third year of his reign. She was called "The Great Harry," had three masts*, carried 80 guns, measured 165 feet in length, and 36 feet in breadth from outside to outside, and cost upwards of 14,000*l*. This ship constituted the most noble monument of Henry VII.'s regard for the navy; but his designs were matured and perfected by his son Henry VIII., in whose reign England may be said to have first possessed a permanent navy. Previously to his reign our sovereigns had [illegible] ships, when they wished to transport [illegible] or to undertake any considerable naval enterprise it was usually effected by requisitions of ships and seamen from the different seaport towns of the kingdom, or by hiring them from the merchants of Hamburg, Lubeck, Genoa &c., which were dismissed as soon as the occasion for their service was over. But Henry, whose naval force, as in the preceding reigns, was chiefly dependent on foreign auxiliaries, caused several "shippes royall" to be constructed for the service of the state, one of which the "Regent," measured 1000 tons burthen and another, the 'Marie Rose,' measured 500 tons burthen, and carried 700 men. At the conclusion of his reign in Jan. 1547 the verified list of the navy amounted to seventy-one ships and vessels of all sorts measuring 11,268 tons. During the succeeding [illegible] and Mary the naval force of [illegible] and at the demise of the [illegible] twenty six vessels, measuring 7,110 tons burthen. During the long and prosperous reign of Elizabeth which ensued, the navy was greatly encouraged. The naval force collected to oppose the Armada, [illegible] of 150 ships with nearly 30,000 men, amongst [illegible] equipped with about 15,000 men, of these 34 ships with 6,225 men, a larger royal armament than had ever before assembled together belonged to the crown, the remainder being made up from London, Bristol, Yarmouth, the Cinque Ports &c. During the last twenty-five years of Elizabeth's reign the navy almost doubled its number, and at her death in 1603 it amounted to forty-two ships, measuring 17,000 tons and carrying 8,346 seamen. The reign of James I. was remarkable for the first able and scientific naval architect, Phineas Pett, to whom the art of shipbuilding was indebted for many improvements. "In my own time," says Raleigh, 'the shape of our English ships hath been greatly bettered, in extremity we carry our ordnance better than we were wont, we have added crosse-pillars in our royall shippes to strengthen them, we have given longer floares to our shippes than in olden times and better bearing under water." The striking of topmasts was also invented in this reign, and besides the improved shape of the vessels, Raleigh mentions various minor improvements, adding 'to the courses we have devised studdingsails spritsails, and topsails, the weighing of the capstan is also new, and the [illegible] bonnet, we have fallen into consideration of the length of cables and by it we resist the malice of the greatest winds that can blow.' At the death of James I. in 1625, the royal navy consisted of thirty-three ships measuring 19,400 tons. The navy was first divided into rates and classes under Charles I., who built several new ships in the beginning of his reign and among others the "Sovereign of the Seas," a larger ship than had ever been built in England, carrying [illegible] 683 tons. But in 1648 Prince [illegible] ships, none of which ever returned to England, and so reduced was the navy at the commencement of Cromwell's government, that he could muster only fourteen men-of-war, some of them carrying only forty guns. But his vigorous administration speedily raised the navy to a [illegible] power formerly unknown, and under the [illegible] of Blake, it became not merely equal but superior to that of the Dutch, then the greatest maritime

* Down to the year 1545, the "Great Harry" was the only ship of that description in the British fleet. She was accidentally burnt at Woolwich in her sixty fifth year.

power of Europe. It was during the Protectorate that the classes into which Charles I had first divided the navy were clearly defined, and a regular system established, which has, with little alteration remained in force down to the present time At the death of Cromwell in 1658, the navy amounted to one hundred and fifty seven ships, measuring 21,770 tons, and carrying 30,000 men

At the restoration of Charles II in 1660 (from which is dated the third period of English naval history), the whole fleet amounted to only sixty-five ships but under the able administration of the Duke of York, the royal fleet soon augmented to a fine armament, and though the retirement of the latter, in consequence of his inability to take the Test Act, and the subsequent extravagance of the king, caused the navy to decay, yet such [illegible] measures were afterwards taken by the Duke, on [illegible] all to office, for its restoration, that at the demise of Charles II the navy amounted to 179 vessels, measuring 103,558 tons During the foregoing reign, a remarkable change had taken place in scientific and mechanical operations, and the art of shipbuilding so long practised on vague and imperfect principles, began to be more highly and extensively developed, for not only were the proportions and qualities of vessels improved, but the mind of the designer was directed to theoretical investigation, and thus, coeval with the third period of naval history, may be justly reckoned the full development of the science of naval architecture On his accession to the throne James II continued to evince the same warm interest which, as lord high admiral, he had always manifested for the welfare of the navy He suspended the navy board and appointed a new commission with which he joined Sir Anthony Deane, the best naval architect of the time four hundred thousand pounds were annually set apart for naval purposes, and so diligent were the commissioners in the discharge of their duty, that on the abdication of James, in 1688 the navy amounted to [illegible] ons, and carrying [illegible] administration of William and Mary who made little alteration in the system adopted by their predecessor 99 new ships were added to the fleet, and the celebrated engagement off Cape la Hogue, in 1692, gave the British navy an ascendency over that of France, which it has ever since preserved Queen Anne at her accession found the navy to consist of 272 vessels, measuring 159,020 tons, but in the third year of her reign a most destructive storm visited this country and the adjacent coasts, by which the navy sustained great damage and loss No fewer than ten men-of-war were totally lost, and many more were driven on shore and damaged All measures adding to the strength and efficiency of the navy were exceedingly popular during this reign, and every plan compatible with financial economy was adopted for its benefit, so that though the number of ships was less at the end of Anne's reign, 1714, than at its commencement, the tonnage had increased 8199 tons During the first four years of George I large sums were voted for the extraordinary repairs which were required after the long war A general survey was made of the dockyards and seastores, new dimensions for several classes of ships were established, and at the death of this monarch, in 1727 the navy consisted of 233 ships measuring 170,862 tons The navy remained stationary for the first twelve years of the reign of George II [illegible] with Spain in 1739 the navy was [illegible] and a scale of increased dimensions was established in 1742. In the wars of 1744 and 1755, our naval enterprises were crowned with the most signal success, and at the demise of George II, in 1760, the navy consisted of 412 ships, measuring 321,104 tons, the vote for the naval service of that year being 5,611,500*l*, 51,645 seamen, and 18,355 marines [illegible] during the long [illegible]

It may be sufficient, therefore, to observe, that though the combined fleets of France and Spain appeared to have an ascendency during the American war, the victories of Rodney restored our previous superiority The nature of the struggle with revolutionary France, the bitterness with which it was carried on, and the fleets required not merely for the protection of our own shores, but for that of [illegible] and of our numerous colonies in [illegible] an immense increase of our naval force, and while our navy was thus progressively augmented, the decisive victory of the 1st of June, 1794, followed by those of St Vincent, Camperdown, the Nile, Copenhagen and Trafalgar almost destroyed every fleet that could be opposed to it, leaving us the undisputed masters of the ocean

From the commencement of hostilities in 1793 to the peace of Amiens, the following table will show the losses sustained both by the English and their enemies, including the ships surrendered to be held in trust

| Loss sustained by the English | | Captured from the Enemy | |
|---|---|---|---|
| Ships of the line | 5 | Ships of the line | 56 |
| Frigates | 13 | Frigates | 209 |
| Sloops and smaller vessels | 41 | Sloops and smaller vessels | 275 |
| Total | 59 | Total | 570 |

From the declaration of war in May, 1803, to the general peace concluded in 1815, the number of ships and vessels of war captured and destroyed by the British, with the amount of loss sustained by our fleets during the same period, will be found in the following abstract —

| | | Captured | Destroyed |
|---|---|---|---|
| French, Dutch, Spanish, Turkish, Danish, American | ships of the line | 55 | 14 |
| | frigates | 79 | 23 |
| | Total | 134 | 37 |
| British | ships of the line | 0 | 0 |
| | under | 80 | 17 |
| | Total | 80 | 17 |

In the last seven years of the war the British naval force averaged one hundred and forty ships of the line in commission, and five hundred and eighty frigates, sloops, and smaller vessels, those in harbour, ordinary, and building, being estimated at three hundred during the same period Since the peace of 1815 great improvements have taken place in every department of naval architecture, masts, rigging, sails ordnance, implements, and instruments, have all undergone revision, alterations not only in the form and magnitude of British ships but even in the arrangement of the materials composing them, have been effected, and it is perhaps not going too far to assert, that never at any former period was our navy in a condition better calculated to maintain its long undisputed sovereignty of the ocean

The following table will show the force of the British Navy at five distinct periods viz the year after the breaking out of the French revolutionary war, in 1820, five years subsequently to the peace, in 1830, on the accession of William IV, on the accession of her present Majesty, in 1837, and in 1840 —

| Ships, &c | 1793 | | | | | 1820 | | | | | 1850 | | | | | 1867 | | | | | 1840 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In Commission | Ordinary | Building | Total | Tons | In Commission | Ordinary | Building | Total | Tons | In Commission | Ordinary | Building | Total | Tons | In Commission | Ordinary | Building | Total | Tons | In Commission | Ordinary | Building | Total | Tons |
| Of the Line | 26 | 84 | 12 | 122 | | 14 | 113 | 22 | 149 | | 11 | 75 | 18 | 107 | | 23 | 59 | 11 | 96 | | 28 | 54 | 23 | 105 | |
| Under small vessels | 109 | 82 | 8 | 199 | | 113 | 255 | 93 | 464 | | 143 | 262 | 64 | 469 | | 163 | 219 | 43 | 425 | | 149 | 220 | 34 | 403 | |
| Steamers | | | | | | 7 | 4 | 1 | 12 | | 42 | 11 | 1 | 54 | | 65 | 15 | 7 | 87 | | | | | | |
| Grand total | 135 | 166 | 20 | 321 | 102, | 127 | 368 | 117 | 613 | 60[illegible] | 104 | 311 | 83 | 498 | 41[illegible] | 228 | 289 | 61 | 578 | 467,565 | 242 | 259 | 64 | 595 | 500,232 |

The parliamentary vote for the service of the navy in 1851 was 6[illegible] The effective list of the royal navy consists at present [illegible] ships of all classes Of these we may call, in old-fashioned phraseology, line-of battle ships, comprising among them [illegible] two-deckers which have been converted into steam block or guard ships Of this 96, 16 only are at this moment in commission — that is, manned, equipped, and fit for sea, of the remaining majority 58 are lying in ordinary in the Medway, Portsmouth harbour, Plymouth, and elsewhere, whence with reasonable promptitude they might be despatched to sea On the effective list of flag officers there are 101 admirals, vice and rear admirals, 465 captains, 565 commanders, and 1232 lieutenants

*Classes and Rates* — It is of great importance, in order to insure union in the movements of a fleet and to facilitate the fitting out and repair of ships, that those of the same rate or class should not differ materially in size or

build from each other Until the Restoration vessels appear to have been "rated" from the complement assigned to each, without any reference to the ordnance they carried, but on the recommendation of a committee appointed in 1745 this method was superseded by classification according to *guns* In 1793 our ships, which, in [illegible] wars, had outgrown their [illegible] were rated anew at so many guns and upwards, but the latitude of the term "and upwards" giving rise to great irregularities, an investigation took place in 1816 when by an order in council the rule which existed previously to 1793 was revived, and ships were ordered to be rated thenceforth from the number of guns and carronades actually carried, and not according to the erroneous denominations which had latterly grown into use His late majesty William IV made some alterations in this mode of rating ships, but not such as materially to interfere with the arrangement introduced by his predecessor The royal navy, as at present constituted, comprises three principal classes — 1 Rated ships and yachts, including frigates, sloops and corvettes 2 Ships and bomb vessels [illegible] corvette-built or otherwise 3 All smaller vessels, including brigs, ketches, brigantines, schooners, cutters, tenders, &c Ships of the first class are commanded by captains, of the second class, by commanders, of the third class by lieutenants and subordinate officers

The classification of the royal navy is at present as follows — *First rate* all ships carrying 110 guns and upwards, or whose complement [illegible] *Second rate* one of her Majesty's yachts, [illegible] carrying [illegible] and whose [illegible] *Third rate* the other royal yachts, and all yachts bearing the flag or pendant of an admiral or captain superintendent of a dock-yard, and all ships whose complements are under 750 and not less than 620 *Fourth rate* ships whose complements are under 620 and not less than 450 *Fifth rate* ships whose complements are under 450 and not less than 300 *Sixth rate* all other ships bearing a captain

Steam vessels are assigned a rate at the discretion of the lords of the admiralty Ships or vessels fitted as troop ships surveying ships, fire ships, store ships or vessels used on any temporary service, are also given a rate not above the fourth Ships of the 1st rate carry 100 guns and upwards, those of the 2d rate 80 and upwards, the 3d rate from 70 to 80, the 4th rate from 50 to 70, the 5th rate from 36 to 50, and the 6th rate from 24 to 36 (For the chief of these details we are indebted to an able and beautiful little work, entitled an *Epitome of the Royal Naval Service of England*, by Mr Miles)

*Government of the Navy* — The general direction and control of all affairs connected with the navy is intrusted under her Majesty to the lord high admiral or to the commissioners for discharging the functions of that officer The duties of the lord high admiral were formerly judicial as well as administrative, he having not merely to govern the navy but to preside over a court for adjudging all nautical cases, and for taking cognizance of all offences committed on the high seas But the judicial are now separated from the other duties of this high functionary, being devolved upon the judge of the Admiralty Court *See* ADMIRALTY, COURT OF

From the reign of Queen Anne down to the present time, with the exception of the [illegible] which William IV while Duke of Clarence held office, the duties of the lord high admiral have been discharged by commissioners These have consisted generally of a first lord, and of four or six junior lords Civilians may be appointed to these offices, but at least two of the lords are always professional men But though assisted by junior lords practically all the power and authority of the board is vested in the first lord The powers exercised by the Board of Admiralty are very extensive and important By their orders all ships are [illegible] fitted for sea or laid up in ordinary [illegible] put in commission, or out of commission, armed, stored, and provisioned, employed on the home or on foreign stations All appointments or removals of commission and warrant officers are made by them, and all instructions issued for the guidance of their commanders, all promotions in the several ranks emanate from them, all honours bestowed for and without services, and all pensions, gratuities, and superannuations for wounds, infirmities, and long services, are granted on their recommendation All returns from the fleet are sent to the Board of Admiralty and every thing that relates to the discipline and good order of every ship All orders for the payment of naval moneys are issued by the lords commissioners of the admiralty, and the annual estimate of the expenses of the navy, prepared by them, is laid before parliament for its sanction All new inventions and experiments are submitted to them before being introduced into the service, all draughts of ships must have their approval all repairs, alterations and improvements in the dock-yards, and all new buildings, of every [illegible] must be decided upon by them before they [illegible] (*Sup to Encyc Britan*, art. "Navy")

Under the superintendence of the lords commissioners, the civil departments of the admiralty are directed by a surveyor of the navy, an accountant-general, a storekeeper-general, a comptroller of victualling, and a physician-general

There are three gradations of admirals, viz admirals, vice-admirals, and rear-admirals, and each of these dignities consists of three divisions, distinguished by the colour of their flags Thus there are admirals of the red, the white, and the blue squadrons, bearing their respective flags at the main-top-gallant-mast head; vice-admirals of the red, the white, and the blue squadrons, bearing their respective flags at the fore top-gallant-mast head, and rear-admirals of the red, the white, and the blue squadrons bearing their respective flags at the mizen-top-gallant-mast head All admirals whatever be their rank, take the common title of *flag officers*

Admirals rank with generals in the army, vice-admirals with lieutenant-generals, and rear admirals with major-generals The command of each ship is entrusted to a captain, or to a commander, who has under him a certain number of lieutenants, according to the size of the ship, with a master, purser, midshipmen, gunners, &c A captain of [illegible] standing ranks with a colonel in the [illegible] three years standing with a lieutenant-colonel, a commander ranks with a major, and a lieutenant with a captain The captain is responsible for the discipline and efficiency of the crew, and the good order of the ship Now standing he is furnished with minute instructions for his guidance, in every particular much must always necessarily depend on his conduct and character He has power to order punishment to be inflicted, but it must be done in the presence of all the officers and ship's company An account, stating all the circumstances, must also be entered in the [illegible] which is forwarded each quarter [illegible] regulation has tended to repress hasty and inconsiderate punishment, and has done much to improve the conduct of the officers, as well as to promote the proper discipline of the navy

*Composition of the Navy* — The navy is composed of two bodies of men — seamen and marines (*see* MARINES), and the officers under whose command it is placed are divided into three classes viz commissioned, warrant, and petty officers Commissioned officers comprise flag officers (*see supra*), commodores, captains, commanders, and lieutenants appointed by commission from the lords commissioners of the admiralty, or by a commander in-chief having authority in cases of vacancies by death or the decisions of courts martial abroad to make such appointments Warrant officers are those who hold their appointment by warrant from the lords commissioners of the admiralty, to this class belong masters, secretaries physicians, surgeons &c Petty officers are divided into two classes *quarter-deck* and *working*, the former, comprising midshipmen, masters assistants volunteers, &c are entered by order of the lords commissioners or by a commander-in-chief abroad, the latter, including captains of the maintop foretop, &c &c are appointed by the captain or commander of the ship or vessel to which they belong

Any person may enter the navy as a common seaman, on application to the commanding officer of any of her Majesty's ships in commission provided he be approved by the examining surgeon and have not [illegible] discharged from the service with disgrace Persons who have never been at sea are rated as landsmen, and seafaring men are rated as "ordinary" or "able" seamen besides numerous [illegible] of petty officers, to which they are rated at [illegible] of the commanding officer Seamen are also obtained for the navy at the breaking out of a war or any other emergency, by the practice of impressment The antiquity and legality of this practice cannot be questioned, but very great and serious doubts have been and may be entertained as to its expediency Foreigners are the only persons exempted at common law from impressment, but exemptions have been created by acts of parliament in favour of various classes as landsmen, apprentices, seamen employed in the fisheries, watermen in the service of fire insurance companies &c *See* IMPRESSMENT

Young gentlemen enter the service as volunteers of the first class; and every officer commissioning a ship is allowed to make one fresh entry A volunteer must remain two complete years in that capacity, and attain the age of fourteen before he can be rated [illegible] when he has completed six years' service and [illegible] of age [illegible] and also [illegible] the rank of lieutenant, and shall be [illegible] such examinations as he ought to be able to hold a master's mate if his conduct be satisfactory to his captain

No person can receive a commission as lieutenant unless he have passed both the above examinations; but having done so, he [illegible] that rank A lieutenant is not [illegible] for a commander's commis-

sion till he have served two years at sea in a ship of war as lieutenant, nor is a commander eligible for a captain's commission till he have served one complete year at sea in a ship of war as commander

In 1840 a temporary restriction was placed on promotions by a minute of the Admiralty Board This limited the promotion of officers to the rank of captain, and all below that rank to filling up one in three vacancies on the list, with the exception, viz, 1st, of death vacancies on foreign stations, which the commanders-in-chief have authority to fill up, 2d, the reservation to the admiralty of power to promote for special or brilliant services, 3d, of the occasion of a commander-in-chief striking his flag and 4th, on the recommendation of the Board of Customs for services in the coast guard

Captains and admirals are promoted by seniority, on what is termed a "flag promotion" taking place, but a captain must have served as under, in command of a rated ship, before he can obtain his flag, viz

| | |
|---|---|
| In war - - - - | 4 years |
| In war and peace combined - - | 5 — |
| In peace - - - - | 6 — |

All other classes of officers, as was remarked above, are promoted at the discretion of the Board of Admiralty For the various important subjects connected with the pay, pension, discipline, &c of the navy, see the *Navy List* See, also, *Statistics of the British Empire*, and the valuable little work above referred to, *Epitome of the Royal Naval Service of England*, London, 1841 For other particulars relating to the navy see NAVAL ARCHITECTURE, SHIP, and the other naval articles, which will be found under their respective heads in this work

NA'ZARITE (Heb nazar *to separate*), signified in the Jewish dispensation, one separated to the Lord by a vow (Numbers chap 6) The chief observances of the Nazarites were to refrain from drinking wine to suffer the hair to grow and to avoid coming in contact with a corpse This word is [illegible] from Nazarene, which signified a [illegible] was applied in contempt to the early Christians, inasmuch as they were followers of Jesus of Nazareth

In some Eastern countries some Christian communities are still to be met with which have retained the appellation of Nazarenes The sect of Nazarenes which sprung up in Palestine in the second century endeavoured to engraft the rites and observances of the Jews on the religion of Jesus Christ, in this respect they bore a considerable resemblance to the Ebionites whose contemporaries they were, but with whom they must not be confounded No traces of them existed in the 5th century

NEAP or NEAP TIDES, are the lowest tides, being those which are produced when the attractions of the sun and moon on the waters of the ocean are exerted in directions perpendicular to each other When the two forces act in the same or exactly opposite directions the *spring* or highest tides are produced The neap tides take place about four or five days before the new and full moons See TIDES

NEAT A term applied to cattle *neat's foot oil* is the fat obtained by boiling calves feet

NE'BULÆ (Lat nebula *a cloud*) in Astronomy the name given, on account of their general cloudy appearance to a very numerous class of celestial objects being however, for by far the greater part, *telescopic*, and only visible in telescopes of considerable power

It is to Sir William Herschel that astronomy is indebted for the first examination and analysis of these remarkable objects A few of them have indeed been known since the discovery of the telescope, and one or two of them are visible to the naked eye, but his powerful telescopes first disclosed the fact of their existence in immense numbers and in all quarters of the heavens, not indeed distributed uniformly, but generally speaking, with a marked preference to a broad zone crossing the milky-way nearly at right angles, and whose general direction is not very remote from that of the hour circle of 0h and 12h In the southern hemisphere the distribution appears to be more uniform

Nebulæ are divided by Sir W Herschel into the following classes —1st, Clusters of stars, in which the stars are clearly distinguishable, 2d Resolvable nebulæ, or such as excite a suspicion that they consist of stars, and which any increase of the optical power of the telescope might be expected [illegible] 3d, Nebulæ, properly so called, [illegible] pearance whatever of stars, 4th, Planetary nebulæ, 5th, Stellar nebulæ, and, 6th, Nebulous stars

*Clusters of Stars* —These are either globular or of an irregular figure, forming bright isolated patches, which attract attention, as if they were brought together by some general cause The Pleiades is a cluster of this sort the naked eye can distinctly perceive six or seven stars in it, and may catch occasional glimpses of a great many [illegible] fty or sixty crowded to [illegible] and insulated from the rest of the heavens A [illegible] called *Præsepe* or the Beehive, in the constellation Cancer, is resolved entirely into stars by an ordinary telescope In the sword-handle of Perseus is another such spot, crowded with stars, but not so easily resolved There are a great number of less distinct nebulous specks of the same kind, which in ordinary telescopes have much the appearance of comets without tails, and have frequently been mistaken for such when, however, they are examined with instruments of great power, any such idea is completely destroyed They are then, for the most part perceived [illegible] and to run up to a blaze of light in the centre, where their condensation is usually the greatest Many of them are of an exactly round figure [illegible] less definite in [illegible] easy to say where they terminate In some of them the stars are nearly all of a size, in others extremely different, and it is no uncommon thing to find a very red star occupying a conspicuous position in the group

*Resolvable nebulæ* are considered as objects of the same nature as the preceding, but as being either too remote to present a star to the unaided vision to affect us by their individual light They are almost universally round or oval Their regularities of form being extinguished by the [illegible] general figure of the condensed part [illegible] In telescopes of insufficient optical power, all the great globular clusters exhibit themselves under this appearance

*Nebulæ properly so called* Recent observations with superior telescopes render it probable, or rather all but certain that no physical distinction exists between this class of objects and clusters of stars the difference of appearance depending only on the power of the telescope with which they are observed Multitudes of nebulæ which, in Herschel's 18-inch reflector, exhibited not the slightest appearance of resolvability, when examined with Lord Rosse's 6-foot reflector are clearly resolvable, and seem to consist merely of clustering stars, and though doubtless many exist which, under the greatest powers which have been yet applied, show no signs of being composed of separate stars, the inference can scarcely be resisted that they would be completely resolved by a further increase of optical power The great nebula in the sword-handle of Orion, discovered by Huygens in 1656, and repeatedly figured and described by astronomers since that time, is a notable instance. Another in the constellation of Andromeda may be mentioned which is visible to the naked eye, and often mistaken for a comet Its appearance is described by Simon Marius as that of a candle shining through horn Its form is a pretty long oval increasing by insensible gradations of brightness at first very [illegible] t last more rapidly, up to a central [illegible] very much brighter than the rest, is [illegible] ellar, but only nebulous matter in a high state of condensation It has in it a few small stars, but they are obviously casual, and when seen with a reflector of 18 inches there is nothing to excite any suspicion of its consisting of stars But when examined with instruments of superior power the evidence of its resolvability into stars may be regarded [illegible] decisive Mr G P Bond describes it as ex[illegible] very two and a half degrees in length, and upwards of a degree in breadth. Like the last described, a very numerous class of nebulæ are of a round or oval figure [illegible] its density towards the central [illegible] In respect however they differ extremely [illegible] some being bright and gradual in others great and sudden They also present great diversity of appearance, in respect of deviation from the spherical form Some are only slightly elliptic, others much extended in length, and in some the extension is so great as to give the nebula the character of a long, narrow, spindle-shaped ray, tapering away at both ends to points Some nebulæ are annular, but these are among the rarest objects in the heavens T [illegible] is situated half way between the [illegible] and may be seen with a telescope of moderate power

*Planetary nebulæ* have exactly the appearance of planets,—round or slightly oval disks, in some instances quite sharply terminated, in others a little hazy at the borders, and of a light exactly equable, or only a little mottled which, in some of them, approaches in vividness to that of actual planets Whatever the nature of these objects may be, they must be of enormous magnitude. One in Aquarius presents the diameter of 20″, another, in Andromeda, has a visible disk of 12′ perfectly defined and round Granting them to be equally distant from us with the stars, their real dimensions must be such as would fill, on the lowest computation the whole orbit of Uranus. Their intrinsic splendour must also be immeasurably inferior to that of the sun's, for a circular portion of the sun's disk subtending an angle of 20″, would give a light equal to 100 *full moons*, whereas not one of the nebulæ in question is discernible with the naked eye

*Stellar nebulæ* are those in which the condensation of the nebulous matter towards the centre is great and sudden, so sudden, indeed, as to present the appearance

[illegible] or a star w[illegible] present the [illegible] phenomenon of a st[illegible] by a perfectly circular [illegible] in some cases dying av[illegible] da-tions, in others almost suddenly terminated A very fine example of such a star is 55 Andromedæ, R A 1h 43m, N P D 50° 7′

"The nebulæ," says Sir J Herschel, "furnish, in every point of view, an inexhaustible field of speculation and conjecture That by far the largest of them consist of stars there can be little doubt, and in the interminable range of system upon system, and firmament upon firmament which we thus catch a glimpse of, the imagination is bewildered and lost On the other hand if it be true as, to say the least, it seems extremely probable that a phosphorescent or self luminous matter also exists disseminated through extensive regions of space in the manner [illegible] like a tu[illegible] tra[illegible] stars, what, we naturally ask, is the nature and distinction of this nebulous matter? Is it absorbed by the stars in whose neighbourhood it is found, to furnish by its condensation, their supply of light and heat? or is it progressively concentrating itself by the effect of its own gravity, into masses, and so laying the foundations of new sidereal systems or insulated stars? It is easier to propound such questions than to offer any probable reply to them" (*Treatise on Astronomy*, *Cabinet Cyclopædia* See also *Herschel's Outlines of Astronomy*, from which the preceding description is abridged

NECE'SSITY, DOCTRINE OF That scheme which represents all human actions and feelings as links in a chain of causation determined by laws in every respect analogous to those by which the physical universe is governed This doctrine has been attacked and defended with great zeal, in almost every period of speculative inquiry since the Reformation The inductive method of research applied by Bacon and his contemporaries to the phenomena of nature led very soon to the adoption of [illegible] reference to the phenomena of mind [illegible] or rather the distinct re-assertion of the law of association, by Hobbes and the ready solution which it appeared to furnish of states of consciousness which without it, would have seemed capricious and unaccountable encouraged many philosophers to attempt its application to every province of the human mind It is only in connection with this fact that the prevalence of necessarian views in modern times can be adequately explained Without venturing an opinion on the merits of the question at issue between the advocates of free will and of necessity we are sufficiently assured of the historical fact that the distinction between man and nature, between the actions of a self-conscious agent and the workings of blind unintelligent powers, was considered by the great philosophers of antiquity as the groundwork of their systems of morality and as involved in the very conception of moral science It was natural that this distinction should be felt to be a barrier to the progress of the exclusively empirical psychology to which we have alluded To the historians of man's nature the necessity of his actions appeared in the light of an hypothesis which lay at the very foundation of their inquiries, precisely as the natural philosopher is compelled to assume the regular recurrence of the same outward phenomena under the same circumstances The psychologist considers the states of which he is conscious merely as they are related to each other in time, and thus considered it seems to him a mere identical proposition to assert that all that can be known of them is the order of their succession If their succession were arbitrary or uncertain, nothing could be known of it, and the science which he professes could no longer have an existence It is in this consideration, rather than in the dialectic subtleties by which the doctrine has been sometimes defended, that the real strength of the necessarian lies So long as he can maintain the merely phenomenal character of human knowledge he can reduce his opponents to the dilemma of either denying the possibility of [illegible] or of admitting the existence of [illegible] which are its only object In its relation to morality, the doctrine of necessity has been naturally considered to involve dangerous consequences Attempts have been made by modern necessarians to rescue it from this imputation Sir James Mackintosh, in particular, has devoted some portion of his Dissertation to the explanation of the principal ethical terms, on the necessarian hypothesis (*General Remarks*, sec vii p 393 of the reprint) Notwithstanding the ingenuity of this effort, the student will probably find, on careful examination, that the great question at issue is left much in the same state as before

NECK OF A CAPITAL In Architecture, the space above the shaft of a column, between the annulet of the capital above and the astragal at the top of the shaft below

NECRO'LOGY (Gr *νέκρος*, *dead*, and *λόγος*, *discourse*) A collection of biographical notices of deceased persons published shortly after their deaths Such a collection is called a necrology The list of deceased benefactors of a monastery, cathedral, &c, was also termed its necrology

NE'CROMANCY (Gr *νέκρος*, and *μάντεια*, *prophecy*) Divination by consulting the spirits of the dead Necromancy is prohibited in Deuteronomy, and the [illegible] book of Samuel respecting the witch [illegible] or whether it be understood of an actual evocation, or of a deception practised by a soothsayer — shows that necromancy real or pretended, was among the usages of very distant times In Homer, the portion of the *Odyssey* termed the Necyomanteia exhibits the superstition in a very peculiar form Ulysses performs a sacrifice with peculiar solemnities, and pours the sacrificial blood into a ditch the spectres of the dead rush wildly from the infernal regions to taste the blood, and discovering that of Tiresias, of which he was in search, he compels it to answer his questions The rest of the book in which Ulysses appears actually to descend to the shades, and to see the punishments of celebrated criminals is suspected by some commentators to have been an interpolation of later times Similar customs in practising the art of necromancy seem to have been followed for a long period in Greece and Italy Horace mentions the pouring of the blood of a sacrificed sheep into a ditch, in order to attract the manes from beneath But in Thessaly the most celebrated of classical regions for its proficiency in the art of magic, peculiar horrors seem to have attended the exercise of necromancy Lucan's Thessalian witch reanimates the corpse of a soldier slain in battle and compels him to answer her questions respecting futurity But the *ψυχαγωγοι* or professed evokers of spirits in Thessaly seem to have performed their rites whether as impostors or as fanatics, with the sacrifices of human beings and various other enormities Modern necromancy, like most branches of divination in modern superstition has been chiefly accomplished by the agency of devils who either voluntarily or by compulsion act at the behest of the magician *See* MAGIC WITCH

NE'CROLITE (Gr *νέκρος* and *λίθος*, *a stone*) A mineral which is found in small nodules in the limestone of Baltimore and which when struck exhales a fetid odour resembling that of putrid flesh

NECROPHAGANS *Necrophaga* (Gr *νέκρος*, and *φαγω I eat*) The name of a family of Clavicorn beetles, comprehending those which feed on dead and decomposed animal substances

NECROSIS (Gr *νέκρωσις to destroy*) This term is applied in surgery to the mortification of parts of bones

NECROSIS or SPOTTING In Botany a disease of plants, chiefly found upon the leaves and soft parenchymatous parts of vegetables It consists of small black spots, below which the substance of the plant decays

NECTAR in the Mythology of the Greeks and Romans was the supposed drink of the immortal gods (ambrosia being their food) and was fabled to contribute largely to their immortality If we believe the accounts of the poets the qualities of this liquor must have been of a most delicious character It imparted youth bloom, and vigour to the body and possessed the power of repairing all the defects and injuries of the mental constitution

NECTA'RIUM (Lat nectar *honey*) Any part of a flower that secretes a honey like substance It is variously applied to modifications of the petals, stamens and disk and is now not much employed

NEEDLE MAGNETICAL A slender magnetized bar of steel which when suspended freely on a pivot or centre, arranges itself in the direction of the magnetic force of the earth See COMPASS MAGNETISM, VARIATION

NEEDLE ORE (From the acicular form of its crystals) A native sulphuret of bismuth, copper, and lead it occurs in the gold mine of Schlangenberg, in Siberia

NEEDLE STONE A species of acicular zeolite found in Iceland

NE EXEAT REGNO In Law, a writ to detain a person from going out of the kingdom without the king's licence directed to the sheriff, or to the party himself The use of the writ is to prevent a party from withdrawing his person and property from the jurisdiction of the courts in England but this purpose was served at common law before the Late Insolvent Act by arrest, and bail obtained This writ lies, therefore, where there is a suit in equity for a d[illegible] which [illegible] at law, a[illegible] equity

NEGATIVE, in Logic, denotes the quality of a proposition which denies the agreement between the subject and predicate

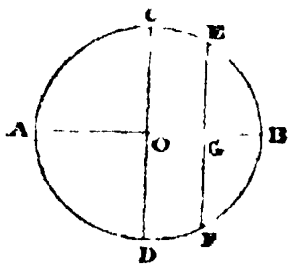
NEGATIVE SIGN In Algebra, the sign of subtraction, — Any quantity to which this sign is prefixed is called a *negative* quantity

[illegible]tive quantities is attended with [illegible] and has given rise to much discussion When a negative quantity is preceded by a positive quantity greater than itself nothing is simpler than the accurate notion of its signification For instance, in the expression $a - b$, where $a$ is greater than $b$ no difficulty can arise about the nature of the operation which is indicated But in algebra quantities are constantly occurring of the form $a - b$, where $b$ is greater than $a$, or of the form $-a$ where the negative quantity stands by itself, and it is often a matter if indeed it be possible, to discover any exact principle by which such expressions are to be interpreted

The definitions usually given by writers on algebra of [illegible] taken in a contrary sense or opposite direction The first of these definitions, which, indeed, presents itself the most naturally, was adopted by Newton in the *Arithmetica Universalis*, and also by Euler, in his *Introductio in [illegible]* The second definition has been [illegible] the application of algebra to geometry and mechanics But it has been shown by D Alembert, and more particularly by Carnot in his *Géométrie de Position*, that both definitions lead to inaccurate notions

With regard to the first definition D Alembert reasons in this manner —Let there be the proportion $1 : -1 = -1 : 1$, which is true because the product of the extremes is equal to the product of the means Now if $-1$ be less than nothing, much more will it be less than 1, therefore the second term is less than the first, consequently the fourth must be less than the third that is to say, 1 must be less than $-1$ therefore $-1$ is both less than 1 and greater than 1 which is absurd Carnot further remarks that a multitude of paradoxes, or rather absurdities arise from the notion that negative quantities are less than 0, for example $-3$ must be less than 2 yet $(-3)^2$ would be greater than $2^2$, because $(-3)^2$ is 9 and $2^2$ is 4, that is to say, of two unequal quantities 2 and $-3$ the square of the greater would be less than the square of the smaller which is contrary to my clear and distinct notions that can be formed of the nature of quantity

The principle that negative quantities are quantities taken in a different sense or opposite direction to positive quantities is shown by Carnot to lead to error by the following example —Let A C B D be a circle of which O is the centre and A B a diameter, we have then A B = A O + O B Through the centre O draw C D perpendicular to A B and through any point in the circle F draw the chord I F parallel to C D meeting A B in G Let A be the origin of the abscissæ, and make A G = $x$ and G I = $y$, then putting $a$ = the radius of the circle we have the equation $y^2 = 2ax - x^2$ The solution of this quadratic gives $y = \pm \sqrt{2ax - x^2}$ which according to the theory under consideration shows that $y$ has two values equal and directly opposite to each other, namely G I represented by the positive root and the other, G F, represented by the negative root that is to say we have G F = $+\sqrt{2ax - x^2}$, and G I = $-\sqrt{2ax - x^2}$ equations which ought to be true whatever be the value of A G or $x$ Let us therefore suppose A G = A O = $a$ G I will then become O C and G I will become O D, therefore the two equations will become G I = $+a$, and G I = $-a$, and, consequently G F + G I = 0, that is, A B = 0 which is absurd although rigorously deduced from the theory The theory therefore is false It may be possible Carnot remarks to oppose metaphysical subtleties to this conclusion but he thinks that no clear and satisfactory answer can be given to the argument




Without entering into metaphysical subtleties, we may remark that there is an evident fallacy in the above conclusion, which arises from first assuming the signs + and − to be *symbols of interpretation* and then considering them as *symbols of operation*, without regard to their directive signification On making $x = a$, the two roots of the above quadratic are $+a$ and $-a$, and the signs are by the theory assumed to signify opposition or contrariety of direction But in the equation $+x - a = o$ (from which G F + G F = $o$ is derived), the directive signification is entirely lost sight of, the signs are regarded as merely symbols of operation, and the equation being interpreted in the usual way simply affirms that the difference between the two roots, *in respect of absolute magnitude* is nothing

Having shown that the usually received notions respecting negative quantities are obscure and inaccurate, Carnot proceeds to establish the true principles of their theory He concludes, 1st, That an isolated negative quantity is a mere creation of the mind, and that those which result from the operations of the calculus are nothing more than simple algebraic forms, incapable of representing any real and effective quantity whatever 2d, That each of these forms, [illegible] its sign, is nothing more than [illegible] absolute quantities, of which the one that was the greater in the case on which the reasoning was founded, becomes the less in the case to which the results of the calculus producing that form is applicable

According to this theory, the true meaning to be attached to the expression *negative quantity* is this —An absolute quantity, which does not belong to the system on which the reasoning has been established, but to another system related to the former in such a manner that in order to render the formulæ for the first system applicable to it the sign which precedes it must be changed from + to −, or from − to + For example if $y$ represent the difference between the two quantities $a$ and $z$, it does not follow that, by substituting $-y$ for $+y$, the quantity represented by $y$ becomes negative, but merely that, of the two quantities $a$ and $z$, the one which was the greater in the case in which $y$ has the sign + becomes the smaller when the sign of $y$ is changed into − The [illegible] suffice to give a notion of the na- [illegible] which attend the rigorous interpretation of the negative sign in symbolical algebra For full information on this abstruse subject, the reader is referred to the [illegible] —Carnot *Géométrie de Position*, Mascheroni [illegible], *Warren on the Geometrical Square Roots of Negative Quantities*, 1828, *Peacock's Algebra*, Id *Report of the British Association for* 1834, *De Morgan's Trigonometry*, Young's *Mathematical Dissertations*, and the articles connected with the subject in the *Penny Cyclopædia*

NEGLIGENCE (Lat *negligo*, *to neglect*) In the Fine Arts, a want of observance of admitted rules and principles in the several parts of a work, such as in costume in the disposition of the light and shade, &c

NEGROES The Ethiopian or fourth variety of the human race, according to the division of Blumenbach and his followers widely spread over the surface of the earth, occupying almost the whole of Africa south of that great belt of desert which extends, in the latitude of the tropic of Cancer, from the Atlantic to the Red Sea The distinctions of this race are marked and peculiar, but they are not universal, or every where the same Thus the colour varies although less so, perhaps than that of any other of the great varieties of mankind, the Hottentots, and various southern tribes belonging to the Ethiopian race, are in this and other respects widely different from their brethren The woolly hair dark jet colour, and some external peculiarities of conformation seem chiefly to belong to those numerous tribes which inhabit the west coast of Africa, between the equator and the tropic of Cancer But, even within that region some tribes are to be found whose physiognomy is very different from that which we are accustomed to regard as representing the Negro type South of the equator many of the tribes are inferior in strength and [illegible] [illegible] New Guinea off the south-eastern extremity of Asia, a native population is found with most of the characteristics of the African negro

The Negro race appears to have been subjected to the tribute of furnishing slaves to its more powerful and intelligent neighbours from a very remote period of antiquity [illegible] European slave ships had visited the [illegible] Africa, the Arabs bore off slaves in their caravans, across [illegible] of the continent and [illegible] for example) we find mention made of Black or Ethiopian slaves See SLAVE TRADE

By the mixture of the Negro and white races the mulatto is produced, the Sambo is the offspring of a Negro and an American Indian The numerous varieties of these [illegible] of Negro European [illegible] denominated accurately in the West Indies It is probably, be estimated that there are now on the continent and islands of America including Negroes, Mulattos, but exclusive [illegible] a greater proportion [illegible] individuals of African descent, viz

| | |
|---|---|
| In the United States | 3,500,000 |
| British colonies | 900,000 |
| Hayti | 700,000 |
| Spanish, French, &c West Indies | 1,200,000 |
| Brazil | 2,500,000 |
| The free states of continental America, formerly Spanish colonies | 1,000,000 |
| | 9,800,000 |

Of whom five or six millions are now in a state of slavery;

the remainder, except in Hayti, forming an inferior and generally an oppressed class of free inhabitants The ultimate destiny of this multitude of human beings is a matter of very anxious speculation Hayti, peopled by the slaves of the French colony of St Domingo, who threw off the yoke at the [illegible] have [illegible] established an independent community and the progress of that community in civilization is not such as to encourage the sanguine hopes of the philanthropist

It has long been a favourite theory of many philosophers that the negro races are naturally inferior in point of intellect, and do not possess the same capacity for improvement as the Europeans, or people of the Caucasian variety This supposition has, however, been vehemently denied, and it has been contended over and over again that the peculiar circumstances under which they have been placed sufficiently account for the condition of the Africans [illegible] want of a literature and their low [illegible] weight should be attached to the [illegible] mentioned is true, but still we do not think that they are sufficient wholly to account for the existing state of things. Egypt was at a very remote period, the principal seat of science and of art, and various nations of Africa were in contact with and had a pretty extensive intercourse with, the Egyptians, and also with the Phœnicians, and afterwards the Romans But they seem to have profited little or nothing by this association And while the people of Greece Asia Minor and Magna Græcia raised themselves in a comparatively brief period to the highest pitch of civilization and refinement the nations of Africa continue without a solitary exception, down even to the present day, immersed in [illegible] Surely however, during the space [illegible] years, opportunities must have been afforded to some of them to make some advances But if so, not one has had sagacity to profit by by them Africa, in fact, does not seem to have produced a single great man She has had no Hercules no Minos no Theseus, no Confucius, no Manco Capac Among all the varieties of superstition that exist in it we look in vain for hero worship — for the divine honours paid in rude but improving [illegible] in other parts of the world by the public gratitude to departed heroes, legislators, and authors of important discoveries in the arts

With the exception of that of the ancient Egyptians and Ethiopians whose descent is involved in the greatest uncertainty, almost all the civilization that exists in Africa seems to be of foreign origin The introduction of Mohammedanism though in a debased form, has gone far to banish cannibalism from many countries, and some of them have also adopted the letters and literature of Arabia But the progress they have hitherto made is not such as to lead to any very sanguine anticipations as to their future advancement, and it would not indeed, be very philosophical to suppose that those who have been wholly unable to produce any thing original should attain to much eminence in the practice of foreign arts and sciences

It is unnecessary to enter into any examination of the *vexata questio* whether the varieties of the human race in Africa originally sprung from different sources or whether they all belong to the same stock, but changed to the state in which we find them by the influence of circumstances in the lapse of ages Whatever conclusion may be come to on this point cannot in anywise affect the question as to the comparative intelligence of the African people The same circumstances that are supposed by those who contend for the original identity of the races to have so greatly affected their appearance and physical capacities, could hardly fail to have an equally powerful influence over their mental faculties This in fact is substantially admitted by Dr Pritchard, who has ably contended for their common origin, and the equality of their intellect with that of the other races "The tribes," says he, "in whose prevalent conformation the negro type is discernible in an exaggerated degree, are uniformly in the lowest stage of human society, they are either ferocious savages, or stupid, sensual, and indolent Such are the Papals, Bulloms, and other rude hordes on the coast of Western Guinea and many tribes near the Slave coast, and in the Bight of Benin, countries where the slave trade has been carried on to the greatest extent, and has exercised its usually baneful influence On the other hand, wherever we hear of a Negro state the inhabitants of which have attained any considerable degree of improvement in their social condition, we constantly find that their physical characters deviate considerably from the strongly marked or exaggerated type of the Negro The Ashantee the Sulima, the Dahomans are exemplifications [illegible] remark The Negroes of Guber and Hausa, where a considerable degree of civilization has long existed, are, perhaps, the finest race of genuine Negroes in the whole continent, unless the Jolofs are to be excepted The Jolofs have been a comparatively civilized people from the æra of their first discovery by the Portuguese" — (*Researches into the History of Man*, ii 338 3d ed )

Here we have it distinctly laid down that the existence of the distinguishing features of the Negro race in a strongly marked degree is uniformly associated with the lowest state of barbarism, and that as they recede from this strongly marked type, we find a greater degree of civilization and improvement The inevitable conclusion is, that every variety of the Negro type, which comprises the inhabitants of almost all central Africa, is indicative of mental inferiority, and that ferocity and stupidity are the characteristics of those tribes in which the peculiar Negro features are found most developed We believe that this is a perfectly correct statement and we do not know that [illegible] could show more conclusively the [illegible] inferiority of the great bulk of the African people

But we do not form our opinion as to their inferiority on their configuration and appearance, but on the fact that while numberless European and Asiatic nations have attained to a high state of civilization, they continue, with few exceptions, in nearly primeval barbarism It is in vain to pretend that this is the result of the unfavourable circumstances under which they have been placed An intelligent enterprising people contend against unfavourable circumstances, and make them become favourable, but the Africans, with the questionable exception of the ancient inhabitants of the valley of the Nile, have never discovered any considerable degree of enterprise or invention or any wish to distinguish themselves either in arts or arms From the remotest antiquity down to the present day they have been hewers of wood and drawers of water for others, and have made little or no progress and the only legitimate inference from this lengthened induction seems to be that they are incapable of making it, that civilization will not spring up spontaneously amongst them, and that if it ever grow up it must be introduced from abroad and fostered and matured under foreign auspices (For full information on this subject, see the elaborate article on Africa in the *Geographical Dictionary* )

NEHALENNIA The name of an ancient Dutch and Flemish divinity who presided over commerce and navigation Her origin and general character are unknown and even her name suggests only forced and unsatisfactory associations but the sixteen altars whereon her image and name were represented which were found in the island Walcheren in 1647 leave no doubt of her former influence (See *Grimm's Deutsche Mythologie*, and the authorities there cited )

NEITH One of the most ancient Egyptian deities, supposed to be identical with the Grecian Minerva or Rhea Her name according to Jablonski indicates old or harmonious She was regarded as an incarnation of nature and as the patroness of all the arts Her most celebrated temple was at Sais where she was worshipped with peculiar veneration and where stood the veiled image so famous in the mythology of Egypt the rash inspection of which cost the adventurer either his life or his reason (See Schiller's poem *Das verschleierte Bild zu Sais* )

NEMATOIDEANS *Nematoidea* (Gr νημα, *a filament* and ειδος *form* ) The name of an order of *Cœlelmintha* or cavitary intestinal worms, comprehending those which are diœcious, and have a round, filiform, elongated body

NEMATONEURA (Gr νημα, and νευρον *nerve* ) A name proposed for that division of the *Radiata* of Cuvier including animals in which nervous filaments are distinctly traceable and the alimentary canal floats loosely in a distinct abdominal cavity

NEM CON A contraction for *nemine contradicente*, signifying no one contradicting *nem diss*, contracted for (Lat ) *nemine dissentiente*, signifies no one dissenting

NEMEAN GAMES One of the four great national festivals of Greece, in which all the states participated (See GAMES ) They were celebrated at Nemæa (whence their name), a village in the north eastern part of Argolis By some they are said to have been established by the Epigoni children of the warriors who besieged Thebes, in memory of Ophaltes, but others relate that they were first instituted by Hercules, in honour of Jupiter, after his victory over the Nemean lion They were held every third year, under the presidency of citizens chosen by lot from the states of Argos Corinth and Cleonæ The games were the same as those of Olympia The victorious combatants were crowned with parsley See especially *Wachsmuth's Historical Antiquities of Greece*, Oxf transl vol ii 162, and a memoir by Villoison, in the 38th volume of the *Mémoires de l'Ac des Inscriptions*

NEMESIS A Greek divinity, worshipped as the goddess of vengeance According to Hesiod, she was the daughter of Night, and was represented as pursuing with inflexible hatred the proud and insolent The reluctance of the Greeks to speak boastfully of their good fortune,

lest they should incur a reverse, is well known; and from various passages of the *Iphigenia* and other ancient writings it is clear that human victims were sometimes offered to propitiate this [illegible] goddess were [illegible] Nowhere, however, was her worship so pompously celebrated as at Rhamnus, a town of Attica, where she had a statue by Phidias, [illegible] by Mardonius to Greece, [illegible] the best [illegible] of Phidias A fragment supposed to be the head of this statue was presented to the British Museum in 1820, where it may still be seen

NEMO'CERA (Gr *νημα, a thread*, and *κερας horn*) The name of a family of Dipterous insects, including those which have long [illegible]

NEMOGLOSSA (Gr *νημα* and *γλωσσα, a tongue*) The name of a tribe of Hymenopterous insects, including those which have a long filiform tongue, as the bee tribe

NEO'CORUS Gr *νεος, ναος temple, κορεω I keep or take care of*) In Greek [illegible] as guardians of temples and their treasures (See *Mem de l'Ac des Inscr* vol xviii 140)

NE'OLOGISM, NE'OLOGY (Gr *νεος new* and *λογος, word*) A new phrase or word introduced into a language, or any innovation on ordinary modes of expression Most European tongues have their classical diction fixed by precedent and authority, and words introduced by bold or careless writers since this standard was established, go by the name of neologisms until usage has added them at last to the received national vocabulary *Neology*, in the last century was the name given by orthodox divines in Germany to the novel system of interpretation which then began to be [illegible] ny to the records of revealed religion See [illegible]

NEOME'NIA (Gr *νεος, new*, and *μην a month*) A festival observed by the Greeks at the beginning of every lunar month in honour of all the gods but more especially of Apollo thence called *Νεομηνος* as being the author of all light, and the grand luminary from which all time receives its distinctions and divisions At these solemnities the Athenians offered up prayers and sacrifices, in the temple of Erechtheus, for the prosperity of their city during the month that had commenced Games were also instituted during their celebration and grand entertainments given by the richer to the poorer citizens

NE'OPHYTE (Gr *νεος young, φυτος planted*) In the primitive church newly converted Christians were so termed, and the same appellation is still given, in the Roman Catholic church, to converts made by missionaries [illegible] person entering on the priestly [illegible] newly received into the communion of the church

NEOPLATONI'CIANS or NEOPLATONISTS In Ancient Literature the mystical philosophers of the school of Ammonius Saccas and Plotinus are commonly so called who mixed some tenets of ancient Platonism with others derived from a variety of sources and particularly from the demonology of the East They flourished in the 4th and 5th centuries of the Christian era Some, however, have contended that this title is more properly applicable to the eclectic Platonists, or school of Antiochus and Philo (See PLATONISTS ECLECTICS) For a singular view of the doctrines and tendency of the Neoplatonists, the reader may consult the *Quart Rev* July, 1840

NEPE'NTHE (Gr *νη* priv, and *πενθος sorrow*) A species of magic potion, mentioned by the Greeks and Romans, which was supposed to have the power of obliterating all pain and sorrow from the memory of those who partook of it It is now used figuratively to express any efficient remedy in giving rest and consolation to an afflicted mind

NEPHA'LIA (Gr *νηφαλιος sober*) Grecian festivals or sacrifices instituted in honour of various deities as Aurora, Venus &c They were so called because no wine was offered during their celebration It was chiefly at Athens that these festivals were observed

NE'PHELINE (Gr *νεφελη, a cloud*) A mineral from Somma, near Vesuvius and Capo di Bova near Rome, in nitric acid its transparent fragments become *cloudy* It is a double silicate of alumina and soda It [illegible] known by the name of *sommite*

NEPHRITE A hard tough mineral composed chiefly of silica, with lime, soda, and potash It is difficult to break, cut, or [illegible] by [illegible] of a greenish [illegible] It [illegible] into sword and knife handles and has even been cut into the form of a chain, which, from its extreme toughness, is not easily broken Little plates of it were formerly suspended from the neck for the [illegible] whence its name The Chinese [illegible] articles composed of it Its essential components are silica, alumina and magnesia

NEPHRI'TIS (Gr *νεφρος, a kidney*) Inflammation of the kidney This disease is attended by pain in the [illegible] ing the ureter, and increased [illegible] posture nausea and vomiting are common attendants and the appearance of the urine is generally far from healthy Bleeding, warm baths, sudorifics, and aperients, with opiates and diluents, are the principal remedies resorted to

NEPHROTOMY (Gr *νεφρος*, and *τεμνω, I cut*) The operation of extracting a stone from the kidney

NEPOTISM A word [illegible] characteristic of many high [illegible] tholic countries, and more particularly of popes a propensity [illegible] aggrandize their family by exorbitant grants and [illegible] conferred on members of it literally [illegible] The [illegible] of the highest and wealthiest families of the Roman nobility owe their elevation entirely to this species of patronage

NE'PTUNE The Italian name of the deity called by the Greeks Poseidon (*Ποσειδων*) He was brother of Jupiter, and, in the partition of empire after the death of Saturn, the sea fell to his share, but in subservience to the former His queen was Amphitrite, and his paramours nearly as numerous as those of his brother, but their progeny was not so celebrated, with the exception of the hero Pelops

His most famous temples were at the Corinthian isthmus, Helicè, [illegible] and Fænarus, [illegible] temple of Pæstum, in Italy, still in existence Neptune was said to preside over horses and the manger He is represented similar in appearance to Jupiter, but his symbols are a trident and the dolphin *Neptunalia* were festivals celebrated by the Romans during the months of July in honour of Neptune There were other festivals in honour of Neptune in his capacity of presiding over horses, called *consualia*, but the former were instituted to him in his character of god of the sea During the solemnity it was customary to live in booths erected on the banks of the Tiber

NEPTU'NIAN THEORY The geological theory of Werner, which refers the formation of all rocks and strata [illegible] to [illegible]

NEREI'DIANS *Nereidæ* The name of the family of Dorsibranchiate Annelidans of which the genus *Nereis* is the type The characters are, an even number of tentacula attached to the sides of the base of the head, and a little farther forwards two others which are biarticulate, between which are two simple ones Their branchiæ consist of small laminæ between which is spread a network of vessels, each foot is also furnished with two tubercles two packets of bristles, one cirrus above and another beneath

NE'REIDES (Gr *Νηρειδες*) The daughters of Nereus and nymphs of the sea They were originally conceived to be of a beautiful form, but later fictions degraded them to the idea of a mermaid The nereids are said by most ancient writers to have been fifty in number, but Propertius makes them [illegible] most famous of these goddesses were [illegible] Doto Thetis, &c Their worship was almost invariably connected with that of Neptune

NE'REUS (Gr *Νηρευς*) A marine Grecian deity, son of Ocean and Earth He possessed the gift of prophecy, and was distinguished for his knowledge and love of truth and justice

NERI'TA (Lat *Nerita* the name of a shell-fish in Pliny) This term was applied by Linnæus to a genus of his Vermes Testacea, characterized by having a shell with the columella [illegible] thus, which renders the aperture of a semicircular form this aperture is always closed by an operculum The genus is ranked by Cuvier amongst his Pectinibranchiate Gastropods and is subdivided into the subgenera *Natica*, Lam, *Nerita*, *Voluta*, and *Neritina*, Lam *Nerita* proper is a marine shell, while *Neritina* is an inhabitant of fresh waters Examples of both genera are found fossil in the strata of the Paris basin

NE'ROLI The name given by perfumers to the essential oil of orange flowers It is procured by distillation with water in the same way as the other volatile oils

NE'RVINE A medicine resorted to in nervous affections

NE'RVOUS FEVER A low fever in which nervous symptoms or sensorial debility, are especially prevalent the treatment consists in allaying nervous irritation and supporting the strength

NERVOUS SYSTEM In Physiology The nerves are fibrous chords in direct or indirect connection with the brain, and extending their ramifications into every part of the body their ultimate structure is filamentous, and they consist of a peculiar grey substance, their size depending upon the number of filaments enclosed in the common sheath They are often so interwoven as to form a kind of network or *plexus*, and some of them have what are termed *ganglia*, or rounded masses of nervous matter, not fibrous, but apparently composed of [illegible] and [illegible] network

[illegible] of nerves, one of which is connected with the brain and with the spinal chord,

and are media of sensation and of voluntary motion they are [illegible] or the *cerebro-spinal* ne[illegible] in communication with the brain and spinal chord, or with the cerebro-spinal nerves, by very small filaments, and they have numerous ganglions throughout their course they preside over the nutritive functions, upon which the mind has no direct influence these are the nerves of *organic life*, or *ganglionic* or great *sympathetic* nerves

The cerebro-spinal nerves convey impressions from their extremities to the brain, and they also convey the influence of the will from the brain to the voluntary muscles, these passing and repassing, or receptive and emissive influences, are conveyed by distinct sets of nervous filaments, which, however, are generally enclosed in the same sheath, and nerve the terms *centr* [illegible] have been distinctively applied to them

The history of the nervous system in all its details forms an extended and complicated, but a highly important part of anatomy and physiology, the investigations connected with which have led to many useful practical results, which, however, have thrown but little light upon the cause of the phenomena, or the ultimate nature of the nervous influence The works of Sir Charles Bell Dr Marshall Hall and Dr Wilson Philip must be consulted in reference to the functions of the different classes of nerves, there is a good general account of the subject in Baly's translation of *Müller's Physiology*

NERVOUS SYSTEM In Comp Anat In some of the lowest-organized animals the nervous system has been detected in the form of simple filaments, these are afterwards found connected with a nervous ring surrounding the œsophagus As organization advances nervous matter begins to be accumulated upo[illegible] brain, and upon different parts of the [illegible] forming ganglions

When the principal ganglia ted filaments are not parallel, or not symmetrical in their course they are associated with the type of organization which characterizes the molluscous or *heteroganglia* division of animals When the ganglia ted filaments are two in number symmetrical, and run parallel with each other along the ventral aspect of the body they are associated with and bespeak the type of organization characteristic of the articulate or *homoganglia* te division When the brain ceases to present the form of a ring, and sends down the back a prolongation of its substance called the spinal marrow the rest of the organization is that which characterizes the vertebrate or *myelencephalous* subkingdom or primary division of animals In the vertebrate and articulate animals the superficial tract of the spinal or ventral chords is sensitive the deeper seated tract moto[illegible]

NERVU'RES in Entomology are corneous tubes for expanding the wing and keeping it tense, and to afford protection to the air vessels they are termed costal post-costal mediastinal, externo-medium interno-medium anal, axillary &c according to their relative positions In Botany *nervures* are the veins of leaves

NESS The termination of several names of places in Great Britain where there is a headland or promontory as Inverness, Sheerness The word is probably derived from the Ir nez or the Germ nase, *nose*

NESTO'RIANS The followers of Nestorius, patriarch of Constantinople in the first half of the fifth century This prelate agitated the Christian world after the Arian controversy had been quietly settled by the introduction of certain subtle disputations concerning the incarnation of our Lord from which hatred and contentions arose which harassed the church for the space of more than two centuries He affected to distinguish with peculiar precision between the divine and human natures united in Christ, and, in guarding over carefully against the propensity which he discovered in the Christians of his own day to confuse the two, and look upon them as absorbed into one compound substance, he forbade men to entertain any combined notion at all and kept constantly before their eyes both the god and the man He insisted for instance, that the Virgin should not be entitled *Mother of God* but *Mother of Christ* or of *Man*, the human nature being essentially distinct from and only inhabited by the divine, as a temple by its divinity The opinions of the Nestorians were indeed, little more than subtle logical refinements upon mysteries which will not bear the application of such tests, and it was the habit of mind which they engendered that chiefly rendered them pernicious, and the fierce passions with which they were combined that gave them their celebrity and widely extended influence Nestorius himself was condemned by the third general council held at Ephesus, in the year 431 his principal adversary being the president of the assembly Cyril, the learned patriarch of Alexandria The unfortunate prelate was deposed, and banished by the emperor to an oasis in Upper Egypt, where he died His opinions, however, spread throughout Asia, and appear to have been carried along, with the advancing stream of Christianity to the furthest parts of India and China In more central regions, they were soon afterwards counteracted by the spread of the opposite heresy of Eutyches For notices of the opinions which sprang out of these rival [illegible] see INCARNATION EUTYCHIANS MONOPHYSITES, MONOTHELITES Besides the well known authorities, the reader may consult Du Pin *Hist du Nestorianisme*, 1698, *Assemanni Bibliotheca Orientalis*, and *Grant's Researches among the Nestorian Christians*, 8vo, 1841

NESTS, ESCULENT A species of nests built by swallows peculiar to the Indian Islands, and very much esteemed in China and other parts of the world These nests resemble in form those of other swallows, they are formed of a viscid substance, [illegible] as well as consistence are not [illegible] isinglass Esculent nests are principally found in Java, in caverns usually situated on the sea coast Nothing satisfactory is known as to the substance of which these nests are composed (See the *Commercial Dict*, art "Birds Nests")

NET or NEAT In Commerce something pure and unadulterated with any foreign mixture Thus wines are said to be *net* when not falsified, and coffee rice &c, to be so when the filth and ordures are separated from them The word *net* is also used for what remains after the tare has been taken out of any merchandize, *i e* when it is weighed clear of all package (See TARE) *Net Produce* (Ital netto proceduto) is used in mercantile language to express what any commodity has yielded after all tare and charges have been deducted

NET (Germ netz) is a textile fabric of knotted meshes for catching fish, and other purposes Each mesh should be so secured as to be incapable of enlargement or diminution The French government offered in 1802 a prize of 10,000 francs to the person who should invent a machine for making nets upon automatic principles and adjudged it to M Buron who presented his mechanical invention to the *Conservatoire des Arts et Metiers* It does not appear, however, that this machine has accomplished the object in view, for no establishment was ever mounted to carry it into execution Nets are usually made by the fishermen and their families during periods of leisure The formation of a mesh is too simple a matter to require description in this dictionary

NETHINIMS Among the Jews, the servants of the priests and Levites employed in the lowest and meanest offices about the temples They were, as the Scripture expresses it the hewers of wood and drawers of water for the house of God To this office the descendants of the Gibeonites were originally condemned by Joshua, but at a later period the same duties were assigned to the Canaanites who had surrendered themselves and were spared

NETTINGS Nets of small rope placed in a ship for various purposes as stowage, or defence against accidents, also against boarding

NETTLERASH An eruption upon the skin much resembling the sting of a nettle It usually lasts for a few hours, and then disappears or changes its place, it is relieved by bathing the affected part with a mixture of one part of vinegar and eight or ten of water, and by mild aperient medicines

NEURALGIA (Gr *νευρον a nerve*, and *αλγος pain*) An acute painful affection in the course of the nerves generally subject to intermission One of the most distressing forms of this disease is the *tic douloureux*

NEUROLOGY (Gr *νευρον* and *λογος, a description*) The doctrine of the nerves See NERVOUS SYSTEM

NEUROMA (Gr *νευρον*) A tumour formed in or upon a nervous trunk

NEUROPTERANS *Neuroptera* (Gr *νευρον a nerve*, *πτερον a wing*) The order of Tetrapterous Mandibulate insects including those in which the nervures of the wings are so disposed as to form a more or less regular network They are distinguished from the Coleopterous Orthopterous and Hemipterous orders of four-winged insects by the first or interior pair of wings being membranous diaphanous and [illegible] the second pair in texture and properties [illegible] is unprovided with a sting The antennæ are usually setaceous Some neuropterans merely pass through a semi metamorphosis the rest a complete one, the larvæ have always six hooked feet Many of these insects are carnivorous in their first state and their last The dragon-fly may be regarded as the type of this order

NEUROTOMY (Gr *νευρον*, and *τεμνω, I cut*) The cutting of a nerve

NEUTER (Lat *neuter*), in Grammar, signifies that gender which nouns possess that are neither masculine nor feminine *Neuter* or *intransitive* verbs are those which represent the properties of a state or process, as *I rest, I fall, I grow*, &c See GRAMMAR

*Neuter* was the name given to the "labourers" of the hive-bee before it was discovered that they were essentially females though infertile

NEUTRALITY In International Law, the condition of a state which does not take part in a war between other states A neutral nation has the right of

furnishing to either of the contending parties all supplies which do not fall within the description of *contraband of war* (*see* CONTRABAND OF WAR), and to conclude treaties with either unconnected with the subject of the war It appears to have been the old principle, with regard to the maritime trade of a neutral nation, that the property of an owner belonging to the hostile country might be seized by a belligerent on board a neutral power's vessel but the general rule now asserted is that the flag covers the cargo by which means right of search, except for specific purposes, is rendered unnecessary But this rule is in effect set aside, according to the will or necessities of the most powerful belligerent as it was during the last wars between England and the Continental powers

NEUTRA'LIZATION (Lat neuter, *neither*) In Chemistry, the combination of an acid and alkali in such proportions that the peculiar properties of each are rendered inert

NEU'TRAL SALTS Combinations of acids and bases which are neither acid nor alkaline, but in which the acid is exactly *neutralized* by the base

NI'UVAI'NES (Fr neuf, *nine*) In the Roman Catholic Church, prayers offered up for nine successive days, in order to obtain the favour of Heaven (See the *Dict de la Conversation*)

NEW CONNEXION METHODISTS, or KILHAMITES, so called from Mr Alexander Kilham, who was the immediate means of their separation from the Wesleyans, and withdrew from this body on the ground of the almost irresponsible power exercised by the Conference Having petitioned this convocation that the people might have a voice in the formation of the laws by which they were to be regulated the choice of their own pastors and other officers and the disposal of their [illegible] refused, [illegible] party on a more liberal basis The members of this body do not exceed 13,000 (*Life of Kilham* by Thomas Grundel *General Rules of the New Connexion Methodists*)

NI'WEL (Fr noyau) In Architecture the space either solid or open, round which the steps of a staircase are turned

NEW RED SANDSTONE The sandstone immediately above the coal measures *See* GEOLOGY

NEWS (Germ neues, Lat novus Gr νεος) Literally fresh information This word has been fancifully derived from the initial letters of the four cardinal points of the compass *north*, *east* *west* and south

NEWSPAPERS Publications in numbers consisting commonly of single sheets and published at short and stated intervals, conveying intelligence of passing events In Rome under the government of the emperors, periodical notices of passing events (diurna, acta diurna) were compiled and distributed for general reading, but our accounts of these ancient newspapers derived from classical sources, are somewhat obscure and uncertain In modern Europe the earliest occasional sheets of daily intelligence seem to have appeared at Venice during the war of 1563 against the Turks (see GAZETTE) and the earliest regular paper to have been a monthly one published in the same city by the state but these were distributed in manuscript and owing to the jealousy of the [illegible] so down to very late times It is said to have been published [illegible] ing the time when the arrival of the Spanish Armada was apprehended, but the specimens preserved in the British Museum, and so long regarded as authentic seem now to be demonstrated forgeries The *Mercuries Intelligencers*, &c of the civil wars, seem to have been the first English papers which appeared regularly The *Gazette de France* appeared regularly from 1631 to 1792, forming a collection of 163 volumes, it was continued also, but with some interruptions through the period of the Revolution, and the name still exists the journal so called being at present one of the organs of the Carlist party From their first imperfect beginning newspapers have gradually increased in number matter and consequence until they form, in many European countries, one of the most important features in the social economy of the people, exercising a marked influence on [illegible] more espe [illegible] In France newspapers are generally undertaken in shares The editors and principal writers are more responsible and more generally known than in England this is either a cause or an effect of the general prejudice in that country against anonymous writing, which is by no means so common as among ourselves, but perhaps, one of its consequences is, that newspapers are more notoriously under the control of particular sections of the political world or of powerful individual Political newspapers have their subsidiary articles on subjects of theatrical or literary criticism added in the shape technically termed *feuilleton*, a subdivision of the page This custom was introduced about 1800 in the most influential paper of that period and has since been generally followed The periodical press of France was under strict control during the Empire the censorship was continued until 1819, and re-established in 1820, but again abolished in 1821 At that period a law was passed compelling the proprietors to give security for the good conduct of their journals, under a penalty of 10,000 francs in Paris, and various lesser sums in the departments The censorship was, however, again instituted and again abolished in 1827 By the famous ordinances of 1830 the liberty of the periodical press was suspended In 1835, laws of a very severe character were passed to subject the proprietors of journals to easier conviction and heavier punishment in case of [illegible] libel against government [illegible] multiplying the provisions of that law In December, 1851, the revolutionary government of Louis Napoleon Bonaparte commenced its career with a sweeping suppression of the press unparalleled in modern times

In Great Britain newspapers are subjected to several statutory enactments By 38 G 3 c 78 no person can print or publish any newspaper until an affidavit has been delivered at [illegible] the name and places of abode of [illegible] proprietor, specifying the amount of shares in the undertaking, the title of the paper and description of the building in which it is intended that the paper shall be printed A [illegible] spaper is to be delivered within six days [illegible], to the commissioners of stamps, under a penalty of 100*l* Persons publishing newspapers without the name and place of abode of the printer affixed may be apprehended and carried before a magistrate, and peace officers by virtue of a warrant from a justice of the peace, may enter any place to make search, &c By 60 G 3 c 9 every periodical, pamphlet or paper, published at intervals not exceeding 26 days containing public news or intelligence, or any remarks thereon or on any matter in church or state not containing more than two sheets, or published at a less price than sixpence, shall be deemed newspapers and subject to the same regulations and stamp duties But a recent decision in the case of Mr Dickens's "Household Words" has thrown some doubt on what should be the right interpretation of the law By 1 W 4 c 73 securities may be demanded, to the amount of 400*l* or 300*l*, from both principal and sureties when it is intended to publish a newspaper or pamphlet of the description mentioned in 60 G 3 c 9. These securities are intended to secure payment of damages or costs which may be incurred in an action for libel against the conductor of the paper The laws respecting the stamp duties on newspapers were placed on a new footing in 1836 Instead of imposing an equal fixed duty on newspapers, it has been proposed to repeal the duty entirely, and to substitute in its stead a post-office duty But we confess that we should not regard this as a desirable change, for it would have the effect of exempting from the duty all newspapers printed and circulated in large towns There have rarely been more than five or six daily morning papers in London and about as many evening Of one of the former (*The Times*) the net profits have been estimated in some years at 60 000*l* The machinery which produces these huge sheets has been greatly increased of late years in power and rapidity by numerous ingenious applications of the steam engine A morning paper in considerable circulation generally employs besides various contributors and correspondents, an editor, a sub editor, from ten to fourteen regular reporters (*see* NEWSPAPER REPORTING), together with numerous irregular or occasional reporters, who multiply copies of the pieces of intelligence which they collect by means of polygraphs, and send them round to different newspapers to take the chance of their insertion

The following calculation was formed in 1840, of the number of periodical papers appearing in various countries, since which period it is probable that there has been a considerable increase —Great Britain and Ireland 483 France 490, Russia, 288 [illegible] (Holland and Belgium), 160, German [illegible], excluding Austria and Prussia 305, Sweden, 82, Denmark, 80, States of the Church, 6 only It is obvious that without any [illegible] to the amount of copies of each newspaper this circumstance furnishes no grounds whatever for speculating on the proportion between the demand and supply of newspapers and the population in these respective countries and wherever (as in England) newspapers are subjected to a heavy duty, each individual paper must necessarily sell a greater number of copies than elsewhere in order to afford a profit, but the circulation of some French newspapers is said to exceed that of any among ourselves The United States, at the same time had 800 newspapers [illegible] upwards of 1000 about fifty of these [illegible] See among other antiquarian authorities as to early newspapers, *D Israeli's Curiosities of Literature*, vol i, *Chalmers's Life of Ruddiman*, and the *Conv Lexicon*, art. "Zeitung" See also the *Commercial Dictionary*.)

**NEWSPAPER REPORTING.** The name given to that system whereby the parliamentary debates and speeches delivered at public meetings, &c are promulgated throughout the country As it is contrary to the rules of both Houses that any stranger should be present, the publication of the debates is held to be a breach of privilege; but this regulation has always been defeated, either, as in former times, by the means adopted by Dr Johnson and others of publishing the speeches of the different members under [illegible] names or, as at present by the Houses themselves tacitly giving their sanction to the practice The [illegible] of the present system of parliamentary reporting may be fairly ascribed to the late Mr William Woodfall, whose retentive memory enabled him, after having listened to the debates, daily to communicate to the public, in what he called *A hasty Sketch of the Proceedings in Parliament last Night*, a full and most accurate account of the different speeches Secret deliberations, however, have been so long renounced, that the right of the public to be present through their agents the reporters, is as clearly established now as if no theoretical privacy had ever existed, but if any member were repeatedly to insist upon the exclusion of strangers, as all are called who neither are members nor officers of the house there can be no doubt that this abuse of the privilege would lead to such a modification of the standing order as would deprive individual members of any control over a matter so interesting to the nation The process of parliamentary reporting, and the qualifications of those by whom the task is performed, cannot be adequately described within the narrow limits of this article, but it is hoped that the reader may be enabled to form some idea of both from the following brief outline Every publication not copying from, or abridging any other but giving original reports, keeps one of a series of reporters constantly in the gallery of the Lords, and another in the Commons These, like sentinels, are at stated periods relieved by their colleagues when they take advantage of the interval to transcribe their notes, in order to be ready again to resume the duty of note-taking, and afterwards that of transcription for the press A succession of reporters for each establishment is thus maintained and the process of writing from their notes never interrupted till an account of the whole debates of the evening has been committed to the hands of the printer There are only seven publications for which a reporter is constantly in attendance, and these include the London morning newspapers, from which all others that give debates are under the necessity of copying or abridging them The number of reporters maintained by each varies from ten or eleven to seventeen or eighteen They are for the most part gentlemen of liberal education — many having graduated at the Universities of Oxford, Cambridge Edinburgh Glasgow, or Dublin, and they must all possess a competent knowledge of the multifarious subjects which come under the consideration of parliament The expedition and ability with which their duties are performed must be admitted by every one who attends a debate and afterwards reads a newspaper while the correctness and rapidity with which their manuscript is put in type and printed has long been a subject of surprise and admiration (See the *Parliamentary Companion*, a valuable brochure )

**NEW STYLE** In Chronology *See* STYLE

**NEW TESTAMENT** The term given to that portion of the Bible which comprises the writings of the apostles and their immediate disciples It consists of five historical books, viz the respective Gospels of Matthew, Mark Luke, and John, and the Acts of the Apostles (attributed to Luke), of twenty-one apostolical epistles of which the early fathers have unanimously ascribed fourteen to St Paul, three to St John, two to St Peter, one to St James, and one to St Jude, and of the book known by the name of the Apocalypse or the Revelation of St John *See* BIBLE EPISTLE, EVANGELISTS

**NEWTONIAN PHILOSOPHY** This term is used in various senses Sometimes it is used to denote the doctrine of the universe as delivered by Sir Isaac Newton in the *Principia*, sometimes the corpuscular, or modern, or experimental philosophy as opposed to the the theories of Descartes and others, but most frequently, perhaps, the mathematical theory of universal gravitation *See* GRAVITATION PHYSICS

**NEW YEAR'S DAY** The celebration of the commencement of the new year dates from high antiquity The Jews regarded it as the anniversary of Adam's birthday, and celebrated it with splendid entertainments — a practice which they have continued down to the present time The Romans also made this a holiday, and dedicated it to Janus with rich and numerous sacrifices, the newly elected magistracy entered upon their duties on this day all undertakings then commenced were considered sure to terminate favourably, the people made each other presents of gilt dates, figs, and plums; and even the emperors received from their subjects new year's gifts, which at a later period it became compulsory to bestow From the Romans the custom of making presents on New Year's Day was borrowed by the Christians, by whom it was long retained, but even in those countries where it lingered longest, in France and Scotland for instance, it is falling rapidly into desuetude, and congratulatory wishes are now almost universally substituted for the more substantial presents that were formerly conferred on this day as marks of affection and esteem

**NEXI** (Lat necto, *I bind*) In Roman Antiquities persons freeborn, who, for debt, were delivered bound to a creditor, and obliged to serve him until they could discharge it

**NIBELUNGEN, LAY OF THE** The name given to the most ancient existing monument of German epic poetry The origin of this poem is veiled in great obscurity, it is supposed to have existed, in substance at least, two centuries before the reign of Charlemagne, and, like the early compositions of poets in all ages, to have consisted originally of detached ballads and poems, which were afterwards gradually collected, and at length moulded into the complete form in which they at present exist The last of the modifications which it underwent took place towards the end of the 12th century, and is attributed to the Minnesaenger Henrich von Ofterdingen The story turns upon the adventures of Chrimhold of Burgundy who is first won by the valiant Siegfried and after he is treacherously murdered gives her hand to Attila, king of the Huns, chiefly in the hope that through his power and influence she may be revenged on the murderers of her former lord The assassins accordingly and all their kin, are induced to visit Attila when by the instigation of the queen a deadly feud arises, in the course of which almost the whole army on both sides is cruelly slaughtered By the powerful but reluctant aid of Diederich of Bern however the murderer of Siegfried is at last vanquished, and brought bound to the feet of the queen, who relentlessly raises the sword of the departed hero, and with her own hand strikes off the head of his enemy The famous Hildebrand whose exploits are depicted on the *Helden-Buch* instantly avenged the atrocious and inhospitable act by stabbing the queen who falls exulting on the body of her hated victim The work is divided into thirty eight books The *Nibelungen Lied* formed for many centuries the chief traditionary record of the romantic deeds and sentiments of the German nation, but at the era of the Reformation it sank wholly into oblivion, from which however, it has within the last thirty years been rescued and permanently placed by the labours and commentaries of Hagen, Zeune, Simrock and Schlegel among the most conspicuous monuments of human genius All the questions relating to its origin nature, and characteristics are discussed with great interest by the German literati to many of whom indeed it forms a distinct branch of study and we cannot refrain from inserting in our pages Schlegel's notice of this poem which whatever interest it has excited in Germany, is still comparatively unknown in England

Among the heroic poems of those nations which in contradistinction to those of the Greeks and Romans, whose skilful unfolding of incidents and dramatic vividness of representation were peculiar and unrivalled have remained satisfied with a more simple mode of poetry, the *Nibelungen Lied* claims a very high place, — perhaps among all the heroic chivalrous poems of modern Europe, it is entitled to the first It is peculiarly distinguished by its unity of plan, or rather it is a series of pictures each naturally following the other, and all delineated with great boldness and simplicity and a total disregard of all superfluities The German language appears in this work in a state of perfection to which in the subsequent periods of its early history it had no pretensions In addition to all its natural liveliness and strength, it seems at that time to have possessed great flexibility, which soon [illegible] affectation, roughness, [illegible] The heroic legends of all nations have a great deal in common, so far as their essence and purpose are concerned, their variety is only [illegible] peculiar feelings [illegible] s of different nations In the *Nibelungen Lied*, in the same manner as in the legends of Troy and of Iceland, the interest turns on the fate of a youthful hero, who is represented as invested with all the attributes of beauty magnanimity and triumph but dearly purchasing all these perishable glories by the certainty of an early and predicted death In his person, as is usual, we have a living type both of the splendour and the decline of the heroic world The poem closes with the description of a great catastrophe borrowed from a half-historical incident in the early traditions of the north In this respect also, as in many others, we cannot fail to perceive a resemblance to the *Iliad* If the as[illegible] more tragica[illegible] Homer, the death of the German hero, on the other hand, has in it more solemnity and stillness, and is withal

depicted with more exquisite touches of tenderness, than any similar scene in any hero-poem with which we are acquainted The *Nibelung Lied* is no mere poem abounding in variety In it both sides of human life, the joyful as well as the sorrowful, are depicted in all their reality The promise of the opening stanza is fulfilled —

Von Freuden und Festes Zeiten, von Weinen und von Klagen,
Von kühner Helden Streiten, mögt Ihr nun Wunder hören sagen

(*Schlegel's History of Literature*, Edin 1818, vol i p 270 272) See, for further information, the *Conversations-Lexicon*, an

NICARA'GUA [illegible] *salpina echinata*, a tree growing in Nicaragua, it is a species of Brazil wood It is used [illegible] to dye a bright but fugitive red Nicaragua wood differs greatly in their quality as well as price, one sort being so deficient in colouring matter that six pounds of it will only dye as much wool or cloth as one pound of Brazil wood, while another variety of it will produce nearly half the effect of an equal quantity of Brazil wood, and will sell proportionally dear (*Bancroft on Colours*, vol ii p 332)

NICE, COUNCIL OF The first, and, according to most writers, the most important, œcumenical council held in the Christian church It was convened, A D 325 at Nicæa, by the emperor Constantine, in order to settle differences that had arisen in the Christian church in respect to the doctrines of Arius This council was attended by upwards of 250 bishops, of whom a great majority came from the East, besides presbyters deacons, and others from all parts of the Christian world The chief question, as was remarked above, was the Arian heresy, and the council issued in the excommunication of Arius (*See* ARIANS) The decision of this council had not the effect of restoring tranquillity to the Eastern church, for the Arian controversy was still warmly carried on, but it has supplied that mode of stating the doctrine of the Divinity (as far as relates to the Father and Son) in which it has ever since been received by the orthodox *See* NICENE CREED, COUNCIL

NICE'NE CREED The confession of faith in which the consubstantiality of the Father and Son is asserted against the Arians (*See* art ARIANS) This creed was commenced by the council of Nice A D 325, and completed by the second general council of Constantinople, A D 381 But the words "and the Son," after those "who proceedeth from the Father," were added by the Latin church (certainly before A D 411) expressing a point of doctrine in which it differs from the Greek The Nicene creed was generally used by the Eastern churches in the administration of baptism, but was not inserted in their daily service till the fifth century In the service of the church of Rome it was inscribed A D 1014

NICHE (Fr niche) In Architecture, a square or cylindrical recess in a wall, usually made for the reception of a statue

NICKEL A white metal ductile, malleable attracted by the magnet and which, like iron, may be rendered magnetic Its specific gravity when hammered is about 9 It is rather more fusible than pure iron, is not altered by exposure to air and moisture at common temperatures, but is slowly oxidized at a red heat It is found in all meteoric iron, but its principal ore is a copper-coloured mineral found in Westphalia and called *kupfernickel*, nickel being a term of detraction used by the German miners, who expected from the colour of the ore to find that it contained copper The salifiable oxide of nickel consists of 30 nickel + 8 oxygen Its salts are mostly of a grass-green colour and the ammoniacal solution of its oxide is deep blue, like that of copper Ferrocyanate of potassa precipitates it of a white or very pale green colour

Since the manufacture of German silver, or *argentane*, became an object of commercial importance, the extraction of nickel has been undertaken upon a considerable scale The cobalt ores are its most fruitful sources, and they are now treated by the method of Wohler to effect the separation of the two metals The arsenic is expelled by roasting the powdered *speise* first by itself next with the addition of charcoal powder, till the garlic smell be no longer perceived The residuum is to be mixed with three parts of sulphur and one of potash, melted in a crucible with a gentle heat, and the product being edulcorated with water leaves a powder of metallic lustre, which is a sulphuret of nickel free from arsenic, while the arsenic associated with the sulphur, and combined with the resulting sulphuret of potassium, remains dissolved Should any arsenic still be found in the sulphuret, as may happen if the first roasting heat was too great, the above process must be repeated The sulphuret must be finally washed dissolved in concentrated sulphuric acid, with the addition of a little nitric, the metal must be precipitated by carbonates alkali, and the carbonate reduced with charcoal

In operating upon kupfernickel, or speise, in which nickel predominates, after the arsenic, iron, and copper have been separated, [illegible] upon the mixed oxides of cobalt [illegible] dissolve them into a blue liquor This being diluted with distilled water deprived of its air by boiling, is to be decomposed by carbonate potash till the blue colour disappears, when the whole is to be put into a bottle tightly stoppered and set aside to settle The green precipitate of oxide of nickel, which slowly forms, being freed by decantation from the supernatant red solution of oxide of cobalt, is to be edulcorated and reduced to the metallic state in a crucible containing crown glass Pure nickel in the form of a metallic powder is readily obtained by exposing its oxalate to moderate ignition (*Ure's Dict. of Arts, &c*)

NICOLAI'TANS One of the earliest Christian sects, mentioned in the Revelations of St John, where the angel of God reproaches the church of Pergamos with harbouring persons of this denomination They are there characterized as inclining to the licentious and pagan practices of the Gentiles, but the fathers have also accused them of partaking in a great measure of the Gnostic opinions It is doubtful, however, whether on this point there be not some confusion between the Nicolaitans of the first and the followers of Nicolaus of the second century (See *Mosheim* (transl 1790), i 143. *Gieseler's Text Book* (transl ), i 69)

NICOTI'NA A poisonous alkaline base, extracted from the leaves and seed of the *Nicotiana tabacum*, or common tobacco It derives its name from Nicot, a Frenchman, [illegible] tobacco into France

NICITA'TION (Lat nicto, *I wink*) Winking of the eyes This is generally a nervous affection, and very frequently it becomes a trick or habit Where it arises from any local irritating cause, bathing the eyes with warm water affords relief

NIDDUI A sort of minor excommunication among the Hebrews, which continued [illegible] about a month If not removed within that period, it was prolonged for sixty or even ninety days If during this term satisfaction was not made, the excommunicated person fell into the *cherem*, which was the second species of excommunication, and afterwards into the *scammatha*, which was the most dreadful of all

NIDIFICA'TION (Lat nidus, *a nest*, facio, *I make*) The process by which birds construct their nests

NIE'LLO (Ital) A method of engraving on plate. *See* art ENGRAVING, where the process is described

NIGHT (Lat nox, Ger nacht) The part of the natural day during which the sun is below the horizon

NIGHT HERON *See* ARDEA

NIGHTINGALE A migratory species of Passerines, and the sweetest of song-birds, the type of the subgenus *Luscinia*, which is more closely allied, according to Mr Blythe to the thrush family than to the fauvettes (*Curucidæ*) among which it is placed by Cuvier The [illegible] the southern counties of [illegible] more common [illegible] till the beginning of May, the females do not arrive till a week or ten [illegible] later Migrating to the south they [illegible] country for the purpose of breeding and the famed song of the male is his love chant and ceases when his mate has hatched her brood "Vigilance anxiety, and caution now succeed to harmony, and his croak is the hush the warning of danger and suspicion, to the infant charge and the mother bird" If by accident his mate be killed, the male resumes his song, and will continue to chant very late in summer unless he can attract as he commonly soon does, another female The nightingale feeds chiefly on the larvæ of insects, which abound at the season of its arrival in this country The nest is built near the ground, the eggs are four or five in number, of a uniform dark brown colour the young are excluded in the month of June, and are ready to accompany the parents in their southward [illegible] the month of August

NIGHT JAR The name of a remarkable British bird, the type of the genus *Caprimulgus*, distinguished by the [illegible] of its beak which perhaps has arisen the [illegible] treats of cattle, and its other [illegible] " the equivalent of which it has received in most European languages, and which Linnæus has continued in its generic designation It is scarcely necessary to observe that the structure of the bill renders the act of sucking impracticable in the night-jar or any other bird The genus *Caprimulgus* is characterized by a wide and deeply-cleft beak, armed with strong [illegible] capable of engulphing the larger insects, the nostrils placed at its base are like small tubes, the wings are lengthened, the feet short, feathered to the toes, which are connected together by a membrane at their base, the claw of the middle toe is commonly pectinated at the base The night-jars are most active and hunt their prey in the dusk, they have the same soft and soft plumage as other nocturnal birds Our common species (*Capr Europæus*) is remarkable

for the loud sound it emits, like the burr or jarring of a spinning-wheel

NIGHTMARE An oppressive sensation and struggle during sleep, otherwise called *incubus* (which see), produced usually by indigestion *See* EPHIALTES

NIGHTSHADE *See* DULCAMARA and BELLADONNA

NIGHT WATCH A portion of the night as distinguished by a change of the watch Among the Romans the night was divided into four watches, each of three hours' duration, and styled first second, third, and fourth watches, according to the military usage, by which the guard was relieved four times during the night The first watch began at six in the evening and lasted till nine, according to our mode of computing time, the second lasted from nine till twelve or midnight, the third from midnight till three in the morning (called *cock-crowing*), and the fourth commenced at three and ended at six thus completing the twelve hours The Jews originally divided the night into three watches, but at a later period, and previously to the appearance of our Saviour, they adopted the Roman division of the night, which is frequently alluded to in the New Testament In the Roman mythology, Nox was the goddess who presided over the night She is represented clothed with a tunic thickly set with stars, and in her honour the Romans sacrificed a cock during the night

[illegible] Ovid

NIGRINE (Lat niger *black*) Silico-calcareous oxide of titanium It occurs in Ceylon and Transylvania

NIMBUS (Lat) In Painting and Sculpture a circular disk round the heads of divinities, and sovereigns and saints

NIMBUS CLOUD In Meteorology *See* CLOUD

NINSIN ROOT A bitter root, said to the medicinal qualities of ginseng It is the root of the *Sium ninzi*

NINTH In Music, one of the dissonant intervals in music being properly a second double

NIOBE In Mythology daughter of Tantalus, and one of the Pleiades married to Amphion king of Thebes Proud of her numerous and flourishing offspring she provoked the anger of Apollo and Diana, who slew them all she was herself changed by Jupiter in Phrygia, into a rock from which a rivulet fed by her tears, continually pours The subject of Niobe and her children was a great favourite with the poets of antiquity Besides the beautiful story in Ovid (*Met* vi 146), there are numerous epigrams in the Greek *Anthology* which appear to be descriptive either of the group of figures to which we refer below or to some similar group See more especially that beginning,

Ταντάλιδι καὶ Νιόβᾳ κλυτὸν ἄμμιν φάτις ἄγγελον ἄτας

This fable has also afforded a subject for art and particularly for the sculptor of the beautiful group in the tribune at Florence known by the name of Niobe and her Children Some antiquaries attribute it to Scopas Winkelman inclines to believe it the workmanship of Praxiteles It is beautifully characterized by Hazlitt in his 'Treatise on Art,' in the *Ency Britannica*

NIPPERS In Sea language small ropes or selvages for attaching the messenger to the cable

NISI PRIUS In Law a term originating in a legal fiction, when the pleadings in a cause in one of the superior courts of common law (*see* PLEADING) are concluded, and an issue of fact is raised between the parties The issue is appointed by the entry on the record or written proceedings to be tried by a jury from the county of which the proceedings are dated at Westminster *unless before* the day appointed (nisi prius) the judges shall have come to the county in question The judges of assize, by virtue of their commission of nisi prius try the causes thus appointed on their several circuits unless they are dated of London or Middlesex, in which case they are tried in London or in Westminster at the sittings during or after term *See* COURTS SUPERIOR, and TERM

NITRATES Salts of the nitric acid, thus *nitrate* of potassa is a compound of one atom of nitric acid and one atom of potassa *See* NITRE

NITRE, *Nitrate of Potassa*, *Saltpetre* This salt consists of 54 nitric acid + 48 potassa, its equivalent therefore, is 102 It is spontaneously generated in the soil, and crystallizes upon its surface in several parts of the world, especially in India, whence nearly the whole of the nitre used in Britain is derived It has occasionally been produced artificially in *nitre beds*, formed of a mixture of calcareous soil with animal matter, in these nitrate of lime is slowly formed, which is extracted by lixiviation and carbonate of potash added to the solution, which by double decomposition, gives rise to the formation of nitrate of potash and carbonate of lime the latter is precipitated, the former remains in solution, and is obtained in crystals by evaporation Nitre crystallizes in six-sided prisms, soluble in seven parts of cold water and in less than its weight of boiling water It has a cooling saline taste and is anhydrous At 616° it fuses, and at a red heat is decomposed Its great use is in the manufacture of gunpowder, and in the production of nitric acid. It is also employed in the preservation of meat

*Nitrate of soda* crystallises in rhombs hence termed *cubic nitre* It is found in [illegible] and is imported into England from America It is used as a manure and as a source of nitric acid, but, being slightly deliquescent, it cannot be employed in the manufacture of gunpowder

Nitre has sometimes been mistaken for Glauber's salt, and, when taken in the quantity of half an ounce or an ounce it acts as a powerful poison In such cases the stomach should be evacuated as rapidly as possible, and the symptoms of spasm relieved by opiates In doses of 5 to 15 grains it is diuretic and diaphoretic

NITRIC ACID This acid is a compound of 1 atom or equivalent of nitrogen = 14 and 5 of oxygen (8 × 5) = 40, hence its equivalent in the dry or anhydrous state, as it exists for instance, in nitre is 14 + 40 = 54 As it usually occurs in the liquid state, it is a compound of 1 equivalent of dry acid, 54 and 2 of water (9 × 2), 18, hence the equivalent of the liquid acid is 72 It is commonly known in commerce under the name of *aqua fortis*, and is prepared by distilling a mixture of sulphuric acid and nitre It is commonly yellow or even [illegible] coloured, but it may be deprived of nitrous [illegible] occasions this colour by heat and is then colourless It is intensely corrosive and sour, fumes when exposed to air, and [illegible] of gravity of 1 when in its utmost state of concentration It boils at 248° and freezes at −50° It is a most powerfully oxidizing agent and is decomposed with more or less rapidity by almost all the metals

The salts which it forms are called *nitrates*, they are all soluble in water, they are decomposed by heat and, when mixed and gently heated with sulphuric acid, they evolve nitric or nitrous acid

NITRIC OXIDE or NITROUS GAS This gas was discovered by Hales and more accurately studied by Priestley It is obtained during the action of nitric acid diluted with about two parts of water upon metallic copper it is copiously evolved and may be collected over water 100 cubical inches of this gas weigh between 32 and 33 grains its density, therefore compared with air is 1037 It is at once easily recognized by forming orange-coloured fumes whenever it escapes into the air or comes into contact with oxygen so that this gas and oxygen are excellent tests of each other's presence It consists of equal volumes of nitrogen and oxygen or of 1 equivalent of nitrogen and 2 of oxygen hence it is termed a binoxide or deutoxide of nitrogen The respective weight of its components therefore, are 14 nitrogen + 16 oxygen = 30 and the equivalent of the gas is 30

NITRITES Salts of the nitrous acid, thus *nitrite* of potassa is a compound of 1 atom of nitrous acid and 1 atom of potassa &c

NITROGEN (Gr νιτρον and γεννᾶιν *to produce*) A simple gaseous body which forms a constituent part of nitric acid and which being unrespirable has also been termed *azote* from α privative and ζωη *life* It was identified as a peculiar gas by Dr Rutherford in 1774 and shown to be one of the components of atmospheric air by Lavoisier in 1774 It is generally obtained by burning a piece of phosphorus in a jar full of air inverted over water The phosphorus during its combustion combines with the oxygen of the air to form phosphoric acid which is dissolved by the water and the remaining element of the air namely the nitrogen remains Nitrogen is a colourless inodorous and tasteless gas not absorbed by water and having no action on vegetable colours It extinguishes all burning bodies, and is itself uninflammable It is a little lighter than atmospheric air 100 cubic inches weighing 30 16 grains Its equivalent is 14, and it combines with oxygen in 5 proportions, giving rise to the following compounds —

| | | By volume N | O | By weight N | O | Equiv | Symbols |
|---|---|---|---|---|---|---|---|
| 1 | Nitrous oxide | 100 + | 50 = | 14 + | 8 = | 22 = | *n* + *o* |
| 2 | Nitric oxide | 100 + | 100 = | 14 + | 16 = | 30 = | *n* + 2*o* |
| 3 | Hyponitrous acid | 100 + | 150 = | 14 + | 24 = | 38 = | *n* + 3*o* |
| 4 | Nitrous acid | 100 + | 200 = | 14 + | 32 = | 46 = | *n* + 4*o* |
| 5 | Nitric acid | 100 + | 250 = | 14 + | 40 = | 54 = | *n* + 5*o* |

NITROMURIATIC ACID Nitrohydrochloric acid of modern nomenclature The mixture of nitric and of muriatic (or hydrochloric) acid, formerly called *aqua regia* from its solvent power over gold, the *king* of the metals

NITRONAPHTHALASE A compound resulting from the action of nitric acid on napthalin a modification of it has been termed *nitronaphtalase*

NITROSACCHARIC ACID By the action of sulphuric acid on gelatine a peculiar saccharine matter is formed, which combines with nitric acid, and forms a crystallized acid designated as above.

**NITROSULPHU'RIC ACID** An acid resulting from the mixture of one part of nitre with eight or ten parts of sulphuric acid It was originally proposed by Mr Keir as a useful agent for separating the silver from the copper of old plated goods At the temperature of about 200° it dissolves silver, while it scarcely acts upon copper or lead, unless diluted, or at higher temperatures

**NI'TROUS ACID** When two volumes of nitric oxide and one of oxygen are mingled in an exhausted glass globe they form a dense orange-coloured vapour, which may be liquified by cold, and which is *nitrous acid* Its elements are so condensed that 1 volume of nitrogen and 2 of oxygen form 1 volume of nitrous acid vapour, the specific gravity of which is 3 17 The presence of this vapour renders nitric acid red and fuming, in which state it is commonly termed *nitrous* acid

**NI'TROUS OXIDE** Protoxide of nitrogen, a gas obtained by heating nitrate of ammonia, which salt is thus resolved into nitrous oxide gas and water When nitrous oxide is respired it produces effects somewhat similar to those of intoxication, hence it has been called *laughing gas*

**NIZAM** The title of one of the native sovereigns of India, between whom and the East India Company many subsidiary treaties exist This title is derived from Nizam-ul-Mulk, who in the beginning of last century obtained possession of the Mohammedan conquests in the Deccan, his successors in the sovereignty having assumed his name as their title of dignity, which they have retained to this day

**NOBILISSIMUS** was a title of dignity given to the princes of the imperial family of Rome It is said by Doucine to have originated with Justin, but others hold it to be of much more ancient date

**NOBI'LITY** The general appellation for a distinguished order of society which exists in every civilized country, with the exception of the United States and Norway (*See* PEERAGE) In Roman antiquity persons were not noble by birth but in consequence of the public offices held by their ancestors who had the sole right to bequeath their images to their descendants (*Jus imaginum*) (*See* HERALDRY) Originally the patricians were the only nobles, they alone being eligible to the magistracy, but when the *equites* and even the *plebs* were admissible the great body of the nobles began to be formed The first in any family who was raised to a curule office was styled *novus homo* See NOVI HOMINES

**NOBLE** an English coin of the middle ages value 6*s* 8*d* current in the reign of Edward III According to Knighton, the *rose noble* was a gold coin in use about the year 1344

**NOCTHORA** *See* SACOLIN

**NOCTILU'CA** A term applied by Boyle and some of the older chemical philosophers to phosphorus

**NOCTU'RN** (Lat *nox night*) An [illegible] of psalms and prayers celebrated in the [illegible] church at midnight after the example of David (Ps 118) It was said to have been introduced into the West by St Ambrose It now forms part of the service of matins

**NOCTU'RNAL** *Nocturna* (Lat *nox* night) A tribe of Raptorial birds including those which fly by night, and have the eyes directed forwards also a family of Lepidopterous insects which, in like manner, are active chiefly in the night season

**NODE**, in Surgery, is a hard tumour upon a bone which creates considerable pain and often is attended by caries or necrosis They are most common upon the tibia and bones of the head and fore-arm where they are thinly covered by flesh

**NODES**, in Astronomy are the two points in which the orbit of a planet intersects the plane of the ecliptic The point in which the centre of a planet passes from the south to the north side of the ecliptic is called the *ascending node*, and in astronomical computations is usually indicated by the symbol ☊, the opposite point or that in which the planet passes to the south side of the ecliptic, is called the *descending node* and is indicated by ☋ The straight line which joins these two points, formed by the intersection of the plane of the planet's orbit with the plane of the ecliptic is called the *line of the nodes* The nodes of the lunar orbit were anciently called the head and tail of the dragon

The position of the nodes on the ecliptic is one of the elements by which the situation of the plane of an orbit in space is defined In fact, it is easy to see that, if the position of the line of the nodes and also the inclination of the orbit to the ecliptic, be known the position of the plane of the orbit is entirely determined The two nodes being distant 180° it is only necessary to indicate the position of one of them the longitude of the ascending node, or its distance from the first point of Aries, is the element used by astronomers In all the planetary orbits the line of the nodes is variable, having a retrograde motion from east to west in respect of the fixed stars, but so slow that it amounts only to a few seconds in a year The regression of the moon's nodes is very considerable, as it completes a revolution in about 19 years (*See* MOON) This retrograde motion of the nodes of all the planets is a necessary consequence of their mutual attractions For the positions and variations of the nodes of the different planets, see PLANET

**NO'DULE** (Lat. nodus, *a knot*) Rounded irregular lumps or masses

**NO'DUS** In Botany a point situated upon the axis of a plant, whence a leaf or leaf-bud originates

**NOEL** The French name of Christmas Day, derived either from *dies natalis* (Lat *birthday*), or from an abbreviation [illegible]

**NOETIANS** Ecclesiastical History a sect so called from Noetus [illegible] They acknowledged only one person in the divinity, and, consequently, were accused of maintaining that God the Father had suffered on the cross *See* PATRIPASSIANS

**NOGGING** In Architecture, brickwork carried up between upright pieces or quarters

**NO'GGING PIECES** In Architecture, the horizontal pieces of timber fitting in between the quarters, to which they are nailed in a brick-nogged partition, which they serve to st[illegible]

**NO'LI ME [illegible] NOLI'** [illegible] Surgery, is a disease of the skin, commencing with small ulcerations which destroy the part They sometimes affect the cartilage of the nose which is destroyed by their progress, almost [illegible] more rapidly than they

**NOLLE PROSEQUI** In Law, an acknowledgment or agreement by the plaintiff in a suit that he will not further prosecute it, either as to the whole or a part of the cause of action (as, for instance, where, on the defendant's demurring to one count in a declaration, the plaintiff enters a nolle prosequi as to that count, and proceeds to trial on the other counts), or as to one or more out of several defendants

**NOMADES** (Gr [illegible], from νομος *pasture*) Tribes of [illegible] The nomades of classical times were generally tribes devoted to pastoral pursuits, for the ancients knew of no races of savages subsisting wholly by the chase The principal nomadic tribes of antiquity were those of southern Russia and the interior of Asia, from whom sprung, in the decline of the Roman empire, many of the tribes which overran western Europe, and at a later era, those which conquered empires in western and southern Asia

**NOME** (Gr νομος, from νεμω, *I divide*) The Greek name for the provinces into which Egypt was divided from the most remote antiquity According to Diodorus Siculus the division into nomes was performed by Sesostris whom some modern writers consider as identical with the Remeses II of the monuments, but it is supposed to have subsisted from the time of the earliest Pharaohs There were 36 nomes, which, in the time of Strabo, were thus divided —10 in the Thebaid, 10 in the Heptanomis, or intermediate district (which, according to its name, probably consisted in earlier times of 7 only), 10 in the Delta This division was not materially altered until the latest age of the Roman government (See D Anville *Memoires sur l'Egypt*, *Wilkinson's Manners and Customs of the Ancient Egyptians*, vol ii)

**NO'MENCIA'TOR** An officer employed by the candidates for the great state offices of Rome to accompany them through the streets and whisper them the names of such citizens as they might meet, in order that they might then address them by name, and canvass their votes It is derived from Lat nomen, and the old word calo, *I call*

**NO'MENCIA'TURE** was originally applied to a catalogue of the most ordinary words in any language, with their significations &c, drawn up for the purpose of facilitating their use and retention to those who are endeavouring to acquire a language But, in a more general sense, this term is employed to denote the language peculiar to any science or art thus we speak of the nomenclature of chemistry botany, &c

**NO'MINALISTS** A term originally applied to a scholastic sect which arose in the 11th century Its founder was John Roscelin, a churchman of Compiegne, who asserted that general terms have no corresponding reality either in or out of our minds, being in truth, words and nothing more (*flatus vocis*) This doctrine naturally excited great consternation among the schoolmen, with whom hitherto, all that was real in nature was conceived to depend on these general notions or *essences* Its promulgator underwent much persecution for his opinions, and was ultimately compelled to retract them, as inconsistent with the doctrine of the Trinity as it was then stated He found however, an able successor in the person of Peter Abelard, who attracted numerous disciples by his dialectical skill and eloquence, and with his followers, whom he led in a body to Paris, was the occasion of founding the celebrated university of that city After his death the ancient realism was restored to its supremacy, nor do we meet with a nominalist until the 13th century, when William of Occam revived his doctrines under some modifications The last mentioned philosopher may, in fact, with greater justice, be styled a conceptualist, as he distinctly stated

the formation of general terms to depend on the conditions of thought, and hence to possess a species of subjective reality, as the sign or indication of an actual process of thought, though not either distinct objects of consciousness or realities in nature Those who hold either of the latter theories are realists The controversy is one which has excited great attention among modern philosophers and Dr Thomas Brown style themselves conceptualists There are however, expressions in Locke's writings which would rather stamp him as a realist, under the former of the two modifications which we have given above (See articles SCHOLASTIC PHILOSOPHY, THOMISTS, SCOTISTS) There are very profound observations on the subject of this controversy in the first volume of *Hallam's Literature of the Middle Ages* See also *Brucker's Hist Crit Philosophiæ*

NOMINATIVE CASE In Grammar, that form of a noun which names or designates a substance *absolutely* or without regard to any other substance

NOMOCANON (Gr *νομος law*, *κανων*, *canon* or *rule*) In Ecclesiastical Law, a work in which canons of the church and imperial laws touching the same subjects, are collected and compared The first was made by Joannes Scholasticus (A D 551) The most celebrated was that of Photius, patriarch of Constantinople

NOMOPHYLACES (Gr *νομος the law* and *φυλακες, guardians*) Among the Athenians magistrates or legal officers, whose business it was to see that neither the privileged citizens nor the lower classes made any innovation upon the laws They held seats in all the public assemblies and during the public games and festivals had chairs erected for them equal to those of the archons Thus was also the splendour of those officers calculated to impress on the competitors the laws

NOMOTHETÆ (Gr *νομος law* and *τιθημι I lay down*) A body of citizens at Athens chosen by lot out of such as had been judges in the court Heliæa to the number of a thousand Their office seems to have been a sort of inspectorship of existing laws with the duty of proposing amendments

NONÆ ET DECIMÆ In Ecclesiastical Law the contributions of tenants of the church were anciently so called the nonæ or ninth part standing for a species of rent, the decimæ for the tithe due to the church

NONAGE In Law *See* INFANT MINORITY

NONAGE'SIMAL (Lat nonagesimus, *the ninetieth*) In Astronomy, is the *ninetieth* degree of the ecliptic reckoned from either of the points in which it is intersected by the horizon It is therefore the highest point of the ecliptic at any instant and its altitude is equal to the distance of the pole of the ecliptic from the zenith The nonagesimal is used in calculating the parallaxes of the moon

NO'NAGON (Lat novem, and *γωνια angle*) In Geometry, a plane figure having nine angles and consequently nine sides The area of a regular nonagon is $= \frac{9}{4} \tan 70^\circ = 6\ 1818242$, the side being 1

NON COMPOS MENTIS (Lat) In Law a general term for those afflicted with mental incapacity *See* LUNACY, IDIOT

NO'NCONDU'CTOR This term is applied to certain phenomena connected with the passage of heat and electricity through bodies, those substances which resist the direct passage of those influences (and occasionally allow it to pass) are called *nonconductors*

NONCONFORMISTS A general term under which all the religious communities which do not conform to the liturgy of the church established in England may be comprehended It belongs more properly to the large body of clergy who, at the Restoration refused to subscribe to the Act of Uniformity and were in consequence ejected from their benefices on St Bartholomew's day 1662 This act was first promulgated by Elizabeth, and required all persons to give their assent to the Book of Common Prayer and the Thirty-nine Articles, any one who should be convicted of speaking or preaching against it The act of Charles II contained still stricter provisions enjoining every beneficed person not only to use the book but to declare his assent and consent to every part of it, and enacting that unless this were done on a certain day he should be, *ipso facto*, ejected Other declarations were also to be subscribed, as, "That it is unlawful to take arms against the king on any pretence whatsoever," That no obligation from the covenant lies upon himself or any other person It is said that two thousand persons resigned their preferments in consequence, and even after this their party was subjected to the further infliction of the conventicle acts, which forbade more than five persons besides the family to assemble together for religious worship and the fifth time with intent to print address and preach any conformist clergyman who should take up his residence within five miles of any corporate town, or other place where he had been minister *See* DISSENTERS.

NONES (Lat *nonæ*, In the Calendar, one of the three days in the month called because they fell on the *ninth* day reckoned inclusively before the Ides March May July October, that is the seventh day of the month, and the nones, consequently, on the 7th In the other months, the ides were on the 13th day, and the nones on the 5th *See* CALENDAR, CALENDS IDES

NON EST INVENTUS (*He is not found*) In Law, the formal Latin words anciently used in the sheriff's return to a writ of capias that the defendant was not to be found within his bailiwick

NO'NIUS A name frequently given to that useful contrivance the vernier, for subdividing the divisions of graduated arcs or scales into minute parts, from its invention having been erroneously ascribed to Pedro Nunez or Nonius, a Portuguese, who lived in the early part of the 16th century The contrivance employed by Nonius was widely different from the vernier now universally used It consisted in describing within the same quadrant 45 concentric arcs, the innermost and the outermost into 90 equal parts the next within it into 89 and so on, the innermost being consequently divided into 46 only With this instrument the observed altitude of an object could be read off on the outermost arc only to degrees, but the fractions were obtained in the following manner — The plumb line or moveable index, must intersect one of the concentric arcs at, or very near a point of division Now it is evident that the number of parts read off at this point must be in the same proportion to the degrees and fractions of a degree intercepted on the outermost arc as the number of parts into which the point is divided, is to 90° The index being therefore multiplied by 90 and divided by the number of parts in the arc gives the observed altitude to fractions of a degree Thus if the plumb-line intercept 25 parts exactly on the arc in which the number of parts is 78 the angle measured will be 28 846° the fraction is easily converted into minutes and seconds Nonius supposed that this artifice was known to Ptolemy It was adopted by Tycho Brahe, but soon abandoned by him for the method of diagonal divisions in consequence of the difficulty of dividing accurately the different arcs (*Robins's Mathematical Tracts*, vol ii) *See* VERNIER

NON-JURORS In English History, that party among the clergy of the national church who refused to take the oath of allegiance to the new government after the Revolution As many of these clergy at the same time that they opposed a conscientious resistance to the usurpations of James II had nevertheless continued to preach submission to the sovereign on the principle of his divine right by hereditary succession to the obedience of his subjects it became impossible for them with consistency to submit to a monarch crowned only by authority of parliament It was therefore much desired by many friends of the new government to make some exception in their favour from the necessity of taking the oaths, not an amendment made by the House of Lords in the act requiring this oath which purposed to excuse the clergy from taking it unless called on by the privy council was rejected by the Commons Eight bishops including the primate Sancroft with about four hundred clergy, were in consequence excluded from their sees and benefices The original non-jurors were peaceable and honest men for the most part but many of them soon became implicated in all the violence of the Jacobite faction *See* JACOBITES PRETENDER

NON-NATURALS A term applied by the old physicians to certain matters which are necessary to life, but do not form a part of the living body, such as air, food, excretions, sleep &c

NONPAREIL *See* PRINTING

NON-RESISTANCE, THE DOCTRINE OF, in Politics, is that which inculcates the unlawfulness, on religious grounds of resistance by force to the commands of a prince or magistrate This is strongly laid down by the inspired writers and especially by St Paul, in the 13th chapter of his Epistle to the Romans In the ordinary acceptation of the doctrine it is taken to enforce the duty of obedience to the lawful commands of magistrates But in that peculiar sense which is attached to it in English constitutional history it means unqualified obedience to every command especially of the prince or supreme magistrate, whether lawful or not, and consequently condemns all forcible opposition even to tyranny or usurpation But the advocates of non-resistance, in this extended sense, do not appear to have ever contended that it applied to commands of inferior magistrates in the same sense and degree as to those of the highest they therefore supposed a peculiar sanctity in the person and office of the ruler which no other officer possessed, and thus combined the doctrine of divine right with that of passive obedience or non-resistance These doctrines are plainly laid down in the formularies of the church of England, in which, in the phrase of Bolingbroke (*State of Parties*), they *skulked* until the reign of James I (See especially that *On Wilful Disobedience and Rebellion*)

But in that reign they were more generally avowed by the learned and loyal; and in 1622 the University of Oxford sanctioned them by a solemn decree. The events which led to and followed the great rebellion naturally led men's minds to pay greater attention to the speculative part of politics, and, while Hobbes was framing a theory of absolute monarchy on the principle of the social contract, a different class of reasoners arrived at the same result through a peculiar interpretation of scripture. Sir Robert Filmer (especially in his *Patriarcha*), Bishop Sanderson, and others, made the regal power originate in the patriarchal, and endeavoured to prove that all other forms of government being unrecognized by scripture, were usurpations. Dean Sherlock, the ablest writer of the school of divine right (see his *Case of Resistance to Supreme Powers*, 1684), endeavoured to prove the absurdity of the theory of the social contract, and to show from scripture the unlawfulness of resisting any command, even of an usurping power. It is in answer to these reasoners that *Locke's Essay on Government* was written. In it he confutes the arguments for unqualified non-resistance, by showing that scripture and reason make no distinction between [illegible] opponents [illegible] and however [illegible] lowest magistrate, must be obeyed [illegible] of Oxford pronounced its second decree in favour of the tenets of divine right and non-resistance. But the current of court opinion changed at the Revolution. The doctrine of non resistance was almost proscribed, but maintained by the non jurors, who professed to *obey* the usurping government while they refused to *recognize* it. In 1709 it was preached by Sacheverell, with the apparently inconsistent result of a riot. His sermon, together with the Oxford decree were burnt by order of the House of Lords. But the doctrine is at this day frequently asserted by the high church party. (See *Dr Pusey's Sermon on the 5th of November*, 1838.)

NO'NSUIT, in Law, is the renunciation of a suit by the plaintiff. It is either adjudged, in consequence of certain neglects or delays in the prosecution of the suit, or it is voluntarily elected by the plaintiff. It is usual to call on the plaintiff, when he is unable to make out a case to support his pleadings for default of the necessary evidence, and the jury are about to give their verdict, to elect, if he pleases, to abandon his prosecution and submit to a nonsuit, upon payment of costs. The effect of which is, that as a nonsuit is not except in certain cases, a peremptory bar, he is able to bring another action afterwards for the same cause.

*Judgment as in case of a nonsuit* arises from the statute 14 G. 2. c. 17, which enacts that where any issue is joined in an action in the courts of record at Westminster, and the plaintiff has neglected to bring the issue to be tried, the court may, unless it sees reason for allowing the plaintiff farther time, give judgment for the defendant as in case of a nonsuit, which has the same force as a nonsuit both as to costs and as to its effects on the action.

NOOTH'S APPARATUS. A series of three glass vessels placed vertically for the purpose of impregnating water with carbonic acid gas. The lower vessel contains the marble and muriatic acid for the evolution of the gas, the central vessel holds the water through which it is made to pass, under the pressure of the column of water in the third or upper vessel which is closed by a conical stopper which serves as a safety valve.

NO'PAL. The *Cactus opuntia*. The plant upon which the cochineal insect chiefly breeds.

NORFOLK CRAG. A tertiary formation which rests on London clay or chalk, and includes marine shells. A line drawn from Cromer on the northern coast of Norfolk to Wayburn, about six miles west, and thence extending southerly about eighteen miles towards Norwich, includes all the regular beds of this rock. See GEOLOGY.

NO'RMAL (Lat. norma *a rule*.) An adjective signifying that the ordinary structure peculiar to a family, a genus, or a species is in no wise departed from.

NO'RMAL. A term sometimes used for perpendicular. In the geometry of curve lines, the normal to a curve at any point is a straight line perpendicular to the tangent at that point, and included between the curve and the axis of the abscissa.

NORMAN ARCHITECTURE. *See* ARCHITECTURE, and ENGLISH ARCHITECTURE.

NORNS. [illegible] three Fates, equivalent to [illegible]. Their names were Urd, Worand, and Skuld, or *Past*, *Present*, and *Future*. They were represented as endowed with great beauty, but of a melancholy and sombre disposition, they were consulted even by the gods, and their decrees [illegible].

NORROY. See KING AT ARMS, HERALD.

NORTH (Geog.) In Geography, one of the [illegible] horizon, that which to European latitudes is opposite the sun at mid day.

NORTHERN LIGHTS. The name popularly given to the *aurora borealis*.

NORTHING, in Navigation, is the difference of latitude made by a ship in sailing northwards.

NOSING OF A STEP. In Architecture, the projecting rounded edge of the tread of a step.

NOSOLOGY. (Gr. *νοσος a disease* and *λογος a discourse*.) In Medicine, the terms specially applied to the classification and nomenclature of diseases, and to their general methodical arrangement. See DISEASE.

NOSTA'LGIA. (Gr. *νοστος, I return*, and *αλγος, grief*.) A species of melancholy, resulting from absence [illegible].

NOSTRUM. (Lat.) Literally, *our own*, applied to quack medicines retained for profit in the hands of the inventor or discoverer, or of his assignee.

NO'TABLES. In French history, the deputies of the states under the old régime, appointed and convoked on certain occasions by the king. In 1786 this assembly was summoned, 160 years after its last meeting, and proposed various reforms in different branches of the government. It again met for the last time, in 1788.

NO'TACANTHA. (Gr. *νωτος, the back* and *ακανθα, a spine*.) The name of a family of Dipterous insects, comprehending those in which the upper part of the thorax or epistenum is armed with teeth [illegible].

NO'TARIES APOSTOLICAL AND IMPERIAL. Public notaries appointed by the popes and emperors, in [illegible] jurisdiction over other powers, [illegible] in foreign states. Edward II. forbade the imperial notaries to practise in England. Charles VIII. of France, in 1490, abolished both these classes of notaries, and forbade his lay subjects to employ them.

NO'TARY, or NOTARY PUBLIC. In English Law, one who publicly attests documents or writings, chiefly in mercantile [illegible] in a foreign country, [illegible] and the like. The statutes 41 G. 3. c. 79. and 3 & 4 W. 4. c. 70. regulate the admission of notaries in England. In London, they must have been apprenticed seven years to a notary before such admission.

The name notary, among the Romans, appears to have signified a short-hand writer, and to have denoted originally the persons who acted in that capacity, especially at meetings of the senate. Afterwards, the notarii were secretaries to courts, officers &c. In modern Europe, the notary is an officer whose attestation is necessary to the validity of certain instruments, and his duties are more or less important in different countries. In France, the notary is the necessary maker of all contracts &c. where the subject matter exceeds 150 francs, and his instruments which are preserved and registered by himself are the originals, the parties retaining only copies. The presence and administration of a notary is also essential to the division of lands or goods of inheritance.

NOTATION (Lat. notatio), is defined by Dr Johnson to be "the act or practice of recording any thing by marks as by figures or letters."

Mathematical notation embraces two distinct subjects, namely symbols of number and quantity and symbols of operation. The system of numerical notation adopted in all European countries depends on the very refined idea of giving to each symbol a *local* as well as an absolute value. A refinement of this sort could only have been adopted by a people considerably advanced in the arts of civilization, but though the present system has been traced to the Hindus among whom it appears to have been in use two thousand years ago, the epoch and country of its origin are entirely unknown. It is probable that the first numeral characters consisted simply of strokes or straight lines which could be easily cut in wood or stone, and would be alike intelligible to all nations. Such characters are in fact, preserved in the Roman notation with very little change. Thus, assuming a perpendicular line | to signify *one*, two lines | | would express *two*, the addition of a third | | | *three*, and so on till the reckoner had reached *ten*, which completed the first series of the numerical scale. He might then be supposed to throw a dash across the last stroke or unit to mark the completion of the series and thus X would come to signify *ten*. The [illegible] repetition of this mark would denote *twenty*, *thirty* and so forth, till he arrived at a hundred, or *ten* tens which completes the second series and might be denoted by adding another dash to the mark for ten, or by merely connecting three strokes, thus [illegible]. The repetition of this symbol would in like manner indicate the successive [illegible] *tenth* of which would be marked by the [illegible] another stroke so that four combined strokes ⋀⋀ would express a thousand. Such were the symbols originally employed in the Roman notation, in process of time it would be perceived that the inconvenience in writing, arising from so many repetitions of the same character, might be avoided, by [illegible] for the intermediate numbers, and [illegible] by the division of the

symbols already in use Thus, having parted in the middle the two strokes X, either the under half Λ, or the upper half V, was employed to signify *five* Next, the mark ⊏ for a hundred was divided into ⌜ or ⌞, either of which represented *fifty* Again the four combined [illegible] in the progress of the arts to assume [illegible], was frequently expressed thus ⌜|, and this last form by partition gave the two portions ⌜ or ⌞ to represent *five hundred* (*Leslie's Philosophy of Arithmetic*, Introd )

The numeral notation of the Greeks, though far less convenient than that now in use, was formed on a perfectly regular and scientific principle, and might be used with [illegible] calculation, to which the Roman system was totally inapplicable They divided the twenty four letters of the alphabet into three classes, and, by adding another symbol to each class, they had characters to represent the units, tens, and hundreds

Thus, instead of the digits 1, 2, 3, 4, 5, 6, 7, 8, 9 they represented the units by the letters α, β, γ, δ, ε, ϛ, ζ, η, θ the tens were denoted by ι, κ, λ, μ, ν, ξ, ο, π, ϟ, and the hundreds by ϱ, σ, τ, υ, φ, χ, ψ, ω, ϡ

To represent the thousands they employed the first series with the iota subscribed, ͵α, ͵β, ͵γ, ͵δ, ͵ε, ͵ϛ, ͵ζ ͵η, ͵θ With these symbols they could express any number under 10,000, thus ͵θ ϡ ϟ θ, denoted 9999, ͵ηλγ, denoted 8033, ͵δα, 4001, and so with the others To denote the myriads they made use of the initial letter M, writing the number over it Thus, $\overset{\alpha}{M}$, $\overset{\beta}{M}$, $\overset{\gamma}{M}$, &c, corresponded respectively to 10,000, 20,000, 30,000, &c $\overset{\lambda\eta}{M}$ expressed thirty eight myriads, or 380,000, $\overset{\delta\tau\circ\beta}{M}$ was equal to 43,720,000, so that the letter M placed under any number produced the same effect as is produced in our system by writing four ciphers to the right of the number Diophantus and Pappus expressed the myriads more simply by a point after the number thus, δ,τοβ ηκε denoted 43,728,025, and in this manner they proceeded to 9999 9999, or to any number under 100 000,000, which was the extent of their notation before the time of Archimedes who showed how it might be extended indefinitely By assuming 100 000 000 or the square of the myriad, as a new unit and taking this any number of times capable of being expressed by the previous notation he could represent any number which is expressed in the modern notation by sixteen digits Assuming again, the number which in our system is denoted by 1 with sixteen zeros as a second new unit he was enabled to express any number consisting of twenty four digits This method can obviously be continued to any length A great improvement was afterwards introduced by Apollonius, who proposed the simple myriad instead of its square, for the root of the system, and thus any large number was constituted of periods of four characters, the first of which, on the right hand represented units, the next, towards the left the number of myriads the third the square of the myriads and so on to infinity The different periods were distinguished by breaks or blanks In this manner a *local* value was given to the symbols, and a single step only was wanting to assimilate this notation entirely to our own It only required that to be done for the simple tens which had been done for the myriads or tens of thousands (For an account of the Greek notation and arithmetic, see Delambre, *Astronomie Ancienne*, tome ii )

From an inspection of the manuscripts preserved in public libraries, it appears that the Arabians had not generally adopted the denary numerals before the beginning of the 13th century of our era For several ages after the formation of their empire they used Greek [illegible] to keep their accounts, and although [illegible] oriental nations, they wrote from right to left yet they implicitly followed the Greek mode of ranging the numerals and performing the calculations It is probable that they derived their knowledge of the Indian digits through the medium of the Persians, but the subject is involved in much obscurity The epoch at which the denary numerals were introduced into Europe is also uncertain, but it appears to have followed, at no great interval, the Saracen conquests in Spain Vossius places this epoch about the year 1250, Du Cange thinks they were unknown before the 14th century, and they are very rarely to be found in the dates of any writings before the year 1400 They appear to have been first used by astronomers, and afterwards circulated over Europe in the almanacs

*Symbols of quantity* are entirely arbitrary, but the letters of the alphabet may be said to be exclusively adopted by mathematicians When the quantities belonging to any investigation are numerous, it may be necessary to have recourse to different alphabets, and it is always of very great importance to select such symbols as will most readily suggest the thing signified, as the initial letter of a word or letters which have acquired a sort of conventional right to be applied to particular purposes It is unfortunate that so little attention has been paid to this subject, and that some general principles [illegible] renders it often a troublesome task to compare with one another different investigations of the same problem, or the results of different methods of analysis There are, however, a few rules, which, though altogether arbitrary, seem to be recognized by all modern writers of any authority Thus, in algebra, the letters at the beginning of the alphabet are the symbols of quantities supposed to be known and those at the end of the quantities sought In analytical geometry and mechanics, *x*, *y*, and *z* are always used to denote the rectangular co-ordinates of a point in space In trigonometry, the sides of a triangle are usually denoted by *a*, *b*, and *c* and the angles opposite by A, B, and C respectively In astronomy, the Greek letters are most frequently used to represent angles Indices are usually employed when it is desirable to retain the same letters for the same class of quantities

*Symbols of operation* are equally arbitrary with those of quantity but there is much less diversity in the manner of employing them The signs + and −, universally used to signify addition and subtraction, seem to have been introduced by Stifelius a German, as the oldest work in which they are found is [illegible] published at Nuremberg in 15[illegible] duced the character √ originally *r*, the initial letter of *radix* (root) to denote the root of a quantity The sign of equality = was introduced by Robert Recorde, and he gives as a reason that no 2 things can be more equalle [illegible] namely than the two parallel lines In the modern calculus the letters of the alphabet are used as symbols of operation thus *d* for the differential and *f* for the integral of a quantity Finite differences and sums are denoted by the corresponding Greek letters Δ and Σ The fluxional notation introduced by Newton, and which continued to be used in this country till foreign books began to be more freely imported after the last war, has at length been entirely abandoned for the differential notation of Leibnitz and the Bernoullis The former is in fact utterly incapable of representing the extremely general processes of modern analysis (See Notes to the English translation of *Lacroix's Elementary Treatise on the Differential and Integral Calculus*, *Lubbock on Notation* in the *Memoirs Roy Astr Soc* vol iv , art "Notation," *Encyclopædia* )

NOTCHBOARD (It nocchia) In Architecture, the board which receives the ends of the steps in a staircase so called, because it is notched out to receive the ends of the steps

NOTE (Lat nota) In Music a character by which the elevations and depressions of sounds are marked, as well as the swiftness or slowness of their motions

NOTES (Lat nota) in Literature were originally marks affixed by the critics who reviewed the works of an author to those places which they considered to be spurious or faulty or which on any other account were worthy of remark In modern times the meaning of the term has been enlarged being now used as synonymous with *annotation* or *commentary* Among the Romans praiseworthy passages were usually marked with LL (*laudabiles loci*), and faulty passages indicated by θ, a contraction or more properly, a symbol for αθετησον (*Pers Sat* iv 12 ) Among the Greeks good passages with the letter Χ signifying χρηστον excellent, and against those which were condemned the word αχρηστον was written which Gellius calls *ad notamentum culpæ*

Notes in Printing, are — shoulder notes these are at the top of the page in the outer margin, and contain the book chapter, or date or both of them, side notes or marginal notes which give an abstract of the text, as in acts of parliament, or parallel passages, and different readings as in the Bible and bottom notes or foot notes, which are placed at the bottom of the page, and generally contain commentaries and explanatory annotations

NOTHING (*No thing* the negation of being ) In Mathematical language, the term *nothing* is of frequent occurrence, and denotes either the absence of magnitude in circumstances in which magnitude might have existed, as when equals are taken from equals, or it denotes the limit to which a variable magnitude approaches by continual diminution, as when it is said that a magnitude is susceptible of all values between nothing and infinity

NOTICE in Law, is that by which a party is supposed to communicate, or to receive, that presumed or real knowledge which is necessary to affect the receiver with legal liabilities For instance, when a party proceeds to recover premises by ejectment, notice must be served by him, according to certain prescribed formalities, on the tenant in possession, in order to compel him to come in and defend the action This is an instance of actual notice Constructive notice is that which is presumed to arise from certain facts as, for instance, in equity, a purchaser is presumed to have notice of a suit

pending which may affect the subject matter of the sale, except where, by a late enactment (2 Vict c 11 ), express notice was rendered necessary

NO'TODO'NTA (Gr *νωτος, back; ὀδους, tooth* ) The name of a genus of Lepidopterous insects

NO'TONECTIDÆ (Gr *νωτος, νηκτω, I swim* ) The family of Hemipterous insects of which the water-boatman (*Notonecta*) is the type

NOTTURNO In Music, originally synonymous with serenade (which see), but applied at present to a piece of music in which the emotions chiefly of love and [illegible] modern composers Chopin, [illegible] distinguished in this department

NOUN (Lat nomen, *a name* ) In Grammar, that part of speech which denotes a *conception*, in contradistinction [illegible] which is expressed by a *verb* [illegible] bstantives and adjectives, the first denoting real or supposed *substances*, the second qualities or properties conceived as belonging to substances *See* GRAMMAR

NOVA'CULITE (Lat novacula, *a razor* ) The stone of which [illegible] It is of a slaty str[illegible] gan edge to the metal to the fine silicious particles which it contains

NOVA'TIANS The followers of Novatian, a presbyter of Rome who was stigmatized as a schismatic and heretic and founded a sect of this name in the 3d century, which continued to flourish to the end of the 5th The aim of Novatian was to deny readmission into the church to all persons who, in time of persecution or on other accounts, had once lapsed from the faith In this extreme severity of sentiment he was opposed by the [illegible] number of the clergy of Rome and especially by [illegible] Cornelius upon whose election to the see Novatian, who was a [illegible] withdrew from the communion [illegible] established a society of which he became himself the first bishop This sect was also known by the title of Cathari or Puritans which they assumed to express the high sense they entertained of the excellence attainable by, and necessary to, all professors of Christianity

NO'VEL (From the Italian novella derived from the Latin novus, *new* ) A species of prose fictitious composition

The Italian novella, of which the best and earliest specimens are those contained in the *Decameron* of Boccaccio was rather a short tale turning on an event or on a series of adventures of humour pathos or intrigue than a novel in the modern acceptation of the term In its present signification in the English language it seems to express a species of fictitious narrative somewhat different from a romance, yet it would be difficult to assign the exact distinction, and in the French language the same name (roman) is used for both, while it differs from a tale merely in the circumstance that a certain degree of length is necessary to constitute a novel

Although, in fact the terms novel and romance are often used indifferently, yet they have also often been treated as distinct classes of composition in English literature Perhaps if we seek to draw the distinction with as much of accuracy as the subject will admit we may say that the proper object of a novel is the delineation of social manners, or the development of a story founded on the incidents of ordinary life or both together Thus will be excluded from the class of novels on the one hand tales of which the incidents are not merely improbable (for this may be the case in a novel) but occurring out of the common course of life and such as are founded on imaginary times and imaginary manners tales of supernatural incidents, chivalrous romances pastoral romances, &c , and on the other hand we must exclude from the same class fictitious narratives, in which the author's principal object is neither the story nor the costume, but which are obviously written with an ulterior view, although their incidents and character may perhaps, in other respects, fall under the definition suggested above Thus political philosophical, and satirical fictions are clearly not to be ranked as novels But it obvious that no definition can be drawn which shall on this subject, entirely satisfy the caprices of popular language

Of the novel, in this confined sense the works of Richardson, and those of Fielding and Smollet, afforded, perhaps the first examples in English literature The first of these authors gave birth to the sentimental novel, the latter two to the comic or humorous Marivaux, Prévost, &c spread the former style of composition in France, where, as well as on the Continent generally, it attained a high degree of vogue The novel of manners, whether comic or serious, has, perhaps, been always a more popular species of fiction in England It may be doubted whether the historical fiction, to which Sir Walter Scott has given such universal popularity belongs strictly to the class of novel or romance By aiming at the delineation of real, although past manners, and by the general turn of the story it seems to resemble the former, while the romantic character of many of its incidents seems to assimilate it to the latter

For the general history of prose fictitious composition, see ROMANCE

NO'VELS (Lat novellæ constitutiones, *new constitutions* In the Roman Law supplementary constitutions or decisions of emperors so called because they appeared after the [illegible] publications of law made by them Those of Justinian are the best known, and are commonly understood when the general term is used The *Novels* together with the *Code* and *Digest*, form the whole body of law which passes under the name of that emperor

NOVE'MBER (Lat novem, *nine* ) The eleventh month of the Julian year, but the ninth month in the old Roman year, which began with March *See* CALENDAR, YEAR

NOVI MSILES The name given by Romulus to the gods of the Sabines, whom he adopted after the conquest of that people The term was afterwards applied to those heroes or demigods who, in consequence of their power or virtues were deified after death

NOVENNALIA (Lat novem, *nine*, and annus, *a year*), among the Romans, signified, as the derivation of the term implies, festivals held in honour of the dead every *nine years*

NO'VICE (Lat novitius ) A person admitted into a religious community as an inmate, for the purpose of preparation for becoming a member The state of preparation is termed *novitiate* The custom of giving novices the religious dress did not begin until the 12th century The age of profession is fixed by the Council of Trent at sixteen years D[illegible] the novitiate the novice is still [illegible] his intention The term *novice* was applied to recruits in the ancient Roman soldiery, from which circumstance it appears to have been borrowed in ecclesiastical usage

NOVI HOMINIS, among the Romans, were such persons as by their own personal merit, had raised themselves to curule dignities without the aid of family connections This reproach, as is well known, was addressed by Catiline to Cicero.

NOX (Lat ) In Mythology, the goddess of night In the Grecian mythology she was the daughter of Chaos, the sister of Erebus and Tartarus and the mother of Æther, Hemera Manatas Momus the Fates &c &c , which were all personifications of the natural phenomena life, sleep death &c

NOYADES (Fr noyer ) The name given to a peculiar punishment resorted to in the first French revolution The *noyades* were effected by drawing out a plug inserted in the bottom of a boat in which the wretched victims were launched The genius of iniquity [illegible] ays a writer in the *Edin Review* often displays itself in the same invention It will be remembered that when Nero was desirous of despatching his mother, and found himself at a loss for an expedient, Anicatus proposed to him the model of a ship upon a new construction framed in such a manner that a part might be withdrawn and the [illegible] passenger committed to the waves ' (*Tac Ann* [illegible] *ar* 3 )

NOYAU (Fr ) A delightful liqueur, it is flavoured with bitter almonds or the kernels of peach stones, and contains prussic acid

NU'CLEUS (Lat ) Literally any thing round which matter has accumulated or to which it is affixed. In Botany it has several significations - 1 The central [illegible] [illegible] ovule 2 That part of a seed con[illegible] [illegible] testa and consisting of either the embryo and albumen or of the embryo only 3 In lichens, the disk of the shield, which contains the sporules and their cases 4 In the language of the older botanists what is now termed by gardeners a *clove*, that is, the secondary bulb of a bulbous plant

NUCLEUS In Astronomy the solid part or body of a [illegible] distinguished from its nebulosity *See* COMET

NUCULA (Lat nux *a nut* ) Either the fruit, called otherwise a gland or acorn, or any small, hard, one seeded pericarp, or the female organ of the plant Chara

NU'DIBRA'NCHIANS *Nudibranchiata* (Lat nudus, *naked*, branchiæ *gills* ) The name of an order of hermaphrodite Gastropodous Molluscs which have the branchiæ exposed on some part of the back

NU'DIPEDA'LIA (Lat nudus, *naked*, and pes, *a foot* ) A religious ceremony among the Greeks, Romans, and other nations, observed on account of some public calamity [illegible] which [illegible] [illegible] the votaries appeared with the feet uncovered In various other religious observances this practice was adopted, thus, the Roman matrons, when they offered up supplications to the goddess Vesta, always walked to her temple barefooted ; —

Huc pede matronam nudo descendere vidi — OVID.

A similar ceremony existed among the Jews

NU'DITIES (Lat nuditas, *nakedness*) In the Fine Arts figures entirely divested of drapery

NUISANCES, in Law, are of two kinds public or common, which annoy the king's subjects in general, and private, which are defined "any thing done to the hurt or annoyance of the lands, tenements, or hereditaments of another" The general remedy for public nuisances is by indictment or presentment, for private nuisances by action on the case for damages

NULLIPORES *Nulliporæ* (Lat nullus, no, and porus *a pore*) The name of a family of Lithophytous Polypes the axis of which presents no visible pores on its surface

NUMBER (Lat numerus), is defined by Euclid to be an assemblage or collection of units or [illegible] species This definition excludes the [illegible] Newton defines number as the abstract ratio of one quantity to another quantity of the same species, and hence there are three kinds of numbers namely integers fractions, and surds Number abstractedly considered, conveys merely the notion of *times* or *repetitions*

Mathematicians consider numbers under different points of view, or with relation to different properties, and hence arise the various distinctions which have been introduced, as even or odd, whole or fractional, rational or irrational, perfect or imperfect prime or composite, abundant or defective, &c Numbers also acquire various denominations from the manner in which they are composed, as triangular numbers pyramidal numbers, polygonal numbers, &c (See the respective adjectives

The theory of numbers forms one of the most subtle parts of the algebraic analysis Judging from the fragments which have been preserved, the ancient mathematicians had pushed their researches into the properties of numbers to a considerable extent, but until the invention of algebra, and the introduction of a more convenient notation, the difficulties of the subject could only be partially overcome The most ancient existing work on algebra is that of Diophantus, and it is devoted entirely to numbers From the time of Diophantus, who lived in the 3d century, to that of Vieta, Bachet and Fermat who flourished in the 16th, no advancement was made in the theory, but the discoveries of these illustrious mathematicians carried it far beyond its ancient limits Euler was the next from whom it received any considerable extension, he was followed by Lagrange, who added many important theories, and it has received its latest perfection from the hands of Gauss and Legendre The theory of numbers may be studied in the following works —the *Arithmetic* of Diophantus, with a Commentary by Bachet, and notes by Fermat, Toulouse 1670, *Waring's Meditationes Algeb*, Euler *Introd in Anal Infinitorum Opuscula Analytica* and various papers in the *Petersburg Memoirs*, Lagrange in the *Berlin Memoirs*, Gauss, *Disquisitiones Arithmeticæ* or the French translation, Legendre *Essai sur la Théorie des Nombres* 2d edit 1808 For the mystical properties of numbers the curious reader may consult *D S Boetii Arithmetica* Parisiis, 1521, *P Bungi Numerorum Mysteria*, 1591, *Taylor's Theoretic Arithmetic*, 1816

NUMBERS, BOOK OF *See* PENTATEUCH

NUMEʹNIA (Gr νέος, *new*, and μὴν *a month*) Grecian festivals celebrated at the commencement of every lunar month, in honour of all the gods, demigods, and heroes of antiquity They were observed with games and public entertainments the expense of which was defrayed by the wealthy citizens *See* NEOMENIA

NUMENIUS The name under which Cuvier separated the curlews, as a distinct genus, from the other *Scolopaces* of Linnæus They have a beak arcuated like that of the ibis, but it is more slender and is cylindrical throughout, the tip of the upper mandible extends beyond the end of the lower one, and projects a little downwards in front of it The toes are palmated at the base

NUMERALS The symbols or characters by which numbers are expressed *See* NOTATION

NUMERATION is the art of classing and expressing numbers Though the mode of reckoning numbers by *tens* or *decads* has prevailed among all civilized nations and has become incorporated with the very structure of language, there is nothing in the nature of the subject which rendered its adoption a matter of necessity Any other number might have been chosen for the root of the numerical scale, and, in fact, if a scale were now to be selected by mathematicians familiar with the properties of numbers, there are several considerations which would lead them to adopt *twelve*, in preference to ten The selection [illegible] universal, [illegible] principle, and it is easy to see that it arose from the practice so familiar in the early stages of society of [illegible] by the fingers of both hands In various languages however traces are found of an earlier and simpler mode of reckoning We may suppose the earliest of all to be that of counting objects in *pairs* It is still familiar among sportsmen, who reckon by *braces* or *couples* To count by *threes* was another step, and has been preserved by the same class of men under the term *leash* [illegible] which *three* dogs and no more [illegible] hand The numbering by *fours* has had a more extensive application it was evidently suggested by the custom of taking in the rapid tale of objects a pair in each hand Our fishermen, who generally count in this way call every *double pair* (of herrings, for instance) a *three* or *cast* and the term *warp*, which has exactly the same import, [illegible] It [illegible] races of savages inhabiting the forests of South America count only by fours, at least they express the number *five* by four and one, *six* by four and two, and so forth The [illegible] has its [illegible] the [illegible] of one hand [illegible] appears [illegible] to have been adopted by various savage nations of America, and we learn from Mungo Park that it is practised by the Yolofs and Foulahs of Africa, who designate 10 by two hands 15 by three hands, and so progressively It is even partially used in this country among wholesale traders In reckoning articles delivered at the warehouse the person [illegible] of the *tale*, having traced a long horizontal [illegible] to draw, alternately above and below it, a *warp*, or four vertical strokes each set of which he crosses by an oblique score and calls out *tally* as often as the number *five* is completed (*Leslie Philosophy of Arithmetic*)

The mode of reckoning by *twelves* or *dozens* may be supposed to have had its origin in the observation of the celestial phenomena, there being twelve months or lunations commonly reckoned in a solar year It appears in the subdivision of weights and measures as twelve ounces to a pound twelve inches to a foot and is still very generally employed in wholesale business extending to the second and even the third term of the progression Thus *twelve* dozen or 144 make the long hundred of the northern nations, or the *gross* of traders, and twelve times this again or 1728 make the *double gross* Traces of reckoning by *tuentus* or *scores* remain in our own and other European idioms The expression *three score and ten* is familiar The French language has no term for the numbers in the second series of the denary scale above *soixante* or sixty *Eighty* is expressed by *quatre vingts* and *ninety* by *quatre-vingts et dix*, *four twenties and ten* The inhabitants of Biscay are said still to reckon by the powers of twenty or the terms of progressive scores, and [illegible] mode of numeration w[illegible] M[illegible] Se

ARITHMETIC BINARY DUODECIMALS SEXAGESIMALS

The primary object of numeration is to find names for the different numbers and, as there are an infinity of numbers while the number of words is limited it became necessary to devise some systematic method of combining a few words so as to express by means of them any number whatever It is obvious that when large numbers are to be expressed, the lower scales, as the binary ternary &c, would be exceedingly inconvenient, on account of the multitude of words that would be required On the other hand, as a name is required for at least every unit in the scale every high scale would be no less inconvenient In the denary scale, the nomenclature is sufficiently convenient and in our language almost perfectly regular A name is given to the 9 units of the first order, the unit of the second order is *ten*, and, by the different combinations of this word, all numbers are named to 99 eleven and twelve are only *apparent* exceptions A new appellation is wanted for the unit of the third order, or *hundred* This suffices till we reach the fourth order, or *thousands*, and might even have sufficed to a hundred *hundreds* or ten thousand A thousand thousands is called a million, and a million millions a billion, further continuation is useless

The second object of numeration is to express the nomenclature thus formed by the combinations of a small number of written symbols This is most conveniently effected by the very refined artifice of giving to each symbol a *local* as well as an *absolute* value So that the same symbol 3 for example, is made to express not only *units* but 3 *tens*, 3 *hundreds*, 3 *thousands* &c, or 3 *tenth parts*, 3 *hundredth parts*, &c, according to its distance towards the left or right from the unit's place in any combination of symbols *See* NOTATION

NUʹMERATOR, in Arithmetic, is that part of the numerical expression of a fraction which indicates how many of those parts into which the unit is supposed to be divided are expressed Thus, in the fraction $\frac{7}{12}$, the lower number 12 is the denominator, and shows that the unit is divided into 12 parts, 7 is the numerator, and shows how many of those parts are to be taken

NUMISMAʹTICS (From the Greek νόμισμα, Latin nummus, *a coin*) The science of coins and medals The distinction between these classes of objects is, in modern times, that the coin is struck for the purpose of circulation as money, the medal not as a piece of money

but as a token commemorative of some person or event But ancient coins are often termed, in common language medals The parts of a coin or medal are, the obverse or face, containing generally the head, bust, or figure of the sovereign or person in whose honour the medal was struck, or some emblematic figure in the coins of commonwealths, and the reverse, containing various figures or words The words around the border of the coin form what is termed the *legend* those on the face the *inscription*, which occupy the lower extremity of the pieces and separate from the rest by a horizontal line they are termed the *exergue*

The earliest Grecian coins which we possess appear to have been nearly of a spherical shape they contain, on the obverse, some emblems of the particular cities which struck them, and on the reverse, deep indentations made by the puncheon in which the metal was held while the obverse was struck These marks, or the dye were soon brought into a more regular shape, sometimes forming a neat square, sometimes a circle Types were afterwards introduced on both surfaces of the coin, by inserting some small object in one compartment of the dye Ancient coins have been divided into various historical series, as exhibited in the following table —

- **Grecian**
  - 1 Civic
    - Of Græcia Propria and the Islands
    - Of Greek colonies
    - Of Graco-Asiatic cities
  - 2 Monarchic
    - Kings of Macedon
    - Kings of states formed out of the Macedonian conquests Syria Egypt &c &c, and the independent princes of Epirus and Syracuse
- **Roman**
  - 1 Consular
    - Roman asses
    - Coins of the families
  - 2 Imperial
    - Roman
    - Grecian — Provinces, Colonies and Municipia
  - 3 Medallions
    - Grecian
    - Roman
- **Barbarian**
  - 1 European of Thrace, &c
  - 2 Asiatic, of Persia &c
  - 3 African

The objects on Grecian civic coins are either, 1 the emblems of the cities, 2 figures of deities and their attributes, 3 miscellaneous or general symbols usurped by many states and cities, usually consisting of warlike objects The legends on Greek republican coins are either the name of the city or its initial letters, or monograms — *i e* figures forming a portion of the name in which the characters are so interlaced that a limb of one applies to many

The earliest coins which bore the heads of princes were those of Macedon commencing with Alexander the Great, and closing with the extinction of the dynasty of the Lagidæ in the Augustan age Four principal series of Grecian monarchical coins (either of Greek states or such as adopted the Greek language and customs) have been formed — 1 Of Macedon 2 Of Sicily Caria Cyprus, Heraclea Pontus 3 Of Egypt Syria the Cimmerian Bosphorus, Thrace &c &c from the era of Alexander the Great down to that of Christ 4 Of dynasties which flourished subsequently to the latter era including some kings of Thrace Bosphorus and Parthia with those of Commagene Edessa Judæa to which may be added some lines of Barbarized monarchs as those of Mauritania The most beautiful monarchic series are those of the Seleucidæ in Syria and Ptolemies in Egypt The unit of the Grecian silver coinage, in point of value may be considered as the drachma which is of a size between our sixpence and shilling the smallest silver coin is the dichalcos only $\frac{1}{12}$th of the drachma, the largest the tetradrachma, containing four drachmæ The commonest gold coin is the didrachma weighing two silver drachmæ, and in value 20, or 15*s* sterling Grecian copper coins are generally small

The Roman coinage differs from the Grecian in many respects, the greater size of the copper coins in early times and their superior workmanship in later the prevailing simplicity of devices, &c, form characteristic marks of difference In the first period of the republic they were cast The consular copper coins have separate symbols for the pieces according to their respective value, as the head of Janus for the *as* Jupiter for the *semis* &c The *as* also bore the impress I, to denote its quality of unity as a measure of value The name *family coins*, applied to many coins of the republic, arose from the custom of inserting the name of some distinguished family in the field of the coins A silver coinage was first introduced into Rome 266 B C The oldest coin was the denarius, equivalent to ten asses the earliest of these have the head of Janus for which that of Rome was afterwards substituted on the obverse, with a variety of symbols on the reverse The [illegible] into Rome [illegible]

the scrupulum, one third of the denarius in weight, a coin weighing two thirds, and another weighing a whole denarius Afterwards the chief gold coin was the *aureus* (twice the weight of the denarius), and its parts The imperial Roman coins form by far the most complete and varied series which we possess of ancient or modern times The symbols on the reverse have been arranged under four heads as relating to religion, war, games, and the embellishments of the city, under the numerous subdivisions of these subjects The obverses contain the portraits of emperors and empresses The characters on the reverses of the coins are, generally speaking, explanatory of the type, expressing in a few brief words the history of some occurrence immediately after which the coin was struck, &c The legend on the obverse mostly contain titles annexed to the imperial dignity, often expressed in abbreviations productive of not a little obscurity

Not less than three hundred portraits are preserved in the series of Roman imperial coins The term *medallion* is applied to those productions of the Roman or provincial mints which, in gold, exceed the size of the aureus, in silver, of the denarius, [illegible] in copper coin of ascertained value It [illegible] were intended for circulation as coins, or struck, like medals among ourselves, as commemorative tokens

Modern coins present so wide a variety as to render it impossible to include any classification of them within the limits of the present notice In England, Roman coins were current until the arrival of the Saxons we have the coins of five out of the seven kingdoms of the heptarchy, among them some small copper coins, the only specimens of that metal coined before the reign of Elizabeth Coins struck prior to the reign of Charles II had their devices impressed by the blows of a hammer The system of lettering on the edges which was succeeded by graining, was invented in order to obviate the fraudulent practice of clipping and filing the current coin

NUMMULITES (Lat nummus, *money* and Gr λίθος *a stone*) An extinct genus of the order of Molluscous animals called Cephalopoda, of a thin lenticular shape divided internally into small chambers These occur so abundantly in some parts of the chalk formation, that the name of nummulite limestone is given to the strata so characterized

NUNCIO An envoy of the pope to the court of an emperor or king to negotiate ecclesiastical affairs (*See* LEGATE) Previously to the council of Trent the papal nuncios acted as judges in the first instance of matters which lay within ecclesiastical jurisdiction, but since that time they have formed a kind of [illegible] decisions of the respective bishops It [illegible] however holds good only in those countries which still hold themselves subject to the decretals and discipline of the council of Trent for in other kingdoms and states, such as France Austria Tuscany &c which though Roman Catholic hold themselves independent of the Roman pontiff in matters of discipline the papal nuncio has no jurisdiction whatever and is invested merely with a diplomatic character like the ambassadors of any secular power The term *nuncio* is the Italian form of the Lat *nuntius*

NUNCUPATIVE WILL (Lat nuncupo, *I name*) In Law a will orally delivered by the testator *See* WILL

NUNDINÆ (Lat nonus *ninth* and dies *a day*) The market days or fairs at Rome were so called, because they recurred every ninth day On this day the people from the country and neighbouring towns flocked to Rome with the produce of their farms or industry On that day also all public proclamations were made causes heard witnesses cited and judgments given The nundina were originally considered as *dies nefasti*, on which no other business could be done, but for the convenience of the country people, this prohibition was removed by the *Lex Hortensia*

NUNS Female devotees among the Roman Catholics, who like the monks of the other sex, seclude themselves in religious communities and make profession of perpetual chastity *See* MONACHISM

The origin of this institution is commonly ascribed to St Syncletica the contemporary of St Anthony Among nuns as among monks there are various orders, some abandoning themselves entirely to contemplation and spiritual exercises but many others to the more active duties of private and public charity

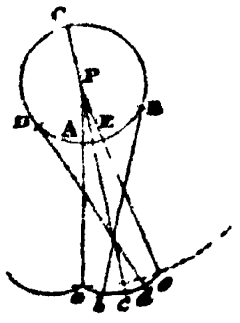
NURSERY In Gardening a plot of ground, or an entire garden, set apart for the propagation of plants, more particularly trees and shrubs The situation ought to be open and airy, and the soil of an average quality, neither too heavy nor too light, so as to be adapted to the majority of plants but in a complete nursery there [illegible] other peculiar soils, for such plants as are not readily propagated and grown in ordinary soils Where tender plants are propagated, or where hardy plants are to be raised from seeds or struck from cuttings which are not easily ger-

minated or rooted in the open ground and in the ordinary manner, hot-beds, frames, and hand-glasses are also requisite Every private garden of any extent requires a nursery to raise and bring forward young plants as a reserve for supplying failures by disease or accident in the general garden, and in every country where private gardens or plantations of trees are frequent, public or commercial nurseries are formed by persons who adopt [illegible]

NUTATION [illegible] ly the name given to a small gyratory movement of the earth's axis in virtue of which, if it subsisted alone without the precession of the equinoxes the pole of the equator would describe among the stars in a period of about nineteen years a small ellipse having its longer axis equal to 18 5″ and its shorter to 13 74″, the longer being directed to the pole of the ecliptic, and the shorter, of course, at right angles to the longer

In order to understand the nature of this phenomenon it is necessary to consider it in connection with that of precession, both depending on the same physical cause and forming in fact, essential constituent parts of one and the same great phenomenon The action of the sun and moon on the protuberant mass about the earth's equator tends constantly to draw the plane of the equator towards that of the ecliptic, or to diminish the angle between them In consequence of the earth's rapid rotation about its axis the inclination of the two planes is not permanently altered but a motion is communicated to the plane of the equator of such a kind that its axis revolves with a slow conical motion about the axis of the ecliptic or which is the same thing, the pole of the equator describes a circle in the heavens about the pole of the ecliptic as a centre keeping constantly at the same mean distance of about 23° 28′ from it The direction of this motion is from east to west and its velocity amounts only to 50 1″ annually, so that the whole circle requires for its description a period of 25 868 years

Let us now consider what would be the effect of the moon's action independently of that of the sun The lunar orbit does not coincide with the ecliptic it is inclined to it in an angle of about 5° 9′ and the position of the line in which the two planes intersect that is the line of the nodes, goes back on the ecliptic with a motion which carries it through a complete revolution in about eighteen years and seven months The axis of the lunar orbit therefore also describes a conical motion about that of the ecliptic or its pole describes a small circle in the heavens about the pole of the ecliptic at the distance of 5° 9′ and in the same period of about eighteen years and seven months Now the effect of the moon's attraction on the parts of the terrestrial spheroid exterior to the inscribed sphere is to produce a slow conical motion of the earth's axis not about the pole of the ecliptic but about the pole of the lunar orbit which is itself in a state of comparatively rapid motion about the pole of the ecliptic The point therefore in the sphere of the heavens round which the pole of the earth's equator revolves [illegible] of continual circulation round the pole of [illegible] path which the pole of the equator describes is not a circle but a sort of epicycloidal curve or gently undulated ring This will be rendered evident by the annexed figure Let P be the pole of the ecliptic which is supposed to be fixed A the pole of the moon's orbit moving round the small circle A B C D in the space of nearly nineteen years *a* the pole of the earth's equator, which at each moment moves in a direction perpendicular to the varying position of the line A *a* and with a velocity varying with the intensity of the acting forces during the revolution of the moon's nodes but on the whole, so slow as to carry it round only in 25 868 years When therefore, A arrives successively at B C D and E the line A *a* will take the positions B *b*, C *c*, D *d*, E *e* the earth's pole will thus, in one tropical revolution of A have arrived at *e*, and its direction having been always perpendicular to B *b*, C *c*, &c, the path which it will have described will be of the form *a b c d e* The same thing will be repeated at each succeeding revolution of the moon's node, and it is this alternate increase and diminution of the distances *P a P c*, *P e*, which constitute the phenomenon of the nutation




As the effect of the sun [illegible] motion about its centre of [illegible] of the attracting body from the plane of the equator, it is evident that the effect of the sun is greatest at the solstices, and is reduced to nothing at the equinoxes On this account, the obliquity of the ecliptic is subject to a small semi-annual variation, depending on the sun alone This is called the *solar nutation* Its existence is, however, only a deduction from the theory of attraction, for its amount which is less than half a second is too small to be sensible to observation The result produced by the combined action of the sun and moon is called the *lunar-solar nutation*, [illegible] of the [illegible]

The uranographical effect of the nutation is to produce a periodical fluctuation of the apparent obliquity of the ecliptic, and of the velocity of the regression of the equinoctial points Hence arises the distinction between apparent and mean right ascension and declination, the former being given by direct observation, and the latter being the results obtained when the observed places of objects have been cleared of the periodical fluctuations arising from nutation Formulæ and tables, for the reduction of observations to a common epoch, are given in all works on practical astronomy

The discovery of the nutation of the terrestrial axis belongs to Bradley and was a consequence of his other great discovery, the aberration of light In prosecuting his observations with a zenith sector, with a view to establish his theory of the aberration, he found a greater apparent change in the declinations of stars near the equinoctial colure than could arise from a precession of 50″ in a year, and at the same time exactly the reverse effect in the case of stars near the solstitial colure In the course of five years the changes in question amounted in some instances to 9″ or 10″, and as it was evident that they could not be explained by any alteration of the quantity of precession Bradley reverted to an idea which had previously occurred to him, in attempting to account for the phenomenon of aberration 'I suspected,' says he 'that the moon's action upon the equatorial parts of the earth might produce these effects For if the precession of the equinoxes be according to Sir Isaac Newton's principles caused by the action of the sun and moon upon those parts the plane of the moon's orbit being at one time above ten degrees more inclined to the equator than at another it was reasonable to conclude that the part of the whole annual precession which arises from her action would in different years be varied in its quantity whereas the plane of the ecliptic wherein the sun appears keeping nearly always the same inclination to the equator that part of the precession which is owing to the sun's action may be the same every year, and from hence it would follow that although the mean annual precession proceeding from the joint actions of the sun and moon were 50″ yet the apparent annual precession might sometimes exceed and sometimes fall short of that mean quantity according to the various situations of the nodes of the moon's orbit'

A long series of observations on stars situated in different parts of the heavens proved the correctness of this theory and it was found that all the phenomena were capable of being explained on the hypothesis that the pole of the equator describes a small circle about its mean place contrary to the order of the signs and in the same period as that of the revolution of the moon's nodes Bradley himself afterwards remarked that they would be still more accurately represented by supposing the curve described by the pole about its mean place to be an ellipse instead of a circle This is confirmed by accurately calculating from theory the amount of all the forces which tend to displace the terrestrial equator The result shows the path of the pole to be an ellipse and gives nearly the same values of its semi transverse and conjugate axes as are given by observation The values were found by Von Lindenau from a series of 810 observations embracing three complete revolutions of the moon's nodes to be 8 977″ and 6 682′ respectively The value of the semi axis major of the small ellipse imagined by Bradley is called the *constant of nutation* and enters as an element into all reductions of astronomical observations Von Lindenau's determination above cited is adopted by the German astronomers The value generally used by British astronomers is 9 25′ which was deduced by Dr Brinkley, Bishop of Cloyne from his own observations with the Dublin circle Very recently this important astronomical element has been investigated by Dr Robinson of Armagh from the Greenwich observations with the mural circle from 1812 to 1835 and the result at which he arrives is 9 2913′ (*Memoirs Roy Astr Soc* vol xi 1840, *Airy's Math Tracts*, *Herschel's Outlines of Astronomy*) *See* PRECESSION

NUTHATCH The name of a shy and solitary bird of the genus *Sitta* (*S Europæa*) It frequents woods, and feeds on insects chiefly, but also eats the kernel of the hazel nut which it cracks by fixing it in a chink, and striking it from above with all its force The nuthatch lays her eggs in holes of trees, and hisses like a snake when disturbed

NUT OF A SCREW In Architecture a piece of wood, iron, or other metal pierced cylindrically, wherein is cut a spiral groove, adapted to an external cylindrical spiral cut on a bolt Its use is to screw two bodies together, a head being placed on one end of the bolt to counteract the action of the nut Two bodies are thus held together by compression, the bolt between the head and the nut being a tie

NUTRIA, or NEUTRIA The commercial name for the skins of *Myopotamus [illegible]* (the *Coypou* of Molina, and [illegible] In France the skins were, and perhaps still are, sold under the name of *racoonda*, but in England they are imported as *nutria* skins deriving their appellation most probably from some supposed similarity of the animal which produces them, in appearance and habits, to the otter, the Spanish name for which is nutria Indeed, Molina speaks of the *coypou* as a species of water rat of the size and colour of the otter

Nutria fur [illegible] in the hat manufacture, and has become, [illegible] st 15 or 20 years, an article of very considerable commercial importance The imports fluctuate considerably In 1823, they amounted to 1 570,103 skins, but they have not in any other year been much more than half that number In 1826 they were only 60 871 In 1837 and 1838, the imports were, at an average, 358,280 skins a year Those entered for home consumption pay a duty of 1½*d* a skin They are principally brought from the Rio de la Plata Nutria skins are very extensively used on the Continent Geoffroy mentions* that in certain years a single French furrier (M Bechem) has received from 15 000 to 20 000 skins

Like the beaver, the coypou is furnished with two kinds of fur, viz the long ruddy hair which gives the tone of colour, and the brownish ash coloured fur at its base which like the down of the beaver is of much importance in hat making, and the cause of the animal's commercial value

The habits of the coypou are much like those of most of the other aquatic Rodent animals Its principal food in a state of nature is vegetable It affects the neighbourhood of water swims perfectly well and burrows in the ground The female brings forth from 5 to 7 at a time and the young always accompany her

The coypou is easily domesticated and its manners in captivity are very mild (See *Martin*, in the *Proceedings of the [illegible] Society* 1835)

NUTRITION See Food Digestion

NUTMEG The fruit of the *Myristica moschata* a beautiful tree of the family of the *Laurineæ* of Jussieu which grows in the Moluccas Islands All the parts of this tree are very aromatic, but only those portions of the fruit called mace and nutmeg are sent into the market The entire fruit is a species of *drupa* of an ovoid form, of the size of a peach, and furrowed longitudinally The nutmeg is the innermost kernel or seed contained in a thin shell which is surrounded by the mace, and this again is enclosed in a tough fleshy skin which opening at the tip separates into two valves The nutmeg tree yields three crops annually, one in April which is the best, one in August, and one in December

Good nutmegs should be dense and feel heavy in the hand When they have been perforated by worms they feel light and though the holes have been fraudulently stopped, the unsound ones may be easily detected by this criterion

Nutmegs afford two oily products 1 Butter of nutmeg vulgarly called oil of mace is obtained in the Moluccas by expression from the fresh nutmegs to the amount of 50 per cent of their weight It is a reddish yellow butter-like substance, interspersed with light and dark streaks and possesses the agreeable smell and taste of the nutmeg from the presence of a volatile oil It consists of two fats, one reddish and soft soluble in cold alcohol another white and solid, soluble in hot alcohol 2 The volatile oil is solid or a *stearoptene* and has been styled *myristicine* (*Ure's Dict of Arts &c*)

NUTS (Lat *nux*) The fruit of different species of *Corylus* or hazels The kernels have a mild farinaceous oily taste, agreeable to most palates, a kind of chocolate has been prepared from them and they have sometimes been made into bread The expressed oil of hazel nuts is little inferior to that of almonds Besides those raised at home, nuts are imported from different parts of France Portugal, and Spain but chiefly from the latter The Spanish nuts in highest estimation, though sold by the name of Barcelona nuts are not shipped from thence, but from Tarragona whence the annual average export is estimated at from 25 000 to 30,000 bags, 4 to the ton The annual entries of nuts for home consumption amount to from 100 000 to 125 000 bushels the duty of 2*s* a bushel yielding from 10 000 to 12,000*l* nett (*Commercial Dict*)

NUTTALLITE A mineral associated with calcspar, from Bolton in Massachusetts it occurs in prismatic crystals and appears from Dr Thomson's analysis to be an alumino silicate of lime potash, and iron

NUX A kind of fruit, hard, dry, not splitting, and containing only one seed it is also extended by some writers to any similar fruit whether it contains one cell or more than one See Nuts

NUX VOMICA (Lat) The fruit of a species of strychnos growing in the East Indies It produces the alkaloid salts, strychnia, and brucbia, and is a very virulent poison

NYCTALOPS (Gr *νυξ, night* and *οπτομαι, I see*) One who only sees distinctly in twilight, or the dusk of evening

NYMPH, *Nympha* (Gr *νυμφη, a nymph*) The Metabolian insects are so called when in the second stage of [illegible] especially when they possess the [illegible] See Pupa

NYMPHÆA, a the name given to some public baths at Rome consecrated to the nymphs, with whose statues they were adorned

NYMPHADÆ In Zoology a name given by Lamarck to a family of Bivalves

NYMPHÆACEÆ (*Nymphæa* one of the genera) In Botany, a natural order of plants, containing the water lilies of various parts of the world, they are Polypetalous Polyandrous Exogens, with the sides of the cells of the fruit covered with numerous seeds Their stems burrow among the mud of the places where they grow, and have slightly astringent narcotic properties The species are most valued for the beauty of their flowers, which in *Victoria regia* are the largest in nature, measuring as much as four feet in circumference

NYMPHALIS A genus of diurnal Lepidopterous insects now [illegible]

NYMPHIPARA (Gr *νυμφη* nymph, *παρα*, *I produce*) A hy [illegible] family of Dipterous insects, and changed by Latreille into *Pupipara* See that word

NYMPHS (Gr *νυμφαι*) Female beings in Grecian Mythology partaking of the nature of gods and men They peopled all the regions of earth and water, and according to the places of their [illegible] inhabited the streams, the Oreades the mountains the Dryades the woods, the Hamadryades trees, with which they were born and died They are represented as very beautiful, they constituted the attendants of various of the higher female divinities, especially Diana and were also considered as having been the nurses of many of the gods, as Jupiter and Pan See Naiads, Nereids

NYSTAGMUS (Gr *νυσταγμος*) A winking of the eyes, as observed in a drowsy person

# O.

O A letter of the vowel series, which, if arranged according to the nature of the sound, occupies a position between *a* and *u* It is susceptible of numerous interchanges for which the reader is referred to the *Penny Cyclopædia* The Greeks had two forms of this letter, *ο* (*ουικρον* or little *o*) and *ω* (*ουμεγα*, or large *o*), the former of which was equivalent to the short, and the latter to the long pronunciation of this letter in other countries Among the Irish the letter O prefixed to a name was originally considered as a mark of family dignity, it is now however we believe considered to be merely equivalent to *Fitz* in England and *Mac* in Scotland, indicating *son*

O In Music the O circle or double C or semicircle, is a note which we call a sembreve, and the Italians *circolo*, used by them to mark what they call *tempo perfetto*, and what we call triple time

OAK (Germ *eiche*) The general name of a well-known hard-wooded forest tree much cultivated for the purposes of timber, particularly in [illegible] and in other cases when much exposure to [illegible] is required There are several varieties of this valuable tree, but the common English oak (*Quercus robur*) claims precedence of every other The oak timber imported from America is very inferior to that of this country the oak from the central parts of Europe is also inferior, especially in compactness and resistance of cleavage The knotty oak of England the "unwedgeable and gnarled oak," as Shakspeare called it, [illegible] age (from 50 to 70 years), is [illegible] Some timber is harder, some more difficult to rend, and some less capable of being broken across, but none contains all the three qualities in so great and equal proportions, and thus, for at once supporting a weight, resisting a strain and not splintering by a cannon shot, the timber of the oak is superior to every other

A fine oak is one of the most picturesque of trees it conveys to the mind associations of strength and duration which are very impressive The oak stands up against the blast, and does not take, like other trees, a twisted form from the action of the winds Except the cedar of Lebanon, no tree is so remarkable for the stoutness of its limbs they do not exactly spring from the trunk, but divide from it, and thus it is sometimes difficult to know

* *Annales du Muséum*, vol vi p 82 The [illegible] speaking, good, but the tail is too ha [illegible] scription

which is stem and which is branch The twisted branches of the oak, too, add greatly to its beauty, and the horizontal direction of its boughs spread over a large surface, completes the idea of its sovereignty over all the trees of the forest

The oak is raised from acorns, sown either where the oak is to stand, or in a nursery whence the young trees are transplanted

The colour of oak wood is a fine brown, and is familiar to every one it is of different shades, that inclined to red is the most inferior kind of wood The larger transverse septa are in general very distinct producing beautiful flowers when cut obliquely Where the septa are small and not very distinct, the wood is much the strongest The texture is alternately compact and porous, the compact part of the annual ring being of the darkest colour, and in irregular dots, surrounded by open pores, producing beautiful dark veins in some kinds particularly pollard oaks Oak timber has a particular smell and the taste is slightly astringent It contains gallic acid and is blackened by contact with iron when it is damp The young wood of English oak is very tough often cross grained and difficult to work Foreign wood and that of old trees is more brittle and workable Oak warps and twists much in drying, and, in seasoning, shrinks about $\frac{1}{32}$d of its width

Oak of a good quality is more durable than any other wood that attains a like size Vitruvius says it is of eternal duration when driven into the earth it is extremely durable in water, and in a dry state it has been known to last nearly 1000 years The more compact it is, and the smaller the pores are the longer it will last but the open porous and foxy coloured oak which grows in Lincolnshire and some other places, is not near so durable

Besides the common British oak (*Quercus robur*) the sessile fruited bay oak (*Quercus sessiliflora*) is pretty abundant in several parts of England particularly in the north The wood of this species is said by Tredgold to be darker heavier harder and more elastic than the common oak, tough, and difficult to work and very subject to warp and split in seasoning Mr Tredgold seems disposed to regard this species as superior to the common oak for ship-building But other and also very high authorities are opposed to him on this point, and on the whole we should think that it is sufficiently well established that for all the great practical purposes to which oak timber is applied and especially for ship building the wood of the common oak deserves to be preferred to every other species A well informed writer in the *Quarterly Review* has the following remarks on the point in question —

'We may here notice a fact long known to botanists but of which our planters and purveyors of timber appear to have had no suspicion, that there are two distinct species of oak in England —the *Quercus robur* and the *Quercus sessiliflora*, the former of which affords a close-grained firm, solid timber rarely subject to rot the other more loose and sappy very liable to rot and not half so durable This difference was noted so early as the time of Ray, and Martyn in his *Flora Rustica* and Sir James Smith in his *Flora Britannica* have added their testimonies to the fact The second species is supposed to have been introduced some two or three years ago from the Continent where the oaks are chiefly of this latter species especially in the German forests the timber of which is known to be very worthless But what is of more importance to us is that *de facto* the imposture abounds, and is propagated every day in the New Forest and other parts of Hampshire in Norfolk and the northern counties, and about London and there is but too much reason to believe that the numerous complaints that were heard about our ships being infected with what was called improperly enough *dry rot* were owing to the introduction of this species of oak into the naval dock yards, where we understand, the distinction was not even suspected It may thus be discriminated from the true old English oak — The acorn stalks of the *robur* are *long*, and its leaves *short*, whereas the *sessiliflora* has the acorn stalks *short* and the leaves *long* the acorns of the former grow singly or seldom two on the same footstalk, those of the latter in clusters of two or three close to the stem of the branch We believe the Russian ships of the Baltic that are not of larch or fir are built of this species of oak, but if this were not the case, their exposure on the stocks, without cover, to the heat of summer, which, though short, is excessive, and the rifts and chinks which fill up with ice and snow in the long winter are enough to destroy the stoutest oak and quite sufficient to account for their short-lived duration"

OA'KUM The yarns of which rope is composed when twisted into fibre When mingled with pitch it is used for stopping leaks

OA'NNES In ancient Mythology, the most celebrated divinity of the Babylonians He was represented as a sea monster, with human feet and hands, and was said to dwell in the abysses of the Red Sea, whence he was in the habit of issuing daily, and proceeding to Babylon, where he communicated instruction on religion, the science of government, and the useful arts It has been generally supposed that Oannes was identical with the god Dagon,

> —— Sea monster, upward man,
> And downward fish,

and it is certain that the worship of marine animals constituted a leading feature in the religious observances of the Syrians and the adjacent nations *See* DAGON

OAR In Nautical Affairs, a long piece of timber flat at one end, and round or square at the other, by which a boat, barge, or galley &c is propelled through the water The flat part dipped into the water is called the *blade*, the other end is the *loom*, which terminates in the handle The fulcrum of the oar is the hole in the gunwale called the *rowlock* or between two pins called *thole pins*, or one thole pin with a loose strap for confining the oar There are various nautical phrases contingent upon this term, a few of which may not perhaps be out of place here *To boat the oars* signifies to lay them in from rowing, *to feather the oar*, to hold the blade horizontally so as not to catch wind, *to lie on the oars* to suspend rowing for any interval, this is also the salute given to persons of distinction in passing, to *ship* and *unship the oars*, respectively to fix them and throw them out of the rowlocks

OA'SIS (Derived from the Coptic ouah Arab wâh) The name given to those fertile spots watered by springs and covered with verdure which are scattered about the great sandy deserts of Africa The most noted are situated in the Lybian desert The oases of Egypt are nothing more than valleys or *depressions* of the lofty plain which forms the extensive table-land of Eastern Africa They bear, in many respects a similarity to a portion of the valley of Egypt being surrounded by steep cliffs of limestone at one distance from the cultivated land which vary in height in the different oases, those rising from the southern oases being the highest, neither do they present a continuation of cultivable soil all of them being intersected by patches of desert They no doubt owe their origin to the springs with which they abound the decay of the vegetation thence arising having produced the soil with which they are now covered Their fertility has been deservedly celebrated, but the glowing eulogiums of travellers on their surpassing beauty are probably in a great measure to be ascribed to the trying contrast they present to the deserts of burning and with which they are surrounded It may appear contradictory considering the high opinion the ancients entertained of the fertility and beauty of the oases that they should have selected them for places of banishment, but that such was the case at least under the Romans is certain A law of the *Digest* lib 48 tit 22 refers to this practice, and it has been supposed that the poet Juvenal was one of those who suffered a temporary banishment (*relegatio*) to the oases though the evidence of this is by no means clear (*Biographie Universelle* art *Juvenal*) But the fact of their being selected as places of banishment is not in anywise inconsistent with the received opinions as to their salubrity and fertility They were selected not because of their being naturally noxious or disagreeable, but because of their being as it were out of the world and from the extreme difficulty of escaping from them The larger oases have some fine remnants of antiquity, the most celebrated of which is the temple of Jupiter Ammon at Siwah See the *Geo Dict* art Egypt and the authorities there referred to) *See* DESERT

OAST The term applied to a kiln for drying hops, and which differs from a kiln for drying corn chiefly in being heated by a stove with flues instead of an open fire the smoke and heat of which passes up through the corn

OATFIELD *See* OPEN FIELD LAND

OATGALLS *See* GALL NUTS

OATH is defined by Paley the calling on God to witness to take notice of what we say, and invoking his vengeance or renouncing his favour if what we say be false or if what we promise be not performed" By the jurisprudence of nearly all known nations it has been admitted in one form or another as the solemn test of truth in judicial proceedings Thus, as a general rule, all evidence in such proceedings must be given on oath by English law, and the having taken such oath subjects the witness to the penalties of perjury if his testimony be false The only exceptions are 1 In favour of Quakers Moravians, and Separatists, whose "affirmation" is now admissible in all judicial proceedings, whether civil or criminal The 1 & 2 Vic c 77 extends this privilege to persons who have been Quakers or Moravians but have left those communities, retaining their objections 2 Persons entitled to privilege of peerage give in their answers in chancery, "upon their honour," instead of on oath, and corporations put in answers under the great seal Oaths are administered publicly in court,

where the witness is about to give his evidence viva voce, and by competent authority where the evidence is reduced into writing [illegible] of the witness being termed his "affidavit."

Any believer in a definite form of religion can be a witness, and the oath may be administered "according to such forms and ceremonies as he may declare to be binding" (1 & 2 Vic c 108) But persons who cannot take an oath are incapable of being witnesses, such, therefore, as will not declare their belief in God, in a future state of rewards and punishments, and that perjury will be punished by the Deity, are excluded, as well as those who, from their years or ignorance, are incapable of comprehending the nature of an oath

Oaths are still required by law on many occasions besides the giving evidence in judicial proceedings and were formerly in a still greater number until the 5 & 6 W 4 c 62, which substituted declarations in a great variety of cases, especially relating to the customs, excises, and post-office Besides the Quakers and Moravians, several small sects of Christians profess conscientious objections to oaths grounded on the express language of the scriptures The church of England in common with the Catholic church in all ages and with most varieties of Christians considers judicial oaths lawful and declares them so by her 39th article They have also been held mischievous or unnecessary by some philosophical writers especially Bentham in his *Rationale of Evidence* The only answer to his reasoning appears to be that however unreasonable the belief that the duty of truth is rendered more imperative by the formality of an oath still while such belief is a prevalent one or while the imagination of witnesses in general is impressed by its solemnity the convenience of retaining the practice overbalances the disadvantages

OATS See AVENA

OBEDIENCE PASSIVE in Politics, signifies the unqualified obedience which according to some political philosophers, is due from subjects to the supreme power in the state, insomuch that not only its lawful but its unlawful commands may not be forcibly resisted without sin The doctrine of passive obedience or non resistance was strongly professed by the church of England in the time of King James I, much commented on by writers both for and against it, under Charles and James II and condemned at the Revolution See NON RESISTANCE and DIVINE RIGHT

OBELISK (Gr ὀβελίσκος dim from ὀβελός, Lat obelus *a needle or dart*) A lofty quadrangular monolithic column diminishing upward with the sides gently inclined but not so as to terminate in an apex at the top, neither is it truncated or cut off at the summit but the sides are sloped off so as to form a flattish pyramidal figure by which the whole is suitably finished off and brought to a point, without the upper part being so contracted as to appear insignificant Egypt was, properly speaking the land of obelisks, and they are unquestionably to b[illegible] the most ancient monuments of that [illegible] people Much learning and ingenuity has been expended in endeavouring to ascertain their origin and the purposes for which they were erected, but it does not appear that any satisfactory solution of the problem has hitherto been given It has been frequently asserted that obelisks were originally erected in honour of the sun of which they were said to be symbolical, and that they served the purposes of a gnomon or sun-dial, but this opinion is now almost totally rejected and it is generally believed that obelisks were nothing more than monumental structures serving as ornaments to the open squares in which they were generally built, or intended to celebrate some important event and to perpetuate its remembrance They were usually adorned with hieroglyphics and we learn from the testimony of Diodorus and Strabo that the inscriptions with which they were charged declared the amount of gold and silver the number of troops and the quantity of ivory perfumes and corn which all the countries subject to Egypt were required to furnish The two largest obelisks were erected by Sesostris in Heliopolis They were formed of a [illegible] granite and measured 180 feet in height [illegible] became a Roman province, Augustus removed these obelisks to his own capital, and this practice found numerous imitators both in some of his successors to the imperial throne and at a much later period in many of the Roman pontiffs from the 16th century down to the present times Of these obelisks that of the Lateran, which is the largest now known, being 105 feet in height exclusive of the pedestal, and weighing 440 tons was brought by Constantine from Heliopolis to Alexandria and thence by Constantius his son to Rome, where it was erected in the Circus Maximus The obelisk next in size to that of the Lateran was placed originally in the Vatican circus by Caligula, but it now stands in the piazza of St Peter's, its entire height is 132 feet including the pedestal, &c The obelisks most generally known at least in name are the Luxor, which was removed to Paris in 1833, and the two monoliths called Cleopatra's Needles, of which one is standing and the other on the ground, but these are smaller than those we have adverted to, the Luxor being 76 feet in height, and the Needle of Cleopatra which still stands being about 63 feet in height, exclusive of the pedestal, &c A full consideration of the Egyptian obelisks would involve us in the discussion of several most important questions, on which our limits preclude us from entering Of these perhaps the most extraordinary is the wonderful knowledge of mechanical power which the Egyptians evinced in erecting and removing such gigantic structures,—a feat which it would require the greatest skill and ingenuity of modern engineers, even in the present compar[illegible] accomplish [illegible] see also *Sir G Wilkinson's Egyptians*, vol iii, *passim*, which contains some excellent illustrations of the different methods adopted by that people for removing their huge structures from place to place)

OBELUS [illegible] mark so called from its re[illegible] Gr [illegible] usually thus — or thus — in ancient MSS It was used by Origen, in his *Hexapla*, to mark the passages where something is found in the Septuagint which is not in the Hebrew The common use of the line — in modern writing is to mark the place of a break in the sense where it is suspended, or where there is an ungrammatical transition, but a paragraph introduced where the sense is suspended is more properly marked by the sign of a parenthesis

OBERON In Medieval Mythology, the King of the Fairies Wieland's beautiful poem, and Weber's romantic opera of this name the *Midsummer Night's Dream* and innumerable other poems and tales of which he is the hero have made the name of Oberon so familiar that it will be unnecessary to do more in this place than to state the origin of the fable The name Oberon first appears in the old French *fabliaux* of Huon of Bordeaux it is identical with Auberon, or Alberon the first syllable of which is nothing more than the old German word Alb *elf* or *fairy* which in the Helden-Buch and other old German poems is expressed variously by Alberich or Albin (See *Grimm's Deutsche Mythologie*, p 256) He was represented as endowed with magic powers and with the qualities of a good and upright monarch rewarding those who practised truth and honesty and punishing those who acted otherwise His wife's name was Titania or Mab whose powers have been so beautifully depicted in *Romeo and Juliet*

OBESITY (Lat obesus *fat*) Unhealthy fatness The tendency to the formation of fat is often so excessive as to constitute a disease and it occasionally prevails in particular habits so as to cause a most unsightly bulk of body and to be independent of diet The celebrated Lambert who exhibited himself some years ago, was a remarkable specimen of this disease He died in the fortieth year of his age and weighed, a little before his death 739 pounds There is an account in the *Philosophical Transactions* for 1813 of a girl only four years old, who weighed 256 pounds from accumulation of fat

When obesity is limited to the abdomen, arising from excessive deposition of fat in the omentum, and producing what is called a pot belly or where it is the result of indolence and indulgence in luxurious diet, a slow and prudent change from a full to a spare diet, and the judicious use of purgatives and of appropriate modes of exercise have occasionally effected remarkable cures

OBIT (Lat obitus *death*) In the Roman Catholic liturgy a service performed for the repose of a departed soul

OBITUARY (Lat obitarium) A register in which are enrolled the names of deceased persons for whom obits are to be performed and the days of their funeral It is also used for the book containing the foundation or institution of the several obits in a church or monastery In the former sense it is synonymous with *necrology*, in the latter with *martyrology*

OBJECT-GLASS (of a refracting telescope or microscope) The lens which first receives the rays of light coming directly from the object, and collects them into a focus where they form an image which is viewed through the eye-glass

The excellence of an object-glass depends on the distinctness of the image which it forms On account of the unequal refrangibility of the rays of light, it is necessary in order to procure a distinct image, to employ an achromatic combination of lenses, formed of substances having different dispersive powers and of such figures that the aberration of the one may be corrected by that of the other The substances chiefly used are crown-glass and flint glass, the dispersive powers of which are respectively as 3 to 5 By combining a convex lens of crown-glass with a concave lens of flint glass, having their focal distances in that proportion, an image would be formed free from colour, but it would not be free from aberration The determination of the form of the compound lens which shall give the least possible aberration for parallel rays is a problem which admits of exact

calculation The following are the dimensions found by Sir John Herschel for an object-glass of thirty inches focal length of the form shown in the annexed figure, where A B is the exterior surface of crown glass on the outside towards the object and C D the concave lens of flint-glass placed on the inside towards the eye radius of the exterior surface of the crown lens, 28 6304 inches, radius of the exterior surface *b* of the flint lens, 41 1687 inches, radius of the surfaces *c*, 10 1604 and 10 [illegible] *Metr*, art "Light, § 471) When the lenses have the forms here [illegible] each separately, a [illegible] powers, and the two inside surfaces have so nearly the same curvature that they may be ground on the same tool and united by a cement to prevent the loss of light at the two surfaces



Such are the forms indicated by theory, but the practical difficulties of forming a good achromatic object-glass, for a large telescope, are so great that it often costs more than all the rest of the instrument This, however, principally arises from the extreme difficulty of procuring disks of flint-glass, above a certain size sufficiently free from veins and imperfections to be fit for the purpose The Northumberland equatorial at the Cambridge observatory by Cauchoix of Paris, is of 11¾ inches effective aperture, but the largest in use at the present time are those of the great telescopes belonging to the central observatory at Pulkowa in Russia, and to the observatory at Cambridge in the United States, the extreme diameter being 15¼ inches, and the effective aperture about 15 inches in both cases. They are the workmanship of Merz and Mahler of Munich Some large disks of flint glass of English manufacture apparently of good quality, were exhibited by Messrs Chance of Birmingham at the Great Exhibition in London, in 1851, one of which was no less than 27 inches in diameter An object-glass of two feet aperture is said to have been actually ground by Mr Ross, a London optician, but as yet it has not been tested

In the fine telescopes formerly constructed by Dollond the object-glasses were composed of three lenses, the two exterior ones, A B and C D, being of crown glass and [illegible] of flint, [illegible] a more perfect correction of the spherical aberration, but the advantage is more than balanced by the greater complexity of their construction, the risk of imperfect centering and the loss of light at the six surfaces



Various attempts have been made to dispense with the concave flint lens, by the substitution of some other refractive substance. Dr Blair found that the dispersion of crown-glass was corrected by a fluid lens composed of a mixture of solutions of ammoniacal and mercurial salts He succeeded in making object glasses in this manner, but it soon appeared that they were not durable, the fluid undergoing some chemical change which entirely destroyed its [illegible] Professor Barlow [illegible] which has also made [illegible] His correcting lens is [illegible] carbon, inclosed between two disks of glass and a ring of the same material, the fluid being introduced at a high temperature A telescope which he made on this principle had a single object lens of 7 8 inches and the fluid lens was placed at the distance of 40 inches behind it The performance of this telescope was, however far *inferior to* [illegible] the same dimensions, with the common [illegible] matic object glass *See* ACHROMATISM [illegible]

O'BJECT, [illegible] in Philosophy, opposed to *subjective* *See* SUBJECT, SUBJECTIVE

O'BLATE (Lat oblatus, *offered*) In Ecclesiastical Antiquities 1 A person who on embracing the monastic state, had made a donation of all his goods to the community 2 One dedicated to a religious order by his parents from an early period of his life 3 A layman residing as an inmate in a regular community to which he had assigned his property either in perpetuity or for the period of his residence 4 A layman who had made donation, not only of his property, but his person, as bondsman to a monastic community In France the king possessed, in ancient times, a privilege [illegible] a certain number of *oblati*, [illegible] monasteries, whom they were bound to maintain

OBLATE, in Geometry signifies flattened at the poles Thus, an *oblate* spheroid is a spheroid of the same form as that which is produced by the revolution of an ellipse about its shorter axis Such is the figure of the earth *See* DEGREE EARTH

OBLA'TION (Lat oblatio, *an offering*), means, properly, an offering presented to the church This practice commenced at an early period in the history of the church, for [illegible] Christian priesthood had no other maintenance [illegible] than the free gifts or oblations of the people In the middle ages, oblations were of various kinds, and were known by different names, [illegible] purposes for which they were presented [illegible] *Liturg* i. 67)

[illegible] (Lat obligo, *I bind*) In the most general sense a duty imposed by law, to the fulfilment [illegible] and towards another Obligations, [illegible] law are said to arise in four ways; out of contracts, quasi-contracts delicts or quasi-delicts A principal obligation is that by which a debtor is bound to his creditor an accessory obligation that by which one is bound to another to satisfy the contract of a third party The Roman jurisconsults divided obligations into natural, civil, and mixed, and also into civil and prætorian An obligation, by the law of England, is a bond with penalty and condition, it may also be by statute or recognizance He who enters into an obligation is styled obligor, he towards whom it is entered into, obligee

OBLIGA'TO (Ital) In Music, a term applied to a movement or composition written for a particular instrument It sometimes means that a movement is restrained by certain rules, to give particular expression [illegible] action, &c

OBLIQUE (Lat obliquus) Not direct, deviating from the perpendicular Thus, *oblique angle*, in Geometry, is an angle greater or less than a right angle *Oblique circle*, in the Stereographic Projection, is any circle oblique to the line of projection *Oblique planes*, in Drilling are such as recline from the zenith *Oblique projection* in Mechanics, is where a body is projected in a line making an oblique angle with the horizontal line *Oblique sailing*, in Navigation, is that which includes the calculation of oblique-angled triangles *Oblique sphere*, in Geography, is that in which the axis of the world is inclined to the horizon of the place

OBLIQUE MOTION In Music, that wherein one of the parts holds on a sound, whilst the other rises or falls on any note whatsoever

OBLIQUITY OF THE ECLIPTIC In Astronomy, the inclination of the plane of the earth's equator to the plane of the ecliptic or the angle formed by those two planes, on which the phenomena of the seasons depend *See* ECLIPTIC

O'BLONG In Elementary Geometry, a rectangle, or right-angled parallelogram, whose length is greater than its breadth An *oblong spheroid* is generated by the revolution of an ellipse about its longer axis, and therefore elongated at the poles hence the term is used in contradistinction to *oblate spheroid*, which denotes a spheroid flattened at the poles The *oblong* spheroid is otherwise called the *prolate* spheroid

O'BOE (Ital) A musical wind instrument, sounded through a reed It is shaped somewhat like a clarionet, being slender in the upper part, but spreading out conically at the bottom and consists of three joints or pieces, besides the reed Its compass is generally two octaves and a fifth from C below the treble clef, to G, the fourth line above the staff The ancient name of oboe was *waught* which is still visible in the modern word *wait* (*see* WAITS), and in this form the oboe was in use as far back as the reign of Edward III It is only since the beginning of the present century that the Italian form of this word came into general use, previously to that period the French name, *hautbois*, was universally current

O'BOLUS (Gr ὀβολός) An Athenian silver coin of very small dimensions, being only equal in value to about 1½*d* of our money, or less, according to some computations Seven of them were equal to an Attic drachma

OBRI'NE The name of a military order, instituted in the 13th century by Conrad duke of Mazovia in Poland, styled also the order of Jesus Christ It was instituted to levy war against the Russians

OBSCU'RANTS, OBSCURA'NTISM A kind of [illegible] Germany [illegible] was applied [illegible] Aristotle, and their doctrines (See *Conv Lex*)

O'BSEQUIES (Lat [illegible] *obsequiæ*) were solemnities performed a[illegible] the [illegible] The term is now used for the funeral itself

OBSE'RVANTS, otherwise RECOLLECTS A branch of the Franciscan order *See* RECOLLECTS

OBSE'RVATORY A place or building destined for the purpose of making astronomical or physical observations, and furnished with appropriate instruments

[illegible] have been erected in [illegible] the tower of Babel being supposed [illegible], and the tomb [illegible] Chinese have also traditions of observatories which existed in the remotest ages of their histories In fact, as the observation of the relative positions of the celestial bodies [illegible] instruments must have [illegible] existence of observatories must have been coeval with the first progress made in

practical astronomy (See Bailly, *Histoire de l'Astronomie Ancienne*)

According to Wendler the first regular observatory in Europe was erected at Cassel in 15[illegible] by William Landgrave of Hesse That of Tycho Brahe, in the island of Huen was founded 1576 From this time private observatories began to be multiplied, and some of them, as that of Hevelius at Dantzic, produced results which materially contributed to the progress of astronomy, but it was only in the following century that they came to be regarded, in the principal countries of Europe, as important and necessary public establishments The royal observatory of Paris was built in 1667 that of Greenwich in 1675, the latter being professedly for the benefit of navigation

This original intention has never been lost sight of, and under a succession of eminent astronomers the Greenwich observatory has done more towards determining the lunar motions, and the positions of fixed stars with which the moon's places may be compared by observations made at sea, than all the other observatories of Europe taken together The instruments essentially necessary to an astronomical observatory are a transit instrument and sidereal clock, for the purpose of observing right ascensions, a circle, for observing polar distances, and a barometer and thermometer, for the purpose of ascertaining the state of the atmosphere, in order to determine the corrections to be applied for refraction For the purpose however, of observing the moon still nearer to her conjunctions with the sun, an altitude and azimuth instrument of admirable solidity and firmness was erected at Greenwich in 1847, and an excellent series of observations has already been made with it Furnished with this apparatus, the astronomer is in a condition to obtain all the data requisite for the formation of catalogues and tables, and for establishing or perfecting the theories of the celestial motions and physical astronomy Another instrument though of secondary importance, is also wanted for the observation of phenomena out of the meridian, as eclipses occultations, comets, &c The most convenient instrument for this purpose is the equatorial (see the term), and if the astronomer carries his views to the exploring of the sidereal spaces, to observe the forms of nebulæ, and watch the changes and motions of double and multiple stars, the equatorial must be furnished with a telescope of the largest kind, or a powerful reflecting telescope, suspended so as to have a free motion in azimuth, may be employed instead of it In this department of astronomy all depends on the goodness of the telescope, the objects to be examined being, in fact, only limited by the power of seeing them But as these researches have no immediate practical application, they are not considered as included among the purposes for which public observatories are established, and are therefore left to the zeal of individuals

Public observatories are now established and maintained by the governments of almost every civilised country, and means are provided of publishing the observations, and rendering their results immediately available to the progress of astronomical science The number of private observatories, particularly in this country is very considerable, and several of them in regard to the sumptuousness of their instruments vie with and even excel, the first and best appointed public institutions The following is a list of the principal public observatories, with their latitude and [illegible] time) from that of Greenwich, as given [illegible] *Almanac* —

| | Latitude | | | | Longitude. | | | |
|---|---|---|---|---|---|---|---|---|
| | ° | ′ | ″ | | h | m | sec | |
| Abo (Finland) | 60 | 26 | 57 | N | 1 | 29 | 8.8 | E |
| Altona | 53 | 32 | 45 | N | 0 | 31 | 46.6 | E |
| Armagh | 54 | 21 | 12 | N | 0 | 26 | 3 | W |
| Berlin | 52 | 31 | 13 | N | 0 | 53 | 35 | E |
| Bremen | 53 | 4 | 36 | N | 0 | 35 | 15 | E |
| Cape of Good Hope | 33 | 56 | 3 | S | 1 | 13 | 5 | E |
| Copenhagen | 55 | 40 | 53 | N | 0 | 50 | 19.8 | E |
| Dorpat (Russia) | 58 | 22 | 47 | N | 1 | 46 | [illegible] | E |
| Dublin | 53 | 23 | 13 | N | 0 | 25 | 22 | W |
| Edinburgh | 55 | 57 | 23.2 | N | 0 | 12 | 43.6 | W |
| Geneva | 46 | 11 | 59.4 | N | 0 | 24 | 37.5 | E |
| [illegible] | 51 | 31 | 48 | N | 0 | 31 | 46 | E |
| [illegible] | 51 | 28 | 39 | N | 0 | 0 | 0 | |
| [illegible] | 54 | 42 | 50 | N | 1 | 22 | 0.5 | E |
| [illegible] | 55 | 4 | 0.2 | N | 5 | 21 | 3.8 | E |
| [illegible] | 43 | 17 | 50.1 | N | 0 | 21 | 29 | E |
| Munich | 48 | 8 | 45 | N | 0 | 46 | 26.5 | E |
| Oxford | 51 | 45 | 40 | N | 0 | 5 | 1.5 | W |
| Palermo | 38 | 6 | 44 | N | 0 | 53 | 25.6 | E |
| Paramatta (New South Wales) | 33 | 48 | 49.8 | S | 10 | 4 | 6.25 | E |
| Paris | 48 | 50 | 13 | N | 0 | 9 | 21.5 | E |
| Petersburg | 59 | 56 | 31 | N | 2 | 1 | 19.8 | E |
| Rome | 41 | 53 | 52 | N | 0 | 49 | 54.7 | E |
| St Fernando (near Cadiz) | 36 | 27 | 45 | N | 0 | 24 | 49.1 | W |
| Turin | 45 | 4 | 6 | N | 0 | 30 | 48.4 | E |
| Vienna | 48 | 12 | 35 | N | 1 | 5 | 51.9 | E |

**OBSE'SSION** (Lat obsidium *I besiege*) The state of a person vexed or besieged by a evil spirit In the language of exorcists, demoniacal obsession differed from demoniacal possession in the latter, the demon had possession of the patient internally, in the former, he attacks him from without Thus, the state of Sara, the bride of Tobias whose bridegrooms were killed by an evil spirit hindering her (Tobit iii 8), was one of obsession Well known marks of obsession were the being miraculously hoisted or elevated in the air speaking languages of which the patient had no knowledge aversion to the offices of religion, and so forth *See* POSSESSION, DEMONIACISM

**OBSIDIAN** So named, according to Pliny, from Obsidius, who first found it in Ethiopia A glassy lava Volcanic glass It is of various colours, but usually black, and nearly opaque In Mexico and Peru it is occasionally manufactured into cutting instruments, or cut into ringstones It consists of silica and alumina, with a little potash and oxide of iron

**OBSI'DIONAL CROWN** (Lat obsideo, *I besiege*) In Roman Antiquities, a crown granted by the state to the general who raised the siege of a beleaguered place It was formed of grass growing on the rampart *Obsidional* coins in Numismatics are pieces struck in besieged places to supply the want of current money They are of various base metals, and of different shapes Some of the oldest known are those which were struck at the siege of Pavia under Francis I

**OBSOLETE** (Lat obsoletus) In Zoology, the term implies that a part, or a spot, or other character, is scarcely discoverable

**OBSTE'TRICS** (Lat ars obstetricia from obstare, *to stand so as to give assistance*) The name frequently given to the science of midwifery

**OBTE'MPER** (Lat obtempero, *I obey*) In Scotch Law, to obey or comply with a judgment of a court

**OBTU'NDENTS** (Lat obtundo, [illegible] and other bland medicines, supposed to sheathe parts from acrimony, and to blunt that of certain morbid secretions

**OBTURA'TOR MUSCLES** (Lat obturare, *to close up*) Certain muscles which fill up openings in bones

**O'BVERSE or FACE** In Numismatics, the side of the coin which contains the principal symbol usually, in the coins of monarchical states, ancient and modern, the face in profile of the sovereign In some instances, the full or half length figure *See* NUMISMATICS

**OCCASIONALISM** or the System of Occasional Causes In Metaphysics, a name which has been given to certain theories of the Cartesian school of philosophers, especially Arnold Geulinx, of Antwerp, by which they account [illegible] action of the soul on the body, [illegible] voluntary motion According to these theories (which were more or less clearly developed by different writers), the will was not the *cause* of the action of the body, but, whenever the will required a motion, God caused the body to move in the required direction *See* HARMONY PRE ESTABLISHED

**OCCIDE'NTAL** (Lat occidens, *setting*) In Gem Sculpture, a term applied to those precious stones which possess an inferior degree of hardness and beauty

**OCCIPITAL BONE** (Lat occiput *the hind head*) The irregularly shaped bone which forms the posterior and inferior part of the skull

**OCCULTA'TION** [illegible] sometimes called Lunar [illegible] Stars by the Moon, are those phenomena in which a star or planet becomes hidden from our view by the intervening passage of the moon By analogy a total eclipse of the sun might be called an occultation of the sun by the moon

As the motion of the moon in her orbit is from west to east it is obvious that when she is about to pass over a star the first contact or the immersion, must occur on her eastern limb, and the emersion [illegible] of the star must take place on her western [illegible] Should, however be observed, that some slight exceptions to this rule may be found where the moon has considerable motion in declination, and where the star is only grazed over by a small portion of the northern or southern limb In these few exceptional cases, the disappearance and reappearance of the star may both occur either on the eastern or the western side of the limb

An occultation like a solar eclipse, is presented only to a portion of the terrestrial globe For suppose an observer to be stationed at the star with the moon between him and the earth, and that he could perceive the moon's disc projected on that of the earth, then he would observe that the moon, in her passage over the earth, only covered a portion of the terrestrial disc, and it is evident that the phenomenon of the occultation of the star could only be presented to that portion of our globe

The principles which enter into the calculation of occultations are [illegible] as for eclipses of the sun, [illegible] difference consists in the star having neither sensible parallax nor [illegible] diameter so that the moon's motion and parallax [illegible] employed in place of the relative motion and the [illegible] parallax For the mode

of conducting the calculation it will therefore be sufficient to refer to the article Eclipses, page 381, and to observe that the consideration may perhaps be simplified by giving to the star a motion contrary and equal to that of the moon, and then supposing the moon herself to be stationary

In the case of a planet, it may be necessary to take into account its motion and parallax, and perhaps its semidiameter, if great nicety is to be observed

For minute details, in reference to the calculation of [illegible] in all their varieties the reader [illegible] the Appendix to the *Nautical Almanac* for the year 1836

OCCU'LT SCIENCES (Lat occultus, *hid*) A term applied to the imaginary sciences of the middle ages — magic alchymy astrology especially the former

O'CCUPANCY In Law the taking possession of [illegible] one of a thing of which there was [illegible] acquired by such taking possession And [illegible] man held land *pur auter vie* for [illegible] and died before that other, as this estate could not descend to his heir, nor revert to the donor until the determination of the life upon it, it was considered to belong of right to the first who took possession of it for the remainder of the life, which was termed general occupancy And, when the gift was to one *and his heirs* for the life of another the heir was said to take as special occupant By the Stat of Frauds (29 C 2 c 3 sec 12) a man is enabled to devise lands held by him pur auter vie, and if no such devise be made, and there be no special occupant, it goes to his executors and administrators

O'CEAN (Gr *ωκεανος*) In Geography, the vast body of water which surrounds the continents, and is the receptacle of all their running waters It is divided by geographers into five great basins, viz the Pacific Ocean (so called by reason of its comparative stillness) which separates Asia from America, and is the largest of all the basins, 2 the Atlantic Ocean, which has Europe and Africa on its eastern shore, and America on its western, 3 the Indian Ocean, which washes the south of Asia and the south-eastern coast of Africa, 4 The Arctic Ocean, which surrounds the north pole, and 5 the Antarctic which surrounds the south pole Other smaller portions of the great connected body of water are called *seas*, of which the Mediterranean the German, the Baltic, and Black seas, are the most considerable The superficial extent of [illegible] with any certainty [illegible] defined From the nearest [illegible] of the extent of the continents and principal islands it is supposed that nearly three fourths of the whole surface of the globe are covered by water The Pacific Ocean [illegible] the dry land

*Depth of the Ocean* [illegible] perficial extent of the ocean cannot be easily ascertained it will readily be supposed that its depth is a problem of much greater difficulty The bottom appears wherever it has been reached by the sounding line to have similar inequalities to those of the surface of the land hence the depth must be extremely various, and it might be supposed from analogy that the greatest depth of the ocean is at least equal to the height of the highest mountains above its surface Lord Mulgrave found no bottom in the North Atlantic Ocean with a sounding line of 4680 feet, and Mr Scoresby sounded to the depth of 7200 feet, without the lead touching the ground These experiments are not altogether to be depended on for the determination of such great depths, for, the pressure [illegible] the lead may be drawn out [illegible] by currents, of which it may encounter more than one, flowing in different directions Over a great portion of the Atlantic and Pacific Oceans no bottom has been found The depth of the ocean in general and the form of the bed on which it rolls, cannot, therefore, be determined by experiment The mathematical theory of the oscillations of fluids has, however, thrown some light on the subject Laplace demonstrated that the difference which is indicated by observation between the height of two consecutive tides depends on the law of the depth of the sea, and that, but for the influence of accessory circumstances, it would disappear altogether if the depth were constant It follows, therefore, that, since the difference between the consecutive tides is extremely small, the depth of the sea, taking in a large extent of ocean, must be nearly uniform, that is to say there must be a certain mean depth from which the variations are not considerable (*Méc Céleste*, book xiii)

*Level of the Ocean* —Were it not for the disturbing actions of the sun and moon, and of the winds, the level of the ocean would be every where the same, and its surface would have the form determined by the attraction of the whole mass of the earth, combined with the centrifugal force belonging to its velocity of rotation, that is to say, the surface would be that of an oblate spheroid of revolution This uniformity however can never be established The tide at every instant is at different heights in different parts of the ocean, and therefore the form of the surface within the limits of the rise and fall of the tides, is variable But even if we neglect the alternate rise and fall of the water which constitutes the tides, and take the surface of the ocean at its mean height, it is found by accurate levelling that all its parts do not coincide with the surface of the same spheroid Gulfs and inland seas, which communicate with the ocean by narrow openings, are affected according to their position with regard to the prevailing winds The level of the Red Sea was found by the French engineers in Egypt, to be 32½ feet higher than that of the Mediterranean which is supposed to be a little lower than the ocean Humboldt concluded, from observations made on the Isthmus of Panama, that the waters of the Gulf of Mexico are about 2 feet higher than those of the Pacific Ocean The Baltic and Black seas rise in spring from the great quantity of river water poured into them, and are lowered in summer by the joint effects of a small supply and increased evaporation

*Colour of the Ocean* — The usual colour of the ocean is a bluish-green, of a darker tint at a distance from land and clearer towards the shores According to Mr Scoresby, the hue of the Greenland sea varies from ultramarine blue to olive green and from the purest transparency to great opacity The surface of the Mediterranean, in its upper part, is said to have at times a purple tint In the Gulf of Guinea the sea sometimes appears white, about the Maldive Islands black, and near California it has a reddish appearance Various causes cooperate to produce this diversity of tint The prevailing blue colour may be ascribed [illegible] of the blue rays of light which [illegible] perty pass in greatest abundance through the water The other colours are ascribed to the existence of vast numbers of minute animalculæ, to marine vegetables at or near the surface, to the colour of the soil the infusion of earthy substances, and very frequently the tint is modified by the aspect of the sky The phosphorescent or shining appearance of the ocean, which is a common phenomenon is also ascribed to animalculæ, and to semiputrescent matter diffused through the water

*Temperature of the Ocean* — Water being a slow conductor of heat, the temperature of the ocean is much more uniform than that of the atmosphere At a certain distance from the equator it follows, though not very closely the mean temperature of [illegible] latitudes, the solar action being greatly modified by the existence of currents which convey the temperature of one region to another, so that at any place the temperature of the water depends in some measure on the direction of the currents Within the tropics the mean temperature at the surface is about 80° of Fahrenheit, and generally ranges between 77° and 84° At great depths the temperature is probably nearly the same under every latitude In the torrid zone it is found to diminish with the depth, in the polar seas it increases with the depth, and about the latitude of 70° it is nearly constant at all depths But the small number of observations which have yet been made on this subject do not indicate any uniform law, according to which the variation of temperature at different depths is regulated

*Saltness of the Ocean* — The ocean holds in solution a variety of saline matters, of which by far the most abundant is common salt, constituting in general about two thirds of the whole The saltness of sea-water at particular places is influenced by temporary causes—storms, for example, as well as by the neighbourhood of large rivers and permanent accumulations of ice A series of experiments on this subject were made some years ago by the late Dr Marcet, and [illegible] conclusions which he deduced [illegible] Southern Ocean contains more salt than the Northern Ocean in the ratio of 1 02919 to 1 02757 2 That the mean specific gravity of sea-water near the equator is 1 02777 3 That there is [illegible] between sea-water under different [illegible] 4 That there is no satisfactory evidence that the [illegible] is more salt than at the surface 5. That the ocean in general contains more salt where it is deepest and that its saltness is always diminished in the vicinity of large masses of ice 6 That small inland seas, though communicating with the ocean, are much less salt than the ocean 7 That the Mediterranean contains rather larger proportion of salt than the ocean (*Phil Trans* 1817, *Prout's Bridgewater Treatise*)

The peculiar bitter taste of sea water does not appear to belong to it beyond a certain depth, and is ascribed to the vegetable and animal matter held in a state of decomposition near the surface *See* Tides

OCE'ANUS In Greek Mythology, the oldest of the Titans according to some, the son of Ouranos and Gaia. His consort was Tethys his daughters the Oceanides In Homer the word ocean usually designates the "river" or stream which, according to his notion encompassed the earth

OCHLO'CRACY (Gr *οχλος* a crowd and *κρατειν to govern*) A word coined to express the condition of a state in which the populace have acquired an immediate illegal control over the government; and, by a figure

commonly used in the exaggeration of political speakers and writers a government in which the power of the lower classes predominates, either for a time or permanently

O'CHRE (Gr *ὤχρα*) In Painting, a colour prepared from a species of earth It is of various hues as yellow, red, green blue and black The colouring matter of ochre is always oxide of iron

O'CHREA (Lat *a boot*) A name applied to stipules that are membranous, and surround the stem like a vagina or sheath, cohering by their anterior margins, as in *Polygonum*

OCHRE OF IRON A hydrated oxide of iron

OCHROLITE A name given by Klaproth to an earth supposed to exist in the mineral since called cerite

O'CREÆ (Lat), in Roman Antiquities, were a sort of military boots made of tin, and ornamented with gold and silver They were equivalent to the *κνημῖδες* of the Greeks and the greaves of the English *See* GREAVES

*See* OCTOEDRITE

(Gr *ὀκτω eight*, and *ετος, a year*) A cycle or period of eight years, at the lapse of which three lunar months were added This cycle was in use till Meton's invention of the golden number, or cycle of nineteen years

O'CTAGON (Gr *ὀκτω* and *γωνια angle*) In Geometry, a plane figure of eight sides and consequently having eight angles When the sides and angles are equal, it is a *regular* octagon If *a* denote the side of a regular octagon, the area is $a^2 \times 2 \tan 67\frac{1}{2}^\circ = a^2 \times 4.828427$

OCTAGON In Fortification, a place which has eight sides or bastions

OCTA'NDRIA (Gr *ὀκτω* and *ανηρ, a man*) In Botany, that class of plants which has eight stamens

OCTANS In Astronomy *Octans Hadleianus* (Hadley's Octant) one of the constellations formed by Lacaille in the southern hemisphere *See* CONSTELLATION

O'CTANT In Geometry the eighth part of a circle In astronomy, *octant* denotes a position or aspect thus the moon is in her octants when she is in the positions intermediate between her syzygies and quarters or at 45°, 135° 225° and 315° from her conjunction

OCTA'NUS A fever which returns every eighth day

OCTASTY'LOS (Gr *ὀκτω eight* and *στυλος a column*) In Architecture a temple or other building having eight columns in front

O'CTAVE (Lat *octavus*) In Music an harmonical interval, containing five tones and two semitones, called, by the ancient authors, *diapason*

OCTAVE, in Ecclesiastical Antiquities signified the eighth day after a feast the feast day itself included Thus the first Sunday after Easter is the octave of Easter styled *octava infantium* and by other names The Circumcision (Jan 1) is the *octave natalis domini* the octave of Christmas The introduction of octaves is said to have been founded on and borrowed from the Jewish ritual The *octave* of a feast is sometimes called the *Utas* or "the Utas day" thus 'Wrytyn at Norwich on the Utas day of Peter and Powll" (*Paston Letters*, vol iii p 189)

OCTA'VO (Lat) Usually contracted 8vo, that which by a peculiar folding has eight leaves to a sheet

OCTO'BER (Lat *octo*) The eighth month of the old Roman year, which began with March The commencement of the year was transferred by Numa Pompilius to the 1st of January but the months retained their names October is now the tenth month *See* CALENDAR

OCTOE'DRITE A mineralogical name applied to the octoedral oxide of titanium

OCTOHE'DRON (Gr [illegible]) (Geometry) A solid contained under eight equal and equilateral triangles Let

A = the linear edge or side,
B = the whole surface,
C = the solid content,
R = radius of circumscribed sphere,
*r* = radius of inscribed sphere,

then,

$A = r\sqrt{6} = R\sqrt{2} = \sqrt{(\frac{1}{6} B \sqrt{3})} = \sqrt[3]{(\frac{3}{4} C \sqrt{2})}$
$B = 12 r^2 \sqrt{3} = 4 R^2 \sqrt{3} = 2 A^2 \sqrt{3}$
$C = 4 r^3 \sqrt{3} = \frac{1}{3} R^3 = \frac{1}{12} A^3 \sqrt{2}$
$R = r\sqrt{3} = \frac{1}{4} A \sqrt{2} = \frac{1}{4} \sqrt{B \sqrt{\frac{1}{3}}} = \sqrt[3]{\frac{3}{4}} C$
$r = \frac{1}{4} R \sqrt{3} = \frac{1}{12} A \sqrt{6} = \frac{1}{4} \sqrt{(B \sqrt{3})}$

O'CTOPODS (Lat *Octopoda*) (Gr *ὀκτω, eight*, *πους, a foot*) The name of Dibranchiate Cephalopods, including those which have only eight feet or cephalic tentacular appendages, also of a sub-order of Apterous insects including those which have eight feet, as the Tracheary Arachnidans

OCY'THOI (Gr *ωκυς, swift*, and *θεω, I run*) The name applied by Rafinesque to a naked Cephalopod, supposed to be that which inhabits and constructs the argonaut shell

O'DALISQUES, properly ODALIKS (Turkish oda, *a chamber*) Female slaves employed in domestic service about the persons of the wives, female relatives, &c of the sultan

ODD NUMBER In Arithmetic, any number not divisible by 2 without remainder, the series of odd numbers is 1, 3, 5, 7, 9, &c, and the algebraic form by which they are expressed is $2n + 1$ Every prime number, excepting 2, is an odd number. The differences of the successive terms of the series of square numbers produce the odd numbers

ODE (Gr *ωδη, a song*), among the Greeks and Romans, was a short lyric composition, usually intended to be sung, and accompanied by some musical instrument, generally the lyre, hence the expression lyric verse In the modern sense of the word the ode appears to be distinguished from the song by greater length and variety, and by not being necessarily adapted to music It is distinguished also from the ballad, and other species of lyric poetry, by its being confined to the expression of sentiment or of [illegible] subject, not admitting of narrative, except [illegible] The odes of Pindar Anacreon, and Horace, are, in fact, the models on which the modern notion of the ode is formed, and which have been imitated in similar compositions in modern times Until the science of Greek metres was so accurately explored as it has recently been, the Pindaric ode was supposed to admit of an excessive irregularity in the length and measure of lines, and hence the Pindaric odes of the last and preceding century are constructed on a system of absolute licence in this respect In point of fact, however a scheme of perfect metrical regularity pervaded the Greek ode both in Pindar and in the dramatic choruses, in which a strophe, or succession of lines in varied metre, is exactly answered in the antistrophe or corresponding series On the other hand, the Anacreontic ode consists of a number of lines of the same metrical length and arrangement The Horatian ode, again is generally constructed on a different system, of which we have only a few instances in Greek, in the Fragments of Alcæus and Sappho it consists of an indefinite number of stanzas, precisely similar to each other, each forming a complete metrical whole (*See* METRE) The Dithyrambic ode (quod vide) was a bacchanalian song, and as from the attributes of the divinity to which it was dedicated, it admitted great irregularity and licence, the name has been transferred in modern times to all odes [illegible] a wild and impetuous character

ODELITE A variety of black mica from Sweden is so called

ODI'UM or ODEON (Gr *ωδη, a song*) In ancient Architecture a building wherein the poets and musicians contended for the prizes, both in vocal and instrumental music Pericles, who was the first person to erect one of these buildings at Athens, instituted it for the choragi of the different tribes to rehearse their performances, but these buildings in the end were used for far different purposes from those for which they were originally destined An odeum was to be found in all the principal cities of antiquity The word odeon has been preserved in most modern languages thus there is an odeon in Paris, appropriated to theatrical and other similar purposes, and in Munich there is a concert-room with this name

O'DIN A Scandinavian deity, who seems like the Jupiter of the Greeks to have formed the connecting link between the ancient and more recent systems of their mythology The conqueror Odin appears to have been a chieftain who led the Asi (the Goths) from the confines of Asia to northern Europe But, when deified by public adoration the attributes of an earlier deity seem to have been transferred to him Odin is the chief of the gods by his wife Freya he has two chief sons, Thor and Balder the death of the latter (for the Scandinavian gods are not all immortal) furnishes many legends to the northern mythology, and is known to English readers by Gray's translation *The Descent of Odin* (See this article in the *Conv Lex*, and in the *Encycl* of Ersch and Gruber) The more ancient Odin among the Romans, was regarded as the representative of their god Mercury *See* WODAN

ODO'METER (Gr *οδος, a road* and *μετρον, measure*) An instrument attached to the wheel of a carriage by which the distance passed over is measured *See* PERAMBULATOR

ODONTA'LGIA (Gr *οδους, a tooth*, and *αλγος, pain*) The toothache

ODONTO'LOGY (Gr *οδους*, and *λογος, a discourse*) The branch of anatomical science which treats of the teeth *See* DENTES.

O'DORIN One of the products of the redistillation of the volatile oil obtained by distilling bone, it has a very concentrated and diffusible empyreumatic odour, and is regarded by Unverdorben as a peculiar salifiable base

O'DYSSEY (Gr *Οδυσσεία*) An epic poem, attributed, in general to Homer but [illegible] supposed not by the hand of [illegible]

subject of the poem is the return of Ulysses (*Ὀδυσσεύς*) from Troy to his native island Ithaca.

ŒCO'NOMY (Gr *οἶκος a house*, and *νέμω, I distribute*) In Architecture, the harmonious and skilful combination of the parts of a building, which renders them suitable to their several purposes, and tends to connect them conveniently with each other

ŒCUMENICAL (Gr *οἰκουμένη*, scil *γη, the inhabited earth* used in the New Testament) In the Greek language applied to ecclesiastical matters in the sense of universal Several patriarchs of Constantinople and Rome assumed the title of œcumenical (particularly John A D 590, and Cyril, his successor) to express their opposition to the pretensions of the bishop of Rome (from whose [illegible] prelates resorted from every part of Christendom under the jurisdiction of the Roman empire (Palmer, *Church of Christ*, vol ii p 150) *See* Council

ŒCUS (Lat) In Ancient Architecture, an apartment [illegible] ing room

ŒDEMA (Gr *οἰδάω, I swell*) A puffiness or swelling of parts, arising from water collecting in the cellular membranes

ŒDIPUS A personage renowned in the early or mythological stage of Grecian history the son of Laius and Jocasta An oracle had warned Laius that he should be killed by his son in consequence of which he caused the child to be exposed, with one of its feet pierced and fastened with a thong (from which circumstance he was accordingly derived from the swelling of the foot) The slave entrusted with him carried the child to Polybus, king of Corinth, and deceived Laius with a false report Œdipus, when grown up, slew, in ignorance his father Laius, acquired the sovereignty of Thebes, after conquering the Sphynx and married his mother Jocasta On becoming acquainted with their fatal destiny Jocasta killed herself and Œdipus deprived himself of sight Such is the outline of the story familiar to us by the noblest efforts of the Greek tragedians The tale of Œdipus himself affords the subject of two tragedies of Sophocles the first (*Œdipus Tyrannus*), the most perfect example of dramatic *skill* which antiquity has left us, the second (*Œdipus at Colonus*), perhaps the most beautiful of ancient dramatic *poems* The fate of his offspring is portrayed in several of the remaining dramas of the three great tragedians The miseries inflicted on Œdipus seem to us to be wholly undeserved, and of a kind that it is impossible to approve He was a mere passive instrument in the hands of Fate or Destiny, and was not morally culpable for the death of his father or the marriage of his mother The acts, in fact were the acts of the gods and not of Œdipus In themselves they were bad, but as he was totally ignorant of and did not intend them, he is no more to be blamed than a dagger in the hand of an assassin is to be blamed for the murder And hence there can be no real sympathy with the miseries inflicted on Œdipus and still less with those entailed on his offspring, who are made to suffer without cause or reason of any kind

ŒNANTHE CROCATA In Botany the name given to the hemlock dropwort a poisonous plant growing in Pembrokeshire. It is called by the inhabitants of the country *fine fingered root* and has some reputation as a remedy in diseases of the skin

ŒNOMANCY (Gr *οἶνος wine* and *μαντεία prophecy*) A mode of divination among the Greeks, from the colour, sound, &c of wine poured out in libations

ŒNOTHIONIC ACID (Gr *οἶνος*, and *θεῖον sulphur*) The acid which is formed during the action of sulphuric acid upon alcohol Sertuerner gave it the above name it is the sulphovinic acid of Vogel and other chemical writers

ŒSOPHAGUS (Obs Gr *οἶσω, to carry* and *φαγω I eat*) The tube by which food is conveyed from the posterior part of the mouth, or *pharynx*, to the stomach The gullet

ŒSTRUS (Gr *οἶστρος, a gad fly*) The name of a genus of Dipterous insects, some of which lay their eggs in the skin of quadrupeds, which they pierce for that purpose, others near the nose, up which the larvæ creep to the frontal sinuses The flies of an allied genus (*Gasterophilus*) attach their eggs to the hairs in situations where they can be licked off and swallowed, when, their vitality protecting them from the action of the gastric juice, they are hatched in the stomach, and the larvæ attach themselves to the inner membrane, forming what are called 'bots" in the horse

OFFERINGS Literally, gifts presented at the altar in token of acknowledgment of the divine goodness Offerings constituted a large portion of the Jewish worship They consisted chiefly of bread, salt, fruits wine and oil, and had different names according to the purposes for which they were employed A distinction has often been made between offerings and sacrifices (*see* SACRIFICE), the former being said to refer only to the fruits of the earth, the latter to animals, but this can scarcely have been the case, for both the burnt and the sin offering required animals to be sacrificed. Among the Greeks, Romans and other nations, the same practice prevailed of offering at their altars wheat flour, and bread In a modern sense the term *offering* is [illegible] payable by custom to the church [illegible] sc This latter custom has obtained from the first period of Christianity when those who officiated at the altar had no other maintenance or allowance than the free gifts or [illegible] the people

[illegible] first part of the Mass, in which the priest prepares the elements for consecration In the English communion service it denotes the sentences which are delivered by the officiating priest while the people are making their oblations or offerings (See Palmer, *Orig Liturgicæ*)

OFFICE FOUND In English Law, an inquiry executed by some officers of the crown, when certain events have occurred in consequence of which the crown becomes entitled to take possession of real or personal property Such are the finding of treasure under certain circumstances the intestacy of a bastard, &c The verdict of a coroner's jury of felo de se" is an instance of office found, on which the crown is entitled to take possession of the effects of the deceased

OFFICER is used generally to signify any person in the enjoyment of a post or office whether civil or military under the crown Under their different heads will be found a notice of the chief civil and military officers, to these the reader is referred

OFFICIAL In the Canon Law, the deputy or lieutenant of a bishop, abbot &c, or an ecclesiastical judge appointed by them The principal official of the bishop is his chancellor whose jurisdiction is coextensive with the diocese An *officialis foraneus* (styled in English law commissary) is appointed to part of a diocese when large The court of the official is styled in the canon law his *officiality*

OFFICINAL In Pharmacy, such medicines as are directed by the Pharmacopœia to be kept ready for use in the apothecaries shops

OFFING A Nautical term denoting a part of the sea at a considerable distance from the shore where there is deep water

OFFSET In Architecture, the superior surface left uncovered by the continuation upwards of a wall where the thickness diminishes forming a ledge

OFFSETS in Surveying are short distances from the chain-line usually measured with a rod called an offset staff the most convenient length for which is 6 feet 7 2 inches, being equal to 10 links of the surveying chain *See* SURVEYING

OFFSETS In Gardening young radical bulbs when separated or taken off from the parent roots are so called One of the chief methods of propagating plants is by offsets *See* PROPAGATION OF PLANTS

OGEE In Architecture, the same as *cyma reversa* see that art and MOULDING

OGHAMS A peculiar kind of short-hand writing in use among the ancient Irish It consisted of certain lines and marks which derived their power from their situation and position as they stood in relation to one horizontal principal line over or under which they were placed or through which they were drawn, the characters or marks, according to their position, standing in the place of vowels, consonants diphthongs &c (See the elaborate article in *Rees's Cyclopædia*)

OGIVE (Itym uncertain) In Architecture, the term used by the French for the pointed arch

OGRES (Fr) The well known name of those imaginary monsters with which the nursery tales of England abound They are usually represented as cannibals of malignant dispositions, and as endowed with gigantic height and power It is difficult to speak with certainty of the origin of these fabulous creations, but it is probable that the term ogre is derived from Oegir, one of the giants in the Scandinavian mythology (see *Grimm's Deutsche Mythologie* p 146), though it has been alleged, with perhaps more [illegible] been borrowed from the Ogurs o [illegible] and savage Asiatic horde, which overran part of Europe ab [illegible] th century

OGYGIAN DELUGE The name given to a great inundation mentioned in fabulous history, supposed to have taken place in the r[illegible] of O[illegible] Attica, whose death is fixed in *Blair's Chronology, Tables* in the year 1764 before Christ *See* DELUGE

OIL GAS The inflammable gases and vapours (chiefly *hydrocarbons*) which are obtained by passing fixed oils through red-hot tubes, and which may be used as *coal gas*, for the purposes of illumination, it yields a more brilliant light than the latter, but is too expensive to be generally adopted The apparatus for the production of oil gas is described in the *Quarterly Journal*, vol viii A gallon of common whale oil yields from 90 to 100 cubical feet of gas, and an Argand burner, giving the light of six or seven wax candles, consumes from 1½ to 2 cubical feet per hour, whereas, to produce the

same light, from 5 to 6 cubic feet of coal gas are required

**OIL OF BRICKS** A term applied by the old chemists to the empyreumatic oil obtained by subjecting a brick which has been soaked in oil to the process of distillation at a high temperature This oil is used by lapidaries as a vehicle for the emery by which stones and gems are sawn or cut

**OIL OF VITRIOL** *See* SULPHURIC ACID

**OIL-PAINTING** Painting in which the medium for using the colours is oil It is said to have been unknown to the ancients, and not used earlier than the 14th century, its invention being attributed to John Van Eyck, sometimes called John of Bruges By him it was supposed to have been imparted to one Antonio da Messina, who first brought it to Venice Giovanni Bellini, by a stratagem got possession of the secret and made it publicly known Oil is the vehicle used in painting pictures of all kinds, and is executed in a manner and with colours peculiarly adapted to it The various colours chiefly used in oil painting are white lead Cremnitz white chrome yellow Naples and patent yellow, the ochres Dutch pink, terra da Sienna, yellow lake, vermilion, red lead, Indian and Venetian red the several sorts of lake, brown pink, Vandyke brown, burnt and unburnt umber ultramarine, Prussian and Antwerp blue ivory black blue black asphaltum The principal oils are those extracted from the poppy, nut, and linseed With the latter driers are introduced

**OILS** (Germ oehle) The term oil is applied to two dissimilar and distinct organic compounds which are usually called *fixed* oils and *volatile* oils The fixed or fat oils are either of vegetable or animal origin, they are compounds of carbon, hydrogen, and oxygen, the relative proportions vary but little in the several species The following analyses of olive and spermaceti oil may be assumed as types of the rest —

| | Olive Oil | Spermaceti Oil |
|---|---|---|
| Carbon - - | 772 | 780 |
| Hydrogen - - | 133 | 118 |
| Oxygen - - | 95 | 102 |
| | 1000 | 1000 |

The *fixed oils* abound in the fruit and seed of certain plants, they are lighter than water unctuous and insipid or nearly so, some of these require a low temperature for their congelation, such as linseed oil, others, such as olive oil, concrete at a temperature higher than the freezing point of water, some are solid at common temperatures, such as cocoa nut oil Some of these oils when exposed to air absorb oxygen, and gradually harden forming a kind of varnish, these are called *drying oils* and are the basis of paints, such as linseed oil, others become rancid, as almond oil All these oils, like the different kinds of fat, consist of two proximate principles called *stearine* and *elaine* the former is the fatty portion which first concretes on cooling the oil and from which the elaine or oily portion may be separated by pressure These oils cannot be volatilized without decomposition At a red heat they are resolved into volatile and gaseous products, among which carburetted hydrogen in several of its forms, predominates, hence the use of these oils when volatilized and burned by the aid of a wick, as sources of artificial light The action of the alkali on the fat oils is highly important as forming soap

The *volatile oils* are procured obtained by distilling the vegetables which afford them with water, they fluctuate in density a little on either side of water they are sparingly soluble in water, forming the perfumed or medicated waters, such as rose and peppermint water, they are mostly soluble in alcohol, forming essences A few of them, such as oil of turpentine, of lemon peel of copivi balsam, &c, are hydrocarbons, that is consist of carbon and hydrogen only, the greater number however contain oxygen as one of their ultimate elements They are chiefly used in medicine and in perfumery, and a few of them are extensively employed in the arts as vehicles for colours and in the manufacture of varnishes, this is especially the case with oil of turpentine

**OISANITE** An ore of titanium, from the department of Oise

**OLD MAN OF THE MOUNTAIN** The chief of the band Assassins* who established themselves in the mountainous district of Kohistan in Persia, in the 11th century, was so called *See* ASSASSINS

**OLD RED SANDSTONE** A series of rocks interposed between the mountain limestone and slates (*See* GEOLOGY) It is included in *Murchison's Devonian System of Rocks*

**OLD TESTAMENT** The name given to that part of Scripture which contains the collected works of the inspired writers previously to the advent of our Saviour. The period of their being collected is unknown Some of them were in existence before the Babylonish captivity (600 years B C), others were collected at a later period, and the collection as it at present stands was completed in the second century before Christ. The Jews divided the Old Testament into the Law, the Prophets and other writings known by the name Hagiographa, of which the Psalms were at the head The contents of the Old Testament may be conveniently divided into the Historical Books, of which there are 17, the Poetical, of which there are 5, and the Prophetical, of which there are 16, distinguished into the books of 4 greater and 12 minor prophets The Historical Books include the Pentateuch, the Book of Joshua, Judges, Ruth, 2 Books of Samuel, 2 Books of Kings, 2 Books of Chronicles, the Book of Ezra, of Nehemiah, and of Esther, the Poetical Books include the Book of Job, the Psalms, the Proverbs, Ecclesiastes, and the Song of Solomon, and the Prophetical comprise (of the greater) Isaiah, Jeremiah, Ezekiel, and Daniel, and (of the minor) Hosea, Joel, Amos, Obadiah, Jonah, Micah, Nahum, Habakuk, Zephaniah, Haggai, Zachariah, and Malachi *See* BIBLE TESTAMENT, PROPHETS, PSALMS, &c

**OLEA'CEÆ** (Olea, one of the genera) The natural order of plants which contains the olive tree and the ash, it consists of trees or shrubs inhabiting the temperate parts of the world and distinguished from others by their flowers being monopetalous and diandrous, with a valvate astivation *See* OLIVE

**OLECRA'NON** (Gr ὠλενη, *the ulna*, and κρανον, *the head*) The head of the ulna The process of the ulna which forms the elbow

**OLEFIANT GAS** This variety of carburetted hydrogen is obtained by heating a mixture of two measures of sulphuric acid and one of alcohol It is of somewhat less specific gravity than atmospheric air, 100 cubic inches weighing 30·5 grains It burns with a bright white flame, and produces during combustion such proportions of carbonic acid and water as show that 1 volume of the gas is constituted of 2 atoms or volumes of hydrogen and 2 atoms of carbon hence the equivalent of olefiant gas is $(2h + 12car) = 14$ When 2 volumes of chlorine are mixed with 1 of olefiant gas and inflamed, hydrochloric acid is formed, and the charcoal of the gas makes its appearance in the form of dense black soot If the mixture, instead of being kindled be left standing over water, it soon condenses into a liquid looking like oil (hence the term *olefiant gas*), which is a hydrochloride of carbon It has an aromatic odour, not unlike that of oil of caraways

**OLEIC ACID** The product resulting from the action of alkalies upon the *elaine*, or liquid part of oils and fats

**OLEIN** *See* ELAIN

**OLEON** A peculiar liquid obtained by the distillation of a mixture of oleic acid and lime

**OLEON LAWS OF** *See* MARITIME LAW

**OLFACTORY NERVES** (Lat oleo, *I smell*, and facio *I cause*) The nerves of smell The first pair of nerves They arise from the part of the brain called the *corpora striata*, and, perforating the ethmoid bone, are distributed over the mucous membrane of the nose

**OLIBANUM** A gum resin, imported from the Levant, in yellowish white and nearly opaque drops or tears, it has a bitterish flavour and has been used in medicine When burned it exhales rather an agreeable odour and is sometimes called *frankincense* It is either the produce of the *Juniperus lycia*, or of the *Boswellia serrata*

**OLIGARCHY** (Gr ὀλιγοι, *few*, and ἀρχειν, *to govern*) A state in which the sovereign power is lodged in the hands of a small exclusive class is so called It differs from aristocracy, in that the latter term appears to designate a government in which the whole of a particular class or interest, as the noble the wealthy &c, share directly or indirectly in the management of public affairs while in an oligarchy, it is a party or section formed out of one of these classes which enjoys the advantages of government

**OLIVA** (Lat oliva, *an olive*) A genus of Pectinibranchiate Gastropods dismembered from the *Voluta* of Linnæus, and so called on account of the long and elliptical shape of the shell The aperture is narrow, long, and notched opposite to the spire, which is short; the folds of the columella are numerous, and resemble striæ The animal has a large foot the anterior portion of which is marked off by an incision on each side The horns or tentacula are slender and the eyes are on the middle of their outer side The proboscis and the breathing tube are tolerably long, there is no operculum The species of *Oliva* rival the cowries in beauty

* There are few words which have undergone more changes in their signification than the word assassin In the Latin of the middle ages the form assassinus is found in the sense of a cutthroat, a murderer, and the Italian assassino has the same meaning The French assassin, however, has a more limited signification, and is applied to those only who murder from motives of gain, or who kill by lying in wait, or by surprise Dr Johnson, in his remarks, which are in many instances very unjust, has censured Addison for using assassin in a different sense from that in which it is used at another Assassin implies, in point of fact, an hired murderer (Spectator, vol 24)

O'LIVE (Lat olea ) A genus of trees belonging to the Diandria Monogynia class of plants The *Olea Europæa* has an upright stem, with numerous branches, grows to the height of twenty or thirty feet and differs from most trees in yielding a fixed oil from the pericarp instead of from the seed The olive tree has in all ages been held in peculiar estimation, and some authors have styled it a 'mine upon earth' It was sacred to Minerva Olive wreaths were used by the Greeks and Romans to crown the brows of victors and it is still universally regarded as emblematic of peace The olive flourishes only in warm and comparatively dry parts of the world, as the south of France and Spain, in Italy Syria, and the north of Africa, and though it has been raised in the open air in this country, its fruit did not ripen The fruit is a smooth oval plum, about three quarters of an inch in length and half an inch in diameter, of a deep violet colour when ripe, whitish and fleshy within, bitter and nauseous, but replete with a bland oil Olives intended for preservation are gathered before they are ripe In pickling the ... is to remove and to preserve them green by impregnating them with a brine of aromatized sea salt; and for this purpose various methods are employed But it is chiefly for the sake of its oil that the olive tree is cultivated Olive oil is pale yellow its density is 910 When fresh, and of fine quality, it is almost tasteless, having only a very slight and agreeable nutty flavour It is less apt than most other fixed oils to become viscid by exposure and hence is preferred for greasing clock and watch-work It is largely used as an article of food It is the principal article of export from the kingdom of Naples The quantity of olive oil imported into England during 1850 amounted to nearly 21,000 tons There was formerly a duty of eight guineas a ton on olive oil In 1842 this was changed to a discriminating duty of 2*l* and 4*l*, but it is now admitted free (See *Dict of Commerce*, &c )

O'LIVILE A peculiar amylaceous or crystalline substance obtained from the gum of the olive tree

O'LIVINE A variety of *chrysolite* containing oxide of iron, of an olive green colour It is sometimes found associated with meteoric iron

O'LLA PODRI'DA (Span *putrid mixture* ) The name given to a favourite dish of all classes in Spain, consisting of a mixture of all kinds of meat cut into small pieces, and stewed with various kinds of vegetables The epithet *podrida* is applied to this dish in consequence of the poorer classes being obliged to serve it up so often that the odour arising from long keeping is far from agreeable The phrase *olla podrida* is often used metaphorically in England for any incongruous melange

OLY'MPIAD (Gr ὀλυμπιάς ) In Chronology, a Grecian epoch of four years being the interval between the celebration of the Olympic games

The Olympic games so famous in Grecian history were said to have been instituted about 1354 years before the Christian era, but, having fallen into disuse they were revived by Iphitus king of Elis 844 years B C About a hundred years later the practice was introduced of designating the Olympic period by the name of the victor The first who received the honour was Corabus and the commencement of the Olympiad of Corabus forms the principal era of Grecian chronology The games in which he was victor were celebrated about the time of the summer solstice, 776 years before the era of the incarnation, in the 3938th of the Julian period and 23 years according to the reckoning of Varro before the foundation of Rome Before the introduction of the Metonic cycle the Olympic year began sometimes with the full moon which followed, sometimes with that which preceded the summer solstice Subsequent to the introduction of that cycle, the year always commenced with the eleventh day of the moon which followed the solstice and it is usually regarded as beginning on the first day of July It is necessary to observe, in the comparison of dates, that as the Olympiads begin about the 1st of July, the first six months of a year of our era correspond to one Olympic year, and the second to another The first year of the first Olympiad began 776 years and six months before our era; hence, in order to reduce the date by Olympiads to our era, the rule is this — Multiply the number of the past Olympiad by four, and add the odd years, subtract the sum from 777 if before Christ or subtract 776 from the sum, if after Christ the remainder will be the year before Christ or after Christ, if the event happened in the first six months of the Olympic year, that is, between July and January, but if the event happened in the last six months of the Olympic year, or between January and July the remainder in either case must be diminished by one For example, — the foundation of Rome (according to Varro) was laid in the 3d year of the 6th Olympiad, and 10th month of that year; required the date Here 5 complete periods are elapsed therefore $5 \times 4 + 3 = 23$, and $777 - 23 = 754$ which being diminished by one gives 753 B C for the date The month corresponds to April



The method of computing time by Olympiads did not come into use till after the death of Alexander; and first appears in the Parian Chronicle, which was engraved about sixty years after that event. The first historian who used it was Timæus Siculus who wrote a few years later About 200 years B C Eratosthenes of Alexandria digested a chronological table of the Olympiads

OLYMPIC GAMES The greatest of the national festivals of Greece, celebrated once every four years at Olympia or Pisa in Elis ... of Olympian Jupiter ... Pelops ... Hercules ... but it appears that they had ... were revived by Iphitus, 776 B C From this period it is that the Olympiads are reckoned Like the other public festivals, the Olympian games might be attended by all who bore the Hellenic name, and such was their universal celebrity that spectators quaternally crowded to witness them, not only from all parts of Greece itself, but from every Grecian colony in Europe, Asia and Africa In these games, none were allowed to contend but those who could prove that they were freemen of genuine Hellenic origin, and unstained by crime or immorality The superintendence of these games belonged sometimes to the Pisans but for the most part to the Eleans, by whom the Pisans were destroyed On one occasion in the 104th Olympiad, the management was forcibly seized on by the Arcadians The contests at these games consisted in the athletic exercises and also in those of music and poetry The victors were crowned with garlands of wild olive (See *West's Pindar*, *Thirlwall's Greece*, vol i 384, and the other authorities ) The place where these renowned games were celebrated is a plain, now called Anti-Lalla opposite the little town of Lalla They commenced a little after the summer solstice, on the 14th of the Attic month Hecatombæon

O'MBRIA (Gr ὄμβρος rain ) A name formerly applied to certain fossil Echini under the supposition of their ... from the clouds

OMBRO'METER (Gr ὄμβρος rain, and μέτρον measure ) A name sometimes given to the rain gauge See RAIN GAUGE

O'MELET A pancake or fritter made of eggs, common in Spain France and Germany

O'MENS Casual indications from which men believe themselves enabled to conjecture or foretel future events The essential characteristic of all omens is their happening by accident, and it is this which distinguishes them from all other modes of divination This branch of superstition seems nearly as ancient as the world itself, and in none do we find such remarkable indications of sameness of origin Many external circumstances appear to be received in almost all countries as ominous One of the most remarkable instances of this coincidence is mentioned in a recent number of the *Edinburgh Review* The omens in which the Thugs or secret murderers of India believe with peculiar devotion, are almost the very same which an ancient Roman would have observed with equal attention, especially the appearance of animals on the right or left hand In classical antiquity however omens appear to have multiplied and to have been the subjects of more curious superstition in later than in earlier ages There are numberless omens in Homer but they ... the simplest description —thunder and ... of some sacred birds especially as some ... erved, those which have the highest flight and might be supposed to have arrived immediately from the throne of Jove himself Omens among the Greeks (and, we may add among almost all nations in periods of ignorance, and among the vulgar of the present day), may be divided into three classes those derived from natural occurrences relating to inanimate objects lightning earthquakes phosphoric appearances &c, those derived from animals especially birds the region of their appearance, their voices &c, and those which the individual drew from sudden sensations of his own Sneezing in most times and countries, has been a peculiarly ominous occurrence The Romans, as is well known, carried the science of omens to a very profound depth the flight of birds was the main element in *augury*, the omens afforded by the entrails of sacrificed animals in the learning of *extispicium* One remarkable variety between Greek and Roman divination has often been noticed the right hand in the former generally denoted good luck and the left the contrary Among the Romans this rule was reversed, although their writers in later times often adopt the ... See AUGURS

OME'NTUM ... from Lat omen, because the *soothsayers* prophesied from its inspection ) The membrane is formed of a duplicature of the peritoneum and encloses more or less fat It is attached to the stomach and lies on the anterior surface of the intestines

O'MNIBUS (Lat *for all* ) The name given to a peculiar kind of public carriage, too well known to require to be described, which takes a number of passengers at a cheap common rate They were first introduced

into Paris in 1825, whence they were introduced into London in 1829, and they are now to be met with in almost every large town both of this country and the Continent

O'MNIUM In France, a term used at the Stock Exchange to express the aggregate value of the different stocks in which a loan is now usually funded (See *Investments*, *Funds*, *Consols*, &c.)

OMNIVO'RIA (Lat. omnis, *all*, and voro, *I eat*.) The name given by Temminck to an order of birds, including those insessorial species which feed on both animal and vegetable substances; as the starling

OMOHYOI'DEUS A muscle which pulls the os hyoides obliquely downwards; it is sometimes called the coracho-hyoideus, as it arises from the superior costa of the scapula and is inserted into the base of the os hyoides

OMPHALO'DIUM (Gr. ομφαλος, *the navel*.) The centre of the hilum of a seed, through which the nourishing vessels pass from the placenta into the seminal [illegible]

OMPHALO'TOMY (Gr. ομφαλος, and τεμνω, *I cut*.) The division of the navel string.

ONAGRA'CEÆ (*Onagra*, an old name for the genus *Œnothera*.) An extensive natural order of Polypetalous Exogenous plants, very common in gardens, where they are much valued for the beauty of their flowers. They are known by all the parts of their flowers being arranged in fours. The genera *Fuchsia* (*Enothera*, and *Epilobium* are common illustrations of the order.

ONEIROCRI'TICS, or ONEIROCRITICAL SCIENCE (Gr. ονειρος, and κρινω, *I judge*.) The science of interpreting dreams; treated of by Artemidorus, Macrobius, and other classical writers, by Thomas Aquinas, and others of the schoolmen; and among many other moderns, by Cardanus and Mago a Neapolitan philosopher. According to all these writers, the secret of oneirocritical science consists in the relation supposed to exist betwen the dream and the thing signified, but they are far from keeping to the relations of agreement and similitude, and they frequently have recourse to others of dissimilitude and contrariety.

ONEIRODYNIA (Gr. ονειρος, and οδυνη, *pain*.) Disturbed dreams, including the nightmare and somnambulism.

ONISCI'DÆ The name of a family of Isopodous Crustaceans, of which the wood louse (*Oniscus*) is the type.

O'NOMANCY or ONO'MOMA'NCY (Gr. ονομα *a name* and μαντια *prophecy*.) A species of divination from the letters of a person's name. Many fancies of this sort were current among the ancients, such as that names in which the numeral letters amounted to the highest sum were most lucky.

ONOMA'STICON (Gr. ονομα.) A work containing words or names with their explanation arranged in alphabetical or other order, a dictionary, commonplace book, &c. The best known work under this title is the *Onom* of Julius Pollux in ten books, a valuable repertory of ancient philological learning.

ONOMATOPŒI'A (Gr. ονομα *name*, ποιεω *I make*.) Literally the making or manufacture of names, a word expressing by its sound the thing represented. In most languages the cries of animals are thus expressed, and the line of Aristophanes,

Ὁ δ' ηλιθιος αντις προβατον βη Ζη λεγων βαδιζει

shows that the modern Greeks have not correctly retained the sound of the eta (which they pronounce like our *e*), as the sound imitated from nature would not be thus represented. Ennius imitated the sound of a trumpet by the word *taratantara*, and to represent the croaking of frogs Aristophanes used βρεκεκεξ κοαξ κοαξ (*Frogs*, l. 209.) Greek and German are peculiarly rich in words of this description. M. Charles Nodier has published a dictionary of those in French (*Dictionnaire des Onomatopées Françaises*.)

ONTO'LOGY (Gr. των ὄντων, *being*, [illegible] conditions. *See* METAPHYSICS.

ONY'CHIA (Gr. ονυξ *the nail*.) A whitlow.

ONYCHOTEU'THIS (Gr. ονυξ *a claw*, τευθος, *a calamary*.) The name of the genus of Calamaries in which the suckers of the cephalic appendages are armed with a hook.

O'NYX A regularly banded agate, much prized for cameos, especially where the colours are very distinct and opposed. Any stone exhibiting layers of two or more colours strongly contrasted is called an onyx.

O'NYX In Surgery, an abscess of the cornea of the eye so called from its resemblance to the stone termed an onyx.

O'OLITE. (Gr. ωον, *an egg*, and λιθος, *a stone*.) A granular variety of carbonate of lime, frequently called *roestone*. The frequency of the occurrence of this particular form of limestone in a great series of deposits, lying between the subcretaceous formations and the new red sandstone, has caused English geologists to give the whole series the name of oolitic. It is largely developed in England and France. *See* GEOLOGY.

OOZOA (Gr. ωον *an egg*, ζωον *animal*.) A name applied by Thomas and Carus to [illegible] division of the animal kingdom, including those [illegible] with the nervous and sanguiferous systems are incompletely developed, and in which the organization resembles the simple condition of the ovum of the higher classes. This [illegible]

O'PACITY (Lat. *opacus*, *dark*.) In Optics, that quality of bodies which renders them opaque or incapable of transmitting light. According to the Newtonian theory of light, opacity in natural bodies arises from the multi[illegible] parts. Newton [illegible] the [illegible] of a medium entirely void, or filled with some subtle matter of a different density from the body. If light enters such a body, and experience proves that it does penetrate the surfaces of [illegible] to the light will again escape from the surface. On this hypothesis, Sir J. Herschel remarks, that unless we admit a cause of opacity in atoms different from that which causes it in their aggregates, the atoms cannot be otherwise than absolutely pellucid, since no reflections can take place where there are no intervals, and no change of medium. Of the sufficiency of this cause, either in natural bodies or atoms, there does appear, he adds, some room for doubt, as it seems difficult so to conceive their internal reflections that the rays subjected to them shall be *all* and *for ever* returned, entangled, as it were, and running their rounds from atom to atom, without a possibility of reaching the surface and escaping, which, were they to do, it is evident that every body so constituted receiving a beam of light would in fact only dispose it in all directions in the manner of a self-luminous one. (*Ency. Metr.* art. "Light.")

O'PAL A beautiful mineral characterized by its iridescent reflection of light; it is very brittle. It consists of silica, with about 10 *per cent.* of water. *Common opal* in some of its characters resembles the preceding, but it has no play of colours, and is abundant, the former being a very rare mineral. Opal is found in different parts of Europe, but particularly in Hungary; in the East Indies, &c. (For some curious details as to this stone, see *Plin. Hist. Nat.*, lib. 37. c. 6.)

OPALI'ZED WOOD Wood petrified by silica, and acquiring a structure resembling common opal.

O'PEN FIELD LAND A [illegible] by hedges or other fences, and in [illegible] individuals or under different crops. In former times, only those parts of a farm which lay around the farmyard were enclosed, while the more distant parts were open and called open fields, or out fields.

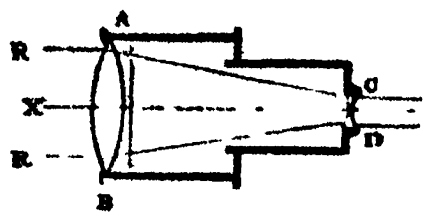
O'PENINGS In Architecture, the piercings or unfilled parts in a wall, left for the purpose of admitting light, air, &c.

O'PERA (Ital. *work*.) A musical drama, in which the music forms an essential part, and not merely an accompaniment. The whole dramatic art of the ancients possessed much of an operatic character. The choric parts were sung, and if the dialogue was not carried on in the musical tone termed *recitative* in modern times, it was certainly delivered in an artificially raised and sustained key very different from the ordinary or oratorical speech. The first operas in modern times were performed in Italy about the end of the 15th century. The *Orpheo* of Politziano has been cited as the first complete piece of this sort. Jean Antoine Baif introduced the opera into France, where the earliest representation of this kind is said to have taken place at the marriage of the Duc de Joyeuse, in 1582. In 1707 the opera of *Arsinoe* consisting of English words adapted to Italian airs was performed at Drury Lane, and a succession of entertainments of this kind terminated in the Italian opera. The first attempt at a wholly [illegible] was made by Sir William D'Avenant in 165[illegible] is divided into *seria* and *buffa* according to the subjects and the character of the music, and between the limits of both there is a third species or *mezzo stile*, not very accurately definable. The opera, properly speaking admits only of singing and recitation although in some of the German operas dialogue is also introduced. The romantic opera, which is considered as a German invention, is a compound between the two Italian species. Metastasio in Italy, and Goethe in Germany, have both written for the opera; but these are splendid exceptions, and the poetry has, in most instances, been held entirely subservient to the music. At the beginning of last century the opera, on its more general introduction into France and England, was attacked as an absurdity by almost all the wits and critics of the day. There were not, however, wanting defenders of this favourite child of the gay and fashionable world, and foremost among

them was Voltaire, to whose apology for the opera, in the preface to his tragedy of *Œdipe*, we take leave to refer the reader

OPERA-GLASS A small telescope used in theatres, whence it has its name.

The common opera-glass is nothing else than the Galilean telescope, invented by Galileo in 1609, which was the first ever employed for the purpose of exploring the heavens A section of the instrument is represented in the annexed figure It consists of an object glass A B, the focal length of which is usually from 4 to 8 inches The eye-glass C D, is a double concave or plano-concave lens from half an inch to 2 inches focus, the distance between the two lenses is equal to the difference of their focal lengths, and the magnifying power is in the ratio of those lengths Rays of light R R falling on the object glass are refracted towards the axis X Y and proceed to meet in the focus of the lens at F But before they reach that point they are intercepted by the concave lens C D, the focus of which is also at F, and by which they are restored to their parallelism The rays therefore proceeding from the object enter the eye which is applied to the lens C D, without crossing each other,




and hence the distinctness of the [illegible] of all other telescopes, hence, also there is no inversion of the image and as there are only two glasses, the loss of light is inconsiderable

The lens A B may be either single or compound If a single lens of plate-glass is used it should be nearly convexo-plane, if a convex of plate and a concave of flint be combined to form the compound lens the former should be nearly convexo-plane, and the latter concavo-plane As to the eye glass it is always single, and the plano-concave form is perhaps better than the double concave the eye being in fact never placed in actual contact with it For any magnifying power above 3 or 4 it ought to be limited to an aperture rather less than that of the pupil of the eye, and where distinct vision is desired, the eye should be placed as accurately as possible on the axis of the instrument (*Coddington's Optics*)

The area or field of view of this instrument is very limited, and for this reason it cannot be used with any high magnifying power See TELESCOPE

OPERCULUM Lat operio *I cover*) The lid of any thing applied by botanists to the cap of the pitcher of *Nepenthes* to the loose apex of such fruits as that of *Lecythis* to the conical limb of the calyx of *Eucalyptus*, and to the body which closes up the theca of a moss

OPERCULUM In Zoology this term is applied to the apparatus supported by four bones which protects the gills of fishes, also to the horny or calcareous plate which closes the aperture of univalve shells, and to the four calcareous pieces which defend the entrance to the tube of *Balanites* or bell barnacles

OPHICLEIDE (Gr ὄφις *a serpent*, and κλεὶς *a key*) The largest brass wind instrument used in the orchestra of the trumpet species and forming the bass to that class of instruments Its compass is from double B♭ to A♭ above the line in the bass clef, being three octaves

OPHI'DIANS, *Ophidia* (Gr ὄφις and εἶδος *form*) The name of the order of reptiles which includes all the serpentiform species of that class, corresponding to the *Amphibia serpentes* of Linnæus

O'PHIOMANCY (Gr ὄφις and μαντεία *prophecy*) The art of divination from serpents Thus the seven coils of the serpent seen on the tomb of Anchises were held to indicate the number of years of Æneas's future wanderings —

Septem etenim gyros, septena volumina traxit

O'PHITES (Gr ὄφις) The name of an early sect of Christian heretics, who emanated from the Gnostics, so called from their worshipping the serpent that tempted Eve They considered the serpent as the father of all the sciences, which, but for the temptation of our first parents, would never have been known (Mosheim, *Eccl Hist* vol i)

OPHIU'CHUS, or OPHIU'CUS, also called *Serpentarius* One of the constellations of the northern hemisphere

OPHTHA'LMIA, or OPHTHALMI'TIS (Gr ὀφθαλμὸς, *the eye*) Inflammation of the eye This term is applied to diseased action of various parts of the eye In common cases its seat is the conjunctiva or membrane and it is relieved by fomentations of warm water or decoction of poppy heads by leeches cupping purging and in violent cases these depletive measures must sometimes be carried to a considerable extent, and aided by blisters to the temple or nape of the neck Emetics have sometimes been of service When all inflammatory symptoms have subsided, local astringents and mild strengthening eye-waters, may be resorted to; but so long as any inflammation remains they should be most cautiously applied Sometimes the iris is the seat of inflammation This is attended with fever, great intolerance of light and pain, [illegible] interior chamber of the eye and the sight is destroyed by the permanent damage done to the part

There is another form of ophthalmia in which the conjunctiva and inner membrane of the eyelids becomes inflamed and purulent as in the *Egyptian ophthalmia* which form of the disease is highly contagious The swelling and purulent inflammation of the eyelids is so great as to close or distort them, and the ulceration sometimes extends over the cornea, the humours escape, the whole organ is frightfully disorganized, and the agony that attends the whole progress of the worst form of the malady is indescribable The treatment originally resorted to consisted in bleeding and purging the plan afterwards adopted was to give [illegible] of tartar emetic, to remove the granulations by the scissors or knife and [illegible] of nitrate of silver or alum [illegible]

There is a variety of ophthalmia called *metastatic* caused by the translation of some other disease such as gout, or by the application of some morbid poison to the part. Its treatment depends upon its origin

The purulent opthalmia of new-born infants generally yields to the skilful application of mild astringent eye-waters and to gentle aperients

After the small-pox and measles, and some fevers, especially in scrotulous habits the glands of the eyelids form a morbid secretion which irritates and glues together the parts This disease has been termed *psorophthalmia*, it frequently yields to fomentation with warm water, to a drop of vinous tincture of opium into the eye at bedtime and to the application of the ointment of nitrate of mercury or red precipitate

O'PIATE (Gr ὀπὸς, *juice*) A medicine producing sleep See ANODYNE

OPISTHO'GRAPHUM (Gr ὀπισθεν, *behind* and γραφω *I write*) In Classical Antiquity a set of tickets, or roll of parchment or paper, answering the purpose of a memorandum book or commonplace book to enter notes and other extemporary matters to be revised afterwards, so called from [illegible] over both on the front and back Any [illegible] MS in which the transcriber had employed both the front and back of the papyrus was indeed an [illegible] practice to which allu [illegible] verse of Juvenal —

Scriptus et in tergo, nec dum finitus Orestes.

OPISTHO'TONOS (Gr ὀπισθεν, *backwards*, and τεινω *I draw*) A spasmodic action of the muscles, by which the body is bent backwards

O'PIUM (Gr ὀπὸς, *juice*) The inspissated juice of the poppy obtained by wounding the unripe seed capsules of the *Papaver somniferum* collecting the milky juice which exudes and dries in the sun and kneading it into cakes The cakes of the best opium are covered externally with pieces of dried leaves and the seed capsules of some species of *Rumex* It should be of a rich brown colour, tough consistency and smooth uniform texture, its peculiar narcotic smell should be strong and fresh, its taste bitter, warm and somewhat acrid The chemical analysis of opium has rendered it probable that its activity as a medicine depends upon the presence of a peculiar alkaline base called *morphia*, in combination with an acid which has been termed *meconic acid* Opium also contains *narcotine narceine codein*, gum resin extractive matter, and small portions of other proximate principles

The chief countries in which opium is prepared are India, Egypt, Turkey, and other parts of Asia, it is even cultivated in Italy France, and England, but the climate of Europe seems to be too uncertain to allow of its regular production Opium is pretty extensively used, both as a masticatory [illegible] in Turkey and India, but its great [illegible] China and the surrounding countries where the habit of [illegible] as become all but universal The supplies [illegible] market are derived from India and Turkey but chiefly from the former Indian opium is distinguished into three kinds the Patna or that grown in the province of Bahar, the Benares and the Malwa; of which the first is in the highest repute The cultivation of opium in India is a strict government monopoly. Every one who chooses may, within the prescribed regulations, engage in the opium cultivation; but the drug, when prepared, must all be sold to the government at a fixed price, which is said to be so far from remunerating the growers that, were it not for the advances which government [illegible] to enable [illegible] to carry on the business, the cultivation of opium would be discontinued

in the greater portion of India This monopoly has sometimes yielded a nett revenue of 1,000,000*l* a year This revenue has, however, of late years materially decreased, owing to the introduction into China of large supplies of opium from Turkey, into which it is found impossible to extend the monopoly The East India opium is exported in chests of 1½ lbs each. The introduction of opium into China was a legitimate branch of traffic down to the close of the last century Ever since that period, however, the trade has been contraband, but though the Chinese government has issued edict upo[illegible] tation of the drug, the [illegible] China has, in little more than forty years, risen from 1000 to about 27,000 chests per annum Such an extraordinary increase in a trade prohibited by law is attributable only to the corruption of the Chinese authorities At first the trade was carried on at Whampoa, fifteen miles below Canton, and next at Macao, whence it was driven by the exactions of the Portuguese, and the principal entrepôt was, till the recent outbreak of hostilities between the British and Chinese, in the bay of Lintin The opium is kept on board ships commonly called receiving ships, of which there are often ten or twelve lying together at anchor The sales are mostly effected by the [illegible] Canton, who give orders [illegible] which, on the order being produced, is handed over to the Chinese smuggler, who comes alongside at night to receive it Frequently, however, the smuggler purchases the opium on his own account, paying for it on the spot in silver, it being a rule of the trade never violated that the money must be paid before the opium is delivered When the drug is landed the laws are equally set at defiance in its progress through the country, smoking houses being it is said every where established During the first ten years of the present century, the exports from India to China were about 2 500 chests In 1821-1822 after the introduction of Malwa opium into the markets of Bombay and Calcutta, the exports increased to 4 628 chests, and owing no doubt to the greatly increased supply and lower price of the article the exports in 1831-1832 exceeded 20 000 chests, worth more than 13 000,000 dollars, and in 1837-1838 exceeded 30 000 chests worth 20 000 000 dollars In the beginning of 1839 the Chinese authorities resorted to decided measures to put a stop to opium smuggling, and the hostilities that consequently ensued between the two nations are now matters of history But we are convinced that no system of restriction, how rigorous soever will ever be able to check the smuggling of opium into China where the popular tastes and habits are so decidedly in its favour Accordingly we learn from the British consul at Canton that the imports of opium in 1845 amounted to 38,000 chests worth 23 000 000 dollars being little short of double the value of all the other articles imported put together The opium consumed in England is derived chiefly from Turkey but the supply is liable to great fluctuations This remark is applicable to all the other places whence opium is imported into England as well as to the quantity annually re-exported from England In 1850 the quantity of opium imported into England was upwards of 126,000 lbs Previously to 1828, the duty upon opium was 9*s* per lb, but in that year it was reduced to 4*s*, and again in 1836 to 1*s*, where it has since remained

OPOBA'LSAM (Gr *οπος juice* and *βαλσαμον balsam*) Balsam or balm of Gilead A compound of resin and essential oil of a peculiar fragrancy It exudes from a species of *Amyris*

OPODE'LDOC A term invented and formerly applied by Paracelsus to a plaster for all external injuries, but in modern usage it signifies a liniment made by dissolving soap in alcohol with the addition of camphor and volatile oils

OPO'PONAX A gum resin having a peculiar and rather disagreeable odour formerly used in medicine It is the juice of the *Pastinaca opopanax*

OPOSSUM the common name of the Marsupial quadrupeds of the genus *Didelphis*, characterized by three kinds of teeth, viz incisors, canines and molars, by hinder hands, and a prehensile tail With this organization the opossums, as might be expected are arboreal in their habits, and feed on a mixed diet in which animal food preponderates The larger species have a well-developed abdominal pouch, in which the young are [illegible] early stage of development In [illegible] possums the characteristic pouch is nearly rudimentary, and the young are carried by the parent on the back, where they cling to the fur, and likewise hold on by entwining their little prehensile tails round that of the mother the name *Didelphis dorsigera* is on this account given to one of the species The true opossums are now limited to the American continent but, during the Eocene period there were species of *Didelphis* in both France and England

OPPOSITION Act of opposing In a general sense the fact of being in a state of contrary action or disagreement In Politics the name given in Great Britain to the party in parliament opposed to the administration for the time being, and which would most likely succeed to power were it displaced A party in parliament which, though opposed to government, has no chance of succeeding to power were ministers dismissed, is not usually characterized by the term Opposition

OPPOSITION, in Astronomy denotes the aspect of two bodies when diametrically opposite to each other Thus the moon, or a planet, is said to be in opposition with the sun when it pass[illegible]

OPPOSITION In [illegible], *west*, which see

OPS In Mythology, the Latin appellation of the Greek goddess Rhea or Cybele, which see

OPSIOMETER (Gr *οψις, sight*, and *μετρον, measure*) An instrument for measuring the extent of the limits of distinct vision in different individuals and consequently for determining the focal lengths of lenses necessary to correct imperfections of the eye A contrivance for this purpose, by M Lehot, is described in the *Annales des Sciences d'Observation* for June 1829 and in the Notes by M Quetelet to the French translation of *Herschel's Treatise on Light* Its principle depends on the appearance presented by a straight line placed very [illegible] the eye [illegible] is carried into p[illegible] on a narrow rule covered with black velvet, and furnished with a suitable apparatus for marking the exact points at which the thread begins and ceases to be distinctly seen when held in a certain position with respect to the eye An instrument for the same purpose, on a different principle, had formerly been suggested by Dr Young

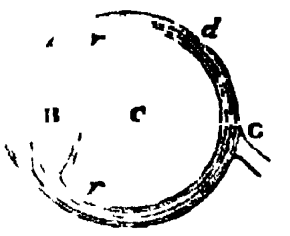
OPTATIVE MOOD *See* GRAMMAR

OPTIC NERVES The second pair of nerves They arise from the *thalami nervorum opticorum*, and, perforating the bulbs of the eye, form the *retina*

OPTICS (Gr *οπτομαι, I see*) That branch of physical science which treats of light and vision

The theory of light and the different hypotheses respecting its propagation, having been explained under the term LIGHT and its most remarkable properties being [illegible] REFLEXION REFRACTION DISPERSION INTERFERENCE POLARIZATION REFLEXION, REFRACTION &c), we shall here confine ourselves to the explanation of the phenomena and laws of vision, and the formation of images, and this in fact, comprehends all that is meant by *Optics*, in the strict sense of the word

*Description of the Eye* —The human eye is of a spherical form, having a slight projection in front The annexed figure represents a horizontal section of it through its axis It consists of three principal chambers, filled with different *humours*, or transparent media of different refractive powers The first of these media occupying the anterior chamber A is called the *aqueous*




humour, and consists almost entirely of pure water The cell in which the aqueous humour is contained is bounded on its anterior side by a strong horny transparent substance called the *cornea* the figure of which is an ellipsis of revolution about its major axis The posterior side of the cell is formed by the *iris* a kind of circular opaque screen consisting of muscular fibres, by the contraction or expansion of which an aperture in its centre, called the *pupil*, is increased or diminished according to the illumination, in order to protect the eye and preserve its sensibility by equalizing the quantity of light admitted into it The second humour, called the *crystalline lens*, B enclosed in its capsule lies immediately behind the pupil Its figure is a solid of revolution, having its anterior surface much less curved than the posterior, and both surfaces are ellipsoids of revolution about their lesser axes The crystalline is somewhat denser towards the centre than at the outside, the increase of density serving to correct the aberration, by shortening the focus of the [illegible] The third or *vitreous* humour C, [illegible] posterior chamber of the eye This fluid scarcely [illegible] [illegible] humour in its refractive power, [illegible] [illegible], or refractive power

The [illegible] refractive powers of the different [illegible] according to Sir David Brewster, the ray of light being supposed to fall out of air from air —

| Aqueous Humour | Crystalline Lens | | | Vitreous Humour |
|---|---|---|---|---|
| | Surface | Centre | Mean | |
| 1 336 | 1 3767 | 1 3790 | 1 3779 | 1 3394 |

But as the rays refracted by the aqueous humour pass into the crystalline, and from the crystalline into the vitreous humour, the indices of refraction of the separating surfaces of these humours will be —

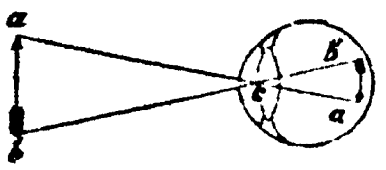
From aqueous humour to outer coat of crystalline 1 0466
From aqueous to crystalline, using the mean index - 1·0353

From vitreous to crystalline outer coat - - 1 0445
From ditto to ditto, using the mean index - - 1 0332
("Optics," *Cab Cyclopædia*)

The posterior surface of the cell of the vitreous humour is covered by the *retina*, *d*, a network of inconceivably delicate nerves, all branching from the *optic nerve* O which enters the eye obliquely at the inner side of the orbit next the nose The retina lines the whole of the cavity C from *r* to *r*, at which points the capsule of the crystalline commences Its nerves are immersed in the *pigmentum nigrum* a very black velvety matter which covers the choroid membrane and the use of which is to absorb and stifle all the light which enters the eye as soon as it has done its office of exciting the retina, thus preventing internal reflections and consequent confusion of vision The whole of these humours and membranes are contained in a thick tough coat, called the *sclerotica*, which unites with the cornea and forms what is commonly called the *white of the eye* The spot at which the optic nerve, O, enters the eye is totally insensible to the stimulus of light, and is therefore called the *punctum cæcum* (Herschel on Light *Ency Met*)

From this description of the eye it is evident that light in passing through it must undergo a series of refractions, in the same manner as in passing through a system of lenses When a pencil of luminous rays, proceeding from an exterior point, passes through the transparent cornea and penetrates the aqueous humour the divergency of the rays is diminished by this first refraction The rays which pass through the pupil undergo a second refraction at the anterior surface of the crystalline, which renders them further convergent, and on leaving the crystalline and passing into the vitreous humour they receive their final degree and produce an image at a focus on or very near that membrane Experience and calculation prove that when vision takes place with the least effort the luminous point (or any very small object on which the eye is fixed) is at such a distance from the eye that the rays enter the eye with precisely that degree of divergence which is required in order that after suffering the several refractions they may be brought to meet in a point on the retina itself Hence it has been concluded that the sensation of sight is caused by the impression made by light on the retina, when it is concentrated on it in a single point or within a very small space

The image of an object on the retina is evidently inverted with respect to the position of the object itself, for the ray proceeding from the upper extremity of an object *a* falls on the lower extremity *a'* of the image on the retina Writers on optics have often puzzled themselves with attempts to explain the cause of erect vision from an inverted image, the subject, however is not worth the [illegible] has been expended on it "Erect," [illegible] "means nothing more than having the head farther from the ground and the feet nearer than any other part Now the earth and the objects which stand on it preserve the same relative situation in the picture on the retina that they do in nature In that picture, it is true men stand with their heads downwards but then at the same time, heavy bodies fall upwards, and the mind or its deputy the nerve which is present in every part of the picture judges only of the relations of its parts to one another How these parts are related to external objects is known only by experience and judged of at the instant only by habit"




Another circumstance the cause of which has also been much discussed is that although [illegible] of each object at which we look is formed on the [illegible] both eyes the object appears [illegible] Single vision with two eyes is attributed [illegible] to the habit of referring the two impressions made on corresponding points of the two retinas to the same object, and, in fact, if we press slightly on the cornea of one eye, so as to derange its optical axis the two images, being no longer on parts of the retina which habitually correspond, will appear double Those who have had one eye distorted by a blow see double till habit has taught them anew to see single, though the distortion remains (For a review of the various theories that have been proposed to account for this phenomenon, the reader may be referred to a paper on the Physiology of Vision, by Professor Wheatstone in the *Phil Trans* for 1838)

Straight lines drawn from the extremities of an object [illegible] in the centre of the pupil, in [illegible] point is called the optical centre of the eye, and form the angle *a c b* which is called the visual angle On leaving the crystalline and entering the vitreous humour the rays are slightly refracted and form another angle, *a' c b'* the base of which is the magnitude of the image on the retina These two angles are not perfectly equal, so that *a' b'*, the magnitude of the image on the retina, or the apparent magnitude is not exactly proportional to the real magnitude, *a b* for a given distance But the difference is so small that it may in general be neglected and the visual angle becomes the measure of the apparent magnitude, or the apparent magnitude of an object is proportional to its linear magnitude divided by its distance from the eye

As the judgment which we form of the real magnitude of a distant object depends not only on the apparent magnitude, but also on our estimation of its distance, an erroneous estimate of the distance will necessarily produce an illusion with respect to the magnitude Such illusions are frequent in the night time when the darkness prevents us from distinguishing the real places of objects and their relative positions An unusual increase or deficiency of the transparency of the atmosphere produces the same effect, and at sea, where little assistance can be derived from the appearance of intervening objects, it requires a particular training of the eye to judge correctly of distances

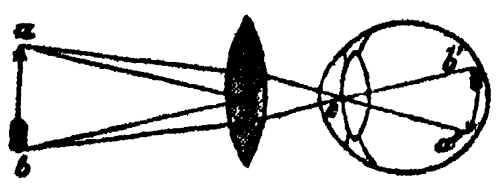
The effect of light on the eye has a sensible duration after the eye is shut or the luminous object removed During the twinkling of the eye, we never lose sight of the object [illegible] and by burning [illegible] with a rapid motion it appears [illegible] The persistence of light on the retina gives rise to a great number of illusions such as the apparent augmentation of volume of a musical chord [illegible] the train of light which appears [illegible] It was estimated by Dr [illegible] that a coal whirled round at the distance of 165 feet, maintained its impression during the seventh part of a second Experiments, however of a more accurate kind have shown that this time is not constant, but is influenced by several circumstances Light must act on the eye for some continuance of time in order to produce a complete impression, and it is found that the time during which the impression that has been produced can preserve an equal intensity after the action of light has ceased is greater in proportion as the impression is less intense On the other hand the duration of the impression is greater the more intense If the impression has been made by a strongly illuminated object as the setting sun it often passes through a series of different colours, in other circumstances, it disappears, and is renewed after some seconds, disappears again, and so on several times in succession

The eye possesses considerable power of adjusting its parts so as to give distinct vision for all distances within certain limits The first of these limits is the least distance from the eye at which small objects, as the print of a book can be seen without effort, and the second, the distance at which the image of the object becomes confused The space between these limits is the field of vision, but both its extent and distance from the eye vary considerably with respect to different individuals, and sometimes even with respect to the two eyes of the same individual From the [illegible] of the eye and the refractive powers [illegible] instances, it is found by calculation that the focal distances of two luminous points situated at the two limits of the field of vision, differ by about one sixth part of the diameter of the eye

All the refractions which take place in the interior of the eye are in the same direction, consequently the eye, regarded as an optical instrument is not achromatic The absence of colour about the images formed on the retina excepting in very particular cases is to be ascribed in part to the small breadth of the pencil of luminous rays which passes through the pupil but principally to the small focal distance of the eye in consequence of which the unequally refrangible rays can never be much separated from each other It has also been surmised (*Coddington's Optics*) that a compensation takes place between the refractions at the cornea and the crystalline, a ray which is less refracted by the former being more refracted by the latter, in consequence of its passing through it at a greater distance from the axis

Distinct vision depending on the convergence of the luminous rays which proceed from an object to a focus on the retina it follows that if, from any defect in the original structure of the eye or any deterioration of its form or powers, the rays which enter the pupil are not rendered sufficiently [illegible] at the retina, or are rendered too [illegible] brought to a focus before they reach the retina, an imperfect and indistinct image will be produced It happens with most persons, between the ages of thirty and [illegible] that the crystalline lens is beginning to undergo a change, [illegible] its form but also its density and refractive power, are altered in such a manner as to leave it capable of affording distinct vision only of very remote objects This defect is remedied by a convex lens, which makes up for the flatness of the crystalline, and renders parallel rays slightly convergent before entering the eye Let *a b* be an object, *c* the lens, and *e* the centre of [illegible] placed at the focal [illegible] ject is at the focus, the rays of a pencil diverging from any point *a* in it will emerge parallel to each other and

to *a c*; they will therefore, after refraction in the eye, be brought to converge on the retina at a point *a'*, such that *e a'* is parallel to *a c*. Similarly, rays from *b*, after refraction through the lens and the eye will converge to the point *b'*, such that *e b'* is parallel to *b c*. Thus a distinct image *a' b'* will be formed on the retina, and the apparent angular magnitude of the object seen through the lens will be the angle *a' e b'* which is equal to *c b*, the angle subtended by the object at the centre of the lens, and therefore greater than the angle subtended by the object at *e*, the centre of the eye. Hence the image appears enlarged; but the nearer the lens is to the eye, the less will be the difference between the apparent magnitudes of the image as seen with and without the lens. When such lenses are employed in the form of spectacles, the enlargement of the image (which in this case is not intended) is hardly sensible, because the lens is commonly of low power, and because the person who must use it, to see distinctly, cannot easily make a comparison between the appearance of an object seen with or without the lens. The lenses of spectacles ought to be of the meniscus form (*see* LENS), in order to refract without much indistinctness, pencils coming to the eye with any degree [illegible] spectacles are called *periscopic*, and [illegible] first pointed out by Dr Wollaston.



Sometimes the eye is so formed that its power of giving convergence is too great, and the rays are brought to a focus before they reach the retina. Persons having this defect are called *short-sighted* from their inability to see distant objects distinctly. It arises from an increase of density in the central part of the crystalline, and its inconvenience is obviated by a concave lens, which increases the divergence of the rays before they enter the eye. For the same reason as mentioned above, the lens should be of the convexo-concave form, that is, convex on the outer side and concave on the inner side, the curvature of the latter being greater than that of the former. This lens diminishes the apparent magnitude of objects, but the effect is scarcely sensible. (*South Optics*, Herschel's Treatise on Light, *Ency. Metropolitana*, Brewster's Optics, *Cabinet Cyclo.*, *Coddington's Optics*, Biot, *Cours de Physique*.) For optical instruments, see LENS, MICROSCOPE, TELESCOPE, &c.

OPTIMA'TES (Lat.) A word sometimes used to denote the Roman nobility, in contradistinction to the plebeians, or populares.

OPTIMISM. In Moral Philosophy and Theology, the system which regards physical and moral evil as elements of the universal order of things, so that every thing is good viewed in relation to the whole, or in the ordinary phrase in which the doctrine is expressed, all is for the best." This system was justified with philosophical inductions, by Leibnitz in his *Theodicæa* (which see), and is popularly illustrated by Pope in his *Essay on Man*; but it is best known (as far as the name is concerned) by the irony of Voltaire in his celebrated romance of *Candide*. The optimism of Leibnitz was based on the following trilemma: If this world be not the best possible, God must either, 1 not have known how to make a better, 2 not have been able, 3 not have chosen. The first position contradicts his omniscience, the second his omnipotence, the third his benevolence. (See *Creuzer, Leibnitzii Doctrinæ de Mundo Optimo*, Lips. 1795.)

OPTIMUS MAXIMUS. Epithets assigned to Jupiter by the ancient Romans to indicate his superlative greatness and goodness.

OPTION (Lat. *opto*, *I wish* or *choose*.) In Ecclesiastical Law, a prerogative of the archbishops of the church of England. Every bishop is bound immediately after his confirmation or consecration, or canonical conveyance to the archbishop, to nominate to any one benefice or dignity belonging to his see which the archbishop may [illegible]. If the archbishop die before [illegible] right of filling it up passes to his executors or administrators.

OPTION, at the Stock Exchange, signifies a per centage given for "the option" of putting or calling for selling or buying stock in time bargains at a certain price.

OPUNTIA. In Botany, the name given to those Cactaceous plants commonly called *Indian figs*. Their stems consist of flat joints, broader at the upper than at the lower end, becoming, however, eventually both continuous and cylindrical. [illegible] is South America, but in some [illegible] Mount Etna is [illegible]. The cochineal insect (*Opuntia cochenillifera*) is fed on one of the varieties of *Opuntia*.

OR (Fr. *gold*.) In Heraldry, one of the metals employed in blazonry. It is equivalent to topaz among precious stones, and Sol among planets. In engraving, it is represented by a surface sprinkled with equidistant dots

ORA. An old Saxon coin, valued at sixteen pence, and [illegible] twer[illegible] *Domesday Book* and in the old records of the kingdom.

O'RACLE (Lat. *oraculum*, from *os*, *a mouth*.) The name primarily given to the response delivered by the ancient heathen divinities to those who consulted them respecting the future, but afterwards applied both to the place where responses were given as well as to the divinities from whom the responses were supposed to proceed. To the desire so natural to man to obtain a [illegible] knowledge, coupled with the ennobling belief that [illegible] desires [illegible] is doubtless to be traced which has in all, but more especially in the earlier stages of society, exercised so powerful an influence over the human mind. But, of all the modes of divination, that by consulting the oracle was the most popular. In other cases, as the interpretation of events depended on man alone, there might be mistake or deception, but in the oracle, when the deity was believed to pronounce either in his own voice or in that of a [illegible], it was supposed that it could be none. The oracles obtained such credit and celebrity in antiquity, but more especially among the Greeks, that they were resorted to on every occasion of doubt and emergency, both by princes and states, as well as by private individuals.

The general characteristics of oracles were ambiguity, obscurity, and convertibility, so that one answer would agree with several various and sometimes directly opposite events. Thus, when Crœsus was on the point of invading the Medes, he consulted the oracle of Delphi as to the success of the enterprise, and received for answer*, that by passing the river Halys he would ruin a great empire. But whether it was his own empire or that of his enemies that was destined to be ruined was not intimated, and, in either case, the oracle could not fail to be right. The answer of the oracle to Pyrrhus is another well-known instance of this sort of ambiguity, —

Aio, te, Æacida, Romanos vincere posse, —

as it might either be interpreted in favour of or against Pyrrhus. This ambiguity and equivocation was not, however, the worst feature that characterized the oracles of antiquity. They were at once ambiguous and venal. A rich or a powerful individual seldom found much difficulty in obtaining a response favourable to his projects, how unjust or objectionable soever. Such, for instance, were unquestionably the motives that dictated the favourable responses of the Pythia at Delphi to Philip of Macedon, which drew from Demosthenes the famous declaration, that the goddess *Philippised*. But such and so powerful is the influence of superstition, that this system of fraud and imposture maintained a lengthened ascendency, and the interested responses of the oracles frequently sufficed to excite bloody wars, and to spread desolation through extensive states.

The first oracles had their origin in the East, at a period to which the monuments of profane history do not ascend. The most ancient oracle is supposed to be that of Meroe, to which were afterwards added those of Thebes and Ammon, in all of which places the worship of Jupiter Ammon prevailed. From the Egyptians the use of oracles, along with a knowledge of many arts and sciences, passed to the Greeks, who soon surpassed every other nation both in the number and celebrity of their oracles. It has been affirmed that no fewer than three hundred oracles were established in different parts of Greece, but of those the oracles of Jupiter at Dodona, of Apollo at Delphi, and of Trophonius near Lebadeia (see these articles), may be mentioned as having enjoyed the highest reputation†. The oracles of antiquity had many leading features in common, but there were also several peculiarities about them, of which the variety of modes in which the oracular responses were delivered is one of the most striking. At Delphi responses were delivered by the Pythia, at Ammon by the priests, and at Dodona they issued from the hollow of an oak. Sometimes [illegible] was communicated by letter, sometimes the desired information could only be obtained by casting lots, and sometimes the divinities chose to announce their will by dreams, visions, and preternatural voices.

Among the Jews there were several sorts of oracles. Of these the Urim and Thummim (which see) bore a [illegible] Bath Kol ("Daughter of the Voice" mentioned in the *Talmud* and other Jewish works) which originated after the time of Malachi, may be regarded as completely identical with them. The Old Testament teems with

* The Greek verse is,

Κροισος Αλυν διαβας μεγαλην αρχην καταλυσει.

Thus rendered in Latin,

Crœsus Halyn superans magnam evertet opum vim.

† It does not appear that the Romans ever had regularly established oracles among themselves; but on various important emergencies [illegible] to [illegible] Greece, and especially to that of Delphi [illegible]

instances of the other species of oracles in which supernatural revelations were made by means of dreams and visions, but every rational mind, even apart from scripture, must [illegible] wide distinction [illegible] in this manner [illegible] and the jugglery practised [illegible] avarice and cunning of the priests. There are two points respecting oracles which have given rise to much controversy, viz whether oracular responses ought to be ascribed to mere human ingenuity or to diabolical agency, and at what time responses ceased altogether to be given. With regard to the first point, most of the Christian fathers were of opinion that they ought to be attributed to diabolical machinations, [illegible] satisfactorily [illegible] the treatises of Van Dale *De Oraculis Ethnicorum* 1683, and of Fontenelle *Histoire des Oracles*, 1687. With regard to the other question, at what time the oracles ceased to give responses, it has been frequently asserted that they became silent ever after the birth of Christ. Eusebius was the first who maintained this opinion, and many writers of [illegible] have [illegible] homage to the great Author of Christianity by [illegible] such views. In the *Hymn of the Nativity* [illegible] of his minor poems, Milton, [illegible] the following lays—

> The oracles are dumb,
> No voice or hideous hum
> Runs through the archèd roof in words deceiving.
> Apollo from his shrine
> Can no more divine
> With hollow shriek the steep of Delphos leaving.
> No nightly trance or breathed spell
> Inspires the pale-eyed priest from the prophetic cell.

It appears, however, from the edicts of the emperors Theodosius, Gratian and Valentinian, that oracles existed and were occasionally at least consulted down to A.D. 328. For several centuries previously they had been gradually sinking in public esteem, but at that period they entirely ceased, and there can be little doubt that this desirable consummation was mainly effected by the enlightening power of Christianity, and by the influence which even at so early a period it had acquired over a large portion of the then civilised world. (In addition to the works already quoted, see *M'Culloch's Geo. Dict.*, art. "Delphi," Clavier, *Mém. sur les Oracles des Anciens*, 1819, &c.)

**O'RAL**, *Oralis* (Lat. os, *a mouth*.) This term is applied to the various parts which form or relate to the mouth of animals.

**ORA'NG**, in the Malay language, signifies man, orang-utan is the man of the woods. It is by this term that we [illegible] ignate the Indian or red orang (*Simia satyrus*, Linn.). This species inhabits the great islands of Borneo and Sumatra, and attains the height of from four to five feet, measured in a straight line from the vertex to the heel. It has neither tail, cheek-pouches, nor ischial callosites, but has an appendix to the cæcum coli, as in man. It wants the ligament of the hip-joint, and acquires an enormous laryngeal pouch when full-grown. See CHIMPANZEE.

**O'RANGE**. The well-known [illegible] of the orange tree, the *Citrus aurantium* of botanists. India and China are the native countries of the orange, and the Portuguese are entitled to the honour of having transferred the plant to other countries. The principal varieties of the orange tree are the orange, the lime, the lemon, and the citron, fruits which have now become so common as to give a tropical character to the dessert. The orange is not considered to have been grown in Europe till the 14th century, and in England they have been cultivated in conservatories since 1492. They are propagated either by seeds, by cuttings, by layers, by grafting, or by inoculation, but the plants grown from seeds require so long to come to perfection that they are seldom so propagated in England. Oranges are imported into this country in chests and boxes packed separately in paper. The best are brought from the Azores and Spain, but very good ones also come from Portugal, Italy, Malta, and other places. The orange trade carried on by this country is of considerable value and importance. Not only is the fruit held in high estimation, but, from the extreme productiveness of the tree, it is sold at a price [illegible] sometimes even less expensive than our [illegible] mestic fruits. The entries for home consumption at an average of the three years ending [illegible] amounted to [illegible] 30,000 boxes, each box containing about 720 lemons and oranges; the duty amounted to about 70,000*l.* a year. [illegible] The [illegible] yield an essential oil scarcely less esteemed as a perfume than the celebrated ottar of roses; while, as if nature had intended every part of it for the use of man, the wood of the tree is susceptible of the highest polish, and is extensively employed in the arts.

**O'RANGEMEN**. The name given to the society instituted in Ireland in 1795 to uphold the Protestant religion and ascendency, and for the discouragement of Catholicism. It had [illegible] secretly organized, destructive of orange [illegible], and [illegible] processions. It was at length suppressed by [illegible].

**ORANGERY**. A kind of [illegible] terre, to preserve orange trees in during the winter season. For trees in large boxes a proportionably large and lofty house is requisite; it may be opaque on the north side, with a glass roof [illegible] convenient or desired length, width [illegible] one of moderate size, the height at the back wall may be fifteen feet, at front ten feet, and the width of the house fifteen feet. The floor may be either perfectly level, and the boxes placed on it, the largest behind, so as their tops may form a slope to the front glass, as in the conservatory of Prince Borghese at Rome, or if the trees are young, a stage may be erected for a few years, in order to raise the [illegible] but if the trees are of a considerable size, the best way is to have square pits in the floor at regular distances, somewhat larger than each box, and in these to sink the boxes, covering them with mould, sand, or moss, nearly to the level of the pavement, so that each tree so placed and dressed will appear as if planted in a small compartment of earth. Such is the plan of the large conservatory in the royal gardens at Monza. The walk, unless where a stage is adopted, should be in the middle of the house, with corresponding doors in each end, but where the trees are young, and placed on a stage like greenhouse plants the walk should be in front, as in no other situation could the eye of the spectator meet the foliage of the plants. Where the walk is in the middle and a double row of trees on each side, as at Monza, the effect in winter is truly magnificent and gratifying.

Where the trees are to be planted as standards in the borders or floor of the house it is essentially requisite to the health and beauty of the plants that the building be glazed on all sides. Showers might be supplied in Poddiges's manner; heat by steam, hot water, or flues, and in winter the beds might be covered with turf strewed with daisies, violets, and primroses; these would come early into flower, and if the turf were kept very short about the roots of the flowering plants, and the trees in excellent condition, only those who have seen the first rate regularly planted standard orange groves of Nervi could form an idea of the effect which, by contrast with the external winter would be felt as luxurious, and as anticipating real spring. An orangery is distinguished from a conservatory by its having an opaque roof, while that of the latter is glazed. The orangery at Versailles is the [illegible] hat ever was built.

**ORATORIO** [illegible] from Lat. oratorium, *a small chapel*, which again is derived from orare *to pray*.) A sacred musical composition, consisting of airs, recitatives, duets, trios, choruses &c., the subject of which is generally taken from scripture. The text is usually in a dramatic form, as in Handel's *Samson*, but it sometimes takes the form of a narrative as in *Israel in Egypt*, occasionally it is of a mixed character, as in Haydn's *Creation*, and sometimes it consists merely of detached passages from scripture, as in the *Messiah*. The origin of oratorios has been variously ascribed, but the most prevalent opinion regards them as originally founded upon the spiritual songs and dialogues which were sung or recited by the priests of the oratory. (*See* ORATORY.) The more recent introduction of this species of musical drama is on all sides attributed to St. Philippo Neri, about the middle of the 16th century, but oratorios, properly so called, were not produced till about a century afterwards. At first the persons introduced were sometimes ideal, sometimes parabolical, and sometimes, as in the later oratorios, taken from sacred history, but this species of drama soon assumed a more regular form, and oratorios became great favourites in Italy, where they were constantly performed during the Carnival, and they have since given birth to some of the noblest and most elaborate compositions of the great masters both of that and other countries. Oratorios were first introduced into England by the great Handel in 1720, though they were not publicly performed till 1732, and such was their success that in 1737 they began to be performed twice a week during the season of Lent, a custom which, under the able management of J. C. Smith, Linley, and Arnold, &c., successively, was regularly continued down to a very recent period, when, in consequence of the introduction of profane music and other irregularities during the management of Mr. Ashley, they began to degenerate, and were at length discontinued.

Within the last twelve years similar performances, though not entitled *oratorios*, have been again revived at Exeter Hall by the *Sacred Harmonic Society*, on a scale of magnificence previously unknown.

**ORATORY**, signifies commonly a room in a private house set apart for prayer. It differs from a chapel, inasmuch as it does not contain an altar, nor may mass be celebrated in it.

**ORATORY**. *See* ELOQUENCE, RHETORIC.

**O'RATORY, PRIESTS OF THE** Various congregations of ecclesiastical persons living in community who profess by a special vow have assumed this title The first congregation of the Oratory was founded by St Philippo Neri, at Rome, in the beginning of the 16th century Similar societies were soon formed in Italy and the Low Countries, but without any mutual connection The congregation of the Oratory at Paris was founded by the cardinal Pierre de Berulle 1611, and had several houses in different parts of the country It produced many men of celebrity, among others, Malebranche and Massillon There can be no doubt that its [illegible]

ORB (Lat orbis), in the language of the old astronomers, usually signifies a hollow sphere, and they supposed the heavens to consist of such orbs or spheres, enclosing one another, and carrying with them in their revolutions the different planets The *orbis maximus*, or great orb, was that in which the sun is placed As the orbs were concentric, and their number equal to that of the known planets, with one for the moon and another for the fixed stars, it was necessary to suppose them to be transparent or crystalline Orb also denotes any round or circular body, and sometimes it is used synonymously with *orbit*

ORBICULATES, *Orbiculata* A tribe of Brachyurous Crustaceans including those which have an oblong oval carapace

ORBI'CULUS In Botany, the whole mass of that part of a flower called the corona in the genus *Stapelia*, also, a round flat hymenium contained within the peridium of some genera of fungi

ORBIT (Lat orbis, *a circle*) In Astronomy, the path which any celestial body describes by its proper motion The orbits of all the planets and satellites are ellipses, and recent discoveries seem to show that the orbits of double stars, which revolve about each other, are curves of the same kind Some comets have been supposed to move in hyperbolic orbits For the magnitudes and eccentricities of the planetary orbits, *see* PLANETS *See* also MOON SATELLITE STAR

ORBIT In Ornithology, the term is applied to the rim which surrounds the eye this is generally the base of feathers, for the facility of its movements, but especially so in the parrot tribe and the heron

ORBIT In Osteology the bony cavity in which the eyeball is imbedded Each orbit is formed by seven bones,—the frontal, sphenoid, malar, lachrymal, ethmoid, palatine and superior maxillary

O'RCHARD (Gr ορχατος) An enclosure devoted to the cultivation of fruit trees The most productive orchards are generally such as are situated on declivities open to the south or south-east, and sheltered from the north, north-east, and west The most suitable soil is a calcareous loam with a dry subsoil The climate of orchards so situated is always warmer than any other kind of situation which this country affords and the subsoil is more certain of being dry The surface of the soil in the case of orchards so situated, is generally kept under pasture, which, while it prevents the earth from being washed away by rains, is favourable to the running of the roots immediately under the surface by which they are sooner called into action by heat in spring and sooner thrown into a torpid state by cold in autumn The principal fruits grown in orchards of this description in Great Britain are the apple, the pear, the plum and the cherry, and, wherever wheat can be ripened in the plains, these fruit will arrive at perfection on declivities such as we have mentioned

O'RCHESTRA (Gr ορχηστρα, from ορχεῖσθαι, *to dance*) In Architecture that part in the interior of a theatre situate immediately between the stage and the place assigned to the audience In the Greek and Roman theatres it was the part appropriated to the chorus and its evolutions and was almost level with the stage In the theatres of the moderns, it is the place appropriated to the musicians The word is also applied to any erection for the performers at a concert

ORCHIDA'CEÆ (Orchis is one of the genera) A natural order of Herbaceous Endogens, inhabiting all parts of the world except the most frozen and dry upon the verge of the frozen zone, remarkable for their extraordinary forms They are well known for the singular [illegible] Some of them grow in the earth, others inhabit rocks and the branches of trees, and a few appear to be true parasites They all belong to the class *Gynandria* of Linnæus, are often very agreeably scented, and some [illegible] as in the case of vanilla which [illegible] of benzoic acid The [illegible] called *salep* is prepared from the amylaceous roots of several terrestrial species

ORCHIL *See* ARCHIL

O'RCIN A crystallizable colouring matter or principle, obtained from a species of lichen (*Variolaria orcina*)





**O'RDEAL** (In modern Latin ordalium, from the German urtheil *judgment*) The practice of referring litigated questions, and the guilt or innocence of parties under accusation to the judgment of God (testified, in popular belief, either by the event of lots, or by the success or failure of certain experiments is of very ancient date and was [illegible] Pagan [illegible] settled in the [illegible] Roman [illegible] modes of Jurisprudence The ordeal was awarded in various cases; either arbitrarily by the court, or at the request of a party accused, who was anxious to clear himself, either as an alternative for trial by compurgation or by battle, or as the regular mode of deciding an issue In the earlier ages of modern European history, the ordeal was under the peculiar protection of the clergy, who afterwards discountenanced it, and its gradual suppression must be mainly attributed to the decrees of popes and councils, of which several were pronounced against it in the course of the thirteenth century, beginning with the decree of the fourth Lateran council in 1215 Among the various forms of ordeal in use among different nations, the following are some of the most remarkable The trial of the eucharist was used chiefly among the clergy, the accused party took the sacrament in attestation of his innocence, and it was believed that if he were guilty he would be immediately visited with punishment for the sacrilege Of the same description was the corsnedd, or trial by the consecrated piece of bread or cheese, so much in use among the Anglo-Saxons The trial of the cross was used, both in civil and criminal questions, in many European countries See the supplementary formulæ to those of Marculfus, cited by Meyer, *Institutions Judiciaires*, liv iii c 6 It appears that the litigants or the accuser and accused, were to stand upright before a cross, and that he who fell or changed his position first was cast or condemned This popular mode of ordeal was abolished by the capitulary of 816 in the reign of Louis le Debonnaire, as irreverent towards the mystery of the cross, but the abolition seems only to have been carried into effect in Italy and the provinces adjoining the seat of empire The ordeal of hot water, in which the accused party plunged his hand into a vessel of boiling water, was used by the Salian Franks when pagans, as early as the fifth century It was afterwards extensively practised In what was called the expurgatio simplex, the accused plunged his arm to the wrist, in the triple ordeal, to the elbow Trials by burning iron were of various sorts carrying a red-hot bar in the hand and walking barefoot over heated [illegible] of 803, [illegible] from the celebrated example of Queen Emma Among the Saxons, the iron was awarded to freemen the water to those of inferior conditions There can be no doubt that, in these severer forms of ordeal some precaution was occasionally used by the clergy, under whose inspection and management the trial took place to preserve parties whom it was wished to clear from suspicion from the ordinary consequences of such exposure There were also ordeals by lot as by the casual choice between a pair of dice one marked with a cross and the other blank mentioned in the laws of the Frisons The famous trial of the bier, in which the supposed perpetrator was required to touch the body of a murdered person, and was pronounced guilty if the blood flowed, may be regarded as a species of ordeal, although founded more on usage than legal enactment, as this form of superstition did not become prevalent until later times, when ordeals were no longer a recognized part of the law To the same head may be referred the various absurd and cruel methods which were adopted in different countries to try suspected witches One of the most remarkable instances of the solemn application of the ordeal in later times took place in 1498 when the truth of the doctrines preached by Savonarola [illegible] was put to the test by [illegible] a Franciscan [illegible] however, may be rather regarded as the appeal of an enthusiast to the divine judgment than as an example of a recognized usage Ordeals are of common use in the [illegible] of various heathen nations, especially of the Hindoos

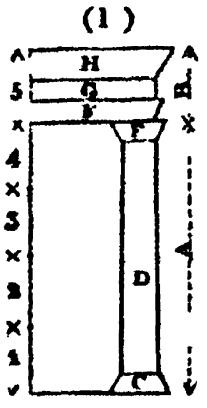
By the Anglo-Saxon laws, an option was given to the culprit in ordinary cases, when presented of a crime by the neighbourhood, or appealed against by the injured party, of defending himself by compurgation or by the ordeal (of hot water or hot iron) If, being a villain, he could procure the testimony of his lord in favour of his character the ordeal was simple, if otherwise, threefold In the laws of William the Conqueror, we find that accusations between an Englishman and a Frenchman were decided either by the Roman mode of trial battle or by the ordeal [illegible] as Sir F Palgrave [illegible] afforded a last chance of escape to the accused party, than as an ordinary mode of deciding on guilt or innocence, since

it does [illegible]
unless [illegible]
testime[illegible]
the fac[illegible]
the civil law, which, according to principle, was only applied where the evidence was sufficient to warrant a conviction, and the defendant refused to confess When, however, [illegible]ompurgation was abolished in [illegible] Hen II, the trial by ordeal became more important than before It appears that, in presentment by the inquest (whence originated the grand jury), the culprit was immediately adjudged without option, to clear himself by ordeal, that, if he escaped this test, he was still condemned to abjure the country, so that the presentment became in some sort equivalent to a final trial The *second* inquest or jury trial, at this period is thought to have been only awarded as a matter of special favour But when ordeal had been forbidden by the 18th canon of the fourth Lateran council, in 1215 as before mentioned it was immediately disused in England, and hence after a considerable interval, during which the practice of criminal law seems to have remained in a very uncertain state, the practice of trial by the second inquest, or petty jury, from being the exception gradually became the general rule (See as to the early ordeals *Mem de l'Ac des Inscr* vol xv)

ORDINAR (*Lat ordo*) In the Fine Arts, the regular disposition of the parts of a work so that neither confusion nor jarring effects may prevail

ORDER In Architecture, a system or assemblage of parts subject to certain uniform established proportions, regulated by the office each part has to perform An order may be said to be the genus whereof the species are Tuscan, Doric, Ionic, Corinthian [illegible] and consists of two essential parts — a column A (see fig 1), and an entablature B These are subdivided the first into three parts namely the base C the shaft D and the capital E, the second also into three parts — namely, the architrave or chief beam F, which stands immediately on the column the frieze G, which lies on the architrave, and the cornice H, which is the crowning or uppermost member of an order In the subdivisions certain horizontal members are used which, from the curved forms of their edges, are called mouldings These are the ovolo, the talon the cyma the cavetto the torus, the astragal the scotia, and the fillet, which are defined under their several names in this work The character of an order is displayed, not only in its column, but in its general forms and detail whereof the column is, as it were the regulator, the expression being of strength, grace, elegance lightness, or richness Though a building be without columns, it is, nevertheless, said to be of an order, if its details be regulated according to the method prescribed for such order

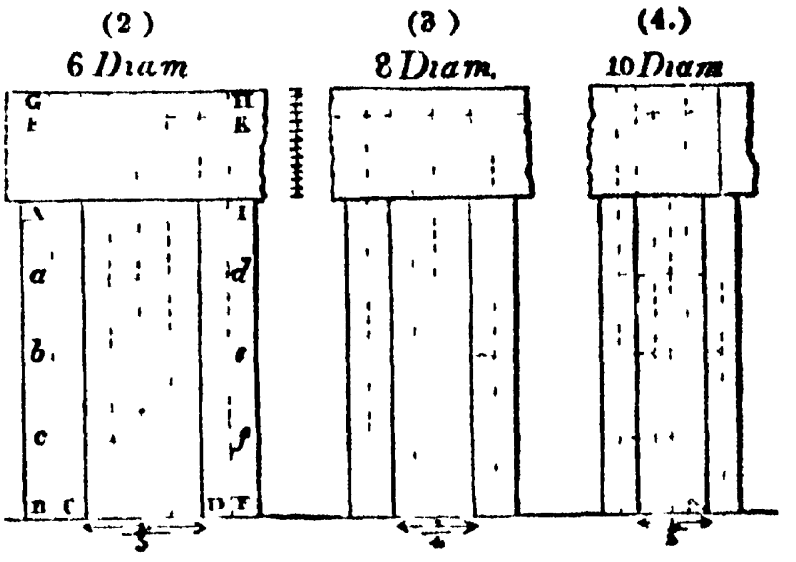
(1)




In setting up, or, as it is more technically expressed, in profiling an order, it is usual to make the entablature of the height of one fifth of the entire order The height of the column is measured in terms of its lower diameter which is divided into sixty parts called minutes, used as a scale for the different subdivisions In the Doric order the semidiameter of the column is called a module it is however, divided into thirty parts, so that there is, in fact, no essential difference between the scale of this and the other orders The columns vary from seven to ten diameters in height in the different orders The height of the entablature is usually divided into ten parts, whereof three are assigned to the architrave three to the frieze, and four to the cornice, except in the Doric order, in which the height is divided into eight parts, whereof the architrave has only two, the frieze and cornice each three

The rule above given for regulating the relative heights of the column and entablature is founded upon the practice of the ancients, who rarely exceeded or fell short of the proportion it establishes Whether this practice of assigning one fifth of the height of the whole order to its entablature was arbitrary or empirical is worth inquiry which, we are inclined to think, has not been bestowed upon it in any architectural work at least not in any one which has fallen under our notice though the principles developed in a work by Le Brun, entitled, *Theorie de l'Architecture Grecque et Romaine, deduites de l'Analyse des Monumens Antiques* (fol Paris, 1807), if carried through correctly, seems to point to the reason of the practice. One of the most obvious principles of proportion in respect of loads and supports, and one apparently founded on Nature herself, is, that a support should not be loaded with a greater mass than itself; or, in other words, that there should be an equality between the weights and supports; that is, in this case, between the entablature and column In respect of the voids left between the columns or supports below the entablature, there seems to have been a great diversity of practice; for we find them varying from 1·03 to 2·18, unity being the measure of the supports Le Brun makes the areas of the supports, weights, and voids equal to one another; and in the monumental specimens of the Doric order, such as the Parthenon, &c., he seems borne out in the law he endeavours to establish, but in lighter specimens, such as the temple of Bacchus, at Teos, where the supports are to the voids as 1 to 2·05, and in the temple of Minerva Polias, where the ratio is 1 2·18, he can hardly be considered correct Indeed, there scarcely seems a necessity for such a limitation of the voids as he prescribes, seeing that without relation separately to the weight and support, stability would be obtained so long as the centre of gravity of the load fell within the external face of the support If, then, it be admitted that, as in the two examples above mentioned, the voids should be equal to the weights and supports jointly, we have the key to the rule, and, instead of being surprised at the apparently strange law of making the entablature one fourth of the height of the column we shall find that none but the result assumed can flow from the investigation

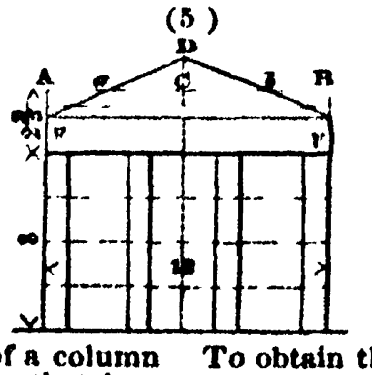
(2) (3) (4.)




Let fig 2 let AB be the height of the column and let the entablature the column be one third of the height of the column (D) Now if AB be subdivided into four equal parts at *a b* and *c* and the horizontal lines *a d b e c f* be drawn, also if C D be divided horizontally into four equal parts and lines be drawn perpendicularly upwards intersecting the former ones, the void will be divided into 16 equal parallelograms one half whereof are to be the measure of the two [illegible]ts B C and D I being made equal then [illegible] C D it will be manifest, from inspection that the two semi-supports will jointly be equal to 8 of the parallelograms above mentioned or one half of the void We have now to place the weight or entablature, A G H I, upon the supports or columns and equal to them in mass Set up from A to I another row of parallelograms each equal to those above mentioned, A I K I These will not be equal to the supports by two whole parallelograms, being in number 6 only instead of 8 dividing, therefore, 8, the number in the support by 6, the number already obtained, we have 1·333 &c, which is the height A G must be that the weights may equal the supports, exceeding one quarter the height of the column by only $\frac{33}{100}$ of such quarter, a coincidence singularly corroborative of the rule laid down From inspection of figures 2, 3, and 4, it is evident that, when the void is $\frac{1}{4}$d of the height of the columns in width the columns will be 6 diameters in height, when $\frac{1}{4}$th of their height, they will be 8 diameters high, and when $\frac{1}{5}$th of their height, they will be 10 diameters high, also that the intercolumniation called sys-

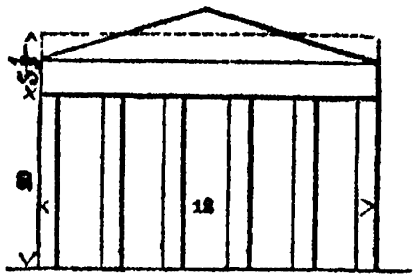
[illegible] is the general form of a tetrastyle temple, wherein the columns are assumed at pleasure eight diameters high then, 4 × 8 = 32, the area of the supports, and as, to fulfil the conditions, the three voids are to equal twice that area, or 64, they must in all be equal to 8 diameters, for $\frac{64}{8}$ = 8, and the whole extent, therefore will be 12 diameters of a column To obtain the height of the entablature, so that its mass may equal that of the supports, as the measures are in diameters, we have only to divide 32, the columns, by 12, the whole extent of the façade, and we have two diameters and two thirds of a diameter for the height of the entablature, making it a little more than one quarter the height of the column, and again agreeing in terms of the diameter with many of the finest examples of antiquity, or very nearly so If the pediment

(5)



be employed it is evident the dotted lines A C, C B being bisected in *a* and *b* respectively, that the triangles A E *a*, *b* B F, are equal to *a* D C and D C *b*, and the loading or weight will [illegible] Similar results are obtained in fig 6, [illegible] is 10 diameters, the number of columns 6; the whole, therefore, 180, the supports being 60 Here $\frac{60}{18} = 3\frac{1}{3}$ diameters will be the height of the entablature

(6.)




We cannot leave the subject without adverting to the rules given by Vitruvius (chap ii book iii) — rules which were not his own only, but the result of the practice of the time in which he lived, and which, within small fractions, are most singularly corroborative of the assumed hypothesis of making the voids equal to the supports Speaking of the [illegible] ing the eustylos as the most beautiful, he thus directs the formation of temples with that interval between the columns The rule for designing them is as follows — "The extent of the front being given, it is, if tetrastylos, to be divided into eleven parts and a half, not including the projections of the base and plinth at each end, if hexastylos, into eighteen parts if octastylos, into twenty-four parts and a half One of either of these parts, according to the case, whether tetrastylos, hexastylos, or octastylos, [illegible] of one of the colur [illegible] be eight parts and a [illegible] and the heights of the columns will have proper proportions" Further on in the same chapter he gives directions on araeostyle, diastyle, and systyle temples, on which it is unnecessary here further to enlarge Let the above rules be examined The tetrastylos is $11\frac{1}{2}$ parts wide and $8\frac{1}{3}$ high the area, therefore of its whole front will be $11\frac{1}{2} \times 8\frac{1}{3} = 97\frac{2}{3}$ The four columns will be $4 \times 8\frac{1}{3} = 34$ or a very little more than one third of the whole area, the remaining two thirds, speaking in round numbers being given to the intercolumns or voids The hexastylos is eighteen [illegible] a half high the whole area, therefore, is $18 \times 8\frac{1}{3} = 150$ The six columns will be $6 \times 8\frac{1}{3} = 51$, or exactly one third of the whole area, the voids or intercolumns occupying the remaining two thirds The octastylos is $24\frac{1}{2}$ parts in extent and $8\frac{1}{3}$ in height $24\frac{1}{2} \times 8\frac{1}{3} = 208\frac{1}{3}$ The eight columns will be $8 \times 8\frac{1}{3} = 68$, or very little less than one third of the area, and the voids or intercolumns about double, being the remaining two thirds

The average of the intercolumniations in the first case will be $\frac{11\frac{1}{2} - 4}{3} = 2\frac{1}{2}$ diameters

In the second case $\frac{18 - 6}{5} = 2\frac{2}{5}$

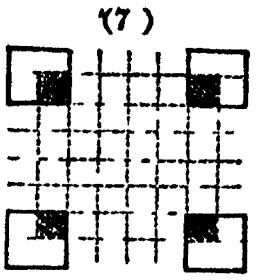
In the third case $\frac{24\frac{1}{2} - 8}{7} = 2\frac{357}{1000}$

As, in our opinion a discrepance between practice and theory will not shake the principle, we are not fearful of candidly submitting a synoptical view of some of the most celebrated examples of antiquity in which a comparison is exhibited between the voids and supports certain it is that in every case the former exceed the latter and that, in the early Dorics, the ratio between them nearly approached equality In comparing, however, the supports with the weights, there is every appearance of that portion of the [illegible] taking a mean of [illegible] supports are to the weights as 1 1 16, in the five of the Ionic order, as 1 1 05, and in the four of the Corinthian order, as 1 1 04, a coincidence so remarkable that it must be attributed to something more than accident and deserving much more extended consideration than our limits here admit

| | Order | No of Columns | Supports. | Weights | Voids. |
|---|---|---|---|---|---|
| Temple of Jupiter Nemæus | Doric | 6 | 1 00 | 0 79 | 1 03 |
| Parthenon | — | 8 | 1·00 | 1 07 | 1 04 |
| [illegible] at Rome | — | 6 | 1 00 | 1 14 | 1 16 |
| [illegible] Minerva [illegible] | — | 6 | 1 00 | 1 40 | 1 17 |
| [illegible] | — | 6 | 1 00 | 1 13 | 1 21 |
| [illegible] | — | 6 | 1 00 | 1 45 | 1 36 |
| Temple of [illegible] | Ionic | 6 | 1 00 | 0 89 | 1 24 |
| [illegible] | — | 4 | 1 00 | 1 15 | 1 71 |
| [illegible] | — | 4 | 1 00 | 0·96 | 1 72 |
| of Bacchus at Teos | — | 8 | 1 00 | 1 35 | 2 05 |
| of Minerva Polias | — | 4 | 1 00 | 1·01 | 2 18 |
| Portico of Septimius Severus | Corinth | 6 | 1 00 | 0 93 | 1 37 |
| Maison Carrée | — | 6 | 1 00 | 0 93 | 1 58 |
| Temple at Jackly | — | 6 | 1·00 | 0·90 | 1·62 |
| Pantheon | — | 8 | 1 00 | 1 43 | 1 84 |

We close this short inquiry by adverting to a curious fact connected with it; viz the area of the points of support for the edifice which such an arrangement affords In fig 7 the hatched squares represent the quarter piers or columns in a series of intercolumniations every way, such intercolumniations being 2 diameters, or 4 semidiameters these, added to the 2 quarter piers, will make 6, whose square, 36, therefore, is the area to be covered with the weight, the 4 quarter piers or columns = 4, hence the points of support are $\frac{4}{36}$ of the area = 0 111

(7)



Now, in twenty-five of the principal buildings in Europe (*see* POINTS OF S [illegible]) will be seen to be 0·168 on the mean, [illegible] from the result here given, but if we take the subjoined buildings, the mean will be found to differ much less, viz —

| | |
|---|---|
| Temple of Peace | 0 127 |
| S Paolo fuori le Mura | 0·118 |
| St Sabino | 0 100 |
| S Filippo Neri | 0 129 |

ORDER OF SUPERPOSITION A Geological term, implying the regular succession of arrangements which [illegible] forming the exterior crust of our globe invariably [illegible] (Geology) Although certain strata or [illegible] are occasionally wanting they never depart from the [illegible] der of superposition

ORDER OF THE DAY In Parliamentary usage, one method of superseding a question already proposed to the House is by moving "for the order of the day to be read" [illegible] to precedence, must be for the order generally, and not for any particular order, and if this is carried, the orders must be read and proceeded on in the course in which they stand But it can be in its turn superseded by a motion "to adjourn" See *Hatsell's Prec Parl* vol ii, who says that the first instance he has met with of this proceeding was on the 1st of April, 1747

ORDERS HOLY A term, properly speaking, applied to the different ranks of [illegible] but, in ordinary language used to indicate the *character* of such persons The Roman Catholic church admits of seven orders four minor, secular, or petty, of doorkeeper, exorcist, reader, and acolyth, three major, of deacon, priest, and bishop The first are mere formalities, and generally conferred on the same day, the admission to the latter constitutes the sixth sacrament of Romanism [illegible] four minor, but has the additional one of sub-deacon See ORDINATION

ORDERS, RELIGIOUS, are of three kinds, 1 Monastic 2 Military 3 Mendicant

1 The Monastic orders were distinguished by the rules to which they were subjected by their respective founders Of these the principal are the Basilian, the Benedictine, and the Augustinian

i The earliest comprehension of a number of conventual societies under one rule was effected by St Basil, archbishop of Cæsarea, in Asia Minor, who united the hermits and cenobites already established in his diocese, and prescribed an uniform constitution for them, in which he strongly recommended the obligation of a vow upon admission This recommendation was a novelty in the monastic system, which [illegible] up to that time (A D 370) without an [illegible] This institution prevailed throughout the eastern districts of Christendom and has subsisted in the Greek church up to the present time with little variation

ii In the West the first order of monks was founded by Benedict of Nursia (A D 529) He conceived that the ends of monastic seclusion might be better attained by a milder discipline, uniformly imposed, than by the fanatical and arbitrary austerities of many of the European communities While other reformers of the monkish system have aimed at repairing its laxity and degeneracy by the infusion of [illegible] severity, he alone seems to have [illegible] have provided [illegible] by the imposi [illegible] He insisted [illegible] useful manual labour [illegible] as was the custom with oth [illegible] for the employment of the day This rule was revised three centuries later by another Benedict, a native of Ariane, in the south of France

From this remodelled system which was more severe than its predecessor and was soon [illegible] the Benedictine monasteries already [illegible] rous, arose various branches, all more or less famous in ecclesiastical history The order of Cluni the Cistercians, the Chartreux the Camaldulenses, Præmonstratenses, &c are distinct off-shoots from this main trunk,

and for many centuries have covered the face of Catholic Europe

iii The original inhabitants of the monasteries were laymen, the spiritual duties of the institution being performed by the pastor of a neighbouring village, or by one or two resident ecclesiastics St Augustin set the example of a clerical society, by living, in common with his inferior clergy, under certain instructions which he drew up for their direction His authority was widely followed in later times, and the order of Augustinian canons, consisting expressly of persons ordained or destined to the sacred profession, claims a place among the three principal monastic institutions These canons were afterwards divided into the regular and secular, according as they observed what traditionally [illegible] ascribed by the founder himself, [illegible] who, in later times, had reorganized the system

2 i The Military orders form also an important feature in ecclesiastical and political history The necessity which the monks were under, in unsettled times, of assuming arms themselves to defend the possessions which they had accumulated may have suggested the first idea of uniting the military with the religious profession

The earliest order, however, of this kind — that of St John of Jerusalem or the Knights of Hospitallers — arose in the 11th century, out of religious communities whose care of an hospital in Jerusalem had been consigned The Hospitallers were afterwards better known under the titles of Knights of Rhodes and, still later, of Malta

ii The Knights Templars also received their appellation from Jerusalem, the place of their origin and early abode They were founded in 1118, and to them certain military duties were from the first specially prescribed, as the defence of Palestine and the protection of pilgrims in the Holy Land After the expulsion of the Christian arms from that region they spread over Europe and became a very numerous and powerful body, until having excited the fears or avarice of popes and princes, they were condemned by a council assembled at Vienna, and exterminated by a [illegible]

iii The third Military [illegible] This institution, again was an offspring of the crusades and a native of Palestine, originating in the officer of an hospital at the siege of Acre On the termination of the holy wars, these knights became established in Germany and distinguished themselves by the conquest and conversion of Prussia and Pomerania Their order only ceased to exist when, at the Reformation its members abandoned the cause of the papacy and embraced the prevalent opinions of the north of Germany To these may be added various inferior military orders especially those of Spain and Portugal *See* CALATRAVA and ALCANTARA ORDERS OF

3 i The Mendicant orders were the creation of the papacy, for the advancement of its own political purposes It was in the 12th century that the apprehensions of the holy see were first excited by the rise and spread of heretical opinions, nor, at that period were either the secular or the regular clergy disposed to rouse themselves from their indolence and vice to combat with these active assailants The counteracting force also which the monks had supplied, in earlier ages to the independent spirit of the secular priesthood, had lost much of its efficacy, and in some measure been turned against the central authority of Rome A new ally was required, and was furnished in the order of St Dominic, which after [illegible] the extinction of the heresy of the Albigenses was placed upon a permanent footing by [illegible]

ii The [illegible] contemporary institution, and avowed the same principle of poverty and mendicity Our limits allow us merely to mention — iii The Carmelites (who derived their name from Mount Carmel, in Syria, where the order originated), iv The Augustinians, who complete the number of the Mendicant orders, and, v The Jesuits *See* JESUITS

ORDINAL, or ORDER The name given in England to an old work containing the ritual or religious ceremonies necessary to be performed before the ordination of a priest It was composed in the reign of Edward VI and revised by the English clergy in 1552

ORDINANCE An obsolete word signifying decree or enactment After the time of Philip le Bel (1327), the laws made by French kings were generally termed ordinances (ordonnance), a term which in its most comprehensive sense included also their edicts, declarations, and letters patent The right to issue ordinances for the execution of the laws (equivalent to proclamations and orders in council) is conferred on the monarch by the French charters, and it was on an ambiguity of language in the clause conferring this right in that of 1814, that a defence was [illegible] for the illegal proceedings of the ministers [illegible] in 1830 The best collection of the *Ordonnances des Rois de France* is that begun by order of Louis XIV, of which the first volume appeared in 1723 it extends to 12 vols folio

The Self denying Ordinance, in English History was a resolution of the Long Parliament in 1644, by which its members bound themselves not to take certain executive offices particularly commands in the army, the effect of which, as is well known, was the transference of power, first in the the army and then in the state, from the Presbyterian to the [illegible] party

ORDINANDUS In Ecclesiastical Antiquities, one about to receive orders — *Ordinant* a [illegible]

[illegible] n of the Civil Law for any judge who has authority to take cognizance of causes in his own right, and not by delegation, used, in English law, with reference to ecclesiastical judges only Thus, a bishop is ordinary in his own diocese, an archbishop, for the purpose of appeals, in his province

ORDINARY In the Court of Session in Scotland, a single judge (by courtesy styled lord), who decides with or without a jury, as the case may be There are five such judges their decisions may be brought by appeal under review of the divisions of the court to which they respectively belong *See* SESSION, COURT OF

ORDINARY In the Navy, the establishment of the shipping not in actual service

ORDINARY, in Heraldry, is a portion of the escutcheon comprised between straight or other lines It is the simplest species of charge, and many of the most ancient escutcheons known contain no other bearing, although [illegible] also of great antiquity the ordinary [illegible] charge [illegible] An ordinary should, it is said comprise the [illegible] shield The number of ordinaries in common use is considerable, among the chief are the pale, fess bend, bar saltier, chevron, cross (which see) Each of these is usually bounded by straight lines, but the lines may be also diversified in various manners Thus an ordinary bounded by serrated lines is said to be *indented*, bounded by undulating lines, *wavy*, and there are many other deviations from the straight line as *ingrailed invected, nebuly, raguly rayonny dancetty embattled* or *crenelly, battled embattled, [illegible]* Varied in two styles, if [illegible] only on the upper it is said to be *superingrailed superinvected*, &c, if only on the [illegible]

ORDINARY, of Newgate [illegible] in this prison is so called whose duties consist in preaching and reading prayers to the prisoners preparing condemned criminals to meet their fate, and in accompanying such to the place of execution

ORDINATE (Lat ordino *I arrange*) In Geometry, a straight line drawn from any point in a curve perpendicularly to another straight line, which is called the abscis (See ABSCISS) The abscis and ordinate together are called the *co ordinates* of the point The situation of a point in a plane is determined when its distances from two straight lines in the same plane are known, and, when a series of points are so situated in respect of each other that the co ordinates of each have the same mathematical relation these points form a curve, the nature of which is expressed by the relation of the co ordinates See CO-ORDINATES

ORDINATION The ceremony of conferring orders in the church which is derived by all communities that admit a regular commission and succession in the ministry from the time of the apostles, from the authority of Jesus Christ, of whom it is said, in St John's Gospel (xx 21), that, after his resurrection, he said, "As my father has sent me, even so send I you" and then he breathed upon them, and said to them "Receive ye the Holy Ghost whose soever sins ye remit they are remitted unto them and whatsoever sins ye retain they are retained" Prayer and the imposition of hands are also mentioned as forming part of the ceremony of ordination of deacons in the Acts, and ordination is even now conferred under similar forms in most Christian churches

The Romish church holds ordination to be the sixth of its seven sacraments, as being an institution of Christ conferring a special grace [illegible] show that it differs from a sacrament, [illegible] received definition of such, as containing no matter, like the water in baptism, or [illegible] They deny that the vessels [illegible] delivered to the newly ordained person [illegible] the Romish rite can be taken as the matter of a sacrament, not being recommended by any Scripture authority, nor indeed known in the church till the tenth or eleventh century (See *Hooker's Eccl Pol* books vii and viii)

In the Presbyterian church the term *ordination* has a meaning wholly distinct from that in which it is received by other Christian churches, being applied exclusively to that solemn act by which a *licensed* preacher or probationer is inducted into the charge of a particular parish or congregation, and not, as is sometimes erroneously asserted, to the act by which he is entitled to preach the Gospel, or, in other words, to the ceremony [illegible] which [illegible] conferred in the English church In the Episcopal church a clergyman can be *ordained* but [illegible] the Scotch church he is said to be *ordained* as

often as he leaves one parish to be inducted into the [illegible]

ORDNANCE A Military term, applied generally to all sorts of great guns used in war, as cannons, mortars, howitzers carronades &c See the respective terms

ORDNANCE BOARD OF The name given to the board which provides the troops of the line, the regiments of artillery and engineers, the militia, volunteers, and the navy, with guns, ammunition, and arms of every description The Board of Ordnance also superintends the affairs of the regiments of artillery and engineers, the provision of forage for the whole of the troops at home, and the erection of fortifications and military works at home and abroad, &c At the head of this board is placed an officer, called the Master-general of the ordnance, who has the military command of the artillery, and of the corps of bombardiers sappers and miners Besides the Master-general there are officers connected with the ordnance at the Horse guards general, the Clerk of the ordnance, and the Storekeeper of the ordnance, which are self-explanatory terms

ORDONNANCE (Fr ) In Architecture the right assignment, for convenience and propriety, of the measure of the several apartments, that they be neither too large nor too small for the purposes of the building, and that they be conveniently distributed and lighted

OREADS (Gr ὄρος, *mountain* ) In Greek Mythology, nymphs of the mountains, companions of Diana, and usually invoked along with that goddess

ORES (German erze ) The mineral bodies from which metals are extracted Metals exist in the ores in one or the other of the four following states —1 In a metallic state, and either solitary or combined with each other, in the latter case forming alloys 2 Combined with sulphur forming sulphurets 3 Combined with oxygen forming oxides 4 Combined with acids forming carbonates, phosphates, &c , which generally go by the name of metallic salts

Certain ores which contain the metals most indispensable to human necessities have been treasured up by the Creator in very bountiful deposits [illegible] in great masses in rocks of different kinds in lodes, veins nests, concretions or beds with stony and earthy admixtures, the whole of which become the objects of mineral exploration These precious stores occur in different stages of the geological formations, but their main portion after having existed abundantly in the several orders of the primary strata, suddenly cease to be found towards the middle of the secondary Iron ores are the only ones which continue among the more modern deposits even so high as the beds immediately beneath the chalk, when they also disappear or exist merely as colouring matters of the tertiary earthy beds

The strata of gneiss and mica-slate constitute in Europe the grand metallic domain There is hardly any kind of ore which does not occur there in sufficient abundance to become the object of mining operations and many are found no where else The transition rocks and the lower part of the secondary ones, are not so rich neither do they contain the same variety of ores But this order of things, which is presented by Great Britain Germany, France, Sweden, and Norway is far from forming a general law, since in equinoxial America the gneiss is but little metalliferous, while the superior strata, such as the clay schists, the siemitic porphyries the limestones, which complete the transition series, as also several secondary deposits, include the greater portion of the immense mineral wealth of that region of the globe

All the substances of which the ordinary metals form the basis, are not equally abundant in nature, a great proportion of the numerous mineral species which figure in our classifications are mere varieties scattered up and down in the cavities of the great masses or lodes The workable ores are few in number being mostly sulphurets, some oxides, and carbonates These occasionally form of themselves very large masses, but more frequently they are blended with lumps of quartz felspar, and carbonate of lime which form the main body of the deposit, as happens always in proper lodes The ores in that case are arranged in layers parallel to the strata of the formation, or in veins which traverse the rock in all directions, or in nests or concretions stationed irregularly, or finally disseminated in hardly visible particles These deposits sometimes contain apparently only one species of ore, sometimes several which must be mined together, as they seem to be of contemporaneous formation, whilst, in other cases they are separable, having been probably formed at different epochs Under the particular metals will be found an account of the localities of ores, &c ; but the following general observations may prove useful in presenting a condensed resume of the whole subject

1 *Tin* exists principally in primitive rocks, appearing either in interlaced masses in beds, or as a constituent part of the rock itself, and more rarely in distinct veins Tin ore is found indeed sometimes in alluvial land, filling up low situations between lofty mountains,



2. *Gold* occurs either in beds or in veins, frequently in primitive rocks; though it is also found in other formations, and particularly in alluvial earth When this metal exists in the bosom of primitive rocks, it is particularly in schists It is not found in serpentine but it is met with in greywacke in Transylvania The gold of alluvial districts called gold of washing or transport, occurs, as well as alluvial tin, among the debris of the [illegible]

[illegible], particularly in veins and beds, in primitive and transition formations, though some veins of this metal occur in secondary strata The rocks richest in it are gneiss, mica-slate, clay-slate greywacke and old alpine limestone Localities of silver-ore itself are not numerous, at least in Europe, among secondary formations, but it occurs in combination with the ores of copper or of lead

4 *Copper* exists in the three mineral epochas —1 In primitive rocks principally in the state of pyritous copper in beds in masses, or in veins, 2 In transition districts, sometimes in masses, sometimes in veins of copper pyrites, 3 In secondary strata, especially in beds of cupreous schist

5 *Lead* occurs also in each of the three mineral epochas abounding particularly in primitive and transition grounds, where it usually constitutes veins, and occasionally beds of sulphuretted lead (galena) The same ore is found in strata or in veins among secondary rocks associated now and then with oxide of iron-oxide and calamine (carbonate of zinc), and it is sometimes disseminated in grains through more recent strata

6 *Iron* is met with in four different mineral eras, but in different ores Among primitive rocks magnetic iron ore and specular [illegible] of enormous size [illegible] (hæmatite) are found generally in veins, or occasionally in masses with sparry iron both in primitive and transition rocks, as also sometimes in secondary strata, but more frequently in the coal measure strata, as beds of clay-ironstone, of globular iron oxide, and carbonate of iron In alluvial districts, we find ores of clay ironstone, granular iron-ore bog- [illegible] The iron ores which be[illegible] almost always the metallic aspect, with a richness [illegible] even to 80 per cent of iron, while the ores in [illegible] formations become in general more and more earthy, down to those in alluvial soils, some of which present the appearance of a common stone, and afford not more than 20 per cent of metal, though its quality is often excellent

7 *Mercury* as a sulphuret occurs principally among secondary strata in disseminated masses, along with combustible substances, though the metal is met with occasionally in primitive countries

8 *Cobalt* belongs to the three mineral epochas, its most abundant deposits are veins in primitive rocks, small veins containing this metal are found, however, in secondary strata

9 *Antimony* occurs in veins or beds among primitive and transition rocks

10, 11 *Bismuth* and *nickel* do not appear to constitute the predominating substance of any mineral deposits, but they often accompany cobalt

12 *Zinc* occurs in the three several formations namely, as sulphuret, or blende particularly in primitive and transition rocks as calamine in secondary strata, usually along with oxide of iron, and sometimes with sulphuret of lead

In the analysis of ores, it is impossible to lay down any general rule, so numerous are the ores themselves, and so diversified the means necessary to be adopted in the various analytic processes Under each particular metal will be found an account of its most important ores, and we shall here restrict ourselves to a few general remarks on the theory of smelting ores

It is probable that the coaly matter employed in that process is not the *immediate* agent of their reduction, but the charcoal seems first of all to be transformed by the atmospherical oxygen into the oxide of carbon, which gaseous principle then surrounds and penetrates the interior substance of the oxides with the effect of decomposing them, and carrying off their oxygen That this is the true mode of action is evident from the well-known facts that bars of iron, strained with pounded charcoal, in the steel-cementation chest most readily absorb the carbonaceous principle to their innermost centre, while their surfaces get blistered by the expansion of carburetted gases formed within, and that an intermixture of ores and charcoal is not always necessary to reduction, but merely an interstratification of the two, without intimate contact of the particles In this case, the carbonic acid which is generated at the lower surfaces of contact of the strata, rising up through the first bed of ignited charcoal, becomes converted into carbonic oxide, and this gaseous matter passing up through the next layer of ore, seizes its oxygen, reduces it to metal, and is itself thereby transformed once more into carbonic acid; and

so on in continual alternation It may be laid down, however, as a general rule, that the reduction is the more rapid and complete the more intimate the mixture of the charcoal and the metallic oxide has been, because the formation of both the carbonic acid and carbonic oxide becomes thereby more easy and direct Indeed the cementation of iron bars into steel will not succeed, unless the charcoal be so porous as to contain, interspersed, enough of air to favour the commencement of its conversion into the gaseous oxide, thus acting like a ferment in brewing Hence, also, finely pulverized charcoal does not answer well, unless a quantity of ground iron cinder or oxide of manganese be blended with it, to afford enough of oxygen to begin the generation of carbonic oxide gas whereby the [illegible] [illegible] [illegible]

pedal trumpets 16 feet to 8 feet C The 32 feet pipe with the remainder of the 2 octaves of double pedal pipes are in front The choir organ from C C C 16 feet [illegible] is all at 8 feet pitch, and stopped diapasons, principal, harmonic flute, fifteenths, [illegible] open diapason, wood, and [illegible] the swell descends to C and has one octave, and stopped diapason, principal, [illegible] harmonica, horn, trumpet hautboy and clarion

The ophicleide or tuba mirabilis, on the swell manual from C C to F has the same compass as the swell but separate from it, forms its prominent feature, having power equal to the whole of the great organ, with a full, fine, and smooth tone

The first clavier is the choir, the second the great organ [illegible] affecting either, or, in other words, the performer may [illegible] in the usual [illegible] at [illegible] clavier To [illegible] mechanical movements requires more draw stops than real stops of pipes, although the same object is gained by the fourth clavier as by a fourth separate organ The collected lengths of the trackers, or wood rods, which communicate from the keys to the sound boards, would extend four miles and a half The 32 feet C is 1 foot 8½ inches in diameter the same note, in wood, 3 feet by 2 feet 6 inches, and would hold 12 pipes and 13 gallons of wine There are two octaves and a half of bells The pedal pipes are played with the fingers, as easily as the great organ, by a newly invented valve* which resists the pressure of wind There are at present 63 draw stops in this organ, including the tuba mirabilis recently inserted and including coupler stops The choir and swell have 2 draw stops to each row of pipes, as the fourth clavier may require

In the late Industrial Exhibition of all Nations an organ by Mr Willis deserved and attracted much notice It was in point of tone very successful, and was exceedingly well voiced This instrument is built upon the German plan, and contained nearly 4500 pipes Its principal novelty was a contrivance for acting on the draw-stops intended to supersede the use of composition pedals One of its great merits was the great quietness of its action The reader will find in the SUPPLEMENT a detailed plan of this instrument.

ORGAN POINT In Music, a succession of chords, in some of which the harmony of the fifth is taken unprepared on the bass as a holding note, whether preceded by the tonic or by the harmony of the fourth of the key

ORGA'NICAL DESCRIPTION OF CURVES In Geometry, signifies the description of curves on a plane by means of instruments, as the circle is described by a pair of compasses the ellipse by means of a thread passing round two pins in the foci, the epicycloids by the revolution of circles on the circumferences of other circles, the conchoid by means of the *trammel* the cissoid by the motion [illegible] &c See *Schooten's Exercitationes Mathematicæ*, *Newton's Arith Universalis*, *Maclaurin's Geometria Organica* &c

ORGA'NIC DISEASE A disease in which the structure of an organ is morbidly altered, opposed to *functional* disease, in which the secretions or functions only are deranged, without any apparent change of organization Tuberculated induration of the liver is an [illegible] that viscus the secretion [illegible] a *functional* derangement of it

ORGA'NIC LAWS In Modern Political Phraseology, the name given to laws directly concerning the fundamental parts of the constitution of a state According to the distinction taken by some French writers fundamental laws are merely declaratory continuing the principles or theory of government Organic laws are those which apply those principles to the actual condition of society by positive enactment, and add the sanction of punishment

ORGA'NIC REMAINS The organized bodies, whether of animals or vegetables found in a fossil state, are so called See GEOLOGY

ORGANISTS The old name given in the Roman Catholic Church to those priests who organized or sang in parts The name *organists of the hallelujah* was applied in the Church of [illegible] certain priests who assisted in the performance of the mass They were generally four in number, and derived their name from singing in parts, or organizing the melody appropriated to the word hallelujah

ORGANIZA'TION (Lat ) The processes by which an organized body is formed also the totality of the parts which constitute, and of the laws which regulate, [illegible]

ORGANOGRAPHY (Gr οργανον, *a tool* or *instrument*, and γραφω, *I describe* ) A term usually applied to an account of the structure of plants It comprises all

* For this valve Mr Hall had the silver medal awarded to him by the Society for Promoting Arts and Commerce, May 31st, 1841

[illegible] tions are performed, and teaches the relation which one part bears to another, with the dependence of the whole upon the common system *See* BOTANY

O'RGANON (Gr οργανον ) In Philosophical language, nearly synonymous with *method* and implying a body of rules and canons for the direction of the scientific faculty, either generally or in reference to some particular department For an account of the *Organon* of Aristotle and that of Bacon, see articles ARISTOTELIAN and BACONIAN [illegible]

O'RGIES [illegible] the mysteries of Bacchus, [illegible] of the Greeks and Thracians Writers from the word οργη, *anger*, from the fury and excitement of the Bacchanals, or from the wrath of Ceres against Jupiter (*Clem Alex* ) But these fanciful etymologies after the manner of the Greeks seem to show that the word was really of foreign origin, and adopted by them together with the thing itself The author of the article "Mysteries" in the *Encyc Brit* would derive it from Hebr argoz, *a chest*, from the casket containing the secret symbols of the god According to his view, the orgies were the mysteries of Osiris, the Egyptian Bacchus, and from Egypt transplanted to Greece, where they became mingled with the gross corruptions peculiar to the worship of the Bacchus of Thebes Others imagine the origin to have been in Thrace The frantic solemnities of these rites are most poetically described in the *Bacchæ of Euripides* The mysteries which they enveloped are extremely obscure

ORGUES In Fortification, long and thick pieces of wood shod with iron, and suspended each by a separate rope over a gate so as to be ready to be let fall and stop it up upon the approach of an enemy The term also denotes a machine composed of arquebuses, or musket barrels linked together so that they may be discharged all at once, and used to defend breaches

ORGYIA (Gr οργη, *I stretch out*, and γυιον, *a limb* ) A name applied by Ochsenheimer to a genus of Lepidopterans

ORICHA'LCUM (Gr ορος, *a mountain*, and χαλκος, *brass* ) Literally mountain brass This was the name given to a peculiar kind of mixed metal in general use among the ancient Greeks and Romans It is proved to have been made on much the same basis as brass, but various opinions have been entertained respecting the precise nature of the ingredients employed in its composition and no definite conclusion has been arrived at on the subject

O'RIEL (Ityn uncertain ) In Gothic Architecture, a bay window According to some passages in early writers it seems also to signify a recess, but the former is the signification now usually attached to it

O'RIENT (Lat orior *I rise* ) The east, or eastern part of the horizon In surveying, *to orient* a plan signifies to mark its situation or bearing with respect to the four cardinal points

O'RIFLAMME The ancient royal standard of France It was the banner of the abbey of St Denis which was presented by the abbot to the lord protector of the convent whenever engaged in the field on its behalf This protectorship was attached to the countship of Vexin, and when that county was added to the possessions of the crown by Philip I this banner, which he bore in consequence, became in time the great standard of the monarchy By some it is said to have been lost at Agincourt, but, if so, it was restored Its last display in the field was in the reign of Charles VII Its derivation is uncertain: according to some, 'quasi aurea flamma" According to Count de Gebelin the last syllable is the same with "flamm" (Germ fahne) Felibien says it was still to be seen, in 1535 in an abbey, almost devoured by moths. (See *Mem de l'Ac des Inscr* vol xiii )

ORI'GANUM OIL OF The distilled or volatile oil of the wild marjoram It is imported from the south of Europe, and used in liniments and embrocations as a stimulant

ORI'GENISTS An early Christian sect who pretended to draw their opinions from the writings of the celebrated Origen They maintained that Christ was the Son of God only by adoption and denied eternity of punishments They existed in considerable numbers in the fourth, fifth, and sixth centuries and their tenets spread among the monks of Egypt This sect of Christians must by no means be confounded with the Origenarians who sprang up at a somewhat later period than the former and whose tenets surpassed in abomination even those of the Gnostics (See *Mosheim* (transl ), ed 1790 i 392 )

ORI'GINAL (Lat originalis ) In Law where the several parts of an indenture are interchangeably executed between the parties, that part which is executed by the [illegible] the others counterparts [illegible] But, when all

the parties execute every part, all are originals. The *original* of any deed or document is the best evidence; and a copy not admitted until reasonable proof has been given that the former is destroyed, lost, &c., or that it is in the possession of the adverse party, who has been duly warned to produce it (*See* EVIDENCE) The writ which a plaintiff sued out of chancery, in order to commence a suit, was formerly called an "original writ," the use of it is abolished, in personal actions, by 2 W 4 c 39 *See* PLEADING

ORIGINAL In the Fine Arts, a work not copied from another, but the work of the artist himself When an artist copies his own work, it is called a duplicate A certain freedom and ease are always discernible in an original, which in a copy are looked for in vain, though copies have sometimes been executed which it is almost impossible to detect, and which have deceived even excellent judges

ORIGINAL SIN Theology, to use the language of the English Church Homilies, or ninth article, "standeth not in the following of Adam but is the fault and corruption of the nature of every man that naturally is engendered of the offspring of Adam, whereby man is very far gone from original righteousness and is of his own nature inclined to evil," and it "deserveth God's wrath and damnation" By the "following of Adam" here meant the imitation of Adam's sin by those to whom this article is directed, having held that the words of Scripture, "in Adam have all sinned," related not to any inherent vice in the race of Adam, but to the propensity of mankind to imitate his transgression (August *De Nat et Gratia*) With this exception, the original depravity of man's nature and the consequent necessity of "a new birth unto righteousness" have been commonly held by all sects of Christians But a great and important difference has prevailed as to the character and cause of that depravity The belief of St Augustine is thus expressed by Bishop Burnet —"That a covenant was made with all mankind in Adam as their first parent, that he was a person constituted by God to represent them all and that the covenant was made by him so that if he had obeyed all his posterity would have been happy through his obedience, but by his disobedience they were all to be esteemed to have sinned in him his acts being imputed and transferred to them all" This doctrine of *imputed guilt* has been held by many of the stricter sects and varieties of Christians both in and out of the church of Rome, it is said by some to be the most consonant to the words of our article, as no doubt it is to the views of the framers of it, whose sentiments were deeply tinctured with Calvinism But it may be questioned whether those words are not as easily applicable to what is, I believe, the more common opinion among Protestants (I mean) —that original sin is not the sin of Adam imputed to his descendants but is that actual depravity of evil which philosophy, [illegible] existing in the human mind, and developed with its growth in each individual subject, the source of which or its permission by the Divine Author of Good is involved in the inevitable obscurity which surrounds the great question of the origin of evil

ORI'LLON In Fortification, a mass of earth lined with a wall, raised on the shoulder of a bastion for the purpose of covering the retired flank

ORION One of the finest [illegible] formed by Ptolemy It is situated in the southern hemisphere with respect to the ecliptic but the equinoctial passes nearly across its middle Orion is one of the most remarkable constellations in the heavens It contains seven stars, which are very conspicuous to the naked eye, four of them form a square and the three others are situated in the middle of it in a [illegible] Two of the four are stars of the first magnitude [illegible] It gel in the left foot and Betelgueze [illegible] The three stars in the middle of [illegible] second magnitude, and form what is called the *belt of Orion* They are [illegible] and the *Yard-wand* [illegible] the figure of a man [illegible] time Orion is of great antiquity, and occurs in the books of Job, Amos, and Isaiah Orion contains a remarkable nebula, and thousands of small stars which are only visible in powerful telescopes

ORION In Greek Mythology, the son of Hyrieus, according to Homer, a youth slain by Diana, on account of the love borne to him by Aurora, but according to others, a king and a mighty hunter Antiquity is full of contradictions respecting the origin, character, and fate of this mythological personage and [illegible] which it agrees respecting him is his [illegible] stars after his death Those who wish to see all the circumstances of his history [illegible] investigated should consult the dissertation of the late Prof Müller of Gottingen, *Über Orion*, which appeared in the *Rhein Mus Philol* ii 12

ORISMOLOGY (Gr ορισμος, *a term*, and λογος, *a discourse*.) That branch of natural history which relates to the explanation of the technical terms of the science It is also called Glossology and Terminology

O'RLO (Ital *a hem or edge*) In Architecture, the plinth to the base of a column or a pedestal

O'RLOP DECK The lowest deck or rather partial deck of a ship below the water, on which the cables are coiled, the sails &c stowed

ORMOLU (Fr) Bronze or copper gilt usually goes under the name The French are celebrated in this branch of manufacture

O'RNAMENT (Lat ornamentum) In the Fine Arts *See* DECORATION

ORNITHI'CHNITES (Gr ορνις, *a bird*, ιχνος, *a trace*) The footmarks of birds which occur in different strata Some of these are very remarkable, as proving the existence of birds at very remote periods, for instance, at the early epoch of the new red sandstone formation An account of these, as occurring in the red sandstone of Connecticut, is given by Professor Hitchcock in the *American Journal of Science and the Arts*

ORNITHOLITES (Gr ορνις, and λιθος, *a stone*) The name given to fossil birds

ORNITHO'LOGY (Gr ορνις, *a bird*, and λογος, *a description*) The science which teaches the natural history and arrangement of birds (*See* AVES for the general organical characters of the class, and the modifications of the feet by which the five orders of the Quinary arrangement are [illegible])

[illegible] this class of birds is by no means so clearly indicated by either external or anatomical characters as that of Mammals, and the systems of Ornithology present, in consequence, greater discrepancy than the Mammalogical ones It is not without interest to observe that if conditions of the procreative function be taken as guides to the primary division of the class, such division will present the binary character, as in the class of Mammals and of Reptiles, for example, birds may be divided into two great groups, in one of which the young are able to run about or swim and provide food for themselves the moment they quit the shell, while in the other the young are excluded feeble, naked, blind, and dependent on their parents for support The species comprised in the first of these groups have been termed *Aves præcoces*, those of the second *Aves altrices*

Professor Nitzsch divided the feathered tribes into three grand primary groups, corresponding with the three great divisions of the matter of our planet, as air, earth, and water which constitute respectively the principal theatres of their vital actions

This first order consists of the Raptorial and Passerine birds, the birds of flight *par excellence* which he accordingly terms 'Luft-vogeln," or *Aves aereæ* The second order embraces the birds of the earth, "Erd-vogeln" *Aves terrestres* represented by the ostrich and common fowl The third great division includes the birds which frequent the waters, *Aves aquaticæ* (Wasser-vogeln) typified by the heron and the gull

Sundewall's ornithological system has four primary groups or cohorts

In the Quinary arrangement of birds proposed by Mr Vigors there may be traced a similar principle to that which guided Nitzsch in his ternary classification Thus, the first order (*Raptores* Virg) includes the birds which soar in the upper regions of the air, which build their nests and rear their young on the highest rocks and loftiest trees The second order (*Insessores*) includes the birds which affect the lower regions of the air, and which are peculiarly arboreal in their habits, whence the name of Perchers [illegible] Nitzsch's *Aves terrestres* [illegible] of Illiger, *Rasores* If the aquatic birds of Nitzsch be divided into those which frequent the fresh waters, and are restricted to wading into rivers, lakes, &c in search of their food, and those which have the power of swimming or diving and for the most part frequent the great ocean, we shall then have the two remaining orders of the Quinary arrangement, viz *Grallatores* and *Natatores* The chief merit of this arrangement is its aim to express the natural affinities and their circular progression in the whole and in the several parts

Linnæus and Cuvier have six orders of birds, which are characterized as follows by the latter naturalist —

"Of all classes of animals, that of birds is the most strongly characterized —that in which the species bear [illegible] which is separated [illegible] Their systematic arrangement is based, as in the Mammalia, on the organs of manducation, or the beak, and in those of prehension, which are again the beak, and more particularly the feet

"One is first struck by the character of *webbed feet*, or those wherein the toes are connected by membranes that distinguish all *swimming birds* The backward position of their feet the elongation of the sternum, the neck, often longer than the legs to enable them to reach below them, the close glossy plumage impervious to water,

altogether corcur with the feet to make good navigators of, as *Pelmipedes*

"In other birds, which have also most frequently some small web to their feet, at least between the two external toes, we observe elevated tarsi, legs denuded of feathers above the heel-joint, a slender shape, in fine, all the requisites for wading in shallow waters in search of nourishment Such, in fact, is the source of food of the greater number, and although some of them resort exclusively to dry places, they are nevertheless termed 'shore-birds' or 'waders' (*Grallæ*)

"Amongst the true land birds, the *Gallinaceæ* have, like our domestic cock, a heavy carriage, a short flight, the beak moderate, its upper mandible vaulted, the nostrils partly covered by a soft and tumid scale, and always the edges of the toes indented, with short membranes between the bases of those in front They subsist chiefly on grain

"Birds of prey (*Accipitres*) have a crooked beak, with its point sharp and curving downward, and the nostrils pierced in a membrane that invests its base their feet are armed with strong talons They live on flesh and pursue other birds, their flight accordingly is mostly powerful The greater number still retain a slight web betwixt their external toes

"The Passerine birds (*Passeres*) comprise many more species than all the other families, but their organization presents so many analogies that they cannot be separated although

Finally, the nam d to those birds in which the external toe is directed backwards like the thumb, because the greater number of them avail themselves of a conformation so favourable for a vertical position to climb the trunks of trees"

Anterior to Cuvier, but subsequently in the order of publication, is Pallas's modification of the ornithological system of Linnæus It is contained in his great posthumous work, entitled *Zoographia Rosso Asiatica* He also divides the class of birds into six orders —

1 *Præpetes*, having the characters of the *Accipitres*, with which it is synonymous
2. *Oscines*, including the genus *Columba*, with the *Picæ* and certain *Passeres* of Linnæus
3 with the *Crassirostres*, Gra- Rav
4 *Pulveratrices*, having the characters of the *Gallinæ*
5 *Grallæ* This order commences with the genus *Otis*, and includes, as in the system of Cuvier, the Struthious birds with the true waders
6 *Hydrophilæ* The characters of this order corresponds with that of the *Palmipedes*, with which it is equivalent As an example of the views entertained and expressed by Pallas of relations of analogy, the following passage may be taken from his exposition of the nature of his *Hydrophilæ* — '*Rostra* in hoc ordine admodum variant, ut nullus ordinis character inde desumi possit et quasi reliquos ordines æmulari videntur ut *Diomedeæ* et *Catarractæ* Rapaces, *Larі Sternæ*, *Alcæ*, *Cepphi*, et *Colymbi*, Oscines, *Iriæ*, *Pulveratrices*, *Lundæ*, Passeres, et tandem *Serratirostria genera* Phœnicopterum et Plataleam inter *Grallas* referant"

The primary division of the class of birds adopted by the author of the article 'Aves" in the *Cyclopedia of Anatomy and Physiology*, includes seven orders, the Struthious birds, by virtue of their remarkable anatomical peculiarities being separated from the *Grallæ* of Linnæus and Cuvier The following are the orders

1 RAPTORES, *Accipitres* Linn Cuv Birds of prey
2 INSESSORES, *Passeres* Cuv Perchers
3 SCANSORES, Cuv Climbers
4 RASORES, *Gallinæ* Linn Cuv Scratchers
5 CURSORES, Illig Coursers
6 GRALLATORES, *Grallæ* Linn Waders
7 NATATORES, *Palmipedes*, Cuv, *Anseres*, Linn Swimmers

Scopoli and Latham have divided birds into *nine* orders, Temminck has *sixteen* orders, Brisson has *twenty-eight*, and Lacepede has *thirty-eight* orders, but the principles and the characters on which a classification of birds is most philosophically founded, appear to be sufficiently illustrated in the systems that have been already explained

ORNITHOMANCY (Gr ορνις, μαντεια *divination*) Divination by the flight of birds The Etruscans were the most celebrated observers of it *See* AUGURS

ORNITHORHYNCHUS (Gr ορνις, ρυγχος, *a beak*) The name of the genus of Monotrematous Mammals, of the mouth, which resembl is peculiar to the fresh-water rivers and lakes of Australia and Van Diemen's Land

OROMA'SDES. In Persian Mythology, the principle of Good, created by the will of the great eternal spirit Zeruane Akherene, simultaneously with Ahriman, the principle of Evil, with whom he is in perpetual conflict Oromasdes is the creator of the earth, sun, moon, and stars to which he originally assigned each its proper place, and whose various movements he continues to regulate According to the Persian myths, the world which is to last 12,000 years, during which the war between the Good and Evil Principle is to go on increasing, is at length to be consumed the Evil Principle exterminated, and a new world created in its room, over which Oromasdes is to reign as the sole and supreme monarch The great apostle of the Persians, Zoroaster, was the prophet of Oromasdes, and there is an old prophecy extant that after the lapse of ages a descendant of Zoroaster shall be sent by Oromasdes to redeem the world He could not fail to perceive how striking a resemb scheme of the Jews, and which was consummated by the advent of Jesus Christ *See* AHRIMAN, POLYTHEISM

ORPHEAN MYSTERIES The mysteries of which Orpheus was the founder were so called These mysteries were at a remote period in the highest estimation, and exercised an important influence over the intellectual development of mankind Orpheus is said to have been taught his mysteries by the Idæan Dactyli, to Thrace, whence they were propagated throughout all Greece by his initiated followers The nature of these mysteries is involved in an impenetrable veil of obscurity, but there can be no doubt that they partook of the general character of all containing a purer knowledge of religion than was compatible with the superstitious observances then prevalent On the union of these mysteries with the Bacchanalian orgies they fell into merited contempt, and were at length gradually disused. (*See* MYSTERIES) The initiated in these mysteries, as well as the persons employed to initiate candidates in them, were called, in some cases, *Orpheotelestæ*)

ORPHEUS A mythological personage, according to the common story, a son of the Thracian river Æagrus and the muse Calliope His power of moving inanimate things by music the share he bore in the Argonautic expedition, his descent into the Shades to recover his wife Eurydice, and his death by the violence of the Thracian women, are well-known circumstances in ancient romantic fable Moderns have imagined that his name is a general mythic for the earliest bards who came with their from Thrace to Greece Whether any fragments of poetry, either of the real Orpheus or of this supposed school, existed in Grecian classical ages has been doubted What passed as the poetry of Orpheus in the time of Aristotle seems to have been decidedly spurious as much so as the poems which we possess under the same name some of which are thought to be as recent as the 4th century after Christ Orphic poetry of ancient esoterical religion and import of the Mysteries (See *Lobeck's Aglaophamus*, *Bode's Orpheus*, Hedemann, *Initia Philosophiæ Græcæ*, *the History of the Literature of Greece*, Lib U K p 231, *Mem de l'Acad des Sciences*, vol xii)

ORPIMENT (Lat auripigmentum) Yellow *sulphuret of arsenic*, it forms the basis of the yellow paint, called *king's yellow* The solution of orpiment in ammonia has been used as a yellow dye

ORPIN (Fr) In Painting a yellow colour of various degrees of to approach, also to red

ORPINE The English name for the succulent herbaceous plant called by botanists *Sedum telephium*, which see

ORRERY A machine for representing to children the motions and relative magnitudes and distances of the bodies composing the solar system As these machines are often procured by well-meaning but ignorant people at considerable expense, it may be useful to quote an authority that will not be called in question "As to getting correct notions on this subject" (the magnitudes and distances of the planets), says Sir John Herschel, by drawing circles on paper, or, still worse, from those very childish toys called orreries, it is out of the question' (*Astronomy*, *Cab Cyc* p 287 For the description of an orrery see *Ferguson's Astronomy*, by Brewster.)

ORRIS ROOT The root of the *Iris Florentina*. It has an agreeable odour, much like violets, and is sometimes used in perfumed powders, it is also turned into little balls for issues, called *orris peas*

ORTHITE (Gr ορθος, *straight*) A mineral which occurs in straight rays or layers in Scandinavian granite It contains cerium and yttria

ORTHOCERATITES *Orthocerata* (Gr ορθος, and κερας *a horn*) The name of a family of Cephalopods with chambered siphoniferous shells which are straight, or are continued straight after commencing with a gentle curvature resembling a horn

ORTHODOX or ORTHODOXY (Gr ορθος, and δοξα, *opinion*) These terms are restricted in application to right judgments in matters of religious faith, and af-

though every sect maintains of course the exclusive correctness of its own views, yet the title of orthodoxy is appropriated by ecclesiastical historians to the standard maintained by the Catholic or universal church The term orthodox is generally restricted also to those principal tenets which have been always held by the great mass of professing Christians Large bodies of dissenters in England are allowed by the church to be orthodox, inasmuch as they hold the three creeds, and therefore profess the principal articles of the Christian faith in common with those who differ from them in matters of church authority and discipline

ORTHODROMICS (Gr ορθος and δρομος, *course*), in Navigation, is sailing on a right course, or on the arc of a great circle, which is the shortest distance between two points on the sphere

ORTHOEPY (Gr ορθος, and επος, *a word*), in Grammar, signifies literally the right use of words, but it is applied, at least by modern writers to signify that part of prosody which treats of the manner of uttering words, or of pronunciation in its limited sense *See* PRONUNCIATION

ORTHOGONAL (Gr ορθος, and γωνια, *angle*) In Geometry the same as [illegible]

ORTHOGRAPHIC PROJECTION [illegible] of points on a plane by straight lines at right angles to the plane *See* PROJECTION

ORTHOGRAPHY (Gr ορθος and γραφω, *I write*) That part of grammar which relates to the method of denoting sounds by visible signs, to the different kinds of letters, and their combination into syllables and words

ORTHOGRAPHY In Architecture, a geometrical representation of an elevation or section of a building

ORTHOPNŒA (Gr ορθος and πνεω *breathing*) A difficulty of breathing which is increased by any deviation from the erect posture

ORTHOPTERANS, *Orthoptera* (Gr ορθος and πτερον, *a wing*) An order of insects including all those species which have the wings disposed when at rest in straight longitudinal folds Latreille characterizes the insects of this order as having the body generally less firm in texture than in the Coleoptera and covered by soft semi-membranous elytra furnished with nervures which, in the greater number [illegible] in a straight line The wings [illegible] most frequently in the manner of a fan and divided by membranous nervures running in the same direction The maxillæ are always terminated by a dentated and horny piece covered with a [illegible] corresponding to the exterior divisions of the maxillæ of the Coleoptera They have also a sort of tongue

The *Orthoptera* undergo a semi metamorphosis of which all the mutations are reduced to the growth and development of the elytra and wings that are always visible in a rudimental state in the nymph As both this nymph, or semi-nymph, and the larva are otherwise similar to the perfect insect, they walk and feed in the same way

The mouth of the *Orthoptera* consists of a labrum two mandibles, as many maxillæ, and four palpi those of the jaws always have five joints, whilst the labial palpi as in the Coleoptera, present but three The mandibles are always very strong and corneous, and the ligula is constantly divided into two or four thongs The form of the antennæ varies less than in the Coleoptera but they are usually composed of a greater number of joints Several, besides their reticulated eyes have two or three ocelli The inferior surface of the first joints of the tarsi is frequently fleshy or membranous Many females are furnished with a true perforater formed of two blades frequently enclosed in a common envelop by means of which they deposit their eggs The posterior extremity of the body, in most of them, is provided with appendages

All the known *Orthoptera* without exception, are terrestrial, even in their two first states of existence Some are carnivorous, or omnivorous, but the greater number feed on living plants

ORTIVE (Lat ortus, *a rising*) In Astronomy, having reference to the rising of a star or planet, thus, *ortive amplitude*, or *eastern amplitude*, is the arc of the horizon intercepted between the point where a star rises and the east point

ORTOLAN The name given in France and England to a species of *Frangillidæ* greatly esteemed for the delicacy of its flesh when in season It is the *ortolano* of the Italians, and the *fettammer* of the Germans The ortolan is a native of northern Africa, but in the summer and autumnal months it resorts to southern Europe, and frequently migrates to the central and even the northern parts There are large establishments in Italy and in the south of France for feeding these birds, the flesh of which is styled by Prince Musignan *carne squisita*

ORUS, or HORUS An Egyptian god, son of Isis and Osiris [illegible] (II 144) answering to the Greek [illegible] appears in Egyptian paintings sitting on the lap of Isis. (See *Egyptian Antiquities*, London, 1836, vol ii)

ORVIETAN An antidote to poison, said to have been [illegible] Italy

ORYCTEROPUS (Gr ορυκτηρ, and πους, *a foot*) A genus of Edentate Mammals peculiar to the African continent and provided with feet and claws well adapted for digging, from which circumstance, and the heavy shapeless form of the only known species of this genus, it is called at the Cape of Good Hope the ground [illegible] The principal food of the orycterope is the termite and other species of ants, which it dislodges by its strong and sharp claws, and entraps by means of a long extensible and glutinous tongue It differs from the true ant-eaters principally in having molar teeth The orycterope is about the size of a hog, stands low, has short hair, and is of greyish brown colour It has four toes before and five behind, and inhabits burrows Its flesh is eaten

ORYCTOGNOSY, or ORYCTOLOGY (Gr ορυκτος *fossil*, and λογος *a discourse*) The branch of zoological science which treats of fossil organic remains These terms are sometimes used to denote those parts of mineralogy which have for their object the classification of minerals, their description, nomenclature, and arrangement

ORYZA (Arab aruz) The name by which rice was known to the ancient Greeks and Romans, and which has been adopted by modern botanists as the generic name of the plant yielding that invaluable grain The genus *Oryza* belongs to the class *Hexandria*, order *Dygynia*, and has ten glumes to a single flower, and two halea nearly equal adhering to the seed. It affords many varieties of which the most common is the *Oryza sativa*, or the English rice This plant is raised in immense quantities in India China and most eastern countries, in the West Indies Central America and the United States, and in some of the southern countries of Europe It, in fact occupies the same place in most intertropical regions as wheat in the warmer parts of Europe, and oats and rye in those more to the north Forming as it does, the principal part of the food of the most civilized and populous eastern nations it is more extensively consumed than any other species of grain It is light and wholesome, but is said to contain less of the nutritive principle than wheat. When rough or in its natural state in the husk it is called *paddy* There is an immense variety in the qualities of rice That which is principally exported from Bengal has received the name of *cargo* rice It is of a coarse reddish cast, but is sweet and large-grained, and is preferred by the natives to every other sort It is not kiln dried but is parboiled in earthen pots or caldrons, partly to destroy the vegetative principle so that it may keep better and partly to facilitate the process of husking Patna rice [illegible] is superior to any other sort of rice imported from the East It is small-grained, rather long and wiry and remarkably white But the rice raised on the low marshy grounds of Carolina is unquestionably very superior to any brought from any part of India

The produce of lands naturally or artificially irrigated is as far as rice is concerned from 5 to 10 times greater than that of dry land having no command of water, and hence the vast importance of irrigation in all countries where this grain is cultivated But it is worthy of remark that owing to the not unfrequent occurrence of severe droughts there is a greater variation in the crops of rice than in those of any other species of grain Those who like the Hindoos depend almost entirely on it for subsistence, are consequently placed in a very precarious situation There can be no doubt that famines are at once more frequent and severe in Hindostan than in any other quarter

A few years ago, England was principally supplied with cleaned rice from Carolina Latterly, however, the imports of Carolina rice have been much reduced An improved method of separating the husk, which throws out the grain clean and unbroken has recently been practised in this country, and as the grain when in the husk is found to preserve its flavour and sweetness better during a long voyage than when shelled, large quantities are now imported rough from Bengal and the United States Unquestionably, however, the oppressive discriminating duty of 11*s* a cwt on American and other foreign cleaned rice did more than any thing else to increase the imports of rough grain, but, in 1842, the duty upon foreign rice, not a British possession, was reduced to 6*s* per cwt, and in 1846 it was again reduced to 1*s* per cwt, hence there is now every facility for importing [illegible] commodity from all parts of the world

[illegible] A celebrated festival observed by the Athenians, for full information respecting which the reader is referred to *Plutarch's Life of Theseus*, by whom it was instituted The name is derived from *απο του φερειν τας σχας*, from carrying σχαι, i e. *boughs hung up with grapes*

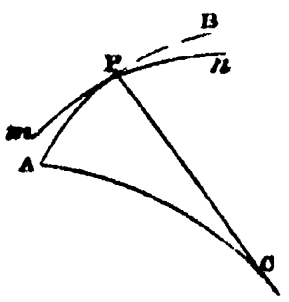
OSCILLATION (Lat. oscillatio.) In Mechanics,

the vibration or alternate ascent and descent of a pendulous body (*See* PENDULUM.) The centre of oscillation is a point in the oscillating body, [illegible] matter of the body were there collected the oscillations would be performed in the same time (*See* CENTRE OF OSCILLATION.) The axis of oscillation is a straight line passing through the point of suspension parallel to the horizon, or perpendicular to the plane in which the oscillations are made. Oscillations in small arcs of a circle, or [illegible] are isochronal, or performed [illegible] *See* CYCLOID.

OSCILLATORIA. Minute filamentous organized beings, which have the faculty of exercising oscillatory movements.

OSCULATING CIRCLE. *See* OSCULATION.

OSCULA'TION. (Lat. *osculare, to embrace*.) In Geometry, one curve is said to osculate another when the two curves are in contact in such a manner that the number of points common to both is the greatest possible. Let A B be a curve, of which A C is the evolute, from P any point in A B draw P C to touch A C in C. With C as a centre, and a radius C P, describe a circle *m n*, then the circle *m n* osculates the curve A B at the point P. From the theory of the evolution of curve lines, the curvature of A B at the point P is equal to that of the circle, in fact, it is obvious from the development that the curvature of the involute at any point between A and P is greater than that of the circle and at any point beyond P it is less than that of the circle, consequently at P it is exactly the same as that of the circle described with the radius C P. The circle *m n* has, therefore, a more intimate contact with A B than any other circle which passes through P.




The theory of osculating curves in general is most easily explained by the methods of the differential calculus. Let $y = fx$ and $y = Fx$ be the equations of two curves, suppose $x$ to become $x + h$, and let the functions $f(x + h)$, $F(x + h)$ be developed by Taylor's theorem, then, if all the terms of the first development are respectively equal to the corresponding terms of the second, the curves are the same in every respect, or coincide. If the first terms only are equal, the two curves have only one common point, if the two first terms of the one development are respectively equal to the two first of the other, then two contiguous points coincide or are common to both curves, if the three first terms in each are respectively equal the curves have three common points, and so on. Now the number of terms of the first development which can be made equal to the corresponding terms of the second depends on the number of constants in the function $fx$ (supposing $Fx$ to contain more constants than $fx$). The equations of a straight line being $y = ax + b$, contains two constants, the straight line can thus be made to coincide with two contiguous points of a curve, it then becomes a tangent and the contact is said to be of the first order. The general equation of the circle is $(y - b)^2 + (x - a)^2 = r^2$, and contains three constants, a circle can therefore be determined which shall have three common points with a curve, it then *osculates* the curve, and the contact is said to be of the second order. In general, if the equation of the osculating curve is of the order $n$, it may have a contact of the same order with the curve which it osculates, and it is a consequence of this theory that no osculating curve of an inferior order can be made to pass between two curves having a contact of a higher order, for example, no straight line can be drawn through P between the curve A P and the circle *m* P *n* (Lagrange, *Theorie des Fonctions Analytiques*, Lacroix, *Traité du Calcul Différentiel et Intégral*.)

OSIANDRIANS. In Ecclesiastical History a sect among the Lutherans, so called from their founder Osiander, a celebrated divine. They differed from the followers of Luther and Calvin as to the efficient cause of justification.

OSIER. The name given to various species of willow or salix, chiefly employed in basket making on account [illegible] (See *Loudon's Arboretum Britannicum*, where contains full information on all the points relative to osiers.

OSIRIS. In Mythology [illegible] the chief Egyptian divinities the brother and husband of Isis, and together with her the greatest benefactor Egypt, into which he introduced a knowledge of [illegible], and the arts and sciences. After [illegible] ations at home, he [illegible] Asia, where he encountered great difficulties, there the worship of the gods and the arts of civilisation, but on his return he found his own subjects excited to rebellion by his brother Typhon, by whom he was ultimately assassinated. Both ancient and modern writers have differed considerably respecting the powers and attributes of Osiris.* His principal office, as an Egyptian deity, was to judge the dead, and to rule over that kingdom into which the souls of the good were admitted to eternal felicity. The characters of Osiris, like those of Isis, who was thence called "[illegible] 10,000 names," were numerous [illegible] of the deity which signified the divine goodness, and in his most mysterious and sacred office as an *avatar* or manifestation of the divinity on earth, he was superior to any even of the [illegible] for as Herodotus observes, though all the [illegible] not worship the same gods with equal reverence, the adoration paid to Osiris and Isis was universal. He was styled "the Manifester of Good," and to this title he had an undisputed right, for he appeared on earth to benefit mankind, and after having performed the duties he had come to fulfil, and fallen a sacrifice to Typhon the evil principle (which was at length overcome by his influence after his leaving the world), he "rose again to a new life" and became the judge of mankind in a future state. Other titles of Osiris were, "President of the West," "Lord of the East," "Lord of Lords," "Eternal Ruler," "King of the Gods," &c. These, with many others, are commonly found in the hieroglyphic legends accompanying his figure, and the Papyri frequently present a list of 49 names of Osiris in the funeral rituals. Osiris has been identified with many of the Grecian divinities, but more especially with Jupiter, Pluto, and with Bacchus, on account of his reputed conquest of India. Osiris was par- [illegible] so sacred was [illegible] to visit it without express permission, and the latter was regarded with such veneration that persons living at a distance from it sought, and with difficulty obtained permission to possess a sepulchre within its necropolis. The worship of Osiris was at a later period introduced into Rome, but the prurient imagination of the Romans soon converted the rites and mysteries of this deity into a means for practising the most unbounded licentiousness, which at length reached such a height that his worship was prohibited by law. Osiris was venerated under the form of the sacred bulls Apis and Mnevis, or as a human figure with a bull's head, distinguished by the name Apis-Osiris. He is usually represented as clad in pure white, and his usual attributes are the high cap of Upper Egypt, a crosier, a flagellum, and sometimes a spotted skin, an emblem supposed to connect him with the Grecian Bacchus. (For full particulars respecting the supposed history of Osiris, together with explanations thereof, we beg to refer to *Plutarch's Treatise on Isis and Osiris*, and for a resume of the whole subject illustrated with ingenious observations, the reader may consult *Sir G. Wilkinson's Manners and Customs of the Ancient Egyptians*.) *See* ISIS.

OSMAZOME. (Gr. *οσμη, odour*, and *ζωμος, broth*.) The extractive matter of muscular fibre, which gives the peculiar smell to boiled meat and flavour to broth and soup.

OSMIUM. A metallic substance found associated with the ore of platinum, its peroxide is extremely volatile, and has a peculiar pungent odour, which suggested the name of the metal [illegible] *osmium nitrum*. Neither osmium nor its compounds [illegible] applied to any use, and it is a rare substance.

OSSEANS, OSSEI, or PISCES OSSEI. In Ichthyology, a primary division of the class of fishes, including all those [illegible] bony skeleton.

OSSIFIC BRECCIA. The cemented mass of bone found in certain caverns and fissures of rocks.

OSSIAN'S POEMS. The name given to a collection of poems, alleged to have been the production of Ossian, the son of Fingal a Scottish bard who lived in the third century. They were first given to the world in an English version by James M'Pherson, Esq., in 1760, with the assurance that they were translations made by himself from ancient Erse manuscripts which he had collected in the Highlands of Scotland, and such was the enthusiasm which their appearance excited, that they may be almost said to have given a new tone to poetry throughout all Europe. There were not, however, wanting many distinguished persons who from the first denied their authenticity, foremost among whom was Dr Johnson, who boldly pronounced the whole of the poems ascribed to Ossian to be forgeries, and his opinion was corroborated by Hume, Gibbon, and many others, who defied M'Pherson to produce a manuscript of any Erse poem of earlier date than the sixteenth century. On the other hand, M'Pherson's assertions as to the genuineness of the poems found warm supporters in Dr Blair (see his *Critical Dissertation on the Poems of Ossian*), Dr Henry, Lord Kaimes, and many other distinguished names, and almost to a man in the whole body of the Highlanders. In this unsettled state the

* So cautious were those initiated into the worship of Osiris, that they made a scruple even of mentioning him; and Herodotus, wherever he relates any thing concerning this deity, excuses himself from uttering his name.

controversy remained till the year 1900, when Malcolm Laing, so well known for his historical labours, added a dissertation appended to the second volume of his *History of Scotland*, endeavoured to establish, from historical and internal evidence, that the so-called poems of Ossian are [illegible] sensation created by [illegible] Many converts were made to the opinions therein set forth, but the general disbelief in the authenticity of the poems was not complete till 1805, when a committee of the Highland Society of Edinburgh, which had been appointed in 1797 to inquire into their nature and authenticity, reported to the effect "that they had not been able to obtain any one poem the same in title and tenor with the poems of Ossian" Since that period the controversy, so far as it regards their translation from Erse manuscripts, may be said to be terminated But although these poems had never been committed to writing, or rather have not been handed down in writing, there can be, we believe, but little doubt that many of them still exist in the Highlands of Scotland in a dress not very different from that in which they were rendered by M Pherson into English, having been committed to memory, and transmitted from one bard or storyteller to another in regular succession, and consequently their pretensions to be regarded as historical authority [illegible] be denied Their scenes sometimes laid in Scotland, but more frequently in Ireland, and they may be justly considered the *Iliad* and *Odyssey* of the Celtic race of the two islands have come [illegible] tradition only —what the poems of Homer were in likelihood to the Greeks themselves before they were acquainted with the art of writing "The value of Ossian," says Mr Skene, "as an historical poet, must stand in the highest rank, while, whether the chief part of these poems are of ancient or of modern composition, there can remain little doubt that in him we possess the oldest record of the history of a very remote age" (*The Highlanders of Scotland their Origin, History, and Antiquities*, vol i p 215) Those who wish to see this subject exhibited in all its bearings, though, perhaps with a slight prejudice against M'Pherson may consult the elaborate article in the *Edinburgh Review*

OSSIFICATION The formation of bone The change of any soft solid of the body into bone

OSTA'RA An ancient German and Celtic divinity worshipped with peculiar ceremonies by the Anglo-Saxons Many writers regard her as identical with the Phœnician goddess Astarte, but, be this as it may, she was regarded as the queen of spring and of the morning and from her name is derived the German *Ostern* (Anglice, *Easter*), which period of the year the ancient Germans were in the habit of celebrating with fires and festivals in gratitude for the advent of spring (See *Grimm's Deutsche Mythologie*, p 181) The town Osterode on the Hartz is said to have been named from this goddess

OSTEOCOLLA (Gr *οστεον*, *a bone* and *κολλα glue*) An old mineralogical term for *encrusting* carbonate of lime, to which the property of uniting a fractured bone has been attributed

OSTEOGENY (Gr *οστεον*, *a bone*, and *γινομαι*, *I generate*) The formation of [illegible]

OSTEOLOGY (Gr *οστεον*, *a bone*, and *λογος*, *a discourse*) The doctrine or history of the bones See ANATOMY, BONE

OSTEOLOGY In Painting and Sculpture, a description of the bones of animals

OSTRACEANS, *Ostracea* The family of Bivalves of which the oyster (*Ostrea*) is the type, and which is characterized by the mantle being widely open, without special [illegible]

OSTRACION (Gr *οστρακιον*, *a shell*) A genus of fishes of the order *Sclerodermi*, or rough-skinned, in the system of Cuvier It is characterized by the armour of regular bony plates soldered together, with which the body is invested, the only moveable parts being the tail, fins, mouth, and a small gill flap which pass, as it were, through holes in the coat of mail The body generally presents a quadrangular form, whence the name of trunk-fish, commonly given to the species of this genus

OSTRACISM (Gr *οστρακισμος*) A form of condemnation at Athens by which persons who [illegible] or influence were [illegible] banished for ten years with [illegible] return after that period It was not inflicted as a punishment, but merely as a precaution [illegible] preserve the democracy The process in this condemnation was as follows The people being assembled each man wrote the name of the person he wished to banish on a shell (*οστρακον* whence the name *οστρακισμος* and delivered it to the archons, who counted the numbers Only one individual could be subjected to the ostracism at the same meeting and 6000 hostile votes were necessary to the infliction of this condemnation Hence if 6000 votes and upwards were recorded against one or more individuals, the one was banished against whom the greatest number of votes had been given (See *Mem de l'Acad. des Inscr.* vol xvi)

OSTRACODES, *Ostracoda*. (Gr *οστρακωδης*, *a shell, like form*) The name of a family of Entomostracans, comprehending those which have the shell folded in two, [illegible] of a bivalve mollusk [illegible] great known bird and the type of the Cursorial or Struthious order It is distinguished not only from its immediate congeners the *Cassowaries* and *Apteryx* but from all other birds by having only two toes which correspond with the two outermost toes in the rest of the class The wings are furnished with loose and flexible plumes but are long enough to increase its speed in running The elegance of these feathers arising from their slender stems and the distinct barbs, has occasioned them to be [illegible] in all ages, and they still constitute a valuable [illegible] commerce The beak of the ostrich is depressed, of a moderate length, and blunt at the end, the tongue is extremely short, the eye is large, and the lid fringed with short simple feathers like eyelashes The legs are of prodigious strength, and the tarsi very long The ostrich has a capacious crop, a [illegible] cœca, [illegible] d by a very long intestinum rectum with internal connivent valves, which latter structure is unique in the class of birds It is likewise remarkable in this class for its large urinary receptacle The ostrich abounds in the sandy deserts of Arabia and Africa It attains the height of seven or eight feet, is gregarious in favourable localities, lays eggs of three pounds weight which are incubated by the male principally, and defended [illegible] feeds on grain grass, &c to [illegible] pebbles are taken into the gizzard, so obtuse is its taste that it will swallow pieces of metal, wood, &c When pursued it dashes stones behind it with great violence, and exceeds in swiftness all other terrestrial animals, it is only the comparatively limited power of sustaining its course that enables the mounted Arab to run it down

OTALGIA (Gr *ους*, *the ear*, and *αλγος*, *pain*) The ear ache

OTARIA (Gr *ους*) The name of the genus of seals characterized by having [illegible] and by the double cutting edge [illegible] or incisors, a structure unknown in other animals the molar teeth are simply conical and with a single fang These seals are principally confined to the southern hemisphere

OTITIS (Gr *ους*) Inflammation of any part of the organ of hearing

OTTAR or ATTAR OF ROSES The volatile or odorous oil of the rose, it is of a soft buttery consistence, and deposits when fluid a crystallizable portion, which is sparingly soluble in alcohol it is much used as a perfume The finest ottar of roses is prepared at Ghazeepore in India

OTTAVA RIMA (Eighth or octuple rhyme) An Italian form of versification consisting of stanzas of two alternate triplets and a couplet at the end; the verses being in the proper Italian metre, the heroic of eleven syllables It is the form peculiarly adopted and embellished by the poets termed Romanzieri, from Pulci to Tortigurra (See ROMANCE) It [illegible] the hands of an able [illegible] varying from the [illegible] although rather deficient in variety, and possessing too little repose and solemnity for the sustained majesty of epic poetry It has been adopted by the Germans, who have given to it something of an elegiac turn, and, of late, by English poets, of whom the most distinguished is Lord Byron, who has employed it in his *Beppo* and *Don Juan*, works belonging to a mixed cast of poetry, between the serious and the burlesque

OTTER A [illegible] habits by its short, strong [illegible] which serve as oars to propel it through the water, and by its long and strong tail, which acts as a powerful rudder, and enables the animal to change its course with great ease and rapidity The teeth, which consist, in each jaw, of six pointed incisors two strong and sharp canines, and ten trenchant and cuspidated molars, determine the piscivorous diet and predatory habits of the species The otter used to be met with in most of the British rivers and lakes, but the increase of population and the unintermitting hostility which its destruction of the valuable fish of its native streams have called down upon it, have greatly thinned its numbers, and have exterminated it from many of the localities where it was formerly common, so that the otter, as a captive in our menageries, is now regarded with almost the same interest which an exotic species usually excites

The otter selects for its retreat some convenient excavation concealed by the overhanging roots of the trees which grow from the banks of rivers, or other natural screen The female goes with young nine weeks, and produces from three to five cubs in March or April The usual weight of a full-grown male is from twenty to

twenty-four pounds The fur of the otter is remarkably fine and close It consists of two kinds of hair, the longer and stiffer shining hairs, which are greyish at the base and a rich brown at the point, concealing an extremely fine and soft fur of a whitish grey colour, brown at the tip The hair and fur of the under part of the body, the cheeks, and the inner parts of the legs, is of a brownish grey throughout

The otter is hunted in many parts of England, and especially in Wales with dogs especially [illegible] this kind of sport and with all the [illegible] the chase When the otter is [illegible] becomes exceedingly [illegible] takes the water [illegible] a long time underneath it, [illegible] distance from the place at which he dived Then the anxious watch that is kept of his rising to 'vent,' the steady purpose with which the dogs follow and bait him as he swims, the attempts [illegible] to drown his assailants by [illegible] fastened on him, the baying of the hounds, the cries of the hunters and the fierce and dogged resolution with which the poor hopeless quarry [illegible] and exciting as the veriest epicure in hunting could desire" (*British Quadrupeds*, p 133)

The few species of otter which have been recognized in distant parts of the world do not greatly differ from the *Lutra vulgaris* of Europe The sea-otter is an animal [illegible] presents such modifications of its palmated feet and [illegible] teeth as to form the type of a distinct subgenus (*Enhydras*), which connects the otter with the seal

OTTOMAN An epithet given to the Turkish empire from Othman I, who ascended the throne in the 14th century It is also applied to a peculiar kind of sofa much in use in Turkey, and which has been imitated both here and on the Continent

OUNCE (Lat uncia) A denomination of weight In troy weight the ounce is the 12th part of the pound, and weighs 480 grains In avoirdupois weight the ounce is the 16th part of the pound, and equal to 437½ grains troy *See* WEIGHT

OURANOGRAPHY (Gr *ουρανος*, *heaven*, and *γραφω I describe*) A term frequently used to signify a description of the heavens and the heavenly bodies

OUROLOGY, or OUROSCOPY (Gr *ουρον λεγω I speak*, and *σκοπεω I view*) The judgment of diseases from an examination of the urine

OUTCROP A Geological term implying the exposure of a stratum at the earth's surface

OUTLAWRY, in Criminal Law is a punishment inflicted for a contempt in refusing to be amenable to the jurisdiction of a competent court The act 2 W 4 c 39 gives a provision for more expeditious and less expensive proceeding to outlawry in civil cases [illegible] mesne process than had previously prevailed It is issued against a defendant after he has been five times proclaimed at a county court, but if the defendant has previously left the kingdom, he can set it aside by writ of error, or even on motion The effect of outlawry in civil cases is a forfeiture of personal goods and chattels immediately upon the outlawry, and his chattels real and the profits of his lands when found on inquisition

OUTLIER In Geology a portion of a rock or stratum detached and at some distance from the principal mass

OUTLINE In the Fine Arts *See* CONTOUR

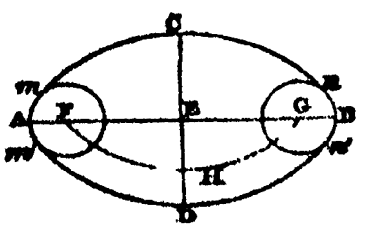
OUTPOSTS In a Military sense, a body of men posted beyond the main guard, so called as being the bounds or limits of the camp

OUTRE (Fr) In the Fine Arts, anything exaggerated or over [illegible]

OUTRIGGER The [illegible] or piece of timber for [illegible] ten[illegible]ary purposes

OUTWORKS In Fortification, works raised on the outside of the ditch of a fortified place, for the purposes of covering the place, or keeping the besiegers at a distance *See* FORTIFICATION

OVAL (Lat ovum, *an egg*) A popular name for any curve figure [illegible]llipse or the transverse section of an egg [illegible] oval is made up of four circular arcs joined so as to leave no angular appearance, or present any rapid change of curvature It may be described as follows — Let A B and C D be the length and [illegible] each other at E With C as a centre and a radius equal to A E describe an arc intersecting A B in F and G, with F and G as centres, and a radius equal to A F or B G, describe the small arcs *m* A *m'* and *n* B *n'* for the ends of the oval, and with C and D as centres (or centres near those points), and C D as a radius, describe the arcs *m* C *n* and *m'* D *n'* It may be remarked, that the construction will fail when the breadth C D is not greater than half the length A B, but in this case C D may be produced, and points found in it by trial for the centres of the required arcs




The *Ovals of Descartes* are a species of geometrical curves [illegible] that philosopher as the loci which [illegible] rays [illegible] about an axis the true state of which [illegible] order that all the rays which proceed from the same point, or converge towards one may be refracted towards another point or rendered parallel or divergent They may be defined as the loci of the vertex of a triangle on a given base [illegible] of whose sides has a given ratio to the sum or difference of a given line and the other side Their generation has thus some resemblance to that of the ellipse and hyperbola which are the loci of a triangle on a given base whose sides in the case of the ellipse have a given sum, and in the case of the hyperbola a given difference (See the *Second Book of Descartes' Geometry*)

Ovals are also produced by the construction of many curves of higher orders particularly those in which [illegible] is the fourth, sixth, &c.

OVALBUMEN The albumen or white of egg, a term adopted in order to distinguish it from the albumen of the serum of the blood, which may be called *seralbumen*

OVARIA The two organs which contain the female ova

OVARIUM In Plants a hollow case, enclosing ovules or young seeds, containing one or more cells, and ultimately becoming the fruit, it is always situated in the centre of the flower, and, together with the style and stigma, constitutes the female system of the vegetable kingdom When it is united to the calyx, it is called inferior, when separate from it, it is termed superior

OVATION An inferior kind of triumph, which, according to the ancient Roman custom, was granted to distinguished military leaders The name is said to be derived either from ovare (*to cry O*[illegible] the cry of [illegible] or from ovis *a sheep* the animal [illegible] sions instead of bullocks According to Dionysius of Halicarnassus, the first ovation was celebrated by P Posthumius Tubertus (A C 503), some years after the expulsion of the kings Some antiquaries imagine the distinction between the triumph and the ovation to have originally consisted not in the greater or less degree of honour but in the latter being strictly appropriated to successes by which peace was obtained, or to distinguish brilliant achievements in time of peace Thus we find that ovations were permitted, though triumphs were not, in civil wars An ovation was celebrated by Mark Antony and Octavius to solemnize their reconciliation

OVERHANG In Architecture *See* BATTER

OVERSEERS OF THE POOR Officers annually appointed in every parish, under the hand and seal of two justices, under the statute of 43 Eliz Their number by that statute, is four, three, or two for each parish By subsequent statutes any place maintaining its own poor, whether a parish or not, has overseers Assistant overseers with a salary, may be elected by the inhabitants of parishes, under 59 G 3 *See* POOR LAWS

OVERSHOT WHEEL In Mechanics, a water-wheel to which the water is conveyed over the top of the wheel [illegible] the axle In this case, the water acts [illegible] ght, and not by the impulse of the stream

OVERT ACT (Fr ouvert *open*) In Law an open or manifest act from whence criminality is implied No indictment for high treason is good unless some *overt act* is alleged [illegible]

OVERTURE (Fr ouverture) The introductory piece of music prefixed to an opera or oratorio Its movements in works of the modern school generally contain snatches of the more prominent and leading airs in the opera, and introduce the audience to a general notion of the emotions which it is the desire of the author to excite

The word *overture* also signifies a *proposal*, in which sense it is always used in the Presbyterian church to indicate those resolutions proposed by presbyteries and synods, and afterwards laid before the General Assembly, either for its sanction or rejection

OVIDUCT (*Ovum* [illegible] *I conduct*) The [illegible] ovary either to the uterus or to an external outlet In Mammals this part [illegible] title from the circumstance of its being [illegible] described by Fallopius about the year 1560 in the human subject, in which this tube or canal passes from each side of the fundus of the [illegible] *See* FALLOPIAN TUBE.

OVIFEROUS or OVIPAROUS (Lat ovum, *fero* or *I bear*) In Zoology certain receptacles in which the [illegible] from the ord[illegible]

called, as the long pouches [illegible] of the body in many of the [illegible] Crustaceans Likewise the [illegible] tail of the higher Crustaceans, as [illegible] to which the eggs are attached [illegible] ov[illegible]

[illegible]um, and pario, *I produce*) The mode of generation by the exclusion of the germ in the form and condition of an egg, the development of which takes place out of the body either with or without incubation Fishes reptiles and birds are called Oviparous Vertebrata although some of both the former classes hatch the egg within the body and bring forth their young alive as the viper and dog-fish

OVIS (Lat *a sheep*) The name by which Linnæus and Cuvier distinguish the sheep as a genus from the goats and antilopes The character assigned by Cuvier to the genus *Ovis* is as follows — Horns directed backwards and then inclining spirally more or less forwards the profile or chaufrin more or less convex and no beard" to this may be added in most cases a sebaceous sac on the fore part of each foot The *Mouflons* or *Musmons* of Africa and Sardinia, from which it is generally believed our domestic races of sheep are derived, form the species *Ovis ammon* of Linnæus, and *Ovis musimon* of Schreber The coat of these wild sheep consists of coarse, stiff, long and nearly straight hairs, but they possess the same character, that of an imbricated surface, which gives to the shorter and finer wool of the domestic races the felting property on which its peculiar utility depends *See* HAIR

Of the domestic animals belonging to Great Britain sheep are, with the exception perhaps of horses and cattle, by far the most important They can be reared in situations and upon soils where other animals would not live They afford a large supply of food and one of the principal materials of clothing Wool has long been a staple commodity of this country and its manufacture employs an immense number of people "The skin dressed forms different parts of our apparel, and is used for covers of books The entrails properly prepared and twisted serve for strings for various musical instruments The bones calcined (like other bones in general) form materials for tests for the refiner The milk is thicker than that of cows, and consequently yields a greater quantity of butter and cheese, and, in some places is so rich that it will not produce the cheese [illegible] of water to make it part from the whey The [illegible] remarkably rich manure, insomuch that the folding of sheep is become too useful a branch of husbandry for the farmer to neglect To conclude whether we consider the advantages that result from this animal to individuals in particular or the kingdoms in general we may with Columella consider it as in one sense, as the first of the domestic quadrupeds '*Post majores quadrupedes ovilli pecoris secunda ratio est, quæ prima sit si ad utilitatis magnitudinem referas Natura præcipue contra frigoris violentiam protegit corporibus pro nostris liberaliora præbet velamina, et etiam ceteris mensas jucundis et numerosis dapibus ornat* — *De Re Rustica*, lib vii cap 2 And in addition to what Mr Pennant has so forcibly stated, sheep are particularly deserving the attention of the agriculturist, both from the influence of improvements on the breed, and from their generally affording larger profits than can be obtained from the rearing and feeding of cattle (*Statistics of the Brit Empire*, vol i p 492)

The principal varieties of the English sheep are the large Lincolnshire the Dorset breed, the South-down, and the Cheviot

The Lincolnshire sheep are of a large size big-boned and afford a great quantity of wool, owing to the rich marshes on which they feed but their flesh is coarser, leaner, and less finely flavoured than that of the smaller breeds

The Dorset sheep are mostly white-faced, their horns are finely curved, their fleece clear and white, but many of them are without wool upon their bellies, their legs are long and small and their general form handsome and well proportioned This breed is prolific, and is principally esteemed for producing lambs at an earlier period than other varieties Great numbers of these premature victims to luxury are yearly sent to the London markets, where they fetch the price of 10*s* 6*d* to 15*s* per quarter The manner of rearing the lambs is curious they are imprisoned in little dark cabins, the ewes are fed on oil-cakes, hay, corn, turnips, or cabbages which are given them in a field contiguous to the apartments where the lambs are kept, and at proper intervals the nurses are brought in to give suck to their young ones, while the attendants at the same time make their lodgings perfectly clean, and litter them with fresh straw Great attention is paid to this, as much of the success of rearing these unseasonable productions depends upon warmth and cleanliness"

The South-down sheep have dun or black faces, and are of the same hardy nature as the Cheviot breed, being able to live and thrive on the barest chalk hills Their wool is fine and their mutton well-flavoured They have of late years in consequence of these valuable qualities, extensively been introduced [illegible] horns, and are mostly white-faced and white-legged, the body is long, with fine clean small-boned [illegible] the meat of is highly esteemed for its flavour They are very valuable as mountain sheep, on account of their hardiness and the superior value of their wool There is a singular variety of sheep [illegible] which the monstrous [illegible] has become hereditary these are called Norwich horned sheep and have from four to eight horns growing irregularly from the head

It is no possible to form any accurate estimate either of the number of sheep or of the quantity of wool annually produced in this country With the exception of Mr Luccock's, most of the statements put forth with respect to both these points seem very much exaggerated But Mr L's estimate, which is considerably under any that had previously appeared, was drawn up with great care, and is supposed to approach nearer to accuracy

| | | |
|---|---|---|
| According to Mr Luccock, the Number of long-woolled sheep in England and Wales, in 1800, was | 4,153,308 | |
| Of short woolled, ditto - - | 14,854,299 | |
| Total number shorn - | | 19,007,607 |
| Slaughter of short-woolled sheep per annum - - | 4,221,748 | |
| Carrion of ditto - - - | 211,087 | |
| Slaughter of long-woolled ditto - | 1,180 413 | |
| Carrion of ditto - - - | 59,020 | |
| Slaughter of lambs - - - | 1,400 560 | |
| Carrion of ditto - - - | 70,028 | |
| | | 7,140,856 |
| Total number of sheep and lambs - | | 26,148,463 |

In some parts of England there has been an increase in the numbers of sheep since 1800, but in others there has been a decrease But we have been assured by competent judges that on the whole, the number has not sensibly varied in the interval

In the *General Report of Scotland* (vol iii Appendix p 6) the number of [illegible] estimated at 2,800,000, and, allowing for the increase that has taken place since 1811, they may now be estimated at about 3,500 000 Hence the total number of sheep in Great Britain will be 29,648 000 It is not supposed that there are 2 000 000 of sheep in Ireland (*Statistics of the British Empire*, vol i p 496)

The foreign breeds of sheep are exceedingly numerous, but of these perhaps the Asiatic variety is the most [illegible] India the sheep is long-tailed, and in [illegible] Tartary and China &c, the tail is not only elongated but loaded with a mass of fat in some instances weighing ten pounds The power which this animal possesses to accommodate itself to different climates seems almost unlimited in the hot plains of Asia its covering becomes coarse and scanty, while in the frozen regions of Thibet its thick wool has an under lining of the finest kind, forming an important article in manufactures and commerce (See the *Geo Dict*, art "Asia," and the authorities there cited)

OVISAC (*Ovisacus* [illegible] *sack*) The cavity in the [illegible] tains the ovum In Mammals it forms, after the ovum is expelled the *corpus luteum*

OVIPOSITOR (Lat ovum, and pono, *I place*), in Entomology is the instrument by which an insect conducts its eggs to their appropriate nidus, and often bores a way to it, the same instrument is, in some genera, used as a weapon of offence, when it is called the 'aculeus"

OVOLO (Ital) In [illegible] profile is the quadrant o[illegible] architecture there is a deviation from that exact form, which is most apparent at the upper portion, where it resembles the form of an egg, whence this moulding derives its name

OVOVIVIPAROUS (Lat ovum, *an egg*, vivo, *I live*, and pario, *I produce*) The mode of generation by the exclusion of a living fœtus more or less extricated from the egg-coverings which has been developed within the body of the parent without any vascular or placental adhesions between the ovum and the womb The marsupial animals among the Mammalia, the viviparous blenny and dog fish among [illegible] and many [illegible] Mollusks, the scorpion and flesh fly among [illegible] earth worm, and many of the intestinal worms, are examples of [illegible]

OVULUM [illegible] The name of a genus of Pectinibranchiate Gastropods characterized by having a shell of an oval form and with a long and narrow aperture, without furrows or teeth on the side of the columella; the spire is concealed, and the two extremities of the aperture are equally prolonged into a canal

This diminutive is also applied to the ovum of the Mammalia on account of its relatively minute size it is, however, a true ovum having all the essential parts, as the germinal spot germinal membrane, vitellus, vitelline membrane, and chorion *See* OVUM

OVULUM In Botany, a small pellucid pulpy body, borne by the placenta of a plant, and gradually changing into a seed, it consists of a central nucleus, enclosed within a definite number of coats, varying from one to two, and furnished with an aperture or foramen, through which impregnation takes place

OVUM (Lat *an egg*) In Anatomy, the body formed by the female in which, after impregnation, the development of the fœtus takes place It is generally formed in a special organ, called the ovarium, but in some of the simplest animals, as the Polypes, the common cellular parenchyme of the body seems to have the unlimited faculty of producing the ova The essential and apparently first-formed part of an ovum is a minute pellucid cell called the 'germinal vesicle," which is characterized by an opaque speck or nucleus, called the "germinal spot" The vesicle is immediately surrounded by a stratum of granules or nucleated cells, which form the "germinal disk" These parts float in a greater or less quantity of fluid and granules, called the yolk, which is generally of some well marked colour as the [illegible] violet, red through the presence of [illegible] The yolk is inclosed in a thin, delicate, structureless coat, called the vitelline membrane," and this is finally surrounded by an outer tunic called the 'chorion" Between the chorion and vitelline membrane there is commonly a greater or less quantity of albumen In the birds this fluid which is called the "white," and the 'yolk," is in great quantity, the chorion is laminated and the outer layer is combined with earthy salts to give due firmness and preserve the shape of the egg while subject to the weight of the parent during incubation Two twisted strings of firm albumen, called 'chalazæ' are continued from each end of the yolk a little below the poles and serve to keep uppermost the 'cicatricula' or 'treid,' formed by the impregnated germinal vesicle and disk A space intercepted between two of the layers of the chorion, or 'membrana putaminis" at the great end of the egg contains a small quantity of gas containing more oxygen than atmospheric air this space is called the 'vesica aerea' (For the chemical properties of *ovum* see Egg)

OVUM In Architecture the same as Ovolo, which see

OWL *See* NOCTURNALS and STRIX

OW'LING In Law, so called from its being generally committed during the night An offence consisting in conveying sheep or wool to the sea side in order to export them This offence was formerly capital particularly if the offenders neglected to surrender after proclamation made for that purpose, — it is now punishable with seven years' banishment

OWL, THE Among the ancients generally was considered as an omen of misfortune or death As however according to Philostratus the Egyptians represented Minerva under the form of an owl the Athenians so peculiarly under the care of this goddess looked upon the appearance of this bird as a favourable omen From this circumstance it formed upon ancient coins the symbol of Athens and her foreign possessions

OX Synonymous with the generic name *Bos* which see, in a more restricted sense it signifies the castrated male of the [illegible] variety

OXAMIDE *See* OXAMIDE

OXALATES Salts of the oxalic acid

OXA'LIC ACID A vegetable acid first discovered in the juice of the *Oxalis acetosella*, it was afterwards ascertained that the same acid might be produced artificially by the action of nitric acid upon sugar this process yields it in slender prismatic crystals, intensely sour and soluble in about 10 parts of cold water These crystals consist of 1 atom of real acid and 3 of water the equivalent of the acid is 36, and in its anhydrous state as it exists in the dry oxalates it is constituted of 2 atoms of carbon ($6 \times 2$) = 12, and 3 of oxygen ($8 \times 3$) = 24 so that it may be represented by an atom of carbonic acid and one of carbonic oxide Solutions of oxalic acid, or of soluble oxalates, yield an insoluble precipitate in solutions containing lime and its salts hence its use in the laboratory as a test of the presence of that earth The solution of oxalate of ammonia is generally used for the purpose Oxalic acid is a powerful poison and from its resemblance to Epsom salt, it has sometimes been sold and mistaken for that harmless aperient In such cases, the best antidote is a mixture of chalk and water, and where it is immediately administered it generally prevents the accession of fatal symptoms, it forms an insoluble oxalate of lime, which is inert

OXALIDA'CEÆ (Oxalis, one of the genera) A natural order of herbaceous or shrubby Exogens, inhabiting the [illegible] parts of the world Their foliage is generally acid and [illegible] supply the place of sorrel *Oxalis acetosella* contains pure oxalic acid, and many are used in Brazil against malignant fevers

OXAMIDE A white substance produced during the destructive distillation of oxalate of ammonia hence its name, compounded of *oxalis* and *ammonia* It is a compound of nitrogen hydrogen oxygen and carbon in such proportion as to form oxalate of ammonia by the addition of one atom of water (See Dumas, *Theorie des Amides*, *Chim App aux Arts*, v 84)

OXGANG (Germ ochs, *an ox*, and gang, *a walk*), in English Antiquities, was used to signify as much land as a single ox could *ear* or plough in a season [illegible] was contracted or expanded according [illegible] the land, forty acres constituting the *maximum* and six the *minimum* of the measure

OXIDATION, or OXIDIZEMENT The act of combination with oxygen

OXIDE (Gr *ὀξυς*, *acid*, and *εἶδος*, *form*) Compounds containing oxygen, but which are not *acid*, have been termed *oxides* [illegible] class of bodies [illegible] oxides of the base we general[illegible] [illegible] (Greek [illegible] nal numerals, designating the first second, third, &c oxides by the terms *protoxide*, *deutoxide*, *tritoxide*, &c, and when the base is saturated with oxygen (still not acid), it is termed a *peroxide* Combinations of bases with one atom and a half oxygen, or of two base and three oxygen are now generally distinguished by the term *sesquioxides*

OXYGEN (Gr *ὀξυς*, and *γενναω*, *to generate*) This important element was discovered, in 1774, by Dr Priestley It has been termed *dephlogisticated air*, *vital air*, and *empyreal air* As it forms a component part of many of the acids, it was termed, at the framing of the new nomenclature, *oxygen gas* There are several compounds of oxygen which, when exposed to heat, are decomposed and yield the gas in a state of purity of these the best is chlorate of potash, but as that salt is expensive, we generally resort to black oxide of manganese which at a dull red heat, gives out a considerable quantity of tolerably pure oxygen gas

Oxygen gas is colourless, tasteless, and inodorous, it is electro-negative and therefore when compounds containing it are electrically decomposed it always appears at the positive surface It is a little heavier than atmospheric air, in the proportion, that is, of 11 to 10, 100 cubical inches weighing 34 6 grains It is not absorbed by water and is neither acid nor alkaline It has a powerful attraction for most of the simple substances, especially for the electro-positive bodies the act of combining with it is called *oxidation* The compounds thus formed are divided into *acids* and *oxides* among the latter are the alkalis and almost all salifiable bases Oxidation is often attended with the evolution of heat and light, as in all processes of combustion in atmospheric air sometimes it is slow, and unattended with such phenomena as in the gradual rusting of metals Oxygen is a most powerful [illegible] constitutes one fifth of the [illegible] is the principle which enables combustible bodies to burn in it The product of combustion that is, the oxide or acid is sometimes itself gaseous, as when charcoal, by burning, is converted into carbonic acid, or it is liquid, as hydrogen by combustion produces water, or it is solid as when iron by burning produces oxide of iron Oxygen gas is also essential to respiration, that is to the evolution of carbonic acid from the blood

OXYGONE (Gr *ὀξυς* and *γωνια angle*) In Geometry a term applied to figures in which all the angles are acute

OXYHYDROGEN BLOWPIPE When a mixture of one volume of oxygen and two of hydrogen are burned whilst issuing from a small aperture they produce intense heat and instruments under the above name have been contrived for their safe combustion, so as to avoid the risk of explosion

OXYMEL (Gr *ὀξυς*, and *μελι*, *honey*) A mixture of honey and vinegar It is sometimes made the vehicle of medicines as oxymel of squills &c.

OXYMURIATE OF LIME The valuable bleaching compound obtained by exposing slaked quicklime to the action of chlorine is commonly so termed; it is, however a chloride of lime

OXYMURIATIC ACID [illegible] applied to chlorine, under the [illegible] muriatic acid and oxygen The fallacy of that opinion was first demonstrated by Davy, who showed that, in all the apparent cases of the evolution of oxygen from chlorine, its source was referable to the presence of water or of an oxide [illegible] for bases than oxygen [illegible] when metallic oxides are exposed to its action the chlorine combines with the metal to form a chloride (formerly called a *muriate*), and the oxygen is evolved.

OXYOPIA (Gr *ὀξυς*, and *ὠψ*, *the eye*.) Preternaturally acute vision

OXYURIS, *Oxyuris* (Gr *ὀξυς*, and *οὐρα*, *a tail*) The

name of a family of Pupivorous Hymenopterans, comprehending those which have a sort of tail, or terminal appendage, produced by an external ovipositor or borer A genus of intestinal worms (Cœlelminthans) is also called *Oxyuris*

OYER (From the Norman French oyer, *to hear*) In Law, when an action is brought on a bond or other specialty the defendant, previously to pleading in bar, may crave oyer of the instrument on which the action is brought, that it be read to him, which prayer must be granted Whenever offer of a deed is necessarily made by the party relying on it (by what is termed a *profert in curia*), the other party may crave oyer Oyer is not in strictness demandable of a record, or of an act of parliament

OYER AND TERMINER (Fr *to hear and determine*) In Law, a commission directed to the judges, and other gentlemen of the courts to which it is issued, by virtue of which they have power, as the terms imply, *to hear and determine* certain specified offences

OYEZ (Plur imperative of the same verb) "Hear ye" The cry of ushers in Norman courts of justice, metamorphosed into the English "O yes"

OYSANITE *See* OISANITE

OYSTER (Lat ostrea, *an oyster*) This name is generally understood to designate the species of Ostracean bivalve called *Ostrea edulis*, which is one of a numerous genus characterized by an inequivalve shell composed of two irregular lamellated valves of which the convex or under one adheres to rocks piles or to the shell of another individual The animal is unprovided with either a byssus or a foot it is the best flavoured of its class and has consequently been always esteemed Vast beds of oysters are artificially formed and preserved too with great care, at the estuary of the Thames and many other localities where the temperature of the water is somewhat raised by a mixture of salt and fresh water, in which they best thrive Certain restrictions and regulations are enforced in reference to the sale of oysters in the metropolis in order to favour the multiplication and rearing of this valuable bivalve They are permitted to be sold from August to May but during May June and July However the spat or young are in May when they are said to be sick they recover in June and July and in August are perfectly well Oysters differ in quality according to the different nature of the soil or beds The best Britain oysters are found at Purfleet, the worst near Liverpool The nursing and feeding of oysters is almost exclusively carried on at Colchester, and other places in Essex The oysters are brought from the coast of Hampshire Dorset and other maritime counties, even as far as Scotland, and laid on beds or layings in creeks along the shore where they grow, in two or three years to a considerable size and have their flavour improved There are said to be about 200 vessels from 12 to 40 or 50 tons burden immediately employed in dredging for oysters, having from 400 to 500 men and boys attached to them The quantity of oysters bred and taken in Essex and consumed mostly in London, is supposed to amount to 14 000 or 15 000 bushels a year (*Supp to Ency Brit*, art 'Fisheries') Oysters formed a great luxury among the Romans and as in France, were served at the commencement of a repast The largest and best of Italy were caught on the shores of the Lucrine, but the Romans used to send vessels even to the coasts of Britain in quest of this luxury the British oysters being then as now in the highest estimation

OZÆ'NA (Gr ὀζω *I smell*) An ulcer in the nose which discharges a fœtid purulent matter, and is sometimes symptomatic of caries of the bones

# P.

P. A consonant of the labial series As was to be expected from the approximation of this letter in sound to *b*, it is susceptible of interchange with the latter in nearly all the languages of which we have any knowledge, but more especially in the German Both in this country and on the Continent there are whole districts in which not only is the ear of the natives insensible to the difference between the sound of these letters, but with a tendency to error of which it would be vain to investigate the cause they are almost invariably confounded in pronunciation Of this peculiarity several counties of Wales among ourselves, and the whole of Lower Saxony in Germany present noted examples For the most usual abbreviations of this letter see ABBREVIATION

P In Music, an abbreviation of the Italian word *piano*, soft, denoting that the force of the voice or instrument is to be diminished P P means *piu piano*, or more soft, and P P P *pianissimo*, as soft as possible.

PACE (Fr pas) A denomination of linear measure, of uncertain extent; assumed by some to be 5 feet, by others 4 4 It is the quantity supposed to be measured by the foot from the place where it is taken up to that where it is set down The ancient Roman pace, considered as the thousandth part of a mile, was five Roman feet, and each foot contained between 11·60 and 11·64 modern English inches, hence the pace was about 58 1 English inches, and the Roman mile, the *mille passus*, equal to 1614 yards *See* MILE

PA'CHA (Pronounced *pasha*, contracted from the Persian padi shah *foot of the shah*) A title of honour, given in the Ottoman dominions to the governors and chief assistants of the sultan, and to the learned (See *Von Hammer's History of the Turkish Empire*, vol i p 137) Independent authority attributed particularly to the governors of provinces called *pachalics* The well-known distinction of rank between the two classes of pachas consists in the number of horse-tails which are carried before them as standards the higher having three and the lower two There were until recently 25 pachaliks subdivided into sanjiacates, besides various independent jurisdictions scattered over the empire

PA'CHACA'MAC The name given by the idolaters of Peru to the being whom they worshipped as the creator of the universe, this divinity was held in the highest veneration In the fruitful valley of Pachacama (whence the name) the incas dedicated to his honour a temple of such splendour and wealth that notwithstanding the rapacity of the Spanish soldiers by whom it was plundered previously to the arrival of Pizarro, that general is said to have drawn from it treasures to the amount of 900 000 ducats The ruins of this temple which still remain furnish a high notion of its former magnificence

PA'CHYDE'RMATA (Gr παχυς *thick* and δερμα, *skin*) An order of quadrupeds, including the elephant, horse pig &c, distinguished by the thickness of their hides

PACHYGLOSSA'TA *Pachyglossi* (Gr παχυς and γλωσσα *a tongue*) The name of a family of parrots (*Psittacini*) comprehending those which have a thick protractile tongue

PACHYO'TES *Pachyoti* (Gr παχυς, and ους *an ear*) The name of a family of bats (*Cheiroptera*) including those which have thick external ears

PACIFIC The name given by Magalhaens the first European who traversed it to the ocean which extends between America on the east and Asia and Australia on the west in consequence of his enjoying fair weather on entering it after having previously experienced a track of bad weather and tempestuous gales in the straits which bear his name The Pacific is the greatest expanse of water on the globe

PACIFICATION EDICTS OF The term usually applied to the edicts issued by the French monarchs in favour of their Protestant subjects in the view of allaying the commotions occasioned by their previous persecutions The first edict of this nature was promulgated by Charles IX in 1562, but the most celebrated was the edict of Nantes (which see) issued by Henry IV in 1598, and revoked by Louis XIV in 1685

PACKET in Navigation meant originally a vessel appointed by government to carry the mails between the mother country and foreign countries or her own dependencies It is now used as nearly synonymous with an ordinary vessel chiefly of small burden, that freights goods and passengers

PACKFONG The Chinese name of the alloy of nickel and copper commonly called *German silver* It is an alloy of 7 parts of zinc 2 copper and 6 5 nickel

PACK HORSE A horse employed to carry goods on its back in bundles called packages or packs In countries not yet intersected by roads this is the usual mode of transporting goods In Britain horses were formerly employed for this purpose, but for these carts and waggons are now substituted In Spain mules and asses are still so employed and in Asia and Africa camels and dromedaries

PACOS The Peruvian name of an earthy looking ore, which consists of brown oxide of iron, with imperceptible particles of native silver disseminated through it (See *Ure's Dictionary of Arts, &c*)

PADDING in Calico printing, is the impregnation of the cloth with a mordant

PADDLE A kind of oar used by savage nations in navigating their canoes The paddle is broader at the end than the common oar, and being employed at the stern of the canoe, not only impels her forwards, but regulates her course exactly like a rudder *See* SCULLING

PADDLES *See* STEAM NAVIGATION

PA'DDOCK This term was formerly applied to a strip of ground in a park, paled round for hounds to run matches in; but at present it is chiefly used to denote a small inclosure adjoining the stable for a stock horse, a mare and foal or any

PADI'SHA *protector* or *throne* and

shah *prince*) A title of the Turkish sultan and Persian shah Formerly the Turkish [illegible] title upon the kings of France a [illegible] peans sovereigns but we believe that the honour is now likewise shared by the emperors of Austria and Russia *See* PACHA

PA'DUAN COINS In the Fine Arts, coins forged by the celebrated Paduans, Cavino and Bassiano, who were also [illegible] Julius III [illegible] Gregory XIII [illegible] These coins hold the first rank in imitations of ancient medals for their masterly execution M Beauvais says of them, "that they are seldom thinner than the ancient coins themselves, that they seldom appear as worn or damaged, whilst others very frequently do, especially in the reverse, which sometimes, as in many Othos, appears half consumed by time, and while (he observes) counterfeit medals are [illegible] of as irregular a form as the real, these of the Paduan masters are generally circular" Still more modern forgers who were without the riders which these Paduans possessed for impressing have been content to mould them from their productions, but these are cast coins, which it requires no very extraordinary knowledge to detect The marks of the file upon their edges are mostly a sure sign of the imposition, those, however, who collect these objects of art should be constantly on their guard

PÆ'AN (Gr Παιαν) Among the Greeks, properly a hymn in honour of Apollo who was also called Pæan Also a war song before or after battle in the first case in honour of Mars, in the second as a thanksgiving to Apollo

PÆAN In Ancient Poetry, a foot consisting of four syllables, of which there are four kinds, the Pæan primus, [illegible] T

PÆDOBAPTISTS (Gr παις *a child*, and βαπτιζω, *I baptize*) Those who hold that baptism should be administered during infancy [illegible] Christian churches which allow [illegible] thus denominated from that circumstance and are thereby distinguished from the Antipædobaptists, i e those who deny the validity of infant baptism *See* BAPTISTS

PA'GAN (Lat paganus, from pagus *a village*), among the Romans, was, as the term imports applied to all who lived in [illegible] to the inhabitants of cities [illegible] it is the opposite of *Christian* being synonymous with heathen gentile, and idolater and was originally so applied because the inhabitants of villages continued to adhere to their idolatrous practices after Christianity had been introduced into towns and cities The precise period when the term pagan was first used in its present acceptation has not been ascertained *See* HEATHEN

PAGANA'LIA (Lat) Festivals held in each Roman village in honour of the local tutelary divinities They were instituted by Servius Tullius, who commanded every inhabitant of each *pagus* or village to assemble annually on a certain day and offer public sacrifices In instituting these festivals Servius had both a political and religious object in view for as every inhabitant was compelled to bring a small coin, varying with the age and sex of the bearer, he was annually acquainted with the strength of each district, and consequently with that of the kingdom

PA'GANISM A general appellation for the religious worship of the whole human race, except of that portion which has embraced Christianity, Judaism, or Mohammedanism Under the head POLYTHEISM, we have given a brief outline of the different kinds of pagan worship, and we shall in this place confine our remarks to the origin of the system

That in the most ancient times one God, sole, eternal, indivisible, the creator of the universe was acknowledged and worshipped, has been proved by the most profound investigators of antiquity The existence of this belief may not only be traced in the tradition of all peoples but is expressly affirmed by some of the greatest philosophers of the heathen world Nothing, indeed, could exceed the contempt with which some of them regarded the gods of the vulgar, though fear of danger or some other cause often taught them to conceal the sentiment.

The causes of idolatry were manifold, and were mostly of oriental growth A great king regarded it as below his dignity to enter into the minute details of administration he placed vicars or ministers over provinces and cities over the great departments of national polity If the onerous charge was inapplicable to an earthly, it was still more so to the celestial Sovereign hence the subordinate deities which we perceive in the religious systems of all nations, — the presiding genii of the Chaldæans, the numerous gods of Greece and Rome The worship due to the Supreme alone was soon transferred to those imaginary entities which, from functionaries, were transferred into so many independent chiefs, until the simple primeval notion of the divine unity was lost. The other causes of idolatry are foreign to our purpose the one already assigned, which is indisputably the most ancient and the most obvious, is of itself sufficient to account for the fact

In its origin paganism, as a system, was simple. A few great divinities were placed in heaven to guide the affairs of the visible and invisible worlds By degrees each great phænomenon, each law of nature, each region and city, each river fountain, wood, tree, mineral, had its tutelary deity The laws of nature were often inexplicable, what more obvious than to infer that each was subject to superior power? As the ideas of men became more precise and refined, gods were placed over human faculties and passions thus the understanding and the will, love and revenge, were the offspring of certain deities Mere abstractions were similarly personified, until the empire of reason, of sentiment, and of morals, was [illegible] peopled with air and ocean with these [illegible] Beings not merely themselves attaining that mysterious dignity might have not become at once part of [illegible] gods a distinction earned by some uncommon merit In all countries we find instances of deification Nor need this surprise The human mind is naturally prone to exaggeration — the human heart to be led astray by the [illegible] of its own feelings Thus he who, during life, proved himself a benefactor to his countrymen, who taught them useful arts, or freed them from some impending evil, would be regarded with affectionate admiration by his contemporaries, and time, which so constantly increases every object, would convert a great exploit, a shining virtue, into a divine effort But it not unfrequently happened that men were [illegible] for brute strength unaccompanied by [illegible] the [illegible] which form the noblest distinction of the hero It may, however, be observed, that in such cases men were always reverenced for the quality most wanted in a state If a district were infested by wild beasts or by predatory savages, a Hercules arose to free it If a country required laws, a Minos established them If the culture of the grape was unknown, a Bacchus appeared to teach it Such benefactors, it was believed deserved, as they certainly obtained, the peculiar favour of heaven, — rewards which far transcended those bestowed on other men In most cases, however, each was held to be a divinity, or at least the offspring of one As the generation of the gods was a received tenet, and their union with mortals of constant occurrence imagination had little difficulty in the filiation of a benefactor Mortals were [illegible] to a god as their founder [illegible] and on the honour, the example was speedily followed by others with equal appearance of justice Hence the prodigious number of divinities, heaven and hell, the earth and the planets, air and ocean the whole frame of nature, every part of the universe visible and invisible, even the realms of [illegible] by them and hence idolatry [illegible] endless in its forms of worship as in its objects

It has indeed been contended that even in the most unenlightened times, men — except, perhaps, the grossest in comprehension — were never so absurd as to receive this almost infinite plurality of deities, that each derived its name from its being a distinct manifestation of the divine energy, that the Neptune of the sea, the Apollo of the sun, the [illegible] the Jove of the thunder, [illegible] on the distinct modes in which the Supreme manifests himself to the world In short, that those denominations were but so many imaginative terms for the emanations of the all pervading Deity, and that under each distinct emanation this deity might be worshipped without the charge of idolatry But this hypothesis is too refined to be just, and is contrary to experience The known progress of the human mind is from sensual to ideal not from the ideal to the sensual, philosophy is the end, not the beginning of knowledge If that great patriarchal truth the unity of the Godhead, was obscured by successive ages of ignorance, it could be regained only by an opposite and equally laborious process of the intellect, and even when thus recovered, it could not be communicated without danger to the multitude (*Cab. Cyc., Arts &c of the Greeks and Romans*, vol ii) *See* MONOTHEISM

PAGE (Modern Lat pagius, of uncertain derivation, according to some from pagus *village*) In high life, a youth attached to the service of a royal or noble personage In the ancient Persian court (which has been not ill termed the prototype of all courts) we find the usage of employing a number of youths of the noblest families of the empire in personal [illegible] Among the Greeks and Romans [illegible] institutions, strictly so called were unknown), no analogous custom appears to have prevailed Among the northern nations, on the other hand personal service of this sort was common The name page, however, appears confined to slaves and attendants of an inferior description, in modern Europe, until the reigns of Charles VI and VII of France (*Fauchet's Origine des Chevaliers*) As chivalric institutions prevailed the office, by whatever

name called, became of importance, courts and castles were the schools in which the young noble passed through the degree of page, in order to reach the farther steps of esquire and knight, when he became "hors de page" In the 16th century the chivalrous character had become much adulterated, but the custom of bringing up sons as pages at courts continued until the disorder and licence of the age rendered the service so dangerous that it was no longer sought by the better classes as a mode of edu- [illegible] Pages then became, as they are [illegible] from some courts (the Prussian, for instance) they have entirely disappeared, and the young noblemen of the cadet school perform the office of pages on solemn occasions. (See Sainte-Palaye, *Memoires sur la Chevalerie*, *Mem de l'Ac des Inscr* vol xx.)

PAGE In Printing, one side of the leaf of a book A folio volume contains 4 pages in every sheet, a quarto 8 an octavo 16, a duodecimo 24, and an octodecimo (18mo) 36 pages

PA'GEANT, in its general sense, a public representation or exhibition of a showy and splendid character It was a very early custom in the middle ages both in England and on the Continent, to celebrate festive occasions of a public nature, as royal visits marriages &c by some ornamental show in the public streets of cities During the period of chivalry these shows began to be exhibited with the addition of masked figures representing allegorical personages with appropriate scenery and as, in process of time speeches in verse or prose were put into the mouths of these figures and sometimes a kind of dramatic entertainment performed between them the pageant consequently holds a place in our early literature The earliest speaking pageant of which we have any account was presented on the triumphal entry of Henry VI into London, in 1432, and the poetical part of it is conjectured to have been supplied by Lydgate The reign of Henry VIII was fertile in pageants of an extraordinary magnificence and splendour, but in that of queen Elizabeth they assumed a different form and were both devised and enacted with much more elegance partly from the tincture of romantic gallantry which distinguished the court of the maiden queen and was perceptible in all the homage rendered to her by her subjects, and partly from the sudden development of the poetical genius of the nation The pageants gradually became more dramatic and thus approximated more nearly to the more elegant character of the masque (see Masque), which, under her successor became the fashionable court entertainment Pageants however were still presented by the city of London which retained a poet laureat of its own for the purpose of inditing the spoken part of them down to the year 1708 or thereabouts, and the lord mayor's procession still retains some characteristics of these ancient entertainments The derivation of this word is wholly unknown and has afforded much scope to the fancy of etymologists

PA'GINA (Lat) In Botany the surface of a leaf

PAGO'DA (Pers poutghal *a house of an idol*) In Architecture the East Indian name for a temple containing an idol Sometimes it signifies the idol itself The pagoda is generally of three subdivisions First an apartment whose ceiling is a dome resting on columns of stone or marble this part is open to all persons Second, an apartment forbidden to all but brahmins Third and last, the cell which contains the statue of the deity, enclosed with a massy gate

PAGODA, is also the name of a gold coin, value from 8s to 9s, current in several parts of India It is also the name of a silver coin [illegible] value on which are [illegible] pedimages of the Hindoo [illegible]

PA'GODITE A species of [illegible] calcite or serpentine which the Chinese carve into figures

PAGU'RIANS, *Paguridæ* (Lat pagurus *hermit crab*) The name of a tribe of Macrurous Decapod Crustaceans, of which the genus *Pagurus* is the type Most of the species of this family inhabit, parasitically, the deserted shells of univalves

PAI'NIM A poetical expression used by English writers for *pagan*

PAINS AND PENALTIES, BILL OF A species of process employed to inflict punishment on state offenders out of the ordinary course of justice Every bill brought into parliament for the purpose of inflicting such punishment is a bill of pains and penalties, of which bills of attainder (*see* Attainder) are, properly speaking a species; but the term is more commonly confined to bills introduced to inflict specified penalties for particular offences The latest instance of this extraordinary proceeding was the bill of pains and penalties against Queen Caroline (1820), introduced into the House of Lords, and passed by them, but which was not carried into the Commons

PAINTER. In Naval language a rope used to fasten a boat either alongside of the ship to which it belongs, or to some wharf quay &c as occasion requires

PAI'NTERS COLIC The peculiar disease, which usually terminates in palsy and mental imbecility, to which painters and others subject to lead poisons are subject. It is also called colic of Poitou and Devonshire colic; the miners employed in lead-works being also liable to its attacks *See* Colic.

PAI'NTING (Fr peinture, Lat pictura), strictly defined, is an art which by means of lines and colours, represents on a plane surface all objects presented to the eye or to the imagination The etymology of the word (γραφειν) used to express painting among the Greeks, being the same as that employed for writing, seems to identify the tools with which it was performed among that people viz a style or pen of wood, used on a levigated plane of wood, metal, or some other prepared ground, the mode, letters or lines Until its operations become founded on the faithful representations of visible objects of nature, undisfigured by mannerism and modification from the fashion and habits of a country such for instance, as we meet with in the Indian Egyptian and Chinese representations of the human form it is scarcely entitled to the appellation of art, hence we shall in this article dismiss with very few remarks its appearance in those countries where traces of it in that condition are to be found reserving the principal part of this article for that development, simplicity of end and uniformity of pursuit which enabled the Greeks the great arbiters of form to carry it to a degree of excellence which no subsequent age or nation has been able to reach, or even rival

It seems probable that drawing and recorded language were coeval in invention In Greek we have mentioned that the same word (γραφειν) expressed the act of performing one as well as the other Goguet in his *Origine des Lois* says that the first essay of the art of writing using the expression in its most general sense, was by means of the representation of corporeal objects Its invention would thus be carried back to a period almost as remote as that of the existence itself of the human race The earliest people he says naturally used this method for exhibiting their thoughts and commenced by representing to the eye the objects they wished to impress on the mind The origin however of painting properly so called involved as it is in the greatest obscurity presents one of the most difficult questions in the history of the arts and opinions are very much divided as to the country that gave birth to it Some authors have assigned its invention to a period antecedent to the siege of Troy (*Plin* l xxv) Others to one long after (*Plin* l xxxv) Lhoyer says that the Egyptians boasted of being acquainted with the art six thousand years before the Grecians, but his words are Affirmant vana prædicatione ut palum est Profane no less than sacred history rejects such a chimera But though such a period of antiquity be fabulous it is quite certain that painting was much used by them at a very early period It is argued by Goguet that as much as it was in his power Cambyses destroyed the monuments of art he found in Egypt Hence may be considered as posterior to his invasion such of the monuments as display specimens of the art The epoch whereof we are speaking is 525 B C This, however, is an argument far from satisfactory where all is conjecture The specimens Egyptian [illegible] extant exhibit a collection of [illegible] figures which indicate extremely slender advances in the art They are all rudely and falsely drawn no notion of grouping as we understand it nor sentiment, appears in any of their productions As the Phœnicians were an early cultivated people and have the credit of the invention of letters they may perhaps have a claim to the invention equal to that of any other nation In the time of Solomon 1012 B C they were so well skilled in the arts that that king employed them in building the temple The Scriptures record the magnificence and splendour of their buildings abounding with decorated apartments and sculptured ornaments and we know from the coins of the Phœnicians that have reached us that in the design and execution of their coinage they were not far behind the Greeks

Thou also son of man take thee a tile and lay it before thee and pourtray upon it the city even Jerusalem" are the words with which the fourth chapter of Ezekiel commences, the words in the Septuagint being [illegible] This is about 590 B C, and would tend to show that the art was practised by the Jews so early as that period The commandment, "Thou shalt not make to thyself any graven image," which some sects, even in the present day construe into a prohibition against all art was merely a prohibition of the worship of idols, for we find Moses himself by the command of God employing sculpture for the sanctuary The employment of art of this nature is found also in many other passages of Scripture, which will doubtless occur to the reader.

The Persians the Arabians, and the Parthians, from the peculiar opinions they entertained, could have no claims [illegible] of the art of painting [illegible] the human

figure in a state of nudity was considered almost as indecorous as the appearance before them of a naked man himself Their figures are clothed almost invariably with drapery falling in clumsy folds profusely plaited Worshippers of fire they use no representations of the Deity, and it is curious that in their successful invasion of Egypt they displayed no taste for the arts and religion of that primeval country not that they had, perhaps, in the former much to acquire

The art of painting in China, if we may judge of it from the time it first became known to Europe, has remained the same time immemorial It has never exceeded the bounds of imitation, and even in that respect it is devoid of taste and truth The human figure with the Chinese is a distorted misrepresentation, and their perspective is attained by piling one object on the top of another till the picture is all earth and no sky Invention and imagination were never known among them, and though in many respects ingenious in manipulation, their dexterity is exhausted in painting the fins of a fish, or the petals of a plant In such a country it would be vain to look for the origin or progress of the art

Etruscan art is known to almost every person by the vases that bear that name In the article ARCHITECTURE we have touched upon the perfection at a remote period of time of the arts of Etruria, a country which in its ancient state, was the most powerful and civilized in Italy Diodorus speaks of the rich and powerful cities in their territories, and of the uncontrolled sway which their fleets exercised on the seas encircling the peninsula Though the history of this nation is involved in obscurity, though the Romans strove to remove all the memorials of their ancient fame sufficient information has reached us to demonstrate the height of perfection to which they carried the fine arts About twelve miles from the town of Civita Vecchia stood the ancient Etruscan city of Tarquinia near which are found a considerable number of sepulchral grottos, whereof some are decorated with paintings and figures much in the style of those on the Etruscan vases These antiquities have been published with a detailed description and plates by the late Mr Byres Some of the pictures represent combats and in others the subjects are dances of females all executed with considerable spirit The pottery however which we have above noticed, appears to afford the greatest number of their specimens of the arts of design the forms displayed in the contours of the vases no less than the paintings with which they are decorated evince a wonderful attainment of elegance in design purity of form and ingenuity in its delineation The power over line and the facility of execution they reached may be easily conceived from the absorbent nature of the material upon which they wrought No retouching was possible but the whole must have been completely arranged in the mind before it could be struck off by the artist Pliny states that in his day the town of Arden an ancient city of Etruria contained some paintings which he ascribes to a period anterior to the foundation of Rome and mentions with surprise their then perfect state of preservation At Lucurium also he describes some pictures of Atalanta and Helen which were simply painted on the wall and exhibited great merit in execution These Caligula after a fruitless attempt failed in removing Cere another Etruscan city boasted some paintings of an early date All these specimens are doubtless of a remote epoch but attempts to fix it with precision would not be likely to bring us to the exact or even proximate period of their execution The history of painting however can only be told under the head of Grecian art to which we shall now proceed, premising that in our account we shall use most freely the *Lectures on Painting* of the late Henry Fuseli, professor of painting of the Royal Academy who whatever may be thought of his pictures was an enthusiastic lover of his art, a scholar and a critic of the highest order

The vocabulary of the technical expressions *nature*, *beauty grace taste copy imitation, genius* and *talent* is explained as follows – By *nature* is meant the general and permanent principles of visible objects neither disfigured by accident nor distempered by disease neither modified by fashion nor local habits *Beauty* is that harmonious whole of the human frame, that unison of parts to one end, which enchants us It is the result of the standard set by the great masters of the art the ancients and confirmed by modern imitation *Grace* is an artless balance of motion and repose, springing from character, founded on propriety, and neither falling short of the demands nor overleaping the modesty of nature Applied to execution it is that delicate superpower which hides the means by which it is attained By *taste* is meant not crudely the knowledge of what is right in art but an estimation of the degrees of excellence by comparison, proceeding from justness of refinement *Copy* though generally confounded with *imitation* is essentially different in operation and meaning Precision of eye and obedience of hand are the requisites of the former without pretence to choice or selection; whereas choice, directed by judgment or taste, is the essence of imitation "Of *genius* I shall speak with reserve," says the professor, "for no word has been more indiscriminately confounded" by genius is meant the power which enlarges the circle of human knowledge, which discovers new materials of nature, or combines the known with novelty whilst *talent* arranges, cultivates and polishes the discoveries of genius

Religion was the motive of Greek art, it was therefore natural that they should endeavour to invest their own authors, for they considered themselves of divine origin, with the most perfect form, and as man possessed that exclusively, they completely and intellectually studied his elements and constitution The climate that was favourable to the development of that form, the establishment of exercises by their civil and political institutions, created models in nature which raised Greek art to the highest excellence

*Skiagrams*, or simple shaded outlines, similar to those known under the name of *silhouettes*, were the first essays of the art They had no addition of character or feature but what the profile of the object thus delineated could afford Greek art had her infancy, but the Graces rocked the cradle and Love taught her to speak If ever legend deserved belief, the amorous tale of the Corinthian maid who traced the shade of her departing lover by the secret lamp, appeals to our sympathy to grant it"

[illegible] was the *monogram* which is the [illegible] outline filled in with the addition [illegible] From this to the *monochrom* or painting of a single colour on a tablet primed with white, then covered with what was called pume wax first amalgamated with a resinous pigment, generally of a red sometimes of a dark brown or black colour was the next advance Through this inky ground the outlines were traced with a firm though pliant *style*, called a *cestrum* the line could be altered with the finger or a sponge and easily replaced by a fresh one When the whole was settled it was suffered to dry, and covered with a brown encaustic varnish, the lights were worked over again and rendered more brilliant with a more delicate point according to the gradual advance from mere outlines to some indication, and at last to masses of light and shade thence to the superinduction of different colours or the invention of the *polychrom*, which, by the addition of the pencil to the style, raised the stained drawing to a legitimate picture and at length produced that vaunted harmony the magic scale of Grecian colour. If these conjectures be founded in fact the supposed momentaneous productions on the Etruscan vases, which we have above noticed would be no longer matter of astonishment and indeed it appears much more likely that such should have been the case than that the figures so drawn should have been the magic produce of a winged pencil rather than the result of gradual improvement exquisitely finished *monochroms*"

The period at which the Greeks planted the cestrum cannot be ascertained Apollodorus of the 90th Olympiad, and Zeuxis in the 94th are said to have used it with freedom and power, Parrhasius painted the battle of the Lapithæ and Centaurs on the shield of the Minerva of Phidias to enable Mys to chase it, but this was most probably a monochrom designed with the cestrum for greater accuracy It was nearly a century after this that Apelles and Protogenes had a competition in drawing lines with the pencil in which delicacy and evanescent subtlety being the characteristic some notion of their mechanical skill may be formed Of the *encaustic* method used by the ancients no account can be given on which reliance may be placed The most probable account," says Fuseli "is that it bore some resemblance to our oil painting and that the name was adopted to denote the use of the materials inflammable or prepared by fire, the supposed durability of which whether applied hot or cold authorized the terms [illegible] and *encaustic*"

Polygnotus is the first great name that appears on record at a period when some satisfactory history of the art might be commenced He flourished about 400 years B C So great was his success in the Pœcile at Athens and the Lesche or public hall at Delphi, that in a general council of the Amphictyons, it was solemnly decreed that his expenses, whenever he travelled in Greece should be borne at the public charge. From the description of his pictures by Pausanias, it would seem that composition in painting, as we now understand that term, was not at all understood, inasmuch as that author begins his description at one end of the picture and finishes at the opposite extremity, which indicates pretty plainly that there could be no central group or figure to which the rest were subordinate. Aristotle says that Polygnotus improved his model, and it would be unjust to pronounce considering the variety of powers [illegible] arts of his pictures were distinguished, that the primitive arrangement we have just mentioned arose from want of comprehension in the artist

After Aglaophon, Phidias Panænus, Colotes, and Eve-

nor, the father of Parrhasius, came Apollodorus, the Athenian "This painter applied the essential principles of Polygnotus to the delineation of the species, by investigating the leading forms that discriminate the various classes of human qualities and passions The acuteness of his taste led him to discover that as all men were connected by one general form, so they were separated each by some predominant [illegible] racter and bound them to a class [illegible] considered Apollodorus as the first colourist of his age It is probable from their descriptions that he was the inventor of local colour and tone, which received from the former the term splendour Zeuxis succeeded to Apollodorus, and, by uniting in one figure the most perfect parts of many models produced an ideal form, which, in his opinion, constituted the supreme degree of human beauty. Lucian describes a picture he exhibited at the Olympic games as remarkable for its invention It was the representation of a female Centaur suckling her young, and the account is to be found in the memoir inscribed with the name of Zeuxis This artist used but few colours; but he seems to have understood the extension of light to masses, from the circumstance of his painting monochroms on a black ground, adding the lights in white. "Pinxit et monochromata ex albo," says Pliny

Parrhasius, a native of Ephesus, but a citizen of Athens, was the son and disciple of Evenor, and cotemporary of Zeuxis By his subtle examination of outline, he "established that standard of divine and heroic form which raised him to the authority of a legislator from whose decisions there was no appeal That he was a thorough master of allegory is evident from his embodying by signs universally understood the Athenian people (ΔΗΜΟΣ) in which he expressed at once its contradictory qualities "Perhaps' observes Fuseli, 'he traced the jarring branches to their source the aboriginal moral principle of the Athenian character which he made intuitive This supposition alone can shed a dawn of possibility on what else appears impossible' In his competition with Timanthes the Cythnian or, as some say of Sicyon he had the mortification to have been declared by a majority of votes inferior to him [illegible] ject of the competition in which he was thus defeated was the contest of Ajax and Ulysses for the arms of Achilles

No picture of antiquity has acquired so much celebrity as the sacrifice of Iphigenia in Aulis by Timanthes Quintilian informs us that it was painted in contest with Colotes of Teos, an artist from the school of Phidias and crowned with victory at its rival exhibition This picture, which has been the subject of the unlimited praise of critics of antiquity, has, in modern times been the subject of criticism from the circumstance of Timanthes hiding the face of the father (Agamemnon) of the victim to be immolated in his mantle unable by his art to express the intensity and agony of his grief Upon this Sir Joshua Reynolds observes in his Eighth Discourse, "If difficulties overcome make a great part of the merit of art difficulties evaded can deserve but little commendation' The French critic Falconet has not been less unsparing than the president in his condemnation of the artifice The answer of Fuseli to these critics appears to us satisfactory He says 'The subject of Timanthes was the immolation of Iphigenia Iphigenia was the principal figure, and her form her resignation or her anguish, was the painter's principal task the figure of Agamemnon, however important, is merely accessory and no more necessary to make the subject a completely tragic one than that of Clytemnestra the mother no more than that of Priam, to impress us with sympathy at the death of Polyxena." Again, 'They ascribe to impotence what was the forbearance of judgment Timanthes felt like a father, he did not hide the face of Agamemnon because it was beyond the power of his art,—not because it was beyond the possibility but because it was beyond the dignity of expression, because the inspiring feature of paternal affection at that moment and the action which of necessity must have accompanied it could either have destroyed the grandeur of the character and the solemnity of the scene, or subject the painter with the majority of his judges to the imputation of insensibility' The same expedient to express grief was adopted by Michael Angelo in the figure of Abijam, and by Raphael in the Expulsion from Paradise, borrowed from Masaccio These were the artists who formed the second school of art, and established its end and limits on it was founded the third period of style, in which refinement induced a grace and beauty to forms not to be surpassed The masters of this period were Apelles, Protogenes Aristides, Euphranor Pausias, and the pupils of Pamphilus and his master Eupompus This last-named artist was of Sicyon; and his authority was so great that out of the Asiatic and Grecian schools of painting he formed a third by dividing the last into the Attic and the Sicyonian When consulted by Lysippus (*Pliny*, l. xxxv.) on a standard of imitation in art, he pointed to the crowd passing by; observing that nature,



not an artist, should be the object of imitation Pamphilus, a Macedonian the master of Apelles, and the most scientific artist of his day adopted the doctrines of Eupompus To the art of painting he joined the study of mathematics, and held the opinion that without the aid of geometry no painter could ever arrive at perfection. In Apelles of Cos, or, according to Lucian, of Ephesus, we are told by Pliny unrivalled excellence was found Grace was his powerful and peculiar faculty, in which and in knowing where to stop, he surpassed all that preceded him, and left not his equal in the world The story of the lines which were drawn by himself and Protogenes in competition with each other is not a legendary tale, but a well-attested fact into the nature of them however, it would be now useless and unavailing to inquire Aristides of Thebes and cotemporary of Apelles was the first who by the rules of art attained a perfect knowledge of expressing the passions and affections of the mind The history we have of the picture which Alexander, at the sacking of Thebes, sent to Pella, proves his power of infusing the passions into his works In it were expressed the anguish of maternal affection and the pangs of death Euphranor the Isthmian and pupil of Aristides, is said to have carried still farther the refinements of that expression so powerful in the hands of his master Skilled in sculpture as well as painting, his conceptions were noble and elevated, his style masculine and bold, and he was the first who distinguished himself by imparting majesty to his heroes

Asclepiodorus, the Athenian sculptor as well as painter was as the latter celebrated for the beauties of a correct style and the truth of his proportions Apelles allowed himself to be in these respects, as much inferior to this artist as he was to Amphion in the good ordering and disposition of his figures About this period appeared Nicomachus Nicophanes Pyreicus and others Nicias, an Athenian, 322 B C was in great repute for the great variety and noble choice of his subjects for the mode of distributing his lights and shadows and for consummate skill in the representation of quadrupeds In Rome, about 301 B C Fabius, a noble Roman, painted the Temple of Health and gloried so much in the art that he assumed the surname of Pictor Without a further enumeration of masters we may add, that for a long period after the reigns of Vespasian and his son Titus, painting as well as sculpture continued to flourish in Italy Even under their successors Domitian Nerva, and Trajan they met with as much encouragement as in the most palmy state of the arts in Greece Under Adrian Antonine Alexander Severus Constantine, and Valentinian the art of painting continued to be an object of interest but at length, in the reign of Phocas with the fall of the empire with the rest of the noble arts and sciences it was involved in the common heap of ruins

Painting in Italy owes the dawn of its restoration to the feeble rays that emanated from the pencil of Giovanni Cimabue who was nobly descended and born at Florence in the middle of the thirteenth century He was the disciple of some indifferent painters, who had been brought from Greece by the government of Florence these he soon surpassed both in drawing and colouring Without the art of managing his lights and shadows, and but slenderly acquainted with the rules of perspective he nevertheless laid so firm a foundation for the future improvement of the art as to entitle him to the name of the father of the first age of modern painting His death took place in the year 1300 at Florence where, and at Pisa some of his productions are still to be seen Giotto his pupil also a Florentine was a more able painter than his master He divested himself of the shackles in which the system of the Greek art of that age had bound his master adding somewhat of grace to his figures and nature to his colouring Of a picture which he painted in the church D Ognissanti at Florence, representing the death of the Virgin with the Apostles about her, Vasari related that M Angelo da Buonaroti used to say that the truth could not be nearer approached than in it — Non potere essere più simile al vero di quello ch era He was the friend of Dante and Petrarch, and painted the portrait of the former On his decease, in 133 , the city of Florence erected his statue in marble over his tomb

In the year 1410 thirty years before the invention of printing by Gutemburg, John Van Eyck, born in the Low Countries in 1370, is understood to have invented the art of painting in oil, which he taught to Antonello of Messina, who visited Flanders to become acquainted with the secret he it was who first practised and taught it in Italy The principal masters who flourished in this first period of the resuscitation of the arts were Andrea Orgagna, so celebrated for his Loggia in the great square at Florence, Pietro Cavallino, Stefano, Bonamico, Buffalmacco, Pietro Laurati, Lippo Spinello Casentino, Pisano, &c The art did advance though but slowly, gathering little strength till the appearance of Masaccio Sculpture had already produced respectable specimens of its reviving powers in the basso-relievi of Lorenzo

Ghiberti some works of Donato, and the Christ of Philippo Brunelleschi when the first symptoms of imitation appeared in the frescos of Tommaso da San Giovanni commonly called Masaccio, from the total neglect of his appearance and person Masaccio first conceived that parts are to constitute a whole, that composition ought to have a centre, expression truth, and execution unity his line deserves attention, though his subjects led him not to investigation of form, and the shortness of his life forbade his extending those elements [illegible] nearly a century afterwards, carried to perfection " Masaccio who was born in Tuscany in 1417 is considered the father of the second or middle age of painting His death caused it is supposed, by poison, occurred in 1443 Andrea Montegna, born at Padua in 1431, was a disciple of Jacopo Squarcione Though correct in his drawing, well versed in perspective and apparently acquainted with the antique albeit the best antique statues had not then come to light, his neglect of nature induced a crudeness of taste and grotesqueness of fancy He died in [illegible] having been the first who practised the art of engraving in Italy In this place we must not forget the master of so great a man as Leonardo da Vinci, Andrea Verocchio, a Florentine, born in 1432 He was well skilled in geometry optics music architecture sculpture and painting, the last whereof he is said to have abandoned, because, in a picture whereon he was engaged of the baptism of our Saviour his pupil Leonardo had under his order painted in an angel holding up some part of our Saviour's garment so far excelling Andrea's own figures that enraged at being outdone by a youth he resolved never again to wield the pencil It is said he was the first who preserved individual likeness by moulding the face in plaster of Paris Leonardo da Vinci, of noble descent and born about 1445 in a castle so named near Florence surpassed all his predecessors His powers seem to have been unlimited he was an admirable sculptor and architect a skilful musician an excellent poet expert in anatomy and chemistry and well versed in all parts of the mathematics Rubens had a very high opinion of his works and especially of his Cenacolo in the refectory of the Dominicans at Milan which he abandoned without finishing the head of Christ exhausted by a wild chase after models for the heads and hands of the apostles had he been able to conceive the centre the radii would have followed of course He was many years director of the academy of painting at Milan, which city he much benefitted by his contrivance of the canal that supplies it with water from the river Adda He had the honour of expiring in the arms of Francis I — an honour by which destiny atoned to that monarch for his future disaster at Pavia when he became a captive His death took place in 1520 The last master of this period was Bartolomeo della Porta Though not endowed with the comprehension of Leonardo he first gave gradation to colour form and masses to drapery and dignity to execution Fra Bartolomeo as he was called being a member of a religious order was a native of Savignano a village about ten miles from Florence, and was born in 1469 Nudities were scarcely ever represented by him though he was a perfect master of drawing the human figure He was the first who used the lay figure Fuseli says of him He was the true master of Raphael whom his tuition weaned from the meanness of Pietro Perugino and prepared for the mighty style of Michael Angelo Buonarotti Of this master, the greatest beyond comparison that ever appeared we cannot refrain from again quoting the same author at considerable length to which if necessary, might be added the testimony of Sir Joshua Reynolds whose parting wish when he took leave of the Royal Academy was that the last words he might pronounce within its walls might be the name of this wonder of mankind " Sublimity of conception grandeur of form, and breadth of manner are the elements of Michael Angelo s style By these principles he selected or rejected the objects of imitation As painter as sculptor, as architect, he attempted and above any other man succeeded, to unite magnificence of plan and endless variety of subordinate parts with the utmost simplicity and breadth His line is uniformly grand, character and beauty were admitted only as far as they could be made subservient to grandeur The child the female meanness deformity were by him indiscriminately stamped with grandeur A beggar rose from his hand the patriarch of poverty; the hump of his dwarf is impressed with dignity; his women are moulds of generation; his infants teem with the man, his men are a race of giants" Again, "He is the inventor of epic painting in that sublime circle of the Sistine Chapel, which exhibits the origin the progress and the final dispensations of theocracy Michael Angelo was of noble family, and born at Castel Caprese, near Florence in 1474 His master was Domenico Ghirlandaio He died in great wealth, at Rome, in 1564; from thence his remains were removed to Florence, and there honourably interred His principal disciples were Marcello Venusti, Il Rosso, Giorgio Vasari and Fra Bastiano Raphael Sanzio d'Urbino was born on Good Friday in the year 1483, and died on Good Friday in the year 1520 The grace and mild genius of Raphael were perhaps, much more capable of exciting our sympathies than the burst of inspiration which the works of the last-named master universally exhibited As Michael Angelo was the father of epic painting so was Raphael that of dramatic painting "If, separately taken the line of Raphael has been excelled in correctness, elegance, and energy, his colour far surpassed in tone and truth, and harmony; his masses in roundness, and his chiaro-oscuro in effect considered as instruments of pathos, his pictures have never been equalled, and in composition, invention, expression, and the power of telling a story, he has never been approached" Giulio Romano was his greatest pupil His conceptions were more extraordinary, more profound, and more elevated than even those of the master himself His style was drier and harder than any of Raphael s school and he was frequently harsh and ungraceful He died at the age of fifty-four, in the year 1546.

Giorgio del Castel Franco called, because of his size and beauty Giorgione and Tiziano Vecelli combined to form the alluring and fascinating charm of colour Born in the Venetian States and in the same year, 1477, they laid the foundation of the Venetian school Of the latter, our professor says he penetrated the essence and the general principle of the substances before him, and on these established his theory of colour He invented that breadth of local tint which no imitation has attained, and first expressed the negative nature of shade his are the charms of glazing and the mystery of reflexes, by which he detached, rounded, connected, or enriched his objects His harmony is less indebted to the force of light and shade or the artifices of contrast, than to a due balance of colour equally remote from monotony and spots His backgrounds seem to be dictated by nature Landscape whether it be considered as the transcript of a spot, or the rich combination of congenial objects or as the scene of a phenomenon dates its origin from him he is the father of portrait painting, of resemblance with form character with dignity, and costume with subordination" Antonio Laeti, or Allegri, called Correggio from the place of his birth, in the duchy of Modena completed the charms of colouring and chiaro-oscuro Giulio Romano, when he saw the Leda and Venus he had painted for Frederic duke of Modena, de[illegible] possible for colouring to be carried [illegible] at Modena and Parma, at which last place he passed the greater portion of his life, and died at the age of forty in the year 1534 Though the power of Correggio [illegible] was that of his chiaro-[illegible] of a globe imperceptibly gliding through lucid demi tints into rich reflected shades composes the spell of Correggio and affects us with the soft emotions of a delicious dream The merits of Raphael are pathos and character the power of Titian was his colour, and of Correggio his harmony We have not space to dwell on the lively genius of Pordinone, who disputed the superiority of Titian, the meagre style of Andrea Vannuchi, surnamed del Sarto nor the extraordinary vigour and puerile imbecility of conception of Pellegrino Tibaldi; but we must not pass without notice the name of Sebastiano del Piombo, a Venetian who died at the age of 62, in 1547 His name Del Piombo is derived from an office he held in the management of the lead mines given him by pope Clement VII For some time he practised the science of music to which he was bred, but the fascinations of painting drew him aside from his original pursuit and he became a disciple of old Gio-Ballino, continued his studies under Giorgione, and, having attained considerable perfection [illegible] went to Rome. Here he so ingratiated himself with Michael Angelo by joining the party against Raphael that he was assisted in his designs by that great master and especially in that wonderful picture now in the National Gallery here, of the Raising of Lazarus which gained the universal applause of Rome and was even put on a par with the celebrated picture of the Transfiguration by Raphael. Equally favoured by Michael Angelo was Daniel Ricciarelli of Volterra in whose picture of Christ and the Women, in the Descent from the Cross as well as in that of Sebastian s just mentioned, the master hand that directed them is manifest The depravation of the style of Michael Angelo is sufficiently visible in the works of Giorgio Vasari, born at Arezzo in 1514, to whom the world is more indebted for the labours of his pen, in the History of the Lives of the most celebrated Painters, Sculptors, and Architects, first published at Florence, in 1550, than those of his pencil him Fuseli describes as the most superficial artist, and the most abandoned mannerist of his time. "He overwhelmed the palaces of the Medici and of the popes, the convents and churches of Italy, with a deluge of mediocrity, commended by rapidity and shameless bravura of hand, he alone did more work than all the artists of Tuscany together; and to

him may be truly applied, what he had the insolence to say of Tintoretto, that he turned the art into a boy's toy" Felibien has taxed him with the flattery of the masters of his time, and partiality to those of his own country, but his work is nevertheless a valuable record of the lives of men to whom the world is much beholden, and contains many interesting anecdotes, which, but for him, would have been lost for ever His death happened in 1578 Primaticcio, the scholar of Giulio Romano made abbé of St Martin de Troyes by Francis the First studied and spread the style of his master in France, where he decorated the palaces of that king with mythology and allegory, in which he was assisted by his pupil, Nicolo del l Abbate an excellent artist Primaticcio continued in France from the period of his first establishment there, lived in great pomp and state, more like a nobleman than a painter, through four several reigns, and died at the age of 80, in the year 1570 After Polidoro da Caravaggio, whose abilities [illegible] sentations of Roman military [illegible] school scarcely deserves notice till the appearance of Nicolas Poussin of Andilly, a town in Normandy, who was born in 1594 He was descended of a noble family of Picardy, but that his productions have shed a ray of lustre on the family which no nobility of blood could have effected [illegible] the name of the French Raphael [illegible] Nicolas was the disciple of Simon Varin, a French painter of mediocrity and afterwards studied in the academy of Domenichino and also in company with the famous sculptor Francesco Fiammingo, who was born in the same year and bred in the same house with him After a stay of more than 16 years in Rome, he was invited, by a letter under the hand of Louis XIII himself, to return to his native country where he was received with every honour declared first painter to the king and had a considerable pension conferred upon him Upon the death of this king and that of the cardinal Richelieu he returned to Italy to settle his affairs and re[illegible] Rome he [illegible] ended his days in Rome at the age of 71 years Such was his attachment to the ancients that it may be said he less imitated their spirit than copied their relics and painted sculpture The costume, the mythology, the rites of antiquity were his element his scenery his landscape are pure classic ground His eye though impressed with the tint and [illegible] and imitation of Tiziano s idiom inspired him to charm with colour crudity and patches frequently deform his effects " The mantle of Correggio seemed to have fallen on Parmegiano though he possessed not the mode of expressing that expanse of harmony which no other eye than that of Correggio has conceived Francesco Mazzuoli called from Parma the place of his birth Parmegiano was born in 1504 and died at the early age of thirty-six That disengaged play of delicate forms the 'Sveltezza of the Italians is the prerogative of Parmegiano though nearly always obtained at the expense of proportion His grandeur as conscious as his grace sacrifices the motive to the mode simplicity to contrast His St John loses the fervour of the apostle in the orator, his Moses the dignity of the lawgiver in the savage With incredible force of chiaro-oscuro, he united bland effects and fascinating hues but their frequent ruins teach the important lesson that the mixtures which anticipate the beauties of time are big with the seeds of premature decay

Towards the end of the sixteenth century Lodovico Caracci, with his cousins Annibale and Agostino founded a school at Bologna, in which it was proposed to select the beauties, correct the faults supply the defects and avoid the extremes of the different styles and so attempt to form a perfect system The recipe of ingredients for the formation of a perfect painter are contained in a sonnet by Agostino, well known to artists they are as follows — Roman design, Venetian motion and shade Lombardy's dignified tone of colour, the fierce style of Michael Angelo, Raphael s symmetry Titian s truth to nature, and Correggio s sovereign purity add to these the decorum and solidity of Tibaldi, the learned invention of Primaticcio, and a little of Parmegiano s grace or, to save all this trouble, imitate the works of our dear Nicolo This was empiricism unworthy of such men as the Caracci, whose talents were splendid and of a very high order Lodivoco was "the sworn pupil of nature" "Agostino with a singular modesty which prompted him rather to propagate the fame of others by his graver than by steady exertion to rely on his own power for perpetuity of name combined with some learning a cultivated taste, correctness though not elegance of form, and a Correggiesque colour" Annibal, whose taste was unequal to both of these, though his power of execution was far superior, was born at Bologna, in 1560, and was the disciple of his cousin Lodovico His great work was the *Farnese Palace*, in which whilst we admire the vigour of the execution, we cannot help lamenting the choice of subject, which is "a chaotic series of trite fable and bacchanalian revelry, without allegory, void of illusion, merely to gratify the puerile ostentation [illegible]" Such was [illegible] he genius of Raphael that his deathbed request was to be buried in the same tomb with him, which request was complied with, in the Pantheon at Rome, 1609 This eclectic Bolognese school did not last long its scholars soon followed each his own peculiar taste Its principal eleves were Schidone, Guido Lanfranco Albani Zampieri called Domenichino and Francesco Barbieri called Guercino The merits of these are summed up as follows, by the admirable critic we have so often quoted in this article —" Schidone, whose mind was in his eye, embraced and often applied the harmony and colour of Correggio, whilst Lanfranco strove without success to follow him through the expanse of his creation and masses Grace attracted Guido, but it was the studied grace of theatres, his female forms are abstracts of antique beauty, attended by languishing attitudes and arrayed by voluptuous fashions His male forms, transcripts of models found in a genial climate, are sometimes characteristic of dignified manhood or apostolic fervour, sometimes stately courteous, insipid" "His Aurora deserved to precede a more majestic Sun and Hours less clumsy His colour is occasionally bland and harmonious sometimes vigorous and sometimes insipid Albani formed Nereids on plump Venetian models, and contrasted their pearly hues with the rosy tints of Loves, the juicy brown of fauns and satyrs of rich marine or sylvan scenery Domenichino aimed at the beauty of the antique the expression of Raphael the vigour of Annibal Caracci the colour of Lodovico, and, mixing [illegible] st Guercino broke [illegible] mind, form, and costume to effects of colour fierceness of chiaro oscuro, and intrepidity of hand From this period the art declined rapidly in Italy it was indeed held up for a short period by the exertions of Nicolas Poussin of whom we have already spoken Pietro da Cortona and Luca Giordano possessed very considerable talents but they were much abused in their exercise by implicit obedience to the tasteless commissions of their employers

Germany though without much apparent intercourse at the time with Italy had profited by the progress of the arts therefore towards the end of the fifteenth century, we find the works of Albert Durer had succeeded the rude and uncouth productions of Schon Wolgemuth, and Altorfer Albert Durer was born at Nuremberg on Good Friday 1471 Notwithstanding his style was crude and ungraceful his prints were esteemed throughout Italy copied at Venice by the celebrated Marc Antonio, and so much admired by even Raphael himself that he decorated his own chamber with them and often lamented that such a man had been educated in a country where the want of models and works of art must have so retarded his progress His principal works were painted at Prague for the Emperor Maximilian I He died in 1528 Fuseli says of him Albert Durer was, in my opinion a man of great ingenuity without being a genius He studied and as far as his penetration reached established certain proportions of the human frame but he did not invent a style every work of his is a proof that he wanted the power of invention of concluding from what he saw to what he did not see, that he copied rather than selected the forms that surrounded him and [illegible] tacked deformity and meagreness to fulness and sometimes to beauty Lucas of Leyden was but a clumsy imitator of Albert Aldegraver, Beheim and George Pentz from the study of Raphael, known to them through the medium of Marc Antonio s prints and from the style of Michael Angelo, distilled through prints from [illegible] seem to have made some advances in the [illegible] of its state in Italy attracted hosts of German, Dutch and Flemish students, who "though content to feed on the husks of Tuscan design imbibed the colour of Venice, and spread the elements of that excellence which distinguished the succeeding schools of Flanders and of Holland

Peter Paul Rubens, born in Cologne in 1578, and Rembrandt Van Rhyn born near Leyden in 1606 by their extraordinary powers showed that Italy was not the only spot in which art could take root, but that Flanders and Holland afforded a soil in which it could flourish The former of these, bred at Antwerp under the instruction of Otho Van Veen, had, previous to his journey to Italy acquired an unbounded power over the instruments of his art, and on his arrival was the successful competitor for fame with those masters whom he selected as objects of emulation Venice was the centre of attraction for him; and there from the splendour of Paulo Veronese, and the glow of Tintoretto he compounded "that florid system of mannered magnificence which is the element of his art, and the principle of his school" His scholars saw through the eye of their master instead of seeing through that of nature, but from this censure must be excluded the illustrious name of Van.

dyck, and that of Abraham Diepenbeck Of the portraits of Vandyck no mention is here necessary to enhance the esteem in which they are held " The fancy of Diepenbeck, though not so exuberant excelled in sublimity the imagination of Rubens his Bellerophon Hippomenes Ixion, Sisyphus fear no competitor among the productions of his master Rembrandt, except in what relates to form, was a genius of the highest order " In spite of the most portentous deformity and without considering the spell of his chiaro oscuro such were his powers of nature, such the grandeur, pathos, or simplicity of his composition, from the most elevated or extensive arrangement to the meanest and most homely, that the best cultivated eye the purest sensibility and the most refined taste dwell on them equally enthralled " His followers, such as they deserve to be called were a race of " colourists content to tip the cottage, the hamlet, the boor, the ale pot, the shambles and the haze of winter with orient hues or the glow of setting summer suns '

Switzerland rests its title to distinction on the names of Hans Holbein and Francesco Mola, the former of Basil, born in 1498, died in London at the age of 46, the latter, the scholar of Giuseppe d Artino and Francesco Albani, was born at the village of Coldre in 1621 and died in Rome in 1666 The Swiss school exhibited a style poised between the emaciated dryness of Albert Durer and the bloated corpulence of Goltzius

The school of the Caracci seems to have taken its deepest root in France, which with few exceptions has not produced artists greatly above mediocrity The exceptions however, which are to be named are Nicolas Poussin who has already been mentioned to this must be added those of Eustache Le Sueur, Charles Le Brun, Sebastian Bourdon and Pierre Mignard ' The Seven Works of Charity by S Bourdon teem with surprisingly pathetic and always novel images and in the Plague of David by Pierre Mignard our sympathy is roused by energies of terror and combinations of woe which escaped Poussin and Raphael himself

From what cause may be difficult to say but the labours of the Spanish school were confined almost within the narrow limits of individual imitation The degree of perfection in this respect was indeed great though the means pursued were very different and the works of Diego Velasquez Joseph Ribera and Murillo though never approaching the great style of art impress us with respect for their powers and deservedly received the homage of the Spanish nation

In this country Henry VIII was the first monarch who seems to have taken any interest in the art He invited Titian to England and patronised Holbein and Torregiano But this patronage very unlike that bestowed by Francis I on Andrea del Sarto Primaticcio Nicola, Cellini and others was so restricted in the choice of subjects that neither Henry nor his daughter Elizabeth deserve our veneration for the assistance they rendered to the arts of the country In the court of Henry's father a profligate Flemish painter of the name of Mabuse, had indeed been employed but it is not known whether he came here at that king's solicitation or driven by his own distresses The pencil of Holbein among its other employments was of course employed to portray the beauties of Henry's wives or of those he intended to make so sometimes indeed to obtain a just report of the latter he was despatched to the Continent and in the case of Anne of Cleves through his faithless pencil Cromwell the minister lost his head If painting was at this period likely to have taken root and flourished here, the Reformation and the worse than absurd edicts passed by Edward VI and Elizabeth forbidding statues and pictures in churches were nipping frosts that destroyed its growth Charles was the first real patron of the arts that governed this country By him was Rubens invited to the country but the unfortunate fate of the monarch intercepted the progress that art then seemed likely to make His son in possession of the cartoons of Raphael, and with the magnificence of Whitehall before his eyes suffered Verrio to contaminate the walls of his palaces or degraded Lely to paint the Cymons and Iphigenias of his court whilst the manner of Kneller swept away completely what yet might be left of taste under his successors The state of art continued extremely low in this country till the appearance of Reynolds Walpole says that in the commencement of the reign of George I the arts of England were sunk almost to the lowest ebb The names of Reynolds Hogarth Gainsborough, and Wilson, in their time entitled this nation to some rank in the art; though we have as yet had no indication of that great style of art whose history has occupied a considerable portion of the preceding pages The names we have mentioned have been succeeded by others, and some now living, which have, perhaps, not only prevented the accusation of a retrograde movement, but have raised the art generally in the country higher than it was ever known in a preceding period yet much remains to be done The genius of the nation seems bound up in commerce and politics; total ignorance of the first principles of art seems still to pervade those who only are capable of affording patronage, and many a collector, on whose walls hang the most splendid specimens of the Roman and Florentine schools, must, if he will speak the truth, admit that his admiration of the tobacco pipes pewter pots, and vulgar boors of the Dutch school a school of low ideas and good painting, is more profound than of the sublime conceptions of Raphael and Michael Angelo

*Practice of Painting* — The nature of this work precludes a very enlarged notice of the theory and practice of painting we shall however subjoin a few leading observations on the subject One of the principal requisites for its successful practice is *anatomy* It is obvious that to represent successfully the human form its construction in the skeleton, and the tendons and muscles by which the bones of the skeleton are connected and move, is knowledge that must be acquired, inasmuch as they appear more or less through the integuments with which they are covered Without this knowledge the living model becomes useless to him, for that, after a very short period of standing, sinks into languor, which an acquaintance with the origin and insertion of muscles enables the painter to correct, and thus animate the work It was the constant observation of the youth in [illegible] mes that enabled the Grecians so suc- [illegible] and develop the muscular system in their sculpture these afforded models of the most perfect nature *Comparative anatomy* is another of the requisites to be acquired by the artist, since the painting of animals must necessarily involve a want of the same information as is requisite for the human figure *Symmetry* which results from the relative proportion of the parts to each other follows from the knowledge of anatomy It is by the knowledge of this that the length of a finger may be made to measure the height of a figure Without at the most thorough acquaintance of the rules of *perspective* no objects can be placed properly in a picture Some have said that though it is a science of the first importance to a painter yet he is not to be too strictly confined to its rules but to endeavour to render them subservient to his own purposes We confess that such is not our opinion nor can we conceive how any violation of truth which any infraction of the rules of perspective would be can be made agreeable in a picture The rules, too of perspective are so simple, and their practice so easily acquired that no excuse can be admitted for the neglect of so indispensable an accomplishment The science of *optics* is so far necessary as to enable the artist to determine how the reflexes against the sides of surfaces in shade would affect the intensity of them This is called chiaro oscuro The determination of shadows, and the direction in which they would fall, depends upon the science of optics combined with that of perspective As perfect form is produced by leaving out peculiarities, and retaining only general ideas, so this principle extended in the other branches of the art, gives what is called the grand style to invention to composition, to expression and even to colouring and drapery *Invention* in painting is not the same as in poetry, inasmuch as that the subject is supplied by the poet or historian The subject should be general, and kept free from all that might tend to embarrass or divide the attention of the spectator 'Whenever," observes Sir Joshua Reynolds in his Fourth Discourse, " a story is related every man forms a picture in his mind of the action and expression of the persons employed The power of representing this mental picture on canvass is what we call invention in a painter, and as in the conception of this ideal picture the mind does not enter into the minute particularities of the dress furniture, or scene of action so when the painter comes to represent it he contrives those little necessary concomitant circumstances in such a manner that they shall strike the spectator no more than they did himself in his first conception of the story The painter may deviate from strict historical truth [illegible] grandeur of his design, such being but [illegible] ' A painter of portraits retains the individual likeness, a painter of history shows the man by showing his actions He has but one sentence to utter but one moment to exhibit *Expression*, which in painting signifies the representation of the emotions and passions of the mind must, like invention not descend to peculiarities Thus Bernini, in representing David casting the stone from his sling, mistook accident for generality when he made him bite his under lip *Colouring* also, has its laws and in this the same general principle must be attended to All trifling or artful play of little lights, or an [illegible] variety of tints is to be avoided, a quietness and simplicity must reign over the whole work, to which a breadth of uniform and simple colour will very much contribute. Grandeur of effect is produced by two different ways, which seem entirely opposed to each other One is by reducing the colours to little more than chiaro oscuro, which was often the practice of the Bolognese schools and the other by making the colours very distinct and forcible, such as we

see in those of Rome and Florence, but still the presiding principle of both those manners is simplicity" *Drapery*, again, is managed by the same general laws minute attention to the minor details of drapery injure the general effect, the folds should communicate easily, and be so cast as to have the appearance of accident, they must also be so contrived as to give the greatest effect to the figure Artifice is as much as possible to be avoided

Annibal Caracci considered twelve figures sufficient for any story, more than that, he thought, could only be employed to fill up space, or, as he expressed himself, they would be figures to be let.

Painting is divided into twelve branches, which their names sufficiently explain, viz history, which comprises mystory and allegory, grotesque, such as the celebrated Loggia at the Vatican, portrait fancy, animals, fruits and flowers, battle pieces, landscape sea views; still life, which comprises all inanimate objects, but is chiefly applied to household furniture and instruments and architecture

PAI'RING In Parliamentary language that practice by which two members of the House of Commons, of opposite political opinions agree to absent themselves from divisions of the house during a stated period See PARLIAMENT

PA'LACE (Lat palatium whose etymology is not precisely ascertained) In Architecture a word generally used to denote the residence of kings and princes On the Continent however, the term is used with a much more extended signification, and even in this country the residences of bishops, and of some noblemen are so called

PA'LACE COURT A court of justice erected by Charles I, and made a court of record with power to try personal actions between party and party within a liberty extending to the distance of twelve miles round Whitehall Various malpractices having crept into this court, it was found necessary to effect its abolition in 1849

PA'LADIN In the Romances of the Middle Ages a term derived from the Roman Palatinus (from palatium *a palace*) having its origin in the customs of the Byzantine court by which the officers of the palace (palatini comites palatii) were regarded as the highest dignitaries of the country, hence palasin or paladin in the early French romances for a lord or chieftain and the name was thence appropriated by the Italian romantic poets to the heroes of their legends the warriors of Charlemagne

PALÆOGRAPHY (Gr παλαιος *ancient* and γραφω *I write*) The science or art of deciphering ancient inscriptions, including the knowledge of the various characters used at different periods by the writers and sculptors of different nations and languages, their usual abbreviations initials &c The science termed diplomatics is in effect a branch of palæography (See DIPLOMATICS) Among many other modern authorities on this subject, the reader may be referred to Mr Ottley's remarkable paper in the *Archæologia* vol xxvi on an ancient MS of Aratus Champollion *Traité d'archéographie* the publications of the Ecole des Chartes under the directions of M Champollion at the Royal Library at Paris, Kopp, *Bilder und Schriften der Vorzeit* 1819 *Palæo-Critica* 1817 The most valuable compilation of palæographical knowledge is to be found in the *Traité de Diplomatique* of the Benedictines of St Maur 6 vols 4to 1748 See also *Maffei*, *Istoria Diplomatica* 1727, Trombelli *Arte di Conoscere l'Età de Codici* 1778 But as Mr Ottley truly observes nothing is more fallacious than the idea of being able to determine the ages of ancient inscriptions from the particular forms of their characters, and it is more folly upon such grounds to attempt to build any solid argument"

PALÆONTOLOGY (Gr παλαιος *ancient* λογος *a discourse*) The branch of zoological science which treats of fossil organic remains

PALÆOTHE'RIUM (Gr παλαιος and θηριον *beast*) The name of a genus of extinct Pachydermata It was characterised by having twenty eight complex molar teeth, four canines, and twelve incisors four in each jaw Cuvier concludes that the palæotheres like the tapirs had also a short fleshy proboscis Their remains characterize the gypsum quarries belonging to the eocene tertiary formations near Paris They have also been found in the corresponding strata of the Isle of Wight About twelve species of this extinct genus are already known

PALÆ'STRA (Gr παλαιστρα) Properly a wrestling place or school (παλαιειν *wrestling*) and hence the place where public games of strength were performed and, by metaphor such games themselves (*studium palestræ*, Horace) In Architecture, the palæstra was a part of the gymnasium (see *Pausan* vi 21 2, and 23 4), especially appropriated to the athletes The art of wrestling was termed palæstrice (παλαιστρικη).

PALANQUI'N A sort of chair or chaise used by the Chinese, and in most parts of the East, as a vehicle of conveyance from one place to another They are furnished with cushions and curtains, many of them are fitted up in the most costly style, and are usually borne by eight men, who relieve each other at intervals

PA'LATALS (Lat palatum, *the palate*) The letters *d*, *g*, soft and hard *j* *k* *l* *n* and *q* are so called, from the organ chiefly employed in their pronunciation

PA'LATE (Lat palatum) In Anatomy, the roof of the mouth That part which is formed by the lower portions of the superior maxillary and palatine bones is called the "hard palate," that which is due to the extension of membranous and muscular substance unsupported by bone is termed the "soft palate" In Zoology the modifications of the bony palate, and the "palatal ridges," and other inequalities of the soft parts are of use in the classification of the species of Mammalia

PALATE (Lat palatum) The base of the lower lip of a personate corolla

PALATINATE The name formerly given to two states of Germany, which were designated, by way of distinction, the Upper and Lower Palatinate and though not contiguous, were under the control of the same sovereign till 1620 At that period they underwent great changes which it would be out of place here to indicate, but since the wars of the first French revolution, which contributed more than any event on record to unsettle the ancient landmarks they have been divided among different German sovereigns and their very name has disappeared from the maps of Germany The word Palatinate is of feudal origin and signifies, in a more restricted sense the province or seigniory of a palatine, i e of a high dignitary during the middle ages who originally held office in the court of the sovereign and was designated the *comes palatii* but who afterwards obtained the privilege of exercising the same power, rank, and jurisdiction within his own province or district, as the comes palatii exercised in the palace

PALATINE COUNTY See COUNTY

PALATO PHARYNGEUS A muscle which arises at the root of the uvula and soft palate and is inserted into the upper and back part of the thyroid cartilage, it draws the uvula and soft palate downwards and backwards and pulls the thyroid cartilage and pharynx upwards

PALE (Lat palus *a stake*) In Heraldry the first and simplest kind of ordinary It is bounded by two vertical lines at equal distances from the sides of the escutcheon of which it encloses one third It seldom contains more than three charges The *pallet* when borne by itself is one half of the pale but sometimes as many as three pallets are borne together A coat bisected by a vertical line with different field on each side of it is said to be *party* (or divided) *per pale* The pale is a very ancient and honourable bearing

PALE WITHIN THE The expression well known in Irish history applied to that portion of Ireland to which for some centuries after its invasion by the English under Henry II in 1172 the dominion of the latter was confined The limits of the *pale* seldom extended beyond the modern province of Leinster and were frequently much less considerable (*Statistics of the British Empire* vol i p 429)

PALEA (Lat palea *chaff*) A name given to the bracts that are stationed upon the receptacle of Compositæ between the florets and having generally a membranous texture and no colour, also the interior bracts of the flowers of grasses

PALES The Italian goddess presiding over cattle, who was worshipped with great solemnity Her festivals, called *Palilia* were celebrated on the 21st of April the day upon which according to tradition the foundations of Rome were laid by Romulus — the dies natalis urbis Romæ — as a great rustic holiday On this day the shepherds purified their flocks by making them pass round a great fire made of laurel pine, and olive branches, sprinkled with sulphur An offering of wine, milk and millet was then placed on the altar of the goddess who was entreated to bless the earth and the flocks with fecundity and to avert injury from them both The term *palilia* is frequently written *parilia* in the ancient MSS, but no doubt can be entertained as to the correctness of the former

PALETTE (Fr) In Painting the light board held by a painter while at work, on which the colours are arranged in their various tints

PA'LFREY A word seldom used, except in novels and romances to signify a small or gentle horse such as is fit for a lady's use It is also used by the old poetical writers for a horse used by kings or nobles on state occasions

PALICI In Grecian Mythology twin divinities worshipped in Sicily and especially in the neighbourhood of Etna; sons according to some of Jupiter and Thalia the daughter of Vulcan, according to others of Vulcan and Ætna, daughter of Ocean Their heads appear on coins of Catania Their name is said to be derived from returning (παλιν *iterum*) out of the earth, under which

their mother had borne them (*Æschyl Ætna*, apud *Macrob Saturn*, v 19.) Their celebrated Sicilian temple is mentioned by Virgil: —

Pinguis ubi et placabilis ara Palici *Æn* ix 585

PALI'LLOGY, or PALILOGY. (Gr παλιν, *again*, and λεγω, *I speak*) In Rhetoric, the repetition of a word, or fragment of a sentence, for the sake of greater energy: also, epanalepsis and epizeuxis Thus Cicero (*pr Cæc* x 24 "Ferro hqui't, ferro, te rejeci," "The living the living shall praise thee" (Psalms) A peculiar species of palilogy also called *deuterologia*, or *anadiplosis*, is where the last word of a verse, or of a paragraph in prose, is repeated at the beginning of the next —

——— supervenit Ægle —
Ægle naiadum pulcherrima. *Virg Eclog* vi 20

——— the innocent sleep —
Sleep that knits up the ravell'd brow of care *Macbeth*

PA'LIMPSEST (Gr παλιν, *again*, and ψαω, *I rub or efface*) The name given to a sort of parchment from which whatever was written thereon might be erased so as to admit of its being written on anew The term means literally *twice-rubbed* (*membrana iterum abrasa charta deletilis*), not as the glossary of Ducange would seem to denote, because the parchment had twice undergone erasure, or the writing been twice obliterated but because it had been twice prepared for writing which was principally effected by rubbing it with pumice, first in the course of manufacture after the skin had been cured, and again by the same process after the original writing had been taken away by washing or in any other manner The strict and precise sense of *palimpsest* is therefore "twice prepared for writing" the repetition of such preparation being the prevailing idea in the etymology and not erasure, as some have erroneously supposed The great antiquity of the practice of making palimpsests may be gathered from an extract from a letter from Cicero to Trebatius — Ut ad epistolas tuas redeam cætera belle, &c nam quod in palimpsesto laudo equidem parsimoniam, sed miror quid in illa chartula fuerit quod delere malueris quam hæc non scribere nisi forte tuas formulas Non enim puto te meas epistolas delere ut reponas tuas An hoc significas nihil hiemis? Frigebat? Ne chartam quidem tibi suppeditare (*Cic ad Fam* l 7 c 18) But while there can be no doubt as to the antiquity of this practice, the attention of the learned was first directed to the subject in modern times by Montfaucon in a curious essay entitled *Dissertation sur la Plante appellée Papyrus* &c which appeared in the *Mem de l Acad Fran* vol vi and in which the origin of the Palimpsest MSS is briefly and plainly described in the following words —

"Cela (le papier bombycin) vint fort a propos dans un temps ou il paroit qu'il y avoit grande disette de parchemin ce qui nous a fait perdre plusieurs anciens auteurs voicy comment Depuis le 12e siècle les Grecs plongez dans l'ignorance s'aviserent de racler les ecritures des anciens MSS en parchemin et d'en oter autant qu'ils pouroient, toutes les traces, pour y ecrire des livres d'Eglise ce fut ainsi qu'un grand prejudice de la republique des lettres les Polybes les Dions les Diodores de Sicile, et d'autres auteurs que nous n'avons plus furent metamorphosez en Homelies en Pentecostaires en Homelies et en d'autres livres d'Eglise Après une exacte recherche, je puis assurer que des livres ecrits sur du parchemin depuis le 12e siècle j'en ay plus trouvé dont on avoit racle l'ancienne ecriture que d'autres Mais comme tous les copistes n'estoient pas également habiles à effacer ainsi ces premiers auteurs il s'en trouve quelques-uns où l'on peut lire au moins une partie de ce qu'on avoit voulu raturer

We have already seen that the practice of which Montfaucon speaks had a much more ancient date than that which he assigned to it, although it was in all probability most frequent during the middle ages when, in consequence of the scarcity and expense of parchment, and the growing demand for the writings of the fathers and of books of devotion the monks were induced to efface the writings of the ancient authors to make room for their own Our limits preclude us from entering at length into the means adopted by the monks of effacing the original writing, or of that still more interesting process by which in recent times the original writing has been again brought to light and which has thus put us in possession of some most valuable works and fragments of the classic authors which had been given up as lost. On these points we beg to refer the reader to an able article in the *Edin Rev* vol xlviii, in which all that has been done in the restoration of ancient MSS is set forth with great clearness and brevity; and shall content ourselves with observing, that the most important of these discoveries are the treatise of Cicero, *De Republica*, which was found in the Vatican library at Rome, in a MS which had been rewritten, with a Commentary of St. Augustin on the Psalms; and the *Institutions of Gaius*, found also in the same place. For the restitution of the former the learned world is indebted to Angelo Mai, the principal librarian of the Vatican library at Rome, who may [illegible] palimpsests, and for the [illegible] Goeschen who were sent to Rome for the purpose of examining MSS by the Royal Academy of Sciences at Berlin

PALI'NDROMUS (Gr. παλιν, and δρομος, *a course*) A verse or line which was the same when read backwards or forwards The well-known verse which has been put into the mouth of the devil may serve for an example: —

Signa te, signa, temere me tangis et angis.

PALINGENE'SIA (Gr παλιν, and γενεσις, *birth*) In Philosophy, a new or second birth—regeneration The doctrine of the destruction and reproduction of worlds and living beings is oriental, but the word in question appears to be of Stoical origin (*Diog Laert* vii 72) The Stoics are said to have held that the demiurgus or creator had absorbed all forms in himself and reproduced [illegible] In the language of the New Testament it [illegible] (Titus iii 5)

PA'LINODE (Gr παλιν *again* and ᾠδη *song*) In Poetry a recantation properly a piece in which the poet retracts the invectives contained in a former satire (See *Mem de l Acad des Inscr* vol xii)

PALINU'RUS The steersman of the vessel of Æneas, drowned according to Virgil off the coast of Italy (Æn v) and afterwards met with by the Trojan hero in the shades A promontory on the coast received his name

PA'LISADES or PALISADOS In Fortification, stakes driven into the ground, and sharpened at the top, for the purpose of defence against the surprise of an enemy They are usually 9 or 10 feet long and planted so as to make an angle inclining outwards from the work

PA'LLA In Latin, the long outer garment appropriate to Roman females of respectable rank A part of it was thrown over the left shoulder, and hung down from the arm It is particularly described by Apuleius (*Met* xi) The palla was not worn by men except some effeminate persons, although the long robes of barbarians are sometimes called by its name by Latin writers There seems to have been a shorter palla. (*Martial* i 93)

PALLA'DIUM (Gr Παλλαδιον) A wooden statue of Minerva or Pallas which was said to have fallen from the skies as a sign to Ilus the founder of Troy, to convince him he was under the guidance of Jupiter On its preservation depended the safety of Troy, and, accordingly Ulysses and Diomed were commissioned to steal it and performed the enterprise According to other accounts the palladium was conveyed from Troy to Italy by Æneas, and was afterwards preserved with great care in the temple of Vesta at Rome The word palladium passed into European languages in which it signifies that particular law or privilege which is regarded as the safeguard of the people's liberties The trial by jury, and the freedom of the press are each called the *palladium* of the British constitution

PALLADIUM A metal discovered in 1803 by Wollaston, associated with the ore of *platinum* It resembles platinum in colour and lustre and it is ductile and malleable but very hard Its specific gravity is 11 8 Its fusibility is intermediate between gold and platinum, it is oxidized and dissolved by nitric acid its oxide forms real salts

PALLAS or more properly PALLAS ATHE'NE In Mythology the Grecian goddess of wisdom identified at a later period with the Roman Minerva, to whom were assigned all the attributes of her Grecian sister The term is probably derived from the Gr παλλω, *to brandish a spear* See MINERVA

PALLAS One of the four small planets which revolve between the orbits of Mars and Jupiter discovered by Dr Olbers of Bremen, on the 28th of March 1802 Its symbol is a lance ⚳ On account of the minuteness of this planet, and the nebulous appearance by which it is surrounded it is extremely difficult to arrive at any certain conclusion respecting its real magnitude Sir W Herschel estimated its diameter at eighty miles, and Schroeter at 2888 miles or nearly the size of Mercury, but astronomers prefer the former measure The light of the planet [illegible] the cause of which is [illegible] The following are the elements of the orbit [illegible] in the Berlin *Astronomisches Jahrbuch* for 1831 —

Semi axis major = 2 77263
Eccentricity = 0 24199
Period of revolution = 1686 25 days
Inclination = 34° 35′ 49″ 1
Longitude of ascending node = 172° 38′ 22″·8
Longitude of perihelion = 121° 5′ 0″ 5

The motion of the planet in its orbit is greatly disturbed by the powerful attraction of Jupiter See PLANET

PALLETS in Clock and Watch-work, are the pieces connected with the pendulum or balance which receive

the immediate impulse of the swing-wheel, or balance-wheel They are of various forms and constructions,

ata (Lat pallium *a mantle*, and branchia, *gills*) The name of an order of Acephalous Molluska including those in which the gills are situated on the internal surface of the lobes of the mantle

PA'LLIUM (Lat *a cloak*) A vestment which, by ancient usage, is sent from Rome to all archbishops of the Roman Catholic church and to the four Latin patriarchs of the East on their accession The history of this usage, and the gradual submission of the Western patriarchate to it authority Rheinwald, in the new *Encyclopædia* of Ersch and Gruber, art "Pallium" It is now a short white cloak, with a and falling period of the greatest power of the Roman see (introduced by Gregory VII himself) for the archbishops to come to Rome for the purpose of receiving it it is now delivered as a mandatory, or merely by a delegate from Rome Some simple bishops receive the pallium as a mark of honour The cloth of which the pallium is made is woven from the wool of ten white lambs, blessed at Rome on the festival of St Agnes, and deposited on the tomb of St Peter during the eve of his festival

PALM (Lat palma, *the hand*) An ancient measure of length taken from the extent of the hand There were two different palms, one corresponding to the length of the hand and the other to the breadth The Roman palm was about 8¼ English inches The English palm is understood to be 3 inches

PALMA'RES (Lat palma *the hand*) Muscles belonging to the hand The *palmaris brevis* is situate between the wrist and little finger and assists in contracting the palm of the hand, the *palmaris longus* is situate on the forearm and bends the hand

PA'LMER. In Ecclesiastical History a name popularly given to crusaders returned from the holy war or pilgrims from Palestine from the branch of palm tree which they were wont to carry with them as a staff in commemoration of their journey

PA'LMIPEDS *Palmipedes* (Lat palma *a palm* and pes *a foot*) The name given by Cuvier and Temminck to an order of birds corresponding to the *Anseres* of Linnæus, and the *Natatores*, or swimming birds, of Illiger

PA'LMISTRY (Lat palma *the hand*) A species of divination which foretold future events from the inspection of the lines and marks on the hands and fingers *See* CHIROMANCY

PALM OIL An article imported from the west coast of Africa it is solid and of a reddish yellow colour It is used in the manufacture of soap candles have been made of its stearine and it is sometimes burned in lamps and made into ointments It is chiefly the produce of the *Elæus Guineensis*

PALM, ORDER OF THE FRUITFUL A society formed in 1617 in Germany and connected by a species of chivalrous institution, for the preservation and culture of the German language Lewis prince of Anhalt was the first head of the order This body is said to have done much for the German language but to have ended by attempting too much in the way of refinement and innovation It was dissolved in 1680 (*Ersch and Gruber's Encyclopædia*)

PALMS, called by Linnæus from their noble and stately appearance, the princes of the vegetable kingdom are a natural order of Arborescent Endogens chiefly inhabiting the tropics distinguished by their fleshy colour six parted flowers enclosed within spathes their minute embryo lying in the midst of albumen and remote from the hilum, and regularly pinnated or pinnatisect articulated leaves, sometimes called fronds Wine oil flax flour sugar, and salt says Humboldt are the produce of this tribe, to which Von Martius adds three utensils weapons, food, and habitations The most common species is the cocoa-nut Their wounded stems, or spathes yield in abundance a saccharine fluid known in India by the name of toddy The succulent rind of the date is a most nutritious as well as agreeable fruit Sago is yielded by the interior of the trunks of nearly all except *Areca catechu*, the well-known *pinang* or betel nut the fruit of the latter species is remarkable for its narcotic or intoxicating power The common canes or rattans of the shops are the flexible stems of species of the genus *Calamus*

PALM SUNDAY (Dominica Palmarum Pascha Floridum) the Sunday before Easter is the day of celebration of the triumphal entry of Christ into Jerusalem But the custom of carrying palm branches on particular days of festivity (*Baiophoria*) was an older Jewish observance The feast of Palm Sunday appears to have been observed all along in the Eastern church, but is said to have been revived in the West by Gregory the Great The earliest known Latin homily for the day is by the Venerable Bede

PALP. (Lat. palpus, *a feeler*) A jointed sensiferous organ, attached in pairs to the *labium* and *maxilla* of insects, and termed respectively "labial" and "maxillary" palpi, or feelers

PALPA'TORS *Palpatores* The name of a family of Clavicorn beetles, including those which have very long maxillary feelers, or palps

PALSY *See* PARALYSIS

PALU'DAMENTUM The peculiar military dress of a Roman general (imperator), in the times of the republic (*Apud Apologia*), afterwards adopted by the emperors It was worn only in the campaign, and exchanged for the toga in Rome Vitellius, according to Tacitus, was advised not to enter the city in it, as it would be making it look like a city taken by storm (*Hist* ii 89 See *Mem de l'Acad des Inscr* vol xxi)

PALUDI'NA (Lat palus, *a marsh*) A genus of fresh water or marsh snails, so called from their location in marshes, ditches and slow streams Many species are common in Great Britain a beautiful example, called the agate marsh shell (*Paludina achatina*, Lam), may be found in the smaller tributaries of the Thames

PAMPAS The name given to one of the great systems of South American plains, which can scarcely with propriety be called *deserts* inasmuch as they are covered with luxuriant herbage and inhabited by vast herds of wild cattle and droves of horses The region of the Pampas forms the basins of the Paraguay and La Plata, and includes the vast plains of Buenos Ayres extending from the foot of the eastern ridge of the Andes to the sea like Plata, and ward into the deserts of Pa (*Humboldt's Geography*)

PAMPHLET A word for which various etymologies have been suggested as for instance pagina filata *a* leaves stitched together with a thread, while others consider it to be derived simply from pamphlet or paper *papyr* It signifies a short treatise or essay generally speaking on some subjects of temporary interest which excites public attention at the time of its appearance We commonly understand by the word pamphlet a production of the above character when it comes from the publishers merely stitched together in sheets and not bound The word is of considerable antiquity being used by Chaucer Pamphlets became of common use in political and religious controversy about the middle of the 16th century in England under the reign of Elizabeth in France during the wars of religion

PAMPRE (Fr from Lat pampinus *a cluster*) In Sculpture, ornaments consisting of vine leaves and grapes

PAN (Gr Πάν) The chief rural divinity of the Greeks who presided over flocks and herds He was said by some to be the son of Mercury, and his birthplace was Arcadia to which province his worship seems to have been confined in early times The introduction of his worship into the other Grecian states is thus accounted for When Philippides, an Athenian courier, was traversing Mount Parthenius above Tegea a short time before the battle of Marathon he was encountered by Pan who commanded him to ask the Athenians why they paid no respect to a divinity who had ever been friendly to them and was still ready to promote their welfare and in consequence of this remonstrance the Athenians after the defeat of the Persians dedicated a temple to this divinity beneath the Acropolis, and propitiated his favour by annual sacrifices and torch races He was represented with the head and breast of an elderly man while his lower parts were like the hind quarters of a goat whose horns he likewise bore on his forehead His emblems were the shepherd's crook and pipe of seven reeds his own invention The name Pan is derived probably from the Gr πάειν *to feed flocks* which, as being the most general mode of life in primitive times, has led to the belief that this god was a symbol of Universal Nature, an idea to which Milton alludes in the beautiful lines, —

> —— while Universal Pan,
> Knit with the Graces and the Hours in dance,
> Led on the eternal spring

PANACE'A (Gr πᾶν, *all* and ἀκέομαι, *I cure*), signifies a remedy which professes the power of curing all sorts of diseases The word is said to be derived from Panacea, a daughter of Esculapius the goddess of health, to whom in conjunction with her better known sister, Hygeia the power of healing all diseases was ascribed.

PANATHENÆA (Gr Παναθήναια, from πᾶν, *all*, and Ἀθηναῖος, *Athenian*) The great national festival of the inhabitants of Attica, celebrated in honour of Minerva There were two solemnities of this name, the great and little The former were celebrated once in every five years the latter in every third year or as some think every year The exhibitions at these festivals were torch races, gymnastic, and musical, and poetical contests, with sacrifices and feasts, and, at the great

Panathenæa, the sacred stole (πέπλος), decorated by the hands of chosen virgins with embroideries representing the deeds of heroes and gods, was hung upon the mast of a machine in the form of a ship, and conveyed, to the Acropolis in a procession, and placed on the statue of Minerva

PANCARTES or PANCHARTÆ. In Diplomatics, royal charters, in which the enjoyment of all his possessions (enumerated in the instrument) is confirmed to a subject The word, however, is used in other and looser significations

PANCRATIUM (Gr πᾶν, *all*, and κρατεῖν, *to subdue*) A kind of athletic exercise practised by the Greeks, which combined wrestling and boxing together

PANCREAS (Gr πᾶν, and κρέας, *flesh*, from its fleshy consistence) A glandular viscus of the abdomen, situated under and behind the stomach, its duct enters the duodenum, into which it conveys a fluid very like the saliva Its use appears to dilute the bile and render it more miscible with the food It is commonly called the *sweetbread* in animals

PANDÆMONIUM (Gr πᾶν and δαίμων *a demon*) The general appellation bestowed by Milton on

> —— the high capital
> Of Satan and his peers *Par Lost*, i 81

PANDANACEÆ (Pandanus one of the genera) A natural order of Arborescent Endogens inhabiting the Indian Archipelago, and most of the tropical islands of the old world They have the aspect of gigantic pine-apples, bearing the flowers of a sparganium and are remarkable among arborescent Monocotyledons for their constant tendency to branch which is always effected in a dichotomous manner and also for their leaves being arranged so distinctly in a spiral manner that they have acquired the common name of *screw pines* The seeds of *Pandanus* are eatable

PANDECTS or DIGESTS (Gr πανδέκτης from πᾶν *every thing* and δέχομαι *I receive*) The great compilation of the Roman law published by the Emperor Justinian See Digest

PANDORA (Gr πᾶν and δῶρον *a gift*) Literally *the all gifted* In Grecian Mythology, the name given to the first mortal female who ever lived She was formed of clay by Vulcan at the request of Jupiter and was created for the purpose of punishing Prometheus (*see* Prometheus) for his numerous impieties All the gods vied in making her presents thus, from Venus she received beauty from the Graces the power of captivating Mercury taught her eloquence and Minerva wisdom, but Jupiter gave her a box filled with innumerable evils which she was desired to give to the man who married her She was then conducted to Prometheus, who sensible of the deceit would not accept of the present, but his brother Epimetheus not gifted with the same prudence, fell a victim to Pandora's charms accepted the box, from which on its being opened there issued all the ills and diseases which have since continued to afflict the human race Hope alone remained at the bottom of the box, as the only consolation of the troubles of mankind

PANDOURS A kind of light infantry formerly organized as separate corps in the Austrian service, raised from the Servian and Rascian inhabitants of the Turkish frontier, and originally under leaders of their own styled Harumbachas Since 1750 they have been included in the regular army

PANDURIFORM Literally *fiddle shaped*, applied by botanists to the leaves of some plants

PANEGYRIC (Gr λόγος πανηγυρικὸς *a speech addressed to a general assembly* and πανήγυρις *panegyris*) In Oratory, an eulogy or harangue, written or spoken in praise of an individual or body of men Among the ancients, orations were recited in praise of the departed on various occasions, before solemn assemblies hence the name Among the later Romans the baser practice prevailed of reciting panegyrical orations on distinguished living persons in their presence Among the moderns panegyrical oratory has been chiefly confined to funeral discourses from the pulpit In France however the eloges or orations pronounced in some literary and scientific societies on the decease of a member bear something of the character of classical panegyrics

PANEL In Law, said by Sir H Spelman to mean "schedula," or "pagina," as a *panel* of parchment, &c It commonly designates the roll containing the names of jurors whom the sheriff returns to pass on a trial In Scottish law, the accused person in a criminal action from the time of his appearance is styled the "pannel"

PANIC (Lat Pan), is usually applied to a sudden and groundless alarm The word originated in the stratagem which Pan had recourse to during the Indian expedition of Bacchus, on being surrounded by a numerous army; viz ordering his men suddenly to raise a simultaneous shout, which, favoured by the echoes of a rocky valley, had the appearance of so augmenting their numbers that the enemy were inspired by terror, and instantly took to flight

PANICLE A form of inflorescence in which the primary axis develops secondary axes, which themselves produce tertiary, or, in other words, a raceme bearing branches of flowers

PANNEL, or PANEL (Fr panneau) In Architecture, an area sunk from the general face of the surrounding work In Joinery, it is a tympanum, or thin piece of wood, framed or received in a groove by two mounters or upright pieces, and two traverses or cross pieces

PANOPLY (Gr πᾶν, and ὅπλον, *armour*) Literally all the armour that can be worn for defence, complete armour

PANOPTICON (Gr πᾶν, and ὀπτικὸς, *I see*) A term coined by Jeremy Bentham to denote the plan of the prison which he designed and recommended for adoption in his *Theory of Punishments* This building was distinguished by [illegible] an account of which the reader will find in the *Edin Review*, pp 19 20 but its greatest peculiarity consisted in its form, and in the disposition of its cells, which were so constructed that the inspector could see each prisoner at all times without himself being seen, and hence the origin of the term

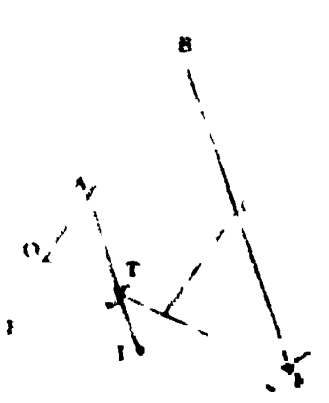
PANORAMA (Gr πᾶν, *all*, and ὅραμα *I see*) A picture in which all the objects of nature that are visible from a single point are represented on the interior surface of a round or cylindrical wall the point of view being in the axis of the cylinder The rules according to which the [illegible] called perspective are easily [illegible] The lines on the panorama are the intersections of the cylindrical surface of the picture with one or more conical surfaces having their summits at the point of view and of which the bases are the lines of nature which the artist proposes to represent In executing this kind of perspective the artist divides the horizon into a considerable number of parts, twenty, for example and draws in the ordinary way, on a plane surface a perspective view of all the objects comprised in each of these portions of the horizon He then paints on a canvass representing the development of the cylindrical surface the twenty drawings, in as many vertical and parallel stripes and the picture is completed by stretching the canvass on the cylindrical wall of the rotunda which is to contain the panorama When a painting of this kind is well executed, its truth is such as to produce a complete illusion No other method of representing objects is so well calculated to give an exact idea of the general aspect and appearance of a country as seen all round from a given point

The first panorama exhibited in London was painted by Barker in 1793 it represented the objects about Portsmouth and the Isle of Wight A panorama of London was the first that was introduced into Germany, in 1800 Since that time they have become common in all the principal cities of Europe

PANSTEREORAMA (Gr πᾶν, στερεὸς, *solid*, and ὅραμα, *I see*) In Bilievo a model of a town or country in cork wood pasteboard or other substances

PANSY (Fr pensée, *a thought*) A term applied chiefly to the garden varieties of *Viola tricolor*, and others which are usually cultivated under the name of *heart's ease* See Viola

PANTAGRAPH (Gr πᾶν, and γράφω, *I write*) Frequently but improperly written *Pentagraph* An instrufor copying reducing or enlarging plans It consists of a jointed rhombus, A B C D made of wood or brass, and having the two sides B A and B C extended to double their length The side A D and [illegible] are adjusted from A [illegible] that if O a [illegible] corresponding distances A O is to B O in the same ratio as A T to B E or B F Small sliding boxes for holding a pencil or tracing point are brought to the corresponding graduations, and fixed in their positions by screws and a third is fixed at the point F Now, since in




every position of the instrument the two sides A D and B F are parallel and the points O and T are so taken that O A A T O B B F the three points O T, and F must necessarily range in a straight line, consequently, if any one of these three points be taken as the centre of motion, and another of them be carried along the boundaries of any figure, the third will trace out a similar figure, reduced or enlarged according as it is nearer to or farther from the centre of motion than the point which is carried along the figure to be copied Suppose the point O to be made the centre of motion the tracer to be fixed at F and the crayon or drawing point at T, the division of A D corresponding to O, then, while F is carried along

any figure, T will describe a similar figure reduced in the proportion of O T to O F, or of O A to O B But if the tracer be fixed at T, and the drawing point at I, the copy will be enlarged in the proportion of O B to O A, or if the fulcrum be placed at I the tracer at O, and the crayon at I the figure delineated will be enlarged in the proportion of O I to I I If the points O and I be brought to coincide with F and D, and the fulcrum be placed at D then the distance I D and D I being equal, the original figure will be transferred into a copy of exactly the same dimensions The pantagraph was invented by the Jesuit Christopher Scheiner in 1603, and is described by him in a tract entitled *Pantographice seu Ars Delineandi &c* published at R
A more perfect instrument for accomplishing the same objects has recently been invented by Professor Wallace of Edinburgh who has given it the name of *Eidograph* for a description of which see the *Transactions of the Royal Society of Edinburgh* vol xiii , or *Wallace's Geometrical Theorems and Analytical Formulæ*, 1839 Both instruments may be so modified as to produce a reversed representation of the figure to be copied, an application which is useful for the purposes of copper-plate [illegible] lithography

PAN'TALOON One of the chief characters in all pantomimic representations He was originally dressed in a manner similar to that from which a well-known article of modern dress has derived its name His name is said by antiquarians to be derived from the Italian words "Pianta-leone," as it were the "lion planter," in allusion to the boastful language of the Venetians (See *Lord Byron's Childe Harold* canto iv ) The pantaloon of the original Italian pantomime was a Venetian burgher

PAN'TECHNICON (Gr *πας*, and *τεχνη art*) signifies a place in which, as the term imports every species of workmanship is collected and exposed for sale The large building near Belgrave Square is an excellent specimen of this species of work

PAN'THEISM (Gr *Πας*, and *Θεος God* ) In Metaphysical Theology the theory which identifies nature or the *το παν*, the universe in its totality with God This doctrine differs from atheism in the greater distinctness with which it asserts the unity and essential vitality of nature, parts of which all animated beings are The most ancient Greek philosophers were pantheists in this sense, Anaxagoras being the first who distinctly stated the coexistence with nature of a reasonable creator — 'a mind, the principle of all things' In this sense too, Spinoza may be called a pantheist The pantheism of Schelling, and many modern German philosophers, is of a different stamp According to these thinkers God is conceived as the absolute and original Being revealing himself variously in outward nature, and in human intelligence and freedom It is not easy to see how pantheism in this sense differs from the Christian view of God, as expressed in the sublime language of St Paul "In whom we live, and move, and have our being' The world is, indeed, conceived to be animated by the presence and agency of the Deity, but his distinctness and independent subsistence are definitely laid down as the condition and ground of all phenomenal existence and of reason itself God may exist without the world, but the world is inconceivable without God (See this article in *Ersch and Gruber's Encyclopædia* ) It must, however, be remarked, that many pseudo-philosophers of modern times assume the name of Pantheists as a convenient medium for the dissemination of *atheistical* opinions which they have not the courage boldly to avow

PAN'THEISTIC (Gr *Πας*, and *Θεος, God* ) In Sculpture a term applied to statues and figures which bear the symbols of several deities together, the meaning of which has been a subject of much dispute among antiquaries

PANTHE'ON (Gr *πάνθειον*, from *πας, all*, and *θεος, a god* ) A temple dedicated to all the gods Two magnificent structures of [illegible] Athens, the other at Rome In [illegible] though comparatively [illegible] remains of the ancients The foundation of this building is generally ascribed to Agrippa, the son-in-law of Augustus It now forms a Christian church, dedicated to the Virgin Mary and All Saints, and generally called the Rotunda The form is circular, and its roof a hemispherical dome 144 feet diameter, its height being the same from the pavement to the top of the dome It has a noble Corinthian portico, consisting of sixteen granite columns of the Corinthian order, of which eight stand in front Pliny ranked this edifice as one of the wonders of the world Since its erection it has been grievously spoiled of its ornaments The term pantheon has been applied to places of public exhibition in which every variety of amusement is found It is also used for a work containing a view of the mythology or all the gods of the ancients (as the term imports), as in *Tooke's Pantheon*

PANTOCHRONO'METER (Gr *πας, χρονος, time,* and *μετρον, a measure* ) A term recently invented and applied to an instrument which is a [illegible] of the compass, the sun dial, and the universal [illegible], and performs [illegible] all three

PAN'LEXIS (Gr *πας* and *λεγω* ) A work of universal instruction or science, equivalent to *dictionary* or *encyclopædia*, which see

PAN'TOMIME (Gr *πας*, and *μιμεω, I imitate* ) A species of theatrical entertainment, in which according to the derivation of the word, the whole action of the piece should be represented by gesticulation, without the use of words also a theatrical performer skilled in mimicry The English pantomime is an amusement peculiar to our theatre A class of actors in vogue at Rome, who performed pieces in dumb show, expressing every thing by their dancing and gestures, were also called pantomimes, and were in all probability the archetypes of this species of amusement among ourselves (See the *Conversations-Lexicon*, and as to ancient pantomimes, *Mem de l'Ac des Inscr* vol xxiii ) *See* MIMES

PA'PACY The office of pope, or historically, the succession of popes in the see of Rome The origin of the term is oriental The word papas was used in lower Greek with the signification of father, and is still applied by the Greek church to the priests of that communion In the Western church the title was not uncommonly given to bishops in general, and was not confined to the Roman pontiff for several centuries In this article it will be our endeavour to trace, with the conciseness which our limits demand the steps by which the bishops of Rome attained to the vast religious and political importance which they once possessed, and of which they still retain the shadow

1 It is generally agreed that a certain degree of deference was paid to the church of Rome by the Christian societies dispersed throughout the empire in the primitive age As St Peter appears to have held a certain prominency among the apostles, so was his see looked up to, and its advice occasionally resorted to by the other metropolitan churches which, though its equal in rank, might allow to it some moral superiority But as the other apostles did not hesitate to rebuke St Peter when his conduct appeared to their judgment to deserve it nor to take the lead and initiative when he paused in the career which the Holy Spirit pointed out so we find Irenæus of Lyons interfering to [illegible] of Victor of Rome, and Cyprian [illegible] of heretical baptism, in concert with the Asiatic church, and in opposition to the Roman

2 It is in the fourth century that the first dawn of substantial power appears in the Roman see Upon the recognition of Christianity by the civil government, the bishop of Rome is found in the enjoyment of precedence among the prelates of the empire The patriarch of Constantinople is expressly exalted by Theodosius (A D. 381) to the *second* rank The canons of the council of Sardis 347 (the genuineness, however, of which is suspected) allow bishops in certain cases an *appeal* to the Roman pontiff Even the removal of the seat of government to Constantinople, although the very fact of its residence at Rome had undoubtedly contributed to the pre-eminence of its bishop in earlier times, seems to have favoured the pretensions which the popes began now openly to maintain Rome was no longer under the immediate eye of the emperor The patriarch of Constantinople although he enjoyed the imperial favour up to a certain point, was not allowed to outstep it, and was subject to be deposed if he forgot for a moment the relative position in which he stood The emperors of the West on the other hand took up their abode at Milan, or Ravenna, and when they had been overturned and the barbarians began to found new dynasties upon the ruins of the Italian provinces, the popes were among their most useful instruments in civilizing and consolidating the fragments of their power

Again, the nearer contact which thus took place between the Italian clergy and the children of the pagans of the north afforded the popes an opportunity of diffusing the idea of their own supremacy at the same time that they extended the limits of Christianity and while Antioch and Alexandria were trembling before the birth of Mahometanism, and Constantinople was losing one by one its fairest provinces and strongest partizans, the dominion of the Western primacy was acquiring daily a wider basis and a more devoted people

3 With Gregory I, at the end of the sixth century, commenced one of the most important epochs in the papal history The system of aggrandizement, of which he laid the foundations, consisted in the conversion of the heathen, upon the principle above mentioned, and the connection of the monastic orders with the Roman see, by releasing them from the immediate jurisdiction of their own diocesans

4 The next important step in our history is the famous donation of Pepin, by which the Italian provinces which the French king had conquered from the Lombards were transferred by him, not to his own dominions, nor

to the Greek emperor, who had the ancient hereditary claim, but in temporal sovereignty to the pope But even this political power thus acquired was not in itself pregnant with such important consequences as the principle which was sanctioned by the immediate occasion of the donation, for Pepin had taken counsel with Pope Zachary whether he should be justified in overturning the throne whose servant he was, and had so to do However, the possessions into the hands of the Roman bishops, confirmed and enlarged by the addition of the territory of Rome itself by Charlemagne at the close of the eighth century have continued up to this day, with little extension or diminution, to form the temporal patrimony of St Peter It is to be observed, that the nature and extent of the power accorded to the popes by Charlemagne has given rise to much dispute, and the partizans of the Roman see have been charged with The most "seems to be this, that the Roman pontiff possessed the city of Rome and its territory by the same right that he held the exarchate of Ravenna and the other lands which he received from Charlemagne, that is to say that he possessed Rome as a feudal tenure though charged with less marks of dependence than other fiefs generally are, on account of the lustre and dignity of the city which had so long been the capital of the empire" (*Cent VIII* pt 2 cap 2 note)

5 The dissensions which took place among the successors of Charlemagne in the 9th century afforded a tempting opportunity for political encroachment on the part of the Roman bishops In 879, Charles the Bald was proclaimed emperor by Pope John VIII and his immediate successors received their nomination also from the same source It was in the same century that the forgery of the decretal epistles gave a colour and authority to many temporal claims of the Roman see

6 It was not however, till the pontificate of Gregory VII (1073—1086) that the principle of temporal aggrandizement which we have been tracing received a systematic development The grand project which that prelate entertained was to reduce the whole territory of Christendom to a feudal subjection to the holy see He assumed the right of appointment to all the crowns of Europe, and with such success that when his principal opponent Henry IV of Germany, had succeeded in dispossessing him of his pontifical chair, and placing therein the antipope Clement III the victorious monarch continued to recognize, in the creature whom he had thus installed in the papal prerogatives the very same authority which Gregory had claimed over him and received from his hands his own imperial crown A main feature in this political scheme was the reduction of the whole body of the clergy into immediate dependants upon the papal throne In order to effect this the law of celibacy was strictly enforced, the elections of bishops by their diocesan clergy discouraged and almost abolished and their investiture by their national sovereigns in itself a monarchical usurpation became the great subject of contention between the pope and the emperor in which though the former was finally unsuccessful yet principles were advanced during its progress and claims bequeathed to posterity, which smoothed the way for the more fortunate aggressions of later pontiffs and exalted the power of the papacy to its greatest height under Innocent III at the beginning of the 13th century

7 The power of excommunication had long been exercised and wantonly abused before the time of Gregory, the interdict by which a whole state was laid under a spiritual ban, was not adopted till about that period This weapon was unsparingly wielded by Innocent III, and the degradation to which John of England was subjected by him through these means is one of the strongest instances of the extent to which the papal power was advanced But Innocent though his clergy were better disciplined subjects in this pretensions invested with the superior efficacy of prescription had new and greater difficulties to contend with than his famous predecessors At this time the tide of human opinion was already on the turn Numerous sects arose and prepared to undermine the influence of the ancient see The laity were more conscious of the yoke which had been imposed upon them, and more anxious to avail themselves of an opportunity to cast it off the clergy also, the main stay of the papal cause, were beginning to excite general murmurs by their corruption of manners It is between Gregory and Innocent, therefore, that the period of the substantial greatness of the Roman see must be placed by the historian who contemplates both eras from a distance, and observes the seeds of decay which began to manifest themselves in the latter The violence, however, and assumption which we have traced to this time, continued to grow under the successors of Innocent, who appear to have been ignorant of the reformation itself, that the foundations of their authority were slipping rapidly from under them But the same causes which we have enumerated as counteracting the apparent glory of Innocent's pontificate continued to work steadily against his successors, and at length when Luther arose to consolidate the force resulting from the three the papacy though relaxing nothing from its extravagant pretensions found itself suddenly shorn of one third of its subjects at once and deprived of a great proportion of its influence over the rest From that time to the present the power of the papacy has continued to retrograde, even in spiritual matters It has been forced to concede a certain degree of independence to the clergy of France, and to [illegible] concordats with Napoleon and some other Catholic princes It has even encouraged [illegible] schemes of its earlier [illegible] assert the interference of the church between the prince and the subject to be tyrannical and unchristian Its spiritual influence however though harassed on all sides by the free and discursive opinions of the day, continues still, from its combined [illegible] to be the most remarkable feature [illegible] in the recent political events of Europe has been very great, while the number of its subjects is probably at this moment much greater than at the times of Gregory or Innocent

PAPA'VERA'CEÆ (Papaver, one of the genera) A natural order of narcotic plants belonging to the Polypetalous division of the Exogenous class, and nearly related to *Ranunculaceæ* with which it corresponds in habit and the structure of the seeds but differs in having parietal placentæ and a calyx of only two pieces The common poppy the horned [illegible] and some other genera, are well-known [illegible] for the sake of their flowers or destroyed as showy but troublesome weeds Opium is the inspissated juice of *Papaver somniferum*

PA'PER (Gr *παπυρος*, Fr *papier*) A thin and flexible substance of various colours but most commonly white used for writing and printing on, and for various other purposes It is manufactured of vegetable matter, reduced to a pulp by means of water and grinding, and is made up into *sheets*, quires, and reams, each quire consisting of twenty four sheets, and each ream of twenty quires

For the chief purposes to which paper is applied in modern times the ancients had recourse to a variety of materials, stone, tablets of wood plates of lead, skins, parchment linen layers of wax tablets of ivory and, above all the papyrus The ability to write created a necessity for some material on which to inscribe, and all these various materials were resorted to in succession, as the ineligibility of each induced a fresh endeavour to discover some more desirable substitute

As our present object is to trace the progress of paper, rather than to enter into a minute account of those materials which were employed antecedent to its manufacture it will not be necessary to dwell upon the other substances, which are as diversified as human ingenuity could devise, but pass on to the papyrus the immediate precursor of paper, and the nation from which it was first manufactured Egypt has the honour of the invention, and Isidore even fixes the locality at Memphis the date remains in some obscurity although it has been warmly disputed Varro, the Roman ascribes it to the time of Alexander the Great after the founding of Alexandria, but we find in Pliny the recital of a passage, extracted from the writings of Cassius Hemina, an ancient annalist, in which he speaks of some books found in the tomb of Numa when it was opened, 535 years after his decease and asserts that these books were of *paper* and had been interred with him As Numa preceded Alexander 300 years, this circumstance if admitted would carry back the date of the invention anterior to that time However the antiquity of such a date is much doubted, but as Pliny gives an account of the manner of making the papyrus paper and it seems to have been in high reputation in the time of Alexander the Great it is probable that such improvements were made during his reign as to enhance the value and increase the manufacture

It is true in use long after the invention of e argument by which it is contended that the manufacture was of more modern date although the only fair inference seems to be that it was only rare or expensive It appears, however, that after the time papyrus paper was chiefly manufactured at Alexandria and continued a source of profit to that city up to the 8th century, to the close of which it remained in general use throughout Europe, Italy retained it to the eleventh, and France even so late as the twelfth century

We have thought it but right thus briefly to narrate the differences of opinion which have prevailed respecting the origin of paper Our own belief is, that the transition of the use of the papyrus in its natural state to that in its manufactured was so gradual, that it does not leave room to fix on any precise point at which to

say that the papyrus became paper Probably the first step arose from the perception that the leaf was not strong enough for its purposes, and then how simply came the remedy of placing the leaves together, the waters of the Nile, amid which the plants grew serving to cement them, afterwards came a pressure to flatten the [illegible] and this simple process seems to give the origin of paper We believe that many an invention for which the learned have contended, has advanced by steps as simple and as gradual, leaving it impossible to decide at what point invention began, since it was only improvement that was taking place

The next improvement in paper was its manufacture from cotton It is supposed that the Chinese and Persians were acquainted with this material for its production, and that the Arabians learnt it from their conquest in Tartary The ancient paper bears no marks of the wire through which the water is drained in modern paper-making, and it is therefore inferred that a different process was employed Paper made from cotton was in [illegible] Greeks than with the Romans [illegible] paper from cotton cannot be traced further back than to the tenth century and the oldest manuscript document written on this cotton paper is dated 1050

When or by whom linen paper was invented seems uncertain some give the credit to Germany some to Italy some to Greece, but the Chinese appear to have the best pretensions The Rev Dr Dibdin in his *Typographical Antiquities* says that 'the art of paper-making with linen rags is supposed to have been discovered in the eleventh century, though Father Montfaucon was in the twelfth Montfaucon acknowledges that he has not been able to meet with a single leaf of paper with a date anterior to the death of St Louis in 1270" Its introduction into England took place about the year 1342, in the reign of Edward III, although some have supposed it as early as 1320 France had it in 1[illegible] and Italy [illegible]67 The Germans possess a specimen bearing the date of 1308 although it has been surmised that this single instance may have been a mixture of linen with cotton

In the Preface to the *Kalendars of the Exchequer* published by the Record Commission it is stated that "some of the letters addressed to Hugh le Despencer from Gascony (at various periods in the reign of Edward II), are written on very stout and beautiful vellum, others on paper, of a sound and strong fabric well sized, and such as may altogether be called a good article And although, in the Tower, there are a few letters upon cotton paper, yet parchment or vellum was generally used, and these are amongst the earliest examples of any continued correspondence upon the more commodious material, which in England was very rarely employed It is highly probable that in the south of France, the supply was received from the Moorish merchants or manufacturers of Spain' The original register of the privy seal of Edward the Black Prince from July, 20 Edw III, to January, 21 Edw III, forming one volume, is on paper"

It is a commonly received opinion that the first paper mill was erected in England during the reign of Elizabeth, though it has been asserted that the first mill was set up in Charles the First's reign by a German of the name of John Spilman or Spielman, that the king granted him a patent, and a salary of *20l* a year Both these opinions are proved to be erroneous by an entry in the privy purse expenses of Henry VII, dated May 25th, 1498, published in the *Excerpta Historica* 'For a rewarde yeven at the paper myine *16s 8d*' which establishes with certainty an [illegible] Dr Dibdin gives this account of Spilman [illegible] thority of Dr Harris, but the statement is invalidated by Mr Nicholls in his *Progresses of Queen Elizabeth* who has reprinted in that work a poem of the date 1588 of which the following is the title —*A Description and playne Discourse of Paper, and the whole Benefits that Paper brings, with Rehearsall and setting forth how there is a Paper-mylle built near Dartford by an high [illegible] called Master Spilman, Jeweller to the Queene's Majestie*, 1588 Perhaps no other manufacture ever remained so long nearly stationary [illegible] the last fifty years such great and rapid improvements have been made in it, as to equal if not to surpass [illegible] branch [illegible] writing and [illegible] sable to the prosecution of the latter, render its manufacture of the highest utility and importance But even in a commercial point of view, its value is very considerable France, Holland and Genoa had for a lengthened period, a decided superiority in this department The finest and best paper being made of linen rags its quality may be supposed to depend, in a considerable degree, on the sort of [illegible] country where it is manufac- [illegible] is said to account for the greater whiteness of the Dutch and Belgian papers as compared with those of the French and Italians and still more of the Germans The rags used in the manufacture of writing paper in Great Britain are collected at home, but those used in the manufacture of the best printing-paper are imported principally from Italy, Hamburgh, and the Austrian states, by way of Trieste

We believe, however, that it was owing rather to the want of skill than, as has sometimes been supposed, to the inferior quality of [illegible] that the [illegible] [illegible] comparatively recent period During the 17th century most part of our supply was imported from the Continent, especially from France The manufacture is said to have been considerably improved by the French refugees who fled to this country in 1685 But it is distinctly stated in the *British Merchant* (vol ii p 26) that before this no sort of paper except brown was made here previously to the Revolution In 1690 however, the manufacture of white paper was attempted, and within a few years most branches were much improved In 1721 it is supposed that there were about 300 000 reams of paper annually produced in Great Britain which was equal to about two thirds of the whole consumption In 1783 the value of the paper annually manufactured was estimated at 780 000*l* At present besides making a sufficient quantity of most sorts of paper for our own use we annually export about 100,000*l* worth of books We still however continue to import certain descriptions of paper [illegible] and a small supply of paper [illegible] amounts to about *2800l* a year

In 1813 Dr Colquhoun estimated the value of paper annually produced in Great Britain at 2 000 000*l*, but Mr Stevenson an incomparably better authority upon such subjects estimated it at only half this sum From information obtained from those engaged in the trade, we incline to think that the total annual value of the paper manufacture in the United Kingdom exclusive of the duty, may at present amount to about 1 200 000*l* or 1 300 000*l* There are about 700 paper mills in England, and from 70 to 80 in Scotland The number in Ireland is but inconsiderable About 27 000 individuals are supposed to be directly engaged in the trade and besides the workmen employed in the mills the paper manufacture creates a considerable demand for the labour of millwrights machinists smiths carpenters iron and brass-founders wire workers, woollen manufacturers and others in the machinery and apparatus of the mills Some parts of these are very powerful, and subject to severe strain, and other parts are complicated and delicate, and require continual renovation Owing to this, the manufacture is of much greater importance as a source of employment than might at first be supposed, or than it would seem to be considered by government, who have loaded it with an excise duty amounting to more than three times as much as the total wages of the work-people employed!

We pass on from this brief account of the history and statistics of paper to the mechanical process of its production, only remarking that many articles have been resorted to in its manufacture —the tendrils of the vine, the stalks of the nettle the thistle and mallow*, the bark of the willow the hawthorn the beech the aspin, and the lime Some patents have been obtained for making it of straw, and the bine of the hop it is presumed might furnish material for the supply of paper to all England but leaving these inferior substitutes, we shall confine ourselves to the description of paper made from linen rags that being the staple of the manufacture

The rags in the London market are sold to the manufacturers according to their respective quality under the terms fine 2d 3d English rags, and SPFF, SPF FF, &c foreign rags fine being wholly linen and of the best quality is used for the finest writing paper and so in their gradation down to the commonest, which is coarse, often canvass and can only be made into an inferior printing paper when it has been thoroughly bleached In these inferior papers some cotton is mixed There are also the strong, coarse bags in which the rags are packed, and the coloured rags only fit for the most common papers, though out of these the blue are usually sorted for the purpose of making blue paper It is necessary that these rags should be dusted, and, to effect this they are either placed in a cylinder for [illegible] pivots at each end, and enclosed in a box which receives the dust as it falls through the net-work, or else their

* The works of the Marquis de Villette, published in London, [illegible] of marshmallow, and at [illegible] sheets of paper made of the nettle, [illegible] of the species of conferva, couch grass, [illegible] tree was furnished from the tree yellow willow, sallow [illegible] poplar oak [illegible] of the dark coloured, and [illegible]

The Chinese make their paper in large sheets of the raw vegetable matter as it has all the appearance of the pulp having been [illegible] with flat surface [illegible] and the other with the [illegible] essential in its quality of receiving a fine and delicate impression of engravings, either from copper or wood.

sorting takes place over a table frame covered with wire net, through which the dust falls into a box beneath as the workwoman proceeds in her labours The first of these modes, however, is a great preservation of the health of those employed in the work The rags are then cut into pieces not exceeding three or four inches square, the parts that have seams being thrown into a separate heap, or the sewing thread might make filaments in the paper In this process the rags are scrupulously sorted according to their texture and degree of strength [illegible], for, were they not carefully [illegible] the texture would be reduced [illegible] course and be lost in the preparation or if preserved when reduced to pulp would not be found of the same consistency as the coarse sort and the paper when manufactured would necessarily be clouded and inferior It is for these reasons that this part of the process is important When carefully sorted, and the different degrees of texture having, by a longer or shorter process, been reduced to a pulp of similar consistency, they may then be mixed together, but this cannot be previously done While in this state the rags often appear so dirty and discoloured as to preclude all hope, to an inexperienced eye, that they can ever assume the purity of that beautiful fabric so valuable to the artist and the scribe This purification used formerly to be effected by water running through a receptacle filled with the rags, which in its passage eventually carried off their soil, but the present more expeditious process is that of boiling them mixed up with lime in a species of chest, so perforated as to allow the admission of steam, and by this means they are partially bleached It is but due to the superior cleanliness of our own country to state, that the rags collected in England require little bleaching, but, as these form a small proportion of the quantity used in our extensive manufactories bleaching takes an important place in the process The superfluous moisture is squeezed from the rags and they are placed in a sort of chamber or receiver, which is air tight and pipes are conducted into it from a retort which convey chlorine, formed, by the application of heat from manganese, common salt, and sulphuric acid This part requires much care, for if carried beyond its due point it proves most injurious to the durability of the fabric The rags when taken from this chamber are strongly imbued with a most nauseous smell and require profuse and frequent washings After this process they are put into the beating engines, and pass through a sort of trituration, which reduces them to a coarse and imperfect pulp, which is called half stuff or first stuff, and this is again levigated until it assumes the appearance of cream

The state and quality of this pulp is of the utmost importance to the final perfection of the paper If in the levigation, the fibre should have been so entirely destroyed as to reduce it to [illegible] the paper will inevitably prove liable to break [illegible] away and be rotten and this must result whatever previous excellence of the material A fibre is absolutely necessary to the production of a serviceable paper Mr Murray in a little work on the subject full of practical science recommends that a small proportion of unbleached flax should be added to the half stuff,—an expedient that would doubtless much increase the strength and durability of our manufacture But unfortunately so far from means being taken to improve its consistency, others are resorted to, for the sake of an increased profit, which deteriorate almost to destruction we mean the introduction of plaster of Paris, or other earthy substances, into the pulp, and this can never be done without ensuring brittleness and want of cohesion as the result While the pulp is in this state the size, made from sheep skins and other animal substances together with a solution of alum, is introduced, excepting only in the manufacture of writing paper, and then the sheets are most generally sized after their formation

Having described the preparation of the material, we shall pass on to its formation into paper

The fine pulp, or stuff, as it is technically called is transferred into a chest or large tub with a revolving agitator, from thence into a vat, usually about 5 feet in diameter, and 2½ feet in depth, and sustained at a proper temperature by means of a fire, and it is generally arranged for this vat to be placed against a wall of the room, that the fuel to the fire may be supplied at an aperture externally to prevent any injury from smoke During the whole of the subsequent process it is requisite that the pulp in the vat should be stirred up at short intervals, to keep it of an equal consistency There are three workmen employed in this stage of the operation, called the *dipper*, the *coucher*, and the *lifter* The dipper is provided with a mould formed of well-seasoned mahogany, across which parallel wires are stretched close together, a few other stronger ones being also placed at right angles with them, and at some distance from each other The lines formed in the paper by these wires are called water marks, but, in the modern improvement of wove paper, these are avoided by using wire cloth woven in a loom, which, being tightly stretched over the frame, produces no water-mark This mould is provided with another frame, called a *deckle*, which fits it exactly, and forms a boundary line to the sheet of paper, which would otherwise have a rough and jagged edge This contrivance, by supplying an edge to the mould, gives it the character of a sieve, which enables the dipper after he has dipped the mould into the vat, and taken [illegible] of the pulp and given it a gentle [illegible] thickness, to drain the water away, he then removes the deckle, replaces it on another mould, and proceeds as before; whilst the second workman, the coucher, removes the sheet of paper thus made on to a felt, being a piece of woollen cloth, and then returns the mould to the dipper, who, in the meantime, has been operating with another mould, and forming another sheet they thus exchange the moulds, the one dipping and the other couching, until they have completed six quires of paper, which is called a *post* When this quantity is completed, the heap is conveyed to the vat press and subjected to heavy pressure These six quires remain in the vat press until the dipper and the coucher have perfected another post, when they are removed to give place to it, and then the office of the third workman, the lifter, commences He separates the sheets of paper from the felts, and forms them into a pile, which is again subjected to a second press, which detaches from them a great quantity of moisture Here it remains until the workmen are prepared to replace it with a similar quantity, when it is taken to the drying rooms and hung up on lines to dry These lines are carefully covered with wax, both to prevent adhesion and contraction, and the opening of the windows should be strictly attended to, that the drying may not proceed too rapidly This being accomplished, it is taken down, shaken to make the dust fall out, and to separate the sheets from each other, and laid up in heaps, ready to be sized The size is prepared of a due consistence twice filtered and a portion of alum added The workman dips a handful of the sheets, holding them open at the edges that they may more equally imbibe the moisture, and after this process they are again subjected to the press They are afterwards dried, sorted, brought under repeated and excessive pressure, and, finally, made up into quires and reams

But as the process of paper-making must necessarily be comparatively slow when practised by hand, machinery has been resorted to, which has nearly supplanted the old method We believe France has the honour of the invention although it has been greatly improved in England by Messrs Donkin and Co That in most general use here is after Fourdrinier, who invented the endless web of wire One of these machines can produce 20 superficial feet of paper per minute, and it is this which enables us to enter into competition with the foreign market which we could not otherwise do, on account of the difference in the value of manual labour In the old method it took three months after receiving the rags into the mill to complete the paper by the machine, they can receive the rags on one day, and deliver the paper made from them on the next

The stuff, having been prepared and bleached in an expeditious manner by machinery, is emptied into the chest or tub as before and from thence is delivered gradually into the vat, where it is kept in continued motion by means of revolving fans called *hogs* Nearly at the top of the vat there is a gate which can be raised or lowered at pleasure by means of which the flow of stuff is regulated on to the lip or trough, from which it falls upon the endless web of fine wire, which is kept continually moving in a horizontal direction over a series of revolving rollers, and is placed immediately under the hanging lip of the trough, so that the pulp may have the shortest distance possible to fall These revolving rollers prevent the wire web from falling in or bagging, and keep it level, and as it is preserved at a due tension from side to side it has all the appearance of a table A leather strap or ledge of wood, on each side forms the boundary line of the paper, answering the purpose of the deckle in the hand-making process, these are moveable according to the intended width of the paper The long cascade or continuous stream of pulp, regulated with reference to the proposed thickness of the paper to be made, thus gently descends on this moving wire plane, which is perpetually travelling onward and onward, and, for its more perfect equalization, a second movement is resorted to, by means of a sort of crank, which gives the web a jerking motion at short intervals, and diffuses the liquid pulp unvaryingly over the surface At the end nearest to the trough the pulp is, of course perfectly fluid, but as the web travels on the moisture partially sinks through the fine apertures of the web-ing and the material coagulates There has been a fashion prevalent of late years of having paper barred or ribbed this appearance is given at this juncture While yet moist, just before passing from the wire web-ing it is subjected to the pressure of a wire roller which gives the indentations of the stripes or lines,

this cylinder is called a *dandy* from this it travels to a web of cloth or felt, during which advance it is subjected to heavy pressures, from passing between rollers covered with felt, and called the *pressing rollers* This process answers to the wet press in the hand made paper, and formerly this was the termination of the labours of the machines, the remaining work of drying &c being ac- [illegible] incalculable improvement [illegible] e drying rollers These [illegible] metal, which effect in a few moments the perfect drying of the paper while yet moist it passes over the first moderately warm, again over the second, of larger diameter, of greater warmth and again over the third with an augmented heat The paper is now perfectly dry, and any casual inequalities are removed from its surface The final action of this wonderful machine is to wind the paper round a last roller or reel, which when full is exchanged for another, [illegible] the machine is finished, and the paper, being in long webs of many yards requires to be cut into sheets After different methods had been tried, a supplementary machine has been invented, which receives the web from off the reel on to a drum, cuts it into sheets of proper lengths with a circular knife, continually revolving while the divided web proceeds, and these sheets are received and placed in regular heaps by children

Mr Dickinson has recently made great improvements in the machine, which has consequently been followed by a corresponding improvement in the paper manufactured by the house of Messrs John Dickinson & Co, which has long been celebrated for producing paper of a superior quality

The manufacture of the paper being thus completed the sheets are separately examined, and every knot or blemish carefully removed, the torn or damaged ones being laid apart In this state they are subjected to the action of a powerful press, in the full and open size of the sheet they are afterwards cut round the edge and then counted into quires of twenty-four sheets, which are folded in the middle, and put into reams each ream containing twenty quires, of which the two on the outside are made up of twenty sheets each from the damaged sheets that were thrown out In this state they are again pressed, and finally tied up in wrappers These wrappers are stamped by the exciseman, and by the act 6 & 7 Will 4 c 52, the paper is charged with an excise duty of three halfpence a pound

When the duty on paper was charged according to the size the makers were obliged to be particular in the dimension The following table shows the exact size of the different writing, drawing, and printing papers, as enforced by the excise under the powers vested in them by act of parliament

| | First Table — Writing | | Second Table — Drawing | | Third Table — Printing | |
|---|---|---|---|---|---|---|
| | *Inches* | | *Inches* | | *Inches* | |
| Double Atlas | | | 35 by 31½ | | | |
| Grand Eagle, or Double Elephant | | | 40 | 26½ | | |
| Double Demy | | | | | 38½ by 26 | |
| Columbier | | | 34½ | 23½ | | |
| Atlas | | | 34 | 26½ | | |
| Atlas, small | | | 31 | 25 | | |
| Imperial | 30½ by 22 | | 30½ | 22 | | |
| Double Crown | | | | | 30 | 20 |
| Elephant | | | 28 | 23 | | |
| Super Royal | 27½ | 19½ | 27½ | 19½ | | |
| Long Royal | | | 27½ | 18 | | |
| Royal | 24 | 19½ | 24 | 19½ | 26 | 20 |
| Ditto | | | | | 24½ | 19½ |
| Double Pott | | | | | 20½ | 17 |
| Large Fan | | | 23½ | 20½ | | |
| Small Fan | | | 22½ | 13½ | | |
| Medium | 22½ | 17½ | | | 23 | 18 |
| Extra large Post | 21 | 16½ | | | | |
| Thick and thin Post | 19½ | 15½ | | | | |
| Small Post | 16½ | 13½ | | | | |
| Demy, single | | | | | 22 | 17½ |
| Ditto | | | | | 21½ | 19½ |
| Demy | 20 | 15½ | 22 | 17 | | |
| Short Demy | | | 20½ | 14 | | |
| Copy, or Bastard | | | 20½ | 16 | | |
| Crown | | | 20 | 15 | | |
| Single Crown | | | | | 20 | 15 |
| Foolscap | 16½ | 13½ | 16½ | 13½ | | |
| Little Foolscap | | | 17½ | 13½ | | |
| Pott | 15½ | 12½ | 15 | 12½ | | |

It will be seen, by the preceding table, that the largest sheet of hand-made paper is 11 feet 7 inches in length by 2 feet 7 inches and a half in breadth, while machine-made paper is of the width of 5 feet, and appears to be unlimited as to its length

PAPER HANGINGS This important and elegant substitute for the ancient "hangings" of tapestry or [illegible] cloth came into use about 200 years ago, the manufacture has undergone a gradual succession of improvements and has now reached a high state of beauty and [illegible] sometimes [illegible] by blocks, each colour being laid on by a [illegible] in wood or metal upon a plain or [illegible] patterns are sometimes printed in varnish or size, and gilt or copper leaf applied, or bisulphurate of tin (*aurum musivum*) is dusted over so as to adhere to the pattern, and in what are called *flock papers*, dyed woods minced in powder are similarly applied Powdered steatite or French chalk, is used to produce the peculiar gloss known under the name of *satin* Striped papers are sometimes made by [illegible] trough, which has part [illegible] which the colour is delivered, and a number of other very ingenious and beautiful contrivances have lately been applied in this important branch of art The invention of the paper machine, by which any length of paper may be obtained, effected a great change in paper hangings, which could formerly only be printed upon separate sheets, and were much more inconvenient to print as well as to apply to the walls A plausible suggestion upon the subject of "intellectual paper hangings" will be found in No 504 of the *Penny Magazine* The reduction of the duty on paper, and the [illegible] duty to paper hangings, not only create a greater demand for, but are likely to lead to further improvements in, this manufacture

PAPER MONEY *See* Banks

PAPER SAILOR, or PAPER NAUTILUS *See* Argonaut

PAPIER-MACHÉ A name given to articles manufactured of the pulp of paper, or of old paper ground up into a pulp, bleached, if necessary, and moulded into various forms This article has lately been used upon an extensive scale for the manufacture of mouldings, rosettes, and other architectural ornaments, pilasters, capitals and even figures as large as life, have also been made of it It is lighter more durable, and less brittle and liable to damage than plaster, and admits of being coloured gilt, or otherwise ornamented Another article sometimes goes under the same name which is more like pasteboard consisting of sheets of paper pasted or glued and powerfully pressed together, so as to acquire when dry the hardness of board and yet to admit while moist of curvature and flexure tea trays, waiters, snuff-boxes, and similar articles are thus prepared, and afterwards carefully covered by japan or other varnishes, and often beautifully ornamented by figures or landscapes and other devices, &c occasionally inlaid with mother of pearl A mixture of sulphate of iron, quicklime, and glue, or white of egg with the pulp for papier-maché, renders it to a greater extent water-proof, and the further addition of borax and phosphate of soda contributes to make it almost fire-proof The [illegible] manufactory in England is that of [illegible] Wellington Street, Strand, who has recently published a concise history of the manufacture, embellished with numerous illustrations

PAPILIONACEÆ *See* Leguminaceæ

PAPILIONA'CEOUS A name given to the corolla of leguminous plants, from its fancied resemblance to the figure of a butterfly it is that of the garden pea and bean, and consists of a large upper petal or vexillum, two lateral petals called alæ, and two intermediate petals forming a carina

PAPILIO'NIDÆ (Lat papilio, *a butterfly*) The name of a family of Lepidopterous insects, of which the genus *Papilio* is the type *See* Diurnals

PA'PIST (Lat papa, *the pope*) A word in common use to designate a member of the Roman Catholic church It has a shade of meaning somewhat different from *Romanist* being employed generally with a certain degree of prejudice and obloquy attached to it

PA'PPUS A name given to the calyx of Compositæ, which exists in the rudimentary condition of a cap or [illegible] r of slender hairs or in some other [illegible]

[illegible] ne given to the written scrolls, made of the *papyrus*, which have been found in various places, but more especially in Egypt and Herculaneum [illegible] as follows — The interior of [illegible] the rind had been removed was cut into thin slices in the direction of their length, these being laid on a flat board in succession, similar slices were placed over them at right angles, and their surfaces being cemented together by a sort of glue, and subjected to a proper degree of pressure and well dried, the papyrus was completed [illegible] depended of course on [illegible] as that of the sheet o [illegible] succession beside each other, [illegible] was [illegible] indefinite [illegible] been preserve [illegible] ppearance they [illegible] until ren-

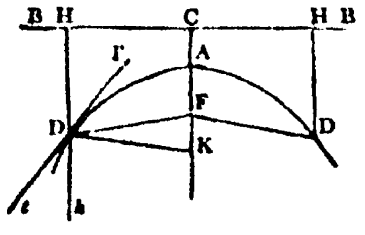
dered pliable by gradua [illegible] of an English climate; [illegible] appear to have been dr [illegible] *Wilkinson's Manners and Customs of the Ancient Egyptians* vol iii p 147–8) Much interest was excited by the discovery of the papyri rolls at Herculaneum, and great expectations were entertained by archæologists that treasures of the valuable remains of antiquity would be restored to the world but after all the trouble that has been taken, and all the ingenuity that has been displayed in unrolling and deciphering many of them, little or nothing has been found worthy of the pains They consist chiefly of Greek sophists and rhetoricians, works on music, medicine, and the arts, and some on natural and moral [illegible] &c All the deciphered papyri are contained in the work *Herculanensium Voluminum quæ supersunt*, published at Naples 1793–1827

PAPY'RUS In Botany, a Cyperaceous plant found in the districts of many tropical countries, but especially in the valley of the Nile and whose soft cellular flowering stem afforded the most ancient material on which paper was made [illegible] the general [illegible] genus *Cyperus*, which was extensively used for making mats, baskets, boats, and many other purposes, the species confined to the manufacture of paper being usually designated *Cyperus papyrus* or *Byblus* The latter was particularly cultivated in the Sebennytic nome, though other parts of the Delta also produced it, and probably even some districts in Upper Egypt The paper made from it differed in quality, being dependent upon the growth of the plant and the part of the stalk whence it was taken The process of the manufacture is minutely described by Pliny in his *Hist Nat* xiii 11, 12 The period at which paper began to be manufactured from the papyrus is involved in great obscurity but there can be little doubt that Pliny was greatly in error when he assigned it a date posterior to the reign of Alexander the Great, for we meet with papyri (see above) of the most remote Pharaonic periods, the same mode of writing on which is shown from the sculptures to have been common in the age of Suphis or Cheops, the builder of the great pyramid, more than 2000 years before the Christian era The manufacture of paper from the papyrus continued in general use down to the end of the 7th century, when it was superseded by parchment (which see)

PAR OF EXCHANGE *See* EXCHANGE

PA'RABLE (Gr παραβολη from παραβαλλω, *I compare*) In Rhetoric, in the original sense, a comparison, but the word has become in modern language, appropriate in a particular meaning The parables of the New Testament are illustrations, in the form of short tales, after the oriental manner in each of which not only a moral or religious truth is conveyed but the objects contained in the hidden sense are distinctly represented by parallel objects or types in the external narrative

PARA'BOLA In Geometry, one of the conic sections, formed by the intersection of the cone with a plane parallel to one of its sides Considered as a plane curve, the parabola may be defined as follows — A point F, and a straight line B B', being given by position in a plane, let another point D be supposed to move in such a manner that its distance D F from the given point is always equal to its distance D H from the given straight line the point D will trace out the parabola

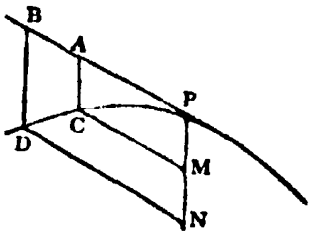



The given line B B' is called the *directrix* of the parabola, the given point F is the *focus*, the straight line F C, drawn through F perpendicular to the directrix, is the *axis*, any straight line parallel to C [illegible] *parameter*, the point in which the diameter meets the curve is the [illegible] a straight line equal to the double of the distance between the vertex of any diameter and the directrix is called the *latus rectum* or *parameter* of that diameter

From the preceding definition of the curve its algebraic equation is easily found Let A be the origin of the rectangular co-ordinates, A K = $x$, K D = $y$, and A F = A C = $a$ we have D K$^2$ or $y^2$ = D F$^2$ − F K$^2$, but D F = D H = C K = $x + a$, and F K = A K − A F = $x - a$, therefore $y^2 = (x + a)^2 - (x - a)^2$, whence $y^2 = 4ax$, or, if we assume $p = 4a$ (= the parameter of the axis) the equation becomes $y^2 = px$, that is the square of the ordinate is equal to the rectangle under the abscissa and the parameter This property holds true of every other diameter as well as of the axis, the ordinate being taken parallel to the tangent at the vertex of the diameter It was on account of this property that the curve received its name.

Let F D = $r$ and the angle A F D = $\phi$; then F K = $r \cos. \phi$ and consequently C K = $2a - r \cos. \phi$ But by the definition of the curve, C K = F D = $r$, therefore $r = 2a - r \cos. \phi$, whence $r = \frac{2a}{1 + \cos. \phi}$. This [illegible] parabola through D, it is a property of the curve that the angle H D T and consequently the vertical angle A D $t$, is equal to F D T. A ray of light, therefore falling on the curve in the direction A D and being reflected by it would pass through the point F, and as this takes place with regard to every ray parallel to the axis it follows that the concave surface formed by the revolution of a parabola about its axis is that by which all the parallel rays of light are collected into a single point Hence the point F is called the *focus* or burning point

Another remarkable property of the parabola is the following — Let P A be [illegible]




[illegible] P A$^2$ P B$^2$ For, making C M and D N parallel to P B, and assuming $p$ = the parameter of the diameter P N, we have, from a property already mentioned, M C$^2$ = $p$ P M, and N D$^2$ = $p$ P N, therefore M C$^2$ N D$^2$ P M P N, or P A$^2$ P B$^2$ A C B D Hence the parabola is the curve described by a projectile in a vacuum, for a body projected from P in the direction P A and not resisted, would pass over spaces in that direction proportional to the times, and, in consequence of the accelerating force of gravity, through spaces A C and B D proportional to the perpendicular [illegible] on proportional to the squares of the times, or proportional to the squares of P A and P B *See* GUNNERY, PROJECTILE

The parabola is remarkable, as being the first curve of which the indefinite quadrature was found Let P N be a diameter, and P B [illegible] its vertex and B D and D N respectively parallel to P N and P B, it was demonstrated by Archimedes that the area contained by P N, N D, and the parabolic arc P C D, is equal to two thirds of the parallelogram P B D N

The curve which has now been described is called the *conical* or *Apollonian* parabola, but the term parabola is also applied to all algebraic curves of a higher order determined by an equation of the form $y^{m+n} = a^m x^n$ The curve whose equation is $y^3 = a^2 x$ is called the cubical parabola, and that which has for its equation $y^3 = ax^2$, the semicubical parabola This latter curve is celebrated in the history of the algebraic analysis as being the first curve that was rectified or found equal in length to an assignable straight line, and the honour of the discovery belongs to an Englishman, William Neil, who died in 1670 at the early age of thirty-three The same discovery was made nearly at the same time by Van Heuraet in Holland till then it had been supposed by geometers impossible to assign a straight line equal to the arc of any algebraic curve (the rectification of the cycloid had been found by Sir Christopher Wren), but the discovery of the method [illegible] there are innumerable classes [illegible] definite rectification In fact, all parabolas of this form $y^{2n+1} = ax^{2n}$, where $n$ is any number whatever, may be rectified (Montucla, *Histoire des Mathematiques*, tom ii p 151) *See* CONIC SECTIONS

PARABO'LIC CONOID The solid generated by the rotation of a parabola about its axis It is equal in content to $\frac{1}{2}$ the circumscribed cylinder, and to $\frac{3}{8}$ of the con [illegible]

PARABOLIC CURVE [illegible] which the equation is of the form $y = a + bx + cx^2 + dx^3 +$ &c. Curves of this kind are frequently employed for the purpose of representing a number of observations, or for approximating to the areas of other curves, for it is always possible to cause a parabolic curve to pass through any number of points in a given curve, by making as many of the coefficients $a, b$ &c [illegible] and terminate as there are points given [illegible] curve thus described will differ less from the given curve according as the number of points is greater But the area of the parabolic curve can always be determined therefore that of the other curve may be found to any required degree of approximation

PARABOLIC SPINDLE The solid conceived to be [illegible] of a parabola about its base, or [illegible]

PARABOLOID is sometimes used to denote the parabolas of the higher orders, and sometimes the solid formed by the rotation of a parabola about its axis or the parabolic conoid

PARACELSISTS Followers of the school of Paracelsus in medicine physics and mystical science The founder of this school may perhaps be called with justice the most distinguished quack who ever made a figure in the world He practised medicine "with the boldness of a wandering empiric," and established a

[illegible] He mingled his medical and chemical knowledge with the speculations of the [illegible] a theosophy of his own He died in [illegible] continued to influence the schools of Germany for more than a century (See *Hallam's Introduction to the Literature of the Middle Ages* i 541 639 ii 70 &c , and *Mosheim*, vol iv )

PARACENTESIS (Gr παρακεντεω, *I perforate*) The operation of *tapping* any of the cavities of the body for the purpose of withdrawing a contained fluid

PARACENTRIC (Gr παρα, and κεντρον, *centre*) In the higher Geometry, the name given to a curve line having this property, that a heavy body descending along it by the force of gravity will approach or recede from a *centre* or fixed point, by equal distances in equal times

PARACENTRIC MOTION, in Astronomy, denotes the rate at which a planet approaches nearer to, or recedes farther from the sun or centre of attraction, in a given interval

PARACEPHALOPHO'RES (Gr παρα *beside*, κεφαλη *head* and φερω *I carry*) A name given by M De Blainville to a class of Molluscous animals in which the head is but little distinct from the body, and is always provided with some of the organs of sense

PARACHU'TE (Fr parer, *to ward off*, and chute, *fall, a guard against falling*) An apparatus resembling the common umbrella, but of far greater extent, intended to enable an aeronaut in case of alarm to drop from his balloon to the ground [illegible] This is effected by means of the resistance of the air sphere When the parachute is detached and abandoned with its load in the [illegible] it descends at first, from the continued action of gravity, with an accelerated motion, until the increased velocity produces a resistance equal to the force of attraction or the weight of the apparatus with its load After this equilibrium has been attained, the parachute will descend with a nearly uniform velocity According to theory, this terminal velocity, supposing the surface of the parachute to be flat, is equal to that which a heavy body would acquire in falling through the altitude of a column of air incumbent on that surface, and having the same weight [illegible] A circular parachute having a diameter of 24 feet, weighing with its load 225 pounds would acquire a terminal velocity of 24 feet per second, and a person descending with it at this rate would receive the same shock on reaching the ground as if he dropped freely from a height of $2\frac{3}{8}$ feet (For the method of solving this problem see *Hutton's Mathematical Tracts* vol i p 316 ) The actual resistance of the air is, however, greater than is given by theory, and is besides augmented by the oscillations of the parachute, which occasions it to descend not only but, on account of the action of the wind, the axis of the parachute will probably become inclined to the vertical, in which case the resistance will suffer a diminution

One of the most remarkable instances of descent from a great height with a parachute is that of Garnerin, a Frenchman, who ascended in a balloon from an enclosure, near North Audley Street in London, on the 2d of September, 1802 After hovering seven or eight minutes in the atmosphere, he cut the cord by which his parachute was attached to the balloon It instantly expanded, and for some seconds descended with an accelerating velocity till it became tossed extremely, and took such wide oscillations that the basket or car was at times thrown almost into a horizontal position The intrepid aeronaut [illegible] escaped destruction by being precipitated on the houses in St Pancras, and at last forcing [illegible] in Oakley Street, Lambeth He [illegible] and trembled exceedingly at the moment he was released from the car (*Ency Brit*, "Aeronautics")

An experiment of this kind made by Mr Cocking a few years ago, was attended with fatal consequences Having conceived a notion that the vibrations might be avoided by giving the machine a different form, this projector constructed one in the form of an inverted umbrella, that is, having the concave side [illegible] and bound to a strong wooden hoop to [illegible] collapse in the descent The diameter of the hoop was 34 feet and there was also a hole of 6 feet in diameter in the middle of the parachute, which, it was supposed, would also contribute to give greater steadiness Having attached himself to the machine he proceeded to Vauxhall Gardens on the 21st of [illegible] and set away from the balloon [illegible] and with violent oscillations the hoop broke, and the unfortunate projector fell dread unmangled, at Lee, near Blackheath The persons in the car of the balloon were also placed in great danger, having narrowly escaped suffocation from the quantity of gas expelled in consequence of the great velocity with which the balloon darted upwards immediately on being liberated from the parachute They suffered extreme pain, and for a time were deprived of sight by the [illegible] they had carried up with [illegible] air, by means of [illegible] Without this, they would probably have perished,

PARACLETE (Gr παρακλητος, *advocate*) A name attached to the Holy Spirit, as an advocate, intercessor, or comforter of mankind; such as he is represented, John, xiv 16 26 , Rom viii 26. It was not an uncommon opinion of the early heretics, that the Paraclete, whose mission was promised by Christ, was to appear corporeally upon the earth and complete the dispensation announced by our Lord and the apostles; and [illegible] between the person of the Comforter and the [illegible] of his grace upon the disciples on the day of Pentecost Accordingly, several of them, Simon Magus, Manes and others gave themselves out as this expected Paraclete and Tertullian himself was at one period infatuated by the claims advanced by Montanus to this personification

PARACRO'STIC A poetical composition in which the first [illegible] mence [illegible] According to Cicero (*De Divinatione*, ii 54 ), the original Sibylline verses were paracrostics *See* Acrostic

PARACYA'NOGEN When cyanuret of mercury is decomposed by heat, a brown solid matter remains having the same composition as gaseous cyanogen, hence designated as above

PARA'DE (Fr ) The place where troops draw up to do duty, mount guard, &c The original meaning of the word is *show* or *ostentation*, and it is used as above, because on these occasions officers and men are expected to be in full uniform or completely equipped

PA'RADIGM (Gr παραδιγμα, *an example*) In Rhetoric, a general term used by Greek writers in the sense of "example" or "illustration" of which "parable" and "fable" are species (*Quintilian*, v 2 ) Hence, in early theology, those writers who narrated the lives of religious persons by way of examples of Christian holiness were styled Paradigmatics

PA'RADISE (Gr παραδεισος said to be derived from a Persian or Chaldaic word or from the Arabic firdauz *a fruitful valley*) This name of oriental origin, was used by the Greek historians to denote the extensive parks or pleasure grounds of the Persian monarchs (Xenophon *Cyrop* and *Econom*, *Diod Sic* xvi 41 , xviii 36 , described by *Quintus Curtius*, viii 1 , who does not use the word See also *Aulus Gellius*, ii 20 ) The Septuagint have employed the word in their translation of Genesis ii 8 to signify the abode in which Adam and Eve were placed by their Creator It also occurs in other parts of their translation (Numbers xxiv 6 , Genesis xiii 10 , Ez xxviii 13 , xxxi. 8 ) It is used in the N T in the memorable passage, Luke, xxiii 43 The speculations into which this mysterious passage has led learned and pious men, in all ages of the church, form too extensive a subject to be entered upon here. The mythologies of many nations contain similar ideas, whether derived from the ancient tradition of a paradise, or formed out of the inherent sense of man of his own imperfection and longing after a better state, from which he imagines himself to have fallen (See, especially, the first part of *Buttmann's Mythologus*, and *Bryant's Mythology* ) The rabbins have formed, as usual, a strange collection of [illegible] ple narrative of Scripture [illegible] an upper or heavenly, and [illegible] The lower is situated somewhere under the terrestrial equator Each is divided into seven dwellings, and each of these is twelve times 10 000 miles in length and breadth A column ascends from the lower to the upper heaven, by which the souls of the blessed mount after a temporary sojourn in the former A wall of partition divides paradise from hell, and this will fall when the Redeemer comes, and all Israel be gathered together in blessedness

The celestial paradise is generally referred to as identical with heaven, or the place of bliss hereafter Some critics, who weigh very nicely our Lord's expression in addressing the penitent thief, "To-day shalt thou be with me in paradise," have imagined the existence of a distinct abode for the souls of the just before the final judgment When we consider, however, that, upon the authority of another passage in Scripture, we affirm that our Saviour went down into hell between his death and resurrection, it will be better, perhaps, not to affix too definite a meaning either to the one expression or the other

The local situation of the terrestrial paradise has been a favourite su[illegible] with the fathers of the church [illegible] The reader may consult, if he will, the first volume of the compilation called the *Ancient Universal History*, where the matter is seriously discussed at great length; he will also find it treated in an [illegible] article of the *Enc Metropolitana* (See also Schirmer *Das Paradies*, Zurich, 1816 ) The most ordinary opinion has placed it on the Euphrates and Tigris Josephus regards the Pison

[illegible] Genesis as the Ganges, the Gihon as the [illegible] in places his in Palestine Huet (*De la Situation du Paradis Terrestre* 1691) enumerates a variety of these theories The paradise of the Moslems is termed in the *Koran* Gannath or the Happy Gardens, and its description is evidently borrowed from the notions of the rabbis and oriental Christians See chiefly chapters lv lvi , but these passages, although flowery enough, contain a very small part of the extravagances, chiefly drawn from tradition which make up the vulgar Mohammedan notion of paradise (See in addition to the article of Sprenger cited at the end of the preceding article in the unfinished *Imago Japeti* of Preusser and Gruber )

PARADOX (Gr παρα δοξαν, *contrary to received opinion* ) A term applied to any proposition which seems to be absurd, or at variance with common sense, or to contradict some previously ascertained truth , though, when properly investigated it may be found to be perfectly well founded The reader will find in Bishop Horsley's 19th Sermon the nature of a paradox, and the points wherein it differs from a contradiction, clearly illustrated

PARADO'XUS (Gr παραδοξος, *wonderful* ) A name devised to express the obscure nature of a genus of Trilobites [illegible] which is characterized by [illegible] of the prominent even-formed eyes which are borne on the shield of all other Trilobites The segments extend beyond the sides of the body, and are free at their lateral extremity It serves also as a specific name for obscure and anomalous animals, as the *Ornithorhynchus paradoxus*, *Lepidosiren paradoxa*, &c

PARAFFINE A substance contained in the products of the distillation of the tar of beech wood It is a tasteless inodorous fatty matter, fusible at 112°, and resists the action of acids and alkalis It appears to be a hydro-carbon Its name is compounded of parum and affinis, *akin*, to denote the remarkable chemical indifference which is its characteristic feature A similar substance has been obtained by Dr Christison from the petroleum of Rangoon

PARAGE (Lat par, *equal* ) In Feudal Jurisprudence the body of nobles (peerage) was so termed, the word likewise expressed equality of condition in various legal relations as for example, between the lords in partnership of a fief Parage was also a custom by which the elder of several coheirs of a fief rendered homage for the whole, and thereby guaranteed the enjoyment of it to his coheirs as well as himself, in the same manner, one of several copurchasers might be admitted to a similar privilege

PARAGO'GE (Gr παρα *by the side of*, and αγω *I bring* ) In Grammar a figure by which one or more letters are added at the end of a word, *e g* in the ordinary formation of diminutives in most languages See METAPLASM

PARAGO'GIC LETTERS (Gr παραγωγη, *an addition* ) In the Semitic languages, letters which by their addition to the ordinary form of the word import additional emphasis, or some peculiar inflexion into the sense Their real meaning and authority have been much debated among Hebrew scholars

PA'RAGRAPH (Gr παραγραφος), ordinarily signifies a small subdivision of a connected discourse, and is indicated by the sign ¶ in modern orthography

*Paragraphe*, as used by Greek rhetorical writers, is a poetical figure employed when the writer sums up in a few words the substance of a previous passage, by way of transition to a new one It was probably so called by analogy (*Eustathius on Hom Il* i 304 )

PARALEI'PSIS (Gr παραλειπω, *I omit* ) In Rhetoric, the artificially exhibited omission or slight mention of some important point, in order to impress the hearers with indignation, pity, &c called by the Latins præteritio, omissio, &c , as in the famous lines —

> Occidat illa dies ævo, nec postera credant
> Sæcula nos certe, taceamus, et obruta multa
> Nocte tegi nostra patiamur crimina gentis

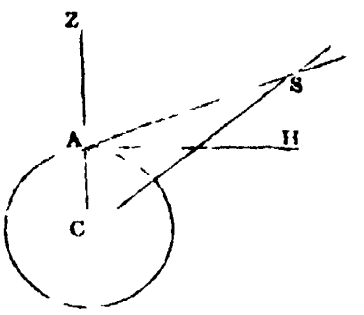
The passage, Hebr xii 32, may be given as another instance; or the following from Cicero — "Prætereo illum nefarium conatum tuum," &c (*Conc c Antonium* )

PARALIPO'MENA (Gr [illegible] *left out or aside* ) A term applied [illegible] of a supplementary character The two books of the Old Testament called by us, after Saint Jerome, the Chronicles are also termed Paralipomena

PARALLACTIC INSTRUMENT An astronomical instrument for determining the moon's parallax described by Ptolemy in his *Almagest* and usually called *Ptolemy's Rules* The term *parallactic* is sometimes applied to the equatorial, but in this sense the proper word would seem to be *parallatic*, as derived not from *parallax*, but from *parallel* the instrument being constructed for the purpose of following the stars in their diurnal parallels (Lalande *Astronomie* § 2678 )

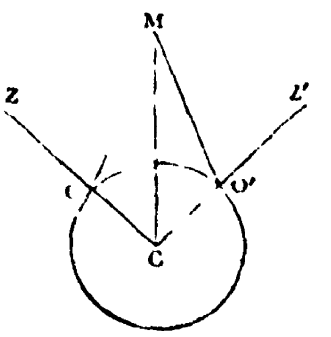
PA'RALLAX (Gr παραλλαξις *change* ) A change of place or of aspect The term is [illegible] to denote the difference between the [illegible] and its *true* place, or that in which it [illegible] the observer [illegible] centre to which the motion is referred When [illegible] of reference is the centre of the earth, the change of aspect is called the *diurnal parallax*, when it is the centre of the earth's orbit, the change is called the *annual parallax*

*Diurnal Parallax* —Let C be the centre of the earth A the place of the observer, Z his zenith, and S a celestial body On observing the body from A, it will be seen in the direction A S, making the angle Z A S with the zenith But if the observer could be placed at C, he would see the body in the direction C S, making the angle Z C S with the zenith The difference between these two angles Z A S and Z C S is the parallax of S, which, therefore, is equal to the angle A S C Hence it appears that the parallax of a celestial body is the angle comprised between two lines drawn from the body, the one to the centre of the earth, and the other to a point on its surface On account of the immense distance of the fixed stars the diurnal parallax is altogether insensible with regard to them It may amount to a degree in respect of the moon, but the greatest parallax of the nearest planet does not exceed 30″




It is evident from the inspection of the figure, that although the distance of the object S remain the same, the angle A S C is [illegible] but is greatest when S is seen in [illegible] horizon A H, and diminishes as the altitude of S increases, until it vanishes altogether at the zenith, where the two lines A S and C S merge into the line C Z In order to discover the law of this variation let $a = C A$, the semidiameter of the earth, $d = C S$, the [illegible] from the centre, $Z = Z A S$ [illegible] and $P = A S C$, the parallax Now [illegible] triangle being in the same proportion [illegible] of the opposite angles, we have $d : a :: \sin Z : \sin P$, whence $\sin P = \frac{a}{d} \sin Z$ But as P is always a very small angle, the arc may be substituted for the sine without sensible error, and the formula becomes $P = \frac{a}{d} \sin Z$, that is to say the parallax is proportional to the sine of the zenith distance At the horizon Z is a right angle, and $\sin Z = 1$ in this case, therefore, the expression for the parallax becomes $P = \frac{a}{d}$ This is called the horizontal parallax, and when its amount has been determined by any means with respect to a celestial body, the parallax of the body at any altitude is found by multiplying the horizontal parallax by the cosine of the altitude, or sine of the zenith distance

Since the parallax of [illegible] in terms of its distance and the earth's [illegible] it follows, reciprocally that the distance of the body is given in terms of its parallax The determination of the parallaxes of the different bodies of the solar system is therefore a problem of great importance in astronomy but it is attended with considerable difficulty in practice, although the principle on which it depends is extremely simple It may be described as follows —Let two observers be stationed at the points O and O′, of which the latitudes are supposed to be known, and which are both situated on the same meridian, and let them simultaneously observe the zenith distances of the body M (supposed the moon) These observations will give the angles Z O M and Z′ O′ M and [illegible] M O C and M O′ C The [illegible] O C O′ is also known, being the difference or the sum of their latitudes, according as they are on the same or opposite sides of the equator But the two sides C O and C O′ of the quadrilateral M O C O′ being radii of the earth, are also supposed to be known, hence the quadrilateral is determined, and its diagonal C M may easily be computed by the rules of plane trigonometry But when C M is found, the horizontal parallax is also determined, being equal, by what has been already shown, to the quotient obtained by dividing the radius C O by the distance C M In this manner the horizontal parallax of the moon was determined by Lacaille at the Cape of Good Hope and the latter simultaneously at Berlin There are methods, however,



by which the lunar parallax may be determined by observations made at a single place

The moon's mean horizontal parallax amounts to 57′ 4″ 17, or 95116 of a degree In respect of all the other bodies of the solar system the parallax is an extremely [illegible] with sufficient precision and certainty That of the sun, the most important of all, is most accurately found by observations of the transits of Venus over his disk, as was first suggested by James Gregory in his *Optica Promota* It amounts only to 8″ 6′, whence we infer that the mean distance of the sun from the earth is 23 984 times the length of the earth's radius, or about 95,000,000 miles (*See* SUN) This determination suffices for [illegible] times, when the distance of any one planet from the sun is known that of every other can be deduced from the times of revolution (See *Kepler's Laws*)

When the parallax of a celestial body has been determined, we can find not only the distance of the body but also its diameter and real magnitude For the apparent diameter being found by observation the true magnitude is given by this proportion — The horizontal parallax is to the apparent radius, as the radius of the earth to the true radius of the body

The effect of parallax is to depress the observed body in the vertical circle or to increase its zenith distance If the body at the time of the observation is on the meridian, the parallax only affects its declination, but if it is not on the meridian, the observed right ascension and declination are both altered and the effect on each of these co-ordinates must be computed from the previously known horizontal parallax by the rules of spherical trigonometry The computation in the case of the moon, is considerably complicated by the earth's ellipticity

*Annual Parallax* — In what has yet been said the centre of the earth has been taken as the point of reference, and therefore regard has only been had to the difference of apparent situation occasioned by the eccentric position of the observer at the surface of the earth But the sun, and not the earth, may be regarded as the centre to which the motion is referred, and the position of any celestial body of which the distance from the sun is not so great as to be incomparable with the semidiameter of the earth's orbit would be different if viewed from the sun from what it is when viewed from the earth This difference is called the *annual parallax*, or *parallax of the great orb* It is the angle under which the semidiameter of the earth's orbit would be seen from a superior planet or from a fixed star [illegible] the enormous distances [illegible] excepting two or three instances, which perhaps may be still regarded as doubtful not one of them has yet been discovered to be sensibly affected by annual parallax, though observations have been carried to such nicety that did the quantity in question amount to a single second, it could not possibly have escaped detection

From observations of right ascension and declination, Piazzi deduced a parallax of 4″ for Sirius, and of 5 7″ for Procyon, and Calandrelli one of 4″ for α Lyræ, but these determinations have been proved to be erroneous Dr Brinkley compared [illegible] observations with the Dublin circle indicated a [illegible] parallax in the three stars, α Lyræ, α Cygni, and α Aquilæ, but Mr Pond showed that no sensible parallax in any of these stars could be deduced from the Greenwich observations, and Mr Airy has confirmed this conclusion in respect of α Lyræ Mr Henderson, however, has found a probable parallax of 1″ in the star α Centauri from observations made at the Cape of Good Hope Sir William Herschel first pointed out the micrometrical measurements of the distances of two stars very close to each other, or nearly in the same line of vision, as a likely method of detecting parallax, for the apparent distance between two such stars, if either has a sensible parallax, must vary at different times of the year, and this method has very recently been applied by Struve, at Dorpat, to α Lyræ, and by Bessel, at Konigsberg, to the double star 61 Cygni The results obtained by the latter are the most unequivocal By a series of observations with the heliometer, continued from August 1838, to March 1840, Bessel obtained the value of the parallax = 348″, a little more than the third of a second of space Assuming this determination, and astronomers seem to regard it as established within certain small limits, the distance of the star from the earth must be 519,200 times the sun's distance,—a distance so enormous that light, which travels at the rate of 192,000 miles in a second, would require 9½ years [illegible] it (*Monthly Notices of the R Astr Soc* [illegible] For the history of researches on the subject of the annual parallax, see *Mem R Astr Soc* vol xii) See STAR

PARALLELEPIPED (Gr παραλληλος επιπεδον) frequently, but incorrectly, written *Parallelopiped* A solid contained by six planes, three of which are parallel to the other three The content of this solid is found by multiplying the area of one of its faces by its distance from the opposite face Consequently parallelepipeds on equal bases and of the same height are equal

PARALLELISM In geometry are defined by Euclid [illegible] and [illegible] in the elements of geometry, and has accordingly given rise to much learned discussion The difficulty consists [illegible] so as to make the [illegible] than two right [illegible] ly produced, will at length meet on the side on which the angles are which are less than two right angles" But this is not a self evident truth It is in fact a proposition which requires to be demonstrated and the converse of it namely, that two straight lines which meet one another make with any third line the interior angles less than two right angles, forms the 17th proposition of Euclid's first book Geometers have attempted in many different ways, but without complete success, to remove this blemish from the Elements The methods which they have employed for this purpose are of three kinds 1 By adopting a new definition of parallel lines, 2. By introducing a new axiom; 3 By reasoning merely from the definition of parallel lines and the properties of lines already demonstrated

Some geometers, among whom are Wolfius, Boscovich, and Thomas Simpson, have adopted the following as the definition of parallel lines namely that "straight lines are parallel which preserve always the same distance from each other," but this [illegible] as remarked by D'Alembert, is [illegible] The correct definition would be, that two straight lines are parallel when there are two points in the one from which the perpendiculars drawn to the other, and on the same side of it, are equal" The difficulty then consists in demonstrating that *all* the perpendiculars drawn from the one of these lines to the other are equal Another definition, which has been adopted by Varignon, Bezout, and others, is, that "parallel lines are those which make equal angles with a third line towards the same parts, or make the exterior angle equal to the interior and opposite" When this definition is adopted, the difficulty [illegible] that straight lines which are equally [illegible] must be equally inclined [illegible] straight lines which fall upon them

Of the new axioms which have been substituted in place of Euclid's, we shall merely notice that given by Thomas Simpson, in the second edition of *Elements*, namely that "If two points in a straight line are posited at unequal distances from another straight line in the same plane, those two lines, being indefinitely produced on the side of the least distance will meet one another" By help of this axiom [illegible] are parallel, the [illegible] by the other are equal, and also perpendicular to the other parallel, and thence the proposition from which all the [illegible] namely that a straight line falling on two parallels makes the alternate angles equal Playfair remarks on this method, that it is extremely plain and concise, and perhaps as good as any that can be followed when a new axiom is assumed

Legendre, in his *Elements of Geometry*, has attempted to overcome the difficulty of parallel lines by previously demonstrating that all the angles of a triangle are equal to two right angles, from which proposition it is easy to prove every thing with respect to parallels His demonstration, however, is of too refined and subtle a kind to be admissible into the Elements (See the Notes to *Playfair's Euclid*, *Legendre's Geometry*, and *Leslie's Geometry* But the reader who wishes to have a complete view of what has been written on this subject should consult a learned *excursus* to the first book of *Camerer's Euclid*, Berlin, 1825, and also *Colonel P Thomson's Geometry without Axioms*)

It may be remarked, that [illegible] which exists with respect [illegible] is of a metaphysical rather than of a mathematical kind, and the learner need not perplex himself about subtleties which can hardly be considered as affecting the rigour of geometrical truth

PARALLELOGRAM Gr παραλληλογραμμον A plane four-sided figure, of which the opposite sides are parallel The area of a parallelogram is found by multiplying the length of one of its sides by that of the perpendicular let fall upon it from the opposite side Hence parallelograms on equal bases, and of the same altitudes, are equal

PARALLEL PLANES, are such as never meet, though indefinitely produced

PARALLEL RULER A mathematical instrument,

formed of two equal rulers connected by two cross bars or blades moveable about joints, so that, while the distance between the two rulers is increased or diminished their edges always remain parallel, and consequently if the edge of one of the [illegible] line [illegible]

PARALLEL SAILING, in Navigation, is sailing on a parallel of latitude, or circle parallel to the equator [illegible]

[illegible] OF ALTITUDE, in Geography, are small circles of the sphere parallel to the horizon, also ca[illegible]

[illegible] DECLINATION In Astronomy, small circles of [illegible] o the equator

PARALLEL [illegible] on the terrestrial [illegible] are [illegible] circles parallel to the equator but, in [illegible] celestial spa[illegible] they are parallel to the ecliptic

PARALLEL SPHERE in Geography is that position of the sphere in which the equator coincides with the horizon, and the poles are in the zenith and nadir This is the appearance which the sphere would have to a spectator placed at the pole The stars neither rise nor set, but move constantly in circles parallel to the horizon, and the sun rises and sets only once a year

PARA'LOGISM (Gr παρα, *beside*, and λογος, *reason*) In Logic and Rhetoric, a reasoning which is false in point of form, i e in which a conclusion is drawn from premises which do not logically warrant it It is the opposite to a syllogism or correct logical deduction *See* SYLLOGISM

PARA'LYSIS (Gr παραλυω, *I weaken*) Palsy A diminution or loss of power of any part of the body In general one side only is affected, or the upper or lower extremities Whatever debilitates the system may produce palsy; it is also produced by pressure upon certain parts of the brain and spinal marrow, and occasionally by poisons, by local injuries, and by the sudden [illegible] of certain evacuations It frequently [illegible] tortion of the mouth or eye, the speech becoming indistinct and the judgment often impaired The treatment of palsy depends upon a careful consideration of its cause, more or less depletion is generally required, together with purges and nervine stimulants, such as ammonia &c and blisters to the head and neck

PARAMETER In Geometry a constant straight line belonging to each of the three conic sections, otherwise called the *latus rectum* In the parabola, the parameter is a third proportional to the abscis and its corresponding ordinate, in the ellipse and hyperbola, the parameter of a diameter is a third proportional to that diameter and its conjugate The term is also used in a general sense, to denote the constant quantity which enters into the equation of a curve

PARA'MO (Sometimes rendered though incorrectly by *desert* or *heath*) The name given in South America to a mountainous district covered with stunted trees, exposed to the winds, and in which a damp cold perpetually prevails Under the torrid zone the Paramos are generally from 10,000 to 12 000 feet in height Snow often falls on them, but remains only a few hours in which respect they are distinguished from the *Nevados*, which enter the limits of perpetual snow The Paramos are almost constantly enveloped in a cold thick fog, so that when a thick small rain falls, accompanied with a depression of the temperature they say at Bogota or at Mexico, *cae un paramito* Hence has been formed the provincial word *emparamarse*, — to be as cold as if one were on a *paramo* (*Humb Pers Nar* ii p 252)

PARANAPHTHALINE A substance so termed from Gr παρα, *near to*, because it closely resembles *naphthaline* It appears to be a mixture of paraffine and naphthaline

PARANTHINE A rare mineral, so named by Hauy, [illegible]

PARANYMPH [illegible] A bridesman It is translated in our version of the Scriptures by "master of the feast"

PARAPET, or [illegible] (Ital parapetto, *breast work*) In [illegible] r screen raised on the extreme edge of a rampart or other work through which [illegible] openings are cut for the cannon to fire through The solid parts of the parapet, between the embrasures, are called the *merlons* In common language a parapet is a breast wall raised on the edges of bridges quays &c to prevent people from falling over

PARAPH (Gr παρα, *beside*, γραφω, *I touch*) In Diplomatics, the figure formed by a flourish of the pen at the conclusion of a signature This formed, in the middle ages, a sort of rude provision against forgery, like the flourishes in the plates of bank notes. In some countries (as in Spain) the paraph is still a usual addition to a signature

PARAPHERNALIA (Gr φερνη, *a dowry*) In the Civil Law the apparel jewels, &c of a wife, which are held to belong to her as a species of separate property The husband may dispose of them in her lifetime, but cannot bequeath them away from her, and if he have not parted with them before his death, she may retain them against his executors [illegible] his creditors, where his other [illegible] satisfy their claims

PARAPHO'NIA (Gr παρα, and φωνη, *voice*.) Alteration of voice

PARAPHRASE (Gr παρα, *beside*, and φραζω, *I speak*) In Rhetoric, the rendering of a passage or portion of writing in other phraseology, more distinct and easier of explanation, and therefore usually at greater length A loose translation or one in which a new series of ideas and illustrations conveying the same general meaning with those of the original is substituted for them, is also termed a paraphrase, although not with strict propriety

PARAPHY'SES (Gr παρα and φυω *I grow*) A term used in describing [illegible] of the sessile ovate abortive bodies [illegible]

PARAPLEGIA (Gr παραπληττω, *I strike inharmoniously*) Palsy of the upper or of the lower half of the body

PARASANG (Gr) A Persian measure of length, according to Herodotus, equal to 30 stadia and (reckoning 8 stadia to the English mile) equal to 3¾ English miles The length of the parasang was reckoned differently by different authors, and such are the discrepant estimates of the ancients that some have assigned it the length of 60 stadia The word is supposed to be derived from the Persian seng signifying *a stone*

PARASCENIUM (Gr παρα, and σκηνη, *a scene*) In Antiquities, called also *postscenium*, the back part of a theatre beyond the stage, or the room to which actors withdrew on quitting the stage It was equivalent to the modern *green room*

PARASITE (Gr παρα, *at hand*, and σιτος, *food*) Originally according to Crates in Athenæus, a term of honour, being the appellation of certain ministers at sacrifices, whose office is not distinctly ascertained (See *Mem de l'Acad des Inscr* vol xxxi) The habits of a luxurious age produced the race of poor companions, ready guests at the table of a patron, who formed a standing character in the later Greek comedy Some attribute the first conception of the dramatic personage to Araros, the son of Aristophanes Diphilus, according to Athenæus gave the most complete portrait of it in his comedy *Telesias* Our notions of the ancient parasite are now derived chiefly from the Latin comic poets Ingenious writers have divided parasites into four classes —1 The poor confidential friend, whose services to his patron are sometimes rendered with a mixture of real attachment, as in the character of Ergasilus in the *Captives* of Plautus 2 The guest who is invited with a view to make him pay for his reception by the exertion of his powers of entertainment (Anglicè diner out), the "ridiculi" and "derisores" of Plautus, and what [illegible] by Juvenal Balatro, the two umbræ of Mæcenas at the supper of Nasidienus, seem to have partaken of this quality These degenerated, thirdly, into the class of mere buffoons, who were invited to play tricks and undergo practical jokes, under pain, as Ergasilus complains in the play already cited, if they refused to lend themselves to the manual pleasantries of their guests, of "taking up their beggar's wallet and marching" The fourth and worst class κολακες, were the attendant flatterers of their patron Such is Artotrogus, or Toutcutter the humble companion of Pyrgo-Polinices in the *Miles Gloriosus* of Plautus, and the best known of all parasites Gnatho, in the *Eunuch* of Terence

PARASITES In Zoology, this term, as designative of a group of animals, is variously applied by different naturalists Lamarck includes under it a family of antennated Arachnidans, Cuvier, Latreille, and Kirby apply the term to an order of Apterous insects, Straus to a tribe of Crustaceans but all the sections include animals of parasitic habits

PARASITICAL PLANTS, are those which grow into the tissue of other species, and feed upon their juices Of this kind are the mistletoe, the broom rape (*Orobanche*) the *Lathræa*, and among exotics, the monstrous *Rafflesia* Such plants have no proper roots The term *parasite* is however often applied to mosses, orchidaceous plants Tillandsias and the like, which are mostly perennials growing upon the bark of trees, but deriving their food from the air by means of their own roots

PARASTATÆ (Gr παρα, *from*, and ιστημι, *I stand*) In Architecture pilasters, or rather square pillars which stand insulated *See* ANTA

PARATAXIS (Gr παρατασσω *I arrange side by side*) In Grammar opposed to Syntax The mere ranging of propositions one after another, as the corresponding judgments present themselves to our mind, without marking their dependance on each other by way of consequence or the like

PARBUCKLE In Naval language, to roll a cask

or any cylindrical body by pulling upon ropes fastened towards the place [illegible] the ground or [illegible] ends or quarters

PA'RCÆ The Latin name of the Fates According to Klausen (art "Parcæ," in the *Encyclopedia* of Ersch and Gruber), the original Roman Parca (the thrifty or avaricious goddess) was equivalent to Mors, the goddess of death, the third of the Fates It was not until the Augustan age, when the Greek and Roman mythology became mingled, that the Parcæ became plural (*Virg Ec* iv 47) and acquired their similarity to the Greek Moiræ, Clotho Lachesis, and Atropos

PARCEL A ROPE In Naval language, to cover it smoothly with tarred canvass, which is then bound over with spun-yarn

PARCENERS In Law *See* COPARCENERS

PA'RCHMENT (Fr parchemin) A material formed of the prepared skins of calves or sheep and goats when intended to be written upon A similar but finer kind of calves', kids', and lambs' skin is called *vellum* The skins are first prepared as for tanning then shaved down and pumiced and limed, stretched and carefully dried The parchment of drums is made of the skins of asses calves, and wolves, ass skin is used for battledores, and goat skin is preferred for sieves For some kinds of bookbinding parchment is dyed green by verdigrease (See *Ure's Dictionary of Arts*)

Parchment was known at a very early period It was used for writing as early as the year 250 before the Christian era by Eumenes, king of Pergamus, who, desirous of collecting a library which should vie with that of Alexandria, but prevented by the jealousy of the Ptolemies from obtaining a sufficient quantity of papyrus, had recourse to this substitute, and its invention at Pergamus claimed and secured to it the lasting name of Pergamena whence *parchment* (*Sir G Wilkinson's Manners and Customs of the Ancient Egyptians*, iii 151) In the beginning of the eighth century, the use of the papyrus was almost entirely superseded by parchment, on which we find that all the public documents under Charlemagne and his dynasty were written When the different kinds of parchment came into use for the purposes of writing, they were rolled up before they could be sealed hence the word *volumen* from Lat volvere, *to roll* And as parties wrote to the very bottom of the parchment, [illegible] to the place where the cord used for the folding was fastened, we may account for the well known expression *opus ad umbilicum perductum*

PA'RDON In Law [illegible] prerogative of the crown to pardon all offences merely against the crown or the public, excepting the offence of committing any person to prison out of the realm, which by the Habeas Corpus Act is made a præmunire, unpardonable even by the king and excepting those offences in the prosecution of which private justice is in some measure concerned, as nuisances and offences against a popular or penal statute after information, for thereupon the informer has a private property in his part of the penalty Pardon is granted under the great seal, or by warrant under the sign manual, countersigned by one of the principal secretaries of state, or by act of parliament Its effect is, in almost all cases, to make the offender a new man and [illegible] the penal consequences attach-

[illegible] παρα, and ἐκβαινω, *I go out of*) The word used by Greek authors [illegible] Latins is called digression, by *Quintilian* [illegible] "alienæ rei, sed ad utilitatem causæ pertinentis, extrâ ordinem occurrens structura"

PARIGORIC (Gr παρηγορεω *I assuage*) That which allays pain *Paregoric elixir* is a camphorated tincture of opium flavoured by oil of aniseed

PARIRA BRA'VA The root of the *Cissampelos pareira*, brought from South America It has a sweetish and a bitter flavour and has been used in nephritic complaints and some affections of the bladder

PARMELIA In Botany a kind of lichen, the *Lecanora parella*, found on rocks in mountainous countries especially in the north of Europe It is the *Perelle* of Auvergne, where it is extensively used by the dyer, and is found equal to orcha (*Rocella tinctoria*)

PARE'NTHESIS [illegible] in the [illegible] tically cohere, by way of explaining something It is [illegible] and is a species of parentheses

PARENCHY'MA (Gr παρεγχεω *to strain through*) The spongy and cellular tissue of animals and vegetables The old physiologists supposed that the crude juices underwent [illegible] in the cellular substance

PARENCHYMATOUS ENTOZOONS *Parenchymatosa* (Gr παρεγχυμα) An order of Entozoa, including those which have their nutrient canals simply excavated in the parenchymatous tissue of which their [illegible] *See* HELMINTHA

PARENTHESIS (Gr. παρα and ἐν, and the verb τιθημι, *I place*.) In Rhetoric, a figure by which a series of words is inserted in a sentence, having no grammatical [illegible] with those which precede or follow, with the object of explaining some detached portion of the sentence. In ancient authors, a parenthetical form of writing is [illegible] because much [illegible] have conveyed by way of parenthesis is now inserted in separate ex-[illegible]

PARGASITE A variety of actinolite, from Pargas in Finland

PA'RGET (Etymology uncertain) In Architecture the plaster formed of lime, hair, and cow-dung, used for coating [illegible] of [illegible]

PARHELION or MOCK SUN (Gr παρα, and ἡλιος, *the sun*) A meteor which consists in the simultaneous appearance of several suns, "fantastic images of the true one" These images appear at the same height above the horizon as the true sun, and they are always connected with one another by a white horizontal circle or halo, of which the pole is at the zenith and the apparent semidiameter equal to the sun's distance from the zenith The images or mock suns, which appear on the same side of this circle with the true sun, are tinted with the prismatic colours, and sometimes a part of the circle itself contiguous to them appears coloured But those which appear on the circumference opposite to the sun are always without colour, whence it may be conjectured that these (as well as the luminous ring itself) are produced by reflection, and the others by refraction In general when these phenomena are produced, the sun is surrounded by one or more concentric circular coronæ which exhibit the colours of the rainbow, and sometimes arcs of circles or even entire circles, appear touching the coronæ These also are coloured and contain other parhelia The phenomenon has been described by Aristotle, Pliny, Scheiner, Descartes, and many others, but the most perfect apparition yet recorded is that which was observed by Hevelius at Dantzic, on the 20th of February, 1661 It is represented in the annexed figure



Parhelia have continued visible for two three, or four hours In general two, but sometimes four and even six or seven are visible together

No very satisfactory explanation of the cause of these curious but rare phenomena has yet been given Huygens supposed them to be produced partly by the reflection and partly by the refraction of the sun's rays, falling on an infinite number of small cylinders of ice suspended vertically in the atmosphere, and having certain determinate positions relative to the sun and the observer This theory is explained at length in the second volume of his *Opera Posthuma* (See also *Smith's Optics*, *Priestly on Light*, Biot, *Traité de Physique*, tom iii)

Fraunhofer, in a memoir on halos and parhelia, published in *Schumacher's Astronomische Abhandlungen*, p iii has attempted to explain these phenomena on a different principle On looking at the sun through a horizontal grating of very fine wires two images of the sun appear one above and the other below the true sun, and, if there is some inequality in the distances between the wires the images appear slightly coloured, and a vertical streak of light is seen [illegible] that this affords a clue to the theory of [illegible] small spherules of moisture floating in the atmosphere are disposed in horizontal parallel lines with tolerable regularity, two vertical parhelia (but this is a very rare phenomenon) will be seen, and if they are disposed in vertical lines, the more common phenomena of horizontal parhelia with the luminous circles may be produced It must be confessed, however that even when this arrangement of the particles of vapour in parallel lines is admitted several circumstances attending the phenomena will still remain unexplained

*Parasclenæ*, or images of the moon, are also seen under similar circumstances as parhelia the same theory will of course apply to both

PARIAN CHRONICLE (So called from the island of Paros, where it was originally found) The name given to one of the celebrated marbles imported into England with the rest of the collection known by the name of the Arundelian In its perfect state it contained a chronological register of the principal events in the history of ancient Greece during a series of 1318 years beginning with the reign of Cecrops, the first king of Athens, B C 1582, and ending with the archonship of Diognetus, but the last ninety years are nearly obliterated by the injuries of time, so that the part which now remains ends at the [illegible] of Diotimus, B C 354

The [illegible] on which the chronicle is engraved is 5 inches in thickness, and measured, when Selden viewed it, 3 feet 7 inches by 2 feet 7; but one corner had been broken off It contained originally about 100 lines, each consisting on an average of 116 words, or 130 letters;

so that the whole might have been comprised in six octavo pages

This venerable monument was purchased at Smyrna, with many others by Mr W Petty, who was employed by the Earl of Arundel, in the year 1624 for the purpose of collecting marbles [illegible] curiosities in Italy Greece, and [illegible] brought to England, in 1627 it was placed in the gardens belonging to Arundel House, the site of which is now occupied by Arundel, Norfolk, Surrey, and Howard Streets [illegible] Strand, and early on the following day it was examined, with eager curiosity, by some of the most distinguished literati of that time; among whom were Sir R Cotton, Selden, Patrick Young, and Richard James After much labour it was deciphered and [illegible] published by Selden in the year 1628, accompanied [illegible] translation and commentary

During the civil wars and the subsequent usurpation of Cromwell, the Parian Chronicle was unfortunately broken into smaller fragments, and almost entirely defaced The upper part, containing nearly half the original tablet, is said to have been used in repairing a chimneypiece or hearth in Arundel House, but luckily the inscription, or at least as much of it as could be made out, was preserved in the copy which Selden had previously taken and published In the year 1667 the remaining fragments were presented by the Hon Henry Howard, grandson of the first collector, to the University of Oxford, where they are now deposited

The genuineness of this valuable relic of antiquity was universally acknowledged throughout Europe as soon as its contents were made known Its authority was considered as equal, if not superior, to any other, writers of the first eminence derived the greatest advantage from it in their historical and chronological researches, and it was not till the year 1788 when the Rev John Robertson a gentleman of considerable learning and industry, published an elaborate volume called *A Dissertation on the Authenticity of the Parian Chronicle*, in which he maintained it to be a fabrication of modern times that its authenticity was impeached The doubts and objections of Mr R were founded on the following considerations — 1 The characters have no certain or unequivocal marks of antiquity 2 It is not probable that the chronicle was engraved for private use 3 It does not appear to have been engraved by public authority 4 The Greek and Roman writers for a long time after the date of this work, complain that they had no chronological account of the affairs of ancient Greece 5 This chronicle is not once mentioned by any writer of antiquity 6 Some of the facts seem to have been taken from authors of a later date 7 Parachronisms appear in some of the epochs, which we [illegible] in the 129th Olympiad, [illegible] history of [illegible] unsatisfactor[illegible] frequently imposed upon by spurious books and inscriptions and therefore we should be extremely cautious with regard to what we receive under the venerable name of antiquity

These observations were made the subject of separate chapters and disquisitions, and were illustrated with such candour and extensive erudition that for a short time the credit of the Parian Chronicle was shaken in the public opinion Early however, in the following year, the objections of Mr Robertson were replied to by Mr Hewlett, in a pamphlet entitled *A Vindication of the Authenticity of the Parian Chronicle*, Lond 1789, by Mr Gough, in the ninth vol of the *Archæologia*, and by Porson, in the *Monthly Review*, and the result of their inquiries, coupled with the defence of Wagner (Gott 1790), and the more recent investigations of Hales in his *Chronology* and of Böckh in the second volume of his *Corpus Inscriptionum* leave no doubt respecting the authenticity and antiquity of the Parian Chronicle It is impossible within our limits to give a detailed account of the manner in which these different writers [illegible] Mr Robertson suffice [illegible] shed satisfactorily that the Parian Chronicle is written in pure and classical Greek, that the characters bear several marks of antiquity, that the events it recounts are infinitely too minute and detailed to have been forged, and lastly, that the silence of classical writers respecting it (which is perhaps the strongest argument against its [illegible]) may be easily accounted for from the retired and [illegible] situation of Paros The reader will find in vol i of *Hales's Analysis of Chronology* an examination of the dates assigned to the different events recorded in the Parian Chronicle)

PARIAN MARBLE See MARBLE

PARIAS The lowest class of the inhabitants of some parts of Hindostan, who have, properly speaking no caste, and are supposed to be descended from original races of [illegible] since conquered by foreign invaders In the widest sense the term appears to comprehend *all* the different classes of distinct non-Hindoo tribes, and degraded or foreign races, not comprised in the four Hindoo [illegible] of the whole popu[illegible]

PARIETAL (Lat *paries a wall*) In Botany any organ which grows from the sides of another Those ovaries are parietal which grow from the sides of a calyx, and placentæ or ovules have this name when they proceed from the sides of the ovary

PARIETAL BONES Two arched and irregularly square bones one on each side of the superior part of the skull So called from *paries, a wall*, because they protect the brain like walls

PAR-IMPAR Among the Romans, the game of *even or odd* The game was played exactly as it is at present among the children of our own country

PARING AND BURNING The operation of paring off the surface of worn-out grass land, or lands covered with [illegible] like of the ashes [illegible] of weeds seeds, insects, &c [illegible] use of this mode of improving land, the greater number preferring a naked fallow even for one or two years, alleging that more injury is done by the vegetable matter lost in burning, than benefit obtained by the ashes produced Where the object is to bring land abounding in coarse herbage immediately into a state of good culture, paring and burning is evidently the most rapid mode that can be employed, and if the soil contains calcareous matter, burning will have nearly the same effect on it as if a dressing of quicklime had been applied Much, however, depends on the mode in which the land is treated afterwards

PARISH (G[illegible]) Properly, an ecclesiastical [illegible] subject to the ministry of [illegible] ges of the church, the parochia was the district placed under the superintendence of the bishop and was equivalent to the diocese It denoted, says Bingham, not only what we now call a parish church, but a city with its adjacent towns or country regions It was not until the Christians became sufficiently numerous to present distinct congregations in the smaller towns and villages that the bishop appointed his presbyters to reside among them, and thus subdivided his diocese into several parishes This constitution is recognized in several councils and other monuments of the fifth century It is, indeed, probable that in many cities there existed more than one church and congregation even in the time of the apostles, but it does not appear whether these deserved the name of parishes, as being each under the distinct superintendence of its respective pastor But although parishes were originally ecclesiastical divisions, they may now be more properly considered as coming under the class of civil divisions, and consequently claim our attention under this head It is not easy to determine the era of the division of England into parishes, they are mentioned in the laws of King Edgar so early as 970, when the whole kingdom seems to have been divided into parishes, but it is probable that the division was not made at once, but by degrees [illegible] Blackstone pretty clear and certain [illegible] of parishes were originally ascertained by those of manors, for it very seldom happens that a manor extends itself over more parishes than one, though there are often many manors in one parish The parochial division of England was nearly the same in the reign of Edward I (1272—1307) as at present

Parishes are frequently intermixed with one another This seems to have arisen from the lord of the manor having had a parcel of land detached from the main part of his estate, but not sufficient to form a parish of itself. It was natural for him to endow the church which he had erected upon his principal estate with the tithes of these disjointed lands [illegible] happened that there was no church in any [illegible] them

The boundaries of parishes depend on immemorial custom, but it is probable that they were not settled with very minute precision till the introduction of the poor laws, when [illegible] of the claim for relief upon their pa[illegible] became a matter [illegible] of each parish [illegible] by legislative enactment

In the northern counties, where the parishes sometimes embrace thirty or forty square miles, the poor laws, the due administration of which must always depend on an intimate knowledge of the situation and character of every one applying for relief could not be properly carried into effect To remedy this inconvenience, an act was passed in the 13th of Charles II permitting townships and villages, though not entire parishes, severally and distinctly to maintain their own poor Hence townships in the north of England may be regarded as divisions subordinate to parishes, and are, in practice, as distinctly limited as if they were separate parishes

Towns originally contained but one parish, but, from

the increase of inhabitants, many of them are now divided into several parishes

Besides parishes or townships, there are places which are deemed extra-parochial, or not within the limits of any parish These were formerly the site of religious houses, or of castles, the owners of which would not permit any interference with their rights At present they enjoy some most valuable privileges, among others, a virtual exemption from the poor's rate, because there is no overseer on whom the order of a magistrate may be served — from the militia laws, because there is no constable to make the return — and from repairing the highways, because there is no surveyor Their tithes are by immemorial custom, payable to the king instead of the bishop The number of such places is not inconsiderable amounting to more than 200 It seems highly inexpedient that any part of the country should enjoy such an exemption from burdens imposed for the benefit of the community Extra-parochial wastes and marsh lands, when improved and drained, are assessed to all parochial rates in the parish next adjoining In some counties, *liberties* interrupt the general course of law as affecting hundreds, in the same manner as extra-parochial places do with regard to parishes This inconvenience is particularly felt in Dorsetshire The number of parishes and parochial chapelries in England and Wales is not exactly ascertained, but there are not many doubtful cases, and for any general purpose they may safely be taken at 10,700 About 550 parishes extend into two counties or into more than one hundred or other divisions (*Blackstone's Commentaries*, Introd § 4, and *Preliminary Remarks to Census of* 1831 pp 14—18)

The parishes of Scotland are purely ecclesiastical for an account of the system on which they are divided, we must refer the reader to the article PRESBYTERY

PARISH CLERK The name of one of the lowest functionaries of the English church Parish clerks are regarded by the common law as persons having freeholds in their office, and consequently though they may be punished, they cannot be deprived, by ecclesiastical censures In former times parish clerks were frequently in orders, and even at present this is sometimes the case They are generally appointed by the incumbent, but by custom may be chosen by the inhabitants

PARK A considerable extent of pasture and wood land surrounding or adjoining the country residence of a man of wealth, devoted to purposes of recreation or enjoyment, but chiefly to the support of a herd of deer, though sometimes to cattle and sheep Parks were originally nothing more than portions of forest scenery appropriated by the lord of the soil for the exclusive use of animals of the chase, but this is now become in many cases a secondary consideration and the chief uses of a park are as indications of wealth and extent of territory, and as grazing grounds for domesticated animals

PARK OF ARTILLERY An assemblage of the heavy ordnance belonging to an army with its carriages ammunition waggons, and stores, on ground contiguous to that occupied by the troops when encamped *See* ARTILLERY PARK

PARLIAMENT (In modern Latin *parliamentum* in French *parlement*, from the Fr *parler to speak*) The supreme legislative assembly of Great Britain and Ireland

*Origin of Parliament* — By the principles of the feudal system every sovereign and every great feudatory had his council, composed of his greater and lesser vassals which occasionally assembled to assist him both in judicial and legislative matters, and which was held in theory to be permanent, so that its assent was necessary to the validity of his acts And it was also an ancient custom, in several of the western kingdoms of Europe for such potentates to hold assemblies of their barons at the great festivals of the year, termed *cours plenieres* and *parlemens*, principally, however, for the mere purpose of show and magnificence occasionally such special assemblies were summoned for more important purposes and the meeting in 1146 at which the crusade of Saint Louis was undertaken is said to furnish the first occasion in which the word parliament is used for a deliberative assembly In France however, the word was afterwards transferred to signify the principal judicial courts of that country (*See* PARLIAMENT) The only realms in which it appears to have become appropriated to the great legislative assemblies are England, Scotland and the Norman kingdom of Sicily The parliament of the latter country consisted, in the 13th century, of spiritual and temporal barons summoned by the king's writ, and occasionally, but not uniformly, of deputies from the towns similarly summoned

All the extensive and laborious researches which have been made, of late years, towards dispelling the obscurity which rests over the commencement and early constitution of our parliaments have only shown that little new information is attainable on the subject We can, indeed, conjecture pretty accurately the process by which meetings of delegates for the purpose of apportioning taxation became gradually assemblies, granting or refusing supplies with absolute authority; and that by which a convention summoned for the object of representing grievances to the sovereign and giving their approbation to his acts became a sovereign legislative body But to investigate the internal changes in the assembly itself, the mode by which it became divided into distinct chambers, the manner in which the peerage was formed as a distinct body out of the free baronage of the country and that in which the lower house acquired the features of a regular representative body, may be safely pronounced with our present knowledge impossible

The Norman and Plantagenet kings had two councils, — the great council of the kingdom, and the lesser or privy council, and it may be freely stated, after making all deductions from the principle on the score of arbitrary powers occasionally exercised by the sovereign that, ever since the Norman conquest the supreme legislative power in England has been placed in the king in great council conjointly It was, moreover, in early times, a court of crimi[illegible] in all the more[illegible] It interfered even in matters of ecclesiastical discipline, in questions of peace and war of grace and justice, and, by way of advice in the appointment to vacant offices, civil or ecclesiastical The [illegible] of the great council were at stated festivals [illegible] Norman kings, but after the civil wars in the reign of Stephen they were summoned at irregular periods The inferior or privy council which, as well as the great council, is indifferently termed *curia regis* in early writers, was composed of members named by the king, and constantly attended on his person, and this inferior body usurped during the decadence of the great council and before the full establishment of parliament many of the legislative functions of the former but by Magna Charta all aids and scutages were to be assessed by the great council, which thus in principle at least, possessed a control over the extraordinary revenues of the crown Any meeting of the great council, or of a portion of it, went by the ordinary name of a parliament or colloquy

But of the constituent parts of this assembly, and the changes which took place in it, no writers give a satisfactory account All we know is that it was supposed to consist of all the tenants in chief of the crown, but by the charter of King John, the archbishops bishops abbots, [illegible] From this distinction is supposed to have arisen the institution [illegible] nobility [illegible] of England from those of all other feudal monarchies

From these mixed assemblies to a representative body [illegible]

Oxford But the better known and more distinct evidence of [illegible] of the system is found in the Earl of Leicester's parliament after the battle of Lewes, in 48 Hen 3 when four knights for every county (except nine) were summoned to attend with the barons probably as representatives of the inferior nobility or lesser barons, and in the following years were issued the earliest writs of summons to parliament These were to archbishops bishops and abbots, to certain earls and barons of the party of the Earl of Leicester, and to the sheriffs of counties and boroughs, to return two knights and burgesses, besides four from each of the Cinque Ports And although no subsequent writs directed to the sheriffs for the purpose of county elections are in existence earlier than 18 Edw 1, nor of borough elections earlier than the 23d of the same reign, yet it is at least highly probable that the example set by the rebellious Earl of Leicester was ever after substantially followed, and that the representatives of counties and towns were occasionally summoned to parliament, as well for the purpose of assessing tallage and other aids demanded, as for that of giving their counsel respecting other affairs of the government Edw 1 rarely held more parliaments in a year, nor does it appear that these were legislative assemblies they were rather supreme courts of justice, chiefly attended by the ordinary or privy councillors of the king, while the legislative assembly, certainly composed, after the 23d of this reign, of lords spiritual and temporal and representatives of the commons, was summoned to meet the king occasionally during one of these parliaments

The constitutional law of the country, whatever it may have been in practice, was first declared by the statute 15 Edw 2, which annulled the award against the king's favourites, the Despencers In this act the legislative authority was declared to reside in the king, with the assent of the prelates, earls, barons, and commons, as-

sembled in parliament; and from that time the real existence of that body, and of the form of government which has ever since subsisted has been uninterrupted except only during the period of the Commonwealth

The division of parliament into two houses took place at a period which it is not possible to ascertain; but it is probable that the three orders met in separate conventions for the purpose of assessing taxation, and that the representatives of the commons were at no period admitted to sit in the same chamber with the earls and barons after these were expressly summoned by the king Although the numbers of both houses have varied materially, no fundamental alteration in their constitution took place from this time until the union with Scotland (See the Report of the [illegible] the Dignity of a Peer, *Hallam's* [illegible] *England*)

HOUSE OF LORDS — 1 *Temporal Peers* — The origin of the English peerage is involved in the same obscurity which rests on other parts of our early constitutional history The greater barons, as before stated, appear under the first Plantagenet kings to have been those who were personally summoned to the council while inferior tenants in capite were summoned together by a general compellation, but at what period their dignity became strictly hereditary is unknown

Baronies are either by tenure, by writ, or by patent The first were the original feudal titles, in which dignity was invariably attached to the possession of land The greater barons, who sat of right in the great council are supposed up to the reign of Henry III to have been those who were in the possession of entire baronies But from the date of 22 Edw I it appears that the possessors of entire baronies ceased, of right, to be summoned to parliament, and it is therefore generally held that no barony by tenure subsists at the present day although some recent efforts have been made to establish a title to this peculiar dignity, the latest claim having been made on the barony of Berkeley, by virtue of possession of the castle of that name

Baronies by writ were created by writ of summons to parliament, which constituted an individual so addressed by name baron of the realm and, it is supposed also made that dignity hereditary The earliest writ of this description was issued 49 Hen 3, and two now existing baronies (Despencer and Roos) are considered to have been created by it In the case of a barony by writ the dignity is not conferred until the person so summoned has actually sat in parliament Baronies by writ descend in fee to all the heirs of the body of the person first created If there be no son and more daughters than one the title falls into abeyance until only one daughter or the sole heir of only one daughter survives

Baronies by patent are created by letters patent under the great seal conferring the dignity on the donee, in which are inserted words of limitation These are usually to the heirs male of the body of the donee, and where there are no words of limitation in letters patent, it is held that the dignity will pass in the same course Otherwise the limitation is to other classes of heirs or to specified persons, and their heirs by way of remainder See REMAINDER

*Viscounteies* are always created by letters patent This is the most modern of English titles of peerage, and was first conferred on John Viscount Beaumont 18 Hen 6 The title vice-comes or vice-earl had been long employed to denote the sheriff of a county

*Earldoms* were introduced into England by the Normans at the Conquest The dignity of an earl seems to have been originally attached to the possession of a particular tract of land, but in the reign of Edward III it began to be conferred by charters or letters patent with an express limitation either to heirs general or heirs male of the body of the grantee The word earl is of Saxon origin, but answers in dignity to the count (comes), in languages of Latin descent

Of *Marquisates* the first was that of Dublin conferred on Robert de Vere, Earl of Oxford for life, by Richard II The term marquis is derived from the Latin marchio, signifying a military officer, governor of the mark or frontier This dignity has been always conferred by letters patent

*Dukedoms* are [illegible] peerage The first was cr [illegible] he Black Prince was ma [illegible] is been a question whether the duchies of Cornwall and Lancaster were not duchies by tenure, but every other dukedom is a mere personal honour, and conferred by charter or letters patent The term duke is derived from the Latin dux, *leader of an army*, answering to the German herzog, which has the same signification

All peerages are forfeited by attainder for high treason, and attainder is consequent either on judgment or on outlawry, upon an indictment for that offence Nothing but a reversal of such act of attainder by parliament can restore an attainted person, or his posterity, to the lost dignity But where a peerage is vested in a person in tail male, with remainder over to another in tail male, if the first be attainted the peerage is forfeited as to him and his issue male, but, failing such issue male, the dignity becomes vested in the remainder-man, or his descendant

Peerages by writ are also forfeited by attainder for felony, but not peerages by charter or letters patent

By the twenty second and twenty-third articles of the Union between England and Scotland sixteen representatives are elected by the Scots peers to serve in every parliament of the United Kingdom The eldest sons of Scottish peers were rendered, by a decision of the House of Commons shortly after the union, incapable of sitting in parliament It was held for a long time that a Scottish peer could not sit in the House of Lords if he became a peer of Great Britain, but the point was decided the other way in 1780

By the Act of Union between Great Britain and Ireland (39 & 40 G 3 c 67), twenty-eight lords temporal are elected for life by the peers of Ireland Peers of Ireland, who are members of the House of Commons, are not eligible to serve as peers while they continue members of the former house

2 *Lords Spiritual* — The right of the two archbishops and twenty-four bishops of England and Wales to sit and vote in parliament as members of the House of Lords, is generally said to belong to them as barons of the realm It is undoubtedly probable that at the period of the Conquest a change took place in the tenure of the lands which were held by bishops and the high regular clergy, and that the Norman tenure by barony then introduced for the first time, was made to comprehend both spiritual and temporal possessions which under the Saxon kings had been regarded in a different light But it is most probable that the dignitaries of the church were constituent members of the great council of the realm, by the English as well as all other feudal constitutions independent of their quality as barons (see *Hallam, Middle Ages* c viii part 3), but that the place which was assigned them in the House of Lords when the two houses became separate, was in virtue of their baronial character Under the Plantagenet kings the clergy were summoned to meet by their representatives, as well as the laity, when subsidies were required, and under Edward I (see *Luders on Parliaments* chap iii) attempts were made to unite them and the laity together in parliament, but they were always resisted by the clergy, and at last they ceased altogether to attend in any capacity, retaining their own assemblies (*See* CONVOCATION) At the period of the dissolution of monasteries by Henry VIII the spiritual lords consisted of the then archbishops and bishops, and of twenty-six mitred abbots, and two priors, all of whom were then removed on the dissolution of their houses The present spiritual lords have the same rights and privileges in every respect as the temporal except that it is still a disputed point in constitutional law whether they have a right, on charge of treason and felony, to a trial by the peers, and it is also doubted whether they have judicial power, as peers, in capital cases

By the Act of Union between Great Britain and Ireland, four lords spiritual from among the archbishops and bishops of that country sit in the House of Lords by rotation of session

HOUSE OF COMMONS — I *Persons qualified to serve in it* — Persons incompetent to sit as members of parliament are first [illegible] under the disqualities of alienship attainder [illegible] minority lunacy & [illegible] next those who are disqualified by the possession of certain offices or by certain other temporary causes Clergymen, peers Scotch peers, Irish peers for places in Ireland, the eldest sons of Scotch peers for places in Scotland the fifteen judges of England, the Scotch judges and barons of the Scotch exchequer, are ineligible Where the influence of government is supposed to have a direct control over the party, a disqualification has been created by various statutes Persons concerned in the management of the revenues, with some few exceptions are ineligible So are persons holding new offices under the crown created since 1705, together with other persons mentioned in 6 Anne, c 7 So pensioners during pleasure or for a term of years, police magistrates government contractors, and placemen in public offices specified in 15 G 2 c 22 There are also offices connected with the excise and customs which only disqualify the holder from sitting and voting, but not from being elected Persons returned on a double return are not competent to sit until the return is decided by a committee

The acceptance of any office of profit from the crown by a member vacates his seat, by 6 Anne, c 7 And there are two places of no profit, the acceptance of which is considered to vacate a seat, viz the stewardship of the [illegible] the manor of [illegible] receiving new [illegible] so are those who accept a foreign employment, as ambassadors

A member becoming a bankrupt is incapable of sitting and voting for a year unless within that time the commission is superseded or the creditors paid, if this be not done within the year, the seat of the member is vacated

W [illegible]

II *Electoral Franchise* [illegible] Scotland and Ireland, and the changes introduced by the Reform Act the House of Commons consists of 658 members [illegible] English and Welsh, 53 Scotch, 105 Irish — divided as follows

| | English and Welsh | Scotch | Irish |
|---|---|---|---|
| Counties - - - | 159 | 30 | 64 |
| Boroughs - - - | 337 | 23 | 39 |
| Universities—Oxford - | 2 | | Dublin 2 |
| Cambridge | 2 | | |
| | 500 | 53 | 105 |

All persons are competent to vote in the election of members of parliament, except infants women, aliens (unless made denizens by letters patent or naturalized by act of parliament), persons convicted of felony and certain other infamous crimes, peers, Irish peers, unless themselves members of the House of Commons and persons holding various employments under government not freehold offices There are also some temporary disqualifications, arising out of employment in particular characters at elections and the receipt of public alms They must however possess a certain qualification, which (except in the universities, in which the right of voting belongs to all such as have attained certain academical degrees) is one of property

1 In English and Welsh counties the right of voting belongs to all such as possess a freehold estate in lands tenements, or hereditaments, of the value of 40s per annum above reprises, or who are seised of lands or tenements in copyhold or any other non-freehold tenure for life, or for a larger estate of the value of 10*l* per annum, or entitled [illegible] tenements for the unexpired residue [illegible] sixty years of the same value or of a term of not less than twenty years of the value of 50*l* per annum and occupiers of lands and tenements at a *bona fide* rent of 50*l* or more per annum But freehold tenements for life, if under the value of 10*l* per annum do not confer a vote, unless the party is in the actual occupation of them or unless they have come to him by devise marriage, &c, and not by gift or sale And in the case of freeholds [illegible] possession for six months before the last day of July [illegible] year in which the voter is registered is a necessary condition, in that of leaseholds, &c, twelve months

2 The qualifications of voters in cities and boroughs in England, were, under the law as it stood before the Reform Act, extremely various and depending more on the local law of every place than on the general custom of the country The principal franchises were —1 In respect of property, thus freeholders to the amount of 40s voted in many towns and cities which were counties of themselves, leaseholders, copyholders &c in other places, and burgage tenants The franchise of burgage tenure, which existed in some towns, depended on the possession of certain ancient tenements which conferred a right to vote 2 In respect of corporate privileges Freemen or burgesses and in London liverymen (*see* CORPORATION), enjoyed by virtue of their privilege a right of voting in corporate towns 3 In respect of inhabitancy Voters in this respect were of four sorts inhabitants paying scot and lot, inhabitants householders house keepers, pot-wallers (*i e* pot-boilers), legally settled, inhabitants householders resiant, inhabitants generally In many towns, several of these qualifications were recognized at the same time as conferring a right to vote

The alterations introduced into the system of borough qualifications by the English Reform Act were twofold In the first place, a new franchise is created which is everywhere the same Every capable person who occupies within the limits of a borough any house or building falling within the specifications of the act, which is either separately or jointly with land held within the same borough as owner, or of the same landlord of the clear yearly value of 10*l* is entitled to vote, provided he has occupied such premises for twelve months previous to the last day of July in the year in which he is registered, and provided he has been rated, and paid all rates for the relief of the poor due up to the 6th of April next preceding, and also all assessed taxes In the next place former franchises are modified as follows —Freemen, and in cities being counties of themselves freeholders and burgage tenants, are to retain their qualification But no one can claim to be registered as a burgess or freeman who was admitted since the 1st of March, 1831, except he derive his title through birth or servitude, or for a freehold or burgage tenement for an estate acquired since that day All other borough franchises are abolished saving their rights to individuals possessed of them at the passing of the Reform Act

Finally, the act requires that every person, in order to be registered as a voter for a city or borough must have resided for six calendar months next previously to the last day of July in that year within such city or borough, or within seven miles of it And it is also provided that no tenement situate within a borough, and capable of conferring a qualification on its occupier to vote within the borough, shall give a vote for the county

Several boroughs in Wales, as well as in Scotland, are *contributary*, several towns being joined in one for the purpose of [illegible] parliament

The system of [illegible] voters, [illegible] Wales, was framed by the Reform Act *In* [illegible] register is formed by the overseers of the poor in every parish or township making the [illegible] persons who have delivered to them, [illegible] July in each year, a claim to vote in respect of property situate within their district The lists thus drawn up by the overseers, according to a form specified in the act, are delivered to the high constable, and by him to the clerk of the peace for the county The overseers are empowered to object to any person on their list whom they conceive not entitled to vote They are also to receive written notices of objection by third parties, who are themselves voters or claimants duly delivered to them, and to mark the names of all parties so objected to on the list The lists thus formed are revised by the barrister or barristers appointed for that purpose These officers are nominated by the senior judge of assize travelling the summer circuit within his district, and by the chief justice of the King s Bench in the metropolitan county and boroughs Their courts for the purpose of revising the lists and deciding on claims and objections, must be held between the 15th September and 25th October in every year The lists revised by them form the register for the county, which is the authentic list of voters until the next registration Any person having his name and qualification once inserted in the register is not bound to make a claim another year

In cities and boroughs the course is somewhat different On or before the last day of July in every year the overseers are to make out an alphabetical list of persons entitled to vote under this act and another of persons entitled to vote in respect of ancient rights (except freemen the list of whom is to be made by the town clerk, and in London by the clerks of the several companies) Any person whose name has been omitted in either of these lists is to give notice of a claim, in writing, to the overseer or town clerk Objections are to be made, in boroughs only by parties whose names are inserted in the list The lists are revised by the barristers in the same manner as those for the counties, and delivered to the returning officer

3 In Scotland the right of voting in counties is declared by the Scotch Reform Act 2 & 3 W 4 c 65 to be in the owners of ancient rights (termed superiorities) not acquired since 1831 in such persons as have been owners for six months previous to the last day of July of "any lands feu duties, or other heritable subjects," of the annual value of 10*l* after deductions Where two or more parties are interested in any subject to which a right of voting is for the first time attached by the act, as life renter and as fiar the right shall be in the former The right is also extended to tenants for life or on lease of fifty seven years or more, at 10*l* per annum, tenants on lease of nineteen years or more, or occupants at 50*l* per annum and tenants who have paid for their interest a price of 300*l*

4 In Scottish boroughs the right of voting is in occupiers of houses &c (as in the English Reform Act) of the yearly value of 10*l* Claims by qualified persons to vote for counties are to be lodged with the schoolmaster, and he is to make out the lists of claimants and objections Claims for votes in boroughs are given in to the town clerk, and the lists made out by him The sheriff holds courts to decide on questions relative to the registration his powers and duties are analogous to those of the revising barrister in England

5 In Ireland, the right of voting in counties is in freeholders at 5*l* per annum (by the act 13 & 14 Vict c 69, by 2 & 3 W 4 c 88, in leaseholders for sixty years at 10*l* per annum, for fourteen years at 20*l*, in copyholders at 10*l* per annum, and by 13 & 14 Vict c 69, in all tenants rated at 12*l*, and duly registered as prescribed in the act.

6 In counties of cities counties of towns and boroughs in Ireland the franchise is in 10*l* freeholders, 20*l* leaseholders, 10*l* householders, and in the 40*s* freeholders entitled under 4 G 4 c 55, but not in any persons acquiring such freeholds since 1831, except by descent, marriage, &c, and by the act 13 & 14 Vict c 69, in 8*l*. and upwards occupiers who have occupied for twelve months and paid the rates due The existing rights of freemen, &c are saved

By the same act, the list of persons entitled to vote is annually made out, in counties, by the clerks of unions,

and in boroughs, by the town clerk, at the request of the clerk of the peace The registration lists are kept for inspection, and published by the persons appointed Revision courts are held by assistant barristers to decide on claims and objections, with power of appeal The revised lists are printed and delivered to the sheriff of a county, or the returning officer of a city or borough, and these lists constitute the register for one year No enquiry is made at the election, except as to the identity of the voter, and whether he has voted before

III *Mode of Election* —1 In England and Wales, when the sheriff receives the writ commanding him to return a knight or knight of the shire, or division of the shire, he makes proclamation, within two days after receiving the writ, at the place where the election is to be holden, that is, the principal polling place Counties and divisions are subdivided into convenient districts with a [illegible] and after the Bribery [illegible] proposed, and the election proceeds In boroughs the sheriff (or other officer to whom the writ is directed) sends his precept to [illegible] who acts in the same manner as the [illegible], and boroughs are similarly divided into polling districts

When a candidate is proposed, he may be called on by any other candidate or any two of the electors to swear to his qualification The qualification required by 9 Anne c 5, is, for a knight of the shire 600*l* per annum in lands and tenements, freehold or copyhold, for his own life, or a greater estate For burgesses 300*l* per annum of similar property Eldest sons of peers, or of persons qualified to sit as knights of the shire are themselves qualified Members for the universities are not required to possess any qualification

It is still questionable whether the returning officer can refuse to return a candidate who refuses to take the qualification oath before the poll After the election and before he takes his seat each member must deliver to the clerk of the house a paper signed by himself containing a description of his estate of qualification and is sworn to its value at the same time at which he takes the other oaths His qualification may then be questioned in a petition against his election

When more candidates are proposed than the number to be returned, the election is decided by the sheriff's declaring the majority on view (by calling on them to hold up their hands) But a poll may be demanded by a candidate or elector, either before or after such declaration by the sheriff

The poll must commence on the day on which it is demanded, or on the day after By the Reform Act (s 58) three questions only can be asked of any person offering to vote as to his right,—whether he is the same person whose name appears on the register, whether he has already voted, whether he has the same qualification for which his name was inserted on the register, and he may be required to take the oath specified in the act as to his person and qualification Besides this, the oaths of allegiance, and supremacy, and abjuration, may be put to an elector at the request of any candidate unless the elector be a Roman Catholic in which case he may be required to take the oath specified in 10 G 4 c 7 All the foregoing oaths are to be taken before commissioners The bribery oath may also be administered at the poll by the returning officer There are also certain local oaths required by act of parliament to be taken at the election for particular boroughs

By the Reform Act the poll was limited, in England and Wales, to two days duration both in counties and boroughs And now by a recent enactment the poll is declared, in counties, the day next but one after its close, in boroughs, the day after its close By 5 & 6 W 4 c 1 the duration of the poll in boroughs was further limited to a single day The return is made in counties by tacking the names of the persons chosen to the writ, in boroughs, by tacking them to the precepts and returning them to the sheriff, who then tacks them to the writ, and forwards the whole together to the clerk of the crown in chancery Where the votes are equal, it is the practice to make double returns

2 In Scotland, the sheriff fixes the day for a county election at not less than ten or more than sixteen days after the writ is received the counties are divided into polling districts, not exceeding fifteen in number, and the poll lasts two days In boroughs similar regulations are adopted to those in England, but the sheriff or his substitute, superintends the poll, which may last three days The sheriff [illegible] officer

3 In Ireland, the sheriff [illegible] place of a county election five days after receiving the writ, and from ten to sixteen days after such proclamation the election is held In boroughs, the sheriff of a county of a city or town, the mayor, [illegible] officer, holds the election, not [illegible] receipt of the precept from [illegible] commence on the day on which it is demanded, and continue two days (13 & 14 Vict c 69) but may be closed on any day on which not more than 20 persons have polled

IV *Election Committees* — In the first parliament of James I a committee of privileges and returns was appointed, to which the trial of every petition against an election was referred which was not heard before the House of Commons A similar committee was appointed at the commencement of every session, until the present practice of trying such petitions before select committees began This practice is founded on a variety of statutes, beginning with 10 G 3 c [illegible] common's called the Grenville Act consolidated [illegible] 22

There are six sorts of petitions referred to a select committee —1 Complaining of undue election 2 Of undue return 3 That no return has been made to the writ in due time, &c 4 That the return is not according to the requisition of the writ, or complaining of special matters contained in it (as double returns or special returns) [illegible] on, or of appointing [illegible] a select committee, [illegible] defend such right The four first may be subscribed by any candidate or person claiming a right to vote, the two last by all persons A petition to be admitted as a party to defend such return or oppose the prayer of such petition, is addressed to the house and not referred to a committee An election petition is presented to the house by a member within a certain time limited by the house No proceedings will be had on petitions complaining of an undue election or return, &c, unless the subscriber, within fourteen days after its presentation, or farther time limited by the house, enter into certain recognizances for the payment of costs and compliance with other conditions

When such a petition is presented, a day and hour are [illegible] the house for taking it into consideration With all time, under the Grenville Act, if 100 members were present, the parties and agents attending, thirty-three were selected by ballot, which number, on each party striking off one alternately was reduced to eleven If more than one petition is to be taken into consideration on the same day, successive lists of thirty three were formed two, three, or more, according to the number of members present in the house Voters, petitioners, members against whom [illegible] and those whose return has not been [illegible] disqualified from serving, and their names, if drawn were set aside If no party appeared [illegible] petition, the clerk of the house and the [illegible] the list to eleven This system was considerably altered by the provisions of 2 & 3 Vict c 38 an act introduced by Sir Robert Peel Under it a general committee of elections is appointed by the speaker at the beginning of every session This general committee chooses six members and a chairman to form a select committee to try an election petition out of the whole list of members, divided and corrected in the manner therein specified

The same nicety it is said, is not required in election petitions, as to their form, as in pleadings at law, but it is now decided by a series of precedents, that it is necessary that the matter intended to be proved should be sufficiently set forth in the allegations of the petition, and that, on the hearing of the petition, it will not be competent to the party to go into evidence in proof of facts not distinctly alleged therein But there is a considerable variety in the decisions as to what is sufficiency of allegation An election petition, when once presented can only be withdrawn by permission of the house to which jurisdiction in this respect is still left by the Grenville Act The house will therefore require to be satisfied that there is no fraud or concert in the withdrawal Supplemental election petitions may be presented, on the discovery of new matter after the presentation of the first petition

In petitions of the first four classes parties (if the election is defended) are required to send in to the clerk of the House of Commons lists of the votes to which they intend to object

Select committees sit every day, but with power to adjourn for twenty-four hours on their own authority, and for a longer period on leave obtained from the house on motion Members may only absent themselves by leave, or on excuse to be allowed by the house if any are absent otherwise, the committee cannot sit Committees are not dissolved by prorogation of parliament, but adjourned to the next time of meeting

In the first four classes of petitions, the committee have to try the merits of the election, and to determine, by their votes, whether the petitioners, or the sitting members, or either of them, were duly returned, or whether the election is void, and a new writ ought to issue The fifth class raises the question as to the right of election, [illegible] returning officers &c The determination of the committee is in each case final and conclusive, [illegible] reported in a report to the house at the conclusion of its sittings. A committee has also the power, if it pleases, of making a special report, instead of

in which case the house ... as may seem proper An examination into the bad votes given on each side is termed a scrutiny, and the effect of it is, that if on balancing the number of good votes retained after such examination the petitioner has the majority it is reported that he ought to have been returned Where an incapacitated person has been elected the principle of parliamentary law is, that if his disqualification was sufficiently known to the electors at the time they returned him, their votes are considered as lost, and it is reported that the next on the poll ought to have been returned If the fact of his disqualification was not known the election is simply void It appears however not to be absolutely decided whether the incapacity which renders the votes thrown away must be an inherent or contingent incapacity, as, for example, where it was *publicly known* that a candidate was disqualified by reason of having been guilty of acts of bribery with reference to the election In this case it has been argued that the election is not void, but that the votes given for the person so disqualified are thrown away In other cases, bribery treating undue interference, &c, have the effect of avoiding elections, and the report is, that a new writ ought to issue

Finally, an election committee has the power of declaring either the petition or the opposition to it 'frivolous and vexatious' in its report, the effect of which is to fix the party against whom such declaration is made with the payment of costs These costs are ascertained by application to the speaker who directs two persons to tax them and then grants a certificate on production of which in a superior court judgment may be entered up for the amount

V *Mode of Assembling Parliament* — Parliament can only be convened by the authority of the king and by 6 W & M c 2 must be held at least once every three years, but, in point of fact as the Mutiny Act Land Tax, and Malt Act are only passed for a single year, the sittings of parliament are of necessity annual The same order by the king in council which commands the lord chancellor to cause the great seal to be affixed to a proclamation for dissolving parliament, is accompanied with a warrant to issue writs for a new one Writs for the return of members of the House of Commons are directed to the sheriffs of counties with certain exceptions viz the returning officers of places counties in themselves the Bishop of Durham, the Chancellor of the Duchy of Lancaster, the Chamberlain of the County Palatine of Chester, the Constable of Dover and the Warden of the Cinque Ports On a vacancy during the sitting of parliament, the writ issues under warrant of the speaker by the authority of the house itself

VI *Meeting of Parliament Preliminary Proceedings* — The new parliament meets on the return day of the writ, unless prorogued by writ of prorogation but when it is intended that it should meet for the actual despatch of business on the day to which it is prorogued, notice to that effect is given by proclamation forty days before, and the parliament begins only on the day to which it is prorogued The acts of meeting and passing a statute constitute together a session Upon the assembling of parliament the king meets it in person, or by representation, and explains in his speech the reasons of convening it In modern times the speech is not delivered until the commons have chosen a speaker, which they receive a command from the k[illegible]

The [illegible] is expressly [illegible] His duties are, — to act entirely as the servant of the house which appoints him He takes the chair, which he cannot do unless forty members are present, maintains order, by naming (if necessary) members who are disorderly, explains and informs on questions of order or practice if he is referred to He can neither speak nor vote unless in case of equality of votes, or in committees of the whole house where as soon as the chair is taken, he is reduced to the [illegible] member

On the first day of the meeting of every new parliament certain oaths are administered to the members by the Lord Steward of the King's Household these are the oaths of allegiance [illegible] and [illegible] ration, but, by the Roman Catholic Relief Act, members professing that religion take, instead of these oaths, a declaration substituted for them By 33 G 2 c 20 they are also required to make oath that they are qualified, and deliver in their qualification at the table But, previous to being sworn, every person returned is to all intents and purposes a member of the house, except as to the right of voting only Before the king's speech is taken into consideration, it is usual to read a bill as a matter of form. The king's speech being then reported to the house an address of thanks as moved or as amended, is returned The usual committees are then appointed of these the committee of privilege is the only one of which the [illegible] are at present of a practical kind

The method of proceeding in making laws is, for the most part, similar in the two houses, but different in public and private bills

VII *Method of Proceeding in Parliament* [illegible] are divided into public [illegible] in a parliamentary sense, is merely derived from the payment of fees, which are due on private and not on public acts Constitutionally, public acts are in general, such as relate to the kingdom at large, private acts, to individuals and classes Many acts, however, which immediately concern classes only are within the [illegible] of public acts, as, for [illegible] persons, or all lords of manors [illegible] tion between the classes is, that the courts of justice are officially bound to notice public acts, but private acts must be formally shown or pleaded This rule, however, admits of certain technical exceptions

All private bills affecting the peerage must begin with the lords, all bills which directly or indirectly, impose a charge on the people must begin with the commons This class, therefore, includes all bills under which tolls may be levied for private benefit, such as bills for making roads canals, railways bridges, inclosure bills, and bills containing clauses inflicting pecuniary penalties for [illegible] against private property, &c

All other private bills may begin with either house indifferently, but in practice, one large class of private enactments — viz estate bills which enlarge or alter the power of individuals in disposing of their property, divorce bills, bills to enable parties, under statutable restrictions, to alienate, &c, — begin in the lords, that house from its judicial character, being best fitted for the discussion of similar subjects On the other hand, bills concerning the parliamentary rights, &c of particular places usually commence, by custom, in the commons There is one instance of a bill which begins with neither house but with the crown, viz a bill for a general pardon Bills are always read in each house, after leave has been given to bring them in three times before they are passed (with the exception of bills of grace, such as for a general pardon which are passed on the first reading) General petitions against a bill are usually ordered to lie on the table until the second reading, on which occasion counsel are heard against a bill whenever leave is given for their introduction The second [illegible] period for discussion on the [illegible] bill is then (as indeed it is, on principle in every stage) open to the proposal of amendments If a bill be rejected either on the first or second reading it cannot be again proposed that session After the second reading the bill is committed, *i e* referred either to a select committee or, if the bill be of importance, to a committee of the whole house Such a committee requires in the commons, the presence only of forty members, in the lords of all members in attendance In committee the bill is debated clause by clause, with the advantage that members are not restricted, as in a debate of the house, to speaking once The proper province of the committee is to consider the bill in its details When the bill has gone through the committee the chairman reports it to the house with such amendments as the committee may have made The house can then agree or disagree with the amendments of the committee (*See* AMENDMENT ) The bill is then engrossed and afterwards read a third time In the commons it is usual to read a bill which originates with the lords the third time on the same day on which it is reported A new clause added to a bill on the third reading is termed a rider A bill thrice read, and passed, admits of no farther alteration, except for clerical errors A bill sent from the commons to the lords is usually read the first time in the latter house on the day on which it is brought, and, when it has passed through the different stages, is sent back to the commons, with the amendments if any have been made, with which the commons then agree or disagree, the same process, substantially, being followed vice versâ, where the bill originates with the lords The amendments returned with a bill from one house to another are taken into separate consideration, and the amendments, if agreed to, are always considered as proceeding from that house in which the bill first originated If one house cannot agree to the amendments proposed by the other, a conference is usually held between members deputed by each house, who can only make use of the instructions delivered by the house in their arguments the conference being desired by that house which disagrees with the amendments in question If the house which amends is not satisfied at the first conference with the reasons alleged for its disagreement by the other, it desires another conference, if this too is unsuccessful, what is termed a free conference may be demanded, in which the managers of the conference are not under the same restrictions as to instructions, but may urge their own arguments If one or more free conferences fail of producing unanimity the bill is dropped It is necessary to observe, that in bills of supply (which originate in the commons) the lords cannot make any except verbal amendments, they must either admit

or reject altogether When a bill has passed both houses it is deposited in the House of Lords to wait for the royal assent (except in the case of a bill of supply, which is presented by the speaker to the throne) The royal [illegible] by letter patent under [illegible] The bill then be[illegible] roll by the clerk of the parliament, delivered into chancery, and by usage, although [illegible] king's press

VIII *Private Bills* —Petitions for private bills must be presented at the commencement within fourteen days after the first Friday in the session and on being presented by a member, are referred to a committee which is then named consisting of five members selected by the committee clerk The committee try the petition as to whether or not the standing orders, applicable to the case have been complied with in case they make their report accordingly to the house leave is then given to bring in a bill, unless as in some cases, it is expedient first to re-commit the report The bill having been read a first time, after an interval which is varied in practice according to the nature of its subject, the house proceeds to the second reading on which occasion objections to the *principle* of the bill are usually made specific objections to its provisions being more properly reserved to a later stage A member may, individually, oppose a private bill in any stage, or he may present a petition against it On the bill being read a second time, it is referred to a committee which is formed in the same manner as the first committee on the petition In the committee on the bill all the blanks left on its first introduction are filled up and amendments introduced, and if unopposed the bill is reported Opposition to a private bill, in a committee of the House of Commons is conducted as follows — The petition against the bill, having been referred to the committee is read there, if the parties supporting it appear, the promoters of the bill first state their case and produce and sum up their evidence in support of its preamble, the opponents next state their case produce and sum up their evidence in support of it, the promoters then reply, and the committee vote If the committee resolve that the preamble is proved, the clauses are read and the opponents are at liberty to make objections to each successively, the promoters not being called upon otherwise to offer evidence in support of them The presence of five members of the committee is necessary to any proceeding A committee cannot dissolve itself and consequently its existence continues until it has reported to the house, although by adjourning indefinitely or by voting the chairman out of the chair they might in effect entirely release themselves from the duty imposed on them, but the house, in similar cases, has exercised the power of ordering the committee to proceed forthwith

When the report is brought up and read as in the case of other bills, it is ordered to lie on the table After seven days the amendments having been read and agreed to it is ordered to be engrossed, after which it is competent to any member to move the third reading of it Additional clauses added at this time are termed riders When passed, the member who presented the petition, with seven others takes it to the House of Lords and delivers it to the lord chancellor If the lords make amendments the concurrence of the commons to these amendments is moved by the same member Should the lords' amendments not be agreed to (a rare occurrence in private bills), a conference is held by a deputation from both houses, and should the disagreement continue, the bill is finally withdrawn or [illegible]

IX *Standing Orders of the House of Commons* The[illegible] are a series of regulations adopted by way of resolutions of the house at various periods from 1685 to the present time, relating partly to the internal order &c of the house partly to certain preliminaries and forms required on the introduction of particular bills, both public and private and to the promulgation of statutes The most numerous of these relate to private bills, and specify the mode of signing and presenting, the time for giving notices and their necessary contents the formalities to be required respecting instruments, and a variety of other particulars When a resolution is made which is intended to be permanent, it is usual to add the form 'Ordered that the said resolutions be standing orders of the house" [illegible] bills are sometimes (but only [illegible] dispensed with by the house, or [illegible] complying with them

X *Public Business in the two Houses* —In the Commons, a house for the transaction of business consists of forty members, by an order of the year 1640, and, if a less number be present, the speaker will not take the chair This rule extends to committees of the whole house The speaker of the House of Commons cannot speak in the house, the speaker of the House of Lords may A call of the House of Commons is an expedient to secure attendance for an important occasion when it is made, members absent without leave may be ordered to be taken into custody No member can be present on the debate of a bill or other business concerning himself The order "for the sergeant-at-arms to take into custody strangers that are in the gallery of the house" is repeated every year, the first instance having been in 1705, so that the House of Commons is supposed to sit with closed doors, although the order is partly permitted to be infringed When the speaker's mace lies upon the table of the House of Commons, it is a house, when under, a committee, when out of the house, no business can be done, when in the hands of the sergeant at the bar no motion can be made

With regard to the manner of speaking and voting in the commons, motions are made, and petitions presented, [illegible] bills are moved for [illegible] A member who wishes a motion put [illegible] delivers it to the speaker, who, when it has been seconded, puts it to the house, it cannot then be withdrawn except by leave of the house The *motion to adjourn* is put in order to supersede a motion of which the house is already in possession The motion *for reading the order of the day* has equally the effect of superseding the existing question The motion *for the previous question* has been commonly but mistakenly attributed to Sir Harry Vane, as its inventor It can take place only in a house and not in a committee, in which latter the equivalent motion is *that the chairman do now leave the chair* The speaker names the member whom he first perceives to rise in order to speak but the house is not bound by the speaker's decision It is understood to be the rule, that a member may speak even after the question put, if the affirmative voice only has been given, and the negative not yet given The effect of the speaker's "naming a member" on the occasion of disorder in the house is that such member after being heard if he pleases, is directed to withdraw and the house then considers what penalty to inflict In the commons votes are given by *ay* and *no*, if a division is demanded, the speaker (by a resolution of 1603) appoints two tellers on each side to count Strangers are directed to withdraw, and the doors closed before the question is put On a division one party leaves the body of the house the other remains, and the general rule is, that the side which is for the *motion* goes out, thus on the question on a bill the *affirmative* voices go out but this rule is governed in its application by various special usages On a division in a committee of the whole house the ayes go on one side and the noes on the other The speaker has the casting vote in a house, the chairman in a committee

*In the House of Lords* —The general rules of proceeding in the House of Lords vary little in material points from [illegible] The speaker can debate [illegible] seriatim, the youngest baron voting first [illegible] of the lords to vote by proxy is only [illegible] on the king Proxies from spiritual lords are only to spiritual, proxies from temporal only to temporal No lord can hold more than two proxies The lord chancellor is ex officio speaker of the House of Lords, and as he is able to speak and vote, he has no casting vote the rule therefore in case of equality of voices always is, that the presumption is in favour of the negative side

With regard to messages between the two houses, those from the commons to the lords are sent by one member but will not be received unless eight at least attend in all Messages from lords to commons are sent by two masters in chancery or, on special occasions, by two judges Messages from [illegible] sorts those to the commons [illegible] their part are usually written in the king's own hand, those which are sent when a member of the house is put under arrest on account of the public service are verbal, and delivered by a minister of the department of service concerned (See *Hatsell's Precedents in Parliament*)

XI *Jurisdiction of Parliament as a Court of Justice* — i For the trial of a peer, indicted for treason or felony, or for misprision of either, the lords spiritual and temporal sit as the court of the lord high steward of England an office which is in general created *pro hâc vice* by a commission under the great seal But, if the trial should occur during the sitting of parliament, it is said to be before the same court "of our lord the king in parliament," in which case the high steward is only, as it were pro tempore speaker of the house, and has a vote with the other peers, whereas, in his own courts, held in the recess of parliament, he is judge of the court, and, like any other judge, sole arbiter on the question of law

ii The House of Lords has also a twofold jurisdiction; 1 in criminal cases, 2 in civil cases — 1 The first is for the trial of [illegible] and misdemeanors by the method of parliamentary impeachment by the House of Commons (See IMPEACHMENT) The proceeding on a bill of attainder or of pains and penalties, is, in fact, a legislative act, and not a judicial one (See ATTAINDER, PAINS AND PENALTIES, BILL OF) 2 The jurisdiction of the House of Lords, in civil cases, is divided by Lord Hale

into their jurisdiction in the first instance, and in the second instance as a court of appeal; but the former, which consisted in [illegible] of interference, occasionally exercised [illegible] purposes, is now obsolete. In the last instance, the House of Lords is the supreme court of judicature in the kingdom. Appeal lies to it, by writ of error, from the court of King's Bench, and from the subordinate court of appeal of the Exchequer Chamber, and appeal from the High Court of Chancery also not only in order to obtain the reversal of a decree, but also on any interlocutory matter. On writs of error, the House of Lords pronounces the judgment, on appeals, it gives directions to the court below to rectify its own decree.

XII. *Privilege of Parliament*, in the ordinary sense of the words denotes the privileges of individual members of either house, enjoyed by virtue of their seats. These privileges are partly limited by known precedent, or by statute, but they are to a great extent customary and the houses themselves constitute the only tribunals before which the inquiry whether their privileges have been violated or not can be instituted.

The first privilege is freedom of speech in debates; this claim is sanctioned by the statute 2 W. & M. 2, which declares the liberties of the people. This privilege does not extend to the publication of what is spoken; if a member publish his speech without the authority of the house, he is liable to the common legal tribunals for its contents. An exception to the privilege also is to be found in the jurisdiction of the house itself, which has the power of committing, expelling, or fining (the latter not exercised since the reign of Elizabeth) a member for a libel or contempt against the dignity of the house.

The next privilege of freedom from arrest in civil suits, is probably as old as parliament itself. Privilege of parliament was formerly supposed to exempt peers and members of the House of Commons from civil actions as well as arrests, but this was finally abolished by 10 G. 3. This is the privilege of peerage, not of parliament, consequently it extends to Scotch and Irish peers. The exemption does not extend to criminal cases, or breaches of the peace, or to attachments in case of contempt by the superior court. And by a peculiar process enacted by 10 G. 3 a member of parliament may be made a bankrupt. Unless the commission is superseded within twelve months from its being issued he vacates his seat. The liberation of parties improperly arrested is effected either by the authority of the houses themselves, or when parliament is not sitting or (in the case of peers) when it is dissolved by writ of privilege or on motion in the superior courts. The duration of the privilege, in the case of members of the lower house is not exactly defined. It is the general opinion that it extends to [illegible] and forty days before the next [illegible] bers of parliament are not liable [illegible] as jurors during sitting or adjournment.

The old privilege of franking was [illegible] to continue during the same period which is mentioned as that of freedom from arrest. By 35 G. 3 [illegible] it was restrained to letters within an ounce in weight and the number to ten sent and fifteen received. It is now altogether abolished.

The general or "ancient and just" privileges of the houses are, as has been said, undefined. "The law of parliament," says Hallam, "as determined by regular custom, is incorporated into our constitution; but not so as to warrant an indefinite uncontrollable assumption of power in any case, least of all in judicial proceedings where the form and essence of justice are inseparable from each other."

Besides the general privilege of parliament we may here briefly notice the privileges claimed by the two houses, or by members of them, with respect to the conduct of their legislative proceedings.

Two privileges peculiar to the House of Lords are: 1. That possessed by every peer of giving his vote by proxy (See antè, *Rules of Business in the two Houses*.) 2. That which he possesses of entering on the journals of the house his dissent from a vote of the house, together with his reasons for it, which is styled his protest. The first protests, with reasons annexed, are said by Lord Clarendon to have been made in 1641.

Of the peculiar privileges of the House of Commons, the most important is that of originating all money bills, and this, in principle, is a very ancient part of the constitution. But it was not before 1690 that it was fully established that the lords could not alter, any more than originate, any rate or tax granted by the commons. This privilege is now understood under the following limitations. — In bills of aid and supply the lords can neither originate them nor make any alterations beyond verbal amendments. In bills which impose pecuniary burdens as a collateral object, — such, for example, as bills for turnpike roads and canals, or for the management of the poor — the lords may make amendments but not such as affect the quantity, disposition or collection of the rate. No amendments may be made by the lords which appear likely, in their consequences, to bring a charge on the [illegible] insert or alter pecuniary penalties [illegible].

By a resolution bearing date 1667, and now strictly adhered to, any proposition for taxing the subject must be first examined by a committee of the whole house, and their opinion reported. The effect of this rule is, that subjects on which frequent speaking by the same member, and other departures from regular proceedings are desirable, are discussed in a meeting unfettered by some of the special rules of the house.

When a bill of supply has received the concurrence of the lords it is returned to the commons, and by them presented to the throne.

XIII. *Adjournment*.—An adjournment is a continuance of the session from one day to another. This is done by each house for itself either from day to day, or over a recess as at Christmas and Easter. In neither house can the speaker adjourn unless upon motion of the house. The king can signify his desire of an adjournment, but has no further power.

XIV. *Prorogation of Parliament*. A prorogation is [illegible] and is made by the royal authority, either expressed by the lord chancellor in the king's presence or by writ under the great seal, or by commission. In the proclamation for prorogation if it is intended that parliament, when next it meets, shall proceed to the despatch of business, notice is given of that purpose, and such notice bears date usually forty days at least before the day appointed for meeting; but, in time of rebellion or danger of invasion the king is empowered to call together parliament with fourteen days' notice only.

XV. *Dissolution of Parliament* is effected either, 1. By the king's will which is the exercise of one of his highest prerogatives; this is usually done by proclamation after parliament has been [illegible] the demise of the crown, but by 7 & 8 [illegible] parliament continues six months after that event, assembles immediately if under prorogation or adjournment, and if there be no parliament at the time the members of the last parliament are empowered to reassemble themselves. 3. By efflux of time, viz. at the end of every seventh year if not sooner dissolved by the Septennial Act 1 G. 1. s. 2. c. 38. The seven years are counted from the day on which parliament was appointed to meet in the writ of summons.

PA'RLIAMENT or PARLEMENT (Fr. parlement). The title of certain high courts of justice under the old French monarchy. The French parliament, like those of England and Naples, was in its origin a convocation of the great vassals of the crown who treated of judicial as well as political matters in their assemblies. Saint Louis was the king who first introduced into this body counsellors of inferior rank, chiefly ecclesiastics, as legal assistants; and the earliest registers of the proceedings of the parliament which afterwards became fixed at Paris are of the date of 1254. The important step of rendering that court [illegible] capital city, is generally [illegible] 4); from that time the great barons gradually discontinued their attendance, and the lawyers occupied the higher places and more important functions of the court. The twelve peers of France however remained constant members of the parliament after the other great vassals had by disuse, ceased to be considered as members of it (although they likewise in process of time ceased to take part in its judicial business). The parliament of Paris thenceforward remained the chief tribunal of the country until the revolution, with the exception of the short period of its suppression by Louis XV. in 1771, but as the great fiefs of the French monarchy were successively united to the crown, the supreme feudal court of each was invested with the title and attributes of a parliament. These were fixed at Toulouse, Grenoble, Bordeaux, Dijon, Besançon, Rouen, Aix, Pau, Rennes, Metz, Douay, Nancy. The most remarkable prerogative exercised by the parliaments is one of which the origin has not been satisfactorily accounted for, that of registering the edicts of the sovereign, and thereby giving them the force of law. M. Meyer (*Institutions Judiciaires*, liv. iv. ch. 9.) supposes that it arose from the character of the parliament, as the court of the feudal lord of each province; thus the edict of the king of France was referred to the parliament of Bordeaux, to examine whether it interfered with the special rights and duties of the same sovereign as duke of Guienne &c. It appears however to have been the received doctrine by the end of the 14th century, that this formality of registration was essential to the validity of an edict in every province. Hence the [illegible] parliaments, and especially that of Paris, [illegible] French history, [illegible] the [illegible] power of the [illegible] (See LIT OF JUSTICE.) It was usual for [illegible] undoubtedly legal, although [illegible] parliaments, to convey remonstrances to the king on the

subject of his edicts But Louis XIV ordained that these remonstrances should be presented before they had been registered their edicts were to bind them The parliaments had also a power of a legislative character that of pronouncing *arrêts de réglement* by which they gave authority to decisions on points of law binding on present but in future cases The counsellors of parliament were, by a law of Louis XI , immoveable except in case of legal forfeiture , but the place of counsellors and presidents early became purchaseable and afterwards transmissible by hereditary descent Hence, in part, the powerful esprit de corps which distinguished those bodies As a high court of appeal, the parliament of Paris was divided into five chambers , one termed the great chamber, three *des enquêtes*, one *des requetes* Besides these, the *chambre de la tournelle*, in which criminal cases were tried, was a fluctuating court in which members of all the chambers sat in turn

PA'RLOUR (Fr parler, *to speak*), signified originally the little room in which in former times the nuns and monks used to give interviews to their visitors , or in which the novices used to converse together at the hours of recreation

PARME'NIANISTS In Ecclesiastical History a name given to the Donatists (see that article) from Parmenianus Bishop of Carthage, one of their chief leaders, and an antagonist of Augustine

PARNA'SSUS (Mod Gr [illegible] mountain in ancient Greece [illegible] and from the numerous objects of classical interest of which it formed the theatre, considered "holy" by the Greeks On its side stood the city of Delphi, near which flowed the Castalian spring, the grand source of ancient inspiration , and from this circumstance, in metaphorical language, the word Parnassus has come to signify poetry itself A good collection of the Italian poets, printed at Milan, bears the title *Il Parnasso Italiano*

PA'RODY (Gr παρα and ᾠδη *a song*) A species of composition in which the form and expressions of portions or passages of grave or serious writings are closely imitated in similar passages of a ridiculous character Parody is a species of burlesque (see BURLESQUE) but the imitation is more close and exact than in ordinary burlesque composition Antiquity has left us no complete works of this species although some fragments are preserved by Athenæus and other writers The *Batrachomyomachia*, the authorship of which is attributed to Homer though a very ingenious specimen of the burlesque, is not in the modern sense of the word a parody The French critics do not seem to draw an adequate distinction between the nature of a parody and a *travestie*

PAR'O'L (Fr parole) In Law word of mouth Thus, a parol agreement is contrasted with one in writing, parol with written evidence See for the legal principles bearing on this distinction in different cases see AGREEMENT, CONTRACT, EVIDENCE

PARO'LE In Military matters the allowing of prisoners to enjoy certain indulgences on their giving their word of honour (*parole d'honneur*) that they will not serve during the continuance of the war against the country by which they are liberated or upon their pledging their word to abide by such other conditions as may be stipulated

PA'RONOMA'SIA (Gr παρα and ονομα *a name*) In Rhetoric, a figure by which the same word is used in different senses or words similar in sound are set in opposition to each other , so as to give a kind of antithetical force to the expression

PARONY'CHIA (Gr παρα, and ονυξ, *the nail*) A whitlow

PARO'NYMOUS (Gr ονομα *name*) In Grammar words of similar derivation or principal words with their derivation e g *equus*, *equus*, *equito* , *man*, *manhood*, *mankind*

PARO'TID GLAND (Gr παρα and ους *the ear*) A large gland situated under the ear between the maxillary process of the temple bone and the angle of the lower jaw It secretes saliva, which is carried into the mouth by the *Stenonian duct*

PAROTI'TIS Inflammation of the parotid gland The *mumps*

PA'ROXYSM (Gr παρα, and οξυς *sharp*) In Medicine, the periodical exacerbation of a disease

PARR This name is applied in most parts of England and Scotland to the young of the salmon (*Salmo salar*, Linn ) up to near the end of their second year, when they lose their dark lateral bars by the superaddition of a silvery pigment and congregate together for their seaward migration From the circumstance of the milt and roe being developed at this immature period a precocious condition by no means uncommon in the cold-blooded tribes, the parr has been regarded by some ichthyologists as a [illegible] was described as such by Willughby and Ray under the name of *Salmo [illegible]* see SALMON

PA'RREL In Naval language, the collar of greased rope or trucks by which the yard is confined to the mast while it slides up and down it

PA'RRICIDE (Lat pater, *a father*, and cædo, *I kill*), implies properly, the murder or murderer of a father But the term is also extended to the murder of any near relative, as a husband, wife, mother, &c , and even to [illegible] persons as a king, archbishop [illegible] and no law against parricides from an opinion that human prudence could never reach to the guilt of parricide This was actually the case at Rome, but at a later period parricide was punished by the Roman law with greater severity than any other kind of homicide The delinquent, after being scourged, was sewed up in a leathern sack, with a live dog a cock, a viper, and an ape, and so cast into the Tiber The English laws treat this crime only as simple murder , but in some of the German states the criminal convicted of parricide is put to death with exquisite torture, the penalty being that such persons shall be beaten to death with iron clubs, beginning with the feet, and gradually ascending to the head

PA'RSEE (Pers parsi) The name given by English writers to the Persian refugees, driven from their country by the persecutions of the Mussulmans who now inhabit various parts of India Their principal emigration to Baroach, Surat, and the neighbouring coast, is supposed to have taken place about the end of the 8th century The sacred fire, the emblem of their religion (see GUEBRES) called *behrem*, is believed by them to have been brought by the first emigrants from Persia, and, after many changes of place is now preserved at Odisari and Nausari, near Surat, and at Bombay In this latter city, under the protection of the British government, they have grown into a colony of considerable numbers and of great opulence They have become particularly distinguished in the art of shipbuilding, and the dockyard of Bombay is now almost exclusively in their hands Their character is variously estimated by different observers but all agree in attributing to them industry and economy, and attachment to their religion and to those of the higher class strong sentiments of honour and honesty Their number is said to equal 700 000 , and at Bombay, according to late calculations, at least 20 000

PA'RSING The art of resolving a sentence into its grammatical elements or parts

PA'RSON (Lat persona ecclesiæ) In Law, one that has full possession of all the rights of a parochial church His title is derived from the Latin persona because in his person the church itself which he occupies is represented and he is a corporation sole A parson, or rector has the freehold of the parsonage house, the glebe the tithes and other dues during his life Four requisites are necessary to constitute a parson holy orders presentation institution and induction See these terms In common language parson is a vulgar term for a clergyman of any kind

PART (Lat pars) In Music a single piece of the score or partition being one set of the successions of sounds which constitute the harmony

PARTERRE (Fr) A system of beds of different shapes and sizes in which flowers are cultivated connected together, with intervening spaces of gravel or turf for walking on The form of the beds may vary according to the taste of the designer , but their breadth should never be greater than will admit of the spectator who wishes to gather flowers or the gardener who is to cultivate them reaching the middle Where the object is chiefly to produce a display of flowers the beds should be of simple shapes with few acute angles, as these can never be completely covered with plants , but where the object is to display a curious figure to be seen from a point considerably above the level of the parterre, the beds may be formed of arabesque shapes, or like the figures used in embroidery and lace-work Figures of this description are generally planted with dwarf box, kept low by clipping with only here and there a flowering plant or a small bush placed in the broadest parts of the beds or scroll-work Parterres of this description were in use during the time of the Romans, as appears by the description of Pliny's own garden by himself, in which the letters composing his name were planted of box, kept regularly clipt a practice not uncommon in Rome and its neighbourhood at the present day Embroidered parterres, however were brought to the highest degree of perfection in the time of Louis XIV , when the arabesque style of ornament was introduced into every thing The flowers and flowering shrubs in cul- [illegible] always an object of luxury and requiring to be kept up at considerable expense of watering in the climate of France, and scroll work of box This description of parterre was imitated in England but smooth green turf not being here an object of luxury, beds of flowers became more [illegible] and as the number of [illegible] the number of turf

beds and scroll work diminished, till, at the present time, the latter is rarely to be met with In this manner has gradually arisen the modern English flower garden, which consists of small beds, more or less orbiculate, and scattered over a surface of smooth turf, so as to combine into groups, which are planted with flowers, or low flowering shrubs, sometimes in masses of only one kind in a bed, and at other times of several kinds mixed together

PARTERRE In French the pit of a theatre

PARTHENON (Παρθενων from παρθενος *a virgin*) It was a peripteral octostyle of the Doric order, with 17 columns on the sides, each 6 ft 2 in in diameter at the base and 34 ft high elevated on three steps Its height, from the base of the pediment, was 65 ft, and the dimensions of the area 233 ft by 102 The eastern one of which the contest of Minerva with Neptune for the government of Athens On the metopes was sculptured the battle of the Centaurs with the Lapithæ, and the frieze contained a representation of the Panathenaic festivals Ictinus Callicrates, and Carpion were the architects of this temple, Phidias was the artist, and its entire cost has been estimated at 1½ million sterling Of this building 8 columns of the eastern front and several of the lateral colonnades are still standing Of the frontispiece, which represented the contest of Neptune and Minerva nothing remains but the head of a horse and the figures of two women without heads Part of the Centaurs and the Lapithæ is in better preservation, but of the numerous statues with which this temple was enriched that of Adrian alone remains The Parthenon however dilapidated as it is still retains an air of inexpressible grandeur and sublimity, and it forms at once the highest point in Athens, and the centre of the Acropolis It is hardly necessary to inform the reader that the chief portion of the sculpture of the Parthenon is now placed in the British Museum where it forms, with some additions the collection of the Elgin Marbles *See* ELGIN MARBLES

PARTICIPANTS A semi religious order of knighthood, founded by Pope Sextus V in 1586 in honour of Our Lady of Loretto The members of this order were allowed to marry The order was soon extinguished, and the title of Knights of Loretto is now conferred on some civil servants of the pope

PARTICIPLE (Lat participium) A part of speech which *partakes of* the properties both of a verb and an adjective It may be described either as a verb without affirmation or as an adjective with the addition of the notion of time *See* GRAMMAR

PARTICLE (Lat particula *little part*) In Grammar, a general term to express the subordinate or secondary parts of speech —the adverb the preposition and the conjunction But it is more in accordance with grammatical precision to apply this term to those minor words to be met with in all languages which serve apparently to give clearness and precision to a sentence but respecting whose exact use Grammarians are not agreed To this class belong the Gr γε αρα του δη &c, the Germ ja, wohl, &c, and the English *now, then truly* &c The term *particle* is also applied by to those words or enclitics (as they are and κλινω, *I lean*) which cannot be used separately, but must form part of the preceding word, as in *virumque*

PARTICLE, in Physics, denotes the minutest parts into which a body can be mechanically divided It is in general used synonymously with molecule corpuscle, atom, but sometimes these terms are distinguished

PARTICULARISTS In Theology Reformed who have held the doctrine of decrees of salvation and reprobation As a party name it seems to date from the Synod of Dort That branch of the Baptists attached to high Calvinistic opinions is still called the church of the *Particular* Baptists

PARTIDAS, LAS SIETE (Span *the seven parts*) A celebrated ancient Spanish code of laws drawn up in the reign of Alphonso X of Castile (about 1260) so called from the number of principal parts into which it is divided This famous collection did not acquire the obligatory virtue of a code until 1538, when sanctioned by Alphonso XI

PARTITION (Lat partitio) In Music, the arrangement of the several parts of a composition on the same page or pages so that they should fall under each other, so that the performers of the parts may play or played jointly or separately as the composer intended It is commonly called a *score*

PARTITION In Architecture, the vertical assemblage of materials which divides one apartment from another It is usually however employed to denote such division when constructed of vertical pieces of timber called *quarters*

PARTITION In Politics, the division of the states of a sovereign or prince after his decease among his heirs as was the custom in some of the princely families in the ancient German empire; or among other powers, such as that of the states of the king of Spain, which was in ice) between William III, by the treaties of 1698 and igning monarch, was without near heirs But the most celebrated partitions in history to which the name has become almost exclusively attached, were those of Poland, by Russia Prussia, and Austria The first of these took place in 1772 when various provinces were wrested from the republic in pretended satisfaction of ancient claims, and the old and vicious constitution guaranteed by the three powers The second was submitted to by Stanislas in 1793, when Russia obtained the remainder of Lithuania and Prussia Dantzic, Thorn, and an extensive district This partition was followed by the insurrection under Kosciusko, which brought about the third and last partition in 1795, when the remnant of the country was dismembered It was organized in 1807 altered in 1815, but the conditions under which Poland was then annexed to Russia as a separate kingdom were entirely set aside after the Polish insurrection of 1830 and it is now substantially and in fact a province of Russia These partitions overturned the ancient balance of power in Europe, and prepared the way for the violent changes which followed the French revolution (See Koch *Revolutions de l'Europe*, Rulhieres *Histoire de l'Anarchie de Pologne*, Ferrand, *Histoire des Trois Demembremens de Pologne*, 3 vols. Paris 1820, *Ed Rev* vol xxxvii p 462)

PARTNERSHIP A relation established between two or more persons by an agreement to combine property or labour in furtherance of a common undertaking, and for the acquisition of a common profit A community of profit between the parties is the true criterion of a partnership for one partner may stipulate to be free from loss and this stipulation would be effectual as between himself and his partners though he would be liable equally with them to the world at large A dormant partner that is, one who in point of fact participates in the profits of a firm but is not held out as a member of it, will nevertheless be liable for its engagements, because he takes part of that fund which is a security to creditors for payment of their debts There is no particular form necessary to the constitution of a partnership, nor is it necessary that the contract should be in writing It may be dissolved at the individual pleasure of any one partner, if no stated period has been fixed for its continuance, and, even if such a period has been fixed, it will be dissolved, in the absence of any proviso to the contrary by his bankruptcy attainder or death or by marriage, in the case of a female Courts of equity also, will put an end to it by decree on proof of lunacy or gross misconduct A partnership is by any of the above matters terminated as between the partners themselves, but to prevent a continuing liability to strangers public notice of the dissolution is necessary One partner cannot sue another at law in respect of the partnership account unless a balance has been struck the remedy being in equity, which affords a machinery better adapted to the investigation of accounts As against the partnership bound by the engagements of any one partner acting with reference to the joint business either by his simple contracts on the purchase and sale of goods, or by negotiable instruments circulated on its behalf

PARTNERS OF THE MASTS The woodwork round the mast at the deck to strengthen and support the deck against the pressure of the mast The term is also applied to the similar supports round the capstan and pumps

PARTRIDGE WOOD A variegated wood imported from Martinique it is said to be the produce of the *Hostoria coccinea*

PARTY In Politics a body of men united under different leaders for promoting by their joint endeavours the national interest upon some particular principle in which they are all agreed The origin of party may be traced to that law of the human mind which is founded in our natural desire of sympathy and our disposition to afford it From the earliest ages down to the present time the principle of mutual co-operation has been adopted with success in executing favourite designs and in aiming at the accomplishment of certain ends Among the ancient Romans, for example, "*idem sentire de republica*" formed a principal ground of friendship and attachment, and the same feeling, modified by different forms of government and other circumstances, is at present in full operation in all the civilized states of Europe and America The benefits of party may be briefly stated to be, increased energy in pursuit of a common object, regular co-operation, mutual control and regulation, and an advantageous division of labour But though party or combination may in this manner be productive of good results, as every other principle abounding in our nature, it is liable to be abused and it certainly is no

doubt that it is frequently attended with such evil consequences as great [illegible] It involves a [illegible] of what is [illegible] in a way [illegible] dividuals Perhaps the worst effect of party is its tendency to generate narrow, false, and illiberal prejudices, by teaching the adherents of one party to regard those that belong to an opposing party as unworthy of confidence, and in making them oppose good measures because they happen to be proposed by a different party, and support bad measures because they are proposed or supported by their own party A thorough-going party adherent is in fact a political slave a person who allows others on all occasions to think for him, who, as far as politics is concerned, has no principle or rule of action, save that of slavish adherence and blind obedience to the dictation of the leader of his party (The uses and abuses of Party are discussed with great ability in vol xxx of the *Edin Review*) The different parties, both of England and other countries, will be found under their respective heads

PARTY In Heraldry — as party per pale, fess, &c, terms used [illegible] division of a shield by a line running in [illegible] either of these ordinaries

PARTY WALL In Architecture, the wall separating two buildings belonging to different owners or occupiers The regulations relative to the thickness of party walls in the metropolis have been the subject of several statutes, beginning with one passed 19 Car 2 and ending with the 14 Geo 3 better known by the name of the Building Act. This last governs the thickness of all party and external walls to be built after 24th day of June, 1774

PARULIS (Gr παρα, and ουλον, *the gum*) A gumboil

PA'RUS (Lat parus, *a titmouse*) A genus of Conirostral Passerine birds allied to the crows, characterized by having the conical beak straight and rather slender, with few hairs at its base, nostrils round, and covered by reflected bristly feathers, the hind toe is strong and armed with a long hooked claw To this genus belong the native birds commonly called tits or titmice, of which the tomtit (*Parus cæruleus*, Ray) is the best known species The great tit (*Parus major*), the marsh tit (*Parus palustris*), the cole tit (*Parus ater*) and the crested tit (*Parus cristatus*) have the bill longer and more pointed, the last-named species is rare in this country They are active little birds continually flitting from spray to spray and suspending themselves in all kinds of attitudes rending apart the seeds on which they feed devouring insects and not even sparing small birds when they happen to find them sick and are able to destroy them They store up provisions of grain build their nests in the holes of trees, and produce more eggs than is usual among the Passerine birds

PA'SCHAL CYCLE The name given to the cycle which serves to ascertain when Easter occurs It is formed by multiplying by each other the cycle of the sun which consists of 28, and the cycle of the moon which consists of 19 years See PASSOVER

PA'SCHAL FLOWER The *Anemone pulsatilla*, so called from [illegible] about Easter

PASIGRAPHY In Literature (Gr πας *universal* and γραφω, *I write*) The imaginary universal language to be spoken and written by all nations the invention of which has exercised the ingenuity of so many learned men, has been denoted by this word Leibnitz seems to have been one of the first who conceived this to be possible Many writers in Germany (where the name was invented) have followed him in the endeavour to devise schemes for this fanciful object In England Bishop Wilkins in the reign of Charles II, invented a scheme for a universal language grammar and character

PASQUINA'DE (Ital pasquinata) A satirical writing directed against one or more individuals A mutilated ancient statue of a gladiator dug up at Rome about 300 years ago, which now lies in the court of the Capitol was [illegible] by the Romans, Pasquino, from the [illegible] of a barber of eccentric and well-known character opposite to whose house it was originally set up This statue, and another, called by the populace Marforio which was situated near it were used for the purpose of bearing satirical placards often reflecting on the court and church of Rome, which were affixed to them at night frequently in the form of a dialogue between the two statues So annoying did Pasquin often become to [illegible] that [illegible] design was [illegible] but the ministers of the reigning pontiff are said to have dissuaded him from it, representing that if this were done "the frogs in the Tiber would croak louder than ever Pasquin had spoken" He has, however, lost his public spirit, and rarely or never ventures to attack the powers that be But his statue is still the occasional receptacle of jocose comments on private matters M Matthews (*Diary of an Invalid*) mentions an instance which occurred during his stay at Rome A man of the name of Cæsar common among the townfolk there, had married a girl of the name of Roma Pasquin was placarded with Ave Cæsar natus Romæ respice quam [illegible] The man replied by Mariorio Cæsar imperat To which the retort was Ergo coronabitur Hence Pasquinate and Pasquinade became, in Italy, conventional words to signify satire of that description and have been naturalized in other languages In French and German they have been used in the legal vocabulary for libel

PASS, in a military sense, signifies a strait or narrow defile which shuts up the entrance into a country

PASSAGE (Lat [illegible]) In Architecture, the part of a building allotted for giving access to the different apartments

PASSAGE In Music, a portion of an air or tune consisting of one, two, or three measures

PASSAGE, BIRDS OF *See* MIGRATION

PASSANT In Heraldry, a term used to describe a beast when represented in a walking position Passant guardant, walking with the full face turned towards the spectator

PASSEPARTOU'T In Engraving, a plate or wood block, whose centre part is entirely cut out round the outer part, whereof a border or ornamental design is engraved, serving as a frame to what may be placed in the centre

PA'SSERINES, *Passeres*, or *Passerinæ* (Lat passer, *a sparrow*) The name given by Linnæus and Cuvier to the typical order of birds including those which neither manifest the violence of the birds of prey, nor have the fixed regimen of the terrestrial birds, but which feed on insects, fruit or grain, according to the slenderness or strength of their beak, some with sharp and toothed mandibles pursue and feed on small birds All the Passerines have short and slender legs, with three toes before and one behind, the two external toes being united by a very short membrane They form the most extensive and varied order of birds, and are the least readily recognizable by distinctive characters common to the whole group Their feet, being more especially adapted to the delicate labours of mdification, have neither the webbed structure of those of the *swimmers*, nor the robust strength and destructive talons which characterize the feet of the *bird of rapine*, nor yet the extended toes which enable the *wader* to walk safely over marshy soils and tread lightly on the floating leaves of aquatic plants, but the toes are slender, flexible, and moderately elongated, with long, pointed, and slightly curved claws

The Passerines in general have the females smaller and less brilliant in their plumage than the males, they always live in pairs build in trees and display the greatest art in the construction of their nests The young are excluded in a blind and naked state, and wholly depend for subsistence, during a certain period, on parental care The brain arrives in this order at its greatest proportional size, the organ of voice here attains its utmost complexity, and all the characteristics of the bird as power of flight, melody of voice, and beauty of plumage are enjoyed in the highest perfection by one or other of the groups of this extensive and varied order

The beak of the Passerines varies in form according to the nature of their food which may be small or young birds, carrion insects fruit, seeds, vegetable juices, or of a mixed kind The modifications of the rostrum have therefore afforded convenient characters for the tribes or subdivisions of the order these are termed, 1 *Dentirostres*, 2 *Conirostres*, 3 *Tenuirostres*, 4 *Fissirostres* See those words

PASSIFLORACEÆ (Passiflora or Flos passionis, one of the genera) A natural order of twining plants with very showy flowers furnished with numerous rays of brilliant colours between the corolla and the stamens They chiefly inhabit the hotter parts of the world, and bear a fruit not unlike that of the gourd, to which natural order they are related Independently of the beauty of their flowers, some yield fruits eaten under the name of granadilla and water lemon, and others have a hard black wood [illegible]

PASSING NOTE [illegible] graces wherein two notes are connected by [illegible]

PA'SSION (Lat [illegible]) The sufferings of our Lord, which he is described as having endured between the Last Supper and the moment of his death. Passion week is that in the course of which these sufferings took place, namely that immediately preceding Easter (See as to its solemn ceremonial in the Romish church, this article in Ersch and Gruber) It was [illegible] *Ille mœsta luctuosa, mythosa funesta* [illegible]

PA'SSIONS [illegible] given to the different emotions of the mind, as love, anger, &c Various ingenious speculations have been instituted to ascertain whether the precise situation of the impetus of the pas-

sions be in the spiritual or material part of man Some philosophers, and among these Des Cartes, considered them wholly seated in the corporeal system Malebranche regarded the passions as the effects of the soul which proceed from uncommon influence and motion in the blood and animal spirits Though the passions," says Burton, in his *Anatomy of Melancholy*, "dwell between the confines of sense and reason, yet they rather follow sense than reason, because they are drowned in corporeal organs of [illegible] into eleven, six in the *coveting* and five in the *invading* Aristotle reduceth all to pleasure and pain, Plato to love and hatred, Vives to good and bad If good it is present, and then we absolutely joy and love, or to come and then we desire and hope for it if evil we absolutely hate it, if present it is sorrow, if to come, fear All other passions are subordinate unto these four or six, as some will, — love, joy, desire, hatred, sorrow, fear The rest, as anger, envy emulation pride, jealousie, anxiety, miserie, shame, discontent, despair, ambition avarice &c, are reducible unto the first" (*i e* the *irascible*) With several writers it has been a question whether the passions be each a distinct innate disposition or merely modifications of those dispositions which are common to all mankind The theories and conjectures of philosophers upon this subject are almost boundless, but to pursue them would be of little advantage, even if our limits permitted, and we shall merely refer the reader for ample particulars to the works of Hume Reid, Hartley Locke Lord Kames, &c (See also *Maass's Versuch Uber die Leidenschaften* 2 thle Halle 1805)

Passions In Painting and Sculpture the representation in the countenance and other parts of the violent emotions of the mind produced by anger fear grief &c The expression of the passions is a language without which the painter can never hope for success it is in this that he has the means of appeal to the sympathy of the spectator The close observation of nature under similar circumstances is the only mode by which his aim can be accomplished

PA'SSOVER or PASCHA A festival among the Jews which derives its English name from God's *passing over* the houses of the Israelites and sparing their first born when those of the Egyptians were put to death The name of passover or paschal lamb was likewise given to the *lamb* slain in memory of that deliverance The festival lasted seven days, beginning on the evening of the 14th of the month Nisan and commenced with killing the lamb The regulations appointed for this festival are detailed in Exod xii

That the passover had a typical reference to our Saviour has been the universal belief of the Christian world in all ages and is mainly grounded on passages in St John and St Paul (John xix 36, 1 Cor v 7) Christ is said to be our passover, his blood being shed to protect mankind from the divine justice, as the blood of the paschal lamb which was sprinkled upon the door-posts of the Israelites' houses, preserved them from the visitation of the angel of the Lord

PA'SSPORT A warrant of protection and authority to travel granted to persons moving from place to place by the competent officer The word appears to be derived from the [illegible] some continental countries of giving [illegible] from the admiral of a naval station to vessels leaving harbours within his jurisdiction As passports are not required in our own country the only species known to British travellers is that of foreign passports, which, for an Englishman travelling on the continent of Europe are usually made out by the resident minister or consul of the country he intends first to visit in London, or at one of the ports They are also granted by the Foreign Office to respectable persons on payment of a small fee (7*s* 6*d*) They are subject to visa or inspection by the proper authorities at the place where the traveller disembarks, and also at other places which he may reach according to the police regulations of each particular country and on passing the frontiers of states Austria and Russia are the only European states which at this time require absolutely the visa of an ambassador or minister of their own for travellers entering their domains by land In France, and in many continental countries, home passports are necessary for the native traveller According to the letter of the French law (since 17[illegible] a Frenchman cannot pass the limits of the canton in which he is domiciled without a passport, but in practice it is not required within the extent of the department Legally speaking the strict formalities of an internal passport, in France, require the direction of a journey to be specified, and its exact execution attested by the visas and signatures of the police authorities at every place mentioned in it, and these laws are, from their severity, so incapable of complete execution, that it is a common saying that no man but a rogue is ever entirely en regle with respect to his passport, suspicious characters being usually the most particular in their attention to formalities, for fear of detection A Frenchman travelling without properly authenticated papers, is liable to arrest and detention for a period of [illegible] The sums fixed in France are two francs for a passport to travel at home, and [illegible]

PASTE [illegible] In Gem Sculpture a preparation of glass, calcined crystal, lead, and other ingredients, for imitating gems This art was well known to the ancients, and, after being long lost, was restored, at the end of the fifteenth century by Milanese painters

Some modern artists have succeeded in obtaining compositions possessing a hard fine and brilliant appearance, but *pastes*, or mock diamonds, as they are called, depend most for brilliancy on the art displayed in setting the foil or tinsel behind them Several recipes have been given by M Fontanieu, but the most [illegible] for the production [illegible] — Take of litharge [illegible] 4, and of white arsenic 2 parts These ingredients are to be well mixed together in a crucible and melted, the fused metal is thrown into water, and should any of the lead employed be reduced to the metallic state, it becomes separated by this process and the glass is remelted for use For the finer kinds rock crystal is used instead of flint or sand, as it occurs in a much purer state, *i e* more free from the admixture of metallic oxides, which give to vitreous compounds their different colours In place of the above, Loysel recommends the following ingredients to form a compound having the same specific gravity as the oriental diamond, and on this account considered superior as it more nearly approaches the gem with regard to its refractive and dispersive powers, but, like the former it requires to be kept for some two or three days in a fused state in order to expel the superabundant alkali and to perfect the refining A moderate [illegible] The following is its composition — [illegible] purified by being washed first in muriatic acid and afterwards in pure water until all traces of acid are removed 100 parts, red oxide of lead (minium) 150 parts, calcined potash 30 to 35 parts, calcined borax 10 and oxide of arsenic 1 part (See the *Polytechnic Journal* for July 1841)

The term paste is also applied to the earthy mixture for pottery and porcelain, also to dough and to the solution of starch or wheat flour made by first mixing it with a proper portion of cold water and then adding boiling water under constant stirring so as to form an even solution Alum is often added to paste to strengthen it

PA'STEL (Lat pastillus) In Painting, a crayon formed with any colour and gum water, for painting on paper or parchment The great defect of this mode of painting is its want of durability See CRAYON

PA'STERN The part of the horse's foot under the fetlock to the heel

PASTICCIO (It) In Painting a picture painted by a master in a style dissimilar to that in which he generally painted David Teniers could for instance imitate, with surprising exactness the styles of many of the first masters of Italy and Flanders The same may be affirmed of Luca Giordano a Neapolitan artist

PASTIL In Pharmacy a kind of lozenge A compound of charcoal with odoriferous substances which diffuses an agreeable [illegible] its slow combustion

PA'STORAL [illegible] Bucolic Idyl

PA'STOUREAUX (Old Fr *shepherds*) Insurgent peasants who took up arms in France during the absence of King Louis IX on his crusade They were led by an apostate Cistercian monk who took the name of Jacob Master of Hungary who seduced them to follow him in various [illegible] They committed various excesses in the Province of Flanders, on which they at first assembled to Bourges where their leader was killed in a tumult, and his horde dispersed

PA'STURE Land under a particular decription of grasses and herbage which is eaten on the spot by horses, cattle &c Hill pasture is a term applied to hilly and mountainous lands which are kept perpetually under the natural grasses and herbage which spring up on them; while artificial pastures are such as are sown by art on lands which are occasionally subjected to the plough In all artificial pastures the principal grass is rye grass, and the principal herbage plant the white clover Perpetual pastures are such as are never subjected to the plough, and never receive any other manure than what is left on them by the pasturing animals, but artificial pastures are occasionally mown, and sometimes receive a top-dressing of dung, or some mixture of dung and earth, lime, &c

PATAVINITY A term in use among critics to denote a provincial idiom in speech, so named after that of Livy the historian, from his being born at Padavium, a provincial town of the Roman empire Wherein the alleged defect of Livy's writings consists has never been distinctly pointed out by any critic, ancient or modern

PATE In Fortification, a kind of platform encompassed with a parapet, and having nothing to flank it

**PATEE, or PATTEE** (Fr ) In Heraldry a sort of cross, small at the centre and widening towards the ends, which are very broad

**PATELLA** The small, flat, and somewhat heart-shaped bone, which is placed at the fore part of the knee [illegible] (Lat *a dish*) the *kneepan*

**PATELLOIDS** *Patellæ* The name of a family of Cyclobranchiate Gastropods, having the limpet (*Patella*) as the type

**PA'TEN** (Lat patina ) In Ecclesiastical usage, the stand or saucer on which the chalice rests It was frequently highly ornamented by artists in the 15th and 16th centuries In the administration of the Eucharist in England, the paten is the vessel on which the bread is placed

**PA'TENT**, in Commercal Law, is defined a privilege from the crown granted by letters patent, conveying to the persons specified in the sole right to make, use, or dispose of some new invention or discovery, for a limited period This power is said to be inherent in the crown, but was first defined by stat 21 Jac c 3, which gives the term of fourteen years or under, "so they be not contrary to the law, nor mischievous to the state by raising prices of commodities at home, or hurt of trade, or generally inconvenient" Ever since the reign of Anne it has been a condition in patents, that the inventor should, by an instrument technically called a "specification," particularly describe and ascertain the nature of his invention, on failure of which the patent becomes void These letters are obtained on petition to the crown, and are granted on the recommendation of the attorney or solicitor general An injunction may be obtained or an action brought for the infringement of a patent, but it is necessary to show the novelty and utility of the invention and that it is of something capable of being turned immediately to account in commerce, no patent will be good for a mere philosophical principle neither organized nor capable of being so It is now held that a new process or method is well as an article may be the subject of a patent A party who believes himself to have discovered an invention but has not yet been able to reduce it to practice may enter a *caveat*, that is an instrument by which notice is desired to be given by any one who may seek a patent for a similar invention The law of patents was amended by 5 & 6 W 4 c 77 and some difficulties under which inventors were placed were removed, but the whole policy of the Patent Laws has once more been brought before Parliament, with every prospect of their being entirely remodelled

The phrase *letters patent* is also frequently applied to the state documents or ordinances of the German sovereigns in which sense it is equivalent to the *bulls* of the pope or the *ukases* of the czar

**PATENT YELLOW** A pigment obtained by fusing a mixture of oxide and chloride of lead

**PATERA** (Lat patere *to be open*) In Roman Antiquities a large open goblet or cup of gold silver marble or earth &c used in offering libations to the gods

**PATERA** In Architecture the representation of a cup usually in bas relief and employed to decorate friezes fascia imposts &c

**PATERINI** One of the names by which the Paulicians a sect which appeared in Italy in the 11th century, were very commonly known The origin of the term is obscure, as is also the connection of the sect with the Manichæans of the East (See *Faber on the Church of the Waldenses* [illegible])

**PATER NOSTER** The Latin expression for *Our father* signifying the Lord's Prayer See ROSARY

**PATER PATRATUS** In Roman Classical Antiquities the chief of the fecials or heralds specially named for the performance of certain solemn acts such as declarations of war

**PATHE'TIC** (Gr παθητικος, from πασχω *I suffer*) In Painting and Sculpture, the expression of the softer or more sorrowful passions Its tendency is to depress and compose the feelings of the spectator

**PATHETIC NERVES** A pair of small nerves which influence the expression of the face They rise in [illegible] trochlear muscle of the eye

**PATHOGNOMONICS** (Gr παθος *a disease* and γνωμη *opinion*) Symptoms which are peculiar to particular diseases, and by which they are recognized, are termed [illegible]

**PATHOLOGY** (Gr παθος, and λογος, *a discourse*) Literally the doctrine of disease As physiology teaches the nature of the functions of the body in a state of health, so pathology [illegible] these functions which [illegible] It [illegible] therefore, are to ascertain the various symptoms which characterize the disorders of each organ of the body, and especially the diagnostic and pathognomic symptoms, which afford the means of discrimination between diseases that resemble one another, [illegible] both predisposing and exciting, by [illegible] duced, to point out the tendency and probable issue of each disease from the varying appearance of the symptoms; and finally to explain the symptoms of recovery, and the nature and operation of the remedies adapted to the various circumstances and periods of disease (*Conversations Lexicon*)

**PATHOS** (Gr πασχω *I suffer*) In Rhetoric and particularly [illegible] chiefly the tender, emotions of the mind In France, this term is generally used in a somewhat disparaging sense, being applied to that species of composition which indulges in strained and unnatural declamation

**PATINA** (Gr πατανη, *a dish*) In Numismatics, the fine rust with which coins become covered by lying in peculiar soils, which, like varnish, is at once preservative and ornamental It is, says Mr Pinkerton a natural varnish, not imitable by any effort of human art, sometimes of delicate blue, like that of a turquoise, sometimes of a bronze brown equal to [illegible] of bronze, sometimes [illegible] the azure hue, which [illegible] It is also found of a fine purple, of olive, and of a cream colour or pale yellow, which last is exquisite The Neapolitan patina is of a light green, and, when free from excrescence or blemish, is very beautiful Sometimes the purple patina gleams through an upper coat of another colour, with as fine effect as a variegated silk or gem In a few instances a rust of deeper green is found, and it is sometimes spotted with the red or bronze shade, which gives it the appearance of the East Indian stone called bloodstone These rusts are all, when the real product of time as hard as the metal itself, and preserve it much better than any artificial varnish could have done, concealing, at the same time not the most minute particle of the impression of the coin Gold admits no rust but iron-mould when lying in a soil impregnated with iron Silver takes many kinds but chiefly green and red, which yield to vinegar, for in this metal the rust is prejudicial

**PATOIS** (Supposed to be derived from Lat pater, *a father*) A word in general use in most European countries signifying the dialect peculiar to the lower classes

**PATRES CONSCRIPTI** See CONSCRIPT FATHERS

**PATRIARCH** (A compound of πατηρ *father*, and αρχω, *I govern*) The title given by the sacred writers to the earliest heads of families recorded in Scripture, from Adam to Jacob and his sons This title was assumed also in the early ages of the church by the bishops of the principal cities of the empire, as Rome, Constantinople Antioch &c The name was adopted from the practice of the Jews, who after the dispersion, subjected themselves to the spiritual superintendence of the patriarchs resident at Tiberias and Babylon The first mention of a Christian patriarch occurs about 440 They were for the most part superior to archbishops or metropolitans being set over several provinces This however was not always the case The patriarchs of Ephesus and Cæsarea for instance were subject to the bishop of Constantinople and were only on a par with diocesan prelates (See *Hooker Eccles Polity*, 6, 7, *Mosheim*, vol i pp 179 349 trans 1790)

**PATRICIANS** (Lat patres *fathers*) The first order or nobility of the Roman people When the constitution of Rome was monarchical they elected the king, and after the expulsion of the Tarquins all the great officers of state as consuls prætors, &c, were chosen from their body for many generations Of the patricians, also, the senate was composed, but in after times, both this and the great magistracies were thrown open to the plebeians The subdivisions of this order were as follow —First they were classed into three tribes, called Ramnenses Titienses and Luceres, of which the first contained the original patricians of Romulus the two latter being probably admitted to their privilege at different subsequent times Each of these tribes again was divided into ten curiæ and each curia again contained ten clans or gentes The general assembly of the patrician houses who constituted the populus, in contradistinction to the plebs or plebeian citizens, was called *comitia curiata* because they voted therein by curiæ, and this, in the earliest times was the Roman popular assembly, to which plebeians were not admitted

**PATRICK, SAINT, ORDER OF** An Irish order of knighthood instituted by George III in 1783, composed of the sovereign a prince of the blood royal, a grand master and fifteen knights, the lord lieutenant of Ireland for the time being is grand master

**PATRIPA'SSIANS** (Lat pater *father*, and passio, *suffering*), are persons who, by overlooking the distinction between the persons of the Trinity, are reduced to allow that the Father himself suffered on the cross This argument has been advanced against heretics of various denominations, and the title has, in consequence, been applied to many such It is the Sabellians, however, who considered the Father, Son, and Spirit as three modes or representations of the one God, that are generally [illegible] this term See SABELLIANS [illegible] ent 4)

**PATRISTIC** (Lat pater, *father*) In Theology, of or belonging to the fathers of the church, as patristic theology, literature, study

**PATRO'LE** (Fr patrouille) In Military language, a detachment, ordinarily of from four to eight men, under [illegible] The patroles are drawn from the posts of the city, and set out at an hour fixed by the commandant They are usually accompanied, in Continental towns, by an officer of police

**PA'TRON** (Lat patronus, from pater, *father*) The relation of patron and client, in ancient Rome, has been explained under the head CLIENT After the extinction of republican sentiments and usages, the term patron was still applied to advocates who defended causes for hire But the right of patronage analogous to that which had subsisted under the commonwealth, may be said only to have existed in the relation between masters and freedmen, the latter of whom were placed under various obligations to their former owners In the usage of the Roman Catholic Church a *patron* saint is the peculiar protector of each country community, profession, &c, or of individuals The prime minister of the pope is termed the cardinal-patron (As to the Roman patrons see *Mem de l'Acad des Inscr* vol xii)

**PA'TRONAGE** In the Church of Scotland the right of presentation to livings in lay patrons was recognized by the old practice of the church with the exception of the period from 1690 to 1712, during which lay patronage was abolished and the right of presentation lodged in the heritors (land owners) and members of the kirk session In 1712 lay patronage was restored, but still under the control of the parishioners whose *call* (as it was termed) was necessary to ratify the presentation But the call gradually became a mere nominal ceremony and disregard to the expressed wishes of the parishioners in one or two instances was the cause of the great secession from the Scottish kirk (See BURGHERS) In 1834 by an act of Assembly (*see* VETO ACT), the right of the parishioners was fully revived, it [illegible] that the disapproval of a majority [illegible] presentation This act of the General Assembly however was found by the courts of law not to be efficient but, after the establishment of the Free Church in 1843 an act, commonly called Lord Aberdeen's Act was passed which removed all doubts on the subject and acknowledged within certain reasonable limits, the right of the members of the church to have a voice in the nomination of their pastors

**PATRONY'MIC** (Gr πατηρ and ονομα *a name*) A name which designates a person by alluding to one of his ancestors either immediate or remote, as Pelide *i e* Achilles the son of Peleus, Eacide *i e* Achilles the grandson of Æacus Patronymics were chiefly employed by the classical poets of antiquity

**PAULIANISTS** A sect of heretics who embraced the Sabellian doctrines of Paulus of Samosata a bishop of Antioch in the third century, from whom they derived their name See SABELLIANS PATRIPASSIANS

**PAULICIANS** A sect of heretics whose history is interwoven with that of the Greek church in the 9th and 10th centuries, who appear to have arisen in considerable numbers in Armenia, and to have adopted the name by which they are distinguished from Paulus one of their leaders in order to avoid the imputation of connection with the Manicheans with which they were generally [illegible] Their opinions are to be collected only from the [illegible] of their enemies who accused them of [illegible] doctrine of the two principles and denying the inspiration of the Old Testament to have proceeded from the Supreme God At the same time the charges which were brought against them alleging their contempt for the worship of the Virgin and of the cross seem to point them out as in some respects genuine reformers in doctrinal points, and to have led their bigotted enemies to invent other and more scandalous imputations against them, for the sake of more effectually blackening their character In the East, they underwent a series of persecutions for two centuries a remnant, however, sur- [illegible] A colony of Paulicians [illegible] Thrace, from whence in the 11th century, they spread themselves over the West where they were known under the names of Cathari, Paterini, &c, and have been supposed to have been connected with the [illegible] France (See *Mosheim*, vol ii, *Hist of the Church of the Waldenses and Albigenses*, 1848)

**PAUPER** *See* POOR LAWS

**PAUSE** (Gr παυω, *I stop*) In Music, a character denoting silence in a part for a certain time, according to the sort of pause marked

**PAVAN** (Lat pavo *a peacock*) A slow and stately dance formerly practised in England, but now confined to the Spaniards It derived its name from the peculiarity of the dresses of those who engaged in it, the motion of which produced a fancied resemblance to the peacock's tail

**PA'VEMENT** (Lat pavimentum.) In Architecture, a causeway or floor paved with stone, brick, or other hard material for greater convenience of walking *See* ROADS

**PAVESE** or **PAVOIS** A large shield, used in the warfare of the middle ages to cover assailants advancing to the [illegible]

**PAVILION** (Fr pavillon) In Architecture, a projecting apartment on the flank of a building, usually higher than the rest of it Summer houses in gardens are sometimes called by this name, but improperly The term pavilion is also used to signify a military tent

**PA'VO** (Lat *a pea-fowl*) The name given by Linnæus to the genus of Gallinaceous birds of which the splendid Indian species *Pavo cristatus* Linn) is the type They are characterized by a crest of peculiar form, and by the tail coverts of the male extending far beyond [illegible] erection into a broad and [illegible] ix and silky barbs of these feathers, and the eye like spots which decorate their extremities, are known to every one The Indian pea fowl exist wild in the north of India, whence they were introduced into Europe by Alexander the Great A distinct species of pea fowl exists in the Isle of Java

**PAWNBROKER** A species of banker, who advances money at a certain rate of interest upon the security of goods deposited in his hands, having power to sell the goods at the principal sum, and the interest thereon, be not paid within a specified time The practice of advancing money [illegible] seems to have [illegible] but the first public establishments of this kind were founded in Italy under the name of Monti di Pietà in the 14th and 15th centuries, and were intended to counteract the exorbitant usurious practices of the Jews who formed at that period the great money-lenders of Europe From Italy these establishments gradually spread over the Continent, in many parts of which they still exist (See MONT DE PIETÉ) For a view of the advantages and disadvantages of pawnbroking, and the law as to pawnbrokers &c, see the *Commercial Dict*

**PAX** An allegorical divinity among the ancients, worshipped as the goddess of peace She had a celebrated temple at Rome which was built by Vespasian and was consumed by fire in the reign of Commodus This term is sometimes applied to a small image of Christ because, in former times the kiss which the people gave at before leaving church was called the kiss of peace But the common pax or osculatorium was a metallic plate with a crucifix engraved on it It is now disused (See Ducange *Osculatorium*, Milner, in the *Archæologia* vol xx p 34)

**PAYMASTER GENERAL OF THE FORCES** This office was formerly extremely lucrative from the interest on the large sum of money which remained for a long time in the possession of the paymaster In 1782 it was deprived of these extraordinary emoluments and the salary fixed at 1000*l* a year The paymaster is constituted by letters patent under the great seal, he is ex officio of the privy council sometimes of the cabinet In the Pay Office there are under him a deputy paymaster, a cashier, and various assistants

**PAYMASTER OF THE HOUSEHOLD** An officer in the lord steward's department This office has superseded that of the ancient cofferers It has a salary of 400*l* per annum

**PEACE JUSTICES OF** *See* JUSTICES

**PEAK** In Naval [illegible] the name given to the upper corner of those [illegible] which are extended by a gaff or by a yard crossing the mast obliquely, as the mizzen yard of a ship &c

**PEARLASH** Impure carbonate of potash *See* POTASH

**PEARLS** These are substances formed by certain bivalve Mollusks, consisting of concentric layers of a fine compact nacre or substance identical with that which lines the inside of the shell, they are sometimes found free and detached within the lobes of the mantle, but most commonly adherent to the nacrous coat of the shell, which on that account is termed "mother of pearl" The species of bivalve which produces the most valuable pearls is the pearl oyster of Ceylon, *Meleagrina margaritifera*, Lam A pure pearl is generally spherical, and has a white or bluish, or yellowish white colour, with a peculiar lustre and iridescence, and consists of alternating concentric layers of membrane and carbonate of lime When steeped in dilute muriatic acid, the carbonate is decomposed with effervescence, and films of membrane remain undissolved

Pearls were in the highest possible estimation in ancient Rome, and bore an enormous price *Principium cum [illegible] rerum pretii, margaritæ tenent* (*Plin Hist Nat* lib ix c 35) Their price in modern times has very much declined, partly, no doubt, from changes of manners and fashions, but more, probably, from the admirable imitations of pearls that may be obtained at a very low price According to Mr Milburn, a handsome necklace of Ceylon pearls, smaller than a

large pea, cost from 170*l* to 300*l*, but one of pearls [illegible] be had for 15*l* the [illegible] each, and those in the latter at about 1*s* 6*d*. When the pearls dwindle to the size of small shot, they are denominated *seed* pearls, and are of little value. They are mostly sent to China. One of the most remarkable pearls of which we have any authentic account was bought by Tavernier, at Catifa, in Arabia, a fishery famous in the days of Pliny, for the enormous sum of 10,000*l*! It is pear-shaped, regular, and without blemish. The diameter is 63 inch at the largest part, and the length from 2 to 3 inches. It is in the possession of the shah of Persia.

The pearl oyster is fished in various parts of the world, particularly on the west coast of Ceylon, at Tuticoreen, in the province of Tinnevelly, on the coast of Coromandel, at the Bahrein Islands, in the Gulf of Persia, at the Sooloo Islands, off the coast of Algiers, off St Margarita, or Pearl Islands in the West Indies, and other places on the coast of Colombia, and in the Bay of Panama in the South Sea. Pearls have sometimes been found on the Scotch coast, and in various other places.

The pearl fishery of Tuticoreen is monopolized by the East India Company, and that of Ceylon by government. But these monopolies are of no value, as in neither case does the sum for which the fishery is let equal the expenses incurred in guarding, surveying, and managing the banks. It is therefore sufficiently obvious that this system ought to be abolished, and every one allowed to fish on paying a moderate licence duty. The fear of exhausting the banks is quite ludicrous. The fishery would be abandoned as unprofitable long before the breed of oysters had been injuriously diminished, and in a few years it would be as productive as ever. Besides giving fresh life to the fishery, the abolition of the monopoly would put an end to some very oppressive regulations enacted by the Dutch more than a century ago. (For full details respecting the pearl fishery, see the *Commercial Dict.*)

PEARLSINTER. In Mineralogy, a siliceous mineral found in volcanic tufa; it is also called *fiorite*.

PEARLSTONE. A variety of obsidian, a volcanic product of a pearly lustre; it is a silicate of alumina.

PEASTONE or PISOLITE. A variety of limestone composed of globular concretions of the size of a pea.

PEAT. The natural accumulation of vegetable matter on the surface of lands not in a state of cultivation, always more or less saturated with water, and generally abounding in modifications of extractive matter, varying with the nature of the plants of which the peat is composed.

Peat is generally of a black or dark brown colour, or when recently formed of a yellowish brown; it is soft and of a viscid consistence, but it becomes hard and darker by exposure to the air. It is generally more or less mixed with earthy substances. When steeped in water it gives out a brown liquor, more or less dark. When thoroughly dried it may be set fire to, and burns slowly, giving out a gentle heat without much smoke. This smoke communicates a peculiar flavour to all the articles with which it comes in contact, and this flavour is considered a characteristic of spirits which have been distilled in vessels heated by this kind of fuel, and also of malt, corn, and fish which have been dried by it. Peat abounds in every part of the world, but more especially in the cold moist climates of temperate regions. It covers many thousand acres in Ireland, and in the Highlands and western counties of the Lowlands of Scotland, and in the western counties of England; but all these bogs are rapidly disappearing in consequence of being drained, and having their surfaces slightly covered with earth, and stirred and sown with grass seeds.

When peaty matter accumulates on the sides of declivities it is generally comparatively dry, and is then called hill peat, but when peat accumulates on hollow places, or on flat surfaces, it is generally thoroughly saturated with water, and is then called peat bog. In most cases the principal plant which forms the peaty matter is the *Sphagnum palustre* of Linnæus, a moss which is common on all moist peaty surfaces throughout Europe, and is frequent in many parts of North America. This moss continues growing upwards from the points of the shoots, while decay is advancing in a similar manner from their lower extremities, thus forming a thick close mass of vegetable matter, which as it increases in height [illegible] cut and dried, to be used as fuel, or to be mixed with dung or lime and rotted into manure.

When peaty matter accumulates on a surface which abounds in springs, the water sometimes oozes out beneath the peat, and between it and the natural soil, in such quantities as to raise up the layer of peat, and float it off to a distance, sometimes carrying every thing before it and ending by burying under it lands in a state of culture. About the middle of the 18th century, a remarkable irruption of this kind took place near Annan in Dumfries-shire, and such irruptions are frequent in Ireland. The [illegible] favourable to the growth of peat are [illegible] in springs, a flat surface or hollow surrounded by hills, and a moist climate. Hence peat-bogs are more abundant in Ireland, and in the western counties of Scotland, than in any other part of the British empire.

When an accumulation of peat has taken place in a level situation, or on a declivity not abounding in springs, the matter accumulated is comparatively dry, and is then called peat moss. One of the most remarkable peat mosses in Britain is the Flanders Moss, in Stirlingshire. It rests on a flat surface of excellent alluvial soil, of which it covers about 4000 acres. Great part of this peat moss, being quite light, has been cut into small pieces, and floated off by means of a stream of water to the sea, thus exposing the natural soil, and rendering it fit for culture. This operation was commenced at Blair Drummond, towards the end of the last century, by the celebrated Lord Kames, and is still continued by his son, Mr Drummond.

PEATS. Peat bog cut out in small square or rectangular pieces, and dried for being used as fuel. These pieces are cut out with light spades in the summer season, spread abroad to dry, and afterwards carted home and put up in stacks, or heaps, which are thatched to exclude the rain. These peats are afterwards used as fuel, not only for domestic purposes, but for burning lime, and for heating kilns for drying corn, &c. To facilitate the drying of peat, the water is sometimes pressed out of the square pieces after they are cut and thrown out of the bog, by a compressing machine, which also renders the material more compact and durable in the fire. Peats are also sometimes charred by a smothered combustion, so as to be rendered better adapted to serve as a substitute for pit coal, coke, or charcoal in smelting iron or other metals, in generating steam, &c. Attempts have been made to separate astringent matter from peat, and to use it in tanning leather.

PEAT SOIL. Peat in a state of decomposition on which corn or other agricultural crops may be grown. The process of turning living peat into peat soil is greatly facilitated by draining, and by laying earth or lime on its surface, and afterwards mixing the earthy matter with the peat by ploughing or digging. In this manner every kind of peaty surface may be rendered available for agricultural purposes, and accordingly, in Ireland, in Lancashire, and in Ayrshire, good crops of corn, potatoes, and artificial grasses are produced on the surface of peat lands, which consist of a layer of peat from five to twenty feet in depth. The plants which thrive best on the surface of beds of peat of this description are those which extend their roots immediately under the surface. Hence few trees will thrive in such soils with the exception of the spruce fir, the silver fir, the birch, and two or three kinds of willows. Peaty soil is extensively used in gardening, in the culture of plants which are found growing on this soil in a wild state.

*Peat from wood* or *woody peat* is a composition of the branches, trunks, and roots of trees with their leaves, and the shrubs and plants which have grown up among them, which have lain so long in water as to have decayed into a mass soft enough to be cut with a spade. The colour is a blackish brown like that of mossy peat, and it may be used as manure for fuel, and for the growth of plants. Peat of this description is found in some parts of Holland, and also in the Vale of Kennett, in Berkshire, but is most abundant in North America, where it forms the soil in which many of the plants and trees of that country thrive with the greatest vigour. Wherever it can be found it is the most suitable of all kinds of peat for garden purposes. This kind of peat is frequently burned for its ashes both in Britain and Holland, and these from the alkali they contain, are found an excellent manure.

*Peat sandy*, or *sandy peat*, is mossy peat in a state of decay or mould naturally mixed with sand brought over it, from soil lying above its level, or by the overflowings of rivers. It is used in gardening for the same purposes as heath soil.

PEBBLES. A term applied to rounded nodules, especially of siliceous minerals such as rock-crystal, agates, &c. Among opticians the term pebble generally means the transparent and colourless rock-crystal or quartz [illegible] used as a substitute for glass in spectacles [illegible] hardness renders it more durable, and little apt to be scratched.

PECCARI. A Pachydermatous quadruped allied to the hog, but generically distinguished by the absence of the outer toe of the hind foot, and the presence of a peculiar gland, which exudes its secretion by an orifice situated on the back, whence Cuvier devised the name *Dicotyles* (two navels) for the genus. The incisor and molar teeth resemble those of the hog, but the canines do not project from the mouth. The metacarpal and metatarsal bones of their two middle and largest toes are confluent, as in the Ruminants, with which their stomach

also divided into three compartments, the caecal appendages, pre[illegible] Two species of peccari are known, both natives of South America, viz the collared peccari (*Dicotyles torquatus*), and the white-lipped peccari (*Dic labiatus* Cuv)

PECHBLEND, or PITCHBLEND An ore of uranium

PECK. A measure of capacity containing two gallons, or the fourth part of a bushel The imperial peck contains 554 55 cubic inches *See* MEASURE

PE'CORA (Lat pecus, *a sheep*) The name given by Linnæus to an order of Mammals corresponding with the Ruminantia of Cuvier

P'ECTEN (Lat *a comb*), in Comparative Anatomy is the vascular membrane, in structure resembling the choroid, plicated with parallel folds like the teeth of a comb, [illegible] of birds from the back of the retina [illegible] humour to, or near to, the [illegible] where it finally terminates in a point This organ resembles a flattened conical bag, whence it is also termed "marsupium"

In Zoology, the name is applied to the genus of bivalve shells commonly called 'clams' They have a hinge like that of the oyster, but have been removed on account of their shell being inequivalve semicircular, always regularly marked with ribs, which radiate from the summit of each valve to the circumference and fur[illegible], called 'ears,' which [illegible]

The animal is chiefly remarkable for the little dark green metallic globule which terminates most of the tentacles of the exterior row of those at the circumference of the mantle These specks are conjectured to be rudimental ogans of vision, whence Poli was induced to call the soft parts of the pecten 'argus'

PE'CTIN (Gr πηκτος, *coagulated*) Also termed *Pectic Acid* The gelatinizing principle of certain vegetables such as currants apples &c It may be abundantly obtained from some of the esculent roots especially carrots whence their excellence as an ingredient in soup To obtain it from this source the carrots are rasped and the pulp strongly pressed so as to render it as dry as possible, in this state it is washed in repeated portions of cold soft water, till all soluble matters are removed from it The pulp thus prepared is then boiled with 5 parts of bicarbonate of potash to every 100 of the washed pulp, the decoction is filtered and chloride of calcium added to it which forms a bulky precipitate of *pectate of lime*, this is well washed, and the lime removed by very weak muriatic acid Pectin or pectic acid thus obtained, is in the form of a jelly which forms insoluble compounds with the earths and several of the other metallic oxides It seems doubtful whether this jelly is not a *product*, resulting from the action of the alkaline carbonate of the lignin of the carrot It must however be easily formed for when carrots are stewed or boiled for a length of time they become very gelatinous When pectic acid is boiled in a strong solution of potassa, oxalate of potassa is produced

PECTINA'TUM TECTUM (Lat pecten *a comb*) In Architecture, a roof which has obtained this name from its shape resembling that of a comb and contrived to throw off the rain water in two ways

PECTINIBRANCHIATES *Pectinibranchiata* (Lat pecten, and branchia *gills*) The name given by Cuvier to his sixth order of Gastropods It is the most extensive division of that class since it includes almost all the spiral univalve shells, as well as several which are merely conical The order is thus characterized by Cuvier — "The branchiæ compose [illegible] ranged parallel like the teeth [illegible] two or three lines (according to the genera) to the floor of the respiratory cavity, which occupies the last whorl of the shell and which communicates outwards by a wide aperture between the margin of the cloak and the body Two genera only — *Cyclostoma* and *Helicina* — have, instead of branchiæ a vascular network clothing the ceiling of the cavity in all respects the same as that of the order, and they are the only ones which respire [illegible] water being the medium of respiration [illegible]"

All the Pectinibranchiates have two tentacula and two eyes, raised sometimes on pedicles, a mouth in the form of a proboscis more or less lengthened, and separate sexes The penis of the male, attached to the right side of the neck, cannot in general be drawn within the body, but is reflected into the branchial cavity, it is sometimes very large The *Paludina* alone has the organ concealed, and it comes out through a hole pierced in the right tentaculum, the rectum and the oviduct of the female also creep along the right side of the branchial cavity, and there is between them and the branchiæ a peculiar organ, composed of cells filled with a very viscous fluid, the use of which is to form a common envelop for the inclosure of the eggs, and which the animal deposits within them The form of that envelop is often very complicated and very remarkable

The tongue is armed with little hooks (or curved spinules), and wears down the hardest bodies by slow and oft-repeated frictions

The grand difference between these animals lies in the presence or absence of the canal formed by the prolongation of the margin of the branchial cavity on the left side, and which passes along a [illegible] in the shell, to enable the animal to breathe without leaving its shell There is also this distinction between the genera, that some want the operculum, and the species vary in the filaments, fringes and other ornaments that deck the head the foot or the cloak

PE'CTORALS, or PECTORAL FINS (Lat pectus, *the breast*) The anterior and lateral pair of fins, which represent in fishes, the fore legs or anterior members of other vertebrate animals

PECULA'TION (Lat *peculium*) A term of the Roman law, rendered in that of France by *concussion* The embezzlement by a public officer of public money Peculation, in the Roman law, also comprehended offences relating to the coin

PECULIAR In Ecclesiastical Law, an exempt jurisdiction which is not under the ordinary of the diocese, but has one of its own They are, — royal, of which the king is ordinary, peculiars of archbishops, bishops, deans, chapters prebendaries, and the like, to which were formerly added peculiars of monasteries the jurisdiction over which by 31 H 8 c 13, was granted to the ordinary within whose diocese they were situate, or to such persons as the king should appoint

PE'CULIUM (Lat) In the Roman Law, the property which a slave might acquire independent of the control of his master This property was frequently permitted to accumulate so as to enable the slave to purchase his freedom The son being, on the principles of the Roman law unemancipated during the lifetime of his father, whatever property he might acquire appertained in strictness to the latter, but by degrees certain species of property acquired by the child obtained the title and character of *peculia* Of these however the only one which was absolutely the child's was that which the son acquired in military service (peculium castrense) or in public service of any kind which by a legal fiction was regarded as equivalent to military

PE'DAGOGUE (Gr παιδαγωγος, from παις *boy*, and αγωγος, *leader*) Among the ancient Greeks a slave charged with the personal care of a boy from the earliest age after infancy (from the milk in the loose phrase of Plutarch, from about the age of seven as it is more accurately stated by Æschines) until he became a youth (μειρακιον) i e until the seventeenth or twentieth year The pedagogue's duty was to attend his charge on all occasions when he left his father's house to the lecture rooms of masters the theatre, &c (See especially Plato, *Sympos*) He was also intrusted with the duty of instructing and [illegible] he child in inferior branches of education [illegible] manners He was, consequently of a very superior order of common slaves and must be understood as excepted when Aristotle recommends that a child should be left to converse as little as possible with persons of the servile class (*Politic* vii 15b) The custom of entrusting children to slaves in this manner was common in other Grecian states, the Romans also employed a slave for similar purposes, with the title of *custos* or *magister*

In modern times and especially in Germany the word *pedagogic* is [illegible] education

PEDAL [illegible] as *Organ Point* which see

PEDAL MA'SCHI A Turkish officer whose duty consists in looking after the interests of the Sultan in cases of legacies The Ottoman treasury receives through this officer a tithe of all bequests made to heirs male

PEDALS (Lat pes *a foot*), in such musical instruments as the organ harp and pianoforte are either keys acted on by the feet of the performer (whence the name), to modify the tone of these respective instruments, or levers acting on the swell of the organ, and on the stops The invention of the pedals or foot-keys of the organ is attributed to a German named Bernhard who lived in the 15th century It was long, however before their utility and importance were acknowledged by other nations and it is a singular [illegible] is the first to introduce the org[illegible], she was the last to adopt this invention Within the last twenty years many improvements have been made in the construction of pedals, and few organs, except those of small dimensions, are now built without them *See* ORGAN

PE'DATE In Botany, a palmate leaf, with the two lateral lobes themselves divided into smaller segments, the midribs of which do not run directly into the common central point, as in the leaf of *Arum dracunculus*

PE'DESTAL (Lat pes, *a foot*) In Architecture, the substruction to a column [illegible] of a pedestal are three;

The whole height of a pedestal is from one quarter to one third of the height of the column, with its entablature

PE'DICEL (Lat pes) One of the ramifications of that part of a flower called the peduncle

PEDICE'LLATES, *Pedicellata* (Lat pes) The name of an order of Echinoderms, comprehending those which have the vesicular pedicellate organs, which are termed feet in this class, but which project from various parts of the surface of the body

PE'DIMANES *Pedimani* (Lat pes, and manus, *a hand*) The name of a family of Marsupial animals, of which the opossum (*Didelphis*) is the type, they are distinguished by the opposable property of the hinder [illegible] the fore feet being organized like those of [illegible]

PE'DIMENT (Lat pes) In Architecture, the low triangular mass representing the gable of a roof over the front of a building, portico, door, window, &c, though sometimes these ornaments are terminated upwards by segments of circles A pediment is frequently ornamented with sculpture The heights of pediments are seldom more than two ninths of their width

PE'DIPALPS *Pedipalpi* (Lat pes, and palpo, *I feel*) A name given to a tribe of pulmonary Arachnidans, comprehending those which have the feelers in the form of pincers, or armed with a didactyle claw, as the scorpions

PE'DIAR See HAWKER

PEDO'METER, or PODOMETER (Gr πους *the foot* and μετρον, *measure*) An instrument for the purpose of registering the number of paces taken by a man in travelling or walking whence the distance is ascertained It is in the form of a watch, and receives its movement from the motion of the body so that it advances one division at each step The number of divisions may be noted by an index or hand in the same manner as the number of vibrations of a watch balance The best construction or rather the only one now used in this country is that of Mr Payne, watchmaker, of Bond Street See PERAMBULATOR

PEDU'NCULATES, *Pedunculata* The name of an order of Cirripeds comprehending those which have the body supported by a flexible tubular stem

PEDU'NCULUS (Lat pes, *a foot*) That part of a branch or stem that immediately bears the flowers

PEEP-O' DAY BOYS The well known appellation of certain insurgents who appeared in Ireland in 1784 They obtained this name from visiting the houses of their antagonists, called *defenders* at break of day in search of arms

PEER (From the Latin *par* French *pair*) Equal which meaning it still retains in the language of the common law as trial by jury is said to be by the peers or equals of the defendant In this sense the name remains as a relic of feudal institutions according to which every rank of society formed an association for the purpose of mutual defence and the decision of disputes, as the tenants of a lord paramount or inferior who met as equals (pares curiæ) in the court over which he presided Hence, in the French monarchy the highest vassals of the crown formed a rank apart and were called pares or peers with reference to each other, and the designation became a title of honour The peers of France differed in number at different periods of the early French monarchy as their domains became united to the crown, but according to heraldic theory there are six temporal —the Dukes of Burgundy Aquitaine and Normandy and Counts of Flanders Toulouse and Champagne and six spiritual,—the Archbishop of Rheims and the Bishops of Laon, Beauvais Noyon, Chalons, and Langres In later times new peerages were created, as the duchy of Brittany and counties of Artois and Anjou At last the title remained as a simple dignity and Louis XIV increased the number of dukes and peers (ducs et pairs) until at last they amounted to thirty seven They had no privileges except precedence, and a seat in the parliament's On the restoration of Louis XVIII hereditary peerage was established in France on the model of that of England, but was abolished in 1831, and the members of the present chamber of peers are nominated for life by the people For the history and privileges of the English peerage see PARLIAMENT There is a curious analysis of the English peerage in the *Quart Review* vol 41

PE'GASUS In Greek mythology, a winged horse, produced by Neptune, or, according to some authors, which sprung from the blood of Medusa when Perseus cut off her head See BELLEROPHON

PEGASUS This name is applied in Zoology, to a genus of Lophobranchiate fishes with large pectoral fins by means of which they are enabled to take short saltatory flights through the air

PEGASUS One of the 48 ancient constellations of Ptolemy situated in the northern hemisphere

PELAGIANISM The [illegible] maintained by Pelagius, a British monk [illegible] after attaining to considerable notoriety in his own day, by first eliciting the discussion of the great questions respecting grace and predestination, has succeeded in bequeathing his name as a designation in all after ages for those who have held the extreme opinions by which he was distinguished His tenets are thus clearly stated by a modern writer —"1 That the sins of our first parents are imputed to themselves alone, and not to their posterity, that we derive no corruption from their fate; that we inherit no depravity from our origin, but enter into the world as pure and unspotted as Adam at his creation It was a necessary inference from this doctrine that infant baptism is not a *sign* or *seal* of the remission of sins, but only a mark of admission into the kingdom of Christ 2 That our own powers are sufficient for our own justification, that as by our own free will we run into sin, so by the same voluntary exercise of our faculties we are able to repent and reform, and raise ourselves to the highest degree of virtue and piety, that we are indeed assisted by that external grace of God which has taught us the truths of revelation, which opens to us our [illegible] and animates [illegible] either immediately or immediately [illegible] is necessary either to awaken us to religious feeling, or to further us in our progress towards holiness, in short, that man, by the unassisted agency of his natural perfections, under the guidance of his own *free will*, is enabled to work out his own salvation" (*Waddington's Hist of the Church*) These opinions were formally condemned by a decree of Pope Zosimus, about 418 and again by the council of Ephesus in 431 Their principal opponent was the famous Augustin, who, in the course of his arguments against them, advanced an explanation of the questions involved in the discussion, which has been stigmatized as leading directly to the opposite extreme of fatalism (See *Mosheim*, vol ii cent 5) The Pelagian opinions respecting original sin are condemned in the 9th article of the English church

PELECA'NIDÆ The name of a family of swimming birds of which the pelican (*Pelecanus*) is the type

PELLAGRA (Lat pellis *the skin*, and æger, *sick*) A disease of the skin somewhat resembling *elephantiasis*, and occasionally producing great constitutional derangement It is endemic in certain districts of Italy, especially in the Milanese

PE'LLICLE (Lat pellis *skin*) A thin membrane In Chemistry the term is applied to the film of salt or other substances which forms upon the surface of solutions during evaporation

PE'LLITORY OF SPAIN The root of the *Anthemis* [illegible] It [illegible] when chewed [illegible] especially to toothach

PELTA (Lat *a shield*) In Botany a term used in describing lichens to denote a flat shield without any elevated rim as in the genus *Peltidea*

PELTA'STÆ Light armed infantry were so named among the Greeks from carrying the pelta or target (See *Mem de l'Ac des Inscr* vol xxxii)

PELTATE (Lat pelta, *a shield*) A leaf or any other organ which is fixed to the stalk by the centre, or by some point distinctly within the margin, as in the *Tropæolum*

PE'LTRY (Germ peltz from Lat pellis, *a skin*) The name given to the skins of different kinds of wild animals found in high northern latitudes particularly in America, such as the beaver, sable wolf, bear &c When the skins of such animals have received no preparation they are termed *peltry*, but when the inner side has been tanned by an aluminous process, they are denominated *furs*

PE'LVIS (Gr πελυς *a basin*) The inferior part of the abdomen the bony circumference of which is formed by the two *ossa innominata*, the *sacrum*, and the *os coccygis* It contains the rectum the urinary bladder, and internal organs of generation

PE'MPHIGUS (Gr πεμφιξ *a vesicle*) A fever attended by almond-shaped vesicular eruptions

PE'NALTY (Lat pœna, *punishment*), is of three kinds says Lord Coke, *pœna pecuniaria*, *pœna corporalis*, and *pœna exilii* Where any thing is prohibited by statute under a penalty if the penalty or part of it, be not appointed by the statute to the informer, it goes to the crown Penal statutes are to be construed strictly. See STATUTE

PE'NANCE See PENITENCE

PENA'TES The household gods of the ancient Italians who [illegible] were worshipped in the [illegible] The term is derived from penitus, *within* Penates is in fact a generic term, comprising in its strict sense all the gods worshipped in the interior of the [illegible] including the Lares with whom they [illegible] In connection The number and names of the Penates were indeterminate As there were public as well as domestic Lares so there were public Penates, who exercised a general influence over the destinies of the whole Roman people Thus Tacitus relates, that "delubrum Vestæ cum

Penatibus populi Romani" was consumed, along with other very ancient temples in the great fire during the reign of Nero But the term may perhaps, become deroul as belonging to the rhetorical style of that author, and to signify merely the tutelary god of the republic

The subject of the domestic deities of the Romans, the Lares and Penates is involved in great obscurity from the conflicting statements of the classic authors respecting them Those who wish to see the question investigated in all its bearings may consult *Muller's Etruscans*, vol i p 90 Sq Jacket *De Dis Penatibus*, Hartung, *Religion der Romer*, &c See also the notes by Prof Ramsay of Glasgow, appended to his valuable little work entitled *Elegiac Extracts from Tibullus and Ovid, with English Introductions and Notes* 12mo 1840)

PE'NCIL (Lat penicillum) In Painting Drawing &c, the instrument wherewith the colours are applied Pencils are of various sorts sizes, and materials, suited to the nature of the work The *black lead pencil* is made of long slips of black lead (plumbago or graphite), inclosed in cylindrical pieces of cedar, and is too well known to need further description

PENCIL OF LIGHT Optics is a collection of the rays or evanescent streams of light converging to a point, as the focus of a lens or mirror

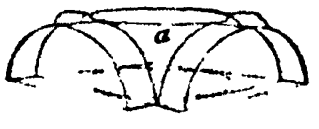
PE'NDANT (Lat pendo *I hang*) In Gothic Architecture, an ornamented polygonal piece of stone or timber hanging down from the vault or roof of a building Of stone pendants some exquisite examples may be seen in Henry VII's Chapel at Westminster In ancient writers the springers of arches which rest on shafts or corbels, are called *pendants*

*Pendants of a Ship* are those streamers or long colours which are split or divided into two parts ending in points and hang at the mast head or at the yard arm ends

PE'NDANT In Painting &c a picture or print which from uniformity of size and subject seems to hang up as a companion to another The term may also be applied to bassi rilievi of similar sizes

Pendant is also the general term for all kinds of ornaments worn in the ears by both sexes in savage and by females chiefly in civilized countries, usually termed ear-rings, which see

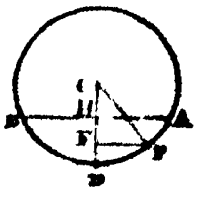
PENDE'NTIVE (Lat pendo *I hang*) In Architecture the portion of a vault between the arches under a dome called by the French *fourch* or *panache* lettered *a* in the diagram by which it will be seen that it falls at its superior part into a circle inscribed in the square formed on the plan of the four arches Hence it is obvious that a dome may be formed by means of pendentives over any regular polygon




PE'NDULUM (Lat pendulus, from pendo *I hang*) If any heavy body suspended by an inflexible rod from a fixed point be drawn aside from the vertical position and then let fall, it will descend in the arc of a circle of which the point of suspension is the centre On reaching the vertical position it will have acquired a velocity equal to that which it would have acquired by falling vertically through the versed sine of the arc it has described in consequence of which it will continue to move in the same arc until the whole velocity is destroyed, and if no other force than gravity acted this would take place when the body reached a height on the opposite side of the vertical equal to the height from which it fell Having reached this height it would again descend, and so continue to vibrate for ever, but in consequence of the friction produced, and the resistance of the air, each successive excursion will be diminished, and the body soon be brought to rest in the vertical position A body thus suspended, and caused to vibrate is called a *pendulum*, and the passage from the greatest distance from the vertical on the one side, to the greatest distance on the other, is called an oscillation

In order to investigate the circumstances of the motion, the body must be regarded as a gravitating point and the inflexible rod as devoid of weight This is denominated the *simple pendulum*, and the problem to be resolved is to determine the motion of a point constrained to move in a circular arc in virtue of the accelerating force of terrestrial gravity

Let C be the fixed point, A D B the arc described by the pendulum, C D the vertical, and P the place of the pendulum at a given instant Draw P E perpendicular to C D, and put D F $= x$, E P $= y$, the arc D P $= s$, D H (the versed sine of the arc D A) $= h$, and the radius C D $= l$, also let $v$ = the velocity at P, and $t$ = the time of descent through A P




The equation of the circle being $y^2 = 2lx - x^2$, we have the differential equation $ds = \frac{l\,dx}{\sqrt{(2lx - x^2)}}$, and, by the doctrine of falling bodies, the velocity at P is that which a body would acquire in falling through H E, or equal to $\sqrt{2g\,HE}$ ($g$ being the accelerating force of gravity) therefore $v = \sqrt{2g(h-x)}$ But $dt = \frac{ds}{v}$, therefore, on substituting the values of $ds$ and $v$ above given, we get the equation

$$dt = \frac{l}{\sqrt{2g}} \cdot \sqrt{\frac{dx}{\{(h-x)(2lx-x^2)\}}}$$

This equation, being developed and integrated gives the time of descent from A to D, or the time of a semi oscillation, as follows ($\pi$ being the ratio of the circumference to the diameter, or $= 3\ 14159$) —

$$\frac{\pi}{2}\sqrt{\frac{l}{g}}\left[1 + \left(\frac{1}{2}\right)^2 \frac{h}{2l} + \left(\frac{1\ 3}{2\ 4}\right)^2 \left(\frac{h}{2l}\right)^2 + \&c\right]$$

When the arc of vibration is small, it is only necessary to take account of the first two terms of the series, whence the time of a whole oscillation from A to B, which we shall denote by T, is given by the formula —

$$T = \pi\sqrt{\frac{l}{g}} \times \left(1 + \frac{h}{8l}\right),$$

and if the arc is so small that $h$ (its versed sine) becomes evanescent in comparison of $8l$, we have simply $T = \pi\sqrt{\frac{l}{g}}$

Whence it appears that the time of an oscillation in an infinitely small arc is directly as the square root of the length of the pendulum and inversely as the square root of the accelerating force of gravity

Suppose gravity to be a constant force (as it is at any given place on the earth's surface), the time of oscillation is proportional to the square root of the length of the pendulum, consequently if $T'$ denote the time of oscillation of a seconds' pendulum and $l'$ its length, we have $1 : T' :: \sqrt{l} : \sqrt{l'}$ Now let N be the number of oscillations the first pendulum makes in a given time and N' the number the second makes in the same time, then the number of oscillations being evidently in the inverse ratio of the times, we have $N : N' :: T' : T$, or $N : N' :: \sqrt{l'} : \sqrt{l}$, whence $l = \frac{N'^2}{N^2} l'$, so that if the length of one pendulum be known we can compute the length of another pendulum by observing the number of oscillations that each makes in any given time, for example in an hour

In like manner if we suppose the same pendulum to be transported to different parts of the earth (in which case $l$ is constant and $g$ variable) and assume that the values of N and $g$ at the first station become respectively N' and $g'$ at the second, we shall have $T : T' :: \frac{1}{\sqrt{g}} : \frac{1}{\sqrt{g'}}$, whence $g' = \frac{T^2}{T'^2} g$, or $g' = \frac{N'^2}{N^2} g$ So that the force of gravity at different places may be compared by observing the number of oscillations which a pendulum makes at each place in a given time Or if we suppose the times of oscillation constant (that is if we suppose two pendulums so adjusted as to be at seconds at two different stations) and $l$ and $g$ variable, then, since $T = \pi\sqrt{\frac{l}{g}}$, and $T' = \pi\sqrt{\frac{l'}{g'}}$, we shall have $\frac{l}{g} = \frac{l'}{g'}$, or $l' = l\frac{g'}{g}$, whence the length of the seconds pendulum at any place is directly proportional to the intensity of gravity at that place

According to the theory [illegible] the time $t$ in which a body [illegible] by the accelerating force of gravity [illegible] is given by the equation $t = \sqrt{\frac{2s}{g}}$ Let $2s = l$, then $t = \sqrt{\frac{l}{g}}$ But the time T, of the oscillation of a pendulum whose length is $l$, is $T = \pi\sqrt{\frac{l}{g}}$ therefore $T : t :: \pi : 1$, consequently the time of the oscillation of a pendulum is to the time that a heavy body would fall freely by the force of gravity through half its length, as the circumference of a circle to its diameter

If we suppose the time to be expressed in seconds, and make $T = 1$ we shall have $g = \pi^2 l$ Now Captain Kater found the length of the seconds pendulum at London to be 39 13929 inches, and we know that $\pi^2 = 9\ 8696$, therefore $g = 9\ 8696 \times 39\ 139 = 386\ 29$ inches, or $g = 32\ 2$ feet It follows therefore, that the space through which a body falls freely at London in a second of time is 16 1 feet

*Compound Pendulum* —The simple pendulum as above defined, is only a theoretical abstraction, for the oscillating body can neither be so small that it may be regarded as a mathematical point, nor can the rod be entirely devoid of weight When the body has a sensible [illegible] the apparatus is called a *compound pendulum*,

and instead of being supported by a single point it is supported by an axis, or [illegible] same straight line [illegible] heavy body oscillating about an axis of suspension is a compound pendulum

In every compound pendulum there is necessarily a certain point at which if all the matter of the pendulum were collected the oscillations would be performed in exactly the same time This point is the centre of oscillation (*See* CENTRE OF OSCILLATION ) It is situated [illegible] of the pendulum [illegible] suspension (the axis being always supposed horizontal), which is determined by the following formula — Let $dm$ be the element of [illegible] its distance from [illegible] of the centre of [illegible]

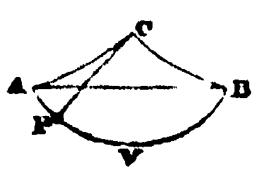
$$x = \int r^2 \, dm \, - \int r \, dm,$$

that is, the distance of the centre of oscillation from the axis of suspension is equal to the moment of inertia of the oscillating body divided by its moment of rotation This value of $x$ is the length of the isochronous simple pendulum, and is what is always to be understood by the term *length of a pendulum*

The centre of oscillation possesses a very remarkable property which was discovered by Huygens, namely that if the body be suspended from this point, on a horizontal axis passing through it parallel to the former axis of suspension, its oscillations will be performed in the same time as before, in other words the axes of suspension and oscillation are interchangeable This property furnishes an easy practical method of determining the centre of oscillation, and thence the length of a compound pendulum

*Applications of the Pendulum* — The most important application that has been made of the pendulum is to the measurement of time It is said that Galileo, while a young man having had his attention drawn to the oscillations of a lamp suspended from the roof of a church in Pisa, perceived that although their extent was gradually diminished they continued to be made in equal times, and thence conceived the idea of employing a pendulum as a means of measuring small intervals of time in astronomical observations But though a pendulous body by the isochronism of its oscillations, furnishes a means of dividing time into equal portions, it could obviously be of no great use until a method was devised of continuing the motion and registering the number of oscillations The application of clock work to this purpose has been claimed for various individuals but is generally and deservedly ascribed to Huygens, and the invention one of the most important that ever was made in reference to practical astronomy dates from the year 1656

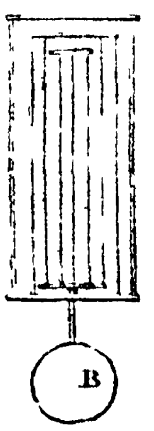
Huygens researches on the subject of the oscillations of the pendulum are contained in his admirable work entitled *Horologium Oscillatorium* He soon found that the oscillations in circular arcs of different amplitudes are not equal the wider requiring rather a longer time than the narrower, and with a view to remedy this defect he undertook to investigate the nature of the curve in which the oscillations would be performed in equal times, whatever might be the extent of the arc described The [illegible] was found to be [illegible] object was to devise a means of causing a pendulum to vibrate in such a manner that its centre of oscillation shall describe the arc of a cycloid This was also effected by Huygens by the following construction, which depends on another property of the cycloid, namely, that its evolute is a similar curve — If A C and B C be two semicycloids, or semicycloidal cheeks, each equal to the half of A V B, touching A B in A and B, and meeting one another in C, and if there be fixed at C a pendulum P hanging by a thread P C, equal in length to the semicycloid, then P, in its oscillations, will describe the cycloidal arc A V B Nothing more simple or beautiful in point of theory could be conceived than this construction but on attempting to reduce it to practice, it was soon found to possess no advantage, in consequence of the mechanical difficulty of making the cycloidal cheeks with the requisite accuracy [illegible] a flexible string it [illegible] showed that the error of a hundredth of an inch in the form of the curve would cause a greater irregularity than a circular vibration of 10 or 12 degrees Accordingly, the use of cycloidal cheeks was abandoned, and the attention of artists directed to the means whereby the oscillations might be confined within very small circular arcs, in which case any inequality in the lengths of the arcs becomes insensible In clocks of the best construction the arc of vibration is very small; and the pendulum is made very heavy, in order that, by possessing a great momentum, it may be less affected by the imperfections of the machinery.




*Compensation Pendulum* — The value of the pendulum as a regulator of timepieces depends on the isochronism [illegible] depends on the invariability of the distance between the points of suspension and oscillation But, as every known substance expands with heat and contracts with cold, the length of the pendulum will vary with every alteration of temperature, and the rate of the clock [illegible] To counteract this change To counteract this, numerous contrivances have been employed The principle is, however, the same in all, and consists in combining two substances, whose rates of expansion are unequal, in such a manner that the expansion of the one counteracts that of the other, and keeps the centre of oscillation of the compound body always at the same distance from the axis of suspension A brief description of the two compensation pendulums in most common use the *Mercurial Pendulum* and the *Gridiron Pendulum*— will suffice to explain the means by which compensation is obtained

*Mercurial Pendulum* — This was the invention of Mr George Graham, a celebrated watchmaker, who subjected it to the test of experiment in the year 1721 The rod of the pendulum is made of steel, and may be either a flat bar or a cylinder The bob or weight is formed by a cylindrical glass vessel, about 8 inches in length and 2 inches in diameter, which is filled with mercury to the depth of about 6½ inches The cylinder is supported and embraced by a stirrup, formed also of steel through the top of which the lower extremity of the rod passes, and to which it is firmly fixed by a nut and screw on the end of the rod Now the effect of an increase of temperature on this apparatus is evidently as follows — In the first place the rod expands, and the distance between the axis of suspension and the bottom of the stirrup is increased In the second place, by the expansion of the mercury in the cylinder its column is lengthened, and the distance of its centre of gravity from the bottom of the stirrup consequently increased But as the expansion of mercury is about sixteen times greater than that of steel, the height of the mercurial column may be so adjusted by trial that the expansion of the rod and stirrup shall be exactly compensated by that of the mercury, and the centre of oscillation of the whole suffer no change This pendulum is perhaps, the most perfect of all compensators but its adjustments are attended with considerable difficulty it is seldom used excepting in astronomical observatories

*Gridiron Pendulum* — This was contrived by Mr Harrison the inventor of the chronometer It consists of a frame of nine parallel bars of steel and brass, arranged and connected as in the annexed figure The bars marked *s* are of steel, the four marked *b* are of brass the centre rod of steel, is fixed at top to the cross bar connecting the two middle brass rods, but slides freely through the two lower bars, and bears the bob B The remaining rods are fastened to the cross pieces at both ends, and the uppermost cross piece is attached to the axis of suspension It is easy to see, from the mere inspection of the figure that the expansion of the steel rods tends to lengthen the pendulum, while that of the brass rods tends to shorten it, consequently if the two expansions exactly counteract each other the length of the pendulum will remain unchanged The relative lengths of the brass and steel bars are determined by the expansions of the two metals, which are found by experiment to be, in general, nearly as 100 to 61 If, then, the [illegible] be [illegible] of the four brass bars [illegible] When the compensation is found on trial not to be perfect, an adjustment is made by shifting one or more of the cross pieces higher on the bars




Harrison's pendulum has been greatly improved by Troughton, who substituted for the two pair of brass rods two cylinders of brass, sliding the one within the other to which the steel rods are attached For a description of this, and various other modes of compensation we refer the reader to an excellent chapter on the subject by the late Captain Kater, in the volume of *Mechanics* in the *Cabinet Cyclopædia*

*Application of the Pendulum to the Determination of the relative Force of Gravity at different Places* — There are two methods of determining the relative intensity of gravity by means of [illegible] According to the first, the absolute [illegible] simple pendulum which makes a certain number of oscillations in a given time is accurately ascertained at each of the places, and the comparative force of gravity is then given by the formula $g' = \frac{l'}{l} g$ According to the other method, an invariable pendulum is swung at the different places, and

the number of its oscillations noted at each, when the relative gravity is given by the formula $g' = \frac{N'^2}{N^2} g$ Each of these methods has been followed in the delicate experiments which have been made for the purpose of determining the figure of the earth, but though the results of both appear to be nearly equal in point of accuracy, the latter method, on account of its affording greater facilities in practice, is now generally adopted

It will readily be conceived that a pendulum would be altogether unfit for the purpose of determining the minute variations of gravity if it were attached to a clock, or any machinery by which its motions could be influenced It must be suspended from a [illegible] to which it can communicate [illegible] the most delicate precautions are necessary to avoid the effects of friction and other disturbing causes, by which the experiment may be influenced The method followed by the French astronomers, in their operations connected with the measurement of the meridian was this — The pendulum was composed of a sphere of platinum suspended by a slender iron wire from a knife edge of hardened steel resting on plane surfaces of polished agate It was placed in front of a well-regulated astronomical clock, with which its oscillations were compared and the distance between its centres of suspension and oscillation determined by calculation from the length of the wire and the diameter of the sphere ascertained by actual measurement A different and in many respects preferable mode of measuring the lengths of the seconds' pendulum, was adopted by Captain Kater grounded on the property of oscillating bodies discovered by Huygens, namely that the centres of suspension and oscillation are convertible From this property it follows that if two knife edges turned in opposite directions, are inserted in the same pendulum and the mass be so adjusted, by means of a moveable weight sliding on the rod, that the oscillations are performed in exactly equal times when the pendulum is suspended from either knife edge then the distance between the knife edges is the true length of the isochronous simple pendulum In this manner the measurement is effected more directly, and no calculation is required for finding the centre of oscillation A third method lately put in practice by the celebrated astronomer Bessel consists in suspending a ball and wire first from the upper end and then from the lower end of a rod of a given length the ball being in both cases at the same distance below the rod From the difference of the times of oscillation of the two pendulums thus formed the length of the simple pendulum can be computed in terms of the rod which is the difference of their lengths The French method is described with all the requisite details in the third volume of *Base Metrique* in *Delambre's Astronomie* tome iii, and in the *Recueil d'Observations Geodesiques &c* by Biot and Arago Paris, 1821 Captain Kater's pendulum is described in the *Phil Trans* for 1818, and Bessel's in his *Untersuchungen über die Länge des einfachen Secundenpendels* Berlin 1828

Captain Kater's pendulum was formed of a very thin bar of plate brass with a heavy bob and moveable weight by means of which the isochronism was obtained when the suspension was made from the opposite knife edges But a much simpler modification has been adopted in the recent experiments The experimental pendulums of the Royal Astronomical Society consist merely of a plain straight bar of iron or copper 2 inches wide half an inch thick and about 62½ inches long At the distance of 5 inches from one end of the bar is placed the apex of one of the knife edges A, and at the distance of 39·4 inches therefrom the apex of the other knife edge B and the required adjustment to synchronism is produced by filing away one of the ends of the pendulum until the vibrations are found by trial to be equal in both positions of the pendulum It is obvious that, for the purpose of merely ascertaining the variations of gravity, a bar of this form with a single knife edge would equally answer the purpose, but the advantage of the double suspension is this, that besides having two distinct and independent pendulums each of which is a check upon the other, it furnishes the means of ascertaining whether the pendulum has sustained any accidental injury, which would be immediately discoverable from the inequality of the number of vibrations between the two knife edges




*Corrections* — In order that the results of different sets of experiments may be exactly comparable with each other, several corrections must be applied The first of these is on account of the length of the arc of vibration, which, being of a finite and variable extent, the duration of the oscillations is consequently unequal, but always greater than in the case of an infinitely small arc The number of oscillations is reduced to the case of an infinitely small arc by the formula

$$N \times \frac{M \sin (A + a) \sin (A - a)}{32 (\log \sin A - \log \sin a)}$$

where N is the number observed, M the logarithmic modulus = 4342945 A the initial, and $a$ the final arc of vibration, and as the arcs are always small, the computation may be shortened by using the arcs instead of the sines

In the second place, all the experiments must be reduced to a common standard of temperature, which, in this country, is assumed at 62° of Fahrenheit Let $e$ denote the rate of expansion of the metal, $t$ the mean height of the thermometer at the time of the experiment, then the correction of the number of vibrations on account of the temperature is $N \times \frac{1}{2} e (t - 62°)$

A third correction is required on account of the atmospheric pressure The effect of the pressure of the atmosphere on the pendulum is to diminish the force of [illegible] was formerly applied, regard being had to the height of the barometer But it was recently remarked by Bessel that the pendulum drags with it a certain portion of air, the amount of which depends on the form of the pendulum, and consequently the specific gravity of the actually moving mass cannot be previously computed, but must be ascertained for each pendulum by actual experiments in air and in a vacuum See a paper on this subject by Mr Baily in the *Phil Trans* for 1832 Also *Memoirs of the Royal Astr Soc* vol vii

*Application of the Pendulum to the Determination of the Figure of the Earth* — The ellipticity of the earth is deduced from the observed number of oscillations made by an invariable pendulum at different latitudes, by means of the following theorem — Let N = the number of oscillations made by a pendulum at the equator in a mean solar day N' = the number of oscillations made by the same pendulum at the latitude $l$ G = the force of gravity at the equator, and $g$ = the same force at the latitude $l$, then supposing the figure of the earth to be that of an oblate spheroid of revolution we have $g = G (1 + n \sin^2 l)$ But by the property of the pendulum $g$ G N' N therefore $N' = N (1 + n \sin^2 l)$ In this equation the quantity $n$ depends upon the centrifugal force of rotation at the equator and the ellipticity, and, according to a theorem discovered by Clairaut, its value is $\frac{5}{2} m - e$, $m$ being the ratio of the centrifugal force to gravity and $e$ the ellipticity Newton showed that $m = \frac{1}{289}$ whence $n = \frac{5}{2 \times 289} - e$, therefore, as $N'^2$ is given by observation the only unknown quantities in the equation $N' = N (1 + n \sin^2 l)$ are N and $n$ so that by combining the results at two different latitudes we can determine these quantities and consequently, $e$ The length of the seconds pendulum being also proportional to the intensity of gravity it is obvious that the lengths might be substituted in the above equation for $N'^2$ and $N^2$

The seventh volume of the *Memoirs of the Royal Astr Society* contains the results of experiments made with the invariable pendulum at 7 different latitudes The values of N and $n$ deduced from the whole of these results, are respectively

$$N^2 = 7411625711 \quad n = 0051491,$$

whence the ellipticity deduced from the whole is $\frac{1}{285 \cdot 26}$

It is remarkable that all the pendulum experiments agree in giving a greater ellipticity to the earth than is found by the comparison of measured arcs of meridian

As the force of gravity varies inversely as the square of the distance from the centre of the earth a correction is obviously required for the differences of altitude of the stations where the observations are made Accordingly, the results at every station are reduced to what they would have been if the observations had been made at the level of the sea Let $h$ = the height of the station above that level and R = the radius of the earth, $g$ = the force of gravity at the station and $g'$ the same force at the level of the sea, then $g \quad g' \quad R^2 \quad (R + h)^2$, whence, expanding the quantity $(R + h)^2$, and leaving out $\frac{h^2}{R^2}$ as insensible, we have $g' = g \left(1 + \frac{2h}{R}\right)$, in which we may substitute for $g'$ and $g$ either the lengths of the seconds' pendulum, or the square of the number of its oscillations at the station and the level of the sea The result however is modified by the local attraction of the mass of ground surrounding the station, and Dr Young assumes that the formula should be multiplied by the fraction 6

The following table, from Mr Airy's treatise on the Figure of the Earth (*Ency Metrop*), shows the length of the seconds' pendulum in English inches at a few of the stations, where it has been [illegible] It is to be remarked, however, that a degree of uncertainty

nttends all the results, on account of the error in the correction for the density of the air, which may amount to about 0018 for each

| Station | La[illegible] | Observers |
|---|---|---|
| | ° ′ *Inches* | |
| Spitzbergen | 79 50 N 39 21469 | Sabine |
| Unst | 60 45 39 17162 | Biot and Kater |
| Leith Fort | 55 59 39 15546 | Biot and Kater |
| London | 51 31 39 13929 | Kater |
| Paris | 48 50 39 12851 | Borda, Biot, and Sabine (mean) |
| [illegible] | 44 50 39 11296 | Biot |
| [illegible] | 40 43 39 10120 | Sabine |
| [illegible] | 38 40 39 09510 | Biot (twice) |
| [illegible] | 20 52 39 04690 | Freycinet |
| [illegible] | 10 39 39 01888 | Sabine |
| [illegible] | 0 25 39 02074 | Sabine |
| Bahia | 12 59 S 39 02433 | Sabine |
| Isle of France | 20 10 39 01681 | [illegible] |
| Cape of Good Hope | 33 55 39 07800 | [illegible] |

PENICILLIATE, (Lat penicillum *a pencil*) In Zoology when a part supports one or more small bundles of diverging hairs

PENINSULA (Lat pene *almost*, and insula, *an island*) A portion of land, as the term implies, nearly surrounded by water, as Africa, the Morea, California In common parlance the term Peninsula is usually applied to Spain and Portugal and the struggle so long maintained between these countries, aided by the British, and the French, at the commencement of the present century was called the Peninsular war

PENITENCE or PENANCE in the Roman Catholic Church, is one of the seven sacraments Priestly orders give the power to confer this sacrament, but as a matter of discipline, their power is not exercised without authority from the Ordinary either general or special except in cases of necessity The terms penitence and penance are likewise used for the good works commanded by a priest to a penitent, to be performed in satisfaction of the sins of which he absolves him Public penance in the earlier times of the church was imposed for great offences committed after baptism It consisted in exclusion from the church solitude, prayer and fasting and the readmission was only gradual the penitent being first allowed to approach the doors of the church, then to attend at sermons and readings but not at prayers then to pray, kneeling &c The time of penance varied according to different usages St Basil mentions two years for theft seven for sensuality fifteen for adultery, twenty for homicide, and the whole life for apostacy Public penance for secret sins was generally remitted about the 7th century, and its commutation for the repetition of prayers and bestowing of alms began in the next These alms were frequently applied by the penitent to the purchase of masses for himself or others Afterwards the usage of pilgrimage as a mode of penance became general and finally, indulgences began to be sold in the 12th century

PENITENTIARY A prison in which convicted offenders are placed and subjected to a course of instruction and discipline with a view to their reformation Imprisonment after conviction is of two kinds the simply repressive and penal and that which is at the same time reformatory But it is obvious that there is no advantage in attempting to produce the latter effect in those short imprisonments of a year or a few months, which form the ordinary punishments of our law for smaller offences Crimes of a higher order are with us usually punished by transportation and hence there is less room for the development of the penitentiary system among ourselves than in other European countries and in the United States of America At Genoa the convict is only subjected to the penitentiary system at the end of the first year of his imprisonment some writers on the subject recommend two years as a more appropriate limit for the commencement of this species of discipline In England the first act for the establishment of penitentiaries was passed in 1776, at the suggestion of the philanthropist Howard and judge Blackstone and attempts were made in consequence at Gloucester and other places with little success In 1812 the act was passed under which the Millbank prison was erected as a general penitentiary for England and Wales It is now adapted to contain 800 male and 400 female prisoners The chief object in penitentiaries, besides conferring moral and religious instruction on the prisoners, is to employ them in some useful labour, but there is always considerable difficulty in carrying into effect this part of the system [illegible] to reconcile it with the necessity [illegible] as far as possible At Millbank [illegible] principal occupation of a large proportion of the inmates *See* PRISONS

PENITENTIARY GRAND An officer of the Roman [illegible] usually a cardinal, appointed by the pope to grant absolution in cases reserved for the papal authority, dispensations for marriages, &c In like manner, bishops appoint penitentiaries to perform the same office in such cases as are reserved for episcopal absolution Briefs granted by the grand penitentiary are at the present time entirely gratuitous, and headed with the words 'pro Deo"

PENITENTS A name given in Roman Catholic countries to certain religious fraternities distinguished by their parti-coloured garments Of these there were a great variety in France Spain, and Portugal, &c but the most extraordinary were the White Penitents a body of fanatics, who appeared in the north of Italy in 1399, clothed in white, and bearing crucifixes, under the guidance of a priest, whose real history seems unknown, but concerning whom many strange stories were told, among others, that he professed to be the prophet Elias, and that his mission was to announce the immediate destruction of the world The contagion of this outburst of religious feeling extended to Tuscany and there over the whole of Italy, and was accompanied by a general cessation of violence and private war But it lasted only a few months (Waddington, *Hist of the Church*, p 546, and the authors there referred to)

PENNATULARIÆ (Lat penna, *a feather*) The name of a family of Polypes, of which the sea-pen (*Pennatula*) is the type

PENNON A term sometimes poetically used for a streamer or banner, but restricted in the middle ages to the banner of a knight, baronet, or esquire

PENNY The twelfth part of a shilling The penny was formerly a silver coin, first struck in England by the Saxons It contained the 240th part of their pound, and its weight was about 22½ grains Till the time of Edward the First the English penny was struck with a cross so deeply sunk in it that it might on occasion, be easily broken and parted into halves, thence called halfpenny, or in four parts, thence called *fourthings*, or farthings Edward the First also reduced the weight of the penny to a standard, ordering that it should weigh the 20th part of an ounce It afterwards suffered successive diminutions, till in the reign of Elizabeth its value was reduced to the 62d part of an ounce of silver This proportion is still observed

PENNYWEIGHT A weight equal to twenty-four grains or the 20th part of an ounce troy This was the weight of the silver penny in the time of Edward the First See PENNY

PENS (Lat penna *a feather*) Well-known instruments for writing usually formed of the quills of the goose swan or some other bird Metallic pens have been occasionally employed for a lengthened period, but it is only within these few years that they have been extensively introduced They first began to be largely manufactured by Mr John Perry, of London Mr Perry having succeeded in giving to his pens a greater degree of softness and elasticity than was possessed by any metallic pens previously in use, they speedily obtained a very extensive sale This success brought crowds of rivals into the field, so that metallic pens are now manufactured in vast quantities and of an immense variety of forms But though they have superseded to a very considerable extent the use of quills, and have some peculiar advantages it does not appear possible to give them the elasticity of the quill nor fit them so well for quick and easy writing In the manufacture of steel pens the best metal made from Dannemora or hoop (L) iron is employed It is laminated into slips about 3 feet long and 4 inches broad of a thickness corresponding to the desired stiffness and flexibility of the pens These slips are subjected to the action of a stamping-press, somewhat similar to that for making buttons The point destined for the nib is next introduced into an appropriate gauged hole of a little machine and pressed into the semicylindrical shape, where it is also pierced with the middle slit and the lateral ones, provided the latter are to be given The pens are now cleaned, by being tossed about among each other in a tin cylinder about 3 feet long and 9 inches in diameter, which is suspended at each end upon joints to two cranks formed one on each of two shafts The cylinder by the rotation of a fly-wheel acting upon the crank-shafts, is made to describe such revolutions as agitate the pens in all directions, and polish them by mutual attrition In the course of four hours several thousand pens may be finished upon this machine (See *Commercial Dict*, and *Ure's Dict of Arts, &c*)

PENSIONARY THE GRAND of Holland, was the prime minister of the states of the province of Holland He proposed the measures to be discussed in the assembly of the states He also transacted business with foreign ministers and fulfilled other important functions His term of service was five years, and he was capable of re-election

PENSIONER Literally one who receives a pension or allowance At the universities of Cambridge however and Dublin, this term has a peculiar meaning, being applied to those students who live at their own expense, i e without any support from the beneficent foundations of

the respective colleges In this sense it is synonymous with commoner at Oxford

PENTACRINITES (Gr πεντε, *five*, and κρινον, *lily*) The name of a tribe of Echinoderms, comprehending those in which the animal consists of an angular, jointed flexible column fixed at the base and supporting on its free extremity a concave disc or body terminating in five dichotomizing, jointed, semicylindrical arms Most of the species of this tribe are extinct

PENTADORON (Gr πεντε and δωρον *a palm*) In Ancient Architecture, a brick of five palms in length used by the Greeks in the construction of their public edifices

PENTAGON (Gr πεντε, and γωνια, *angle*) In Geometry, a plane figure, having five angles, or contained by five sides It is a regular pentagon when its sides and angles are equal, and may be inscribed in a circle The length of the side of a regular pentagon is equal to twice the sine of 36°, radius being unit, and its area = 5 sin 36° × cos 36°, or, making the side = *s*, the area = $\frac{5}{4}s^2 \times \tan 54°$ It is a remarkable property of the regular pentagon, that the square of its side is equal to the sum of the squares of the sides of the hexagon and decagon inscribed in the same circle

PENTAGRAPH See PANTAGRAPH

PENTAMERANS *Pentamera* (Gr πεντε, and μερος, *a joint*) The name of a section of Coleopterous insects including those which have five joints on the tarsus of each leg

PENTA'METER (Gr πεντε, and μετρον, *measure*) A species of verse consisting of five feet or measures (whence the name), and which when subjoined to a hexameter verse constituted what is denominated *elegiac* The scheme of the pentameter is as follows —

⏑ ⏑ | – ⏑ ⏑ | – | – ⏑ ⏑ | – ⏑ ⏑ | – |

Or more properly thus,

– ⏑ ⏑ | – ⏑ ⏑ | – – | ⏑ ⏑ – | ⏑ ⏑ – |

It must be observed, that the cæsural pause at the third foot must always terminate a word, and, as a general rule, the last word of the verse must consist of two syllables, although a quadrisyllable, especially in proper names, is sometimes admitted

The first Greek elegiac writers were Callinus and Tyrtæus, who were followed by Mimnermus, Theognis, Solon, in the regular series, Propertius, Tibullus, and Ovid, in Rome The variety of themes sung by these different writers proves the capacity of this measure for adaptation to every subject, whether mournful, as the term *elegiac* would imply, or political and warlike, like the strains of Tyrtæus and Callinus, or erotic like those of Propertius Tibullus, and Ovid, or historical and mythological, like the *Fasti* of the last The pentameter has not been generally introduced into any modern language with which we are acquainted, though Goethe and Schiller have left us some excellent specimens of the facility with which it might be engrafted on the German language The hexameter and pentameter distich is beautifully described in the following lines of Schiller —

Im Hexameter steigt des Springquells flüssige Säule
Im Pentameter drauf fällt sie melodisch herab

Thus admirably rendered by Coleridge, who was long considered as the original author —

In the hexameter rises the fountain's silvery column
In the pentameter aye falling in melody back

Every page of Ovid's *Heroides*, or *Tristia*, illustrates the manner in which the hexameter breaks as it were and falls back in the pentameter, thereby adding a most exquisite grace to the rhythm indeed the secret genius of the metre appears to consist in this display The following instances, taken from Penelope's letter to Ulysses, will illustrate the truth of this observation —

Tros Anchisiades et Dardanis incipit heros
Vare tuæ jussus abire domum

Again,

Sive quis Assaracus sive hunc Ilumque vocari
Auctor habet

Besides this peculiarity in the pentameter, grammarians have pointed out several others, an observance of which is necessary to constitute a perfect pentameter Of these perhaps the most important is the axiom that although either a spondee or a dactyl may be used at pleasure in the first two feet of the verse, a dactyl should be preferred to a spondee whenever practicable, and a comparison of the ancient authors will show that on the frequent use of the former much of the beauty of this elegant measure depends *See* HEXAMETER

PENTAPOLIS (Gr πεντε, and πολις, *a city*) A name given by the ancient Greeks to certain countries which were remarkable for having five distinguished cities, thus there was the Pentapolis of Lybia, Italy, and Asia Minor but the most celebrated was the Pentapolis Cyrenaica (or of Egypt) whose five cities were Berenice, Arsinoe Ptolemais Cyrene, and Apollonia

PENTASTYLE (Gr πεντε, and στυλος, *a column*) In Architecture a building having five columns in front

PENTATEUCH (Gr πεντατευ-χος, from πεντε, and τευχος, *an instrument*), signifies the five volumes of the books of Moses, viz Genesis, Exodus, Leviticus, Numbers, and Deuteronomy

1 The book of *Genesis* (as the term implies) gives an account of the creation of the world and of man, the fall of man the flood and the history of the Jewish patriarchs Abraham Isaac and Jacob down to Joseph (1 [illegible]) This book was looked upon with great veneration by the Jews, as comprising the history of their venerable founder Abraham, and his nearest descendants, — around whom [illegible] its venerable antiquity, and from its furnishing rich materials for historical geographical and antiquarian investigations It contains, besides, numerous subjects for moral and religious reflections, which are referred to in many other later portions of the Old and New Testament

2 The book of *Exodus* (Gr εξ, and οδος, *a way*), narrates the fortunes of [illegible] after their migration to Egypt [illegible] his endeavours to emancipate the Jewish nation from Egyptian [illegible] through [illegible] Moses This book, besides being peculiarly valuable in a religious point [illegible] to the agricultural or *fixed* mode of life

3 The book of *Leviticus* (so called from Levi, a priest) consists chiefly of the law and ordinances of the Jewish priesthood, or regulations as to the different kinds of sacrifices to be offered up, the duties of masters towards their slaves, regulations as to marriage, &c It is replete with interesting antiquarian matter

4 The book of *Numbers* (so called from its giving an account of the numbering of the people) contains besides an enumeration of many civil and ceremonial ordinances, and embraces an historical period of 38 years, chiefly relating to the captivity and the wilderness

5 The book of *Deuteronomy* (Gr δευτερος and νομος *law*), contains chiefly (as the term implies) a condensed summary of the ordinances delivered in the three preceding books

There are two ancient and authentic copies of the Pentateuch the one written in Samaritan or Phœnician characters, the other in Chaldean, which was adopted by the Jews, in preference to the former, after their return from Babylon The differences between the two are represented as not material, but it is imagined that some alterations and additions have been made in the Samaritan text in order to favour the peculiar prejudices and claims of that people

The Pentateuch was, down to a recent period, universally attributed to Moses, but some German theologians have attempted to prove, in our opinion with but little success, that Moses was not the author There are no doubt several passages, especially in Deuteronomy which could not possibly have been written by Moses, but these can easily be accounted for as interpolations of a copyist, and do not affect the authenticity of the whole Pentateuch The chief arguments for the genuineness of the Pentateuch are ably given in the *Penny Cyclopædia*, to which we beg to refer the reader

PENTATHLUM (Gr πεντε, and αθλος, *a contest*) A general appellation given by the Greeks to their five chief bodily exercises, viz running, leaping, throwing the quoit or discus hurling the javelin, and wrestling These five exercises were termed *Quinquertium* by the Romans

PENTECOST (Gr πεντηκοστος, *fiftieth*) A Jewish festival, so called because it was observed on the *fiftieth* day after the feast of unleavened bread, i e the fifteenth of the month Nisan and next day after the Feast of the Passover Being fifty days or seven weeks after this latter, it also obtained the name of the Feast of Weeks It occurred about the beginning of the harvest, and seems to have been instituted as an acknowledgment of the goodness of God in giving the fruits of the earth It also commemorated the giving of the law on Mount Sinai upon that day The diffusion of the Holy Spirit upon the apostles upon the same day, as recorded in Acts ii, has occasioned its observance to be continued among Christians In England it is known by the name of Whit Sunday, and in Germany by that of *Pfingsten*

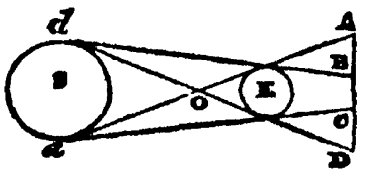
PENTELA'SMIDÆ (Gr πεντε, and ελασμα, *a layer*) The family of Pedunculate Cirripeds, of which the common barnacle (*Pentelasmis crocea*) is the type The principal organs of the body are protected by five shelly plates

PENTELICAN MARBLE See MARBLE

PENULT or PENULTIMA (Lat penè ultima, *almost last*) In Grammar and Prosody, the last syllable of a word but one

PENUMBRA (Lat *pene*, almost, and *umbra*, shadow) An imperfect shadow The penumbra of the earth is occasioned by the apparent magnitude of the sun and [illegible] behind the earth within [illegible] by a part only, and not [illegible] us distinguished from the *umbra*, or perfect shadow, which is the conical

space within which no part of the disk is visible Let S be the sun, E the earth, A D the orbit of the moon, and let *a* A, *a* C, *d* B, *d* D, be tangents to S and E As soon as the moon passes the point A, a portion of the sun's disk at *a* will be intercepted, and the visible portion will become less and less until the moon reaches B, where total darkness begins From A to B, therefore, the moon is in the penumbra The umbra extends from B to C When the moon passes C, it will again receive the light from the border of the solar disk at *a*, and will be in the penumbra from C to D The whole penumbra thus forms a cone, of which the apex is at O, and the angle at the apex equal to A O D As the obscurity evidently becomes greater in proportion as more of the solar disk is concealed, and insensibly merges into total shade, it is extremely difficult in eclipses of the moon to determine by observation the exact time at which the moon's limb passes the point B or C, and the eclipse begins or ends




In solar eclipses those parts of the earth which are covered by the penumbra of the moon are only partially deprived of the sun's light Let E be the moon and A D part of the earth's orbit For a spectator on the earth placed between A and B, a part of the sun's disk is concealed, and the sun is partially eclipsed The limits are calculated from the known [illegible] of the sun and moon, and their respective [illegible] the earth *See* ECLIPSE

PENUMBRA In Painting &c, the boundary of shade and light where the one blends with the other, the gradation being almost imperceptible

PEPERINO An Italian name for a particular kind of volcanic rock, formed by the cementing together of sand, cinders, &c

PE'PLUM An upper garment anciently worn by the Grecian, and especially by the Athenian females it was without sleeves, and fastened by a clasp on the arm or shoulder The celebrated peplum of Minerva was carried every year, in the Panathenaic processions of Minerva from the Ceramicus to the temple of Ceres, and thence to the Parthenon where it was offered to the goddess The antiquity of this kind of ceremony is evinced by the passage in the *Iliad* (book v) where the Trojan women offer a similar robe

PEPPER *See* PIPERACEÆ PIMENTO

PE'PTIC [illegible] digestion *See* DYSPEPSIA

PEDAMBULATOR (Lat ambulo, *I walk*) A machine for measuring distances on roads, also called *odometer* and *surveying wheel* Various sorts of machines have been constructed for this purpose both in ancient and modern times One is described by Vitruvius in his work *De Architectura*, lib x c 14 The machine commonly employed consists of a wheel to which a sort of double pole is attached carrying an apparatus of clockwork, which is set in motion by the revolution of the wheel, and shows the number of miles furlongs &c passed over by an index and dial The apparatus may be drawn along by a person on foot or by a carriage to which it is more usually attached For the sake of facility in reckoning the circumference of the measuring wheel is made equal to an aliquot part of a mile usually half a pole or 99 inches (See the *Repository of Arts*, vi 219)

PERCEPTION (Lat) In Mental Philosophy that power act, or state of the mind which has a conscious reference to external objects Various theories of perception have arisen among philosophers, differing as this reference is supposed to be more or less immediate or as the objects to which it refers are conceived to possess an independent reality or not These theories are designated by the terms *idealism* and *realism*, which latter is subdivided into natural or positive, and relative or negative realism The best known system of idealism is that of Bishop Berkeley *See* IDEALISM

According to the scheme of negative or relative realism all that we can know of an object is the feeling which it excites in our minds The cause of this feeling we necessarily judge to be something external to ourselves, but what it is in itself we have no means of knowing This is the view adopted by the great majority of philosophers, from Plato and Aristotle down to Kant and Brown

The theory of natural realism is the one supported by Dr Reid under the name of the *common-sense* system This [illegible] in perception to be in [illegible] to our consciousness, its qualities are not merely felt by us, but discovered *in it* We derive a certain sensation from the whiteness or roundness of an object, but it is the object itself and not our minds that are white or round This doctrine, which was also that of the ancient Stoics, and expressed by them in nearly the same words as those used by Reid (see Cicero *Acad Quæst*), is in fact rather a statement than an explanation of the problem It has been recently supported with great acuteness by a learned writer in the *Edin Review*, No 113, to which we refer our readers for a full account of all possible theories of perception

PERCH in Land Measure, [illegible] or equal to 30¼ square yards [illegible] used as a denomination of long measure, when it signifies the same thing as a rod or pole, being 5½ yards, or 16½ feet

PERCHERS The name of an [illegible] ing the *Scansores* and *Passeres* of Cuvier *See* ORNITHOLOGY

PERCHLORIC ACID When sulphuric acid is poured upon chlorate of potash, gaseous oxide of chlorine is evolved and the saline matter which remains is a mixture of bisulphate of potash and perchlorate of potash, by washing it with cold water the former salt is dissolved, but the latter remains in the form of a white powder When this is mixed with half its weight of sulphuric acid diluted with one third of water, and heat applied, white vapours rise which condense as a colourless liquid in the receiver This is a solution of perchloric acid, which consists of 1 equivalent of chlorine = 36, and 7 equivalents of oxygen (8×7) = 56, the equivalent of the perchloric acid, therefore, is (36+56) 92 Perchlorate of potash requires 65 parts of water at 60° for solution

PERCOIDS *Percoidæ* (Lat perca, *a perch*) The name of the tribe of Acanthopterygian fishes of which the [illegible] the type

PERCUSSION (Lat) In Mechanics, the striking of one body against another, or the shock arising from the collision of two bodies *See* COLLISION

PERCUSSION CAPS *See* GUN

PERCUSSION, CENTRE OF That point in a solid [illegible] axis at which, if an obstacle were [illegible] to resist the rotation of the system no motion would be communicated to the axis, or, which is the same thing, if the axis were not fixed the system would acquire no tendency to revolve through the shock applied at that point The centre of percussion is in the straight line passing through the centre of gravity perpendicular to the axis, and [illegible] from the axis is expressed by the formula $\int r^2 d m - \int r d m$, where $d m$ is the element of the mass, and $r$ the distance of $d m$ from the axis *See* CENTRE

PERCUSSION OF FLUIDS *See* HYDRODYNAMICS

PERIDIOLA (Gr περιδέω *I bind round*) The membrane by which the sporules of Algaceous plants are immediately covered

PERENNIALS (Lat perennis *lasting throughout the year*) In Botany, those plants whose roots remain alive more years than two but whose stems flower and perish annually Gardeners generally call them Herbaceous plants They differ from annuals and biennials not only in the time of their duration, but also in this, that the two former perish as soon as they have flowered, the act of reproduction exhausting their vital energies Notwithstanding this distinction it is not at all times easy to say whether a plant is a perennial or not, as for instance in the *Agave Americana* commonly called the American aloe This plant is herbaceous, and lives for many years, but when it flowers it dies so that in one respect it is annual its whole life being regarded as only one season of growth in another respect it is truly perennial Such perennials are called by De Candolle *monocarpi*

PERENNIBRANCHIATES, *Perennibranchiata* (Lat perennis branchia, *gills*) The name of that division of Batrachian reptiles including the species which preserve the external branchiæ, or branchial apertures, throughout life as the Siren, Proteus, and Menopome

PERFECT CADENCE In Music *See* CADENCE

PERFECTIBILITY The capability of arriving at perfection This word which is entirely modern, and scarcely as yet admitted in our language on classical English authority is commonly used in reasoning on the social condition of mankind The theory of the indefinite perfectibility of the human faculties, which constitutes the basis of many modern systems is perhaps nowhere so plainly developed as in the Preface to the *Tableau Historique de l'Entendement Humain* of Condorcet

PERFECT NUMBER In Arithmetic, a number equal to the sum of all its divisors Thus 6 is a perfect number, for its divisors are 1, 2, and 3, and 1 + 2 + 3 = 6 In like manner, 28 is a perfect number, for its divisors are 1, 2, 4, 7, 14, the sum of which = 28

In general, every number of the form $2^{n-1}(2^n-1)$, the latter factor being a prime, is a perfect number, the sum of its divisors being equal to the number itself The difficulty, therefore, of finding perfect numbers arises from that of finding primes of the form $2^n-1$, which is very laborious The only values of $n$ yet discovered which make $2^n-1$ a prime number are 2, 3, 5, 7, 13, 17, 19, and 31 Substituting these values of $n$ successively in the formula of the perfect number, we shall obtain the following results —

If $n = 2$, then $2^{n-1}(2^n - 1) = 6$
$n = 3$, $2^{n-1}(2^n - 1) = 28$
$n = 5$, $2^{n-1}(2^n - 1) = 496$
$n = 7$, $2^{n-1}(2^n - 1) = 8128$
$n = 13$, $2^{n-1}(2^n - 1) = 33550336$
$n = 17$, $2^{n-1}(2^n - 1) = 8589869056$
$n = 19$, $2^{n-1}(2^n - 1) = 137438691328$
$n = 31$, $2^{n-1}(2^n - 1) = 2305843008139952128$
all which are perfect numbers

PE'RFECT TENSE That form of the verb denoted in English by the auxiliary *have*, as [illegible] in action first had at the time when we [illegible] termed the preterite tense from Lat præteritum, *past*

PERFU'ME (Fr parfum) A term used to denote the volatile effluvia from any body affecting the organ of smelling, or the substance emitting [illegible] Perfumes were in general use among the ancients (see the *Quart Rev* vol xxiii), and in France, Germany Spain, and Portugal, and even though not to so considerable an extent, in England they are regarded almost as necessaries In general they are made of musk, ambergris, civet, rose and cedar woods, orange flowers jessamines, jonquils, tuberoses, and other odoriferous flowers Aromatic drugs, such as storax, frankincense, benzoin cloves, &c &c, enter into the composition of a perfume, and many perfumes are composed of aromatic herbs or leaves, [illegible] &c &c (See the article Perfumery in *Useful Arts, &c*)

PERGAMENEOUS (Lat pergamena *parchment*) In Botany, [illegible]

PE'RGOLA (Lat [illegible]) [illegible] gallery in a house It is used by Plautus to signify a balcony, in which the courtezans placed themselves to catch the attention of passengers By Winckelmann it is thought to be an arbour in a garden, or a terrace overhanging one

PERIA'NTHIUM (Gr περι *around*, and ανθος, *a flower*) A calyx and corolla the limits of which are undefined, so that they cannot be satisfactorily distinguished from each other, as in many Monocotyledonous plants

PERI'BOLOS (Gr περι, and βαλλω, *I cast*) In Architecture a court or enclosure entirely round a temple surrounded by a wall One of the most extraordinary examples of a peribolos is at Palmyra where the great temple is surrounded by a wall with two rows of interior columns, each side whereof is from 700 to 800 feet long

PERICARDI'TIS Inflammation of the pericardium It is of the same origin as

PERICA'RDIUM (Gr, περι *about*, καρδια *the heart*) The membranous sac which surrounds the heart

PERICA'RPIUM (Gr [illegible]) Every part of a ripe fruit on the outside [illegible]

PERICHÆ'TIAL (Gr περι and χαιτη *a bristle*) The leaves situated at the base of the setæ of mosses

PERI'COPE (Gr περι, and κοπτω *I cut, something cut out, an extract*) A word used by theologians to designate [illegible] Bible extracted for the purpose of reading [illegible] the communion service and other portions of the ritual, or as a text for a sermon or homily

PERICRA'NIUM (Gr περι and κρανιον, *the skull*) The membrane of the bones of the skull

PE'RIDOT In Mineralogy, the prismatic chrysolite

PE'RIDROME (Gr περι, and δρομος, *a course*) In Ancient Architecture, the space in a peripteral temple between the walls of the cell and the columns It is a term that may be applied to any gallery of communication round an edifice

PE'RIGEE (Gr περι and γη *the earth*) In Astronomy, that point of the moon's orbit which is nearest to the earth Anciently the term *perigee* was applied to the orbits of the sun and planets, as well as to the moon, because they were supposed to circulate round the earth Since the true centre of motion has been discovered, the term *perihelion* is used to denote the corresponding point

PERIGO'NIUM (Gr περι and γονη, *a race*) A synonym of the word perianth

PERIGY'NIUM (Gr περι and γυνη, *a female*) The urceolate body formed in the genus *Carex* by two bracteæ, which become confluent at their edges and enclose the pistillum leaving a passage for the stigmas at their apex Also used occasionally to denote that organ commonly called the disk

PERIGYNOUS A term applied to stamens which originate from the side of a calyx

PERIHE'LION (Gr περι and ηλιος *the sun*) In Astronomy, the point in the orbit of a planet or comet which is nearest the sun It is the extremity of the major axis of the orbit nearest to that focus in which the sun is placed and its position, or [illegible] the elements by which the orbit is determined See PLANET

PERI'METER (Gr περι [illegible]) In Geometry, the circuit or [illegible] In round figures it is equivalent to circumference, or periphery, but the term is more frequently applied to figures bounded by straight lines

PE'RIOD (Gr περιοδος) In Astronomy and Chronology, the [illegible] interval [illegible] the end of which the same [illegible] the [illegible] which [illegible] its orbit [illegible] Period, or Cycle, is also used in arithmetic, to denote the recurrence of a series of digits or numbers in the same order, as in circulating decimal fractions

PERIOD OR SENTENCE in Rhetoric, has been defined "a passage, i e series of words, developed in properly connected parts" In a stricter sense, a period is a sentence so framed that the grammatical construction will not admit a close and the meaning remains suspended until the end of it A sentence in which the sense would permit of a stop before its completion is, in this sense, not a period The Greek and Latin languages were much more periodic than most modern tongues, that is, they admitted of the construction of sentences so that a single grammatical connection should run through a great series of words, while a similar series, in a modern language, would be so arranged as to form several distinct grammatical wholes

PERIOD, THE JULIAN In Chronology *See* JULIAN PERIOD

PERIO'DIC ACID [illegible] in composition to the *perchloric*, [illegible] dent of iodine + 7 equivalents of oxygen

PERIODICALS In Literature, strictly publications continued in numbers, appearing at regular intervals But papers of the same description appearing at uncertain intervals (especially in Germany), are often comprehended under this general name The first periodical in the character of a review was the *Journal des Savans* in 1663

PERIŒCI (Gr περι *about*, and οικεω *I dwell*), in Geography, is used to denote those inhabitants of the globe who live under the same parallel of latitude but [illegible] diameters that is in places which have the [illegible] but differ in longitude by 180°. They have their spring summer, winter and autumn in the same months of the year, but when it is noon with the other

PERIOSTEUM (Gr περι and οστεον, *a bone*) The membrane which invests the bones It is of a fibrous texture and vascular

PERIO'STRACUM (Gr περι, and οστρακον *a shell*) The layer of animal substance or cuticle, which covers the outer surface of shells, and which the French con-

*nam*

That school of ancient philosophers which derived its origin from Aristotle The name was given them from the Gr περιπατοι or *walks* in the Lyceum the scene of Aristotle's instruction (For the doctrines of the Peripatetics, see ARISTOTELIAN PHILOSOPHY) The immediate successors of Aristotle in the peripatetic doctrine were Theophrastus, Eudemus the Rhodian (from whom is derived the title of the Eudemian Ethics) Dicæarchus of Messana, Aristoxenus of Tarentum and Strato of Lampsacus among the later Peripatetics are preserved the names of Glycon of Troas Hieronymus of Rhodes, &c It would be unreasonable to expect that so elaborate a system as that of Aristotle should have received any important addition to its leading doctrines at the hands of his followers They contented themselves either with defending and interpreting their master's doctrines, or with applying his method to the explanation of natural philosophy Under their hands his system seems to have degenerated into a species of empirical materialism, a scheme as widely [illegible] doctrines, as was the dry scheme [illegible] in the dark ages passed for the philosophy of Aristotle (For notices of the later Peripatetics see Cicero *Acad Quæst*, and *De Finibus* [illegible], Lactant *De Ira Dei*, c 10, Plutarch, *De Solertia* &c) The Peripatetic school produced no men of note after its great founder which is attributable to the current of free speculation being shackled by the authority of Aristotle whose dogmas it was content to illustrate without daring ever to impugn, and in this respect its spirit was remarkably contrasted with the scepticism of the new Academy (See *Ritter's Hist of Anc Philosophy* book ix ch i)

PERIPETEIA, or REVOLUTION (Gr περιπετια) According to Aristotle, in his *Art of Poetry*, a necessary condition or circumstance of the drama, being a change of fortune, from happiness to misery, or the reverse, which takes place in the situation of the principal personage See CATASTROPHE, DRAMA

PERIPHERY (Gr περι, and φερω, *I carry*) In Geometry, the circumference of a circle or ellipse, or of any other curvilinear figure

PERI'PHRASIS, or CIRCUMLOCUTION (Gr περι, and φραζω, *I speak*) In Rhetoric, the use of several words to express the sense of one, or of a more involved and prolix form of expression to convey a meaning which might be adequately denoted by a shorter phrase

PE'RIPLUS (Gr *περί*, and *πλοῦς*, *sailing*) A circumnavigation The word is only used as the title of some treatments which remain to us of narratives of voyages of the classical ancients The *Periplus* of Hanno [illegible] scription said to have been [illegible] mory of a voyage along the western coast of Africa, respecting which much discussion has arisen among modern geographers The date of this voyage is uncertain but generally fixed by conjecture at [illegible] or more years before Christ The *Periplus* of Scylax, which is supposed to belong to the age of Augustus, contains a succinct account of some [illegible] Europe and Asia Two works [illegible] ass under the name of Arrian, who wrote in the second century after Christ, the first contains a description of the Luxine, the [illegible] lf)

[illegible] *breathe*) Inflammation of the lungs *See* PNEUMONIA

PERI'PTERY, *Peripteral* (Gr *περί*, and *πτερον*, *a wing*) In Architecture, a building surrounded with a wing, aisle or passage The word *peripteral* characterizes one of the species of Greek temples, in which the cell is surrounded by a single row of columns, to distinguish it from the word *dipteral*, which designates a temple with two ranks of columns

PE'RIS, in the Persian Mythology are a class of imaginary be[illegible] allied to the elves or fairies of more northern [illegible] supposed to be the descendants of the fallen angels, and excluded from Paradise till they have made atonement for their sins (See Moore's beautiful poem, "Paradise and the Peri," in *Lalla Rookh*)

PERI'SCII (Gr *περί* and *σκια* *shadow*) A name applied by the ancient geographers to the inhabitants within the arctic and antarctic circles because as the sun at certain times of the year does not set to them or the course of his diurnal revolution, their shadows describe an entire circumference

PE'RISPERM (Gr *περί*, and *σπερμα*, *a seed*) A term used by some to denote the testa and by others the albumen of a seed

PERISTA'LTIC (Gr *περιστελλω*, *I contract*) A term applied to the peculiar motion of the intestines, by which their contents are gradually propelled from one end of the canal to the other

PE'RISTOMES, *Peristomidæ* (Gr *περί*, and *στομα*, *a mouth*) The name of a family of Pectinibranchiate Gastropods, including those species in which the shells have the margin of the aperture or mouth unbroken and continuous

PE'RISTYLIUM (Gr *περί*, and *στυλος*, *a column*) In Architecture, a court, square, or cloister with columns on three sides hence improperly so called In peristyles with columns on each of the four sides that towards the south was frequently higher than the rest This species was called a Rhodian peristylium

PERITHE'RIDES (Gr) In Architecture *See* ANCONES

PERITONÆ'UM (Gr *περιτεινω* *I extend round*) The membrane which envelops the abdominal viscera and lines the cavity of the abdomen Hence also *peritonitis* or inflammation of the peritoneal membrane

PERITRO'CHIUM (Gr *περιτροχεω*, *I run about*) In Mechanics a wheel or circular frame of wood, fixed upon a cylinder or axle round which a rope is wound, and the wheel and cylinder being moveable about a common axis a power applied to the wheel will raise a weight attached to the rope with so much the greater advantage as the circumference of the wheel is greater than that of the cylinder This mechanical power is called the *axis in peritrochio*, the windlass and capstan are constructed on the same principle

PE'RJURY (Lat *pejero*) In Law is a wilful false oath taken in a court of justice, by a witness lawfully required to depose the truth in a matter of some consequence to the point in question A false oath therefore taken before no court, or before a court incompetent to try the issue in question, does not constitute the offence of perjury Perjury is a misdemeanor at common law and by several statutes punishable by fine and imprisonment, and by transportation for a term not exceeding seven years

PE'RKUNOS One of the chief divinities of ancient Prussia, who, together with Rikollos and Potrimpos formed the sacred Trinity of the Slavonic and the adjoining nations He was regarded as the god of the elements, and his worship extended even to Russia, Poland, Bohemia, where there were numerous temples erected to his honour (See *Grimm's Deutsche Mythologie*)

PE'RMIT An order or written permission from an officer of the customs, authorizing the removal of goods [illegible] from one place to another

[illegible] IN In Algebra it denotes the arrangement of any determinate number of things or letters in all possible orders one after the other For example, two letters, *a b*, give the two permutations *a b* and *b a*, and three letters, *a b c*, give the six permutations *a b c*, *a c b*, *b a c*, *b c a*, *c a b*, *c b a* *Permutation* is effected by placing the letters in all possible orders, so that all the letters enter into each result, and each enters into it

[illegible] letters which enter into the results, without regard to the order of the arrangement

To find the number of permutations that can be made upon any number of letters *n*, taken together, we may reason in this way — Suppose the total number of permutations that can be made of *n* — 1 letters to be known, and let it be designated by Q Let us consider one of the given letters, *f*, by itself, and suppose it to be placed on the right of each of the Q permutations of the other *n* — 1 letters, there will result Q permutations of *n* letters each ending with *f* But as each of the *n* letters may be considered separately in the same manner as *f*, it follows that the total number of permutations of the *n* letters is equal to Q × *n* Let *n* = 2, Q then denotes the number of permutations of one letter, whence Q = 1, and Q × *n* = 1 × 2 Let *n* = 3, Q then denotes the number of permutations of two letters, which is just found equal to 1 × 2 Therefore Q × *n* = 1 × 2 × 3 Let *n* = 4, Q then denotes the number of permutations that can be made on three letters, or 1 × 2 × 3 Therefore Q × *n* = 1 × 2 × 3 × 4

In general, the number of permutations that can be made upon *n* letters, taken together, is expressed by the continued product

$$1 \times 2 \times 3 \times \quad (n-1) \times n$$

For example, the number of changes that can be rung upon twelve bells is 1 × 2 × 3 × 4 × 5 × 6 × 7 × 8 × 9 × 10 × 11 × 12 = 479001600

PERNIO *See* CHILBLAIN

PERORA'TION (Lat *per*, and *os*, *mouth*) The concluding part of an oration, in which either the arguments and representations of the speech are briefly recapitulated, or a short and comprehensive conclusion deduced from them, or a brief appeal made to the sentiments or passions of the audience

PERO'XIDE The highest degree of oxidizement of which a metal or other substance is susceptible without becoming an acid

PERPENDICULAR In Geometry, a straight line is said to be perpendicular to another straight line when the adjacent angles formed by their intersection are equal and, consequently, each is a right angle A straight line is perpendicular to a curve at a given point when it is perpendicular to the tangent to the curve at that point In this case the perpendicular is sometimes called a *normal* to the curve (See NORMAL) A straight line is perpendicular to a plane when it is at right angles with every straight line in the plane [illegible] the point of intersection A plane is [illegible] to a plane when any straight line in the first which is perpendicular to the common intersection of the two planes is also perpendicular to the second plane

PERPETUAL MOTION In Mechanics, a machine which when set in motion, would continue to move for ever, or at least until destroyed by the friction of its parts without the aid of any exterior cause The discovery of the perpetual motion has always been a celebrated problem in mechanics on which many ingenious, though in general ill-instructed, persons have consumed their time, but all the labour bestowed on it has proved abortive In fact the impossibility of its existence has been so fully demonstrated from the known laws of matter, that it is rather an insult than a praise to say of any one that he has occupied himself with the research Nevertheless the pursuit of the chimera has been the cause of many useful inventions

In speaking of the perpetual motion it is to be understood that from among the forces by which motion may be produced we are to exclude not only air and water, [illegible] and its attractive forces, which may all be considered of the same kind as gravitation

It is an admitted principle in philosophy that action and reaction are equal, and that when motion is communicated from one body to another, the first loses just as much as is gained by the second But every moving body is continually retarded by two passive forces, the resistance of the air and friction In order, therefore, that motion may be continued without diminution, one of two things is necessary, — either that it be maintained by an exterior force (in which case it would cease to be what we understand by a perpetual motion), or that the resistance of the air and friction be annihilated, which is physically impossible The motion cannot be perpetuated till these retarding forces are compensated, and they can only be compensated by an exterior force, for the force communicated to any body cannot be greater [illegible] d this is only sufficient to [illegible] f motion when there is no

[illegible] therefore a [illegible] either an attractive force like that of gravitation or magnetism or an elastic force, that of a spring for example) greater than itself

But it may be argued that by some arrangement or combination of mechanical powers a force may be gained equal to that which is lost in overcoming friction and atmospheric resistance This notion at first mention appears plausible, and is in fact that by which most speculators have been led astray It is, however, entirely erroneous, for by no multiplication of forces or powers by mechanical agents can the quantity of motion be increased Whatever is gained in power is lost in time, the quantity of motion transmitted by the machine remains unaltered

Although the perpetual motion has been demonstrated again and again to be impossible on any known principle of mechanics projectors have not thereby been deterred from the pursuit In 1775 the Academy of Sciences at Paris resolved not to consider or admit into their Memoirs any future proposal for the discovery of the perpetual motion, yet such appears to be the seductive nature of the subject that innumerable schemes designs and projects for accomplishing it have since been and even to the present time continue to be, put forward, and there are very recent instances of men of no common attainments and reputation and well versed moreover in the principles of mechanical science who have been deceived by the [illegible] into a belief of its attainment (see Montucla *Hist des Math* tome iii p 813, *Repertory of Arts* vols vii and xiv, *London Journal of Arts*, May 1827, Airy *Trans of the Cambridge Phil Soc* vol iii part 2, Poppe *Wunder der Mechanik* 1832, and various papers in the earlier volumes of the *Memoires de l'Academie des Sciences*, and the *Philosophical Transactions*)

PERPETUITY, in the doctrine of Annuities is the sum of money which will purchase a certain annuity to continue for ever This is equal to the product of the annuity into the number of years in which the simple interest of any sum will equal the principal For example, if the rate of interest be 4 per cent the simple interest of any sum will amount to a sum equal to the principal in twenty-five years The value, therefore of the perpetuity of 100*l* per annum is 2500*l* The number of years is equal to unit divided by the rate of interest or 100 divided by the rate per cent

PE'RRY (Lat pirum, *a pear*) A fermented liquor made from pears in the same manner as cider from apples The pears best fitted for producing perry are exceedingly harsh and tart, but it is itself pleasant and wholesome

PERSECU'TIONS The name by which several periods in the history of the Christian church are historically distinguished Of these by far the most sanguinary occurred [illegible] of the Christian era, and originated in the desire of the Gentile nations to extirpate the followers of the Christian faith On the accession of Constantine to the throne of the Western world, these Gentile persecutions ceased and the subsequent history of the church is disfigured by persecutions raised by the more powerful against the weaker of the Christian sects

PERSEUS Son of Jupiter and Danae one of the most distinguished heroes of the Grecian mythology His history is too well known to be recapitulated here His chief exploit was the conquest of *Medusa* (which see)

PERSEUS One of the forty eight ancient constellations, situated in the northern hemisphere

PERSEVE'RANCE, or FINAL PERSEVERANCE In Theology, the continuance of the elect in a state of grace to the end of their lives, which, according to some theologians, must always be the case with him who has once been truly called into such a state Since God is represented as the image of perfection and immutability in himself, so, it is argued, having once begun the preparation of a human being for a blessed eternity, he will not leave his work unfinished, but the person concerned must necessarily persevere to the end in a state of acceptance, under the absolute decree of which he was originally elected unto life

PERSIAN WHEEL In Mechanics, a contrivance for raising water to some height above the level of a stream In the rim of a wheel turned by the stream a number of strong pins are fixed [illegible] buckets [illegible] As the wheel turns the buckets [illegible] the stream, where they are filled and return [illegible] other side till they reach the top Here an obstacle is placed in such a position that the buckets successively strike against it and are overset, and the water emptied into a trough As the water can never be raised by this means higher than the diameter of the wheel, it is obvious that this rude machine is capable of only a very limited application Sometimes the wheel is made to raise the water only to the height of the axis In this case instead of buckets the spokes are made hollow, and bent into such a form that when they dip into the water it runs into them, and is thus conveyed to a box on the axle, whence it is emptied into a cistern Such wheels are in common use on the banks of the Nile, and elsewhere

PERSISTENCE (Lat per, *through*, sisto, *I remain*), in Optics signifies the duration of the impression of light on the retina after the luminous object has disappeared Thus, if a lighted torch is whirled round rapidly, a continuous circle of light is seen A great number of illusions of the same kind, as the augmentation of the [illegible] a musical chord when in vibration [illegible] in accompanying a falling meteor, &c, are explained by this property of vision, and it has been ingeniously applied by Professor Wheatstone to measure the velocity of electric light

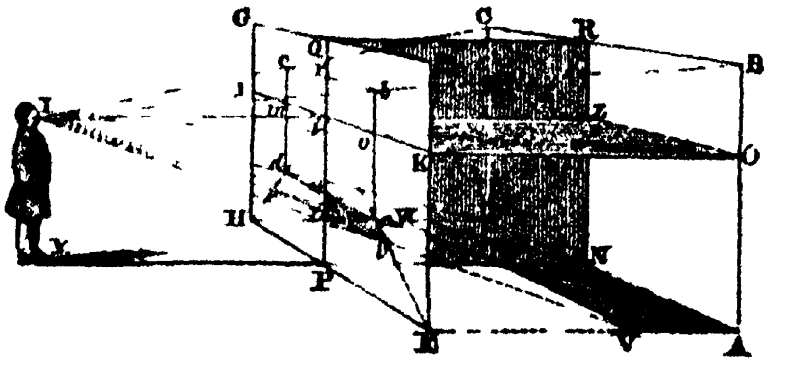
PERSON *See* GRAMMAR

PE'RSONAL PROPERTY, according to the division recognized by our law is best defined negatively as including every thing which may be made the subject of property and which is not legally considered as appertaining to land The original distinction was undoubtedly between things moveable and immoveable But, on the one hand a personal interest may be acquired in things immoveable, [illegible] in land by lease for years (chattels real), while on the other hand, some things not affixed to the soil and some bare rights and privileges are considered as freehold The distinction, therefore, is scarcely maintained with philosophical accuracy, although we may still consider that every thing which is of a freehold nature is either obviously or constructively connected with the enjoyment of land or, in technical language, *savours of the realty*, while every thing wholly unconnected with land falls under the denomination of chattels personal The term *chattel* is derived from the barbarous Latin word *catallum*

Besides chattels real already adverted to, personal property is said to be either *in possession* or *in action* The first class of objects includes every thing comprehended under goods and chattels ready money and stock, or such animals as are the subjects of property the second class are legally termed *choses* or things in *action*, and are defined to be things to which a man has a bare right without any occupation the possession whereof may be recovered by a suit or action at law Of this class therefore, are all debts and the securities for them unless these securities attach on land Sums of money due on bond on bills of exchange and promissory notes, property in the funds all fall within this comprehensive class, which originally so trifling as to be hardly noticed in early jurisprudence, now comprehends by far the greater part in value of the moveable property of our commercial community

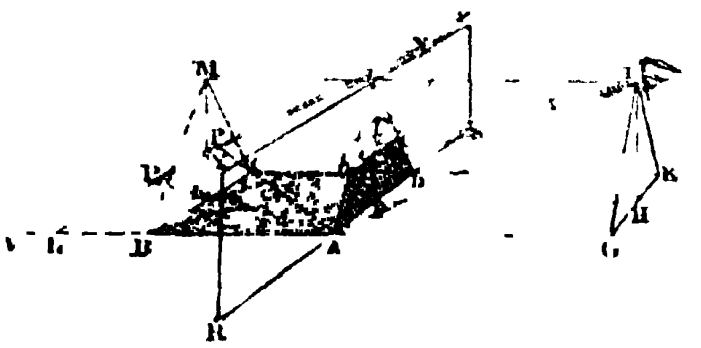
PERSONIFICATION, or PROSOPOPOEIA In Rhetoric and Composition a figure of speech being a species of metaphor (*see* METAPHOR) by which inanimate objects or abstract notions are represented as endued with life and action sometimes by being addressed as living agents (*see* APOSTROPHE), at other times, by being coupled with attributes which belong only to living agents

PERSPECTIVE (Lat perspicio, *I look through*) In the Fine Arts the art of delineating on a given transparent plane or superficies objects as they appear to an eye placed at a given height and distance From the definition it is evident that to delineate the true appearance of an object on a plane surface it becomes necessary to know the laws according to which the apparent linear dimensions of an object increase or decrease, and they are these generally —1 The visual angle or the apparent magnitude of a line will be less the greater the distance and the converse, 2 It will be less the more obliquely a line is viewed, 3 The law of diminution will be nearly in proportion to the obliquity and distance conjointly In the following diagram, let the eye



of the spectator be at I, and let E I G H be the plane on which the appearance of objects is observed This is called the *perspective plane*, or *plane of the picture* Now the [illegible] will [illegible] considered with respect to the perspective plane [illegible] particular situations of object planes are the main points for consideration It is manifest that any plane passing through the eye can only be seen on the perspective

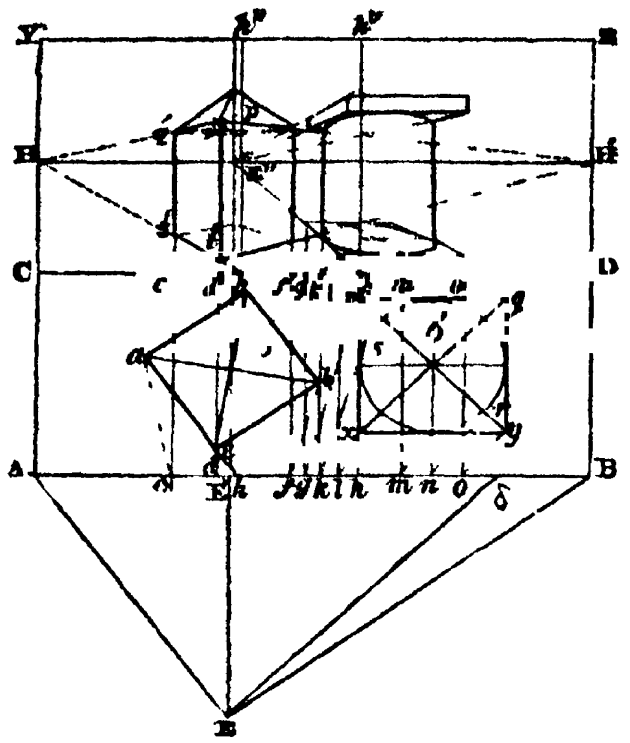
plane as a line, for the eye, having neither elevation above nor depression below such plane, can see no part of its surface, its edge being all that is visible to the eye Of [illegible] in perspective, viz [illegible] O K I M, parallel to the horizon [illegible] *plane*, Q P R N, perpendicular to the [illegible] intersects the perspective plane in the line L K, called the *horizontal line*, and the last in the line Q P, called the *vertical line* Planes [illegible] through the eye must have a *direct* or an *oblique* [illegible] tion relative thereto If the former, it must be parallel to the perspective plane, which is supposed to be placed *directly* before the eye, thus, the plane A B C D is a direct one, and parallel to the perspective plane G L Of the planes situated obliquely to the eye, the most considerable is A F H D, which is called the *ground plane*, and is parallel to that of the horizon From the foregoing observations, then, it appears that objects in the surfaces of the horizontal and vertical planes cannot be seen by the eye at I, and therefore cannot be represented on the perspective plane If O B be an object in the direct plane, and from the extreme points O and B the visual rays O I, B I be drawn to the eye at I, they will pass through the perspective plane in the points *o* and *b*, and by joining them the right line *o b* will be the representation of the line or object O B on the perspective plane In like manner the representation of O A is *o a* and *b r* and *a n* will be the representation of B R and A N, and consequently *r b a n* of R B A N &c &c So all lines parallel to A B or C D in the object plane will have their perspective lines parallel to *a b* and *c d* in the picture on the perspective plane, and however the object plane A C may be divided their representations on the perspective plane or planes of the picture will divide that in a similar manner Any point B in a direct plane has the same ratio of distance from the horizontal and vertical planes as its perspective has from the horizontal and vertical planes viz that of the distances of the planes from the eye from the nature of similar triangles hence the forms of objects on the perspective plane when they are presented in a direct view, may be drawn with facility The last species of plane whereon it is supposed we may view the natural object is that of the ground itself as A D H I above which the eye has more or less elevation, as P equal to I Y This is hence called the [illegible] its [illegible] H F with the perspective [illegible] It is more important than all others as being the common table as it were on which every thing is placed In respect to the horizontal plane, we have seen that the two remote angles there of A and D are represented by *a* and *d* in the perspective plane, the other two angles, I and H are in the same plane also as being common to both, therefore by drawing the lines *a* I and *d* H there [illegible] and H on the perspective plane [illegible] perspective appearance of the ground plane A D H I Thus, *a* I is the perspective of A F, *n* P of N P and *d* H of D H and lines that are parallel in the ground plane and perpendicular to the perspective plane are not so in their perspective picture, but converge to a point *r* called the *point of sight* in the perspective plane, because exactly opposite to the eye or the point in which a perpendicular from the eye falls on the plane In the ground plane draw V W parallel to A D, its perspective *v w* will be parallel to *a d* in the picture and *a d w v* will be the perspective of the part A D W V in the original plane We shall now proceed to a demonstration of what relates to forming the perspective appearance or picture of the ground plane and objects upon it Let A B C D in the following diagram, be a right-lined figure on the ground



plane V G K C, [illegible] right angles with the perspective pla[illegible] I [illegible] the distance of the plane, and H I the height of the eye at I H F is parallel to G B or C K, and bisects A D and B C in the points F and E On the point F raise the perpendicular E M, equal to H I, and draw the lines B M, C M, G I, and K I Draw the visual lines I A, I B, and I M, which is called the *principal ray* [illegible] I G B M intersects the perspective plane in the line A *t*, and the ray B I being in the said plane G M, must intersect the line A *t* in some point *b*, which is therefore the perspective of the point B hence A *b* is the perspective of the line A B Also, as the plane I K C M intersects the perspective plane R Z in the line D *s*, and the ray I C is in that plane, and intersects the line *s* D in the point *c*, that point will be the [illegible] point C, and D *c* that of the [illegible] points *b c*, the line *b c* will be the perspective of the line B C in the ground plane Let A B equal D C, then B C will be parallel to A D, and as in this case A *b* is equal to D *c*, *b c* will be parallel to A D also From this it is manifest *that all right lines, as* B C *in the ground plane, which are parallel to the ground line* A D *will also be parallel to the same in their representations on the perspective plane* It is moreover evident *that the representations* A *b*, I *e*, D *c*, *of all lines* A B, F E, D C, *perpendicular to the ground line* A D, *converge or tend to the point of sight s in the perspective plane* If the line A B be carried out infinitely in the direction of V, then, supposing the point B to move along that line continually, the visual ray B I will keep rising on the plane I G B M towards I M, making the angle B I M less and less, till the point B being at an infinite distance the ray I B will coincide with I M, and consequently the line A *s* will be the perspective of A B continued infinitely So D *s* will be the representation of the line D C continued infinitely Hence *the triangle* A *s* D *will on the perspective plane, be the true representation of the plane* A B C D *carried out infinitely on the plane of the horizon* Hence, also, the line Y *s* Z is the perspective of the horizon or boundary of the sight at an infinite distance, and therefore all objects on the plane of the horizon will, in their representations, be seen to rise from the ground line towards the point of sight, and lessen [illegible] as they grow more distant, till at last they [illegible] in the horizontal line Y Z We now come to lines which be oblique to or make an angle with the ground line A D, or any other parallel to it Make A L equal to A G or I *s*, and draw A *p* to make any angle *p* A R or *p* A D with the base A D, acute or obtuse Then in the horizontal line Y *s* take *s* X, equal to I *p* and draw *p* X and *s* X, the plane I X *p* A will intersect the perspective plane in the line A X Draw the visual ray I *p* which, being in the plane I X *p* A, must go through the perspective plane somewhere in the line A X which suppose at *r* Then is the point *r* the perspective of *p*, and since the point *p* is supposed to pass from A to *p* in describing the line A *p* its perspective *r* will move in the plane A Z from A to *r*, and describe the line A *r*, which therefore will be the representation of the line A *p* If A *p* be carried out infinitely, and the point *p* supposed to move constantly therein, its representation *r* will appear to move towards X, till at length the point *p* being at an infinite distance, *r* arrives at and coincides with X in the horizontal line A X is therefore the representation of the line A *p* infinitely continued and X is called the *accidental point* to which the representations of all lines parallel to A *p* tend Let I P be taken equal to A I and *s* Z equal to *s* I, then, joining A P and *s* Z the triangles A P I and *s* Z I are equal Then will the plane *s* A P Z intersect the perspective plane in the line A Z which will be the representation of the line A P carried to an infinite distance But since A I is equal to I P and L P is parallel to A D, therefore A P is the diagonal of a square and contains an angle D A P of forty five degrees with the ground line A D, hence the point of distance Z is that to which all rays parallel to A P tend in the perspective plane Let A B equal A D, then is A B C D a geometrical square, and its diagonal A C, whereof the representation is A *c*, and the point *c* is therefore [illegible] the perspective diagonal A Z intersects the ray [illegible] D Make *s* Y equal *s* Z or *s* I, and join D Y, and it will be the perspective diagonal of D B (the other diagonal of the square A C) infinitely continued and D *b* the representation of the diagonal D B determined by the intersection of the lines D Y and A *s* as before Thus it is demonstrated that A *b c* D on the perspective plane A S Z Y is the true picture or perspective representation of the original square A B C D on the ground plane, as required

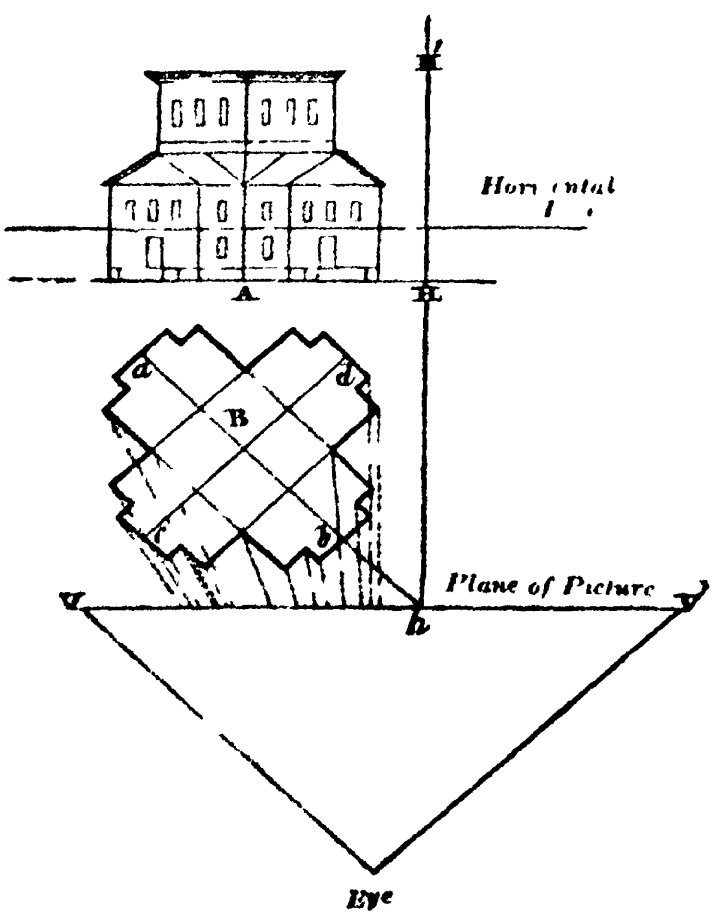
From the above principles are deduced the common rules of perspective of which we shall give two or three examples A B C D is a ground plane, whereon are seated the objects O and O' The line A B is the plan of the plane of the picture or its intersection with the ground plane and C D Y Z is the plane of the picture, or the perspective plane, as we have before called it It will be observed that one of the objects, O, lies obliquely towards the perspective plane, and the other is parallel to it or direct We will first deal with the former From the station of the eye, E, parallel to *a e* and *e b*, two of the sides of the object, draw the lines E A and E B, cutting the plane of the picture in A and B Then will A be the vanishing point of all lines parallel to *a e*, as will be B of all lines parallel to *e b* E' is the place of the eye at the intersection of the ground plane with the picture, being a perpendicular from A B to E. If H H' be the horizontal line, then H E'', equal to A L', is the place of the eye on the perspective plane From the different points of the object *a e b* draw towards E as a centre the visual rays *a c*, *e d*, *b f*, intersecting A B in

, and $f$; and from
verticals $c\,c'$, $d\,d'$,

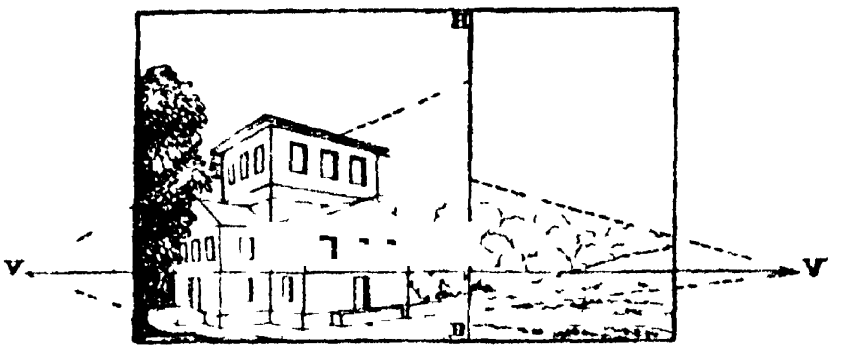


sides $a\,e$ and $e\,b$ respectively On the plan continue of the sides $a\,e$ till it intersects the picture in $h$, and ce C $h'$ on the perspective plane equal to A $h$ on the , and draw the vertical $h'\,h''$, which will be the *line heights* on which they are to be set out Then if $h'\,p$ he height of the object O lines drawn from $h'$ and $p$ he vanishing point H will intersect the verticals in d $r$ and $s'$ and $t'$ In like manner lines drawn from nd $r'$ towards the vanishing point H will give the esentation of the other side Lines drawn in oppo directions at the top of the figure (dotted in the ram) will enable the draftsman to draw diagonals from se intersection a vertical may be raised for crowning object with a pyramid or other figure In respect he object O′, which on the plan is a square circumbing a circle, the object being direct or parallel to picture, all those lines parallel to it will be horital, and the vanishing point of the returning sides $q\,y$ will be found in F′ (or E″ in the picture), which the former case is found by a line from F parallel ose sides intersecting the picture Similarly a line F parallel to $x\,q$, intersecting the picture in $\delta$ will he vanishing point of all diagonals of a square in that ction The visual rays tending to F, shown at $g\,k\,l$ are to be transferred to the picture by verticals as be

In this object $h\,h'\,h''$ will be seen to be the line of hts, on which all heights are to be set out The pective extent of a circle is easily obtained by lines nding its convexity transferred by the visual rays $s\,k$ o the picture which, aided by the diameters will give form required To give the reader a general notion e common mode of proceeding in perspective repreations of buildings, we present the following dians B is the plan of a building to be thrown into




perspective, inclined to the plane of the picture at any angle $v\,h\,a$ The vanishing points of all lines parallel to $a\,b$ are found by a line from the eye parallel to $a\,b$ cutting the picture in V Similarly, V′ is found to be the vanishing point of all lines parallel to $c\,d$ If $a\,b$ be continued to $h$, it gives the place of the line H H′, whereon the heights of the different parts of the elevation A may be set according to their several altitudes The place of the horizontal line is chosen so as to afford the most agreeable representation of the object, its height depending of course, on that at which the eye would most probably be placed, or might be supposed to be The visual rays to the eyes are shown by the dotted lines Having thus prepared the geometrical plan and elevation of the object, the plane of the picture is set out as under, and the reader must observe that the whole extent of it hori-




zontally must not take in an angle of more than sixty degrees that being as great as the eye can take in without turning the head though in internal views a [illegible] erally tolerated It is to be observed that in this diagram the representation, for the sake of greater distinctness is doubled in dimensions from the plan The place of H H′ is transferred to the picture, and the height carried down from it to the vertical lines, whose places have been found by the visual rays above mentioned The vanishing points V and V′ are transferred to the horizontal line V V′ and the horizontal lines in the sides tend thereto It is obvious that a similar process enables the draftsman to make internal representations the principles whereon they are conducted being precisely the same It is needless to expatiate on the importance of perspective to the painter, and though Fresnoy has advised that "the compasses should be rather in his eyes than in his hands," it is clear that without a knowledge of its laws he can never hope to succeed

That perspective was unknown to the ancients, as some have supposed is a mistake What has led to such an error has been perhaps, the violation of its rules in basso relievo and particularly in those on the Trajan column where attention to them would have been impossible if not improper Another ground for the supposition is the ignorance of perspective displayed in the paintings of Herculaneum and Pompeii But such examples are no proof How many painters of our own days some of them even possessing a certain sort of reputation, are sadly ignorant upon the subject The truth is that the ancients were not only eminent for their success in painting walls with architectural subjects, but they were also known to have required the practice of this branch of the arts in the decorations of their theatres To such a point of perfection was it carried, if we may rely on Pliny that in the decorations of the theatre of Claudius Pulcher the imitations were so striking that the birds attempted to alight on the tiles of the roofs This probably, however is but a figurative description of the work and that it was so intended, for otherwise it would be drawing rather too largely on our credulity Vitruvius tells us in the Preface to his 7th Book that perspective was well understood at a very early period His words are, "Agathasius at the time when Æschylus taught at Athens the rules of tragic poetry, was the first who contrived scenery, upon which subject he left a treatise This led Democritus and Anaxagoras, who wrote thereon, to explain how the points of sight and distance ought to guide the lines, as in nature, to a centre, so that by means of pictorial deception, the real appearances of buildings appear on the scene, which, painted on a flat vertical surface, seem nevertheless to advance and recede" Neither was the practice of perspective confined to the representations just mentioned Its knowledge was considered equally necessary in pictures The painter Pamphilus, whose celebrated school of design was at Sicyon, taught perspective publicly, and carried his opinions on this head to such an extent that he considered no perfect painting could be executed without a knowledge of geometry "Omnibus letteris eruditus præcipuè arithmeticæ et geometriæ, sine quibus negabat artem perfici posse"

The earliest authors on the subject whose works have reached us are Bartolomeo Bra[illegible] of M[illegible] whose work *Regole di Prospettiva e Misure de' Antichità di Lombardia* appeared in 144[illegible] and Pietro del B[illegible] who as he died in 1443, probably wrote earlier Baltazzare

P[illegible] advanced the [illegible], publishing his work at Pesaro in 1[illegible], established its principles on a basis which left little to be done by our countryman Dr Brook Taylor, the first Englishman who wrote scientifically on the subject The works on the subject are in every language very abundant, but, in our own, the work of Thomas Malton, published in folio, London, 1776, entitled *A complete Treatise on Perspective in Theory and Practice, on the Principles of Dr Brook Taylor*, is the most valuable to the student, and should be in the hands of every one who has a desire to be thoroughly [illegible] subject

PERSPECTIVE, AERIAL *See* AERIAL

PERSPIRATION (Lat perspiratio) The vapour secreted by the ramification of the cuticular arteries over the surface of the body In the healthy state it is slightly acid and saline According to Lavoisier and Seguin, the greatest amount of perspiration exceeds six pounds in the twenty four hours, and the smallest two pounds, it is at its maximum immediately after taking food and decreases during digestion Whatever quantity of food is taken, or whatever are the variations of the atmosphere, the same person, after having increased in weight by all the food he has taken, returns in twenty-four hours nearly to the same weight he was the day before, provided he is not growing and has not indulged in any excess

The substances perspired are water, carbonic acid, saline substances, lactic acid, and some organic matter In certain cases of disease, the perspiration is not only greatly modified as to quantity but often as to quality

PERTURBATION In Astronomy the deviation of a celestial body from the elliptic orbit which it would describe if acted upon by no other attractive force than that of the sun, or central body about which it revolves If the planets exercised no attraction on each other the orbit described by each of them would be accurately an ellipse having the sun in one of its foci, and the law of the motion such that the area described by [illegible] the centre of the sun and the planet [illegible] areas in equal times But in consequence of the universal [illegible] body in the system is more or [illegible] ive influence of all the others and is consequently forced to deviate from the path it would describe in virtue of the central force acting alone The forces which cause these deviations are called the *perturbing* forces, and the determination of their effect on each orbit is the great problem of physical astronomy

The simplest case of the problem is a system in which there are only three bodies — a central body and two revolving bodies disturbing the motions of each other Such, for example would be the case of the sun the earth and the moon if all the other planets were conceived to be annihilated [illegible] force was inverted [illegible] let one of the revolving bodies be called the *disturbed* and the other the *disturbing* body Now it is by no means difficult to obtain a general idea of the effects that must be produced by the disturbing force It is easy to see for example that in certain positions of its orbit the motion of the disturbed body must be accelerated and in others retarded, that in one case it may be drawn above and in another depressed below the plane of the orbit it would describe about the central body But a far more difficult problem remains — namely that of determining the ultimate effect of the reciprocal action of the revolving bodies after an infinite number of revolutions When the masses and distances of the bodies are supposed to be given this is a problem of pure mathematics, but such is its difficulty that even when restricted to three bodies, its general solution transcends the power of analysis, and it is only in a particular case (that however, which is presented by nature) namely when the mass of the disturbing body is very small in comparison of the central one that mathematicians have succeeded in integrating the equations of motion, and determining the final results

It is easy to conceive that if the problem presents great difficulties when only three bodies are taken into consideration, these difficulties must be infinitely increased when it is attempted to investigate the reciprocal actions of all the individuals composing the solar system To determine the circumstances of the motions of so many bodies projected in space and abandoned to their mutual attractions, is a problem indeed which far transcends the power of any known calculus Nevertheless there are circumstances in the peculiar constitution of the solar system which enable us not only to foresee the general effect, but to determine the form and dimensions and position of an orbit, and the place of the body in it, at any given time past or future, with all the precision which [illegible] These circumstances [illegible] place, by reason of the immensely preponderating attraction of the sun, the force by which any planet is attracted by another is extremely feeble in comparison of that by which it is retained in the orbit it would describe if there was no other body than itself and the sun Hence the deviations from that orbit are small and the disturbing action of each planet admits of being computed independently of the others In the second place, all [illegible] of a few degrees [illegible] comparatively feeble influence in drawing one another from the planes of their orbits In the third place, the system is broken up into subordinate and partial systems, which are almost independent of one another Thus, for example, the Sun, Jupiter, and Saturn form a system, in which the two planets exert a very sensible action on each other, but are very little affected by the influence of any other body, and the same is the case, though in a less degree, with Venus and the Earth By reason of these circumstances mathematicians have been enabled to accomplish what would otherwise have been impossible, and to express the disturbing forces of the several bodies of the system by algebraic equations, from which the positions of all the planets and the principal satellites are computed for several years to come, and reduced into tables for the purposes of navigation

The inequalities produced in the motions of the planets by their reciprocal actions are divided into two kinds The first depend on the *configurations* of the planets, that is the relative positions they have with regard to each other, and, as the inequalities depending on this cause increase, diminish and disappear after certain intervals of time they are called *periodic inequalities* Those of the second kind are independent of the relative positions of the planets they are also periodic, but their periods are incomparably longer than those of the first kind, hence they are called *secular inequalities*, as if their periods were not to be reckoned by years, but by centuries It is by the discovery of the periodic nature and ultimate compensation of all the inequalities of both kinds, occasioned by the perturbing forces that the permanent stability of the system is demonstrated

In order to assure the stability of the planetary orbits, three elements must remain constant or be subject only to small periodic fluctuations These are, 1 The major axis of the orbit, or the planet's mean distance from the sun 2 The inclination of its orbit to a fixed plane, and 3 The eccentricity of the orbit Now with respect to the major axes, it has been demonstrated by Lagrange that they are exempted altogether from secular inequalities, and are subject only to periodical changes depending on the configurations of the planets They are therefore restored to their former values when the planets resume the same relative positions, and their mean values, and consequently the mean motions which depend upon them, remain unalterably the same With regard to the inclinations and eccentricities, they are affected both by periodic and secular inequalities, but their secular changes are confined within very small limits, and ultimately work out a compensation Besides, the inclinations and eccentricities of the different orbits are connected with each other in such a manner, that whatever any one orbit gains in either of these respects is lost among the others These relations are defined by the two following theorems discovered by Lagrange than which analysis has furnished no more remarkable or beautiful results —

1 If the mass of every planet be multiplied by the square root of the major axis of its orbit, and the product by the square of the tangent of its inclination to a fixed plane the sum of all these products will be constantly the same under the influence of their mutual attraction

2 If the mass of each planet be multiplied by the square root of the axis of its orbit, and the product by the square of the eccentricity the sum of all such products throughout the system is invariable

From the periodic nature of the changes produced in the three elements mentioned above, it follows that the whole effect of the perturbing forces is to cause the system to oscillate about a mean state and that the inequalities of the planetary motions are all compensated in the long run and that consequently the system contains within itself no element of destruction, but is calculated to endure for ever unless an external force be introduced These results of [illegible] have point of view, by far the most [illegible] whole range of astronomical discovery They are not deduced, however from the solution of [illegible] of the motion of bodies mutually [illegible] but are founded on certain conditions which belong to the individual system, viz 1 That the eccentricities of the orbits are inconsiderable, 2 That the inclinations to the plane of [illegible] all the planets, primary [illegible] are direction Now these conditions are not necessary consequences of gravitation For anything that has been proved to the contrary, a system might exist under the Newtonian law of gravitation in which not one of them would be satisfied Of their final causes, however, we are, and may ever remain, entirely ignorant, but the fact of their existence (for the chances are almost as infinity to one

that they are not accidental) proves clearly enough that [illegible] the directions of [illegible] must have been communicated to all the planets and satellites by the same mechanical cause

The history of the problem of the perturbations dates from the discovery of universal gravitation Newton himself pointed out the general effects which the mutual attractions of the planets must have on the motions of each other, and applied his theory to the investigation of the precession of the equinoxes, and the inequalities of the moon The problem of three bodies was solved by Clairaut, D'Alembert, and Euler, about the middle of the last century Euler first pointed out the periodic nature of the variations of the orbits of Jupiter and Saturn occasioned by their mutual perturbations Laplace remarked that on taking account of some of the first terms of the analytical development of the expressions of the perturbed orbits, those on which the secular inequalities depend are capable of increase only within certain limits and Lagrange demonstrated generally that no secular inequality of this order proceeding to the time can possibly enter into the expression of the greater axis of the orbit, or the mean motion which depends on it It may be said that the discoveries of these two great mathematicians completed the theory of gravitation inasmuch as every inequality in the system not previously accounted for was by them referred to its proximate cause, and its analytical expression assigned The labours of all succeeding mathematicians in the department of physical astronomy have been confined to the extension and simplification of their theories

For a popular account of this subject the reader may consult *Laplace's Systeme du Monde*, *Sir J Herschel's Outlines of Astronomy*, and *Airy's Gravitation* The mathematical theory is contained in the *Mecanique Céleste*, and other works on physical astronomy (See also, *Encyclopædia of Nat Phil*, *Woodhouse's Astronomy*, [illegible], *Théorie Analytique du Système du Monde*, Gautier, *Essai Historique sur le Probleme des Trois Corps*)

PERTU'SSIS The hooping cough

PERU'VIAN BALSAM The produce of the *Myroxylon Peruvianum*, a tree which grows in the warmest parts of South America It is obtained by boiling the twigs in water It is a thick brown liquid of a fragrant odour and a pungent and bitterish flavour

PERUVIAN BARK *See* CINCHONA

PERVIGI'LIUM (Lat from vigil *watchful*, a watch lasting through the night) The nocturnal festivals to some deities were so styled by the Romans The *Pervigilium Veneris*, a beautiful relic of Latin poetry is attributed by some critics to Catullus

PESTILENCE (Lat pestis) Any contagious or infectious disease which is endemic or epidemic and mortal The term is also used in a moral sense *See* PLAGUE

PE'TALISM (Gr πεταλον, *a leaf*) In Antiquity a form of condemnation practised at Syracuse by which persons who from their wealth or influence were considered dangerous to the state were banished for five years, with leave to enjoy their estates and to return for that period It was in fact only another form of the Athenian ostracism (*see* OSTRACISM) with this difference that in the latter the condemnation was written on shells and lasted for ten years whereas in petalism leaves were made use of and the condemnation lasted only five years

PI'TALITE A Swedish mineral of a grey or reddish colour and a foliated texture It is a silicate of alumina and lithia, and contains between five and six per cent of the latter alkali

PETALO'CERANS *Petalocera* (Gr πεταλον *a leaf*, κερας, *a horn*) A tribe of Coleopterous insects including those which have antenna terminated by a foliated mass

PETALOI'DEUS (Gr πεταλον and ειδος *like*) A term applied by botanists to any organ the texture and colour of which resemble a petal

PE'TALS (Gr πεταλον) In Botany, the divisions of the corolla of a plant

PETA'RD (Fr) In Artillery, an engine formerly much used for breaking down gates barricades &c The petard had some resemblance to a high crowned hat It was formed of gun metal was about seven inches deep and five inches in diameter at the mouth and held from nine to twenty pounds of gunpowder When about to be used it was screwed to a thick plank, and suspended before the gate to be burst open Petards were first used by the French Hugonots at the siege of Cahors in 1579 Their use is now discontinued, and it has been discovered that gunpowder in loose bags is equally efficacious

PE'TASUS (Gr) A broad brimmed hat used on journeys by the classical incients, hence a petasus with wings attached to it is the emblem of the celestial traveller Mercury

PETAURI'STA *Petaurus* (Gr πεταω, *I expand* and ουρα, *a tail*) The name of a genus of Marsupial animals, which have the power of taking extensive leaps like the flying squirrel by means of a membrane which stretches between the fore and hind extremities aided by the expanded tail

PETECHIÆ (Lat petechia) Small spots produced by effusions of blood in the skin, immediately under the cuticle They resemble flea-bites, and usually indicate an altered and impure state of the blood

PE'TER-PENCE The popular name of an impost, otherwise termed "the fee of Rome," or, in the Anglo-Saxon, "Romescot" originally a voluntary offering by the faithful to the see of Rome, afterwards a due levied in various amounts from every house or family in a country Peter pence were paid in France, Poland, and other realms In England this tax is recognized by the Norman laws of William the Conqueror Edward III discontinued the payment when the popes resided at Avignon, but it was afterwards revived, and finally ceased in the reign of Henry VIII

PE'TIOLE That portion of a leaf that connects the lamina with the stem of a plant, the footstalk

PETI'TION (Lat peto, *I ask*) signifies generally a supplication preferred by one person to another, who is supposed to be capable of granting the request The right of the British subject to petition either house of parliament, or the king is founded on the Bill of Rights But this act is not considered as having repealed 13 C 2 stat 1 c 5, by which it is criminal to solicit or procure the putting the hands of more than twenty persons to a petition for alterations in church or state, unless by consent of three or more justices, or a majority of the grand jury at assizes or sessions, &c, and repairing to the king or parliament to deliver such petition with above the number of ten persons is also rendered criminal

PETITION In Law an application in writing, addressed to the Lord Chancellor, the Master of the Rolls, or to the equity side of the Court of Exchequer, in which certain facts are set forth as the ground on which the petitioner rests his prayer for the order and direction of these respective courts Petitions are of two kinds —*cause petitions* or *exparte petitions* The former are those in regard to matters of which the court is already in possession by virtue of there being a suit concerning their subsistence (the petitioner in this case being either generally a party to such suit or in some way or other possessing an interest therein) the latter (*exparte petitions*) are so called when there is no suit existing about the matter of the petition Both these kinds of petitions are susceptible of numerous subdivisions

PETITIO PRINCIPII (Lat *a demand of the principle*) In Logic, a popular designation for a species of vicious reasoning which consists in tacitly assuming the proposition to be proved as a premise of the syllogism by which it is to be proved, vulgo *begging the question*

PI'TONG The Chinese white copper, it is an alloy of copper and nickel *See* PAKFONG

PI'TRIS In Ornithology *See* PROCELLARIÆ

PI'TRIFACTIONS (Lat petra *a stone* and facio, *I make*) A general term by which naturalists designate the conversion of vegetable or animal materials into a stony substance The word is equivalent with such expressions as organized fossils organic remains, &c which however are all liable to exception on the ground of not distinctly explaining what they are meant to denote and though the term *petrifaction* is itself open to censure on the same score it does not seem that any other word more acceptable to the naturalist has hitherto been found to supersede it The branch of science which treats more peculiarly of substances in a petrified state is usually denominated *Oryctology* which see

PI'TROBRU'SIANS The followers of Peter de Bruys a heretic or reformer of the 12th century who declaimed with great success against the vices of the clergy and gathered around him considerable numbers of adherents in the south of France The exact opinions which he advanced are only to be collected from the assertions of his adversaries, who at a time when the lower classes throughout Europe were listening eagerly to violent and perhaps fanatical oppugners of the dominant church, did not fail to exaggerate and discolour their doctrines to suit their own purposes Besides the vague charge of Manicheism which was made against most of these sectarians the imputations cast upon them chiefly refer to their contempt for the ordinances of the church, in which it is very probable that along with the real abuses of the day, the crucifixes, images, and relics, the ignorant multitude may have included the sacraments and other purer ceremonies in one indiscriminate abhorrence A treatise was composed [illegible] St Bernard (See *Faber's Albigenses* [illegible] *History of the Church* ch xviii)

PI'TROLEUM A brown liquid bitumen, found in several parts of Europe, in Persia, and in the West Indies It is often termed *Barbadoes tar*

PI'TROLINE A substance [illegible] the petroleum of Rangoon, [illegible]

PE'TROSI'LEX A variety of flint or hornstone The term is sometimes applied to compact felspar

PETU'NTZE (Chinese) A decomposing variety of felspar, used in China in the manufacture of porcelain

PE'WORTH MARBLE called also *Sussex Marble* [illegible] limestone, occurring in the [illegible] the remains of fresh-water shells *See* GEOLOGY

PEUTINGERIAN MAP or TABLE (Germ Peutinger Tafel, so called from Conrad Peutinger, a native of Augsburg, who was the first to make it generally known) The name given to a map of the roads of the ancient Roman world, written on parchment, and supposed to have been [illegible] the time of Alexander Severus, A D 22[illegible] which is 21 feet in length, and only [illegible] is deposited in the imperial library at Vienna, but copies of it are to be found in the *Ptolemy* of Bertius, in Horne, *Orbis Delineato*, in Bergler, *Historique des Grands Chemins de Empire Romain*, and part of it in *Murray's Encyclopædia of Geography* Combined with the celebrated *Antonine Itinerary*, which it serves admirably to illustrate, though it differs from the latter in several essential particulars, the Peutingerian Table may be justly regarded as one of the most valuable bequests of ancient geography to modern times In this table the high road which traversed the Roman empire in the general direction of east and west is made the first meridian and to this every part is subjected The objects along this line are minutely and faithfully exhibited, but of those lying to the north and south of it only some general notion can be conveyed From the novel and peculiar construction of the table, every object is of course enormously extended in length and reduced in breadth (See *Manner's Introduction* to his new edition of the *Peutingerian Table* Leipsic 1824)

PEWTER An alloy of tin with lead and antimony frequently bears this name but the best pewter was formerly made of 12 parts of tin with 1 of antimony, and a very small addition of copper A fine pewter is made, according to Aiken by fusing together 100 parts of tin, 8 of antimony 1 of bismuth, and 1 of copper The use of these additions to tin is to harden it and preserve its colour, and a good pewter when clean and polished, has a silvery lustre and does not readily tarnish Common pewter of which measures and pewter pots are made, is an alloy of lead and tin

PHAETON (Gr φαεθων *shining*) In Mythology the son of Apollo and Clymene one of the Oceanides according to most writers The fable of his adventures is well known Taunted with his doubtful origin he asked his father to lend him the chariot of the sun for a day, as a proof of his filial rights Unable to guide the fiery steeds, he was dashed to the ground by Jupiter with a thunderbolt to prevent his consuming the heavens and earth The best known narrative is that in *Ovid's Metamorphoses*

PHAGEDÆ'NIC (Gr φαγειν *to eat*) A term applied to ulcers which rapidly corrode and destroy the parts which they attack

PHALA'NGER, *Phalangista* (Gr φαλαγξ *a phalanx*) The name of a genus of Marsupial animals including those in which the second and third toes of each hind foot are united together as far as the last phalanx in a common cutaneous sheath, and which have a hinder thumb but no lateral cutaneous parachute

PHALA'NGES In Anatomy the small bones of the fingers and toes

PHALA'NGIUM, or SHEPHERD SPIDER The name of a genus of Arachnidans including those in which all the legs are very long and slender, the tarsi sometimes consisting of more than fifty joints

PHALANX (Gr φαλαγξ) The close order of battle, in which the heavy armed troops of a Grecian army were usually drawn up There were several different arrangements of the phalanx peculiar to different states, but the most celebrated was that invented by Philip of Macedon The men stood close together sometimes with their shields locked, in ranks of several men in depth displaying in front a row of long extended spears The phalanx whose charge was irresistible on a smooth plain by a lighter body, was found to be overmatched by the combined strength and activity of the Roman legion which was able to take advantage of any inequality of ground, and charge in flank and rear, and when once an accident offered an opening in the unwieldy mass of the enemy, their confusion was inevitable and rally hopeless The phalanx is described in most works on Grecian antiquities, but see especially the *Mem de l'Ac des Inscr* vol xxiv xxv, and the Essay in vol xii by M de Maignal

PHALERA In Roman Military Antiquities, various kinds of ornaments were so called, chiefly but not exclusively appropriated to the equipment of horse soldiers, it was [illegible] the frontlets of the horses themselves [illegible] however, as the ornament of the man, and not the horse, that Virgil uses the word in the lines—

Euryalus phaleras Ramnetis et aurea bullis
Cingula humeris nequicquam fortibus aptat

(See the 3d and 22d Memoires of M le Beau on the Roman Legion, in *Mem de l'Acad des Inscr.* vols xxviii and xxxix)

PHALEROPE, *Phaleropus* (Gr φαλιερος, *scolloped*, and [illegible] The [illegible] ird, with the [illegible] [illegible] (Gr φανερος, and νευρον, *a nerve*) A name applied by Rudolphi to all those animals in which the nerves are distinctly eliminated

PHANTASMAGO'RIA (Gr φαντασμα *appearance spectre*, and αγορα *I collect*) A optical apparatus by means of which the images of objects can be magnified or diminished at pleasure, and motion given to them whereby a strong illusion is produced The apparatus is in fact nothing more than a magic lantern, in which the images are received on a transparent screen, and the sliders on which the figures are drawn rendered perfectly opake, excepting in the figures themselves, so that all light is excluded, excepting that which is transmitted through the image The lantern, mounted on wheels, is made to recede from or approach to the screen, by which the enlargement or diminution of the image is effected, and in order to preserve distinctness in the picture the tube in the side of the lantern which carries the lens is, by a particular mechanism drawn out or pushed in, so as to increase or diminish the distance between the lens and the slider, according as the [illegible] recedes from the screen The [illegible] very popular exhibition in lecture rooms (See *Hutton's Dictionary*, *Young's Natural Philosophy*, *Halle's Natural Magic*)

PHARISEES A sect among the Jews, whose name is derived from *Pharas*, a Hebrew word signifying *separated* or *set apart*, [illegible] the rest of the nat[illegible] peculiar holiness The time of their origin is not accurately determined, but they are referred to by Josephus as a considerable sect B C 110 In the time of our Saviour they constituted the most influential party among the Jews Though their rivals the Sadducees numbered amongst themselves some individuals of the highest rank, and those who affected to be conversant with the manners and philosophy of the Greeks and Romans the Pharisees embraced a greater proportion of the upper classes, and were supported by the admiration of the people, and the national feeling in favour of the opinions and habits of their ancestors Besides being strict interpreters of the written law, their sect superinduced upon it what they called the traditions of the elders and asserted that Moses delivered an oral law as a supplement to that of the scriptures They are frequently reproached by our Saviour with explaining the latter by the former, so as in effect frequently to destroy the validity of the written law They also attached a mistaken importance to many outward ceremonies of human invention, which they observed with a studied ostentation which gained for them the esteem and veneration of the multitude They maintained in opposition to the Sadducees, the popular doctrine of the resurrection, which, however, they appear to have corrupted with some vague notions touching the transmigration of souls

PHARMACO'LOGY (Gr φαρμακον *a medicine* and λογος) The history of the properties and uses of drugs

PHA'RMACOPŒIA (Gr φαρμακον, and ποιειν, *to make*) A book containing directions for the preparation of medicines

PHA'RMACY (Gr φαρμακον) The branch of knowledge which relates to the medical and chemical history of the different articles of the *Materia Medica* to the mode of prescribing them, their effects, and composition

PHARMA'KOLITE In Mineralogy, a term applied to the native arseniate of lime

PHA'ROS Properly the name of an island at the mouth of the harbour of Alexandria, on which a light house was erected, whence it came to be applied as common name for all lighthouses *See* LIGHTHOUSE

PHARYNGOTOMY (Gr φαρυγξ, and τεμνω, *I cut*) The operation of making an external opening into the windpipe necessary in certain cases of suffocation

PHA'RYNX (Gr φερειν, *to convey*, because the food is conveyed by it into the œsophagus and stomach) The back part of the mouth it is somewhat funnel shaped, attached to the fauces behind the larynx, and [illegible]

PHASCOLARCTOS (Gr φασκωλος, *a pouch*, and αρκτος, *a bear*) The name of a genus of Marsupial animals, of which the koala is the type its dentition is like that of the kangaroo rats, but it has no tail, and has short hind legs

PHA'SCOLOME, *Phascolomys* (Gr φασκωλος, and μυς *a mouse*) The name of a Marsupial quadruped commonly called the wombat which has the teeth of

Rodent animal, with the exception of an additional true molar on each side of both jaws

PHASE (Gr *φασις, appearance*), in A[illegible] notes the different appearances of the planets according as a greater or smaller portion of the hemisphere illuminated by the sun is visible to the observer The phases of the moon sometimes denote in particular the new moons, the full moons, and the quarters, these being the principal phases

PHASE in Natural Philosophy denotes the particular state, at any given instant, of a phenomenon which undergoes a period of change, or increase to a given point, and then diminishes in a regular gradation Thus we speak of the *phase of a tide*, the *phase of an eclipse*, &c

PHASIANIDÆ (Gr *φασιανος, a pheasant*) The name of the family of Gallinaceous birds of which the genus *Phasianus* is the type The pheasant is a native of warmer and dry[illegible] the Linnæan specific name *P[illegible]* Cuvier states that it was brought from the banks of the Phasis by the Argonauts and subsequently became diffused over all temperate Europe It is consequently a matter of difficulty to preserve the species in this country, and were it not for the assistance which the common fowl affords in hatching the eggs of the pheasant the breed would probably soon become extinct, for although the female produces a great many eggs in the artificial preserves of the wealthy sportsman yet she soon forsakes the task of incubation, when disturbed, as is too often the case, by the male

When roused the pheasant will not unfrequently perch upon the first tree, and seems more intent upon the dogs than the approach of the sportsman they betray themselves likewise by the habit which they have of crowing or making a chuckling noise at the time when they perch Foxes destroy many pheasants and as these are commonly females engaged in incubation the tendency to diminution of the race from this cause is increased But the chief loss of the pheasant breeder is caused by the mortality of the young birds, about the time of changing their nestling feathers produced by the development of great numbers of a peculiar species of Entozoon (*Syngamus trachealis*) in the windpipe This accumulation occasions a difficulty of breathing, and the convulsive attempt to gasp the air, or expel the worms has occasioned the name of "the gapes" to be given to this disease

The best remedy is a preventive treatment, by due attention on the part of the keepers to the young pheasants in keeping them clean and administering plenty and variety of food When the disease is far advanced obliging the birds to breathe air strongly impregnated with fumes of tobacco, carefully watching its effect, is the best remedy

The male pheasant is distinguished like most *Gallinacea*, by its superiority in size and brilliance [illegible] from the female, and the dependency of the [illegible] on the generative function is proved by the remarkable instances of assumption on the part of the female of more or less of the male livery consequent upon the [illegible] function in her either by age or by [illegible] the female organs The food of the pheasant varies according to the season in winter it consists chiefly of grain and seeds, in spring and summer of insects and nutritive bulbous roots, as that of the "crow-foot" (*Ranunculus bulbosus*)

The pure breed of *Phasianus colchicus* is distinguished by the absence of the white ring round the neck and the reddish copper tint of the croup Another species from China, with a white ring round the neck and a greener cast of colour especially upon the croup has also been imported and turned wild It seems to have produced a prolific race of hybrids with the common pheasant

China produces several other species which are remarkable for their superb and brilliant plumage, as the golden pheasant (*Ph pictus*), Amherst's pheasant (*Ph Amherstii*), both of which have a gorgeous ruff round the neck, and the latter is remarkable for its exceedingly long tail Also upon[illegible] Reeves's pheasant (*Ph Re[illegible]*) (*Ph nycthemerus*) from China, and the *Phasianus lineatus* from the mountains of Thibet, approach nearer in their carriage to the common fowl

PHŒNICIN (Gr *φοινιξ, purple*) The purple powder which is precipitated when sulphuric solution of indigo is diluted with water It appears to be an anhydrate of indigo

PHŒNICITES MARBLE *See* MARBLE

PHENOMENON, plural, *Phenomena* (Gr *φαινω, I shine*) In Natural Philosophy, this term is usually applied to those appearances of nature of which the cause is not immediately obvious such as the phenomena of light, of the magnet, of electricity, &c, produced by physical experiments, or unusual natural appearances, as meteors, comets, earthquakes, &c, which occur without the intervention of human agency

PHIGALIAN MARBLES so called from having been discovered near the site of Phigalia, a town of Arcadia, the name given to a series of sculptures in alto relievo, now deposited in the British Museum, where they form part of the collection known by the name of the *Elgin Marbles* They originally formed the fringe round the interior of the cella of the temple dedicated to Apollo the Deliverer, a title conferred on him by the Phigalians in gratitude for his having delivered them from a pestilence They represent the combat of the Centaurs and the Lapithæ, and that of the Greeks and Amazons The similarity, both in design and execution, which they bear to the decorations on the Parthenon leaves no doubt that they are the workmanship of the same great artists which designed, constructed, and [illegible] that monument of the golden age of art *See* PARTHENON, ELGIN MARBLES

PHILADELPHIANS (Gr *φιλεω, I love, ἀδελφος, brother*) A secret society said to have existed in France during the government of Napoleon, and to have produced the conspiracy of Colonel Malet in 1812 An account of it is given, but we do not know how far it is to be understood as narrating matters of fact in the *Histoire des Sociétés Secrètes de l'Armée* published in 1814

PHILANTHROPINISM A name given in Germany to the system of education on natural principles, as it is termed which was promoted by Basedow and his friends in the last century and mainly founded on the notions of Locke and Rousseau An institution for the purposes of education, founded under the protection of the Duke of Dessau in 1774, was the first so called "Philanthropin" It was dissolved in 1793, and of the similar institutions afterwards founded, only one it is said has continued to maintain itself But the influence of the labours of the Philanthropinists has undoubtedly entered largely into the modern system of education (*Conv Lex*)

PHILANTHROPY (Gr *φιλεω, I love* and *ανθρωπος a man*) A general term for a benevolent feeling towards the whole human race It is opposed to misanthropy

PHILIBEG or FILIBEG *See* KILT

PHILIPPIC The title of several orations of Demosthenes against Philip king of Macedon the spirit and animosity of which has caused the name to be transferred to similar compositions Thus Cicero gave this name to the orations which drove Mark Antony from Rome, and impelled the senate to prosecute the war against him after the murder of Julius Cæsar

PHILOCTETES In Mythology the son of Pœan, according to some authors one of the Argonauts The friend and companion of Hercules and one of the most celebrated heroes of the siege of Troy though but little referred to in the *Iliad* His adventures, too long to be here recounted form the subject of one of the tragedies of Sophocles

PHILOLOGY (Gr *φιλεω I love* and *λογος speech, discourse*) This word appears to have been used by the classical ancients to designate the whole circle of belles-lettres and even of the sciences cultivated as they then were very imperfectly and more in a theoretical than an inductive shape considered not with respect to their respective subject matters but to the language in which they were conveyed A philologist was one who studied or taught the elegance of diction as applicable to every branch of human learning, nor can the meaning of the designation be very accurately [illegible] of the *γραμματικος*, or grammarian [illegible] the term philology was usurped in a wider sense so as to comprehend learning in general After the revival of letters the word was introduced into modern European languages but in a much more restricted signification It then comprehended grammatical criticism and etymology and some branches of archæology, and as these studies were almost confined to the ancient languages, and other relics of classical antiquity which alone were then studied in a scientific manner the [illegible] were the learned investigators of the [illegible] idioms and literature Commentaries on ancient authors, etymological works, and glossaries of their language, grammars &c were then the [illegible] nally denominated philological and [illegible] philology considered in this sense is now more extensive, as the modern European and non-European languages have also become the subjects of accurate investigation, it is with the same general meaning that the word is chiefly used, at least among English writers, at the present day It is defined by Johnson "criticism, grammatical learning" In this popular sense philology may be said to embrace, 1 Etymology, or the science of the origin of words, 2 Grammar, or the science of the construction of language in general and of individual languages, 3 Literary criticism, or the investigation of merits and demerits in style and diction,

Of late years, however, a new and very extensive province has been added to the dominion of philology, namely, the [illegible] in a more general sense, considered [illegible] respect to the light it throws on the nature of the human intellect and progress of human knowledge, and historically, with refer-

ence to the connection between different tongues, and the connection thus indicated between different nations and races Some attempts have recently been made to confine the use of the word philology to this particular branch of learning It comprehends, 1 *Phonology*, or the knowledge of the sounds of the human voice, which appears to include orthography, or the system to be adopted when we endeavour to render, by our own al- [illegible] *Etymology*, 3 [illegible] language by grammatical forms, according to the various points of view from which men contemplate the ideas which words are meant to express

*Classical Philology* —By German writers the use of the word philology is still not uncommonly restricted to this branch of study The earliest commentators, lexicographers, and [illegible] whose works we possess, flourished in Greece and Rome at various periods between the Christian era and the fall of the Roman empire During the middle ages the knowledge of the classical languages, or of the works written in them, ceased to be cultivated as a science Philology was revived about the end of the 14th and beginning of the 15th century, and chiefly by the labours of various learned Greeks expelled from their own country by the encroachments of the Romans In the 15th century, Italy was peculiarly animated with a zeal for classical literature, which, in fact, essentially injured, during the whole of that period the cultivation of the native language of the country In the following age, the cultivation of this study passed chiefly into the hands of the French Dutch, and Germans, nor was it long retained in any perfection among the students of the first of these nations In the hands of the industrious writers of Holland and Germany classical philology assumed a new form Less elegant, and pursued in a less poetical mind than it had been among the Italians it became a vast and laborious science [illegible] Dr [illegible] is said to have been chi [illegible] erials of knowledge the task of criticism and of separating the true from the false in classical idiom and diction, began with the 17th, and the earliest name in this department of study is perhaps still the most illustrious that, namely, of Richard Bentley Since his time we have had many distinguished classical scholars in our own country especially in the present day which has produced Parr Porson and Elmsley but Germany still remains the true nursery of classical research, and the school of Wolf Heyne and Hermann in that country has laid down canons of inquiry as to the genuineness and authority of some of the earliest works in the ancient language which have imparted a new character to classical criticism in general See LANGUAGE CLASSICS

PHILOLOGY SACRED The art of criticising the languages and dialects of the Hebrew and Hebræo Greek writers in order to elucidate the meaning of the sacred scriptures The Hebrew language, consisting principally of the old Phœnician, with admixtures of the Aramean from Mesopotamia, introduced by Abraham and his horde, received also a few modifications owing to the long servitude of the Israelites in Egypt How old the book of Job may be is still a *vexata questio* among critics some of whom suppose that it was originally written in *Arabic* and afterwards translated while others trace it to a remote period of *Hebrew* literature, but whether it be older or not than the works of Moses the Pentateuch must ever be considered the basis of the Hebrew as a fixed written language The institution of the schools of the prophets under the Judges no doubt tended to give that polish and poetic character seen in the writings of David and Solomon, but the Hebrew language remained essentially the same down to the conquest of Palestine, first by Shalmanesar (who introduced an Aramean population in lieu of the expelled ten tribes), and secondly by Nebuchadnezzar, who (B C 588) took the holy city, and captured the two remaining tribes, transporting them also according to a still prevalent eastern custom, into his own territories The Jews, however, during their captivity at Babylon, not only acquired new habits but received many additions to their language, both of words and idioms, and henceforward they spoke a dialect usually known as the *Hebræo-Aramaic*, bearing nearly the same analogy to the Hebrew that the modern Italian bears to the Latin [illegible] the later [illegible] may be discovered [illegible] The prophets Haggai Zechariah, and Malachi the Chaldee, present a few instances of [illegible] the new dialect is most of all perceptible [illegible] and other uninspired commentaries by which alone the Scriptures could be made intelligible to the common people Schultens, Rosenmuller, the elder Michaelis Bishops Louth and Horsley, Gesenius Ewald, and Prof Lee have successfully la- [illegible] the study of the Hebrew language, [illegible] of the Hebrew Scriptures are by [illegible] and De Rossi After the cessation of Hebrew prophecy on the death of Malachi, about 400 years B.C, the Aramean dialect prevailed more or less, owing to the adherence of the Jews to their national language, down to the capture of Jerusalem by Titus The conquests of Alexander, however, had an undoubted influence over the learned castes, who gradually became acquainted with the Greek language, and accordingly (B C 280), Ptolemy Philadelphus invited *forty* Jewish scribes to Alexandria to translate into Greek the Pentateuch that part of the Jewish history relating to the Egyptians Some years afterwards the other books of the Old Testament were translated by different hands, but the name *Septuagint* (*see* SEPTUAGINT) is a misnomer, and the story connected with it (resting wholly on the very questionable authority of Plutarch and Diodorus Siculus) is quite unworthy of credit The work, however, is written in good Macedonian Greek (κοινὴ διάλεκτος), with a few Hebrew admixtures, and hence the Septuagint should be studied in connection with the New Testament, which presents similar features In the time of Christ the Aramaic (as the Gospels furnish abundant proof) was the vulgar language of Palestine, and even Galilee had a separate though cognate dialect (Luke, xxii 59, Acts, ii 7) After the descent of the Holy Spirit, the followers of Christ became gifted with that power of expression necessary to carry the tidings of the Gospel into distant countries, and the Greek language, so far as the regions west of Palestine were [illegible] was the great medium of communication Here [illegible] and Apostles wrote in this lang [illegible] But though their words were inspired, their words were of their own creation, and hence arose those peculiarities of diction, Hebrew expressions, &c, the understanding of which is absolutely necessary to an intimate acquaintance with the inspired writers of Christianity This, indeed, constitutes the science of sacred philology, and in this work the labours of Wetstein, Mill Griesbach, and Scholz have been employed in producing a pure Greek text from the examination of the best MSS, while the most celebrated critics of the New Testament, Bengel, the younger Michaelis Kuinoel De Wette, Bp Marsh, Stuart Ernesti, Winer and Robinson have spent their best days in elucidating the meaning of the Evangelists and Apostles — the great pillars of the church, of which Christ is the head corner stone

PHILOSOPHER'S STONE *See* ALCHEMY

PHILOSOPHY (G [illegible] in common acceptation [illegible] sum total of systematic human knowledge It is commonly divided into three grand departments, metaphysics, physics, and ethics If we include in the first logic, this may be regarded as a complete distribution of science, properly so called The first has for its object those truths which go beyond mere experience, as the nature of being, of God, of the soul &c, as they are in themselves or as they are apprehended by us (*See* METAPHYSICS) The second relates to objects as they are in nature as subject to the relation of cause and effect The third contemplates human actions as they *ought* to be, not merely as they are, and takes account of the ideas of duty, freedom, responsibility, and the like — of all, in short which constitutes the distinction between *an action* and *an event*

This word was first used by the Pythagoreans and adopted from them by Socrates who [illegible] himself a lover or seeker of wisdom only, in distinction from a *sophist* or one who conceives himself to be in the possession or exercise of wisdom

Many valuable histories of philosophy have appeared of late years, especially in Germany The most celebrated are those of Brucker Tennemann and Ritter A sketch of the history of philosophy written by the late Mr Dugald Stewart originally prefixed to the *Encyclopædia Britannica*, is now printed in a separate volume

PHILTER (Gr φίλτρον *I love*) A drug or preparation supposed by the ancients to have the power of exciting love Nothing certain is known respecting the composition of these celebrated potions, but there can be no doubt that recourse was frequently had to them by the ancients and that their operation was so violent that many persons lost their lives and their reason by their means The Thessalian philters were in the highest celebrity (See *Ivo* vi 610)

PHILYRA In Mythology one of the Oceanides, and mother of the centaur Chiron by Saturn, who visited her in the shape of a horse Alarmed at the monstrosity of her offspring, she implored Saturn to change her nature, who [illegible] and changed her into a linden tree which received Greek by her name He [illegible] for that

PHLEBOTOMY (Gr φλεψ, *a vein*, and τεμνω, *I cut*) The operation of opening a vein for the purpose of taking away blood

PHLEGETHON (Gr φλεγεθων, *burning*) The mass of fire which according to the poets of Rome and Greece, washed the shores of the infernal regions It is

also the name of one of the rivers of the infernal regions *See* COCYTUS

PHLOGI'STON (Gr φλογιζω, *I burn*) An imaginary principle, by which Stahl and the chemists of his school accounted for the phenomena of combustion, the matter of fire fixed in combustible bodies

PHLYCTÆ'NA (Gr φλυκταινα) A small vesicle which contains a serous fluid

PHLYZA'CIUM (Gr φλυζιον, *to be hot*) A pustule upon the skin

PHOCA'CEANS, *Phocacea*, or Seal Tribe The name of the family of carnivorous and amphibious Mammals of which the seal (*Phoca*) is the type *See* SEALS

PHOCÆ'NA (Gr φωκαινα, *a porpoise*) A subgenus of dolphins, distinguished by the absence of the beak-like [illegible] the jaws

PHOCE'NIN A peculiar fatty matter contained in the oil of the porpoise (*Delphinum*) When saponified it yields a volatile odorous acid called *phocenic acid*

PHŒ'BUS (Gr φοιβος, *luminous*) A name of Apollo, often used [illegible]

PHŒNICOPTE'RUS (Gr φοινιξ, *red*, and πτερον, *a wing*) The generic name of the flamingo also a term applied to other animals which have red wings, as the *Bombycilla phœnicoptera*

PHŒNIX [illegible] among the [illegible] connected with its [illegible] longevity and death, regarded as the emblem of [illegible] She was described as of the size of an eagle, her head finely crested her body covered with a beautiful plumage and her eyes sparkling like stars She was said to live 500 or 600 years in the wilderness, when she built for herself a funeral pile of wood and aromatic gums, which she lighted with the fanning of her wings, and thus *apparently* consumed herself, but not *really*, this being merely the process by which she endowed herself with new vitality she then

[illegible]

Four periods of history are mentioned by ancient writers as having been graced by the appearance of the phœnix The first was in the reign of Sesostris, the second in that of Amasis, the third in that of Ptolemy III, king of Egypt, and the fourth in that of Tiberius There is, however, a great discrepancy of opinion on this point, as well as on every other relating to the phœnix The history and imaginary attributes of the phœnix have formed a theme to poets in every age, and in most languages its name has passed into a proverb By the fathers of the church it was frequently brought forward as an illustration of the doctrine of the resurrection (see Spanheim, *De Usu et Præstantia Numismatum* diss v c 13, and the authorities cited in that learned work) [illegible]

[illegible] as an emblem of the renovation of the world and the revival of the golden age under their beneficent rule The chief [illegible] notices with regard to the phœnix are Herodotus, book ii, Ovid, *Met* xv 391, Pliny *Hist Nat* x 2, and Tacitus *Annal* vi 18 Besides these, the reader may consult, in the third volume of Wernsdorf, *Poetæ Minores* (to which the editor has prefixed a learned introduction) the poem *De Phœnice*, which is usually attributed to Lactantius, and in which every circumstance on record with regard to the phœnix has been chronicled with the most laborious precision The reader will also find in Metral's work *Le Phœnix ou l'Oiseau du Soleil* (Paris 1824), a resume of all that has been written, both in ancient and modern times, respecting the history and peculiarities of the phœnix

PHŒNIX One of the modern constellations in the southern hemisphere

PHOLA'DIANS *Pholadea* (Gr φωλεος, *a lurking place*) The family of Lamellibranchiate Bivalves of which the genus *Pholas* is the type they are remarkable for the *hiding places* which they excavate for themselves in rocks and clay

PHONE'TIC WRITING (Gr φωνη, *sound*) That writing in which the signs used represent sounds in opposition to *ideographic*, in which they represent objects or symbolically denote abstract ideas, as in the figurative part of the Egyptian hieroglyphics The signs representing sounds are usually arbitrary, or at least have become so in process of time, as in the ancient Roman alphabet of which the letters are for the most part derived from the Hebrew or Phœnician, in which languages they may have originally partaken of a symbolical character But, in a species of phonetic writing which is intermixed with the figurative hieroglyphics in Egyptian inscriptions every letter is denoted by a figure representing some object, the name of which begins with that letter *See* HIERO-GLYPHICS

PHO'NICS (Gr φωνη) The doctrine of sound the same as *acoustics* (*See* SOUND) As sound, like light, is subject to certain laws of reflection and refraction, the science, like that of light, may be treated under three [illegible] In [illegible] these have been denominated *phonics*, *cataphonics*, and *diaphonics*

PHO'NOLITE (Gr φωνη, and λιθος, *a stone*) A species of compact basalt sonorous when struck

PHO'RCUS In Mythology a marine deity, son of Pontus and Terra, father of the Gorgons the dragon that guarded the apples of the Hesperides, and other fabulous monsters

PHORONO'MIA, or PHORONO'MICS (Gr φερω, *I bear or carry*) A term sometimes used to denote the science of motion In this sense, it was employed by Hermann, a mathematician who flourished in the beginning of the 18th century, in a work entitled *Phoronomia, seu de Viribus et Motibus Corporum Solidorum et Liquidorum* (Amstel 1716), and of great merit for the time in [illegible] being now employed [illegible] moving bodies, *phoronomia* or *phoronomics*, seldom occurs in works of modern science

PHO'SGENE GAS (Gr φως, *light* and γιγνομαι, *I produce*) A compound of chlorine and carbonic oxide, made by exposing equal measures of those gases to the sunshine, or to bright daylight They will not unite in the dark

PHO'SPHATES Salts containing *phosphoric acid*

PHOSPHITES [illegible] *phosphorous acid*

PHOSPHORESCENCE [illegible] mission of light by substances at common temperatures, or below a red heat

PHOSPHORESCENT ANIMALS Those species are so called which have the faculty of emitting a luminous fluid They are much more numerous than the electric animals, belonging to most of the Invertebrate classes and frequently rendering vast tracts of the ocean luminous by their prodigious numbers The glow-worm (*Lampyris*), the phosphorescent sea-pen (*Pennatula phosphorea*) and the brilliant pyrosome (*Pyrosoma Atlanticum*) are amongst the most remarkable of these animals

PHO'SPHORITE Native phosphate of lime

PHO'SPHORUS (Gr φως, *light*, and φερω, *I carry*) So called from its property of shining in the dark It was discovered in 1668 by Brandt an alchemist of Hamburgh, and was originally obtained by distilling urine, but it is now always extracted from *bone earth* by a process contrived by Scheele The bones are calcined, so as to destroy the animal matter and being powdered, are mixed with water, to which half their weight of sulphuric acid is added The bone earth, consisting chiefly of phosphate of lime is thus decomposed sulphate of lime is formed and phosphoric acid is evolved, or, rather, superphosphate of lime which being much more soluble than the sulphate remains in the liquid, and may be obtained by its evaporation It is mixed with about half its weight of charcoal, and put into a well-luted earthen retort the beak of which dips into water At a bright red heat the phosphorus distils over into the water It is purified by carefully melting it under water, and straining it through a piece of chamois leather

Pure phosphorus is almost colourless and semitransparent it may be cut with a knife and its surface has a waxy lustre It fuses at 108° boils at 550° and is converted into vapour having according to Dumas a density = 4 3 It is sparingly soluble in fixed and volatile oils, and in ether and alcohol but insoluble in water It shines in the dark and emits a luminous vapour, undergoing a slow combustion and exhaling a peculiar smell like garlic When rubbed or heated to a temperature of about 110° it takes fire and burns with great rapidity, with a white flame, emitting abundance of acid fumes, in oxygen gas its combustion is so intensely brilliant that the eye can scarcely bear the light

The product of the perfect combustion of phosphorus is *phosphoric acid* a fusible substance very soluble in water, and intensely sour It appears to consist of 1 equivalent of phosphorus = 16, and 2½ of oxygen = 20, its equivalent being 36

There are two other acids of phosphorus, namely, the *phosphorous acid*, consisting of 16 phosphorus + 12 oxygen and the *hypophosphorous acid*, which appears to be a compound of 2 equivalents of phosphorus (16 × 2) = 32, and 1 of oxygen = 8 When phosphorus is boiled in a solution of caustic potash a gas is evolved, which is remarkably distinguished by its spontaneous inflammability, each bubble, as it rises through the water, taking fire upon the surface, and producing a beautiful ring of smoke this gas is commonly called *phosphuretted hydrogen* Phosphorus may be made to combine with the greater number of the metals, forming compounds called [illegible]

PHOTOGENIC DRAWING (Gr φως, and γιγνομαι, [illegible] DAGUERROTYPE was written under which we have adverted to the extraordinary results obtained by Daguerre the mode by which they were produced [illegible] not been made public since that time, however, all the details of the manipulation have been fully

disclosed, and they are extremely interesting and curious, though the explanation or theory of the process is still somewhat obscure The whole subject has lately acquired much additional importance from its extended applications, namely, from architectural objects, sculpture, and interiors of ro[illegible] nd more lately to groups, and even [illegible] it is undergoing almost daily extension and improvement *See* PHOTOGRAPHY

PHOTO'GRAPHY Under the general term photography we now include all those processes for the production of pictures, which depend upon the chemical influences of the solar radiations As the name implies, these pictorial representations of external objects were supposed to result from the action of LIGHT — *the illuminating [illegible] of the sun* recent investigations, however, [illegible] probable that these chemical changes are due [illegible] which is associated with light *See* [illegible] in photography, although it may not prove to be absolutely correct, is however too firmly established for us to hope for any change, and we therefore shall include under it our consideration of the daguerreotype, calotype, [illegible] such other processes as are of [illegible] general attention

Mr Wedgwood, the celebrated potter was the first who attempted to produce pictures by the sunshine he was aided in his investigations by Sir Humphry Davy, but the results were not satisfactory since no means of rendering the pictures permanent were then discovered M Niepce, of Chalons on the S[illegible] investigations of the same kind, disc[illegible] the resins underwent a change by exposure to sunshine and by spreading solutions of them over glass and metal plates, and placing them in the camera obscura, images were slowly impressed upon these prepared surfaces this process was called by the inventor HELIOGRAPHY M Niepce associated himself with M Daguerre, but he died previously to the discovery of the very beautiful process, the *Daguerreotype*

The outline of this process is as follows — A piece of copper is plated in the usual way with silver by passing the metals together through a rolling mill, and is then cut into pieces of a proper size The silver surface is carefully polished and cleansed by wiping it over with a piece of cotton dipped in dilute nitric acid washing and drying When thus duly prepared — and much depends upon the manner in which the preliminary operations are performed and the materials used,—the plate is subjected to the diffused vapour of iodine which forms a slightly brown or yellow film upon the silver it is then ready to be subjected to the action of the image to be represented which is thrown upon it care being taken to exclude all other light, by the well-known instrument the camera obscura In the course of a few seconds or minutes, the requisite time depending upon the intensity of th[illegible] is removed, and though nothing is as yet [illegible] it has received the image, which is brought out and rendered evident by subjecting it inclined at an angle of about 45° to the vapour of mercury This operation is performed in a box with a glass side, at the bottom of which is a basin of mercury heated to about 170°, so that the operator may see the progress of the appearance of the image and remove the plate when it is perfect, but light must be as far as possible excluded and more especially daylight The plate is then washed by cautious immersion in a solution of hyposulphite of soda and lastly with boiling distilled water, and allowed to dry it is now perfect may be exposed to light without injury, but must be carefully protected from all friction by covering it with a glass The action of the various shades of light upon the film of iodine, and the subsequent influence of the mercurial vapour, upon which the visibility of the picture depends have not been satisfactorily explained and require further experimental elucidation The perfection of the drawing, and the extraordinary manner in which the minutest details are represented, we have noticed in our former article, they must, however be seen to be accurately judged of and duly appreciated

Various improvements have been from time to time [illegible]

[illegible]

instead of the former substance only The sensibility of the plates is by this means infinitely increased so that, under favourable circumstances, portraits can be produced in a few seconds of time The application of chloride of gold to the surface of the silver plate after the picture is finished as was recommended by Fizeau, has given a much greater degree of permanence than those productions previously exhibited The principles of photography, or of photogenic drawing, as Mr Fox Talbot called his process, in the first instance may be explained as follows — If a piece of paper be dipped into a weak solution of nitrate of silver, carefully dried and preserved out of the contact of light, it remains white, but if exposed to light it gradually becomes discoloured, acquiring a brownish or grey tint, and ultimately blackens, the depth of colour depending upon the intensity of the light and duration of exposure If any opaque or translucent object be laid upon a sheet of paper so prepared so as wholly or partially to intercept the incident rays a representation of the object is obtained upon the paper Where the rays have been wholly intercepted, it remains white, where partially so, various shades are produced, and wherever they have fallen without interruption, the utmost blackness is obtained If [illegible] transparent colours [illegible] a piece of the prepared paper, and exposed to the sunshine, a copy is obtained in which the lights of the original are shades, and the shades lights in proportion to their intensity, but if such a picture be taken upon a piece of paper, this may be again copied by a repetition of the process, and then the lights and shades will be as in the original It is, however, obvious that such a photograph will only be durable whilst kept in the dark, and that exposure to light will gradually obliterate the whole, to fix it, the paper must be washed in a solution of hyposulphite of lime or of soda which removes all remaining and unaltered salt of silver, but leaves the image untouched. In this process the paper after having been impregnated with nitrate of silver, or with ammonia nitrate of silver is generally dipped in a solution of common salt, by which chloride of silver is formed, and this is more susceptible of the influence of the chemical agency of the solar rays than the mere nitrate

The *calotype* process of Mr Fox Talbot consists of the following manipulatory details — good letter paper is washed on one side with a solution of the iodide of potassium, it is, when dry washed with a solution of nitrate of silver, to which a small quantity of acetic acid has been added, and the paper is then washed with clean and pure water Papers thus prepared will keep without deterioration for some time To use the paper, a few drops of a solution of nitrate of silver are mixed with about an equal quantity of a saturated solution of gallic acid With this mixture the paper is washed on its prepared side and placed in the camera In a few minutes a picture is impressed upon the paper, which is removed from the instrument, and in a dark room again washed over with the mixture, called the *gallo-nitrate of silver* The picture slowly developes itself and when it has acquired the proper degree of intensity, the action is checked by plunging it into water, and subsequently the picture is fixed, and the yellow colour of the iodide of silver removed by the use of [illegible] of soda The picture thus obtained is a *negative one*, [illegible] the lights and shadows are reversed but by taking a copy from this as already described a *positive* picture is obtained, in which nature is most faithfully represented with all the delicate gradations of light and shadow This process has been applied to glass plates in the following manner Albumen, the white of egg, being strained, is mixed with some iodide of potassium, and floated over the surface of the glass, when dry, the silver solution is applied, and subsequently the gallo-nitrate of silver Thus prepared, the glass plate is adjusted in the camera and the image impressed, the remainder of the process is the same as on paper

Collodion or gun-cotton, dissolved in ether has been also used This preparation is floated over the glass and the iodide and silver salt applied The sensibility of the collodion process is perhaps greater than almost any other except the *instantaneous* process, which has been lately discovered by Mr Fox Talbot

This process is also upon albumenised glass, over which a solution of nitrate of silver containing alcohol is floated and then a preparation of the protiodide of iron with acetic acid and alcohol after which a stronger solution of nitrate of silver is applied To this process the name of *amphitype* has been given Sir J Herschel introduced several very interesting photographic processes, the cyanotype and the chrysotype amongst others

Dr Woods of Parsonstown, introduced the use of the iodide of iron in his process of the *catalissotype*, and Mr Robert Hunt that of sulphate of iron in his *ferrotype*, both processes of extreme sensibility The chromotype the fluorotype and the other processes of Mr Hunt, are fully described in his *Researches on Light.* Sir J Herschel has fully described his processes in his memoirs in the *Philosophical Transactions* The production of photographs naturally coloured has been achieved by M Niepce de St Victor By voltaic agency he produces upon the surface of a silver plate a dark purple coating of oxide of copper and chloride of silver This is *eaten out* in colours, when exposed to the influences of solar radiations It has not yet been found practical to give permanence to these reproductions of natural colour, but we may hope soon to unite delicacy of detail and truthfulness of representation, with the additional beauty of native colouration

PHOTOMETRY (Gr φως, and μετρον, *measure* ) The science which treats of the measurement of light Attempts to determine the relative intensities of different

lights were made at an early period in the history of experimental science For the purpose of comparing the light of Sirius with that of the sun, the celebrated Huygens employed a tube having a very small aperture at one end to which a lens, which allowed only a disk to be seen and this small portion afforded a light which appeared equally bright with Sirius, whence he concluded the distance of Sirius to be 27664 times greater than that of the sun (*Huygenii Cosmotheoros*) Celsius appears to have been the first who proposed to measure light directly by means of what he called a *lucimeter* His method, however, which was an extremely imperfect one, consisted simply in observing the greatest distance from the eye at which small circles painted on paper were distinctly visible in different lights It was reserved for Bouguer to establish photometry on true principles Having been induced by Mairan's remarks on the relative proportion of the sun's light at the summer and winter solstice to investigate the subject, he undertook a series of experiments of which the results were first published in his *Essai d'Optique*, 1729, and afterwards in his *Traité d'Optique sur la Gradation de la Lumiere*, which appeared in 1760, two years after his death In the same year appeared the *Photometria* of Lambert, in which the subject was treated more generally and with great mathematical elegance The principle adopted by Bouguer and Lambert is extremely simple Though the eye cannot judge of the proportional force of different lights, it can distinguish in many cases with great precision when two similar surfaces presented together are equally illuminated, or when the shadows of an opaque object thrown upon them by different lights are equally dark But, as the particles of light proceed in straight lines, they must spread uniformly and hence their density will diminish in the duplicate ratio of their distances From the respective situations, therefore, of the centres of divergency when the contrasted surfaces become equally bright, we may easily compute their relative degrees of illumination The objection to this method is that the apparatus admits of uncertain comparison Even the light of the sun, in different parts of the same latitude, and in the same climate, is subject to considerable variation, much more so any artificial light the force of which must always be influenced by a number of undefinable circumstances In this respect therefore the photometer used in this article has a great and decided advantage

A simple and elegant application of the principle of Bouguer was made by the late Dr Ritchie His apparatus consists of a rectangular box, about an inch and a half or two inches square open at both ends and blackened within, [illegible] Within inclined at angles of [illegible] two rectangular plates of plane looking glass cut from one and the same strip, to ensure equality of their reflecting powers and fastened so as to meet at the top in the middle of a narrow [illegible] in much broad which [illegible] or oiled paper In comparing, by means of this instrument the illuminating powers of two different sources of light they must be placed at such a distance from each other and from the instrument between them, that the light from every part of each shall fall on the reflector next it and be reflected to the corresponding portion of the oiled paper The instrument is then moved nearer the one or the other, till the two portions of the paper corresponding to the respective mirrors are equally illuminated of which the eye can judge with considerable certainty

The modification of this method which consists in contrasting the shadows of an opaque object formed by different lights is usually ascribed to Count Rumford, by whom it was proposed in the *Phil Trans* vol lxxxiv but was long before used by Lambert It is generally supposed that the equality of two shadows can be appreciated with more certainty than that of two lights but when the lights are of different colours, their estimation by either method admits of little precision

M Arago has proposed a method of determining the relative intensities of different lights entirely different in principle from any of the preceding and probably susceptible of much greater accuracy It is founded on the properties of polarized light When two lights are to be compared, the rays from each are polarized by causing them to pass through a plate of tourmaline cut parallel to the axis, or by reflecting them from a plate of glass, on which they fall at the polarizing angle They are then received on a plate of rock crystal, cut perpendicularly to the axis and observed through a doubly refracting prism Each light will thus give two images tinged with the complementary colours The images are then brought into such a position that the red of the one falls over the green of the other If the two lights are equal in intensity, this superposition will produce a white image, if unequal, the image will be slightly coloured with red or green according as the one or the other predominates The apparatus which this method requires is somewhat complicated and its manipulation must be attended with considerable trouble (See the Notes to the French translation of Sir J Herschel's *Treatise on Light* Pars 1834)

PHOTOPHOBIA (Gr φως, *light*, and φοβεω, *I terrify*) An intolerance or dread of light, it is a symptom of internal ophthalmia

PHRASE (Gr φρασις, *speech or expression*) In Music, a short melody in which a perfect musical idea is not entirely developed

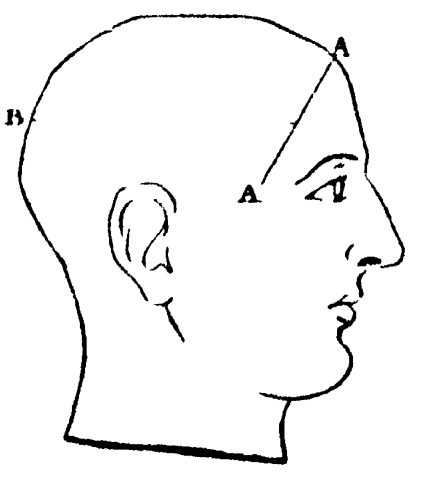
PHRASEOLOGY (Gr φρασις, and λογος, *science*), properly the science or knowledge of style, but used in common language to signify the peculiarities of diction of a writer, school, &c

PHRATRY (Gr φρατρια) A subdivision of Athenian citizens, analogous to the Spartan *obe* and Roman *curia* distinguished by particular rites and ceremonies that bound its members together Each of the four ancient tribes was divided into three phratries, and each phratry into thirty sections or clans, which bore a name exactly answering to the Roman *gens* (γενος), and this division remained subsequently to and independent of the ten tribes of Clesthenes The free Athenians registered their own or their adopted children in the phratries to which they themselves belonged, at the festival of the Apaturia, but what the age of registry was is uncertain

PHRENIC (Gr φρενες (plural of φρην, *the mind*), *the* Latin *to the diaphragm*

PHRENITIS (Gr φρην, *the mind*) Inflammation of the brain or its membranes

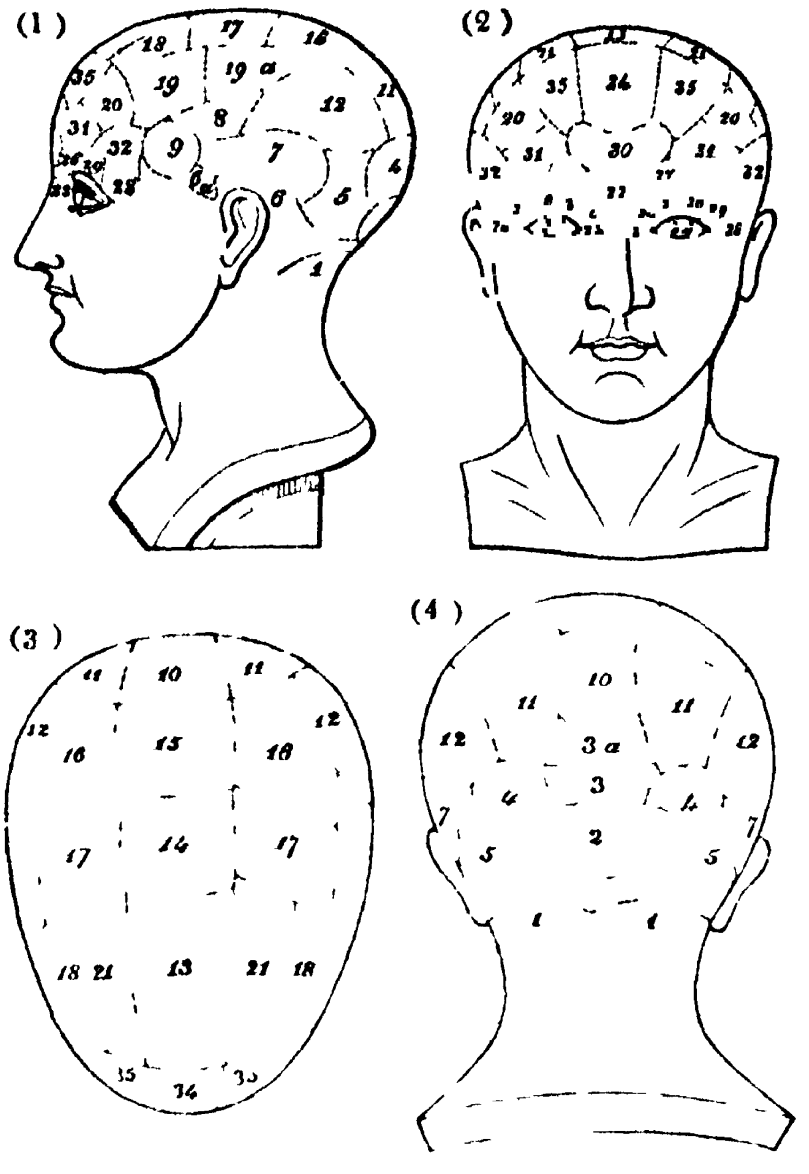
PHRENOLOGY (Gr φρην *the mind* and λογος *discourse*), ought, according to its etymology, to signify mental philosophy The word has however been appropriated by cranologists, on account of the light which their observations of the convolutions of the brain and corresponding elevations on the skull are supposed to throw on the nature and province of our different faculties Those who wish to judge how far this pretension is justifiable may consult the works of Dr Spurzheim and of Mr Combe on the subject These gentlemen divide our faculties into three classes the intellectual or perceptive the sentiments or emotions and the animal propensities To the first of these is assigned the anterior portion of the head, the second occupies the middle and upper while the posterior region and the cerebellum are allowed to the third and most inglorious division That this distribution in its general outline, is borne out by facts observation is sufficient to convince us but whether the subdivision of those regions into minute special organs corresponding to distinct faculties is equally well supported and whether the mental analysis implied in it can be considered sound and accurate, are questions which our limits forbid us to discuss We subjoin however for the reader's convenience in consultation, the following outline of the different faculties with their uses and abuses which we have borrowed from the Introduction to Mr G Combe's *Notes on the United States of America during a Phrenological Visit in* 1838 9 40 is pro[illegible]ng the most recent as well as the most [illegible] of the present state of this much canvassed science The subjoined figure will be of use in illustrating the observations




This figure shows the three great phrenological divisions of the brain The line B runs through the centre of ossification of the parietal bone (the organ of Cautiousness No 12), and terminates in the centre of ossification of the frontal bone situated at the point where it touches the line A A (the organ of Causality, No 35) The portion above the line B is named the coronal region, and serves to manifest chiefly the moral sentiments The line A corresponds to the posterior lateral edge of the superorbitar plate, on which the anterior lobe of the brain rests The space before the line A A indicates the size of the anterior lobe, the region devoted to the manifestation of the intellectual faculties If the space before the lower A be long, the organs of the observing faculties are large, and if the space forward from the point where the line B meets the line A A be long, the reflecting organs are large The space below B and behind A A manifests the propensities common to man with the lower animals We may remark that in the above figure the coronal region would be said to be large, indicating powerful moral sentiments, the intellectual region about an average, and that of the so called animal propensities moderate

# PHRENOLOGY.

**The faculties generally recognized by phrenologists are the following ***




Order I FEELINGS

Genus I PROPENSITIES — *Common to Man with the Lower Animals*

† { THE LOVE OF LIFE
APPETITE FOR FOOD — *Uses* Nutrition — *Abuses* Gluttony and drunkenness

1 AMATIVENESS — Produces sexual love

2 PHILOPROGENITIVENESS — *Uses* Affection for young and tender beings — *Abuses* Pampering and spoiling children

3 CONCENTRATIVENESS — *Uses* It renders permanent emotions and ideas in the mind — *Abuses* Morbid dwelling on the internal emotions and ideas, to the neglect of external impressions

3 *a* INHABITIVENESS — *Uses* It produces the desire of permanence in place — *Abuses* Aversion to move abroad

4 ADHESIVENESS — *Uses* Attachment friendship and society result from it — *Abuses* Clanship for improper objects, attachment to worthless individuals

5 COMBATIVENESS — *Uses* Courage to meet danger and overcome difficulties tendency to oppose and attack whatever requires opposition and to resist unjust encroachments — *Abuses* Love of contention, and tendency to provoke and assault This feeling obviously adapts man to a world in which danger and difficulty abound

6 DESTRUCTIVENESS — *Uses* Desire to destroy noxious objects, and to kill for food It is very discernible in carnivorous animals — *Abuses* Cruelty murder desire to torment, tendency to passion rage and harshness and severity in speech and writing This feeling places man in harmony with death and destruction, which are woven into the system of sublunary creation

7 SECRETIVENESS — *Uses* Tendency to restrain within the mind the various emotions and ideas that involuntarily present themselves until the judgment has approved of giving them utterance, it is simply the propensity to conceal, and is an ingredient in prudence — *Abuses* Cunning deceit, duplicity and lying

8 ACQUISITIVENESS — *Uses* Desire to possess, and tendency to accumulate articles of utility to provide against want — *Abuses* Inordinate desire of property, selfishness, avarice, theft

9 CONSTRUCTIVENESS — *Uses* Desire to build and construct works of art — *Abuses* Construction of engines to injure or destroy, and fabrication of objects to deceive mankind

Genus II SENTIMENTS

I *Sentiments common to Man with the Lower Animals.*

10 SELF-ESTEEM — *Uses* Self-respect self-interest, [illegible] personal dignity — *Abuses* Pride, [illegible] conceit, excessive selfishness, love of dominion

11 LOVE OF APPROBATION — *Uses* Desire of the esteem of others, love of praise, desire of fame or glory — *Abuses* Vanity, ambition, thirst for praise independently of praiseworthiness

12 CAUTIOUSNESS — *Uses* It gives origin to the sentiment of fear, the desire to shun danger, and circumspection, and it is an ingredient in prudence — *Abuses* Excessive timidity, poltroonery, unfounded apprehensions, [illegible]

13 BENEVOLENCE — *Uses* Desire for the happiness of others, universal charity, mildness of disposition, and a lively sympathy with the enjoyment of all animated beings — *Abuses* Promiscuous injurious indulgence of the appetites and fancies of others, prodigality, facility of temper

II *Sentiments proper to Man*

14 VENERATION — *Uses* Tendency to venerate or respect whatever is great and good, gives origin to religious adoration — *Abuses* Senseless respect for unworthy objects consecrated by time or situation, love of antiquated customs abject subserviency to persons in authority superstitious awe

15 FIRMNESS — *Uses* Determination, perseverance, steadiness of purpose — *Abuses* Stubbornness, infatuation, tenacity in evil

16 CONSCIENTIOUSNESS — *Uses* It gives origin to the sentiment of justice, or respect for the rights of others, openness to conviction, the love of truth — *Abuses* Scrupulous adherence to noxious principles when ignorantly embraced, excessive refinement in the views of duty and obligation, excess in remorse or self-condemnation

17 HOPE — *Uses* Tendency to expect future good, it cherishes faith — *Abuses* Credulity with respect to the attainment of what is desired, absurd expectations of felicity not founded on reason

18 WONDER — *Uses* The desire of novelty, admiration of the new the unexpected, the grand, the wonderful and extraordinary — *Abuses* Love of the marvellous and occult, senseless astonishment, belief in prodigies, magic, ghosts, and other supernatural absurdities

19 IDEALITY — *Uses* Love of the beautiful and splendid desire of excellence poetic feeling — *Abuses* Extravagance and absurd enthusiasm, preference of the showy and glaring to the solid and useful, a tendency to dwell in the regions of fancy and to neglect the duties of life

19 *a* The organ of Sublimity, but not sufficiently ascertained

20 WIT — Gives the feeling of the ludicrous, and disposes to mirth

21 IMITATION — Copies the manners, gestures and actions of others, and appearances in nature generally

Order II INTELLECTUAL FACULTIES

Genus I EXTERNAL SENSES

FEELING OR TOUCH
TASTE
SMELL
HEARING
SIGHT

*Uses* To bring man into communication with external objects, and to enable him to enjoy them — *Abuses* Excessive indulgence in the pleasures arising from the [illegible] to the extent of impairing bodily health and debilitating or [illegible] the mind

Genus II KNOWING FACULTIES WHICH PERCEIVE THE EXISTENCE AND QUALITIES OF EXTERNAL OBJECTS

22 INDIVIDUALITY — Takes cognizance of existence and simple facts

23 FORM — Renders man observant of form

24 SIZE — Gives the idea of space, and enables him to appreciate dimension and distance

25 WEIGHT — Communicates the perception of momentum [illegible] gives equilibrium

26 [illegible] colours and their harmonies

Genus III KNOWING FACULTIES, WHICH PERCEIVE THE RELATIONS OF EXTERNAL OBJECTS

27 LOCALITY — Gives the idea of relative position

28 NUMBER — Gives the talent for calculation

29 ORDER — Communicates the love of physical arrangement

30 EVENTUALITY — Takes cognizance of occurrences or events

* The organs are double, each faculty having two lying in corresponding al[illegible] the hemispheres of the brain except [illegible] those organs such as [illegible] eventuality, [illegible] represented in the figures, 9, 15, & [illegible] of each, [illegible] the frontal part of the skull

† These organs are not fully ascertained by [illegible] facts indicate that they [illegible] the base of the brain The first is not marked on the bust, but the second is indicated by b a on Fig 1

31 TIME — Gives rise to the perception of duration.
32 TUNE — The sense of Melody and Harmony arises from it.
33 LANGUAGE — Gives facility in acquiring a knowledge of arbitrary signs to express thoughts, readiness in the use of them, and the power of inventing and recollecting them

Genus IV REFLECTING FACULTIES, WHICH COMPARE, JUDGE, AND DISCRIMINATE.

34 COMPARISON — Gives the power of discovering [illegible] ences of phenomena, and the relation of cause and effect.

The most accredited works in favour of phrenology are Mr Combe's writings, and the *Phrenological Journal*, which is ably conducted The most hostile inquiry into the pretensions of phrenology [illegible] appeared in 1826, in the *Edinburgh Review* [illegible] article, which was well known to have emanated from the pen of Mr (now Lord) Jeffrey, the views of the phrenologists are treated with ridicule, and their weak side subjected to one of the most vigorous attacks ever made in literary criticism

PHRYGA'NIDÆ *Case-worm flies* The family of Trichopterous insects of which the genus *Phrygania* is the type *See* TRICHOPTERANS

PHRYGIAN MARBLE *See* MARBLE

PHRY'GIANS An early sect of heretics, so called from Phrygia the country where they abounded They regarded Montanus, the founder of the Montanists (which see), as their prophet, and their distinguishing characteristic was the spirit of prophecy to which they laid claim

PHTHIRI'ASIS (Gr *φθειρ, a louse*) A disease in which the body is overrun with lice

PHTHISIS (Gr *φθινω, I consume*) Consumption, which see

PHYCOMA'TER (Gr *φυκος, sea-weed*, and *ματηρ mother*) The gelatine in which the sporules of Algaceous plants first vegetate

PHYLACTERY (Gr *φυλακτηριον, a protection or preservation*) An amulet or preservative against infection The phylacteries of the Jews were derived from the injunction contained in Exodus, xiii 9, and consisted of slips of parchment inscribed with verses of the law, enclosed in cases, and worn during prayer on the arm and between the eyes

PHY'LÆ (Gr *φυλη a tribe*) The tribes into which the whole of Attica was divided in antiquity Originally there were but four phylæ, which were frequently remodelled, but remained the same in number till soon after the expulsion of the Pisistratidæ, when Clisthenes caused their number to be increased to ten What the precise nature of the change effected on this occasion was is not known, but it is probable that the new tribes embraced a large number of citizens that had been excluded from the former The phylæ were afterwards increased to twelve, by the addition of two in honour of Antigonus and his son Demetrius The Athenian senate was composed of fifty delegates from each of these tribes

PHY'LARCH (Gr *φυλαρχος, ruler of a phyle*) An Athenian officer appointed for each phyle or tribe to superintend the [illegible] members and other common duties He [illegible] to that of the Roman tribune, but its functions never reached the same importance

PHYLLO'DIA (Gr *φυλλον, a leaf*) A term applied to the petioles of certain leafless plants which become so much developed as to assume the appearance of leaves, all the functions of which they perform

PHYLLONY'CTERANS (Gr *φυλλον*, and *νυκτερις, a bat*) The name of a primary division of the order *Cheiroptera*, including the "foliated bats," or those species which have the ears and nose complicated by grotesque and variously-figured membranous foliations, serving the purpose of antennæ, and augmenting the sense of touch in these night-flying and short sighted species The tribe is also characterized by having a single finger, the innermost, armed with a hook-shaped claw, and the molar teeth beset with sharp pointed tubercles adapted for [illegible]

PHYLLOPHAGANS *Phyllophaga* (Gr *φυλλον*, and *φαγω, I eat*) The name of a tribe of Marsupials, including the Phalangers Petaurists and Koala, also of a tribe of beetles including those which live by suction of the tender parts of vegetables as the leaves and succulent [illegible]

PHYLLOPODS *Phyllopoda* (Gr *φυλλον*, and *πους, a foot*) An order of Crustaceans, comprehending those in which the feet are of a flattened leaf-like form

PHY'LLOSTOMES, *Phyllostomata* (Gr *φυλλον*, and *στομα, a mouth*) A family of bats, including those in which the nose supports a simple leaf-shaped appendage

PHYSA (Gr. *φυσα, a bubble*) A genus of fresh-water snails; so called from the thinness and inflated appearance of the shell Several species of bubble-shell are found in England, as *Physa fontinalis*, in the Thames, *Physa alba*, in North Wales, *Physa hypnorum* common in ponds and slow streams

PHY'SALIS, or PHYSA'LIA (Gr *φυσα*) The name of a hydrostatic Acalephan, commonly called the P[illegible] s size, the brilliancy, [illegible] pain produced by its contact

PHY'SALITE In Mineralogy, a species of topaz

PHYSCO'NIA (Gr *φυσκων, a big bellied fellow*) This term is applied to various enlargements of the abdomen unconnected with dropsy or with accumulations of air, such as morbid states of the liver or of the spleen

PHY'SICS (Gr *φυσις, nature*) The science of nature In modern language, however, the term has a less general signification than its derivation implies Nature signifying the assemblage of all the bodies of the universe, the *science* of *nature* comprehends every species of knowledge which regards the external world But bodies may be studied under three different points of view, they may be examined with relation to their different properties with relation to their constituent parts, and with relation to their appearances and exterior qualities These three distinct views give rise to the three great divisions of natural science, namely, *Physics Chemistry* and *Natural History* Physics has for its object the properties of bodies, chemistry studies their elementary principles, and natural history observes their physiognomy or external appearance

PHYSIO'GNOMY (Gr *φυσις, nature* and *γνωμων, a rule or measure*) The art of interpreting the indications of the inward disposition supposed to be afforded by the outward appearance especially the features of the face (See *Lavater's Physiognomy*)

PHYSIO'LOGY (Gr *φυσις*, and *λογος a discourse*) The science of things generated or alive, but [illegible] e of vital phenomena [illegible] to the two great classes [illegible] into *animal* and *vegetable physiology* [illegible] have proposed the term for biology, but the restricted [illegible] os to the life of an individual in other [illegible] words, as biography, would be an objection to this change, even if the word physiology were less appropriate than it is or if its use in the sense above defined had not been sanctioned by philosophers of other nations

The chief object of the physiologist is to ascertain the precise mode in which each part or organ of a living being reacts when stimulated When the precise conditions and mode of the reaction of the circulating fluid upon the solids and reciprocally are understood, a true and intelligible definition of life may perhaps be given

In animal physiology, the simplest condition under which life can be contemplated is that which it presents in the torpid hybernater

During this state a dark nutrient fluid, the venous blood (see BLOOD) is propelled, by the contractions of a hollow muscle (see HEART) along the arteries to every part of the body, whence it is again returned to the heart by the veins With respect to this chief manifestation of life in the torpid animal it may be asked, What is the cause or condition of the reaction of the fibres of the hollow muscle upon the stimulating fluid? How does each tissue of the body select from the currents [illegible] [illegible] tissues secrete? There are questions which physiology has yet to resolve the electric conditions of the parts concerned have not been ascertained The blood is maintained in a fit state for the preservation of the tissues of the torpid animal by slowly parting with some noxious or useless principles, through the excretion of the kidneys, and of the different mucous and serous surfaces The reaction of the circulating fluids upon the solids supersedes the ordinary chemical reaction, by which they would be decomposed and destroyed, and thus the torpid animal is kept alive, but it is the life of the plant or of the ovum The functions of circulation, nutrition, excretion, are manifested when life is thus reduced, as in the plant, to its simplest condition, and these must, therefore, be its most essential actions In the torpid animal, the phenomena of irritability and contractility of muscular fibre are superadded, as in the action of the heart, and this is dependent on the connection of the muscular fibre with a nerve. The power of the external decomposing forces is increased by elevation of temperature, and the stimulus of heat produces in the torpid animal, in a manner not understood, a reaction of the mucous surface of the lungs this reaction influences, through the nerves the muscles of respiration, and atmospheric air is inspired and brought into contact with the thin membrane over which the pulmonary capillaries are richly spread. The result of this contact is the immediate elimination of the carbon

from the blood, which changes its dark for a florid red colour, or converts it from venous to arterial blood

The blood so changed stimulates in a different and more potent manner the parts over which it is distributed, the heart contracts more vigorously and frequently, the brain and nervous system now receiving more blood and that of different kind begin to react on the application of stimuli to which they were before insensible

First, self-consciousness, then sensation of external impressions [illegible] a stimulus to the muscular sys[illegible] duces the reaction of vibratile [illegible] and by which the animal moves its parts upon each other or its entire body upon external matter, are successively manifested, and to circulation, nutrition, excretion, and respiration, are now added the functions of sensation and voluntary motion But with this greatly increased activity of the whole organic machinery, there is a proportional increase of vital decomposition, *i e* of abstraction by the tissues of assimilating particles from the capillary blood, and of addition to the same of effete particles, and those actions demand not only increased activity in the organs which eliminate the waste and noxious particles from the blood, and expel them from the body but also a means of supplying new blood This is effected by digestion, chylification and lacteal absorption

It is the consciousness of this want that impels the newly roused hybernating animal to seek for its appropriate food the first use to which the machine is put is to supply itself with the means for its continued activity, and this completes the circle of the functions by which animal life is maintained

It is a law, that the ener[illegible] body should not be uniform at first the power is in excess and the body grows, afterwards it is unequal to the waste and the body shrinks, it is at no period perhaps, quite perfect, the machinery of renovation thus in time becomes unequal to its office and the ordinary chemical decompositions and recompositions take the place of those in which life had before essentially consisted

A given term of life characterizes each species of animal but that the species should continue it is necessary that the death of the individual be compensated for This is effected by the power which living beings possess of detaching a portion of themselves which portion contains in itself potentially all the faculties or functions of life, develops their organs progressively and according to the pattern of the parent from which it was derived and when arrived at maturity in like manner generates or separates another portion of itself, with similar powers of development and growth then decays and dies Thus the species of living beings are maintained by the function of generation through a long, but apparently not an indefinite period of time for the history of the changes of the earth's surface teaches us that the duration of the existence of species as well as of the individual is limited and that many species have become extinct So far however as observation has been able to reach the death of a species seems to have been rather a violent than a natural one We have, as yet, had no experience of the extinction of a species by a gradual abrogation of the procreative powers in the individuals of successive generations Of the introduction of new species we know of no natural cause nor can hardly form a conception of such

The science of physiology is that of the different functions of which life is the manifestation, that is to say of circulation nutrition, excretion, respiration sensation muscular contraction digestion absorption generation with other subordinate faculties, as the maintenance of equable temperature the production of vocal sounds the mental phenomena To explain these functions we must first know the instruments by which they are performed, secondly, the matters which they attract those which they reject and the nature of that which remains thirdly, by what forces these matters are transported attracted retained and rejected, and finally the nature of the stimuli appropriate to each part and the mode in which such part reacts when stimulated Physiology has thus many departments, and each department has its [illegible]

PHYSIOLOGY VEGETABLE [illegible]

PHYSOGRADES *Phys[illegible]* (Gr [illegible] and *grad[illegible]* *I proceed* [illegible]

PHYTOPHAGANS *Phytophaga* (Gr [illegible] *a plant*, and *φαγω*, *I eat*) The name of a tribe of Cetaceous Mammals, synonymous with *Herbivora* Also applied by Lamarck to a section of his order of Trachelipod Mollusks

PHYTOGRAPHY (Gr *φυτον*, *a plant*, and *γραφω*, *I describe*) [illegible] branch of science which concerns [illegible] to be observed in describing and naming plants *See* BOTANY

PHYTOLOGY (Gr *φυτον* and *λογος*, *a discourse*) A book containing an account of herbs and plants

PHYTOPHAGOUS (Gr *φυτον*, *a plant*, and *φαγω*, *I eat*) Plant-eating

PHYTOZOONS *Phytozoa* (Gr *φυτον*, *a plant*, and *ζωον*, *an animal*) This term is applied by various naturalists to different sections of the sub kingdom *Zoophyta* of Cuvier

PIA MATER A thin vascular membrane covering [illegible] brain and the spinal marrow

PIANO [illegible] *See* P &c

PIANOFORTE (It) A musical stringed instrument of the keyed species Its name, compounded of two Italian words signifying *soft* and *loud* was probably given to it to distinguish it from the Harpsichord and spinet, in which no lightness of touch could lessen the strength of the sound produced from the quills always striking the strings with equal force, whereas in the piano-forte, the strings are put in vibration by means of small hammers connected by levers with the key or finger board, which hammers quit the string the moment it is struck, a damper falling down upon it the moment the finger quits the key The invention of the piano-forte is ascribed to a German named Schroeder, who lived at the beginning of last century, but it was first introduced into England in 1766 by Zumpe, by whom it was greatly improved Within the present century this instrument has received many useful and valuable improvements from the hands both of Englishmen and foreigners, so that it may be now fairly regarded as, next to the organ, the noblest and [illegible] whole compass of musical [illegible] musicians have devoted [illegible] of pieces for this instrument, [illegible] Hummel, Czerny Hertz Kalkbrenner Cramer Moscheles, Chopin, Thalberg Liszt, &c have made the instrument itself almost their exclusive study There is an excellent article on the piano-forte in the *British and Foreign Review for* 1839

PIARISTS (Patres Scholarum Piarum) Members of a religious order founded at Rome by Casalanza, a Spanish nobleman, early in the 17th century They were bound by a special vow to devote themselves to the purpose of education They still continue to superintend a great number of schools in Hungary Poland Bohemia, &c

PIASTRE A silver coin of Spain Italy Turkey, South America, [illegible] &c, varying in value in every country *See* MONEY

PIAZZA (Ital) In Architecture a square open space surrounded by buildings Improperly used in England to denote a walk under an arcade

PIBROCH Martial music produced by the bagpipe of the Highlanders It is said to signify also the instrument itself but the former meaning, if indeed there are *any* instances of the latter to be found in any classical writer has received the sanction of the two most celebrated poets of their time, Lord Byron and Sir Walter Scott The connoisseurs, says the latter writer, in pipe-music affect to discover in a well composed pibroch, the imitative sounds of march, conflict, flight pursuit, and all the current of a heady fight' (See a note in *Beattie's Essay on Laughter and Ludicrous Composition*, chap iii for a description of the nature of the pibroch) The 17th stanza of the 2d canto of the *Lady of the Lake*, in which the effects of this martial music are so admirably depicted must be familiar to every reader

PICA In Printing a type of a moderate size, so called because it was used in printing the *Pie*, the service book of old Catholic times, which [illegible] to derive its appellation from the [illegible] of the text and rubric

PICAMAR The bitter principle of tar, whence it derives its name (*in pice amarum*)

PICARDS The name of a fanatical and immoral sect of Christians who sprang up in Bohemia in the 15th century They derived their name [illegible] Picard native of Flanders who styled himself the New Adam, and attempted to revive the absurdities of the Adamites of the 2d century in imitating the state of primeval innocence They were completely annihilated by Ziska, the great general of the Hussites who, struck with their abominable practices, had marched against them

PICHURIM BEAN [illegible] brought from Brazil, and used me[illegible] It has a musky odour, and is supposed to be the produce of a species of *Laurus*

PICI (Lat picus *a woodpecker*) The name given by Linnaus to a group of birds corresponding to the *Scansores* and part of the *Picariæ* of Cuvier

PICIDÆ *Woodpeckers* The family of birds of which the genus *Picus* is the type

PICKET In Fortification, a stake used in laying out ground, to mark the bounds and angles Pickets are of various lengths, according to the purpose they are to serve One end is sharp and shod with iron, and the other sometimes carries a small flag, for the purpose of rendering it visible at a distance

PICROMEL (Gr *πικρος*, *bitter*, and *μελι*, *honey*)

A peculiar substance, of a sweetish bitter taste, which exists in bile

PICROTOXIA (Gr *πικρος*, *bitter*, and *τοξικον*, *a poison*) A poisonous bitter principle which exists in the *Cocculus indicus*

PICTS WALL One of the barriers erected by the [illegible] and the Germ malerisch) In the strict sense of the word all objects which afford fit combinations of form and colour for the imitation of the painter In literary composition, a style which represents objects and events in such a manner as to call up vivid impressions as it were of visible realities is termed picturesque

A great diversity of opinion prevails as to the precise nature of that quality which peculiarly recommends objects for pictorial representation, but it would be impossible in this place to lay down any general rules on the subject that would be of any use for the guidance of the student Meanwhile however, it may be necessary to notice the fact, that the term picturesque is used in a totally different sense from that above adverted to, being applied by many writers to such natural objects as [illegible] appearance in general tends to [illegible] with have a *sublime* or *beautiful* character [illegible] that of which the surface is broken and the motion abrupt and irregular, and, among trees, "not the smooth young beech, nor the fresh and tender ash, but the rugged oak or knotty wich elm, is picturesque Nor is it necessary they should be of great bulk, it is sufficient if they are rough and [illegible] with sudden variations of their [illegible] the ass is generally thought to be more picturesque than the horse, and among horses, it is the wild and rough forester or the worn-out cart horse, to which that title is applied In our own species objects merely picturesque are to be [illegible] gipsies and beggars who [illegible] them that character, bear a close analogy to the wild forester and the worn out cart horse, and again to old mills, hovels and other inanimate objects of that kind" Such objects, it is argued are neither beautiful nor sublime, and though far less [illegible] and alluring than those which possess [illegible] beauty or sublimity, are nevertheless endowed with qualities of their own which are not only highly suited to the painter and his art but attractive also to the rest of mankind whose minds have been at all cultivated or improved, and to such objects the [illegible] to be exclusively applied It is [illegible] for the [illegible] to admit of a satisfactory solution, though it must be conceded that great caution is necessary before joining a third and distinct character to the two graces which it is universally admitted embellish natural forms — the sublime and beautiful But on this question our limits preclude us from entering and we must refer the reader to Price's elaborate work on the *Picturesque* for full information (See also the *Quart Rev* vol xv)

PIEDROIT (Fr) In Architecture a pier or square pillar partly hid within a wall It is without base or ca[illegible] a pilaster

[illegible] a term denoting that the composition where the word is appended is *full*, that is for [illegible]

PIEPOUDRE COURT In English Law a court established to decide on the spot disputes arising at fairs or markets It was styled in Lat *curia pedis pulverizati* and derived its name from the itinerant dusty footed dealers (in old Fr *pied pouldreux*), for whose convenience it was principally instituted

PIER In Architecture, the solid between the openings of a building, or that from which an arch springs An abutment pier, in a bridge is that next the shore For the mode of building the piers of a bridge, see BRIDGE

PIER In Engineering identical with mole, and is used to [illegible] erected to form harbours [illegible]

PIERCED [illegible] used when a charge is represented as perforated, so as to show the field under it

PIERIDES A name of the Muses, who were so called from Pieria a district of Thrace This was also the name of the nine daughters of Pierus, the king of Emathia, [illegible] with the nine arts tempted the [illegible] to a contest of musical skill, but, being worsted were changed by the latter into magpies In memory of their victory over the Pierids the Muses are considered by some authors, to have adopted the name

PIETISTS The name given to certain reformers of the doctrines and practice of the Lutheran church that arose in Germany towards the end of the 17th century, and caused great dissensions in that body The Pietists may be divided into two classes, of which the one proposed to effect merely an amendment of life and manners, and to promote a more evangelical spirit and conception of gospel truth than was cherished by the reformed churches, which, at the period in question, had degenerated into great coldness and formality Out of the discussions which this agitation excited there arose, however, a more violent and fanatical sect, who accompanied the assaults they made on the doctrine and discipline of [illegible] by various mystical extravagances [illegible] Dippelius and Petersen were their [illegible] The same school of theologians gave birth to the celebrated enthusiast Jacob Behmen (See *Mosheim*, vol v p 312 trans 1790) The term *Pietist* is at present applied in Germany much in the same sense of disparagement as the word Methodist is vulgarly used among ourselves, to those persons who make a display of strong religious feelings

PIEZOMETER (Gr [illegible] *measure*) [illegible] of liquids

PIGMENT (Lat pigmentum) A term applied by anatomists to the mucous secretion which covers the iris of the eye, and gives it its various colours, and to the dark matter which covers the anterior surface of the choroid membrane, and the interior surface of the ciliary processes

PIGMENT In Painting, a general term denoting any colour used by artists

PIGMY or PYGMY (Gr *πυγμαιος*, sc *ανηρ*, from *πυγμη a cubit, a diminutive man*) By ancient authors on natural history this name was applied to a fabulous race of dwarfish and deformed human beings, it is now restricted to a species of ape the *Simia troglodytes* of Blumenbach or the Chimpanzee (See *Tyson's Anatomy of a Pygme*, with an Essay concerning the Pygmies of the Ancients fol 1699) Ancient fable (as ancient as Homer, *Il* b 3) described a nation of pygmies dwelling somewhere near the shores of the ocean, and maintaining perpetual wars with the cranes, of which Athenæus gives the mythological origin Ctesias the Greek historian, as quoted by Photius represented a nation of them as inhabiting India and attending its king on his military expeditions Other ancients believed them to inhabit the Indian islands and Aristotle places them in Ethiopia, Pliny in Transgangetic India Some modern lovers of the marvellous have constructed these stories from legends of pigmy nations inhabiting the northernmost part of the earth These numerous fables appear to originate partly, as Strabo long ago observed in the [illegible] growth of particular races under the [illegible] of severe climate or great privations thus the Esquimaux or Laplanders furnished the ancient Northmen with their legendary Dwergar or nations of malicious dwarfs Some of the low caste races which inhabit the forests of interior Hindostan are feeble and puny enough to have given origin to the account of Ctesias, while the pygmies of the Malay Archipelago and the interior of Africa were probably up[illegible] (See the *Encyc Metropolitana*)

PIGNUT The bulbous root of the *Bunium bulbocastanum*, so called because pigs are fond of and dig for them

PIKE In Ichthyology [illegible] English term for a fish belonging to the order [illegible] section *Abdominales* family *Lucidae*, and genus *Esox* See MALACOPTERYGIANS

PIKE In Military affairs an offensive weapon used in antiquity and modern times down to the invention of the bayonet, by which it has been universally superseded, consisting of a shaft of wood of 12 or 14 [illegible] mounted with a flat pointed steel, [illegible] spear It was chiefly used by the infantry

PILASTER (Ital pilastro) In Architecture, a square pillar engaged in a wall usually projecting not more than one fifth or one sixth of its width Pilasters are subject to the same rules of proportion as columns

PILCHARD In Ichthyology, the common name for a fish closely resembling the common herring, but smaller, and at the same thicker and rounder They are found chiefly on the coasts of Devon and Cornwall, particularly the latter where they are taken in great numbers from July to September It is a saying of the Cornwall fishermen that the pilchard is the least fish in size, but greatest in number and for gain, taken from the sea For some curious details on the pilchard fishery see the *Com Dict*

PILE In Heraldry [illegible] which is represented of a wedge-shape [illegible] from the chief downwards towards the point, said to represent the piles on which bridges and other erections are founded

PILE In Artillery a heap of shot or shells, piled up by horizontal courses [illegible] The form of the pile [illegible] by [illegible] which may be a triangle a square, or a rectangle In a triangular pile the base is an equilateral triangle, and there is one shot at the vertex The number in the successive horizontal courses, reckoned from the top downwards, are represented by the triangular numbers 1, 3, 6, 10 [illegible] $\frac{1}{2}n(n+1)$, the sum of which is $\frac{1}{6}n(n+1)(n+2)$; which, therefore, is the number of shot in a pile of $n$ courses. *See* FIGURATE NUMBERS

If the base is a square, the number in the successive courses is represented by the series of squares 1 4 9 16, &c , and the number in the pile of $n$ courses is $\frac{1}{6} n (n + 1) (2 n + 1)$

If the base is a rectangle, $n$ the number of shot in the shortest side (or the number of courses), and $n + d$ the number in the longest side, then the number in the pile continued until there is a single row of $d + 1$ shot at the top is $\frac{1}{6} n (n + 1) (2 n + 1 + 3 d)$

PILE DRIVER An engine for driving down piles It consists of a large ram or block of iron, which slides between two guide posts Being drawn up to the top, and then let fall from a considerable height, it comes down on the head of the pile with a violent blow It may be worked by men or horses, or a steam engine

PILES In Building, pile timbers driven into the ground or bed of a river for supporting the foundations of an edifice, or the piers of a bridge They are round or square, and formed of any wood which does not rot under water oak, elm, and chiefly fir, are employed The end of the pile which penetrates the ground is pointed and shod with iron, and the top is bound with a [illegible] prevent the piles from being [illegible] the ram by which they are driven down

PILES A disease originating in the morbid dilatation of the veins of the lower part of the rectum and upon the verge of the anus, and frequently caused by costiveness and irregularity of alvine evacuation, the contents of the rectum pressing upon the veins, and preventing the return of their blood so that they become turgid and varicose, often forming bleeding or ulcerated enlargements and tumours Mild aperients, especially sulphur and castor oil, are necessary in the relief of the early stage of piles when there is much inflammation, cold and astringent lotions may be used and the pain is often relieved by fomentations with decoction of poppies When the tumours are large and flaccid an ointment of powdered galls, with a little opium and acetate of lead, often affords relief, and, in old relaxed piles the internal use and local application of copaiba balsam and even *Ward's paste* which contains black pepper, do good In many cases of protrusions of the tumours, they require removal by [illegible] nife

PILGRIMAGE A journey undertaken for devotional purposes to some spot hallowed by religious associations The custom of making these pilgrimages has long been recommended and enjoined by the Roman church and they are frequently imposed by way of penance, the remission of sins, and various spiritual advantages being promised as the reward of the faithful and pious pilgrim There exist traces in the history of the early church of such journeys being occasionally undertaken from the natural motives, we may suppose of curiosity or of a deeper interest in process of time, the custom of celebrating festivals in honour of martyrs at the place of their sepulture drew larger numbers together from a distance, who doubtless soon began to look with some complacency upon their own merits in doing honour to the saints at the expense of fatigue or danger to themselves But the systematic establishment of pilgrimage as a meritorious work seems to be of much later date That which was undertaken to the tomb of St Martin of Tours is among the earliest canonically enjoined Such places of devotion became gradually very numerous of which, however, Jerusalem was held naturally in the highest estimation The difficulties which presented themselves to the pilgrims who attempted to accomplish this journey, when Palestine had fallen into the hands of the Saracens, were the proximate cause of the excitement which armed Europe to the rescue of the Holy Land The cupidity of the persons in whose custody these shrines were, and the immorality which ensued from the desultory habits which the pilgrims acquired, called forth the earliest animadversion of the church at the council of Chalons in the 9th century but the evil seems to have continued steadily on the increase until at the time of the Reformation, we find what was originally a harmless, and even a pious practice, degenerated into one of the most crying abuses of the ecclesiastical system The earliest pilgrimage on record is perhaps that of Helena, the wife of Constantine, to the Holy Land. (See *Schroeck's Kirchen Geschichte*, part 5 8 19 23 25 )

But pilgrimages are not confined to Christian nations According to a command in the *Koran* every good Mussulman [illegible] and there are many other places in Persia endowed with sufficient sanctity to attract multitudes of pilgrims The Hindoos have also their pilgrimages the most celebrated of which is to the city of Juggernaut where stands the temple erected in honour of the deity of the same name, a full account of which will be found in the *Geo Dict* art "Juggernaut" Among existing [illegible] the most celebrated is that of Mariannell in Austria.

PILEUM The orbicular hemispherical shield or apothecium of a lichen, the outside of which changes to powder, as in *Calycium*.

PILLAR In Architecture *See* COLUMN

PILLORY (Fr pilori, [illegible] *a pillar* ) A wooden engine on which offenders were formerly exposed to public view [illegible] insult It was a common punishment in England, and, by the "statute of the pillory," 51 Hen 3 c 6 , appointed for forestallers, users of deceitful weights, perjury, forgery, &c By 56 G 3 c 138 it was abolished in all cases except perjury , and as it was discretionary in that instance it had been long wholly disused It was finally abolished in 1837 by the statute 1 Vict c 23 The French punishment of the same description is now termed the "carcan," from the iron collar by which the neck of the criminal is fixed to a post , anciently, "pilori " It is not now specially [illegible] particular crimes but in heavy cases [illegible] imprisonment or forced labour

PILOSE (Lat pilus, *a hair* ) In Zoology, when an animal or part is covered with hair

PILOT A person qualified and appointed by proper authority to conduct ships in and out of particular harbours or along certain coasts, at a certain fixed rate, depending on the draught of water The pilot has the charge of the vessel while in *pilot water* and the captain or master neglects or opposes the pilot's advice on his own responsibility (See *M Culloch's Commercial Dict* )

PIMELITE (Gr πιμελη *fatness* ) A green hydrated silico aluminous mineral, containing oxide of nickel, of a *greasy* feel

PIMENTO The berry of the *Myrtus pimenta*, allspice or Jamaica pepper *See* PIPERACEÆ

PIN A small bit of wire, usually brass, with a point at one end and a spherical head at the other No fewer than fourteen distinct operations are necessary in making this little article for an account of which see *Ure's Dict of Arts &c* [illegible] in *Babbage's* [illegible] *of Nations* p 3 where the pin is cited as an admirable instance of the good effects of a division of labour

PIN A term of Chinese diplomacy, signifying a petition or address from foreigners to the emperor of China or any of his viceroys or deputies

PINACOTHECA (Gr πιναξ *a picture*, and τιθημι, *I place* ) In Ancient Architecture, the apartment in a house for the reception of paintings

PINCHBECK An alloy of copper of zinc , a species of brass much resembling what is now termed *Mosaic gold* It was brought into notice by a person of the above name

PINEAL GLAND A small heart-shaped protuberance of the brain hanging by two peduncles from the beds of the optic nerves immediately over the *corpora quadrigemina* Some fanciful physiologists have asserted that it is the seat of the soul

PINE *See* ABIES

PINION In Mechanics a small wheel which plays in the teeth of a larger, or sometimes only an arbor or spindle having notches or leaves which are caught successively by the teeth of the wheel, and the motion thereby communicated

PINITE (From the mine *Pini*, at Schneeberg in Saxony ) A soft crystallized mineral, composed of alumine silex and oxide of iron

PINK, DUTCH In Painting, a colour of a reddish hue

PINNA (Lat pinna *a fin* ) The name of a genus of Ostracean Acephalous Mollusks commonly called 'wing-shells" remarkable for the size of the byssus, by which they adhere to rocks, and which the natives of Sicily manufacture into gloves socks, and other articles of sale

PINNACE A small light vessel with sails and oars it is at present generally understood as one of the boats belonging to a ship of war

PINNACLE (Lat pinna ) In Architecture, a small square [illegible] not necessarily, [illegible] terminating upward pyramidally and crocketted and foliage at the angles [illegible] part

PINNATIFIDS A term applied by Linnæus to the feet of those birds which have the toes bordered by a scalloped membrane, as the coots

PINNATIPEDS, *Pinnatipedia* (Lat pinna *a fin*, and pes, *a foot* ) A term applied by Temminck to an order of birds comprehending those which have the digits bordered by membranes

PINNIPEDS, *Pinnipedes* The name of a section of crabs (Brachyurous Decapods) in which are comprehended those [illegible] feet, if not [illegible] for swimming

PINNOTHERES (Gr πινοτηρης, from Lat pinna, and Gr. θηρευω, *I pursue* ) A small parasitic species of crab, which takes up its abode in the shell of the *pinna* and other bivalves

PINT A measure of capacity, being the eighth part of a gallon *See* MEASURES

**PIO'NEERS**, in the Military Art, are certain soldiers, in all infantry and cavalry regiments, whose business it is to clear the road before an army, to sink mines, and throw up works and fortifications Pioneers are provided on a march with hatchets, axes, spades, pickaxes, and all other necessary implements

**PIPE** A wine measure usually containing 105 (very nearly) imperial, or 126 wine gallons Two pipes or 21 imperial gallons, make a tun But in practice the size of the pipe varies according to the description of wine it contains Thus, a pipe of port contains 138 wine gallons of sherry 144 of Lisbon and Bucellas 11 of Madeira 110 and of Vidonia 120 The pipe of port is to be observed, is seldom accurately 138 gallons and it is usual to charge what the vessel actually contains

**PIPE CLAY** A species of clay abounding in Devonshire and other parts of England, employed in the manufacture of various sorts of earthenware

**PIPERA'CEÆ** (Piper, one of the genera) A natural order [illegible] the hotter [illegible] Richard they are monocotyledonous, but that they are really dicotyledonous is proved by their medullary rays articulate leaves, and two-lobed embryo They are closely related to *Polygoneæ Saurureæ* and *Urticaceæ*, from all of which they are distinguished by obvious characters Common pepper represents the ordinary property of this order The cubebs of the shops is the produce of the *Piper cubeba* and *canenum*, betel, an acrid stimulating substance, much used for chewing by the Malays, is obtained from *Piper betel* and *siriboa* Black pepper is the unprepared fruit of *Piper nigrum*, and white pepper is the same deprived of its pulpy covering Long pepper consists of the half-ripe flower-heads of *Piper longum* and *chaba*

**PI'PERIN** A white crystalline substance extracted from black pepper It is tasteless and free from pungency, the acrimony of pepper residing in a peculiar fixed oil

**PI'RACY** (Gr πειρατης, from πειρα, *an attempt*) In Law, an offence which consists in the commission of those acts of robbery and depredation upon the high seas which, if committed on land, would have amounted to felony there By the statutes 11 & 12 W 3 c 7 and 6 G 1 c 19, piracies committed on the sea or in haven &c, where the admiral has jurisdiction, may be tried at sea or on land, in his majesty's islands, &c, by commissioners under the great seal appointed for that purpose, who may commit the offenders, and call a court of admiralty for the purpose of the trial By the same statutes various acts are enumerated as amounting to piracy, and aiders and abettors of pirates are declared accessaries, punishable as principals By subsequent enactments acts of trading with pirates, and acts of hostility committed by natural born subjects against his majesty's subjects under colour of a foreign commission, are declared piracy In the realm of England, felonies robberies and murders committed by pirates, are triable under 28 H 8 c 15 by the king's commission of oyer and terminer, as if the offences had been committed on land (See as to the pirates of antiquity, the *Mem de l'Ac des Inscr* vol xii)

*Piracy* is also frequently used to signify any infringement on the law of copyright It is extremely difficult to lay down any general principle on which to decide as to what is and what is not piracy Generally it is held, that one writer may borrow the ideas or theories of another, but that he must dress them up and explain them in a different way, and in his own language This, however, is often done so as merely to evade the law, and it were well, in order to make greater attention be paid to originality, were the law as to piracy less lax than it is at present (See as to the existing law of piracy, the art Copyright Books in *Com Dig*)

**PISALPHALTUM** Mineral pitch, an indurated bitumen

**PI'SCES** (Lat pisces, *a fish*) The name of the fourth great subdivision of Vertebrate animals, or the class of fishes characterized by a branchial respiration, a bilocular heart, and a covering of scales The nasal cavities do not communicate with the mouth, but have only external apertures *See* ICHTHYOLOGY

**Pi'sces** (The Fishes) One of the twelve zodiacal constellations, the twelfth in order from Aries *See* CONSTELLATIONS, ZODIAC

**PISCIS AUSTRALIS** (The Southern Fish) One of Ptolemy's 48 constellations of the southern hemisphere The brilliant star Fomalhaut, of the first magnitude belongs to this constellation

**PISCIS VOLANS** A small modern constellation of the southern hemisphere, formed by Bayer It is situated on the antarctic circle

**PISE** (Fr) In Architecture, a species of wall constructed of stiff earth or clay carried up in moulds, and rammed down as the work is carried up

**PISIDIUM** (Lat pisum, *a pea*) A genus of fresh water Gastropods, so named on account of the resemblance of the shell to a small pea. Many of the species are British, as *Pisidium obtusale*, which may be found in the New River, *P pusillum*, *P nitidum*, *P pulchellum*, &c

**PI'SOLITE** (Gr πισος, and λιθος, *peastone*) A concretional carbonate of lime The concretions generally contain a coarse trial grain of sand

**PISTACHIO PISTACHIO NUTS** (Ger pistachen; Du pistasjes, Fr pistaches, It pistacchi, fastucchi, Sp alfocigos, Lat pistaciæ) The fruit of the *Pistachia vera* a kind of turpentine tree It grows naturally in Arabia, Persia and Syria, also in Sicily, whence the nuts are annually brought to [illegible] They are oblong and pointed, about the size and [illegible] containing a kernel of a pale green colour covered with a yellowish or reddish skin They have a rich, oily and unctuous taste, resembling that of sweet almonds, their principal difference from which consists in their having a greater degree of sweetness accompanied with a light grateful flavour, and in being more oily The nuts imported from the East are superior to those raised in Europe

**PISTI'LLUM** The organ which occupies the centre of a flower within the stamens and disk (if the latter be present) It is distinguished into three parts an upper or stigma, a lower or ovarium, and a central part or style It is the female organ of the flower, and contains the ovules or young seeds within the ovary

**PISTOLE** A gold coin common in many parts of Germany, equivalent to about 8*s* 6*d* sterling

**PI'STON** In Machinery, a short cylinder of wood or metal which fits exactly the cavity of a pump or barrel, and works up and down in it alternately Two sorts of pistons are used in pumps one hollow, with a valve, used in the sucking pump and the other solid, which is employed in the forcing pump *See* PUMP

**PIT** *See* SHAFT

**PITCH** (Fr picts) In Music, the degree of acuteness or gravity of a note

**PITCH** (Germ pech) The same as ASPHALT and BITUMEN which see

**PITCH** The residuum which remains after boiling tar in an open iron pot or in a still till the volatile matter be driven off It is most extensively used in shipbuilding

**PITCHBLENDE** A mineral found in Saxony, it is a compound of the oxides of uranium and iron

**PITCH OF A ROOF** In Architecture, the inclination of the sloping sides to the horizon It is usually described by the ratio of its height to its space

**PITCHSTONE** A siliceous mineral, the fracture of which resembles that of pitch or resin It is of various colours

**PITCOAL** *See* COAL and GEOLOGY

**PITH** A cylindrical or angular column of cellular tissue arising at the neck of the stem of a Dicotyledonous plant and terminating at the leaf-buds with all of which, whether they are lateral or terminal, it is in direct communication It forms the centre of a stem, and is covered over by the wood Its use is to act as a reservoir of nutritious matter for the young leaves when first deve-

**PITHECUS** (Gr πιθηκος *an ape*) The subgeneric name of the orang utan, *Pithecus satyrus*, Geoff.

**PITOT'S TUBE** In Hydraulics an apparatus, so called from the name of its inventor for measuring the velocity of a stream, or of a body moved through stagnant water A tube open at both ends is bent into two unequal branches at right angles to each other It is then placed in the stream, the longer branch in a vertical position, and the shorter turned round so that the water enters directly into the orifice, which should be somewhat contracted When thus placed, the water enters the tube with the velocity of the stream, and the pressure causes it to rise in the upright branch of the tube to the height from which it must have fallen in order to acquire this velocity The height to which the water rises in the tube is measured by placing a graduated rod in the tube of such specific gravity as to float on the water, or if the tube is of glass, the height may be measured externally The corresponding velocity is obtained from the formula $v = \sqrt{(2gh)}$, where $v$ denotes the velocity, $g$ the acceleration of gravity, and $h$ the height to which the water rises expressed in units of the same [illegible] The result is tolerably accurate, except when the velocity is small, but the effect is somewhat diminished by the friction on the tube

**PITTACAL** (Gr πιττα, *pitch*, and καλλος *ornament*) A fine blue substance, obtained by the action of a solution of baryta upon the heavy oil of tar

**PITUITARY GLAND** A gland situated within the cranium, between a fold of the *dura mater*, in the *sella turcica* of the sphenoid bone

**PITUITARY MEMBRANE** The mucous membrane of the nose

**PITYRI'ASIS** (Gr πιτυρον, *bran*) A cutaneous disease consisting of irregular scaly patches, unattended by

inflammation When it affects infants, it is called *dandriff* A similar exfoliation of the cuticle in reddish patches is not uncommon in adults Soap and water, and mild cooling lotions or very weak nitro-muriatic lotion, are the best applications

PIU (Ital) In Music, a word frequently prefixed to another to increase the strength of its meaning, as *più allegro* a little quicker

PIVOT (Fr) In Military language, that officer or soldier upon whom the different wheelings are made in the various evolutions of the drill, &c

PIVOT In Mechanics, the extremity of the axle about which a body revolves

PLACA'RD (Said to be from the Greek πλαξ, *a tablet*) A writing affixed to a wall, post, &c in a public place, is commonly so called, and as this was in ancient times the common mode of publishing proclamations and edicts, and also of giving notoriety to libels and seditious advertisements, the word is not uncommonly used in early modern writers in both these senses

PLACE'NTA (Gr πλακους, *a cake*) The afterbirth In the human subject it is a single subcircular, flattened, and lobulated organ, composed of the capillary extremities of the fœtal hypogastric arteries and umbilical vein, and of a fine cellular structure, which receives the maternal blood from the tortuous uterine or decidual arteries

The placenta forms a single lobe in the New World monkeys, the bats, the Insectivora and the Rodentia It surrounds the fœtus like a broad hoop in the Carnivora It is bilobed in the Old World monkeys and subdivided into many separate lobes, called cotyledons, in the true Ruminantia The placenta is replaced by a diffused vascular villosity of the chorion in the *Camellidæ*, the ordinary Pachyderms and the Cetacea The placenta is absent and the chorion ceases to be vascular in the Marsupialia

PLACE'NTA In Botany, a copious development of cellular tissue, formed at some point of the inside of a carpel, on which the ovules or young seeds arise

PLACENTALIA The name of that primary division of the class Mammalia which includes the orders that have either a placenta or a vascular chorion by which the fœtus is attached to the parietes of the uterus

PLA'CITA (Lat), in the Middle Ages, were public courts or assemblies, in which the sovereign presided [illegible] the affairs of the state [illegible] Placita," because "generalitas universorum majorum tam clericorum quam laicorum ibidem convenebat." The same custom appears to have existed in [illegible] According to the *Black* [illegible] let 13, this term was also applied to penalties or fines

PLA'GIAL MELODIES (Gr πλαγιος, *oblique*) In Music such as have their principal notes lying between the fifth of the key and its octave or twelfth

PLA'GIARISM (From the Latin legal term plagium, which signified the offence of stealing a slave, or kidnapping a free person into slavery) A plagiary, in the modern sense of the word, is one who borrows without acknowledgment, in literary composition, the thoughts or words of another, and the theft itself is styled plagiarism

PLA'GIOSTOMES, *Plagiostoma* (Gr πλαγιος, *transverse*, and στομα, *a mouth*) A tribe of Cartilaginous fishes comprehending all those which have the mouth situated transversely beneath the snout Also the name of a genus of Univalve Mollusks

PLAGUE "A typhus fever eminently contagious, [illegible] lity at an uncertain pe- [illegible] buboes ensue" This is Cullen's brief but correct definition of this horrible disease The best account of the plague, and of its ravages, is to be found in Heberden's work on the *Rise and Decline of Disease* See also the article CHOLERA in this work

PLAID A [illegible] cloth much worn by the Highlanders [illegible] ng a prominent part of the national costume and in being by the variety of its patterns, the different Scottish clans

PLAIN CHANT In Music a term in ancient ecclesiastical music to signify [illegible] which was confined within the natural

PLAINS In Geography, the general term for all those parts of the dry land which cannot properly be called mountainous, and which compose by far the greater part of the earth's surface Plains have different physical [illegible] and the people [illegible] for them different names, thus we have the steppes of Asia, the deserts of Africa, the pampas of South America, and the prairies or savannahs of North America See these different terms

PLAN (Lat planus) A drawing of something on a plane

PLAN In Architecture, an horizontal section of the walls partitions staircases &c of a building, showing the distribution of the [illegible] plot

PLANA'RIA (Lat planus *flat*) The name of a genus of *Sterelmintha*, or Parenchymatous Intestinalia of Cuvier, which do not inhabit the interior of animal bodies, but closely resemble, in their organization, the parasitic species of Trematode Entozoa They lead from this order to the Suctorious Anellides, or leeches

PLANE, in Geometry, is a surface without curvature, or it is a surface such that if any two points whatever in it be joined by a straight line, the whole of the straight line will be in the surface

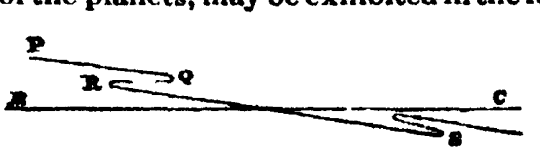
PLANE PROBLEM, in Geometry is a problem [illegible] tersections of straight lines [illegible] the conic sections or any of the higher curves Such problems as require the construction of the conic sections were called, by the ancient geometers, *solid problems*

PLANE SAILING, in Navigation, is the art of determining the ship's place, on the supposition that she is moving on a plane, or that the surface of the ocean is [illegible] be a spheroid On account of the [illegible] of the terrestrial radius this supposition may be adopted for short distances without leading to great [illegible] for the [illegible] by the solution of a right-angled [illegible] the meridian between the ship and [illegible] of the place whence she departed [illegible] of the triangle, the distance on the parallel between the place of departure and the foot of the perpendicular is the base of the triangle [illegible] and the distance sailed [illegible] The angle at the ship is called the [illegible] the complement of the [illegible] the perpendicular the [illegible] distance sailed, and the course, any two being given, the triangle can be laid down on the chart, and all the other parts of it found *See* NAVIGATION

PLA'NET (Gr ἀστηρ πλανητης, *wandering star*) The name given by the ancient Greeks to a few conspicuous stars which constantly change their situation in the heavens, and thus appear to *wander* among the constellations The discovery of satellites and periodic comets has rendered it necessary to adopt a more precise definition, in order to individualize the class of objects to which the t [illegible] accordingly modern astronomers [illegible] planet a body which, in a telescope of sufficient power, exhibits a round and well-defined disk, and which revolves about the sun in an elliptic orbit, [illegible] from a circle

The number of [illegible] the earth at present [illegible] twenty-three Five [illegible] Mar Jupiter, and Saturn— have been known from [illegible] omy; Uranus was discovered [illegible] 1781, Neptune in consequenc [illegible] on in 1846 Ceres, one of a group of which fifteen are at present known, was discovered by Piazzi, at Palermo, on the first day of the present century These last and Neptune are never visible to the naked eye, under favourable circumstances Uranus may be discerned without a telescope, and Mercury, though it appears as a large star, is seldom to be seen (in our climate at least), in consequence of its proximity to the sun

*Of the apparent Motions of the Planets* — On watching the motions of any of the conspicuous planets for a few days or weeks, their change of position among the fixed stars becomes sufficient [illegible] even without the aid of an instrument to [illegible] their relative distances Their paths deviate little from that followed by the sun [illegible] through the heavens, [illegible] irregular Sometimes they advance rapidly, then relax in their speed, come to a stop, and then move for a while [illegible] position Through the most considerable part of their orbits they [illegible] to the [illegible] said to be [illegible] their motion [illegible] stationary [illegible] and the planets make the entire circuit of the heavens These phenomena, which are called the *stations* and *retrogradations* of the planets, may be exhibited in the following manner —

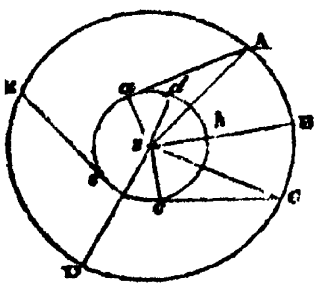



Let E C represent the ecliptic developed on a plane surface the path of a planet, found by laying down its observed positions with reference to the ecliptic from day to day, will present [illegible] P Q R S From P to Q [illegible] slower as the planet approaches to Q At Q it is stationary, from Q to R retrograde, at R again stationary; from R to S direct, and so on Such is the general character of the apparent motion, but the arcs and times of retrogradation differ greatly in respect of the different planets

Mercury and Venus exhibit phenomena peculiar to themselves inasmuch as they never appear in the opposite quarter of the heavens to the sun, but oscillate about the sun from side to side the oscillation of the former being much quicker and performed in a much smaller arc than those of the latter The distance of Venus from the sun never exceeds an arc of about 47°, and at its greatest distance the planet does not continue above the horizon more than about 3 hours after sunset Its brilliancy, however, is such, that it may frequently be seen in the morning several hours after the sun has risen Mercury never recedes farther from the sun than 28° 20′, and does not appear above the horizon more than 1h 40m after sunset, or before sunrise For these reasons, Mercury and Venus were regarded by some of the ancient astronomers as satellites of the sun and supposed to describe orbits round that luminary The other planets, Mars, Jupiter, and Saturn, being frequently seen in opposition to the sun, and at all different distances from it, were supposed to have independent motions

In order to explain and represent the apparent motions of the planets, the ancient astronomers had imagined various hypotheses, of which the most celebrated is that of epicyles and deferents, invented by the geometer Apollonius and adopted by Ptolemy after whom it was called the Ptolemaic system of the universe and implicitly believed in during many centuries According to this hypothesis each planet moves uniformly in a small circle, called the *epicycle*, the centre of which is carried along, with a uniform motion, in the circumference of another large circle, called the *deferent* which has the earth at its centre (See Epicycle) By supposing the velocity of the planet in its epicycle to be greater than that with which the centre of the epicycle is carried along the deferent, and by assigning proper relations between the lengths of the radii of the epicycles and deferent circles (their absolute lengths are immaterial) the apparent geocentric motions may be represented with all the exactness of which the ancient observations admitted Ptolemy placed the earth at the centre of the universe and nearest to it the moon Next to the moon was Mercury, then Venus then the sun, after which followed in order Mars, Jupiter and Saturn the distances of the three last being arranged according to their respective periods of revolution it being natural to suppose that those which required the longest time to complete their periods must revolve in the widest circles At the present day, and familiar as we now are with the true nature of the celestial motions this complicated system appears abundantly absurd, but it should be recollected that Ptolemy possessed no means of forming any accurate notions of the distances of the planets he was unacquainted with the alternate increase and diminution of their apparent diameters, with the phases of Venus and all the other information afforded by the telescope in short, he knew of no phenomenon which could not be reconciled to his theory, and he does not appear to have ever regarded his system of epicyles and deferents in any other light than a mere hypothesis, by means of which the celestial motions could be reduced to calculation

All the apparent irregularities of the planetary movements are got rid of at once by referring to the sun as a centre, instead of the earth A great step in theoretical astronomy was made by Copernicus, who first demonstrated that all the phenomena were explicable in the simplest manner by supposing the sun to be placed at the common centre of the planetary motions, and ascribing to the earth a double motion, namely a diurnal rotation about its axis and an annual revolution about the sun On this hypothesis, the truth of which has been established by a multitude of different considerations the stations and retrogradations of the planets and all the geocentric appearances which so much perplexed the ancient astronomers, become simple consequences of relative motion In order to illustrate this, let us consider the appearances which must result from the combined motions of the earth and an *inferior* planet, that is, a planet nearer to the sun than the earth is Let S be the sun, A B C D the orbit of the earth, and *a b c d* that of Mercury, both moving in the same direction, or in the order of the letters Suppose A to be the position of the earth, and *a* that of Mercury at its greatest eastern elongation the line A *a* will be a tangent to the orbit at *a* As the earth advances from A towards B, and the planet from *a* toward *b* the angle of elongation S A *a* will continue to diminish, till the earth arrives at a certain point B, when the planet is at *b* in the same straight line with the earth and the sun, the angles A S B and *a* S *b* described by the earth and the planet being proportional to the respective [illegible] In this situation the planet [illegible] *inferior conjunction* When the earth has passed B, the planet, advancing [illegible] motion, will begin to appear [illegible] sun, and the angle of elongation continue to increase till the planet arrives at *c*, and the earth at C, where the visual line is again a tangent to the orbit The angle of elongation has now attained its maximum value and for this planet will [illegible] altogether when the earth arrives at D and the planet at *d*, the three points D S and *d* being in the same straight line The planet is now at its *superior conjunction*, and *beyond* the sun Soon after this the planet appears on the eastern side of the sun, and the angle of elongation continues to increase till the planet comes round to *e*, and the earth arrives at E, where the line E *e* is again a tangent to the orbit The earth the planet, and the sun have now precisely the same relative situations in respect of each other as they had when the earth was at A and the planet at *a*, so that the series of changes will here recommence and proceed in the same order as before The intervals after which these phenomena occur may be easily computed from a knowledge of the periods of revolution of the earth and planet and of the proportion of the radii of their respective orbits, which is, moreover known immediately [illegible] S A *a*, for, [illegible] as radius to the cosine of S A *a* that is, the radius of the planet's orbit is equal to the the radius of earth's orbit multiplied by the cosine angle of greatest elongation

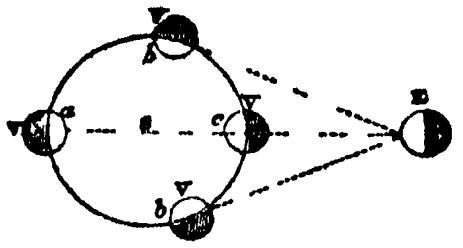



From the preceding figure it is easy to see how the phenomena of the stations and retrogradations must arise At the point *b*, where the planet is at its inferior conjunction the earth and planet are both moving in the same direction, but as the planet is moving faster, it will leave the earth behind it, and the apparent motion, as seen from the earth, will be the same as if the planet stood still and the earth moved in a contrary direction, with a velocity equal to the difference of their relative motions The apparent motion of the planet is therefore contrary to the apparent motion of the sun and consequently retrograde At the superior conjunction *d*, the planet and earth are moving in [illegible] respect of the line D *d*, the relative [illegible] the same as if the planet stood still and the earth was moving in its proper direction with a velocity equal to their united motions the apparent motion of the planet in this situation is therefore direct At the points of greatest [illegible] and the planet is moving in the direction [illegible] vision, A *a* or C *c* and the earth perpendicular ( [illegible] of the planet at [illegible] it is direct at *a* and *c*, and retrograde at *b* there must be a point between *a* and *b*, and another between *b* and *c*, where the apparent motion is neither direct nor retrograde that is, where the planet appears stationary The problem of determining the stationary points is one of pure geometry, and very easily resolved when the orbits are supposed to be circular and the motion uniform, but, in the case of elliptic orbits and unequable motion, it is considerably more complicated The stationary points of Mercury are variable from 15° to 20° of elongation from the sun, those of Venus are about 2°0 Mercury continues to retrograde about twenty two days, Venus about forty-two

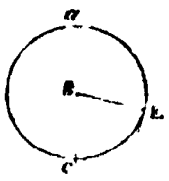
The apparent motions of the *superior* planets or those which are at a greater distance from the sun than the earth is are explained with equal facility As their orbits embrace that of the earth, they are not confined to certain limits of elongation from the sun, but appear at all distances from it even [illegible] of the heavens When the [illegible] are situated beyond the sun, in the same straight line with the sun and earth, and when the earth comes between them and the sun, they are said to be in *opposition* All the superior planets, when in opposition and for some time before and after, appear to [illegible] but the extent of the arc of [illegible] during which the motion is retrograde [illegible] very different in respect of the different planets Mars continues to [illegible] Jupiter 121, and Saturn 138

*Phases of Planets.* It is a necessary consequence of the [illegible] the earth supposing them to be [illegible] by the sun exhibit phases like the moon according to the aspect under which the illuminated half of their surfaces is seen from the earth When viewed through the telescope, this is found to be the case with Mercury and Venus, and to a certain extent also with Mars, and the appearance of the phase is in every case exactly such as is determined *a priori*, on the supposition that the planet is seen by the reflected light of the sun Let S be the sun, E the earth, and V Venus, in different positions of her orbit When the planet is at its superior conjunction *a* the whole of its illuminated surface is seen from the earth, and it consequently exhibits a round disk At the points of greatest elongation, *b* and *b*, one half only of the illuminated hemisphere is visible, and it therefore

appears half mooned at these points At *c*, the inferior

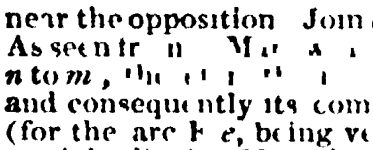


to the earth, and it is B appear gibbous (*i e* more than the half full), and between *b* and *c* it will appear in the form of a crescent, like the moon in its first or last quarter The phases of Mercury are precisely similar With respect to the superior planets, the absence of phases is a necessary consequence of their great distances from the sun in comparison of the earth's distance Let S be the sun, E the earth, and M Mars It is evident



earth is at E, or in such a position that the of the planet perpendicular to E M, and intersecting the surface in *x* the visible surface between *x* and *n*, so that to be but can never appear as a crescent These phenomena prove in the most convincing manner that the planets are opaque spherical bodies, deriving their light from the sun

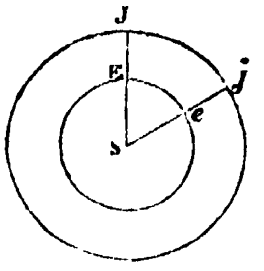
*Distances and Periodic Times of the Planets* —Practical astronomy furnishes various methods of determining the distances of the planets from the sun in terms of the earth's distance and the times in which they complete their revolutions It has already been stated that the distances of Mercury and Venus may be compared with that of the earth by observing the angle of greatest elongation In the case of a superior planet an approximation to the relative length of the *radius vector* (the line which joins the planet with the sun) may be obtained by observing the angular velocity of its apparent retrogradation about the time when it is in opposition Thus, con-



ceive E *e* to be a small portion of the earth's orbit described in a given interval of time a day for example, and M *m* to be the corresponding portion of the orbit of Mars described in the near the opposition Join *e* and *m* and produce them to S As seen from Mars appeared to have retrograded from *n* to *m*, the angle *n m* is given by observation and consequently its complement *m e* E becomes known (for the arc E *e*, being very small may be regarded as a straight line) Now in the triangle *e* S E, right-angled at E the angle at S is given, being the angle described by the radius vector of the earth in the given interval, consequently the angle S *e* E becomes known and hence also S *e m* Supposing therefore, the periodic time of Mars to be known the arc M *m* or the angle M S *m* will be given, and therefore *m* S *e* which is its difference from E S *e*, becomes known In the triangle S *e m* we have therefore given the two angles S *e m* and *e* S *m* and consequently also the third angle *e m* S, whence the triangle is given in species and the ratio of S *e* to S *m* is determined But S *m* is the distance of Mars from the sun, which therefore is determined in terms of the radius vector of the earth

The method of finding the planet's distance, which has just been described requires that the periodic time be previously known There are various methods of determining the periodic time, independently of a knowledge of the distance of the planet from the earth One is to observe the times at which the planet is in either of its nodes *i e* when it passes through the plane of the ecliptic As the orbits are all inclined to the ecliptic, and have the sun nearly at their centres, they are intersected by the plane of the ecliptic in two opposite points, which are called the *nodes* Now it is easy to ascertain by observation when a planet is in its node, for, as it then passes from the one side of the ecliptic to the other, from the north to the south side, for example, we have only to convert the observed right ascensions and declinations into longitudes and latitudes and the change from north to south latitude between two successive observations will indicate that the planet has passed its node in the interval, while a simple proportion, grounded on the quantity of its motion in latitude, will fix the precise hour and minute at which it was in the ecliptic The interval between two successive passages of the planet through the same node differs from the *sidereal* period, or the interval which the planet occupies in returning to the same point of the heavens or the same *star*, as seen from the centre of the sun, by a very small quantity, depending on a minute motion of the node and which in a general view of the subject may be disregarded

Another and more convenient method of finding the period of a superior planet consists in determining, from the observations of a few consecutive days, the exact time at which it is in opposition to the sun At this instant the longitude of the planet is 180°, and on the day of the opposition it passes the meridian twelve hours after the sun The interval between two successive returns to the opposition is the *synodic* period of the planet, this differs very considerably from the sidereal period, but the latter is easily deduced from it Let E and J be the positions of the earth and Jupiter when Jupiter is in opposition The next opposition will take place after the earth has made a complete revolution, together with a certain arc E *e*, which we shall call the corresponding to Jupiter's



the number of days between the two oppositions, or the synodic period, is known call this 365 + *t*, then the time in which the arc E *e* or *x* has been described becomes *t* days We have therefore 365 *t* 360° *x*, whence *x* or the angle J S *j*, is known But, if *p* denote the sidereal period, we shall have *x* 360° *t* *p*, and therefore $p = \frac{360\ t}{x}$ On account of the orbits not being exactly circular, these intervals are not quite equal, but by taking the average of a considerable number of observed oppositions the the mean synodic periods (a sidereal periods) are obtained with the utmost accuracy

The following table exhibits the mean sidereal periods of the planets and their mean distances from the sun in terms of the mean distance of the earth from the sun supposed equal to unity In respect of the planets between Mars and Jupiter, we give Ceres only, as a type of the group

| Planet | Mean Sidereal Period | Mean Distance from the Sun |
|---|---|---|
| | *Days* | |
| Mercury - | 87 969258 | 0 387098 |
| Venus - | 224 700787 | 0 723332 |
| The Earth - | 365 256361 | 1 000000 |
| Mars | 686 979616 | 1 523692 |
| Ceres | 1681 93100 | 2 767245 |
| Jupiter - | 4332 58821 | 5 202776 |
| Saturn - | 10759 219817 | 9 538786 |
| Uranus | 30686 820830 | 19 182390 |
| Neptune - | 60126 710000 | 30 036800 |

*Relations between the Periods and Distances* — On comparing the columns of the above table, the idea of a certain relation between the periods and distances cannot fail to suggest itself, as they both increase in a tolerably regular progression (the small planets between Mars and Jupiter being accounted as one) though the periods increase in a much more rapid proportion than the distances Jupiter for example is five times more distant from the sun than the earth is, but his period is nearly twelve times that of the earth Kepler the great founder of physical astronomy undertook to investigate the analogy, and after almost laborious comparison of the numbers (and their various powers) representing the periodic times and the mean distances of the six planets known in his age, discovered this most remarkable law — 'That the squares of the periodic times of any two planets are to each other in the same proportion as the cubes of their mean distances from the sun" (*See* KEPLER'S LAWS) Taking for example the earth and Mars, whose periods are respectively 365 256 and 686 979 days, and distances in the proportion of 1 and 1 5237, it will be found that $(365\ 256)^2 : (686\ 979)^2 :: 1 : (1\ 5237)^3$, very nearly Nor is this merely an empirical relation, deduced from observed facts, but not referable to any known cause, on the contrary, it is a necessary result of the law of gravitation and pregnant with important consequences From its being observed in the planetary system it follows that all the planets are bodies of the same kind as the earth and that they are all acted upon in the same manner by the solar (modified only by the distance) which alone determines their periods, and retains them in their orbits

A curious relation of the numbers which express the relative distances of the planets from the sun was discovered by M Bode an astronomer of Berlin Let the number 10 be assumed to represent the distance of the earth from the sun, then the distances of the other planets may be expressed in round numbers as follows —

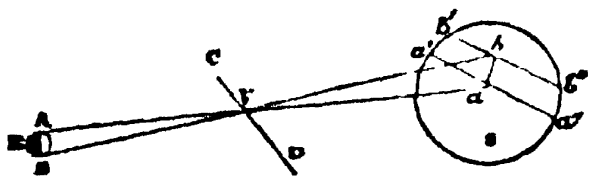
Mercury - - - - 4 = 4
Venus - - - - 7 = 4 + 3 $2^0$
The Earth - - - 10 = 4 + 3 $2^1$
Mars - - - - 16 = 4 + 3 $2^2$
The New Planets - - - 28 = 4 + 3 $2^3$

| | | | |
|---|---|---|---|
| Jupiter | - | - | $52 = 4 + 3\ 2^1$ |
| Saturn | - | - | $100 = 4 + 3\ 2^5$ |
| Uranus | - | - | $196 = 4 + 3\ 2^6$ |

It had been conjectured by Kepler that an unknown planet must exist circulating between the orbits of Mars and Jupiter, a conjecture which has been strangely verified by the discovery of fifteen planets circulating in that region nearly in equal periods, and at equal distances from the sun, and exactly in a place where a planet was wanting to fill up the above progression The progression is however purely empirical, and in the case of Neptune (discovered in 1846) it fails entirely inasmuch as it gives for the distance of that planet the number 388, whereas the true distance, expressed in terms of the same unit, is only 300

*Real Dimensions* [illegible] *Orbits* — Hitherto we have spoken of [illegible] planets from the sun only in relation to the sun's distance from the earth, but it is interesting to determine what these distances [illegible] which we are [illegible] Kepler's law of the relation between the periods and distances of the real dimensions of any one orbit have been ascertained those of all the other orbits will be found immediately when the periodic times of the planets are respectively known In fact, the dimensions of the orbits having been already stated in terms of that of the earth, it is only necessary to find the earth's distance from the sun, in order to find the respective distances of all of them Now, to find the earth's distance from the sun is the same thing as to find the sun's horizontal parallax that is the angle which the radius of the earth would subtend if seen from the sun for the determination of that angle gives the relation between the earth's distance and its semidiameter, which is known from the actual measurement of degrees of the terrestrial meridian Of the various methods which astronomers possess of determining the sun's horizontal parallax the most accurate is that which depends on observations of the transits of Venus over the sun's disk, a phenomenon, however, of very rare occurrence, so that the method can very seldom be practised

When Venus is at her inferior conjunction, and at the same time very near one of her nodes, the planet will be projected on the disk of the sun, and through the effect of her proper motion, combined with that of the earth, will be seen as a black spot to pass over, or *transit*, the solar disk, describing a chord which will be referred to different positions on the disk by observers stationed at different points on the earth's surface Let E be the earth, V Venus S the sun and C D a portion of Venus's orbit described while she is transiting the sun's disk




Suppose A and B to be the two opposite extremities of the earth's diameter which is perpendicular to the ecliptic a spectator at A would see the centre of Venus projected on the sun's disk at *a* and describing in her successive positions the chord *a' a a''*, while a spectator placed at B would, at the same instant, see her projected on the disk at *b*, and describing the chord *b' b b''* Now it is evident that if there be any means of measuring the [illegible] between the two chords *a a'* and *b b'* or the [illegible] that distance will give the sun's horizontal parallax, for the two triangles A V B and *a* V *b* being similar *a b* is to A B as *a* V to A V, or as the distance of Venus from the sun is to the distance of Venus from the earth But the relative distances of the earth and Venus from the sun are known; therefore the ratio of *a* V to A V is known, and consequently that of *a b* to A B This ratio is that of 68 to 27, or 2½ to 1 (very nearly), therefore the distance *a b* as seen from the earth is 2½ times greater than A B as seen from the sun, or, which is the same thing, equal to 5 times the sun's horizontal parallax The whole difficulty of the problem, therefore, consists in determining the distance of the two chords *a' a''* and *b' b''*, or their relative positions on the sun's disk, from which their distance can be deduced One of the best ways of accomplishing this is to note, with great accuracy, the instants at which Venus enters and emerges from the solar disk, so as to obtain the exact time occupied in the transit, for, the relative motion of Venus being accurately known the time occupied in the transit gives the length of the chord described, and the sun's [illegible] being also known, the arcs cut off by *a a'* and *b b'* are thus found, and the difference between the versed sines of those arcs is evidently the distance between the chords, or the line *a b* The problem, however, is rendered much more complicated by the earth's rotation, and other circumstances here neglected, of which it is unnecessary to take account in a general explanation

The last transit of Venus took place in 1769, and was the occasion of the first of the celebrated voyages of Captain Cook to Otaheite It was observed at Otaheite, at Wardhus in Norway, at Cajaneburg and Kola in Lapland, at Petersburg, Paris, California Hudson's Bay, &c The general result of all the observations, as discussed by Encke, gave the sun's horizontal parallax equal to 8·5776″ Hence, the sun's distance is given in terms of the earth's radius by the proportion

sin 8·5776″ : radius  radius of earth  sun's distance,

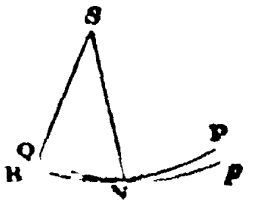
whence, on reducing the radius of a circle to seconds, we have the sun's distance $= \frac{360 \times 60 \times 60}{8\cdot5776 \times 2 \times 3\cdot14159} = 24047$ terrestrial radii Assuming the earth's semidiameter (*see* EARTH) to be 4000 miles in round numbers, the sun's distance from the earth will therefore be 24047 × 4000 = 96 188 000 or about 96 millions of English miles

This application of the transits of the inferior planets to the important purpose of determining the sun's distance from the earth was first pointed out by James Gregory, in his *Optica Promota*, published in 1663 Those of Venus recur after intervals of 113 years, but as Venus returns to her [illegible] at the same [illegible] of her orbit in about eight years, and the difference of their latitudes at two successive conjunctions amounts only to 20 or 21 which is less than the sun's diameter, it will generally happen that two transits take place within eight years, the first before the planet has passed the node, and the second after the passage of the node But three transits cannot take place within 16 years, hence, after two transits have occurred within 8 years, another cannot be expected before 105, that is 113 — 8 years, and may not happen until after 121 years The two last transits took place in 1761 and 1769, the two next will take place in 1874 and 1882, after which there will not be another till 2004 By reason of the small distance of Mercury from the sun, the difference between his horizontal parallax and that of the sun cannot be so accurately ascertained and hence the transits of that planet, though of more frequent occurrence than those of Venus, cannot be employed with such certainty in determining the sun's parallax

Having found the mean distance of the earth from the sun in terms of a known unit the mean distances of all the other planets from the sun, the ratios of which to that of the earth were given above, may be expressed in the same terms They are, in round numbers, as follows —

| | | | | |
|---|---|---|---|---|
| Mercury | - | - | - | 37,000,000 miles |
| Venus | - | - | - | 68,000,000 |
| The Earth | - | - | - | 96,000,000 |
| Mars | - | - | - | 142,000,000 |
| Ceres | - | - | - | 262,000,000 |
| Jupiter | - | - | - | 485,000,000 |
| Saturn | - | - | - | 890,000 000 |
| Uranus | - | - | - | 1 800 000 000 |
| Neptune | - | - | - | 2 800,000 000 |

*Inclination and Nodes of the Planetary Orbits* — The planes of the planetary orbits are inclined to each other under different angles and, in determining the circumstances of a planet's motion, one of the first steps to be taken is to fix the situation in space of the plane in which it moves For this purpose it is necessary to refer it to some other plane whose situation is assumed to be known The plane of the ecliptic is that to which we naturally refer the bodies of the solar system and the line of the equinoxes is taken as the origin of angular reckoning in that plane Hence, to determine the position in space of the plane of a planet's orbit, we must determine its inclination to the ecliptic and the position of the line in which it intersects the ecliptic with respect to the line of the equinoxes Let S be the sun, P N R the orbit of of a planet and *p* N Q the projection of that orbit on the plane of the ecliptic, intersecting the line of the equinoxes S Q in Q, then Q is the point from which the longitudes are reckoned, N is the node S N the line of the nodes, or line in which the plane of the orbit intersects the ecliptic, the angle Q S N the longitude of the node as seen from the sun, and P N *p* the inclination of the orbit If R be supposed to be on the south side of the ecliptic, and P on the north side, and the planet's motion to be in the direction R P, then N is the *ascending* node The place of the node is determined by observing the planet when its latitude is very nearly equal to nothing, and the equinoctial point Q being known, the *geocentric* longitude of the node (the angle formed by drawing straight lines from Q and N to the earth) is determined by observation, whence there are sufficient data for computing, by a trigonometrical process, the *heliocentric* longitude Q S N, and also the inclination P N *p* The places of the nodes are not absolutely fixed In consequence of the mutual attractions of the planets to each other, they have a slow retrograde motion in respect of the fixed stars The inclinations are also subject to a slight variation, but so small as to amount at most to a few seconds in a century Hence, in mentioning the longitudes of the nodes, and the inclin-



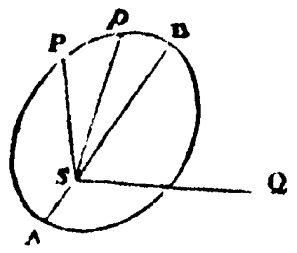
ni ns of the orbits it is necessary to state the epoch to which the elements refer In the following table the values of the inclinations and longitudes of the ascending nodes for Ceres and Neptune, the former of which is referred to Jan 1 1820, and the latter to Jan 1 1848

| Planet. | Inclination. | | | Longitude of ascending node | | |
|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ |
| Mercury | 7 | 0 | 9 1 | 45 | 57 | 30 9 |
| Venus | 3 | 23 | 28 5 | 74 | 54 | 12 9 |
| Mars | 1 | 51 | 6 2 | 48 | 0 | 3 5 |
| Ceres | 10 | 37 | 2 2 | 80 | 41 | 24 0 |
| Jupiter | 1 | 18 | 51 3 | 98 | 26 | 18 9 |
| Saturn | 2 | 29 | 3 7 | 111 | 56 | 37 4 |
| Uranus | 0 | 46 | 28 4 | 72 | 59 | 35 3 |
| Neptune | 1 | 46 | 59 0 | 130 | 5 | 11 0 |

The ancients gave the name of *zodiac* to that zone of the heavens within which the planets were observed to move, and which, consequently, had a breadth of 14°, or twice the inclination of the orbit of Mercury The inclinations of the four recently discovered planets being greater than that of Mercury, they go beyond the zodiac, and hence have been named the *extra-zodiacal* planets

*Figures of the Planetary Orbits* — When the inclination of a planet's orbit and the situation of the line of the nodes have been determined the radius vector of the planet, at any instant, may be computed in terms of the sun s distance from the earth, from the planet's latitude and longitude found by a single observation By computing therefore the values of its radius vector at a great many different points of the orbit and laying down each on paper at the proper angle of elongation round the sun, the form of the orbit which the planet describes will be ascertained A few observations of this sort will show that the radius vector varies in length and, consequently, that the orbit is eccentric This fact was known from the time of Hipparchus but the true form of the planetary orbits was not discovered till Kepler found by a laborious computation of the distances of Mars at its oppositions, from the observations of Tycho Brahe that the orbit of that planet is an ellipse He subsequently found the same thing to be true of the orbit of the earth, and of the other planets then known, and hence established the first of those important laws respecting the planetary motions which still go by his name, viz that the orbits of al the planets are ellipses of which the sun occupies one of the foci *See* KEPLER'S LAWS

The same observations which show the orbit to be an ellipse will also serve for the determination of its eccentricity, which is half the difference between its greatest and least distances The only element which then requires to be known, in order to fix the path described by the planet in space is the position of the orbit on its plane or the situation of its transverse axis with respect to the line of the equinoxes Let A P B be the projection of an orbit on the plane of the ecliptic A B its transverse axis and S Q the line of the equinoxes S being the focus occupied by the sun The point A is the *perihelion* of the orbit, and B the *aphelion*, the line A B is the line of the *apsides*, and the position of A B with respect to S Q will be known by means of one of the angles Q S A or Q S B, which are respectively the longitudes of these points In modern tables the angle Q S A, or *longitude of the perihelion* is that whose value is given The eccentricities of all the planets are subject to a very small secular variation, the line of the apsides is also in a state of continual but slow revolution so that the perihelia are gradually shifting their places on the planes of the orbits In the case of all the planets excepting Venus, the motion of the line of the apsides is direct, that is to say, it is in the same direction as the motion of the planet in its orbit The perihelion of Venus referred to the fixed stars, moves in a contrary direction The following table shows the eccentricities and longitudes of the perihelia of the different planets, the epoch as before, being January 1 1801, for the old planets, 1820 for Ceres, and 1848 for Neptune




| Planet. | Eccentricity of Orbit | Longitude of Perihelion | | |
|---|---|---|---|---|
| | | ° | ′ | ″ |
| Mercury | 0 205515 | 74 | 21 | 47 |
| Venus | 0 006861 | 128 | 43 | 53 |
| The Earth | 0 016784 | 99 | 30 | 5 |
| Mars | 0 093307 | 332 | 23 | 57 |
| Ceres | 0 078459 | 147 | 7 | 31 |
| Jupiter | 0 048162 | 11 | 8 | 35 |
| Saturn | 0-056151 | 89 | 9 | 30 |
| Uranus | 0 046679 | 167 | 51 | 16 |
| Neptune | 0 008720 | 47 | 12 | 57 |

*Motion of the Planets in their Orbits* — When the six elements of which numerical values have been given, viz the mean distance and eccentricity of the inclination of the orbit and longitude of the ascending node the perihelion, have been determined for each planet, it will be possible to compute the position of a planet in its orbit provided we know the law according to which the planet moves at every point of the orbit and also the instant of time at which it occupied any given point The motion in the orbit is given by the second of Kepler's laws, viz "The areas described by the radius vector are proportional to the times employed in describing them" Thus, if the planet has moved from A to P (see the preceding figure), or the radius vector S P has described the area A S P in the time $t$, and the area A S $p$ in the time $t'$, then $t : t'$ :: sector P S A : sector $p$ S A The problem which proposes to find the point P, or the angle A S P (which is called the *true anomaly*), from the condition that the area A S P shall be to the whole ellipse as the given time in which A P is described is to the time of a whole revolution, is important in practical astronomy, and known by the name of Kepler's problem *See* KEPLER'S PROBLEM

*Magnitudes and Rotations of the Planets* — When the planets are examined through powerful telescopes, they are seen to be round bodies, having measureable, and even considerable, apparent diameters The distance of a planet being known, if the visual angle subtended by its diameter be measured by the micrometer, the real magnitude of its diameter will be discovered In this manner it is found that all the planets are incomparably smaller than the sun, though some of them are vastly larger than the earth The diameter of Jupiter is eleven times greater than that of the earth, whence his volume is about 1280 times greater than the earth That of Saturn is little less considerable The surfaces of the larger planets are also seen to be diversified by dark patches or spots, from the attentive observation of which it is found that they resemble the earth in having a rotation about their own axes Mercury, Venus and Mars revolve about their axes in nearly the same time as the earth Jupiter and Saturn in less than half that time The small planets between Mars and Jupiter are so small and indistinctly seen that their diameters cannot be accurately measured, and their periods of rotation are unknown Pallas, considered to be the largest of them, was supposed by Sir William Herschel to have a diameter of only 80 English miles In the following table the true diameters and the volumes are given in terms of the diameter and volume of the earth supposed to be unit —

| Planet | Diameter | Volume | Sidereal Rotation | | |
|---|---|---|---|---|---|
| | | | hrs | m | sec |
| Mercury | 0 798 | 0 063 | 24 | 5 | 28 |
| Venus | 0 975 | 0 927 | 23 | 21 | 7 |
| The Earth | 1 000 | 1 000 | 24 | 0 | 0 |
| Mars | 0 517 | 0 179 | 24 | 39 | 21 |
| Jupiter | 10 800 | 1280 000 | 9 | 55 | 50 |
| Saturn | 9 982 | 994 000 | 10 | 29 | 17 |
| Uranus | 4 [illegible] 2 | 80 490 | unknown | | |
| Neptune | [illegible]37 | 14 500 | unknow | | |

(For other particulars respecting the several planets, their masses densities &c see the respective terms)

The force which retains the planets in their orbits is the attraction of the sun, and if they were acted upon by no other force, the laws of Kepler would be accurately observed, and the elements of their orbits would remain invariable But each planet exercises an attracting force on every other, in consequence of which the motions, though principally obedient to the predominating influence of the sun, are affected by a number of forces of which the intensities and directions are perpetually changing Hence all the elements of the orbits their magnitudes and forms, their inclinations to the ecliptic, and their positions on their planes, are in a state of constant oscillation, fluctuating, however, between certain mean values from which they never greatly depart *See* GRAVITATION, PERTURBATION

*Hypothesis of Laplace, respecting the Formation of the Planetary System* The motion of the planets in elliptic orbits, and the relation between their periods and distances are necessary consequences of the law of gravitation which prevails throughout the universe, but the solar system presents several remarkable phenomena of which [illegible] which cannot be sup[illegible] and which lead almost [illegible] that all the bodies which belong to it have had a common origin, and been formed under the agency of the same mechanical laws All the planets, as well as satellites move in the same direction, from west to east The orbits of all the large planets are situated very nearly in the plane of the ecliptic, and, so far as has been discovered, they all revolve about their axes in the same direction, also from west to east To account for these phenomena, Laplace

has hazarded the speculation that all the planets and satellites have had their origin in the solar atmosphere, which he supposes to have extended beyond the orbits of the most distant planets, and to have undergone a progressive contraction by the radiation of heat into the stellar spaces Now, as the solar atmosphere partakes of the sun's rotation about his axis, and in fact may be regarded as part of his mass, in proportion as its limits are contracted by cooling, the rotatory motion must increase, according to a well-known principle of mechanics, and the centrifugal force thus becoming greater, the point or limit at which it is balanced by gravity approaches nearer the centre Supposing, therefore the atmosphere to have extended to this limit at any epoch it must in cooling have abandoned the molecules situated there and at the different limits successively produced by the increased velocity of the sun's rotation This effect, however, would only take place at the equator, for on the parallels of latitude the centrifugal would not equal the attractive force Thus, zones of vapours would continue to be abandoned at the equator, and if the condensation of the molecules of these zones continued without any disruption taking place, the matter would, in the long run form a solid or liquid ring, circulating about the sun in the plane of his equator But the uniformity which would be necessary for the production of this effect, both in all the parts of the zone and in the cooling, must render such a phenomenon extremely rare In fact, the ring of Saturn is the only instance of it in the planetary system In almost every case each zone of vapours must have been broken up into numerous masses, which, moving with nearly the same velocities would continue to circulate about the sun nearly at the same distances These separate masses would assume the spheroidal form, with a motion of rotation in the same direction as their revolving motion In short they would become so many planets in the state of vapour But if any one of them was considerably larger than the rest, it would finally by its attraction unite all the others about its centre, and thus the zone originally abandoned would be transformed into a single spheroidal mass of vapours, circulating about the sun This latter case must have been the most common An instance however, of permanent separation occurs in the group of small planets between Mars and Jupiter

Conceiving the planet to have been detached from the solar atmosphere in the manner now described the further cooling would occasion a nucleus to be formed at its centre which would progressively increase by the condensation of the vapours surrounding it The condition of the planet would now perfectly resemble that of the sun, and consequently similar results would follow from the continuance of the condensation Hence the formation of the satellites from the atmospheres of the planets as the planets are formed from that of the sun

This hypothesis of Laplace does not explain the origin of the comets, which may be regarded as small nebulosities wandering from one solar system to another and formed by the condensation of nebulous matter which appears to be scattered through the universe in great profusion Whatever may be the fate of the hypothesis it must be allowed the merit of assigning a mechanical cause for some of the most remarkable phenomena of the universe, without invoking the aid of any other force than that of gravity, — a property which belongs to matter in every form *See* ASTRONOMY SATELLITE STAR, SUN

PLANE TABLE An instrument employed in land-surveying by means of which a plan is made on the spot without any protraction or measurement of angles It consists of a plane rectangular board, about sixteen inches square, to the under side of which a centre is attached with a ball and socket, or parallel plate screws by which it can be fixed upon a staff head or three-legged stand, and set horizontal by means of a circular spirit level A boxwood frame is accurately fitted round the [illegible] of stretching and [illegible] ual to divide one face [illegible] in the middle of the board, but this graduation is scarcely of any use and may be dispensed with The reverse face of the frame is divided into equal parts, as inches and tenths, for the convenience of ruling parallel lines and squares and for shifting the paper A compass box with a magnetic needle is screwed into one side of the table to indicate the bearings, and to enable the surveyor to set up the instrument at a new station parallel to the position it had at a former one A brass rule or index, with a sloping edge, and having perpendicular sight vanes erected at each extremity, completes the apparatus

The plane-table is used as follows — Two stations are selected as the extremities of a base line, the distance between which is accurately measured and a line drawn on the paper representing that distance according to the assumed scale The instrument is then set up at one of the stations, and a fine needle or pin being stuck into the table, at one extremity of the line drawn on the paper, the edge of the index is brought to press gently on the pin and coincide with the line, and the table turned round till the object at the second station is bisected through the sight-vanes; the table is then clamped, and the direction of the magnetic meridian marked. The fiducial edge of the index, still in contact with the upright pin, which serves as a centre, is then directed successively to all the different objects which have been selected as stations and lines drawn on the paper the direction of each The table is removed to the second station, and the pin placed at the corresponding point on the paper which forms a second centre The edge of the ruler is next directed as before towards each of the objects which were observed from the first station and lines drawn in those different directions The intersections of the lines drawn from the second centre with those drawn from the first marks on the paper the position of each of the observed objects

The plane table is not susceptible of great accuracy, but it is extremely useful in forming a sketch-map, or filling up the details of a survey, where the principal points have been fixed by the theodolite, or some equivalent instrument *See* SURVEYING

PLANETA'RIUM A machine for exhibiting the relative motions of the planets, and their positions in respect of the sun *See* ORRERY

PLA'NIPENNATES, *Planipennes* (Lat planus, *flat*, penna, *a feather*) The name of a tribe of Neuropterous insects comprehending those which have flat wings of which the interior pair almost equal the superior ones, and are simply folded underneath at their anterior margin The antennæ are multiarticulate much longer than the head without being clubbed or styliform The maxillary palps are setiform or somewhat thicker at the extremity shorter than the head and composed of from four to five joints The ant-lions (*Myrmeleon*) and termites are examples of this tribe

PLANISPHERE A projection of the sphere and its various circles on a plane *See* PROJECTION

PLANK (Fr planche) In Architecture a board that exceeds nine inches in width

PLANO-CONCAVE In Optics a lens which is plane on one side and concave on the other *Plano-convex* is a lens plane on one side and convex on the other *See* LENS

PLANORBIS (Lat planus, and orbis *an orb*) A genus of marsh snails so called from the form of the shell, which is that of a flattened orb arising from the volutions being coiled on the same plane Many species of this genus are common in Britain

PLANT In Natural History *See* BOTANY.

PLANTAGENET The surname of the royal family of England from Henry II to Richard III inclusive The origin of the name is involved in deep obscurity The best antiquaries derive it from the well known story of the Earl of Anjou the ancestor of the royal race, who having made a pilgrimage to Rome, where he was scourged with broom twigs assumed the name of *Plantagenista* (literally a *broom twig*) which his descendants retained The name Plantagenet belongs to the noble house of Buckingham

PLANTATION A piece of ground planted with trees for the purpose of producing timber or coppice wood In new countries not generally cultivated and more especially in warm climates the term plantation is applied to land employed in the culture of the more important crops, such as the sugar cane, coffee, pepper, cotton, &c In Britain it is exclusively applied to lands planted with trees or shrubs

PLANTIGRADES, *Plantigrada* (Lat planta, *the sole of the foot*, gradior *I march*) The name of a tribe of Carnivorous Mammals, comprehending those which apply the whole or a great part of the sole to the ground in progressive motion

PLANTING The art of [illegible] of trees Also the art of inserting plants [illegible] dibble trowel, or by other means in use in agriculture and gardening *See* ARBORICULTURE

PLASHING A mode of repairing or modifying a hedge by bending down a portion of the shoots, cutting them half through near the ground, to render them more pliable and twisting the [illegible] upright stems so as to render the whole [illegible] fence, and at the same time preserve all the branches alive For this purpose the branches to be plashed or bent down, must not be cut more than half through, in order that a sufficient portion of sap may rise up from the root to keep alive the upper part of the branches Where hedges are properly formed and kept, they can very seldom require to be plashed, but this mode of treating a hedge is most valuable in the case of hedges abounding with hedgerow trees, when from neglect, or from any other cause, the hedge has become of irregular growth

PLASTER In Architecture, the material of which ornaments are cast, and also that with which the fine stuff or gauge for mouldings and other parts is mixed, when quick setting is required

PLASTER In Pharmacy, a compound, generally of oxide of [illegible] for external applications

PLASTER OF PARIS *Gypsum*, or sulphate of

lime, commonly termed *plaster stone*, and found abundantly near Paris

PLA'STIC (Gr πλαστικος, *I form.*) In Sculpture, that which can be modelled, as clay, &c In the arts it has a more extended signification and signifies those materials and circumstances which are susceptible of being formed and fashioned to the purpose wanted

PLASTIC CLAY A clay used in the manufacture of pottery See also GEOLOGY

PLATANIST *Platanista* A name applied by Pliny to a fish in the river Ganges having a snout and a tail like a dolphin, but much larger In modern Zoology, it is the generic appellation of the Gangetic dolphin (*Delphinus gangeticus* Cuv )

PLA'TBAND (Fr plate and bande ) In Architecture a square moulding projecting less than its height or breadth The fillets between the flutes of columns are sometimes called, but improperly, by this name It is also sometimes used to denote the lintel of a door

PLATE [illegible] In Architecture, a piece of timber lying horizontally on a wall for the reception of the ends of girders joints, rafters, &c.

PLATE The name usually given to gold and silver wrought into articles of household furniture For the regulations under which the manufacture of plate is carried on see the *Com Dict*

PLA'TFORM (Fr plateforme ) In Architecture a plane surface, lying level, of any materials used in a foundation or elsewhere, for the reception of the foundations of a building, or for the piers of a bridge also a level [illegible]

[illegible] guns are placed

PLATING The art of covering copper and other metals with silver or gold It is effected in various ways Sometimes the silver is attached to and rolled out with the copper by pressure, sometimes the one metal is precipitated from its solutions upon the other and of late manufacturers have availed themselves of electro-chemical decomposition for the purpose See VOLTAYTE

PLA'TINUM (So called from the Spanish word plata *silver*, on account of its colour ) A metal of a white colour exceedingly ductile malleable, and difficult of fusion It is the heaviest substance known its specific gravity being 21 5 It undergoes no change from air or moisture and is not attacked by any of the pure acids, it is dissolved by chlorine and nitromuriatic acid, and is oxidized at high temperatures by pure potass and lithia It is only found in South America and in the Uralian Mountains it is usually in small grains of a metallic lustre, associated or combined with palladium rhodium iridium and osmium, and with copper, iron lead titanium, chromium gold and silver it is also usually mixed with alluvial sand The particles are seldom so large as a small pea but sometimes lumps have been found of the size of a hazel nut to that of a pigeon's egg In 1826, it was first discovered in a *vein* associated with gold by Boussingault in the province of Antioquia in South America When a perfectly clean surface of platinum is presented to a mixture of hydrogen and oxygen gas, it has the extraordinary property of causing them to combine so as to form water and often with such rapidity as to render the metal red hot *spongy platinum* as it is usually called obtained by heating the ammonio-muriate of platinum, is most [illegible] and a jet [illegible] d by the metal thus ignited a property which has been applied to the construction of convenient instruments for procuring a light The equivalent of platinum is about 98 It is precipitated from its nitromuriatic solution by sal ammoniac, which throws it down in the form of a yellow powder composed of bichloride of platinum and sal ammoniac

PLATONIC BODIES The five regular geometrical solids so called because they were treated of or described by Plato They are the tetraedron, the hexaedron the octaedron, the dodecaedron and the icosaedron Besides these five, there can be no other solids bounded by like, equal and regular plane figures, and whose solid angles are all equal

PLATONISM The philosophy of Plato To give a satisfactory account of the system of this great thinker, within the limits which the nature of the present work necessarily impose upon us, would be an undertaking of no common difficulty Those of our readers who are adequately conversant with the original writings of Plato must be well aware that the views entertained in our own country of his philosophical character and merits are, to say the least partial and incomplete, while those who add to this knowledge an acquaintance with the researches of our German contemporaries on this subject will [illegible] ability, at the same time that they appreciate the [illegible] of [illegible] more adequate comprehension [illegible] of the mind of Plato is its comprehensiveness This quality discovers itself equally in the form in which his philosophy is communicated, and in that philosophy itself The form to which we allude is, it is well known, that of the dialogue The Dialogues of Plato are at once vivid representations of Athenian life and character, and constituent parts of a system of universal philosophy; the harmonious productions of a genius which combined the dramatic imagination with the [illegible] in a degree which has never before nor since been equalled It is in this circumstance that we must seek alike for the influence which Plato's writings have exerted and for the difficulty of rightly apprehending their meaning What has been said of history in general may with equal truth be applied to the Platonic dialogues — that they are "philosophy teaching by examples" In place of a formal refutation of sophistry, we are introduced to living sophists, in the room of an elaborate system of philosophy we meet the greatest philosophers of his day, reasoning and conversing with the simplicity in the pursuit of [illegible] with [illegible] full of natural prejudices with many abounding with individual peculiarities

Under no other or less complex form of composition could Plato have accomplished the manifold purposes which he had in view, purposes not of the philosopher only but of the reformer and educator of the moral and intellectual nature of his countrymen In most of his dialogues one or other of these intentions is the prominent one in some the refutation of [illegible] opinions in others the establishment of his own, while [illegible] seem chiefly aimed as exemplifications of scientific method generally, though we agree with Schleiermacher in thinking that there are none which do not contribute to the gradual development of his own system

But it is not merely in the form in which his doctrines are clothed that we discern the comprehensiveness of Plato's genius The same quality is as we have said, equally apparent in the philosophy of which his dialogues are the vehicle By referring to the articles ELEATIC, IONIC, and PYTHAGOREAN PHILOSOPHY, the reader will be able to form some conception of the systems which preceded that of Plato In each of these some leading idea is taken up, and traced, generally to the exclusion of all others, through all its possible consequences These three schools may indeed, be severally taken as the representatives of the three constituent portions of universal philosophy the Eleatics of the logical or dialectic, the Ionians of the physical, and the Pythagoreans, though in a less exclusive degree of the ethical element It was in Plato that these different tendencies first converged Each viewed by itself was essentially partial and one sided and, with whatever of truth it might contain, must necessarily by its very exclusiveness, combine much of error Of this circumstance the sophists had taken advantage, and, by setting the doctrines of one system in contradiction to those of another, had succeeded in the introduction of a universal scepticism Plato was thus led clearly to discern the necessity of laying the foundations of science deeper than they had been laid by his predecessors The ultimate unity of all knowledge, properly so called, and the mutual dependence of all its parts on each other is the fundamental intention of his philosophy How this first principle was to be attained, whether indeed it were attainable or not, could only be ascertained by a previous inquiry into the nature not of *being*, but of *knowledge* This is one mark which distinguishes Plato from earlier speculators, and it is important to bear it in mind, if we would form a correct estimate of the services rendered by him to the progress of philosophy The hint was unquestionably given by Socrates, but Plato was the only one among his immediate disciples who appears to have followed it up He may, in truth, be styled the founder of the ancient psychology, and the dialogue entitled *Theætetus* may be considered one of the most important contributions to the most important branch of that science the theory of perception and judgment which antiquity affords It is in this dialogue that the negative side of the inquiry into knowledge, which we have alluded to, is contained Knowledge, it is there shown is not to be confounded either with the impressions on the senses or with the judgments (δοξαι) founded upon them Sensation by its very nature, is relative only it is the joint effect of the conditions of our internal constitution and a motion, or change, communicated from without Judgment in so far as it is founded on a prior impression, can have no validity save in reference to that impression Pure knowledge, therefore, if it exist at all, must be sought in some other direction It is here that the celebrated doctrine of ideas finds its place Without entering into the question more deeply than our limits allow it is sufficiently clear that no other word, such as conception, notion, or the like, is adequate to convey all that Plato meant by an *idea* Having failed in finding alike knowledge in the senses and permanent being, its object in nature, he was driven, in order to avoid the sophistic doctrine of the relative nature of [illegible] seek for the true objects of reason [illegible] from the material universe. In place of the doctrine of Protagoras "Man is the measure of all things, he substituted, God is the measure of

all things," meaning by this, as he elsewhere explains himself, that in the divine nature reason and being are one From this original unity which is denominated by Plato the good or the supreme good [illegible] hand, human reason, on the other, [illegible] stitute all in nature that is real, [illegible] reason can apprehend We might hence be led to suppose that the modern term "law" may be correctly used in place of the Platonic "idea" But, when we examine the matter more narrowly, we shall find an essential difference between the two words, not merely in the ontological or theological considerations just alluded to, but also in the habit, which Plato inherited from his master Socrates, of referring the laws of the universe [illegible] *cal* standard The three great ideas order or fitness, are the ultimate unities to which he conceives it to be the business of the reason to refer all its conceptions These ideas are themselves included in the highest unity, or God, from whom it is that they derive their reality But the supreme nature is to us incomprehensible it is in the consciousness of our separation from the great source of being that philosophy takes its rise The senses it is which first suggest to us this want we strive to be [illegible] ceptions and [illegible] a self recognizing [illegible] part [illegible] pure Ideas [illegible] all the other [illegible] of the true ethics as [illegible] and [illegible] of our world [illegible] very imperfect sketch of the Platonic [illegible] three constituent parts The threefold division even we nowhere find expressly laid down in the written works of Plato, but, besides that it is throughout implied, the fact that it is taken for granted by his immediate successors, Xenocrates and Aristotle [illegible] formed part of Plato's [illegible] this comprehensive view of universal science, we are indebted to Plato for many valuable discoveries and many more most pregnant hints, in subordinate branches of inquiry Among these may be enumerated the discussion of the theory of pleasure and pain, and their relation to desire and emotion, in the *Philebus*, of the first principles of the science of grammar in the *Cratylus* and *Sophist*, of the nature of mathematical science and its place in general philosophy, *Rep* vi, &c The ethics of Plato, though, in many important respects, they must be allowed to be greatly defective, as, in particular, in the omission of the notions of duty and responsibility, are yet far from deserving the contemptuous treatment they have met with from certain writers among ourselves In the *Republic*, which contains the substance of his moral doctrines, the intention of Plato manifestly was to develop the idea of perfect humanity, alike in the individual and in what he regarded as an enlarged transcript of the individual, the state (See Ethics) The most important contribution to the study and right understanding of the Platonic philosophy with which modern times have furnished us, is to be found in the arrangement of his *Dialogues* and the introduction prefixed to each by the celebrated Schleiermacher, a work which has recently been translated into English See also *Ritter, Gesch der Philosophie*, b viii, and for some abstruse portions of Plato's doctrine *Trendelenburg's Ideæ Plat ex Aristot illust*

The best editions of Plato's works are those of Bekker and Hallbaum For an account of his life, see *Ast's Leben und Schriften Platon*

PLATOON' In the art Military, a small square body of musketeers, drawn out from the main body to strengthen the angle of a larger square, or to do duty in ambuscades or defiles, &c, when there is not room for whole regiments or battalions to act

PLATYRHINES *Platyrhinæ* (Gr πλατυς, *wide* and ρις, *a nose*) The name of a section of the Linnæan genus *Simia* including those species which have the nostrils separated by a wide interspace These monkeys are peculiar to the New World

PLATYSOMES *Platysoma* (Gr πλατυς, and σωμα *body*) The name of a family of Coleopterous insects comprehending species with a wide and much depressed body These insects are found under the bark of trees, and form the genus *Cucujus* of Fabricius, now subdivided

PLEA'DING (Lat placitum, Norman French plaid, together with the verb placitare, *to plead*; derived from placitum, the decree or sentence of a judicial or legislative authority) Pleadings in English law are the preparatory allegations in writing which intervene between the commencement of a cause and its trial

The first object [illegible] between two litigant parties is always [illegible] subject for decision This must be accomplished by disengaging the point in debate from all the extraneous matter in which the complaints and answers of the respective parties have involved it This is the principle from which all the subtleties of the system of pleading, commonly called *special pleading*, are derived and, in so far as it has departed from this object, it has wandered from its original purpose

Pleadings were conducted orally in the first times of our jurisprudence, the parties, or their advocates, exposing the state of facts on which they relied successively before the judge, who moderated between them, and [illegible] other until the judge was able to fix upon [illegible] point [illegible] was called, that is the question, whether of fact or law, on which the judge, or the jury, was eventually to decide Hence issues are said to be *in fact* or *in law* The same principle governs the course of *written pleadings* now adopted

The plaintiff, or complaining party, having summoned the defendant into court, by a writ stating the nature of his complaint makes his first statement which is termed a *declaration* The defendant may now answer him, either by denying that there is any ground in law for the action, either because there is defect *in substance* in the plaintiff's alleged right, or defect *in form* in his proceedings, or by controverting the facts which he alleges, or alleging new facts in answer to them In the former case the defendant *demurs* to the declaration, in the latter case he answers by one or more *pleas*

A demurrer may take place either at this or at any subsequent stage of the proceedings, and may be made either by plaintiff or defendant. And it is either *general* to substance, or *special* to form (But, by the increased liberality of the courts many errors in form may now be amended on application which formerly were fatal) If the demurrer comes to be argued (which is done in term time or in bench before all the judges of the court in which the action is brought), the court will examine the whole pleadings on both sides, and their decision on the point of law is final as to the action

The defendant may answer or *traverse* the facts, 1 By pleading what is termed *the general issue*, a form which, in its original signification imported an absolute denial of the facts on which the plaintiff founded his complaint, and concludes with the words, "and of this the said defendant puts himself on the country," that is, offers to have the issue tried by a jury But by the refinements introduced into pleading, the general issue was gradually admitted in each of the several *forms of action* to which we shall presently refer, not only to deny the plaintiff's facts but to allow the defendant to bring forward other facts in answer, although these more properly form the subject 2 of *special pleas* When the defendant admits all or a part of the plaintiff's facts, but relies on certain other facts as exonerating him from the liability asserted by the plaintiff, he ought to state these facts in answer, for instance, in order to answer the claim of a debt, that it is barred by length of time, or that the defendant has a set off to allege against it this is termed a plea by way of confession and avoidance The plea stating such new facts concludes with the assertion, "and this the said defendant is ready to verify" To this the plaintiff may reply in his second statement, called a *replication* either by denying the defendant's facts, that is, a replication *by way of traverse* or by alleging fresh ones, the defendant may deny these, or again allege fresh ones in his *rejoinder*, sometimes a *surrejoinder*, a *rebutter* and a *surrebutter* may be added, and the edifice of pleading is raised by stories gradually narrowing by the exclusion of superfluous facts, until it reaches its summit in the production of one or more issues, either in law or fact the decision of which finally arranges the dispute, and by what are called the new rules of pleading framed in 1834 many defences which might formerly have been given under the general issue must be pleaded specially

Thus, in an action of debt, the defendant pleads *specially* the statute of limitations, that is, that more than six years have passed since the cause of action accrued, the plaintiff replies admitting the length of time, but alleging that the defendant has since promised to pay the debt this the defendant denies in his rejoinder, and hereupon, [illegible] on the fact of the promise, issue is joined

A plaintiff complains of breach of covenant by his lessee in not repairing premises The [illegible] pleads admitting the lease and the want of repair but alleges that he had received from the plaintiff a release from all his liability The plaintiff replies admitting the release, but asserting that it was obtained from him by force or duress The defendant may perhaps deny the legal sufficiency of this ground, or *demur to the replication*, or he may traverse it in his rejoinder denying the force or duress In the former case, an issue of law is raised for [illegible] the latter [illegible] for the jury

[illegible] for the parties [illegible] respective [illegible] paper to the [illegible] When issue is joined, these pleadings are entered on a parchment roll, and the issue is likewise entered; in the form of appointing a day for the trial of the demurrer, if the issue be in law, or in the form of a precept to the sheriff [illegible] This roll is called the record, and is preserved as an au-

thentic memorial of the proceedings in the case; the verdict, and the judgment, being entered on it

Such is a brief outline of the forms of pleading as ap- [illegible] complaint can be made [illegible] But, according to the nature of the injury complained of, his action will assume a particular form, allotted by law to enable him to recover the particular remedy he seeks *See* ACTION, and the [illegible] actions under their several heads

PLEASURE-GROUND The portion of ground adjacent to a dwelling-house in the country which is exclusively devoted to ornamental and recreative purposes In the ancient style of gardening, the pleasure-ground was laid out in straight walks, and regular or symmetrical forms, evidently borrowed from architecture, but in the modern style it is laid out in winding walks and in forms borrowed direct from nature A portion of lawn or smooth grassy surface may be considered as essential to the pleasure-ground under any style

PLEBEIANS The free citizens of Rome who did not come under the class of the patricians or clients Though always personally independent, they had in early times no political power, the government being entirely in the hands of the patricians who with the descendants of the king, formed the original people The class of plebeians was of after growth and probably drew its numbers from various sources, as from clients whose obligations were dissolved by the death of the heads of their patrons, and the [illegible] conquered states who were admitted to the rights of citizens In plebeian families with patrician names it was supposed to have arisen from marriages of disparagement contracted between the higher and lower classes

As this body, from its constitution, naturally grew in vigour while the patricians became weaker, it soon formed the main strength of the Roman armies, and became desirous of sharing in the advantages of the conquests made by its prowess while the patricians on their part refused to admit them to all their privileges and, far from yielding to the demands of the other party exercised the severe rights which as creditors they possessed over the liberties of many of its members This state of things produced a continued series of collisions between the two orders, in which the latter gradually gained ground, till, in the last ages of the republic it was admitted to a full share of all the powers and privileges before confined to one order

PLEBISCITUM (Lat *a decree of the people*) In Roman History a law enacted by the common people, under the superintendence of the tribune or some subordinate plebeian magistrate without the intervention of the senate The term however is used in a more peculiar sense, being applied chiefly to the law made when, upon a misunderstanding with the senate, they retired to Mount Aventine

PLECTOGNATHES, *Plectognathi* (Gr πλέκω *I connect* and γνάθος, *a jaw*) [illegible] an order of fishes, including those which have the maxillary bones anchylosed to the sides of the intermaxillaries, which alone form the jaws.

PLECTROPO'MA (Gr πλῆκτρον, *a spur*, and πῶμα, *a lid*) A name applied by Cuvier to a genus of Percoid fishes, characterized by having the angle of the preoperculum produced or divided into a series of spines like those which arm the rowel of a spur All the species are exotic and belong to warm climates

PLE'CTRUM (Gr πλῆκτρον, from πλήσσω, *I strike*) The small ivory instrument with which the ancients struck the lyre

PLEIADES In Mythology the seven daughters of Atlas and Pleione were so called whose names were Alcyone, Maia Electra Merope, Calano Sterope, and Taygeta They were loved for seven years by Orion, from whose solicitations they were at length released by the interposition of Jupiter, who transformed them to the stars, where they now form a cluster in the neck of the constellation Taurus Only six of these stars are visible to the naked eye, and the ancients supposed that the seventh concealed herself out of shame for having bestowed her love on a mere mortal, Sisyphus, while [illegible]

PLENARY [illegible] of an office [illegible]

PLENE ADMINISTRAVIT (Lat) In Law, a plea pleaded by an executor or administrator to an action on a liability of the deceased, that he has *fully administered* [illegible]

PLENICORNIA (Lat plenus, *full*, and cornu, *a horn*) The name of a tribe of Ruminants, including those which have horns composed of an uniform solid osseous substance as the antlers of deer *See* CORNUA

PLENIPOTENTIARY *See* AMBASSADOR

PLEONASM (Gr πλέον, *more*) In Rhetoric, a redundant phrase or expression, sometimes introduced to give additional energy, at other times needless and ungraceful

PLEOMORPHISM (Gr πλησιος, *near*, and μορφη, *form*) A term applied to crystallized substances the forms of which closely resemble each other, but are not absolutely identical The primary form of sulphate of strontia is a rhombic prism very [illegible] sulphate of [illegible] measures [illegible] of the prism, the difference exceeds 2° Similar differences are observable in the rhomboedrons of carbonate of lime and carbonate of iron. Such substances therefore are *pleomorphous*

PLESIOSAUR, *Plesiosaurus* (Gr πλησιος, and σαυρος, *a lizard*) The name of a genus of extinct marine saurians, chiefly remarkable for their length of neck The head is small, but like that of a crocodile, the vertebræ are articulated generally by nearly plane surfaces, the cervical vertebræ have an articular surface, divided by a longitudinal impression, for a rudimental rib on each side, and two vascular foramina beneath the digital bones of both the hind and fore extremities are flattened, and are enveloped in a sheath of skin like the paddles of the *Cetacea* The remains of the *Plesiosauri* occur in the formations from the muschelchalk to the chalk inclusive, but are most common in the lias and kimmeridge clay beds

PLE'THORA (Gr πληθω, *I fill.*) A redundant fulness of the blood-vessels It results from various causes generally referred to *sanguine plethora*, to which the robust and athletic are most subject, and to *serous plethora* which attacks debilitated constitutions

PLEURA. (Lat) The membrane which covers the inner surface of the thorax and its viscera It forms two distinct portions, or bags, which, being applied laterally to each other, form the partition called the *mediastinum*

PLEURITIS, *Pleurisy* Inflammation of the pleura. This disease begins with fever, cough pain in the side, a peculiar hard and strong pulse the symptoms often run on with great rapidity attended by very painful respiration and other alarming symptoms (*See* PNEUMONIA) The treatment must be prompt and decided it consists in bleeding, blisters, and purging, and in the after treatment, great care must be taken against an insidious and local form of the disease which often extends to the lungs

PLEURONECTIDÆ (Gr πλευρα *a side*, and νηχτης *a swimmer*) The name of a family of [illegible] which swim on their side, and of which the *Pleuronectes* or sole, is the type, they are [illegible] flat-fishes

PLICA (Lat plico, *I entangle*) A disease said to be peculiar to Poland, Lithuania, and Tartary, in which the hair becomes matted and inextricably entangled It is often called *Plica Polonica*

PLICIPENNATES, *Plicipennes* (Lat plico, *I fold*, and penna, *a feather*) The name of a tribe of Neuropterous insects, comprehending those which have the inferior wings wider than the others, and folded longitudinally The mandibles are wanting in this tribe, which is represented by the genus *Phryganea*, or caddisflies

PLINTH (Gr πλινθος, *a brick*) In Architecture, the lowest member of the base of a column, bearing, as its name indicates the form of a square brick or tile (*See* BASE) Sometimes the abacus of the Tuscan capital is called the plinth of the capital

PLIOCENE (Gr πλειων, *greater*, and καινος, *recent*) A geological term applied to the most modern of the divisions of the tertiary epoch, because the major part of its fossil testacea are referable to recent species *See* GEOLOGY

PLOTTING, in Surveying, signifies describing or laying down on paper the several angles and lines of a tract of land which has been surveyed and measured It is usually performed by means of a *protractor* (see the term) sometimes by the *plotting scale*

PLOTTING SCALE A mathematical instrument used in *plotting*, or setting off the lengths of lines in surveying It consists of two graduated ivory scales, one of which is perforated nearly its whole length by a dovetail shaped groove, for the reception of a sliding piece to which the second scale is attached and with which it [illegible] the [illegible] angles [illegible] the [illegible] the scales, or [illegible] the plan

PLOTUS A genus of web-footed birds of the family *Pelecanidæ*, and nearly allied to the cormorants They are generally known by the name of *Anhinga*, or "darters," from the rapidity with which they shoot down into the water in the capture of fish The white billed anhinga (*Plotus melanogaster*) is the most common and best known species it is a native of the tropical regions of both North and South America

PLOUGH (Germ pflug) An implement drawn by horses and guided by a driver by which the surface of the soil is cut [illegible] slices and successively raised up and turned [illegible] object of the operation is to expose a new surface to the action of the air and to render it fit for receiving the seed, or for harrowing, or for

other operations of agriculture Ploughs are of two kinds, those without wheels, commonly called swing- [illegible] one or more wheels, called wheel [illegible] parts which compose both kinds of plough are the beam by which it is drawn, the stilts or handles by which the ploughman guides it, being two levers connected with the beam, the coulter fixed into the beam, by which the furrow slice is cut, the share, also attached to the beam, by which the slice is raised up, and, finally, the mould-board, by which the slice is turned over The most improved form of the swing plough is that in general use in Scotland and the North of England which is known as a modification of what is called Small's improved [illegible] The most improved wheel plough is the Scotch plough with a wheel attached to the beam, for the purpose of keeping the share at a uniform distance beneath the surface The subsoil plough, the invention of Mr Smith of Deanston, in Stirlingshire, is the swing plough, of a somewhat stronger construction than that in common use, but without the coulter and the mould-board The use of this implement is to follow the common plough and loosen the subsoil at the bottom of the furrow without raising it to the surface The most improved form of this implement contains a muzzle (the instrument by which it is drawn), so contrived as that the horses may walk on the firm soil The use of the subsoil plough is one of the greatest modern improvements that has been introduced into the culture of arable land Draining ploughs are of different kinds The mole plough, instead of a share and mould board, has a small iron cylinder attached to the lower extremity of the coulter, and which, being drawn through grass land, leaves in its track a small opening which has been compared to the underground track of a mole and into which the water percolates from the surface through the narrow slit formed by the upper part of the coulter and is thus carried off to an open drain The other kinds of draining ploughs cut out the soil raise it to the surface, and turn it over in the manner of the common plough, thus leaving a deep furrow, which is commonly further deepened and modified by the spade and afterwards partially filled with stones draining tiles or other materials through which water may find its way and finally covered with the surface soil Draining ploughs, though in theory promising a saving of manual labour yet in practice are found inconvenient from the number of horses required to work them Their use is therefore generally confined to free, deep loamy soils with an even surface

PLOUGHING The act of turning over the soil by means of the plough Trench ploughing is effected by the plough passing twice along the same furrow the first time for the purpose of throwing the surface soil into the bottom of the furrow, and the second time for raising a furrow slice from under that which had been already turned over and raising it up &c turning it upon the first furrow slice, by means of which the surface soil is entirely buried and a stratum of subsoil laid over it thus effecting in the field what trenching with the spade does in the garden Trench ploughing can only be employed [illegible] is naturally dry and of [illegible] rendered so by draining and subsoil ploughing, for bad subsoil brought to the surface would be unfit for receiving seeds or plants *See* PLOUGH

PLUG In Architecture, a piece of wood driven horizontally into a wall, its end being then sawn away flush with the wall, to afford a hold for the nailing up dressings &c

PLUMBA'GIN A crystallizable substance extracted from the root of the *Plumbago Europæa*

PLUMBA'GO, *Graphite Black Lead* This useful substance is a compound of carbon generally with a minute quantity of iron, there is, however some doubt as to the nature of the combination The finest plumbago is from Borrodale in Cumberland

PLUMB-LINE, PLUMMET (Lat plumbum, *lead*) A heavy body (usually a piece of lead whence the name) suspended by a flexible thread for the purpose of indicating the perpendicular to the horizon, or the direction of terrestrial gravity In former times the plumb line constituted an essential part of the apparatus employed for adjusting astronomical instruments, but it is seldom used in modern observations, excepting those made with the zenith sector, its place being either more conveniently supplied by the spirit level, or the method of determining the zenith point by combining direct and reflected observations rendering it unnecessary For the common artificer's plummet, see LEVEL

PLU'MULA (Lat pluma, *a feather*) The growing point of the embryo [illegible] the apex of the radicle and [illegible] base of the cotyledons by which it is protected [illegible] It is the rudiment of the future stem of a plant

PLUPERFECT TENSE (Lat plus quam perfectum, *more than perfect*) In Grammar the tense which denotes that an action was finished at a certain period to which the speaker refers.

PLURAL *See* GRAMMAR

PLURA'LITY. In Ecclesiastical Law, the holding of more than one benefice It was ordained by the council of Lateran A D 1215, that whosoever should take a benefice with cure of souls, if he should before have attained a like benefice should, *ipso facto*, be deprived of the latter Exceptions were made to this rule in certain cases of *in commendam*, by a constitution published in the council of Lyons, but it could always be evaded by dispensation from the pope See the Reformation dispensations in England are granted by archbishops The first English enactment on the subject was that of 21 Hen c 13, and rendered the former benefice void if of the value of 8*l* or above A benefice, therefore, with which another may be held, must be below that value in "the king's books" By the 4th Canon, 41, no licence or dispensation for the holding of more benefices than one can be granted to any one unless graduate as A M in one of the universities, and he must reside a reasonable time on each benefice, and licensed as a preacher, nor may they be more than thirty miles asunder, and he must have under him a preacher properly licensed in that where he resides least Formerly dispensations even from the injunctions of this canon were obtained from the crown, but none it is said, since the Revolution The practice was very common in this country in Roman Catholic times, and though as we have already observed, restrained by various statutes still subsist to a considerable extent Until every benefice is made capable of supporting an incumbent it is manifestly impossible to abolish it entirely, and in the case of an individual holding one rich and one poor living together, the arrangement [illegible] practically does not exist Under the existing dispensations two benefices may be obtained on various pleas, but measures of further restraint are understood to be in contemplation

PLUS In Algebra the additive or positive sign +, which being placed between two quantities, signifies that they are to be taken collectively or added together According to Dr Hutton this character was first used by Stifelius, as a contraction of the letter *p*, the initial of *plus*

PLUTO (Gr Πλουτων) Called also Hades (Ἀιδης) Aidoneus (Ἀιδωνευς) by the Greeks, or Orcus by the Romans was the brother of Jupiter and Neptune and lord of the infernal regions He is not like his brothers, celebrated for amours but remained faithful to Proserpine whom he carried away from the plains of Sicily, and made his queen

Pluto is represented as an old man with a dignified but severe countenance, holding in his hand a two-pronged fork

PLUTO'NIC ROCKS Unstratified crystalline rocks, probably formed at great depths beneath the surface by igneous fusion The term is opposed to *volcanic rocks*, also formed by fire, but having cooled near the surface See GEOLOGY

PLUTUS (Gr πλουτος, *wealth*) The god of riches, said to have been the son of Jasius and Demeter or Ceres There are no particulars known as to his worship but he is introduced as an actor in the play of Aristophanes which bears his name, and he bears a part also in the *Timon* of Lucian

PLUVIAMETER (Lat pluvius, *rain*) See RAIN-GAUGE

PNEUMA'TICS (Gr πνευμα *air or breath*) The science which treats of the mechanical properties of elastic fluids and particularly of atmospheric air

Elastic fluids are divided into two classes,—permanent gases and vapours The gases cannot be converted into the liquid state by any known process of art, whereas the vapours are readily reduced to the liquid form by pressure, or diminution of temperature In respect of their mechanical properties there is, however, no essential difference between the two classes

Elastic fluids in a state of equilibrium, are subject to the action of two forces, [illegible] force acting from particle [illegible] the gases, in the same manner as on all other material substances but the action of the molecular forces is altogether different from that which takes place among the elementary particles of solids and liquids, for, in the case of solid bodies, the molecules strongly attract each other [illegible] liquids, [illegible] be indifferent to internal motion, but, in the case of the gases, the molecular forces are repulsive, and the molecules, yielding to the action of these forces, tend incessantly to recede from each other, and, in fact, do recede, until their further separation is prevented by an exterior obstacle Thus, air confined within a close vessel exerts a constant pressure against the interior surface, which is not sensible, only because it is balanced by the equal pressure of the atmosphere on the exterior surface This pressure exerted by the air against the sides of a vessel within which it is confined is called its *elasticity*, or *elastic force*, or *tension*

*Conditions of equilibrium* — In order that all the parts of an elastic fluid may be in equilibrium, one condition only is necessary, namely, that the elastic force be the same at every point of any horizontal plane. Two causes tend to produce inequality of pressure in the different parts of such a fluid, in both cases, namely, the mobility of the particles, and the action of gravity upon them. Conceive a close vessel to be filled with air or other gas, and let *a* and *b* be two molecules situated in the same horizontal plane. It is evident that if the two molecules are in a state of equilibrium, the force with which *a* repels *b* must be exactly counteracted by that with which *b* repels *a*, for otherwise motion would take place. The same thing takes place in respect of every horizontal section of the gas, but the pressure on each section varies with its altitude. Suppose *c* and *d* to be two molecules situated in a horizontal section, *lower* than that in which are *a* and *b*. It is evident that the molecules *c* and *d* sustain a greater pressure than *a* and *b*, for, in the first place the whole of the pressure on *a* and *b* is transmitted to them by the principle of the equality of pressure in all directions, and in the second place, they sustain a new pressure, arising from the weight or gravity of all the molecules situated between the two horizontal planes *a b* and *c d*.

The principle which has just been explained is proved experimentally by the diminution of the pressure of the atmosphere at greater altitudes. A column of air reaching from the ground to the top of the atmosphere exerts a pressure equal to the weight of a column of mercury of the same diameter and whose height is equal to that in the barometric tube. Now, on carrying the barometer to the top of a mountain, for example, the mercurial column is observed gradually to become shorter as we ascend, and the diminution of the column and consequently of atmospheric pressure, is connected with the increase of altitude by a certain constant law, which enables us to deduce the one from the other and to apply the barometer to the very important purpose of determining the relative altitudes of places on the surface of the earth. *See* HEIGHTS MEASUREMENT OF.

*Law of Mariotte* — In order to determine the relation between the density and pressure of the elastic fluids in the state of equilibrium, let A C B be a graduated bent tube (like a siphon barometer) having two unequal branches of which the shorter is hermetically sealed at B and the longer open at A. Let a small quantity of mercury be poured into the tube just enough to fill the bend and intercept the communication between the air in C B and the external atmosphere, and let the level F F be marked at which it stands in the two branches of the tube. It is evident that in this state the pressure of the air imprisoned between F and B is exactly equal to that of the atmosphere. Now let mercury be poured into the tube at A, it will rise slowly in the branch F B, and much more rapidly in the open branch F A. Let mercury then be continued to be poured in until it stands at two points D and F′, so situated that the altitude of D above F′ or D F′, is just equal to the height of the column in the barometer, or about 30 inches. In this state the elasticity of the air in the space F′ B is in equilibrium with the pressure arising from the weight of the mercurial column F′ D and the pressure of the atmosphere exerted on D. But the weight of the mercurial column F′ D is just equal to the atmospheric pressure, consequently the air in F′ B is compressed by a force equal to twice the atmospheric pressure. Now on observing the length of the column F′ B it will be found exactly one half of E B, or the air has been reduced to half its former volume. On increasing the length of the open branch of the siphon and pouring in a proper quantity of mercury it is found that a pressure of three atmospheres reduces the volume of air at B to one third, and of four atmospheres to a fourth of its first volume, whence it is inferred, generally, that *the volumes of gases are inversely as the pressures which they support*. This fundamental property of elastic fluids is called the *Law of Mariotte* from its having been discovered by that philosopher in France. It has been verified in several ways on all the known gases, and, in the case of dry air its verification has been pushed, by MM. Dulong and Arago, to pressures [illegible] (Lame, *Cours de Physique*). [illegible] ject of vapours or steam subjected to a smaller degree of pressure than that which is necessary to reduce them to the liquid state, and even for mixtures of different gases. It is important, however, to observe, that it is supposed no variation of temperature has taken place during the experiment. The apparatus above described is called a *manometer*.

The density of bodies being inversely as their volumes, the law of Mariotte may be otherwise expressed by saying *the density of an elastic fluid is directly proportional to the pressure it sustains*. Under the pressure of a single atmosphere the density of air is about the 770th part of that of water, whence it follows that under the pressure of 770 atmospheres, air is as dense as water. Thus, the average atmospheric pressure being equal to that of a column of water of about 32 feet in altitude, at the bottom of the sea, at a depth of 24640 (= 770 × 32) feet, or 4⅔ miles, air would be heavier than water, and though it should still remain in a gaseous state it would [illegible]. The repulsive energy of the molecules of the elastic fluids is greatly augmented by an increase of temperature, and it is of the utmost importance in many physical inquiries to ascertain the relation between the temperature and the elastic force. If air and several other gases, sustaining the same constant pressure, are exposed to an increase of temperature which affects all of them equally, it is proved by observation that they all undergo an equal expansion, that is to say, the increase of volume of all the gases is the same for equal augmentations of temperature, and proportional to the augmentations. Experience also shows that within a considerable range of temperature, the indications of the air thermometer differ very little from those of the mercurial thermometer, so that, within this range, the expansion of any gas whatever is proportional to the increase of temperature indicated by the degrees of the ordinary thermometer. From the temperature of [illegible] to that of boiling water, or from zero to [illegible] centigrade thermometer, Gay Lussac found the expansion of air subjected to a constant pressure to be in the ratio of unity to 1.375, which gives an expansion of 0.00375 for each centigrade degree. This being assumed, let V be the volume of any gas at the zero temperature, P its elastic force, or the pressure it sustains and D its density. Now suppose the values of V and D to be [illegible], when the temperature is increased *t* degrees, then the pressure P being supposed constant, we have evidently

$$V' = V(1 + at),$$

and the density being inversely as the volume, we have also

$$D' = \frac{D}{1 + at}$$

Now suppose the pressure to be varied without any change of the temperature and let *p* denote the new pressure and *d* the corresponding density, the law of Mariotte gives

$$P : D' :: p : d, \text{ whence } p = \frac{P\,d}{D'},$$

and on substituting for D′ its value given by the preceding formula and making $\frac{P}{D} = k$, we obtain

$$p = k\,d\,(1 + at)$$

for the expression of the elastic force of any gas in a function of its density and temperature.

The coefficient *k* is constant for the same gas, but has a different value for different gases, depending on their densities or specific gravities. With respect to atmospheric air its value may be found thus. The density of air, compared with water, is 0.0013 and that of mercury 13.59, therefore supposing the height of the barometer to be 30 inches the value of *k*, or the height of a column of air of uniform density, exerting on its base a pressure equal to that of the atmosphere, is $30 \text{ in.} \times \frac{13.59}{0.0013} = 313860$ inches or 26155 feet (about five miles), the temperature [illegible] of freezing water.

*Flow of Fluids through Orifices* — Elastic fluids, in escaping from a vessel by a small orifice or tube into a vacuum, observe like liquids a law first discovered by Torricelli, namely that the velocity of the molecules when they escape from the orifice is equal to that which they would have acquired by falling through a height equal to the height of a vertical column of uniform density producing the same pressure as is exerted by the gas at the level of the orifice. Thus, it has just been shown that the pressure of the atmosphere when the barometer stands at 30 inches and the temperature is that of freezing, is equal to that which would be produced by a column of air of uniform density extending to an altitude of 26155 feet. Now, putting *g* = the accelerating force of gravity = 32 feet per second the velocity which a heavy body would acquire [illegible] in a height of 26155 feet is [illegible] 1294 feet in a second, which [illegible] with which air rushes into a vacuum. If the temperature varies, the velocity will vary also, and will become $1294\sqrt{(1 + at)}$. For example, if the temperature were 16° centigrade (about 61° of Fahrenheit), the velocity would be 1332 feet per second.

[illegible] gases are proportional to the pressures by which they always rush into a vacuum with the same velocity whatever its density may

be in the vessel from which it escapes; for the homogeneous column of the same density, and exercising the same pressure as the air in the vessel, must in all cases have the same altitude

The velocities with which the different gases enter a vacuum are inversely as the square roots of their densities; for they are proportional to the square roots of the altitudes from which the molecules are supposed to fall and these altitudes are inversely as the densities Thus hydrogen gas, the lightest of all the gases, and [illegible] 0688 of that of air, would enter a va[illegible] of 4933 (= 1294 divided by the square root of 0 0688) feet in a second It is to be remarked, however, that all those laws relative to the flow of gases are rather the deductions from theory than truths derived by direct experiment

In the case of air or any gas flowing into a space containing a gas of an inferior density the velocity will be the same as that of an incompressible liquid of similar density with the effluent gas, and capable of exercising a pressure equal to the difference between the pressures of the two gases Taking for example the case of a gas flowing from a gasometer into the atmosphere let $h$ denote the height of the barometer, and $h + H$ that of the column of mercury exercising a pressure equal to the elasticity of the effluent gas, so that H is the difference of the two pressures Also let $\Delta$ denote the density of mercury $d$ that of the gas in the gasometer corresponding to the pressure $h + H$, and $v$ the velocity per second, then

$$v = \sqrt{\left(2g\,H\,\frac{\Delta}{d}\right)} = 8\sqrt{\left(H\,\frac{\Delta}{d}\right)}$$

Now if, in the formula $p = k\,d\,(1 + a\,t)$ we substitute the pressure in the gasometer $(h + H)\,\Delta$ for $p$ and also for $k$ its value as above determined in feet, this expression will become

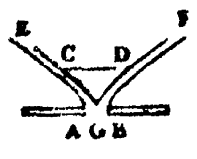
$$v = 1294\sqrt{\left\{\frac{H}{h + H}\,(1 + a\,t)\right\}}.$$

where $v$ is expressed in feet If, therefore, A denote the area of the orifice in feet, the volume or number of cubic feet discharged in a second will be $v\,A$ It is to be observed that the volume thus determined is the volume of a gas of the same density as in the gasometer if it were required to find the number of cubic feet at a different density corresponding to the pressure of a mercurial column whose height $= h'$ it would be necessary to multiply the above expression by the ratio $(h + H) - h'$

From the experiments of D'Aubuisson it has been ascertained that air in passing through an orifice pierced in a thin plate, forms a *vena contracta* whose area as in the case of a liquid, is 0·65 of the area of the orifice The application of cylindric adjutages increases the quantity passing through the orifice to 0·93, and a conical tube to [illegible] The length of the adjutage may be 20 or 30 times the diameter of the orifice before the discharge begins to be diminished by friction If therefore, we suppose the gas to flow through a cylindric tube, and assume the multiplier 0·93, and also express the area of the orifice in terms of the diameter of the tube which we shall suppose $= m$ feet, then observing that $4\,A = 3\,14159\,m^2$, the formula for the number of cubic feet discharged in a second, the density being measured by $h + H$, will become

$$\cdot 845\,m^2\sqrt{\left\{\frac{H}{h + H}\,(1 + a\,t)\right\}}$$

The principle of the lateral communication of motion holds good with respect to the gases as well as the liquids On this principle we may explain a curious fact observed in the efflux of air from a blowing machine, and in the escape of steam from the valves of boilers If a circular disk of four or five times the diameter of the orifice be placed close to it, not only will it not be forced away by the current of the elastic fluid but it will be retained by a considerable force, insomuch that if the orifice be directed downwards, the disk though formed of a dense metallic substance will be supported in opposition to its gravity For [illegible] force through the aperture A B have its [illegible] (C D) [illegible] [illegible] A B [illegible] vity F G F At first the space C G D will be filled with the effluent air, but if a lateral communication of motion takes place, the air in this cavity will join itself to that which escapes by the edges of the plate, and a vacuum be formed in the space C G D, and the plate C D be forced towards the aperture by the pressure of the atmosphere on the opposite side But as it approaches the orifice the action of the effluent air will become more intense, and the dimensions of the void space be diminished, so that the plate will assume a position in which the forces tending to move it in opposite directions will be balanced




It has been demonstrated by Newton, in the second book of the *Principia* that the velocity with which sound is propagated through the air is the same as that which a heavy body would acquire by falling through *half* the height of the homogeneous atmosphere and consequently equal to $8\sqrt{1\cdot375}$ or about 917 feet per second But this theoretical determination is found to differ considerably from experiment, which gives a velocity of 1125 feet per second when the temperature of the air is at 62° of Fahrenheit's thermometer Laplace suggested a very probable explanation of this discrepancy, namely, that the condensation caused by the vibrations produced a degree of sensible heat by which the elasticity of the air is increased, or, rather, the density diminished, while the elastic force remains the same In consequence of this extrication of heat the number given by the formula of Newton must be multiplied by the square root of the number which expresses the ratio of the specific heat of the air under a constant pressure to its specific heat under a constant volume This number is found by experiment to be 1 375, the square root of which is 1 173 and on applying this correction, with the proper corrections for temperature, the theoretical determination does not differ very widely from the experimental result *See* SOUND

Pneumatics forms a branch of physical science which has been entirely created by modern discoveries Galileo first demonstrated that air possesses weight His pupil Torricelli invented the barometer, and Pascal, by observing the difference of the altitudes of the mercurial column at the top and the foot of the *Puy de Dome*, proved that the suspension of the mercury is caused by the pressure of the atmosphere Otto Guericke, a citizen of Magdeburg, invented the air pump about the year 1654, and Boyle and Mariotte, soon afterwards detected by its means the principal mechanical properties of atmospheric air Analogous properties have been proved to belong to all the other aeriform fluids The problem of determining the velocity of their vibrations was solved by Newton and Euler, but more completely by Lagrange The theoretical principles relative to the pressure and motion of elastic fluids, from which the practical formulæ are deduced were established by Daniel Bernoulli, in his *Hydrodynamica* (1738), but have been rendered more general by Navier (*Mem de l'Acad* 1830) The experiments of D'Aubuisson, above referred to, are given in different volumes of the *Annales de Chimie* (1826, 1828 1829) *See* GAS, RESISTANCE VAPOUR

PNEUMATIC RAILWAY *See* RAILROAD

PNEUMATO'MACHI (Gr πνευμα, *spirit*, and μαχη, *contest*) In Ecclesiastical History, a name of reproach, given by the orthodox to those various classes of heretics who in the fourth and fifth centuries, impugned the divinity of the Holy Ghost *See* MACEDONIANS

PNEUMATO'SIS (Gr πνευματοω *I inflate*) Emphysema A collection of air in the cellular membrane, rendering the part tumid, elastic, and crepitating when pressed It rarely arises spontaneously, but generally from some wound which affects the lungs, and by which the air spreads through the cellular membrane In some rare cases it is an effect of certain poisons

PNEUMOBRAN'CHIATES, *Pneumobranchiata* (Gr πνευμα, *air*, βραγχια *gills*) A name applied by Hunter to the Perennibranchiate reptiles of recent zoologists, and by Lamarck to an order of Gastropodous mollusks

PNEUMO'NIA, or PNEUMONITIS An inflammation of the lungs This disease generally attacks those of robust habit after exposure to the cold or wet, and suppressed perspiration it is sometimes produced by any inordinate exertion of the lungs Fever, cough, difficult breathing, a strong hard and quick pulse usher in the disease, which if neglected, sometimes proceeds so rapidly as to end in suffocation, it may also prove fatal by terminating in suppuration and gangrene A free and abundant expectoration, perspiration or diarrhœa, are favourable symptoms of its termination in resolution Large bleeding at the outset, repeated however, with much circumspection local bleeding purges, and diaphoretics of calomel and [illegible] doses of opium, hemlock [illegible] he cough and procure sleep, constitute the leading principles of treatment

PNEUMO'THO'RAX (Gr πνευμα, and θωραξ, *chest*) An accumulation of air in the sac of the pleura

POA (Gr ποη, *grass*) A name given by botanists to a genus of grasses of considerable extent and very abundant in the pastures of Europe One of the commonest of all weeds is the *Poa annua* *Poa trivialis* and *pratensis* are other species, sown extensively as a part of the artificial pastures and lawns, which are now commonly made with picked grasses instead of "hay seeds" In general, they appear to be nutritious and agreeable to cattle

POACHERS *See* GAME LAWS

POCO (Ital) In Music, a word frequently prefixed to another to lessen the strength of its signification, as *poco largo*, a little slow

PO'DAGRA (Gr ποους, *the foot*, and αγρα, *a seizure*) *See* GOUT

**PODESTA** One of the chief magistrates of Genoa and Venice is so called

**PODIA'TIA** (Gr *πους a foot*) The stalk-like elongations of the thallus, which, in certain lichens, support [illegible] *yce*

[illegible] (Gr *foot*) A genus of birds, [illegible] ed in the order of Palmipeds by Cuvier, but forming the transition from the waders to the swimmers by having the webs of the toes incomplete and formed by a scalloped membrane, as in the coot The legs are, however, placed far back, so as to render them efficie[illegible] use in [illegible] In[illegible] s proper[illegible] [illegible] lotero[illegible], the fe[illegible] through the water, and[illegible] it swims [illegible] the feet with a simultaneous action of its wings, but these, like the pectoral fins of fishes, serve mainly to direct and vary the course of the bird.

**PODIUM** (Lat) In Architecture, the part in an amphitheatre projecting over the arena, above which it was raised about 12 or 15 feet in this part sat the personages of distinction The word is also used to signify a balcony

**PŒ'CILE** (Gr) A celebrated portico or gallery at Athens, where Zeno inculcated his doctrines The Poecile was adorned with the statues of gods and benefactors, and the picture of Polygnotus, so well known to the classical reader, which represented Miltiades at the head of the 1000 Greeks at the battle of Marathon, was here [illegible]

**POECILOPODS** *Pœcilopoda* (Gr *ποικιλος varied*, and *πους, a foot*) The name of an order of Entomostracous Crustaceans, including those which have feet of different forms and uses, the anterior ones being ambulatory or prehensile, the posterior branchial and natatory

**POETRY** (Gr *ποιησις, a poem*, and *ποιητικη τεχνη the art of poetry*, from *ποιεω, I make* according to Aristotle, because the writers of each different class of poems epic, elegiac, &c, were said, in common language, to "make" them, and called *ποιηται ελεγειοποιοι epic-* [illegible] *Poet* sec III) To produ[illegible] definition of poetry has been, hitherto unsuccessfully attempted by writers on taste, and by poets themselves A popular one sufficiently adapted to general notions, is furnished by the *doyen* of living critics, Lord Jeffrey — 'The end of poetry is to please, and the name, we think, is strictly applicable to every metrical composition from which we derive pleasure without any laborious exercise of the understanding (*Ed Rev* xi p 216) But in the first place it has been truly observed, that "verse is the limit by which poetry is bounded it is the adjunct of poetry, but not its living principle' —"Poetry, says Coleridge, 'is not the proper antithesis to prose but to scien[illegible] P[illegible] science, and prose to metre"—'[illegible] object of science is the acquirement or communication of truth, the proper and immediate object of poetry is the communication of immediate pleasure' In the next place, Lord Jeffrey's definition would clearly include burlesque composition Is this strictly *poetry*? It was intended certainly in their rather artificial analysis of poetry by ancient critics in the *Poetics* of Aristotle the rules of comic composition are as elaborately laid down as those of any other species Yet the excitement of the ridiculous is altogether of a different nature from that produced by poetry in the modern sense of the word which is [illegible] tender [illegible] feeling [illegible] ing to the reader that pleas[illegible] state and degree of excitement which arises in the poet himself in the act of composition (*Literary Remains*) The end of poetry, then appears to be to produce intellectual pleasure by exciting emotions either of the elevated or pathetic order But in what mode does poetry effect this? The sight of a distressed object raises tender feelings, a tale of distress does the same to be witness of some stupendous event, [illegible] and so does [illegible] scription is not poetry Some dramas, almost utterly destitute of poetical merit, retain a hold on theatrical audiences merely because they are transcripts of painful scenes actually occurring in domestic life But these are not poetry, although constantly mistaken for it So again, the mere narration of a grand and surprising circumstance is not poetry, however akin to poetical the emotion it inspires Few passages in poetry retain a greater hold on the imagination than the well-known accounts of [illegible] the fires of Moscow, or the [illegible] or the execution of Charles the First, or mere descriptions of the Alps or Niagara the most prosaic writer who treats these subjects if he only adhere to truth and bring out the actual particulars can be sure of producing an effect which may be termed as regards the reader, poetical, but not by the employment of poetry This consideration leads us to its great characteristic It is essentially a creative art: its operation is "making," not transcribing "Imitation" it is, as Aristotle defines it; not because it copies, but because it has its model in nature, and [illegible] it without losing its charac[illegible] Lord Bacon explains by saying, that poetry "doth raise and erect the mind, by *submitting the shows of things to the desire of the mind*" The imagination alters these "shows of things" by adding or subtracting qualities and poetry produces to view the forms which result from the operation

But Lord Jeffrey goes on, in the passage which has been already quoted to give an analysis of the elements of poetical pleasure, which appears to us singularly clear and accurate "This pleasure arises, in general, be analysed into three parts that which we receive from the excitement of passion or emotion, that which is derived from the play of imagination, or the easy exercise of reason, and that which depends on the character and qualities of the diction" The two first are the vital and primary species of poetical delight And this analysis may lead us to consider the faculties by the exercise of which these several pleasures are produced, — faculties widely different, yet all poetical, some of them more and some less essential to the production of poetical pleasure, some less and some more conspicuous in different poets, all united in hardly any

1 Imagination is, emphatically, the great poetical faculty It is 'the first moving or creative principle of the mind, which fashions out of materials previously existing new materials and original truths" It is 'a complex power, including those faculties which are called by metaphysicians conception, abstraction, and judgment" the first enabling us to form a notion of objects of perception and knowledge, the second "separating the selected materials from the qualities and circumstances which are connected with them in nature," the third selecting the materials (*Stewart* see the article "Poetry" in the *Encycl Britannica*) Its operations are most various, and it exhibits itself in poetry in very different degrees and forms It may shine here and there, chiefly in comparison, or in bold and pleasing metaphor breaking the chain of a narrative, as in Homer and the earlier poetry of most nations, [illegible] connected only by those exqui[illegible] links of thought which are present in the mind of the poet, in daring, compressed, rapid language, as if language were inadequate to its expression, as in the inspired prophets, in Æschylus and often in Shakspeare, it may predominate in entire sustained conceptions, grasping at general features, as in Milton, it may cling more closely to the "shows of [illegible] lling in particulars reproducing with start[illegible] images little altered, graphic, and minute, as in Dante, and here it often approaches to fancy Imagination combined in a greater or less degree with thought or reflection but with little of the other poetical qualities produc[illegible] which suits the taste of a refined and [illegible] has[illegible] hold on the general mind [illegible] rules from Milton in being, if simple, neither "sensuous nor passionate" of which striking examples may be found in Wordsworth, and sometimes in Goethe the writer of a very different cast

2 No distinction has given critics more trouble, in the way of definition than that between imagination and fancy "Fancy' it has been said, 'is given to beguile and quicken the temporal part of our nature, imagination to incite and support the eternal" — 'The distinction between fancy and imagination," says another, "is simply that the former altogether changes and remodels the [illegible] something extraneous, [illegible] but associates it with things to which in some view or other it bears a resemblance" Now the latter is an operation of thought, wit, or judgment, and this perhaps will lead us to a right conclusion The poetry of true fancy is merely that of imagination "at a lower point of excitement" or employed on less elevated subject matter The poetry of the *Midsummer Night's Dream* for instance, may be termed either imaginative or fanciful with equal correctness But there is also a spurious fancy the offspring of a quick wit adopting poetical diction are we wrong in calling this the real quality of one of the most charming of modern poets whose wit is very nearly allied to imagination, yet not the same, — Thomas Moore?

3 Lord Jeffrey as we have seen, associates with the pleasure of imagination tha[illegible] [illegible] exercise of reason" This is [illegible] by the faculties of thought, wit, and ref[illegible] It may be doubted whether the expression of thought however energetic and acute, clad in current poetical diction is really poetry Certainly it is so, if at all, in a very inferior degree to that of the imagination And yet whe[illegible] we reflect how much of the pleasure which we derive from verse is of this kind, how many of the greatest names in the history of poetry have [illegible] gained for this alone and that one [illegible] (as the French) seems to have placed its idea of poetry entirely in the expression of thought and feeling, and chiefly the former, we can scarcely refuse it an important place It also takes many

shapes. It appears in the form of witty or acute conceits, as in Donne and Cowley, and many French and Italian poets, nearly allied to that spurious fancy of which we have spoken It lightens in flashes of high-minded indignation or keen sarcasm in Juvenal assumes a still loftier moral tone in Persius, and often in Dryden mixed with grave, energetic, powerful reflection It takes the easier tone of acute knowledge of the ways of man, and light satire in the pages of Horace and enlivens the charming narrative of Ariosto It often assumes a rhetorical character, as in Corneille and Lucan There is a trivial experiment by which the difference between this and imaginative poetry may be tested Turn both into prose, the latter retains its poetical character, the former seems to lose it

4. The expression of passion, sentiment, or pathos, is the most common and universal of all sources of poetical pleasure It is the very soul of all early and simple poetry, it pervades no less that of the most civilized communities Yet this class of poetry is less truly and emphatically poetical than the imaginative, although more popular The pleasure occasioned by it is of a mixed nature it arises from the excitement of peculiar sympathies, not produced, but heightened only by the form in which that excitement is conveyed This is the reason why mere popularity is not a test of the excellence of poetry The uncritical reader calls that the best poetry by which he is best pleased Devotional poetry, for instance appeals to an elevated and universal class of sympathies, and on this account often passes for worth more than, as poetry, it really is The highest attribute of a poet in this branch of the poetical faculty is a sensibility to all the springs of our passions, joined with the art of expressing it, these, when united with that power of personification which is more peculiarly the dramatic faculty, produce the drama in its highest and noblest shape, such as it is exhibited by Shakspeare and by him alone But the power of giving language to the sentiments of any common and elevated passion is by itself a great poetical merit The passion of love is the staple of numberless bards The passion for war or conflict unhappily natural to man is a source of poetry it is impossible not to perceive in Homer and Scott independently of their art of narration and energy of description an exultation in the animal excitement of the imaginary battle the *certamina gaudia* [illegible] peculiarly and intensely poetical [illegible] of love the natural propensity to exhibit self to self in a romantic or elevated point of view forms a great part of the charm of such a muse as that of Byron Again independently of the direct expression of feeling there is in some poets a general colouring derived from it thrown as a light veil over all the objects presented, which is a singularly attractive attribute Such is the tinge of grave and serious tenderness which shades the poetry of Sophocles and Virgil, and assumes, perhaps, a more feminine character in that of Tasso

These are the most [illegible] subjective qualities of true poetry [illegible] a more objective character which can scarcely be said to belong to it strictly *as* poetry, and yet can scarcely be excluded from a general review

5. The dramatic faculty of which we have already spoken seems to consist in acute powers of observation of the varieties of human character together with the rarer power of delineating it with such force as to bring the imaginary person distinctly before the reader It is the wonderful and unique characteristic of Shakspeare in whom all individuality, as has been often observed seems absolutely lost If we are to look for a second to Shakspeare in this high faculty, we shall find him among poets, only in Scott But it is a power often much developed in writers who are not poets in any sense such as Le Sage and De Foe

6. The descriptive faculty is of the same kind that of bringing the objects of external nature or passing scenes of whatever sort, vividly before the reader's fancy When the objects or scenes so represented are such as the painter might choose with advantage for the exercise of his art, the faculty is properly termed picturesque, though that word is often of a looser acceptation It is obvious that this also is a faculty common to poets, with many others who are not so, but sustained energy of description, as in Homer, forms a magnificent ground work for strictly poetical ornament In the poetry of modern times especially in this country and in Germany, the description of external nature has been made subservient to the purposes of imagination and reflection by writers of high genius, and this combination peculiarly characterizes the taste of the age

7. Lord Jeffrey ranks last the pleasure derived from diction, as of a secondary order which it undoubtedly is, and yet almost essential The highest poetry, without beauty of style, is rarely or never popular We have no [illegible] this peculiar quality, but, [illegible] it may suffice to observe that Virgil [illegible] poets, he of whose charm the greatest proportion is derived from simple beauty and felicity of diction, through a whole range of ill-chosen subjects, always graceful always equable and as nearly approaching to faultlessness as human skill can construct

8. Lastly we must not omit the pleasure of *melody* not essential to poetry since there may be poetry without verse, not always a merit of the poet's own, since much depends on the language, — and a Greek or Italian poet, cæteris paribus, will ever be preferable to an English or German one, on this account alone, but a grace which heightens the charm of the noblest poetry, and sometime[illegible] the most indifferent

P[illegible]S (Gr *ποικίλος*, *variegated*) In Geology, a term applied to the new red sandstone formation in consequence of the varieties of colours which it exhibits

POI'NDING In Scottish Law a species of diligence (s[illegible] ables is [illegible] P[illegible] real or personal, the former affecting the debtor's moveables on the lands to which the debt attaches, the other his moveables generally The effect of real poinding is to give the user of it right to the rents

POINT A steel instrument used by engravers for tracing the work on a copper plate

POINT In Heraldry an ordinary somewhat resembling the pile (*see* PILE), but issuing from the base of the escutcheon instead of the chief seldom used in English, but frequently in foreign armories

POINT In Music a character used by many instead of the dash its chief use being to distinguish those notes from which an intermediate effect is required dissimilar to the dash

POINT BLANK, in Gunnery denotes the position of the gun when pointed so that its axis is parallel to the horizon *Point blank range* is the distance to which a shot fired in the *point blank* or horizontal direction is carried

POINTING, in Artillery denotes placing the gun so as to give the shot a particular direction This is usually done by help of the gunner's quadrant or level *See* LEVEL

POINTS Small flat pieces of cordage put through the sails in horizontal rows for the purpose of reefing them

POINTS OF SUPPORT in Architecture are the collected areas *on the plan* of the piers, walls columns, &c upon which an edifice rests or by which it is supported It is evident that the smaller their total area, compared with the superficies of the whole building, the greater is the skill exhibited by the architect, and this for many reasons, not the least whereof is the greater resultant economy We subjoin a table of some few buildings in Europe, examined in this respect They are arranged in the order of the ratio of their points of support whose area as well as their total superficies, are added in separate columns

| Ratio of Area to Points of Support | Edifice | Total Area in English Feet | Area of Points of Support |
|---|---|---|---|
| 0·056 | Temple of Claudius in Rome, now church of St Stefano | 36,726 | 2,051 |
| 0·100 | Church of St Sabino in Rome (destroyed) | 15,131 | 1,543 |
| 0·118 | Church of St Paul in Rome, [illegible] | 106,513 | 12,655 |
| 0·127 | [illegible] | 67,123 | 8,571 |
| 0·129 | [illegible] Naples | 22,826 | 2,944 |
| 0·139 | Church of St Giuseppe, Palermo | 26,046 | 3,611 |
| 0·140 | Church of Notre Dame, Paris | 67,313 | 8,784 |
| 0·146 | Church of St Dominico Palermo | 31,144 | 4,988 |
| 0·151 | Church of St. Sulpice, Paris | 60,760 | 9,127 |
| 0·154 | Pantheon, or Church of St [illegible] | 60,287 | 9,269 |
| 0·155 | Church of St Peter, ad Vincula, Rome | 21,520 | 3,353 |
| 0·157 | Church of St Vital, Ravenna | 7,276 | 1,142 |
| 0·163 | Temple of Juno Lucina, Sicily | 6,821 | 1,110 |
| 0·167 | Central building of baths of Diocletian, Rome | 351,636 | 58,797 |
| 0·169 | Cathedral, Milan | 12,[illegible]83 | 21,366 |
| 0·170 | [illegible] | 84,023 | 14,311 |
| 0·172 | [illegible] | [illegible] | 2,649 |
| 0·176 | [illegible] Baths of [illegible] Rome | 15,353 275,503 | 48,911 |
| 0·194 | [illegible] Girgenti, Sicily | 6,849 | 1,330 |
| 0·201 | Cathedral Sta M del Fiore, Florence | 84,802 | 17,030 |
| 0·217 | Mosque of Sta. Sophia, Constantinople | 105,200 | 22,567 |
| 0·232 | [illegible] at Rome | 34,238 | 7,954 |
| 0·235 | [illegible] Galuzzo, Rome | 9,206 | 2,167 |
| 0·261 | St Peter's, Rome | 227,069 | 59,308 |
| 0·268 | Hotel des Invalides, Paris | 29,003 | 7,790 |

POINTS OF THE COMPASS In Geography and Navigation, the points of division of the circle representing the horizon, or of the compass card over which the

magnetic needle is suspended A diameter of the circle being drawn to represent the meridian, or north and south directions and another at right angles to it to represent the directions east and west, the circle is thus divided into four quarters, each of which is subdivided into eight equal parts, so that the whole circle is divided into thirty-two equal parts, and the points of division are termed the points of the compass Each has a particular name indicating its place with reference to the four principal or *cardinal points*, namely, the north, south, east, and west points See COMPASS

POINTS OF THE ESCUTCHEON, in Heraldry, are nine These are marked by letters in the cut attached to the article HERALDRY, which is copied from those in the ordinary English works on the elements of the science They are—A, dexter chief, B, middle chief, C, sinister chief (Fr chef, *head*), D, honour point, E, fess point which is the centre of the shield (fascia *belt*, or *sash*, from the belt encircling the middle of a man), F, nombril point (navel), G, dexter base, H, middle base, and I, sinister base It will be observed, that the greater part of these names are taken from those parts of the human body which the shield was taken figuratively to represent

POI'SON (Fr *poison*) A substance which disturbs, suspends, or destroys one or more of the vital functions Poisons are classified by Orfila under the four heads of Irritants, Narcotics, Narcotico-acrids, and Putrefiants or Septics See TOXICOLOGY

POISON-FANG The superior maxillary teeth of certain species of serpents are so called, which, besides the cavity for the pulp appear to be perforated by a second longitudinal canal which is open at both ends, and receives at that next the base of the fang the termination of the duct of the poison gland The tooth essentially consists of a narrow and thin plate bent upon itself lengthwise, and with the approximated margins adherent together In some poison fangs the line of adhesion is visible along the convex side of the tooth

There is generally but one poison fang on each maxillary bone as in the viper and naia but sometimes there are a few additional teeth behind the principal fang The fang ordinarily lies recumbent, but when the serpent designs to strike with this weapon it is erected by a rotatory movement of the jaw and the poison gland is at the same time compressed and emptied of its secretion wh[illegible] hollow fang into the wound

P[illegible] [illegible]ose glands which secrete an acrid or venomous liquor which is conveyed along an instrument capable of inflicting a wound are so termed The glands at the sides of the head of poisonous serpents, those at the base of the hollow jaws of the centipede, at the aculeated tail of the scorpion, communicating with the sting of the bee or the spur of the ornithorhynchus, are examples

POLACCA A peculiar vessel with three masts navigated chiefly in the Levant and other parts of the Mediterranean

POLACRE A peculiar rig of a vessel having pole masts, no tops and sometimes no crosstrees whereby the yard and sail are lowered almost close down to the yard next below

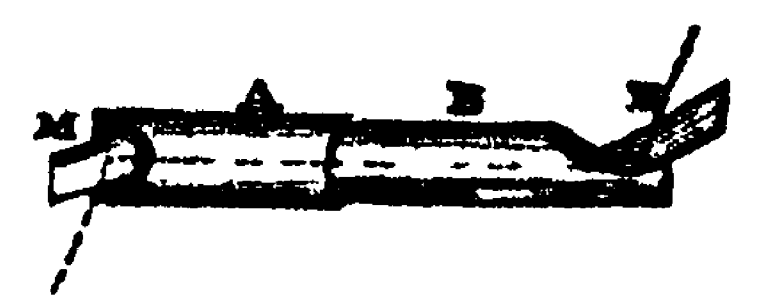
POLAR Having reference to poles, as *polar circles polar regions polar projection* &c

POLARITY In Physics that property of bodies in consequence of which, when at liberty to move freely they arrange themselves in certain determinate directions or point as it were, to given poles Thus an iron bar acquires polarity by magnetism and when suspended from a single point ar[illegible] itself in the direction of the magnetic meridian or points to the magnetic poles of the earth When light is supposed to consist of material particles emitted from the sun, it is necessary, in order to explain certain phenomena of optics to assume that the particles are endowed with *polarity* which merely signifies that the opposite sides of a particle have different physical properties See POLARIZATION

POLARIZATION OF LIGHT Light which has undergone certain reflexions or refractions, or been subjected to the action of material bodies in any one of a great number of ways acquires a certain modification in consequence of which it no longer presents the same phenomena of reflexion and trans[illegible] light which has not been subjected to such [illegible] This modification is termed the *polarization of light*, its rays being supposed, according to particular theoretical views to have acquired *poles* (like the magnet) or sides with opposite properties

The polarization of light may be effected in various ways, but chiefly in the following —1 By reflexion at a proper angle from the surfaces of transparent media, as glass, water, &c 2 By transmission through crystals possessing the property of double refraction 3 By transmission through a sufficient number of transparent uncrystallised plates placed at proper angles 4 By transmission through a number of other bodies imperfectly crystallized, as agate, mother of pearl, &c The following experiment will serve to illustrate the first of these modes and also give a clear idea of the difference between common and polarized light

Let A and B be two metallic or pasteboard tubes, open at both ends, and fitting into each so as to turn stiffly Into each of these let a piece of polished glass M N having one of its sides roughened, and blackened with melted pitch or black varnish so as to destroy its internal



reflexion, be fixed in such a position that its [illegible] of 33 degrees with the axis of the tubes Let the t[illegible] be placed so that the light from the sun or any [illegible] on the plate M shall be reflected along the axis, and let the tube A be fixed in that position The light which traverses the axis of the tube will fall on the plate N, from which it will be again reflected, and may be received by the eye, or on a screen The apparatus being thus arranged, let the tube B be turned round within A, carrying with it the reflector N, which in its revolution will always preserve the same inclination to the axis of the tube, and the ray of light reflected from N will describe a conical surface Now, on attending to the ray reflected from N, it will be observed in the course of the revolution constantly to vary in intensity at two opposite points it will acquire a maximum of intensity, and at other two opposite points, intermediate between these it will entirely disappear On comparing the positions of the reflecting planes at the occurrence of these phases it will be found that the intensity of the light is greatest when the plane N is *parallel* to M, and that there is no reflexion from N when the two planes are *at right angles* It thus appears that a ray of light reflected from the surface of glass at this particular angle of 33 is incapable of being reflected a second time from a similar surface, perpendicular to the former, at an equal angle of incidence This property is expressed by saying that the light reflected from M is *polarized in the plane of reflexion* It has in fact, acquired some property or modification, in virtue of which while it preserves the power of being again reflected in the same plane, it ceases to be subject to the ordinary law of reflexion in a perpendicular plane

If the ray reflected from M, instead of being received on a second reflecting surface N be thrown upon a crystal of Iceland spar, or any doubly refracting crystal, so placed that its principal plane (*i e* the plane passing through the direction of the ray and the shorter diagonal of the rhombus) is parallel to the plane of reflexion M, then there will only be a single refraction, the extraordinary ray will disappear and the ordinary ray alone be produced But if the face of the crystal be turned round 90° the phenomena are reversed, the extraordinary ray alone is produced and the ordinary one disappears The light therefore in consequence of its reflexion from the surface M ceases to obey the same laws of double refraction as ordinary light

When the ray reflected from M is received perpendicularly on a tourmaline plate it will present different phenomena of transmission according to the position of the axis of the plate that is, the axis of the crystal from which the plate was cut If the axis is parallel to the reflecting plane the whole of the light will be transmitted through the plate, but if the plate be turned round in its own plane until the axis becomes perpendicular to the reflecting plane no portion of the light will be transmitted

From these experiments it appears that light polarized by reflexion possesses the [illegible] characters which are invariably found to belong [illegible] polarized light in whatever way the polarization may have been produced —1 [illegible] bo[illegible] positions of the plane of incidence 2 It is incapable of undergoing division into two equal pencils by double refraction in positions of the [illegible] bodies in which a ray of ordinary light w[illegible] be so divided 3 It is incapable of being transmitted by a plate of tourmaline when incident perpendicularly upon it, in certain positions of the plate, and is readily transmitted by it in certain other positions at right angles to the former

The polarization of light by reflexion is only effected completely when the light falls on the reflecting surface at a particular angle, and it has been mentioned that, in the case of glass the angle which the direction of the ray must make with the surface is about 33°, or the *angle of incidence* (the complement of the former) must be 57°, in round numbers This angle is called the *polarizing angle* It is different for different substances, but from an extensive series of experiments with a great number of different bodies, Sir David Brewster found the following remarkably simple and beautiful relation to subsist in all cases between the [illegible] angle and the refractive power of the medium [illegible] *tangent of the polarizing angle for any medium is the index of refraction belonging to that medium*

All reflecting substances are capable of polarizing light if incident at proper angles but metallic bodies, and

bodies of very high refractive power, like the diamond, appear to do so only [illegible] reflected ray not *entirely* disappearing [illegible] when a perfectly polarized ray would be completely extinguished

When light is reflected at an angle greater or less than the polarizing angle, it is partially polarized A second reflexion in the same plane renders the polarization more complete, and, by repeating the reflexions a sufficient number of times, it may be polarized at any angle of incidence

The second method of effecting the polarization of light, above mentioned, is by transmission through doubly refracting crystals When a ray of common light is separated into two by double refraction, both the pencils at their emergence from the crystal, are found to be [illegible] polarized but in different planes, at right [illegible] other This may be proved by receiving them on a reflecting surface at the polarizing angle or by examining them through a plate of tourmaline, or by interposing a second crystal also having the power of double refraction, and in all cases each pencil will exhibit the [illegible] polarized by reflexion Let a ray of [illegible] rhomboid of Iceland spar, it will be separated into two, of which call O the ordinary ray and E the extraordinary ray Let both pencils be received on a second rhomboid and [illegible] be observed When the [illegible] positions, or have their homologous faces parallel neither [illegible] the second crystal, but O [illegible] ray, and E only an extraordinary ray On turning the second crystal round through an angle of 90°, O produces only an extraordinary ray, and E only an ordinary ray In intermediate positions each pencil is separated by the second crystal into two in the same manner as ordinary light This experiment which was first made by Huygens and accurately described by him may be made as follows — Take two pretty thick rhomboids of Iceland spar and lay them down (the one over the other) on a sheet of white paper, having a small and well-defined black spot on it When the rhomboids are so placed that their homologous sides are parallel, the spot will be seen double through the [illegible] but as if they formed one piece, both images will be equally bright, and the line which joins them will be parallel to the principal sections of the crystals This is shown at A in the figure below If we now turn round the upper crystal in the horizontal plane from left to right two new faint images will make their appearance, as at B Continuing to turn the four images will be all equally luminous, as at C where the crystal has been turned 45° As the rotation proceeds the two original images become extremely faint as at D When the crystal has been turned 90° there will again be only two images as at F two new faint images will again appear at F At G when [illegible] rants, the four will be again equally [illegible] at H they will become unequal, and at I, when the revolution is precisely 180°, they will all coalesce into one bright spot From all these appearances it follows that the ordinary ray is polarized in the principal plane of the crystal, and the extraordinary ray in a plane perpendicular to the principal plane




The phenomena produced by the polarization of light are among the most splendid and singular in the whole range of physical science They have open many new views of the constitution of natural bodies and their explanation constitutes the principal part of the theory of light The general explanation, according to the Newtonian theory of emission, is this — The molecular forces of the crystal, acting on the particles of light give them a rotatory motion round their centres of gravity, till their axes assume certain determinate positions, after which they remain at rest There are, however, cases in which the luminous particles, in traversing the crystal, assume no fixed position, but oscillate about their centres of gravity in regular periods termed by Newton *fits*, and there are even cases in which it is necessary to suppose that they are endowed with a continuous rotation In giving a rational account of these [illegible] phenomena and reducing them to calculation the [illegible] of the undulatory theory have been more successful, and the whole are connected and explained by a simple hypothesis, which may be enunciated as follows —

"Common light consists of undulations in which the vibrations of each particle are in the plane perpendicular to the wave's motion The polarization of light is the resolution of each vibration into two, one parallel to a given plane passing through the direction of the wave's motion, and the other perpendicular to that plane which become in certain cases the origin of waves that travel in different directions When we are able to separate one of these from the other, we say that the light of each is polarized When the resolved vibration parallel to the plane is preserved unaltered, and that perpendicular to the plane is diminished in a given ratio (or vice versâ), and not separated from it we say that the light is partially polarized" (*Airy's Mathem. Tracts* p 389)

The polarization of light by reflexion was accidentally discovered by Malus, a French engineer officer, in the year 1810, and the phenomena which appeared the most remarkable of any that had yet been observed, both on account of their splendour and their intimate relations with [illegible] of physical optics and the [illegible] studied [illegible] and to be varied in every possible way by M [illegible] by Biot Arago Dr Young, Sedgwick Sir Dav [illegible] ster Sir John Herschel and many others But the individual who beyond all doubt contributed most to connect them with theory, and to show their mutual relations and dependencies, was Fresnel whose success in deriving them, by à priori reasoning from the principles of the [illegible] of light, was so complete as to [illegible] truth of that theory on almost the same footing of credibility as that of gravitation itself Analogous phenomena to those of the polarization of light have been found to belong also to radiant heat Professor Forbes of Edinburgh, who has been the most successful investigator in this interesting department of physics, has shown that heat is polarized both by reflexion and refraction He has also succeeded in depolarizing heat, and thereby proved that heat possesses the property of double refraction

See Malus *Theorie de la Double Refraction*, Fresnel, *Mémoires de l Institut*, 1824, 1826 1827, Herschel's Treatise on Light *Ency Metr*, Brewster's 'Optics" *Cabinet Cyclopedia*, various papers in the *Phil Trans* from 1813 to 1819, *Airy's Math Tracts*, 2d ed 1831, and the various scientific journals

POLE In Surveying a measure of length, containing 16½ feet or 5½ yards, it is the same as *rod* Sometimes the term is used as a superficial measure, a *square pole* denoting 5½×5½ yards or 30¼ square yards

POLEMICS or POLEMICAL THEOLOGY (Gr πολεμος *war*) The same as controversial The term is not necessarily applicable to theology only but it is generally so applied and it reflects little credit on human nature that such a subject should have been treated in such a manner as the appellation indicates

POLEMOSCOPE (Gr πολεμος *war* and σκοπεω *I view*) An instrument imagined by Hevelius, for seeing objects which cannot be seen by direct vision It consists of a mirror placed obliquely in a tube or box having an opening in the side opposite the mirror so that rays from any object falling on the mirror are reflected to the eye of the spectator Hevelius chose the name of *polemoscope* because he thought the instrument might be applied, in time of war to discover what was going on in the camp of the enemy while the spectator remained concealed behind a wall or other defence and therefore could not employ a telescope Opera glasses are sometimes constructed on this principle, for the purpose of enabling a person to see others on the right or left, while he appears to look straight forward

POLES (Gr πολος) In Geometry and Astronomy the extremities of an axis of rotation of a sphere or spheroid In spheres the poles of a great circle are the extremities of the straight line perpendicular to the plane of the circle, and passing through its centre The *poles of the ecliptic* are the points about which the stars are carried by the slow motion of the precession of the equinoxes, the *poles of the equator* or *poles of the world* are the two points about which the stars perform their diurnal rotation, the *poles of the horizon* are the zenith and nadir, the *poles of the meridian* are the points of the horizon due east and west

Poles in Physics are the points of a body in which its attractive or repulsive energy appears to be concentrated Thus the *poles of a magnet* are the opposite points in which the magnetic force is collected

POLICE, is a term employed to designate those regulations which have for their object to secure the maintenance of good order, cleanliness, health, &c in cities and country districts, and it is also used to designate the description of force by which these objects are effected This force differs from military in its being commanded by civil officers, and not being under military law, but it is generally drilled and armed in a half military manner, and has a distinctive uniform The police force is employed alike to prevent and detect offences, and may be either open or secret By an open police is meant officers dressed in their accustomed uniform, and known to every body, while, by a secret police is meant officers whom it may be difficult or impossible to distinguish from certain classes of citizens, whose dress and manners they may think it expedient to assume The latter are employed that they may, without exciting the suspicion of guilty parties, or of those who are projecting some outrage, acquire their confidence, and, by making themselves masters of their secrets, secure their apprehension or prevent the outrage It is needless to say that the employment of a

police force of this description is attended with many inconveniences, and sometimes it is believed the officers have stimulated to the commission of the very offences they were employed to detect and prevent Still, however, it does not seem that it should be altogether dispensed with, and, under proper regulations, it affords not only the best means of detecting crimes, but also of preventing the commission of such as require any previous combination or arrangement

The organisation and efficiency of the police differ in different places Its expenses are usually defrayed by a rate laid on the inhabitants of the town or place where it is established The metropolitan police was newly established a few years ago, and is now a most effective force The city of London is not under the charge of the metropolitan police but is protected by a body of men, organised on the plan and in imitation of that body, but placed under the city authorities The metropolitan police amounts in all to upwards of 5,000 men

The police or constabulary force of Ireland is armed, and has more of a military than of a civil character According to recent arrangements, a lord-lieutenant is appointed to each Irish county through whom all communications to the Irish government are made The lords-lieutenant are assisted in the discharge of their duties by an indefinite number of deputy lieutenants All these officers act gratuitously, and are removable at pleasure

The constabulary force of Ireland amounted in 1850 to 12,000 men and the total expense of the force was more than 560,000*l*

**POLICY** *See* ASSURANCE

**POLISH**, *Polishing* (Lat polio, *to make smooth*) In Sculpture the operation of giving a smoothness and gloss to any surface The polishing of marble is effected by first rubbing the surface with freestone after which it is wrought upon with pumice stone, and lastly with the finest emery powder, from which the glossy surface is obtained

**POLITICAL ARITHMETIC** See STATISTICS

**POLITICAL ECONOMY** * Political science is commonly divided into two great departments One of these has for its object to ascertain and establish the principles according to [illegible] of states may be best organized, [illegible] the legislative judicial and executive departments and to assign to each its proper functions, limits, and duties, to determine to what hands, and under what conditions and limitations the supreme power may [illegible] committed and how [illegible] be selected and controlled, to decide in fine how the government under any given set of circumstances, should be framed so that it may be most likely to promote the well-being of those subjected to its authority This is what is commonly called pure politics The other department of political science has a different, more practical and not less important object in view Those engaged in its study do not inquire into the best methods of distributing political power, or of constituting the governing body, but taking them as they exist they endeavour to ascertain the [illegible] *legum* as they were termed by Bacon — [illegible] all governments however formed should act, so as to procure for their subjects the greatest amount of wealth civilisation and happiness This department of the science has received the name of political economy; and we shall endeavour, in this article to give a brief exposition of its objects and principles To enlarge on its importance would be superfluous The history of the human race proves that national prosperity or the well-being of the bulk of the people is not the exclusive attribute of any particular species or form of government It has been and may be enjoyed by all countries how different soever their political organization provided they adopt a sound system of political economy, and it can be enjoyed by none who do not Without therefore, undervaluing the other great branch of the political sciences, or that which treats of the constitution of governments, this seems to possess at least equal claims on the public attention Its leading principles and rules are applicable at all times and under all circumstances, they are equally suitable to despotic monarchies and to republics, and cannot be neglected or contemned by either without the most injurious consequences

It is in general said of political economy that its object is to ascertain the circumstances most favourable for the production of wealth, and the laws which determine its distribution among the different ranks and orders into which society is divided, and this definition seems quite unexceptionable, provided it be clearly understood that by wealth in this science is meant only those articles or products which require some portion of human industry for their production, acquisition, or preservation, and which, consequently, possess exchangeable value A commodity or product is not valuable merely because it is useful or desirable, but it is valuable when, in addition to these qualities, it can only be procured or enjoyed through the intervention of labour It cannot justly be said that food or clothes are more useful than atmospheric air, and yet they are possessed of that value in exchange of which the latter is wholly destitute The reason is, that food and clothes are not like air, gratuitous products, they cannot be had at all times in any quantity and enjoyed without any voluntary exertion [illegible] always required for their pro[illegible] or both, and as no one will voluntarily sacrifice the fruits of his industry without receiving an equivalent, they are truly said to possess exchangeable value

The production and distribution of such articles as exist, and may be obtained in unlimited quantities, independently of voluntary human agency, form no part of the investigations of the political economist. The results of the industry of man comprise the only subjects that come within the scope of his inquiries This may, indeed, be said to be the science of values, or of the circumstances which determine the production and distribution of products possessed of exchangeable value, or which will be received as an equivalent for something else which it has taken some labour to produce or obtain

The word *value* is very frequently employed to express, not only the exchangeable worth of a commodity, or its capacity of exchanging for other commodities, but also its *utility*, or capacity of satisfying our wants, or of contributing to our comforts and enjoyments But it is obvious that the utility of commodities, — that the capacity of bread, for example to appease hunger, and of water to quench thirst [illegible] different and distinct quality from the capacity of exchanging for other commodities Dr Smith perceived this difference, and showed the importance of carefully distinguishing between utility, or, as he expressed it, "value in use," and value in exchange But he did not always keep this distinction in view, and it has been very often lost sight of [illegible] There can be no doubt, indeed, that [illegible] of these opposite qualities has been one of the principal causes of the confusion and obscurity in which many branches of the science not in themselves difficult, have been involved When, for example it is said that water is highly valuable a very [illegible] is attached to the phrase from what is a [illegible] when it is said that gold is valuable Water is indispensable to existence, and has therefore a high degree of utility, or of "value in use" but as it can generally be obtained in large quantities without much labour or exertion, it has in most places but a very low value in exchange Gold, on the contrary is of comparatively little utility, but as it exists only in limited quantities, and requires a great deal of labour on its production, it has a comparatively high exchangeable value and may be exchanged or bartered for a proportionally large quantity of most other things Those who confound qualities so different must obviously arrive at the most erroneous conclusions And therefore to obviate all chance of error from mistaking the sense of so important a word as value, it is better not to use it except to signify exchangeable worth, or value in exchange and to employ the word *utility* to express the power or capacity of an article to satisfy our wants or gratify our desires

Capacity of appropriation is indispensably necessary to make any thing wealth A man is not said to be wealthy because he has an indefinite command over atmospheric air the rays of the sun or the articles with which, in common with others, he is gratuitously furnished by nature, for this being a privilege which he enjoys in common with every one else, can form no ground of distinction but he is said to be wealthy according to the degree in which he can afford to command those necessaries, conveniencies, and luxuries that are not the gifts of nature, but the products of human industry

The proper meaning to be attached to the term wealth being thus ascertained, we shall now proceed to show that labour is the only source of wealth, and having done this, we shall next inquire into the means by which labour may be rendered most efficient, that is into the means by which the greatest amount of wealth may be obtained with the least expenditure of labour when this inquiry is completed, we shall have exhausted that great department of the science which treats of the production of wealth

### I PRODUCTION OF WEALTH

1 *Labour the only Source of Wealth* — It may be necessary, perhaps, to observe at the outset, that by production in this science, is not meant the production of matter that being the exclusive attribute of Omnipotence, but the production of *utility* and consequently of value, by appropriating and modifying matter already in existence, so as to fit it to satisfy our wants and contribute to our enjoyments Nature spontaneously furnishes the matter of which all commodities are made, but until labour has been applied to appropriate that matter, or to

* Economy, from οικος, *a house or family*, and νομος, *a law* Hence, political economy may be said to be to the state what private economy is to a single family

adapt it to our use it is wholly destitute of value, and is not, nor ever has been, considered as forming wealth Were we placed on the banks of a river or in an orchard, we should infallibly perish of thirst or hunger, unless by an effort of industry we raised the water to our lips, or plucked the fruit from its parent tree It is seldom, however, that the mere appropriation of matter is sufficient In the vast majority of cases, labour is required not only to appropriate it, but to convey it from place to place, and to give it that peculiar shape without which it may be totally useless and incapable of administering either to our necessities or our comforts The coal used in our fires is buried deep in the bowels of the earth, and is absolutely worthless until by the labour of the miner it has been extracted from the mine, and

[illegible]

ranged and shaped material that have been fashioned to the various articles of convenience and ornament with which they are furnished were in their original state, destitute alike of value and utility And of the innumerable variety of animal vegetable and mineral products which form the materials of our food and clothes, none were originally serviceable while many were extremely noxious to man The labour that has subdued their bad qualities, that has given them utility and fitted them to satisfy our wants and to minister to our comforts and enjoyments, is plainly therefore the only source of wealth "Labour" to use the words of Adam Smith, "was the first price, the original purchase-money, that was paid [illegible] It was not by gold or by silver, but by labour [illegible] wealth of the world was originally purchased" — (*Wealth of Nations*, b 14)

Those who observe the progress and trace the history of the human race in different countries and states of society, will find that their comfort and happiness have in all cases been principally dependent on their ability to appropriate the raw products of nature and to adapt them to their use. The savage whose labour is confined, like that of the Australian to the gathering of wild fruits or of the fish on the sea coast is placed at the very bottom of the scale of civilization and is in point of comfort decidedly inferior to many of the lower animals The *first* step in the progress of society is made when man learns to hunt wild animals, to feed himself with their flesh and clothe himself with their skins But labour when confined to the chase, is extremely barren and unproductive Tribes of hunters, like beasts of prey whom they closely resemble in their habits and modes of subsistence, are but thinly scattered over the countries which they occupy, and notwithstanding the fewness of their numbers any unusual deficiency in the supply of game never fails to reduce them to the extremity of want The *second* step in the progress of society is made when the tribes of hunters and fishers devote themselves like the ancient Scythians and modern Tartars to the domestication of wild animals and the rearing of flocks The subsistence of herdsmen and shepherds is much less precarious than that of hunters, but they are almost entirely destitute of the various comforts and elegancies that give to civilized life its chief value The *third* and most decisive step in the progress of civilization, in the great art of producing the necessaries and conveniences of life, is made when the wandering tribes of hunters and shepherds renounce their migratory habits and become agriculturists and manufacturers It is then that man begins fully to avail himself of his productive powers He then becomes laborious, and by a necessary consequence his wants are then, for the first time, fully supplied, and he acquires an extensive command over the articles necessary for his comfort as well as his subsistence

The importance of labour in the production of wealth was very clearly perceived by Locke In his *Essay on Civil Government*, published in 1689 he has entered into a lengthened, discriminating and able analysis to show that it is from labour that the products of the earth derive almost all their value "Let any one consider," says he, "what the difference is between an acre of land planted with tobacco or sugar, sown with wheat or barley, and an acre of the same land lying in common, without any husbandry upon it, and he will find that the *improvement* of labour *makes* the far greater part of the value I think it will be but a very modest computation to say, that of the products of the earth useful to the life of man, *nine tenths* are the effects of labour, nay, if we will rightly estimate things as they come to our use, and cast up the several expenses about them what in them is purely [illegible] to labour, we shall find that [illegible] *hundredths* are wholly to be put on the account of labour

"There cannot be a clearer demonstration of any thing than several nations of the Americans are of this, who are rich in land, and poor in all the comforts of life; whom nature having furnished as liberally as any other people with the materials of plenty, *i e* a fruitful soil apt to produce in abundance what might serve for food, raiment, and delight, yet, for want of improving it by labour, have not one hundredth part of the conveniences we enjoy; and the king of a large and fruitful territory there feeds, lodges, and is clad worse than a day labourer in England

"To make this a little clearer, let us but trace some of the ordinary provisions of life through their several progresses before they come to our use, and see how much they receive of their value from human industry Bread, wine, and cloth are things of daily use and great plenty, yet, notwithstanding acorns, water, and leaves or skins must be our bread, drink, and clothing, did not labour furnish us with these more useful commodities, for whatever bread is more worth than acorns, wine than water and cloth or silk than leaves, skins, or moss, that is solely owing to labour and industry the one of these being the food and raiment which unassisted nature furnishes us with, the other provisions which our industry and pains prepare for us, which how much they exceed the other in value when any one hath computed, he will then see how much labour makes the far greatest part of the value of things we enjoy in this world And the ground which produces the materials is scarce to be reckoned in as any, or at most but a very small part of it so little that even amongst us land that is wholly left to nature, that hath no improvement of pasturage, tillage, or planting is called as indeed it is *waste*, and we shall find the benefit of it amount to little more than nothing

An acre of land that bears here twenty bushels of wheat and another in America which, with the same husbandry would do the like are without doubt, of the same natural intrinsic value (utility) But yet the benefit mankind receives from the one in a year is worth five pounds and from the other possibly not worth a penny, if all the profit an Indian received from it were to be valued and sold here, at least I may truly say, not one thousandth It is labour then which puts the greatest part of value upon land without which it would scarcely be worth anything It is to that we owe the greatest part of all its useful products, for all that the straw bran, bread, of that acre of wheat is more worth than the product of an acre of as good land which lies waste, is all the effect of labour For it is not barely the ploughman's pains the reaper's and thrasher's toil, and the baker's sweat is to be accounted into the bread we eat, the labour of those who broke the oxen who digged and wrought the iron and stones, who felled and framed the timber employed about the plough mill oven or any other utensils which are a vast number, requisite to this corn, from its being seed to be sown to its being made bread must all be charged on the account of *labour* and received as an effect of that nature and the earth furnished only the almost worthless materials as in themselves It would be a strange catalogue of things that industry provided and made use of about every loaf of bread before it came to our use if we could trace them, iron wood, leather, bark timber stone bricks, coals, lime cloth, dyeing drugs pitch tar masts ropes and all the materials made use of in the ships that brought away the commodities made use of by any of the workmen to any part of the work, all which it would be almost impossible, at least too long to reckon up"

Mr Locke has here all but established the fundamental principle upon which this science rests Had he carried his analysis a little further, he could not have failed to perceive that neither water, leaves skins nor any one of the spontaneous products of nature has any *value* except what it owes to the labour required for its appropriation The utility of such products makes them be demanded, but it does not give them value this is a quality which can be communicated only through the agency of voluntary labour of some sort or other An object which it does not require any portion of labour to appropriate or to adapt to our use may, like atmospherical air be of the very highest utility, but as it is the free gift of nature, it is quite impossible it should have the smallest value

That commodities could not be produced without the co-operation of the powers of nature, is most certain We are very far, indeed, from wishing to depreciate the obligations we are under to our common mother, or to exalt the benefits man owes to his own exertions by concealing or underrating those which he enjoys through the bounty of nature But it is the [illegible] characteristic of the services rendered by the [illegible] that they are *gratuitous* They are infinitely useful, and they are, at the same time, infinitely cheap They are not, like human services, sold for a price, they are merely [illegible] When a fish is caught, or a tree is felled, do the Nereids, or wood nymphs, make their appearance, and stipulate that the labour of nature in producing it should be paid for, before it be carried off and made use of by man? When the miner has dug his way down to the ore, does Plutus interpose to prevent its appropriation? Nature is not, as so many would have us to suppose frugal and grudging Her rude products, and her ca-

pacities and powers, are all offered freely to man She neither demands nor receives a return for her favours Her services are of [illegible] utility, but being granted freely and [illegible], they are wholly destitute of value, and are [illegible] the power of communicating [illegible]

The utility of water, or its capacity to slake thirst, is equal at all times and places, but as this quality is communicated to it by nature, it adds nothing to its value which is, in all cases, measured by the labour required for its appropriation A very small expenditure of labour being required to raise water from a river to the lips of an individual on its banks its value under such circumstances, is very trifling indeed But when, instead of being upon its banks, the consumers of the water are five, ten, or twenty miles distant, its value, being increased proportionally to the greater expenditure of labour upon its conveyance, may become very considerable This principle holds universally The utility of coal, or its capacity of furnishing heat and light makes it an object of demand, but this utility being a free gift of nature, has no influence over its value or price this depends entirely on the labour required to extract the coal from the mine, and to convey it to the consumers

"Si je retranche," to use a striking illustration of this doctrine given by M Canard, 'de ma montre, par la pensée, tous les travaux qui lui ont été successivement appliqués, il ne restera que quelques grains de mineral placés dans l'intérieur de la terre, d'où on les a tirés, et où ils n'ont aucune valeur De même, si je décompose le pain que je mange, et que j'en retranche successivement tous les travaux successifs qu'il a reçus il ne restera que quelques tiges d'herbes graminées, éparsés dans des deserts incultes, et sans aucune valeur

It is true that natural powers and products may sometimes be appropriated or engrossed by one or more individuals to the exclusion of others and those by whom they are so engrossed may exact a price for them but does that show that they cost the engrossers any thing? If A have a waterfall on his estate, he may probably, get a rent for it It is plain however that the work performed by the waterfall is as completely gratuitous as that which is performed by the wind that acts on a windmill The only difference between them originates in this, — that all individuals having it in their power to avail themselves of the services of the wind no one can intercept the bounty of nature and exact a price for that which she freely bestows, whereas A by appropriating the waterfall, and consequently acquiring a command over it has it in his power to prevent its being used at all, or to sell its services He can oblige B C and D to pay for liberty to use it but as they pay for that which costs him nothing he gains the *whole* that they lose, so that the services rendered by the waterfall are still so much clear gain — so much work performed gratuitously for society

Had Mr Senior attended to this principle he would not have made the strange supposition that if aerolithes consisted wholly of gold they would according to the principles now explained be destitute of value * If, indeed they were so very abundant as to supply every one with as much gold as he desired they would have no value whatever, other than what they might derive from the trouble of gathering them, but if they existed only in limited quantities and were quite incapable of supplying the demand for gold the fortunate finder of one of them would be able to sell it or exchange it for the same quantity of produce it would have commanded had it been produced, like other gold by the labour of the miner, smelter &c But it is obvious that its value is in this case derived from circumstances which though extrinsic to itself depend wholly on the expenditure of labour and that, in fact it is measured or determined by the labour required to produce gold under ordinary circumstances precisely in the same way that the value of the waterfall is determined by the quantity of labour it will save to the party by whom it is bought or rented

Labour, therefore, is the sole source of exchangeable value, and, consequently, of wealth It is the talisman that has raised man from the condition of the savage — that has changed the desert and the forest into cultivated fields, that has covered the earth with cities and the ocean with ships, that has given us abundance comfort and elegance instead of want, misery, and barbarism —

"A[illegible]
[illegible]
Delightful

The fundamental principle, that it is only through the agency of labour that the various articles and conveniences required for the use and accommodation of man can be obtained, being thus established, it necessarily follows, that the great practical problem involved in that part of the science which treats of the *production* of wealth must resolve itself into a discussion of the means by which labour may be rendered most efficient Every measure that has any tendency to add to the power of labour, or, which is the same thing, to reduce the cost of commodities, must add proportion[illegible] obtaining wealth and riches, while every measure or regulation that has any tendency to waste labour, or to raise the cost of commodities must equally lessen these means This, then, is the simple and decisive test by which to judge of the expediency of all measures affecting the wealth of a country, and of the value of all inventions If they render labour more productive, — if, by reducing the value of commodities, they render them more easily obtainable, and bring them within the command of a greater portion of society, they must be advantageous, and conversely Considered in this point of view, that great branch of the science which treats of the *production* of wealth will be found to [illegible] easily understood

I[illegible] applied to the raising of raw pr[illegible] of that raw produce when raised into articles of utility, convenience, or ornament, or to the conveyance of raw and wrought produce from one country or place to another, is said to be agricultural, [illegible] acquaintance with [illegible] methods of applying labour in each of these grand departments of industry, forms the peculiar and appropriate study of agriculturists, manufacturers, and merchants It is not consistent with the objects of the political economist to enter into the details of particular businesses and professions He confines himself to an investigation of the means by which labour in general may be rendered most productive, and how its powers may be increased in *all* the departments of industry

In thus endeavouring to exhibit the importance of labour and the advantages which its successful prosecution confers on man it must not be supposed that reference is made to the labour of the hand only This species indeed, comes most under our observation it is that, too, without which we could not exist and which principally determines the value of commodities It is questionable however whether it be really more productive than the labour of the mind The hand is not more necessary to execute than the head to contrive Some very valuable discoveries have no doubt been the result of accident, while others have naturally grown out of the [illegible] gradually advanced by the efforts of [illegible] These, however, have not been their only, nor, perhaps, their most copious sources and every one how little soever he may be acquainted with the history of his species is aware that we are indebted to the labour of the mind, to patient study and long continued research, for numberless inventions, some of which have made almost incalculable additions to our powers and changed, indeed, the whole aspect and condition of society

2 *Means by which Labour may be facilitated* — Having thus endeavoured to show that man is indebted to labour or industry for all those articles or products which constitute wealth or which are not freely bestowed by nature we have next to inquire into the means by which labour may be rendered most productive or by which the greatest amount of wealth may be obtained with the least labour or at the least expense

It may seem on a cursory view as if an inquiry of this sort would necessarily branch out into an infinity of details But in so far as this science, which deals only with the general principles applicable to all departments of industry is concerned such is not the case On the contrary it will be found supposing the security of property, without which there can be neither industry nor accumulation to be established that all the means by which labour may be facilitated and wealth increased resolve themselves 1st into the better division and combination of employments among individuals and nations, and, 2d, into the more extensive or more judicious application of capital or stock in industrious undertakings All the improvements that ever have been or ever will be made in the great art of producing the various necessaries, conveniences and enjoyments of human life may be classed under one or other of these heads, that is, they will be found to consist either in the better distribution of employments, or in the greater command and better application of capital W[illegible] of these means no people c[illegible] civilization And supposing pr[illegible] well protected, it will generally speaking, be found that those nations have been the w[illegible] most cultivated and refined in which [illegible] has been carried to the farthest extent, and capital been most abundant and most judiciously applied

*Division of Employments* — The division of employ-[illegible]ciety — in the rudest as well as the most improved — we may trace its operation and effects The various physical powers, talents, and propensities, with which men are endowed, fit them for different occupations, and a

* Art "Political Economy," *Encyclopædia Metropolitana*

regard to mutual interest and convenience naturally leads them, at a very early period, to establish a system of barter and a division of employments It was speedily seen that by separating and combining their efforts so as to bring about some desirable end they might with ease accomplish tasks that could not otherwise be attempted Even in the simplest businesses this co-operation is required neither hunting nor fishing, any more than agriculture or [illegible] can be advantageously carried on [illegible] Man is the creature of society, and is compelled, in every stage of his progress, to, depend for help on his fellows — *Quò alio fortes sumus quàm quod mutuis juvamur officiis?* Instead of trusting to his own unaided efforts for a provision of the various articles required for his subsistence, comfort, and security he instinctively associates himself with others and finds in this association the principal source of his superior power Perceiving that he can obtain an incomparably greater command of all that he deems useful or desirable by applying himself in preference to some one department [illegible] he limits his attention to it only As society advances this division extends itself on all sides one man becomes a tanner or dresser of skins, another a shoemaker, a third a weaver, a fourth a house-carpenter, a fifth a smith and so on, one undertaking [illegible] one the distribution [illegible] ultivate and bring to perfection whatever talent or genius he may possess for the particular calling in which he is engaged The wealth and comforts of all classes are in consequence prodigiously augmented In countries where the division of labour is carried to a considerable extent agriculturists are not obliged to spend their time in clumsy attempts to manufacture their own produce and manufacturers cease to interest themselves about the raising of corn, and the fattening of cattle The facility of exchanging is the vivifying principle of industry it stimulates agriculturists to adopt the best system of cultivation and to raise the largest crops, because it enables them to exchange whatever portion of the produce of their lands exceeds their own wants for other commodities contributing to their comforts and enjoyments, and it stimulates manufacturers and merchants to increase and improve the quantity variety and quality of their goods that they may thereby obtain greater supplies of raw produce A spirit of industry is thus universally diffused, and that apathy and lethargy which characterize a rude state of society entirely disappear

But the facility of exchanging or the circumstance of being able readily to barter the surplus produce of our own labour for such parts of the surplus produce of other people's labour as we may desire to obtain and they may choose to part with is not the only advantage of the separation of employments Besides enabling each individual to addict himself in preference to those departments which suit his taste and disposition it adds very largely to the efficacy of his powers and enables him to produce a much greater quantity of useful and desirable articles than he could do were he to engage indiscriminately in different businesses Dr Smith, who has treated this subject in the most masterly manner has classed the circumstances which conspire to increase the productive powers of industry when labour is divided under the following heads — *first* the increased skill and dexterity of the workmen, *second* the saving of time which is commonly lost in passing from one employment to another, and, *third* the circumstance of the division of employments having a tendency to facilitate the invention of machines and processes for abridging and saving labour A few observations on each of these heads are subjoined

1st *With respect to the improvement of the skill and dexterity of the laborer* — It is sufficiently plain that when a person's whole attention is devoted to one branch of business, when all the energies of his mind and powers of his body are made to converge, as it were to a single point, he must attain to a degree of proficiency in that particular branch to which no individual engaged in a variety of occupations can be expected to reach A peculiar play of the muscles, or *sleight of hand* is necessary to perform the simplest operation in the best and most expeditious manner and this can only be acquired by habitual and constant practice Smith has given a striking example in the case of the nail-manufacturer of the extreme difference between training a workman to the precise occupation in which he is to be employed, and training him to a similar and closely allied occupation "A common smith," says he, "who, though accustomed to handle the hammer, has never been used to make nails, if, upon some particular occasion, he is obliged to attempt it, will scarce, I am assured, be able to make above two or three hundred nails in a day, and those too, very bad ones A smith who has been accustomed to make [illegible] has not been th[illegible] diligence, make more than eight hundred or a thousand nails in a day But I have seen several boys, under twenty years of age who had never exercised any other trade but that of making nails [illegible] when they exerted themselves, could make each of them, upwards of *two thousand three hundred nails in a day*, or nearly three times the number of the smith who had been accustomed to make them, but who was not entirely devoted to that particular business" (*Wealth of Nations*, p 4)

2d The influence of the division of labour in preventing that *waste of time in moving from one employment to another*, which must always take place when an individual engages in different occupations, is even more obvious than its influence in improving his skill and dexterity When the same person carries on different employments, in different and perhaps distant places, and with different sets of tools, he must plainly lose a considerable portion of time in passing between them If the different employments in which he is to be engaged could be carried on in the same workshop the loss of time would be less, but even in that case it would be considerable "A man," as Dr Smith has justly observed, "commonly saunters a little in turning his hand from one sort of employment to another When he first begins the new work, he is seldom very keen and hearty, his mind, as they say, does not go along with it and for some time he rather trifles than applies to good purpose The habit of [illegible] every half hour, and to apply his hand in twenty different ways almost every day of his life, renders him almost always slothful and lazy and incapable of any vigorous application even on the most pressing occasions Independent therefore, of his deficiency in point of dexterity, this cause alone must always reduce considerably the quantity of work which he is capable of performing" (*Wealth of Nations* p )

3d *With regard to the influence of the division of employments in facilitating the invention of machines, and processes for abridging and saving labour* — It is obvious that those engaged in any branch of industry will be more likely to discover easier and readier methods of carrying it on when the whole attention of their minds is devoted exclusively to it than if it were dissipated among a variety of objects But it is a mistake to suppose as has been sometimes done that the inventive genius of workmen and artificers is alone whetted and improved by the division of labour As society advances, the study of particular branches of science and philosophy becomes the principal or sole occupation of the most ingenious men Chemistry becomes a distinct science from natural philosophy the physical astronomer separates himself from the astronomical observer, the political economist from the politician, and each, meditating exclusively or principally on his peculiar department of science attains to a degree of proficiency and expertness in it which the general scholar seldom or never reaches And hence in labouring to promote our own ends, we all necessarily adopt that precise course which is most advantageous for all Like the different parts of a well-constructed engine the inhabitants of a civilized country are all mutually dependent on and connected with each other Without any previous consent and obeying only the powerful and steady impulse of self interest, they universally conspire to the same great end, and contribute each in his respective sphere to furnish the greatest supply of necessaries, luxuries, conveniences, and enjoyments

Probably however the most advantageous result of the division of labour may be found in the circumstance of its enabling manufacturers or others engaged in any complicated business or department of industry to employ work-people of very various degrees of skill and force In the cotton manufacture for example, some processes that are indispensable may be quite as well performed by children and women as by the most expert and powerful workmen It is clear however, that but for the distribution of the labour required to bring about any result among different individuals possessing the degree of skill and strength necessary in each particular part of the process none could be employed but those who possessed the skill and strength required in the most difficult and laborious, and consequently workmen at 30*s* or 40*s* a week would have to engage in tasks that might be as well or better performed by girls at 5*s* or 6*s* a week In all the great departments of industry it is of [illegible] to appropriate them exclusively to certain classes of individuals, and to perform the operations requiring less skill, or less strength, by sets of inferior labourers The [illegible] In fact, [illegible] distribution of employments is made, or with which the skill and power of the work-people are proportioned to the results to be produced (For further illustrations of this principle see *Babbage's Economy of Manufactures*, p 172 &c )

It is necessary to bear in mind that the advantages derived from the division of labour, though they may be, and in fact are, partially enjoyed in every country and state of society, can only be carried to their full extent where there is a great power of exchanging, or an *extensive market* There are an infinite variety of employments which cannot be separately carried on without the precincts of a large city, and in all cases the division becomes more perfect, according as the demand for the produce is extended It is stated by Dr Smith that ten labourers, employed in different departments in a pin manufactory, can produce 48,000 pins a day, and since his time the quantity has been more than doubled, but it is evident that if the demand were not sufficient to take off this quantity, ten persons could not be constantly employed in the business, and the division of employments in it not being carried so far, the labour would be less economically and efficiently applied and the cost of the [illegible] The same principle holds [illegible] could not be constructed in a small country having no intercourse with its neighbours The demand and competition of Europe, Asia and America have been necessary to carry the manufactures of Glasgow, Manchester, and Birmingham to their present state of improvement

*Territorial Division of Labour, or Commerce* —Besides that sort of division of labour which enables each individual in a limited society to confine himself to a particular employment, there is another and most important branch of the division of labour, which not only enables particular individuals but the inhabitants of entire districts, and even nations, to addict themselves in preference to certain branches of industry It is on this *territorial division of labour*, as it has been appropriately termed, that the commerce carried on between different districts of the same country, and between different countries is founded The variations in the situation soil climate, mineral products, &c of the different districts of an extensive country, render them more suitable for some than for other species of industry A district where coal is abundant, which has an easy access to the ocean, and a considerable command of internal navigation, is the natural seat of manufactures Wheat and other species of grain are the proper products of rich arable soils and cattle after being reared in mountainous districts are most advantageously fattened in meadows and low grounds Nothing can be more obvious than that the inhabitants of these different districts will be able by confining themselves to those employments for the prosecution of which they have some peculiar capability, to produce a much greater quantity of useful and desirable articles than they could do were they to engage indiscriminately in every possible employment Can it be doubted that a vastly greater supply of manufactured goods, corn, and cattle is produced by the inhabitants of Glasgow, the Carse of Gowrie and Argyleshire respectively confining themselves to manufactures agri[illegible] of cattle than if each endeavoured [illegible] arious products

But it is easy to see that foreign trade or the territorial division of labour between different and independent countries, contributes to increase the wealth of each in precisely the same manner that the trade between different provinces of the same kingdom contributes to increase their wealth There is a still greater difference between the productive powers with which Providence has endowed different and distant countries than there is between the productive powers of the provinces of the same country, and consequently the establishment of a free intercourse between them must be proportionally more advantageous Indeed there are a great many products, and some of them of the very greatest utility that cannot be raised, except in particular situations Were it not for commercial intercourse, we should not be able to obtain the smallest supply of tea, spices, raw cotton, raw silk, gold and silver and a thousand other equally useful and desirable commodities Providence by giving different soils, climates and natural productions to different countries, has evidently provided for their mutual intercourse and civilization By permitting the people of each to employ their capital and labour in those departments in which their geographical situation, the physical capacities of their soil, their national character and habits fit them to excel, foreign commerce or the territorial division of labour, has a wonderful influence in multiplying the products of arts and industry Where the freedom of commerce is not interfered with, each country necessarily devotes itself to such employments as are most beneficial for itself And this pursuit of individual advantage is in the highest degree conducive to the good of the whole By stimulating industry, by rewarding ingenuity, and by using most efficaciously the particular powers bestowed by [illegible] most effectively and [illegible] the mass of necessary and useful products it diffuses opulence, and binds together the universal society of nations by the common and powerful ties of mutual interest and reciprocal obligation Commerce enables each particular state to profit by the inventions and discoveries of every other state It creates new tastes and new appetites and [illegible] also gives the means and the desire of gratifying them The progress of domestic industry is accelerated by the competition of foreigners Commerce has either entirely removed or greatly weakened a host of unworthy prejudices It has shown that nothing can be more illiberal and absurd than that once prevalent dread of the progress of others in wealth and civilization, and that the true glory and real interest of each particular people will be more certainly advanced [illegible] in [illegible] ing to attain a barren pre-eminence in the bloody and destructive though necessary art of war

The influence of commerce in giving increased efficacy to labour and augmenting [illegible] wealth may be easily illustrated Thus in the case of the intercourse or territorial division of labour carried on between England and Portugal, our superior wool and our command of coal, of skilful workmen, of improved machinery, in short, of all the instruments of manufacturing industry, enable us to produce cloth at a much cheaper rate than the Portuguese, but, on the other hand, the soil and climate of Portugal being peculiarly favourable for the cultivation and growth of the grape, she is able to produce wine at an infinitely less cost than it can be produced here And hence it is obvious that England by confining herself to the manufacture of cloth in which she has a natural advantage and exchanging it with the Portuguese for wine, will obtain a vastly [illegible] supply of that commodity than if she attempted to cultivate the grape at home and Portugal, by exchanging her wine for the cloth of England, will obtain a much greater quantity of cloth than if she attempted to counteract the intention of nature by converting a portion of her capital and industry from the raising of wine in which she has an advantage, to the manufacture of cloth, in which the advantage is on the side of another

What has been already stated is sufficient to expose the sophism of the French economists who contended, that as an equivalent must be always given for commodities brought from abroad it is impossible foreign commerce should be a means of increasing wealth. "How they asked can the wealth of a country be increased by giving equal values for equal values?" They admitted that commerce might be the means of making a better distribution of the wealth of the world, but as it did nothing more than exchange one sort of wealth for another they denied that it could make any addition to its amount At first sight this sophistical and delusive statement appears sufficiently conclusive, but a very few words will be sufficient to demonstrate its fallacy The advantage of commerce does not consist in its enabling either of the parties who carry it on to obtain articles of greater value than those they give in exchange It may have cost as much to produce the cloth with which the English merchant purchases the wine of Portugal as it did to produce the latter or it may have cost more But then it must be observed that in making the exchange the value of the wine is estimated by what it takes to produce it in Portugal, which has peculiar capabilities for that species of industry, and not by what it would take to produce it in England were the trade put an end to, and in like manner, the value of the cloth is estimated by what it takes to produce it in England, and not by what it would take to produce it in Portugal The advantage of the intercourse consists in this, that it enables each country to obtain commodities for the production of which it has no natural capability, and which it would therefore cost vastly more to produce directly at home at the price required to produce them under the most favourable circumstances, and with the least possible expense The gain of the one party is not the loss of the other Both benefit by the intercourse, for it enables both to save labour and expense in the production of commodities, so that the wealth of the two countries is not only better distributed, but is also greatly increased, by the territorial division of labour established between them

"The commerce of one country with another is merely an extension of that division of labour by which so many benefits are conferred on the human race As the same country is rendered richer by the trade of one province with another, as its labour becomes thu[illegible] divided and more productive than it [illegible] have been, and as the mutual interchange of all those commodities which one province has, and another wants, [illegible] comforts of the whole, [illegible] a wonderful degree more [illegible] beautiful train of consequences is observable in the world at large,—that vast empire, of which the different kingdoms may be regarded as the provinces In this magnificent empire, one province is favourable to the production of one species of produce, and another province to another. By their

mutual intercourse, mankind are enabled to distribute their labour as best fits the genius of each particular country and people The industry of the whole is thus rendered incomparably more productive, and every species of necessary useful, and agreeable accommodation is obtained in much greater abundance, and with infinitely less expense" (*Wade's Commerce Defended* p 38)

The supply of a great city with its various articles of provision and consumption affords, as has been justly observed, one of the most striking instances of the benefits resulting from the division and combination of employments on the most extensive scale In illustration of this, it may be stated, that at this moment (1841), there are not less than two millions of inhabitants congregated within ten miles round St Paul's comprising a large proportion of the wealthiest individuals in the kingdom The production of the provisions and other accommodations required by this vast population employs not only a very large proportion of the people of the United Kingdom but also an immense number of labourers in the most distant countries The Chinese furnish the tea, the planters of Jamaica and Demerara the sugar and coffee, Ceylon and the Eastern Archipelago the spices, the Portuguese and French the wines, the people of Cashmere in Central Asia the shawls, the Australians and Germans the wool, the Americans the cotton, the Italians and Chinese the silk, the Norwegians the lobsters, the Spaniards and the people of the Azores the oranges, and so forth, required for the supply of London And yet notwithstanding the extreme diversity of the sources whence they are brought, and of the conditions under which they are produced every article is supplied to the exact extent to which it is wanted, and every individual in this immense city may get, on the shortest notice, any quantity of any article how great or how small soever that he requires There is no excess at one time, or scarcity at another The supply of every article is adjusted to the demand with a precision that any one not acquainted with the circumstances would, *a priori* have pronounced impossible

And how it may be inquired are these astonishing results this constant and equable supply of infinitely varied wants, brought about? Had government undertaken such a task, it certainly would have exhibited even with the assistance of a whole army of officers and [illegible] it is now effected [illegible] individuals who in the prosecution of their own interests confer inestimable advantages on this great city, and indeed enable it to subsist Every retail dealer is aware of the ordinary or average demand of his customers for the article or articles in which he deals, and in like manner the wholesale dealers who commission articles of the producers are each and all aware of the quantity that will be taken off by the retailers, whose agents they are and of the periods when they will have to be supplied In this way the aggregate and individual wants of any population, how great soever, come to be accurately known, and the quantity of labour required to supply the different articles of which they stand in need, and no more, is put in motion

It would be unnecessary, in a work of this kind to dwell on the advantages resulting to society from the formation of improved roads, canals and other easy means of communication At bottom however [illegible] of these consists in the facility which enabling products to be conveyed from one place to another, that is, for enabling the division of labour between different parts of the country to be carried to the greatest extent And the same principle that teaches us that it is for the public advantage to construct new and improved roads, and to promote to the utmost the facilities of intercourse between [illegible] the [illegible] should lead us to [illegible] as far as [illegible] restrictions on the [illegible] countries and to give full scope to the [illegible] of labour between our people and those of other nations All the arguments that can be used for the opening of new roads, the throwing of bridges over ravines and rivers, and otherwise improving the means of internal intercourse apply with but little variation and with equal force to the abolition of restrictions on the exportation of native and the importation of foreign produce, the object of the one class of measures as of the other is to facilitate the interchange of the various products of art and industry, and consequently to enable capital and labour to be employed in the channels in which they are sure to be most productive (*See* the art COMMERCE in this Dict, and the authorities therein referred to)

The various provisions made by society for its protection, and for securing and preserving the rights and privileges of individuals, owe their origin to this principle Government itself is wholly founded on a sense of the advantages resulting from the division [illegible] "In the first state of society each [illegible] or himself for the protection both [illegible] his property For these purposes he must be always armed, and always watchful; what little property he has must be moveable, so as never to be far distant from its owner Defence or escape occupy almost all his thoughts, and almost all his time, and, after all these sacrifices, they are very imperfectly effected 'If ever you see an old man here,' said an inhabitant of the confines of Abyssinia to Bruce, 'he is a stranger, the natives all die young by the lance'

But the labour which every individual who relies on himself for protection must himself undergo is more than sufficient to enable a few individuals to protect themselves, and also the whole of a numerous community To this may be traced the origin of governments The nucleus of every government must have been some person who offered protection in exchange for submission On the governor and those with whom he is associated, or whom he appoints is devolved the care of defending the community from violence and fraud, and so far as internal violence is concerned, and that is the evil most dreaded in civilized society it is wonderful how small a number of persons can provide for the security of multitudes About fifteen thousand soldiers and not fifteen thousand policemen, watchmen, and officers of justice, protect the persons and property of the seventeen millions of inhabitants of Great Britain There is scarcely a trade that does not engross the labour of a greater number of persons than are employed to perform this the most important of all services" (*Senior on Political Economy*)

*Definition and Employment of Capital*—The capital of a country consists of those portions of the produce of industry existing in it that may be made directly available, either for the support of human beings or the facilitating of production It consequently comprises all those articles that may be employed for the subsistence, clothing and lodging of the labourers engaged in industrious undertakings, and the various animals tools and machines of which they may avail themselves in performing their tasks It is usual to call the former or the food, clothes, &c required for the subsistence of the labourer, the corn used as seed and in the feeding of horses, coal &c, *circulating* capital while those articles that are more slowly consumed, as the lower animals the houses and the various instruments and machines that either are or may be employed in industrious undertakings are called *fixed* capital But though this distinction be convenient for some purposes no distinct line of demarcation can be drawn between the different varieties of capital and they are alike indispensible to the successful prosecution of most branches of industry Without a supply of the first or circulating capital that is without a supply of food clothes &c, it would plainly be impossible to engage in any sort of undertaking where the return was at all distant, and without the second or fixed capital that is, without the aid of tools and machines (which are merely a more complex species of tools) there are but few sorts of labour that could be carried on at all or with any advantage But the progressive nature of man his foresight and inventive faculty led him even in the earliest ages and in the rudest states of society to provide a reserve of food, and to contrive tools and instruments to assist him in his operations The American hunters make use of clubs and slings to abridge their labour and facilitate the acquisition of game and the same principle which prompts them to construct and avail themselves of those rude instruments never ceases to operate it is always producing some new improvement and in an advanced and refined period substitutes ships for canoes muskets for slings, steam engines for clubs and cotton mills for distaffs

Hence it is only by the employment and co-operation of both descriptions of capital that wealth can be largely produced and universally diffused An agriculturist might have an ample supply of carts and ploughs, of oxen and horses and generally, of all the instruments and animals used in his department of industry, but were he destitute of circulating capital or food and clothes, he would be unable to avail himself of their assistance, and instead of tilling the ground would have to resort to some species of appropriative industry and, on the other hand, supposing he were abundantly supplied with provisions, what could he do without the assistance of a fixed capital, or tools? What could the most skilful husbandman perform without his spade and plough? a weaver without his loom? a carpenter without his saw, his hatchet, and his planes

The division of labour cannot be carried to any considerable extent without the previous accumulation of capital Before labour can be divided, "a stock of goods of different kinds must be stored up somewhere, sufficient to maintain the labourer, and to supply him with materials and tools A weaver cannot apply himself entirely to his peculiar business, unless there is beforehand stored up somewhere either in his own possession or in that of some other person, a stock sufficient to maintain him, and to supply him with the materials and tools of his works, till he has not only completed but sold his web This accumulation must, evidently, be previous to his

applying himself for so long a time to such a peculiar business" (*Wealth of Nations*, 119)

As the accumulation of capital must have preceded the extensive division of labour, so its subsequent division can only be perfected as capital is more and more accumulated. The two [illegible] and division act and react on each other. The quantities of work which the same number of people can perform increases in a great proportion with every fresh subdivision of labour, and according as the operations of each workman are reduced to a greater degree of identity and simplicity, he has, as already explained, a greater chance of discovering machines and processes for facilitating his separate task. The quantity of labour therefore not only increases in every country with the increase of the stock or capital which sets it in motion, but, in consequence of this increase, the division of labour is extended, new and more powerful implements and machines are invented, and the same quantity of labour is made to produce an infinitely greater quantity of commodities.

Besides enabling labour to be divided, capital contributes to facilitate labour and produce wealth in the three following ways.

*First* — It enables work to be executed that could not be executed, or commodities to be produced that could not be produced, without it.

*Second* — It saves labour in the production of almost every species of commodities.

*Third* — It enables work to be executed better, as well as more expeditiously.

With regard to the first advantage derived from the employment of capital, or the circumstance of its enabling commodities to be produced that could not be produced without it, it is plain, as already observed, that the production of such commodities as require a considerable period for their completion could not be attempted unless a stock of circulating capital or of food and clothes sufficient for the maintenance of the labourer while employed on them was previously provided. But the possession of fixed capital, or of tools and machines, is frequently as necessary to the production of commodities as the possession of [illegible] capital. It would, for example, be quite [illegible] to produce a pair of stockings without the aid of wires, and although the ground might be cultivated without the aid of a plough, it could not be cultivated without the aid of a spade or a hoe. If we run over the vast catalogue of the arts practised in a civilized country, it will be found that extremely few can be carried on by the mere employment of the fingers or rude tools with which man is furnished by nature. It is almost always necessary to provide ourselves with the result of previous industry and invention, and to strengthen our feeble hands by arming them, if we may so speak, with the force of all the elements."

In the second place, besides supplying many species of commodities that could not be produced without its co-operation, the employment of capital occasions a saving of labour in the production of many others, and, by lowering their cost, brings them within the reach of a far greater number of consumers. We have been so long accustomed to profit by the services of the most commodious and powerful machines that it requires a considerable effort of abstraction to become fully aware of the advantages we owe to them. But if we compare the arts practised alike by highly civilized societies and those in a less advanced state, we can hardly fail of being convinced that we are indebted to the employment of machinery for a very large proportion of our superior comforts and enjoyments. Suppose that, like the Peruvians, and many other people of the New as well as the Old World, we were destitute of iron, and unacquainted with the method of domesticating and employing oxen and horses, how [illegible] for the worse would be made in our condition. It was customary in some countries, to make cloth by taking up thread after thread of the warp, and passing the woof between them by the unassisted agency of the hand, so that years were consumed in the manufacture of a piece which, with the aid of the loom, may be produced in as many days. Nothing perhaps has contributed so much to accelerate the progress and diffuse the blessings of civilization as the establishment of a commercial intercourse between different and distant nations. But how could this be effected without the construction of vessels, and the discovery of the art of navigation? And if we compare the early navigators, creeping timidly along the shore in canoes formed out of trees partly hollowed by fire and partly by the aid of a stone hatchet or the bone of some animal, with those who now boldly traverse the trackless ocean in noble ships, laden with the produce of every climate, we shall have a faint idea of the advance of the arts, and what we owe to machinery and science. Those who have distinguished themselves in this career, though they have rarely met with that gratitude and applause from their fellow-citizens to which they had so just a claim, have been the great benefactors of the human race. By pressing the powers of nature into our service, and subjecting them to our control, they have given man almost omnipotent power [illegible] most gigantic undertakings. Without [illegible] we should be poor indeed. Such as the naked and half famished savage of New Holland is at this day, such would the Athenian, the Roman, and the Englishman have been, but for the invention of tools and machines, and the employment of natural agents in the great work of production.

The [illegible] derived from the employment of capital consists in enabling work to be done *better*, as well as more expeditiously. Yarn, for example, might be spun by the hand, but the admirable machines invented by Hargreaves, Arkwright, and others, enable a hundred or a thousand times as much yarn to be spun as could be effected by means of a common spindle, at the same time that they have improved its quality and given it a degree of fineness and of evenness, or equality in its parts, which was never previously attained. A painter would occupy months, or it might be years, in painting with a brush the cottons, or printed cloths, used in the hanging of a single room, and it would be very difficult, if not impossible, for the best artist to give that perfect identity to his figures which is given to them by the machinery now made use of for that purpose. Not to mention the other and more important advantages re-

[illegible]

years of patient and irksome labour have been expended, is unable, in point of delicacy and correctness, to match a well-printed work executed in the hundredth part of the time, and at a hundredth part of the expense. The great foreign demand for English manufactured goods results no less from the superiority of their manufacture than from their greater cheapness, and for both these advantages we are principally indebted to the excellence of our machinery.

There are other considerations which equally illustrate the extreme importance of the accumulation and employment of capital. The food and other accommodations enjoyed by a nation cannot be increased except by an increase in the number of its labourers, or in their productive powers, but, without an increase of capital, it is in most cases impossible to employ more workmen with advantage. If the articles applicable to the support of the labourers, and the tools and machines with which they are to operate, be required for the maintenance and efficient employment of those already in existence, there can be no additional demand for others. Under such circumstances the rate of wages cannot rise, and if the number of inhabitants be increased they must be worse provided for. Neither is it at all probable that the powers of the labourer should be augmented, except capital be previously increased. Without the better education and training of workmen, the greater subdivision of their employments, or the improvement of machinery, their productive energies can never be materially increased, and in almost all these cases additional capital is required. It is seldom, unless by its means, that workmen can be better trained, or that the undertaker of any work can either provide them with better machinery, or make a proper distribution of labour among them. Should the work to be done consist of a number of parts, to keep a workman constantly employed in one only requires a much larger stock than when he is occasionally employed in every different part. "When," says Dr Smith, "we compare the state of a nation at two different periods, and find that the annual produce of its land and labour is evidently greater at the latter than at the former, that its lands are better cultivated, its manufactures more numerous and more flourishing, and its trade more extensive, we may be assured that its capital must have increased during the interval between these two periods, and that more must have been added to it by the good conduct of some, than had been taken from it either by the private misconduct of others, or by the public extravagance of government." (*Wealth of Nations*, 152.) It is therefore plain that no country can ever reach the stationary state so long as she continues to accumulate additional capital. While she does this she will have an increased demand for labour, and will be uniformly augmenting the mass of necessaries, luxuries, and conveniences, and consequently, also, the numbers of her people. But with every diminution of the rate at which capital has been accumulating, the demand for labour will decline. When no additions are made to capital no more labour will be, or at least, can be advantageously employed. And should the national capital diminish, the condition of the great body of the people will deteriorate, the wages of labour will be reduced, and pauperism, with its attendant train of vice, misery and crime, will spread its ravages throughout society.

*Objections to Machinery unfounded* — But, admitting what has been stated, still it may be, and indeed has been contended, that [illegible] to the country, machines, on [illegible], only injure the labouring class[es] [illegible] and for labour and

the rate of wages. In point of fact, however, it admits of demonstration that every introduction of improved machinery is sure to increase the aggregate demand for labour, at the same time that by reducing the cost of commodities, it enables the labouring class, in common with the rest of society, to obtain a greater command over necessaries and conveniences It sometimes, indeed, happens that the introduction of machinery is injurious to the labourers employed in a particular department, but if it displace them, it cannot fail to occasion a more than equivalent demand for their services in other departments The introduction of moveable types and printing threw out of employment all those who had been previously engaged in the copying of manuscripts, but, at the same time, it is certain that this invention, by cheapening and multiplying books, has made at least from a hundred to five hundred persons be employed in the book trade for one that was employed in it when it began to be introduced, or that would have been employed in it at this moment had it not been discovered

Precisely similar results follow in all cases in which any peculiar description of hand labour is superseded by machinery At this moment we have an example of the principle before us in the business of hand loom weaving, which is in the course of being superseded by the introduction of power-looms, the hand-loom weavers being like the copying clerks in the 15th and 16th centuries, involved in the great st[illegible] But these how severe soever in the mean time will be but of temporary duration and society will be perpetual gainers by the change Power looms are introduced only because they do their work cheaper than it can be done by the hand But the wealth of those who buy the products of the power-looms is not affected by the change [illegible] ough the reduction [illegible] things the production of which will in the end fully absorb the unemployed hand-loom weavers, at the same time that the cheapened products will be brought within the command of new classes of purchasers, and that the demand for them will be proportionally increased, and this it is plain will open a new field for the employment of many additional hands in the construction of machinery and in the various subordinate departments connected with the manufacture To suppose indeed, that the introduction of improved machinery should, under any circumstances, entail a real injury on society, is to suppose what is contradictory and absurd, it is equivalent to supposing that society might be injured by an increased productiveness of soil, and an increased salubrity of climate, it is to suppose that wealth may be too much increased, and that the necessaries and conveniences of life may be too widely diffused

*Circumstances most favourable for the Accumulation of Capital* —Having thus endeavoured to point out the vast importance of the employment of capital, and the manner in which it co-operates in facilitating production we proceed to explain the circumstances most favourable for its accumulation Now, as capital is nothing but the accumulated produce of previous industry, it is evident that its increase will be most likely to be most rapid where industry is most productive, or, in other words where the profits of stock are highest The man who can produce a bushel of wheat in three days may accumulate twice as fast as the man who, either from a deficiency of skill or from having to cultivate a bad soil is forced to labour six days to produce the same quantity, and the capitalist who can invest stock so as to yield him a profit of ten per cent, has it equally in his power to accumulate twice as fast as he who can only obtain five per cent for his capital Experience, too, shows that while high profits afford greater means of saving they act as incentives to accumulation Hence it is found that in those countries most rapidly increasing in wealth and population, the rate of profit is always comparatively high Thus in the United States, the rate of profit is usually twice as high as in Great Britain or France, and it is to this that the more rapid advancement of the former in wealth and population is entirely to be ascribed We do not mean to say that high profits are necessarily, and in every instance, accompanied by a great degree of prosperity Countries with every other advantage for the profitable employment of industry and stock may be subjected to a despotical government, which does not respect the right of property, and the want of adequate security thence resulting may be sufficient to paralyse all the exertions of those who are otherwise placed in the most favourable situation for the accumulation of capital But we have no hesitation in laying it down as a principle which holds in every case and from which there is really no exception, that if the governments of any two or more countries be about equally liberal and property in each be about equally well secured their comparative prosperity will depend on the rate of profit wherever profits are high, there is a great demand for labour, and the society rapidly augments both in population and riches On the other hand wherever they are low, the demand for labour is proportionally reduced, and the progress of society rendered so much the slower. But however high the rate of profit, had men always lived up to their incomes, that is, had they always [illegible] the whole produce of their incomes in the [illegible] of their immediate wants and desires, it is obvious there could have been no such thing as capital in the world High profits are advantageous, because they afford the means of amassing capital, but something more is necessary to make us use these means, and this is the accumulating principle The desire implanted in the breast of every individual of rising in the world, and improving his condition, has prompted mankind to save a portion of their income, or of the produce of their industry, from immediate consumption, and to set it apart as a fund, or capital, to assist them in their future undertakings It is to this principle, therefore, or rather to its effect, parsimony, that we owe our capital, and it is to capital that we owe almost all our comforts and enjoyments Without its assistance and co-operation, labour could not have been divided, arts could not have made any progress, and mankind must have continued to shelter themselves as in the earliest ages, in caves and forests, and to clothe themselves with the skins of wild animals All the accumulated riches of the world, the cities which cover its surface, the ships which traverse its seas and the innumerable variety of improvements, owe their origin to this principle —to the desire to rise in the world and consequently to save and amass

It has been wisely ordered that this principle should be as powerful as it is advantageous "With regard to profusion," says Smith the principle which prompts to expense is the passion for present enjoyment, which, though sometimes violent, and very difficult to be restrained, is in general only momentary and occasional But the principle which prompts to save is the desire of bettering our condition a desire which though generally calm and dispassionate comes with us from the womb and never leaves us till we go into the grave In the whole interval which separates the two moments, there is scarce, perhaps a single instance in which any man is so perfectly and completely satisfied with his situation as to be without any wish of alteration or improvement of any kind An augmentation of fortune is the means by which the greater part of men propose and wish to better their condition It is the means the most vulgar and the most obvious and the most likely way of augmenting their fortune is to save and accumulate some part of what they acquire either regularly and annually or upon some extraordinary occasion Though the principle of expense therefore, prevails in almost all men upon some occasions and in some men upon almost all occasions yet in the greater part of men, taking the whole course of their life at an average, the principle of frugality seems not only to predominate but to predominate very greatly" (*Wealth of Nations*, 151)

It is this principle which carries society forward The spirit of parsimony, and the efforts which the frugal and industrious classes make to improve their condition, in most instances balance not only the profusion of individuals but also the more wasteful profusion and extravagance of government The spirit of economy has been happily compared by Smith to the unknown principle of animal life the *vis medicatrix naturæ*, which frequently restores health and vigour to the constitution, in spite both of disease, and of the absurd prescriptions of the physician

But however great the capacity of the principle of accumulation to repair the waste of capital, we must take care not to fall into the error of supposing as very many have done that its operations are in all cases promoted by a large public expenditure To a certain extent this is indeed true A moderate increase of taxation has the same effects on the habits and industry of a nation that an increase of his family or of his necessary and unavoidable expenses has upon a private individual Man is not influenced solely by hope, —he is also powerfully operated upon by fear, taxation brings the latter principle into the field To the desire of rising in the world inherent in the breast of every individual, an increase of taxation superadds the fear of being cast down to a lower station, — of being deprived of conveniences and gratifications which habit has rendered almost indispensable; and the combined influence of the two principles produces efforts that could not be produced by the unassisted agency of either They stimulate individuals to endeavour, by increased efforts of industry and economy, to repair the breach taxation has made in their fortunes, and it not unfrequently happens that their efforts do more than this, and that, consequently, the national wealth is increased through the increase of taxation But we must be on our guard against the abuse of this doctrine To render an increase of taxation a cause of greater exertion, economy, and invention, its increase should be slow and gradual; and it should never be carried to such a height as to incapacitate individuals from meeting the sacrifices it imposes on them by such a moderate degree of increased exertion and economy as it may be in their

power to make, without requiring any very violent change in their habits The increase of taxation must not be such as to render it impracticable to overcome its influence, or to induce the belief that it is impracticable Difficulties that seem to be surmountable sharpen the inventive powers and are readily grappled with, but an apparently insurmountable difficulty or such an excessive weight of taxation as it was deemed impossible to meet, would not stimulate, but destroy exertion Instead of producing new efforts of ingenuity and economy, it would produce only despair Whenever taxation becomes so heavy that the produce it takes from individuals can no longer be replaced by fresh efforts, these efforts uniformly cease to be made, the population becomes dispirited, industry is paralysed, and the country rapidly declines

Ambition to rise is the animating principle of society Instead of remaining satisfied with the condition of their fathers, the great object of mankind in every age has been to rise above it,—to elevate themselves in the scale of wealth, to continue stationary, or to retrograde, is not natural to society Man from youth grows to manhood, then decays and dies, but such is not the destiny of nations The arts, sciences, and capital of one generation become the patrimony of that which succeeds them, and in their hands are augmented and rendered more efficient, so that, if not counteracted by the want of security or by other adventitious causes, the principle of improvement would always operate, and would secure the constant advancement of nations in wealth and population

Such is a short outline of the circumstances on which the production of wealth depends It is difficult in separately considering the influence of the combination and division of employments, and of the introduction and improvement of machinery to avoid ascribing an undue degree of importance to the one immediately under consideration But neither is intitled to any pre eminence over the other They are alike important, or rather we should say, they are alike indispensable to the production of wealth It would, indeed be quite as profitable to inquire whether the heart or the lungs be most essential to animal existence as it is to inquire whether the division and combination of employments or the command of capital, including tools and machines be most essential to the growth of opulence and civilization Without their combined and powerful aid man must have continued sunk in primeval barbarism and ignorance Take away the division and combination of employments, and the isolated efforts of individuals will be wholly unable to produce any considerable result, and take away capital or the aid derived from previous savings, and from tools and machinery and we shall immediately sink to the level of the Australian savages

It would be inconsistent with the objects and limits of this work to enter further into details The sketch now given comprises we believe an accurate statement of the great principles that lie at the bottom of the science and by the application of which a correct judgment may be formed of most practical measures affecting the production of wealth But those who wish for more detailed statements and expositions of difficulties must resort to works especially appropriated to such investigations

The second great division of Political Economy has for its object to inquire into the laws which regulate the distribution of wealth among the various ranks and orders of the community

### II Distribution of Wealth

The [illegible] said [illegible] three great classes of labourers, landlords, and capitalists, that is into those who employ themselves for hire in any undertaking, those to whom the lands belong and those who are the owners of capital An individual may combine in his own person each of these separate characters, but [illegible] case of all individuals And whatever be the condition of any country or society, whether it be rude or refined, rich or poor, every person belonging to it, who is not a pauper, or who does not subsist on the bounty of others may be reckoned in one or other of these classes They divide amongst them all the wealth of the community Public functionaries of all sorts, and the various individuals engaged in what are called liberal or learned professions exchange their services for valuable considerations The whole subsistence of such persons, in so far as they depend upon their employments, is derived from wages, and they are as evidently labourers as if they handled a spade or a plough "Every man," says Dr Paley, "has his work The kind of work varies, and that is all the difference there is A great deal of labour exists besides that of the hands many species of industry beside bodily operation, equally necessary, requiring equal assiduity, more attention, more anxiety It is not true, therefore, that men of elevated stations are exempted from work, it is only true that there is assigned to them work of a different kind whether more easy or more pleasant may be questioned, but certainly not less wanted, nor less essential to the common good" (*Assize Sermon*, 29th July, 1795) Hence it is that the inquiry into the distribution of wealth among the different orders of the society, resolves itself into an investigation of the laws which regulate wages, rent, and profit, and of the best methods for [illegible] of the poor, or of those who [illegible] themselves We believe, however, that it will be the preferable plan to refer the consideration of these topics to the heads now mentioned, which will, consequently, comprise all that is essential to a general view of this department of the science

Among the many works that have been written on this science, the first place is due to the *Wealth of Nations*, by Adam Smith an edition of this work was published in 1838 in one volume 8vo, with notes and illustrations by the author of this article See also Ricardo's *Principles of Political Economy and Taxation*, [illegible] *Encyc Metropol*, M'Culloch's [illegible] *onomy*, Say *Traité d'Economie* [illegible] *ples of Political Economy* &c

POLITICS (Gr πολις, *a city*) may be considered either as a science or an art, according to the manner in which it is treated Political science is that which treats of the theory and practice of government, and the subjects which it comprises have been arranged under the following heads —1 Natural law, 2 Abstract politics, i e the object of a state and the relations between it and individual citizens, 3 Political economy, 4 The science of police, or municipal regulation 5 Practical politics, or the conduct of the immediate public affairs of a state, 6 History of politics, 7 History of the European system of states, being the only system in which the modern art of politics has received a practical development, 8 Statistics, 9 Positive law relating to state affairs, commonly called constitutional law, 10 Practical law of nations, 11 Diplomacy, 12 The technical science of politics, an acquaintance with the forms and style of public business in different countries The ancient Greek writers treated the science of politics uniformly with reference to an imaginary perfect state, the constitution of which each propounded according to his own speculative views, and then proceeded to show in what respects existing governments differed from this ideal standard, the cause of these variations, &c

POLL In Politics *See* Parliament

POLLARD A tree with the head cut off at the height of 10 or 12 feet from the ground for the purpose of inducing it to throw out branches all round the section where amputation has taken place, which branches are cut off periodically, when they attain the length of 8 or 10 feet, to be used as fuel fence wood, or for other rustic purposes Pollard trees are for the most part found in hedgerows, which they greatly injure by the dense shade produced by their branches on the plants below and excepting when the round formal heads of [illegible] are interlaced in connexion with overgrown hedge plants or with large trees which have not been pollarded, they disfigure the landscape from the sameness of their appearance and their expression of meanness, as compared with that of trees undecapitated and left in all their native luxuriance In the time of Evelyn the term pollard appears to have been chiefly applied to trees which were lopped or deprived of their side branches, excepting a few at top, leaving the tree standing like a naked pole. Examples of this kind of pollard are frequent among the hedgerow elms in the [illegible] of London The decapitated tree, now called a pollard, was in Evelyn's time called a dottard

POLLEN In Botany, the pulverulent substance which fills the cells of the anthers of a plant consisting of a multitude of little hollow cases filled with a fluid holding very minute molecular matter in suspension. The latter is eventually discharged by the grains of pollen through their hollow tubes, and is supposed to be the spermatic fluid of a plant

POLLEN TUBES, are the tubular processes emitted by the pollen when it comes in contact with the stigma of a plant, and which are supposed to conduct the impregnating matter down the style into the ovules through the foramen

POLL TAX A tax still levied in many of the Continental states and formerly also in England in proportion to the rank or fortune of the individual In England this species of tax was first levied in 1378, and, as is well known, it was from the brutality with which the levying of it was accompanied that the rebellion of Wat Tyler took its rise in 1381 Various poll taxes were levied at different periods in the subsequent history of England; but they were finally abolished in the reign of William III *See* Taxation

POLLUX In Astronomy, one of the twins forming the constellation *Gemini*. (*See* Castor.) Pollux is also

the name of a star of the second magnitude in the same constellation

PO'LYARCHY. (Gr πολυς, *many*, and αρχειν, *to govern*) A word sometimes used by political writers in a sense opposed to monarchy the government of many, whether a privileged class (aristocracy), or the people at large (democracy)

POLYCHRO'ITE (Gr πολυς, and χροα, *colour*) A term applied to the colouring matter of saffron, in consequence of the variety of colours which it exhibits when acted upon by various re-agents

PO'LYCHREST (Gr πολυς, and χρηστος, *useful*) A term applied by [illegible] chemists to certain preparations which they regarded as possessed of multifarious virtues *Polychrest salt* was the sulphate of potash

POLYGA'LEÆ (Polygala, one of the genera) A natural order of irregular Polypetalous Exogens, possessing tonic, astringent, and febrifuge properties The species are also sometimes cultivated for the sake of their beautiful flowers, they are [illegible] temperate climates, and are particularly common at the Cape of Good Hope Rhatany root a powerful astringent, belongs to *Krameria* [illegible] this order

POLY'GAMOUS (Gr πολυς, and γαμος *marriage*) in Grasses, signifies when one of the two florets of which a spikelet consists is unisexual, the other hermaphrodite, as in *Spodiopogon*, &c , in other plants it expresses the presence in the same individual of male, female, and hermaphrodite flowers

POLY'GAMY (Gr πολυς and γαμος *marriage*) The custom of having several wives, a custom apparently common to all nations in remote antiquity and common now to most of those in which the tie of marriage is recognized, and to which Christianity has not extended It was admitted among the Patriarchs and under the Mosaic dispensation (Exod xxi 10 Deut xxi 15), and Selden (*Uxor Hebraica*) has shown its prevalence among the Jews without mentioning the extraordinary instances of sovereigns such as David and Solomon, recounted in Scripture It may be questioned however, whether it continued at the period of our Saviour's preaching Certainly his injunctions in regard to marriage seem rather to be founded on the supposition of monogamy, and the absence of positive injunctions against polygamy has been relied on by some modern disputants with very little reason as an authority that the licence assumed by the holy men of the Old Testament is not revoked The severer manners of Western nations seem to have repudiated it. It was no part of Grecian manners the notion that the Athenian laws allowed of two wives (founded in part on a passage in *Athenæus* l xiii ch 1) seems a mistake but it appears to have been allowed to a citizen in addition to his lawful wife, herself a citizen to live in a kind of legitimate concubinage with a female not belonging to that class Thus if there is any truth in the story of Socrates' two wives) his plague Xantippe was the wife by night, while the softer Myrto was only a wife by courtesy In republican Rome no such licence was known but under the emperors the practice of polygamy seems to have crept in though repudiated both by the moral sense and civil usages of the people Valentinian I legalized it by an edict But the Christian ecclesiastics of the empire strenuously opposed it, and it disappeared altogether, we believe, from Christendom with the fall of the Roman empire In the East it has continued to prevail

A few bold writers in modern times have raised the defence of [illegible] nded on the supposed absence of its expr[illegible] Bernardus Achinus a well known and able but unsteady theologian of the 16th century, who belonged by turns to the Roman Catholic and Protestant communions is among the most remarkable Lyserus (*Polygamia Triumphatrix*) adopted a still more decided view The Rev Mr Madon in his *Thelyphthora* (a work which excited an extraordinary and very unfavourable sensation on its appearance), limited the privilege of polygamy to men, and asserted that the injunction of St Paul, that a bishop "should be the husband of one wife," plainly demonstrated its lawfulness in others, meaning one wife at a time a supposition which is not improbable, although it will scarcely support his conclusions But a greater number of philosophical writ[illegible] have [illegible] of the practice in the [illegible] others, defend it on the ground of the [illegible] cay of female beauty in those [illegible] relies on the strange notion, that the number of females in eastern countries is much greater than that of males, which the traveller Bruce asserts on the authority of his own observations But the supposed fact on which these reasonings rest seems [illegible] maginary At all events, the *practice* [illegible] East is confined to so few that it can have little direct effect on manners, and none on popula[illegible] Mr Urquhart who endeavours to place Turkish usages in a favourable contrast with those of the West, after to a certain extent defending polygamy, says rather inconsistently, "While the law of nature renders this practice an impossibility as regards the community, it is here still further restrained among the few who have the means of indulging in it, both by the domestic unquiet that results from it, and by the public censure and reprobation of which it is the object" (*Spirit of the East*) He adds, that in his time "a case of polygamy was unknown in Candia, among a population of 16 000 Mussulmen" And Niebuhr says that in Arabia the conduct of those who take more than one wife is blamed by all other men" But it seems scarcely to have occurred to most reasoners that while polygamy itself is rare, its re[illegible] with the toleration of [illegible] The man who is not rich enough to take two wives, or who does not choose to encounter the household disturbances which follow such an arrangement falls entirely in with the [illegible] his family a re[illegible] lawful spouse Our We[illegible] [illegible] of the community into two classes a greater number treated with the highest respect, and in whom perfect purity is presumed, a smaller number, abandoned to utter degradation Where polygamy and concubinage are recognized, there is probably much less gross prostitution, but the general character of the sex stands on a lower basis

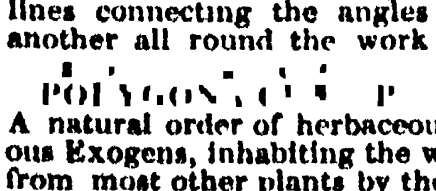
POLYGA'STRIA (Gr πολυς, and γαστηρ *a stomach*) The name of the most minute and simple class [illegible] devoid of spinal marrow and of vascular and respiratory organs with many stomachs of an indefinite form, and androgynous, with spurious locomotive organs of various nature They are all endowed with an organization characteristic of the animal kingdom and manifest such modifications of internal structure and external form that they can be divided into twenty two families, of which eleven are naked and eleven clothed in a siliceous case Forty eight species referable to twenty one distinct genera are provided with eyes or coloured eyespecks and among these nervous ganglia have been detected beneath the eye in *Amblyophis* and *Euglena* They occur in all parts of the world and differ according to diversity of climate region kind of water, &c They are invisible to the naked eye but by their immense numbers, can impart a distinct colour to the water in which they swarm they are one of the causes of the phosphorescence of the sea They enjoy the most extensive powers of reproduction and through their faculty of spontaneous *fission* the individual becomes constant and as it were, perpetually renews its youth By virtue of the imperishability of their external cases the *Polygastria* have formed vast masses of rock, as at Bilin in Bohemia where a single stratum extending over a wide area is no less than 14 feet thick and this consists exclusively of the cases of *Bacillaria Gallionella* &c , united together without any visible cement They sometimes so choke up water by their vast numbers as to cause the death of fishes contained therein They appear never to sleep they are very tenacious of life and fall into a kind of torpidity by excess of dryness heat or cold The more minute species are probably often suspended in the air They act according to external circumstances as the higher organized animals do They are injuriously affected or killed by strong poisons, but can sometimes support great degrees of warmth and cold, and can live with or without light their motions are slow Ehrenberg calculates that the *Monas punctum*, if it were to continue its ordinary rate of motion in a straight line, would traverse one mile of space in five years, while the *Navicula gigantea* would require forty years to travel over the same distance But their movements manifest the phenomena of consciousness and choice, and their muscular power is indicated by the strong maxillary apparatus with which many are provided

POLYGLOT (Gr πολυς and γλωττα, *language*) A word generally applied to such Bibles as have been printed with the text represented in various languages The most ancient instance of this parallel representation of various texts is the work of Origen known by the name of the *Hexapla* in imitation of which several similar editions of the Scriptures have been published since the invention of printing, of which the most important are, — 1 *The Complutensian*, or edition of Cardinal Ximenes printed at Alcala in Spain, 1515, in four languages, comprehended in six vols folio 2 *The Plantin*, Antwerp, 1572 3 *The Polyglot* of De Sacy, Paris, 1645 4 *The English*, or *Walton's Polyglot* London, 1657 These contain among them the Hebrew, Chaldee, Syriac, and Samaritan texts with [illegible], the Septuagint the Greek of [illegible] the Italic and the Vulgate, with [illegible] and Chaldee paraphrases, and [illegible] trations 5 *Hutte* [illegible] twelve languages, the Hebrew Syriac, German, Bohemian, Italian Spanish, French, Danish, and Polish.

**PO'LYGON** (Gr *πολυς*, and *γωνια*, *angle*), according to Euclid, is any plane rectilinear figure having more than four sides or four angles, but, in treating of polygons generally, geometers also include the triangle and the quadrangle If the sides of the polygon are all equal it is said to be a regular polygon, otherwise it is irregular Every regular polygon can be circumscribed by a circle, or have a circle inscribed in it, but of irregular polygons, excepting triangles, there is only one case in which a circle will pass through all their angular points, namely, when the polygon has an equal number of sides, one half of which are equal to one another, and the other half also equal to one another, but different from the former, and the equal and unequal sides are placed alternately It is obvious that all the angles of such a figure are equal

Euclid has shown in the *Elements* how to inscribe a triangle, a square, and a pentagon in a given circle, and as any arc of a circle may be bisected, and the halves again bisected &c, it follows that any regular polygon, of which the sides are $3 \times 2^n$, $5 \times 2^n$, or $15 \times 2^n$ ($n$ being any number whatever, or $3 \times 2^n$, or $5 \times 2^n$, may be inscribed in a circle by elementary geometry Until a recent discovery respecting the division of angles was made by Gauss, it was supposed that if the number of sides of a polygon was any other prime number than 3 or 5, the figure could not be inscribed in a circle, but this geometer in his *Disquisitiones Arithmeticæ*, has demonstrated that every polygon the number of whose sides is a prime number of the form $2^n + 1$, may be geometrically inscribed in a circle When $n = 1$ this form gives 3, or the triangle, when $n = 2$ it gives 5, or the pentagon, when $n = 3$, it gives 9, which is not a prime, when $n = 4$, it gives 17, whence a seventeen-sided figure may be inscribed in a circle geometrically The next prime is found by making $n = 8$ when the form gives 257

In order to investigate the general properties of polygons, it is necessary to divide them into two classes *convex* and *concave*, the first those of which the interior angles are less than two right angles (fig 1), and the second those which have one or more *re-entering* angles, as C (fig 2) If we call those the *interior* angles of the polygon which belong to the interior of the figure (whether less or greater than two right angles) and those *exterior* angles which are obtained by subtracting each interior angle from four right angles the following theorems will be true of the polygons of both classes —




1 The sum of the interior angles of a polygon is equal to as many times two right angles as there are sides *minus* two Thus let S denote the sum of the interior angles R a right angle and $n$ the number of sides of the polygon, then $S = 2(n - 2)$ R

2 The sum of the exterior angles of a polygon is equal to as many times two right angles as there are sides *plus* two Let S' be the sum of the exterior angles as above defined, then $S' = 2(n + 2)$ R

Any polygon may be decomposed into triangles by drawing straight lines from one of its angular points to each of the opposite angles, and the area of the polygon is the sum of the areas of all the component triangles But a beautiful theorem was found by L Huilier of Geneva by means of which, when the sides and angles of a polygon are known the area is found without decomposing it into triangles, which, when the number of sides is considerable leads to laborious calculations The theorem is this — The double of the surface of any rectilinear figure is equal to the sum of the rectangles of its sides, taken two and two *excepting one* multiplied by the sine of the sum of the supplements of the interior angles contained between each pair of sides Thus, in the preceding figure (fig 1), let A, B C D, E be the supplements of the interior angles at those points, then

$$\begin{aligned} 2 \text{ area} = {} & AB \times BC \sin B \\ & + AB \times CD \sin (B + C) \\ & + AB \times DE \sin (B + C + D) \\ & + BC \times CD \sin C \\ & + BC \times DE \sin (C + D) \\ & + CD \times DE \sin D \end{aligned}$$

This formula also gives the area of the polygons of the second class (fig 2), only the supplement of the re-entering angle C' must be taken with the negative sign (See *L'Huilier's Polygonométrie*, Genève, 1789)

POLYGON, in Fortification, is either *exterior* or *interior* The exterior polygon is the figure formed by lines connecting the angles of the bastions with one another all round the work, the interior polygon by [illegible] stions all round

POLYGON, (in Botany) [illegible] one of the genera) A natural order of herbaceous, rarely shrubby, apetalous Exogens, inhabiting the whole world, distinguished from most other plants by the cohesion of the scarious stipules into a sheath, technically called an *ochrea* or *boot*, and by their triangular fruit Sorrel on the one hand, and rhubarb on the other, represent the general qualities of this order While the leaves and young shoots are acid and astringent the roots are universally [illegible] *Rumex crispus* contains pure oxalic acid [illegible] species of Polygonum are used in [illegible] *Rumex* or dock, are well-known plants of this order, which is also sometimes remarkably astringent, as in the case of the *Coccoloba uvifera*, or sea-side grape of the West Indies, an extract of whose bark forms a kind of kino

POLYGONAL NUMBERS, in Arithmetic, are the successive sums of a series of numbers in arithmetical progression When the common difference of the series in arithmetical progression is 1, then the sums of the terms give the *triangular* numbers, when the common difference of the terms of the arithmetical series is 2, the sums of the terms are the *square* numbers, when the difference is 3, the sums are the *pentagonal* numbers, and so on Thus —

| | |
|---|---|
| Common difference = 1, | 1, 2, 3, 4, 5, 6, &c |
| [illegible] | 1 3, 6, 10, 15, 21, &c |
| [illegible] = 2, | 1, 3, 5, 7, 9, 11, &c |
| Square numbers | 1, 4, 9, 16, 25, 36, &c. |
| Common difference = 3, | 1, 4, 7, 10, 13, 16, &c |
| Pentagonal numbers | 1, 5, 12, 22, 35, 51, &c |

and so on These numbers are called, in general, *polygonal* from possessing this property that the same number of points may be arranged in the form of that polygonal figure to which it belongs For example, the pentagonal numbers 5, 12, 22 35, 51, &c may be severally arranged in a pentagonal form Thus, in the annexed figure, 5 points form the pentagon *a b c d e*, 12 the pentagon *a f g h i*, with the former enclosed, 22 the pentagon *a k l m n*, with the two former enclosed




A very remarkable property of polygonal numbers by Fermat, though it has yet been demonstrated only in respect of the triangular and square numbers It is this —Every number whatever is the sum of one two or three triangular numbers, the sum of one, two, three, or four squares, the sum of one, two three four or five pentagonal numbers, and so on *See* FIGURATE NUMBERS

POLYGON OF FORCES In Mechanics, the name given to a theorem, the discovery of which is attributed to Leibnitz The theorem is this —If any number of forces act upon a point and a polygon be taken one of the sides of which is formed by the line representing one of the forces and the following sides in succession by lines [illegible] magnitude, and parallel [illegible] which completes the polygon will represent the resultant of all the forces

POLYGONOMETRY The doctrine of polygons, as trigonometry is the doctrine of triangles The properties of polygons are investigated by resolving them into triangles, their areas, however, may be found when so many of their sides and angles as suffice to determine them are known *See* POLYGON

POLYGRAM (Gr *πολυς many*, and *γραμμα, a line*) A figure of many lines

POLYGRAPHY (Gr *πολυς* and *γραφω, I write*) In Bibliography a name invented to designate a collection of different works either by one or several authors

POLYHALITE (Gr *πολυ-*, and *αλς, salt*) A mineral found at Ischel in Upper Austria, composed of muriate of soda, and of the sulphates of magnesia, lime, and potash

POLYHE'DRON (Gr *πολυς*, and *ἑδρα, seat*) In Geometry a solid body bounded by many faces or planes When all the faces are regular polygons, similar and equal to each other, the solid becomes a regular body It may be demonstrated that only five regular solids can exist namely, the tetraedron the hexaedron, the octaedron the dodecaedron, and the icosaedron See the terms see also PLATONIC BODIES

POLYHEDRON In Optics *See* POLYSCOPE

POLYHY'MNIA, the muse who presided over lyric poetry —

> Nec Polyhymnia
> Lesboam refugit tendere barbiton *Hom. Od* i 1

POLYMI'GNITE (Gr *πολυς*, and *μιγνυμι, I mix*) A mineral which [illegible] of metallic lustre, [illegible] lime, yttria, oxide [illegible] magnesia, potassa, silica, and oxide of tin It is found in Norway

POLYNO'MIAL, or MULTINOMIAL, in Algebra, denotes a quantity having many terms Such, for example, is the expression $a + 2b + 3c + nd$, &c

POLYOPTRON (Gr *πολυς*, and *οπτρον, a looking-glass*) In Optics, a glass through which objects appear multiplied, but diminished It consists of a lens one side of which is plane, but in the other are ground several spherical concavities Each of these concavities

becomes a plano-concave lens, through which an object appears diminished; and when there are a number of them together, the object will be seen through each, and thus multiplied

POLYPES, *Polypi* (Gr πολυς, and πους, *a foot*) The name of an extensive group of radiated animals in the system of Cuvier, associated together by the common character of a fleshy body, of a conical or cylindrical form, commonly fixed by one extremity, and with the mouth situated at the opposite end and surrounded by more or less numerous arms or tentacles Under this external form is masked various grades of organization, of which three at least have been well defined by recent and minute anatomical researches

The lowest grade of organization is manifested by the fresh water polype (*Hydra*) and the compound marine corallines (*Sertularia Tubularia*, &c) The body here consists of a granular parenchyma, having a contractile power in every part, not requiring a distinct allocation and arrangement of muscular fibres When it is defended, as in the Corallines, by a polypary it can be retracted into its cell without being folded upon itself The oral tentacles are not provided with vibratile cilia, the stomach is not distinct from the parietes of the body The polypes thus organized have been termed *Dimorphea* by Ehrenberg, and *Nudibrachiata*, or Hydriform Polypes, by Dr Farre In the second group of Polypes the body is distinctly membranous and fibrous and the stomach forms a separate pouch suspended in its centre The stomach has but one external orifice, which serves for mouth and vent, but posteriorly it communicates with the main cavity of the body This is divided into several compartments by vertical partitions passing from the walls of the cavity to those of the stomach, and with the chambers thus formed the tubular arms communicate the mouth communicates The arms are not ciliated externally This group of Polypes has been termed *Anthozoa* by Ehrenberg, and includes the Sea-anemones Madrepores Coral plants &c In the third and highest group of Polypes the parietes of the stomach are not only distinct from those of the body but are continued into an intestinal tube which is reflected forward and terminates in a distinct anal aperture near the mouth the tentacula are provided with vibratile cilia The Polypes of this division are aggregated or compound and provided with flexible or calcareous cells they have been termed *Bryozoa* by Ehrenberg and *Ciliobrachiata* by Dr Farre All the groups of Polypes propagate by gemmation and likewise by ova which are first developed into ciliated and locomotive gemmules In the *Ciliobrachiata* the sexes are distinct

POLYPHEMUS *See* CYCLOPS

POLYPUS In Surgery a fleshy tumour, which is occasionally formed in the nostrils the same term is also applied to a fleshy tumour of the uterus

POLYSARCIA (Gr πολυς, and σαρξ, *flesh*) Corpulency

POLYSCOPE (Gr πολυς, and σκοπεω *I view*) In Optics, a lens plane on one side and convex on the other, but of which the convex side is formed of several plane surfaces, or *facettes*, so that an object seen through it appears multiplied The reason of the multiplication of the images is this — When the opposite sides of a thick piece of glass are not parallel an object seen through it appears out of its true place on account of the refraction, consequently if a lens is ground so that portions of its convex surface are differently inclined to its plane side, the object will appear in different places at the same time The polyscope may be used to collect the images of several dispersed objects into a single point, or to collect parts of the same object represented in different places so as to form a single image The instrument is a mere toy, and only used for the purpose of amusement

POLYSPASTON A term used by some of the old writers on mechanics to denote an assemblage of pulleys for raising heavy weights

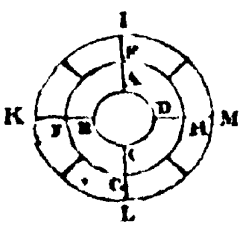
POLYSTYLE (Gr πολυς, and στυλος, *a column*) In Architecture, an edifice in which there are a great number of columns

POLYTECHNIC SCHOOL (Gr πολυς, and τεχνη, *art*) This establishment was founded in 1794, at Paris, by a decree of the National Convention Its object is to instruct youth in the mathematical, physical and chemical sciences Napoleon, who introduced various modifications into its constitution gave a military turn to its discipline It prepares pupils for the artillery service and civil and military engineering The number is limited to 400 Youths are admitted between the age of sixteen and twenty, and the course of study lasts two years In the lists of its professors have been included the illustrious names of Lagrange, La Place, Monge, Berthollet, and from the ranks of its pupils have proceeded almost without exception all the mathematicians and philosophers of France who have attained to eminence during half a century

POLYTHALAMIANS, *Polythalamacea* (Gr πολυς, *many*, and θαλαμος, *a chamber*) A name applied by De Blainville to an order of Cephalopods, including those which have many-chambered shells Like all divisions founded merely on external or dermal characters, it contains animals of different degrees of organization, and which cannot be grouped together in the same order in a natural system *See* TETRABRANCHIATES

POLYTHEISM (Gr πολυς, and θεος, *God*) The doctrine of a plurality of gods Sabianism (or planet-worship), Fetichism, Demon worship, hero worship, and animal worship, together with the *fetichism* of some Negro tribes, may all be considered as varieties of Polytheism That the first deviation from pure Theism, such as we believe to have been at the outset revealed to man, was into the worship of the sun, moon, and stars (the host of heaven, Hebr Tsaba, *an host*, whence Tsabianism or Sabianism, which see), is sufficiently probable The origin of the worship of the good and evil principle as distinct deities, which characterized the religion of some oriental nations, is not so easily explicable Some have attributed it to the recognition of the opposites to those phenomena which had been deified in the Sabian notions — [illegible] to light night to day, &c, some [illegible] the existence of evil or reprobate spirits, some to a mere philosophical theory adopted by priests to popular comprehension Damon worship or the worship of intermediate intelligences appropriated to external objects, and subordinate to the highest God, was a natural effect of Sabianism The worship of heroes, or deified mortals, arose again from it in a later stage of society, and the most probable theory of the greatest systems of Polytheism which have been recorded by divisions of the human race, viz the Egyptian Greek Indian and Scandinavian, seems to be this that hero worship, the most congenial of all to early imagination, superseded former modes of [illegible] were actually heroes who had gradually absorbed to themselves the honours formerly paid to damons or intelligences and to the host of heaven so that their attributes in later mythology present a vague mixture of the characters of all If however this be the case it remains to be explained how *after* the gods of Olympus had acquired their station and attributes in the Grecian religion a secondary race of heroes the *newer*, properly so called (whose worship is quite of recent origin and certainly posterior to Homer), should have found a place in the same mythology The strange system of animal worship seems peculiar to ancient Egypt, and has been derived by some from the natural circumstances of the country, the scarcity of domesticated animals having given them an importance which the priests made use of and connected with superstition As to the theory and general history of polytheism, the following among many other books may be mentioned — *Stillingfleet's Origines Sacræ*, *Kames's Sketches of the History of Man*, *Court de Gebelin Monde Primitif*, *Bryant's Mythology*, the Works of Herder, *Warburton's Divine Legation*, *Cudworth's Intellectual System*, *Vossius De Origine Idololatriæ*, *Mem de l'Acad des Inscr* vol xxxviii

POLYZONAL LENS (Gr πολυς, and ζωνη, *zone*) The name given by Sir David Brewster to a burning lens constructed of several zones or rings, each of which may be again composed of separate segments In the annexed figure A B C D is a central lens formed of one piece of glass, I I G H is a middle ring, or zone composed of four separate pieces, I K I M is another ring composed of eight segments, and surrounding the former The number of zones and of parts in each, may be as great or as small as we please




This method of forming lenses is attended with several important advantages The difficulty of procuring flint glass of sufficient purity to render it fit for the construction of a solid lens of large dimensions is removed, and the expense greatly diminished If impurity exist in any of the spherical segments, or if an accident happen to any of them it can easily be replaced Another advantage attending the construction is that it enables us to correct, very nearly, the spherical aberration by making the foci of each zone coincide Lenses of this kind have been made in France of crown glass, and have been introduced into the principal French light-houses One was constructed, under the directions of Sir David Brewster, for the commissioners of the northern light-houses It was made of pure flint glass, was three feet in diameter, and consisted of numerous zones and segments (See *Brewster's Treatise on New Philosophical Instruments*; and "Optics" in *Lardner's Cyclopædia*)

POLYZOONS *Polyzoa* (Gr πολυς, and ζωον, *animal*) A class of compound animals resembling in their organs of support the Serpulæ and Sertulariæ but in their internal organization approaching nearly to the compound Ascidians

POMACEÆ (Lat pomum, *an apple*) That division of the natural order *Rosaceæ* to which the apple pear,

quince, and medlar belong It differs from *Rosaceæ* proper in having a inferior ovary

POMEGRANATE The fruit of the *Punica granatum* The pulp is acid and the rind highly astringent The dried flowers, which are also astringent, were formerly used in medicine, under the name of Balaustine flowers

POMŒ'RIUM (Lat post, *behind*, and murus, *a wall*) In Roman Antiquities, a space of ground, both within and without the walls of a city, kept free from buildings (*Livy*, xiii ), and consecrated by a religious ce- [illegible] memoir of D [illegible] Mem de l'Acad [illegible] Whenever it was necessary to extend the limits of any city, a new *pomœrium* was formed, and the former one destroyed

POMONA The Roman goddess of fruit trees Her worship was instituted at Rome when the city was a *flamen pomonalis*, who sacrificed to her every year for the preservation of the fruit The story of Pomona and Vertumnus is well known (See *Ovid Met* 14 623) The name is derived from poma, *fruit*

PO'MPHOLIX (Gr πομφος, *a bubble*) An alchemical term for oxide of zinc

PO'MPHOLIX In Medicine, a vesicular eruption upon the skin

PO'MUM ADA'MI *Adam's apple* The protuberance in front of the neck formed by the thyroid gland It has been fancifully supposed to represent the fatal piece of apple eaten by Adam

POND An artificial excavation in the soil, or a natural hollow dammed up for the purpose of detaining water generally made in fields in order to supply drink to pasturing animals The essential difference between a pond and a lake is that the former is formed by art, the [illegible] ing a stream In Gloucestershire, Kent and other counties where the soil does not abound in springs the formation of ponds in the fields is as essential to the business of farming as the building of farm offices A pond in a garden when of a round form is termed a basin, and when of some length with parallel sides, a canal

PO'NE (Lat) In Law, a writ which lies to remove actions of debt, detinue, writs of [illegible] out of the county or other inferior courts into the Common Pleas and sometimes into the Queen's Bench

PONS VAROLII The bridge of Varolius An arched eminence of the [illegible] two exterior crura of [illegible] and passing over the crura of the cerebrum

PO'NTIL In Glass Manufacture, an iron instrument by which the hot glass is taken out of the glass-pot

PO'NTIA (Gr Ποντια one of the names of the goddess of love) A genus of butterflies of which the common white or cabbage butterfly (*Pontia brassica*) is a well-known native species

PO'NTIFEX (Lat) The highest Roman sacerdotal title Numa instituted four pontifices chosen from the patricians, to which were added, long subsequently, four plebeians Sylla increased their number to fifteen The college was divided into two classes distinguished by the epithets *majores* and *minores*, but it is not certain whether this difference of title marked out the patricians from the plebeians or the more ancient members from the seven added by Sylla The pontifices judged in all causes relating to sacred things, and inspected the conduct of the inferior priests They were a self elected body down to the latter ages of the republic when the power of election was sometimes held by the people It was finally vested in the emperors, who added as many to their numbers as they thought fit The chief of the pontifices was called the *pontifex maximus* and was always created by the people, being generally chosen from those who had borne the first offices in the state His station was one of great [illegible] power as he not only had supreme authority [illegible] matters but in consequence of the close connection between the civil government and religion of Rome, he had also considerable political influence The title of pontifex maximus being for life, Augustus never assumed it till the death of Lepidus, after which it was always held by himself and his successors to the time of Theodosius The insignia consisted of the *toga prætexta*, and a conical woollen cap with a tassel (*galerus*) (See the *Mem de l'Ac des Inscr*, vols xii xv xxiv xxxvii) From this word the well known title of Pontiff in modern Europe is derived "Supreme Pontiff" is a common style of the pope

PONTOON A Military term, denoting a kind of flat-bottomed boat, generally lined within and without with [illegible] about 21 feet long, 5 feet broad, [illegible] are carried along with an army for [illegible] temporary bridge called *pontoon bridges*, by which an army is pursued over rivers

POOP A partial deck extending close aft, above the complete deck of the vessel A sea coming over the stern is said to *poop* the vessel.





**POOR, THE.** (Lat pauperes) In Political Economy, the term employed to designate those persons, or that portion of the population of any county, who, being destitute of wealth, are, through age, bodily or mental infirmity, want of employment, or other cause, unable [illegible] have to depend for support [illegible]

The first notice of the poor by the legislature of England appears to have occurred in 1376, and there does not seem to be any good grounds for thinking that any portion of the people were known [illegible] that on previously to the 14th cent [illegible] The truth is, however paradoxical soever the statement may at first appear, that the poor, as a class, owe their existence to the abolition of villenage and the progress of civilization Previously to this abolition, the great bulk of the people were in a state of predial slavery or in a condition closely resembling that of the Spartan helots But in such a state of society the class of persons now known as the destitute poor could not exist It is essential to the idea of slavery, whether predial or absolute, that the masters should provide their bondsmen or slaves with at least the necessaries of life, and, in the event of their neglecting to do so, the law, if it interfere, merely directs that they shall fulfil this natural obligation, or that otherwise they shall sell or assign their slaves to those by whom it will be fulfilled But after the establishment of corporate bodies in the towns and cities and the growth of manufactures and commerce had given birth to a class of free labourers, the poor began to make their appearance, and to attract the notice of the legislature Free labourers owe no compulsory service to any one They are their own masters, and may employ themselves in any way not injurious to others they think fit But it is plain that such persons cannot in the event of their becoming infirm or destitute, claim to be supported by any particular individual or class of individuals They are not bound to serve any one when in health, and consequently, no one can be bound to provide for them when in want Under such circumstances, they have nothing to look to but the [illegible] charity of individuals or the public But as the conduct of individuals must, in such matters be left to be determined by their own sense of what is right and proper, we shall now, without alluding farther to them, briefly inquire what, in this respect is the duty of the public, or whether and to what extent it should interfere to relieve the destitute

The poor and destitute may be divided into two great classes the first consisting of maimed and impotent persons or of those whom natural or accidental infirmities disable from working, and the second of those who though able and willing to work, are unable to find employment, or do not receive wages adequate for their support and that of their families There is a very wide difference in the situation of these classes, and the same means of relief that may be advantageously afforded to the one may not, in various respects, be suitable for the other

With respect, however, to the first class, or the impotent poor, there does not seem to be much room for doubt as to the policy as well as humanity, of giving them a legal claim to relief It has sometimes, indeed, been contended, that by affording relief to those who are unable, from age or the gradual decay of their bodily powers, to provide for themselves the motives that induce individuals, while in health to make a provision against future contingencies are weakened, so that, in attempting to protect a few from the effects of their own improvidence, an injury is done to the whole community This statement is probably, true to a certain extent, though it be difficult to imagine that any considerable portion of a moderately intelligent population will ever be tempted to relax in their efforts to save and accumulate when they have the means of doing so, from a knowledge that the workhouse will receive them in old age! But whatever may have been the faults of individuals, it would be abhorrent to all the feelings of humanity to allow them to suffer the extremity of want An individual is unfortunate perhaps or he may not have been as thrifty or as prudent as he ought, but is he, therefore to be allowed to die in the streets? It is proper certainly to do nothing that can really weaken the spirit of industry, but in order to strengthen it, all relief were refused to the maimed and impotent poor, the habits and feelings of the people would be degraded and brutalized by familiarity with the most abject wretchedness, at the same time, that, by driving the victims of poverty to despair, a foundation would be laid for the most dreadful crimes, and such a shock given to the security of property as would very much overbalance whatever additional spur the refusal of support might [illegible] It does, therefore, appear [illegible] class of poor should be supported in one way or other, and that, when the parties are either without relations or friends, or when these do not come voluntarily forward to discharge this indispensable duty, the necessary funds should be provided

by a tax or rate, made equally to affect all classes, for, if they [illegible] be provided for [illegible] them will fall wholly on the benevolent, who should not, in such a case, be called upon to contribute more than their fair share

II The only question then, about which there seems to be any real ground for doubt or difference of opinion is, whether any legal claim for relief should be given to the able-bodied poor, or to those who are able and ready to work, but who cannot find employment or cannot earn wages adequate for their support? Now this, it must be confessed, is rather a difficult question, and one which does not, perhaps, admit of any very satisfactory solution On the whole however it appears for the reasons we shall now shortly state that it should, under certain restrictions, be decided in the affirmative

In the first place it may be observed, that owing to changes of fashion, to the miscalculation of producers and merchants, and to political events, those engaged [illegible] manufacturing employments are necessarily exposed to many vicissitudes, and when their number is so very great as in this country it is quite essential that a resource should be provided for their support in periods of adversity In the event of no such provision being made, and of the distress being at the same time extensive and severe, the public tranquillity would most likely be seriously endangered Lord Bacon has observed, that "of all rebellions, those of the belly are the worst" It would be visionary, indeed, to imagine that those who have nothing should quietly submit to suffer the extremity of want without attacking the property of others, and hence, if we would preserve unimpaired the peace, and consequently the [illegible] country, we must beware of allowing [illegible] of the population to fall into a state of destitution But without the establishment of a compulsory provision for the support of the unemployed poor, it is difficult to see how they could avoid occasionally falling into this state Through its instrumentality however they are sustained in periods of adversity without being driven by necessity to commit crimes It must indeed, be admitted that a provision of this sort is very liable to abuse Means have, however been devised for checking this tendency, and whatever imperfections may after all attach to it it has not yet been shown how security and good order could be maintained in periods when either employment or food was deficient, were it abolished

In the second place supposing it were possible to maintain tranquillity without making a legal provision for the support of the unemployed poor the privations to which, under such circumstances, they would be forced to submit, would, in all probability lower their notions as to what was necessary for their comfortable subsistence and exert a most pernicious influence over their conduct and character It is perhaps unnecessary to enter into any statements to show the importance of endeavouring to guard against any such obviously mischievous results But Mr Barton has made some observations on this point which are so striking and conclusive that we cannot forbear laying them before the reader "It is to be remembered" says he, "that even those who most strongly assert the [illegible] tendency of our poor laws admit that [illegible] unconnected with these laws do, at times, depress the condition of the labourer Poor families are often thrown into a state of severe necessity by long continued illness or unavoidable misfortunes, from which it would be impossible for them to return to the enjoyment of decent competence if not supported by extraneous means It is well known, too, that a general rise in the price of commodities is seldom immediately followed by a rise in the wages of country labour In the meantime, great suffering must be endured by the whole class of peasantry if no legislative provision existed for their relief, and when such a rise of prices goes on gradually increasing for a series of years as sometimes happens the sufferings resulting from it must be proportionally prolonged The question at issue is simply this, whether that suffering be calculated to cherish habits of sober and self-denying prudence, or to generate a spirit of careless desperation?

"During these periods of extraordinary privation the labourer if not effectually relieved would imperceptibly lose that taste for order, decency, and cleanliness, which had been gradually formed and accumulated, in better times, by the insensible operation of habit and example, and no strength of argument, no force of authority, could again instil into the minds of a new generation [illegible] up under more prosperous circumstances the [illegible] and tastes thus blighted [illegible] of penury Every return [illegible] therefore, vitiate the feelings and lower the sensibilities of the labouring classes The little progress of improvement made in [illegible] be lost and forgotten If we ward off [illegible] blasts of calamity, the sacred flame may be kept alive till the tempest be past, but if once extinguished, how hard is the task of rekindling it in minds long inured to degradation and wretchedness!" (*Inquiry into the Depreciation of Agricultural Labour*, p 32)

In the third place, it will, we suppose, be admitted that when a considerable number of destitute poor persons are thrown out of employment, a provision of some sort or other should be made for their support Suppose now that it is made, not by a compulsory rate, but by the [illegible] rather choose to undergo the greatest privations than submit to solicit a share of this charitable contribution who yet would make no scruple of claiming it had the state given them a legal right to look to it for support But, admitting the truth of this statement, it has been already seen that it is not for the advantage of society that the poor should be forced to submit to such extraordinary privations It is, besides, abundantly certain that many would not be influenced by the motives alluded to, and in the event of the distress being either very severe, or long-continued, even those most disinclined to become a burden on others might be forced to beg a pittance And it is pretty obvious notwithstanding all that has been said to the contrary that the necessary result of such a state of things would be far more prejudicial to the character of the poor — that it would do more to prostrate their pride and independence, and to sink them in their own estimation, than the acceptance of relief from a poor's rate It is idle, indeed, to talk about the independence of a man who is receiving charity, but an individual supported by a poor's rate cannot fairly be regarded in such a point of view He is merely sharing in a public provision made by the state, and as all property has been acquired with the knowledge that it was responsible to this claim on the part of the poor, it cannot justly be considered as entailing any burden on any particular individual It may therefore one should think, be fairly presumed that the pride and independence of the poor will be more likely to be supported under a system of this sort, than if they were obliged to depend in periods of distress on the bounty of others Wherever the poor have not either *de jure* or *de facto* a claim for support [illegible] be allowed to beg [illegible] and disgrace humanity, there is perhaps none more destructive than the prevalence of mendicity A common beggar is the most degraded of beings, and the experience of Ireland down to a very late date as well as of France Italy Spain and in short of every country where there is no established provision for the support of the poor shows that wherever they are compelled to depend on so precarious a resource as charity we look in vain for that manliness and independence of character among the labouring classes which distinguish those of England and find in their stead all those degrading vices which a sense of insecurity and the prevalence of beggary, are sure to produce

The people and legislature of England have acquiesced in the justice and expediency of the principles now laid down A compulsory provision for the support of the poor has in fact existed in England for a lengthened period It grew out of the impotent attempts made in the reigns of Henry VIII Edward VI and the earlier part of that of Elizabeth, to suppress mendicancy and at the same time to provide for the poor by voluntary contributions At length the earlier statutes on the subject were consolidated and the principle of compulsory provision carried to the fullest extent by the famous statute of the 43 Eliz c 2 which enacted that all maimed and impotent persons should be provided for at the expense of their respective parishes and that employment should be found for the unemployed able-bodied poor From this remote period the law of England has regarded every parish in the light of a family, the richer members of which were bound to provide for those who, through inability, misfortune or want of work could not provide for themselves This also is the principle embodied in the law of Scotland with respect to the poor, and provided the means for [illegible] so contrived that indigence and [illegible] without at the same time encouraging indolence and vice the system would seem to be quite unexceptionable Practically however, this has been found to be a problem of exceedingly difficult solution, and this difficulty has made not a few conclude that, however administered, all systematic attempts to relieve the poor are necessarily, in the end, productive of increased want and misery

The poor, no doubt, are naturally anxious that the compulsory provision for [illegible] raised to the highest limit, and [illegible] not only be relieved, but that they should be able, without molestation to eat the bread of idleness But wherever the assessment and administration of the provision for their support is left to the care of those on whom the burden of its [illegible] abuse is not long in [illegible] the sustaining and beneficial influence of the system alone

remains The complicated code of laws respecting settlements, and the establishment of workhouses, owes its origin to this principle — to the wish of the legislature to relieve the poor, and at the same time, to prevent the abuse of the rates, and there is unquestionable evidence to show, that, from the establishment of the system in 1603 down to about 1780, the devices in question were effectual for their object, and that while poverty was relieved no encouragement was given to sloth, or to early and improvident marriages But soon after this period various alterations were made on the old law, which broke down most of the securities against the abuse of the rates, and, in 1795, the pernicious principle was adopted of mixing together wages and poor rates and of eking out what was supposed to be a deficiency in the former by payments from the latter! In consequence of this subversion of the principle on which the poor rates had been previously administered, they began rapidly to increase, and threatened to swallow up the whole, or, at least a very large part of the surplus produce of the land Various devices were resorted to, in the view of checking the evil, but, unaccountable as it may appear not one of them had for its object to revert to those practices and mode of administering the law which the experience of more than 200 years had shown were fully effectual for the prevention of abuse At length the Poor Law Amendment Act was passed in 1834 which introduced a totally new system for the administration of the poor laws Under this act the country has been divided into unions of more or fewer parishes, according to circumstances, the administration of all matters relating to the poor in these unions being intrusted to a board of guardians elected by the rate payers But these guardians are themselves controlled by and in fact are merely the executive officers of, a central board of three commissioners established in London who have power to issue rules and regulations as to the management of the poor which all guardians and other interior officers are bound to obey The central board is assisted by deputy commissioners who attend at meetings of guardians explain the law, and adjudicate or report upon extraordinary cases and see that the rules laid down by the central board are complied with The whole that can be said in favour of this law is that the poor rates have been materially reduced since its introduction, but we incline to think that the reduction would have been about as great had the system for the regulation of the compulsory provision that prevailed in the reign of George II been revived with a few alterations, while many pernicious consequences inseparable from the existing system would have been avoided (See *Wealth of Nations*, M'Culloch's ed note xxii)

We subjoin a table of the sums expended for the relief and maintenance of the poor of England and Wales at different periods since 1748

| Years | Sums expended on Poor | Years | Sums expended on Poor |
|---|---|---|---|
| *Average* | £ | | £ |
| 1748-50 | 689,971 | 1841 | 4,760,929 |
| 1776, 1777 | 1,270,800 | 1842 | 4,911,108 |
| 1783-1785 | 2,004,739 | 1843 | 5,208,127 |
| 1801 | 4,077,891 | 1844 | 4,970,093 |
| 1813 | 6,656,400 | 1845 | 5,298,703 |
| 1821 | 6,959,249 | 1846 | 4,954,104 |
| 1831 | 6,798,888 | 1847 | 5,298,787 |
| 1833 | 5,946,418 | 1848 | 6,180,704 |
| 1839 | 4,406,107 | 1849 | 5,702,963 |
| 1840 | 4,576,803 | | |

POPE A title derived from an oriental word signifying father and in earlier times applied indiscriminately to all bishops and in the East even to ministers, but for many centuries the term has been confined to the bishop of Rome, who is also designated by Roman Catholics as the Holy Father *See* PAPACY

POPERY *See* PAPACY

POPLITEAL (Lat poples, *the ham*) Relating to the posterior part of the knee joint or *ham*

POPULATION (Lat populus, *people*) The inhabitants or people of any particular territory or district

POPULATION, LAW OR PRINCIPLE OF in Political Economy means the law according to which the population of any country would increase, independently of immigration or emigration, under any assumed set of circumstances

The law of population, or of the increase of the human species, has not, till a comparatively recent period, attracted that attention to which it is eminently entitled It was formerly taken for granted that every increase of population was an advantage, and it was usual for legislators to encourage early marriages, and to bestow rewards on those who brought [illegible] of children But the researches of Mr Malthus* have shown the mischievous nature of such interferences they have shown that every increase in the numbers of a people, occasioned by artificial expedients, and which is not either accompanied or preceded by a corresponding increase of the means of subsistence, can be productive only of misery or of increased mortality, that the difficulty never is to bring human beings into the world, but to feed and educate them when there, that mankind do everywhere increase their numbers, till their farther multiplication is restrained by the difficulty of providing subsistence, and the poverty of some part of the society, and that, consequently, instead of attempting to strengthen the principle of increase, we should rather endeavour to strengthen the principles by which it is controlled and regulated

In order briefly to show the principle on which the increase of population depends, we may state that the sexual passion or instinct has appeared in all ages and countries so nearly the same, that it may, in the language of geometers, be called a constant quantity Now, it has been shown by the experience of America and of other countries under nearly similar circumstances, or where there has been a nearly equal command over the means of subsistence, that population has gone on, for a lengthened period, doubling in every twenty or five and twenty years But the same principle or instinct that doubles the population of any particular country in this short period is every where in existence, and is every where about equally powerful And, such being the case, it may be asked, Why does not population every where increase with the same rapidity as in Kentucky or Illinois? The reason is that the increase of population must always depend upon and can never for any considerable period exceed the increase of the food and other accommodations required for the subsistence of human beings, and this increase being very different in different countries, the progress of population must vary accordingly In some it may be rapid in others slowly progressive, and in others stationary or even retrograde

It is certain however that the principle of increase in the species is sufficiently powerful to keep the population of the most favoured countries, or of those where wealth is most easily obtained and rapidly increased, quite up to the level of the means of subsistence This is evinced by the poverty of a considerable portion of the people of such countries, by their usually having more claimants for employ than employers or by the demand for labour being rather greater than that for labourers, in short by the constant pressure as it were, of a part of the population against the limits of subsistence But, when such is the case, even in the most favourably situated countries it is quite obvious that if the principle of increase were allowed to exert its full force in countries placed under less favourable circumstances, — if the same habit of early and universal marriage were indulged in the latter as in the former it could not fail to occasion the most deplorable results Man cannot increase beyond the means of subsistence, and where these are either stationary, or but slowly advancing any such development of the principle of increase as is exhibited in countries where these means are increasing most rapidly would be productive only of increased misery and mortality And hence, in the vast majority of cases the principle of increase is restrained and controlled by prudential considerations Man is not like the lower animals actuated only by instinct To occasion marriage, it is not always enough that the parties should be attached to each other The obligation of providing for the children that may be expected to spring from it, is one that cannot fail to awaken the forethought and to influence the conduct of all but the most improvident and thoughtless If the situation of those who might be disposed to enter into a matrimonial alliance be such as to preclude all reasonable expectation of their being able to bring up and educate their children, without exposing themselves to privations or to the risk of being cast down to a lower place in society they may not improbably either relinquish all thoughts of forming a union, or postpone it till a more convenient opportunity No doubt there are very many individuals in all countries who are not affected by such considerations and who, seeing the future through the deceitful medium of their passions are not deterred from gratifying their inclinations by any fear of the consequences But the great majority of every society act on sounder principles They are anxious not to preserve merely, but to improve their condition in society, and cannot bear the idea that their family should be in a worse situation than themselves Hence the reason that in all old settled or densely peopled countries, marriages are deferred to a much later period than in colonies and newly settled countries, where there are comparatively great facilities for gaining a livelihood, and that a much larger proportion of the population find it expedient to pass their lives in celibacy And it is [illegible] that the forethought and [illegible] of the people and their laudable wish to maintain and better their condition, make them control

* Essay on the Principle of Population, *passim* The first edition of this work was published in 1798

the violence of their passions, and disregard the dicta of spurious advisers It is quite obvious that if the capacity of multiplication, or the principle of increase, in densely peopled countries, where there is a comparatively great difficulty in obtaining supplies of food were not checked by the prevalence of moral restraint arising from the consideration of the circumstances under which society is placed [illegible] to the state of misery and famine [illegible] population of every country has the power, supposing food and other necessary accommodations to be adequately supplied, to go on doubling every twenty or five and twenty years, but as the limited extent and limited fertility of the soil render it impossible to go on permanently producing food in this ratio it unavoidably follows that unless the passions be moderated and a proportional diminution be effected in the number of marriages and births, the standard of subsistence will be reduced to the lowest assignable limit, and famine and pestilence will be perpetually at work to relieve the population of wretches born only to be starved

Although, therefore, the principle or instinct which prompts to the increase of the species be alike powerful in the most opposite conditions and states of society, its development depends on a variety of circumstances Generally however there can be no question that it is sufficiently powerful even where the means of subsistence are acquired with the greatest ease, to keep population on a level with these means, and in all but the most favoured situations, it could hardly fail if not controlled by other circumstances, to make the increase of population outrun that of the means of subsistence, and, consequently to occasion an increase of misery and mortality But this tendency is seldom or never allowed to exert its full influence The principle of increase though one of the strongest implanted in our nature is after all, governed less by instinct than by reason At all events, it is invariably found, when we look at nations or great masses of individuals that the period and frequency of marriages and the rate of increase are determined by the state of the population with respect to food, and that the latter is never outrun by the former

The principle of increase is not therefore, the bugbear, the invincible obstacle to all real improvement it has been represented by those who have overlooked the influence of moral causes in modifying and controlling its action That the tendency to increase is not inconsistent with the improvement of society is a fact as to which, indeed, there can be no dispute Without going back to antiquity, let any one compare the state of this or any other European country 500 or 100 years ago with its present state, and he will be satisfied that prodigious advances have been made that the means of subsistence have increased much more rapidly than the population, and that the labouring classes are now generally in the possession of conveniences and luxuries that were formerly not enjoyed even by the richest lords The principle of increase is not, however merely consistent with the continued improvement of the bulk of society—it is in fact the great cause of this improvement, and of the wonderful progress made in the arts Had the principle been less powerful or had it not existed at all every new discovery by diminishing the necessity for others would have occasioned a decline in the spirit of invention, and society would long since have been either in a languishing or a stationary state But the increase of population, though generally subordinate to the increase of food is always sufficiently powerful to keep invention on the stretch All that numerous class who live by their labour, and who are either striving to raise themselves to a higher station, or to maintain their present position, are at this moment impelled by the same powerful motives to invent and contrive new and more powerful methods of production that impelled their ancestors 5,000 years ago, and so it will be in all time to come The *cuncis acuens mortalia corda* will never cease to operate, and will secure the continued advancement of society To suppose, as some have done that the extraordinary progress already made in science and the arts would have been equal or greater had the tendency to increase been less powerful is in truth equivalent to supposing that industry [illegible] by lessening the motives to their exertion and the advantages derivable from them There might, perhaps, have been less squalid poverty among the very dregs of the population had there been no principle of increase, but it is a contradiction to pretend, had such really been the case that the powers and resources of industry would have been so astonishingly developed, that scientific investigations would have been prosecuted with equal perseverance and zeal, that so much wealth would have been accumulated by the upper and middle classes, or that the same circumstances which urged society forward in its infancy would have continued in every subsequent age to preserve their energy unimpaired and it may well be doubted whether an exemption from the evils incident to poverty would not have been dearly purchased, even by the very lowest classes by the sacrifice of the hopes and fears attached to their present condition, and the extraordinary gratification they now reap from successful industry

If these conclusions be well founded, it follows that the schemes proposed for directly repressing population in the ancient and modern world, besides being for the most part atrocious and disgusting, have really been opposed to the ultimate objects their projectors had in view Could the rate of increase be subjected to any [illegible] few comparatively among [illegible] led to burden themselves with the task of providing for a family and the most effective stimulus to exertion being destroyed, society would gradually sink into apathy and languor It is, therefore, to the principle of moral restraint, or to the exercise of the prudential virtues, that we should exclusively trust for the regulation of the increase of population In an instructed society, where there are no institutions favourable to improvidence, this check is sufficiently powerful to confine the progress of population within due limits at the same time that it is not so powerful as to hinder it from operating, in all cases, as the strongest incentive to industry and economy

Mr Malthus's *Essay on Population* made a great sensation at the time when it appeared, and is valuable from its showing conclusively that the principle of increase is strong enough, without any adventitious encouragement to keep population always on a level with the means of subsistence In other respects, however, it is altogether defective Mr Malthus has not shown that the mischievous consequences that might otherwise result from the operation of the principle of increase are sure to be countervailed by the operation of those prudential considerations to which it necessarily gives rise, nor has he shown the important and powerful influence of the principle in securing the continued improvement of society One of the best expositions of the theory of population is that given by Bishop Sumner in his *Records of the Creation* See also the note on Population in M Culloch's edition of the *Wealth of Nations*

PO'PULIN A crystallizable substance separated from the bark of the *Populus tremula*

PORCATE (Lat porca *a ridge*) In Entomology, when a surface has several parallel elevated longitudinal ridges

PORCELAIN *See* POTTERY

PORCELLANITE An opake brittle variety of jasper

PORCH (Fr porche) In Architecture an arched or flat or ceiled vestibule at the entrance of a church or other building

POROS In Natural Philosophy the small interstices between the particles or molecules of matter which compose bodies There are many considerations which prove that all bodies even the densest are composed of molecules not in absolute contact but separated from each other by intervals which though so small as to be inappreciable to the senses have nevertheless a magnitude considerable in respect of the molecules themselves The porosity of bodies may be demonstrated in many cases by very simple experiments If a piece of wood or marble, granite or other compact stone be plunged under water and placed under the receiver of an air pump on withdrawing the external pressure the air which had been dispersed through the interior cavities or pores, will issue from every point of their surface and rise in a torrent of bubbles In like manner, mercury is forced through a piece of dry wood or leather, and made to fall in a finely divided shower A body plunged deep under a liquid sustains a pressure in consequence of which it is contracted in all its dimensions, and the liquid penetrates the body without producing any apparent disruption of its parts Iron, by being hammered, is reduced in volume, and the dimensions of all bodies are affected by heat and cold The facility with which translucent substances are penetrated by the rays of light evinces extreme porosity And this penetration is not confined to bodies which are usually termed diaphanous, for gold itself, one of the most opake of the metals, when beaten into extreme thinness, transmits a soft green light All these facts [illegible] has been inferred [illegible] any substance of the specific gravity of water must have many times more pores than solid parts

PORIFERA (Lat porus, *a pore*, and fero, *I carry*) A name invented and applied by Mr Hogg to a group of Polyps including the genera *Cellepora*, *Millepora*, and *Tubipora* [illegible] Dr Grant [illegible] of [illegible] sponges

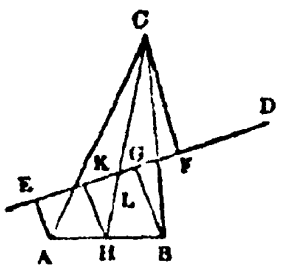
PO'RISM (Gr πορισμα; from πορίζω, *I investigate*), in Geometry, is defined by professor Playfair to be "a proposition affirming the possibility of finding such conditions as will render a certain problem indeterminate, or capable of innumerable solutions"

According to Pappus, the porisms constituted one of

the eight subjects which formed the ancient geometrical analysis Euclid composed a treatise on porisms in three books, of which no trace now remains except some obscure notices preserved in the mathematical collections of Pappus From the manner in which the porisms are mentioned by Pappus it is evident that the ancients set a high value on this class of propositions; but the description which he has given of them is so vague that geometers were long unable to divine his meaning or to discover the peculiar circumstances in respect of which a porism differs from an ordinary problem The subject, indeed, baffled the ingenuity of the most eminent mathematicians, until it was taken up by Dr Simson, of Glasgow, who at length succeeded in restoring a great number of Euclid's porisms, together with their analysis The [illegible] It still remained however, to inquire into the probable origin of the porisms, or the steps by which the ancient geometers had been led to their discovery, and also to point out the relations in which they stand to other classes of geometrical truths This was accomplished by the late Professor Playfair, in an admirable paper, "On the Origin and Investigation of Porisms," published in vol iii of the *Transactions of the Royal Society of Edinburgh*, and afterwards in the 3d volume of his collected Works, Edin 1822

The nature of a porism, and the manner in which it is derived from an ordinary proposition will be best illustrated by an example The following proposition is one of those selected by Mr Playfair for the purpose —

A triangle A B C being given, and also a point D, to draw through D a straight line D F, such that perpendiculars being drawn to it from the three angles of the triangle, namely, A I, B G, C I, the sum of the two perpendiculars on the same side of D E shall be equal to the remaining perpendicular, or that A I and B G together shall be equal to C I




Suppose it done, bisect A B in H, join C H (intersecting D L in I), and draw H K perpendicular to D I

Because A B is bisected in H the two perpendiculars A F and B G are together double of H K, and as they are equal to C F, by hypothesis C I must also be double of H K, and C L of I H Now C H is given in position and magnitude therefore the point L is given and the point D being also given, the line D I is given in position, which was to be found

The construction is obvious Bisect A B in H, join C H, and take H L equal to one third of C H, the straight line which joins the points D and I is the line required

Now, it is plain that while the triangle A B C remains the same, the point L also remains the same, wherever the point D may be The point D may therefore coincide with L, and, when this happens the position of the line to be drawn remains undetermined, that is to say, any line whatever drawn through L will satisfy the conditions of the problem Here then we have an indeterminate case of a problem, and of consequence, a porism which may be thus enunciated —

A triangle being given in position, a point in it may be found such that any straight line whatever being drawn through that point, the perpendiculars drawn to this straight line from the two angles of the triangle which are on one side of it will be together equal to the perpendicular that is drawn to the same line from the angle on the other side of it

For examples of porisms see *Simson's Opera Reliqua*, Playfair's paper above mentioned a paper by Prof Wallace, entitled "Some Geometrical Porisms &c" in the *Edinburgh Transactions* vol iv, *Stewart's General Theorems*, 1746, *Leslie's Geometrical Analysis*, and *Leybourn's Mathematical Repository* See also *Traill's Account of the Life and Writings of Robert Simson M D*; and Chasles, *Aperçu Historique sur l'Origine et le Développement des Methodes en Geometrie*, Brux 1837

The term porism is also used by the Greek geometricians to signify merely the [illegible] to a proposition

POROSITY A property of matter, in consequence of which its molecules are not in absolute contact but separated by intervals or *pores* The quantity of matter in a body is inversely as its porosity, whence the ratio of the porosity of one body to another may be determined from their weight See Pores

PO'RPHYRY (Gr πορφυρα, *purple*) In Statuary, an [illegible] stone of a red, or rather purple and [illegible] more or less variegated, its purple being of all gradations, from violet to a claret colour It is susceptible of a very high polish Egypt and the East furnish very plentiful strata of this material It is also found in Minorca The extreme ease with which the ancients seem to have cut this substance and worked it in sculptural subjects has been a matter of much discussion among the moderns Dr Lister, in a paper of the *Philosophical Transactions*, seems to think that the ancients possessed the secret of tempering steel better than the moderns The French cut it with an iron saw without teeth, using the [illegible] pulverized and mixed with water [illegible] said to have distilled water by the help whereof Francesco Caldi his sculptor gave his tools a hardness and temper capable of working the hardest and most compact substances

PORPHYRY In Geology an unstratified or igneous [illegible] of the [illegible] The term [illegible] found in the preceding article *See* GEOLOGY [illegible] *Annulus clypei*) The name of a genus of sea-nettles (*Acalephæ*), characterized by an internal circular flattened disk of a calcareous and horny texture

PORRECT (Lat porrigo, *I extend*) In Zoology, when a part extends forth horizontally, as if to meet [illegible]

(Lat porrigo) The ringworm, or scald-head

PORT *See* HARBOUR

PORT is, usually, the adverb of larboard, as, the ship heels *to port*, for to the larboard side Put the helm *a-port*, &c

PORT The opening or embrasure in the ship's side for a gun The ports of the lower deck are defended, when at sea, by strong covers hanging from hinges, the ropes by which these are held up or open are called *port lanyards*, and consist of a pendant passing through a leaded hole in the side with a tackle

PORTAL (Fr portail) In Architecture the lesser of two gates, when they are of two dimensions, at the entrance of a building

PORTCULLIS (Fr portecoulisse) In Fortification a sort of machine composed of several large pieces of wood laid across one another, like a harrow, and pointed with iron, used formerly to be hung over gateways of fortified places, to be let down in case of a surprise and when there was not [illegible] the gate

PORTE, THE SUBLIME The official title of the government of the Ottoman Empire said to be derived from a gate of the palace at Brousa the original metropolis of that empire called Bab Humayoon, the sublime gate

PO'RTER A liquor brewed from malt, part of which has been more highly dried than that used for ale It is hopped in the same way as ale, and its deep colour is finally given to it either by burned sugar, which usually goes under the name of *colouring*, or more legitimately by roasted or parched malt Porter was first brewed in 1722 The malt liquor previously drunk consisted of three kinds — ale beer, and "twopenny," and a mixture of either of these kinds was a favourite beverage under the name of half-and-half," or a mixture was drunk called three threads' consisting of equal portions of each of the above kinds of liquor, for a draught of which the publican had to go to three different casks About 1722, Harwood, a London brewer, commenced brewing a malt liquor, which was intended to unite the flavours of ale and beer, or ale, beer, and "twopenny," and having succeeded, he called his liquor "entire," or entire butt," a name intended to intimate that it was drawn from one cask or butt only A mixture of ale or porter, drawn from different casks, is very commonly drunk in London at the present time Harwood's liquor obtained the name of porter from its consumption by porters and labourers From 1722 to 1761, the retail price of porter was 3*d* per pot when it was raised to 3½*d*, at which it continued till 1799, it has never been higher than 6*d* nor during the present century lower than at the present time November 1819 when the price is 4*d* The following account of the fluctuations of the price per barrel since 1816 is from a private source — In July, 1816, the price was reduced from 45*s* to 40*s*, but in October was again advanced to 45*s*, in January, 1817, a further advance was made to 50*s*, and in December of the same year it reached 55*s* In 1819 1820, and 1822, the price was successively reduced from 55*s* to 50*s*, 45*s*, and 40*s* In January, 1824, it was advanced to 45*s*, in November, 1825, to 50*s* but a few months afterwards it again fell to 45*s* Since the abolition of the beer duties in 1830, the price has been 33*s* per barrel

PORT-FIRE In Gunnery a paper tube about 10 inches long, filled with a composition of meal-powder, sulphur, and nitre, rammed moderately hard, used to fire guns and mortars instead of a match (*Hutton's Dict*)

PO'RTICO (Ital, from porticus, Lat) In Architecture, a place for walking [illegible] sheltered occasionally raised after the manner [illegible] with arches Sometimes the portico is vaulted, and sometimes it is with a flat ceiling The most usual application of the word is to the projection supported by columns placed before a building

PO'RTIO, or PORTION is a term anatomically ap-

plied to two branches of the seventh pair of nerves; the *portio dura*, or hard portion, and the *portio mollis*, or soft portion the former is the facial nerve, the latter the auditory or co st c nerve

PO'RTLAND POWDER A mixture of several indigenous bitter herbs which was once a celebrated remedy in the gout

PO'RTLAND STONE A granular limestone belonging to the upper part of the oolite formation, and abounding in the island of Portland, upon the coast of Dorsetshire *See* GEOLOGY

PORTLAND VASE A celebrated cinerary urn or vase, long in possession of B berini at Rome (whence it wa from whom it came into the possession of the Portland family, who deposited it in 1810 in the British Museum of which it is one of the most valuable reliques This beautiful specimen of ancient art was found in the tomb of the Emperor mmæa It is describ tom v ) who was evidently mistaken in representing it as formed of a precious stone The substance is said to be of glass, or composition, it is of a deep blue or violet colour and the figures in the scene depicted on it are white The subjects are explained fi k W Marsh, in the 8th volume of the *Archæologia*, and one by Dr Darwin in the Notes to his *Botanic Garden* ) The late Mr Wedgwood made a mould of this vase and took from it a number of casts made with the greatest skil and original

PO RTRAI ) In Painting, the representation of an individual, or, more strictly speaking, of a face, painted from real life Portraits are of full length, half length, &c , and are executed in oil or water colours crayons &c

PORTREEVE, or PORT GREVE (Ang Sax *gerefa*) Anciently the principal magistrate in ports and maritime towns According to Camden this was the ancient title of the officer who was afterwards called mayor in London

PORT ROYALISTS The name, the members of the celebrated convent l des Champs It was founded about 1204 by Matthieu de Marli, on the eve of his departure for the Holy Land, and though originally limited in its means and objects it gradually acquired such importance as to have secured for it a prominent place in the history of Europe It would be out of place here to give any details of its varied fortunes and the religious controversies which it carried on in the 17th century — the period of its greatest importance, and we refer the reader to the learned work of Reuchlin (*Geschichte von Port Royal*) for full information (See also the eloquent article in vol lxxiv of the *Edin Review*) It was abolished by Louis XIV as a nest of Jansenists and heretics Among the distinguished names connected with the Port Royal are those of Lancelot, Pascal, Arnauld, Nicole de Sacy, and Tillemont The school books which were published for the use of that institution were translated into all the languages of Europe, and maintained their reputation lo g fo nd though they are now fallen in deserve especial mention — 1 *Nouvelle Méthode, pour apprendre la Langue Latine*, 2 *Nouvelle Méthode pour apprendre la Langue Grecque*, 3 *Grammaire Générale*

POSITION (La positio *Iplace*) A rule in Arithmetic called also the rule of supposition, or *rule of false* It consists in assuming a number, and performing upon it the operations directed in the question and then comparing the result with that given in the question, in order to discover the error of the assumption Writers on arithmetic divide the rule into two parts, *single position* and *double position*, the former comprehending those questions in which the results are proportional to the suppositions and where, consequently, only one assumption is required, the latter those in which the results are not proportional to the suppositions, and where two suppositions are necessary in order to deduce the true answer To simple position belong such questions as the following — What number is that from which, if a a third and a fourth of itself be subtracted, the remainder is 60? Double position comprehends questions of this sort — What number is that which, being multiplied by 6, the product increased by 18, and the sum divided by 9, the quotient shall be 20? It will be observed that both these questions are immediately solved by a simple algebraic equation and, in fact, the same process is performed in the arithmetical operation in the assumed number, which, in the algebraic is performed on the unknown quantity The rules given for the solution of questions in double position are founded on certain principles of algebra, which may be applied with much greater facility to the immediate solution of the questions themselves Such questions therefore, cannot be considered as properly belonging to arithmetic, but to what may be denominated numerical analysis Position is also called the *rule of trial and error*, and is sometimes employed with good effect numerical equations the model in the manner best calculated for the end in view by the artist Such positions as are most natural and easy, and which exhibit the peculiar habit of the individual, in portrait painting are to be taken

POSITIVE ELECTRICITY *See* ELECTRICITY

POSITIVE QUANTITY In Algebra, denotes an affirmative or additive quantity; which character is indicated by the sign +, called, in consequence, the *positive sign* The term is used in contradistinction to *negative*, negative quantities being such as are subtractive, and marked by the sign —, which is called the *negative sign*. *See* SIGN

POSSE COMITA'TUS (Lat ) In Law, the power of the county which the sheriff is empowered to raise in case of riot possession kept on forcible entry, rescue, or other force made in opposition to the king's writ or execution of justice It is said to include all knights and other men above the age of fifteen, able to travel within the county Justices of the peace may also raise the posse in order to remove a force in making entry into or detaining lands

POST (Fr poste) In Architecture, any vertical piece of timber, as a truss post, door post, a quarter in a partition

POST In Public Economy a messenger, courier, or conveyance that travels at stated periods, and generally with more than ordinary speed, employed to convey letters or other despatches, whether of government or individuals

POST-ABDOMEN (Lat ) The name applied by Latreille to the five posterior segments of the abdomen of Hexapod insects, and to the caudal crustacea which consists of analogous but more numerous segments

POSTAGE The duty or rate of charge levied on letters or other articles conveyed by post

POSTEA (Lat ) In Law the return of the judge before whom a cause is tried after verdict, of what was done in the cause, which is endorsed on the back of the nisi prius record

POSTERN (Fr posterne) In Architecture a small gate or door at the back of a building

POSTERNS In Fortification, a small gate usually made in the angle of the flank of a bastion, or in that of the curtain

POSTICUM (Lat ) In Architecture, the portico at the back of a temple *See* NAOS

POSTLIMINIUM or JUS POSTLIMINII (Lat limen *a threshold*) In National and Civil Law the right by virtue of which persons taken by an enemy return to their former state of freedom with their former rights and property on its termination, and property so taken reverts to its former owners

POST OBIT (Lat post obitum, *after death*) A bond given for the purpose of securing a sum of money on the death of some specified individual

POST OFFICE A place for the reception and distribution of the letters and despatches that are to be or that have been carried by the post, where the duties on them are paid and where the various departments connected with the business of the post are conducted, or superintended

The conveyance of letters by post is one of the few industrious undertakings which are certainly better managed by government than they could be by individuals It is indispensable to the satisfactory working of the post office that it should be conducted with the greatest regularity and precision and that all the departments should be made subservient to each other, and conducted on the same plan It is plain that such results could not be obtained in any extensive country otherwise than by the agency of government, and the interference of the latter is also required to make arrangements for the safe and speedy conveyance of letters to, from and through foreign countries

The organization of the post office supplies one of the most striking examples of the advantages resulting from the division and combination of employments "Nearly the same exertions that are letter from Falmouth to New 0,000 If every man were to his own correspondence, the whole life of an eminent merchant might be passed in travelling, without being able to forward all the letters which the post office forwards for him in a single evening The labour of a few individuals, devoted exclusively to the forwarding of letters, produces results which all the exertions of all the inhabitants of Europe could not effect, each person acting independently" (*Senior on Political Economy*)

Posts appear to have been established for the first time in modern Europe in 1479, by Louis XI of France They were originally intended to serve merely for the conveyance of despatches, and of persons travelling by government Subsequently, however, private individuals were allowed to avail themselves of

this institution for forwarding letters and despatches, and governments, by imposing higher duties or rates of postage on the letters and parcels conveyed by post than are sufficient to defray the expense of the establishment have rendered it productive of a considerable revenue Nor, while the rates of postage are confined within reasonable limits and do not materially affect the facility of correspondence, is there, perhaps, a less objectionable tax

The post office was not established in England till the 17th century Post-masters, indeed, existed in more ancient times, but their business was confined to the furnishing of post horses to persons who were desirous of travelling expeditiously, and to the despatching of extraordinary packets upon special occasions In 1635, Charles I erected a letter office for England and Scotland, but this extended only to a few of the principal roads, the times of carriage were uncertain, and the post-masters on each road were required to furnish horses for the conveyance of the letters at the rate of 2½*d* a mile This establishment did not succeed, and, at the breaking out of the civil war great difficulty was experienced in the forwarding of letters At length a post office, or establishment for the weekly conveyance of letters to all parts of the kingdom, was instituted in 1649, by Mr Edward Prideaux attorney-general for the Commonwealth, the immediate consequence of which was a saving to the public of 7 000*l* a year on account of post masters In 1657, the post office was established nearly on its present footing and the rates of postage that were then fixed were continued till the reign of Queen Anne (*Black Com*, book i c 8)

From the establishment of the post office by Cromwell, down to 1784 mails were conveyed either on horseback or in carts made for the purpose, and instead of being the most expeditious and safest conveyance the post had become, at the latter period, one of the slowest and most easily robbed of any in the country In 1784 it was usual for the diligences between London and Bath to accomplish the journey in *seventeen* hours while the post took *forty* hours, and on other roads the comparative rate of travelling of the post and stage coaches was in about the same proportion The natural consequence of such a difference in point of despatch was that a very great number of letters were sent by other conveyances than the mail the law to the contrary being easily defeated, by giving them the form of small parcels

Under these circumstances it occurred to Mr John Palmer of Bath, comptroller-general of the post office, that a very great improvement might be made in the conveyance of letters, in respect of economy, as well as of speed and safety, by contracting with the proprietors of stage coaches for the carriage of the mail, the latter being bound to perform the journey in a specified time, and to take a guard with the mail for its protection Mr Palmer's plan encountered much opposition but was at length carried into effect with the most advantageous results The use of mail coaches speedily extended to most parts of the empire, and, while letters and parcels were conveyed in less than half the time that had been required under the old system, the coaches by which they were conveyed afforded by their regularity and speed, a most desirable mode of conveyance for travellers Mr Palmer was the author of several other improvements in the economy of the post office, nor is there any individual to whom the department owes more (*Macpherson's Annals of Com* anno 1784)

Within the last few years, however the construction of railways between most of the great towns of the empire has gone far to supersede the use of mail coaches on the principal lines of road and has added prodigiously to the facilities of correspondence and travelling The journey from London to Liverpool, which had been accomplished by the mail in about twenty or twenty two hours, is now accomplished by railway in nine or ten hours! and on other roads in the same proportion The great expense of the post office consists in fact, not so much in the conveyance of letters from place to place as in their previous collection and their distribution after they have been conveyed to their destination This necessitates the establishment of a vast number of subordinate offices in the remoter parts of the kingdom, many of which do not defray their expenses This is particularly the case in Ireland, where, in 1838 the expense of collecting the gross post office revenue amounted to 39*l* 16*s* 4¼*d* per cent

*Revenue and Rates of Postage* — During 1838 the post office of the United Kingdom produced a gross revenue of 2,346 278*l*, and a nett revenue, after deducting the expense of collection, of 1,676,522*l* This large revenue was derived from rates of postage, varying with the distance according to which letters were conveyed, but so that at an average they amounted to about 7*d* or 7½*d* for a single letter But the fact that the post office revenue had continued nearly stationary during the twenty years ending with 1838, notwithstanding the vast increase in that period of population and of the intercourse between the different parts of the empire, was a conclusive proof that the rates of postage had been carried to a [illegible] arithmetic of the post off [illegible] two and two, instead of always making four, sometimes make only one The effectual reduction of these rates was therefore urgently required, not only because of the importance to a commercial and manufacturing community of having the charge for the conveyance of correspondence fixed at a moderate amount, but because it was all but certain that moderate rates of postage would be more productive of revenue It did not, however, follow, that because an average charge of 7*d* or 7½*d* each on all letters conveyed by post was very decidedly too much, that the plan for making an invariable charge of 1*d* whether the letter were conveyed one mile or 1000 miles, should have been adopted This was to rush from one extreme to another and to endanger a considerable amount of revenue without any equivalent advantage It must, no doubt, be admitted that the proposal for a uniform penny rate of postage, had many recommendations in its favour Being calculated at once to obviate trouble and save expense, it could not fail to be acceptable (what reduction of taxation is not?) to a large portion of the public particularly to persons engaged in business We believe, however, that the scheme was more indebted for its popularity to the oppressiveness of the old rates of postage than to any intrinsic merits of its own Had these been reduced four or five years previously to a reasonable amount, that is, had letters of 1 oz weight coming from Scotland or Ireland to London been reduced to 6*d*, and other letters in proportion, and mercantile circulars been allowed to pass under covers open at the ends at 1*d* or 2*d* each, we venture to say that the clamour for a uniform rate of penny postage would not have made any way But in this, as usually happens on similar occasions, those who delay to make reasonable and necessary concessions at the outset, are in the end compelled to concede a great deal more than would at first have been satisfactory This at all events, has been eminently true in the present instance The clamour for a uniform penny rate became too powerful to be resisted, and parliament whether it were so inclined or not, was obliged to lend its sanction to the measure And under the provision of the act 2 & 3 Vict cap 52, it has been enacted that all inland letters, without regard to the number of enclosures, or the distance conveyed, provided they be paid when posted or despatched, shall, if not exceeding ½ oz weight, be charged 1*d*, 1 oz 2*d*, 2 oz 4*d*, 3 oz 6*d*, and so on, 2*d* being added for every additional ounce up to 16 oz, beyond which, with the following exceptions no packet, whether subject to postage or not is received —

1 Parliamentary petitions and addresses to her Majesty

2 [illegible]

3 [illegible] addressed to or received from places beyond sea

4 Letters and packets to and from public departments, and to and from public officers that formerly franked by virtue of their offices

5 Deeds if sent open, or in covers open at the sides They may be tied with string and sealed, in order to prevent inspection of the contents, but they must be open at the sides that it may be seen that they are entitled to the privilege

With these exceptions, all packets above the weight of 16 oz are forwarded to the Dead Letter Office

But all letters not paid when they are posted or despatched are charged *double the above rates*

All parliamentary and official franking has been put an end to, but members of either house of parliament are entitled to receive petitions to parliament free of charge provided such petitions be sent in covers open at the ends and do not exceed 6 oz weight

To facilitate the working of the plan, envelopes and stamps for single, double, &c letters, are furnished by the post office, and inland letters not provided with such stamps or envelopes must be forwarded *unpaid*

Such are the more prominent features of the new system, and none can deny that it has the recommendations of simplicity and cheapness in its favour, and that it has greatly facilitated correspondence But it may nevertheless be doubted whether its adoption was expedient It is certainly very convenient for merchants, bankers, middlemen, and retail dealers, to get letters for 1*d*, that previously cost them 7*d* or 7*d*½, but their satisfaction is not the only thing to be attended to in forming a fair estimate of the measure The public exigencies require that a sum of above fifty millions a year should be raised, one way or other, and so long as we are pressed by an unreasoning necessity of this sort, it is not much to say in favour of the repeal or diminution of any tax, that those on whom it fell with [illegible] are delighted with the reduction [illegible] England become a necessary of life and its consumption to say the least of it, is quite as indispensable to the bulk of the people, and especially to the labouring classes, as the

writing of letters But would it, therefore, be a wise [illegible] it to Is. [illegible] on the [illegible] ble, and should therefore be repealed, independently altogether of financial considerations But it is easier to make an allegation of this sort than to prove it All taxes, however imposed, if they be carried beyond their proper limits, are objectionable, but provided these be not exceeded, we have yet to learn why a tax on a letter should be more objectionable than a tax on the paper on which it is written or the food of the writer, or on his other things

During the first year (1840) of the new system, the nett revenue of the Post Office fell off about 1,200,000*l* ! But the revenue has continued gradually to increase with the increasing population and wealth of the country, and to such an extent is this the case, that the gross revenue of the Post Office for the year ending January 5, 1851, amounted to 2,264,684*l*, being only 100,000*l* less than the gross revenue of the year ending January 5, 1840—the last year of the old system

POST POSITION In Music, retardations of the harmony, effected by placing discords upon the accented parts of a bar not prepared and resolved according to [illegible]

POSTSCENIUM (Lat post, *behind*, and scena, *a scene*) In Architecture, the back part of the theatre behind the scenes, furnished with conveniences for robing the actors and [illegible] the machinery

POSTULATE (Lat postulare, *to demand*) In Geometry, something to be assumed or taken for granted [illegible] post ates — [illegible] any one point to any other point 2 That a terminated straight line may be produced to any length in a straight line 3 That [illegible] any centre at any distance [illegible] *Euclid*)

POSTULATE In Logic and Philosophy, a proposition of which the truth is *demanded* or assumed for the purpose of future reasoning

POTA'SH [illegible] the ashes of wood When purified by calcination it is termed *pearlash*, and is in that state an impure *carbonate of potassa* The production of potash is carried on upon a large scale in Russia and America, it can only be thus obtained in countries where there are vast natural forests and where the value of timber is little more than that of the labour [illegible] it *See* POTASSIUM

POTASSA *See* POTASSIUM

POTASSIUM This extraordinary metal was discovered by Davy in the year 1807, and was one of the first fruits of his masterly researches into the chemical powers of electricity Its properties are so remarkable, that it was for a time doubted whether it could with propriety be placed among the metals, but the progress of discovery has removed all difficulty upon that point by making us acquainted with other metallic substances the properties of which are, as it were, intermediate between those of potassium on the one hand and the common metals on the other One of the striking peculiarities of potassium is mechanical rather than chemical namely, its low specific gravity it being the lightest known solid, another is its [illegible] affinity for oxygen and its consequent energetic action when placed upon water where it immediately takes fire The specific gravity of potassium is 865 at the temperature of 60°, it is solid at the ordinary temperature of the atmosphere at 80° it becomes soft, and at 150° is perfectly liquid, at 32° it is brittle, and has a crystalline texture In colour and lustre it resembles mercury Its attraction for oxygen is such that it immediately loses its brilliancy on exposure to air, and becomes converted into potassa, heated in the air it burns with a purple flame The equivalent of potassium is 40, and that of *potassa* or *protoxide of potassium* is 48 When potassium is heated in oxygen [illegible] larger quantity of that element and becomes [illegible] which, however, is immediately converted into protoxide by the action of water Protoxide of potassium exists in the state of *hydrate* in what is called *caustic potash*, which is a compound of 48 potassa + 9 water This substance fuses at a dull red heat it is very soluble and deliquescent, and powerfully corrodes almost all animal textures It is the *lapis causticus* of old pharmacy Dissolved in water it forms [illegible] *potassæ* of the Pharmacopœia It [illegible] by pouring water upon a mixture of equal parts of quicklime and carbonate of potassa, the lime abstracts carbonic acid from the carbonate, and becomes converted into an insoluble carbonate of lime, whilst the evolved potassa is taken up by the water The solution thus obtained is powerfully alkaline and caustic, and, as it soon absorbs carbonic acid [illegible] be carefully preserved in well [illegible] Potassa is easily detected and recognized, when in solution, by its alkaline reaction upon proper vegetable colours, rendering for instance, the yellow of turmeric brown, and the blue of violet green when excess of tartaric acid is added to it, it yields a white granular precipitate of bitartrate of potassa and an alcoholic solution of carbazotic acid yields with it yellow and difficultly soluble crystals of carbazotate of potassa When potassa is recommended as for use in pharmacy it has usually been prepared from wood ashes they are best detected by a small portion of chloride of platinum which causes a yellow precipitate of the peculiar chloride of platinum

When potassium and sulphur are heated together they combine and form a sulphuret of potassium With the acids, potassa forms a variety of useful salts, such as nitre, or nitrate of potassa, with nitric acid, sulphate of [illegible] potassa, [illegible] of potassa, [illegible] important salt it forms great part of the residuum or ash of burnt wood from which the [illegible] is obtained Much of the carbonate of potassa imported into this country from Russia is [illegible] of *pearlash* and *potash* It consists of 48 potassa + 22 carbonic acid, [illegible] crystallization and has an alkaline reaction When carbonic acid is passed through a solution of this salt, it becomes converted into bicarbonate of potassa, composed of 48 potassa + 44 carbonic acid Potassium burns with great splendour in chlorine, and forms chloride of potassium, it also combines with iodine, bromine, and fluorine

POTATOES The common name for the roots of the *Solanum tuberosum* which see

POTENTIAL MOOD (Lat possum, *I am able*) In Grammar that mood of the verb which expresses an action conceived as *possible*, denoted in English by the the auxiliary [illegible]

POTENTIAL [illegible] In Scholastic Philosophy, such as are supposed to exist in a body *in potentia* only In Grammar, a mood of the verb, also called the optative by some considered as the same with the subjunctive

POTITII The Roman priests of Hercules who were said to have been instituted by Evander Of an inferior grade to them but in the service of the same god were the Pinarii, but these became extinct through the means of Appius Claudius

POTSTONE A tough variety of steatite, sometimes manufactured into culinary vessels It is the *lapis ollaris* of Pliny

POTTERY AND PORCELAIN The better kind of pottery called in this country *Staffordshire ware*, is made of an artificial mixture of alumina and silica, the former obtained in the form of a fine clay, from Devonshire chiefly, and the latter consisting of chert or flint, which is heated red hot quenched in water, and then reduced to powder Each material, carefully powdered and sifted, is diffused through water mixed by measure, and brought to a due consistency by evaporation it is then highly plastic, and formed upon the potter's wheel and lathe into various circular vessels or moulded into other forms which after having been dried in a warm room, are enclosed in baked clay cases resembling bandboxes, and called *seggars*, these are ranged in the kiln so as nearly to fill it leaving only space enough for the fuel, here the ware is kept red hot for [illegible] and thus brought to the state of *biscuit* [illegible] is afterwards glazed, which is done by dipping the biscuit ware into a tub containing a mixture of about 60 parts of litharge, 10 of clay and 20 of ground flint diffused in water to a creamy consistence, and when taken out enough adheres to the piece to give an uniform glazing when again heated The pieces are then again packed up in the seggars, with small bits of pottery interposed between each, and fired in a kiln as before The glazing mixture fuses at a very moderate heat and gives an uniform glossy coating, which finishes the process when it is intended for common white ware

The patterns upon ordinary porcelain, which are chiefly in blue, in consequence of the facility of applying cobalt are generally first printed off upon paper, which is attached to the plate or other article while in the state of biscuit, the colour adheres permanently to the surface when heat is properly applied other mineral colours, such as the oxides of chrome and manganese, are also occasionally employed in the same way

The manufacture of PORCELAIN is a more refined branch of art, the materials are selected with the greatest caution, it being necessary that the compound should remain perfectly white after exposure to heat it is also required that it should endure a very high temperature without fusing, and at the same time acquire a semivitreous texture, and a peculiar degree of translucency and toughness These qualities are united in some of the oriental porcelain, or *China*, and in some of the old Dresden, but they are rarely found coexistent in that of modern European manufacture Some of the French and English porcelain, especially that made at Sèvres and Worcester, is extremely white, and duly translucent; but it is more apt to crack by sudden [illegible] of temperature, more brittle, and consequently requires to be formed into thicker and heavier vessels, and more fusible than the finest porcelains of Japan and China

The colours employed in painting porcelain are the same metallic oxides used for colouring glass and in all the more delicate patterns they are laid on with a camel-hair pencil and generally previously mixed with a little oil of turpentine Where several colours are used they often require various temperatures for their perfection, in which case those that bear the highest heat are first [illegible] hose which are brought out at [illegible] art of painting on porcelain, or *in enamel*, is of the most delicate description much experience and skill are required in it, and with every care there are frequent failures Besides it is attended with considerable expense The gilding of porcelain is generally performed by applying finely divided gold mixed with gum-water and borax, upon the application of heat the gum burns off, and the borax vitrifying upon the surface causes the gold firmly to adhere it is afterwards burnished.

In the manufacture of various kinds of pottery em- [illegible] in regard [illegible] requisites are necessary which cannot be united in the same vessel To the late Mr Wedgwood we are indebted for vast improvements in this as well as in other branches of the art Crucibles composed of one part of pure clay mixed with about three parts of coarse and pure sand slowly dried and annealed resist a very high temperature without fusion, and generally retain metallic substances but where the metals are suffered to oxidize there are few which do not act upon any earthen vessel and some cause its rapid fusion, as the oxides of lead, bismuth &c Where saline fluxes are used, the best crucibles will always suffer, but platinum may often be employed in these cases and the chemist is thus enabled to combat many difficulties which were nearly insurmountable before this metal was thus applied Whenever silica and alumina are blended, as in the mixture of clay and sand the compound softens and the vessel loses its shape when exposed to a long continued white heat, and this is the case with the *Hessian* crucibles consequently the most refractory of all vessels are those made entirely of clay coarsely powd [illegible] for the sand [illegible] fluxes longer than any other, and is therefore used for the pots in glass furnaces A Hessian crucible lined with purer clay is rendered much more retentive and a thin china cup or other dense porcelain resists the action of saline matters in fusion for a considerable time Plumbago is a very good material for crucibles and applicable to many purposes when mixed with clay it forms a very difficultly fusible compound and is protected from the action of the air at high temperatures it is well calculated for small table furnaces

POULP The English generic name of the eight-footed Dibranchiate Cephalopods (*Octopi*) which have a double alternate row of suckers on each foot

POULTRY Different kinds of birds reared for the production of eggs feathers and for the use of their bodies as animal food The domestic poultry in common use in Britain are the common domestic fowls, or cock and hen, the turkey, the duck and the goose to which may be added as occasionally reared the guinea fowl and the peacock The most generally useful kind of poultry is the common domestic fowl which though a native of India accompanies man through all climates, but which is only productive of abundance of eggs when well fed and warmly lodged Hence all poultry houses when not built adjoining an apartment in which fire is kept, or over a stable or cowhouse where they might benefit by the heat generated by the larger animals ought to be furnished with flues or some other means of generating heat artificially during winter and spring Without some mode of effecting this poultry will seldom produce abundance of eggs in cold weather particularly in the colder parts of Britain Hence in Scotland the common hen roosts in the same room that the cottager lives in, and the poultry house of the small farmer is a loft either over his kitchen or over his cowhouse In the management of poultry it is not sufficient to supply abundance of food and warmth but it is equally necessary that they have ample space for exercise This space should always contain living plants of various kinds, and some gravelly or sandy soil because worms snails, and insects, as well as occasionally grass and herbage, form a part of the food of poultry, and sand or gravel is swallowed by them for the purpose of promoting digestion Hence, no healthy poultry can ever be reared in towns however much the natural food may be imitated by the supply of animal matters, herbage and sand the want of exercise in poultry so circumstanced will soon become evident from the appearance of the fowls, and from the soft shell of their eggs, in consequence of the animal func [illegible]

POULTRY HOUSES [illegible] in which poultry are kept in the night time, the principal features of which ought to be, that each kind of bird shall be separately lodged, and that all shall have access to an ample field, containing a pond and a heap of gravel. *See* POULTRY

POUNCE A powder to prevent ink from spreading upon paper after erasures it is either sandarach (resin of the juniper) in powder, or the powdered bone of the cuttle-fish The term pounce is also applied to coloured powders used by pattern drawers for sprinkling over pricked papers

POUND (Lat pondus, *weight*) A measure of weight In England two different pounds are used the *pound avoirdupois*, and the *pound troy* The pound avoirdupois weighs 7000 grains troy and the pound troy 5760 grains The former is divided into 16 ounces, and the latter into 12 (*See* WEIGHT) Pound is also a denomination of money, [illegible] to 20 shillings, or [illegible] equivalent to a pound of silver, hence the origin of the term

POUPART'S LIGAMENT The tendinous attachment of the external oblique muscle of the abdomen to the superior and anterior spinous process of the os ileum and os pubis

POURPRESTURE, or [illegible] is said to be when any man takes unto himself or appropriates any thing that he ought not, whether it be in any jurisdiction, land or franchise, and generally when any thing is done to the nuisance of the king's tenants, by way of nuisance or hurt to the king's highways or demesnes, by inclosing, &c Pourpresture may also be by tenant against lord of the fee, or by one neighbour against another

POURSUIVANT *See* PURSUIVANT

POWER in Algebra and Arithmetic, denotes the product arising from the continued multiplication of a quantity or number into itself The successive powers of a number are formed and indicated as follows —Thus, taking the number 3,

$3^1 = 3$ the 1st power of 3,
$3 \times 3$ or $3^2 = 9$ the 2d power, or square of 3,
$3^2 \times 3$ or $3^3 = 27$, the 3d power, or cube of 3,
$3^3 \times 3$ or $3^4 = 81$, the 4th power of 3, &c

In like manner the successive powers of the quantity $a$ are $a^1$ $a^2$ $a^3$ $a^4$ &c The numbers indicating the powers are called the *exponents*, and it is obvious from their formation that powers of the same quantity are multiplied by adding their exponents, and divided by subtracting their exponents Powers are considered as negative or fractional which have negative or fractional exponents

POWER, in Mechanics denotes a force which being applied to a machine tends to produce motion A *mechanical power* denotes one of the six simple machines, viz the *lever* the *inclined plane* the *screw*, the *wheel and axle*, the *wedge* and the *pulley*

POWER In Law, a term commonly employed to designate a reservation made in a conveyance either for the party conveying or for some other party, to enable him to do certain acts regarding the property conveyed Powers are either common law authorities, or have their validity from the Statute of Uses To the former class belong powers granted by will or by act of parliament to certain persons to sell estates &c The latter are of several sorts —1 Powers appendant, or appurtenant, are powers granted to one who has an estate given him by [illegible] to a man with power to grant leases in possession 2 A power collateral or [illegible] to one having an interest, either granted by the same deed, or subsisting previously to its execution, but it enables him to create such interests only as will not attach on the interest limited to him, as a power to tenant for life to appoint the estate after his decease among his children 3 A power simply collateral is one given to a party who has not any [illegible] immediately [illegible] of the execution of the deed

POWER OF ATTORNEY In Law, an instrument by which a party empowers another to perform certain acts for him, either generally or for a particular purpose; such as to accept and negotiate letters of exchange, to receive dividends, &c An instrument by which a party authorizes his attorney to appear and plead for him is termed a warrant of attorney (see that article)

POWERS, GREAT, OF EUROPE In the language of modern diplomacy, England, France, Austria, Russia, and Prussia are so called

POZZUOLANA Volcanic ashes used in the manufacture of a mortar which hardens under water They are exported from Pozzuoli a town in the Bay of Naples

PRAAM A sort of lighter used in Holland and the Baltic

PRACTICE A rule in arithmetic for expeditiously solving questions in proportion or, rather, for abridging the operation of multiplying quantities expressed in different denominations as pounds, shillings, and pence, yards, feet, and inches, &c

**PRÆ-A'DAMITES** A term given to those inhabitants of the earth who are presumed by some writers, to have lived before Adam I - ' f theory, a work was published in 1655 by ' ' which proved the means of converting many to its author's opinions

**PRÆCORDIA** (Lat præ, *before*, and cor, *the heart*) The fore part of the chest

**PRÆFECT** (Lat præfectus) A common name of various Roman functionaries, among others a military officer, who had the command of the cavalry of a legion The prætorian præfect was the commanding officer of the prætorian cohorts who were the imperial guard, and always stationed at Rome This office under the time of Severus, engrossed the highest powers to which a subject could attain (*See* PRÆTORIAN COHORTS) Præfect was likewise the title given to the imperial governor of Egypt which was on a different footing from the other provinces which were superintended by senatorial men with the titles of proconsul and proprætor The præfect of Egypt, on the contrary, was always of the equestrian order, and was a military governor This anomaly is said to have arisen from a prophecy which foretold that Egypt should recover its liberty when the Roman fasces and prætexta should come to it, and which Augustus took advantage of to bring that province more immediately under his own superintendence

**PRÆMUNI'RE** In Law a name given to a species of offence, in the nature of a contempt against the king and his government The name is derived from the words "præmoneri," or 'præmuniri facias' which are used in the beginning of the writ preparatory to the prosecution of the offence "Cause A B to be forewarned that he appear before us' &c The first statute of præmunire was passed in the reign of Edward I to restrain the encroachments of the Romish clergy and several subsequent statutes before the Reformation have extended the number of penal acts under this title The principal were those proceeding from an assumption of authority in England by virtue of papal and other foreign provisions But by still later statutes acts of a very miscellaneous character have been rendered liable to the penalties of præmunire as refusing to take the oaths of allegiance supremacy &c

**PRÆNOMEN** *See* COGNOMEN NAME

**PRÆTEXTA** (Lat) A long white robe with a purple border originally appropriated by Tullus Hostilius to the Roman magistrates and some of the priests but afterwards worn by the children of the higher classes, by boys till the age of seventeen (when they assumed the toga virilis) and by girls till they were married

**PRÆTOR** A Roman magistrate ranking in dignity next to the consuls Anciently the name of prætor was common to all the chief magistrates but on account of the continual absence of the consuls in foreign wars and their consequent inability to discharge many of their civil duties a new civil magistrate was created to supply their place (A U 389) to whom the title of prætor was specially assigned He was at first elected from the patricians, but the office was afterwards (A U 418) thrown open also to the plebeians When it was found that a single prætor was inadequate to the due discharge of his duties in consequence of the great influx of strangers another was added (A U 519) to administer justice in cases in which they were involved with the epithet *peregrinus* attached to his title to distinguish him from the more ancient and honourable magistrate the *prætor urbanus* as he was called This latter dignitary corresponded in many respects to the lord mayors mayors or provosts of our country, combining with their functions the judicial power of lord chancellor Besides this he performed the duties of the consuls on many occasions in their absence presiding in the assemblies of the people, and convening the senate So long as the Roman empire was confined to Italy the number of prætors did not exceed two, but on the reduction of Sicily and Sardinia to the form of provinces, two more were added to govern them and again two more were created on the subjection of hither and farther Spain to the Roman yoke The prætors on being elected determined their province, like the consuls, by casting lots Under the emperors the powers of the prætors were reduced their principal functions being transferred to the prætorian præfect, but the name of the magistrate continued to the time of Justinian (*See Niebuhr's Roman History*)

**PRÆTORIAN COHORTS** A body of troops during the Roman dictatorship from the rest of the army by double pay and superior privileges, first instituted by Augustus, and called by that name, in imitation of the select band which attended a Roman general in battle At their first institution they were nine in number three being stationed at Rome, and the rest in the adjacent towns of Italy, and consisted of Italian soldiers only Tiberius assembled them all at Rome, and placed them in a permanent camp, a measure which, while it answered the purpose of keeping the citizens in awe, proved dangerous and sometimes destructive to his successors The emperor Severus disarmed the old guards, and established the prætorian cohorts on a new footing, increasing their number, and filling them entirely with troops draughted from the armies of the northern frontier The command of these troops was vested in an officer called the Prætorian præfect who, as the government gradually degenerated [illegible] from the state of [illegible] to be the head of the army but of the provinces and even of the law In every department of administration he represented the person and exercised the authority of the emperor The prætorian bands were deprived of all their privileges by Diocletian, who replaced them by other troops and were finally abolished by Constantine

**PRÆTO'RIUM** That part of a Roman camp in which the general's tent stood and where he took the auspices It was raised a few feet above the level of the rest of the camp Of the four gates of the Roman camp, that which lay next the enemy was called the *prætorian* gate

**PRAGMA'TIC SANCTION**, more correctly *Pragmatic Rescript* A term of which the use seems to have originated in the Byzantine empire, signifying a public and solemn constitution or decree pronounced by a prince; distinguished from the simple rescript, which was a declaration of law in answer to a question propounded on behalf of an individual In European history several important treaties are called by the name *Pragmatic Sanction*, among which the principal are,—1 The ordinance of Charles VII of France in 1438 which constituted the foundation of the liberties of the Gallican church 2 Charles VI emperor of Germany being without male descendants endeavoured by an instrument termed the Pragmatic Sanction to secure the succession to his female heirs, which caused the Bavarian war of succession 1740 3 The law of succession to the kingdom of Naples when ceded by Charles II of Spain, in 1759, to his third son and his posterity

**PRAIRIE** (Fr) A term in common use for the vast plains or savannahs of the Mississippi and Missouri *See* SAVANNAHS

**PRASE** Green quartz The colouring matter of this mineral appears to be actinolite

**PRAXEANS** A sect of heretics that sprung up in Asia in the second century so called from their founder, Praxeas an Asiatic heresiarch The distinguishing characteristics of this sect were their denial of plurality of persons in the godhead and their belief that it was the Father himself who suffered on the cross The Monarchici Sabellians, and Patripassians adopted these sentiment

**PREAMBLE** The commencement of a statute, which recites the intention of parliament in framing it, and is often admissible in argument to prove its meaning

**PREBEND** (Lat prebenda) The share of the estate of a cathedral or collegiate church received by a prebendary To all such churches there are several prebendaries attached who reside and officiate in rotation

**PRECEDENCY** (Lat præcedo *I go first*) The relative rank of men and women in the etiquette of society strictly it means the order in which they follow one another in a state procession which it is part of the office of heralds duty to ascertain and preserve The following are the degrees of precedency commonly recognized in [illegible] 1 The Sovereign 2 The Prince of Wales 3 The Queen's consort 4 The Queen Dowager 5 The princes of the blood according to seniority 6 The Sovereign's uncles 7 The Sovereign's aunts 8 Husbands of princesses 9 The archbishop of Canterbury 10 The lord high chancellor 11 The archbishop of York 12 Lord high treasurer 13 Lord president of the privy council 14 Lord privy seal 15 Lord high constable 16 Earl marshal 17 Lord high admiral 18 Lord steward of the household 19 Lord chamberlain of the household (The last five, however, take precedence only of all their degree i.e. if dukes they precede all dukes if marquises, all marquises &c) 20 Dukes 21 Marquises 22 Dukes' eldest sons 23 Earls 24 Marquises eldest sons 25 Dukes younger sons 26 Viscounts 27 Earls eldest sons 28 Marquises younger sons 29 30, 31 The bishops of London Durham, and Winchester 32 Other bishops, according to priority of consecration 33 Barons 34. Speaker of the House of Commons 35 Viscounts eldest sons 36 Earls younger sons 37 Barons eldest sons 38 Knights of the Garter 39 Privy [illegible] 40 Chancellor of the Exchequer 41 Chancellor of the duchy of Lancaster 42 Lord chief justice of K B 43 Vice-chancellor 44 Master of the Rolls 45 Lord chief justice of C P 46 Lord chief baron of the Exchequer 47 Judges and barons of the Exchequer of the degree of the coif, by seniority 48 Knights bannerets made by the king in person 49 Viscounts' younger sons. 50 Barons' younger sons 51 Baronets 52 Bannerets not made by the king in person 53 Knights grand crosses of the Bath 54. Knights commanders of the Bath.

55 Knights bachelors 56 Companions of the Bath 57 ... younger sons ... 58 Baronets' eldest sons ... Knights of the Garter's eldest sons ... of the Bath's eldest sons ... 63 Baronets' younger sons ... King's body 65 Gentlemen of the privy chamber 66 Esquires of the knights of the Bath 67 Esquires by creation ... Esquires by office 69 Younger sons of knights of the Garter 70 Younger sons of bannerets 71 Younger sons of knights of the Bath 72 Younger sons of knights bachelors 73 G... ...ed to bear arms

PRECEDENTS in Law, are defined authorities to be followed in courts of justice Precedents, strictly speaking are only binding on tribunals when they are in the shape of actual judicial decisions of the point in question What English lawyers term an extrajudicial opinion, — *i e* the opinion of a judge pronounced where it was not called for to decide the issue, — can only have authority from the character of the individual judge, and not as a precedent When the principles of equity were as yet unsettled it was held by many that precedents were inapplicable in that branch of law, as its very name seemed to imply that each case should be governed by the judge's opinion of its individual merits But Lord Keeper Bridgman, among others seriously refuted this supposition, and precedents have long been of as much authority in courts of equity as in those of common law A form of an instrument or a pleading from which others corresponding in circumstances may be copied, is also termed a precedent

PRECEPTORIES In the Middle Ages a kind of benefices possessed by the more eminent Knights Templar, whom the grand master created and styled *Præceptores Templi*, whence the name Of these preceptories 16 are recorded as belonging to the Templars in England (see *Mon Ang*) but it is averred by some writers that these places were merely cells subordinate to their head-quarters, the Temple in London See COMMANDERY

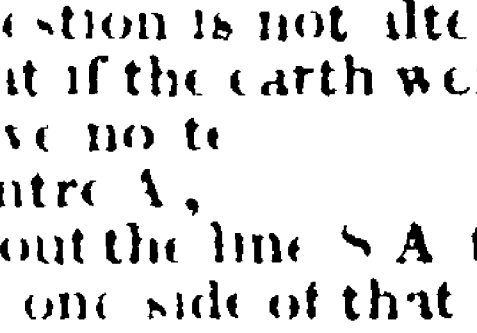
PRECESSION OF THE EQUINOXES A term used in astronomy to denote a small annual variation in the position of the line in which the planes of the ecliptic and equator intersect each other, in consequence of which the sun returns to the same equinoctial point before completing his apparent revolution with respect to the fixed stars

The longitude of a star is counted on the ecliptic eastward from the first point of Aries or the vernal equinox If the line of the equinoxes therefore maintained always the same position with respect to the celestial sphere, the longitudes of the stars would be invariable But on comparing the actual state of the heavens with the observations recorded by ancient astronomers it is found that the longitudes of all the stars have considerably increased and all to the same degree, so that the celestial sphere appears to turn round the axis of the ecliptic with a slow motion from west to east or in the same direction as the sun in his annual revolution The phenomena however will be in all respects the same if instead of supposing the whole firmament to advance in the order of the signs we suppose the axis of the earth's equator to have a slow motion about the axis of the ecliptic in the opposite direction This will give to the line of intersection of the two planes (which is the line of the equinoxes) a retrograde motion from east to west in consequence of which the sun, whose motion is from west to east arrives at the equinoctial points sooner than if they remained at rest, and therefore the equinoxes and the seasons which depend on them come round before the sun has completed an entire circuit of the sphere On this account the motion has been called the *precession of the equinoxes*

Although the existence of the precessional motion of the equinoctial points was known at an early period in the history of astronomy the imperfection of instruments prior to the sixteenth century did not permit of observations being made with sufficient accuracy to determine its precise rate which must therefore be deduced from comparisons of the longitude of the same star calculated from modern observations, although on account of the extreme slowness of the motion, the determination must be liable to some uncertainty unless a considerable interval of time has elapsed between the epochs of observation According to Bradley's observations, ... *Spica Virginis*, at the beginning ... 4944° At the beginning ... Maskelyne found the longitude of the same star ... The difference is 0 5837 in 42 years, which gives 50 03″ in a year The comparison of a great number of observations on different stars gives 50 1″ for the annual precession According ... the equinoctial points retrograde on ... rate of one degree in 71 6 years, and ... quire a period of about 25,800 years to make a complete revolution

The physical cause of the precession of the equinoxes is the combined action of the sun and moon on the mass of matter accumulated about the earth's equator, and forming the excess of the terrestrial spheroid above its inscribed sphere The matter of this spheroidal shell, in reference to the effect of the solar attraction on it, may be regarded as forming a ring about the earth in the plane of the equator Now the solar force, acting on the part of the ring which is above the ecliptic, may at every point be resolved into two parts, one parallel to the plane of the equator, and the other perpendicular to it, and the resultant of all the latter forces must be a force tending to impress on the ring a motion round the intersection of its plane with the ecliptic The same thing holds true of the other half of the ring which is under the ecliptic If the earth, therefore, had no motion of rotation, the plane of the equator would turn round the line of its intersection with the ecliptic until it coincided with the latter plane But while the equator has this tendency to revolve about an axis in its plane, it has also a rotatory motion about an axis perpendicular to its plane, it will therefore, according to a well-known theorem in mechanics, not revolve on either of these axes but on one which divides the angle between them, so that the sine of its angular distance from each axis is in the inverse ratio of the angular velocity round that axis See ROTATION

In order to illustrate this, let E K F H be the earth's equator, A the centre, A B the axis of rotation, S the sun, and F F the diameter of the equator perpendicular to A S and suppose the earth to be in the position it occupies at the summer solstice We may also



suppose the centre of gravity A to be at rest as the effect in question is not altered by the orbital motion It is plain that if the earth were a sphere the sun's attraction would have no te... centre A, ... about the line S A the effect of the attraction on any point on one side of that line would be exactly compensated by the attraction on the corresponding point on the opposite side But the earth being an oblate spheroid, we must consider the effect of the sun's attraction on the mass of matter exterior to the sphere which touches the spheroid at its poles Now let K be an element of the protuberant matter which we may suppose to be all accumulated in the plane of the equator, the sun's attraction on K, acting in the line which joins S and K may be resolved into two parts — one of them acting in the plane of the equator, and the other in a line perpendicular to that plane The part of the solar force acting on K perpendicularly to the equator tends to give that plane a rotatory motion about the axis F F, by drawing K towards the plane of the ecliptic, but the earth at the same time revolves about the axis A B which is perpendicular to F F In consequence of this compound motion the axis of rotation will change its position from A B to A D the pole B moving in a direction opposite to that of the rotation, and as the solar force continues to act at every instant the pole B will have a continuous slow motion about the pole of the ecliptic and the plane of the equator, which is perpendicular to A B, will at every instant intersect the ecliptic in a new line which will slowly recede or go backward on the ecliptic in the direction opposite to that of the earth's rotation

The motion now described may be assimilated to that of a top put into rapid motion with its axis inclined to the horizon In this position the axis of the top slowly revolves about the vertical drawn from the point on which it rests describing the surface of a cone, and any section of the top perpendicular to the axis if produced to meet the horizon will at every instant intersect that plane in a new line, and the line of intersection will revolve with a motion corresponding to that of the axis in the direction opposite to that of the rotation

The attraction of the moon on the spheroidal shell produces a similar effect to that of the sun and in a still greater degree, in the ratio of about 5 to 2 It is easy to see that the effect of both those bodies in displacing the equator of the terrestrial spheroid must vary with their position in reference to it, for if they moved in the plane of the equator, there would evidently be no displacement, and their power to produce it is greatest when the earth is in such a position that the inclination of the equator to the ecliptic, or to the plane of the lunar orbit, is a maximum This inequality of action gives rise to another highly important astronomical phenomenon, namely, an apparent vibratory motion of the equator, which B... ... first discovered its cause and period) ... denominated the *nutation of the earth's axis* See NUTATION

In consequence of the precession of the equinoxes the sun's place ... the zodiacal constellations at any given season of the year is now greatly different from what it was in remote ages Some time before the age of Hipparchus the first points of Aries and Libra corresponded to the vernal and autumnal equinoxes, and those of Cancer and Capricorn to the summer and winter solstices.

These points have now receded 30° from the constellations to which they then corresponded The vernal equinox now happens when the sun is in Pisces, the summer solstice when he is in Gemini, the autumnal equinox when he is in Virgo, and the winter solstice when he is in Sagittarius Astronomers, however still employ the term *the first point of Aries* to denote the position of the vernal equinox On this account the *signs of the zodiac* or ecliptic, which are fixed in respect of the equinoctial points, must be carefully distinguished from the *constellations*, which are moveable with respect to those points (See *Airy's Mathematical Tracts*, *Encyc Brit*, art "Precession," *Woodhouse's Physical Astronomy*, La Place, *Mecanique Céleste*, Poisson *Sur le Mouvement de la Terre autour de son Centre de Gravité* in the *Mém de l'Acad des Sciences de Paris* [illegible],

PRECIPITATE (Lat præceps, *headlong* An appellation of [illegible] *down* and generally [illegible] from [illegible]

PREDACIANS. (Lat præda, *booty*) The English name used by Kirby as synonymous with the *Carnassiers* of Cuvier *See* FERINES

PREDESTINA'TION (In Gr προορισμος Rom viii 29.; Eph i 5 11) The belief that God has from all eternity decreed whatever comes to pass In a theological sense, it is thus defined in the 17th Article of our church — "Predestination to life is the everlasting purpose of God, whereby before the foundations of the world were laid, he hath constantly decreed by his counsel, secret to us to deliver from curse and damnation those whom he hath chosen in Christ out of mankind, and to bring them by Christ to everlasting salvation" The Lambeth Articles agreed to in 1595 by a portion of the clergy, assert that God from eternity hath predestinated certain men unto life certain he hath reprobated" Theological writers have generally forborne to use the word predestination with respect to the rejected "Nefas est dicere Deum aliquid nisi bonum prædestinare" (August, *De Dono Perseverantiæ*) *See* ELECTION, CALVINISM

PREDETERMINA'TION In Scholastic Philosophy, that concurrence of God which determines men in the performance of their actions good or evil, called physical predetermination or premotion

PRE'DIAL (Lat prædium, *farm*) Of or belonging to a farm Thus we often read of *predial* slaves and slavery in opposition to *domestic*, *predial* disturbances in Ireland &c

PRE'DICABLE In Logic a term which can be affirmatively predicated of several others The notions expressed by such terms are formed by the faculty termed abstraction, after the particular circumstances characterizing each individual have been withdrawn from it The predicables are commonly said to be five, genus species, difference, property (which has been subdivided into four heads by no very intelligible system of classification) and accident (which is either separable or inseparable) See these terms and Logic

PREDICAMENTS or CATEGORIES in Logic are a certain number of general heads, or in logical phraseology *summa genera* under one or other of which every term may be arranged Aristotle enumerated ten predicaments, others by subdividing some of these have increased their number Those of Aristotle are — substance quantity quality, relation, place time situation possession action suffering It is evident that all these may be arranged under two grand heads, — substance and attribute *See* CATEGORY, ATTRIBUTE

PRE'DICATE, in Logic is of the two terms of a proposition, that which is affirmed or denied of the other *See* TERM, PROPOSITION Logic

PREDISPO'SING CAUSE In Medicine is any circumstance which renders the body susceptible of disease

PRE-EXISTENCE In Philosophy the existence of any thing before another, commonly used for the existence of the human soul, in some former condition, before it became connected with its present body It was the doctrine of the Pythagorean school and connected with their peculiar tenet of the Metempsychosis It was also the doctrine of Plato, and he uses in support of it arguments which have exercised a strong influence on many minds, and to this day are constantly recurring to those who study the subject on independent principles, particularly the rapidity of learning in early childhood, which he explains as an effort of reminiscence not acquisition Others have enlisted into the service the peculiar sensations which are sometimes raised by scenes persons sounds, words, though seen or heard, as our reason would persuade us, for the first time, as if we were conscious of some prior familiarity with them This poetical, rather than philosophical view of the subject, is beautifully illustrated in a well-known ode of Wordsworth

PRE'FACE (Lat præ, and fari, *to speak*) The observations prefixed to a work or treatise intended to inform the reader of its plan and peculiarities There are few subjects which afford so wide a field for the display of skill and address as preface writing; and those who wish to witness an unrivalled exhibition of these qualities may consult some of Dr Johnson's prefaces, either to his own writings, or to the numerous works which he edited

PRE'FET A [illegible] important political functionary in modern France Under the old [illegible], the officers who were sent into the provinces to superintend the details of administration on behalf of the king were at first styled [illegible] des requêtes These were made perpetual and hereditary [illegible] but later were changed to [illegible] [illegible] [illegible]

universal occupancy, the right to derelict lands by the sudden retiring of the sea, the dominion of seas, navigable rivers, &c

PREROGATIVE COURT The court in which wills are proved, and administrations taken, which belong to the archbishop, by his prerogative *See* LAW, ECCLESIASTICAL.

PRESBYOPIA (Gr πρεσβυς, *old*, and ωψ, *the eye*) An imperfection of vision commonly attendant upon the more advanced periods of life, in which near objects are seen less distinctly than those at a distance It is usually caused by flattening of the cornea, hence convex spectacles are required It often happens that one eye is more affected than the other, in which case glasses of different foci should be used

PRESBYTER (Gr πρεσβυτερος, *elder*, by which word it is translated in our New Testament) One of an order of ministers in the Christian church, frequently alluded to in the Scriptures as having, in its several members, the spiritual care of distinct congregations, and exercising as a class a general superintendence over the concerns of the church It is allowed that, up to the time of Calvin, there never existed a church in which there was not an order of presbytery or priests, subordinate to that of bishops, and, although the words themselves are sometimes confounded in the New Testament, the assertors of episcopacy point out the distinction between the offices as accurately preserved throughout *See* EPISCOPACY and PRESBYTERY

PRESBYTERIANS The name given to that sect of Christians who have embraced the Presbyterian form of government *See* PRESBYTERY

PRESBYTERY (Gr πρεσβυτεριον *a council or assembly of elders*), is that form of ecclesiastical polity according to which there is no gradation of order in the church, but which vests church government in a society of [illegible] rank and power The Presbyterians maintain that the words presbyter (πρεσβυτερος) and bishop (επισκοπος) are [illegible] that we nowhere [illegible] and presbyters or of pastors of different rank, in the same church that all ministers of the gospel, being ambassadors of Christ are inherently equal, and that deacons are laymen whose sole duty it is to take charge of the poor Among other proofs they quote the following — The elders (πρεσβυτερους) who are among you I exhort *who am also an elder* (συμπρεσβυτερος) Feed the flock which is among you, taking the oversight thereof (επισκοπουντες, *acting as bishops over them*) not by restraint but willingly, not for filthy lucre but of a ready mind, neither as being LORDS over God's heritage (1 Peter, v 1 2) It is contended that in this passage, the identity of presbyter and bishop is apparent, and that the apostle himself as an officer of the church was simply a presbyter or elder (See also Hebrews xiii 7 17, 1 Thess v 12 6) On these grounds the Presbyterians assume that the very chiefest apostles were presbyters, or labouring ministers, and that every faithful pastor of a flock ordained by the imposition of hands as sanctioned and taught in Scripture, is a successor of the apostles in every respect in which divinely inspired men can be regarded as having any successors It is farther argued in support of the polity under review, that Timothy himself, though said to be a bishop, was ordained with the laying on of the hands of the *presbytery*' (1 Tim iv 14)

It is, however admitted by the Presbyterians that episcopacy was introduced at an early period into the Christian church and has hitherto been the prevailing polity, but they insist that as St Paul presided at the ordination of Timothy, not as supreme over his brethren, but as moderator or chairman for the occasion, *primus in paribus*, so the moderator of a presbytery instead of being changed or re elected, had in course of time been declared permanent, and hence [illegible] of the episcopal order (*Mosheim*, i 90, *Hill's Theol Institutes*)

But while the Presbyterians trace the origin of their church to the practice of the apostles, and affirm that there are no intimations of episcopacy in Scripture or in the writings of the apostolical fathers, they admit that presbytery, as it now obtains, did not exist between the 2d century and the reformation of religion "The first reformers, who believed that the distinction between bishops and presbyters had no foundation in Scripture, and who wished to apply an effectual remedy to the abuses which appeared to them to have arisen in the progress of human inventions of investing bishops with powers superior to presbyters, did not consider the antiquity or universality of that practice as any reason for its being continued. Recurring to what they considered the primitive Scripture model, they laid the foundation of presbyterian church government on this principle, that all members are equal in rank and power, and they did not admit any official preference, but that which is constituted by voluntary agreement for the sake of order." (*Hill's Theol Inst.* p. 167)





The first presbyterian church, in modern times, was founded in Geneva by John Calvin, about 1541, and the system was thence introduced into Scotland, with some [illegible] John Knox about 1560, but was not [illegible] between presbytery and [illegible] latter (which was patronized by the court) predominated in 1606, but was superseded by the former (to which the great body of the people were attached) in 1638 Presbytery kept its ground from this period till the revolution in 1660, when episcopacy again obtained the ascendancy, which it maintained till 1688, soon after which it was abolished, and the national church of Scotland declared presbyterian —a form which it has since retained [illegible] numerous bodies of dissenters from the Scottish established church, such as the Associate and Relief Synods, are also Presbyterians, their cause of secession being that the church had relaxed the strictness of presbyterian principles

Presbytery has never flourished greatly in England Here the first presbyterian church was formed at Wandsworth, Surrey, in 1572, about 20 years before presbytery was established by law in Scotland, but though the system was never palatable to the English nation generally, an attempt was made to make the established church presbyterian in the reign of Charles I This object was signally promoted by the famous Assembly of Divines at Westminster In 1649, presbytery was sanctioned by the English parliament, and the established church was nominally presbyterian from this date till the restoration in 1660, yet it was never generally adopted or regularly organized, except in London and in Lancashire (*Murray's Life of Samuel Rutherford*, Edin 1828 chap viii) Upwards of 2000 presbyterian clergy were ejected from their cures in England, in consequence of the Act of Uniformity in 1662 [illegible] congregations (about 150) in England [illegible] counties, called presbyterian, some of them in full connection with the Scottish church others differing materially from that polity, while not a few of them have adopted nearly the same church government with the Independents In Ireland, chiefly in the province of Ulster, there are about 400 presbyterian congregations There are upwards of 100 such congregations in our North American possessions, and presbytery has also been introduced to a greater or less extent in the other British colonies

In the United States of America presbytery embraces upwards of 2800 congregations with 2000 ministers (*American Almanac* for 1830) The [illegible] somewhat modified from that which [illegible] Scotland, is the established church in Holland (*Steven's Brief View of the Dutch Eccles Establishment*, ed 1839) It still exists, though to a very limited extent, in Geneva, it prevails also less or more in several of the other Swiss cantons

The constitution of the church of Scotland, which has long been the most perfect and efficient model of presbytery is as follows — The kirk session is the lowest court, and is composed of the parochial minister and of lay elders the number of whom varies in different parishes, but is generally about 12 The minister is moderator *ex officio* This kirk session exercises the religious discipline of the parish, but an appeal may be made from its decisions to the presbytery, the court next in dignity The presbytery from which there is a power of appeal to the synod is composed of the ministers of a number of contiguous parishes (varying in number in different cases) with a lay elder from each A moderator, who must be a clergyman is chosen every half year A presbytery generally meets once a month, but it must meet at least twice a year, and it may hold *pro re nata* meetings This court takes young men on trials as candidates for licence ordains presentees to vacant livings, has the power of sitting in judgment on the conduct of any of its members and can depose them; and has the general superintendence of religion and education within its bounds The number of presbyteries is at present 82 The synod which meets twice yearly, is formed of the members both lay and clerical, of two or more presbyteries At every meeting a moderator is chosen, who must be a clergyman, and a sermon is preached before the court proceeds to business The number of synods is sixteen The general assembly is the highest ecclesiastical court, its decisions being supreme It meets annually in the month of May and sits for ten successive days. Unlike the inferior courts, it consist of representatives chosen by the various presbyteries, royal burghs, and universities of Scotland The number of representatives from presbyteries depends on the number of members of which each is composed No presbytery sends less than two ministers and one lay elder; and none more than six ministers and three elders. The total number of members of the general assembly is 386, of whom 218 are ministers This supreme court has of late consisted of more than this number, as the church

has admitted the ministers of *quoad sacra* parishes as constituent members of ecclesiastical courts; but the civil law has not given its sanction to this measure indeed the question is at present *sub judice* The assembly chooses a new moderator yearly who, in recent times, is always a clergyman A sermon is preached before the opening of the court The assembly is honoured with the presence of a nobleman as representative of the sovereign under the title of lord high commissioner, but this high functionary takes no part in the proceedings of the court except in opening and closing or dissolving its sittings and has no voice in its deliberations The assembly before its close appoints a commission which is equivalent to a committee of the whole house, being composed of all the members of assembly, and one minister additional, named by the moderator The commission meets quarterly, but may hold *pro re nata* meetings

The income of the clergy, which may average about 250*l* yearly including manse and glebe is regulated by the state, and they are nominated to livings by patronage They have no liturgy no altar, no instrumental music The Scottish presbyterians do not kneel, but stand in time of prayer, and in singing the praises of God they sit The sacrament of the Supper is not administered in private houses to any person under any circumstances whatever (*The Directory for the Public Worship of God, by the Westminster Assembly of Divines*) Pluralities have been prohibited, and the residence of clergymen within their repective parishes has always been imperative Their creed is rigid Calvinism and may be found embodied in the *Westminster Confession of Faith* and the *Larger* and *Shorter Catechisms* But though the faith of the Scottish Presbyterians whether churchmen or dissenters is Calvinistic not a few of the Presbyterians in other countries have adopted an Arminian and not unfrequently a Unitarian creed (*Adam's Relig World Displayed* ii 289—305, *Lord King's Inquiry into the Constitution of the Primitive Church*, *Forbes's Presbyterian Letters*)

**Presbytery** In the Scottish Kirk a district composed of a number of adjacent parishes See the preceding article

**Presbytery** In Architecture, a portion of the choir or chancel of a church arranged with seats for the dignitaries of the establishment

**PRESCRIPTION** A title acquired by use and time to incorporeal hereditaments such as a right of way or of common and the like All prescription is either personal as when it is in a man and his ancestors or it is in right of a particular estate, which last being in a man and those whose estate he hath, is called prescription in a *que* estate It presupposes a grant and can therefore give a title to those things only which can pass by grant After uninterrupted enjoyment for thirty and in many cases for twenty years a *primâ facie* title arises by prescription to the thing enjoyed, and unless such enjoyment have continued under some consent or agreement the title becomes in sixty years absolute and indefeasible The time of prescription in most of the ordinary instances to which it applies is now regulated by 2 & 3 W 4 c 71

**PRESENTATION** In Law the appointment of a clergyman to a benefice by the patron which takes place by presenting him to the bishop for institution

**PRESENTATION FEAST OF** In Ecclesiastical Usage the same with the Purification of the Blessed Virgin See PURIFICATION

**PRESENTMENT**, in Criminal Law is defined to be an information made by the jury in a court before a judge who has authority to punish an offence Properly speaking it is the notice taken by a grand jury of their own knowledge, without any bill or indictment found before them at the suit of the king, of any offence nuisance, libel, &c of which they are competent to take notice An indictment, correctly speaking is that which is drawn up and engrossed to be found by the grand jury founded on their presentment or note of instruction Presentment is also comprehensively taken to include inquisitions of office and indictments, as well as presentments strictly so called

**PRESIDENT** (Lat præsideo *I sit foremost*) A title applied to many officers in various capacities but generally denoting a pre-eminency either temporary or fixed among a number of individuals assembled for a definite purpose Thus the superior of a board or council &c is generally entitled president, as is the individual called to preside over a [illegible] or to fill the chair at a club dinner &c [illegible] old English title of chairman is frequently used on such occasions

The supreme executive officer of the United States of America is styled president The qualifications required of a person raised to this dignity are, to be a natural born citizen of the age of thirty five years, and to have resided fourteen years within the States The election is by electoral colleges in every state These colleges contain, in each state, a number of electors equal to all the senators and representatives of that state in congress; but their appointment varies in different states, and at different times, sometimes it is made by their respective legislatures, sometimes by general election throughout the state, sometimes part of the electors are chosen by district and part by general election The colleges in each state vote by ballot for a president (and at the same time for a vice-president), and the votes of all the electors, taken in this manner, are counted by the president of the senate when if any person have an absolute majority of votes, he is duly elected, if not, the election is made by the house of representatives between the three persons having the highest number, in which case the votes are taken by states and a majority of all the states is necessary to constitute a choice On two occasions, of which the last was in 1824, no candidate having had a majority of the whole number of voters, the house of representatives has proceeded to make the election, and on the last of these occasions a majority of states chose a candidate (Adams) who had a smaller number of electoral votes than one of his opponents (Jackson) On one occasion in 1800, the states balloted thirty six times before any candidate could obtain an absolute majority Should the president die during his term of office he is succeeded by the vice president, an event which has recently occurred

In his legislative capacity the president has the power of approving bills sent to him after passing both houses of congress or of returning them to the house in which they have originated with his objections annexed In the latter case the bill must be reconsidered by that house, and if on reconsideration it obtain a majority of two thirds in both houses it passes into a law In his executive capacity he is commander-in chief of the army and navy of the Union and of the state militias when called into the service of the Union he has the power of reprieving and pardoning except in cases of impeachment, he has power to make treaties with the consent of the senate (by a majority of two thirds), he nominates ambassadors, consuls judges of the supreme court and all other officers of the United States whose appointments are not vested elsewhere by the constitution

**PRESIDENT LORD OF THE COUNCIL** The fourth great officer of state in England, appointed by letters patent under the great seal durante bene placito

**PRESS** (Fr presse) The machine by which books, &c are printed Very little improvement in the construction of this instrument took place from the first introduction of the art into Europe till the late Earl Stanhope applied the powers of his mind to the subject, and introduced a new press of a decidedly superior construction The old press was made of wood with an iron screw that had a bar fitted in it, to the lower end of this screw was attached horizontally a flat piece of wood called the platen which was brought down by means of the screw, and pressed the paper upon the face of the types and thus the impression was obtained This press has however entirely given place to presses made of iron Lord Stanhope's press is constructed of iron with a screw, but the bar is fixed to an upright spindle to which a lever is attached connected with a second lever fixed to the top of the screw by a connecting bar These two levers are placed at different angles to each other, and when the platen is brought down to the face of the types, and power is wanted the two levers take such a position with each other so as to act with the greatest advantage, and thus an almost incredible accession of power is gained, which enables the pressman to print larger sheets of paper in a superior manner with less labour and with greater ease to himself This press maintains its superiority over all others

This great improvement in the printing press that Lord Stanhope had accomplished excited other ingenious men to exert their abilities in attempts at further improvements among whom was a Mr George Clymer an American, who brought forward an iron press, called the Columbian press, in which he discarded the screw and obtained his power entirely by levers This press has great power, and consequently great strength, and is made of a size to print larger sheets of paper than any other, but for the common run of printing it does not work so easy as the Stanhope press These two are looked upon as the best presses

There are a variety of others which are great improvements upon the old [illegible], and which are held in estimation by printers but the limits of this work will not admit of the details of their respective merits

The *book press* in the warehouse department, used for pressing books previous to their delivery is the common screw press with a perpendicular screw, and screwed down by means of an iron bar It is also used for pressing paper when wetted prev[illegible] purpose of making it in [illegible] presses, and also in cylindrical or machine printing to cause it to lie flat, otherwise it is apt to wrinkle, particularly large sheets, in being carried round the cylinders upon a flat surface In large establishments Brahmah's hydraulic

press is generally used for these purposes as being much more powerful and also more expeditious, not only in its use, but also in its effect

PRESS A machine for the purpose of compressing or squeezing bodies Any of the mechanical powers may be used for this purpose When constructed on a large [illegible] with great power [illegible] Hydrostatics

PRESS is applied [illegible] literature of a country, or to that part of it more immediately connected with newspapers or other periodical publications

PRESSIROSTRES, *Pressirostres* (Lat pressus, *flattened,* rostrum, *a beak*) A tribe of wading birds, including those which have a flattened or compressed beak

PRE'SSURE Dr Young defines pressure to be "a force counteracted by another force, so that no motion is produced" (*Lectures on Nat Phil*) Thus, when a heavy body is supported on a table, or the ground, the force of terrestrial gravity, which, if the support were removed, would cause the body to descend towards the centre of the earth, being destroyed at every instant by the resistance of the support, produces a pressure A pressure and a moving force differ from one another only in this respect, that the infinitely small velocities which the pressure tends to produce are incessantly destroyed by the resistance of the obstacle, whereas those that are actually produced at every instant by the moving forces are accumulated in the moving body, and produce a finite velocity after a finite time The pressures of two different bodies are, therefore to each other as the masses multiplied by the infinitely small velocities which they tend to produce in the same instant of time and which they would produce if the bodies were free to move

The pressure of a solid body is exerted in the direction of the resultant of all the forces by which the body is acted upon In the interior of liquid and uniform bodies the pressure is equal in all directions (See HYDROSTATICS, PNEUMATICS) *Centre of Pressure*, in Hydrostatics is that point of a plane or side of a vessel containing a liquid to [illegible] equal to the total pressure [illegible] it would exactly balance [illegible]

PRESSWORK, in Printing is the operation of taking impressions from types &c by means of the press distinct from *composing*, which is arranging the types to prepare them for press

PRESTO (It) In Music See ALLEGRO

PRESUMPTION OF LAW, is the [illegible] of the truth of a certain state of facts by the [illegible] of the law It is either 'juris et de jure,' which is a presumption which no evidence to the contrary can be admitted to traverse as the presumption of incapacity in a minor with guardians to act without their consent or it is 'juris' only which may be traversed by evidence as where the property of goods is presumed to be in the possessor until the contrary is shown

PRESUMPTIVE HEIR See HEIR

PRETENDER The name by which the Chevalier Charles Stuart is usually known from his having pretended a right to the British crown, from which he had been excluded

PRE'VOTALES, COURS (Fr *courts of prevots or provosts*) Certain tribunals of summary jurisdiction which existed in France before the Revolution were called by this name They were the courts of the prevots of France and of Paris of the prevots des marechaux (see PROVOST PROVOST-MARSHAL &c) and exercised a summary jurisdiction over vagrants highway robbers disturbers of the peace &c These ancient institutions furnished Napoleon with the model of certain extraordinary courts, with mixed civil and military judges which were formed in 1808 for the purpose of preserving public order in a summary manner All these unconstitutional tribunals were abolished by the first charter of 1814, but with provision for the restoration of the Cours Prevotales should it be thought necessary They were accordingly established in 1815, to last for two years, but expired in 1818

PRIA'PUS (Gr Πριαπος) A divinity introduced into Grecian mythology after the time of Alexander He was the god of fruitfulness, and by the Romans was looked on particularly as the guardian of gardens, in which indecent and rudely sculptured wooden statues of him were usually set up

PRICE (Fr prix), in Commerce, means the value or exchangeable worth of any commodity or product estimated or rated in money, or simply the quantity of money for which it will exchange The price of a commodity rises when it fetches more, and falls when it fetches less money

*Price of freely produced Commodities* — The exchangeable value of commodities — that is, their power of exchanging for or buying other commodities — depends, at any given period, partly on the comparative facility of their production, and partly on the relation of the supply and demand. If any two or more commodities respectively required the same outlay of capital and labour to bring them to market and if the supply of each were adjusted exactly according to the effectual demand — that is, were they all in sufficient abundance, and no more, to supply the wants of those able and willing to pay the outlay upon them, and the ordinary rate of profit at the time, they would each fetch the same price, or exchange for the same quantity of money or any thing else But if any single commodity should happen to require less or more capital and labour for its production, while the quantity required to produce the others continued stationary its value, as compared with these, would, in the first case, fall, and in the second rise, and supposing the cost of its production not to vary, its value might be increased by a falling off in the supply, or by an increase of demand, and conversely

But it is of importance to bear in mind, that all variations of price arising from any disproportion in the supply and demand of such commodities as may be *freely produced in indefinite quantities* are *temporary* only, while those that are occasioned by changes in the cost of their production are *permanent*, at least as much so as the cause in which they originate A general mourning occasions a transient rise in the price of black cloth, but supposing that the fashion of wearing black were to continue its price would not permanently vary, for those who previously manufactured blue and brown cloths, &c would henceforth manufacture only black cloth and the supply being in this way increased to the same extent as the demand the price would settle at its old level Hence the importance of distinguishing between a variation of price originating in a change of fashion, or other accidental circumstance — such, for example, as a deficient harvest, — and a variation occasioned by some change in the cost of production In the former case prices will at no distant period revert to their old level in the latter, the variation will be lasting

When the *price* of a freely produced commodity rises or falls such variation may evidently be occasioned either by something affecting its value or by something affecting the value of money, but when the generality of commodities rise or fall, the fair presumption is that the change is not in them, but in the money with which they are compared This conclusion does not however, apply in all cases and we believe that most part of that fall in the price of commodities which has taken place since the peace, and which has been so generally ascribed to a rise in the value of money occasioned by a decline in the productiveness of the mines has been caused by the increased productiveness of industry arising from the abolition of oppressive restraints on commerce, the opening of new and more abundant sources of supply, and the discovery of new means and improved methods of production

*Price of monopolised Commodities* — Exclusive, however of the commodities now alluded to, there is a considerable class whose producers or holders enjoy either an *absolute* or a *partial* monopoly of the supply When such is the case prices depend entirely or principally on the proportion between the supply and demand and are not liable to be influenced or only in a secondary degree, by changes in the cost of production Antique statues and gems the pictures of the great masters, wines of a peculiar flavour produced in small quantities in particular situations and a few other articles, exist under what may be called absolute monopolies, — their supply cannot be increased and their price must therefore depend entirely on the competition of those who may wish to buy them without being in the slightest degree influenced by the cost of their production

Monopolies are sometimes established by law, as when the power to supply the market with a particular article is made over to one individual or society of individuals, without any limitation of the price at which it may be sold, which of course enables those possessed of the monopoly to exact the highest price for it that the competition of the buyers will afford, though such price may exceed the cost of production in any conceivable degree Monopolies of this sort used to be common in [illegible] in the reign of Elizabeth, but they were [illegible] by the famous act of the 21 Jac 1. c 3, an act which by establishing the freedom of competition in all businesses carried on at home, has been productive of the greatest advantages

The rights conveyed by patents sometimes establish a valuable monopoly for they enable the inventors of improved methods of production to maintain, during the continuance of the patent the price of the article at a level which may be [illegible] sufficient to afford them the ordinary rate of profit [illegible] ever, by stimulating invention, and [illegible] coveries, of which it is the natural and appropriate reward, instead of being injurious, is beneficial to the public

There are also partial monopolies, depending upon situation, connection, fashion, &c, these and other inappreciable circumstances sometimes occasion a dif-

ference of 30 per cent , or more, in the price of the same article in shops not very distant from each other.

[illegible] the supply of monopolised commodities is less [illegible] vary than those that are freely produced and their prices are commonly steady But there are various exceptions to this rule, and of these the partial monopoly of the supply of corn, which the existing corn laws secure to the British agriculturists, may be taken as an example The variations in the harvests of particular countries and their average equality throughout the world, expose a nation which shuts [illegible] of its ports to vicissitudes of price, from [illegible] enjoy a comparative exemption were its ports always open Sometimes the expiration of a monopoly a patent for example, has occasioned a sudden and extraordinary increase of supply, and consequent fall of price , entailing, of course a serious loss on the holders of large stocks of goods produced under the monopoly

*New Sources of Supply* — The effects on prices produced by the opening of new markets, or new sources of supply, are familiar to every one The fall that has taken place in the price of pepper, and of most sorts of commodities brought from the East, since the opening of the trade in 1814, is a conspicuous proof of what is now stated

*Influence of Taxes on Prices* — It is unnecessary to dilate on a topic so familiar to every one When a tax is laid on a commodity its price necessarily rises in a corresponding proportion for otherwise the producers would not obtain the ordinary rate of profit, and would of course, withdraw from the business A considerable part of the price of many articles in this and other countries really consists of the tax or duty laid upon them

These statements will probably suffice to give our readers a general idea of the principles which determine the value of commodities To go deeper into the subject would involve us in discussions that belong to political economy, and which are nowise suited for such a work as this

Such however of our readers as wish for full and satisfactory information as to these topics and the practical operation of the different circumstances to which we have now adverted, would do well to consult Mr Tooke's *History of Prices* This work is especially valuable for the rare union which it exhibits of a perfect knowledge of principles with the most extensive acquaintance with practical details

PRICKING-UP In Architecture the first coating of plaster in work of three coats upon laths It is executed with *coarse stuff* in London usually compounded with road stuff or Thames sand The surface is scratched over, to form a better key for the next coat

PRICK POST In Architecture a post in wooden buildings framed intermediately between two principal posts

PRIEST (Gr πρεσβυτερος *elder*) Etymologically, the Christian priest is merely a minister who presides over the spiritual affairs of a congregation The word however, is commonly used also to represent the Greek ιερευς, who, like the Jewish priest had both a sacrificial and mediatorial character, and the Roman Catholic looks upon the Christian priest in the same light

PRIMÆ VIÆ (Lat *the first passages*) Medical men apply this term to the stomach and bowels

PRI'MAGE A certain allowance paid by the shipper or consigner of goods to the master and sailors of a vessel for loading the same It varies in different places according to their respective customs

PRI'MARY COLOURS The colours into which a ray of white solar light may be decomposed or separated Newton supposed them to be seven, red orange yellow green blue indigo and violet Mayer considered some of these to be secondary colours and that there are only three primary colours in the solar spectrum, namely red, yellow, and blue, certain portions of which constitute white light and all the other colours (*Opera inedita* 1775) Dr Young assumes red, green and violet as the fundamental colours (*Lectures on Nat Phil* p 439) In fact, any three prismatic rays may be assumed as the primary colours, and all the rest compounded from them, provided we attend only to the predominant tint resulting, and disregard its dilution with white (*Herschel on Light*, § 588) *See* CHROMATICS Light

PRIMARY ROCKS, or PRIMITIVE ROCKS *See* GEOLOGY

PRIMATE (Lat primus *first*) A prelate of superior dignity and authority In England the archbishop of York is entitled Primate of England, the archbishop of Canterbury Primate of all England

PRIMATES The name given by Linnæus to the first order of animals in his *Systema Naturæ*, which associated man with the monkeys and bats, and corresponded to the Bimana, Quadrumana, and Cheiroptera of Cuvier

PRIME NUMBERS In Arithmetic, are numbers which have no divisors, or which cannot be divided into any less number of equal integral parts than the number of units of which they are composed, such are 2, 3, 5, 7 11, 13, &c

A general method of finding prime numbers, beyond a certain limit by a direct process is one of the most difficult problems in the theory of numbers, and though often sought after, has not yet been discovered Many remarkable properties of numbers have, however, been detected, by means of which it is in most cases not difficult to determine whether an assigned number is prime or not Some of these properties are the following —

1 Every prime number above 3 is comprehended in one of these forms, $6n + 1$, or $6n - 1$ ($n$ being any whole number), that is to say, if a prime number be increased or diminished by unity, the result is a multiple of 6 In order to prove this, it will be sufficient to remark that every whole number is necessarily comprised in one of other of these six forms (where $n$ is successively 0, 1, 2, 3, &c),

$$6n + 1, 6n + 2, 6n + 3, 6n + 4, 6n + 5, 6n + 6$$

Now the second fourth, and sixth of these forms being divisible by 2, cannot give prime numbers The third gives only numbers divisible by 3, therefore the primes can only be of the form $6n + 1$, or $6n + 5$ But $6n + 5 = 6n + 6 - 1 = 6(n + 1) - 1 = 6n' - 1$ $n'$ being any whole number, it follows therefore that all prime numbers are comprehended in one of the forms $6n + 1$, or $6n - 1$

2 In like manner, every prime number above 2 is of one of the forms $4n + 1$ or $4n - 1$, and every prime number excepting 2 of one of the forms $8n + 1$, $8n + 3$, $8n + 5$ $8n + 7$ In fact prime numbers may be divided in this manner into classes according to any modulus, at pleasure, the first four forms however, are those which possess the most distinctive properties

Although every prime number is comprehended in one of these forms the converse proposition is not true, namely that every number in one of these forms is a prime number No direct rule has yet been given by which it can be determined *à priori* whether a given number be prime or not

3 If a number cannot be divided by another number less than the square root of itself, that number is a prime

4 If $n$ denote any prime number the product, $1 \cdot 2 \cdot 3 \cdot 4 \ldots (n - 1)$ increased by unity is divisible by $n$

It is frequently of use in arithmetical investigations to know whether a number is prime or not Tables of them have accordingly been formed to a certain extent and are given in various works Vega's tables contain the prime numbers under 400 000 The largest prime number which has yet been verified is $2^{31} - 1 = 2147483647$ This was found by Euler

For properties of prime numbers, see Fermat's edition of *Diophantus*, *Euler's Algebra* and *Analysis Infinitorum*, Legendre *Essai sur la Theorie des Nombres*, *Barlow's Elementary Investigations* &c, and especially the *Disquisitiones Arithmeticæ* of Gauss of which there is a French translation by Delisle

*Prime and Ultimate Ratios* — A method of calculation invented by Newton and employed in the *Principia*, being an extension and simplification of the ancient method of exhaustions It may be thus explained — Let there be two variable quantities continually approaching each other in value so that their ratio or quotient continually approaches to unity and at last differs from unity by less than any assignable quantity, the *ultimate ratio* of these two quantities is said to be a ratio of equality In general when different variable quantities respectively and simultaneously approach other quantities considered as invariable so that the differences between the variable and invariable quantities become at the same time less than any assignable quantity, the ultimate ratios of the variables are the ratios of the invariable quantities or *limits* to which they continually and simultaneously approach They are called *prime ratios* or *ultimate ratios* according as the ratios of the variables [illegible] or approaching [illegible] (See *Prime*, 1, book I)

PRI'MER, signified anciently a religious work employed in the Roman Catholic service, but it is now generally used to denote the first book for children.

PRIMER SEISIN (Norm Fr) An ancient branch of the royal prerogative in England whereby it had possession for a year of the lands and tenements of which a tenant in capite died seised, if the heir was of full age; or, if not, until he was of age

PRIME VERTICAL In Astronomy, the vertical circle of the sphere which [illegible] at right angles, and passes through the east and west points of the horizon In dialling prime vertical dials are those which are projected on the plane of the prime vertical, or a plane parallel to it

PRI'MINE In Botany the outermost sac or covering of an ovule, either composed of cellular tissue only, or traversed by numerous veins or bundles of tubes

**PRIMING** (Lat primus, *first*) In Architecture, the first coat of painting

**PRIMIPI'LUS** In Ancient History, the name of the centurion of the [illegible] who had charge of the Roman eagle [illegible] considerable dignity, and entitled its holder to various privileges, which conferred both rank and emolument On quitting his charge, the primipilus assumed his place among the members of the equestrian order, with the title primipilarius (See *Adam's Rom Antiquities*, *Mém de l'Acad des Inscr* vol xxxii)

**PRIMI'TIÆ** The first fruits of any production of the [illegible] were [illegible] Deity by [illegible]

**PRIMITIVE** [illegible] derived from any other language, nor compounded from any other words of the same, as *horse*, *man*

**PRI'MITIVE COLOURS**, in Painting, are red, yellow, and blue, from the mixtures whereof all other colours may be obtained

**PRIMOGE'NITURE** The right of the eldest son, and those who derive through the eldest son, to succeed to the property of the ancestor Among ancient nations the Jews alone appear, as far as is known, to have recognized this [illegible] For some notice of the [illegible] enture, see SUCCESSION LAW OF

**PRIMULA'CEÆ** (Primula, one of the genera) A natural order of herbaceous Exogens inhabiting the northern and colder parts of the globe It is nearly allied to all the regular Monopetalous orders with a capsular superior fruit especially to *Solanaceæ* and *Ericaceæ* from both of which it is readily known by the stamens being placed opposite to the segments of the corolla In this respect it agrees with *Myrsinaceæ* which differ chiefly in their fleshy fruit and arborescent habit The cowslip from which a sedative wine is made, the primrose, auricula and the acrid cyclamen, together with anagallis or the herb pimpernel which regularly closes its flowers at the approach of rain, — are species of this order

**PRI'MUM MO'BILE**, in the Ptolemaic Astronomy is the outermost sphere of the universe, which gives motion to all the others (see those of the moon planets &c) and carries them round with it in its diurnal revolution Its centre is the centre of the earth

**PRI'MURIES**, or **PRIMARY QUILLS** (*Primores* Lunn) The largest feathers of the wings, they rise from the pinion bones, or those corresponding to the metacarpus and digits

**PRINCE** (From the Latin princeps *first leader or foremost*) This title is probably of Teutonic origin the German equivalent furst has the same etymological signification and the Latin nation appears to have translated it In England the title is applied only to members of the royal family, and in no case except that of the eldest son of the reigning king (Prince of Wales) is it connected with a territorial distinction On the Continent, the rank of princes is various In France under the old regime the title belonged only to certain families of high distinction connected with the royal blood, it ranks in Germany below that of duke

**PRINCE OF WALES** The title bestowed by patent on the heir apparent to the crown of England He is born Duke of Cornwall &c but the title of Duke of Cornwall does not necessarily belong to the heir apparent, as it can only be held by the *first begotten* (not *eldest*) son of a king thus Henry VIII was not in the life of his father Duke of Cornwall The origin of the title of Prince of Wales is as follows — When Edward I subdued Wales he promised the people of that country upon condition of their submission to give them a prince who was born amongst them and who could speak no [illegible] with this de[illegible] Wales upon his second son Edward then an infant born within the principality, and unable to speak any language Edward by the death of his elder brother Alfonso became heir to the crown, and from that time this honour has been appropriated to the eldest sons of the kings of England The Earldom of Chester which is likewise usually conferred upon the [illegible] was once a principality and erected into [illegible] parliament in the 21st of Richard II, it was then appointed to be given to the king's eldest son But the whole acts of that parliament were repealed in the reign of Henry IV although the earldom has usually been since given with the principality of Wales The revenue of the last Prince of Wales was 125,000*l*, 60 000*l* being paid from the civil list, and 65 000*l* from the consolidated fund. His income was last regulated by 35 G 3 c 125. To compass the death of the Prince of Wales, or violate the chastity of his consort, is high treason within the statute of 25 Ed 3 The Prince of Wales has a household of his own, of which the chief officers are a comptroller and auditor-general, treasurer, vice-chamberlain, Gloucester king at arms, and herald; besides another class of officers belonging to the duchy of Cornwall, and another as great steward of Scotland As Duke of Cornwall and Earl of Chester, the prince appoints sheriffs, &c for those counties By a statute of the order of the Garter, issued in 1805, the Prince of Wales was declared a constituent part of the original institution Hence every prince becomes a Knight of the Garter the moment he is created Prince of Wales For the constitutional question raised in 1788, respecting the right of the Prince of Wales [illegible] the regency see REGENT

**PRINCEPS SENATUS** Prince or first of the senate In Ancient Rome, the citizen whose name was [illegible] first on the list of the senate by the censors was [illegible] This high dignity was not connected with any [illegible] and at different times only of those who were recognized as the most considerable citizens of the state Before the second Punic war, it seems to have belonged to the oldest of those who had held the office of censor, but the first deviation from this practice was in favour of Fabius Maximus This title was the first germ of the imperial authority of Augustus (*See* SENATE) There is a memoir on the subject in vol xxiv of the *Mémoires de l'Academie des Inscriptions*

**PRINCIPAL** (Lat princeps, *chief*) In Architecture a main timber in an assemblage of carpentry Thus, in a roof, the strong rafters used for trussing the beams are called principal rafters

**PRINCIPAL** The name by which the heads of the Scottish universities are distinguished

**PRINCIPAL** In the Fine Arts the chief circumstance in a work of art to which the rest are to be subordinate

**PRINCIPES** The name given to one of the four grand divisions of the Roman infantry It was their duty to assume the initiative in an engagement, for which they were admirably qualified being the choice men of the Roman army, and from this [illegible] is said to be derived The ot[illegible] he velites, hastati, and triarii, which see (See *Mem de l'Acad des Inscr* vol xxix)

**PRINCIPLE** (Lat principium) In Chemistry a term sometimes applied to certain proximate components of organic bodies, such as *bitter principle*, *febrifuge principle* &c This term, however, is now [illegible] having been found that each bitter, febrifuge narcotic, or other substance, generally contains a principle peculiar to itself upon which its powers depend, and that there is no such common or universal principle as was formerly [illegible] For [illegible] term principle of [illegible] is suggested, as applied in common with "nervous principle," &c, to an imaginary existence

**PRINCIPLES** In the Fine Arts, those general and fundamental truths from which the rules and maxims of art are deduced To each art particular principles are attached on which its theory is founded These principles, before they can be said to have stability, must be found to depend on certain truths which, recognized by every one and indisputable, oblige the mind to concur in the deductions that result from them Before a law in any art is laid down, it is necessary to trace it to the principles from which it springs though there may be causes which prevent those principles being universally admitted such as ignorance prejudice love of novelty and the like Indeed there is an everlasting contest between truth and error in all human institutions The former like light, is acknowledged by all though our passions and interests too often tempt us to obscure it, but as darkness itself proves that light exists so falsehood only enables truth to shine with greater lustre

**PRINTING** (Fr imprimerie) Letterpress printing to which this article is confined is the art of taking impressions from engravings in relief

The process is generally limited to printing from types and from engravings on wood

The history of its origin is enveloped in mystery, and this art which commemorates all other inventions, which hands down to posterity every important event, which immortalizes the actions of the great, and which, above all extends and diffuses the word of God to all mankind, this very art has left its own origin in obscurity, and has given employment to the studies and researches of the most learned men in Europe to determine to whom the honour of the invention is due

Some writers maintain that the art was practised as far back at least as the building of Babylon, and hold that the characters impressed on the bricks found on the supposed site of that city are literally printed we are in possession of metal stamps with words engraved in relief, which the Romans made use of to mark their various articles On this subject Mr Landseer, in his *Lectures on the Art of Engraving*, 8vo 1807, observes, "Had the modern art of making paper been known [illegible] probably never heard the names of [illegible] for, with the same kind of stamps [illegible] the Roman tradesmen used for their pottery and packages, books might also have been printed, and the same engraving which adorned the

shields and pateras of the more remote ages, with the addition of paper, might have spread the rays of Greek and Etrurian intelligence over the world of antiquity Of the truth of this assertion I have the satisfaction to lay before you the most decided proofs, by exhibiting engraved Latin inscriptions both in cameo and intaglio, from the collection of Mr Douce with impressions taken from them at Mr Savage's letterpress but yesterday (in 1805) One of these is an intaglio stamp, engraved on stone, with which a Roman oculist was used to mark his medicines, the other, which is of metal, and in cameo, is simply the proper name of the (Roman) tradesman by whom it has probably been used, 'Titus Valagini Mauri'" Of the latter stamp, the following impression is a facsimile —




Papillon's relation of the two Cunio, who engraved on wood the heroic actions of Alexander the Great and printed impressions from them in the year 1285 the truth of which has been defended by Zani Ottley and Singer, the print of St Christopher carrying the infant Jesus across the sea with an inscription and the date 1423 at the bottom on the same block in the library of Earl Spencer and the decree of the government of Venice, of the date 11th October, 1441 respecting 'playing cards, and coloured figures printed" the art and mystery of making which had fallen to total decay at Venice, in consequence of the great quantity which were made out of Venice and prohibiting the introduction of them under pain and forfeiture and fine — a decree which carries the art of printing back into the 14th century these circumstances taken together prove that the knowledge and the practice of the art of printing existed in Europe long before the time which is usually attributed to it although it had not been applied to the multiplication of books

According to Du Halde and the missionaries the art of printing from engraved blocks of wood was practised in China nearly fifty years before the Christian era, and from the early commercial intercourse of the Venetians with that country there is reason to believe that the knowledge of the art and of its application to the multiplying of books was derived from thence for Venice is the first place in Europe of which we have any account in which it was practised as appears by the decree above mentioned, which is the most ancient document in existence respecting [illegible] but the date of this application of the art [illegible] where it was first practised it is impossible to determine From that decree and the existence of the print of St Christopher it would seem that it had been long applied to the production of playing cards and of religious subjects and when it was extended to books they were printed by the Chinese method still in use each page being engraved on a block of wood and if this plan was followed as most probably it was, from its being the most expeditious and the most correct — of fastening a page of manuscript on the face of the block and engraving from that instead of drawing the characters on the wood - it would at once account for the diversity of characters found in the block books which varied with the different handwritings of the scribes and has completely puzzled the learned who endeavour to ascertain the printer by [illegible] ith some other work, as well [illegible] to manuscripts for which they were sold This appearance too was aided by their being printed on one side of the paper only, the indention being removed by burnishing the back, and two leaves were pasted together thus making them such perfect facsimiles of manuscripts as to require even at the present day great discrimination and even chemical skill to distinguish them from each other, and as these books had neither names, dates nor places affixed to them, it is now impossible to ascertain by whom, when, or where they were executed, and thus the fabrication of these pseudo-manuscripts involved the first introduction of the art of printing books in Europe in complete obscurity

About the year 1450, the great and accumulating expense of engraving blocks for each separate work of the increasing number of books produced by means of printing, led to the important improvement of the art of casting separate metal types, and substituting them for the wooden blocks previously used This formed a new epoch in the art, and is now termed, erroneously, the origin of printing After a lapse of many years, several cities claimed the honour of this invention, but time has reduced these claim s to two — Haarlem and Mentz and this rivalry has employed the [illegible] pens of many learned men who have laboured to prove the respective claims of these cities to the imaginary honour of the invention of printing, for what can be more imaginary than such a honour? seeing the art had been practised in Europe privately and publicly, in a modified form, for sixty or seventy years previously to the period which forms the subject in dispute The claims of Haarlem rest upon the statement of Hadrian Junius, who gives it upon the testimony of one Cornelius, who had been a servant of Laurence Coster, for whom the invention is claimed, but this testimony, is our opinion utterly worthless Modern research gives the credit of the introduction of moveable metal types (unquestionably a grand *improvement*) to Peter Schoeffer the assistant and son-in-law of John Fust or Faust of Mentz, so well known in Europe as Dr Faustus Of two writers who have supported the respective claims of these two places it has been observed that it now seems to be allowed that Heinecken has paid too little attention to the antiquity of the claims of Haarlem and Meerman infinitely too much

The first edition of the *Speculum Humanæ Salvationis* was printed by Coster at Haarlem about the year 1440 as is supposed and is one of the earliest productions of the press of which the printer is known, and of which we shall have occasion to speak hereafter But the celebrated Bible known as the 'Mentz Bible without date' is the first important specimen of printing with metal types this was executed by Gutemberg and Fust, between the years 1450 and 1455, and was the occasion of the secret being divulged, of [illegible] mechanical means as is mentioned [illegible] FELTER The [illegible] followed the *Psalter* of 1457, by Fust and Schoeffer These works are executed in such a manner that with all our boasted skill and our improvements in the art, we are decidedly of opinion perfect facsimiles, taking the ink and workmanship into account could not have been executed in England so lately as twenty five years ago When the secret was made known books avowedly printed issued from the press in all parts of Europe far beyond what could have been calculated upon from a new discovery for before the year 1480 there were printing offices in upwards of 220 places — in Austria Bavaria Bohemia Calabria the Cremonese Denmark England Flanders France Franconia the Frioul Geneva Genoa Germany Holland Hungary Italy Lombardy Mecklenburg Moravia Naples the Palatinate Piedmont Poland Portugal, Rome Sardinia Upper and Lower Saxony Sicily Silesia Spain Swabia Switzerland, Thessalonica Turkey Tuscany the Tyrol Venice the Veronese Westphalia Wirtemberg &c The number of places in which the art was practised the wide extent to which it had spread in so short a space of time combined with the skill which the early printers displayed in their works appear to us to be totally incompatible with the date generally assigned to the invention and we are of opinion that *after* having been long practised in private it emerged into publicity in a state nearly approaching to perfection

It is impossible in this short and rapid sketch of the history of the art to enter into detail or to trace its progress in the different cities and towns or even in the different countries where it was first publicly practised after the secret was divulged in fact it would be impossible to arrive at any satisfactory conclusion, for as the first printers neither affixed their names dates nor places where their productions were executed the greatest research could only result in vagueness and uncertainty There has been great difference of opinion among bibliographers who have written on the subject even respecting the first edition of the Latin translation of the Bible, and Meerman has enumerated ten ancient editions without date in favour of the priority of each of which pretensions have been advanced and supported

William Caxton is generally regarded as first who introduced the art of printing into England and practised it at Westminster but a prior claim is advanced in favour of Oxford which has occasioned much controversy Dr Dibdin, in his *Typographical Antiquities* says "Although Caxton is ca[illegible] printer yet I fully believe in [illegible] ford edition of the *Exposicio sancti Jeronimi in simbolum apostolorum* &c of the date of 1468 which was printed by a foreigner at Oxford who was interrupted in the prosecution of his typographical labours" Several copies of this work are in existence one is in the Bodleian library another in the public library at Cambridge and a third in the British Museum Herbert mentions a fourth in the Earl of Pembroke's library, a fifth in All Souls [illegible] entertained, and Hearne [illegible] school tower at Oxford. Those who deny the priority for Oxford argue that the date is incorrect either from accident or design that being in Roman numerals an X is omitted and that the real date of the book should be MCCCCLXXVIII

Caxton, during a long residence on the Continent on

commercial affairs and political missions, in the reign of Henry VII, acquired a practical knowledge of the art and on his return to England established a printing office in a chapel adjoining to Westminster Abbey where for many years he was indefatigable in translating and preparing works for the press and in printing them, and to him may be fairly ascribed the merit of being the first to introduce the practice of printing generally into England He printed many books on a variety of subjects, and all the productions of his press are objects of great interest to book collectors He commenced printing in England about the year 1474, and was followed by Wynkyn de Worde, Richard Pynson, &c

In the Privy Purse Expenses of Henry the Seventh are the following entries —

"June 6 1499 To the Printers at Westmr, £1"

"Nov 1, 1501 To Richard Pynson the Prynter, in rewarde, £1"

"21 For prynting of new Colletts, £1 13s 4d"

July 12 1503 To Ric Pynson upon a prest for massebokes to be printed, £10" — *Excerpta Historica*, 8vo 1833

Dr Dibdin relates, that, in 1524, Dr Robert Wakefield, chaplain to Henry VIII published his *Oratio de Laudibus et Utilitate trium Linguarum, Arabicæ, Chaldaicæ, et Hebraicæ*, &c 4to The printer was Wynkyn de Worde, and the author complains that he was obliged to omit his whole third part, because the printer had no Hebrew types We have now in the British foundries, in addition to the Roman and Italic characters Arabic, Armenian, Coptic Domesday, Engrossing Ethiopic, Etruscan, German, Greek, Alexandrian Greek, Gothic Hebrew, Hibernian or Irish, Malabaric Malteze Nagari or Brahmin Persian, Philosophical Runic, Russian Samaritan Sanscrit, Saxon, Sclavonian or ancient Russian Script in imitation of writing Swedish Syriac Tamoul Telegu Turkish, also black letter and music, and, in addition, a great variety of fancy types

The first book in which Greek types occur is Cicero's *Offices*, printed in the year 1465, in which the characters are so imperfect that the words are with difficulty deciphered, and the first book printed in Roman characters was Cicero's *Epistolæ Familiares* by Sweynheim and Pannartz, at Rome, in 1467 The Italic type was the invention of Aldus Manutius, the celebrated printer at Venice about 1500, and dedicated by him to the States of Italy, from which it took its name

The art appeared to start into publicity in a state of perfection As it extended, the workmanship became much inferior, so that while the productions of the first printers were executed in a very superior style and the embellishments showed a great proficiency both in design and engraving the productions of their competitors had all the crudeness and imperfection of a new invention, and in the 17th century it had retrograded to a very low state At the commencement of the 18th century Caslon made great improvement in types, and about 1750 Baskerville of Birmingham also made great improvements both in types and printing which were subsequently carried on by Bensley, Bulmer, Corrall Davison M'Creery Whittingham, and a few others, in London, the Foulis at Glasgow, the Ballantynes in Edinburgh, Bodoni at Parma, and Didot at Paris

Many of the manuscripts of the 14th and 15th centuries were written in a beautiful manner, and embellished by borders round the pages, and by the large letters at the commencement of chapters being drawn and coloured with brilliant colours, heightened with burnished gold, and finished with taste, delicacy, and great ability, so as to produce a most splendid effect These were called illuminated manuscripts On the first production of books by the process of printing these ornamental letters were left blank, and both these letters and the borders were finished by hand in the usual manner which gave to the book a perfect resemblance to a manuscript, of which it became by these means a complete fac-simile This is the case with the Mentz Bible by Fust and Gutenberg The first printers soon began to print these large ornamented letters, the letter itself being in some instances red and the ornamental part blue, in others the letter is blue and the ornamental part red, and these were afterwards finished by hand, as is apparent in the Psalter of 1457, printed by Fust and Schoeffer, who also showed great ingenuity and skill in the large letter B in the same book, which is printed with red ink, and the ornamental part, consisting of a flourished line, as if it had been drawn with a pen, extending from the top to the bottom of the folio page, with blue ink Of two copies which we have examined, one was in the library of Geo III, at Buckingham Palace, and the other is in the possession of Earl Spencer

The first edition of the *Speculum Humanæ Salvationis*, which was printed at Haarlem about the year 1440, by [illegible] engravings on wood printed in a [illegible] the body of the work A copy of this rare and curious work, which we examined some years ago in the valuable collection of Messrs Longman, impressed us momentarily with the idea that the engravings were pen and ink drawings, and that the ink had turned brown with age, so precisely was this effect produced by the tone of the ink

We [illegible] blocks of wood with two different colours, as being produced by means of the press, coeval with the generally received opinion of the invention of printing, to show the impossibility of the case For looking at the form of the [illegible] the letter B, and the skill of the working [illegible] it must be evident to every person conversant with the art that this perfection could only be obtained by long practice, and the contrast between these productions of the first practitioners and their competitors, when the art became public, puts the question beyond a doubt, as an examination of the fac-similes given by Heinecken from Fables printed at Bamberg about 1461, from the *Legendas* printed at the same place about 1470, and also the Fables of Æsop by Caxton, will, we think satisfy the most scrupulous and sceptical

Towards the end of the 15th century the art was extended to the imitation of pen and ink sketches with a coloured ground, by the great masters of painting, and in a few years it was further extended to the imitation of drawings in clare-obscure, and that with such success as to induce some of the first artists to encourage it by drawing the subjects on the blocks The first practisers of this extension of the art were, Michael Wolgemuth of Nuremberg who furnished the designs for the *Nuremberg Chronicle*, and also engraved them on wood, and Mair, a native of Landshut, the disciple of Martin Schon, between whom the priority rests of printing in clare-obscure After them were Girolomo Mocetto, Lucas Cranach, Baldassar Peruzzi Hans Burghmair, and Ugo da Carpi (who has been generally regarded as the inventor of this style of printing, but dates prove this opinion to be erroneous) Domenico Beccafumi, John Ulric, Albert Altdorfer Hans Baldung, Lucas Jacobs Leyden (called Lucas Van), all these were born in the 15th century In the [illegible] Parenta, Giovanni Nicolo [illegible] Herbert Goltz or Goltzius Andrew Andreani Henry Goltz or Goltzius, Abraham Bloemaert, Paul Moreelze, Bartolomeo Coriolano Giovanni Batista Coriolano, Christopher Jegher, George Pencz, and Frederick Bloemaert In the 17th century, there were Louis Businck, Vincent le Sueur, Antonio Maria Zanetti Nicholas le Sueur, Comte de Caylus Edward Kirkhall, and John Baptist Michael Papillon This last mentioned engraver, in his treatise on *Engraving on Wood* expressly states that Albert Durer engraved some subjects in clare obscure, and that he had examined them in the collection of the king of France Parmigiano also superintended the [illegible] a number of his own designs, [illegible] on the blocks for [illegible] *into the Origin of Printing in Europe* states, that "one of the greatest princes and connoisseurs of our age used to say, he saw nothing in prints that could give him the pleasure he received from looking at the wood prints, done in chiaro oscuro by Hugo di Carpi" This prince was the Duke of Orleans regent of France

After these were John Baptist Jackson, who executed a number of subjects of a large size, in clare obscure, copied from celebrated paintings in churches in Italy, and from private collections, he afterwards established a manufactory at Chelsea for printing paper-hangings in oil colours a speculation however which was unsuccessful Some of his productions printed in colours were complete failures, the oil having spread in the paper, and the subjects being in the first instance engraved with [illegible] 1754 Mr John Skippe, an amateur, executed many subjects in clare obscure very adroitly

Gubitz an engraver at Berlin has produced a great number of subjects printed in colours, of a very superior character, but none of them can be called imitations of drawings The writer of this article was the first who attempted to imitate drawings in water colours by means of the common printing press and accomplished the applying of all the colours used by artists to the composition of printing ink, thus serving as a pioneer to more skilful persons who might devote themselves to this branch of art, and he succeeded in producing fac-similes of the [illegible] to every one who [illegible] Messrs Wyndham Blanford, of Beaufort House, applied printing in coloured inks to the prevention of forgery, and to embossing on paper, and Messrs Vizetelly and Branston have produced some very tasteful things in colours, but neither of these establishments has, to our knowledge, turned their attention to the imitation of drawings Mr Baxter is now pursuing the subject and has executed many very superior specimens in a manner that would have been deemed totally im-

practicable twenty-five years ago The result is confirming the most sanguine expectations we ever entertained on the subject [illegible] powers of [illegible] works of art are far from being [illegible]

The art of taking impressions in gold from types, and from [illegible] and metals in relief, generally called [illegible] executed most successfully by [illegible] It is also accomplished with bronze of different colours in the most delicate engravings, but however beautiful the effect of bronze may be at first, it unfortunately is not permanent

After this brief sketch of the history and progress of the art of printing in Europe an art more important in the effects it has produced on the human mind, and consequently on the state of society, than any other that has ever been practised, we shall lay before the reader a short outline of the practical part, for the better understanding of which, we shall subjoin a glossary of the chief technical terms in common use

The first operation called [illegible] is to separate the letters called types (see [illegible]) and pages These pages, being placed upon a large flat surface, called an imposing stone in such an order that when they are printed and the sheet of paper is folded, the pages will follow each other consecutively are then wedged up in an iron frame, termed a chase This operation is styled imposing

A printing press is a machine on which the matter to be printed is laid on an even surface horizontally placed either of stone or iron, and the pressure upon the types is produced by a parallel surface of wood or iron, technically a platen, by means of a screw, or lever, or both combined See PRESS

Perhaps the most satisfactory way of explaining the process generally will be to take a printing-office just commencing and describe the whole arrangement, and follow in the order of its proceeding the execution of a work from its being put in hand to its completion

The office having been supplied with all the necessary materials, viz frames cases case racks bulks, boards board racks, imposing stone furniture quoins mallet shooting sticks, brass rule, chases and types in the quantity and variety that may be judged necessary, and also presses with their accompaniments banks and horses with a sink, lye trough, wetting trough and paper boards and in the warehouse with a gathering table poles a peel, and a press to press the books before they are delivered,—it may be said that the office is in a state to commence business

The compositor now proceeds to lay the letter into as many cases as may be judged expedient in the first instance (see CASE) laying the Italic in cases distinct from the Roman each letter or sort in the box appropriated to it having done this with one fount he will put the cases into the case rack, and proceed with another fount till the whole of the letter is laid, he will put the superfluous sorts either into a fount case or into cotins, and he will then be ready to take copy

The pressman has to adjust his press place the footstep so as to give him the greatest advantage in the pull fix the rounce, place the girths so that the carriage shall run in and out properly, fix the back stay justify the platen so that it shall bear equally on all parts of the form and cover his tympans and frisket, and he is also ready to proceed in his work

The compositor having taken copy and received directions [illegible] length of the page any peculiarity [illegible] particular words the use of capital letters, the punctuation the words that are to be in Italic or small capitals, and any other directions that may be deemed necessary, proceeds to make his measure and cut a composing rule, he then begins to compose letter by letter, till he has formed a word, he separates this from the following word by a space and so continues till he has composed a line, he then justifies this line by [illegible] between the words or lessening it [illegible] so that the line shall be tolerably tight [illegible] composing stick and thus proceeds till he has completed a page after having set the head line and direction line with the signature, he ties a page-cord round it, to preserve it from falling asunder, puts it on a page-paper, and places it on the bottom of his frame, and thus continues, page after page, till he has composed a sheet

It may be necessary to state that every line is of the same length, whether the types fill it out or not, the last line of a paragraph lines of poetry, and short lines of any other description are filled up with quadrats to the proper length, in order that they be secured from derangement by being wedged up in the chase, which is termed locking-up

The pages are then taken to the imposing stone, and arranged in the proper order, the page-papers removed; a chase is then placed over them (see CHASE), furniture put about them (see FURNITURE) and the page cords taken away, proper quoins are then selected, and the form is locked up It is then taken to a press, and one impression is printed, this is styled the first proof, which is folded and taken to the reader with the copy; a boy reads the copy to him while he examines the proof and marks the errors of the compositor, and puts a query to any doubtful matter for the author's consideration, the proof is then returned to the compositor, who corrects the errors and mistakes, and a second impression is printed with more care, and generally on better paper, this is styled a clean proof, it is examined by the first proof to see that the errors of workmanship are corrected, which is termed revising, and then sent out with the copy to the author, he makes what alterations and corrections he may think necessary (see CORRECTING), these are corrected by the compositor, another impression is printed, revised, and read finally and with care for press, the margin is then adjusted (see MARGIN), and the corrections being carefully made, it is taken to the press to be printed off

In the mean time after the author has returned the sheet for press the warehouseman delivers out the proper quantity of paper, which the pressman wets, by drawing the paper, to the extent of three four, five, or six dips for each quire, through clean water, according as the paper may be hard-sized or porous, and also as the form may be solid or open, the paper as it is wetted is laid upon a board opened out and another board is laid upon it with weights, on the following day it is turned, which causes fresh surfaces to come into contact with each other, and diffuses the moisture equally throughout every part of the heap, it will be in good condition to print on the next day This wetting the paper causes it to receive the impression of the ink in a much more perfect manner than it could possibly be made to do if dry

The pressman having received the forms lays the inner form on the press and prints one copy, which is called a revise, this he takes to the person appointed to revise it and while that is doing proceeds to secure the form on the table of the press by means of quoins, to place his tympan sheet, to fix the points which make small holes in the paper that enable him to cause the pages to fall precisely on the back of each other when the second side of the paper is printed and to produce an even and uniform impression in all the pages he then cuts his frisket, which preserves the margin of the paper clean, and, when the revise is corrected proceeds to ink the surface of the types by means of balls or rollers When the whole impression of one side of the paper is printed, he lifts the form off the press washes the ink off the face of the type with lye and rinses it with water He then proceeds in a similar manner with the outer form, which completes the sheet and thus sheet after sheet

If it be intended to have large paper copies of a work, the alteration of margin is made when the number of small paper copies is printed off from each form

When the sheet is printed the compositor lays it up, distributes the letter and proceeds sheet after sheet till the body of the work is finished, then the title, dedication, preface introduction contents, and any other prefatory matter is proceeded with, these being always printed the last

The warehouseman then takes [illegible] and hangs them up on poles to [illegible] of [illegible] ther from five or six to ten or [illegible] state of the weather the heat of the room or the pressure of business, when these sheets are dry they are taken down from the poles, carefully knocked up and put away in the warehouse in piles when the book is nearly finished from ten to fourteen consecutive sheets are laid upon the gathering table in order and collected sheet by sheet by boys who deposit each gathering in a heap at the end of the table, which is generally what is styled a horse-shoe table so that when a boy has deposited his gathering he has only to turn himself and begin again These gatherings are then carefully collated to ascertain that the different sheets are correct and in order, and folded up the middle When the work is finished the gatherings are put together, one of each which forms a copy of the work, and pressed; the work is now completed, and awaits the order of the bookseller, &c to deliver the copies either to himself, the bookbinder, or to others, according to circumstances

A new method of obtaining impressions from types by means of cylinders has been introduced, and the power generally employed is steam Mr Konig, a Saxon, had [illegible] employed with advantage [illegible] not receiving encouragement on the Continent to enable him to prosecute his plans, he came to England in 1804, and, after explaining his views to some of the principal printers in London, Mr Thomas Bensley, Mr George Woodfall, and Mr. Richard Taylor embarked in the undertaking, but Mr. Woodfall soon withdrew After innumerable experiments, and a great outlay of capital, the result was not satisfactory, but the experience gained by prosecuting these experiments resulted in the production of a machine to print with cylinders instead of a flat surface as was the case with the printing press which was limited in the size of

the paper by the size of the press and the power of the pressman In cylindrical printing, by which the pressure is communicated in lines, the size may be very considerably increased

The first machine that was constructed was capable of printing 1000 copies per hour of double demy paper on both sides, while a press is estimated to print 250 copies of a single sheet on one side only in the same time

When this machine was completed, the proprietors of the *Times* newspaper, ever ready to adopt any improvement that would expedite its publication, without regarding expense, agreed with the patentees for two machines, and on the 28th of November, 1814, the *Times* was published, executed by cylindrical printing, the moving power being steam these were the only machines constructed under the first patent

Various improvements made upon this of his complex machine were soon effected by other ingenious men, and were adopted by many printers They have become invaluable for the publication of periodicals where the number of copies is great, and also for newspapers, for their power of printing sheets of paper of a size far beyond the capability of any press, and their rapidity of throwing off copies, enable the editors to increase the size, and to delay commencing the printing off for a considerable time later than before their introduction, and thus avail themselves of any intelligence that might arrive in the interval

Perhaps the most complete machine for printing one side of the paper is that used at the office of the *Times*, the carriage on which the pages to be printed are laid travels under the printing cylinders, of which there are four and back again nineteen times in a minute producing two impressions in going and two in returning, or seventy six in a minute, being 4560 copies of four pages of that newspaper in the hour at its ordinary rate of working The paper is laid on at both ends of the machine two persons laying on at each end, and the printed sheets are delivered two at each end

The types are inked by means of rollers and the apparatus for this purpose was the invention of Mr Edward Cowper, the paper is secured in travelling round the cylinders by means of tapes as first practised by Mr Konig the chief improvements in this machine are known as those of Messrs Applegath and Cowper, by the former of whom it was constructed and fitted up

This machine has the appearance of four single machines formed into one and working at less speed than separate machines are in the habit of doing many of which are capable of printing 1500 per hour and we have no hesitation in saying, that if it were requisite for the sake of despatch, the principle might be extended and a machine constructed to print 6000 or 8000 in hour without difficulty

The idea of cylindrical printing in England originated some years anterior to Mr Konig submitting his plan for the late Mr William Nicholson took out a patent for the purpose dated 29th April 1790 but it was never acted on and as to the use of steam as the motive power the late Mr Alexander Tilloch is known to have stated previously to the introduction of the machines that he had long had it in contemplation to apply steam as the power to print off the *Star* newspaper

The late Sir William Congreve took out a patent for a machine to print two colours at once which was made by Messrs Donkin and Company and completely answered the purpose This machine was intended to print stamps and bank bills which Sir William stated would be inimitable, except by the machine of which he was the patentee, but he was too sanguine and the opinion was fallacious for nothing in the process of printing is more easy to execute at the common press by a common workman than this inimitable plan for preventing forgeries

### Glossary to the Article Printing

*Alteration of Margin* is increasing the space between the pages so as to enlarge the margin of a book and make it proportional in large paper copies

*Back Stay*, is a girth or strap of strong leather attached to the back of the carriage and fastened to the hind part of the press its use is to check the carriage in running out beyond the point which will allow the tympan to rise clear of the front of the platen

*Balls* are used for coating the face of the type or engraving with ink for the purpose of obtaining impressions They consist of the ball-stock, stuffed with carded wool and not many years ago were covered with an undressed sheep-skin, the hair taken off, termed a pelt The noisome smell which these balls occasioned in a printing-office by the means used to keep them in good working order, induced many persons to turn their attention to the providing of a substitute for them, but long without success at length Mr B Foster introduced composition balls, made of glue and treacle melted together and cast in a dished mould, so that the edges are thinner than the middle, and attached to a piece of canvass as a substitute for the pelt; these balls were found to answer so well and be so free from any noxious smell, that they have generally superseded the pelt balls

*Bank* A table placed at the side of a press, on one end of which the horse containing the paper to be printed is laid, and at the other the sheets printed during the operation

*Board Rack* Grooves formed in some recess, or under the imposing stone or a bulk, or in a closet, to receive [illegible] which types are placed that are not in [illegible]

*Carriage* That part of a press on which the types are placed to be printed, which is run in till they are immediately under the platen and, when the impression is taken, run out, in order to change the sheet of paper, and to ink the types again

*Case Rack* A frame of wood of the width and depth of a case, with ledges attached to the inside of the upright parts to receive those cases which are not in use

*Coffin* A piece of strong paper twisted into a conical shape like a sugar paper, into which any superfluous types are temporarily deposited Also that part of the carriage of a wooden press in which the stone is bedded

*Composing Rule* A piece of brass rule, the width of [illegible] to the length [illegible] upon which the compositor arranges the types, it facilitates the process, and by means of it he empties his stick when it is full

*Composing Stick* An instrument of simple construction, in which the compositor arranges the words and lines It has a slide which is secured by a screw, by means of which he is enabled to make the lines of any length that may be required

*Direction Line* A line of quadrats at the bottom of each page in which is inserted the first word of the next page which is called the catch-word, in the first page of each sheet there is also inserted in it the number of the volume if more than one, and the signature

*To Distribute* To replace the letters in their respective situations in the cases after a sheet has been printed off, to enable the compositor to proceed with the work

*Footstep* An inclined plane fixed under the front side of the press for the pressman to place his foot upon when at work, to enable him to exert his strength to advantage

*Form* A chase with one or more pages wedged up in it

*Fount Case* A case of large dimension in which the superfluous sorts of a fount are placed, as a depot, till they be wanted

*Frame* It is made of wood of a height to suit a man standing to work at it, on which the cases are placed It is much higher at the back than the front, which brings the most distant boxes nearer to the compositor's hand

*Frisket* A light iron frame, attached to the tympan by joints or pivots which turns down upon the tympan over the sheet of paper to be printed to preserve the margin clean and to retain the paper in its position to effect this the frisket is covered with paper, and openings cut in it the size of the pages to be printed

*Girths* Two pieces of girthweb or strong leather, fastened at one of the ends to the wheel, and wound different ways round it and the other ends attached to the extreme ends of the carriage, by this means turning the rounce one way causes the carriage to run in under the platen and turning it the reverse way causes it to run out again

*Head Line* The line at the top of the page, which contains the folio or number of the page, and frequently the title of the book or the subject of the chapter or of the page

*Horse* An apparatus of a desk like shape, placed on the bank close to the tympan of the press, on which the paper to be printed is laid

*Inner Form* The chase and pages in proper order, wedged up which contains the 2d 3d 6th, 7th, 10th, 11th, 14th, and 15th pages of a sheet in octavo, it invariably contains the second page of a sheet, whatever may be the size of the book

*Justifying* Putting equal space between the words in each line, making the lines of precisely the same length, placing the marginal notes opposite the references, making the pages uniformly of one length and adjusting any peculiar matter so that the whole shall be tight and proper when wedged up

*To Knock-up* At press, it is for the pressmen to make a pair of balls In the warehouse, it is to make the printed sheets even at the edges, which is performed by taking hold of a parcel of sheets by the two edges, holding them slack in the hands, and letting them fall on their bottom edge by their own weight, the [illegible] of hand throwing them flat on the board, [illegible] operation till all the sheets are even at the edges, when they are placed in piles until they are gathered.

*To Lay-up* This is the operation [illegible] ink off the types after the impression is [illegible]

the form on a letter board, loosening the quoins, and working the letter with the hand, pouring on it plenty of water to clean the types for distribution

*Letter Board* A board on which pages of types are placed for distribution and also when they are not immediately wanted There are two ledges of wood grooved in on the under side, which project a little more than an inch, on which it rests, which allows it to be set over other types on boards without putting them in confusion

*Lye Trough* A shallow trough, lined with lead, sufficiently capacious to admit a board on which a form is laid, this trough has some lye in it, with which the surface of the letter, the chase and the furniture is brushed over to remove the ink which has accumulated during the process of printing, the form is then taken out, set upon its edge, and rinsed with water The lye is composed of water and pearlash

*Mallet* (Fr maillet) A wooden hammer, with which the quoins are tightened and also loosened, and which is also used for general purposes

*Measure* (Fr mesure) The space in the composing stick between the end and the slide, which is the length of a line, however large or small the page may be, is styled the measure

*Outer Form* The chase and pages in proper order wedged up which contains the 1st 4th, 5th 8th 9th 12th, 13th and 16th pages of a sheet in octavo, it invariably contains the first and last pages of a sheet, whatever may be the size of the book

*Page Cord* Small twine, even and strong, which is used to tie round the pages of types to secure them from accidents till they are imposed, when the cords are taken off

*Page Papers* Pieces of stout and smooth paper, on which the pages of types in the progress of a work are placed in a safe place till a sheet is ready to be imposed

*Paper Boards* Boards on which paper is laid when wetted, also those boards used in pressing books they are of various dimensions, according to the size of the paper They differ from letter boards in being smooth and even on both sides

*Peel* A thin piece of wood with a long handle affixed to it, in the shape of the letter T, it is used for hanging the sheets of a book upon the poles to dry, and for taking them down again

*Platen* A thick piece of wood, or more generally now made of iron perfectly level on its under side attached immediately under the moving power of a printing press, which produces the impression

*Point* There are always two points used in presswork when a sheet of paper is printed on both sides, they are made of thin iron with a notch at one end and a projecting spur or point at the other end they are attached to the tympan by screws and lie flat upon it the spurs being under the sheet of paper to be printed make small holes in it so that when the reiteration or second side is printed the spurs are placed in these holes, which cause the pages to fall exactly on the back of each other

*Poles* Long pieces of fir wood about an inch and a half thick, and three or four inches broad, placed across the warehouse and other rooms in a printing office at about eight or nine inches apart and about fourteen inches from the ceiling, their ends rest in notches cut in stretchers fastened to the wall Their use is to hang the damp printed paper upon to dry, which is done with facility by means of the peel

*Quadrats* (Fr quadrat) Pieces of metal of the same body as the type but cast lower in height, used to fill up short lines, and to form a blank line or lines where necessary, being cast lower than the type, they do not produce any impression on the paper

*Quoin* A wedge about half an inch thick and of various widths, to wedge up the pages of type in a chase

*Roller* (Fr rouleau) The roller has nearly superseded the use of balls for inking the surface of the types it is formed of a composition of glue and treacle cast on a wooden cylinder, [illegible]

*Rounce* The rounce is the handle by which the carriage of the press, on which the form to be printed is laid, is run in under the platen and out again, it is fixed in the spit, which is the axis that passes through the drum a cylinder of wood on which one end of the girths are fastened The whole apparatus is generally termed the rounce

*Run-in* The act of placing the carriage with the form of types under the platen to obtain an impression. This is effected by turning the rounce

*Run-out* The act of withdrawing the carriage with the form of types from under the platen by turning the rounce the reverse way from the preceding after the impression is taken.

*Shooting Stick* An implement for tightening and loosening the quoins that wedge up the pages in a chase it is in the shape of a wedge, about two inches broad and nine inches long, and is usually made of box wood In use the small end is placed against the quoin, and the other struck by the mallet

*Signature* A letter of the alphabet placed at the bottom of the first page of a sheet, and so on to each sheet consecutively through the alphabet, with the exception of the letters I, V and W, their use is to facilitate collating a book, as a guide to the bookbinder in folding the sheets, and as a ready means of referring to any part of a work before it is bound

*Sink* A corner of the pressroom, generally inclosed and lined with lead, with loose boards upon the lead, in this sink are placed the lye trough and a *wetting trough*, it is here where the forms are washed, rinsed and laid up There is always a pipe to carry off the waste water

*Sorts* It is generally used in the plural, it means any letter, point, mark, space, or quadrat, that is either deficient or redundant in quantity A work runs upon sorts, that is, a greater number of some particular letters are required than the regular proportion, an index for instance

*Space* A piece of metal cast lower than a type, so as not to print used to separate words, they are of different thicknesses, so as to enable the compositor to arrange the words at equal distances from each other in the same line

*Tympan* A wooden frame attached to the carriage of the press by joints and covered with parchment, on which the sheet of paper to be printed is laid, there is another frame called the inner tympan which fits into this also covered with parchment, between these are placed pieces of woollen cloth termed blankets, which form a soft medium between the types and the platen that tends to produce an equal impression

*Tympan Sheet* A sheet of paper, the same that a work is printed on laid upon the tympan and fastened to it at the corners with paste, it is the guide on which the sheets to be printed are laid by which means the margin is kept regular and uniform

*Wetting Trough* Two troughs joined together and lined with lead, one deep containing the water, the other shallow of sufficient size to contain a paper board The paper is wetted for printing by drawing it through the water and opening it out on the board

PRINTING INK A composition with which the face of types and engravings in relief are coated previous to obtaining an impression from them it is made of different colours but books and the generality of printing, are executed with black ink Its composition generally speaking is linseed oil boiled to varnish with colouring matter added to it The preparation of this article was long kept a profound secret by the few manufacturers of it in England who completely monopolized the trade, till Mr W Savage published a treatise on the subject in which he gave the process in detail for making printing ink of every quality and colour which may be consulted with advantage by those who are interested in the subject

PRIOR, PRIORESS (Lat) The heads of certain convents of monks or nuns which are thence denominated *priories* the prior is inferior in dignity to the abbot

PRISCILLIANISTS In Ecclesiastical History, heretics of the 4th century, so named from Priscillian, bishop of Avila in Spain, who was put to death in A D 382 by Maximus tyrant of Gaul, for heresy on the accusation of another bishop, Ithacius one of the earliest instances of persecution to death for that offence The opinions of Priscillian and his followers are said to have been Manichæan but it is remarkable that Sulp Severus, himself sufficiently zealous against their doctrines admits that their persecutor Ithacius was a man of disreputable character and that purity and austerity of manners were often sufficient with him to ground an accusation of Priscillianism This affords a curious parallel with the history of the 12th and 13th centuries, when accusations of Manicheism were liberally brought against sectaries whose avowed tenets extended only to the reformation of ecclesiastical matters and denial of the church's authority (See *Mosheim* cent iv part 2)

PRISM In Geometry a solid contained by planes of which two that are opposite are equal, similar, and parallel and all the rest parallelograms Prisms take particular names from the figures of their ends, or opposite equal and parallel sides When the ends are triangles, they are called triangular prisms, when the ends are square square prisms, when the ends are pentagonal, pentagonal prisms, and so on *A right* prism has its sides perpendicular to its ends; an *oblique* prism is that of which the sides are oblique to the ends The solid content of a prism is found by multiplying the area of the base into the perpendicular altitude, hence all prisms are to one another in the ratio compounded of their bases and altitudes

PRISM In Dioptrics a piece of glass or other diaphanous substance, in form of a triangular prism employed to separate a ray of light into its constituent parts or colours by refraction The prism is the instrument by means of which most of the remarkable phenomena of

light and colours are exhibited. *See* CHROMATICS, OPTICS, [illegible]

PRISMATIC COLOURS The colours produced by de[illegible] *See* PRIMARY COLOURS

PRISMATIC COMPASS A surveying instrument, much used on account of its convenient size and form in military sketching and for filling up the details of a map where great accuracy is not required The construction is as follows — The compass-card divided into degrees and minutes, is attached to the needle and turns with it On one side of the compass-box stands a perpendicular slip, called the sight-vane, having a long narrow perpendicular slit in it, along the middle of which a fine thread is stretched On one side of the box opposite to the sight-vane, there is a prism, through which and through the sight-vane an object is observed and bisected by the thread The use of the prism is this — the rays of light passing from the thread to the eye are refracted in passing through the prism so that the thread appears to be prolonged and to intersect the circle on the card on which the divisions are, [illegible] any object which [illegible] diately by the division with which the thread coincides The angle between two stations is thus obtained being equal when the stations are on opposite sides of the meridian to the sum of their azimuths and to the difference of the azimuths when they are on the same side of the meridian The card is divided to 15′ of a degree which is, perhaps, a smaller angle than can be measured by this instrument (See *Simms's Treatise on Mathematical Instruments*)

PRISMOID An imperfect prism a figure resembling a prism, but not answering exactly to the definition

PRISON (Fr prendre *to take*) Imprisonment is used in most civilized states for three purposes for safe custody of persons charged with offences for the detention of debtors and for punishment under which latter head the reformation of prisoners must be comprehended as being properly only an adjunct to punishment The first principles of order seem to require that these three classes of prisoners should be kept entirely distinct and if possible in separate places of confinement but even the former rule has been generally very imperfectly observed while the latter is in most places impracticable by reason of expense The alleviation of the horrors of imprisonment by physical improvement of the condition of prisoners and the imparting of religious instruction has been from very early times an object with philanthropists but the adaptation of imprisonment to serve the end of punishment has been comparatively speaking only very recently attempted The Society of the Brothers of Mercy in Italy paid much attention to the former subject in the 15th and 16th centuries and the names of S Carlo Borromeo and St Vincent de Paule have derived from it much of their lustre But the earliest instance of a prison managed on any principles of policy and humanity seems to be that of the Penitentiary at Amsterdam erected in 1595 an example which was soon followed by some of the German towns especially Hamburg and Bremen In England it is well known that the impulse of prison improvement was first communicated by the celebrated Howard whose sufferings when taken by a privateer and imprisoned at Brest during the seven years' war, are said to have first directed his attention to the subject The fruits of his observations, in his repeated visits to most of the prisons of Europe, were given to the world partly in his publications and partly on examination before a committee of the House of Commons in 1774 To his suggestions and those of Jonas Hanway are principally owing the provisions of the 19 G 3 c 74 (passed in 1778) truly called the basis of succeeding legislation on the subject Solitary imprisonment was then first instituted The works of Neild and others, and the labours of the Prison Discipline Society (founded we believe chiefly by Mr Fowell Buxton) kept the attention of the public fixed on the subject In 1813 the construction of the Millbank Penitentiary was begun intended as a species of model prison but that establishment, from many errors committed in its foundation and first management, was long before it answered in any degree the views of its projectors Meanwhile practical improvement had proceeded much further in the United States of America where the experiments of solitary confinement and of association in silence were both first instituted on any extensive scale, and have formed the basis of two different systems which now divide the suffrages of observers Europe has in this matter taken lessons from America, and the reports of French visiters (Messrs Beaumont and De Tocqueville, 1834, Messrs De Metz and Blouet sent by government, 1837) of Dr Julius, sent from Prussia, and Mr Crawford from England, have contributed largely to the present state of public opinion on the subject In 1834 inspectors were appointed to report annually on the state of English and Scottish prisons, — a measure which had been earlier adopted with reference to Ireland, and their reports may be consulted with great advantage, both with a view to [illegible] prisons and their prospective reform [illegible] Report of the English Inspector for the Home District" [illegible] particularly valuable from the historical sketch it [illegible] and from [illegible] comparison there instituted between the separate and the silent systems The chief heads of improvement in prison discipline which have been recommended or introduced since public attention was called to the subject are, 1 Inspection and control, 2 Classification, 3 Separate or solitary punishment, 4 The "silent" or non-intercourse system, 5 The introduction of labour, 6 Religious and intellectual instruction — 1 The first of these is matter rather of practical than theoretical development The history of the [illegible] principles urged by General Bentham and his [illegible], the phenomenon which has formed, to a certain extent, the basis of later experiments, is mentioned under the head PENITENTIARY 2 Classification, under the English gaol acts of 1823 and 1824, has been extensively introduced into prisons It is of course a great improvement on the indiscriminate mixture of prisoners of all classes and characters which formerly prevailed, but as a means of reformation, or of punishment it has not answered the views once entertained of it And the reason is obvious the only object of classification is the exclusion of the moral influence of more or less corrupted minds, but by no system of classification (and as many as fifteen classes have been introduced in some prisons) can this be excluded In every class, whether arranged according to age or degree of offence, or in any other practicable mode there will probably be some unusually depraved characters, and then the experiment must fail The only perfect classification is that which constitutes the basis of, 3 The *separate* system, namely the entire separation of prisoners from each other in solitary cells When this has been carried to excess as a means of punishment, namely, seclusion by day and by night without labour, without employment, with only the occasional silent visits of the turnkey or the medical attendant it has generally proved more than human nature can bear, at least for any time, but separate confinement *with* labour as an alleviation, and with occasional visits for religious consolation and instruction, is a very different mode of treatment The separate system is that established in the great eastern penitentiary of Philadelphia now in operation for ten or eleven years, and in that of Glasgow, — which may be mentioned as models in their kind 4 The difficulty of enforcing solitary confinement, in some American prisons, seems to have led to the adoption of the *silent* system of which the prison at Auburn in Pennsylvania, affords the most celebrated instance The prisoners work together in the day but are prevented from all communication at night they are separate It was we believe, introduced several years ago in the Maison de Force at Ghent In England it is in operation at Coldbath Fields, Wakefield, and elsewhere With respect to the comparative advantages of the two systems the work of Messrs Beaumont and De Tocqueville may be consulted for an impartial summary of evidence without the expression of decided opinion (Part I chap ii s 3) The 'separate" was recommended in 1832 by the committee on secondary punishments and is advocated by Mr Crauford, in his *Report on the Penitentiaries of the U S* 1837 and in the 4th Report above alluded to by Dr Julius, by Messrs De Metz and Blouet and by M Moreau Christophe in various works The silent system seems to be supported by M Lucas, *De la Reforme des Prisons*, 1836 while in his *Theorie del Emprisonnement* he attempts to reconcile the two by Messrs Berenger and Gasparin, and by Mr Inspector Williams (4th Report England, Northern and Eastern Division) The chief objections to the separate system are, — 1 As a punishment, its inequality, being felt far more severely by some than others, but to this it may be answered that those who do feel it are precisely those whom it is most desirable to affect — the more depraved 2 Its effects on the mind and passions in some respects, a very difficult and delicate subject, and by far the most serious charge against it 3 That even as a system of reform, for which in subjects presenting any prospect of amendment, it is best calculated, it is utterly useless in short terms of imprisonment "Those best acquainted with the subject in the U S," says Mr Williams conceive that two years' imprisonment are required before any impression can be made and from four to six years to achieve the work of reformation" To the silent system its enemies object, — 1 The extreme difficulty of carrying it into successful operation 2 Its supposed effect in irritating, degrading and even brutalizing the minds of prisoners by its vexatious discipline They appeal in support of this position to the quantity of punishment (corporal or by solitary confinement) which is required to carry it into effect In Wakefield and Coldbath Fields upon this system, [illegible] punishments were inflicted on 13 188 prisoners, or two on each on the average while in all England the proportion was found to be [illegible] punishments to 101 195 prisoners or one to two only But this is explained in some degree, in the

latter prison at least, by the number of short imprisonments & With respect to the introduction of *labour* into prisons of punishment, the chief question seems to be, w e p ' part of the punishment, and be , a ' ' severe nature, or whether it should be used as an alleviation to the rigour of separate confinement, as a ' ' '

ase there are 5 chances in all, 3 of which are in favour of a white ball, and 2 in favour of a black The probability of drawing at the first trial any particular ball will evidently be represented by the fraction $\frac{1}{5}$, hence the probability of drawing a white ball is $\frac{3}{5}$, and the probability of drawing a black ball $\frac{2}{5}$ Now it is obvious that he absolute number of balls in the urn will not affect the elative probabilities, so long as the proportion of white to black balls remains unaltered Suppose, for example, the number of balls increased to 50, of which 30 are white and 20 black; the probability of drawing a white ball at he first trial must still remain the same, there being always 3 chances in favour of a white ball for every 2 in avour of a black Whatever, therefore, the number of balls in the urn may be, the probability of drawing one of a particular colour must remain the same, so long as he ratio of the number of balls of that colour to the whole number in the urn remains unaltered Hence, we derive the following definition, which is, in fact, the basis of the whole doctrine of probabilities —

The probability of the occurrence of any event is measured by a fraction, the numerator of which expresses he number of chances favourable to the occurrence of the event, and the denominator the whole number of chances avourable and unfavourable

This fraction is called the mathematical probability t is important to remark, that all the chances are considered as equal, for example, that, in drawing a ball rom the urn, any one ball has the same chance of being drawn as any other

Every contingent event gives rise to two opposite probabilities,—one that the event will happen, the other hat it will not, and the sum of these probabilities is always equal to unity Thus in the preceding example he probability that a white ball will be drawn from the urn is $\frac{3}{5}$ and the probability that a black ball will be drawn i e that a white ball will *not* be drawn) is $\frac{2}{5}$, and $\frac{3}{5} + \frac{2}{5} = \frac{5}{5} = 1$ In general, let $m$ denote the number of chances avourable to an event and $n$ the number of unfavourable hances, then the whole number of chances or ways in which the event can happen or fail, being $m + n$, the probability that the event will happen is $\frac{m}{m+n}$, the probability that it will not happen $\frac{n}{m+n}$, and the sum of these probabilities is 1 Hence if $p$ denote the probability of he occurrence of any event the probability that it will not occur is $1 - p$ For instance let $p$ = the probability hat an individual of a given age will live over one year, hen $1 - p$ is the probability that he will *not* live over the ear or that he will be dead within the year As the individual must either be alive or dead the sum of the probabilities must necessarily amount to *certainty* which s represented by *unity* and hence the probability of any ontingent event is always a fraction less than unity

*Probability of simultaneous Events* — The probability f the simultaneous occurrence of several independent vents is calculated as follows — Let it be required for xample to determine the probability of throwing aces ith two dice Let the dice be called respectively A and B The probability that A will turn up ace is $\frac{1}{6}$ and if a erson were to purchase the chance of receiving a sum f 36*l* on the occurrence of this event alone the proper um he ought to pay for the chance is 6*l* But if the um is to be received only on condition of A and B both urning up ace the above probability will only be beneficial o him provided B also turns up ace Now the probaility of this event is likewise $\frac{1}{6}$ therefore, the probability f receiving the sum is $\frac{1}{6}$ of $\frac{1}{6}$ that is $\frac{1}{36}$ and the price to e paid for the chance is $\frac{1}{6}$ of 6*l*, that is, 1*l*

The same reasoning may be applied to any number f independent events, and the conclusion which is perfectly general may be expressed in the following terms —

The probability of the occurrence of several independent vents is obtained by multiplying together their separate robabilities" Thus let $p$ denote the probability of an vent A, $q$ that of an event B $r$ that of an event C &c, hen the probability of the joint occurrence of those vents is expressed by the continued product $p\,q\,r$ &c

*Probability of successive Events* — The probability of he successive recurrence of the same or different events s determined precisely in the same manner For example, let the probability be required of throwing ace wice successively with the same die The probability f ace turning up at the first throw is $\frac{1}{6}$, and at the second $\frac{1}{6}$, the probability of ace turning up at both throws s therefore $\frac{1}{6}$ of $\frac{1}{6} = \frac{1}{36}$ Hence the probability that ace will not turn up *both* at the first and second throw s $1 - \frac{1}{36} = \frac{35}{36}$ This last probability, it is necessary to emark, is quite distinct from the probability that ace will not turn up in either throw, and which is found hus — The probability that ace will *not* be thrown at the first throw is $\frac{5}{6}$, and the probability that it will not be thrown at the second also $\frac{5}{6}$ hence, by the former rule, the probability that it will not be thrown at either throw is $\frac{5}{6} \times \frac{5}{6} = \frac{25}{36}$ This added to $\frac{1}{36}$, the probability that ace will be thrown both times, does not give the sum equal to unity, for there are still two cases to be taken account of Ace may be thrown at the first throw, and not at the second, or ace may not be thrown at the first throw, but thrown at the second The probability that ace will turn up at the first throw is $\frac{1}{6}$, and that it will not turn up at the second throw $\frac{5}{6}$, hence the probability that it will turn up at the first, and not at the second, is $\frac{1}{6} \times \frac{5}{6} = \frac{5}{36}$ The probability that it will not turn at the first, but turn up at the second, is $\frac{5}{6} \times \frac{1}{6} = \frac{5}{36}$, and the sum of these added to the sum of the probabilities of the two former cases, gives a result equal to unity A distinct enumeration of the different suppositions that may be made relative to the ace point, in two successive throws of the same die will render this reasoning more obvious The event [illegible] ur ways, which, with their r[illegible] a follows —

1 Ace at both throws, probability $= \frac{1}{36}$
2 Ace at neither throw, probability $= \frac{25}{36}$
3 Ace at first, not at second probability $= \frac{5}{36}$
4 Ace at second not at first, probability $= \frac{5}{36}$

And the sum of these fractions is $\frac{36}{36} = 1$

This reasoning may be rendered general Suppose $m$ = the number of white balls in an urn and $n$ = the number of black balls in the same urn, and that when a ball has been drawn it is immediately replaced in the urn, so that at each trial the whole number of chances is $m + n$ Let $p$ = the probability of drawing a white ball on any trial, and $q$ = the probability of drawing a black ball, we have then $p = \frac{m}{m+n}$ and $q = \frac{n}{m+n}$ And first let us consider the probabilities of the different possible events that may happen on two trials

The only possible ways in which the balls can be drawn in two successive trials are these four —

1 First white second white probability $= p \times p = p^2$,
2 First white second black, probability $= p \times q = pq$,
3 First black second white, probability $= q \times p = pq$,
4 First black, second black, probability $= q \times q = q^2$

Adding together these probabilities we get

$$p^2 + 2pq + q^2 = (p + q),$$

and the sum is equal to unity as will be evident by substituting for $p$ and $q$ their values in terms of $m$ and $n$

It thus appears that the probabilities of all the different combinations that can be formed in two trials are respectively given by the development of the binomial $(p + q)$ It will be observed that the term $2pq$ gives the probability of drawing a ball of each colour in the two trials without distinction of order, that is the white ball may be drawn either at the first or second trial

Now let the number of trials instead of being two, be increased to any number $u$, the probabilities of the different combinations will be given by the development of the binomial $(p + q)^u$ This development is

$$p^u + \frac{u}{1} p^{u-1} q + \frac{u(u-1)}{1\,2} p^{u-2} q^2 + \frac{u(u-1)(u-2)}{1\,2\,3} \cdots \frac{(u-v+1)}{v} p^{u-v} q^v + \&c$$

The first term $p^u$ indicates the probability of drawing a white ball in each of the $u$ trials, or that all the balls drawn will be white The second term $u\,p^{u-1} q$ denotes the probability of drawing $u - 1$ white balls and one black ball in $u$ trials without regard to the order, that is to say the black ball may be drawn at the first second, third, or any other trial The general term

$$\frac{u(u-1)(u-2)\cdots(u-v+1)}{1\,2\,3\cdots v} p^{u-v} q^v$$

gives the probability that in $u$ trials $u - v$ white balls will be drawn and $v$ black balls without distinction of order If the probability of drawing the ball in a determinate order of succession were required, for instance, if it were required to determine the probability of drawing $u - v$ white balls successively and then $v$ black balls; the coefficient of the term must be suppressed, and the probability becomes $p^{u-v} q^v$

The practical question that most frequently arises is, not to determine the probabilities of the repetitions of an event in any precise order but the probability that the number of repetitions will exceed or not exceed a certain limit Thus in the preceding example suppose it were required to assign the probability that not fewer than $u - v$ white balls will be drawn in $u$ trials, it is evident that as the first term gives the probability of drawing $u$ white balls, the second term that of drawing

$u - 1$ white balls, and so on, and as each of these combinations satisfies the condition, the required probability will be found by taking the sum of all the terms of the development of $(p + q)^u$ from the first to that in which the factor $p^{u-v} q^v$ appears, both inclusive As an example, let it be required to determine the probability of throwing ace at least *twice* in four throws of the same die Here we have $p = \frac{1}{6}$, $q = \frac{5}{6}$, $u = 4$, and $u - v = 2$, whence $v = 2$ Now the development of $(p + q)^4$ to the term in which $p^2 q^2$ occurs is $p^4 + 4 p^3 q + 6 p^2 q^2$, which, on substituting for $p$ and $q$ their values, becomes $(\frac{1}{6})^4 + 4 (\frac{1}{6})^3 \times \frac{5}{6} + 6 (\frac{1}{6})^2 \times (\frac{5}{6})^2 = \frac{171}{1296}$ = between $\frac{1}{7}$ and $\frac{1}{8}$

Again suppose the question were to assign the probability of throwing ace at least three times in four trials we should have $u - v = 1$ and therefore $v = 3$ Now the term of the development of $(p + q)^4$ in which $p q^3$ occurs is the fourth, or last but one, the sum of the first four terms therefore, gives the required probability But the calculation of this sum is easy, for, since the sum of all the terms is $(p + q)^4 = 1$, and the last term is $q^4$, the sum of the first four is $1 - q^4 = 1 - (\frac{5}{6})^4 = 1 - \frac{525}{1296} = \frac{671}{1296}$

*Probability derived from Experience* — In what precedes it has been supposed that the number of ways in which an event can arrive are known *a priori*, but it may happen and indeed does happen in the greater number of the most important questions to which the calculus of probabilities is applied that the number of chances favourable and unfavourable to the occurrence of any particular event is unknown and that the ratio of the one to the other can only be inferred from considering the ways in which the event has been observed already to happen Recurring to the case of the urn — let us suppose the urn to contain a certain number of balls of different colours, but that the number of each colour is unknown and that from having observed the result of several trials, we have to determine the probability of drawing a ball of a particular colour at the next trial The method of proceeding is as follows — Taking a simple case, suppose the urn to contain only four balls of two colours white and black and that on four successive trials (the ball drawn being in each case replaced in the urn) three white balls and one black have been drawn Three hypotheses may be formed respecting the number of balls of each colour in the urn and if $p =$ the probability of drawing a white ball and $q =$ that of drawing a black ball, on any hypothesis the three hypotheses with the corresponding values of $p$ and $q$, will be as under, viz —

1 3 white, 1 black $p = \frac{3}{4}$ $q = \frac{1}{4}$,
2 2 white 2 black $p = \frac{2}{4}$ $q = \frac{2}{4}$,
3 1 white, 3 black, $p = \frac{1}{4}$ $q = \frac{3}{4}$

Now, on calculating from each of these hypotheses the probability of the event observed namely of drawing three white balls and one black in four trials which probability, by what was shown above, is expressed by $4 p^3 q$, we have,

by 1st hypothesis, $4 p^3 q = \frac{27}{64}$
by 2d hypothesis, $4 p^3 q = \frac{16}{64}$,
by 3d hypothesis, $4 p^3 q = \frac{3}{64}$

The numerators of these fractions, which represent the relative probabilities of the event which has happened on each of the hypotheses, may be considered as giving the relative probabilities of the hypotheses as to the causes of the event, or to the state of the urn by which the event was determined, and, as one or other of these hypotheses must necessarily be true, the sum of their probabilities must be unity, whence the probability of each hypothesis is respectively

$$\frac{27}{46}, \frac{16}{46}, \frac{3}{46}$$

This result may be expressed generally as follows — The probabilities of the different hypotheses are found by dividing the probability of the event which has been observed calculated according to each hypothesis by the sum of its probabilities calculated on all the hypotheses

Now, in order to find the probability of drawing a white ball at the next trial we may reason in this manner — If the first hypothesis be true, the chance of drawing a white ball is $\frac{3}{4}$, and the probability of the hypothesis being true is $\frac{27}{46}$, therefore the compound probability of both hypothesis and event is $\frac{3}{4} \times \frac{27}{46} = \frac{81}{184}$ If the second hypothesis be true, the probability of drawing a white ball is $\frac{2}{4}$, and the probability of the hypothesis is $\frac{16}{46}$, therefore the compound probability is $\frac{2}{4} \times \frac{16}{46} = \frac{32}{184}$ If the third hypothesis be true, the chance of drawing a white ball is $\frac{1}{4}$, and the probability of the hypothesis is $\frac{3}{46}$, therefore the joint probability of the hypothesis being true and of the event arising is $\frac{1}{4} \times \frac{3}{46} = \frac{3}{184}$ Adding together these partial probabilities, the whole probability of drawing a white ball at a future trial is $\frac{81}{184} + \frac{32}{184} + \frac{3}{184} = \frac{116}{184}$

In like manner, the probability of drawing a black ball at a future trial is

$$\frac{1}{4} \times \frac{27}{46} + \frac{2}{4} \times \frac{16}{46} + \frac{3}{4} \times \frac{3}{46} = \frac{68}{184}.$$

And the sum of the two probabilities is 1, as it ought to be since the ball must necessarily be white or black

The method of proceeding which has been followed in this particular case [illegible] cases where it is required to determine the probability of future events depending on causes not known *à priori*, but only inferred from experience It may be stated generally as follows — Let $c$, $c'$, $c''$, $c'''$, &c be so many independent causes (or hypotheses), each of which may give rise to an event E and let the probabilities of the existence of these causes be respectively $h$, $h'$, $h''$, $h'''$, &c, and those of the events calculated according to each hypothesis $p$, $p'$ $p''$ $p'''$, &c then the probabilities of the event E is $h p + h' p' + h'' p'' + h''' p'''$ + &c

The preceding examples will suffice to give some idea of the manner in which the probability of the occurrence or failure of events depending on chance is submitted to numerical estimation, but for the methods of applying the calculus in particular cases, and especially when the formulæ involve high numbers, and the ordinary processes of arithmetic become unavailable, reference must be made to works specially devoted to the subject, a list of which is given at the end of this article

The calculus of probabilities had its origin in the speculations of Pascal Fermat Huygens and other eminent mathematicians of the 17th century It was first applied to the solution of questions connected with games of chance but it has since by the researches of James Bernoulli, Montmort, Demoivre D Alembert, Simpson Condorcet Lagrange La Place Poisson, and others become one of the most interesting branches of mathematics and been applied with equal success and advantage to numerous [illegible] cations is to the subject of annuities assurances reversions and other interests depending on the average duration of human life and the expectation of the continuance or survivorship of lives of given ages (See ANNUITY, EXPECTATION OF LIFE) Another important application is to determine the most probable *mean* or average of a great number of observations and hence its utility in many cases of practical astronomy and general physics (See PROBABLE ERROR) Condorcet has applied it to determine the value of testimony the verdicts of juries, and the best mode of constituting tribunals and of collecting votes in elections In such applications it is true assumptions more or less arbitrary must be admitted and great uncertainty will always attach to results which are influenced by human will or caprice, nevertheless the knowledge derived from an accurate and systematic analysis of the circumstances concerned, and of the consequences of their various combinations, affords important aid in guiding our judgments, and may be of great use in the practical affairs of life

The following are the principal works on the subject — Montmort *Analyse des Jeux de Hasard* (1st edit 1708, 2d 1713), Bernoulli, *Ars Conjectandi* 1713, De Moivre, *Doctrine of Chances* (1st edit 1718, 3d, greatly enlarged, 1756), Simpson *Laws of Chance*, 1740, Condorcet, *Essai sur l'Application de l'Analyse à la Probabilité des Decisions rendues à la Pluralité des Voix* 1785, La Place, *Theorie Analytique des Probabilités* 3d edit 1820, Poisson *Recherches sur la Probabilité des Jugemens*, 1837, the article in the *Encyc Metropol* by Professor De Morgan and that in the *Encyc Brit* by Mr Galloway (which is published separately) For elementary works the reader may be referred to *Simpson's Laws of Chance*, and *Lacroix's Traité Elémentaire*, &c, and for an explanation of the objects and results of the science without mathematical investigation to Professor De Morgan's *Essay on Probabilities and on their Application to Life Contingencies and Insurance Offices*, in the *Cabinet Cyclopædia*

PROBABLE ERROR In Astronomy and Physics, when the value of any quantity or element, as the declination of a star, the latitude of a place, the specific gravity of a body, &c has been determined by means of a number of independent observations, each liable to a small amount of error the determination (in whatever way it may have been deduced from the observations) will also be liable to some uncertainty, and the *probable error* is the quantity, which is such that there is the same probability of the difference between the determination and the true absolute value of the thing to be determined exceeding or falling short of it Thus, if twenty measurements of an angle have been made with the theodolite and the arithmetical mean or average of the whole gives 50° 27′ 15″; and if it be an equal wager that the

rror of this result (either in excess or defect) is less
an 2 seconds, or greater than 2 seconds, then the pro-
able error of the determination is 2 seconds The me-
od of computing the probable error which is deduced
m the theory of probability is as follows — Let $l$, $l'$, $l''$ &c be the *observed* values, $h$ the number of observations, $m$ the average value (*i e* the sum of the observed values divided by number of observations), then if we call $l - m$ the error of the observation $l$, and $\Sigma (l-m)^2$ the sum of the squares of the errors of all the observations,

he probable error is $.674489 \times \frac{\sqrt{\Sigma (l-m)^2}}{h}$, that is, the

quare root of the sum of the squares of the errors, di-
ded by the number of observations, and multiplied by
he decimal .674489

It is frequently convenient to compute the probable error of a result from another function, which is called he *weight* The weight is the square of the number of bservations divided by *twice* the sum of the squares of he errors, and the probable error is .476936 divided by he square root of the weight This definition agrees ith the former, for $.674489 = .476936 \times \sqrt{2}$

PROBANG A flexible piece of whalebone with a ball f sponge attached to its extremity, for the purpose of

PROBATE OF TESTAMENTS In Law, the exhibiting and proving wills and testaments before the ecclesiastical judge delegated by the ordinary of the place here the party dies It is done by granting letters testamentary to the executor under seal of the court, and uch probate is evidence in questions relating to the personal estates

PROBE (Lat probo, *I try*) A surgical instrument enerally made of silver wire rounded at one end and ointed at the other, for the purpose of examining ounds

PRO'BLEM In Geometry a proposition requiring me operation to be performed or construction to be ecuted, such as to bisect a line, to describe a circle assing through three given points

quires some unknown truth to be
overed and demonstrated

PROBOSCI'DIANS *Proboscidia* (Lat proboscis *a unk*) The name of a family of Pachydermatous Mamals including those which have the nose prolonged to a prehensile trunk or proboscis, as the elephant and astodon

PROBO'SCIS, in Mammalogy signifies the prehenle organ formed by a prolongation of the nose of which e trunk of the elephant is an example In Entomogy the oral instrument of the Diptera is so called in hich the ordinary trophi are replaced by an exarticulate sheath terminated by a pair of tumid lobes abella) and containing one or more lancet shaped struments (scapella), covered by a valve In Malology, the same term is applied to the tongue of certain astropods, when it is so long as to be capable of being otruded for some distance from the mouth, in which se it is generally organized at the extremity for the rpose of boring the shells of other testacea and of

soft parts of the inhabitant

PROCEDENDO *Procedendo in Loquela*) A writ hich lies where an action has been removed from an inrior to a superior jurisdiction, and it does not appear to e court that the suggestion on which the removal ok place was sufficiently proved to send the cause back the inferior court for further proceeding

*Procedendo ad Judicium* A writ which issues out of the urt of chancery, commanding inferior courts to proceed judgment where it has been unjustly delayed

PROCELLA'RIA (Lat procella, *a storm*) A Linean genus of web footed birds, now the type of a family the *Longipennate Palmipedes* in the system of Cuvier, haracterized by the beak being hooked at the tip with a extremity appearing as though a piece had been articulated to the rest, the nostrils are united to form a ube, which lies along the back of the upper mandible, nd their feet instead of a back toe have merely a claw nplanted in the heel Those species in which the lower andible is truncated belong to the true *Procellaria* ome smaller species with a shorter bill rather longer gs, and black plumage, commonly called *Storm-birds*, r *Mother Carey's chickens*, are associated under the eneric name *Thalassidroma* The *Procellariæ* range ver the high seas at the greatest distance from land Their name of *Petrel*, which is a diminutive of *Peter*, as been applied to them from their habit of walking on e waves, which they do with the assistance of their

PROCESS In the Common Law, used in two senses to signify the whole proceedings n an action or prosecution, and to signify the means hereby the defendant in an action is compelled to appear in court When actions were commenced by original rit (*see* PLEADING), original *process* was that which as founded on that writ, commencing with notice, writ of attachment, &c. *Mesne*, or intermediate process, was, properly speaking, such process as issued pending the writ on some collateral or interlocutory matter, as to summon juries or witnesses But in popular language it was taken to signify the whole process, from the commencement of the suit, before the final process which ended it Thus a defendant was said to be arrested on *mesne* process, *i e* on a writ of capias issued *pending* the suit This was done originally when the defendant,

writ of capias
to which
the term mesne process was still, inaccurately, applied The term mesne process is now commonly applied to the writ of summons, which is the instrument now in use for commencing personal actions Thus the popular inaccuracy of language is retained Final process is the writ of execution used to carry the judgment into effect In ordinary language, the regular proceedings of every court of judicature in a suit are called its process

PROCÈS VERBAL In the language of French jurisprudence, an authentic written minute or report of an official act or proceeding, or statement of facts The

power of issuing proclamations is a branch of the king's prerogative, and vested in him alone They have a binding force on the subject, in so far as they are grounded on and enforce the laws of the realm They may be said to be of two sorts the one, enforcing an actually existing law by giving it a particular application to time place and circumstance, the other an exertion of any power vested in the king, which until so exercised is dormant as a proclamation to prohibit any subject from leaving the realm during a certain time Proclamations must be under the great seal By 31 H 8 c 8 it was enacted that the king's proclamations should have the force of law, an enactment which while it subsisted did, in effect, make a complete revolution in the government of this country It was, however, repealed five years afterwards by 1 E 6 c 12 Nevertheless, in later times, it was held by crown lawyers, that the king might suspend or dispense with an existing law in favour of particular circumstances But by 1 W & M stat 2 c 2 it is declared that no such power exists

PROCONSUL Originally an officer invested with consular command without the office Thus, a consul sometimes had his command prolonged to him after his year of magistracy had ceased, with the title of proconsul The provinces which at first were governed by prætors were for the most part, subsequently put under *proconsuls* and *propraetors* who were at first especially appointed at the Comitia Tributa, but afterwards by the Sempronean law entered on their provincial jurisdictions forthwith, on the expiration of their year of consulship or prætorship The office was properly annual, but it might be prolonged, as was done in the case of Cæsar In the time of the republic the proconsul held the military command as well as the civil jurisdiction of his province, and accordingly had about him a large staff of officers as the lieutenants or legati prætects &c But Augustus, on assuming the chief power in the state, remodelled the system by a new partition of the provinces and by separating the civil jurisdiction, which was left the proconsul, from the military command Under the emperors, the proconsuls and propraetors were thus distinguished, the former being appointed to the provinces under the especial superintendence of the senate, the latter to those which the emperor held

PROCRUSTES In Mythology, a famous robber of ancient Greece who tortured his victims by placing them on an iron bed, which their stature was made to fit by stretching or mutilating them so as to suit its dimensions, whence the well-known the *bed of Procrustes* He was Hermione in Argolis More correct recent critic (Bottiger), Procrustes, Sinis Phalæ mptes, &c were all different names for one real or fabulous robber, derived from the different kinds of violence applied by him to travellers

PROCTOR (Lat procurator) In Ecclesiastical Law, he who undertakes for his ecclesiastical or civil court, under 3 G 3 c 127, exercising the same office which is performed by attorneys and solicitors in courts of common law and equity

PROCTORS In the English Universities, both at Oxford and Cambridge, two masters of arts are appointed annually Each college, in both, nominates a proctor in rotation, according to a cycle of years drawn up, on mathematical principles, to suit the number of fellows on the foundation of each The proctors are officers of considerable importance, being, in the first place, the chief police magistrates for the time being of each

university They, with their deputies the pro-proctors, have power not only to enforce the rules of academical discipline on the students but also an extensive summary authority over the townspeople, according to the special privileges of the [illegible] y also have, in both universities [illegible] hority as assistants to the [illegible] votes in the election of many [illegible] be masters of arts, and their [illegible] [illegible]

**P[illegible]** (Lat pro *for* and cura *care*) A Roman provincial [illegible] the affairs of the revenue [illegible] in matters pertaining to it [illegible] charged the office of govern[illegible] vince, as did Pont[illegible] P[illegible] in Judæa, in which case, but not otherwise he had the power of inflicting capital punishment This magistracy did not exist under the republic, its duties being comprised under those of the prætor or proconsul, but was instituted by Augustus They were called *Procuratores Cæsaris*, to distinguish them from the common procurator, who was merely an agent employed by private persons to manage their affairs in their absence when an action was brought against them

**Procurator**, *Procureur*, &c In the Civil Jurisprudence, one who undertakes the care of any legal proceeding for another and stands in his place by virtue of a power or *procuration* from him A *mandatory* is said to differ from a *procurator* in that the latter acts only by virtue of an express written instrument In France before the revolution the procureurs (procuratores ad lites) were officers legally empowered to carry on suits on behalf of clients This body was abolished in 1791 and that of *avoues* substituted in its place The *procureurs du roi*, in France are officers of whom one is appointed to every tribunal of arrondissement, together with a sufficient number of 'substitutes"

**PROCUREUR GENERAL** The public advocate of the crown in France Every *parlement* or *cour souveraine* had, before the Revolution a *procureur-general* attached to it Under the present system of judicature one of these officers is established in every *cour royale* for the criminal [illegible] him in [illegible] court The p[illegible] accusers in the interior courts of assize and *premiere instance* are termed respectively *procureurs criminels* and *procureurs du roi* These officers are charged with the conduct of all criminal proceedings on behalf of the prosecution, and are placed under the immediate control of the minister of justice

**PRO'DIGY** (of very doubtful etymology) in ordinary modern language signifies a surprising though natural event, in contradistinction to *miracle* which is something out of the course of nature Among the Romans however, any extraordinary event or appearance to which from insufficient acquaintance with natural history they could not assign a cause was termed a *prodigy* and regarded as a supernatural event indicative of favourable or (more generally) of unfavourable dispositions of their gods Hence the number of recorded prodigies many evidently false some real but misunderstood, which Livy has inserted in his annals

**PRO'DOMUS** (Gr προ, and δομος, *house*) In Ancient Architecture the portico before the entrance of the cella of a temple, the same as *pronaos* See Naos

**PRO'DUCT**, in Arithmetic and Al[illegible] result of, or quantity produced by the [illegible] of one number by another, or a quantity of any kind by a number See Multiplication

**PRODU'CTA** An extinct genus of fossil bivalve shells closely allied to the living genus *Terebratula* They only occur in the older secondary rocks

**PRO'EM** (Gr προ ειμι *I go before*) A term formerly used for *preface*, which see

**PROEMPTO'SIS** (Gr προ *before*, and εμπιπτω *I fall upon*) The term applied to the lunar equation or addition of a day to prevent the new moon happening too soon, which must be effected by the addition of a day every 330 years and another every 2400 The opposite term is *metemptosis*, which is used to signify the solar equation necessary to prevent the new moon from falling a day too late [illegible] the [illegible] of the [illegible]sextile every 134 years

**PROF[illegible]** [illegible] title, in all universities [illegible] achers in the various faculties In the origin of those institutions the degrees conferred on students were in fact, licences to commence as public teachers, and the terms master doctor and professor seem to have been used indifferently But as in process of time the great body of graduates ceased, in most of them, to have any concern in public instruction, a separate body of recognized teachers gradually arose, endowed in some instances with salaries, in others paid by fees These were the professors But in those universities in which collegiate foundations prevailed, as in Oxford [illegible] into a secondary situatio[illegible] instruction was transacted and still continues to be so, by the functionaries of the several colleges The professors therefore, and the instruction which they convey by lectures, have become only auxiliaries, instead of principals, and attendance on their lectures is in few cases compulsory On the other hand, in universities destitute or nearly so of collegiate endowments (as those of Scotland, Germany, and others founded on the German model), the professors have become at once the governing body of the university, and the sole recognized functionaries for the purpose of education

**PROFI'LE** (Fr profil) In Architecture, the contour of the different parts of an order

**Profile** In the Fine Arts, an outline of the principal parts of an object, free from all fore-shortening, showing their real projections indentations, &c

**PRO'FIT** (Fr profit), in Political Economy, means the advantage or gain resulting to the owner of capital from its employment in industrious undertakings It is the premium, as it were, on accumulation Were there no profit there would be little or no motive to save and amass, and all the vast advantages that society derives from the formation and employment of capital would be unknown But without taking into account the security and consequence conferred on the possessors of capital or wealth and looking only at its tangible results profit consists of that part of the produce raised by the agency of capital employed in industrious undertakings that remains in the hands of those by whom it is employed after replacing the capital itself, or such portions of it as may have been wasted in the businesses and every expense necessarily incurred in superintending its employment

The *rate* of profit is the proportion which the amount of profit derived from an undertaking bears to the capital employed in it

Thus suppose an agriculturist employs a capital equivalent to 1000 quarters of corn or 1000*l* in the cultivation of a farm and that the net surplus produce remaining to him at the end of the year after his capital has been replaced and he has been indemnified for the trouble of superintendence and for every necessary expense incurred in the management of the farm is 100 quarters or 100*l* this net surplus would form the profits of the agriculturist being to the capital by whose agency they are obtained in the ratio of 100 to 1000, or at the rate of ten per cent

It has been shown by Dr Smith and others, that the capital vested in different businesses yields, provided they be not subjected to any species of monopoly about the same rate of net profit and we shall now endeavour shortly to state the circumstances which seem to determine this rate

In this investigation it is not necessary to inquire whether the capital engaged in certain businesses yield rent as well as profits or profits only The competition of the producers will always reduce profits in different businesses to what is taking all things into account, nearly the same common level, and as rent is in every case a surplus over and above profits it may in this investigation be left wholly out of view The laws by which profits are regulated in countries where the best lands only are cultivated, and no rents are paid are in no respect different from those which regulate them in countries where cultivation has been widely extended, and where lands of superior fertility yield a high rent

Suppose therefore that rent is deducted or set aside, it follows that the whole of the remaining produce of industry must in the first instance be divided between capitalists and labourers that is between those who furnish the capital and those who furnish the manual labour made use of in the production of commodities And hence were taxation either unknown or constant the proportion of the produce of industry under deduction of rent falling to the share of the capitalists could not be increased without the proportion falling to the share of the labourers being at the same time diminished and conversely But the share of the produce of industry falling to the capitalists includes, besides profit, the portion required to replace the capital wasted in production, and to defray the wages of superintendence So that the rate of profit is not as has been already stated, determined by the ratio which the share of the produce of industry that goes in the first instance to the capitalists, after every sort of outlay has been deducted, bears to the total capital employed

Suppose, for example that an agriculturist employs a quantity of capital of the value of 1000 quarters of corn, or 1000*l*, in cultivating a farm, that half this capital consists of seed horses and other instruments used in agriculture, [illegible] of wages, [illegible] or set aside, he has produce equivalent to 1200 quarters, or 1200*l*, of this sum 1000 quarters, or 1000*l*, must go to replace his capital, [illegible] that his taxes amount to 100 quarters, or 100*l* It follows that 100 quarters, or 100*l*, will remain for his profits, [illegible] at the rate of ten per cent Now [illegible] case is, *mutatis mutandis*, the case of every man engaged

in business,—it is obvious that the rate of profit may be raised in three, but only in three ways, viz 1 By industry becoming more productive; or 2 By a reduction in the rate of wages; or 3 By a reduction in the amount of taxation And it may be reduced by the opposite circumstances, or 1 By industry becoming less productive, or 2 By a rise in the rate of wages, or 3 By a rise in the amount of taxation Profits cannot be affected in any way not referable to one or other of these heads

To revert to a previous supposition, if by applying other things remaining the same, the produce is increased, by means of the capital and labour employed, from to 1300 quarters, or 1300*l*, the gross amount of profits would in this case be increased from 100 quarters, or 100*l*, to 200 quarters, or 200*l*, and the rate of profit would be raised from 10 to 20 per cent A similar result would be produced, other things being the same, were wages reduced from 500 quarters, or 500*l*, to 400 quarters, or 400*l*, and were taxation reduced from 100 quarters or 100*l*, to 50 quarters, or 50*l*, the rate of profit would be raised from 10 to 15 per cent On the other hand, if we suppose that the quantity of produce, instead of being increased, is diminished, or that wages or taxes are augmented, the gross amount of profit, and the rate of profit, will be proportionally lessened

Had it not been for the gradually decreasing productiveness of the capital laid out on the lands, the productiveness of industry would have increased with every increment of labour, so that, without a corresponding rise in wages and taxes the rate of profit would have been continually increasing But though improvements may materially increase the productiveness of agricultural industry for a lengthened period, the increase cannot be permanent inasmuch as the growth of population never fails in the end to force recourse to inferior lands, which, of course yield less produce in return for the same outlay Thus the productiveness of the capital applied to the soil has a double influence over profits, for in the first place it lessens the quantity of produce obtained by the outlay of capital and labour, and in the second place it increases the portion of that produce going to the labourer as wages The latter must always get enough to enable him to subsist and continue his race, and though, in the event of his resorting to a lower species of food or an inferior standard of comfort a rise in the price of raw produce may not be followed by a rise of wages yet speaking generally the one is always consequent to the other The cost of food is the main regulator of wages, and it is quite impossible to go on for any lengthened period by taking bad land into cultivation or forcing the good land making constant additions to its cost without ultimately raising wages M the adaptation of matter to ou s from the influence of discoveries and inventions more and more productive as society advances, so that the decreasing fertility of the soil is at bottom the only cause of whatever reduction in the rate of profit is to be ascribed to a decline in the productiveness of industry, and it is pretty frequently also the cause of those reductions that are occasioned by a rise in the rate of wages The latter it is true, is also brought about by an increased demand for labour, and by a greater prevalence of moral restraint But a rise of wages caused by the increased cost of necessaries does not depend on contingent circumstances, or on the forethought of the labourers It must be experienced in every country and state of society as it becomes more and more difficult to of food for an increasing population The absolute wages of the labourer, or the quantity of necessaries and conveniences given him for his labour, may be, and indeed frequently are, diminished in the progress of society but when cultivation is far extended he is uniformly almost in the receipt of a larger share of the produce of his labour, so that, as has just been observed profits are reduced in an advanced stage of society because the quantity of produce is diminished and because the larger share of this diminished quantity

I of Smith, as to the circumstances which determine the rate of profit, differs widely from the above He seems to have had no idea of the important principle which shows that, despite the countervailing influence of improvements, the capitals successively applied to the land are sure, in the long run, to decrease in productiveness And not imagining that there was any natural cause why the produce obtained by the outlay of equal amounts of capital and labour should ever be diminished he supposed that profits were lowered through the competition of capitalists, that when capital increased, the undertakers of different businesses became anxious to encroach on each other, and that, in order to attain their object, they offered their produce at a lower price, and gave higher wages to their workmen

B theory appear sufficiently least examination It is easy to see that competition cannot occasion a general fall of profits All that competition can do, and all that it ever does, is to reduce the profits obtained in different businesses and employments to the same common level to prevent particular individuals realizing greater or lesser profits than their neighbours Farther than this competition cannot go The common and average rate of profit depends not on it, but on the excess of the produce obtained by employing capital after it is replaced, along with every contingent expense Competition can not affect the productiveness of industry nor can it, speaking generally, affect the rate of wages, for, such as the ordinary demand for labour is, such will be its supply, and it has no influence over taxation It is plain, therefore, that it has nothing to do with the determination of the common and average rate of profit It hinders individuals from getting more or less than this common rate, but it has no further effect

Hence it appears, that that fall in the rate of profit that is usually observed to take place as society advances is not owing to an increase of capital, or to the competition consequent upon that increase, but to an inability to employ capital with the same advantage as before, resulting (1) from a decrease in the fertility of the soils to which recourse must be had, or (2) from a rise of wages, or (3) from an increase of taxation Of these causes, one may be the more powerful at one period and another at a different period The first not only lessens the quantity of produce raised by the outlay of capital and labour, but it also, as already seen, generally raises in the end the rate of proportional wages It is of course impossible to lay down any fixed principles with respect to the influence of taxation In the progress of society, it may increase or diminish It has been shown that the heavy taxation of Holland during the last century was the principal cause of the low rate of profit in that country (*Principles of Political Economy*, 2d ed p 494) and, no doubt, profits in England are sensibly affected by our taxation

The principles already established show, 1 That so long as the productiveness of industry is undiminished, profits cannot be reduced otherwise than by a rise of wages or of taxes, 2 That so long as the rate of wages is constant profits cannot be reduced, unless industry become less productive, or taxation be augmented, and 3 That so long as taxation remains constant, profits cannot be reduced unless industry become less productive or wages be raised It is supposed, in these cases for the sake of simplicity, that when one of the regulating principles of profit remains constant, the other two vary in the same way But they might vary in different ways, and if so, their influence on profits would obviously depend on the extent to which the variation in the one exceeded the variation in the other Suppose for instance that while the productiveness of industry remains constant a rise of wages and a reduction of taxation are experienced, the effect of this variation will plainly depend on the rise of wages exceeding falling short, or being identical with the reduction in the amount of taxation if it exceed the reduction of taxation profits will be lowered proportionally to the excess if it be less than the reduction of taxation, profits will be proportionally raised, and if the rise of wages and the reduction of taxation be exactly equivalent profits will of course, undergo no change

PROGNOSIS (Gr προ, and γινωσκω *I know*) An opinion respecting the progress and termination of a disease

PROGRAMME An old university term, signifying an outline of the speeches or orations to be delivered on a particular occasion, but now applied in a more extended sense to the outline of any entertainment or public ceremony

PROGRESS The state journeys of royal personages were called by this name in old English In the reigns of Elizabeth and James they were frequent, and somewhat costly to the wealthier subjects, inasmuch as they were usually honoured with the onerous privilege of affording hospitality to royalty The "progresses" of Queen Elizabeth form the subject of a work by Mr Nichols (See also *Quart Rev* vol xli) Perhaps the most celebrated progress in English history is that of James I from Scotland to London on his accession

PROGRESSION In Arithmetic, a series of numbers according to a certain order It is arithmetical geometrical or harmonical.

*An Arithmetical Progression* is a series of numbers, increasing or decreasing by equal differences Thus,

increasing, 1, 3, 5, 7, 9, &c
decreasing 18, 15, 12, 9, 6, &c

Or, generally, $a + d, a + 2d, a + 3d, a + 4d, +$, &c.

Let $a$ denote the least term,
$z$ the greatest term,
$d$ the common difference,
$n$ the number of terms,
$s$ the sum of all the terms,

university. They, with their deputies the pro-proctors, have power not only to enforce the rules of academical discipline on the students, but also an extensive summary authority over the townspeople, according to the special privileges of the universities. They also have, in both universities, peculiar seats in church, as representatives of the head of the university, and the [illegible] of masters of arts and bachelors, and such as have studied from four to ten years.

PRO'CURATOR (Lat. *pro* for, and *cura* care.) A Roman provincial magistrate whose office was to superintend the affairs of the revenue, and to assist the governor in matters pertaining to it. Sometimes the procurator was charged with the office of governor of a province, as did Pontius Pilate in Judæa, in which case, but not otherwise, he had the power of inflicting capital punishment. This magistracy did not exist under the republic, its duties being comprised under those of the prætor or proconsul, but was instituted by Augustus. They were called *Procuratores Cæsaris*, to distinguish them from the common procurator, who was merely an agent employed by private persons to manage their affairs in their absence when an action was brought against them.

PROCURATOR, *Procuréur*, &c. In the Civil Jurisprudence one who undertakes the care of any legal proceeding for another, and stands in his place by virtue of a power or *procuration* from him. A *mandatory* is said to differ from a *procurator* in that the latter acts only by virtue of an express written instrument. In France before the revolution the procureurs (procuratores ad lites) were officers legally empowered to carry on suits on behalf of clients. This body was abolished in 1791, and that of *avoues* substituted in its place. The *procureurs du roi*, in France are officers of whom one is appointed to every tribunal of arrondissement, together with a sufficient number of 'substitutes."

PROCUREUR GENERAL. The public advocate of the crown in France. Every *parlement* or *cour souveraine* had, before the Revolution, a *procureur general* attached to it. Under the present system [illegible] one of these officers is established in every *cour royale*, for the criminal [illegible] him in [illegible] court [illegible] in the inferior courts of assize and *premiere instance*, are termed respectively *procureurs criminels* and *procureurs du roi*. These officers are charged with the conduct of all criminal proceedings on behalf of the prosecution, and are placed under the immediate control of the minister of justice.

PRO'DIGY (of very doubtful etymology) in ordinary modern language signifies a surprising though natural event, in contradistinction to *miracle* which is something out of the course of nature. Among the Romans however [illegible] which [illegible] by they could not assign a cause, was termed a *prodigy* and regarded as a supernatural event indicative of favourable or (more generally) of unfavourable dispositions of their gods. Hence the number of recorded prodigies many evidently false some real but misunderstood, which Livy has inserted in his annals.

PRO'DOMUS (Gr. προ, and δομος, *house*.) In Ancient Architecture the portico before the entrance of [illegible] temple the same as *pronaos*. See NAOS.

PRODUCT, in Arithmetic and Algebra is the result of or quantity produced by the multiplication of one number by another, or a quantity of any kind by a number. *See* MULTIPLICATION.

PRODU'CTA. An extinct genus of fossil bivalve shells closely allied to the living genus *Terebratula*. They only occur in the older secondary rocks.

PRO'EM (Gr. προ *ειμι I go before*.) A term formerly used for *preface*, which see.

PROEMPTOSIS (Gr. προ *before*, and πιπτω *I fall upon*.) The term applied to the lunar equation or addition of a day to prevent the new moon happening too soon, which must be effected by [illegible] every 330 years and also [illegible] every 2500 [illegible] is *metemptosis* which is used to [illegible] on necessary to prevent the new moon [illegible] too late or the suppression [illegible] sextile every 134 years.

PROFESSOR. The recognized title in all universities of the public and other regular teachers in the various faculties. In the origin of those institutions the degrees conferred on students were in fact, licences to commence as public teachers, and the terms master doctor and professor seem to have been used indifferently. But as in process of time the great body of graduates ceased, in most of them, to have any concern in public instruction, a separate body of recognized teachers gradually arose, endowed in some instances with salaries, in others paid by fees. These were the professors. But in those universities in which collegiate foundations prevailed as in Oxford and Cambridge these officers fell into a secondary situation. The necessary business of instruction was transacted and still continues to be so, by the functionaries of the several colleges. The professors therefore, and the instruction which they convey by lectures, have become only auxiliaries, instead of principals, and attendance on their lectures is in few cases compulsory. On the other hand, in universities destitute or nearly so of collegiate endowments (as those of Scotland, Germany, and others founded on the German model), the professors have become at once the governing body of the university, and the sole recognized functionaries for the purpose of education.

PROFILE (Fr. profil.) In Architecture, the contour of the different parts of an order.

Profile. In the Fine Arts, an outline of the principal parts of an object, free from all fore-shortening, [illegible] projections indentations, &c.

PROFIT (Fr. profit), in Political Economy, means the advantage or gain resulting to the owner of capital from its employment in industrious undertakings. It is the premium as it [illegible] [illegible] no profit, there would [illegible] amass, and all the vast advantages that society derives from the formation and employment of capital would be unknown. But without taking into account the security and consequence conferred on the possessors of capital or wealth, and looking only at its tangible results, profit consists of that part of the produce raised by the agency of capital employed in industrious undertakings that remains in the hands of those by whom it is employed after replacing the capital itself, or such portions of it as may have been wasted in the businesses, and every expense necessarily incurred in superintending its employment.

The *rate* of profit is the proportion which the amount of profit derived from an undertaking bears to the capital employed in it.

Thus suppose an agriculturist employs a capital equivalent to 1000 quarters of corn or 1000*l* in the cultivation of a farm, and that the net surplus produce remaining to him at the end of the year after his capital has been replaced, and he has been indemnified for the trouble of superintendence, and for every necessary expense incurred in the management of the farm, is 100 quarters or 100*l*; this net surplus would form the profits of the agriculturist, being to the capital by whose agency they are obtained in the ratio of 100 to 1000, or at the rate of ten per cent.

It has been shown by Dr. Smith and others, that the capital vested in different businesses yields, provided they be not subjected to any species of monopoly, about the same rate of net profit, and we shall now endeavour shortly to state the circumstances which seem to determine this rate.

In this investigation it is not necessary to inquire whether the capital engaged in certain businesses yield rent as well as profits or profits only. The competition of the producers will always reduce profits in different businesses to what is, taking all things into account, nearly the same common level, and as rent is in every case a surplus over and above profits it may in this investigation be left wholly out of view. The laws by which profits are regulated in countries where the best lands only are cultivated, and no rents are paid are in no respect different from those which regulate them in countries where cultivation has been widely extended, and where lands of superior fertility yield a high rent.

Suppose, therefore that rent is deducted or set aside, it follows that the whole [illegible] ce of industry must in the first [illegible] between capitalists and labourers, that is between those who furnish the capital and those who furnish the manual labour made use of in the production of commodities. And hence were taxation either unknown or constant the proportion of the produce of industry under deduction of rent falling to the share of the capitalists could not be increased without the proportion falling to the share of the labourers being at the same time diminished and conversely. But the share of the produce of industry falling to the capitalists includes, besides profit, the portion required to replace the capital wasted in production and to defray the wages of superintendence. So that the rate of profit is not, as has been already stated, determined by the ratio which the share of the produce of industry that goes in the first instance to the capitalists, after every sort of outlay has been deducted, bears to the total capital employed.

Suppose, for example that an agriculturist employs a quantity of capital of the value of 1000 quarters of corn, or 1000*l*, in cultivating a farm, that half this capital consists of seed horses and other instruments used in agriculture, the other half being employed in the payment of wages, and suppose that after his rent has been deducted or set aside, he has produce equivalent to [illegible] quarters or 1200*l*; of this sum 1000 quarters, [illegible] go to replace his capital, [illegible] his taxes amount to 100 quarters, or [illegible] at 100 quarters, or 100*l*, will remain for his profits, which are consequently at the rate of ten per cent. Now, in this case — and this case is, *mutatis, mutandis*, the case of every man engaged

in business,—it is obvious that the rate of profit may be raised in three, but only in three ways, viz 1 By industry becoming more productive, or 2 By a reduction in the rate of wages; or 3 By a reduction in the amount of taxation [illegible] cumstances, [illegible] 1 By [illegible] or 2 By a rise [illegible] amount of taxation Profits cannot be affected in any way not referable to one or other of these heads

To [illegible] other things [illegible] duce is increased [illegible] capital and labour [illegible] to 1300 quarters, or 1300*l*, the gross amount of profits would in this case be increased from 100 quarters, or 100*l*, to 200 quarters, or 200*l*, and the rate of profit would be raised from 10 to 20 per cent A similar result would be produced, other things being the same, were wages reduced from 500 quarters, or 500*l*, to 400 quarters, or 400*l*, and were taxation reduced from 100 quarters or 100*l*, to 50 quarters, or 50*l* the rate of profit would be raised from 10 to 15 per cent On the other hand, if we suppose that the quantity of produce, instead of being increased, is diminished, or that wages or taxes are augmented the gross [illegible] profit, and the rate of profit, will be proportionally [illegible]

Had it not been for the gradually decreasing productiveness of the capital laid out on the lands, the productiveness of industry would have increased with every discovery [illegible] labour, so that, without a corresponding [illegible] wages and taxes the rate of profit would have been continually increasing But though improvements may materially increase the productiveness of agricultural industry for a lengthened period, the increase cannot be permanent, inasmuch as the growth of population never fails in the end to force recourse to inferior lands which of course yield less produce in return for the same outlay The decreasing productiveness of the capital applied to the soil has a double influence over profits, for, in the first place it lessens the quantity of produce obtained by the outlay of capital and labour, and in the second place it increases the portion of that produce going to the labourer as wages The latter must always get enough to enable him to subsist and continue his race, and though, in the event of his resorting to a lower species of food or an inferior standard of comfort a rise in the price of raw produce may not be followed by a rise of wages yet speaking generally the one is always consequent to the other The cost of food is the main regulator of wages, and it is quite impossible to go on for any lengthened period by taking bad land into cultivation or forcing the good land making constant additions to its cost without ultimately raising wages Manufacturing industry or the adaptation of matter to our use necessarily becomes from the influence of discoveries and inventions more and more productive as society advances so that the decreasing fertility of the soil is at bottom the only cause of whatever reduction in the rate of profit is to be ascribed to a decline in the productiveness of industry and it is pretty frequently also the cause of those reductions that are occasioned by a rise in the rate of wages The latter it is true, is also brought about by an increased demand for labour and by a greater prevalence of moral restraint But a rise of wages caused by the increased cost of necessaries does not depend on contingent circumstances, or on the forethought of the labourers It must be experienced in every country and state of society, according as it becomes more and more difficult to obtain supplies of food for an increasing population The absolute wages of the labourer, or the quantity of necessaries and conveniences given him for his labour, may be and indeed frequently are diminished in the progress of society but when cultivation is far extended he is uniformly almost in the receipt of a larger share of the produce of his labour, so that, as has just been observed profits are reduced in an advanced stage of society because the quantity of produce is diminished, and because the labourers get a larger share of this diminished quantity

The theory of Smith, as to the circumstances which determine the rate of profit, differs widely from the above He seems to have had no idea of the important principle which shows that, despite the counterveiling influence of improvements, the capitals successively applied to the land are sure, in the long run, to decrease in productiveness And not imagining that there was any natural cause why the produce obtained by the outlay of equal amounts of capital and labour should ever be diminished he supposed that profits were lowered through the competition of capitalists, that when capital increased, the undertakers of different businesses became anxious to encroach on each other, and that, in order to attain their object, they offered their produce at a lower price, and gave higher wages to their workmen

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Hence it appears, that that fall in the rate of profit that is usually observed to take place as society advances is not owing to an increase of capital, or to the competition consequent upon that increase, but to an inability to employ capital with the same advantage as before, resulting (1) from a decrease in the fertility of the soils to which recourse must be had or (2) from a rise of wages, or (3) from an increase of taxation Of these causes, one may be the more powerful at one period and another at a different period The first not only lessens the quantity of produce raised by the outlay of capital and labour but it also, as already seen, generally raises in the end the rate of proportional wages It is, of course, impossible to lay down any fixed principles with respect to the influence of taxation In the progress of society, it may increase or diminish It has been shown that the heavy taxation of Holland during the last century was the principal cause of the low rate of profit in that country (*Principles of Political Economy*, 2d ed p 494) and, no doubt profits in England are sensibly affected by our taxation

The principles already established show, 1 That so long as the productiveness of industry is undiminished, profits cannot be reduced otherwise than by a rise of wages or of taxes 2 That so long as the rate of wages is constant profits cannot be reduced unless industry become less productive, or taxation be augmented, and 3 That so long as taxation remains constant, profits cannot be reduced, unless industry become less productive or wages be raised It is supposed, in these cases for the sake of simplicity that when one of the regulating principles of profit remains constant, the other two vary in the same way But they might vary in different ways, and if so their influence on profits would obviously depend on the extent to which the variation in the one exceeded the variation in the other Suppose for instance, that while the productiveness of industry remains constant a rise of wages and a reduction of taxation are experienced, the effect of this variation will plainly depend on the rise of wages exceeding falling short, or being identical with the reduction in the amount of taxation if it exceed the reduction of taxation, profits will be lowered proportionally to the excess, if it be less than the reduction of taxation, profits will be proportionally raised, and if the rise of wages and the reduction of taxation be exactly equivalent profits will of course, undergo no change

PROGNO'SIS (Gr προ, and γινωσκω *I know*) An opinion respecting the progress and termination of a disease

PRO'GRAMME An old university term, signifying an outline of the speeches or orations to be delivered on a particular occasion, but now applied in a more extended sense to the outline of any entertainment or public ceremony

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PROGRE'SSION (La progression) In Arithmetic, a series of numbers proceeding according to a certain order It is arithmetical, geometrical or harmonical.

*An Arithmetical Progression* is a series of numbers, increasing or decreasing by equal differences Thus,

increasing, 1, 3, 5, 7, 9, &c
decreasing, 18, 15, 12, 9, 6, &c

Or, generally, $a + d, a + 2d, a + 3d, a + 4d, +$, &c.

Let $a$ denote the least term,
$z$ the greatest term,
$d$ the common difference,
$n$ the number of terms,
$s$ the sum of all the terms,

then the principal properties of an arithmetical progression are expressed by the following formulæ —

$$a = z - (n-1)\,d,\quad z = a + (n-1)\,d,$$

$$d = \frac{z-a}{n-1},\quad n = \frac{z-a}{d} + 1,\quad s = \frac{a+z}{2}\,n,$$

and these expressions become still simpler when the first term, $a$, is nothing

*A Geometrical Progression* is a series of numbers increasing or decreasing in a certain constant ratio, or such that the quotient of any one of them by that which immediately precedes is constantly the same Thus,

increasing, 1, 2, 4, 8, 16, &c
decreasing, 81, 27, 9, 3, 1, &c

Or, generally, $a$, $r\,a$, $r^2\,a$, $r^3\,a$, &c

$$\text{Or } a,\ \frac{a}{r},\ \frac{a}{r^2},\ \frac{a}{r^3},\ \&c\ ,$$

where $a$ is the first term, and $r$ the common ratio in the one case, and 1 — the common ratio in the other

Let $a$ denote the least term,
$z$ the greatest term,
$r$ the common ratio,
$n$ the number of terms,
$s$ the sum of the terms,

then the principal properties of a geometrical progression are expressed as follows —

$$a = \frac{z}{r^{n-1}},\quad z = a\,r^{n-1},\quad r = \left(\frac{z}{a}\right)^{\frac{1}{n-1}},$$

$$n = \log\frac{z}{a} - \log r,\quad s = \frac{r\,z-a}{r-1} = \frac{r^n-1}{r-1}\,a$$

Some of these formulæ may be more conveniently expressed in terms of $s$ which does not enter into any one of the first four Thus,

$$a = \frac{r-1}{r^n-1}\,s,\ \text{or } a = z\,r - (r-1)\,s,\quad r = \frac{s-a}{s-z}$$

*An Harmonical Progression* is [illegible] mon[illegible] propor[illegible] or such that [illegible] terms, the first is to the third as the difference between the first and second is to the difference between the second and third (*See* HARMONICAL PROPORTION) The reciprocals of an arithmetical progression form an harmonical progression Thus the reciprocals of the arithmetical series 1, 2, 3, 4, 5, &c are

$$1,\ \tfrac{1}{2},\ \tfrac{1}{3},\ \tfrac{1}{4},\ \tfrac{1}{5},\ \&c$$

which form an harmonical progression

PRO'HEDRI (Gr προεδροι, [illegible]) Athenian officers chosen to superintend the proceedings in the two legislative assemblies, so called because they had the privilege of sitting in the front seats (προεδρια) The prohedri of the senate were ten in number (*See* PRYTANES) The prohedri of the ecclesia were more in number [illegible] from each tribe which did not [illegible] for the time being Their duties only extended to the one assembly of the people a new set being elected each time and one of their number was appointed [illegible] to propose [illegible], to debate [illegible] the votes

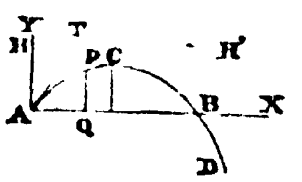
PROHIBI'TION In Law a writ to forbid any court from proceeding in a cause then depending on suggestion that the cause of it does not properly belong to that court In modern times the writ of prohibition is chiefly used where parties have been impleaded before the ecclesiastical courts It issues properly out of the court of King's Bench, but may also be had in some cases out of the Chancery, Common Pleas or Exchequer It is the proper remedy where the court against which it is sued has exceeded its jurisdiction in taking cognizance of matters not properly belonging to it It is granted on motion, but if the question of jurisdiction be doubtful the courts direct the party suing the writ to *declare in prohibition*. This proceeding rested originally on a fiction of law The plaintiff assumed that the writ had been granted, and brought his action against the defendant, on the supposition that he was proceeding in the case, notwithstanding the prohibition, and the merits were then tried on demurrer But now by 1 W 4 c 21, [illegible] with a prayer for a writ

P[illegible] projicio, *I throw forward*), in Mechanics, is a body which, having had a motion in space impressed on it by the action of an external force, is abandoned by this force, and left to pursue its course Thus, a stone thrown from the hand or a sling, an arrow shot from a bow, and a bullet discharged from a cannon are [illegible] they continue in motion

[illegible] —When a heavy body is projected from the earth it is subject to the action of three separate and independent forces — 1 The projectile force or that by which it was put in motion, and in virtue of which, if no other force interfered, the body would continue for ever to move [illegible] with the same [illegible] 2 The force of gravity by which it is [illegible] 3 The resistance of the atmosphere which acting in the direction opposite to that in which the body is moving, tends at every instant to destroy its motion, or to bring it to rest

When the projectile is a body possessing considerable density and the motion is slow, the resistance of the air is inconsiderable, and the body describes almost the same path as if it had been projected in a vacuum, but when the velocity is great, as in the case of a cannon ball (and it is only in such cases that the theory of the motion of projectiles has any practical application), the resistance of the air becomes enormous, and causes the projectile to deviate widely from the path it would have pursued if this force had not been in action The direct investigation of the path of a projectile in a resisting medium being a problem of the [illegible] and attended with very considerable [illegible] the way in which the subject can be rendered most intelligible is to proceed in the first place, on the supposition that there is no resistance, and determine the circumstances of the motion of a body supposed to obey only the impulse by which it was projected and the force of gravity, and then to consider the resistance as a disturbing force, and find the correction that must be applied in consequence to the path determined on the previous supposition

*Motion of Projectiles in vacuo* — In order to determine the path of a projectile on the supposition that it is not resisted by the atmosphere, suppose it to be projected from the point A with a velocity $a$ in the direction A T since gravity acts only in the vertical direction, it is evident that the body will move in the vertical plane passing through A I Let A C D, therefore be its path or trajectory in this plane, and let A X and A Y be the rectangular co-ordinates of the curve, A X being horizontal and A Y in the direction of gravity At the end of any given time $t$ let P be the place of the projectile, $x = $ A Q, its abscissa, and $y = $ P Q its ordinate also let $g$ be the accelerating force of gravity (= 32 feet per second) and A the angle T A X




The body being projected in the direction of the line A I with a velocity $= a$ its velocity in the horizontal direction will continue uniform and $= a \cos A$ In like manner its velocity in the vertical direction A Y due to the projectile force is $= a \sin A$, and at the end of any time $t$ the spaces passed over in those directions if gravity did not act would be respectively $t\,a \cos A$, and $t\,a \sin A$ But the space through which a heavy body falls by the action [illegible] time $t$ is $\frac{1}{2} g t^2$, and as this is in the vertical direction and opposite to A Y, it must be joined to the resolved part of the projectile motion in that direction, with a contrary sign We have, therefore

$$x = t\,a \cos A \quad y = t\,a \sin A - \tfrac{1}{2} g t^2 \qquad (1)$$

On eliminating $t$ from these two equations, and supposing the velocity $a$ to be that which a body would acquire in falling from a height $= h$ so that $a = \sqrt{2gh}$, we obtain [illegible] for the equation of the curve described by the projectile —

$$y = x \tan A - \frac{x^2}{4h \cos^2 A} \qquad (2)$$

This equation belongs to a parabola whose axis is vertical, or parallel to A Y The summit of the parabola is found by differentiating the equation, and making $\frac{dy}{dx} = 0$, which gives $x = 2h \cos A \sin A$, and consequently $y = h \sin^2 A$ for the values of $x$ and $y$ at that point

In order to find the *amplitude* or *range* of the projectile that is, the point B in which it again passes through the horizontal plane from which it was projected we have only to suppose, in the above equation, $y = 0$ This gives

$$x = 4h \cos A \sin A = 2h \sin 2A$$

for the value of A B, and, as the sine of an angle continues to increase to 90°, the value of A B will be greatest when A, the angle of projection, is 45° The amplitude is then $= 2h$, or twice the altitude due to the initial velocity At every other inclination there are two angles which give the same range, the one as much less than 45° as the other is greater

The velocity $v$, at any point in the curve, is found by means of the differential formula $v^2 = \frac{dx^2 + dy^2}{dt^2}$. On differentiating the values of $x$ and $y$ in the equations (1), and adding the results, we find

$$v^2 = a^2 - 2\,a\,g\,t \sin A + g^2 t^2,$$

Let $k$ = the height from which a body must have fallen to acquire the velocity $v$, then $v^2 = 2gk$. But we have also $a^2 = 2gh$, and $t = \frac{x}{a \cos A}$, substituting, therefore, these values in the above equation, we obtain

$$k = h - x \tan A + \frac{x^2}{4h \cos^2 A},$$

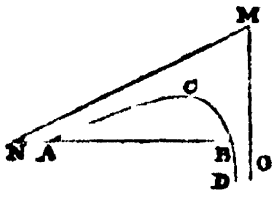
and comparing this with the value of $y$ in equation (2), we have ultimately $k + y = h$

From this equation it appears that if in A Y a point H be taken, such that A H = $h$, the height from which a heavy body must fall to acquire the initial velocity, and a straight line H H′ be drawn though H parallel to the horizon, or to A X, the velocity of the projectile in the curve at any point P is equal to that which a heavy body would acquire by falling freely from the line H H′ to P. The line H H′ is is easily proved, is the directrix of the parabola, and hence all the parabolas described by bodies projected from the same point, and with the same velocities, though with different elevations have the same directrix, and consequently their foci in the circumference of the same circle

Thus it appears that the theory of the motion of projectiles in a vacuum is extremely simple, but, as has been already mentioned, the resistance which the air opposes to their motion, particularly when the velocity is great is by far too considerable to be neglected, in fact it changes entirely the form of the trajectory, and the law of motion by which it is described

*Motion of Projectiles in a resisting Medium* — When the resistance of the air is taken into account the determination of the path described by a projectile is a problem of far greater difficulty, though still capable of rigid solution on assuming an algebraic relation between the velocity and the resistance, but when it is considered that, in order to compute the trajectory of a resisted body it is necessary not only to assume a law of resistance which we never can be quite sure is the true one but also to know accurately the initial velocity of the body together with its density form and dimensions it is easy to see that no great practical advantage is likely to be obtained in any case from the theory, and that recourse must be had to experiment. The problem however regarded merely as a mathematical speculation possesses considerable interest and has been discussed by Newton in the *Principia* (Scholium prop 10 lib ii), by John Bernoulli Dr Brook Taylor Hermann Euler and others. For the solution see Legendre *Exercises de Calcul Integral*, tom i, Poisson *Traité de Mecanique*

The hypothesis usually made with respect to the resistance is that it is proportional to the square of the velocity. On this hypothesis it was shown by Newton that the trajectory has more resemblance to a hyperbola than a parabola. The two branches A C and C D are dissimilar, and the motion in the descending branch C D becomes constantly more nearly vertical and uniform so that ultimately the body would describe a vertical line with a uniform velocity. This branch of the curve has therefore a vertical asymptote M O to which it continually approaches. The other branch A C has likewise an asymptote which makes an angle with the axis A B and intersects it at a distance A N from A, depending on the initial direction and velocity of the projectile.



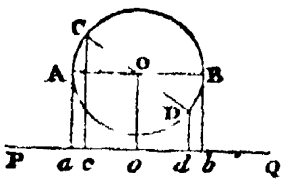

Some anomalous circumstances are observed in experiments with artillery which are quite beyond the reach of theoretical calculation. Bullets are frequently driven to the right or left of the plane in which they were projected as if a force acted upon them sideways as well as vertically, and in this case their path becomes a curve of double curvature. Dr Hutton ascribes this chiefly to a whirling motion acquired by the bullet about an axis, in consequence of its friction against the sides of the piece, for this rotatory motion, combined [illegible] motion, causes each part of the ball [illegible] air in a direction different from what it would do if there were no such whirl. Euler on the other hand, attributes the lateral deflection chiefly to the irregularity of the [illegible] and in a small degree to its rotation. Mr Robins found the range of shot extremely uncertain, falling sometimes 200 yards short of what it did at other times, though there was no visible cause of difference in making the experiment, and Dr Hutton states that the [illegible] of one fifth or one [illegible] be deflection to the right or left, and also in the extent of the range of ca[illegible] See GUNNERY RESISTANCE.

PROJECTION. In Perspective the [illegible] of any object on the perspective plane. See PERSPECTIVE.

PROJECTION OF THE SPHERE. In Geography, the representation of the several parts of the surface of the sphere on a plane, according to some geometrical law by which the different points in the representation can be accurately referred to their relative positions on the sphere. It is a problem of much importance, in consequence of its application to the construction of maps, charts, planispheres, &c.

Projections are of various kinds, according to the situations in which the eye is supposed to be placed in respect of the sphere and the plane on which it is to be projected, but there are three which, by reason of the frequency of their use, are particularly deserving of attention, namely, the *orthographic*, the *stereographic*, and the *central* or *gnomonic*.

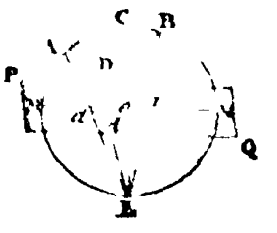
1 *Orthographic Projection* — In this projection the eye is supposed to be at an infinite distance, and the *plane of projection*, i e the plane on which the representation is made, perpendicular to the direction of the rays of light, which are all parallel to each other. The laws of this projection are easily deduced. 1 Any point in space is projected by drawing a straight line from it perpendicular to the plane of projection. 2 A straight line perpendicular to the plane of projection is projected into a point. A straight line A B, parallel to the plane of projection P Q, is projected into an equal straight line a b, and a straight line C D inclined to the plane of projection is projected into a straight line c d which is shorter than C D in the proportion of the cosine of the angle of inclination to radius. 3 A plane surface perpendicular to the plane of projection is projected into a straight line. 4 A circle parallel to the plane of projection is projected into an equal circle, but a circle oblique to the plane of projection is projected into an ellipse, of which the greater axis is equal to the diameter of the circle and the lesser axis is equal to that diameter multiplied by the cosine of the obliquity.




Orthographic projections of the sphere are usually made either on the plane of the equator, or on the plane of a meridian. When on the plane of the equator the meridians are all represented by straight lines intersecting in the centre of the [illegible] the parallels of latitude by circles whose [illegible] respectively equal to the cosines of t[illegible] W[illegible] is on the plane of [illegible] are represented by ellipses and the parallels of latitude by straight lines parallel to the diameter of the projection. Orthographic projections of a hemisphere have this defect that they are much crowded and distorted near the circumference of the representation as may be inferred from the above figure, all the points in the arc A C being compressed within the line a c (which is equal to the versed sine of the arc) while an arc at the vertex of the hemisphere is projected into a line nearly equal to itself.

The orthographic projection has a multitude of other applications. The plans and sections by which artificers execute their different constructions are orthographic projections of the things to be constructed, and a solid body may be represented in all its dimensions by orthographic projections on two planes at right angles to each other. See DESCRIPTIVE GEOMETRY.

2 *Stereographic Projection* — In this projection the eye is supposed to be situated at the surface of the sphere, and the plane of projection is that of the great circle which is every where 90 degrees from the position of the eye. Thus let A C B F represent a sphere cut by a plane P Q passing through the centre and perpendicular to the plane of the great circle A B F, and let F be the position of the eye in this circle. If straight lines be drawn from F to the points A D B in the opposite hemisphere, the points *a d b* in which those lines cut the plane P Q will be the stereographic projections of A D B.



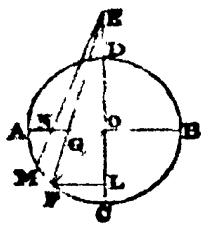

Some of the principal properties of this projection are the following. — 1 The projection of any circle on the sphere which does not pass through the eye is a circle; and circles whose planes pass through the eye are projected into straight lines. 2 The angle made on the surface of the sphere by two circles which cut each other, and the angle made by their projections, is equal. 3 Let C be the pole opposite to F, and *c* its projection; then any point A is projected into a point *a*, such that *c a* is equal to half the tangent of the arc A C.

3 *Gnomonic or Central Projection* — In this projection the eye is situated at the centre of the sphere, and the plane of projection is a plane which touches the sphere at any point assumed at pleasure. The point of contact is called the *principal point*, and the projections of all other points on the sphere are at the extremities of the tangents of the arcs intercepted between them and the principal point. As the tangents increase very rapidly when the arcs exceed 45°, and at 90° become infinite, the central projection cannot be adopted for a whole hemisphere.

The orthographic and stereographic projections were both employed by the ancient Greek astronomers for the purpose of representing the celestial sphere with all its circles on a plane. The area was called by them the *analemma*. Ptolemy wrote a treatise on this projection, and the Arabs derived from it the fundamental theorems of trigonometry. The stereographic projection appears to have been invented by Hipparchus, and was denominated by the Greek astronomers *planisphere*. The name stereographic (derived from στερεος, *a solid*) was given to it by the Jesuit Aguilon, because it results from the intersection of two solids, the cone and the sphere. Hipparchus and Ptolemy appear (though they do not expressly mention it) to have been acquainted with the principal property, namely, that circles on the sphere are projected into circles, which affords great facilities for the construction of maps. The second property, not less remarkable, that all circles in the projection intersect each other in angles equal to those at which the corresponding circles on the sphere, [illegible] to have been first demonstrated by Dr Halley in 1695 in No. 219 of the *Phil. Trans.* where the discovery is attributed to Demoivre or Hooke. From the equality of the angles, it follows that any very small portion of the spherical surface and its projection are similar figures, — a property of great importance in the construction of maps, but which is not peculiar to this projection as it belongs also to Mercator's, and numerous other relations may be assigned between the original and projected figures in which it will hold good. The gnomonic projection is also described by Ptolemy, but as the Greeks had no idea of the trigonometrical tangents, the polar distances were expressed by the ratios of the sines to the cosines of the arcs.

In constructing maps of countries, the object sought to be attained is to lay down the places in their true relative positions, and at the same time to preserve as much as possible the same scale of distances throughout. In the three projections which have been explained, equal portions of the spherical surface are represented by unequal portions of a plane surface, and the deviation from equality becomes greater from the centre to the circumference of the projection. The degrees of latitude are greatly contracted towards the circumference in the orthographic projection, and enlarged in [illegible] so as in both cases to produce a great [illegible]. Geographers have, accordingly, attempted to correct this deviation by placing the point of view at some finite distance without the sphere. This gives rise to the following, which was proposed by Lahire.

*Globular Projection.*—Let A C B be the hemisphere to be represented on the plane passing through the diameter A B, and let E be the position of the eye in a straight line passing through the centre O perpendicular to A B, the representation will be perfect if the several arcs A M, M I, I C, have each the same ratio to their projections A N, N G, G O. This cannot be accomplished accurately, but the nearest approximate will be [illegible] by placing the point I in such a position that I O be the middle point of the arc A C, its corresponding point G is also the middle of A O. The problem therefore is to find a point F in C D, such that on drawing the line F F to bisect A C it shall also bisect the radius A O. Draw F L perpendicular to O C, and join I O. It is evident that F L is half the side of the inscribed square, and G O is half the radius, therefore F I is to G O as O F or O C to O I. But F I : G O :: I I : O I, therefore, L E : O E :: O C : O I, and consequently L O : O E :: C L : O L, whence O I : C I = O I². But D L : C L = F I² = O I², therefore O E = D I, or D E = O L, the cosine or sine of 45°, consequently by the trigonometrical tables, D E = 71, the radius being unity.




The projections which have now been explained are seldom used in delineating the features of a single country, or a small portion of the earth's surface. For this purpose it is found more convenient to employ some of the methods of development of the spherical surface explained under the term MAP.

The projection of the circles of the sphere on a plane is a problem of which the solution is easily found either by the methods of the descriptive geometry, or by common algebra, or spherical trigonometry. Whatever be the situation of the eye, every circle on the sphere, not passing through the eye, forms the base of a cone, of which the eye is the apex, and the intersection of this [illegible] into [illegible] in be no other than a conic section, and its equation can never exceed the second degree. On forming the general equation, and assigning a particular position to the eye and the plane of projection, all the properties of the different kinds of projection are readily deduced. The subject is explained in a popular manner in *Murray's Encyclopædia of Geography* (*Introduction*). Malte Brun's *Geography* and most other works on that science, and treated mathematically by Lambert in his *Beiträge &c.* Berlin, 1772; by Euler in the *Petersburg Commentaries* for 1777, by Lagrange in the *Berlin Memoirs* for 1779, and by Gauss in a Memoir which is translated in the *Philosophical Magazine* for August and September, 1828.

PROJECTURE. In Architecture, the jutting or leaning outwards of the mouldings and other members of architecture beyond the face of a wall, column, &c.

PROLA'PSUS. (Lat.) A protrusion or falling down of a part of a viscus that is uncovered.

PROLATE SPHEROID. In Geometry, a spheroid produced by the revolution of an ellipse about its transverse diameter, so called in opposition to the *oblate* spheroid, which is produced by the revolution of the ellipse about its shorter axis.

PROLE'GOMENA. (Gr. προλεγομενα.) In Literature, preliminary or introductory observations or dissertations prefixed to any work. The famous dissertation prefixed by D'Alembert to the *Encyclopédie*, and the dissertations prefixed by Dugald Stewart, Playfair, Leslie, and Mackintosh to the last edition of the *Encyclopædia Britannica*, are among the best specimens of preliminary [illegible].

PRO'LEGS. In Entomology, are the fleshy exarticulate pediform, often retractile organs, which assist various larvæ in walking and other motions, but which disappear in the perfect insect.

PROLE'PSIS. (Gr. προλαμβανω, *I anticipate*.) In Rhetoric, a figure by which the speaker anticipates and answers imaginary objections such as might be raised against the sentiments which he is urging.

PRO'LOGUE. (Gr. προλογος.) A piece in verse recited before the representation of a play, and serving as an introduction to it. *See* EPILOGUE.

PROLU'SION. (Lat.) A classical word which has been adopted in a rather general sense by authors unwilling to entitle their own productions by a more ambitious designation: an essay or preparatory exercise, in which the writer tries his own strength, or throws out some preliminary remarks on a subject which he intends to treat more profoundly. The early and fugitive pieces of some poets (as the Culex and others attributed to Virgil) have been termed by critics, their prolusions.

PROMI'THEANS. A term applied to small glass tubes containing concentrated sulphuric acid, and surrounded with an inflammable mixture which they ignite on being pressed, and thereby give instantaneous light. The term is derived from

PROMI'THEUS. (From Gr. μητις, *counsel*.) According to the most ordinary form of his legend in Greek mythology, one of the Titans who was exposed to the wrath of Jupiter on account of his having taught mortals the arts, and especially the use of fire, which he was said to have stolen from heaven concealed in a pipe. According to another story, Prometheus was actually the creator of men, and in the *Protagoras* of Plato he is made not to have created, but to have inspired them with thought and sense. His punishment was to be chained to a rock on Caucasus, where a vulture perpetually gnawed his liver, from which he was finally rescued by Hercules. This legend has formed the subject of the grandest of all the poetical illustrations of Greek supernatural belief, the *Prometheus Bound* of Æschylus. Many have recognized in the indomitable resolution of this suffering Titan, and his stern endurance of the evils inflicted on him by a power with which he had vainly warred for supremacy, the prototype of the arch fiend of Milton. Others have sought for a recondite analogy, and discovered in the tortures endured by Prometheus as a sacrifice for mankind, whom he had benefited, a foreshadowing of the great mystery of Christianity.

PRO'MISSORY NOTE. A note or writing by which an individual, or number of individuals, promise or engage to undertake or perform [illegible]. In legal language, however, it is [illegible] engagements to pay certain specified sums of money at certain dates. Such documents, if drawn on proper stamps, are legal negotiable instruments that enjoy the same privileges as bills.

PRO'MONTORY. (Lat. pro, and mons *a mountain*.) In Geography, a point of land, whether high or low, is indifferently [illegible] into the sea. *See* CAPE.

PROMU'SCIS. The name of the suctorious organ of the Hemipterous insects, formed by the union of the two jaws (*maxillæ*) to the lower lip, which they embrace, thus forming a jointed organ containing four long capillary [illegible].

PRONAOS. (Gr. προ, *before*, and ναος, *a temple*.) In Architecture, [illegible]. *See* NAOS.

PRONATOR MUSCLES. Those which are used in turning the palm of the hand downwards.

PRO'NOUNS. In Grammar, parts of speech which are used in the stead of nouns, to avoid needless or inconvenient specification. Pronouns are divided into *substantive* or *personal*, and *adjective*; the latter including

*possessive, demonstrative, relative, indefinite,* and *interrogative* pronouns

PROOI (From the verb *to prove*) In Engraving, an impression taken from an engraving to prove the state of it during the progress of executing it, also one taken before the insertion of the letters are engraved on the plate

PROOF In Printing, an impression on which the errors and mistakes are marked for the purpose of being corrected Proofs are,—first proof, which is the impression taken with all the errors of workmanship After, it is read by the copy, and the errors corrected, which if not many, and carefully done, another impression is printed with more care, to send to the author, this is termed a clean proof On it he makes his corrections and alterations when those are altered in the types, another proof is printed, and read over carefully previously to the whole number being printed off, this is called the press proof

PROOF *See* EVIDENCE

PROOF SPIRIT A mixture of equal weights of absolute alcohol and water, the specific gravity of such a mixture is 0 917, but the density of the proof spirit of commerce is 0 930

PROPÆDI U'TICS (Gr προ, and παιδευω, *I instruct*) A term used by German writers to signify the preliminary learning connected with any art or science that in which it is necessary to be instructed, in order to study the science itself

PROPAGANDA [illegible] given to an association or, as it is termed the congregation *De propaganda Fide*, established at Rome by Gregory XV in 1622, for diffusing a knowledge of Christianity throughout the world It is a committee of cardinals and special agents of the pope, under whose presidency it meets every week Its duties are the superintendence and assistance of missionaries in all parts of the globe, the maintenance of recent converts, the publication of religious works in foreign languages &c Derived from this celebrated society, the name *propaganda* is applied in modern political language as a term of reproach to secret associations for the spread of opinions and principles which are viewed by most governments with horror and aversion

PROPAGA'TION OI PLANTS The greater number of plants are propagated naturally by means of seeds, but, in addition to these many plants are extended over the surface on which they take root by the production of runners or lateral shoots which spread along the surface and root at the joints or buds from which they send up new plants by suckers or side shoots from the roots, and by various other natural means Artificially plants are propagated by seed by runners suckers offsets bulbs tubers layers cuttings grafting budding inarching &c Seeds are gathered when mature and sown on recently stirred soil and covered to different depths, according to the size of the seed the nature of the soil and situation, and other circumstances The plants formed by runners are separated from the parent plant by cutting through the runner and removing the young plant in order to plant it elsewhere Suckers, slips or side shoots from the roots are separated from the parent plant by being slipped down or cut off so as to carry with them a portion of fibrous roots and they are afterwards planted in suitable soil &c Offsets are small bulbs which are produced round the base of larger ones, and being taken off and planted become plants Tubers [illegible] and the eyes may be separated [illegible] to as many pieces as there are buds, in either of which cases new plants will be formed Layers are branches or shoots of either woody or herbaceous plants which are bent down and a portion of their length buried a few inches in the soil, that portion having been previously wounded by cutting bruising or twisting which by checking the descent of the sap, gives rise after a certain period to the production of roots After these roots are formed, the portion of the layer which has produced them is separated from the main stock or parent plant and planted by itself Cuttings are portions of shoots either of ligneous or herbaceous plants, and they are made of the young shoots with the leaves on or of the ripened wood either with or without its leaves, and after they have, either in a herbaceous state with the leaves on, or with the wood mature and with or without the leaves, been properly prepared and planted, they form roots at their lower extremity, each cutting becoming a perfect plant In general, cuttings should be taken from those shoots of a plant which are nearest the soil, because, from the moisture and shade there, such shoots are more predisposed to emit roots than those on the upper part of the plant The young or last formed shoots are to be taken in preference to such as are older, as containing more perfect buds in an undeveloped state, and a bark more easily permeable by roots, and the cutting is to be prepared by cutting its lower extremity across at a joint, the lenticells or root-buds being there most abundant When the cutting is planted, the principal part of the art consists in making it quite firm at the lower extremity, so as completely to exclude the air from the wounded section Cuttings emit roots at this section, either in consequence of the action of the accumulated sap in the cutting, as in the case of the ripened wood in deciduous trees and shrubs, or in consequence of the joint action of the accumulated sap and of the leaves, as in the case of cuttings of soft wood with the leaves on, and in a living state A few plants are propagated by cuttings of the leaves, the petiole of the leaf being slipped off from the parent plant, and probably containing the latent embryos of buds Grafting and budding are processes which have been already explained (See these words) Inarching may be described as a species of grafting, in which the scion is not separated from the parent plant till it has become united with the stock

PRO'PEDS, *Propedes* The name given by Kirby to the soft, fleshy, inarticulate pediform appendages of certain larvæ, placed behind the true feet, and disappearing in the mature insects

PRO PER In Heraldry, any object represented of its natural colour is so termed

PRO'PERTY In Logic a predicable which denotes something essentially conjoined to the essence of the species There are enumerated in books on logic four kinds of property, which are termed "universal, but not peculiar," 'peculiar, but not universal," "universal and peculiar," 'universal and peculiar, but not at every time' The last kind is evidently more properly designated as Accident *See* LOGIC, PREDICABLE

PROPERTY RIGHT OF *See* RIGHT OF PROPERTY

PRO'PHETS (Gr προ *before* and φημι, *I speak*) A title given in the Scriptures to persons inspired, or endowed with the capacity to predict future events The first to whom it is applied is Abraham, and we hear, in the same extended sense, of companies of prophets persons who were employed in the study or exposition of the divine law in which case it does not necessarily imply the power of predicting future events In its more strict signification the term prophet is given to Elijah, Elisha, and others who did not commit their prophecies to writing but whose inspiration is attested in the historical books of the Old Testament and to the sixteen whose books are collected under the subdivisions of the greater and the lesser Jonah, the earliest, lived about 800 B C, and Malachi the latest, about 400 B C

PROPHYLA'CTIC (Gr προφυλασσω, *I defend*) Means used to prevent disease

PROPO RTION (Lat proportio) in Arithmetic and Geometry is the equality or similitude of ratios, four numbers or magnitudes being said to be proportional or in proportion when the ratio of the first to the second is the same as the ratio of the third to the fourth, or when the first divided by the second gives the same quotient as the third divided by the fourth

The definition of proportion has given rise to much controversy among writers on the elements of geometry Euclid's celebrated definition in the fifth book, whatever may be said in favour of its ingenuity and exactness, is found by experience to be much too complicated and refined to be understood by beginners, and accordingly many attempts have been made to substitute for it one more intelligible but on account of the difficulty of defining the term *ratio* in such a manner as to include incommensurable quantities, none of these attempts can be said to have been perfectly successful This imperfection, however must be understood as belonging merely to the metaphysical accuracy of the definition, for many of the treatises which have been composed with the view of superseding Euclid's have all the [illegible] which can be desired On this [illegible] consult *Barrow's Mathematical Lectures*, the notes to *Playfair's Euclid*, *Camerer's Euclid*, Berlin, 1825, De Morgan *On the Connexion of Number and Magnitude*, 1836 and the art "Proportion" in the *Penny Cyc*

Proportion is *continual* or *discrete direct* or *inverse* It is continual when every two adjacent terms have the same ratio or when the consequent of one ratio is the antecedent of the next following thus, 2, 4, 8, 16, &c, are numbers in continual proportion, for the ratio of 2 to 4 is the same as that of 4 to 8, of 8 to 16, &c *Discrete* proportion is when the antecedent of one ratio is different from the consequent of the former, thus, 2, 3, 4 6 The terms *direct* and *inverse* have reference to arithmetical questions in which is denominated the Rule of Three, and which in their enumeration include four numbers, two of which are of one kind and two of another, and moreover each number of the second kind intimately connected with one of the numbers of the first kind by the nature of the question Now when the four numbers are written in the form of a proportion if the antecedents of the two ratios are the related numbers, the proportion is said to be direct, but if the antecedent of the first ratio is the number connected with the consequent of the second, the proportion is inverse For example, let the question be this If 8 yards cost 12 shillings

what is the price of 20 yards? The answer is 30 shillings. Now, in this question, the numbers 8 and 20 are of one kind, and the two others 12 and 30, are of another kind. The numbers form the proportion, and the numbers 8 and 12 (the antecedents of the ratios) are related to each other, and also 20 and 30, 12 shillings being the price of 8 yards, and 30 the price of 20. The proportion is therefore *direct*. But if the question were to find in how many days 4 men will do a piece of work, supposing 6 men can do it in 10 days, the related numbers would be differently placed, for the answer being 15 days, the four numbers written as proportionals must stand thus, 4 6 10 15, and as the numbers 4 and 15 are here the related numbers, or the antecedent of the first ratio is related to the consequent of the second, the proportion is *inverse*. This is also called *reciprocal* proportion, for if one of the ratios be formed of the reciprocals of the given numbers instead of the numbers themselves, the related numbers would stand as in direct proportion, thus, $\frac{1}{4}$ $\frac{1}{6}$ 10 15, or 6 4 $\frac{1}{10}$ $\frac{1}{15}$.

It is a property of proportional numbers, derived immediately from the definition, that the product of the first and fourth terms is equal to the product of the second and third. Hence, when three terms of a proportion are given, the fourth can be found. This is the object of all questions in the Rule of Three.

The preceding remarks apply exclusively to *geometrical* proportion, that is to say, when the proportion consists in the equality of ratios. Writers on arithmetic also mention *arithmetical* proportion, and *harmonical* proportion, for which see the respective terms.

PROPORTION. In the Fine Arts the most proper relation of the measure of parts to each other and to the whole. The Greeks used the word συμμετρια (symmetry), to express this idea. In many instances proportion may be considered as nearly synonymous with fitness, though there is a distinction between them, since every form susceptible of proportion may be considered either with respect to its whole as connected with the end designed or with respect to the relation of the several parts to the end. In the first case, fitness is the thing considered, in the second proportion. Fitness therefore expresses the general relation of means to an end, and proportion the proper relation of parts to an end. It is hence needless to dwell on the intimate connection that exists between beauty and proportion in all complex forms. Payne Knight, *in his Inquiry into the Principles of Taste*, has asserted that in many productions of art "symmetry is the result of arbitrary connection." It would be very easy to show the absurdity of this assertion, if we considered it worth the space.

PROPORTIONAL COMPASSES. Compasses with two pairs of opposite legs, by which distances are enlarged or diminished in any proportion.

PROPORTIONAL SCALES. See SCALES.

PROPORTIONALS. The terms of a proportion, of these the first and last are the *extremes*, and the intermediate the *means*, or the *mean* when the proportion consists of three terms. See PROPORTION.

PROPORTIONS, DEFINITE. In Chemistry. See AFFINITY.

PROPOSITION. [illegible] ence indicative," [illegible] Thus sentences in the form of command or question are [illegible] logical propositions to substance, into categorical and hypothetical, secondly according to quality, into affirmative and negative, thirdly, according to quantity into universal and particular. A categorical proposition is where the sentence affirms or denies absolutely, as "man is mortal." A hypothetical proposition is defined to be two or more categoricals united by a conjunction, as "if Caius is man he is mortal." There are several sorts of hypothetical, [illegible] conditional, disjunctive, [illegible] A proposition is one whose copula (or conjunction) is affirmative, as "man is mortal;" a [illegible] has a negative copula, as "man is not [illegible]." A universal proposition is when the predicate is said of the whole of the subject, as "all men are mortal;" "Caius is mortal," a particular, when it is said of part of the subject only, as "some men are rich." To these two species may be added the indefinite proposition, when the subject has no sign of universality or particularity, or is a singular noun which is either universal or particular according to the matter. The matter of a proposition is said to be either necessary, impossible or contingent, and if the matter of an indefinite proposition be either of the former, it is equivalent to an universal, if the last, to a particular, *e g* "birds fly," *i e* all birds — universal. "No birds are quadrupeds;" here the matter is impossible, and the proposition universal. "[illegible] *g* some birds — particular. [illegible] division of propositions according to quality and quantity is denoted by an arbitrary sign, *e g* A stands for an universal affirmative, in the logic used at Oxford; E for an universal negative, I for a particular affirmative, O for a particular negative.

A categorical [illegible] terms united by a copula [illegible] the first term, *i e* that of [illegible] denied, is the subject; the other (that [illegible] or denied respecting the first) the predicate. In the collocation of our language, the subject usually, but not invariably precedes the predicate. Thus, "Diana of the Ephesians (subject) is great" (predicate), is transposed into "Great is Diana of the Ephesians." In some languages, as Greek and Latin, the latter form of collocation is not less natural or usual than the former. When the subject of a proposition is accompanied (*see* TERM) it is said to be distributed when the universal sign (all, no, every, &c.) is prefixed, and the proposition consequently universal. The predicate is said to be "distributed" in all negative and no affirmative propositions, inasmuch as a negative proposition denies that any part of the predicate agrees with the subject, whereas an affirmative can *never* assert that every part of the predicate agrees with the subject, since can never do so necessarily, by the logical force of the proposition, although it may [illegible] predicate agrees with the [illegible] *g* "Cæsar was the first [illegible]." Two propositions are said to be opposed, when, having the same subject or predicate, they differ in quantity, in quality, or in both. The two universals (A and E) are termed *contraries* to each other, the two particulars (I and O) *sub-contraries*, the universals and particulars (A and E, I and O) *subalterns*, A and O, or E and I (those which differ both in quantity and quality) *contradictories*. A proposition is said to be converted when its terms are transposed, *i e* when the subject is made the predicate, and the predicate the subject. See CONVERSION OF PROPOSITIONS.

PROPOSITION. In Mathematics, a theorem proposed to be demonstrated, or a problem in which something is proposed to be done.

PROPRÆTOR. A Roman magistrate, bearing the same relation to the prætor that the proconsul did to the consul. (See PROCONSUL.) Under the emperors, propraetors as distinguished from proconsuls were appointed as governors to the imperial provinces, the latter being the servants of the senate.

PROPYLÆUM (Gr προπυλαιον). In Ancient Architecture the vestibule of a house. The vestibules or porticos at Athens, leading to the Acropolis, were thus denominated.

PRO RE NATA (Lat. *according as occasion may require*). A term commonly used in medical prescriptions.

PROROGATION. See PARLIAMENT.

PROSCENIUM (Gr προ *before* and σκηνη *a scene*). In Architecture the frontispiece or part in a theatre where the drop scene separates the stage from the audience and beyond the orchestra. In the ancient theatres it comprised the whole of the stage.

PROSCRIPTION (Lat. proscribere, *to proscribe, outlaw or doom to death, to confiscate one's property*). The most vindictive species of proscription was that introduced by Sylla when he wrested Rome from the hands of the Marian faction. It consisted in making out a list of persons supposed to be obnoxious to the state, and getting a sentence of condemnation passed against them, which made it unlawful to harbour a proscribed person. By these measures thousands of citizens perished in the civil wars of Rome. The most celebrated proscription was that of the triumvirs Octavius, Antony, and Lepidus, in which Cicero was slain.

PROSE (Lat. prorsa oratio, from prorsus, adv., *direct or straightforward*). In Literature, all language not in verse. [illegible] good or even admissible, in ordinary criticism, must be conformable to the rules of composition as to style, cadence, &c.

PROSELYTE (Gr προσηλυτος, *one who arrives as a stranger*). A term in use among the Jews after their connection with the Greeks and applied to such foreigners as embraced their religion. These they divided, according to the common opinion, into two classes, distinguished by the terms proselytes of the gate, and proselytes of righteousness. Of these the former were such as merely renounced idolatry, and believed in and worshipped the true God, observing the precepts of the natural law, and, from being admitted within the first gate of the temple, received this appellation. The latter class were those who submitted to circumcision, and in every other respect conformed entirely to the customs of the Jewish people. Dr Burton however, it must be admitted, thinks this distinction unfounded. (*Lectures on the Early History of the First Three Centuries*, I. iii.)

PROSENCHYMA (Gr προσεγχυω, *I pour still more upon*). Cellular tissue, the cellules of which taper to each end, and [illegible] each other at their extremities. It is the first [illegible] in the part of cellular tissue to the condition of woody tissue.

PROSERPINE. The Latin form of Persephone, the

name of a Grecian goddess, sprung from Jupiter and Ceres She was stolen from her mother by Pluto, who, enamoured of her beauty, carried her off from the plains of Enna in Sicily, while sporting with her companions, to the infernal regions, where she became his queen The wanderings of Ceres in search of her daughter were much celebrated by the ancient poets When she at last discovered the place of her concealment, a compromise was entered into, by which Proserpine was allowed to spend two thirds of the year with her parents and the rest with Pluto in his empire

PRO'SODY (Gr προς *to* and ᾠδη *song*, signifying, literally a guide or addition to verse or metre) The science which treats of quantity as accent and the laws of harmony, both in metrical and prose composition In the Greek and Latin languages every syllable had its determinate value or quantity, and verses were constructed by systems of recurring feet, each foot containing a definite number of syllables possessing a certain quantity and arrangement (*See* Foot) The versification of modern European languages, in general, is constructed simply by [illegible] They have therefore, no [illegible] Germans, however, have laboured to subject their language to the ancient metrical system, but with indifferent success

PROSOPO'GRAPHY (Gr προσωπον, *figure* or *person*, and γραφω, *I describe*) In Rhetoric a word used by some critical writers to signify the description of animated objects Of this figure the portraits of the horse and the leviathan in the book of Job are well known and beautiful examples

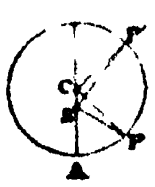
PROSOPOPŒ'IA (Gr προσωπον and ποιεω *I make*) A figure by which inanimate objects, or abstract ideas are personified, and addressed or represented by the poet or orator as if endowed with human shape or sentiments Milton's famous digression of Sin and Death in the *Paradise Lost* is at once a prosopopœia and an allegory

PROSPE'CTUS (Lat) in its most extended sense is applied to the outline of any plan or proposal submitted for public approbation but it is most usually confined to literary undertakings in which it signifies an outline or sketch of the plan or design of a work together with such other circumstances connected with the publication &c as it may be thought desirable to enlarge upon or make known

PROSTATE GLAND In Comparative Anatomy the prostate gland retains its single compact form in most of the Quadrumana but is bifid in the Ruminantia, in the Rodentia and Insectivora it is resolved into numerous slender elongated cæcal tubes, in the mole it is remarkable for its periodical increase of size

PRO'STATES (Gr) The name given to the guardians of the foreign settlers at Athens whose business it was to represent them in courts of law, and protect them from injury

PROSTHAPHE'RESIS (Gr προσθη and αφαιρεσις *subtraction*) A term used by the older writers on astronomy to signify the difference between the true and mean motion or the true and mean place of a planet or the quantity which must be taken from or added to the mean anomaly, in order to get the true anomaly




Let P (or P') be the place of a planet in its orbit S the sun C the centre and A the perihelion of the orbit, the angle A S P is the true anomaly A C P is the mean anomaly, and the difference between A S P and A C P is S P C, which is the prosthaphæresis If A C P be less than a right angle, S P C must be added to A C P in order to get the true anomaly, but if it be greater than a right angle the angle S P C must be deducted The angle S P C is called by modern writers the equation of the *centre* or equation of the orbit

PROSTHESIS (Gr προς, and τιθημι *I place*) A figure of grammar by which one or more letters are added to the commencement of a word, as in the common [illegible] &c *See* METAPLASM

PROSTYLE, or PROSTYLOS (Gr προ *before*, and στυλος, *a column*) In Architecture, a temple or other building with columns in its front face

PRO'TASIS (Gr προτασις from προτεινω *I stretch or put forth*) In Grammar and Rhetoric every properly constructed period (*see* PERIOD) is said to be naturally divisible into two parts, of which the first is termed protasis, the second apodosis In the ancient drama, the protasis was the exposition, usually contained in the first part of the piece, either by way of soliloquy or dialogue, serving to make known the characters and the plot to the audience

PROTEA'CEÆ (Protea, one of the genera) A natural order of arborescent, rigid, useless Exogens, inhabiting the hotter parts of the world, and found in dry, sterile, stony, exposed places, especially near to the sea coast They are known from *Elæagnaceæ* by the woody texture of their leaves; by the irregular calyxes having a valvate æstivation, with the stamens placed upon the lobes, and by the dehiscent fruit The genera *Banksia*, *Dryandra*, *Protea* and *Grevillea* are cultivated for the [illegible] beautiful foliage and flowers The seeds of *Guevina* are sold in Chili for the same use as hazel nuts with us One of the larger timber trees of New Zealand is the *Knightia excelsa*, a plant of this order

PRO'TECTOR In English History, a title which has been three times assumed by daring statesmen — 1 Richard, duke of York, in 1453, was appointed by parliament protector during pleasure 2 The duke of Somerset being constituted one of Henry VIII's sixteen executors, obtained a patent from the young king, Edward VI, in 1548, constituting him protector, with the assistance of the other fifteen as councillors, but he only enjoyed this dignity a few months, and his loss of it was soon followed by his death 3 Cromwell took the title of lord protector of the commonwealth of England, Scotland, and Ireland on the 12th Dec 1653, when the "Barebones Parliament" resigned its authority into his hand His son Richard succeeded him in his title and [illegible] but was never formally installed protector

PRO'TEST In Parliamentary Law, is a privilege peculiar to the members of the upper house of parliament of entering (by leave of the house always presumed) their dissent from a motion or resolution agreed to by a majority of the house together with their reasons for dissenting The paper embodying these reasons of dissent is called a protest and is entered on the journals Protests with the reasons, were first set down, according to Lord Clarendon in 1641 *See* PARLIAMENT

PRO'TESTANTS A general name applied to the various denominations of Christians which have sprung from the adoption of the principles of the Reformation in the 16th century The term was assumed, in the first instance by the reformers of North Germany, who in the year 1529 formally protested against a decree of the imperial diet held at Spires which ordained that the question between the parties should remain unsettled, some restrictions being laid upon the progress of the new opinions, until the calling of [illegible] to which was left uncertain [illegible] cried that the decree was unfavourable and unjust to their party and claimed the immediate summons of a lawful council which they knew it was the interest of the papacy, under the circumstances, to delay In the early period of the Reformation the principal reformed churches were two those of the followers of Luther and of Calvin the partisans of Zuingli having become nearly identified with the latter Since that time the number of subdivisions upon every point of doctrine and discipline has been infinite The general bond of union, however among all continues to this day to be the assertion of private judgment and rejection of any infallible head of the church or ultimate authority in pope or council We believe, also, that no Protestant church has ever relapsed into any one of the prominent results of the Romish system — such as the doctrine of the seven sacraments, of transubstantiation [illegible] the celibacy of the clergy or veneration [illegible]

There are however two lines of argument upon which these principles are maintained the respective assumption of which seems to constitute the strongest line of distinction among Protestants The first is that to which the German and Swiss reformers most generally leaned, which considers the Bible to contain within itself so complete a repository of divine truths as to be its own interpreter as well as the evidence of its own authenticity and inspiration The English reformers, on the other hand endeavoured to base their doctrines upon the practice of the first three centuries and appealed therein to similar principles with the Roman church, which they maintained to be corrupt, not in its origin, but in its growth

PRO'TEUS A marine deity of the Greeks, celebrated for his gift of divination, and the power of changing his form by which means he eluded those who resorted to him for information

PROTEUS In Zoology this name was originally and very aptly applied to a genus of Infusories, which, during life, never for a single minute maintain the same form; the species [illegible] as in the common species called *Proteus anguinus* The term was subsequently used by Laurenti to designate a singular amphibious reptile, peculiar to certain subterranean waters in Carniola, and which, like the American siren, retains the external gills, together with internal lungs or air-bags [illegible]

PROTHONOTARY (Lat proto notarius, or *first notary*) A title originally of the Byzantine empire The Apostolical prothonotaries of the Papal court are officers having precedence of the other notaries or secretaries of the Roman chancery, the papal "notaries participant" rank after bishops but before abbots In England officers in the courts of King's Bench and Common Pleas had this title, until the recent changes in those courts

PROTHORAX (Gr προ, *before*, and θωραξ, *a shield*.)

In Entomology, signifies the first segment of the thorax in insects, by Kirby the term is restricted to the upper part only or shield of that segment

PRO'THYRIDES (Gr προ, and θυρα, *a door*) *See* ANCONES

PRO'THYRUM (Gr προ, and θυρα) In Architecture, a porch before the outer door of a house

PRO'TOCOL (From the Latin protocollum a word derived from the Greek πρωτος *first* and κολλα *glue*, but the etymological significat on attached to this derivation seems unknown) The word protocol, in the French language signifies the formulæ or technical words of legal instruments, in Germany, it has been used to denote the minutes or rough draught of an instrument or transaction It is in the latter sense that the word has been borrowed by diplomacy, in which it signifies the original copy of any dispatch, treaty, or other document

PRO'TOTYPE (Gr πρωτος, *first*, and τυπος *a mark*) In the Fine Arts, the original pattern or model of [illegible] of imitation

PROTOZOA [illegible] ζωον *animal*) A name synonymous with Infusoria and Cuvier and applied to the simplest animals, or those which stand, as it were, on the first step of organization

PROTRACTOR A mathematical instrument for laying down angles on paper, used in surveying, plotting, &c

[illegible] consists merely of a semicircle divided into 180°, and subtended by a diameter, in the middle of which is a notch to mark the position of the centre On placing this notch over the corresponding point and laying the diameter along a given straight line, any angle or multiple of any number of degrees may be made by marking the point on the paper which coincides with the given degree on the limb, and joining this point with the centre when the instrument is removed The protractor is rendered more commodious by transferring the divisions to the edge of a parallel ruler

When a survey is to be plotted on a large scale, and it becomes necessary, in consequence, to lay down the angles with considerable [illegible] required The most approved protractor may be described as follows — It consists of a circular ring connected with its centre by four radial bars The centre of the metal is removed and a circular disk of glass fixed in its place, on which are drawn two lines crossing each other at right angles, the point of intersection denoting the centre of the protractor Round the centre, and concentric with the circle, is fitted a collar carrying two arms, one of which has a vernier at its extremity adapted to the divided circle, and the other a milled head which turns a pinion working in a toothed rack round the exterior edge of the instrument The rack and pinion give motion to the arms, which can thus be turned quite round the circle and set the vernier to any angle that may be required Each of the two arms is prolonged beyond the edge of the protractor, and carries a fine steel pricker which is pressed down when the instrument is placed in its required position and makes a small puncture in the paper It is essential that the points of the two prickers and the centre of the instrument be accurately in the same straight line (*Simms on Mathematical Instruments*)

In Anatomy, the muscles which draw forwards a part are termed *protractors*

PRO'VERB (Lat proverbium) A familiar saying which has been variously defined In point of form there are two species of proverbs, one containing a maxim directly expressed in a concise and familiar style, the other, in which a maxim is expressed [illegible] *e.g.* [illegible] or [illegible] *e.g.* [illegible] hot" In point of substance, proverbs are for the most part rules of moral, or, still [illegible] ial, conduct

In French, the term has been applied to short pieces in which some proverb or popular saying is taken as the foundation of the plot They originated [illegible] for the [illegible] theatre [illegible] the title of the last [illegible] successful writer of proverbs at the time of their highest popularity Those of M Theodore Leclercq at the present time, have met with considerable success

PROVERBS, THE, OF SOLOMON One of the canonical books of the Old Testament According to the arrangement in its present shape, the first nine books form a species of introduction, those from the tenth to the twenty-fourth contain the proverbs of Solomon, properly so called, and the remainder furnishes a kind of appendix, including the thirtieth and thirty-first, which contain the proverbs of Agur, the son of Jakeh, and of king Lemuel

PROVI'NCIA Those countries were called by the Romans provinces which, having been reduced under their [illegible] sent [illegible] settled by ten commissioners, dispatched from Rome in conjunction with the victorious general In its modern acceptation province signifies a grand division of a kingdom or state, comprising several cities towns, &c, all under [illegible] by the ex[illegible] diction

PROVISIONS, in the Navy, daily, 1 lb of biscuit, 1 oz of cocoa, ½ oz of tea, ½ of an imperial pint of spirits, or 1 imperial pint of wine, ½ lb of beef with ½ lb of flour, and ½ lb of pork with ½ a pint of peas on alternate days, or 1 lb of fresh meat with 9 oz of vegetables Part of the flour may be exchanged for suet, currants and raisins, 1 pint of oatmeal, and 10 oz of sugar a week After ten days of salt provisions, an allowance of lemonade

PROVI'SO In Law, a condition inserted in a deed on which its validity depends, commencing usually with the words "provided that," as also in acts of parliament

PROVI'SOR The title, in the ancient French Universities of an officer charged with the management of their external affairs, both spiritual and temporal, and to a certain extent with their discipline also The provisor of the Sorbonne was an officer of high importance [illegible] The principals of Napoleon's lyceum [illegible] rovisors, and the modern royal colleges retain it for the same functionary

PRO'VOST (contracted from Lat præpositus, *placed over*) The title of the chief municipal magistrates of Scotland, equivalent to mayor in England The chief magistrates of Edinburgh and Glasgow are styled *Lord Provost*

PROVOST OF A UNIVERSITY See UNIVERSITY

PRO'XENE (Gr προξενος) In Grecian Antiquities, officers at Sparta who had [illegible] strangers (Herodot vi) [illegible] Grecian republics, wealthy and distinguished men of particular states seem to have accounted it an honour to act as protectors of the citizens of foreign commonwealths thus, Alcibiades was *proxenus* of the Spartans at Athens

PRO'XIMATE PRINCIPLES Distinct compounds which exist ready formed in animals and vegetables, such as albumen gelatine fat &c in the former, and sugar gum starch resins &c in the latter, which are so called without reference to their ultimate composition

PRO'XY (Lat proximus) In Parliamentary Law, every peer spiritual or temporal, can (by license, supposed to be obtained from the king) constitute another lord of parliament of the same order with himself his proxy to vote for him in his absence Proxies cannot be used when the house is in committee, nor can a proxy [illegible] By an order of 20 2 no peer can hold [illegible] this two proxies See PARLIAMENT

PRUD HO'MME (Lat homo prudens) In France during the middle ages municipal tribunals composed of [illegible] or equitable jur[illegible] [illegible] jurisdictions of police &c, were termed councils of *prud hommes* In 1806 a court of this denomination was re-established at Lyons by a law of Napoleon, its principal office is the decision of disputes between masters and workmen in the silk manufacture

PRUNING The art of cutting off parts of plants, and more especially of trees and shrubs, with a view to strengthening those which remain or of bringing the tree or plant into particular forms, calculated to increase particular products Pruning differs according to the kind of plant or tree to be pruned and according to the object in view In the case of forest trees the general object of pruning is to increase the quantity of timber in the trunk by [illegible] the side branches, commencing at the lower part of the tree when it is quite young, and gradually advancing upwards as the tree increases in growth In the case of hedges, the object is to produce a dense mass from the ground upwards, which is effected by shortening the side branches In the case of pruning trees which are cultivated for the sake of their fruit or blossoms, the object is to thin out the branches so as to admit the light and air more freely to their leaves and blossoms, and to concentrate and increase the nourishment to the branches which remain In the case of trees, or shrubs cultivated for the beauty of their shapes, whether natural or artificial, the object of pruning is to deprive the trees or shrubs of all those branches which deviate from or interfere with the natural shape, or with the form which is intended to be produced by art In pruning with a view to produce fruit, it is necessary to know on what description of branches and buds the fruit is produced In some trees, as in the peach, it is generally produced on the wood of the preceding year, in others, as in the apple and pear, it is generally produced on wood of two years' growth; and in [illegible] the current year The general effect of pruning plants is to increase their longevity; since the tendency of all vegetables is to ex-

haust themselves, and, consequently, to shorten their duration, by the production of seeds In the operation of pruning the shoots are cut close to the buds or at a distance from them not greater than the distance of the branch to be cut off because, without the near proximity of a bud the wounds will not heal over In shoots which produce their buds alternately, the cut is made at the back of the bud, sloping from it, so as that it may be readily covered by bark in the same or in the following year This is readily done with a pruning knife by a slanting cut made at an angle of 45° with the direction of the branch, but, in the case of branches where the buds are produced opposite each other, either one bud must be sacrificed, or the branch must be cut off at right angles to its line of direction, and this is more conveniently done by the pruning shears The operation of pruning may in many cases be superseded by rubbing off, or pinching out, the leaf buds, so as to prevent superfluous shoots from being produced

PRU'NING KNIFE A knife the blade of which has a straight edge, formed of well tempered steel, and of no great breadth with a narrow point in order that it may be more readily introduced [illegible] Formerly pruning knives were [illegible] the cuts made by such knives had a tendency to crush the shoot, and leave a rough section, more readily injured by the air and water, and less likely to be speedily healed over Such knives, when of a large size, were ca[illegible]

[illegible] Shears in which one of the blades moves on a pivot which works in an oblong opening, instead of a circular one, by which means a draw cut is produced similar to that effected by a knife, instead of the crushing cut produced by common shears which fractures the section left on the branch, and renders it liable to become diseased or to decay, instead of being covered over with fresh bark Pruning shears are particularly adapted for [illegible] shrubs such as [illegible] gooseberries or roses

PRURI'GO (Lat prurio *I itch*) An itching of the skin with the eruption of small pimples The term is also medically applied to irritation of various parts of the body from other causes, as from vermin worms &c

PRU'SSIAN BLUE This beautiful dark blue pigment was accidentally discovered in 1710 by Diesbach, a chemist of Berlin The process for its preparation was [illegible] the *Philosophical Transactions* for 1724, by [illegible] It is made by adding solution of *ferrocyanuret of potassium* to persulphate of iron The ferrocyanuret of potassium is prepared by gently igniting carbonate of potassa with animal matters, such as horns, hoofs, or dried blood, in iron vessels by which cyanuret of potassium and some cyanuret of iron are formed, the soluble parts are then washed out with water, and sulphate of iron added until the Prussian blue which is formed ceases to be decomposed by the free potassa contained in the solution, the ferrocyanuret of potassium is then set to crystallize, and separated by repeated crystallization from sulphate of potassa It is thus obtained in truncated octoedral crystals of a yellow colour commonly called *Prussiate of potash* It is much used as a test of the presence of metals, and especially of iron, the peroxide of which it throws down from its solutions in the state of Prussian blue This compound has generally been considered as a ferrocyanate of the peroxide of iron, but, according to Berzelius, it is a double cyanuret, that is, a ferrocyanuret of the sesquicyanuret of iron Ferrocyanuret of potassium (prussiate of potash) is composed of 2 atoms of cyanuret of potassium ($66 \times 2 = 132$, and 1 atom of cyanuret of iron ($28 + 26 = 54$, and has, therefore the equivalent $(132 + 54) = 186$

PRU'SSIC ACID The composition and chemical characters of this acid are given under the head of *hydrocyanic acid* Prussic acid is frequently used medicinally as a powerful sedative and anti-irritant, especially to allay cough in phthysis, and to mitigate the spasmodic action in whooping-cough, but from its poisonous nature it requires to be employed with much caution The antidotes for prussic acid, where it has been taken as a poison, are solution of chlorine, by which it is chemically decomposed; and ammonia, which combines with it, and acts as a stimulant

PRY'TANES (Gr πρυτάνεις) The Athenian senate consisted of 500 persons, elected fifty from each of the ten tribes, each of these fifties took it by turn to preside with the title of Prytanes, having one tenth of the year assigned to it, or, more accurately speaking, 34 days were allotted to each of the first four tribes and 35 to the last six; the Attic year consisting of 354 days Each fifty was again subdivided into five bodies of ten, which, when prytanes, took it by turns to perform the duties of prohedri (προεδροι), seven days being allotted each From these prohedri, again, was chosen by lot an epistates (ἐπιστάτης) or president, whose office lasted one day

PSALM (Gr ψαλμος, from ψαλλω, *I sing*) A sacred song or hymn, originally accompanied with music The book of Psalms is called, in the Hebrew, *Thehillim* (*praises*), in conformity with the general object of the collection It seems to have been an article of faith, with most of the early fathers, that the Psalms were all of them composed by David, a strange notion, which the internal evidence of several immediately refutes The Jews divide them into 5 books, ending with the 40th, 71st, 88th, 105th, and last, respectively They, as well as all Christians, retain the number 150, but the divisions have varied There is an apocryphal 151st added in some Greek versions The 15 following psalms to the 134th, called by some 'gradual psalms' or "psalms of the stairs," a term of which various explanations have been given, are thought by Calmet and others to have been composed on the occasion of the deliverance from Babylon, possibly by Esdras, who is considered as the first collector of the Psalms, but they were at least partially used before, as early as the reign of Hezekiah

PSALMODY A general term applied to the whole subject of psalm-singing, &c

PSA'LTER A book of devotion containing the psalms See *Palmer's Origines Liturgicæ*, vol i p 207.

PSALTE'RIUM (Lat *a psalter or psalm-book*) The name of the manyplies or third cavity of the complex stomach of the ruminant quadrupeds, so called because it is occupied by numerous broad folds of membrane resembling [illegible] book

PSA'LTERY [illegible] of musical instruments among the ancient Jews [illegible] was called *nabhlum* (which see) It was [illegible] according to Burney, partly the lyre and partly the harp

PSE'PHOI (Gr) A general name given to several things made use of by the Greeks in giving their suffrages [illegible] as small stones, shells, [illegible] with the *calculi* and *tabellæ* of the Romans, which see

PSEUDEPI'GRAPHY (Gr ψευδης, *false*, and ἐπιγραφη, *inscription*) The ascription of false names of authors to works This was carried to a great extent among the Christians of the fourth and following centuries Thus, the verses known by the name of Sibylline are evident Christian forgeries, and it is extremely difficult to distinguish the spurious works of the Fathers from the true (See Gieseler, *Text-book of Eccl Hist*, 1st period, chap 3 sec 5? for a good section on Christian pseudepigraphy, *Fabricii Codex Pseudepigraphus*, Barbier, *Dict des Ouvrages Anonymes et Pseudonymes*, contains a notice of most works [illegible] to their [illegible] the French language)

PSEUDOBLEPSIS (Gr ψευδης, and βλεψις, *sight*) There are various forms of false vision, some apparently dependent upon nervous irritation, others upon organic derangement Specks, network, colours, and imaginary bodies floating or dancing before the eyes, distorted vision, double vision, are among the most common modifications of this complaint They occur in plethoric as well as in debilitated habits, and are the consequence occasionally of intense study, of weakening evacuations, of debauchery, of hysteria, and of hypochondriasis, the treatment, therefore, which is required is very various Attention to the stomach and bowels, local bleeding, camphor, ether, and other nervine stimulants, change of scene and occupation, varied exercise, are among the efficient remedies A very alarming case of double vision, with coloured circles in rapid motion dancing before the eyes, of two years' continuance, and brought on by too [illegible] study, gave way to cupping and to [illegible] the Highlands

PSEUDO BULB In Botany, an enlarged aerial stem resembling a tuber, from which it scarcely differs, except in being formed above ground, in the epidermis, being [illegible] and in retaining upon its surface [illegible] scars of leaves that at once bore

PSEUDODIPTERAL (Gr ψευδης, *false*, δις, *twice*, and πτερον, *a wing*) In Architecture a term denoting a building or temple wherein the distance from each side of the cell to the columns on the flanks is equal to two intercolumniations, the intermediate range of columns which would stand between the outer range and the cell being omitted

PSEUDOISODO'MUM (Gr ψευδης, ισος *equal*, and δομος, *a house*) In Ancient Architecture a species of masonry in which the height, thickness, and length of the courses are different *See* ISODOMUM

PSEUDOPODS, *Pseudopoda* (Gr ψευδης, and πους, *foot*) A name applied to a tribe of Polygastric Infusories, including those in which the body, by various contractions and changes of form, produces pediform processes

PSEUDOSCORPIONS *Pseudoscorpiones* A family [illegible] having the body divided into several segments, with two or four eyes, and six or eight legs the book-crabs (*Chelifer*)

PSEUDOTHYRON (Gr ψευδης, and θυρα, *a door*) In Architecture a false door

PSITTACINES, *Psittacinæ*, (Parrot tribe) The name of a [illegible] Scansorial birds, of which the genus *Psittacus* is the type.

**PSO'AS MUSCLE** (Gr ψοας, *the loins*) A large muscle upon the fore part and sides of the lumbar vertebræ It bends the thigh forwards, and assists in turning it outwards

**PSO'PHIA** (Gr ψοφεω, *I make a noise*) A subgenus of storks, having a shorter bill than the rest, with the head and neck covered only with a kind of down, and the circumference of the eye naked They frequent wooded regions, and subsist on grains and fruits The best known species (*Psophia crepitans*) is a native of South America, and is remarkable for the ambiguous sound which it emits from time to time and whence its specific name is derived This bird is easily tamed by the Spanish settlers in South America and is even taught by them to guide and defend the common poultry from the rapacious birds, as a shepherd's dog guards his sheep from the wolves

**PSO'RA** (Gr ) The itch *See* ITCH

**PSORIA'SIS** A rough scaly state of cuticle sometimes continuous and sometimes in patches, generally accompanied by chaps or fissures

**PSY'CHE** (Gr ) In Mythology a nymph whom Cupid married, after she had been persecuted by Venus The word signifies the soul, of which Psyche was considered the personification This beautiful allegory is first known to us by the romance of Apuleius but it is presumed to be of much earlier origin from its occurrence in relics of art La fontaine made it the subject of a pastoral and Mrs Tighe recently of a poem

**PSYCHOLOGY** (Gr ψυχη *the soul*, and λογος *discourse*) In its larger acceptation may be taken as synonymous with mental philosophy The word is more frequently used in reference to the lower faculties of the mind and the classification of the phenomena which they present All psychology is built on experience either immediate, or revived by the memory and imagination But, in reflecting on our intellectual faculties we discover in them certain laws, which as soon as they are presented to us we at once recognise as universal and necessary, certain conditions without the fulfilment of which we are sensible that no act of intellection could have taken place This universality is something very different from the empirical truth as a matter of fact which we attribute to the laws of association which are indeed universal but which might for aught we can see have been different from what they are Corresponding to this distinction German writers have discriminated between a higher or rational and a lower or empirical psychology the first that of Kant who sought in all our mental faculties, to determine that only which is necessary and immutable the second that of Hartley who treats all our intellectual acts as alike objects of mere history dependent for their validity only on the fact that they do really recur in such and such order The psychology of Aristotle was of the latter description He consequently, regarded the science as forming one of the physical sciences, or those which are conversant with the contingent and changeable Many pregnant psychological truths are discoverable in that philosopher's work on the soul, in particular, the doctrine of association the master-light of all sound experimental psychology owes its first enunciation to him Among later writers who have made valuable contributions to the science may be enumerated Hobbes, Locke Hartley and Sir Thomas Brown The value of these authors writings in this peculiar province cannot be too highly appreciated It is only when psychology intrudes upon the domain, or usurps the attributes, of the higher philosophy that its claims need to be resisted As a preparation for metaphysical and theological thought and indeed, as an indispensable requisite for the science of man whether history politics, or ethics, it is not easy to exaggerate its importance

**PSYCHOMA'NCY** (Gr ψυχη, and μαντια *prophecy*) A species of divination in which the dead were supposed to appear as spirits, to communicate the wished for information

**PSYCHROMETER** (Gr ψυχρος *cool* μετρον *measure*) An instrument invented by Professor August of Berlin, for measuring the tension of the aqueous vapour contained in the atmosphere It consists of two very sensible thermometers, one of which when an observation is to be made, has its bulb kept moistened, but so that no drop of water remains suspended from it The thermometers being then freely exposed to the air, the temperature indicated by each is observed, and also the height of the barometer from which data the tension of the vapour is computed by means of this formula —

$$e = e' - 0.000378\,(t - t')\,b;$$

where $b$ is the height of the barometer in English inches, $t$ the temperature of the air (in degrees of Fahrenheit), $t'$ the temperature of the wet bulb $e'$ the tension of vapour corresponding to the temperature $t'$ and $e$ the tension of the vapour actually existing The instrument is described in the work of August, *Sur les Progrès de l'Hygrométrie dans les Derniers Temps*, Berlin, 1830, also in the *Lehrbuch der* [illegible] and *Quetelet's Correspondence* [illegible] *et Physique* [illegible] série, tome 2

**PTERODA'CTYLE**, *Pterodactylus* (Gr πτερον *a wing*, δακτυλος *a digit*) The name of a genus of extinct reptiles in which the second digit of the hand is of extreme length, and is considered to have supported an aliform expansion of the skin

**PTE'ROPODS** *Pteropoda* (Gr πτερον, and πους *a foot*) The name of a class of Mollusks, comprehending those which have a natatory wing-shaped expansion on each side of the head and neck

**PTERY'GIANS** *Pterygia* (Gr πτερυξ, *a wing*) A name applied by Latreille to [illegible] tusks corresponding to the Cephalopoda of Cuvier, both of which have locomotive organs, composed of wing-like expansions of the skin

**PTERY'GODA** (Gr πτερυξ) Latreille has given this term to two small, hard, moveable bodies, in the form of little elytra, directed backwards and terminating at the origin of the wings They arise from the two sides of the anterior extremity of the trunk near the exterior base of the two first legs, instead of from the second segment of the trunk like true elytra They are present in Lepidopterous and Strepsipterous insects

**PTERY'GOID** (Gr πτερυξ and ειδος *form*) Wing-shaped The name is applied to processes of the sphenoid bone, which complete the osseous palate behind, and form distinct bones in the oviparous vertebrate animals

**PTISAN** (Gr πτισσω *I bruise*) A weak diluent drink

**PTOLEMAIC SYSTEM** *See* ASTRONOMY

**PTOLEMA'ITES** A sect of ancient heretics among the Gnostics who maintained that the Mosaic Law came partly from God partly from Moses and partly from the traditions of the Jewish doctors (See *Mosheim's Church History*)

**PTY'ALISM** (Gr πτυαλιζω, *I spit*) An increased flow of saliva Salivation

**PUBI'SCENT** (Lat pubescens *hairy*) In Zoology, when a part or whole is covered with very fine recumbent short hairs

**PU'BLICANS** (Lat publicani) The farmers of the public revenue of Rome They formed two distinct classes, the farmers general of the revenues who were regarded as belonging to one of the most honourable grades of citizens and deputies or under publicans of an inferior caste whose reputation was on a par with that of the most degraded citizens Hence in the New Testament, the τελωναι a word rendered publicans by the Latin translators are almost always placed in juxtaposition with sinners (See *Milman's Hist of Christianity*) This term was also applied as a nickname to the Albigenses, which see

**PUBLIC SAFETY COMMITTEE OF** (French Revolution) This famous body was formed out of the convention April 6 1793 and invested with very general powers to provide for the supposed welfare of the state, even the power of arrest and imprisonment was soon conferred upon it After the downfall of the Girondist party (see GIRONDISTES) this committee became the virtual government of France by a decree of Dec 4 1793 Its members were at this period elected every month but in general the same were re-elected From this period its history is in effect that of the revolution It appointed tribunals composed of committees invested with sovereign power to try offences against the state, over the whole country It was in the committee of public safety that the opposition to Robespierre originated, but on the overthrow of that personage its powers were limited by the convention, and on the introduction of the new constitution of October 1794, it became extinct along with the assembly out of which it had been formed

**PUCK** In Mediæval Mythology the 'merry wanderer of the night,' whose character and attributes are so beautifully depicted in the *Midsummer Night's Dream* This celebrated fairy is known by a variety of names; as *Robin good fellow* and *Friar Rush* in England, and in Germany as *Knecht Ruprecht*, but it is by his designation of Puck, that he is most [illegible] England Germany, and the more [illegible] He was the chief of the domestic tribe of fairies, or *brownies*, as they are called in Scotland, and innumerable stories are told of his nocturnal exploits [illegible] the wine, and cleaning the kitche[illegible] were asleep, are the most prominent The word is probably derived from the old Scandinavian púki, *a boy*, it is also synonymous with pug, or monkey, whose form this fairy is said to have most frequently assumed

**PU'DDING-STONE** A conglomerate of rounded pebbles cemented together by a fine-grained and generally silicious or sandy paste When select specimens are cut and polished they resemble a section of a plum-pudding and are often used for ornamental purposes, such as snuff-boxes and slabs

**PUERPERAL FEVER** A fever attended by peritoneal inflammation which comes on about the third day

after delivery The usual febrile symptoms are attended with great tenseness and tenderness of the abdomen the milk disappears, and the bowels are [illegible] by diarrhœa It is most common and dangerous to be [illegible] It is attended with great [illegible] ing modified according to the circumstances of the case, purging with calomel, saline sudorifics, and occasionally opium, to quiet pain and induce rest, are among the remedial means, but it often happens that great irritability of the stomach and bowels or even incessant purging and vomiting, are predominant symptoms, and the fever assumes a typhoid character, in which case the system requires support from cordials

PU'GGING [illegible] laid on the [illegible] floor, to deaden the sound between one story and another

PU'GIL (Lat pugillus) A quantity of any thing which may be taken up between the thumb and two fingers

PUISNE JUDGE (Norm Fr puisné, *younger*) The judges and barons of the King's Bench, Common Pleas, and Exchequer, with the exception of the chief justices and chief baron are so called

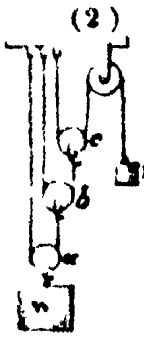
PU'LLEY In Mechanics one of the six simple machines, or mechanical powers It consists of a wheel, moveable about an axis, and having a groove cut in its circumference, over which a cord passes The axle is supported by a box or sheave called the *block* which may either be moveable, or fixed to a firm support

(1)



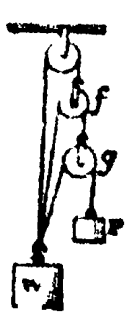

A single pulley serves merely to change the direction of motion, but several of them may be combined in various ways by which a mechanical advantage or *purchase* is gained greater or less according to their number and the mode of combination The purchase gained by any combination is readily computed by comparing the celerity of the weight raised with that of the moving power according to the principle of virtual velocities which is alike applicable to all machines of whatever kind. In fig 1, which represents a system where the several portions of the cord are parallel to each other suppose the weight W to rise 1 inch the two blocks would approach each other by that quantity and consequently, the length of cord connecting a single pair of pulleys would be shortened by 2 inches so that the power P would descend 2 inches Let the number of pulleys in each block be $n$, then while the weight ascends 1 inch the power descends $2n$ inches and consequently when there is equilibrium, the power is to the weight as 1 to $2n$

(2)




In the combination represented in fig 2 the purchase is much greater Here the pulleys are all moveable and each is supported by a separate cord having one end fastened to a fixed obstacle and the other attached to the succeeding pulley excepting the upper block which is fixed It is evident that, for every inch the weight on the first pulley $a$ ascends the second $b$ ascends two the third $c$ ascends four and so on, the velocity being doubled by each additional pulley The purchase finally obtained is, therefore, $= 2^n$, or the power is to the weight as 1 $2^n$

The third combination fig 3 has still greater efficacy In this system each cord is fastened to the weight and passing over a pulley is attached to another pulley excepting the last which supports the power While the weight W rises 1 inch the first moveable pulley $f$ will sink 1 inch which allows the cord applied to it to slacken 2 inches and this joined to the inch which the weight ascends allows the second moveable pulley $g$ to descend 3 inches This allows the next pulley in succession to descend 6 inches which, joined to the 1 inch which the weight ascends, gives 7 inches for the descent of the third pulley In like manner, it is found that the [illegible] pulley is 15 inches Hence, one moveable pulley allows the weight to descend $2 \times 1 + 1 = 3$ inches, two such pulleys, $2 \times 3 + 1 = 7$ inches, 3 pulleys, $2 \times 7 + 1 = 15$ inches, four pulleys $2 \times 15 + 1 = 31$ inches, and so on, so that the purchase obtained by $n$ moveable pulleys is $2^{n+1} - 1$, or the power is to the weight as 1 to $2^{n+1} - 1$ The theoretical advantages however, in all the cases, greatly [illegible] and the rigidity of the rope




The two last combinations are of little, if any, use in practice but various modifications of the first are common *Smeaton's pully*, or *Smeaton's tack*, as it is usually called, contains two rows of wheels, one under the other, in each block, and a single cord is made to pass over them in such a manner that the power and the weight both act in the same line with the centres of the two blocks, so that there is no tendency to twist But this ingenious arrangement is open to several objections, and particularly the great amount of lateral friction of so many independent wheels In White's pulley (*see fig* 1), the wheels in each block turn on the same axis, and consequently revolve in the same time, and they are of different sizes, their dimensions being so proportioned that a point on the circumference of any wheel moves with the velocity of the rope on that wheel To effect this the diameter of the wheels in the upper block must be as the numbers 1, 3, 5, &c, and in the lower as 2 4, 6, &c Instead of separate wheels, the upper and lower blocks are cut in grooves in the above proportions, whereby the friction is reduced to that of one wheel in each block

PU'LMOGRADES, *Pulmograda* (Lat pulmo, *a lung*, gradior *I advance*) The name of a tribe of Acalephans including those gelatinous species which swim by the contraction of the vascular margin of the disk shaped body, where respiration, also, probably takes place

PU'LMONARIES, *Pulmonaria* The name of the order of Arachnidans, including those which breathe by means of pulmonary sacs or lungs

PU'LMONATES *Pulmonata* The name of an order of Gastropodous Mollusks, including those which breathe air, to which the blood is exposed while circulating through a vascular network which lines the internal surface of the bronchial cavity

The order is subdivided into the *Pulmonata terrestria*, [illegible] in the Linnæan genera *Limax* and *Helix*, [illegible] Drap, and *Achatina*, Lam, and the *Pulmonata aquatica* [illegible] the genera *Onchidium*, Buchanan, [illegible], *Lymnæa*, Lam, *Physa* Drap, *Auricula*, Lam, *Conovulus* Lam

PU'LPIT (Lat pulpitum) In Architecture, the raised part in a public building from which an oration is delivered In the ancient theatre it was the higher part of the stage whereon the musicians stood

PU'LSE (Lat pulsus) The pulsation of the arteries depending upon the impulse given to the blood by the action of the heart (*See* HEART) The pulse is usually felt by pressing the *radial artery* at the wrist, and the rapidity, regularity and force of the circulation is thus judged of, and furnishes an important criterion of the phenomena and progress of disease The range of the pulse as to *frequency* in a healthy adult, is usually between 60 and 80 but there are persons whose pulses rarely beat 60 times in a minute, and others, not out of health in whom the frequency exceeds 80, the pulse, in short is extremely capricious, and before any correct inferences can be drawn from it the peculiarities of each individual require to be carefully considered, slight mental affections [illegible] irritability and many other causes produce [illegible] tions of the pulse do not admit of any general description The terms *hard*, *full* *soft* and *wiry* pulse, are used to indicate other obvious modifications independent of the number of pulsations The average rate of the pulse of a healthy infant is for the first year, from about 120 to 108, for the second year from 108 to 90, for the third from 100 to 80 from the seventh to the twelfth year, the pulsations are about 70 When the pulse exceeds 140 beats in a minute it is not easy to count it precisely, and to this it attains in some febrile diseases

An *intermitting pulse* is by no means uncommon, and often produced by trivial causes with many persons in perfect health the pulse will be subject to very extraordinary irregularities, and there are cases on record in which a person's pulse which has always intermitted in a state of health has acquired regularity on the accession of disease The state of the digestive organs has often a marked influence upon the condition of the pulse

PULSE Leguminous plants cultivated for their pods or seeds such as the pea bean kidney bean, &c

PULVILLI in Entomology are the cushions of short hairs very closely set or a membrane capable of being inflated or very soft and concave plates, which cover the underside or the apex of the four first joints of the manus or tarsus and sometimes even of the ends of the moveable spines situated at the apex of the *tibia*, which act so as to produce a vacuum and enable the insect to suspend itself, or walk against gravity

PU'LVINATED (Lat. pulvinar, *a pillow*) In Architecture a term used to express a swelling in any portion of an order, such, for instance, as that of the frieze in the modern Ionic order

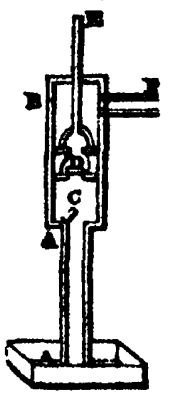
PU'MICE (Lat pumex) A porous volcanic product consisting chiefly of silica and alumina, with traces of potash, soda, and oxide of iron

PUMP A machine [illegible] water Though the forms under which [illegible] is constructed and the mode in which the power is applied may be modified

in an infinite number of ways, there are only three which can be considered as differing from each other in principle These are, the *sucking pump*, the *forcing pump*, and the *lifting pump*, so called from the manner in which they act

The *sucking pump*, or common household pump, is an apparatus of which the principle and construction will be evident from the annexed figure A A is a pipe of any convenient length, the lower end of which reaches below the surface of the water in the well or reservoir, B is a barrel generally of greater diameter than the pipe, C a valve opening upwards, D a piston moved by the rod F in this piston there is also a valve opening upwards When the piston is raised, the air in the barrel between the valves is expanded, and its tension consequently diminished, the pressure of the air in the pipe, therefore, opens the valve C, and the whole air in the pipe and barrel becomes less dense In this state the atmospheric pressure on the surface of the water causes it to rise in the pipe, until the tension of the confined air becomes equal to the pressure of the atmosphere On again depressing the piston, the valve in it opens, and the air passes through it from the barrel as it descends, but the valve C is closed by the downward pressure, and the volume of water which has entered the pipe remains On again raising the piston, the same effect is repeated, and an additional quantity of water enters the pipe Thus, by the alternating motion of the piston, a column of water is raised in the pipe until it reaches the piston when at the bottom of the barrel, and the whole of the air below it has been excluded On raising the piston when the water has reached it, the fluid will be compelled to follow by the pressure of the atmosphere on its surface in the well When the piston is again depressed the water flows through the valve in it, and ascends into the barrel, and by the succeeding strokes of the piston is lifted up until it reaches and flows out of the spout F

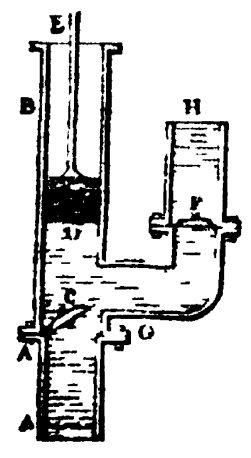
(1)




Although in theory the limit of the height to which water may be raised by the sucking pump from the surface of the fluid in the well to the highest position of the moveable piston, is about 34 feet (the height of a column of water which balances the pressure of the atmosphere), it is not found practicable with pumps of the ordinary construction to raise it more than about 28 feet The difference arises from the difficulty of making the apparatus absolutely air-tight

The *forcing pump* is represented in fig 2 The piston-rod F D is attached to a solid plunger D, adjusted to the cavity of the barrel A pipe G H, furnished with a valve F, opening outwards communicates with the barrel at G On elevating the plunger D the water will ascend through the valve C, in the same manner as in the sucking pump, till the barrel is filled when the plunger is depressed the valve C will shut, and the water between D and C be forced through the valve F into the pipe G H When the plunger is raised, the valve at F shuts, the pressure on its under side being removed, so that the water which was forced into the pipe by the previous stroke cannot return into the barrel At the next stroke of the piston more water is again forced into the pipe, and so on till it is raised to the height required

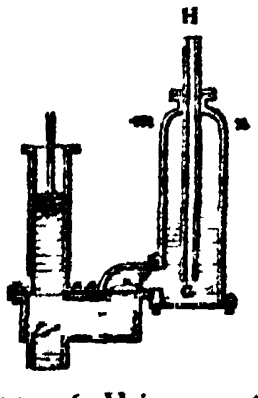
(2)




In this pump the pipe A A may be dispensed with, and the barrel B immersed in the reservoir, in which case the action of the pump is independent of the atmospheric pressure, and could be maintained equally well in a vacuum

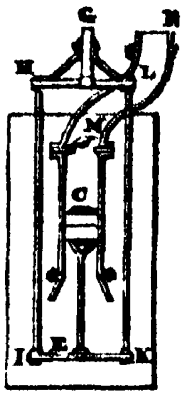
In order to produce a continued stream through the pipe G H, an air vessel *m n*, may be attached to the lateral branch above the valve F, fig 3 The pipe G H reaches to near the bottom of the air vessel, and when the water has been forced into the vessel by the action of the pump, until it reaches above the lower end of the pipe at G, it is evident that, as all communication is then cut off with the external atmosphere, every additional quantity of water thrown into the vessel will tend more and more to compress the air within it, which, acting by its pressure on the surface of the water, forces it through the pipe G H in a continued stream

(3)




The *lifting pump* is represented by fig 4 The barrel of the pump is immersed in the water and fixed to an immoveable frame. The piston with its bucket and valve C, opening upwards, is attached at E to another frame, G H I K L, consisting of two strong iron rods, H I and L K, which move through holes in the frame-work to which the pump is fixed An inclined branch M N, either fixed to the top of the barrel, or moveable by means of a ball and socket, is fitted exactly to the barrel, and furnished with a valve at M Suppose the barrel immersed in the water to a certain depth if the piston frame be now thrust down [illegible] sure through the valve C, so as to maintain the same level in the pump as in the well But when the piston frame is elevated, the valve C will shut (as shown in the figure), and the water above C be *lifted up* with the piston, and forced through the valve M into the branch M N, from which its return will be prevented by the shutting of the valve M when the piston descends

(4)




In each of these different kinds of pumps which have been described, the total effort required to work the machine, independently of friction, is equal to the weight of a column of water, the base of which is equal to the area of a section of the working barrel, and the altitude equal to the distance between the surface of the water in the reservoir and the point to which it is raised In the sucking pump the whole of this effort is expended in raising the piston, in the forcing pump, one part is expended in raising and the other in depressing the piston, and it is advantageous to dispose the machinery so that these two parts shall be nearly equal In small pumps for domestic purpose, the strength of man is usually employed as the moving power, but in raising water from great depths, as the bottoms of mines, the steam engine is applied to this purpose (*See* FIRE ENGINE) For an account of the mechanism of different kinds of pumps, see *Gregory's Mechanics*, vol ii

The *chain pump* used in ships of war consists of an endless chain moving over a wheel on the gun-deck which is turned round by winches, and over a second in the pump-well, having saucers or flat circular pistons at certain intervals Near the pump well, on the side on which the chain on turning the winches ascends, are a few feet of pipe, through this the saucers raise the column of water which being lifted [illegible] of the pipe, falls into the cistern, [illegible] waste-pipe called the *pump-dale*, which carries it overboard [illegible] portion of chain falls through [illegible] *case* Chain pumps, in large ships [illegible]

PUMPERNICKEL The name of a species of bread peculiar to Westphalia it consists of bran, has a little acidity, but is agreeable to the taste, and very nourishing and remains moist for several months It forms the chief food of the Westphalian peasants, but it is regarded as a great delicacy in other parts of Germany, whither it is exported in large quantities They sometimes weigh 60 lbs The term is said to be of French derivation and originated in a French soldier having rejected the bread with disgust, exclaiming, C'est bon pour Nickel,' *i e* for his horse

PUN A play upon words, the wit or point of which depends on a resemblance between the sound and syllables of two or more words, which have different, and perhaps opposite, meanings *See* PARONOMASIA

PUNCHEON In Architecture, a short post The small quarters in a partition above the head of a door are called puncheons

PUNCHEON A measure of capacity for liquids, containing 84 gallons or one third of a tun

PUNCTATE (*L at* punctum, *a point*) In Zoology, when a part is beset with many points or minute impressions, [illegible]

PUNCTUATION The [illegible] words, propositions, or sentences from each other by means of certain marks or points, designed to facilitate the apprehension, or to regulate the enunciation of written language Points or stops are said to have been first used by Aristophanes, the Alexandrian grammarian but the modern system of punctuation is due to Manutius a learned printer, who lived at Venice in the 15th and 16th centuries The [illegible] The comma (,), [illegible] important divisions of a sentence or passage, as, for instance, before and after qualifying propositions or clauses; between single words not connected by conjunctions, before conjunctions which unite sentences, &c 2 The semicolon (;), which distinguishes the longer or more important members of a sentence, as when the latter part is an inference from, or qualification, explanation, or illustration of, the former 3 The colon (:), which is chiefly used to distinguish such members of a sentence as are themselves divided by semicolons into two or more principal

parts 4 The period or full stop ( ) which stands at the end of a complete sentence Besides these may be enumerated the note of interrogation , ) or inquiry , of exclamation ( ) expressing admiration endearment, or any considerable emotion , the parenthesis ( ), used when a clause is inserted which interrupts the progress of the sentence ; with other marks, either less commonly used, or the rules for whose use are less easily defined

PU'NDIT (more correctly written Pandit) The title of learned Brahmins in Hindoostan The term is used ironically in England to designate any one who makes a vast show of [illegible] reality

PU'NIC WARS [illegible] celebrated contests in which the Romans and Carthaginians were engaged for more than three centuries, and which finally terminated in the destruction of Carthage The first commenced A C 264, and ended A C 241 , the second lasted from A C 218 to A C 202 , the third from A C 149 to A C 147 ending with the destruction of Carthage

PU'NISHMENT (Lat pœna *punishment* ) In Jurisprudence, the infliction of suffering, under legal sanction, upon those who have violated the law

It is undoubtedly true that both in legislation and in public opinion respecting punishment the *inductive* theory which considered it as a retribution for crime , and to be governed by our moral feelings of indignation against the offender, has far too generally prevailed and that the primary end, the interests of society, has been overlooked But we are not quite certain whether the present course of opinion does not run too exclusively in the contrary direction , and whether those who adopt the common formula, that "the object of all punishment is the prevention of the offence in future," have reflected on all the consequences of that position

For instance, it is the common practice in this country as well as in others, to connect the administration of justice with the enforcement of the tenets of religion In passing sentence wherever there [illegible] rule fails [illegible] not merely in its tendency to injure society but subjectively as evidencing moral depravity in the person committing it The solemnities of public worship which form part of the [illegible] grand jury), the language in which the jury is commonly addressed both by the judge and the advocates , all these seem based on the assumption, that the moral quality of acts is one of the matters to be brought under their consideration But if the judge has really no concern whatever with that moral quality, and is simply there to see that society may be guarded as far as possible from exposure to material injury by fraud or violence all these ceremonies are utterly out of place They must either be defended as politic devices employing the machinery of religion to aid in terrifying offenders from the commission of crime , or as concessions to popular ignorance And it is certain that in such a case they had far better be abolished altogether, as they strongly lead the mind to dwell on that false view of the object of punishment, which it is the object of Bentham and his school to extirpate

Again, in popular estimation the moral atrocity of an offence is one of the elements in the correct measure of punishment On whatever ground philosophers may object to sanguinary laws, this plain objection is that which has always prevailed in the public mind In the case of forgery for example, the feeling of the majority triumphed in the end over the severity of the law, not because it was thought disproportioned to the injury inflicted on society, or to the importance of repressing the crime, but because it was thought not to deserve it in a moral point of view Now all such expression of sentiment, on the theory in question is founded on a wrong principle , and the writers who adhere to it are forced to admit this feeling as a disturbing cause preventing the right doctrine from being fully carried out , they are forced to admit, as part of their definition of a good punishment, that it shall not be such as to shock the popular notion of moral justice , which is in other words, to admit that penal laws must be governed in part by principles which they condemn as altogether wrong , a very mischievous concession for a legislator to make

That the interest of society is the great object of punishment must be conceded on all hands That the specific object of preventing the offence from being committed is a very important part of that general object, probably by far the most important, may also be conceded But the question is, whether the general object does not comprehend other particular objects also , and whether a punishment which should [illegible] degree the advantage of repressing that particular offence or class of offences, might not be imperfect notwithstanding

This question can only be solved by deciding the great preliminary difficulty of political science, in which so many others are involved , whether the ruling power, which we call the state, or society, or the legislature, has or has not any *moral* authority Those who conclude that it has nothing to do beyond preserving the personal security and property of individuals, of course deny that it has any But those who believe that it has, also, what may be termed a paternal power, and is entrusted by Providence with the maintenance of religion and moral principle, must, consistently, admit that there may be a moral object in punishment beyond the mere prevention of the offence

And it must be observed in passing, that those who do hold the state to possess such a moral authority, and have such moral duties imposed upon it, need not, therefore, hold those to be its principal objects It may very well be that the primary object of the association of men in a political body is security and self defence , yet that association may have other ends not inconsistent with this And although those other ends are in themselves incomparably the most important, it does not at all follow that they are the most important as regards the state When men enter into a particular contract with each other, their mutual duties under that contract are primarily those connected with the object of that contract , they may have other and more important mutual duties, which yet, as regards that contract, are secondary No religious man will deny that the connexion of master and servant involves some duties of a very exalted character , but the principal object of that connexion is, nevertheles [illegible]

We [illegible] but [illegible] as admitted, and consider the effect of that admission on the theory of punishment In the first place, it would be a mistake to suppose that it justifies retribution as an object of punishment No [illegible] justice who cannot judge of [illegible] moral authority of the state, even by those who have carried its divine character to the highest point, has only been likened to the paternal , and no father has the right to chastise a child by way of retribution He has no right to punish at all except with a view to reformation Omitting this mistaken end, the real objects of punishment may be classed as follows —

1 The interests of society , which must be subdivided into

i Its security from the injury to person or property occasioned by the crime

ii Its moral [illegible] prevention

And 2 The [illegible] offender This is admitted as one of the ends of punishment by all writers , but Bentham and his followers regard it as such only so far as it conduces to the security of society by preventing the repetition of the offence , those who embrace the higher view both on this account, and also as the fulfilment of the duty of the state towards the offender himself Considered in either view, it is clearly a secondary object only, the good of society being the first

The security of society is attained by punishment in four ways

1 By forcibly preventing the offender from repeating his offence as by death, mutilation, or perpetual imprisonment

2 By reforming the habits of the offender, and thereby taking away the desire

3 By deterring the offender from repetition by the fear of fresh punishment

4 By deterring others through example And this last is clearly the chief practical [illegible] The admission of other principles, [illegible] necessary in order to satisfy our conception of the existence of the state as a moral agent, need not prevent the [illegible] keeping this steadily in view

[illegible] forbid us from pursuing farther the analysis of punishment, and pointing out in what manner the different kinds and degree of it principally in use follow, or depart from their legitimate ends We will conclude with the classification of punishments given by Bentham, in his *Theorie des Peines* to use the title of the work as given by his translator Dumont If Bentham's theory be defective in its main principles (and although we have presented the reader with [illegible] it, we do not assert that they [illegible] it is at all events only from being imperfect, not erroneous , as far as it goes it is logical consistent and definite And as he was nearly the first writer who introduced [illegible] or arrangement into the [illegible] we are inclined to think that on the whole, he has done more for society in this particular than in any other of the various subjects to which he applied his reforming genius It must not be forgotten that Sir S Romilly and Sir J Mackintosh were the pupils who carried his speculations into practice

He divides punishments into corporeal and privative The first of these are, 1 Simply afflictive, those which consist in the mere infliction of temporary pains, the lash, &c 2 Complexly afflictive, in which pain is joined

with permanent loss, as in the old punishments of mutilation and disfigurement 3 Restrictive, under which he classes together perhaps rather inappropriately imprisonment or the total deprivation of [illegible] and banishment with [illegible] as the galleys, hard labour, &c [illegible] this character with the former 5 Privative punishments are those which deprive the criminal, 1 Of life, 2 Of reputation *only*, such, perhaps, as the amende in French law 3 Of property fine, and confiscations 4 Forfeiture of condition, which, more or less, accompanies infamous punishments in most countries e g civil incapacity in France is attended with various disabilities These eight comprehend all the simple forms of punishment in ordinary use, but he adds a few, which he terms anomalous and only mentions to hold them up to general reprobation 1 What he calls *vicarious* punishments, as when the family of a suicide are punished by the forfeiture of his chattels 2 Transitive, when the penalty passes to future generations corruption of blood in the English law 3 Collective, of which he gives as an instance the [illegible] punishment of corporations for the acts of [illegible] corporators, a more ordinary one is, the compelling the inhabitants of a hundred to make good the damages occasioned by a riot 4 Fortuitous, where individuals wholly unconnected with the offender are implicated, as it were casually in the consequences of his crime, of which he gives as an instance, the avoidance of mesne conveyances by some kinds of confiscation, and consequent loss of innocent purchasers, and the imposition of deodands, where no negligence is imputed (See also *Ed Rev* vol xxii, where his work is reviewed, Lucas, *Systeme Penal*)

PU'PA (Lat pupa, *a puppet*) A genus of land snails, so called from the resemblance of the shell to the pupe, or chrysalis of an insect Several species are British, as *Pupa umbilicata*, Drap, *P marginata*, Drap, *P edentula* Drap

PUPE (Lat pupa) The name of the oviform nymphs of Lepidopterous insects, also applied to Metabolian insects generally, when in the second stage of their metamorphosis

PU'PIL (Lat pupa) A term applied to the central opening of the eye, because it reflects the diminished image of the person who looks into it It is the central aperture of the *iris*

PU'PIPARES *Pupipara* (Lat pupa and pario, *I bring forth*) Those insects are [illegible] produce their young in the condition of a pupe or nymph, as the forest fly *Hippobosca equina*

PU'PIVORES *Pupivora* (Lat pupa and voro *I devour*) The name of a tribe of Hymenopterous insects comprehending those of which the larvæ live parasitically in the interior of the larvæ and pupæ of other insects

PURA'NA (Sanscrit, *a poem*) The sacred books of India which contain the explanation of the Shaster (which see) There are eighteen books of the Puranas, chiefly filled with legends of the inferior gods and the heroes of Hindostan (See *Mem de l Acad des Inscr* vol xxxviii) It should be stated, that Professor Wilson intimates his disbelief of the received opinion as to the great antiquity of the Puranas, and believes the writings now known under that name to be mere imitations of lost originals (Preface to his translation of the *Vishnu Purana*) See *Asiatic Journal*, Dec 1840

PURBECK LIMESTONE *See* GEOLOGY

PU'RCHASE, in Law, means generally, the acquisition of lands or tenements by any other means than descent as by [illegible] deed, or agreement

PU'RGATORY A place appointed for the satisfaction of temporal punishments, which, according to the Roman Catholic church, are distinguished from the eternal of which the latter only are remitted to us by the death of Christ There is none perhaps of the peculiar articles of the Romish faith in favour of which so little can be advanced from the language of scripture, and it may be safely averred that it was not from that source that the opinion ever gained possession of men's minds It seems to be a natural but too strict an inference from the imperfectly disclosed economy of the divine judgments, which we find to admit of every degree of severity in this life, and are liable to conclude from analogy must be subject to some equivalent adjustment in the next Accordingly we discover so [illegible] recognitions of the idea in individual writers several centuries before it can be proved that it formed an established article of faith Augustin is considered the earliest of these, and he speaks [illegible] It was first inculcated as a [illegible] Gregory the Great who seems to have connected it with the then popular belief that the world was closely approaching to its end It was much discussed between the Greeks and Latins at the council of Ferrara 1438 The present Roman Catholic belief is thus expressed in the creed of Pope Pius IV —"Constanter teneo purgatorium esse animasque ibi detentas suffragio fidelium juvari" To which it may be added, that the sins punished in Purgatory are of two kinds,—mortal, repented of, and [illegible] of the creed is derived from the canons [illegible] Trent on the subject, sess 25 The "Romish doctrine" of Purgatory is condemned by Art 22 of our church. The reader will find a good [illegible] to Purgatory well stated (and [illegible] Hooker in his 3d Sermon the latter part, in which he replied to it, is lost It is also set forth with much learning and moderation in *Tracts for the Times*, No 79

PURIFICATION An observance enjoined by the law of Moses upon occasion of certain accidental defilements, which are scrupulously recorded in the Levitical code The purification was generally by water, and in the case of women, who were considered impure after childbirth for the space of forty days if delivered of a male, and eighty if of a female the offering of a lamb and some other sacrifices was required The purification of the Virgin Mary is a festival in the calendar, and is observed on the 2d of February, being forty days after Christmas This festival was established in the 6th century, and is variously termed in ecclesiastical antiquities by the names of ὑπαπαντη Festum Candelarum Candlemas, the Presentation The processions of this day were instituted by Gregory the Great For an account of the ceremonies of purification among the Greeks and Romans, see the article LUSTRATION

PU'RIM The name of the solemn festival among the Jews in which they commemorate their deliverance from the wiles and stratagems of Haman as recorded in the book of Esther The observance of this festival has been religiously maintained by all the Hebrew race from its institution down to the present time It is held in February

PU'RIST A name sometimes applied to rigorous critics of purity in literary style

PU'RITANS The name by which the dissenters from the church of England were generally known in the reign of Elizabeth and the first two Stuarts The term was assumed as the word implies, from the superior purity of doctrine and discipline which the more violent reformers claimed as their own maintaining that they followed the word of God alone purified from all human inventions and superstitions of which they believed the English church to retain a considerable share notwithstanding its alleged reformation [illegible] the use of the name commenced about [illegible] *History of the Puritans*) See DISSENTERS

PURLIN In Architecture, a piece of timber lying on the principal rafters to support them in the middle

PU'RPLE (Gr πορφυρα) In Painting, a colour produced by the mixture of red and blue, and thence partaking of the hue of each Among the ancients, purple was always the distinguishing badge of power and distinction and of all the various kinds in use, the Tyrian dye is the most celebrated This colour was produced from an animal juice found in a shell fish called murex, or conchylium, the quality of which, however, varied with the different coasts on which it was caught

PURPLE OF CASSIUS A compound of the oxides of tin and gold, obtained by adding protochloride of tin to a solution of chloride of gold The true nature of the compound has not been determined, it is used as a purple colour for porcelain painting, and also for staining glass to which it imparts a fine ruby red

PU'RPURA An eruption of small purple specks and patches caused by extravasation of blood under the cuticle, it is generally attended by constitutional debility and often by fever Aperient medicines and sometimes purgatives, carried to a greater or less extent, followed by mild tonics, and in some cases by wine bark, and acids, are the principal remedies, but in the treatment, much will depend upon the concomitant symptoms

In Zoology *purpura* is a generic name of the univalve Gasteropod which secretes the purple fluid which formed the base of the Tyrian dye

PU'RPURI Purple In Heraldry, one of the colours or tinctures used in blazonry It is equivalent to amethyst among precious stones, Mercury among planets In engraving it is represented by diagonal lines from the sinister to the dexter side of the escutcheon

PURPU'RIC ACID A substance resulting from the action of nitric acid upon uric acid, it forms deep red or [illegible] with most bases

PURPURIFERA *Purpurifera* (Lat purpura, *purple*, fero, *I bear*) The name of a family of Gastropodous Mollusks, including those species which secrete the purple [illegible] the ancients

PURSER An officer [illegible] British navy, whose chief duty consists in keeping the accounts of the ship to wh[illegible] at he also acts as purveyor

PURSUIVANTS In Heraldry, a kind of probationers in the Heralds' College of England, not admitted to the full privileges of the college, but advanced by succession into its higher offices They are styled *Portcullis*, *Rouge Dragon*, *Blue Mantle*, and *Rouge Croix*

**PURVE'YANCE, or POURVEYANCE** (Fr pourvoir, *to provide*) In English Law the providing necessaries for the king's house The right of purveyance or preemption, i e of buying necessaries for the household impressing horses and carriages to use or on payment of a settled price, even against the will of the owner, was a valuable part of the ancient prerogatives of the kings of England, especially in times when the court was frequently in progress It was abolished by 12 Ch 2 c 24, and has only been occasionally revived since that time by temporary acts for special purposes The name of "purveyor" had long before become so odious, that by 36 Ed 3 c 2 it was changed into "buyer"

**PUS** (Lat) A bland yellowish fluid, somewhat like cream, found in abscesses, and formed upon the surfaces of what are termed healthy sores, it is heavier than water, and viewed under the microscope, appears composed of translucent globules floating in a colourless fluid

**PUTA'MEN** In Botany, the inner coat, or shell, or stone of a fruit, commonly called the endocarpium

**PU'TLOGS** (Etym uncertain) In Architecture short pieces of timber used in scaffolds wherever the scaffold boards lie They are placed at right angles to the wall, one end of them resting on the ledges of the scaffold, and the other on holes left in the wall

**PUTREFA'CTION** (Lat putrefactio) The spontaneous decomposition of animal and vegetable substances, attended by the evolution of fœtid gases The putrefaction (or putrefactive fermentation) of animal substances is usually attended by more fœtid and noxious exhalations than those arising from vegetable products This appears principally referable to the more abundant presence of nitrogen in the former, and hence those vegetables which abound in nitrogeniferous principles (such as most, if not all, of the cruciform plants) exhale peculiarly nauseous effluvia hence, also such animal products as are destitute of nitrogen are either unsusceptible of what is commonly called putrefaction or suffer it slowly and imperfectly The formation of ammonia or of ammoniacal compounds, is a characteristic of most cases of animal putrefaction, while other combinations of hydrogen are also formed especially carburetted hydrogen together with complicated and often highly infectious vapours or gases in which sulphur and phosphorus are frequently discovered These putrefactive effluvia are for the most part easily decomposed and resolved into new and comparatively innocuous compounds by the agency of chlorine, hence the importance of that body as a powerful and rapidly acting disinfectant

The rapidity of putrefaction and the nature of its products, are to a great extent influenced by temperature moisture and access of air, they do not ensue below the freezing point nor in dry substances, nor under the entire exclusion of oxygen, and hence various means suggest themselves of retarding or preventing putrefaction, as well as of modifying its results a temperature between 60° and 80° a due degree of humidity, and free access of air, are the circumstances under which it proceeds most rapidly The most effective antiputrefactives or antiseptics are substances which either absorb or remove a portion of the water or moisture and enter into new combinations with the organic matter hence the great efficacy of certain salts, sugar, alcohol and several other applications, among which perhaps the most remarkable are some of the volatile oils, such especially as kreasote and other volatile products obtained by the destructive distillation of wood, and pyroligneous acid and pyroligneous spirit, the latter is eminently useful in the preservation of dead bodies for the purposes of dissection and, when properly and sufficiently injected into the vessels and externally applied, indefinitely suspends all the ordinary steps of the putrefactive process

The astringent or tanning principle of vegetables is also a powerful preserver of most organic tissues, it enters into chemical combination with the albuminous and gelatinous membranes and fibres, and the resulting compound, of which leather furnishes a characteristic example, is comparatively little prone to change, although the tanning material itself, as well as the animal principles with which it unites, are separately liable to decay

Among saline substances the antiputrefactive powers of salt are commonly known when a piece of flesh is salted, brine runs from it, in consequence of the energy with which the salt abstracts the component water of the muscular fibre, the flesh becomes indurated, and its susceptibility to putrefactive changes greatly diminished, it becomes at the same time less easy of digestion as an article of food Corrosive sublimate is a far more powerful preservative than common salt, and it appears to act not by the mere abstraction of water, but by entering into chemical union with the fibre Sulphate of copper and several other metallic salts are similarly efficacious, and the most putrescible substances, such as the brain for instance, after having been steeped in such solutions and dried, will remain without further change for an indefinite period the poisonous nature of these and many other metallic salts prevents their employment in the preservation of articles of food

It is probable that the ancient Egyptians employed several of the above-mentioned antiputrefactive and preservative substances in the preparation of their mummies, which have remained for so many hundred years without signs of decay or decomposition and similar cases, when by the careful application of various solvents the preservative substances are removed, the flesh resumes its susceptibility of putrefaction

The inhabitants of northern climates avail themselves of freezing to prevent the putrefaction of their food, and the supplies of game and other articles in the Russian markets are retained in a frozen state, our fishmongers resort to the same expedient for the preservation of their unsold fish, which is daily removed to the ice-house after having been exhibited in their shops, salmon is packed in ice for the purpose of transport and preservation

It is curious to remark the wonderful influence of [illegible] changes which constitute [illegible] that arrangement of the organic elements requisite for the functions of life, when a part of the body dies, the phenomena of gangrene or mortification ensue, that is, of local putrefaction the putrefactive changes are the more energetic in consequence of the proximity of the dead part to the living

All organic tissues may be indefinitely preserved by cautious desiccation, and it is in consequence of the absence of component water that the animal part of bone resists putrefaction dried bones may thus be stored up for ages and when it is required to extract their nutritive parts these are found unimpaired

**PU'TTY** In Architecture, a very fine cement used by plasterers, made of lime only It differs from *fine stuff* in the manner of preparing it, and in its being used without hair Also a composition used by glaziers, consisting of oil whiting &c

**PY'CNITE or SHORLOUS TOPAZ** (Gr πυκνος, *thick*) A prismatic mineral found at Altenburg in Saxony

**PY'CNOSTYLE** (Gr πυκνος, and στυλος, *a column*) In Architecture, an arrangement of columns, in which the intercolumniations are equal to one diameter and a half of the columns

**PY'GMY** *See* PIGMY

**PYLA'GORAS** (Gr πυλαγορας, so called from the assembly of the Amphictyons at Thermopylæ) The title of one of the two deputies from each confederate at the Amphyctyonic Council His functions comprised the diplomatic and deliberative duties of the mission while the care of the sacred rites fell on his colleague, the Hieromnemon (ιερομνημων)

**PYLORI'DEANS**, *Pyloridea* (Gr [illegible] ουρος, *a guard* and ειδος *form*) [illegible] Lamellibranchiate Bivalves comprehending those which have a shell open at both extremities

**PYLO'RUS** (Gr πυλη, *an entrance*, and ουρος, *a guard*) The aperture of the stomach into the duodenum, it guards, as it were, the entrance into the intestinal canal

**PYRA'LLOITE** (Gr πυρ *fire*, and αλλος, *another*) A mineral which undergoes various changes of colour when heated

**PY'RAMID** (Supposed to be from Gr πυρ, *fire*, from the resemblance of the form to a spire of flame, but for a more probable derivation of the word, see *infra*, PYRAMIDS OF EGYPT) In Geometry, a solid contained by a plane polygonal base and other planes meeting in a point This point is called the vertex of the pyramid, and the planes which meet in the vertex are called the sides which are necessarily all triangles

The principal properties of pyramids are the following —1 Every pyramid is equivalent to one third of a prism [illegible] Hence, 2. All [illegible] are equivalent [illegible] and equal altitudes are [illegible] 3 The solid content of a pyramid is measured by the product of the area of the base into one third of the altitude 4 If a pyramid is cut by a plane parallel to its base the frustum (or part comprehended between the base and the section) is equal to the sum of three pyramids having for their common altitude that of the frustum, and of which the bases are respectively the lower base of the frustum, the upper base of the frustum, and a mean proportional between them (See *Legendre's Geometry*, and Notes)

Pyramids are denominated from the figures of their bases, being triangular, quadrangular, pentagonal, &c, according as the base is a triangle, a quadrangle, a pentagon

**PYRAMIDS OF EGYPT** Celebrated monuments of* massive masonry which, from a square base, rise by regular gradations till they terminate in a point, but so

* [illegible] exhibited in some of the principal [illegible] The [illegible] The

that the width of the base always exceeds the perpendicular height The Pyramids commence immediately south of Cairo but on the opposite bank of the Nile, and extend in an unbroken line for many miles in a southerly direction, parallel with the banks of the river

The three largest are situated in the vicinity of Ghizeh, not far from Cairo, and of these the loftiest is called the pyramid of Cheops, from the prince by whom it is supposed to have been erected The sides of its base, which are in the line of the four cardinal points measure at the foundation 763 4 feet, so that it occupies a space of more than 13 acres Its perpendicular height is 480 feet being, consequently, 43 feet higher than St Peter's at Rome, and 136 feet higher than St Paul's Supposing this pyramid to be entirely solid its contents would exceed three millions of cubic yards and the mass of stone contained in it would build a wall 20 feet high and 1 foot thick, that contained in the Plymouth breakwater (*Egyptian Antiquities, Library of Entertaining Knowledge*, ii 213) This huge fabric consists of successive tiers of vast blocks of calcareous stone rising above each other in the form of steps The thickness of the stones, which is identical with the height of the steps decreases as the altitude of the pyramid increases the greatest height being 4 628 ft and the least 1 680 ft The mean breadth of the steps is about 1 ft 9 in The best authorities agree in estimating the number of steps or tiers of stone at 203 According to the information communicated to Herodotus by the priests, 100 000 men were employed for twenty years in the construction of this prodigious edifice, and ten years were employed in constructing a causeway by which to convey the stones to the place, and in their conveyance (Lib ii § 124)

The other pyramids are of inferior dimensions, but they are mostly all notwithstanding, of vast magnitude—*instar montium eductæ* they are not all of stone, some of them being of brick

Many learned dissertations have been written and many fanciful and a few ingenious conjectures have been framed, to account for the original use and object of these imperishable structures But the difficulty of the subject is such, that hitherto no satisfactory conclusion has been arrived at Even in the remotest antiquity their origin was matter of doubt and nothing certain was known with respect to them or their founders (*Plin Hist Nat* lib 36 § 12) On the whole however it would seem to be most probable that they were intimately connected with the religion of the ancient Egyptians and that they were at once a species of tombs and temples but participating more of the latter than of the former character (For some remarks on this part of the subject see *Shaw's Travels* p 170 &c 4to edit, and *Greaves's Pyramidographia* in his Works vol i)

It has long been customary to regard the Pyramids as monuments merely of the power and folly of the monarchs by whom they were raised and of the bondage of their subjects This, however, seems to be a very superficial prejudiced view of the matter The varying magnitude of the Pyramids the fact of their being scattered over a space extending lengthwise about 70 miles and their extraordinary number appear to show pretty conclusively that they must have been constructed from a sense of utility or duty, and not out of caprice or from a vain desire to perpetuate the names or the celebrity of the founders If we had a sufficient knowledge of antiquity it would probably be found that the motives which led to the construction of the Pyramids were, at bottom, nearly identical with those which led to the construction of St Peter's and St Paul's and that they are monuments of the religion and piety, as well as of the power of the Pharaohs

The Pyramids were esteemed by the ancients as one of the seven wonders of the world and most deservedly, for it is impossible to look at these stupendous structures without being overwhelmed with a sense of their sublimity They are associated too with some of the most interesting events in the history of the human race Herodotus, Plato and Pythagoras beheld them with wonder and admiration, Alexander the Great and Napoleon marshalled their hosts under their shadow, and they are probably destined to survive long after the proudest monuments of the present generation have crumbled into dust

The etymology of the word *pyramid* is involved in as great obscurity as the object of the structures themselves [illegible] Greek origin, than which nothing can be more erroneous Perhaps the most probable conjecture is that of De Sacy which is as follows — The ις in πυραμις he regards as a Greek termination, the first syllable πυ he holds to be the Greek version of the Egyptian article *pi* (and so

[illegible] has pointed out four new pyramids in the great pyramidal field of Ghizeh the third pyramid of Ghizeh of the previous ones of which no traditions exists





written by the Greeks from their wish to derive the word from πυρ *fire*); and he refers the syllable μις to the root *ram*, which, in the Egyptian language signified *elevating* or *setting apart from common use* consequently the word *pyramid* will denote a *sacred place or edifice set apart* for some religious purpose (De Sacy, *Observations sur l'Origine du Nom donné par les Grecs et les Arabes aux Pyramides d'Egypte*) See Wilkinson's Egypt, and the authorities there

PYRAMIDAL NUMBERS, in Arithmetic, are numbers formed by the successive sums of polygonal numbers, in the same manner as polygonal numbers are formed from arithmetical progression

| | |
|---|---|
| Arithmetical progression, | 1, 2, 3, 4, 5, &c |
| Polygonal numbers, | 1 3 6, 10 15, &c |
| Pyramidal numbers, | 1, 4, 10, 20 35, &c |

*See* FIGURATE NUMBERS and POLYGONAL NUMBERS

PYRENE'ITE A mineral found in the limestone of the French Pyrenees, it appears to be a variety of the garnet

PYRETOLOGY (Gr πυρετος *fever*, and λογος *a discourse*) The [illegible]

PYREXIE (Gr πυρ *fire*, and ξις *habit*) Fevers, diseases attended by fever

PYRITES (Gr πυρ) Sulphurets of copper and iron commonly distinguished as copper and iron pyrites The former is the principal ore of copper, the latter is an abundant natural product of a brass yellow colour When exposed to air and moisture especially after having been heated, it absorbs oxygen, and yields sulphate of iron or green vitriol The term is derived from πυρ *fire*, either because they sometimes spontaneously ignite or as being hard enough to strike fire with steel

PYROACE'TIC SPIRIT A liquid formed during the destructive distillation of acetate of lead When carefully purified, it has a peculiar spirituous odour, is limpid and very inflammable its specific gravity is 0 792 and it boils at 132° It consists of 3 car + 3 h + ox Hence 1 equivalent of acetic acid (1 car + 3 h + 3 ox) corresponds to [illegible] 1 of carbonic acid [illegible] by heat into carbonate of baryta [illegible] spirit The term *acetone* is now commonly [illegible] compound

PYRO ACIDS (Gr πυρ) The [illegible] applied to the products which are obtained [illegible] certain organic acids to heat The acids are thus modified and give rise to distinct classes of salts Thus we have pyrogallic, pyromalic, pyrotartaric acids &c

PYROCHLORE (Gr πυρ and χλωρος *green*) A name given by Werner to the [illegible] oxide of titanium

PYROLIGNEOUS ACID (Gr πυρ and Lat lignum, *wood*) This term is generally applied to the *acid liquor* which passes over along with tar and gaseous products when wood is subjected to destructive distillation This acid liquor is an impure vinegar from which acetic acid is obtained as follows — The pyroligneous acid freed from tar is saturated with chalk or powdered slaked lime, filtered and evaporated, by which an impure acetate of lime is obtained, this is gently heated so as to destroy part of its empyreumatic matter without decomposing the acetic acid, it is then mixed with sulphate of soda which yields by double decomposition sulphate of lime and acetate of soda, the acetate of soda is filtered off the sulphate of lime, evaporated heated, and redissolved and crystallized In this way a pure crystallized acetate of soda is by proper management obtained, which is mixed in a retort or still with a proper proportion of sulphuric acid and a gentle heat applied which causes the strong acetic acid to distil over and sulphate of soda remains behind This acetic acid is in a high state of concentration, it is lowered by the addition of water, and if intended for the table or for domestic use as a substitute for other forms of vinegar it is usually coloured with a little burned sugar The charcoal which is the residue of this distillation of wood is of an excellent quality, — that employed in the manufacture of gunpowder is thus prepared This manufacture of vinegar is now carried on upon a very large scale, and the greater part of the vinegar used for domestic purposes and in the arts in many of which it is largely consumed is derived from this source

PYROLIGNEOUS SPIRIT See PYROXYLIC SPIRIT

PYROLUSITE A mineralogical term applied by some to the common black or binoxide of manganese, from the facility with which it is resolved by heat into [illegible]

PYROMANCY (Gr πυρ and μαντια, *prophecy*) Among the classical ancients, a species of divination by means of the fire of the sacrifice, in which, if the flames immediately took hold of and consumed the victims or if they were bright and pure, or if the sparks rose upward in a pyramidal form, success was said to be indicated If the contrary took place, misfortunes were said to be [illegible]

PYROMETER (Gr πυρ and μετρον, *measure*)

An instrument for measuring the degrees of heat According to this definition, the pyrometer is synonymous with the thermometer but though the two terms are sometimes applied indifferently to the same instrument, the term *pyrometer* is generally understood to denote either an instrument intended to measure higher temperatures than can be measured by the ordinary thermometer, or an instrument for comparing the expansions of different metals

Various contrivances have been employed for the above [illegible] Mr Lamb was the earliest inventor [illegible] matic rod (about six inches long) of the metal under trial being attached at one extremity to an immoveable obstacle, and heated by lamps, the other end is necessarily pushed forward, and this being fastened to the end of a rack playing into a pinion, communicates a revolving motion to an axle to which a train of wheel work is attached, whereby the minutest expansion of the heated bar is [illegible] dex on a dial [illegible] ntly simple, but [illegible] of so many loosely connected wheels and pinions must have rendered [illegible], and the method is liable to a still more serious objection, namely, that the temperature communicated to the bar by the lamps is entirely unknown Desaguliers, and afterwards Ellicott, made several improvements in the construction of the instrument, tending to give it a more equable motion and to increase its delicacy Graham substituted a micrometer screw for the wheels and levers that had formerly been employed, and on this principle Mr Smeaton contrived an ingenious apparatus, which is described in the *Phil Trans*, vol xlviii

Various other forms of the [illegible] have been proposed, to render it better [illegible] measurement of expansion by heat, [illegible] perhaps are those contriv [illegible] particularly that employed by Ramsden for determining the expansion of the glass rods used in measuring the base on Hounslow Heath for General Roy's survey (See *Phil Trans*, 1785)

[illegible] weights [illegible] inapplicable In order to remedy this deficiency, Wedgwood availed himself of the property which clay possesses of contracting by heat, and remaining afterwards in that state of contraction He found, by repeated trials, that fine porcelain clay contracted uniformly with the degree of heat applied to it accordingly by measuring the dimensions of a cylindrical piece of this substance (which may be done with great accuracy, by observing the depth to which it will sink between two scales of metal inclined to each other under a small angle) and then subjecting it to the heat of a furnace and applying the scale again to it when cold an indication of the degree of heat to which it has been subjected is given by the amount of its contraction Wedgwood divided his scale into 240°, and in order to compare it with that of Fahrenheit's thermometer, made use of a piece of fine silver fitted to the same mould as the pyrometric pieces of clay He [illegible] nsion of the silver between [illegible] scale, the silver and clay were subjected to the same heat, and, by a comparison of the expansion of the one with the contraction of the other, he estimated that each degree of his scale was equal to 130° of Fahrenheit's He also estimated that the zero of his scale corresponded with 1077 5° of Fahr, and from these data comparative tables of the two scales are formed The objections to this method are, that as clay is a heterogeneous mixture, it is not very probable (and there are no means of ascertaining the fact) that its contractions are equal at different temperatures, and that different portions of clay possess different degrees of contractibility It was also surmised that a long or frequent exposure to inferior degrees of heat will cause it to contract, even after it has undergone the action of a high temperature, but this appears to have been disproved (*Phil Trans*, 1782, 1784 1786)

Guyton Morveau invented a platina pyrometer as a substitute for Wedgwood's In a solid plate of highly baked porcelain a groove was cut containing a flat bar of platina, an inch and three quarters in length, two tenths of an inch broad, and one tenth of an inch thick One end of the bar abuts against the bottom of the groove, the other presses against the short arm of a bent lever, of which the long arm, moving on a pivot, becomes the index of the instrument, and marks the degrees on a scale fixed to the porcelain With this instrument he made numerous experiments the general result of which proved that Wedgwood had assigned by far too high a temperature for the degrees of his scale (*Annales de Chimie*, tom xlvi, *Nicholson's Journal*, vol vi)

A pyrometer invented by Professor Daniell is described in the seventh volume of *Brande's Quarterly Journal* The part on which the heat acts consists of a rod or wire of platina, about ten inches in length, and about a seventh of an inch in diameter, placed within a tube of black lead ware, and having one end fixed at the bottom of the tube to the other end is attached a fine wire of platina, which, after passing two or three times round the axis of a wheel, is fastened to a spring by which it is always preserved at the same degree of tension The teeth of the wheel play into a pinion, the axis of which carries an index, whose revolution shows, on a greatly magnified scale, the expansion and contraction of the platina rod With this instrument experiments were made to determine the fusing points of the different metals the results agreed nearly with those of Morveau but differed widely from those of Wedgwood Mr Daniell subsequently [illegible] or rather [illegible] in the *Phil Trans* for 1830, and the *Phil Magazine* for 1831 and 1832

For Mr Prinsep's method of determining high temperatures from the fusing points of pure metals and different metallic alloys, see *Phil Trans*, 1828, or *Phil Mag*, new series, vol iii (See *Library of Useful Knowledge*, *Gr*, *Mechanics*, *Encyc Brit*)

PYROMORPHITE (Gr πυρ, and μορφη, *form*) Native phosphate of lead When heated before the blowpipe, it fuses into a globule, which assumes a polyhedral crystalline form as it cools

PY'ROPE (Gr πυρ, and ωψ, *the eye*) A fiery or brilliant red garnet

PYRO'PHORUS (Gr πυρ, and φερω, *I bear*) A substance which spontaneously takes fire when exposed to air *Homberg's* pyrophorus is made by mixing equal weights of alum and brown sugar and stirring the mixture over the fire in an iron ladle till quite dry, it is then put into an earthen or coated glass bottle, and heated red-hot so long as a flame appears at the mouth, it is [illegible] ment succeeds best in a damp state of the atmosphere, and the ignition is frequently accelerated by breathing upon the powder A mixture of 3 parts of lampblack, 4 of dried alum, and 8 of carbonate of potassa, may be substituted for the above, and calcined in the same way 27 parts of sulphate of potassa and 15 of calcined lampblack, heated to redness in a crucible, and then carefully preserved out of contact of air, also yields a good pyrophorus

It appears from Gay Lussac's experiments that the [illegible] pyrophorus is sulphuret of potassium, the charcoal and alumina only act by being interposed between its particles, but, when the mass once kindles, the charcoal takes fire and prolongs the combustion An excellent pyrophorus is afforded by heating tartrate of lead red-hot in a glass tube, in which it may afterwards be hermetically sealed When the tube is broken, and the black powder within it shaken out through the air it burns with the emission of a dense smoke of oxide of lead This curiously shows the spontaneous inflammability of minutely divided lead

PYRO'RTHITE (Gr πυρ and ορθος, *straight*) A mineral resembling *orthite*, but differently affected by heat

PYROSIS (Gr πυροω, *I burn*) A disease of the stomach attended [illegible] and the throwing up of a quantity [illegible] fluid, it is sometimes called *water brash* and *black water* it is a variety of *heartburn*

PYRO'SMALITE (Gr πυρ, οσμη, *odour*, and λιθος, *a stone*) A native submuriate of iron, which, when heated exhales the odour of chlorine

PY'ROSOME *Pyrosoma* (Gr πυρ and σωμα *a body*) The generic name of certain compound Ascidians, remarkable for the brilliant phosphoric luminosity which they emit

PY'ROTE'CHNY (Gr πυρ and τεχνη, *art*), signifies, in its widest sense the art or science which teaches the [illegible] fire to certain operations, [illegible] ed to those articles and instruments manufactured for amusement, or for grand public occasions The origin of artificial fireworks is lost in obscurity They were in general use in China long before their introduction to Europe which is comparatively of recent date The finest inventions of this kind are due to the celebrated Ruggieri, father and son, who executed in Rome and Paris and the principal capitals of Europe, the most brilliant fire-works that were ever seen

Fire-works are divided into three classes —1 Those to be set off upon the ground, 2 Those which are shot up into the air, and 3 Those which act upon or under water

The three prime materials of this art are, nitre, sulphur, and charcoal, along with filings of iron, steel, copper, zinc, and resin, camphor, lycopodium, &c Gunpowder is used either in grain, half crushed, or finely ground, for different purposes The longer the iron filings the brighter red and white sparks they give, those being preferred which are made with a very coarse

file, and quite free from rust Steel filings and cast-iron borings contain carbon, and afford a more brilliant fire, with wavy radiations Copper filings give a greenish tint to flame, those of zinc a fine blue colour, the sulphuret of antimony gives a less greenish blue than zinc, but with much smoke, amber affords a yellow fire, as well as colophony and common salt, but the last must be very dry Lampblack produces a very red colour with gunpowder, and a pink with nitre in excess It serves for making golden showers. The yellow sand, or glistening mica communicates to fire-works golden radiations Verdigris imparts a pale green sulphate of copper and sal-ammoniac, a palm-tree green Camphor yields a very white flame and aromatic fumes, which mask the bad smell of other substances Benzoin and storax are used also on account of their agreeable odour Lycopodium burns with a [illegible] but it is principally employed in the theatres to represent lightning or to charge the torch of a fury (See, for full information as to the various processes adopted in the construction of fire-works, *Ure's Dict of Arts, &c*, art "Fire-works")

PY'ROXENE (Gr πυρ and ξενος, *a stranger*) The *augite*, supposed to have pre-existed in the volcanic minerals containing it, and not to have been formed by fire

PYROXY LIC SPIRIT (Gr πυρ, and ξυλον, *wood*) This is one of the products of the destructive distillation of wood Its specific gravity when rectified is 0 804 it boils at 150°, it burns with a blue flame and may be used as a substitute for alcohol in lamps for which purpose it is often sold under the name of naphtha It is assumed to be the hydrate of a peculiar hydrocarbon which chemists have designated by the term *methylene* (from μεθυ, *wine* and υλη *wood*)

PY'RRHIC DANCE, called by the Romans Pyrrhica Saltatio A species of warlike dance said to have been invented by Pyrrhus to grace the funeral of his father Achilles though this point is involved in obscurity This dance consisted chiefly in such an adroit and nimble turning of the body as represented an attempt to avoid the strokes of an enemy in battle and the motions necessary to perform it were looked upon as a kind of training for the field of battle This dance is supposed to be described by Homer as engraved on the shield of Achilles Lord Byron describes the Suliotes as still performing this dance (*Childe Harold*) and in the famous ode on the aspirations of Greece after liberty he exclaims —

> "You have the Pyrrhic dance as yet
> Where is the Pyrrhic phalanx gone?
> Of two such lessons why forget
> The nobler and the manlier one?

PY'RRHONISTS The followers of Pyrrho a philosopher of Elis and disciple of Anaxarchus who flourished about 300 B C Their tenets which have come to us only through the reports of unfriendly writers are said to have been so absurdly sceptical that the Pyrrhonists would not put even as much confidence in the senses as was necessary for the preservation of their existence, but this seems partly refuted by the age at which Pyrrho himself died which was 90 years There is a summary of the doctrines of Pyrrhonism in the 2d vol of the historical part of the *Encyc Metropolitana* See SCEPTICISM

PYTHAGORE'ANS The followers of Pythagoras, a native of Samos born B C 570, said to have been the first Greek who assumed the title of a philosopher Pythagoras [illegible] Egypt and the East in search of [illegible] his abode at Crotona one of the Dorian colonies in the south of Italy He here attached to himself a large number of youths of noble descent, whom he formed into a secret fraternity for religious and political as well as philosophical purposes, and by [illegible] in the institutions of Crotona and other Dorian cities Of the strictly philosophical tenets of the Pythagoreans very imperfect records are preserved Many of the doctrines ordinarily imputed to them are evidently the fabrication of the later Pythagoreans a class of visionaries who lived during the decline of the Roman empire The fragments of Philolaus, apparently a genuine follower of Pythagoras, have been collected by Boeckh, but these, combined with what accounts we can glean from Plato, Aristotle, and others, are far from being sufficient to give us the information necessary for a clear understanding of this very singular system One point is sufficiently evident, that the Pythagoreans were the greatest mathematicians of their time, and that they sought in the study of numerical relations that solution of the principal philosophical problems for which their contemporaries, the Ionic and Eleatic philosophers, sought, the first in physical the others in ontological hypotheses Bearing this peculiarity distinctly in mind the student of the history of philosophy will be prepared for much in the Pythagorean doctrine which would otherwise seem capricious and unintelligible To reduce the phenomena presented to the senses to harmony with the laws of reason is the first endeavour of philosophical thinkers to determine its own limits, and the necessary laws of its operation, is among the last of the problems of which the reason enters on the solution The relations of space and quantity as they are the most obvious, are also the most distinct and definite forms, in which the laws of the outward world can present themselves to this faculty We cannot, therefore, feel surprise when we discover in the early mathematicians that error which has more or less prevailed among all great mathematicians who meddled with philosophy — the error of [illegible] the domain of their favourite science beyond its legitimate bounds Precisely as the atomic philosophers have endeavoured to explain all things by a diversity in the figure of their ultimate parts, the Pythagoreans seemed to have found, in the number and proportions of those parts, the true essence of the things themselves Having proceeded thus far, they went a step farther They perceived that the universe and its parts are obedient to certain laws, and that these laws can be expressed by numbers By a mistake prevalent during every period of speculation, they mistook the necessary conditions of a thing's subsistence for the essence of that thing itself, and at once pronounced that numerical relations were not merely all that could be understood in outward phenomena, but were, in fact, all that was real in them Units of number grew gradually into points in space and these into material atoms To every order of existence even to many abstract conceptions a distinct number was assigned God is represented as the original unity, the human soul the earth, the planets the animal creation have each their own peculiar arithmetical essence, as have also the abstrac-

[illegible]

meaning, but how far any such meaning was contemplated by the [illegible] doubt

The outline [illegible] is in a singular table of opposites (συστοιχια) preserved to us by Aristotle in which the two principles of the universe are successively represented under the form of limit and the unlimited odd and even, one and many, right and left male and female still and moved straight and curved, light and darkness good and evil, square and oblong

But it would far exceed our limits to enumerate the various fanciful disguises under which the Pythagoreans voluntarily or involuntarily concealed the result of their meditations Their moral system is more intelligible, being founded as the tone of their general doctrines would lead us to anticipate on the ideas of law and harmony Every state, and every member of a state is to exhibit each in his degree a miniature resemblance of the universal constitution of the world This essentially Greek idea they sought to realize in themselves by a long course of propædeutic discipline, in which music plays a conspicuous part [illegible] were strongly influenced by their [illegible] different in the length of time during which their brotherhood continued Philolaus Lysis, Clinias, Eurythes, and Archytes, in all probability genuine Pythagoreans, were contemporaries of Plato and Socrates (See *Thirlwall's Hist of Greece*, vol ii c 12, *Ritter's Hist of Philosophy*, b iv *Boeckh's Philolaus*, &c)

The doctrine of *metempsychosis*, or the transmigration of souls through different orders of animal existence, is the main feature by which the Pythagorean philosophy is popularly known It is however by no means certain that the genuine Pythagoreans held this doctrine in a literal sense It may have been only a mythical way of communicating their belief in the individuality and *post mortem* duration of the soul

PY'THIAN GAMES One of the four great national festivals of Greece celebrated every fifth year in honour of Apollo near Delphi Their institution is variously referred to Amphictyon, son of Deucalion, founder of the council of Amphictyons, and Diomed, son of Tydeus, but the most common legend is that they were founded by Apollo himself, after he had overcome the dragon Python The contests were the same as those at Olympia, and the victors were rewarded with apples and garlands of laurel As is well known, the priestess who delivered the oracle at Delphi was called Pythia *See* DELPHI

PY THON (Gr πυθων) The name of a genus of large non venomous Ophidian reptiles, having anal hooks, [illegible] series of sub-caudal scutæ

PYX The name given to the box in which the host is kept by the Roman Catholic priesthood

PYXI'DIUM (Gr πυξις, *a small box*) A fruit which divides circularly into a lower and upper half, of which the latter acts as a kind of lid

PY'XIS NAUTICA The Mariner's Compass A constellation of the southern hemisphere, formed by Lacaille

PYX, TRIAL OF *See* COINAGE.

# Q.

Q (Fr queue, *a tail*, its form being that of O with a tail) In all the languages in which it is used it is invariably followed by *u* Q is used as an abbreviation for *question*, Qy for *query*, Q E D for *quod erat demonstrandum*, which was to be demonstrated, &c

QUADRAGESIMA (Lat *fortieth*) In the Calendar, a term applied to the first Sunday in Lent, because it consists of about forty days Quadragesima Sunday is the first Sunday before Easter

QUADRANGLE In Geometry, a plane figure having four angles and consequently four sides

QUADRANS A division of the Roman *as*, consisting of one fourth of it, or three ounces when the *as* was of its full weight (See As, Teruncius) A farthing Before Edward I the smallest coin was a penny or starling It was marked with a cross, so as to admit of being quartered, but, to avoid unfair cutting, halfpence and farthings were coined in the above reign

QUADRANT In Geometry, the fourth part of a circle, an arc of 90 degrees

Quadrant is also a mathematical instrument, formerly much used in astronomy and navigation The instrument is variously contrived and fitted up, according to the purpose for which it is intended, but it consists essentially of a limb or arch of a circle equal to the fourth of the circumference, and divided into 90°, with subdivisions The mural quadrant is of considerable size (6 or 8 feet radius for example) the axis of which moves in a wall or solid piece of masonry Ptolemy in the *Almagest* describes a quadrant with which he determined the obliquity of the ecliptic Tycho Brahe had a large mural quadrant for observing altitudes, and others which revolved on a vertical axis for measuring azimuths Picart, in his measurement of the earth used a quadrant for his terrestrial angles In 1725 a mural quadrant by Graham, was erected in the Royal Observatory at Greenwich which in 1750, was replaced by Bird's quadrant, with which Bradley made his celebrated observations The quadrant has however of late years been entirely superseded by the *mural circle*, it having been found that the circle on account of the symmetry of its form and the advantage which it possesses of allowing the readings to be made at different parts of the limb is an instrument much more to be relied on (See Mural Circle) *Hadley's quadrant* in its principle and application is the same as the *sextant* by which it has been superseded (See Sextant) For further information respecting the quadrant see Lalande, *Astronomie*, s 2311, *Vince's Practical Astronomy*, *Pearson's Practical Astronomy*, and the *Penny Cyclopedia*

Quadrant in Gunnery, or the *gunner's square* is an instrument used for elevating and pointing cannon mortars, &c It consists of two rectangular branches of wood or brass having a quadrantal arch between them, divided into 90° and furnished with a thread and plummet One of the branches being placed in the mouth of the piece, the degree intersected by the thread on the limb shows the elevation

QUADRANTAL TRIANGLE, in Trigonometry is a spherical triangle which has one side equal to a quarter of a circle, or 90°

QUADRANT OF ALTITUDE An appendix to an artificial globe consisting of a thin pliable slip of brass, which is applied to the globe and used as a scale for measuring the distances between points in degrees It is graduated into 90°, the degrees being of the same length as those on one of the great circles of the globe At the end where the division terminates a nut is rivetted on, and furnished with a screw by which it is attached to the brass meridian of the globe at any point This point being placed in the zenith and the quadrant applied to the globe its zero coincides with the horizon, and consequently the altitude of any point along its graduated edge [illegible] respective divisions

QUADRATIC EQUATION In Algebra an equation of the second degree, or one which involves the second power or square, of the unknown quantity

Quadratic equations are of two kinds, *incomplete* and *complete* The incomplete equation is that which contains only terms affected by the square, and not by the simple power of the unknown quantity It is also called an *equation of two terms*, because, by means of proper reductions of the known quantities, it may always be put under the form $a x^2 = b$, or a *pure* quadratic, because, on dividing by the coefficient of $x^2$, it contains only the square of the unknown quantity in one term, or is of the form $x^2 = c$

The *complete* quadratic equation consists of three terms, containing the square of the unknown quantity in one, the simple power in another, and the known quantities in a third It is also called an *affected* quadratic, and its general form is $a x^2 + b x + c = 0$

When the proposed equation consists of only two terms, the method of finding the value of the unknown quantity is obvious Let the equation after reduction be $x^2 = p$, then $x = \sqrt{p}$ Now, if $p$ be a number, its square root, which is the value of $x$, can either be found exactly, or to any required degree of approximation and if $p$ be an algebraical quantity its root may be found either exactly or approximately by the ordinary methods of extraction There is, however, a circumstance respecting the sign of the root which must be attended to The root of any quantity may be either positive or negative, because the square of $+a$ and of $-a$ is equally $a^2$, whence $\sqrt{a^2} = \pm a$, and the equation $x^2 = p$ gives two values of $x$, namely, $x = +\sqrt{p}$, and $x = -\sqrt{p}$

As the square of any quantity, whatever be its sign, is always positive, it follows that a negative quantity can never be formed by the multiplication of any root multiplied into itself, and hence an equation of the form $x^2 = -p$ can have no real root When such an equation occurs in the solution of a problem in which only real quantities are concerned, it shows that some contradiction is involved, either in the data, or in the reasoning by which that result has been produced

A complete quadratic equation is always reducible to the form $x^2 + a x = +b$, and in order to deduce from it the value of $x$ it is necessary to add some known quantity to both sides by which the first will be rendered an exact square The square of the binomial $x + u$, is $x^2 + 2 u x + u^2$, on comparing this with $x^2 + a x$, it is evident that if we suppose $a = 2 u$, or $u = \frac{1}{2} a$, and consequently $u^2 = \frac{1}{4} a^2$ the quantities $x^2 + 2 u x + u^2$ and $x^2 + a x + \frac{1}{4} a^2$ will be equal, and therefore, since $x^2 + 2 u x + u^2$ is the square of $x + u$, so $x^2 + a x + \frac{1}{4} a^2$ must be the square of $x + \frac{1}{2} a$, which is equal to $x + u$ If, therefore the proposed equation be $x^2 + a x = b$ let $\frac{1}{4} a^2$ be added to both sides, and it becomes $x^2 + a x + \frac{1}{4} a^2 = \frac{1}{4} a^2 + b$, which on extracting the square root, gives $x + \frac{1}{2} a = \pm \sqrt{\frac{a^2}{4} + b}$, therefore, by transposition, $x = -\frac{1}{2} a \pm \sqrt{\frac{a^2}{4} + b}$

In like manner, it will appear that if the proposed equation were $x^2 - a x = b$, the equation giving the value of $x$ will be $x - \frac{a}{2} = \pm \sqrt{\frac{a^2}{4} + b}$, whence $x = \frac{a}{2} \pm \sqrt{\frac{a^2}{4} + b}$ The quantity $b$ retains the same sign in the resolved as in the original equation

From these considerations, the rules for the solution of quadratic equations in general follow so obviously that it is unnecessary to state them in form The double sign however which appears in the root, and which shows that the unknown quantity in every quadratic equation has two distinct values, requires some further attention

Taking an example in numbers, let the proposed equation be $x^2 + 2 x = 35$ Adding to each side the square of half the coefficient of $x$, or of 1 it becomes $x^2 + 2 x + 1 = 36$, whence $x + 1 = \pm 6$ and, consequently, $x = -1 \pm 6$, that is, $x = +5$, or $x = -7$ Now, if we transpose the absolute term of the proposed equation $x^2 + 2 x = 35$ to the left side it becomes $x^2 + 2 x - 35 = 0$, and it is easy to see (and may be proved by actual multiplication) that $x^2 + 2 x - 35$ arises from the product of two factors $x - 5$ and $x + 7$, therefore $(x - 5)(x + 7) = 0$ But this last equation may be satisfied in two ways viz either by making $x - 5 = 0$, or by making $x + 7 = 0$ If $x - 5 = 0$, then $x = 5$, and if $x + 7 = 0$, then $x = -7$ There are two values of $x$, therefore, which alike satisfy the proposed equation nearly, $+5$ and $-7$, and these are the two roots found above by the direct solution

What has been now said in respect of the particular example is true of quadratic equations in general Every expression of the form $x^2 + a x - b$ is decomposable into two factors, $x - p$ and $x + q$ in which $p$ and $q$ are quantities independent of $x$, and depending only on $a$ and $b$ Hence the equation $x^2 + a x - 6 = 0$ is identical with the equation $(x - p)(x + q) = 0$, and this last is obviously satisfied alike by making $x - p = 0$, or by making $x + q = 0$ that is, by $x = +p$ or $x = -q$

It follows, therefore, that every quadratic equation has necessarily two roots, and it is obvious that it can have no more than two, for if it could be supposed to have three or any great number, then the expression $x^2 + a x - b$ would be resolvable into as many separate factors of the form $x - p$, $x - q$, $x - r$, &c But this is evidently impossible, for the product of three such factors would necessarily contain the third power of $x$, or $x^3$ which the given equation does not The resolution of equations into as many factors as there are roots is a

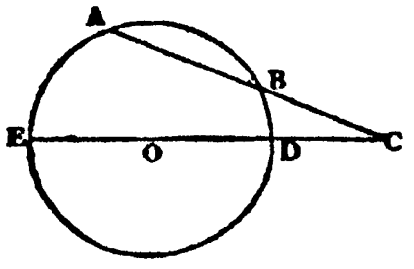
property belonging to equations of every degree. *See* EQUATIONS

The consideration of the nature of the factors into which the proposed equation can be resolved leads to some important consequences The hypothesis $x^2 + a x - b = (x - p)(x + q)$ gives $x^2 + a x - b = x^2 - (p - q) x - p q$, whence, since $x$ is an indeterminate quantity, we must have $a = -(p - q)$ and $b = p q$ Now, since $+ p$ and $- q$ are the two roots of the equation $x^2 + a x = b$, it is evident that $p - q$ is their sum, and $- p q$ their product, therefore, because $p - q = - a$, the sum of the two roots of any quadratic $x^2 + a x = b$ is equal to the coefficient of the second term, having its sign changed, and their product is equal to the absolute number or term which does not contain $x$ having its sign also changed

The roots of quadratic equations may be exhibited by a geometrical construction All quadratics belong to one of the four forms,

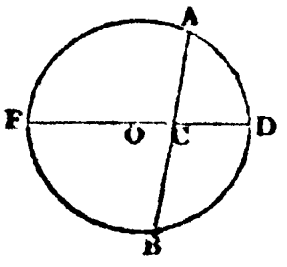
$$x^2 + a x = b c, \quad x^2 - a x = b c,$$
$$x^2 + a x = - b c, \quad x^2 - a x = - b c$$

Now to construct the first form, let a circle be described on a diameter $= a$, or radius $= \frac{1}{2} a$ in the circle inflect a straight line, A B $= b - c$, and produce it to C, so that A C $= b$, and consequently B C $= c$, and draw C D E through the centre O, meeting the circle in D and E, then C D and C E are the two roots of the equation For let C D $= x$, then C F $= x + a$ and the rectangle C D C F $= x (x + a) = x^2 + a x$ But by construction C A C B $= b c$, and by the property of the circle C D C F $=$ C A C B, therefore, $x^2 + a x = b c$, which was the equation given




To construct the second form namely, $x^2 - a x = b c$ let C E $= x$, then C D $= x - a$, and, consequently C F C D $= x (x - a) = x^2 - a x$, but as before, C F C D $=$ C A C B $= b c$, therefore $x^2 - a x = b c$ and the roots of the equation are C F and C D In these two cases, if $b - c = 0$ the straight line C B A becomes a tangent to the circle and if $b - c$ be greater than $a$, another line may be taken which is a mean proportional between $b$ and $c$, and which will be the tangent to the circle, so that the construction is possible in all cases

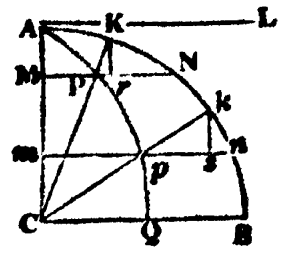
To construct the fourth form, $x^2 - a x = - b c$ let a circle be described with the radius $\frac{1}{2} a$ as before, and inflect in it a straight line A B $= b + c$, take A C = [illegible] and the centre O [illegible] D then E C and C D are the two roots of the equation or values of $x$ For, since E D $= a$, if E C $= x$, then C D $= a - x$, and therefore E C C D $= x (a - x) = a x - x^2$ But E C C D $=$ A C C B $= b c$, therefore $a x - x^2 = b c$, or $x^2 - a x = - b c$ The same construction gives the third form, $x^2 + a x = - b c$, but the two roots are in this case both negative namely $-$ E C and $-$ C D




Hence it follows that every geometrical problem producing a quadratic equation can be constructed by means of a circle and straight lines and, [illegible] problems respecting circles and straight lines be resolved algebraically by means of quadratic equations

QUADRA'TO, or QUADRO (It.) In Music, a name given to the note B in the natural or diatonic scale marked thus ♮, being a semitone minor higher than B mol or ♭

QUADRA'TRIX In Geometry, a transcendental curve, by means of which the quadrature of curvilinear spaces can be determined mechanically The best known of these curves is the *Quadratrix of Dinostratus*, so called from its reputed inventor, a brother of Menechmus and disciple of Plato This curve is generated as follows —




In the circular quadrant C A B, suppose the radius C A to revolve uniformly about C, passing through the different positions C K, C $k$, &c, till it arrives at the position C B, and that during the same time a line A L, at right angles to C A, moves parallel to itself with a uniform motion from the position A L, passing through the different positions M N, $m n$, &c., and arriving at C B at the same instant that C K coincides with C B, then the continual intersection of the revolving radius and the parallel line will trace the quadratrix A P Q

From this mode of describing the curve, it is easy to see how it may be applied to divide an angle into any number of equal parts Let it be required, for example, to trisect the angle A C $k$ Having applied the quadratrix to C A, take A M equal to a third of A $m$, and through M draw M N perpendicular to A C, meeting the curve in P, join C P, and the angle A C P is equal to one third of A C $k$, for by the nature of the quadratrix A M A $m$ A K · A $k$

The application of this curve to the quadrature of the circle depends on the property that the line C Q is a third proportional to the quadrantal arc A B, and the radius Hence the arc A B $= \frac{\text{C B}^2}{\text{C Q}}$, and consequently the area of the quadrant C A B $= \frac{\text{C B}^3}{2\,\text{C Q}}$

If the quadratrix be continued beyond A, without the circle, it will consist of a series of infinite hyperbolic branches, cutting the axis C A produced, in points which are separated from each other by a space equal to 2 A C

Other curves may be formed in a similar manner, by which the quadrature of the circle would be obtained Thus, instead of supposing the lines M N, $m n$ to be intersected by the radiants C K, C $k$, we may suppose straight lines drawn from K $k$ parallel to A C, intersecting M N, $m n$ in $r$ and $s$, these intersections form a different curve, which is called the *Quadratrix of Tschirnhausen*

Let A M $= x$, M P $= y$, and A C $= a$, then, since $x$ $a$ A K A B, or $\frac{1}{2} \pi$, we have A K $= \frac{\pi x}{2 a}$ Hence the equation of the quadratrix of Dinostratus is $y = (a - x) \tan \frac{\pi x}{2 a}$, and that of the quadratrix of Tschirnhausen $y = a \sin \frac{\pi x}{2 a}$ (Montucla, *Histoire des Mathematiques*, *Peacock's Collection of Examples*, *Leslie's Geometry of Curve Lines*)

QUADRATURE in Astronomy, denotes the position of the moon when she is 90° from the sun, or at one of the two points of her orbit equally distant from the con-ju[illegible]

[illegible] of the area of a cur[illegible] differential element of the area of a curve referred to rectangular co-ordinates is $y\,d\,x$, and since $y$ is given in terms of $x$ by the equation of the curve of which the area is proposed to be found, the problem of quadratures in general reduces itself to the integration of the differential $X\,d\,x$ in which X is an algebraic function of $x$ and known quantities In the applications of the higher geometry a problem is conceived to be resolved when it is reduced to quadratures that is, when the variable quantities have been separated and its solution been made to depend on finding the values of one or more integrals of the form $\int X\,d\,x$ In the case of some curves, parabolas for example of different orders, expressed by the equation $y^m = a x^n$, the integral is found in finite terms, in regard to other curves, the circle, for example, it can be represented by a converging series, but it frequently happens, especially in the applications to physical astronomy, that the expression represented by X is too complicated to allow of the integral $\int X\,d\,x$ being found by a converging series, and when this occurs, the only thing that can be done is to find values of it for particular cases only, that is to say, for portions of the area corresponding to values of $x$ taken within certain limits The method of quadratures accordingly forms an important branch of the Integral Calculus

The *quadrature of the circle* is a problem of great celebrity in the history of mathematical science The whole circular area being equal to the rectangle under the radius, and a straight line equal to half the circumference, the quadrature would be obtained if the length of the circumference were assigned, and hence the particular object aimed at in attempting to square the circle is the determination of the ratio of the circumference to the diameter This ratio can only be expressed by infinite series, of which many have been given that converge with great rapidity *See* CIRCLE

It is necessary to make a distinction between the *definite* and the *indefinite* quadrature The definite quadrature would be that which would give either the area of the whole circle, or of some particular portion of it without giving that of every other portion, the indefinite quadrature would give the area of any sector whatever, or the length of any arc [illegible] Gregory undertook to demonstrate that the [illegible] quadrature is impossible, Huygens however, objected to his reasoning, and the opinion of geometers seems to be that no satisfactory demonstration has yet been given of the absolute impossibility of solving the problem It has indeed been proved by Lambert and Legendre that the ratio of the circumference to the diameter, and its square, are irrational numbers But irrational quantities may be

susceptible of geometrical construction, and if a straight line equal to the circumference of a circle having a given ra[illegible] of the line could not be expressed by a finite number

Pretenders to the discovery of the quadrature of the circle occasionally present themselves even at the present day They are only to be found among those who have an imperfect knowledge of the principles of geometry, and when [illegible] futile attempts so frequently made on this and similar subjects, the Academy of Sciences of Paris, in 1775, and the Royal Society shortly after, publicly announced, that they would not examine in future any paper pretending to the quadrature of the circle, the trisection of an angle, the duplication of the cube, or the discovery of the perpetual motion For the history of this famous problem, see the third supplement to the 4th volume of Montucla

It was stated in the article CIRCLE that the approximation to the numerical ratio of the circumference to the diameter had been computed by De Lagny to 128 places of decimals It should have been added that the approximation was carried by Vega to [illegible] and Montucla mentions a MS in the [illegible] at Oxford, in which it is carried to 154 figures In the *Philosophical Transactions* for 1841, the ratio is extended by [illegible], of the Woolwich Academy, to 208 figures of decimals, but this has been found to be correct only to the 152d decimal the 153d and all the following being erroneous In Schumacher's *Astronomische Nachrichten*, No 589 (February 1847) the ratio is given to 250 decimals, computed *twice*, from two different formulæ, by Dr Clausen of the observatory at Dorpat, and it is stated that an independent calculation by Mr Dase of Vienna to 200 decimals gave a result agreeing exactly with Dr Clausen's to the last figure inclusive

QUA'DRICORNS *Quadricornia* (Lat quatuor, *four* and cornu *a horn*) A family of Apterous insects, comprehending those which have 4 antennæ A species of Antelope with 4 horns is called *Antilope quadricornis*

QUA'DRIFORES *Quadrifora* (Lat quatuor and foro, *I pierce*) A name given by Latreille to a family of Sessile Cirripeds, comprehending those in which the opercular covering of the tube is composed of four valves or calcareous pieces

QUADRI'GA (Lat quatuor and jugum, *a yoke*) In Antiquity a car or chariot drawn by four horses which were harnessed all abreast and not in pairs The quadriga is often met with on the reverse of medals which are thence termed *nummi quadrigati* or *victoriati* from there being a representation of a figure of Victory holding the reins

QUA'DRI HY'DROCA'RBON A liquid hydrocarbon in which 4 atoms of hydrogen and 4 of carbon are so combined and condensed as to constitute one atom of quadri hydrocarbon

QUADRILA'TERAL (Lat quatuor, *four*, and latus *a side*) In Geometry a plane figure contained by four straight lines It comprehends the square parallelogram rectangle rhombus rhomboid and trapezium The most general properties of a quadrilateral figure are the two following —1 The sum of the four angles is equal to four right angles, 2 The sum of the squares of the sides is equal to the sum of the squares of the two diagonals together, with four times the square of the straight line which joins the middle points of the diagonals

QUADRILA'TERALS *Quadrilatera* (Lat) The name of a tribe of crabs (Brachyurous Crustaceans) comprehending those in which the carapace or shell is [illegible]

QUADRIPE'NNATES *Quadripennes* (Lat quatuor and penna *a wing*) The name of a section of Anelytron insects including those which have four wings

QUADRIRE'MES (Lat quatuor and remus *an oar*) A ship of war in use among the ancient Greeks and Romans, so called because it had four banks of oars *See* GALLEY

QUADRISU'LCATES, *Quadrisulcata* (Lat quatuor, and sulcus *a furrow*) A name applied to those Ungulate quadrupeds in which the hoof is divided into four parts corresponding to the four digits

QUADRI'VIUM (Lat) In the language of the schools, the four lesser arts,—arithmetic, music, geometry, and astronomy *See* TRIVIUM

QUA'DRUM In Music, the same as *natural*, which see

QUADRUMANES, *Quadrumana* (Lat quatuor, *four* [illegible] the name of an order of Mammalia [illegible] are terminated by hands [illegible] hinder extremities [illegible] the South American monkeys, incapable [illegible]

QUADRUPEDS, *four-footed animals* (Lat quatuor, *four*, pes, *a foot*) All Vertebrate animals with four extremities fitted for terrestrial progression were formerly so called, the scaly reptiles being distinguished, as oviparous quadrupeds, from the hairy warm-blooded viviparous four-footed mammals But as there are both reptiles and mammalia which have only two legs and as those of both classes which agree in having four legs differ essentially in the important characters on which classific distinctions are now founded, the term quadruped is no longer used in a strict zoological sense as indicative of a particular group of animals

QUA'DRUPLE In Arithmetic, fourfold the product of any magnitude or quantity multiplied by 4

QUÆSTOR A Roman magistrate whose office it was to collect the public revenue, whence their name (from quæro, *I seek*) was derived Two quæstors were originally chosen by the kings in the earliest times of the city, and [illegible] remained in the [illegible], when they began to be elected by the people at the Comitia Tributa Soon after this two more quæstors were appointed to attend the consuls in war, and from this time they might be chosen indifferently from plebeians and patricians, the former class having been previously excluded As the Roman empire was extended over all Italy and the other countries that finally owned its sway, the number of quæstors was increased, so that one was appointed to each consul or prætor when he went to his province, and this was done generally by lot, but sometimes the superior magistrate was allowed to choose his own quæstor The quæstorship was the first step of preferment which gave admission into the senate, but it was sometimes held by those who had been consuls Under the emperors the office underwent many changes, Augustus deprived them of the charge of the treasury, which he imposed on the prætors, and gave them the superintendence of the public records, but the former office was restored to them by Claudius

QUA'GGA The name of a Solipedous quadruped, or species of *Equus*, allied to the zebra

QUA'GMIRE Boggy ground saturated with water to such a degree as to be more like mud than firm soil

QUAIL A genus of Gallinaceous birds (*Coturnix*, Cuv), allied to the partridge, but of smaller size, with a more slender beak and shorter tail, and without red eyebrows or spurs

QUA'KERS, or FRIENDS A religious sect which had its origin in England about the middle of the 17th century, and spread, by the emigration of its members, who were exposed to many restrictions and persecutions in this country, over various parts of Europe and North America The founder of the sect was George Fox, who being equally dissatisfied with the tenets of the established church and those of the Puritans succeeded in attaching to himself various persons who agreed with him in the view which he took of the internal operation of religion on men's hearts conceiving it to supersede all the observances of different denominations, nor to be evidenced in any degree by them The Quakers, therefore reject both the sacraments, nor do they appoint any order of ministers but consider the instruction and edification of their congregations as the province of whatsoever person of either sex conceives himself to be impelled thereto at the time by an internal suggestion of the Spirit Upon doctrinal points however, they assert themselves to maintain opinions coincident with those generally received by the orthodox Their internal affairs are managed by yearly, quarterly and monthly meetings, of which the former in this country is held in London and embraces representatives for all the rest A similar arrangement takes place [illegible] the females of the society who are allowed a considerable share in the management of the affairs of their own sex

This society is distinguished in its intercourse with the world by great seriousness of deportment and demure soberness in dress, and generally a scrupulous avoidance of every thing which can encourage vanity and frivolity They are all sensitively averse from all matters of ceremony, which they [illegible] to be the origin in flattery and deception [illegible] to take promissory oaths used in former times [illegible] to the accession of James II their history is an unvaried series of persecutions, either such as they endured in common with other dissenters, or such as were peculiar to themselves in consequence of their refusal to pay tithes and to take oaths Under him the severity of the penal laws was relaxed, but William III was the first prince who enacted laws for the especial relief of the Quakers From this time, their affirmation is received in lieu of oath in judicial proceedings, and an alteration in the method of levying tithes has been provided by which their scruples are satisfied (See among other authorities respecting the Quakers, *Fox's Journal*, *Barclay's Apology*, and *Sewell's History of the Rise, &c of the Quakers* (1722) The Quakers of the present day are thought to be a decreasing sect In 1836, the number of the congregations was estimated at 360 (*Congregational*

*Magazine*) They are most numerous in Yorkshire, Lancashire Durham, Cumberland and Essex

QUA'KING BOG Peat bog in a growing state, and so saturated with water that a considerable extent of surface will quake or shake, when pressed on by the foot or any other body Such bogs are unfit for any useful purpose till they are drained

QUA'LITY (Lat qualis) In Physics, a modification or affection of bodies Sensible qualities are those which immediately affect the senses as light, &c

QUALITY, in the philosophy of Kant, the *second* category in the logical table, comprising the notions of existence or reality, non-existence or negation, and limitation

QUA'NTITY (Lat quantus, *how much*) A property of any thing capable of being increased or diminished Quantities are distinguished into *continued* and *discrete* It is continued when the parts are connected together and the whole is integral which is the object of geometry The parts have an unconnected and independent existence forming multitude or number, which is the object of arithmetic The quantity of matter in any body is proportional conjointly to the magnitude and density of the body, and is measured by its absolute weight Quantity of motion is used synonymously with *momentum*, to denote the product of the quantity of matter in the moving body by its velocity Algebraic quantities are the expressions of indefinite numbers

QUANTITY In Prosody, the amount of time in a syllable Syllables are either short or long, the former being the unit or smallest measure of time the latter consisting of two times This distinction is clearly marked in the ancient languages, in which some syllables are necessarily long or short by position others by the nature of the vowels which they contain, and, in the Latin language, some common or susceptible of being sounded as long or short, according to certain rules of elegance or convenience All the metrical system of the ancient languages is founded on quantity In most modern languages there is strictly speaking no quantity as distinct from emphasis or accent the long syllables being those which receive the arsis the short those which receive the thesis In the German language however critics have endeavoured to establish a conventional system of quantity and thus to adapt that language to regular versification in the ancient Greek and Latin metres *See* RHYTHM, METRE

QUA'RANTINE (Ital quaranto *forty*) A period of time of variable length during which a vessel from certain coasts or ports said or supposed to be infected with certain diseases is not allowed to communicate with the shore, except under particular restrictions A ship in quarantine carries a yellow flag at the main, and when released from this condition she is said to obtain *pratique* The term is derived from the Ital quaranto *forty* it being generally supposed that if no infectious disease break out within 40 days or six weeks no further danger is to be apprehended It is universally believed that the Venetians were the first to adopt regulations for guarding against the introduction of infected persons into their ports, but there is now no civilized country in which it is not practised (For full particulars on the history and policy of, and [illegible] see the *Com Dict*

QUA'RE IMPEDIT In Law, a writ lying for one who has a right of advowson against a person who hinders or disturbs him in his right by presenting a clerk when the church is void

QUART A measure of capacity, being the fourth part of a gallon *See* MEASURES

QUA'RTAN (Lat quartus *fourth*) A species of intermittent fever or ague, which returns every fourth day *See* AGUE.

QUARTATION In Metallurgy the separation of silver from gold by means of [illegible] To extract the whole of the silver from gold by the action of nitric acid, it is necessary that there should be at least three parts of silver to one of gold, otherwise the gold protects the silver from the action of the acid, so that, in thus separating these precious metals it is customary where gold greatly predominates to add silver till it constitutes at least three fourths of the alloy

QUA'RTER The fourth part of any thing As a term of weight, it denotes the fourth of a hundred weight or 28 pounds, as a dry measure, it signifies the fourth of a chaldron

QUARTER The after part of the ship's side *On the quarter* implies the bearing or position of an object seen between aft and abeam

QUARTER DAYS The days usually recorded in England and most Continental countries (not in Scotland) as beginning the four quarters of the year They are 1 Lady Day (25th of March), 2 Midsummer Day (June 24th 3 Michaelmas Day (Sept 29th), and, 4 Christmas Day (Dec 25th)

QUARTER DECK The portion of the uppermost deck of a ship between the main and mizen masts This is the "parade" in men-of-war.

QUA'RTERING In Heraldry, the division of a shield by two lines, fess wise and pale-wise, meeting in the centre of the shield In marshalling, whenever a husband can place his wife's arms on an escutcheon of pretence (*see* ESCUTCHEON), the children may bear them [illegible] whence arises the great variety of shields of some families [illegible] In the Navy, a petty officer, who, besides other duties of superintendence, *cons* the ship, and attends to her steerage

QUARTER-MASTER In the Army, an officer whose business it is to look after the *quarters* of the soldiers, and attend to their clothing bread, ammunition, &c There is a quarter master attached to every regiment, whether of foot cavalry or artillery

QUARTER ROUND In Architecture *See* ECHINUS and OVOLO

QUA'RTERS The stations of a ship's crew in time of action, to which they are summoned by beat of drum, or by the boatswain's pipe

QUARTERS and QUARTERING (Fr quartiers) In Architecture, the upright posts in partitions to which the laths are nailed Quarters are [illegible] the former being saw[illegible] inches broad, the latter usually sawn to a scantling four inches square, or four inches by a less width No quarters should ever be more than fourteen inches apart *Quartering* is a term properly applied only to an assemblage of quarters, though it is not unfrequently used to denote the quarters themselves

QUA'RTER SESSIONS OF THE PEACE In Law a court held by two justices at least, one of whom must be of the quorum quarterly in every county, having a jurisdiction [illegible] matters touching the breach of the peace only but since extended by various statutes (*See* JUSTICES OF THE PEACE) Quarter sessions in boroughs since the Municipal Corporation Act, are held by the recorders

QUARTER STAFF A weapon of defence, so called from the manner of using it one hand being placed in the middle and the other equally between the middle and end

QUA'RTETT A piece of music arranged for four voices or four instruments Of the latter the most celebrated are arranged for two violins, — a tenor violin, and a violoncello, and many of the most distinguished composers among whom we may mention Haydn Mozart, Beethoven Romberg Spohr, Ries Onslow, &c, have not disdained to devote their talents to this species of composition The term *quartett*, though strictly any piece in four parts, is seldom applied except to instrumental pieces

QUA'RTILE ASPECT in Astrology denotes the aspect or appearance of two planets, whose positions are at a distance of 90° on the zodiac

QUARTINE The fourth envelope of the vegetable ovum [illegible] from the outside [illegible] in to books composed of sheets of paper folded into four leaves It is abbreviated 4to

QUARTODECIMA'NES In Church History, those who *imitated the Jews* in celebrating Easter on the 14th day of the paschal moon instead of the Sunday next following were so called after they had been excommunicated as heretics by the councils of Nice, Constantinople and Ephesus *See* EASTER

QUARTZ A German term now universally adopted in scientific language and commonly applied in mineralogy to the purer varieties of silica, especially to rock crystal

QUASIMODO In the Roman Catholic Calendar, the first Sunday after Easter, so called because the *Introit* for that day begins with the words "Quasi modo geniti infantes (1 Pet ii 1) It is also called Dominica in albis as being the day on which those who had been baptized on Easter Sunday deposited their white robes in the sacristy

QUA'SSIA The wood of the *Quassia excelsa*, or *amara*, a native of South America and some of the West Indian Islands It yields an intensely bitter infusion, which may be made with one drachm of the shavings of quassia to a pint of boiling water of this a wine-glass-full may be taken twice a day, with or without other additions as a tonic It is a good vehicle for most of the metallic salts, which are not decomposed by it, as by many other bitter vegetable infusions A strong infusion of quassia, sweetened with brown sugar, is a safe and effective poison for flies

QUATRAIN (Ital quattrino) In Poetry a piece consisting of four verses, the rhymes usually alternate, sometimes also, especially in French poetry, intermixed, the first and fourth, second and third, rhyming together

QUAVER (Sax pazian) In Music, a character, ♪, whose measure is equal to half a crotchet, or one eighth of a semibreve

QUEEN (Anglo Sax cwen, *wife*) 1 A female sovereign, entitled queen regnant, or queen regent She has, in Great Britain, the same power, prerogatives, &c, as a king, which is expressly declared by stat 1 Mar.

1. st 3 c 1 In France, where females do not succeed to the throne, the title queen regent has been given to the mothers of kings holding sovereign authority, or a portion of it, during the minority of their sons, as Catherine de Medicis in the reign of Francis II, Mary de Medicis, in that of Louis XIII

2 *Queen Consort* The wife of a king Her rights and dignities (in England, as well as most other countries) appear to be similar in many respects to those of the "Augusta," or Plissima regina conjux divi imperatoris, in imperial Rome The English queen, like the Roman empress, is capable of receiving a grant from her husband, or making one to him, therein differing from all other wives She can also purchase and convey land, &c, without his concurrence, and sue and be sued alone in short, she is looked upon in all legal proceedings as a feme sole But, except where she enjoys specific exemptions [illegible] with other subjects, and [illegible] maxim, "Augusta legibus soluta est" By the statute of Treasons, 25 Ed 3, to compass or imagine the death of the king's [illegible]" and also to violate and defile her, is treason The queen if accused of treason herself, is tried by the peers of parliament, as Ann Boleyn in 28 Hen 8 The consort of George IV was proceeded against by the method of a bill of pains and penalties

*Queen-gold* was a duty amounting to one full tenth of the value of fines, &c on grants by the crown anciently due to the queen, which Charles I purchased of his consort Henrietta, in 1635, for 10,000*l* but which was not revived after the restoration The queen consort has a separate household consisting of six ladies of the bed chamber, a chamberlain, vice-chamberlain, mistress of the robes, master of the horse, and three equerries, attorney and solicitor general, &c

3 *Queen Dowager* The widow of a deceased king She continues to enjoy most of the privileges which belonged to her as queen consort Nor did she, in ancient times, lose her dignity on remarriage, for Catherine, queen dowager of Henry V, after she had married Owen Tudor, maintained an action by the name of Catherine Queen of England But it is held that no man can marry a queen dowager without [illegible] licence from the king, on pain of forfeiture [illegible] goods according to an act of 6 H 6, which, however is not printed among the statutes The revenue of a queen dowager is settled by statute By 1 & 2 W 4 c 11 his late majesty was empowered to settle 100 000*l* per annum on his queen, to commence at his decease

4 *Queen Mother* A queen dowager who is also mother of the reigning sovereign

QUEEN POST In Architecture an upright post in a roof for suspending the beam when the principal rafters do not meet in the ridge See Roof

QUERCITRON BARK The bark of the *Quercus nigra* or American oak it is a highly valuable dye stuff and is used in the production of some of the most durable yellows

QUERCUS (Lat) This is the most important genus of trees found in the cold countries of the world on account of its producing the various kinds of timber called oak The species are not however confined to Europe or similar latitudes but occur abundantly in the equinoctial parts of Asia and America, they have not however, been found south of the equator It is usually recognized by the cup in which the acorn is seated, but in some tropical species the acorn is so small as to be buried in the cup when the fruit nearly resembles that of the chestnut (*Castanea*) The valuable oak of Great Britain is obtained from two native species the one *Q pedunculata*, the long-stalked or white oak, the other *Q sessiliflora*, the sessile fruited or red oak A prejudice has arisen against the timber of the latter, which, however appears to be unfounded as it is found to be in point of tregth and durability fully equal to the other Oak timber however is affected very much by soil and climate, and hence we have oak of bad quality from both our native species What is called wainscot oak is probably the timber of *Q sessiliflora*, grown rapidly in the dense forests of Hungary, by some persons, however it is supposed to be furnished by an oriental species called *Q cerris* or the mossy-cupped The *Esculus* of Virgil, whose acorns were eatable appears to have been a sweet-fruited variety of *Q sessiliflora* Besides the species already mentioned, the *Quercus ilex* or European oak the *Q suber*, or cork tree, whose bark is in such extensive use, and the *Q ballota*, or Spanish ilex, whose acorns are sweet and eatable, are the more important species Those from North America, although fine trees, are inferior to the oaks of England as regards their timber, and require hotter summers than we have in those islands Oak galls are produced upon *Q infectoria*, in the Levant, by the puncture of a cynips The species are excessively confused by botanists, but a full popular account of this genus will be found in *Loudon's Arboretum Britannicum* For a few popular details, see also the article OAK, in this work



QUESTION The application of torture to prisoners under criminal accusation according to the law of France before the Revolution The question was of two kinds. one, where strong evidence, but insufficient of itself to justify a condemnation to death, existed against a prisoner on a capital charge, he might then be subjected to torture to produce confession This was termed the question préparatoire It was abolished by an ordinance of Louis XVI in 1780 The other, termed question préalable or définitive was applied to the prisoner when convicted of capital offence in order to make him discover supposed accomplices It was abolished by the National Assembly The preparatory question was also of two sorts —one avec réserve de preuves, in which case, if the criminal did not confess under the torture, the other evidence was considered as still subsisting against him, so as to justify his condemnation to some lighter punishment, the other, sans réserve de preuves, in which case, if he persisted in his denial, he was acquitted altogether It was at the option of the judges according to their opinion of the amount of evidence to decide to which of these questions the accused should be subjected The modes of torture applied varied in France, being fixed by the several parliaments within their separate jurisdictions Those in common use at Paris were —the question by water, which consisted in stretching the limbs of the sufferer on a board by means of screws and forcing him to swallow large quantities of water, and the boots, in which his legs were inclosed in wooden cases the whole tightly compressed with ropes, and wedges driven with a mallet between the two cases The question varied in degree, being *ordinary* or *extraordinary* at the discretion of the judges Children and adolescents, old men and women with child were excepted from torture by the French law And, by an ordonnance of 1670, the second application of the question was forbidden in all cases

Torture has been applied as a mode of extorting confession in all countries into which the principles of the civil law have been imported, although the barbarity and uncertainty of the practice were remarked upon even in the best times of Roman jurisprudence The observations of Cicero on the subject are well known, and Ulpian the greatest authority on the civil law, speaks even more directly "Res est fragilis et periculosa (the torture) et quæ veritatem fallit nam plerique patientiâ sive duritia tormentorum ita et tormenta contemnunt, ut exprimi eis veritas nullo modo possit, alii tantâ sunt impatientia ut quidvis mentiri quam pati mallent" It is however an important remark, that as by the strict principles of jurisprudence the torture was only applied in cases where there already existed a mass of evidence against the prisoner sufficient, in ordinary judgment, to warrant his condemnation it did in fact afford him an additional chance of escape and that however great its absurdity on every supposition its barbarity rather arose from its liability to abuse than its legitimate infliction

The practice of judicial torture was not a part of the common law of England, except in one particular case The rack is said to have been first introduced into this country by the dukes of Exeter and Suffolk, in the minority of Henry VI, at all events it was then first made a common engine of discovery in state matters It was used on warrant from the privy council, on prisoners in the Tower of London for a long period afterwards, and more especially in the reign of Elizabeth, to enforce confessions or accusation of accomplices from recusant priests and others suspected of being engaged in treasonable plots against her It was probably employed in the examination of Guy Fawkes after the detection of the Gunpowder Plot, as has been conjectured, among other reasons from the feeble and trembling hand in which the signature of that criminal to his last confession is written when compared with that in which he subscribed his former declarations On the trial of Felton for the assassination of Villiers, duke of Buckingham, the judges were consulted by the privy council as to the lawfulness of the infliction of torture and on their asserting it to be illegal it was not applied there is, however, reason to suppose that it was used at least in one subsequent case in the reign of Charles I (See *Jardine on Torture* 1837)

The exception to which allusion has been made, by which torture was [illegible] the common law is the celebr [illegible] It has indeed been said and was asserted by the judges in 8 Hen. 4, that this infliction was [illegible] in consequence of the first statute of Westm [illegible] but it is at least highly probable that before that period, persons refusing to plead were subjected to imprisonment and ill-treatment to induce them to do so After that statute, the judgment appears only to have been to strait and severe confinement, nor was it until the reign of Hen 4 that its horrible character seems to have been fully determined by law After that time, the prisoner was remanded to the place from whence he came, laid on the ground in a dark room, and "as many weights as he can

bear, and more," laid upon him; with no sustenance except a morsel of the worst bread and a draught of [illegible] worst water [illegible] pleaded or died, [illegible] later practice, was soon decided, as the weights laid on were sufficient to cause speedy death The peine [illegible] et dure was not unfrequently put in practice until the beginning of the last century, and as late as the commencement of the reign of George III the enforcing prisoners to [illegible] other modes of torture [illegible] By 12 G 3 c. 20 any person standing mute, or not answering directly to the arraignment [illegible]

QUICKLIME Pure oxide of calcium See LIME

QUICKSILVER See MERCURY

QUIETISM A name generally applied to the opinions of enthusiasts, who conceive the great object of religion to be the absorption of all human sentiments and passions into devout contemplation and love of God This idea has found its admirers and encomiasts in all ages A sect called Quietists (in Greek, Hesychistæ) existed among the religious of Mount Athos, and in the 17th century it was given in France to a peculiar class of devout persons with a tendency towards a higher spiritual devotion, which seems to have arisen in great measure, out of a natural opposition to the hierarchal coldness and positive morality of Roman Catholic religion at that time, especially under the influence of the Jesuits A Spanish priest Molinos published at Rome a work entitled *The Spiritual Guide* (1675) of which the ardent [illegible] partisans Its leading [illegible] happiness of a soul reposing in perfect *quiet* on God [illegible] as to become conscious of His presence only, and unruffled by external things He even advanced so far as to maintain that the soul in its highest state of perfection [illegible] even beyond the contemplation of God [illegible] entirely occupied in the passive reception of divine influences The work of Molinos was afterwards condemned on the application of the Jesuits Akin to the ideas of Molinos seem to have been those of the French Quietists, of whom Madame de la Motte Guyon and Fenelon are the most celebrated names The former was at one time treated as insane on account of some strange delusions which led her to represent herself (unless she was calumniated) as the mystical woman of the Apocalypse, at another, she was admitted [illegible] Madame Maintenon and high in favour [illegible] her in his treatise *Sur les états intérieurs* [illegible] many of the most dangerous tenets of Quietism were continued The writings of the latter upon this subject were finally condemned by Innocent XII, and the example of the archbishop in submitting to the decision, and declaring himself satisfied and convinced by the opinion of the church has been dwelt on by pious writers as a signal triumph of a truly religious mind The dissolute conduct of some hypocritical persons under the pretence of inculcating the tenets and practice of Quietism, brought it eventually into disrepute more than the repeated condemnations of the head of the Roman Catholic church

QUINCUNX The Latin term properly for that disposition of five objects in which they are made to occupy the four corners and point of intersection of the diagonals of a square, but the word is extended to any number of things so arranged in lines that the members of each succeeding line stand behind the spaces between those of the preceding one Troops were frequently drawn up in this order, which was also a favourite arrangement for plantations of vines

QUINDE'CAGON In Geometry a plane figure bounded by fifteen sides The regular quindecagon is inscribable in a circle by elementary geometry (*Euclid* Book iv)

QUINDECE'MVIRI Roman magistrates whose duty it was to take care of the Sibylline books, and consult them on critical occasions when the senate deemed their advice necessary They were exempted from the privilege of serving in the army, and from other offices in the city, and their priesthood, which was probably in service of Apollo lasted for life Their number, as their name imports, was fifteen by Sylla's appointment but originally they had been ten, an equal number being elected from patricians and plebeians, and by Julius Cæsar they were raised to sixteen

QUI'NIA or QUININE A vegetable base obtained from yellow bark, the *Cinchona cordifolia* This substance, combined with sulphuric acid forms the [illegible] which is now so extensively used as a [illegible] substitute for the various forms of Peruvian bark I obtain quina bruised yellow bark is boiled in repeated portions of water, acidulated by sulphuric acid, till all its soluble matters are extracted, a little excess of quicklime is then added to the strained decoction, and the precipitate which is formed is collected, washed, and carefully dried It is then digested in alcohol which takes up the quina and from which it may be obtained in the form of a yellowish uncrystallizable substance by careful evaporation It is dissolved in dilute sulphuric acid, and the [illegible] water, and intensely bitter It is administered as a tonic and [illegible] from one to five or six grains

QUINQUAGESIMA SUNDAY, in the Calendar, is the seventh Sunday before Easter, and consequently *about* the fiftieth day before that festival, whence the origin of the term

QUINQUA'TRUS In Roman Classical Antiquities the feast of Minerva, which began on the 14th of the Kal of April and lasted five days It is in allusion to the well-known attributes of the goddess that Juvenal makes this the season in which her youthful votaries pray for forensic success

[illegible]

QUINQUENNA'LIA, or LUDI QUINQUENNALES In Classical Antiquity, public games celebrated every five years They were instituted by the emperors in commemoration of different events of their respective reigns Medals struck on these occasions have been discovered, bearing the date of the reign of Posthumus

QUINQUE'REMIS (Lat quinque, *five*, and remus, *an oar* in Greek τριήρης) The name of a class of Roman war ships which were rowed by five banks of oars, whence the name is derived The substitution of the quinquereme for the trireme as the ordinary war vessel, gradually took place in the course of the fourth century before Christ in the interval between the Peloponnesian and first Punic wars The number of vessels of this large class employed in the latter is perfectly surprising According to Polybius the Romans lost 700 in the course of it, the Carthaginians 500 In A U C 498 (the year in which Regulus was sent to Africa) the Romans had 330, the Carthaginians 350 each quinquereme of the former nation carried 300 rowers and 120 soldiers, in all 140 000 men the Carthaginian according to the same computation amounted to [illegible] numbers which would be scarcely credible were they not given by so exact an author See TRIREME GALLEY

QUIN'QUINA Peruvian bark The bark of various species of *Cinchona*, which see

QUINSY (Er squinance) Inflammation of the tonsils This is common inflammatory sore throat it is not infectious It begins with pain on one side of the throat and swelling of the tonsil attended by febrile symptoms, which sometimes run high especially as the tumefaction advances, there is great restlessness and anxiety, and often the utmost difficulty of swallowing even liquids, and of breathing The disease has proved fatal by producing suffocation but it generally terminates in resolution or suppuration in the latter case the abscess breaks, and a good deal of pus is discharged and the patient is at once relieved of all his urgent symptoms, but it occasionally happens that the other side of the throat becomes affected, and [illegible] through the same stages

QUINTAIN An ancient pastime, in which a post was erected with a cross piece turning upon a pivot on the top of it to one end of which a sand bag was suspended and at the other a board was fixed The play consisted in riding or tilting against the board with a lance and passing without being struck behind by the sand-bag

QUINTAL An old denomination of weight, being the same with the *hundred* weight, or equal to 112 pounds

QUINTESSENCE A term applied by the older chemists to alcoholic tinctures or essences made by digestion at common temperatures or in the sun's heat

QUI'NTILE In Astrology, an aspect of two planets distant from each other the 5th of the zodiac, or 72°

QUI'NTILIANS A sect of ancient heretics, so called from Quintilla their founder and leader Their chief peculiarities consisted in attributing extraordinary gifts to Eve for having eaten of the tree of knowledge and in [illegible] women to the sacerdotal and episcopal office

QUINTINE (Lat quintus) A name given in botany to the fifth or innermost envelop of the vegetable ovulum, the most external being the first or primine

QUI'NTUPLE In Music, a species of time, now seldom used containing five crotchets in a bar

QUINZAINE [illegible] a feast day, or the [illegible] cluded But a different rule seems to have prevailed on the Continent (See *Sir H Nicolas's Chronology of History*, p 105)

QUI PRO QUO, or QUID PRO QUO (Lat *one for another*) A conventional term borrowed from the French, who use it in the sense of an error committed by mistaking one thing or person for another; especially a ve[illegible]

QUIRI'NUS An Italian warlike divinity, supposed by some to be the same as Mars When the Romans deified Romulus they called him by this name, and the festivals instituted in his honour *Quirinalia*.

QUIRK In Architecture, a piece of ground cut off from a square plot

QUIRKED MOULDING In Architecture, one whose convexity is sudden, being in the form of a conic section

QUI TAM (Lat *who as well*) In Law, a penal action, in which half the penalty is given to the crown and the rest to the informer The plaintiff describes him as A B "qui tam [illegible]"—who sues as well for [illegible]"

QUIT RENT (Lat quietus redditus) In Law a small rent payable by tenants of manors in token of subjection *See* RENT

QUO'DLIBET (Lat *what you please*) In the language of the schoolmen, questions on general subjects within the range of their inquiries were termed *questiones quodlibeticæ*, or miscellaneous In French the word quodlibet, or quolibet, is retained in the sense of a slight jeu d'esprit, pun, &c What is termed in music a 'pot pourri" was also called in Germany a *quodlibet*

QUOIN (Fr *coin*) In Architecture, the corner or internal and external angle of a building, or of any part of a building

QUOIN In Artillery, a loose wedge of wood put below the breech of a cannon, for the purpose of adjusting its elevation

QUO'RUM A term derived from the words used in the Latin form of the commission issued to justices of the peace, in which the expression occurred quorum unum A B esse volumus,"—' of whom we will that A B be one," thus rendering it necessary that certain individuals (said to be of the quorum) should be present at the transaction of business Hence when in an assembly, committees, &c it is necessary that a certain number should be present to give validity to its acts, that number is generally said to constitute a quorum

QUO'TA (Lat quot *how many*) That part which each member of a society has to contribute or receive in making up or by giving a certain sum

QUOTIDIAN (Lat quotidianus) That form of ague which returns daily

QUO'TIENT (Lat quoties *how often*), in Arithmetic is the result of the operation of division and may be either a magnitude of any denomination or an abstract number When a magnitude of any kind is proposed to be divided into any number of parts and the divisor is consequently an abstract number the quotient is of the same kind with the dividend or quantity proposed to be divided, but when the dividend and divisor are both things of the same denomination or both magnitudes of any kind the quotient is an abstract number, and is the ratio of the one magnitude to the other

QUO WARRANTO In Law a writ filed in the Court of King's Bench by the attorney general or an individual in his name calling upon the person informed [illegible] holds any office franchise [illegible] on a writ of quo warranto presenting many difficulties, it has been superseded in modern times by what is termed an information in the nature of a quo warranto

# R.

R One of those letters belonging to the series called liquids or semivowels It was called the *littera canina* by the Latins, from some fancied resemblance it bears in sound to the snarling of a dog At the commencement of English words derived from the Greek through the medium of the Latin *r* is usually followed by *h*, to represent the force of *ρ* as in *rhetoric rhapsody*, and the same observation applies to this letter when it occurs in the middle of an English word derived from a Greek compound as in *diarrhœa* from *διὰ* and *ῥέω* This letter is susceptible of numerous interchanges more especially in Latin, for a complete list of which see the *Penny Cyclopedia* As an abbreviation R among ourselves stands for *rex* or *regina*, and in ancient times for Rome, R P for *respublica* &c In medicinal prescriptions, R stands for *recipe* or *take*

RA'BBI A Hebrew term for doctor or teacher, the termination being properly the first pronoun possessive This word, which is frequently found in the New Testament, is in use at the present day the rabbis being the [illegible] and more particularly of the [illegible] later doctors *See* TALMUD

RA'BDOMANCY *See* RHABDOMANCY

RACA An ancient Syriac word signifying vanity or folly, and pronounced by the Jews with certain gestures of indignation Our Saviour, in using the word (Matt v 22), intimates that whoever should apply this word to his neighbour, should be condemned by the council of the sanhedrim

RACE'ME (Lat racemus, *a bunch of grapes*) In Botany, a form of inflorescence, in which the flowers are stalked along a common unbranched axis, as in the hyacinth

RACE'MIC ACID (Lat racemus, *a bunch of grapes*) An acid found, together with the tartaric acid, in the tartar obtained from certain vineyards on the Rhine It is the *paratartaric acid* of Berzelius It is less soluble in water than tartaric acid, and differs in the form of its crystals and in its salts yet it appears to be *isomeric*, and to have the same equivalent with the tartaric acid

RACHI'LLA (Gr *ῥαχις, a spine*) A branch of inflorescence, the zigzag centre upon which the florets are arranged in the spikelets of grasses

RA'CHIS (Gr *ῥαχις*) A branch which proceeds in nearly [illegible] the apex of the inflorescence [illegible] to the petioles of the leaves of ferns

RACHIS A term applied by Illiger and other zoologists to the vertebral column of mammals and birds

RACHI'TIS (Gr *ῥαχις, the spine* the part principally affected) The rickets A disease generally confined to childhood known by a large head, protruded breast bone flattened ribs, tumid belly, emaciated limbs, and great general debility, the bones in general, and especially the spine, are variously distorted and deficient in bony matter the system occasionally rallies from this state as growth advances but there is more or less deformity left Tonics cold bathing, regular and proper [illegible] particular bones are inclined to bend attempts must be made to throw the weight off them This disease is frequently symptomatic of a scrofulous state of the glands and viscera, the stomach and bowels are always greatly deranged, and as there appears to be a deficiency of the hardening matter of the bones various salts of lime, and even phosphate of lime have been prescribed the only apparent use of some of these remedies is to render the gastric juice less acrid and acid

RACK (Sax wrecan *to strain torment*, &c, evidently of the same origin as the Germ rachen Ang *to wreak*) An instrument of torture formerly used in England According to Coke (who, however, merely reports the story on traditional authority) the rack was first introduced into the Tower by the Duke of Exeter, constable of the Tower in 1447, and thence called "the Duke of Exeter's daughter" (3 *Inst* p 34) Stowe, in his Chronicle says that the duke's daughter herself invented it The earliest mention of the use of the 'rack or brake' is by Holinshed under the year 1467 But it first became common in the reign of Henry VIII Under that prince, the remaining Tudors, James I, and Charles I down to 1640 the rack was a common implement of torture for prisoners confined in the Tower, and inflicted by the warrant of the council or under the sign manual The rack consisted of an oblong frame of wood, composed of four beams a little raised above the ground, the sufferer was fastened by the hands and feet to the corners where two cross beams joined the longer ones, sometimes by small cords attached to each finger and toe and the cords were twisted by means of rollers so as to raise him from the ground, and stretch his body with extreme violence dislocating the limbs and, according to the Jesuit writers, who have left the most vivid representations of the sufferings of their companions under the state persecution of Elizabeth, sometimes extending the sufferer more than a palm beyond his usual stature'" (Jenner *Societas Europæa*, p 12, see also *Jardine's Reading on the Use of Torture in England* 1837) The Roman *equuleus* is often translated rack by English writers, but whether the equuleus was something similar to the English engine, or a wooden *horse* (as the derivation of the word implies), or, in short, what was its form and description antiquaries have not been able to discover (See among other authorities the learned treatise of Magius, *De Equuleo*)

RACK A railed convenience formed above the manger in a stable for the reception of the hay It should be constructed with openings at the bottom for the seed or dust to pass through

RACK In Machinery, a rectilinear sliding piece, having teeth cut on its edge so that they may work with those of a wheel or pinion which drives or follows the rack The rack may be regarded as a toothed wheel whose radius is infinite

RACK RENT *See* RENT

RACO'VIANS In Eccl History the Unitarians of Poland are sometimes [illegible] from Racow a small city of that country, where [illegible] erected a public seminary for their church in 1602 Here the "Racovian Catechism" originally composed by Socinus, and revised by [illegible] followers, was published (Mosheim, *Eccl Hist* cent 16 sec 3)

RA'DIANT In Geometry, a straight line proceeding from a given point, or fixed pole about which it is conceived to revolve When several radiants forming a system are constrained to revolve in such a manner that all the intersections excepting one are carried along given

straight lines or curves called *directrices*, then the remaining intersection traces a curve whose equation is of an order which is a certain determinate function of the orders of the several directrices Thus, if the intersections but one are carried along straight lines, the remaining one describes a conic section The theory of the description of lines of the second order by the intersection of radiants is given by Newton in the *Principia*, and the subject is treated more generally by Maclaurin in his *Geometria Organica*, and by some recent writers in the *Annales des Mathematiques* See also *Leslie's Geometry of Curve Lines*, Carnot, *Essai sur la Théorie des Transversales* &c

RA'DIANT HEAT When a hot body is suspended in the air, a quantity of heat is emitted in all directions by its surface, passing off in right lines like radii drawn from the centre to the circumference of a circle, these rays pass freely through the air without affecting its temperature, when they impinge upon surrounding bodies they are either *reflected*, *absorbed*, or *transmitted* The quantity of these rays, or of *radiant heat* which is thus emitted, is greatly dependent upon the nature of the heated surface, it is smallest from polished metallic surfaces, and greatest from rough and unmetallic surfaces The radiating power, for instance of polished silver heated up to 212°, being = 1 that of a surface of writing paper is about = P Whether colour has or has not any effect upon this escape of heat from surfaces, is a doubtful question

That this radiant heat is susceptible of *reflection* may be shown by holding a piece of polished tin plate opposite a fire in such a position as admits the reflection of the flame to be seen in it, when an impression of heat is at the same time perceived upon the face, if the surface of the tin plate be roughened or covered with paper scarcely any heat is then thrown off, but the plate itself becomes hot in consequence of the *absorption* of the rays This terrestrial radiant heat especially when it emanates from surfaces which are not luminous as from a flask of hot water for instance is to a great extent arrested in its progress by a plate of transparent glass in which respect it appears to be unlike *solar* heat which passes freely through all transparent media but there are some substances which do not thus impede its progress, among them a transparent plate of rock-salt is most remarkable the rays proceeding through it with little interruption, such substances therefore have been termed *thermophanous* bodies (See Melloni, *Annales de Chim et Phys* vol liii)

RA'DIARIES *Radiaria*, or *Radiata* (Lat radius) The name given by Cuvier to the lowest organized of the primary divisions of the animal kingdom because certain of the animals therein included have a radiated form of a part or the whole of their body See ACRITA, NEMATONEURA ZOOPHYTA

RADIATING POINT In Optics, any point from which rays of light proceed

RADIA'TION (Lat radius *a ray*) In Physics and Meteorology the emission of rays of light or heat from a luminous or heated body

The theory of the radiation and conduction of heat which long remained one of the most obscure parts of physical inquiry, has been reduced by the successive labours of Prevost, Leslie, Fourier, Biot Laplace Poisson Melloni, Forbes, and others to a purely mathematical form, and thereby placed in the same rank with physical optics, with which, indeed it has many principles in common

The general laws of the radiation of heat which have been established by experiment are the following —1 Like all other emanations, its intensity, in a vacuum varies in the ratio of the inverse square of the distance from the radiating point In air and the gases the decrease is a little faster in consequence of a partial absorption 2 The amount of radiation, or the rate at which a body parts with its heat, is proportional to the excess of the temperature of the body above that of the medium in which it is placed This principle was assumed by Newton, and it follows from it that if the times of cooling be taken in an arithmetical progression the heat will decrease in a geometrical progression The principle, however is found by experiment to hold good only within a certain range of temperature, not exceeding 60° of Fahrenheit At the higher temperatures Dulong and Petit found the rate of cooling to be more rapid than in the ratio stated 3 All bodies placed in an enclosed space assume in time the temperature of the enclosure 4 Heat is emitted from every point of the surface of a hot body in all directions, and the intensity of the heating ray is as the sine of the angle which it makes with the surface This result, which is by no means obvious was discovered by Leslie, and its physical cause is, that radiation takes place not from the surface alone, but from certain [illegible] a certain minute but sensible depth within [illegible] for different surfaces 5 The [illegible] varies with the nature of the radiating body and the state of its surface with regard to polish, colour, source of heat &c It is greatest for rough and dark surfaces, and least for bright surfaces of polished metal

The velocity with which radiated heat is propagated through space is entirely unknown It is certain, however, that it is very great, and probably not inferior to that of light.

The doctrine of the radiation of heat was first stated in a precise and satisfactory manner by Prevost of Geneva, about 1790 His fundamental principle being that all bodies are [illegible] heat with one another, it is [illegible] *exchanges* As this emission of heat cannot be attributed to the body which receives it, but for the same radiating body and the same state of surface depends only on the temperature of the body, we are led to suppose that radiation takes place with greater or less [illegible] at all temperatures that it is reciprocal between distant bodies, and that it subsists when the temperatures are equal, though in this case no alteration of temperature takes place By a close attention to the phenomena, we are also led to infer that the faculty of the emission (and also of the absorption) of heat belongs to *all* the molecules of a body, and consequently that radiation takes place not only at the surfaces, but also in the interior of solids and liquids, in the same manner as it takes place in air, or differing only in consequence of its more rapid absorption Fourier and Laplace were thus led to view the constituent molecules of all bodies as so many foci of radiating heat This heat is radiated by every molecule in every direction and is propagated through the pores or void spaces of ponderable matter until it is entirely absorbed by the molecules which it encounters In solids and liquids the absorption takes place at very small distances, in air and the gases at very great distances The mathematical theory of heat is founded on this hypothesis of molecular radiation

*Solar and Terrestrial Radiation* —The measure of heat received from the sun, and of that which is constantly escaping from the earth into the regions of space, are among the most important elements of meteorology If the earth were not surrounded with the atmosphere the quantity of solar light received at any time on a given portion of its surface would be proportional to the inclination of the ray to the surface or to the cosine of the sun's zenith distance but owing to the modifying effects of the atmosphere it would appear from the results of experiments that so far from this law holding good the force of the sun's direct radiation rather increases with the latitude Professor Daniell (*Meteorological Essays*, p 228) suggests that as the [illegible] of the air has been proved to be in proportion to its elasticity it is reasonable to suppose that the difficulty with which heat passes through the atmosphere is in the same ratio The proportion of solar heat absorbed in traversing the atmosphere vertically has been estimated by Leslie and Pouillet at 25 parts in 100, by Kamptz at 32, and by Prof Forbes at 50

The force of solar radiation is measured by the excess of the temperature which a body assumes when exposed to the direct action of the sun's rays above that which it would have in the shade This excess may be roughly measured by two common thermometers one placed in the shade and the other exposed to the sun and having its bulb covered to prevent reflexion The most accurate measurement is however, given by the *actinometer*, an instrument invented by Sir J Herschel, in 1824 for the dynamical measure of solar radiation A description of this valuable instrument and full directions for the method of using it are given in the *Report of the President and Council of the Royal Society on the Objects of Scientific Inquiry in Physics and Meteorology* 1840

From certain experiments made by Pouillet at Paris, he inferred that the whole amount of solar heat annually radiated to the earth is equal to that which would suffice to melt a stratum of ice about 14 mètres or 46 feet thick encrusting the whole earth (*Elémens de Physique et de Météorologie*) but in a subsequent memoir (*Sur la Chaleur Solaire*) he estimated the same quantity at 31 mètres or 102 feet

The measure of terrestrial radiation is of equal importance with that of solar radiation, but no perfect instrument has yet been contrived for its determination The best means consist in the daily register of the minimum temperature shown by a register thermometer, the bulb of which is placed in the focus of a parabolic metallic mirror pointed towards the clear aspect of the sky, and defended from currents It may be supposed that the same atmospheric causes which obstruct the passage of radiant heat from the sun oppose also its transmission from the earth into space

From the theory of terrestrial radiation, a curious deduction was made by Fourier, with regard to the temperature of the region of space through which the earth moves in its orbital revolution On computing the temperature which it is necessary [illegible] planetary spaces to possess in order that [illegible] state of the earth's surface may be such as is actually observed,

[illegible] Svanberg arrived at the same conclusion by a different process but others have given very different estimates Thus Poisson makes it −13° cent or +8½° Fahr , and Pouillet supposes it to be below −115° cent or −175° Fahr (See *Leslie's Experimental Inquiry into the Nature and Propagation of Heat*, 1804 , Prevost, *Essai sur la Calorique Rayonnante*, 1809, Fourier, *Theorie Analytique de la Chaleur*, 1822 Poisson *Memoires de l'Academie* 1835, *Kelland's Inquiry into the Results of the British Association* for 1832, 1836, and 1840 )

RA'DICAL (Lat radix, *a root*), in Chemistry, is a term occasionally used as synonymous with *base* thus sulphur and phosphorus are the *radicals* of the sulphuric and phosphoric acids The term *compound radical* is applied to certain organic combinations, in this case compounds of hydrogen, carbon, or nitrogen constitute the principal radicals

RA'DICAL BASS In Music, the same as *fundamental bass*, which see

RA'DICAL REFORMERS In Politics, that political party in England which desires to have the abuses which from lapse of time or any other cause may have crept into the government, completely *rooted out* (as the origin of the term implies), all our institutions remodelled and, [illegible] of the democratic spirit infused into [illegible]

RA'DICAL SIGN In Algebra, the symbol $\surd$, denoting the extraction of a root It is a modification of the letter *r*, the initial letter of *radix* or root To distinguish the particular root which is to be extracted a number is prefixed to the symbol, thus $\sqrt[2]{}$ $\sqrt[3]{}$ $\sqrt[4]{}$ &c denote respectively the square root cube root fourth root, &c , but as the square root or second root was the first considered, the number is usually omitted, and merely the symbol $\surd$ written Fractional exponents are frequently used instead of the radical sign A *radical quantity* is a quantity to which the radical sign is prefixed

RA'DICLE In Botany that portion of an embryo which eventually becomes the descending axis or root It is the lowest of the two opposite cones of which an embryo plant consists

RA'DIOLITES A genus of fossil shells the inferior valve of which is in the shape of a reversed cone the superior valve convex

RA'DIUS (Lat *a ray*) In Geometry and Trigonometry the semidiameter of a circle or a straight line drawn from the centre to the circumference In the trigonometrical tables the sines cosines tangents &c of circular arcs are expressed in parts of the radius, which is usually assumed equal to 1 The radius is equal to the side of the inscribed hexagon , or it is equal to an arc of 57 29578°, or 57° 17′ 44 81″ the semicircumferences, or 180°, in parts of the radius being 3 141 927

RADIUS In Osteology, a bone of the forearm so called from its supposed resemblance to the spoke of a wheel Its upper end which is the smallest is formed into a round hollowed head and is articulated with the small head at the side of the pulley of the humerus whilst the rounded border of it next the ulna is articulated with the lesser sigmoid cavity of that bone, its lower extremity is articulated with the bones of the wrist

RADIUS OF CURVATURE In the higher Geometry the radius of curvature at any point of a curve line is the radius of the circle which *osculates* the curve at the given point (*see* OSCULATION), or has the same curvature as the curve at that point The curvature of a circle being uniform [illegible] its radius of the osculating circle is [illegible] curvature of any curve must at different points The general expression for the radius of curvature, *r*, of any plane curve defined by the equation $y = f(x)$, is

$$r = \frac{(dx^2 + dy^2)^{\frac{3}{2}}}{dx\,d^2y}$$

(*See* EVOLUTE ) From this expression the value of *r* is readily found when the equation of the curve is given, it is a property of lines of the second order, that the radius of curvature is equal to the cube of the normal divided by the square of the semiparameter

The expression for the radius of curvature of a surface represented by the equation $z = f(x\,y)$ at any point whose co ordinates are *x*, *y*, *z*, is as follows — Make

$$\frac{dy}{dx} = m, \quad \frac{dz}{dx} = p, \quad \frac{dz}{dy} = q,$$

$$\frac{d^2z}{dx^2} = r, \quad \frac{d^2z}{dx\,dy} = s, \quad \frac{d^2z}{dy^2} = t,$$

and let R denote the radius of curvature of a normal section of the surface, then

$$R = \frac{\sqrt{1 + p^2 + q^2}\left((1 + p^2) + 2\,p\,q\,m + (1 + q^2)\,m^2\right)}{r + 2\,s\,m + t\,m^2}$$

RA'DIUS VE'CTOR In Astronomy, is the straight line drawn from the centre of force to the point of the orbit, where the body is supposed to be A body projected in space, and subjected to the action of a centripetal force, as gravity, which varies in the inverse ratio of the distance, describes a conic section which has one of its foci at the centre of force In the parabola, let *p* denote the parameter , and in the ellipse and hyperbola, let *a* denote the semitransverse axis, and *e* the eccentricity , also let *r* denote the radius vector, and *v* the angle which it makes with the transverse axis , then the expression for the radius vector in the parabola, the ellipse, and the hyperbola respectively, is

$$r = \frac{\frac{1}{2}p}{1 + \cos v}, \quad r = \frac{a^2 - e^2}{a + e\cos v}, \quad r = \frac{e^2 - a^2}{a + e\cos v}$$

These expressions are called the *polar equations* of the three curves

RA'DIX, or ROOT *See* ROOT

RAFT A species of float formed of various logs or planks, fastened together side by side, so as to be conveyed from one point to another This means of conveying timber [illegible] in many places [illegible] on the Rhine, o[illegible] near its source down to the navigable stations on its banks, may be interesting to the reader —

A little below Andernach the little village of Namedy appears on the left bank, under a wooded mountain The Rhine here forms a bay where the pilots are accustomed to unite together the small rafts of timber floated down the tributary rivers into the Rhine, and to construct enormous floats, which are navigated to Dordrecht, and sold These machines have the appearance of a floating village, composed of 12 or 15 little wooden huts, on a platform of oak and deal timber They are frequently 800 or 900 feet in length, and 60 or 70 in breadth The rowers and workmen sometimes amount to 700 or 800, superintended by pilots and a proprietor, whose habitation is superior in size and elegance to the rest The raft is composed of several layers of trees, placed one on the other and bound together a large raft draws not less than 6 or 7 feet of water Several smaller ones are attached to it by way of protection, besides a string of boats loaded with anchors and cables, and used for the purpose of sounding the river a[illegible] ng on shore The domestic economy of an East Indiaman or an English man of war is hardly more comp[illegible] Poultry pigs and other animals are to be found on board , and several butchers are attached to the suite A well-supplied boiler is at work night and day in the kitchen , the dinner hour is announced by a basket stuck on a pole, at which sign l the pilot gives the word of command and the workmen run from all quarters to receive their mess The consumption of provisions in the voyage to Holland is almost incredible sometimes amounting to 40 000 or 50 000 pounds of bread , 18 000 or 20 000 of fresh besides a quantity of salted meat, and butter, vegetables &c in proportion The expenses are so great, that a capital of three or four hundred florins is considered necessary to undertake a raft Their navigation is a matter of considerable skill owing to the abrupt windings the rocks and shallows of the river , and some years ago the secret was thought to be monopolised by a boatman of Rudesheim and his sons (*Autumn on the Rhine* )

RAILER (Sax paſtep) In Architecture, an inclined piece of timber in the side of a roof, in the provinces called a *spar* It is of various sorts, as will be seen under the art ROOF, which see

RAGSTONE A dark grey siliceous sandstone

RAIL In Architecture the horizontal part in any piece of framing or panelling Thus in a door the horizontal pieces between which the panels lie are called *rails* whilst the vertical pieces between which the panels are inserted are called *styles*

RAIL, or WATER-RAIL (*Rallus aquaticus* of Lin ) A native species of a genus of Macrodactyle or long-toed waders destitute of alar spines or a frontal shield

RAILING A fence or barrier made of posts and rails The most ordinary fence of this description in the country is formed of wooden posts let into the soil, so as to stand upright to which are nailed or morticed horizontal wooden rails, one above another, at such a distance as to prevent domestic animals from penetrating through them In some cases one horizontal rail is fixed to the posts near th[illegible] another near the top of the post [illegible] them is rendered impervious to [illegible] upright rails nailed to the top and bottom horizontal rail Iron railings are generally formed in this manner

RAILROADS or RAILWAYS Roads constructed of tracks of iron called *rails*, on which the wheels of carriages roll, and to which they are confined by ledges or *flanges* raised either on the rail or on the tires of the wheels

*Theory of Railways* — The object to be attained by the

construction of roads of every kind is to effect the transport of loads by the least possible expenditure of tractive force, and one road is better or worse than another, *ceteris paribus*, according as the same moving power is capable of drawing upon it a greater or less amount of load Since the moving power whatever it may be, is expended in overcoming the resistance which the carriages on which the load is borne offers, this object can only be attainable by the adoption of such expedients as will permanently diminish the amount of that resistance The causes of resistance to the motion of a carriage along the road are the following —

1 *Roughness or Unevenness of the Road Surface* — All asperities formed by stones or other hard substances projecting above the general surface of the road produce a resistance to the moving power since, when the wheels encounter them and pass over them the weight of the load, resting as it does upon the wheels, must be raised through a height corresponding with such projections, and when such projections are frequent or continued, this expenditure of the moving power is also continued, and the same species of resistance is produced as if the moving power had *continually* to raise an equivalent weight In like manner if cavities or *ruts* occur on the road surface, the wheels sink into them, and the moving power is constantly expended in raising the load out of these cavities All roughness or unevenness of surface consisting of nothing more than a multitude of such projections and cavities more or less minute in magnitude, the same causes operate by such means in absorbing the moving power

2 *Softness of the Road* — However free the road surface may be from asperities or cavities if its substructure be of such a nature that it will yield to the pressure of the wheels a resistance will be produced to the moving power, the amount of which will be more or less according to the degree in which this softness or yielding quality exists The wheels sinking into a cavity produced in the soft surface of the road by their pressure the moving power is affected in nearly the same manner as if it had to draw the load out of the cavity which it makes for itself, and a corresponding amount of resistance is the consequence

3 *Acclivity of the Road Surface* — When the surface of the road is not perfectly horizontal but forms an inclined plane up which the load is to be drawn a resistance will be produced by the gravity or weight of the load which will be proportional to the steepness of the acclivity thus if the road surface rise in the direction of the motion one perpendicular foot in 50 feet of distance then as much power will be absorbed in going over every [illegible] as would lift the entire load through one foot of perpendicular height

This cause of resistance differs from the former *causes* In both the former the resistance to the moving power would be equally produced in whichever direction the load is drawn, but the effect of an acclivity is to increase the resistance only in the ascending direction In the descending direction on the other hand it will have the effect of assisting the moving power by causing the gravity of the load to co operate with that power in overcoming the resistance In all roads therefore on which [illegible] in both directions the advantage derived from descending acclivities is to be placed against the power expended in ascending them The principles on which the question of the best possible arrangement of the acclivities on roads of different kinds depends are of great importance not only with reference to the working of roads but also in laying them out or originally constructing them, and there is none about which there has been, and still is a greater difference of opinion among engineers and men of practical science

Such, therefore being the sources of resistance the qualities which must be imparted to a road, to diminish as much as possible the resistance to the moving power, must be the following —

1st, Smoothness and evenness of the road surface

2d, Hardness and durability of the road structure

3d Such an arrangement of the acclivities that the effect of the gravity of the load shall [illegible] the least amount of resistance or the [illegible] the greatest amount of advantage to the moving power

In ordinary roads formed of gravel, broken stone, or pavement the entire surface is [illegible] manner, so that every part of it [illegible] motion of the wheels, and as the tractive power commonly used is the strength of horses the structure of the road must also be more or less made with a view to their qualities Thus it might happen that the great degree of smoothness and hardness which would contribute most effectually to diminish the resistance of the carriages would be incompatible with the continued health and soundness of the horses working on it The paved streets of a town, by reason of their hardness, produce less resistance to the motion of [illegible] gravel roads of the country, but [illegible] more injurious to the horses which work upon them

This difficulty is met by [illegible] only of the road to the [illegible], and imparting to these [illegible] to the peculiar action of the feet and to the circumstances of the structure and health of the animal

This has been accomplished by constructing upon the roadway parallel tracks with a width corresponding to the distance between the wheels, and between these tracks forming a path suitable to the horses

Another advantage attending such an arrangement is, that the extent of the road surface adapted to the action of the wheels is extremely limited, and a greater amount of expense can be incurred in giving it the necessary [illegible] as in common roads, to the whole extent of the road surface

Such are the general principles which have led through a succession of stages of progressive improvement, to that most perfect of all the instruments of transport which human invention has yet devised — the modern railway Such a road consists of two parallel tracks of iron firmly maintained in their places the upper surfaces of which are rendered in a very high degree smooth and level a strength being given to them which renders them capable of sustaining enormous loads without being deranged in their structure or position The carriages are maintained upon such tracks or ledges by means of a projecting flange which is constructed upon the inside of the tires of the carriage wheels and which by pressing on the inside of either rail prevents the carriages from escaping from the rails [illegible] roads will be rendered [illegible] by a brief view of their history from their first invention to their present state

*History of Railways* — About the middle of the 17th century the transport of coals from the pits to the harbour was effected in the coal districts of Northumberland and Durham by laying down parallel tracks of timber with a horse path between them the wheels being confined upon the beams or rails of timber by ledges or flanges projecting from the inside of the tire of the wheels These timber rails were constructed in pieces of about 6 feet long with a section of about 4 inches square they were supported on pieces of timber called *sleepers* laid at right angles to them transversely on the road These sleepers were laid at about two feet apart, so that each pair of parallel rails was supported by three sleepers besides giving support to the rails these sleepers also had the effect of [illegible] the rails in gauge or in keeping them at [illegible] under The rails were fastened to the sleepers by pins driven quite through the rails and half way through the sleepers to preserve the uniformity of the upper surface of the rail, these wooden pins were planed off at the top

The necessity of giving room for the flanges of the wheels running as they did below the surface of the rail, and the small depth between the surface of the rail and the sleeper rendered it impossible to protect the sleepers effectually from the action of the horses feet by any covering of gravel or other material The sleepers were consequently subject to be worn and destroyed The rails also being worn by the action of the wheels still more rapidly than the sleepers required to be frequently replaced and each new rail being pinned down to the same sleeper the ends of the sleepers were gradually perforated by so many holes that the sleepers were weakened and required to be soon replaced These defects were remedied by the adoption of the double timber railway, which consisted in laying upon the surface of the timber rails above described additional rails of timber of equal scantling, attached to the lower rails by wooden pins, passing quite through the upper and half through the lower rails in the same manner as the lower rails themselves were attached to the transverse sleepers This change was attended with many advantages Besides the increased strength given to the rails by the double timbers, the depth of the sleepers below the upper surface of the superior rail allowed the sleepers to be protected from the action of the horses feet by covering them with broken stones, gravel or other road materials The structure of rails and sleepers also being stronger and more weighty, and held down by the road material with which the sleepers were covered allowed a packing or ballasting to be driven under the rails, so as to give greater stability and firmness to the road Another advantage obtained by this arrangement was, that when the superior rails were worn by the action of the wheels, they could [illegible] the inferior [illegible] at which they were attached by pins to the inferior rails, could be varied at pleasure, the pin holes made in the inferior rails would not come in the same place, or near each other, so as injuriously to weaken the latter

The next improvement consisted in the addition of a plate or bar of iron, about two inches broad and half an inch thick, laid along the upper surface of the superior rail and attached to it by nails or iron pins countersunk into it The wheels of the carriages ran upon this iron rail, which formed a more durable surface than that of the wood In the United States of America, railways of this construction are still in very general use They are recommended in that country by the abundance and cheapness of timber, and the comparative high cost of iron Such a road is tolerably efficient where the traffic is light, and can therefore be resorted to in localities and circumstances in which an adequate return could not be obtained for the capital necessary for the construction of the more perfect modern railway In the construction of these timber railways in America many other improvements have been introduced more especially in the substructure of the road In laying out the roadway for the reception of the rails, two parallel trenches are cut along the line of way corresponding to the distance between the rails and transverse trenches at right angles to these are cut to receive the sleepers these trenches are respectively bottomed with a ballasting of broken stone, on which the rails and cross sleepers rest This basis answers the double purpose of a firm and durable support for the road and an effectual means of drainage The scantling of the timbers used for the rails is usually six inches in width by ten inches in depth they are attached to the sleepers, so as to be at once kept from springing from them and from altering their gauge by the following means —A notch is cut in the sleeper corresponding to the size and form of the rail and the rail, at the place where it is let into the sleeper is formed with a vertical surface on the outside and a levelled surface on the inside, increasing in width downwards When let into the notch of the sleeper, the levelled part of the rail is forced into the corresponding cavity of the notch by a wedge driven between the outside edge of the rail and the outer surface of the notch

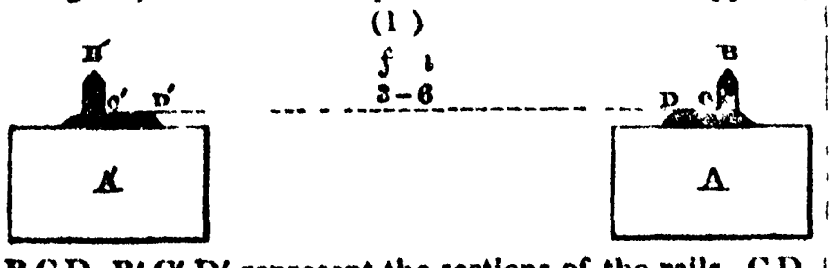
An expedient based upon the general principle of railways has been adopted but from what date we are not informed, in the streets of some of the Italian cities and more particularly in those of Milan Parallel tracks of hewn stone are laid down to receive the wheels of carriages and such a width is given to them as to be accommodated to any variations which are usual in the structure of carriages This width is also such that the wheels are not liable to run off these flagged paths by any irregularity in the course which the horse takes in drawing the carriage

Great facility of draught is obtained by this expedient which has been of late years adopted with some improvement in England A flagged trackway of this kind was constructed some years ago, extending from the West India Docks along the Commercial Road towards the City of London, and a similar expedient was some time afterwards proposed to facilitate the application of steam power on common roads Stone trackways of this kind have been accordingly laid down on some parts of the high road between London and Birmingham This expedient has the advantage in one respect over railways, inasmuch as the carriages are not confined by flanges or any other expedient to the same paths on which the wheels move and consequently the same carriages which run upon them may also move on other parts of the road Thus, one carriage may pass another while both use the same line of stone rails, which cannot be effected when carriages are confined to the rails

In the progress of improvement, the timber railway above described was succeeded by the last iron plate railway or tramway which was for a long period used exclusively in the coal districts and in public works generally, and is still to a considerable extent adopted especially in the railways which are carried through the workings of mines and on which the product of the mine is conducted in waggons being pushed by men or drawn by horses to the foot of the shaft

*The Plate Railway, or Tramway* —About the year 1770 tramways of cast iron came into use in the collieries in the north of England These railways consisted of two rails of cast iron laid parallel to each other at a distance from three to three and a half feet asunder They were usually supported either on timber or stone bearings A cross vertical section of these as first used is represented at fig 1, where A A′ represents the timber supports,

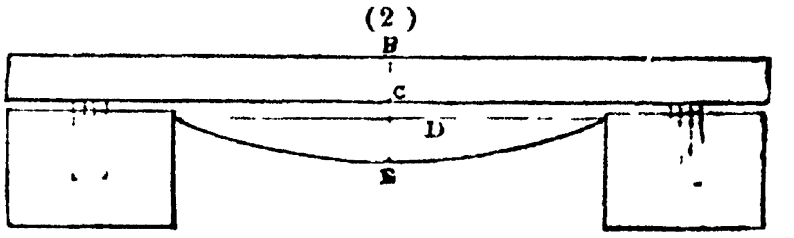
(1)



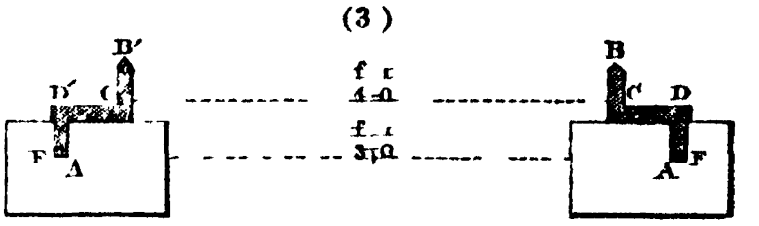

B C D, B′ C′ D′ represent the sections of the rails, C D, C′ D′ represent the horizontal plates attached by nails or pins to the sleeper On this plate the wheel of the waggon rolled The ledges B C, B′ C′ rose perpendicularly from the outside edge C′ of each plate (1) These, by pressing on the outside of the wheels, prevented the waggon from escaping from the road They were subsequently placed on the *inside* of the horizontal plate, so as to act on the *inside* of the wheels

In order to give such rails strength in the vertical direction, to supersede the necessity of a continued support beneath them, they were afterwards cast with a ledge beneath them, projecting downwards from the outside edge of the horizontal plate A side view of such a rail is represented in fig 2, and a cross section of the rails in fig 3.

(2)




(3)




The upright ledges B C, B′C′ (fig 3) rising from the horizontal plates C D, C′D′, and coming within each wheel, kept the wheels on the rails, and the ledge D E, D′E′, projecting downwards, and increasing in depth towards the middle of the distance between the supports as represented in fig 2 gave the necessary strength to the rail The outlines of this ledge formed each a curve, so that the strength at different points between the supports might be proportioned to the mechanical effect of the vertical pressure The flanges B C B′C′ are the same height throughout the whole length of the rail

These tramways were for a long period constructed exclusively of cast iron, but when improved methods of rolling malleable iron were contrived they were formed by rolling and for nearly twenty years back they have been constructed exclusively of wrought iron

*Edge Railway* —Within twenty years after the first introduction of tramways of iron, the form of rail called the *edge rail* was brought into use This rail is constructed in the form of a bar of iron whose width is considerably less than its depth placed as the name implies, with its narrow edge presented upwards Owing to its depth being much greater than its width, its power in proportion to its weight to resist vertical pressure is very considerable The wheels were retained on rails of this description by flanges projecting from the inside of their tires These flanges at the point where the wheels rest on the rails descend below the rails, and the wheel cannot pass off the rail towards the outside, unless the flange rolls over the rail

For a long period after their first adoption, edge railways were confined to the mining districts, and more particularly to the collieries where they were used for the transport of the products of the mines to the places of shipment, but this species of road acquired vastly increased importance when passengers and goods came to be transported on it by locomotive engines, which took place between Liverpool and Manchester in the year 1830 Since that time the construction of railways adapted for general traffic at a speed which would have been formerly thought impossible, has been carried to a great extent in Europe, and in the United States

Subjoined is a table showing the extent of railway in operation and in progress in 1851 together with the capital already invested or to be invested in them, in different countries throughout the world.

| | Railways open | Railways in progress | Capital invested in Railways | Capital to be invested in Railways. |
|---|---|---|---|---|
| | *Miles* | *Miles* | £ | £ |
| United Kingdom | 7,000 | 4,500 | 250,000,000 | 100,000,000 |
| Germany, Austria and Holland | 5,300 | 800 | 66,775,000 | 10,000,000 |
| France | 1,800 | 1,200 | 48,780,000 | 15,350,000 |
| Belgium | 500 | 200 | 8,000,000 | 3,600,000 |
| Russia | 200 | 470 | 5,000,000 | 7,500,000 |
| Italy | 170 | 470 | 3,000,000 | 8,500,000 |
| United States | 10,000 | 200 | 67,000,000 | 2,000,000 |
| Total | 24,970 | 7,840 | 446,555,000 | 146,750,000 |

Within the limits of the present article, it would not be possible to trace, in detail, the successive improvements by which the present methods of laying out and constructing railways for the safe transport of passengers by steam power have been attained. When

the Liverpool and Manchester line was first brought into operation, little, comparatively, was understood of the capabilities of such means of intercommunication, and that line may be regarded as an experimental railway, the results of which have supplied the data on which others have since been constructed and worked The form, strength, and weight of the rails, — the mode of fixing them on the road, — the weight, power, and proportions of the engines, — the form strength, and weight of the carriages and waggons, — the magnitudes of the trains, and the speed of transport, have all been subject to change from year to year, and almost from month to month, since the opening of that line in 1830 to the present time We shall not therefore attempt to trace these improvements, but shall briefly explain the formation and construction of railways, according to the methods and principles at present [illegible]

*Of the Formation and [illegible] Railways* — Whatever be the moving power to be used for the transport of loads upon a railway, its force must be proportioned to the average resistance of such loads and it must be capable of varying its energy to the same extent as that resistance is subject to variation The great perfection which has been attained in the construction of the rails, and in the methods of fixing them in their position upon the road is such that the resistance offered to the tractive power by loads moved on a straight and level railway may be regarded as practically uniform so that the moving power by which a load is transported at a given speed on a straight and level line of railway is subject to a resistance as unvaried and as uniform as any to which moving powers are usually submitted in any of the processes of art, but as the amount of resistance to the tractive powers upon a straight and level railway is diminished by the perfection thus attained in the construction of the road so, in the same degree is any resistance produced by a departure from a perfect level more sensibly felt Thus, if the resistance to the moving power on a straight and level railway, by a load moved at a given speed be equal to the 250th part of the load an acclivity which would rise at the rate of one foot in 250 or nearly at the rate of 20 perpendicular feet in a mile, would produce a resistance to the moving power, by reason of the ascent alone, equal to a 250th part of the load and therefore equal to the resistance which the moving power would sustain on a level line It follows therefore, that, under such circumstances in drawing a load up such an acclivity the moving power would have to overcome twice the resistance opposed to it on a level, for the same causes which produce on a level a resistance amounting to the 250th part of the load equally produce this resistance in ascending the acclivity in addition to which there would be an equal amount of resistance due to the ascent If therefore, under such circumstances the moving power were required to draw the load up the acclivity at the same speed as that at which it drew it on the level, the machine exerting that power must be endowed with properties in virtue of which it is capable of varying its [illegible] without injury to its structure, in the proportion [illegible]

Whether such limits of variation in the resistance or in the moving power as are here referred to for the sake of illustration be those which are requisite in practice or not it is apparent that [illegible] limits must exist to the variation in the resistance whatever these limits may be, corresponding limits must be imposed on the acclivities which have been called, which are [illegible] on which such moving power [illegible] the moving power be incapable [illegible] a greater proportion than two [illegible] gradients must not create more than twice the resistance on the level parts of the line, and, if the resistance on the level parts of the line be equal to the 250th part of the load [illegible] is required to be maintained in ascending the acclivities as on the level

When a carriage of any kind changes the direction of its motion, it does [illegible] by suddenly passing from motion [illegible] to motion in the other Many mechanical effects, which will be sufficiently obvious, forbid this The change of direction is, on the other hand, effected gradually, by causing the carriage to move in a curve Now, in such a motion, it is evident that the wheels which traverse the outer part of the curve will in the same time move over a greater space than those which traverse the inner part, in fact, the inner and outer wheels move over arches of circles which have the same centre, the outer arch being longer than the inner If the wheels, therefore, be (as they always are) of the same magnitude, the outer wheel must revolve oftener on its axle in passing over the curve than the inner, but, besides this, the position assumed by the wheels in passing round a curve is different from that which they have when moving in a straight line If a four-wheel carriage move along a straight road, its axles will be at right angles to the direction of its motion, and therefore parallel to each other; but if it move in a curve, which it does in turning a corner, then its axles are no longer parallel, but each of them is directed to the centre of the curve which the carriage describes The mechanism by which this effect is provided for by four-wheel car[illegible] [illegible] is the perch or pivot on which the axle [illegible] is made to turn By this pivot the fore axle may be placed at any required angle with the axle of the hind wheels As the wheels of all such carriages revolve independently of each other, each upon its own axle, the wheels on the same axle may revolve at different speeds These two provisions, therefore, are brought into play [illegible] The outer [illegible] inner and the axles throw themselves out of parallelism, and take the directions of the radii of the curve

The peculiar structure of railway carriages excludes the possibility of either of these provisions for turning round a curve To maintain in security the carriages on the rails, it has been found necessary to fix the axles truly square with the carriages, and therefore to exclude the pivot or perch by which a common carriage is turned It has likewise been found necessary to key the wheels firmly upon the axle, so that the wheels and axle shall turn together instead of the axle being fixed, as in a common carriage, and the wheels turning upon it The mechanism of a railway carriage is therefore essentially adapted to rectilinear motion, and it contains no expedient by which it can move round a curve When such a carriage therefore, first encounters a curve its tendency is to proceed in the continuation of the straight line in which it has previously moved and which forms a tangent to the curve If this tendency were allowed to take effect the outer wheel would run off the rail on the outside of the curve and the inner wheel would come off the rail in the space between the rails This is prevented by the flange which projects from the tire of the outer wheel and which, at the point where that wheel rests upon the rail descends below the rail When the wheel makes an effort in virtue of the tendency to rectilinear motion, to pass off the rail the flange comes in contact with the inside of the rail and by pressing upon it, throws the carriage inwards, and this taking place with the fore wheels the direction of [illegible] and it is thrown more [illegible] This action of the flange is continued while the carriage is passing round the curve, and it is to it alone that the change of direction of the carriage is due

The tires of the wheels of railway carriages have usually a conical form given to them, becoming gradually smaller from the flange outwards, and, when a carriage rests straight upon the rails the distance between the flanges of the wheels being less than the distance between the rails, a small space is left between the flanges and the rails to allow some play to the flanges without letting them strike the rails When the carriage comes to a curve the flange of the outer wheel comes into contact with the outer rail, and the whole play of the flanges is given to the space between the flange of the inner wheel and the inner rail In consequence of the conical form of the tires of the wheels the outer wheels, in this case rest upon a thicker part of the cone than the inner, and the actual diameter on which they revolve is consequently greater than that on which the inner wheels revolve This effect has been generally regarded as an expedient sufficient to enable railway carriages to run round curves of a certain limited radius, but that this is an error may be easily shown, — if to a four-wheel carriage, wheels of unequal diameter be attached smaller wheels being put on the one side than on the other, and if such wheels were attached to their axles, so that the axles revolve with them and if at the same time the axles be fixed square with the carriage, *such a carriage will be found to be incapable of moving in a curve, notwithstanding the inequality of its wheels*

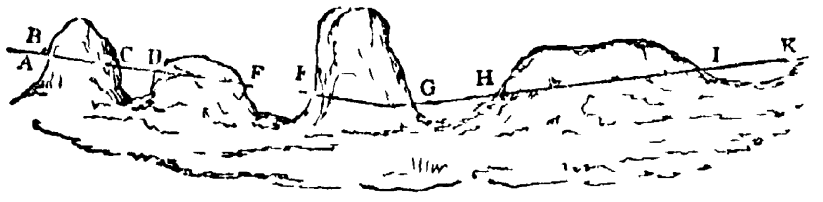
The pressure of the flange on the rail being, therefore, the only means of turning a railway carriage round a curve and such pressure being attended by friction, and therefore by increased resistance to the moving power, curves as well as acclivities are a cause of resistance, and this resistance will be great in proportion to the rapidity of the curve or the shortness of its radius But, independently of this effect of curves, a more serious objection to those whose radius is under a certain limit of magnitude arises from the liability of the carriages to run off, by the flange encountering any obstacle or inequality which would cause it to pass over the rails

The *section* of a railway is therefore limited by those circumstances [illegible] variation of the moving power, and the *plan* is, on the other hand, limited by the necessity of effecting every change of direction of the line by curves whose radius shall have such a magnitude as to exclude all danger of

the carriages running off the line In the laying out of a railway, therefore limitations of its section and plan [illegible] to be necessary to the formation of a railway, an artificial surface must generally be formed by raising some and lowering other parts of the country through which the railway is to pass The expedients by which this is accomplished are attended with more or less difficulty and expense, and the skill of the engineer is eminently required in the selection of such a course for a proposed line of railway as will be attended with the least expensive construction, due regard being had to the permanent expense of working and maintaining it

When a railway is proposed to be constructed between two points, which are called its *termini*, the engineer makes himself generally acquainted with the country between these termini, and selects that course for the line which, with least deviation from [illegible] the proposed termini, will afford the [illegible] the formation of the artificial surface [illegible] limited as it must be in respect to its acclivities, and to the curves by which its various changes of direction are effected This is first accomplished by an *eye survey* or general *reconnoissance* of the country An instrumental survey is afterwards made along the direction which has been selected for the line, and a nearly accurate profile of the country from terminus to terminus, in the proposed direction, is obtained This being accomplished and reduced to a drawing, as represented in fig 4, a line

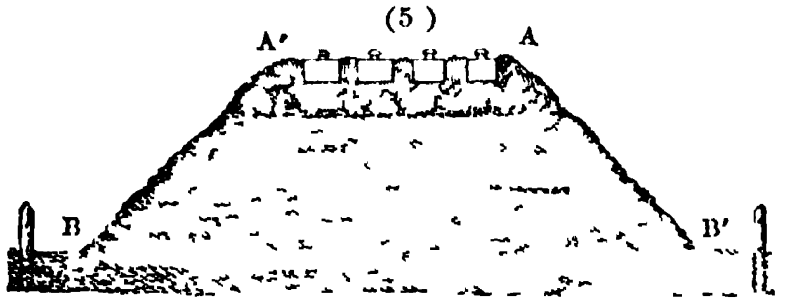
(4)




A B C D E G H I K is drawn regulated by the degrees of inclination which have been decided to be the best practical limits of the acclivities This line will as represented in the figure, in some places as A B, C D, I F, G H I K, pass above and in others B C, D I F G H I below the natural surface of the ground It is therefore to be considered that, in the one case, the artificial surface of the line must be elevated above the natural surface, and that in the other case some expedient must be provided by which the artificial surface may pass at the requisite depth below the natural surface

The surface of a railway is raised *above* the natural surface of the ground by either of two expedients, — 1st by forming a mound of earth with sloping sides having the railway on its summit — this is called an *embankment* (fig 5), 2dly, by constructing a bridge by which

(5)




the railway can be conducted at the requisite elevation, above the natural surface of the ground in the same manner as a road is constructed over a river, — such a bridge is called a *viaduct* Such structures are formed either of masonry or of cast iron, but in countries such as the United States, where timber is abundant, cheap viaducts of carpentry [illegible]

The surface of a railway is reduced [illegible] the natural surface of the ground by either of two expedients, — 1st, by forming an excavation or artificial valley with [illegible] side along the line between the [illegible] — such an excavation is called a *cutting* (fig 6) 2dly

(6)




by undermining the ground and constructing a subterranean archway or vault of sufficient magnitude, the roof of which is usually lined with masonry, and along the bottom of which the railway is conducted,— such an archway is called a *tunnel*

In laying out a railway, the disposition of its cuttings and embankments must be kept in view In general, the material by which the embankments are formed is obtained from the cuttings, and, with a view to the saving of expense, the engineer so arranges his section that the quantity of stuff required for the formation of embankments shall be as nearly as possible equal to that supplied by the cuttings If there be an excess of stuff from the [illegible] then the stuff necessary for the formation of such embankment must be obtained from some excavation made near the embankment expressly for the stuff for the embankment This is [illegible]

The distance along which the stuff is carried from a cutting is carried before it is laid down to form the embankment is called *the lead*, and the quantity of labour necessary to form an embankment out of an adjacent cutting is determined by the number of cubic yards of stuff necessary to form the embankment multiplied by the average *lead*, or the mean distance to which such stuff has to be carried

Where a very [illegible] may happen that the [illegible] ing the embankment [illegible] greater than the [illegible] lead, and [illegible] are [illegible] in each individual case with reference to the price of land and labour

When the elevation above the natural surface of the ground at which the railway must be carried is so great as to render an embankment impracticable, or attended with a disproportionate expense, a viaduct is resorted to, and, on the other hand, when the excavation necessary to give an open cutting would be productive of objectionable expense then the railway is conducted under the ground through a tunnel

The slopes A B, A' B', fig 5, 6, forming the sides of embankments and cuttings depend on the nature of the soil or strata through which the cuttings are made, and of which the embankments are formed In general every material [illegible] will rest, all more steep [illegible] to [illegible] this angle is called, in mechanics the *angle of repose* In the strata through which railway cuttings are made, and from which embankments are usually formed, the slopes of the sides are rarely less than 1½ foot horizontal to 1 foot vertical, and they vary between that and 2 feet horizontal to 1 foot vertical [illegible] or gravelly [illegible] sufficient, but with certain descriptions of clay, such as that called the London clay, a more gradual slope must be allowed With such material, the slopes are constructed at 1¾ or 2 horizontal to 1 vertical, but in general it is better, even at increased expense of earthwork, to allow a sufficient slope in the commencement, and thereby avoid the continual expense attending *slips* as the gradual decadence of the sides of cuttings and embankments is called

The face of slopes both of cuttings and embankments, should be covered with soil and sown with grass seeds, so as to produce a turf which gives a further security against *slips* They may be also, especially the slopes of embankments, planted with shrubs, care being taken, however, not to obstruct the ventilation of the road

When the stratum through which a cutting is required to be made is rock or hard stratified chalk, it will stand with perpendicular sides, and, in such cases, cuttings of great depths may be made at a trifling sacrifice of land The Olive Mount cutting on the Liverpool and Manchester railway is, at the deepest parts, above 100 perpendicular feet from the natural level of the surface to the level of the rails, and cuttings of still greater depth and much greater extent, through stratified chalk, are executed on the Brighton railway, of which the sides are perpendicular

In most cases, however, where cuttings attain to these extraordinary depths, tunnels would be less expensive It sometimes happens that the material of the cutting is required for an adjacent embankment, and under such circumstances, if the sides of the cutting can be perpendicular, and the sacrifice of land small, it may be preferable to *tunnelling* The materials from the Olive Mount cutting above mentioned were required for the formation of the [illegible]

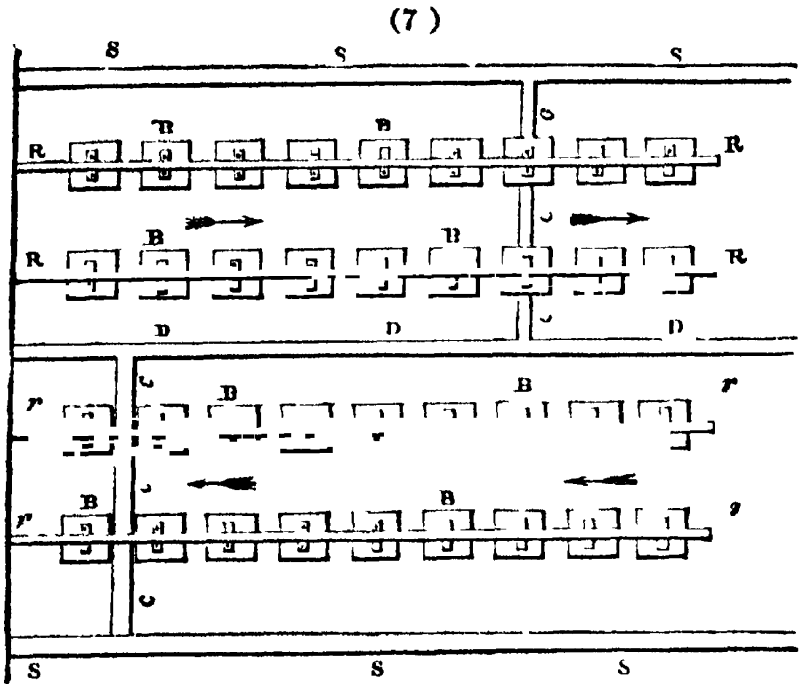
*Drainage* [illegible] the artificial surface of the road intended to receive the rails and their supports is called, should be properly drained This is effected by a centre drain, carried along the middle of the [illegible] and discharging the water [illegible] the sides or embankments The centre and cross drains are covered drains, formed either of brick or stone, or, more economically, of tiles made of a proper form for the purpose

*Road Structure* — The surface of the road being pre-

pared to receive the rails, the props or *chairs* which at fixed intervals form the support of the rails must next be laid down These are sustained on supports of either of two kinds —

1st, In cuttings, or on well-consolidated embankments, stone blocks are provided, roughly formed into a rectangular parallelopiped, the base of which is a square whose side is 2 feet, and the height of which is 1 foot A bottoming of broken stone and gravel being spread to receive these the [illegible] them repeatedly by [illegible] fall in the place where they are intended to rest, until they beat for themselves a solid and unyielding bed It was the practice [illegible] the blocks so that their sides were parallel and perpendicular to the sides of the railway In fig 7

(7)

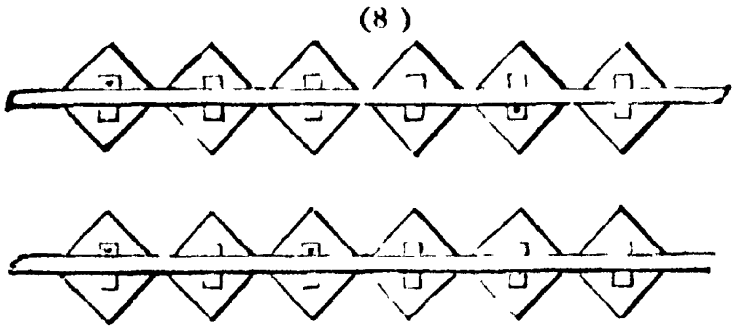



is represented the plan of a railway thus laid on blocks showing its drainage, consisting as is usual with railways having extensive traffic of two lines The line R R, R′ R′ is appropriated to carriages moving in one direction, and the line r r r′ r′ to carriages moving in the other direction By thus causing carriages moving in the same direction to be confined to the same line the collision of trains *meeting* is prevented The centre drains running between the lines of railway is represented at D D D The cross drains are shown at C C C, communicating with the side drains S S S

The blocks are represented at B B, supporting the rails and laid with their sides parallel and perpendicular to the rails

This arrangement has lately been superseded by the diagonal arrangement of blocks represented in fig 8 It

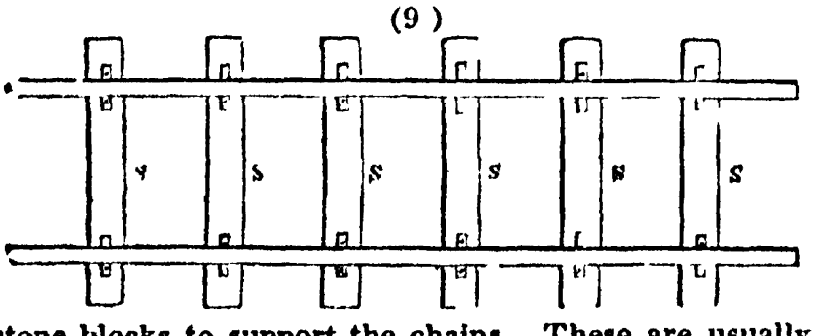
(8)



is considered that this arrangement gives the block a better bearing on its bed, but the chief advantage attending it, as compared with the former position of the blocks is that it renders the base of the block more accessible for repairing and adjustment, from time to time, when the road is in operation

2dly On embankments newly made or other parts of the line where the foundation of the road is liable to yield under the operation of the traffic upon it, wooden sleepers S S, fig 9 extending across the road, are used instead of

(9)



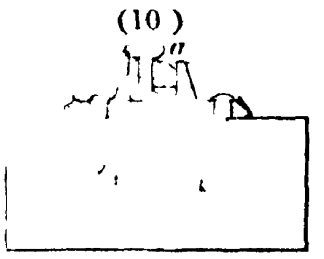

stone blocks to support the chairs These are usually formed of [illegible] split along the centre so as to form two logs one side of which is flat and the other convex They are usually from 8 to 9 feet long and from 9 to 10 inches broad on the flat side and from 4 to 5 inches deep, measured in the thickest part They are laid across the road, with the flat side downwards. The chairs are fastened to them by pins on the convex side, in [illegible] which have been already described to [illegible] chairs being thus connected, by [illegible] same sleeper, the rails are kept [illegible] the yielding of the foundation under the sleeper

Originally stone blocks were universally regarded as the [illegible] the support of the rails wherever they could be laid upon a solid and durable foundation, and wooden sleepers were only resorted to as temporary supports, to be ultimately superseded by stone blocks whenever the foundation of the road should be properly consolidated Opinion, however, soon underwent a change on this subject, and wooden sleepers were used in preference to stone blocks for permanent purposes, but it has been proposed to substitute sleepers of cast iron for those of wood, and the plan has already been reduced to practice generally

The chairs which [illegible] rails or props on which the rails [illegible] to the upper surfaces of the blocks in the following manner — Two holes are drilled in the blocks to a sufficient depth, about 2 inches in diameter, into which plugs of oak or other hard wood are driven, holes are then bored in these 3-8ths of an inch in diameter corresponding in position with two holes in the chair of cast iron, which is to support the rail Iron pins of half an inch in diameter are then driven through the holes in the chairs into the holes in the block a piece of patent felt being placed between the chair and the block, and the chair is thus firmly fastened to the block

The chairs are formed of cast iron, formed with a cavity corresponding to the magnitude and form of the rail [illegible] according to the [illegible] A vertical section of one of the most common forms of chair,

(10)




fixed on a block now in use, with the rail resting in it, is represented in fig 10

A great variety of expedients have been resorted to to maintain the rail fixed in its position in the chair Pins and wedges of iron were first used of various forms, and applied in various ways These, however, have now been very generally superseded by the simple contrivance of a wooden block or wedge driven in between the side of the chair as represented at *a* fig 10 These wedges are prepared by previously passing them through a hydrostatic press so as to harden them by exposing them to a severe pressure Besides affording a very effectual fastening to the rail in the chair these wedges from the nature of the material soften the jar which attends the transition of the wheels over the chairs

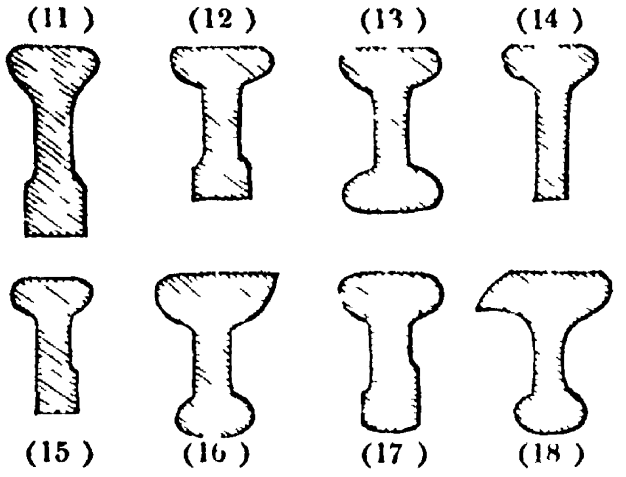
*Weight and Form of Rails* — The weight and form of the rails have been subject to great variation, since the extension of railways to the rapid transport of passengers This has not arisen so much from ignorance of the mechanical properties of the metal thus applied, as from the varying weight and speed of the engines and loads transported upon them The weight of the engines was, in the commencement limited to 6 tons, but the most common weight of these machines at present is from 30 to 40 tons, and their speed as well as the amount of loads which they draw have undergone a corresponding increase The strength and solidity of the structure on which this extraordinary traffic is carried have necessarily undergone corresponding changes The Liverpool and Manchester railway was first laid down with rolled iron rails, weighing 35 pounds per yard supported on chairs 3 feet asunder These were, however, soon found insufficient in strength, and they were replaced by rails weighing 50 pounds, and these again have been replaced by others weighing 60 72 75 and even 85 lbs

The distance between the bearings or chairs has also been subject to [illegible] The [illegible] very strength or weight of the rail [illegible] this distance, the greater the distance between the props, the greater must be the strength of the rail, and so far as regards expense the engineer has to balance the cost of heavier rails against the saving effected by a diminished number of blocks and chairs But independently of the consideration of expense, the effect upon the carriages and engines is to be considered Between chair and chair, a slight flexure of the rail takes place, and the wheels have consequently to pass over a series of eminences, so as to give to the carriages a pitching motion the intervals and degree of which must depend conjointly on the strength of the rails and the distance between the chairs

The least distance between the chairs now used is 3 feet, and the greatest 5 feet, 50 lb rails are very generally used on 3 feet bearings, 65 lb rails on 4 feet bearings, and 75 lb rails on 5 feet bearings All these varieties of construction are used in different parts of the Liverpool and Manchester railway The

Grand Junction railway extending from Birmingham to Newton is laid down uniformly with 65 lb rails on 4 feet bearings, and the London and Birmingham railway has in different places all the above varieties

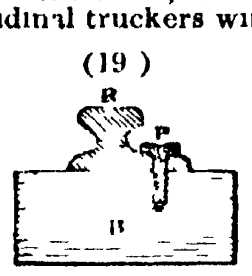
The form of the rail has been much varied The fish-bellied rail was considered to have the most advantageous form, when the Liverpool and Manchester railway was first brought into operation, and for some years afterwards This form gives increased depth to the rail at the parts most distant from the supports, and, in theory, it is unquestionably the most correct the strength of every part to resist vertical pressure being the same But various practical objections have been found against it, which our limits will not allow us to examine or discuss, and the fish bellied rail has accordingly been altogether superseded by the parallel rail which is a rail whose cross section is the same at every part Nothing can be more varied or more capricious than the forms given to the cross section of rails by different engineers The figures 11 to 18 represent a few of this great variety




The form, however, which has obtained most general favour at the present time is that which is represented in fig 13, the cross section of which is nearly the same as the longitudinal section of a dumb bell This form of parallel rail has the advantage of being capable of being reversed either side being turned upwards

In some rare instances modern railways in England have been laid down on *continuous bearings* The rails in such cases, are supported immediately on the longitudinal truckers without chairs This is the case in the Manchester and Bolton railway, and in the Great Western railway a section of a rail as attached to a longitudinal trucker support without a chair, is represented in fig 19, where R is a section of the rail, P an iron pin attaching it to the trucker B These pins are placed at regular distances along the outside base of the rail

(19)




(20)



A section of the rail with its trucker support, used on the Great Western railway is given in fig 20 These rails are fastened to the truckers by screws on each side They weigh from 40 to 50 lbs per yard

*Gauge of the Railway* — The gauge or the distance between the rails, on which depends the distance between the wheels of the carriages and engines and to a certain extent their structure, has recently been a subject of much discussion It is contended by some that all railways constructed in the same country ought to have the same gauge, that though it is not contended that the gauge now in use is the best that could possibly have been adopted, yet that extensive lines of road having been constructed with that gauge more disadvantage will attend any departure from it than could be balanced by any advantages that could attend any other [illegible] In the north of England, the rails had been laid at 4 feet 8½ inches asunder, and on the Liverpool and Manchester railway the first line intended for general traffic was laid down by Mr Stevenson with the same gauge The railway subsequently projected, extending from Liverpool and Manchester to Birmingham (and thence to London) to Preston Wigan, Bolton, Leeds, and other places, were laid down with the same gauge, since the carriages and engines would necessarily have to pass from one to the other But when railways began to be constructed in Belgium and other parts of the Continent, where the same reason for uniformity of gauge did not prevail, the same gauge nevertheless was adopted The first conspicuous departure from this uniformity took place in the Great Western railway, extending from London to Bristol which was laid down with a gauge of 7 feet, and the Eastern Counties railway [illegible] of 6 feet

The gauge [illegible] be regarded as nothing more than its linear modulus, or the index to its general scale. There is nothing *per se* to give one gauge a preference over another, but as the magnitude of [illegible] determines the general magnitude and [illegible] the railway [illegible] bridges viaducts, [illegible] and other works whether of a moveable and perishable or fixed and permanent nature it is a matter of the greatest importance that it should be determined with a just regard to the traffic of the line

*Curves on Railway* With a view to insure the public safety, the legislature has generally required that no curve shall be allowed upon a main line with a less radius than a mile the exceptions to this are where one railway passes into another, and at the termini, or the entrance of depôts or stations In such situations the trains must slacken their speed, and therefore a sharp curve is attended with less danger It has appeared, however, that these restrictions upon the radii of curves have been more stringent than safety requires In a course of experiments made by Dr Lardner, it was established that curves of a mile radius produce no sensible increase of resistance at the usual speed of railway trains, and therefore curves of considerable less radius may be traversed at that speed without danger We may here state, that on the Newcastle and Carlisle railway there are many curves in the main line with radii under half a mile, which are traversed at the usual speed with perfect safety

*Motive Power on Railways* — The motive power on railways [illegible] at present steam power, and is either [illegible] which move along the railway with the load which they draw, or stationary engines, which by means of ropes extended along the line of railway, draw the loads in either direction *See* LOCOMOTIVE ENGINE and STATIONARY ENGINE

The summer and autumn of 1845 and the beginning of 1846 witnessed the rise and development of a gigantic railway mania in England Some 700 or 800 projects, requiring, it was stated, [illegible] were produced during this [illegible] Great Britain, pressing influence of [illegible] the money market, aided by other causes, having led to the crisis of 1847 most of these projects sank into oblivion, or were only partially carried out, and the recklessness evinced by many companies in engaging in ruinous speculations, and the disclosures that were more recently made of the conduct of some leading directors, have shaken the public confidence in all railway companies, and led to an unprecedented depreciation of the stock even of the best lines —(See the *Com Dict*) For *Speed of Railway Traffic, see* LOCOMOTIVE ENGINE

For the details of the structure and operation of railways see the Treatise by Nicholas Wood 3rd edition, London, 1838, *The Steam Engine, &c*, by Dr Lardner, 8th edition London 1851

RAILWAY, PNEUMATIC or ATMOSPHERIC The name given to a system of locomotion on railways by means of the pressure of the atmosphere A simple and ingenious apparatus for this purpose was invented a few years ago, and was exhibited for some time on the West London Railway at Wormwood Scrubs Those who desire to see a brief though clear account of this invention, with a resumé of the advantages likely to accrue from its being [illegible] may consult the well-reasoned letter [illegible] to the President of the Board of Trade (1841) (See also a treatise on this subject, by Mr Samuda)

RAIN (Ger regen) In Meteorology, water falling from the atmosphere in drops

The theory of rain is not yet very satisfactorily established One of the most plausible explanations and indeed the only one which rests entirely on known principles, was proposed by Dr James Hutton in the *Philosophical Transactions of Edinburgh* for 1787 It is now a well-ascertained fact, though it was only matter of conjecture to Dr Hutton, that the capacity of air for moisture, or the quantity of moisture which a given volume of air will hold increases with the temperature, but in a much faster ratio than the temperature, and hence it follows that if two equal portions of air at different temperatures completely saturated with moisture are mingled together, a precipitation must take place in consequence of the mixture, which will have the mean temperature of [illegible] the capacity for retaining moisture increases in a geometrical ratio, and that at the temperature of 15 centesimal degrees air can hold 200 parts of moisture, then at 30 degrees it will hold 400 parts and at 45 degrees 800 parts Now, suppose two equal bulks of damp air, at the respective temperatures of 15 and 45 degrees, to be mixed together the compound must contain 1000 parts of vapour, or either half of it 500 parts, and the temperature of the compound will be 30 degrees But at this temperature the air is saturated with 400 parts, and consequently there will be a precipitation of 100 parts from each of the given bulks

It is obviously not necessary that the commingled por-

tions of air should be fully saturated with moisture, as assumed in the above example, rain will be precipitated if the two masses approach the point of saturation, but the quantity will be proportionally less It is also a consequence of the theory that for a given difference of heat the precipitation will be greatly increased at the lower temperatures, and this is conformable to experience, for showers are most copious during hot weather, and in tropical countries The circumstances therefore, on which according to this theory the quantity precipitated in a given time depends are [illegible] —The principal, cæteris paribus, are the difference of their respective temperatures, the elevation of their mean temperature, and the extent to which the combination takes place

The principal objection to this theory is, that the quantity of rain which actually falls in a given portion of time is often very much greater than can be supposed to be produced by any probable extent of cooling that can take place in the free atmosphere In that case we have recourse to the supposition of a cold and warm current driving swiftly in opposite directions, and contributing [illegible] Sir J Leslie (*Encyc Brit* art *Meteorology*) computes that if two currents of moist air were driving along in opposite directions, with velocities whose sum is 30 miles an hour the one having a temperature of 70° of Fahrenheit, and the other of 50°, the deposition of moisture in the space of an hour would be equal to the height of an inch If the sum of the opposite velocities amounted to 60 miles an hour, and the intermingling influence extended to but a quarter of an inch at the grazing surfaces there would still be produced in the same time a fall of rain reaching to half an inch in altitude These quantities agree sufficiently with observation in certain cases, but the objection still recurs that rain frequently falls from clouds which appear to move very slowly and when consequently the supposition of such velocities is inadmissible

It is the opinion of Mr Luke Howard and some other writers on meteorology, that Dr Hutton's theory is insufficient to explain the phenomena, and that the immediate cause of rain is to be ascribed in many instances at least, to the electric action of the clouds on each other They suppose the hygrometric moisture in the air to be kept suspended by the mutual repulsions of the electric atmospheres of the particles and that when the electricity is from any cause withdrawn the suspending power is likewise removed, and the particles coalesce and fall in consequence of their gravity That rain is connected in some way or other with the electric state of the atmosphere, is a position which may be readily conceded, but as the disturbance of the electric equilibrium remains to be accounted for, this theory as it at present stands, brings us no nearer to definite ideas

Some extraordinary falls of rain have been recorded, the accounts of which, if not given on apparently unexceptionable testimony w [illegible] as fabulous On the 25th [illegible] inches (32 English) within 24 hours occurred at Genoa, and on the 9th October 1827 there fell at Joyeuse in the south of France, a quantity equal to 31 English inches within the space of 22 hours (Prof Forbes's Report on Meteorology, in the *Reports of the British Association for* 1840)

A curious circumstance attending the fall of rain is that the quantity collected in rain gauges placed at the surface of the ground is considerably greater than when the instruments are placed at some elevation above the surface On an average of 13 years the quantity of rain which fell annually in the court of the observatory at Paris was 56 centimètres (22 1 English inches), while the mean quantity which fell on the terrace, at the height of 28 mètres (92 feet) above the court was only 50 centimètres, or 8-9ths of the former quantity A gauge placed on the top of York Minster at an elevation of 212 feet 10 inches, showed a fall of 14 963 inches between February 1833 and February 1834, while two perfectly similar instruments, one placed on the top of the Museum of that city, at a height of 43 feet 8 inches, and the other on the ground, gave respectively 19 852 inches and 25 706 inches (*Reports of the British Association for* 1834) It is supposed that this phenomenon depends, in some measure at least, on the circumstance that the drops of rain, de[illegible] perature [illegible] vapour in the lower strata, and probably of fogs, which are always denser near the surface of the ground, and which yield a considerable deposition of water Any hypothesis of this kind, however, is quite insufficient to explain the great difference observed at York between the products of the rain gauges on the ground and the top of the Minster, and which is most probably to be ascribed to some imperfection in the action of the instrument when exposed to gales of wind It has been suggested that eddies are formed round the rim of the funnel which have the effect of diverting part of the rain

Rain drops vary in size from perhaps the 25th to the 3d part of an inch in diameter and like other falling bodies descend with a continually accelerating velocity until the resistance of the air becomes equal to their weight after which the descent is uniform The terminal velocity is proportional to the square root of the diameter of the drop, but it is perhaps not possible to determine with certainty the actual terminal velocity corresponding to a drop of any given diameter

The average quantity of rain which falls in a year at any given place depends upon a great variety of circumst[illegible] elevation of the re[illegible] of the mountain r[illegible] and *in general* on the different local causes which influence climate It has been found that [illegible] rain which [illegible] and 60°, may be taken respectively at 98, 80, 29, and 17 inches, but this estimate must be regarded rather as a rough approximation to the ratio in which the quantity decreases on going from the equator, than as indicating the actual averages at any particular place, and it is observed that though the annual depth be greatest towards the equator, the number of rainy days in the majority of places increases with the latitude

The greatest depth of rain which has been registered at any place in a year is at Maranham lat 2½° S, and which is stated by Humboldt to be 277 English inches But this is greatly above the average, and indeed more than double the annual quantity which has been observed at any other locality At St Domingo the annual fall is estimated at 120 inches, at Cayenne 116 inches, in the island of Grenada 112, at the Havannah 91, at Calcutta from 76 to 118, at Bombay from 83 to 96, the island of Martinique 87 inches, and at Sierra Leone, 86 Of European countries Portugal appears to be the most humid 123 inches having been observed at Coimbra in a year The average depth at Paris is 19 1 inches (Arago, *Journal de Physique*, 1816), Berlin, 20 9, Brussels, 19, Florence 41 3, Lyons, 39 5 Maestricht 36 1, Marseilles, 18 4, Padua 36 6, Petersburg 18 2, Rome, 31 2, Rotterdam 22 4, Stockholm, 18 7, Vienna, 17 For places in Great Britain the following averages were deduced by Dr Dalton from observations of a number of years — Manchester 36 140 inches, Liverpool 34 118, Lancaster, 39 714, Kendal 53 944, Dumfries, 36 918, Glasgow 21 331, London 20 686 Mr Howard gives [illegible] at London equal to 24 9 inches, Prof [illegible] York, 2[illegible]7, and Mr Adie at Edinburgh 25 inches (On the theory of rain see Kamptz, *Lehrbuch der Meteorologie*, Muncke in *Gehler's Physicalisches Wörterbuch*, *Daniell's Meteorological Essays*, &c)

RAINBOW (Germ regenbogen, Lat iris, Fr arc en ciel) The brilliant-coloured arch which makes its appearance when rain is falling in the region of the sky opposite to the sun, and the sun is shining at the same time

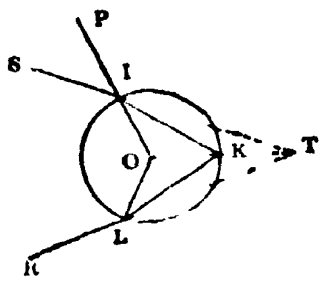
This well known meteor presents, when perfect, the [illegible] concentric arches, the inner being [illegible], and the outer the *secondary* rainbow Each is formed of the colours of the solar spectrum, but the colours are arranged in the reversed order, the red forming the exterior ring of the primary bow and the interior of the secondary The innermost bow is a segment of a circle whose radius subtends an angle of about 42°, the radius of the outer subtends an angle of about 51°, and the common centre is situated in the prolongation of the straight line which passes through the centre of the sun and the eye of the spectator From the conditions invariably accompanying its appearance, the colours of the rainbow were known at an early period to be produced by the sun's rays passing through the drops of falling rain, but the phenomenon is a complicated one and was not fully and satisfactorily explained until Newton had discovered the compound nature of solar light, and the different refrangibility of the component rays

In order to explain the phenomenon of the rainbow, let us suppose a beam of light admitted through a small hole in the shutter of a darkened room to fall on a spherical globule of water at I (fig 1) in the direction S I, and trace the path of the light in the interior of the globule On entering the globule at I it is refracted, and consequently decomposed, the rays of each colour being deflected under a different angle from its original direction For the [illegible] we shall [illegible] to the red ray Let I K be the di[illegible] [illegible] [illegible] [

with a tangent at K But on arriving again at the surface at L, this portion of the ray which was reflected from K will be again divided into two parts; one part will escape at L, and be refracted in the direction L Q, while the other part will be reflected by the surface and proceed in the direction L M M will be the point where the repeated part of the ray will again be divided, one part being refracted in the direction M R and the other be reflected in the direction M N The process will be repeated indefinitely, but the intensity of the light is diminished at each successive impact, and after a few reflexions the quantity which emerges becomes insufficient to make an impression on the eye All this may be shown experimentally by causing a beam of light to fall upon a glass cylinder filled with water and placed in a darkened room the red light emerging at the points K L M will be seen when the eye is placed in the straight lines K P, or L Q, or M R

To apply this experiment to the explanation of the rainbow, it is necessary to determine the inclination of the emerging to the incident ray We shall first take the case of two refractions with a single intermediate reflexion Let S I (fig 2) be the incident ray, I K the direction after the first refraction K the point of reflexion, L the point of emergence and L R the direction of the emerging ray, also let S I and R L be produced to meet in T The angle S T R is called the angle of deviation, and the object is now to find an expression for its value in terms of the angle of incidence Let O be the centre, draw O I P and O L, and join O T, which will evidently pass through K Let us now assume,

(2)




$i$ = O I T = S I P the angle of incidence,
$r$ = O K I = O I K the angle of refraction,
D = S T R the angle of deviation,

then, since O K I = K I T + K T I and K I T = O I T − O I K, we have $r = i - r + \frac{1}{2}$ D, whence

$$D = 4r - 2i \qquad (1)$$

Here D is expressed in terms of $r$ and $i$, but by the theory of refraction we have also the relation

$$\sin i = n \sin r \qquad (2)$$

(where $n$ is the index of refraction for the red ray), so that the value of D depends only on that of $i$

The angle of incidence $i$, may have any value between [illegible] It is obvious that between those values D must have a maximum, for when S I falls perpendicularly on the globule there is no deviation, and when S I merely touches the globule the deviation again vanishes To find the determinate value of $i$ at which the maximum takes place, differentiate the equation (1) and make the differential of D equal to zero, this gives $d i = 2 d r$ Then $\cos i \, d i = n \cos r \, d r$, whence $\cos i = 2 \cos r$, and dividing both sides of the resulting equation by $d i$, $n \cos r = 2 \cos i$ On substituting for cos $r$ in this equation its value found from (2), the following expression is obtained —

$$\cos i = \sqrt{\tfrac{1}{3}(n^2 - 1)}$$

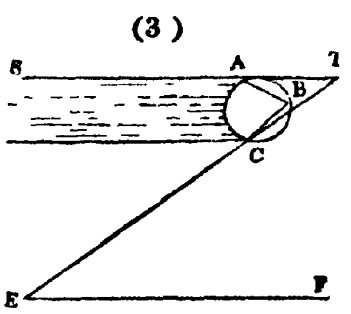
This is the value of $i$ corresponding to the maximum deviation expressed in terms of $n$ But in respect of the red rays, the value of $n$ is found experimentally to be 108 − 81 = 1 3333, and the corresponding value of $i$ given by the trigometrical tables is $i = 59° 23' 30''$ From this the values of $r$ and D are readily deduced, and the three values are as follows —

$$i = 59° 23' 30'', \quad r = 40° 12' 10'', \quad D = 42° 1' 40''$$

The next step towards the explanation of the phenomenon is, to show that no other light than that which [illegible] incidence corresponding to the [illegible] be refracted in sufficient quantity to make a sensible impression on the eye Now since S I is the incident ray, with respect to which the deviation is a *maximum*, the rays which are situated very near to S I, on either side, will enter the drop at very nearly the same angle of incidence, and consequently will emerge very nearly parallel to I R With respect then to the pencil [illegible] at the angle of incidence [illegible] deviation all the rays of [illegible] which emerge after the first reflexion, will on their emergence be parallel and enter the eye situated in the straight line I R in sufficient number to make a vivid impression on the retina But with respect to a pencil falling on the drop at a small distance from I, and consequently making a small angle of incidence the red rays at their emergence will not be parallel but divergent, and the light will consequently diminish in intensity as it recedes from the drop, and at the distance of the spectator will be much too faint to produce a distinct impression It is on this delicate principle that the phenomenon principally depends

The above principles being clearly understood, all the circumstances of the phenomenon admit of easy explanation. Let A B C (fig 3) be a section of a drop of rain made by the plane passing through the centre of the sun, the centre of the drop, and the eye of the spectator, and suppose the rays from the sun's centre to fall on it in the direction S A Let E be the position of the eye of the spectator, whose back is turned towards the sun, and draw E F parallel to S A Now suppose the line E T to be drawn so as to make with E F an angle of 42° 1′ 40″, and to meet the drop at C, then, since the whole of the anterior surface of [illegible] some one of those [illegible] incidence, such that after being refracted at A reflected at B, and again refracted at C, it will emerge parallel to C F, and consequently make with F F the maximum angle of deviation The spectator will therefore see the red colour of the spectrum in the direction E C But it is obvious that all these conditions will be fulfilled in respect of every drop of rain which the line E C will meet, on supposing it to revolve about E F as an axis at the same angle of inclination Hence the red rays thus refracted form the surface of a cone, the axis of which is the prolongation of the straight line drawn from the centre of the sun to the eye, and as the eye of the spectator is at the apex of the cone, a circular segment of red light will be visible, the other part of the circle being cut off by the horizon

(3)




What has now been said has reference only to rays coming from the sun's centre, but the same thing must happen with respect to rays coming from every point of the sun's disk, and as the sun's diameter subtends an angle of about 30′ the spectator will consequently see a band of red light of the breadth of about 30′

The explanation which has now been given of the appearance of the [illegible] applies to all the other colours of the spectrum, the [illegible] being in the value of the index of refraction for the violet ray, in passing from air to water, the index is 109 − 81, we have therefore $n$ = 1 3468, and on computing from this the values of $i$, $r$ and D, by means of the preceding formulæ, there results, appproximately,

$$i = 58° 40' 3'', \quad r = 39° 24' 20'', \quad D = 40° 17'$$

In this case therefore, the angle of maximum deviation is less than for the red ray [illegible] the violet is within the red The breadth of the violet band will obviously be the same as that of the red as both depend on the same cause, namely, the magnitude of the sun's apparent diameter

As the red and violet are the rays whose indices of refraction are the least and greatest respectively, all the other prismatic colours will lie between these two, and occupy bands of the same breadth but with considerable blending into each other, for the distance between the centre of the red and the centre of the violet, being equal to the difference [illegible] maximum deviation [illegible] 1° 45′ The whole breadth of the interior or primary bow is this quantity plus the sun's apparent diameter, or about 2° 15′

The size of the bow depends upon the height of the sun above the horizon When the sun is in the horizon, the bow will be a semicircle to a spectator on a plane, but on the summit of a mountain, he may see a segment greater than a semicircle

We have now to explain the formation of the exterior bow In this case the light suffers two reflexions in the interior of the globule and the path of a ray, as represented in fig 1, is S I K L M R If we denote the [illegible] S I and M R [illegible] D′ and the as before [illegible] and refraction, it is easy to find the equation,

$$D' = 6r - 2i - 180°$$

On proceeding from this by the same method as before to find the value of $i$ corresponding to the *maximum* value of D′, the following equation is obtained —

$$\cos i = \sqrt{\tfrac{1}{8}(n^2 - 1)}$$

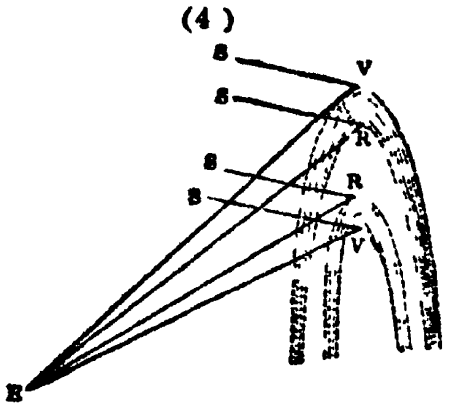
[illegible] for the two [illegible] values in respect of the red and violet rays the values of $i$ and consequently of $r$ and D, are obtained They are as follows —

red, $i = 71° 50'$, $r = 45° 27'$, $D' = -50° 59'$,
violet, $i = 71° 26'$, $r = 44° 47'$, $D' = -54° 9'$,

the minus sign indicating that the incident and emergent rays intersect before the drop

From these values it appears that in the case of the exterior bow the deviation is least in respect of the red ray, and greatest in respect of the violet, the order of the colours is therefore reversed, the red occupying the innermost band, and the violet the outermost, as represented in fig 4, where E R is the red and E V the violet ray, the eye of the spectator being at E The breadth from the middle of the red to the middle of the violet is 3° 10′, or nearly double that of the interior bow The interval between the red of the interior bow and the red of the exterior is 50° 59′ — 42° 2′, or 8° 57′ All these values, deduced as above from the theory of refraction, are found [illegible] those found by actual measurement [illegible] *Phil Trans* for 1700 has computed the diameters of rainbows formed by three four, and five reflexions, but these bows are rarely if ever seen the light being too faint to make an impression on the eye Supernumerary or spurious rainbows are sometimes seen within the primary and without the secondary bow, and having the same order of colours as the bows to which they respectively belong They are explained by Dr Young on the theory of the interference of light (*Phil Trans* 1804, *Lect* vol i p 470) An inverted or distorted iris is sometimes observed lying on the ground, formed by the drops of dew suspended from the tops of the blades of grass, or from spiders' webs In favourable circumstances lunar rainbows are sometimes seen, but their colours are faint and scarcely perceptible

(4)




The first explanation of the true theory of the rainbow is usually ascribed (see *Newton's Optics*) to Antonio De Dominis, archbishop of Spalatro whose work, *De Radiis Visus et Lucis*, was published at Venice in 1611, but stated to have been written twenty years previously It would appear however, from the account of this work given by Boscovich, Montucla, Priestly, and Biot that the merit of De Dominis was confined to a vague statement or surmise, unsupported by experiment that the interior bow is formed by two refractions and an intermediate reflexion He gave no reason for the precise angle which its diameter subtends and with respect to the exterior bow, his attempt to explain its formation is wholly erroneous The true theory of the exterior bow and the determination of the particular angles of deviation under which alone the rays transmitted to the eye are sufficiently dense to be visible belongs to Descartes The explanation given by Descartes in his *Dioptrics*, is complete in every respect, excepting as to the cause of the colours the theory of which was supplied by Newton [illegible] of the Perfective [illegible] See Mixed *Mathematiques*, vol i p 700, *Priestly on Vision*, p 107, *Biot Traité de Physique* tom ii p [illegible]

RAIN GAUGE, also called OMBROMETER UDOMETER and PLUVIAMETER An instrument for measuring or *gauging* the quantity of rain which falls at a given place

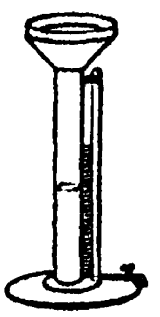
"The *rain-gauge* may be of very simple construction A cubical box of strong tin or zinc, exactly 10 inches by the side, open above, receives at an inch below its edge a funnel, sloping to a small hole in the centre On one of the lateral edges of the box, close to the top of the cavity, is soldered a short pipe in which a cork is fitted The whole should be well painted The water which enters this gauge is poured through the short tube into a cylindrical glass vessel, graduated to cubic inches and fifths of cubic inches Hence, one inch depth of rain in the gauge will be measured by 100 inches of the graduated vessel, and 1-1000th inch of rain may be very easily read off

'It is very much to be desired that, being of such easy construction, more than one of these gauges should be erected, or at least one placed with its edge nearly level with the ground, and another [illegible] building, rock, or tree in the [illegible] place of observation, the height of which must be carefully determined, it having been satisfactorily ascertained that the height of the gauge above the ground is a very material element of the quantity of rain which enters it The quantity of water should be daily measured [illegible]" (*Report of the President and [illegible] Society on the Instructions to be prepared for the Scientific Expedition to the Antarctic Regions*, 1840)





A convenient form of the instrument is represented in the annexed figure, where the rain which enters the funnel is collected in a cylindrical vessel of copper, connected with which at the lower part is a glass tube with an attached scale The water stands at the same height in the cylinder and glass tube, and being visible in the latter, the height is read immediately on the scale, and the cylinder and tube being constructed so that the sum of the areas of their sections is a given part, for instance a tenth, of the area of the funnel at its orifice, each inch of water in the tube is equivalent to the tenth of an inch of water entering the mouth of the funnel A stop-cock is added, by which the water is drawn off when the observation is made



RAISING PLATE, or UPPER PLATE In Architecture, the plate or longitudinal timber on which the roof stands raised or placed

RA'JAH The hereditary princes of the Hindoos are so termed They belong to the caste of warriors, or Cshatriya and are generally dependent on Europeans, except in those parts of the country which the European arms have not as yet penetrated See CASTE

RAKE TO The sea term for *incline*, and applies to the masts stem, and stern-post, &c, the bowsprit, instead of raking is said to *steve* Masts generally rake aft and in peculiar rigs only forward The rake of the mast has an influence on the sailing of the vessel, and the masts of some schooners rake excessively The principal effect seems to be to diminish the effect common to all the sails, of depressing the ship's head

*To rake a ship* is to fire into her head or stern in the direction of her length, or along her decks It is similar to [illegible]

RAM [illegible] See BATTERING RAM

RAMADAN, or RHAMADAN The name given to the great fast or Lent of the Mohammedans It commences with the new moon of the ninth month of the Mohammedan year and while it continues the day is spent uninterruptedly in prayers and other devotional exercises Even the night is passed by the more rigid of the faithful in the mosques which are splendidly illuminated on this occasion, but generally speaking, the arrival of sunset is the signal for a more than usually unlimited indulgence in the pleasures of the table, and on the third evening of the fast, the grand vizier commences a series of official banquets The Ramadan ends on the day preceding the only other great festival of the Mohammedans, — the *Bairam* (which see), equivalent to our Easter

RAMAYA'NA (Sanscr *the Career or Travels of Rama*) the oldest of the two great Sanscrit epic poems, describes the life and actions of the hero Rama, and his wife Sita, and especially Rama's expedition to Ceylon, to rescue Sita from the tyrant Rawana The poem is thought to have been composed before the Christian era, but there is no certain indication of its age A translation of it was commenced by Messrs Carey and Marsh- [illegible] ore), and another by A W von [illegible] H

RAMBATTERING See BATTERING RAM

RAMI'NIA In Botany, thin, brown, foliaceous scales, appearing sometimes in great abundance upon young shoots, and particularly numerous and highly developed upon the petioles and the backs of the leaves of ferns

RA'MISTS, or RA'MIANS In Philosophy, the partisans of Pierre Ramé better known by his Latin name of Ramus royal professor of rhetoric and philosophy at Paris in the reign of Henry II He perished in the massacre of St Bartholomew His system of logic was opposed to that of the Aristotelian party, and during the latter half of the 16th century a vehement contest was maintained between their respective adherents in France Germany and other parts of Europe (Hallam, Introduction to the *Literature of Europe*, vol ii ch 3) "He conferred" says the same writer, 'material obligations on science by denying the barbarous method of the schoolmen What are the merits of his own method [illegible] *Ib* vol i ch 7)

RAMNENSES or RAMNES The name of the first century of the 300 horsemen who constituted the cavalry of Rome under the early kings Most probably the name also applied at first to the original century of patrician houses established by Romulus and distinguished them from the Latienses and Luceres, whose names, in like manner must be supposed to extend not merely to the two [illegible] but to the two centuries of tribes [illegible] by Romulus, on the accession of [illegible] Priscus (See the histories of Niebuhr and Arnold)

RAMP (Fr Rampe) In Architecture, a concave bend or slope in the cap or upper member of any piece of [illegible]

RAMPANT [illegible] term used to

describe lions tigers bears, &c, when represented as standing erect on their hind legs

RAMPART or RAMPIER In Fortification, the wall which surrounds a fortified place It is built of the earth taken out of the ditch, though the lower part of the outer slope is usually constructed of masonry The advantage of earth is, that the balls instead of splintering the work, and rebounding in various directions to the great injury of the besieged, pass forward into the earth, and bury themselves there This also renders the rampart of earth much more durable under the fire of the besiegers than masonry would be The usual height of the rampart is about three fathoms, and its thickness about ten or twelve feet *See* FORTIFICATION

RAMS' HORNS In Fortification, the name given by Belidor to the tenailles *See* TENAILLE

RA'NA (Lat *a frog*) The generic name of the tailless Batrachian reptiles, which have the hind legs longer than the fore, and webbed toes fitted for swimming, and not expanded at the extremity Their head is flat, muzzle rounded, and the opening of their jaws large, the tongue in most of them is soft, and not attached to the bottom of the gullet but to the edges of the jaw, with the free end turned backwards There are but four toes to the anterior feet, the hind ones frequently exhibit the rudiment of a sixth

There are no ribs to their skeleton, and a prominent cartilaginous plate supplies the place of a tympanum, and renders the ear visible externally The eye is furnished with two fleshy lids, and a third, which is transparent and horizontal, concealed under the lower one Inspiration is effected by the muscles of the throat which, by dilating draw in air by the nostrils, and by contracting while the nostrils are closed by the tongue compel the air to enter the lungs, expiration on the contrary, is produced by the muscles of the lower part of the abdomen The young frog, which is called a tadpole is at first furnished with a long fleshy tail and a small horny beak having no other apparent limbs than little fringes on the sides of the neck These disappear in a few days, and the hind feet of the tadpole are very gradually and visibly developed, the fore feet are also developed but under the skin through which they subsequently penetrate The tail is gradually absorbed The beak falls and discloses the true jaws, which at first were soft and concealed beneath the skin, and the branchiæ are absorbed, leaving to the lungs alone the function of respiration in which they participated The eyes which at first could only be discerned [illegible] a transparent spot in the skin of the tadpole are now visible with their three lids Tadpoles reproduce their limbs almost like salamanders

The period at which each of these changes takes place varies with the species In cold and temperate climates, the perfect animal passes the winter underground or in the mud under water without eating or breathing, though if it be prevented from respiring during the summer for a few minutes by keeping its mouth open it dies

RA'NDOM SHOT A shot discharged with the axis of the gun above the horizontal or point blank direction

RANGE, in Gunnery, is the horizontal distance to which a shot or other projectile is carried Were it not for the resistance of the air the path described by a projectile acted upon by the force of gravity would be a parabola, and the greatest range would be obtained by discharging the projectile at an angle of 45° of elevation But by reason of the atmospheric resistance, the path actually described is very different from a parabola and the elevation which gives the greatest range can only be determined by experiment *See* GUNNERY PROJECTILES

RANGE A certain quantity of cable drawn up out of the cable tier and laid along the deck equal in length to the depth of water, in order that the anchor when let go, may reach the bottom without being checked

RA'NGER Formerly a sworn officer of the king's forests whose principal duty it was to see and inquire of trespassers in his bailiwicks and present them at the next court holden for the forest, but now merely an officer of state *See* FOREST

RA'NIDÆ The family of Batrachian reptiles, having a [illegible] (*Rana temporaria*, Linn) *See* RANA

RANTERS A sect which originated in a secession from the Wesleyan connection, on the ground that the Wesleyans paid too much attention to order and decorum in the conducting of public worship and that they were deficient in zeal in obtruding the gospel on the minds of the people by open preaching in the streets and fields [illegible] places of worship They admit of [illegible] thing unknown to every other body of Methodists They are most prevalent in America Their chapels are about 400 in number, their preachers, 2700, their members, 34,000 (*Bourne's Hist of the Prim Methodists*)

RA'NULA (Lat rana, *a frog*, to which it has been supposed to bear some resemblance) A tumour under the tongue, generally arising from some obstruction of the ducts of the salivary glands, when they break they are apt to leave a very troublesome ulcer

RANUNCULA'CEÆ (Ranunculus, one of the genera [illegible] unknown in hot countries, except at considerable elevations They are of great importance, in consequence of their usually poisonous qualities, as evinced by aconite and hellebore in particular, which are the roots of several species Some of them are objects of beauty, as the larkspurs, ranunculus, anemone, and pæony A few are simply astringent, as the coptis or gold thread of North America The plants of this order are readily known by having an indefinite number of stamens separate carpels, exstipulate [illegible] an [illegible]

RANZ DES VACHES (Germ Kuhreigen) The name of the simple and beautiful melody which the Swiss herdsmen are in the habit of playing on the Alpine horn, and sometimes of singing, when they drive out their herds to the mountains It consists of a few simple intervals, and has a beautiful effect in the echoes of the Swiss mountains The natives regard it almost with rapture, and are said to be seized with irrepressible longings to return to their native country when they hear it played in a foreign land

RAPE (Lat raptus) [illegible] well known and detestable [illegible] women This offence has been most properly viewed by all legislators as one of the gravest character, and has been usually visited with the highest penalties The accusation of rape, it is true, is one that may be easily made, and is, no doubt, sometimes preferred in cases where consent has been given The proof, therefore, should be clear in proportion to the enormity of the crime, but when proved it is one that should very rarely indeed escape the utmost vengeance of the law Capital punishment for this offence was abolished in 1841

RAPE An Anglo-Saxon territorial division, of which the etymology is uncertain Sussex is the only county divided into rapes, each containing three or four hundred These subsisted as military divisions at the time when Domesday Book was compiled They were formerly under the superintendence of 'rasse reeves," subordinate to the sheriff of the county

RAPE A plant belonging to the [illegible] (*Brassica rapa* Linn) cultivated in [illegible], which are crushed for oil, and sometimes for its leaves, which are fed off by sheep In Belgium another species or variety of Brassica is cultivated for these purposes, called *colza*, the *Brassica oleifera* of De Candolle

RAPHE (Gr ραφη *a suture*) In Botany the vascular cord communicating between the nucleus of an ovule and the placenta when the base of the former is removed from the base of the ovulum

RAPHE In Anatomy a term applied to parts which look as if they had been sewed or joined together

RA'PHIDES (Gr ραφις) Certain needle-like transparent bodies found lying in the tissue of plants They were formerly thought to be peculiar organs, but are now known to be the crystals of various salts

RAPIO'RES (Lat raptor, *a robber*) Rapacious birds or raveners The name of the order of birds called *Accipitres* by Linnæus and Cuvier, including those which live by rapine and are characterized by a strong, curved, sharp edged, and sharp pointed beak, and robust short legs with three toes before and one behind, armed with long strong crooked talons

RAREFACTION In Physics, an augmentation of the intervals between the particles of matter, whereby the same number of particles occupy a larger space The term is chiefly used in speaking of the aeriform fluids, the terms *dilatation* [illegible] in speaking of solids and liquids Rarefaction is caused by diminishing the pressure, and hence the air becomes rarefied at elevations above the general level The limits to which rarefaction may be carried are not known, but it has been proved by experiments with the air-pump, that air may be rarefied so as to occupy a volume 13 000 times greater than it occupies under the ordinary pressure

RASKO'LNIKS (Russ raskolo, *a division*) The name of the [illegible] and most important body of dissenters from the Greek church in the Russian dominions They designate themselves Starowerzi, or *the Orthodox*, but differ from the Greek church only in the outward forms of religion and in maintaining a more strict ecclesiastical discipline This body was formerly subjected to persecution, but it is now treated with comparative toleration, though its members are still excluded from the service of the state Their number is said to be about [illegible]

RASORES (Lat rado, *I scratch*) Gallinaceous birds, or scratchers The name of an order of birds, including those which have strong feet, provided with obtuse claws for scratching up grains, &c and the upper mandible vaulted, with the nostrils pierced in a mem-

branous space at its base, and covered by a cartilaginous scale *See* GALLINACEÆ

RAT The name of a large destructive and very prolific species of the genus *Mus* (*Mus decumanus* Linn ) Introduced into the British Islands from Asia, not, as is commonly believed, from Norway It has spread over all [illegible] ie expense of the old Bri [illegible] rat" (*Mus rattus*, Linn ) *See* MUS

RA'TCHET, in Clock and Watch Work, is the name given to an arm or [illegible] one extremity of which abuts against the teeth of a *ratchet wheel*, and the other extremity is either freely jointed to a reciprocating driver for the purpose of communicating a continuous motion to the wheel, or is attached to a fixed centre to [illegible] the wheel against reverse motion In the former case it is also called a *click* or *pawl*, the latter a *detent*

RATCHET WHEEL A wheel having teeth formed like those of a saw, against which the ratchet abuts *See* RATCHET

RATE OF A SHIP, in the Royal Navy The navy is divided into three classes Rated ships, commanded by captains, sloops and vessels, by commanders, and the third class by lieutenants Rated ships are divided into six classes —1st, all three-deckers, 2d, two deckers, having 700 men and upwards (war establishment), 3d, [illegible] 4th, ships having from [illegible] from 400 to 250 men, 6th, ships having under 2[illegible] men

*Rate of sailing of a Vessel* is measured by the *log*, which see Various plans have been proposed for this purpose by various forms of the log itself, by the rise of water in tubes communicating with the sea and (by Captain Burney) by the pressure upon a body towed astern and pulling on a spring But the violence and irregularity in the pull, and the uncertainty [illegible] the resistance have probably combined to set aside [illegible] plan, and [illegible] because [illegible] velocity, would show very small changes of velocity for the same reason, however, the mean result shown in a heavy sea would be too great A certain and simple method of ascertaining the velocity at any instant, with precision, is one of the most important desiderata to[illegible] [illegible] naval science

RATHOLITE In Mineralogy a species of garnet found in Sweden, accompanied by calcspar and hornblende

RATIFICA'TION (Lat ratum, *determined*, facio *I make*) The solemn act by which a competent authority [illegible] [illegible] terminated by such [illegible] given by governments to treaties contracted by their representatives In French law ratification is defined [illegible] what has been done or [illegible] s a person on attaining his majority, ratified [illegible] in his minority And ratification is either express or tacit, the latter resulting by implication, from his silence for [illegible] [illegible] jority

RATIO (Lat [illegible] is defined by Euclid (*Elements*, book v def 3 ) to be 'a mutual relation of two *magnitudes* of the same kind to one another in respect of *quantity*" This definition has been much criticised Dr Barrow (*Lectiones Math* ) calls it a metaphysical definition, inasmuch as it is not properly a mathematical definition, since nothing in mathematics depends on it, or can be deduced from it, and supposes that Euclid had probably no other design in making it [illegible] [illegible] It has been remarked, that [illegible] language, if not quite synonymous with [illegible] is a signification only a little more general, [illegible] as above rendered is either [illegible] meaning Dr Simson supposes it [illegible] of some unskilful editor Leslie (*Elements of Geometry*) ingeniously supposes that the Greek word πηλικοτης, which is usually translated *quantity* may have reference to *multitude* or number, as well as to magnitude, and that Euclid's definition may be rendered as follows —"Ratio is a certain mutual habitude [illegible] with respect [illegible] Wallis (*Opera M* [illegible] 5) translates the same word by [illegible] which refers to the number of times the one [illegible] is contained in the other Dr Peacock (*Algebra* [illegible]) remarks that there is no geometrical definition of ratio by which the equivalence of different modes of representation may be ascertained as necessary consequences, and for this reason, ratios in geometry are only considered in connection with each other as [illegible] or not constituting a proportion In [illegible] algebra, a ratio may be defined as the fraction whose numerator is the antecedent, and denominator the consequent of the ratio, and hence, in those sciences [illegible] identified with the theory [illegible] For a [illegible] of what has been written on the subject of geometrical ratios, see *Camerer's Euclid*, Excursus ad lib v Berlin, 1825 )

RATION In the Army a portion of food and ammunition, &c, distributed to each soldier for his daily maintenance The rations of officers vary according to [illegible] [illegible] in their pay

RATIONAL In Arithmetic and Algebra, an expression in finite terms, or one in which no extraction of a root is left, or, at least, none such indicated, which cannot be actually performed by known processes The contrary of these are called *surd* or *irrational* quantities. Thus 2, [illegible] are rational [illegible] and $\sqrt{2}$, $\sqrt[3]{4}$, &c, are irrational [illegible] because their values can only be approximately and not accurately assigned

RATIONAL HORIZON In Geography the plane passing through the centre of the earth parallel to the *sensible horizon* of the place to which it is referred *See* HORIZON,

RATIONALISM The interpretation of scripture truths upon the principles of human reason, which has become famous in the present day by the theological systems to which it has given birth in Germany The history of the progress of the opinions of the reformed churches of that country may be found in Dr Pusey's essay upon this subject He conceives the polemical discussions which prevailed throughout those communities in the 17th and first half of the following century to have prepared the way for the reception of the low views of Christianity as a moral system which were derived from the writings of the concealed or avowed deists of this [illegible] Herbert, Tyndal, Morgan, Toland, &c, and [illegible] which they were reviewed by the sincere but [illegible] [illegible] From the middle of the last century [illegible] in Germany a succession of divines — Baumgarten, Michaelis, Semler, Eichhorn Paulus, Bretschneider &c —who have endeavoured either to affix a lower and more human character to the invisible operations of God upon men through Christianity or to reduce the accounts which we have of the foundation of our religion to the mixture of truth and error natural to fallible men They have questioned the genuineness of almost all the separate parts of Scripture and the accuracy of all their supernatural narratives The discredit into which these theologians appear to have fallen arises in a great measure, from the inability they have shown to produce a connected and consistent system of religion upon the low ground which they have taken up Of later years a much more spiritual conception of the nature of scripture promises and Christian assistances is observable in the writings of German divines, under the operation of which their theological criticism has already assumed a more dignified and exalted tone The sensation created by Strauss's *Life of Christ*, the latest and in some respects the most remarkable production of the Rationalist school may probably have aided in this reaction (See the article 'Rationalismus' in the *Conv Lexicon* The English reader may consult the writings of Mr Hugh Rose and Dr Pusey on the subject of German rationalism, *Atkinson's Law of Universities in Germany*, *Hawkins's Germany*, and two articles in the *Church of England Quarterly Review*, Oct 1837, and Jan 1838 )

RATLINES Small horizontal lines or ropes extended over the shrouds thus forming the steps of ladders for going up and down the rigging and masts To *ratline* the rigging is to fix these ratlines

RATTANS or CANES The long slender shoots of a prickly bush (*Calamus rotang*, Linn ), one of the most useful plants of the Malay peninsula and the Eastern islands They are exported to Bengal, to Europe and above all to China where they are consumed in immense quantities For cane-work they should be chosen long, of a bright pale yellow colour, well glazed, and of a small size, not brittle or subject to break They are purchased by the bundle which ought to contain 100 rattans, [illegible] [illegible] bent together, and tied in the middle In China they are sold by the picul, which contains from 9 to 12 bundles Such as are black or dark-coloured [illegible] short, or from which the glazing flies off on their being bent, should be rejected When stowed as dunnage, they are generally allowed to pass free of freight (*Milburn's Orient Com &c* ) The imports into this country are very considerable (See *Com Dict* )

RATTLESNAKE One of the most deadly of poisonous serpents is so called, on account of the peculiar rattling instrument which it carries at the extremity of the tail, and which is formed of several horny flattened rings loosely attached together, which move and rattle whenever the animal shakes or alters the position of the tail These rings increase in number with the age of the animal, and it is asserted it acquires an additional one at each casting of the skin The generic name of the rattlesnake, *Crotalus* (from the Greek κροταλον a rattle), relates to the above-mentioned peculiarity Two species are well distinguished, viz the *Crotalus horridus* of the United States, and the *Crotalus durissus* of Guiana The genus is peculiarly American In common

with the boa, the rattlesnakes have simple transverse plates beneath the body and tail Their muzzle is hollowed by a little round depression behind each nostril The habits of the rattlesnake are sluggish, they move slowly, and only bite when provoked, or for the purpose of killing their prey They feed principally upon birds, rats, squirrels, &c, which it is believed they have the power [illegible]

RATTLESNAKE ROOT The root of the *Polygala Senega*, a stimulant said to have proved a serviceable remedy in cases of the bite of the rattlesnake

RA'VELIN, in Military Works, is a detached work composed of two embankments [illegible] It is raised before the curtain work, serving to cover it and [illegible] direct fire of the enemy [illegible] to a bridge it is called a [illegible] field fortification

RAY, *Raia* (Lat radius *a ray*) A genus of cartilaginous [illegible] their horizontally [illegible] ly, which is chiefly composed of the immense pectoral fins, the jointed and branched rays of which diverge like the rays of a fan, and support a broad duplicature of the skin which is continuous anteriorly with that of the side of the flattened head, whence the name of the genus The *Raiæ* of Linnæus are now divided into many subgenera of which the sting ray, eagle ray, electric ray, fire flare, skate, &c are the respective types

RAY In Optics, a beam of light propagated in a straight line from some luminous point A ray of white light may be divided by refraction into a number of distinct rays of different colours *See* REFRACTION

RA'YAH The designation by the Turkish government of its non-Mohammedan subjects, who pay the capitation tax Under Bajazet I the taxable Rayahs in Turkey in Europe were numbered at 1,112,000, under Selim, the late sultan 1,337,000

RAZE'E (Fr) The term used for any vessel cut down to an inferior class, as a 74 to a frigate, &c By razeeing, the draught of water is diminished while the centre of gravity is lowered, and the qualities of the vessel have generally, though not invariably been improved

REACH That portion of the length of a river in which the stream preserves the same direction

REACTION A term used in Mechanics to denote the reciprocality of force exerted by two bodies which act mutually on each other, or the general fact collected from observation, that any two bodies repelling or attracting each other are made to recede or approach with equal momenta Newton's third law of motion is that reaction is always contrary and equal to action or that the mutual actions of two bodies are always equal, exerted in opposite directions' In the mathematical consideration of mechanics, this principle must be assumed as a necessary axiom or law, and, in fact, as is remarked by Dr Young (*Nat Phil*), there would be something peculiar and almost inconceivable in a force which could affect unequally the similar particles of matter, or in the particles themselves, if they could be supposed of such different degrees of mobility as to be equally moveable with respect to one force and unequally with respect to another The principle may, therefore, as justly be termed a necessary law as an experimental fact

READER In Ecclesiastical matters one of the five inferior orders in the Romish church In the church of England, a reader is a deacon appointed to do divine service in churches and chapels of which no one has the cure There are also readers (priests) attached to various eleemosynary and other foundations

REAL *See* MONEY

REA'LGAR Red sulphuret of arsenic It is found native, and is composed of 38 arsenic + 16 sulphur

REA'LISM, in Philosophy [illegible] according as it is used in contradistinction to *nominalism*, in the former case relating to the theory of perception, in the second to the theory of abstraction and generalization For the first, see PERCEPTION, and IDEALISM, for the second, SCHOLASTIC PHILOSOPHY, THOMISTS, SCOTISTS and NOMINALISTS

REAL PRESENCE *See* TRANSUBSTANTIATION

REAL PROPERTY Real property is commonly said to consist in "lands, tenements, and hereditaments," of which terms the last is, in fact, coextensive with the term real property itself, expressing the same thing by the quality which the logicians would term its *differentia* viz that it descends to the heir wherever held in perfect right thus distinguished from all other species of full property, which, if possessed in equally absolute right, descend to the executors or administrators of the party Hereditaments are either corporeal or incorporeal, the first being land and its visible adjuncts recognized by the law as [illegible] whatever is [illegible] the [illegible]



corodies (pensions charged on ecclesiastical property, now obsolete), annuities charged on land, and rents reserved out of lands and tenements The quality of the property which the man may possess in those objects included under the term real (technically called his estate) may vary in *tenure* or in *degree* *See* FREEHOLD, COPYHOLD, FEE SIMPLE, &c

REAM A quantity of paper, consisting generally of twenty quires of twenty four sheets each, but what is called the printer's ream contains 21½ quires, or 516 sheets *See* PAPER

REAPING Cutting down corn or pulse with a sickle, hook, or scythe, or by a reaping machine These operations are more advantageously performed when the corn or pulse is not quite ripe, than when it is thoroughly ripe, because in the latter case the seeds are apt to drop out in the process of handling, turning, and drying

REAR The 3d or last division of a fleet, commanded by a rear admiral

REAR GUARD That part of an army, a regiment, or battalion which marches after the main body *Rear rank* signifies the last rank of a battalion, when drawn up in open order

REA'SON (Lat ratio) That particular faculty in man of which either the exclusive or the more intense enjoyment distinguishes him from the rest of the animal creation Like most of the terms in the science of mind, that of reason has been employed in a great variety of significations Dugald Stewart takes it in its widest sense, and comprises under it all the operations of the intellect upon the materials of knowledge which are furnished in the first instance by sense and perception Its office is to distinguish the true from the false, right from wrong, and to combine means for the attainment of particular ends According to this definition, therefore, the province of reason is coextensive with the range of human activity, and it directs itself to the three supreme objects of desire to man,—the good, the beautiful, and the true Mr Hume, however, withdraws the discernment of right and wrong, and of the beautiful and its contrary, from the domain of reason, and, on the other hand also denies the certainty of the truth which it enunciates and limits its convincing force merely to a certain weight of probability Locke's usage of the term, again partaking as it does of the general looseness of his phraseology is very different In one passage reason is declared to be [illegible] about the means, and rightly applies [illegible] the certain agreement or disagreement of two ideas, or their probable connection But in another place, it is said to be conversant with certainty alone, while the discovery of what, as probable enforces a contingent assent or opinion is ascribed to an especial faculty which is called the judgment Bird, on the other hand confines the latter term to the apprehension of intuitive truth, but agrees so far with Locke as to make it one part of reason, whose other part is [illegible] On the whole, [illegible] Locke the terms reasoning and reason were nearly if not quite, equivalent But reasoning and deduction are evidently not the source either of the dignity or the authority of the human intellect The discursive faculty can never establish any other than a conditional truth, which predisposes some anterior and pre-established verity as its basis and verification If there [illegible] something primary [illegible] all reasonings might [illegible] foundation the discursive process would proceed into infinity and its conclusions be, as Hume asserts that they are without any power to enforce assent But there are unquestionably in the human mind certain necessary and universal principles, which shining with an intrinsic light of evidence, are themselves above proof, but the authority for all mediate and contingent principles That which is thus above reasoning is the reason In [illegible] the terms reason and [illegible] and are so used by Stewart, [illegible] philosophy of Kant a broad distinction has been drawn between them Reason is the principle of principles, either speculatively verifies every special principle, or practically determines the proper ends of human action Approximately it may be called the sum of what in Scotch philosophy has been denominated the laws of man's intellectual constitution The understanding on the other hand is coextensive with the very [illegible] of reason [illegible] that which conceives of sensible objects under certain general notions, which again it compares one with another, or with particular representations of them, or with the objects themselves [illegible] generalization [illegible] judgment, and the understanding, when it enunciates its conceptions, becomes also the faculty of judging If the truth of a proposition which is not identical, or the enunciation of a primary truth, cannot be immediately certain. To prove it, recourse must be had to other propositions

previously admitted, the understanding, that is, must deduce one judgment from another, and so becomes the discursive faculty or reasoning Further in discovering these mediate truths, and in the regular and methodical disposition of them for the purpose of conclusion, as well as in the selection of means for the accomplishment of its ends it exhibits itself as a power of adaptation

By adopting this distinction between understanding, much of the difficulty involved in the consideration of instinct will be removed Instinct is defined to be a natural impulse in animals, by which they are led to certain actions necessary to the continuation of the individual and of the species, and enabled to perform them unerringly independent of instruction or experience To the determination is added the power and without a view to the end which their actions will effectuate But these words, while they apply to the instinctive principle as it shows itself in animals, do not belong to it in its highest That in other cases, the spontaneity of the animal operates unconsciously, is fully established by experience The solitary wasp does not itself feed upon flesh, and it cannot know that a larva is to issue from the egg which it is placing in the sand, but yet it deposits in the same hole with it the exact number of green worms that is sufficient for the sustenance of the wasp-worm until, being transformed into a fly, it will be capable of finding food for itself In other cases, it is impossible to deny the presence of judgment and design It is essential to the well-being of the animal that the nest should be built of mud-bait, which, by means of the gluten which proceeds from its body covers itself with pieces of straw or wood and of gravel or light shells, that it should maintain itself in equilibrium with the water in which it lives To accomplish this when its coating is too light it is observed to add a piece of gravel, and a piece of wood when it is too heavy The former cases may be regarded as instinctive the latter as instinctive Although we may be constrained to assign understanding and intelligence to the operations of the inferior animals, they are manifestly destitute of reason However exquisite may be the construction of the bee's cell, it is impossible to ascribe to it a knowledge of the principles of its construction The bee is born architect prior to and independently of all instruction and experience, is perfect in its works, and chooses its means with an unerring certainty But the whole through every part is adapted to the mind, while the means it employs are as various as the individuals, and seldom the best and most appropriate Again, the acts of the inferior animals are solely subservient to the continuation of the individual or the propagation of its kind, whereas the works of the rational animal fall short of perfection in many respects and are rendered still more difficult by a voluntary combination of the beautiful with the simply useful and necessary

REBATE (Fr rabattre) In Architecture the groove recess, or channel, sunk on the edge of any piece of material

REBEC A Moorish word, signifying a stringed instrument somewhat similar to the violin, having three strings tuned in fifths, and played with a bow It was introduced by the Moors into Spain It appears to have been much used at the revival of learning Hence Byron, speaking of Seville says

Nor here war's clarion, but love's *rebec* sounds

Milton, in *Il Penseroso*, calls it "sad rebec"

REBELLION CIVIL In Scottish Law, by a peculiar fiction a charge on letters of horning to pay or perform in terms of his obligation is accounted a rebel, by reason of his disobedience to the king's command contained in the writ The penal consequences formerly attaching to this contempt of the law were abolished by 20 Geo 2 c 50

REBELLION, THE GREAT The revolt of the Long Parliament against the authority of Charles I in English History, is commonly so denominated Nevertheless, as arbitrary and unconstitutional acts were undoubtedly committed on both sides during the struggle which preceded the actual resort to arms, a constitutional lawyer may consider it questionable whether the parliament may be more justly said to have rebelled against the king, or the king against the state The question is very fairly discussed by Mr Hallam, in his *Constitutional History of England* The commencement of the rebellion may be dated from the votes of the two houses concerning the militia Feb 1642 by which they endeavoured to seize on the military power of the realm, immediately after which the king left London for the north of England and after a series of unsuccessful negotiations (*see* CHARLES I) first took up arms, the king's standard was set up August 25 and the civil war was ended by the submission of the king to the Scots in April, 1646 The period of the rebellion is, however, extended, in ordinary language, so as to include the Commonwealth or Protectorate down to the restoration of Charles II in May, 1660

RE'BUS An antiquated species of ingenuity, a great favourite with our ancestors, being an enigmatical representation of a name or thing by using figures for words or parts of words thus an eye, and a ton or barrel, represent the family name of Eyton, an instance of a rebus by the bye of device, as they very commonly are See Device In heraldry, a coat of arms alluding to the name of the bearer (otherwise called *arms pariantes*) is also called a rebus, *e g* three trouts for Troutbeck, three cups for Butler, &c The term is said to be derived from an annual practice of the priests of Picardy, which consisted in presenting to the people of their vicinity on the first day of Carnival in certain years, entitled "Dies *de quibus*"

REBUTTER In Law, the fifth stage of the pleadings in a suit, or the plaintiff's answer to the defendant's rejoinder *See* PLEADING

RECEPTACLE, in Botany, has four different significations —1 That part of a flower upon which the carpella are situated, or, in other words, the apex of the peduncle or summit of the floral branch, of which the carpella are the termination 2 The axis of the theca of *Trichomanes* and *Hymenophyllum*, among ferns 3 That part of the ovarium from which the ovula arise and which is commonly called the placenta And, 4 That part of the axis of a plant which bears the flowers when it is depressed in its development, so that, instead of being elongated into a rachis, it forms a flattened area, over which the flowers are aggregated in corymbus

RECESSION OF THE EQUINOXES *See* PRECESSION

RECESS OF THE EMPIRE In History, the name given in judicial language to the decrees of the German diet They are thought to have been so termed from being pronounced at the time when the diet was about to 'recede,' or separate See DIET

RECHABITES A religious order among the ancient Jews instituted by Jonadab, the son of Rechab, from whom they derived their name It comprised only the family and posterity of the founder who was anxious to perpetuate among them the nomadic life, and with this view prescribed to them several rules, the chief of which were —to abstain from wine, from building houses, and from planting vines These rules were observed by the Rechabites with great strictness (See Jer xxxv 6) In recent times a branch of the body called *tee-totallers* has assumed the name of Rechabites

RECIPE The symbol ℞ at the head of a medical prescription, "take" Dr Paris astrological symbol of Jupiter a planet under the ascendency of which herbs were often collected

RECIPROCAL from the division of unity by any number Thus, ½ is the reciprocal of 2, and conversely 2 is the reciprocal of ½

RECIPROCAL FIGURES in Geometry are two figures of the same kind (triangles, parallelograms, prisms, pyramids, &c) so related that two sides of the one form the extremes of an analogy of which the *means* are the other

RECIPROCAL PROPORTION is when, of four terms taken in order the first has to the second the same ratio which the fourth has to the third, or when the first has to the second the same ratio which the reciprocal of the third has to the reciprocal of the fourth In works of arithmetic the case which give rise to this class of relations is called Inverse Proportion, or the Rule of Three Inverse

RECITATIVE (Lat recitare, *to recite*) In Music, a species of singing differing but little from ordinary speaking used in operas, &c to express some passion, to relate a story, or to execute any short design, and though written in time the performer may alter the parts of the measure as he thinks most suitable to produce certain effects, those that accompany him being dependant on his pleasure

RECKONING In Navigation, the estimated place of a ship, calculated from the rate as determined by the log, and the course as determined by the compass, the place from which the vessel started being known An elegant and ready method for solving this problem has been recently given by Professor Gill of New York, in the first number of his *Mathematical Miscellany*, much more accurate than the method usually given by writers on navigation (*See* NAVIGATION) *Dead reckoning* means the same as *reckoning*, due allowance being made for drift, lee-way currents &c

RECLINATION (Lat reclino, *I repose*), in Dialling, is the angle which the plane of the dial makes with a vertical plane which it intersects in a horizontal line

RECLUSI The common title of a class of religious persons *See* INCLUSI

RECOGNIZANCE In Law, an acknowledgment of

a debt upon record By a fiction of law, the obligation which a party enters into before a court of record or magistrate duly authorized, with condition to do some particular act,—as to appear at the assizes keep the peace, &c ,—is in the form of a recognizance, the party acknowledging himself to be indebted to the king, the plaintiff, &c , with condition that the obligation shall be void on performance of the thing stipulated

RECOI'L, in Artillery, is the rebound or resilience of a piece of ordnance when discharged This has been employed for the determination of the explosive [illegible] oes not appear [illegible] GUNNERY [illegible] Monks of the [illegible] ule The first separation from the original body seems to have taken place towards the end of the 14th century, when some [illegible] returning to stricter discipline as [illegible] the rule of Brothers of the Observance [illegible] from these originated the Recollets (living in a state of *recollection*, or reclusion), first established in Spain by the Count de Belalcazar, about 1484, and afterwards introduced [illegible] they acquired the possession of [illegible] in France, during the [illegible]

RECORD Literally an authentic account of any fact or transaction in writing, contained in rolls of parchment, wood, or any other durable substance, and preserved in a court of record *See* ARCHIVES

RECORD In Law, the authentic testimony in writing, contained in rolls of parchment, of the judgment of a superior court, and of the other proceedings in a case [illegible] —judicial records, [illegible] offices or inquisitions found, records made by conveyance or consent as fines, recoveries, or deeds enrolled (*See* COURT ) Trial by record is used where a matter of record is pleaded in any action, as a [illegible] &c , and the opposite party pleads "nu [illegible] that there is no such record existing On this issue is joined, which can be tried only by inspection of the record

RECORDA'RI FA'CIAS LOQUE'LAM In Law, a writ to remove proceedings out of an inferior court to the King's Bench or Common Pleas It is directed to the sheriff, commanding him to make a record of the plaint and other proceedings, and then to send up the cause It is the common mode by which an action of replevin is transferred from the sheriff's to the superior courts

RECO'RDER The chief judicial officer of a borough or city, exercising within it in criminal matters the jurisdiction of a court of record, whence his title is derived This jurisdiction is now made uniform in extent throughout all boroughs, and is rendered equal to that of the quarter sessions of a county Recorders were formerly chosen without restriction by the corporations with which they were connected, but by the existing municipal system the appointment is vested in the crown, and the selection is confined to barristers of five years [illegible]

RECORDER The name of a musical instrument somewhat resembling the flageolet, formerly in use in this country It had a peculiarly pleasing tone, hence Milton speaks of

> ——— The Dorian mood
> Of flutes and soft recorders

The etymology of the term is involved in great obscurity

RECO'VERY, or COMMON RECOVERY In Law (*see* FINE), a mode of assurance in the form of a fictitious action, by means of which conveyances were made by various tenants possessed of limited rights in real property (by tenants in tail more particularly) The effect of a common recovery duly suffered was to raise an absolute bar, not only of all estates tail, but of all estates in remainder and reversion expectant on such estates tail, and to give the recoverer a fee simple absolute A common recovery, however, did not bar a springing use, or an executory devise A common recovery also avoided all charges, leases, and incumbrances made by those in reversion or remainder By 3 & 4 W 4 c [illegible] w mode of [illegible] tituted for [illegible]

RE'CTANGLE In Geometry, a right-angled parallelogram W [illegible] it becomes a *square* The area of a rectangle is numerically expressed by the product of the two numbers which express the lengths of its adjacent sides, and hence the term [illegible] of a straight line, whose length is equal to a portion of a curve It is effected by the integral calculus

If the curve be entirely in one plane, the length of the arc is $\int \sqrt{dy^2 + dx^2}$, or if it be a curve of double curvature, its length is $\int \sqrt{dx^2 + dy^2 + dz^2}$ In the former case, the equation of the curve being single will give a value of $dy$ or $dx$, as may be found most convenient and this being substituted in the above formula and the expression integrated between the specified limits the actual length is obtained In the second case the equations upon two of the planes of projection being given, the values of $dy$ and $dz$ can be obtained in terms of $dx$ [illegible] the values of $y$ and $z$ in [illegible] being made, the process is the same as before *See* INTEGRAL CALCULUS

It will, however, very rarely happen that the rectification can be obtained in finite terms, as the substitutions generally introduce radical expressions into the differential, which are hardly ever so connected with the rational parts as to be susceptible of a finite integral, and hence it has been an object with mathematicians to transform the expressions into others, the successive terms of which are so related as to diminish at a very rapid rate In this case, the approximation to the value of the arc is [illegible] The first curve which [illegible] Mr Neile [illegible] later the same curve was rectified by Van Heureat, in Holland

RECTIFICATION A Chemical [illegible] a second or more frequently rep [illegible] 'rectified spirit of wine," means spirit which has been redistilled, and by which it is to a great extent freed from wa [illegible]

'NEAR FIGURE, in Geometry, is a figure bounded by straight lines

RE'CTOR (Lat rector ecclesiæ, *ruler of the church*), is a person who hath the charge and care of a parish church The other rector is a layman, or a college or corporate body (*see* art TITHES) He is bound to provide a vicar to serve the church in his place, and to allow the small tithes, or a sufficient stipend, for his maintenance The term *rector* is also employed in Scotland to designate the head master of a public school or academy

RECTRI'CES (Lat rectrix, *a guide*) The name of the tail feathers of a bird, which, like a rudder, direct its flight

RE'CTUM (Lat *straight*) The last portion of the large intestines, so named from an erroneous notion of the old anatomists that it was straight

RECU'MBENT (Lat recumbo, *I lie down*) In Zoology, when a part is leaning or reposing upon any thing

RECU'RRENT NERVES Two branches of nerves from the *par vagum*, in the cavity of the thorax, are so called, they are distributed to the muscles of the larynx and pharynx

RECU'RRING DECIMALS, or CIRCULATING DECIMALS, in Arithmetic, are decimals which arise from the expansion of a fraction whose denominator includes one or more prime numbers, as factors, different from 2 or 5, and not included in the numerator In this case the same figures are continually repeated in the same order Thus, $\frac{2}{11} = 181818$, &c , $\frac{1}{7} = 1428571428571$, &c , *ad infinitum* Their value can always be found by taking one of the periods for a numerator, and as many nines for the denominator as there are figures in the period, and reducing the resulting fraction to its lowest terms Thus, $\frac{142857}{999999}$ being so reduced, is found equal to $\frac{1}{7}$

Recurring decimals were first noticed by Dr Wallis, but their properties have not been extensively investigated

RECU'RRING SERIES In Algebra, a series in which the coefficients of the successive powers of $x$ are [illegible] coefficients [illegible] $a + (a+1)x + (2a+2)x^2 + (3a+3)x^3 + (5a+5)x^4 +$ is a recurring series, th [illegible] of the coefficients of [illegible] of the terms of such a series can always be exhibited in a finite form (See Euler, *Introductio in Analysin Infinitorum*, *Institutiones Algebræ*, &c

RECUSANTS [illegible] History, a term applied to those who refused to acknowledge the king's supremacy as head of the church, chiefly Papists

RED One of the primary colours *See* CHROMATICS

RE'DAN In Fortification, a kind of rampart placed in advance of the principal works to defend the least protected parts The redan usually consists of a rampart of earth, and it is the simplest kind of field fortification *See* FORTIFICATION

RED BOOK The name given to a book containing the names of persons in the service of the state The *Red Book of the Exchequer* is an ancient record, in which are registered the names of all those that held lands *per baroniam* [illegible] the time of Henry II

RE'DDLE A soft argillaceous mineral deeply tinged [illegible] The best specimens, used as [illegible] from Germany

**REDE'MPTORISTS** A religious order founded in Naples by Liguori in 1732, and revived in Austria in 1820 They are bound by the usual monastic vows, and devote themselves to the education of youth and the propagation of Catholicism They style themselves members of the order of the Holy Redeemer (il Santo Redemptore) whence their name, but they are also often called *Liguorists*, from the name of their founder

RED LEAD An oxide intermediate between the [illegible] lead *See* LEAD and MINIUM

[illegible] sandstone *See* GEOLOGY

[illegible] The peroxide of mercury, obtained by the decomposition of nitrate of mercury by heat *See* MERCURY

REDOU'BT In Fortification, a te[illegible] nearly every kind of work intended to [illegible] positions, as also to works constructed within others to prolong their defence, or to detached works used to secure some piece of ground which would be useful to the besiegers, and thereby create delay in offensive operations

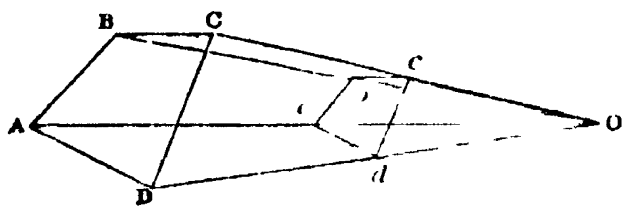
REDU'CING SCALE A scale used by surveyors [illegible] to roods and acres by inspection

[illegible] The process of converting a metallic oxide into metal by expelling its oxygen In some cases it is effected simply by heat, but generally by the joint action of heat and some deoxidizing agent upon the large scale, charcoal is almost always resorted to

REDUCTION In Arithmetic the changing of quantities from [illegible] to another

REDUCTION OF FIGURES, in Practical Geometry, consists in describing figures similar to the given ones, but of different (generally smaller) dimensions The pentagraph and the proportional compasses are the readiest and most accurate methods of performing these reductions, but in the absence of these, many different methods are taught in works of practical geometry The simplest is here annexed

Let A B C D be the figure to be reduced, and *a b* be




the line which is homologous to A B At a convenient place on the paper draw *a b* parallel to A B and equal to the reduced line Draw A *a* B *b* meeting in O and from O draw lines to all the other angles of the figure, then draw *b c* parallel to B C, *a d* parallel to A D &c, and join the last two points Then *a b c d* is the reduced figure sought

If the proposed figure be curvilinear inscribe any polygon within it, and draw the similar polygon as above directed, then trace the curve through the angles of the polygon

REDU'NDANT HYPERBOLA A line of the third order, having three pairs of asymptotic branches Its properties may be seen in *Newton's Enumeratio*

REEF in Navigation signifies to diminish the surface of the sails on the increasing of the wind Sails attached to yards are reefed at the head Strong horizontal bands of canvass, from three to six feet apart extend across the sails these are called *reef bands*, and there are usually four in each topsail and two in the foresail and mainsail The reef band is commonly pierced with two holes in each cloth (or breadth of canvass) in the sail, through each hole are drawn two *reef points* —short pieces of flat rope, each having an eye in one end, and hung one before and the other abaft the sail, each passing through the eye in the end of the other The sail [illegible] lowered and trimmed to the wind so as to shake [illegible] of the reef band are drawn up towards the *yard arm* by the ropes called *reef tackles*, the men then going out upon the yard, which they lean over while their feet are supported by the *foot ropes* gather up the loose canvass of the sail till they reach the reef band, which they keep extended [illegible] the *earings* are *passed* or secured [illegible] being passed first, they [illegible] the two reef points of each pair together over the yard, and [illegible] the surface having been thus diminished by the depth of one reef Gaff sails are reefed at the foot The sail being lowered enough to slack the canvass, the earing which is on the after leech is brought or hove down to the bo[illegible] *reef pendant*, the men [illegible] reach the foot of the sa[illegible] the yard is not lowered, as in reefing the courses, the sail is partly clued up for reefing

REEF, or CORAL REEF, is also applied to a chain of rocks in various parts of the ocean lying near the surface *See* GEOLOGY

REEL A lively dance peculiar to Scotland, generally written in common time of four crotchets in a bar, but sometimes in gig time of six quavers





**REEL** An angler's implement attached to the but of the rod, for the purpose of winding in the line when a fish is hooked The barrel of the reel should be of sufficient diameter to wind in quickly, as a fish is often lost by not being able to bring him rapidly within reach of the landing net, especially where, as in fly-fishing, a great length of line has been thrown out

REFINER In Engraving a word which denotes the passing of the graver into those incisions of the plate, so as to deepen them, where the aquafortis has not bitten in sufficiently

RE-E'NTERING ANGLE In Fortification, the angle of a work whose point turns inwards towards the defended place

REEVE (Ang. Sax. [illegible] *Reve, præpositus*) A word of a very [illegible] composition of so[illegible] [illegible] shire-reeve, the governor of a shire or county, borough reeve port-reeve, &c

REEVE The Sea term for putting a rope through a block or any hole through which it is intended to run

REFECTION (Lat. reficio, *I restore*) In the language of Ecclesiastical communities, a spare meal sufficient only to maintain life, whence the hall in convents where meals are taken is termed *refectory*

REFECTORY (Lat. refectorium) In Architecture, an apartment wherein meals are taken

REFERENDARIES In the early monarchies of Europe after the fifth century, public officers charged with the duty of procuring executing and despatching diplomas and charters The office of great referendary, in the French monarchy, became merged in that of chancellor

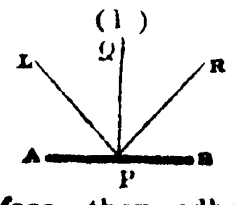
REFLECTING CIRCLE An astronomical instrument for the measurement of angles by reflection (*See* SEXTANT) The term is also applied to a surveying instrument invented by Sir Howard Douglas, which combines the advantages of the Hadley's quadrant and the protractor The object of it is to protract or lay down on the plan the angles measured with the instrument from the instrument itself without any intermediate step or even a register of their values The advantage of such an instrument must be obvious in military surveys where expedition is important while accuracy is thereby far more efficiently insured than by the old and more tedious process It is also advantageously used in forming general sketches of a country

REFLEX (Lat. reflecto *I bend back*) In Painting, the illumination of one body or a part of it, by light reflected from another body The foundation of the law of *reflex* depends upon the knowledge that every body in light reflects that light to a certain degree, in the same way that flame does The stronger in colore, the light on the body the stronger will be the *reflex*, distances being equal Again the more directly the light falls on a body, the more influence it will have in imparting a reflex

REFLEXION, in Mechanics denotes the rebound or regressive motion of a body from the surface of another body against which it impinges In Natural Philosophy, the term is applied to the analogous motions of light, heat, and sound, when turned from their course by an opposing surface The laws of the reflexion of light form the branch of science called *catoptrics*, those of the reflexion of sound are sometimes called *cataphonics* See SOUND

The simplest view which can be taken of the mechanical action whereby reflexion is produced is to assimilate it to that which takes place when an elastic body impinges on another body which it cannot move out of its place If light, heat, and sound are propagated by the pulses of an elastic medium the same theory will apply to them, and it is to be remarked, that in all cases of reflexion the change of motion which takes place follows precisely the same laws as that which is produced by the impact of two elastic bodies

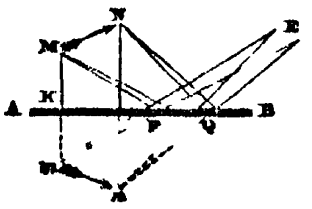
*Reflexion of Light* —When we consider only the *direction* of the ray of light after being reflected from a polished surface and leave its *quantity* or *intensity* out of view, the laws of reflexion are extremely simple Suppose A B (fig 1) to be a smooth polished surface, or mirror, and a ray of light proceeding in the direction I P to impinge on the surface at P, and to be reflected from it in the direction P R Through the point P draw P Q a normal or [illegible] surface, then, adhering to the de[illegible] most writers on optics, the angle I P Q [illegible] *the angle of incidence*, Q P R *the angle of reflexion*, the plane in which are the two straight lines L P and P Q is called *the plane of incidence*, and the plane determined by Q P and P R *the plane of reflexion* Now the two general [illegible] reflexion [illegible] lines L P, P Q, and P R, are in one plane and the angle



of [illegible] and on the [illegible] true, whatsoever surface, or the origin [illegible] experience offers no exception to them whatever, and all the phenomena of reflexion from mirrors or polished surfaces, whether plane or having any regular curvature, are readily deduced from [illegible] consequences

*Reflexion from Plane Mirrors* To determine the path of the reflected rays, and the formation of images by plane mirrors, suppose M N (fig 2) to be an object placed before the plane reflecting surface A B, and the eye to be situated at E The rays of light which proceed from the point M, and are reflected to the eye at F, will impinge on the mirror at P, and appear to come from a point *m*, which, in respect of the plane A B, is symmetrical with M, that is to say, placed in the straight line which is drawn from M perpendicular to the surface, and at the same distance from A B on the opposite side For let M K be the perpendicular and let it be continued till it meet the prolongation of I P in *m*, then, from the equality of the angles of incidence and reflexion, the angles M P K and E P B (which are the complements of those angles) are equal, hence M P K = K P *m*, and the two right angled triangles K P M and K P *m* having also a common side, are every way equal, whence K *m* = K M In like manner the rays which issue from N, and are reflected to E, will appear to proceed from a point *n* symmetrical with N, and as the same thing is evidently true with respect to every other point of the object a perfect image *m n* of the object will be formed on the opposite side of the mirror and at the same distance It will be observed that the image is not properly speaking reversed, like writing looked at through the opposite side of the paper the spectator sees the same side of the object as if he stood in front of the mirror and viewed the object directly, but in the reflected image, right takes the place of left, and left of right

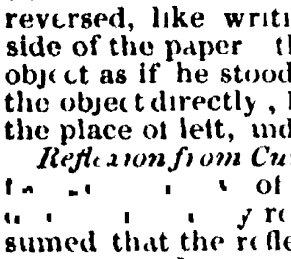
(2)




*Reflexion from Curve Surfaces* - [illegible] the [illegible] of reflexion to [illegible] the [illegible] ly reflected from a curve surface it is assumed that the reflexion takes place at each point of the surface in the same manner as it would from a plane touching the curve surface at that point, and the problem therefore becomes that of determining the direction of the normal at the given point, for when the direction of the incident ray and of the normal at the point of incidence, are both known, the plane of the reflected ray and the position of the ray in that plane are both given The mirror may be concave or convex, and the incident rays may be parallel or divergent

Let D (fig 3) be the centre of a concave mirror, D C its axis, C the centre of curvature at D, and assume the semidiameter of the mirror D I to be small in comparison of its radius of curvature C D Now suppose a ray of light I P parallel to the axis to fall on the mirror at P, then if we draw P C, and make the angle C P R = C P L or P C D P R will be the direction of the reflected ray, for by the nature of curvature C P is a normal to the surface the arc D P being small But on the hypothesis of D P being small we have also R P = R D, and by reason of the equal angles R P C and R C P, R P = R C therefore R D = R C, or R is a given point and, [illegible] all the rays which fall on the mirror p[illegible] (D) are reflected into the same point R From this property the point R, which bisects the radius C D is called *the principal focus* of the mirror, or *the focus of parallel rays* See Focus

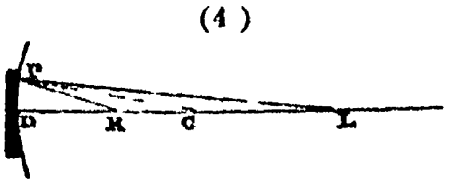
(3)




If the reflecting surface were a portion of a paraboloid, then all rays parallel to the axis would be accurately reflected into the focus at R whatever the extent of the surface might be, but, on account of the practical difficulty of grinding and polishing curve surfaces of any other form than the spherical, the concave and convex mirrors required for optical purposes are always spherical

Suppose, next, the rays to diverge from a point in the axis of the mirror Let L (fig 4) be the luminous point, C the centre of curvature, and P R the reflected ray To find the point R, let I = L P C = R P C, and let R, C, L denote respectively the acute angles at the points indicated by these letters We shall then have obviously, R − I = C and I + L = C, whence L + R = 2C Now, since D P is supposed to be an arc of a small number of degrees, D P may be regarded as a straight line perpendicular to L D, and since the angles R, C, L are also small, we may substitute for the arcs to which they respectively correspond their trigonometrical tangents, namely, $\frac{P D}{D R'}$ $\frac{P D}{D C'}$ $\frac{P D}{D L}$ Hence, if we assume D L = *p*, D R = *q*, D C = *r*, the radius of curvature, the above equation R + L = 2 C will become

(4)



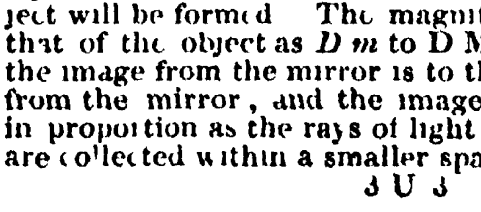

$$\frac{1}{p} + \frac{1}{q} = \frac{2}{r},$$

which gives the relation between *p* and *q*, *r* being a constant quantity for the same mirror If, therefore, L be a given point, then *p* has a given value and *q* is also determined, so that all rays diverging from the point L, and falling on the mirror, are reflected into the point R As the two quantities *p* and *q* enter symmetrically into the equation, each being expressed in terms of the other by the same formula, the points R and L are interchangeable, that is, if R be taken as the radiating point, then I is the focus of the reflected rays Hence L and R [illegible] *conjugate points*, or *conjugate foci*

Since the reciprocals of *p* and *q* always make up the same sum when one of those quantities increases the other diminishes, and *vice versâ* If, therefore, L approaches towards C, R will also approach towards C (the origin being supposed at D) and they will ultimately coincide at that point, so that rays issuing from C would be reflected back on itself If L recede from C, then R recedes from C or approaches D Suppose L to be at an infinite distance, in this case $\frac{1}{p} = 0$, and the equation gives $q = \frac{1}{2} r$, or D R = $\frac{1}{2}$ D C, so that R becomes the *principal focus* as it evidently ought, for when L is at an infinite distance, the rays L P are parallel to the axis

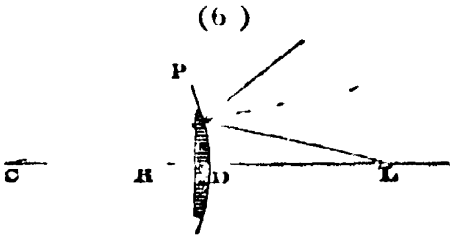
It is evident from the above equation that so long as *p* and *q* have the same sign, that is, so long as L and R are on the same side of the mirror, each of those quantities must be greater than $\frac{1}{2} r$ Suppose the radiating point I to be placed between D and C (fig 5), and let D L or *p* become less than $\frac{1}{2} r$ In this case, *q* must become negative, that is to say, the rays which emanate from L must become divergent after [illegible] same direction as if they diverged from [illegible] R on the opposite side of the mirror, and of which the distance *q* from D is determined by the equation $\frac{1}{p} - \frac{1}{q} = \frac{2}{r}$ This point R′ is called the *virtual focus* of the reflected rays

(5)




The same construction and equation (with the proper changes of sign) apply equally to convex and concave mirrors Let I (fig 6) be the luminous point from which diverging rays fall on the convex mirror P D, of which C is the centre of curvature Denoting, as before D L, D R and D C, by *p*, *q* and *r* respectively, and assuming the constant *r* to be positive, then by exactly the same reasoning as above, we shall find the equation

(6)

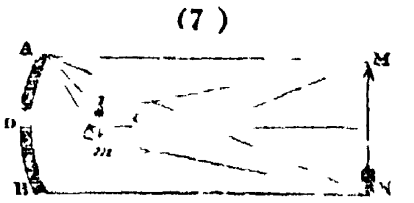



$$\frac{1}{q} - \frac{1}{p} = \frac{2}{r}$$

In this case, *p* and *q* increase or decrease simultaneously and if we suppose *p* to increase to infinity, or the incident rays to become parallel, then we have again $q = \frac{1}{2} r$, so that, for parallel rays the conjugate focus is at the middle of the distance between D and C When the mirror is convex, the conjugate focus is always the virtual focus

From what has now been shown it is easy to see in what manner images are formed by concave or convex mirrors Let M N (fig 7) be an object placed before a concave mirror A B, beyond its centre of curvature C On tracing the path of the rays M A, M D, M B, after reflexion, they will all be found to meet in the point *m* and those which proceed from N will in like manner be found to meet in *n*, whence rays diverging from every point of the object between M and N will meet, after reflexion, in a point situated between *m* and *n*, and in this manner an inverted image *m n* of the object will be formed The magnitude of the image is to that of the object as *D m* to D M, or as the distance of the image from the mirror is to the distance of the object from the mirror, and the image will be more brilliant in proportion as the rays of light coming from the object are collected within a smaller space If the object were

(7)



placed at *m n*, then an enlarged image would be formed at M N It is on this principle that reflecting telescopes and microscopes are constructed *See* TELESCOPE, MICROSCOPE

*Intensity of reflected Light* — It has now been shown that the path of the reflected light can be determined in all cases with proper precision when the form of the reflecting surface is known In the case of direct light when the question is to determine the quantity or proportion of the light which is thrown off by reflection by an opposing surface The following laws, however, have been established by experiment — 1st, The quantity of light regularly reflected increases with the angle of incidence, but does not vanish entirely when that angle becomes 0 2d It depends both on the nature of the medium through which the light is passing when it falls on the reflecting surface and on that of the substance on which it falls 3d, Bodies of different natures, placed in the same circumstances, reflect very different proportions of the incident light

On this subject a great number of experiments have been made by Bouguer, Lambert, Wollaston, Mr Potter, and others The results of [illegible] are given by Bouguer — When a beam of light, the intensity of which is represented by 1000 falls upon water so as to make an angle of 0° 30′ with the surface, the intensity of the reflected light is represented by 721, at an angle of 15° with the surface, by 211, at an angle of 30°, by 65, and at an angle from 60° to 90°, by 18 Of 1000 rays falling upon a surface of glass, and making an angle of 5° with the surface, 543 are reflected, 300 when the angle is 15°, [illegible] when 60°, or above Of 1000 rays fall [illegible] surface of black marble, 600 are reflected when the angle with the surface is 3° 15′, 156 when 15°, 51 when 30°, 23 when 60° and upwards Mercury and the metals exhibit a rapid diminution Of 100 incident rays 75 are reflected when the angle with the surface is very small, and about 60, or more than half, when the angle approaches to 90°, or the incident ray is nearly perpendicular to the surface (*Traité d'Optique* See also the *Edinburgh Journal of Science* for 1830 and 1832)

In order to produce reflexion in a less degree, the only indispensable [illegible] light pass from one medium to another having a different refractive power In passing through a perfectly homogeneous medium, no reflexion takes place, but whenever there is a change of medium (and this change may occur in the same substance by an inequality of density in the different parts, or a different arrangement of the particles), more or less reflexion takes place at the surface which separates the two media Thus in passing through the atmosphere, the solar light undergoes an infinite number of partial reflexions before it arrives at the earth, as every successive thin stratum of air, by reason of its increasing density, forms, as it were, a different medium *See* REFRACTION, ASTRONOMICAL

If any surfaces could be formed of so perfect a polish as to reflect the whole of the incident light, the eye would be unable to distinguish them, and, unless by coming in actual contact with them, we should have no reason to suspect their existence Bodies are only visible in consequence of rays irregularly reflected from their surfaces meeting the eye, for rays which are regularly reflected only show the luminous points from which they emanate, and not the surfaces on which they fall If the lunar surface were as perfectly polished as a globule of pure mercury, the moon would present to us only a reflected image of the sun *See* LIGHT, OPTICS

REFORM ACT In Politics *See* PARLIAMENT

REFORMA'TION An important era in political [illegible] when the doctrines and usages [illegible] then dominant throughout the western states of Christendom, were first successfully called in question This event is commonly dated from the year 1517, when Luther began to oppose the pope and condemned the sale of indulgences Mosheim assigns to it the date 1520, when Luther was excommunicated

Prior to the Reformation, the pope claimed of divine right and exercised, absolute authority over the whole Christian church with the exception of those states and provinces in which the Eastern or Greek church was established Not only was his authority regarded as supreme on subjects of doctrine and discipline, but his decisions were considered as infallible; and whoever ventured to question or gainsay them was treated as a heretic, and was liable to such canonical censures and temporal penalties as the canon law determined Of course, the [illegible] Christian church under the see of Rome His holiness, also, laid claim to supremacy even in temporal things throughout the wide range of his religious authority; though the exercise of this supremacy was not always quietly submitted to; nay, was sometimes resisted with success He regarded all parts of the world not inhabited by Christians as uninhabited, and gave full power to those Christians who might occupy them to make war on the inhabitants, and the countries, if conquered, were parcelled out according to his sovereign pleasure But while the absolutism claimed by the Roman pontiff was [illegible] to arouse jealousy and opposition, which, indeed, it did, in some degree, in different places and at various times, these feelings were greatly increased by several other causes such as the immoral lives of the clergy; the facilities by which their immoralities were pardoned, the exorbitant wealth of the church, the great personal immunities of ecclesiastics, and their encroachments on the jurisdiction of the laity These and similar circumstances, which the invention of the art of printing and the revival of learning had tended more thoroughly and widely to disclose, gradually prepared the public mind for that reformation of religion of which in this article we intend briefly to give an account

Without minutely mentioning the frequent, but comparatively feeble opposition to which the absolutism in [illegible] the church had, in various periods, given rise, it may suffice here to confine ourselves to an account of that course of opposition, in the 16th century, which terminated in the Reformation

According to the doctrine of the Romish church, all the good works of the saints over and above those necessary for their own justification, are deposited, together with the infinite merits of Jesus Christ, in one inexhaustible treasury The keys of this treasury were committed to St Peter, and his successors the popes, who may open it at pleasure, and by transferring a portion of this superabundant merit to any particular person for a sum of money, may convey to him either the pardon of his own sins or a release for any one in whose happiness he is interested from the pains of purgatory Hence the origin (which took place in the 14th century) of the sale of *indulgences* Pope Leo X under pretence of raising contributions towards [illegible] the church of St Peter at Rome, granted, in 1517, the right of promulgating those indulgences in Germany, together with a share in the profits arising from the sale of them, to the archbishop of Magdeburg, who as his chief agent for retailing them in Saxony, employed Tetzel, a Dominican friar, of dissolute morals, but of great activity and energy of character Tetzel, assisted by the monks of his order, executed the commission with great zeal, but with little discretion or decency, and, by disposing of them at a very low price, carried on for some time an extensive and lucrative traffic among the credulous and ignorant The princes and nobles were irritated at seeing their vassals drained of their wealth to replenish the treasury of a profuse pontiff Men of piety regretted equally the corruptions of the church and the delusions of the people Even the most unthinking were shocked at the scandalous behaviour of Tetzel and his associates But it was reserved to Martin Luther, formerly a monk of the [illegible] professor of Theology [illegible] to attack the errors, and the abuses of those [illegible] indulgences, and to shake the foundations of the papal see itself What were the motives which first induced this distinguished person to oppose this traffic cannot now be ascertained The traffic was not a novelty, as it had been practised throughout Christendom for several centuries Some writers have imagined, though with what justice is not evident, that his opposition was founded in jealousy because this gainful trade had not been conferred on the Augustinians, to whom he belonged, but on the Dominicans, a rival order But, whatever were his motives, his opposition at first was confined simply to the sale of indulgences His memorable theses, ninety-five in [illegible] against this practice were affixed to the doors of [illegible] Wittenberg 31st October 1517, while [illegible] inveighed bitterly against the irregularities [illegible] of the monks who published indulgences, as well as against the abuse itself The sentiments [illegible] his theses he proposed not as points [illegible] but merely as subjects of inquiry and [illegible] day on which the learned were invited to [illegible] either in person or by writing and to the whole he subjoined solemn protestations of his high respect for the apostolic see, and of his implicit obedience to its authority No opponent appeared at the time prefixed Meanwhile the theses [illegible] with astonishing rapidity, [illegible] with the greatest avidity, and [illegible] ss of the man who had ventured to attack the plenitude of papal power Meanwhile Tetzel, in opposition to Luther, published counter-theses at Frankfort on the Oder, Eckius, a celebrated divine of Augsburg endeavoured to refute Luther's notions, and Prierias a Dominican friar, master of the sacred palace and inquisitor-general, wrote against him with uncompromising virulence But this

opposition was of little or no avail Luther supported his views by arguments founded on reason or derived from scripture, and his cause was found daily to gain strength

[illegible] of [illegible]

the dispute that was thus raging in Germany, and at at first despised it as a mere monkish squabble But the tidings of Luther's rapid success, and the clamours of the ecclesiastics for aid and vengeance, at length roused him from his apathy, and induced him to take prompt steps to put a stop to the spread of heresy On the 21st Aug 1518, he summoned Luther to appear at Rome within sixty days, before the auditor of the chamber and the inquisitor-general Prierias, who had written against him, whom he empowered jointly to examine his doctrines and to decide concerning them This was evidently an unjust tribunal by which the decision was to be made, and through the influence of Frederick the elector of Saxony, who was favourable to the new doctrines, and of others, and by a submissive letter written to the pope by Luther himself, his holiness agreed to refer the hearing and determination of the cause to his legate in Germany, Cardinal Cajetan a Dominican, eminent for scholastic learning

The reformer accordingly appeared before Cajetan, who, after some discussion, commanded him to retract his opinions, but Luther, with that intrepidity of mind which was his grand characteristic, declared that he could not, with a safe conscience, renounce opinions which he believed to be true, nor should any consideration induce him to do what would be so base in itself, and so offensive to God The result was, that Luther, who with his friends, suspected that even the imperial safe-conduct would not be able to protect him from the legate's power and resentment, was induced to withdraw secretly from Augsburg and return to Wittenberg, previously to which, however, he prepared a solemn appeal from the pope ill informed at that time concerning his cause, to the pope when he should be better able to judge respecting it (*Seckendorf, Comment* lib i p 14, *Luther Opera*, i p 160) But so impatient were Luther's enemies at Rome that even before the sixty days had expired, he was there condemned as a heretic, and Leo in several of the briefs and letters, had stigmatized him as a child of iniquity, and as given up to a reprobate mind But Luther, convinced that his views were agreeable both to scripture and reason was not to be deterred from teaching and promulgating his opinions both from the pulpit and through the press, and as every step taken by the court of Rome against him convinced him that Leo would soon proceed to the most violent measures he had recourse to the only expedient in his power in order to prevent the effect of the papal censures He appealed to a general council, which he affirmed to be the representative of the Catholic church and superior in power to the pope, who, being a fallible man might err as St Peter, the most perfect of all his predecessors had erred As opposition against him increased and as the controversy advanced Luther's views began to expand, and in his disputation with Eckius he went so far as to question the supremacy of the pope over the church, as well as the doctrines of purgatory auricular confession, and absolution, and he about the same time published several treatises, in which he more openly expressed his dissent Luther may now be said to have embraced the fundamental tenet which now characterizes all sects of Protestants, and which was subversive of the slavish obedience in points of doctrine and discipline which had hitherto been paid to the holy see, namely that scripture is the only rule of faith and manners, and that this rule is to be interpreted by the exercise of private judgment A step was at this period (June 1520) taken by the court of Rome fatal to the object which it had in view The pope issued a bull condemning, as heretical and offensive to pious ears, forty-one propositions extracted out of Luther's works, all persons were forbidden to read his works on pain of excommunication, those who possessed copies of them were commanded to commit it to the flames and he himself if he did not within sixty days publicly recant his errors and burn his works, pronounced a heretic, excommunicated, and delivered unto Satan, and all secular princes required under pain of incurring the same censure, to seize his person, that he might be punished as his crimes deserved

This sentence, while it did not disconcert or intimidate [illegible] his [illegible] the new doctrines In some countries [illegible] obstructed the promulgation of the bull, in others, the persons who attempted to publish it were insulted, and the bull itself was torn in pieces and trodden under foot [illegible]



tone, and declared the pope to be that man of sin, or Antichrist, whose appearance is foretold in the New Testament He declaimed against his tyranny and usurpations, and exhorted all Christian princes to shake off such an ignominious yoke Nor did he stop here As Leo had, in execution of the bull, appointed Luther's works to be burnt at Rome the latter, by way of retaliation, assembled all the members of the university of Wittenberg, and with great pomp, in presence of a vast number of spectators, cast the volumes of the canon law, together with the bull of excommunication, into the flames; and his example was imitated in several cities of Germany This took place on the 10th of December, 1520, and on the 6th of the ensuing month the pope launched a second bull against him, by which Luther was finally expelled from the communion of the church Thus separated from all connection with the see of Rome, Luther applied himself more assiduously than ever to the study of the word of God as the only standard of theological truth, and while he was thus enabled to attack with the greater success most of the peculiar papal doctrines, both theological and ecclesiastical, he exposed at the same time, the immoral and secular lives of the clergy, and thus laid the foundation of that reformation of religion which at first he never contemplated but which has been characterized "as a revolution in the sentiments of mankind, the greatest as well as the most beneficial that has happened since the publication of Christianity" (*Robertson's Charles V*, 8vo ed vol ii p 12)

A spirit of inquiry having, by means of Luther's preaching and publications and the violent procedure of the court of Rome been excited in the public mind, the progress of the reformed doctrines was rapid and general and threatened to embrace the whole of Germany, notwithstanding the Emperor Charles V co operated with the pope to check and destroy them Luther, too, was protected, from various motives, not merely by the Elector of Saxony, but by many other princes, and the new views were adopted and sedulously propagated by Melanchthon Carlostadius, and other eminent men. Erasmus, too though he did not long follow in the same course as the German reformer, and ultimately wrote against some of his views, yet discovered and exposed, with great learning and ability many errors both in the doctrine and worship of the Romish church, and may be considered as his auxiliary in the work of reformation

Under such circumstances it was that the imperial diet at Worms was held, January, 1521, to which the different princes were invited, in order to concert the most proper measures for checking the progress of those new and [illegible] the peace [illegible] their ancestors An attempt to condemn him in his absence was frustrated by a majority of the members of the diet, and Luther, under a safe-conduct, was summoned to appear before them He did not hesitate to attend, but neither threats nor entreaties could induce him to retract any of his opinions, or to consent to their being tried by any other rule than the word of God He was allowed to leave the city in safety, but an edict was published in the emperor's name, after his departure, putting him under the ban of the empire The circumstances, however, in which Charles was placed, — the commotions in Spain and the wars in Italy and the Low countries, together with the prudent precaution of the Elector of Saxony in concealing Luther in the castle of Wartburg, all concurred in preventing the edict being carried into effect During his confinement his opinions continued to gain ground, and the [illegible] of Wittenberg ventured on an alteration [illegible] established forms of public worship, by abolishing the celebration of private masses and by giving the cup as well as the bread to the laity in administering the sacrament of the Lord's Supper In a short time, however, the new views were condemned by the university of Paris, and a refutation of them was attempted by Henry VIII of England But neither of these intimidated Luther He published animadversions on both with as much virulence as if he had been dealing with an ordinary adversary

Meanwhile an attack no less violent occasioned by a similar cause, was made on the Romish church in Switzerland The Franciscans being intrusted with the sale of [illegible] executed their commission with [illegible] and rapacious which had rendered the Dominicans so odious in Germany But they were met and opposed (1518) by Zuinglius, a man not inferior to Luther himself in zeal and intrepidity, and who advanced with perhaps more daring and rapid steps to overthrow the whole fabric of the established religion Notwithstanding that the universities of Cologne and Louvain pronounced his doctrines to be erroneous, the cantons of Zurich, Berne, Basil, and Schaffhausen embraced his opinions Several conferences were at different times held between the Roman Catholics and the "Evangelicals," as the followers of Zuinglius

were called, and all of them tended to the spread of the reformed faith After a conference held at Berne in 1528, the council of that canton considering the result to be in favour of the Evangelicals published ten theses, which embodied the substance of the Reformation in Switzerland, and most of the leading principles contained in them are acknowledged by the reformed churches generally, however widely they may differ [illegible] some abstruse points

[illegible] German reformers were at first unacquainted with the proceedings of each other, though both were animated by the same spirit, and, in different places, pursuing a similar object. But, while they both resisted and exposed the usurpations and errors of the Romish church, and generally agreed in their sentiments, they entertained very [illegible] and thus was sown the seed [illegible] have since agitated the reformed churches The chief subject of dispute between the two reformers was concerning the manner in which the body and blood of Christ were present in the Eucharist Luther and his followers, though they rejected the papal belief of transubstantiation, were nevertheless of opinion that the body and blood of Christ were really present in the Lord's Supper, in a way which they could not pretend to explain Zuinglius and his adherents repudiated the doctrine and taught that the bread and wine used at the Eucharist were no more than external symbols to excite the remembrance of Christ's sufferings in the minds of those who received it Both parties maintained their opinions with equal obstinacy, and as this dispute threatened to retard the great work of reformation, and to bring discredit on its adherents, the Landgrave of Hesse invited Luther [illegible] several of the most eminent of their [illegible] to a conference at Marburg, in order to promote unanimity and peace After a disputation of four days, however, neither of the contending parties could be persuaded to abandon their views But as both agreed in their sentiments not only as to the popish hierarchy but as to the fundamental principles of Christianity they parted in Christian charity though not in brotherhood, agreeing to refrain from open controversy

The struggle between the Roman Catholics and the reformers still raged in Germany At the diet of the empire held at Spires in 1526 the emperor's ambassadors used their utmost endeavours to suppress all disputes about religion and insisted on the vigorous execution of the sentence which had been pronounced against Luther and his followers at Worms This attempt was successfully resisted by the majority of the members, and it was at last unanimously agreed to present an address to the emperor entreating him to call a general council without delay and that the princes of the empire should in the meantime be allowed in their respective dominions to manage religious matters as they should think proper These resolutions proved favourable to the cause of the Reformation and gave an impetus to the expression of the public voice The war in which at this time the emperor was engaged with the pope gave a decided advantage to the friends of the reformed [illegible] increased their number At a diet, however held [illegible] place in 1529 the power which had been given to princes of managing ecclesiastical affairs until the meeting of a general council was revoked by a majority of votes, and every change declared unlawful that should be made in the established religion before the determination of the approaching council was known After many ineffectual remonstrances and arguments six princes of the empire and thirteen imperial cities "protested" [illegible] sion Hence arose the denomination o[illegible] Pr[illegible]," a term at first applicable only to the Lutherans, but now common to all who have separated from the church of Rome

As the reformed doctrines in Germany had not yet been reduced to a system, the Elector of Saxony ordered Luther and other divines to commit to writing the leading articles of the [illegible] along with the principal points on which [illegible] om the church of Rome In compliance with this order, Luther delivered to the elec[illegible] which had been agreed [illegible] hence called the Articles [illegible] of the sentiments of the reformers was enlarged and rendered more minute and perspicuous by Melanchthon who performed the task with equal ability and elegance

In 1530 Charles convoked a diet of the empire at Augsburg and directed the reformers to lay before it an account of their tenets in German and Latin The work prepared by Luther and Melanchthon was presented to the diet, hence called the Confession of Augsburg, or [illegible] which was read aloud by the chan-

[illegible]

of the errors and superstitions of the papal faith But after much disputation, not only was it rejected, but the diet published a decree condemning most of the peculiar tenets held by the Protestants and forbidding any person to protect or tolerate such as taught them, enjoining a strict observance of the established rites, with other articles equally galling and tyrannical But the Protestants were now too powerful a body, and their views had assumed so completely the form of a system that they were not easily dismayed On the contrary, they assembled at Smalcalde, where they concluded a treaty of mutual defence, both religious and political, against all aggressors, and formed the Protestant states of the empire into one regular [illegible] In the year 1530, was the Reformat[illegible] established in Germany, first, by the publication of the Confession of Augsburg, and, second, by the league of Smalcalde, which made that creed the bond of union of a powerful political confederacy

It may here be mentioned that the followers of Zuinglius, or Sacramentarians, as they were sometimes called, presented their confession of faith on the part of four cities, Strasburg, Memmingen, Lindau, and Constance, [illegible] by the Confession of Strasburg, or *Confe[illegible]* The reformed cantons of Switzerland were not allowed to join the league of Smalcalde, inasmuch as they refused to sign the Confession of Augsburg, and thus the Swiss Evangelicals or Sacramentarians continued distinct from the Lutherans (as they still do), though they joined in a separate league with the city of Strasburg and the Landgrave of Hesse, who adopted their views The Helvetic Confession of Faith, founded on the articles of Berne already referred to was finally published in 1532 The reformed doctrines had early spread to Geneva, and John Calvin, or Calvin of that city after the death of Zuinglius carried them farther than the Swiss Protestants had done He abolished all festivals except Sabbath discarded all church ceremonies, used leavened bread for the sacrament and taught the doctrines of predestination and election in all their rigour (See PRESBYTERY in this work) Calvinism thus became the third great branch of the Reformation, Luther and Zuinglius being respectively at the head of the other two The systems of Zuinglius and Calvin, however, gradually merged together and they may now be considered as one, having the same confession of faith

It would exceed the bounds to which we must necessarily confine ourselves in this article were we to trace the history of the Reformed faith after the treaty of Smalcalde that treaty among other results (such as confere[illegible] councils particularly the celebrated [illegible] in 1540) gave rise to a war between the emperor and the Protestants But the peace of Augsburg, in 1555, terminated those and similar calamities which had so long agitated the empire The following are the leading articles of that peace namely, that the Protestants who followed the Confession of Augsburg should in future be free from the jurisdiction of the pope and from the authority and superintendence of the bishops that all the inhabitants of the German empire should be at perfect liberty to judge for themselves in all matters, religious and ecclesiastical, that all persons whatever be their religious opinions should enjoy equal civil rights and privileges,—in other words, that a complete toleration in religious matters should obtain, and that all those who should persecute any person under [illegible] pretences should be declared and treated as [illegible] on the empire, invaders of its liberties and disturbers of its peace Thus was the Reformation finally established in many parts of Germany as it exists without any very marked change either as to its extent or its principles, at the present day The conditions on which this desirable object was obtained were honourable to both parties, both Catholic and Protestant and, generally speaking, to the German character This happy state of things was broken many many years after by the thirty years' war (1619—48), but the treaty of Westphalia, which terminated this war, confirmed the articles of the peace of Augsburg, and extended its benefits to the Calvinists as well as to the Lutherans Equal religious rights and privileges were extended to all, as is still happily the case

While these events were taking place in Germany and Switzerland, the spirit of inquiry, which had been evoked so signally in these countries, spread, and roused most of the nations of Europe to a greater or less extent from their mental inactivity or superstitious credulity the doctrines of the Reformation found their way partially into France, also into Spain and Italy Prior to Luther's death (1546) these doctrines had made many converts in the Netherlands, and in the time of Philip II the "Seven United Provinces" which separated from the rest, proclaimed liberty of conscience, and adopted the tenets of Calvinism, to which they have ever since adhered

About the year 1556, the Lutheran creed was adopted

as the state religion in Denmark and Norway This creed was propagated in Sweden soon after Luther's rupture with the church of Rome, by Olaus Petri one of his disciples Both Lutheranism and Calvinism early gained an extensive footing in Poland, which they still retain To Hungary and Transylvania a similar remark applies The history of the Reformation in the British empire is well known, and need not be detailed here Though the Protestant episcopal church is the established religion in Ireland, more than three fourths of the people of that country retain their hereditary attachment to the papal creed Altogether, not more than a

faith,—the two great exceptions being Turkey, where Mohammedanism is established, and the east of Europe where the Greek church is, is the predominant religion in almost all the British

Independently of the truth or falsehood of the doctrinal and other points on which the reformed church dissents from that of Rome, the Reformation was the cause of many interesting and important advantages It burst the fetters by which the human mind had previously been bound, and restored it to liberty It made religion an object of the understanding, and not of the eye, of the heart rather than of the memory "On the whole, the Reformation has been unquestionably good to Europe, it has purified religion and promoted the intellect, and by spreading the love of liberty" (*Dunham's Hist of the European Nations* 2) It has contributed to improve even the church of Rome itself both in science and in morals The desire of equalling the reformers in those talents which had procured them respect, the necessity of acquiring the knowledge requisite for defending their own tenets, or refuting the arguments of their opponents, together with the emulation natural between two rival churches engaged the Roman Catholic clergy to apply themselves to the study of useful science which they cultivated with such assiduity and success that they have gradually become as eminent in literature as they were, in some periods infamous The same principle occasioned a change no less considerable in the morals of the Romish clergy Many of them have in consequence been distinguished for all the accomplishments and virtues which can adorn their profession, and differ greatly from their predecessors before the Reformation both in their maxims and in their conduct" (*Ranke's Hist of Germany during the Ref, Hist of the Great Reformation in Germany and Switzerland* by D'Aubigné, F Paul, *Hist of the Council of Trent* &c)

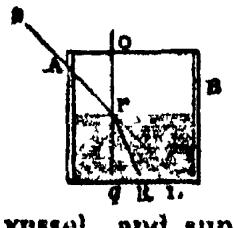
REFORMATION JUBILEE OF 1835 The two hundredth anniversary of the introduction of the Reformation at Geneva was solemnized under this title in August, 1835 The canton, since the Congress of Vienna having become "mixed" in religion the government took no part in this festival the expenses of which were defrayed by voluntary subscription Invitations were sent to the Protestant clergy of all countries, both Lutheran and Calvinist, to attend its solemnization 61 were present from France, 12 from [illegible] 3 from North America The account of this [illegible] was published under the title of *Jubilé de la Reformation de Genève*, Geneva 1835

REFORMED CHURCH, comprises in a general sense all those bodies of Christians that have separated from the church of Rome since the era of the Reformation but it is applied in a restricted sense to those Protestant churches which did not embrace the doctrines and discipline of Luther, and more particularly to the Calvinistic churches on the Continent

REFRACTION (Lat refractus *broken*) In Mechanics, the change of direction which takes place in the motion of a body when it passes obliquely out of one medium into another of different density The term is chiefly applied to the deviation from their rectilinear course of the rays of light in passing through transparent substances

REFRACTION OF LIGHT The deviation of a ray of light from its original path in entering a medium of a different density This change of direction, which takes place at the surface of separation of two media, is the ultimate fact from which many of the most interesting phenomena of light receive their explanation The laws by which it is regulated, and the investigation of the consequences of those laws form the branch of natural philosophy usually termed *Dioptrics*

(1) The phenomenon may be observed




[illegible] of light [illegible] point S [illegible] a small [illegible] vessel A B, then, the vessel being empty, the light will fall on the bottom at a point L in the same straight line with S and A Now let water be poured into the vessel, and suppose the beam of light to fall on the surface of the water at P, then it will be seen that the light no longer continues its course in the same straight line but is bent or *refracted* at P and proceeds through the water in a straight line P R, more nearly perpendicular to the surface A similar deviation takes place in all cases in which light passes from one transparent medium into another, but [illegible] the angle R P L, or the amount of the [illegible] varies according to the nature of the two [illegible], and the degree of obliquity with which the incident ray falls on the surface of separation

Through P draw Q P *q* a normal to the surface, then S P Q is *the angle of incidence*, R P *q* is *the angle of refraction*, and the following laws are found to be observed in all cases —

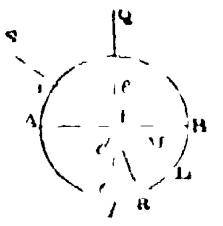
1 The refracted ray P R is in the same plane with S P and P Q, that is, with the incident ray and the perpendicular to the surface at the point of incidence

2 The incident ray S P and the refracted ray P R are always on opposite sides of the perpendicular Q P *q*

3 Whatever be the inclination of the incident ray to the surface, the sine of the angle of incidence has to the sine of the angle of refraction a constant ratio

These three laws, which hold good for curve surfaces as well as for planes, enable us to determine the path of the refracted ray with mathematical precision when the form of the surface and the nature of the refracting medium are both known The two first are easily verified, and have been known from the days of Ptolemy The third, which is very remarkable, was first enunciated in the *Dioptrics* of Descartes, published in 1637, but the discovery belongs to Willebrod Snell, professor of mathematics at Leyden, who died at an early age in 1626 Snell, indeed, made no mention of the sines of the two angles, but the relation which he affirmed to subsist is identical with the law as stated by Descartes Through P (fig 2),

(2)




the point of incidence, as a centre, let a circle be described meeting the incident ray in I and the refracted in R, and through R draw R M perpendicular to the surface A B, meeting P L in M, draw also R *c*, M *d*, T *e*, respectively perpendicular to Q *q* Now the proposition affirmed by Snell was, that for every inclination of S P to the surface the line P R is to P M in a constant ratio But P R = P I, and P I P M T *e* M *d* or as I *c* R *c*, therefore T *e* is to R *c* in a constant ratio and these are obviously the sines of incidence and refraction respectively to the same radius D [illegible] the law of the sines, made no mention [illegible] to be inferred that he himself was the discoverer of the property in question, which, in fact, is usually ascribed to him by the French authors It is, however by no means certain (though asserted by various writers) that Descartes was acquainted with what had been done by Snell, as the work of the latter existed only in manuscript when the *Dioptrics* made its appearance

Let *i* denote the angle of incidence, *r* the angle of refraction and let *n* be the constant ratio of the sines in passing from a given medium A into another given medium B, we have then, by the third law above stated, sin *i* = *n* sin *r* for every value of *i* The quantity *n*, which is constant for the same two media, is greater than unity when the refracting power of the first medium A is less than that of the second B and *vice versâ* Its value must be determined in every case by experiment, and as it is relative to both media, it is convenient for the purpose of comparing the refractive powers of different substances to refer them all to some common medium A, usually assumed to be an absolute void, and in this case the quantity *n* is called the principal index of refraction of the medium B or simply *the index of refraction*. We have therefore this definition —

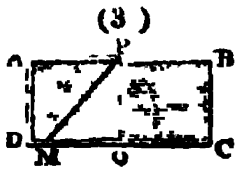
*The index of refraction* of any transparent substance is the ratio of the sine of incidence to the sine of refraction, when light passes from a vacuum into the substance

As there is no known substance of such a nature that light entering [illegible] the angle of [illegible], the index of refraction is always greater than unity Of all known substances, that which possesses the greatest refractive power is chromate of lead, for which the index of refraction is 3, hence in the equation sin *i* = *n* sin *r*, all the values of *n* which have yet been experimentally determined lie between 1 and 3

From the formula sin *i* = *n* sin *r* some remarkable consequences are readily deduced Suppose *i* to have its greatest value, namely 90°, in which case the incident ray becomes parallel to the surface of the medium We have then sin *i* = 1, and the formula becomes 1 = *n* sin *r*, whence sin *r* = 1 — *n*, which is the limiting value of *r*. In the case of water the index of refraction *n* = 1 336 (or nearly $\frac{4}{3}$), and the arc whose sine is the reciprocal of this quantity is 48° 27′ 40″, consequently light cannot enter water more obliquely than under an angle of 48° 28′

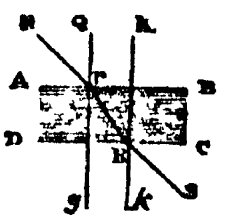
Thus, suppose a vessel A B C D (fig 3) to be filled with water, and a part of the surface A P to be covered over; then on drawing a line P M making with the perpendicular P Q an angle M P Q = 48° 28′, the part A P M D will remain in perfect darkness however the uncovered part of the surface P B may be illuminated

(3)



It is a principle in optics, that if a ray of light passes from a point A to a point B after any number of refractions or reflexions, a ray will pass from B to A by following the same course in an opposite direction From this it follows that if a ray of light S P (fig 4) falling on the exterior surface A B of a medium is refractured into the direction P R, then on arriving at the interior surface C D it will suffer another refraction and escape from the medium in the direction R s making with K k (the perpendicular to C D at R) the angle s R k equal to the angle S P Q With respect to the surface C D, P R K becomes the angle of incidence, and k R s the angle of refraction, and if we suppose the ray to pass from the medium into a vacuum, and $n$ to be the index of refraction of the medium, we have $\sin i = \frac{1}{n} \sin r$

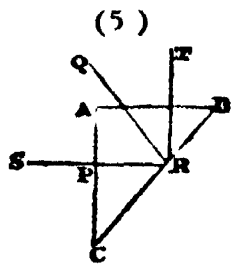
(4)



Now since $n$ is greater than unity, $r$ is greater than $i$, and if we suppose those angles to increase until $r$, or the angle $k$ R $s$, becomes a right [illegible] Then $\sin r = 1$, and we have $\sin i = 1 - n$ for [illegible] value of $i$, beyond which the ray will not leave the surface at R, for if $\sin i$ be greater than $1 - n$, it follows that $\sin r$ must be greater than unity, which is impossible Hence it follows that if the ray P R fall upon the interior surface making with the normal K R an angle greater than $1 - n$ it will not leave the medium, but be reflected internally from R

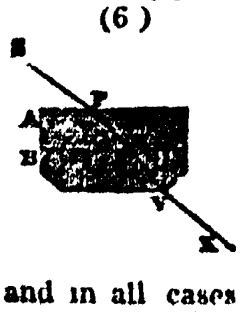
This property admits of various practical applications For ordinary glass the value of $n$ is about $\frac{3}{2}$ so that in passing from glass to air we have $\sin i = \frac{3}{2} \sin r$ Now let $i$ increase until $r = 90°$, then $\sin i = \frac{2}{3}$, whence $i = 41° 49′$, which therefore is the limiting value of the angle of incidence when light passes from glass into air Let A B C (fig 5) be a triangular glass prism having the angle at A a right angle, and the sides A B and A C equal, so that B and C are each angles of 45°, and conceive a ray of light S P to fall perpendicularly on the surface A C at P This will continue its course through the glass in a straight line until it meets the side B C in R making with R Q (the normal to B C) the angle of incidence S R Q = 45° But this angle being greater than 41° 49′, the ray will not leave the medium but be reflected at the interior surface in the direction R T which [illegible] are equal, will be perpendicular to S P, and the ray will fall perpendicularly upon the surface A B and pass through it without refraction The prism thus produces the same effect as a diagonal mirror placed in the plane B C

(5)



When the index of refraction for each of two media has been determined, the refraction which takes place in passing from the one medium to the other is also known, the constant ratio of the sines of incidence and refraction being, in this case, the ratio of the [illegible] of the two media Let $m$ be the index of refraction for the medium A, and $n$ the index for the medium B, then, in passing from A into B, we have $\sin i = \frac{n}{m} \sin r$ Thus, the index of refraction for water is 1 336, and for amber 1 547, therefore in passing out of water into amber the constant ratio of the sines of incidence and refraction will be 1 158, the quotient which arises from the division of 1 547 by 1 336 An immediate consequence of this is, that when a ray of light enters a medium after having passed successively through several others, the path of the ray in the last medium will be the same as if it had entered that medium directly under the same angle of incidence as that by which it entered the first and if the media are bounded by parallel surfaces the direction of the ray after escaping from the last surface will be parallel to its primitive direction Thus, let the ray S P (fig 6), entering the medium A at P, be refracted into the direction P R, and on entering the second medium B be again refracted into the direction R V, the path of the ray V X after leaving the second medium will be parallel to S P, provided the surfaces at P and V are parallel, and in all cases the ray will emerge at V under the same angle of obliquity as it entered the first surface at P

(6)



The principles which have now been laid down are sufficient to enable us to compute the path of a ray of light through any diaphanous substance, or through different substances in succession, when the index of refraction belonging to each substance is known The [illegible] (from *Brewster's Optics*, *Cab Cyclopedia*, [illegible] the indices of refraction for the greater part of the substances which have yet been examined

TABLE of the Refractive Powers of Solid and Fluid Bodies.

| | Index of Refraction. | | Index of Refraction. |
|---|---|---|---|
| Ruby [illegible] | 2 549 | Plate glass, from | |
| [illegible] | 2 500 | 1 514 to | 1 542 |
| Diamond | 2 439 | Crown glass, from | |
| Nitrite of lead | 2 322 | 1 525 to | 1 534 |
| Blende | 2 260 | Oil of cloves | 1 535 |
| Phosphorus | 2 224 | Balsam of capivi | 1 528 |
| Sulphur melted | 2 148 | Gum arabic | 1 502 |
| Zircon | 1 961 | Oil of beech nut | 1 500 |
| Glass — lead 2 parts, flint 1 part | 1 830 | Castor oil | 1 490 |
| | | Caoutchouc | 1 483 |
| Garnet | 1 815 | Oil of turpentine | 1 475 |
| Ruby | 1 779 | Oil of olives | 1 470 |
| Glass — lead 3 parts, flint 1 part | 2 028 | Alum | 1 457 |
| | | Fluor spar | 1 434 |
| Sapphire | 1 794 | Sulphuric acid | 1 434 |
| Spinelle | 1 764 | Nitric acid | 1 410 |
| Cinnamon stone | 1 709 | Muriatic acid | 1 410 |
| Sulphuret of arsenic | 1 768 | Alcohol | 1 372 |
| Oil of [illegible] | 1 641 | Cryolite | 1 349 |
| Balsam of Tolu | 1 628 | Water | 1 336 |
| Guiacum | 1 619 | Ice | 1 309 |
| Oil of aniseed | 1 601 | Fluids in minerals, | |
| Quartz | 1 548 | 1 294 to | 1 131 |
| Rock salt | 1 557 | Talc sheet | 1 111 |
| Sugar melted | 1 554 | Ether expanded to | |
| Canada balsam | 1 [illegible] 49 | thrice its volume | 1 057 |
| Amber | 1 547 | Air | 1 000294 |

TABLE of the Refractive Powers of Gases

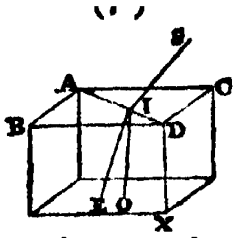
| | Index of Refraction | | Index of Refraction |
|---|---|---|---|
| Vapour of sulphuret of carbon | | Carbonic acid | 1 000449 |
| | | [illegible] hydro | |
| Phosgene | | [illegible] | 1 000443 |
| Cyanogen | 1 000834 | Ammonia | 1 000385 |
| Chlorine | 1 000772 | Carbonic oxide | 1 000340 |
| Olefiant gas | 1 000678 | Nitrous gas | 1 000305 |
| Sulphurous acid | 1 000660 | Azote | 1 000300 |
| Sulphuretted hydrogen | 1 000644 | Atmospheric air | 1 000294 |
| Nitrous oxide | 1 000505 | Oxygen | 1 000272 |
| Hydrocyanic acid | 1 000491 | Hydrogen | 1 000138 |
| Muriatic acid | 1 000449 | Vacuum | 1 000000 |

In the preceding remarks light has been regarded as a homogeneous substance, all the parts of which have the same index of refraction This however, is not the case, refraction never takes place without a separation of the differently coloured rays so that for every transparent body the index of refraction changes with the colour of the light The numerical values of the indices, given in the above table, correspond to the yellow or green rays which occupy the middle of the dispersed pencil For the different refrangibilities of the primary rays, see CHROMATICS DISPERSION SPECTRUM

*Double Refraction* — The phenomena and laws of refraction which have yet been considered, belong to those cases in which a single refraction takes place on the entrance of light into a different medium, or in which a pencil of light on entering a refracting medium continues to form a single pencil and to afford a single image of the object from which it proceeds There are, however, a multitude of substances which, either in their natural state or under accidental circumstances, exercise a peculiar influence on light causing it, in its passage through them, to follow two distinct paths, forming with each other an angle of greater or less amount Such substances are called [illegible] *ces*, and the phenomenon itself [illegible]

The substances or media which produce only single refraction belong to one or other of the four following classes — 1 Gases and vapours 2 Fluids 3 Substances which have passed from the liquid to the solid state so rapidly as to prevent the molecules from taking a regular crystalline arrangement for example, glass glue, &c, gums, resins &c 4 Crystals whose primitive form is the cube, regular octahedron, or rhomboidal dodecahedron all of which belong to the tessular system of Mohs All the substances in the salts precious stones crystals not belonging to the above-named forms, all bodies belonging both to the animal and vegetable kingdoms, in which [illegible] the [illegible] and [illegible], &c, in general all bodies unequally compressed, or which have not the same structure in all directions, separate the light which they refract into two distinct pencils, which

pursue separate courses, and are governed by totally different laws




Iceland spar (carbonate of lime), having its faces made smooth either by cleav [illegible] be laid [illegible] white paper over a black spot O, then, on looking through the crystal, two spots will be seen, one at O, and the other at F On turning the crystal round on its axis, but always keeping the same face on the [illegible] O, will remain invariable, while the other, F, will appear to describe a circle about O If instead of a round spot the object viewed be a straight line, then, on looking through the crystal, a double image of the line will be seen, one passing through O, and the other through F On turning the crystal as before, it will be seen that the distance between the two lines varies, but that they always remain parallel to each other, and that in the course of a complete revolution of the crystal about its axis there are two positions in which the images will coincide, and two other positions midway between the former in which they will attain a maximum distance These phenomena show that a ray of light S I, on entering the face of the crystal at I, is separated by refraction into two pencils, I O and I F, and it is found that on emerging from the crystals the two pencils make the same angle with the surface, and continue their course in a direction parallel to each other and to the incident ray S I

If we cause a beam of solar light to fall on the crystal, and examine the paths of the two pencils, it will be found that I O follows the laws of ordinary refraction, the sine of incidence [illegible] fraction in a constant ratio, and the [illegible] the same plane with the incident ray and the normal to the surface at the point of incidence hence I O is called the *ordinary* pencil But I E is found to follow an entirely different law, and is therefore called the *extraordinary* pencil If, for example the incident ray S I is perpendicular to the face of the crystal, the ordinary refraction does not take place, the angle of incidence being zero, but in this case the angle of refraction of the [illegible] I E, is 6° 12′, and it is not in the same plane with the normal and the incident ray

From a careful examination of the phenomena it is also found that although a ray of light falling on the face of the crystal is refracted [illegible] there is one particular direction [illegible] which the incident ray undergoes only the ordinary refraction This direction is parallel to A X, the shorter axis of the crystal, and is called the *axis of double refraction* It is therefore, to be observed that the axis of double refraction of a crystal is not a fixed line, but a determinate direction with reference to the faces of the crystal, every line parallel to A X [illegible] axis of double refraction In some crystals the extraordinary ray is refracted *towards* the axis A X, in others it is refracted *from* it In the first case the axis is called a *positive* axis of refraction, in the second it is called a *negative* axis

In the crystal we have now been considering (Iceland spar), there is only one direction in which the double refraction does not take place but in many other crystals there are two directions which have this property In examining the phenomena of double refraction in a great number of crystallized substances, Sir David Brewster found that all those crystals whose primitive and simplest form has only one axis of figure, or one pre eminent line about which the figure is symmetrical have only one axis of double refraction The primitive forms which have only one symmetrical axis of figure are the following —

1 The rhomb with an obtuse summit, as Iceland spar, tournaline, quartz, &c
2 The rhomb with an acute summit, of which form are corundum, sapphire, ruby, cinnabar, and arseniate of copper
3. The regular hexaedral prism, as emerald, beryl, arseniate of lead, &c
4 Octohedron with square base, as zircon, oxide of tin, prussiate of potash, &c
5 Right prism with square base, as arseniate of potash, phosphate of magnesia, &c

In all [illegible] and in the primitive forms to which they del[illegible] A X is the axis of figure and of double refraction, and it is the only direction in which there is no double refraction (See *Brewster's Optics*, p 149)

The property of [illegible] double refraction was discovered [illegible] in 1815, and he found that it belonged to all crystals, whether chemical bodies or mineral substances, which are included in the prismatic system of Mohs, or whose primitive forms are,

1 A right prism, base a rectangle
2 A right prism, base a rhomb.
3 A right prism, base an oblique parallelogram.
4 Oblique prism, base a rectangle
5 Oblique prism,
6 Oblique prism, [illegible]
7 Octohedron, base a rectangle
8 Octohedron, base a rhomb

In all these forms there is no axis about which the crystal is symmetrical

In all cases of crystals with two axes of double refraction, both the pencils are refracted according to the laws of extraordinary refraction In a substance called analcime Sir D Brewster found there were several planes along which if the incident ray passes it will not suffer double refraction, whatever be the angle of incidence Each of these planes, therefore, may be considered as containing an infinite number of axes of double refraction, or lines in which there is no double refraction. No other substance has yet been found possessing the same property (*Optics*, p 155)

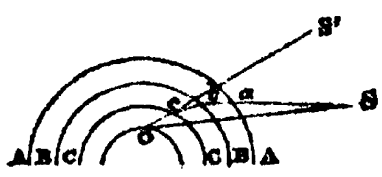
Another very remarkable property is, that in crystals which have only one axis of double refraction the axis has always the same position, being, in fact, in all cases, the axis of symmetry, but in crystals which have two axes of double refraction, [illegible] according to the colour of [illegible] Herschel, to whom this d[illegible] crystals of Rochelle salts the inclination of the two axes for violet light is 56°, while for red light it is about 76° In other crystals, as nitre, the inclination of the two axes is [illegible] violet than for the red rays, but in all ca[illegible]ich joins the extremities of the axes for all the rays is a straight line

The property of double refraction was discovered by Bartholin, in 1669, and was first explained by Huygens on th[illegible] of the propagation of light by means of an[illegible] In The phenomena have been studied with great assiduity in modern times, and, in fact, the investigation of their laws forms one of the principal parts of physical optics, and has mainly contributed towards the establishment of the now generally received theory of undulation Newton does not appear to have paid much attention to the subject, and his theory of emission does not very readily accommodate itself to the explanation of the phenomena, though it must be owned that the supporters of that theory have succeeded, by means of certain arbitrary hypotheses in constructing mathematical formulæ which represent the greater part of the known facts For the complete explanation of all the phenomena, the undulatory theory requires two postulates, or assumptions —1 That the vibrations of the ether take place *transversely* or in the direction perpendicular to the visual ray, and 2 That the elasticity of the medium is unequally developed in the interior of the refracting crystal The first of these assumptions is analogous to what takes place when a blow is given to a cord tightly stretched, the motion is communicated rapidly in the direction of its length while the vibrations are at right angles to that direction With respect to the second assumption, the facts which are known respecting the constitution of crystals render it exceedingly probable, *d priori* All diaphanous bodies which refract light only in a single direction, and according to the Cartesian law, are found to have the same tenacity and the same elasticity in all directions, and their linear dilatations by heat are also the same, but it has been established that with respect to all crystallized substances, which possess the property of double refraction, the elastic force with which they resist compression is greater in certain directions than in others, and also that the linear dilatation corresponding to the same increase of temperature varies with the direction in which it is measured These facts prove that the matter of the crystal possesses an elasticity [illegible] direction, and it is natural to suppose that the other [illegible] must have the same property On these two assumptions [illegible] and unequally developed [illegible], Fresnel has constructed a mathematical theory of double refraction from which all the phenomena which have yet been observed are deduced as simple corollaries (See *Sir J Herschel's Treatise on Light*, *Ency Metropol*, *Airy's Mathematical Tracts*, 2d ed, Poullet, *Elémens de Physique*)

REFRACTION, ASTRONOMICAL Refraction, in Astronomy, [illegible] correction of the celestial [illegible] caused by the refraction of the rays of light in their passage through the earth's atmosphere

It is found by [illegible] that the refractive power of a gas, or aeriform [illegible] is proportional to its density Now the earth's atmosphere is not a medium of uniform density, but of a density continually diminishing as the distance from the earth is increased For the purpose of illustration, the atmosphere may be regarded as composed of a great but finite number of concentric strata, each having a uniform density gr[illegible] of the stratum by which it is enveloped, but less than

that of the stratum which it envelopes Hence on entering each successive stratum the light must undergo a slight deviation from its rectilinear course, and the amount of all these deviations constitutes the phe-




C C, represent the bound-

proceeding from the star S to enter the highest stratum A A obliquely at *a* If no deviation took place, the ray would continue to advance in the same straight line S *a*, but in consequence of entering a denser medium it is refracted, according to the law of Descartes, into a direction, *a b*, more nearly per- the spherical stratum At *b* a greater density, and is refracted into the direction *b c*, still approaching the perpendicular to the surface On arriving at *c* the phenomenon is repeated, and the ray is bent from the direction *b c* to O the ray S O at O the star will appear in the direction S O. Hence the star will appear to have suffered an elevation S' O S, which is the difference between its true and apparent elevations is the *astronomical refraction* become infinitely successive stratum will become infinitely small, and the path of the ray instead of being a polygon will be a curve which, according to the laws of refraction in the same vertical plane

Since the ratio of the sines of incidence and refraction is constant it is evident that the total effect will be the greatest when the luminous rays enter the atmospheric strata with the greatest obliquity, that is to say when the object is seen in the horizon At the zenith there is no refraction, in descending from the zenith to the horizon it continually increases, according to a certain law which may be determined theoretically if the refractive power of atmospheric air at a given density and temperature the dilatation of air by heat and also the law of the variation of the density and temperature in ascending into the higher regions of the atmosphere are supposed to be known At a medium density and at the temperature of melting ice, Biot and Arago found by experiment that for any altitude exceeding 10° above the horizon the law of atmospheric refraction is represented by the formula $r = 60'' 6 \tan (Z - 3 25 \times r)$ in which $r$ is the refraction corresponding to a given zenith distance $Z$ Bradley had given the formula $r = 57'' \tan (Z - 3 25 r)$ From either of these it appears that the increase of refraction is nearly proportional to the tangent altitudes the expression

The following table given by Mr Ivory (*Phil Transactions* for 1838, part 2) shows the amount of refraction at different zenith distances the temperature being 50° of Fahrenheit and the height of the barometer 30 inches The correction (omitting some small terms) for the actual temperature and barometric pressure is obtained by multiplying the tabular refraction by $\frac{1}{1 + c\,(t - 50)} \cdot \frac{b}{30}$, where $b$ is the observed height of the barometer reduced to the fixed temperature of 50° Fahr $t$ the temperature of the air on the same scale, and $c = 002183$

| Zenith Distance | Refraction | Zenith Distance | Refraction |
|---|---|---|---|
| 10° | 10 30″ | 82° | 394 8″ |
| 20 | 21 26 | 83 | 441 42 |
| 30 | 33 72 | 84 | 50 86 |
| 40 | 48 99 | 85 | 593 96 |
| 45 | 58 36 | 85½ | 646 21 |
| 50 | 69 52 | 86 | 707 43 |
| 55 | 83 25 | 86½ | 779 92 |
| 60 | 100 85 | 87 | 866 76 |
| 65 | 124 65 | 87½ | 971 03 |
| 70 | 159 16 | 88 | 1101 35 |
| 75 | 211 70 | 88½ | 1262 6 |
| 80 | 320 19 | 89 | 1466 8 |
| 81 | 363 79 | 89½ | 1729 5 |

The existence of astronomical refraction was known at an early period, though its amount and laws have only been ascertained in recent times Ptolemy, in his book on *Optics*, remarks that in consequence of refraction a star is brought nearer the zenith, and that the effect is greater in the case of a low than a high star, but as no mention is made of the subject in the *Almagest*, it was not then regarded as an element of astronomical calculation Similar notions appear in the *Optics* of Alhazen Walther was the first who began to estimate the effects of refraction near the horizon, and Tycho Brahe constructed, from observations, the first table He supposed the horizontal refraction to be 34′, which is very near the truth (its mean amount being 33′), but he supposed it vanish at the altitude of 45°, though its mean amount that altitude appears, by the preceding table, to be near 1 minute Dominic Cassini gave an empirical formula f computing the refraction at any altitude but the solution of the problem on true principles was first undertaken and successfully accomplished by Newton though h results did not represent the observations, in consequence of the imperfect knowledge which then existed respecting the physical constitution of the atmosphere

REFRACTION TERRESTRIAL The atmospherical refraction, which has just been explained, is the effect produced by the whole atmosphere on a body placed entirely beyond it, but as the density of the atmosphere varies with the height, it is evident that the apparent place of any object placed on a different level from that of the observer must be affected in a greater or less degree by refraction Whether the rays of light come from a more elevated object, and consequently pass from a rarer into a denser medium, or from an object depressed below the horizon of the observer, and consequently pass from a denser into a rarer medium, they are equally bent downwards, and consequently the apparent place of the object is raised This refraction between terrestrial objects is called *terrestrial refraction*, and the density of the air near the surface of the earth liable to great irregularities from being irregularly heated its effects give rise to many very remarkable phenomena Among these are *looming* or *mirage*, the *fata morgana* (see the terms), and horizon of distant ob the atmosphere are invisible Sometimes in consequence of the rarefaction of the air in the neighbourhood of surface of water or of a building or of the earth itself distant object appears to be depressed instead of being elevated, and occasionally it is at once both depressed and elevated so as to appear double in which case one of the images is generally seen in an inverted position, as a reflexion had taken place In very exact observations in geodetical surveys it is found that the refraction is not always confined to the same vertical plane but sometimes produces a deviation amounting to a few seconds laterally

REFRACTIVE POWER in Optics is the degree of influence which a diaphanous body exercises on the light which passes through it For the measure of this influence modern writers generally adopt the square of the index of refraction diminished by unity or $n^2 - 1$, where $n$ denotes the principal index of refraction (See REFRACTION) The reason of this is founded on certain dynamical considerations regarding the physical cause of refraction According to the Newtonian theory of emission the velocity of light is accelerated on entering a denser medium by reason of the increased molecular attraction, and the law of refraction is explained by supposing the index of refraction of any substance to be the ratio of the velocity of light in that substance to its velocity in a vacuum Thus let $u$ denote the velocity of light in a vacuum and $v$ its velocity while passing through a diaphanous substance, then $v - u = n$, or since $\sin - \sin r = n$, the sine of incidence is to the sine of refraction inversely as the velocity in a vacuum to the velocity in the medium Now the increment of the *vis viva* or the excess of the square of the new velocity above that of the former, is $v^2 - u^2$, and the ratio of this to the square of the former is $(v^2 - u^2) \div u^2$, which is the same as the ratio of $n - 1$ to unity

According to the undulatory theory, the velocity of light is diminished on entering a denser body In this case, $u^2 - v^2$ is the loss of *vis viva*, and the ratio $(u^2 - v^2) \div v^2$ or $n^2 - 1$ to 1 is the ratio of *vis viva* which is lost to that which is retained In either case, the ratio $n - 1$ to 1 forms the measure of the *refractive power* of the substance of which $n$ is the index of refraction

Some modern authors employ the phrase *absolute refractive power* to denote the ratio of the refractive power of a substance (as above defined) to its density, that is to say, the ratio $(n^2 - 1) \div D$ where D stands for the density of the body Sir Isaac Newton (*Optics*, p 247) calls this the 'refractive power of a body in respect of its density,' and as it is a consequence of the theory of emission that the refractive power must be proportional to the density the ratio $(n^2 - 1) \div D$, according to the theory, is constant for the same medium, that is to say its numerical value depends only on the nature of the medium, and is independent of its condition, so that liquid and its vapour ought to have the same absolute refractive power, which is contradicted by the experiments of Arago and Petit

The French authors use the term *puissance réfractive* to denote the refractive power, or the number $n^2 -$ while they express the *absolute refractive power*, or the ratio $(n^2 - 1) \div D$, by the term *pouvoir réfringent* It is convenient to have different terms to express two things which are totally different, at least in their numerical measures Thus hydrogen gas has a smaller index of refraction, and consequently a smaller refractive power

than any other substance, but its *absolute refractive power*, or *pouvoir refringent*, is greater than that of any other substance (For a table of the values of the ratio $(n^2 - 1)$ D for a considerable number of different substances see *Brewster's edition of Cab Cyclopædia*)

REFRAIN [illegible] a song, &c *See* BURDEN

REFRANGIBILITY in Optics, is the disposition of the rays of light to be refracted or bent in passing obliquely from one transparent medium into another, but the term is chiefly used to denote the degree of that disposition possessed by the differently coloured rays *See* REFRACTION SPECTRUM

REFUGE, CITIES OF Six cities appointed, according to the words of Moses, under the Jewish dispensation (Deuteron xix 2 9), for the safety of those who had caused the accidental death of any one If a deliberate murderer fled to one of these cities, the elders of the city were to deliver him "into the hands of the avenger of blood." The cities are enumerated in Joshua, chap xx

REFUGÉE A name which has been given in history and political phraseology indiscriminately to persons who flee from religious or political persecution in their own country, and take refuge in another It was originally applied to the French Protestants (refugies) who found an asylum in this country, and among various Continental nations, after the revocation of the Edict of Nantes by Louis XIV

REGALIA (Lat rex, *a king*) In Politics, the privileges, prerogative, and right of property, belonging in virtue of office, to the sovereign of a state The latter class of objects are most commonly termed *regalia minora*, as, in some countries, wrecks strays and newly-formed land &c, in England, forfeitures &c while the former are known by the epithet *majora Regalia* in English Heraldry, the royal insignia crowns sceptres, globes, crosses, &c used at the coronation also the crown jewels *Regalia* of the church, the privileges which have been conceded to it by kings, sometimes the patrimony of a church

REGARDANT (Fr) In Heraldry literally looking behind, applied to any animal whose face is turned towards the tail in an attitude of vigilance

REGATTA (Ital) A word used originally by the Venetians to signify a grand fete in which the gondoliers contested for superiority in rowing their gondolas, but the term has been adopted into all the languages of modern Europe, in which it signifies a brilliant species of boat race In England festivities of this species are almost of weekly occurrence during the summer season

REGEL or RIGEL A star of the first magnitude, [illegible] left heel of the constellation Orion

REGENERATION In Theology the new birth of man unto [illegible] the abolition of the original [illegible] similar language was used respecting the admission of proselytes to the privilege of Judaism so, also, in other religions The Sanskrit name for a Brahmin is said to signify 'twice born,' and Tertullian says that the heathens used baptism in their mysteries, 'in regenerationem.' When our Saviour admonished Nicodemus not to marvel at his words Ye must be born again, he added, with reference, doubtless to the doctrines already taught among the Jews, Art thou a master of Israel, and knowest not these things? (John, iii 10) That baptism is a sign [illegible] as expressed in the 27th Article of the [illegible] is admitted by nearly all Christians (Rom vi 4 11, Tit iii 5, John iii 5) But whether the new birth to which allusion is made in these solemn passages actually takes place by and through baptism whether baptism, duly administered by those authorized is in itself an "opus operatum," in the language of the schools, or whether the regeneration spoken of is the condition of our salvation takes place after, and independent of baptism, by the operation of the Spirit on the inner man—this is a question on which Protestants have never agreed among themselves, and which divides our church at this day The former is the commonly received or Catholic doctrine, and has been so from very early times, as far as we can conclude from the language of the fathers and ancient forms of the church But it does not appear to be positively declared by the Church of England, though inferred from various passages in the baptismal service

REGENT (Lat rego, *I govern*) The person who exercises the powers of a sovereign during the absence, incapacity, or minority of the latter In most hereditary governments the maxim is, that this office belongs to the nearest relative of the sovereign capable of undertaking it, but this rule is subject to many limitations The kings of France exercised at various periods the power of fixing, by ordinance or will, the regency, in case of their decease leaving issue under age, and also the period of their son's majority Nevertheless, these wills have been at various times disregarded in favour of what was esteemed the principle of the monarchy Thus, the testament of Louis XIII, by which he declared his wife future regent, but limited her power in the essential prerogative of the choice of a council, was set aside as to this particular and she was appointed regent with full prerogatives The testament of Louis XIV, as to a regency during the minority of Louis XV, was set aside by the parliament of Paris immediately after his death In England, the right to appoint the regent is now fully recognized to belong to parliament although in 1788, on the occasion of the illness of George III much discussion took place as to the absolute right which some supposed to inhere in the heir apparent The regency, in the event of the demise of the present sovereign leaving issue, is vested by act of parliament in her Majesty's consort

REGENT MASTERS, or REGENTS In the English Universities, a term borrowed from the ancient usages of the University of Paris In that institution graduates in the faculties within a certain period after their degree, had the privilege, which they were bound to exercise of giving public lectures (docendi, legendi, regendi scholas) The same custom was adopted at Oxford and Cambridge, although the regent masters were at an early period succeeded in the performance of this office by the established professors The regents still form the governing body of the universities, in the convocation and [illegible] of [illegible]

REGICIDE (Lat rex, *king*, and cædo, *I kill*) The offence of slaying a king or other sovereign The early Greek republics, unaccustomed to the legitimate rule of monarchs, saw, in the occasional subjugation which they underwent from successful partisans, a mere usurpation, or tyranny, and tyrannicide was with them only the slaying of a public enemy And the hatred which attached itself in the minds of the Roman people to the royal name and authority made them regard the acts of the elder and younger Brutus, even to the latest days of the republic, and long after the establishment of the empire as virtuous and honourable Hence the perverted morality on this peculiar subject which continues to prevail, more or less even to the present day as false in logic as contrary to the plain rules of conscience, for it is obvious that to each individual, a wealthy or powerful oppressor, who commits injuries against him and his friends for which the law can give him no redress, is just as fair a subject for illegal vengeance as a king to any member of the community Yet no one ever sought seriously to set up the right of assassination in such cases, as Buchanan, Languet Mariana and others have done in that of kings English history has three notorious instances of kings (Edward II Richard II and Edward V) murdered by powerful and rebellious subjects But France, above all other countries is fertile in examples of regicide, effected or attempted by private individuals under the influence of religious and political fanaticism Henry III and IV both fell by the hands of Roman Catholic zealots The reader will find in the Discourse of Père Mathieu on the Death of the latter (lately republished in *Cimber, Archives curieuses*) a singular example of the fanaticism of cruelty in the way of retaliation, excited, and not unnaturally by the repetition of such monstrous and desperate acts But the savage execution of Ravaillac did not deter Damien in the reign of Louis XV, from attempting the life of the king from the same motives The assassination of the Duke de Berri and the repeated attempts on the life of Louis Philippe from political enthusiasm, show but too plainly that the morbid passions which actuate [illegible] of Sweden by Ankarstrom is perhaps, the most deliberate instance of this crime on record, for the criminal, though rancorous and determined, was no zealot It must be added that the application of the term regicide to the members of the commission which sat in judgment on Charles I, and to the majority of the convention which condemned Louis XVI, is a violation of that moral sense which judges unerringly of actions, whatever the character of their conduct might be, it was altogether different from assassination, and to confound Vane or Carnot with Ravaillac and Fieschi, under a similar designation, can serve no ends but those of temporary party malice

REGIMENT (Lat rego *I rule*) A body of troops consisting (if infantry) of several battalions, or (if cavalry) of several squadrons, under the command of a colonel The British army consists, at present, of three regiments of horse guards [illegible] regiment of cavalry, of which four are heavy dragoons, five light dragoons, four hussars, and four lancers, three regiments of foot guards, divided into the grenadier guards, the Scots fusiliers, and the Coldstream guards, and ninety-nine regiments of infantry, exclusive of the royal regiment of artillery, and the royal corps of marines Many of the regiments in the British army are distinguished by the name of the counties or districts where the men were originally enlisted Thus the 3d regiment is called the

East Kent regiment, the 6th, the Royal Warwickshire, &c &c. No rule is established with regard to the number of men of which a regiment should consist both in England and on the Continent this point is settled either by the exigencies of service in time of war, or the principles of economy in time of peace In the British army, the three regiments of horse guards consist at present each of 32 officers, 53 non-commissioned officers, 351 privates, and 274 horses The ordinary cavalry regiments have each at an average 27 commissioned officers, 31 non-commissioned officers, 304 privates, and 283 horses The grenadier regiment of guards consists of three battalions, and has 96 officers, 177 non-commissioned officers, and 2080 privates The other two regiments of [illegible] and have each officers [illegible] and 1280 privates The [illegible] consists of nine battalions having 41 [illegible] commissioned officers and men, exclusive of the horse brigade the engineers, and sappers and miners (*Stat of the Brit Empire*, vol ii p 433)

REGISTER, LORD, or LORD CLERK REGISTER A Scottish officer of state who has the custody of the archives, hence also termed custos rotulorum He was of old the principal clerk of the kingdom, from whom other clerks derived their authority The office was formerly at pleasure, but since 1777 for life Salary 1200*l* a-year He is assisted in his duties by a resident deputy

REGISTRY OF BIRTHS, MARRIAGES AND DEATHS Down to the year 1836, in consequence of the defects of the system of registration, no complete or accurate information could be obtained as to the amount of births, marriages, and deaths throughout England, but at that period the necessity of having it superseded by a better system was admitted, which was finally accomplished by the act 6 & 7 Will 4 c 80

This act, passed in pursuance of the recommendation of a committee of the House of Commons on parochial registers 1833, [illegible] tration of births deaths and marriages [illegible] Wales To give effect to [illegible] under the superintendence of an officer resident in London, and there also a central place of deposit is provided for certified copies of all parochial registers with ready means of finding any entry in them It is provided that in every case of *birth* the following circumstances shall be recorded — viz the time and place of birth, the name (if any) and sex of child, name and surname of father, name and maiden surname of mother, rank or profession of father, the signature, description, and residence of the informant, and also the baptismal name of child if added after registration of birth In every case of *death* the register is to record the time and place of death, the name and surname sex, age, and rank or profession of the deceased, *the cause of death*, and the signature, description and residence of the informant In all cases the entries must be signed by the informant, and also by the registrar, who discharges this duty without any immediate expense to the parties requiring registration, his remuneration being derived from moderate fees paid out of the poor s rates The insertion of the cause of death, along with the period of [illegible] and occupation of the deceased [illegible] of the utmost importance to medical science, and to the improvement of vital statistics

The central office in London for the deposit of certified copies of registers, and the general supervision and conduct of the business of registration, is called the General Register Office It is presided over by a registrar-general appointed under the great seal having under him an assistant registrar, chief clerk, and a numerous body of subordinate clerks From this office communications [illegible] all [illegible] registrars of births and deaths, [illegible] riages who all act within their respective districts under [illegible] registrar general, in whom is vested [illegible]

There are upwards of 600 superintendent registrars who may each appoint a deputy, with the approval of the registrar general Each superintendent registrar [illegible] to which he is appointed, which [illegible]

There are upwards of [illegible] who may each appoint a deputy [illegible] guardians or of the poor law [illegible] registrar is appointed to some one of the registrars' districts, into which the whole of England and Wales has been divided and he must reside in that district, and register *all* births and deaths that occur in it

Marriages are registered, 1st, By clergymen of the established church of whom about 12,000 have been furnished with books for this purpose 2dly, By registrars of marriages of whom there were, on the 1st of January, 1840, about 1000; these last are appointed by the superintendent registrars, and register marriages solemnized in their presence in registered places of worship, or in the superintendent registrar's office 3dly, By the registering officers of Quakers And 4thly, By the secretaries of synagogues

The clergymen and the various officers, amounting in all to about 19,000 to whom the business of registration is committed are bound to make quarterly deliveries of *certified copies* of all entries in their respective registers during the previous quarter, to the superintendent registrars of the district to which they respectively belong, and these certified copies are transmitted by the superintendent registrars to the registrar-general. The certified copies are made on separate leaves of paper of a uniform size and peculiar texture, having a distinguishing water-mark On being received at the general register office in London (whither they are sent by post), they are carefully examined, and any defects being noted are made the subject of communication with the person from whom [illegible] ther to furnish [illegible] They are then arranged, paged, and inserted in books for reference

*Alphabetical indexes* of births, deaths, and marriages are prepared and kept in the general register office, and any person, on payment of 1*s*, may search these indexes for any entry, and on finding it may, if he wish, obtain for 2*s* 6*d*, a stamped copy of such entry, which will be "received as evidence of the birth, death, or marriage to which the same relates, without any further or other proof of such entry" There are separate alphabetical indexes for the births, the deaths, and the marriages in each quarter The registrar-general is bound to furnish, once a year one of the principal secretaries of state with a *general abstract account* of the births, deaths, and marriages registered during the foregoing year to be laid before parliament The first of these was prepared in 1838 They have since been continued with various improvements and in a statistical point of view, the sound accurate, and judicious information which they embody cannot be too highly appreciated (*Stat of the Brit Empire*, vol i pp 410—430)

The act 6 & 7 Will 4 c 86 does not extend to Scotland and the Scotch registers of births, marriages, and deaths are so exceedingly defective that, except in a very few parishes they are good for nothing In Ireland the act 7 & 8 Vict c 81 provides for the registration of marriages but the registers of births and deaths in Ireland are if possible in a still worse state than in Scotland Some steps should be taken to place these portions of the empire on a level with England

REGISTRY OF DEEDS, in Law, exists in England only in certain districts, in the three ridings of Yorkshire, and in Middlesex it is established by act of parliament It does not extend to copyhold estates, or to leases not exceeding twenty-one years in possession The intention of the registry was to give notice to purchasers of incumbrances existing on estates But its value in this respect is materially lessened by the prevalence of the equitable doctrine of *notice*, namely, that where a party is either actually or constructively, aware of incumbrances not registered, he is bound by such knowledge

REGISTRY OF SHIPS *See* SHIPS, REGISTRY OF

REGIUM DONUM (Lat *royal gift*) An annual grant of public money in aid of the maintenance of the Presbyterian clergy in Ireland It was instituted by William III in 1690 and remodelled in 1790 The stipends are paid to ministers both of the "Synod of Ulster" and "Seceding Synod," the two principal divisions of the sect

REGIUS PROFESSORS The name given to those professors in the English universities whose chairs were founded by Henry VIII In the Scotch universities, in [illegible] regius professors who have been appointed by the crown

REGLET (Lat regula) In Architecture *See* FILLET

REGRATING *See* FORESTALLING

REGRESSION [illegible] In Astronomy, the *regression of the nodes* is the motion of the line of intersection of the orbit of the moon with the ecliptic, which is retrograde, or contrary to the order of the signs This motion of the nodes of the lunar orbit takes place with considerable rapidity, the whole revolution being accomplished in about 18½ years The nodes of the planetary orbits also regress on the ecliptic, but, in the case of the planets, the regression is extremely slow, that of the nodes of Mercury, which is the most rapid, amounting only to about 42 seconds of a degree in a solar year *See* NODE, PLANET

REGULAR BODIES *See* PLATONIC BODIES

REGULAR FIGURES, in Geometry, are equilateral and equiangular polygons Circles can be described within and about such figures but such figures can be described by geometrical methods only in particular cases General expressions for the radii of the circles

described within and about them ($r$ and R), and for their areas and ratios (which however be given in terms of $\pi$). The [illegible] if $u°$ represent the $n$th part of 180°, we shall have, $a$ being the side, $R = \frac{1}{2} a \operatorname{cosec} u°$, $r = \frac{1}{2} a \cot u°$, area $= \frac{1}{4} n a^2 \cot u°$

Tables of the values of cosec $u°$ and cot $u°$, computed from these expressions, may be seen in most works on [illegible] the values of $n$ as far as 12 (See *Hutton's Mensuration*).

REGULARS In the Roman Catholic Church, those that profess and follow a certain rule of life, and observe the three vows of poverty, chastity, and obedience, are so called

REGULA'TOR In Machinery, a general name for any contrivance of which the object is to produce the uniform movement of machines The regulators most commonly applied are the *fly* and the *governor*, for which see the respective terms

*The regulator of a watch* is the spiral spring attached to the balance This ingenious contrivance, the invention of Hooke, has contributed as much to the improvement of watches as the pendulum to the improvement of clocks

In a paper published in the *Memoirs of the Royal Astronomical Society*, vol xi, the present Astronomer Royal has investigated the mathematical problem of the motion of the regulator applied to the clock-work by which motion is given to large equatorial telescopes For this purpose absolute uniformity of motion is of very great importance The construction usually adopted, in this country at least, depends on the same principle as that of the governor of the steam-engine Two balls suspended from the upper part of a vertical axis by rods of a certain length, are made to expand by the rotatory velocity of the axis, and when the expansion reaches a certain limit, a lever is pressed against some revolving part, whereby a friction is produced which immediately checks the velocity Now the uniformity of the rotatory motion of the spindle depends upon the assumption, that if upon the whole the retarding forces are equal to the accelerating forces the balls will move in a circle and in no other curve But this assumption is incorrect, for the balls may move in a curve differing insensibly from a circle; and, in some instances Mr Airy observed the balls to revolve in an ellipse of considerable eccentricity When this takes place the rotatory motion of the spindle becomes exceedingly variable This injurious effect may be partly counteracted by [illegible] apparatus so that the revolutions [illegible] or very quick, the former method has the effect of giving greater smoothness of motion, but the second insures more completely that the object observed shall remain steady in the field of the telescope

REGULUS In Chemistry The old chemists designated several of the brittle or inferior metals by this term when freed from impurities and obtained in their metallic state it is thus that they speak of *regulus of antimony of bismuth* &c

REHABILITATION, in Foreign Criminal Law is [illegible] he has lost by [illegible] a pardon from the king is said to rehabilitate a witness labouring under *infamia juris* In France persons condemned to imprisonment or compulsory labour may demand their rehabilitation five years after the expiration of their penalty the demand is considered by the cour royale of the district, and pronounced upon by the king in his privy council Various singular forms were attached to the process of rehabilitation in ancient times There are extant letters of Charles VI given in 1383, permitting a criminal whose hand had been cut off for homicide to replace it by another made in such fashion as he may choose

REHEARSAL The recital in private of an opera, oratorio, or, in short, any dramatic work, previously to public exhibition

REIN DEER (Germ rennthier) *Cervus tarandus*, Linn A large species of *Cervus* with branched, recurved, round antlers, the summits of which are palmated These antlers are remarkable for the size of the branch which comes off near the base, and is directed forwards, called the brow-antler, and which is said to be used by the animal to clear away the snow from the hidden lichens which constitute the food of the rein-deer during the long and severe winter of Greenland, their native clime As the female also possesses antlers of similar form, but smaller upon the whole than those of the male, their function as instruments to obtain food is rendered more probable, since in the deer which do not [illegible] These appendages [illegible] and forward [illegible]

The length of the [illegible] that of the head is fifteen inches They are well clothed with hair, which becomes thicker, longer, and of a whiter colour in the winter season, at which time the male has a white beard, like the goat The rutting season is at the beginning of winter, and the hind [illegible] one, rarely two calves in May or June

The rein-deer is swift of foot, sharp-sighted, has an acute smell and hearing It is more cautious and timid in herds than when solitary It can swim well, and often crosses lakes and rivers

The flesh of the rein-deer, which is held in great esteem by the Greenlanders, is usually eaten raw, or dried with the smoke of the *lichen nivalis* The blood is boiled with berries mixed with the fat, which is also preserved separately and used as lard The half-digested contents of the paunch of the rein-deer is the Greenlander's prime luxury, nor is the trail rejected The hide of the rein-deer supplies the Greenlander with a beautiful material for his tent, his clothing, his bedding The bones and antlers are worked into implements for domestic use, for fishing and hunting The tendons are split into threads

The Greenlanders likewise use the spare hides of the rein-deer as an article of barter

REINECKE (The Fox) The name of a celebrated popular German epic poem, which, during the latter part of the middle ages and the early centuries of modern times, enjoyed an almost European reputation It became first known through the medium of a Low German version in the 15th century, and it has, with few interruptions, ever since involved the German literati in discussions as to its origin, which are yet apparently far from being settled It contains a humorous and satirical account of the adventures of Reinecke (the fox) at the court of King Nodel (the lion), exhibits the cunning of the former, and the means which he adopted to rebut the charges preferred against him, and the hypocrisy and lies by which he contrived to gain the favour of his sovereign, who loaded him with honours The king the officers of his court, and all his subjects are represented, as in *Æsop's Fables*, under the names of the animals best suited to their respective characters, and the poem is an admirable satire on the intrigues practised at a weak court The most successful versions of this poem are those of Goethe, in hexameters, of Soltau, in the measure of the original, and the more recent attempt of Ortlepp This poem appears, in some form or other, to have been known throughout Europe For full information respecting it the reader may consult Meon (*Roman du Renard* Paris 1826), and the *Reinhart Fuchs* by Jacob Grimm (Berlin, 1834)

REINFORCE, in Artillery, is that part of a gun nearest to the breech, made stronger to resist the explosive force of the powder *See* GUN

REINFORCE RINGS are flat hoop-like mouldings on the reinforces on the side nearest the breech There are usually two, the second being rather smaller than the first

REIS-EFFENDI The name given to one of the chief Turkish officers of state He is chancellor of the empire and minister of foreign affairs, in which capacity he negotiates with the ambassadors and interpreters of foreign states

REITERS (Germ reuters, *riders*) The German cavalry of the 14th and 15th centuries were so called, especially in France during the religious wars, in which they served on the Protestant side At that period they were lightly armed and carried a long sword and carbine

REJOINDER In Law, the fourth stage in the pleadings in an action being the defendant's answer to the plaintiff's replication The next allegation of the plaintiff is called *surrejoinder* *See* PLEADING

RELAIS In Fortification, a narrow walk of four or five feet wide, left without the rampart to receive the earth which may be washed down and prevent its falling into the ditch It is sometimes for greater security palisaded

RELAPSE (Lat relabor, *I fall back*), is applied, in Ecclesiastical Law, to a heretic who falls back into an error which he has abjured

RELATION, INHARMONIC In Music, a term [illegible] is introduced which was [illegible]

RELEASE [illegible] Law, signifies, properly speaking a discharge of a right *e g* 1 A release of land is a discharge or conveyance of a man's right in lands and tenements to another that has some former estate in possession, on which principle the common mode of conveyance by lease and release is founded, *i e* releasing all the right of the releasor to a party already in possession under a lease for a year 2 A release of a right of action, which may be pleaded in bar (*See* PLEADING) A release "of all demands" discharges all sorts of actions, rights, titles, conditions, executions, appeals, covenants, contracts, [illegible] recognizances, &c

RELICS [illegible] the Romish Church, are the remains [illegible] or of their garments, &c, which are supposed to be held in veneration and are considered in many instances to be endued with miraculous powers They are preserved in the churches, to which they are often the means of attracting pilgrimages,

and in very ignorant times and places have been actually made objects of adoration The virtues which are attributed to them are defended by such instances from scripture as that of the miracles that were wrought by the bones of Elisha (2 Kings, xiii 21 )

RELIE'F, in Feudal Law, is derived from the Latin relevare, *to take up*, because the tenant, by payment of the relief, was said to take up the fief which had fallen to the lord by the death, &c of his predecessor "The heir," says Blackstone, "when admitted to the feud which his ancestor possessed, used generally to pay a fine or acknowledgment to the lord in horses, arms, money, or the like for such renewal of the feud, which was called a relief, because it raised up and re-established the inheritance or, in the words of the feudal writers, 'incertam et caducam hæreditatem relevabat'" Reliefs, together with the other incidents of feudal tenure were abolished in England by stat 12 Car 2 *See* FEUDAL SYSTEM

RELIEF In Architecture, the projection of a figure or ornament from the ground or plane on which it is sculptured In Sculpture, when the whole of the figure stands out, the work is denominated *alto-rilievo*, when only half out, *demi-rilievo*, and when its projection is very small it is called *basso rilievo*

RELIEF *Rilievo* In Sculpture that species of sculpture in which the figures are engaged on or rise from a ground There are three sorts of *rilievo*, — *basso-rilievo*, in which the figures or other objects have but small projection from the ground on which they are sculptured, *mezzo rilievo*, in which the figures stand out about half their natural proportions the other half appearing immersed in the ground, and lastly *alto-rilievo* in which the figures stand completely out from the ground being attached to it only in a few places and in others worked entirely round like single statues such are the metopæ of the Elgin marbles in the British Museum which marbles also in the Panathenaic procession exhibit some exquisite examples of basso rilievo

RELIEF SYNOD A respectable body of Presbyterian dissenters in Scotland whose ground of separation from the established church was the violent exercise of lay patronage which obtained in the latter Though patronage, or the appointment of clergymen to church benefices by presentations had been established by act of parliament in 1712, yet a minority of the clergy were opposed to that measure, at least to the intrusion of a minister into a parochial charge contrary to the sentiments of the people The majority of the church however, entertained different views and rigorously enforced the provisions of the act of 1712 With this state of things the people generally but particularly in rural districts were dissatisfied, and hence the origin of the Secession church, and the Relief *See* BURGHERS

The origin of the Relief may be dated in 1752 Six of the ministers of the Presbytery of Dunfermline having refused, contrary to the express authority of the General Assembly of the Church of Scotland to assist at the admission of Mr Richardson to the parish of Inverkeithing (the people being unwilling to receive him as their pastor), were summoned before this venerable court for contumacy They pleaded conscientious scruples, but this representation had no effect on the assembly, and, as an example to the church one of the six recusants was peremptorily deposed from the office of the ministry, while the remaining five were suspended Mr Gillespie minister of Carnock, the individual deposed, still claimed his pastoral relation to his flock, and though deprived of the use of the parish church preached in the fields, attended not merely by his former hearers, but by many others attracted by the peculiar circumstances of the case A chapel was afterwards built for him in the neighbouring town of Dunfermline, where he continued to preach till his death, and to oppose the law of patronage in the church Mr Gillespie for a few years stood alone, but in consequence of the violent settlement of a clergyman in the town of Jedburgh, the great body of the people of that place, forsaking the established church, gave a call (1759) to Mr Thomas Boston, minister of a neighbouring parish, to be their pastor Mr Boston, for whom they erected a chapel, accepted the invitation and withdrew from the church of Scotland Owing to exactly similar circumstances, the people of the parish of Kilconquhar in Fifeshire, followed the example set them in Jedburgh, and chose Mr Collier to be their minister On the 22d of November, 1759, Mr Gillespie and Mr Boston, with a lay elder from each of their congregations, met in a presbyterian capacity at Colinsburgh, in the last-mentioned parish, to induct Mr Collier to his charge On the evening of the same day these three ministers met and agreed to [illegible] gained accession to their number [illegible] to those which we have already detailed, and at length formed themselves into a synod, which at this date (1851) embraces eleven presbyteries, including 116 congregations being, in point of numbers and influence, the third ecclesiastical body in Scotland The founders of the Relief professed to differ from the established church on no point other than the right of patrons to appoint ministers against the inclinations of the people This still constitutes the leading characteristic of the sect, but on this they have engrafted voluntary church principles, or are hostile to the principle of a national church, or to state endowments of religion The Secession and Relief have been long engaged in considering overtures made mutually to each other for forming a union of [illegible] The Relief Synod have a professor of [illegible] own connection (*Smith's Hist Sketches of the Relief Church*, *Hutchison's Compendious View of the Synod of Relief*, *Adam's Relig World Displayed* vol iii p 223—32, *M'Kerrow's Hist of Secession* v i p 319—21 326—28 )

RELIEVING TACKLES Temporary tackles attached to the end of the tiller in bad weather to assist the helmsman, and in case of accident happening to the tiller ropes They are also strong tackles from the wharf to which the ship is hove down, passed under her bottom and attached to the opposite side to assist in righting her afterwards, as well as to prevent her from oversetting entirely

RELIQUARY A receptacle for the relics venerated in Roman Catholic churches The difference between a *reliquary* and a *case* (Fr châsse) used for the same purpose is that the former is smaller in dimensions, and contains only small fragments, the latter in many instances entire bodies

REMAINDER The difference of two quantities left after the less is subtracted from the greater

REMAINDER A *remainder* in Law, is a future estate in lands tenements or hereditaments, limited to arise after the determination of another estate, as if land be granted to A for twenty years and afterwards to B and his heirs for ever B has a remainder in fee An estate in reversion is the residue left in the grantor, to commence in possession after the determination of some particular estate granted out by him as if A being seised in fee-simple gives to B and his heirs male of his body (thus creating an estate tail) on the failure of such heirs male the land given reverts to A, who therefore, prior to such failure has an estate in reversion in the lands Remainders are either *vested* or *contingent*, vested or *executed* where the estate is invariably fixed to remain to a determinate person after the preceding estate (called the *particular* estate) is spent In this case, the remainder man has a present interest, to be enjoyed *in futuro* Contingent remainders otherwise called *executory* are defined to be where the estate in remainder is limited to take effect either to an uncertain person, or upon an uncertain event so that the particular estate may chance to be determined and the remainder never take effect The doctrines of law with reference to these estates have gradually been moulded into a system so intricate and replete with the most refined distinctions, that it would be impossible to give a cursory view of this branch of our jurisprudence An instance of a vested remainder is to be found in the example before cited of an estate granted to one party for a term of years, and afterwards to another in fee-simple A contingent remainder limited to an uncertain *person* is where for instance, there is an estate to A for life and afterwards to B's eldest son (the unborn) [illegible] of future possible [illegible] tion by way of remainder or executory devise (as a grant of a contingent remainder by will) shall be good which is to take effect after the determination of a life or lives in being and 21 years (the period of minority) afterwards An instance of a contingent remainder limited on an uncertain event is where land is given to A for life, and in case B survives A then to B in fee

The particular estate which precedes (in legal language *supports*) a vested remainder may be either of years, or of freehold to support a contingent remainder it must necessarily be of freehold

REMBLAI (Fr) A term used in Fortification to denote the earth or materials used in filling up a trench or excavation It is opposed to *deblai*, which denotes the materials excavated

REMEMBRANCERS Officers of the Court of Exchequer, who perform various functions, the chief of which is to put the judges of that court in remembrance of [illegible] the king [illegible], —the king's remembrancer, the lord treasurer's remembrancer, and the remembrancer of first fruits, but the duties of the second of these officers were merged in the first by 3 & 4 Will 4 c 99

REMIGES (Lat remigo, *I row*) The quill feathers of the wings of a bird, which, like oars, propel it through the air

REMIPEDS *Remipedes* (Lat. rema, *an oar*, pes, *a foot*) The name of an order of Coleopterous insects, in-

[illegible] ch have tarsi adapted for swimming [illegible]

REMITTENT FEVER Any fever which suffers a [illegible] in its violence during the twenty four hours, but without entirely leaving the patient is called a *remittent*, it differs from a [illegible] there never being a total absence of fever These fevers are most common in autumn, and they vary in degree from extreme mildness to alarming violence and are both inflammatory and malignant The remittent fever of children, or, as it is often called the *infantile* [illegible] is generally symptomatic either of worms in the intestines, or of a foul state of bowels arising from inattention to diet, or from the indigestible trash which children frequently indulge in the tongue is very foul, the head aches, the belly is tumid, food is loathed, the child is drowsy all day, but restless and often delirious at night, and the bowels torpid A proper system of purging is the most essential part of the treatment in these cases, and under it the symptoms, though often [illegible] called with camomile and [illegible] by infusion of senna and aperient salts, are the principal remedies, and saline draughts and diluents in the intervals If bilious diarrhœa ensue, with vomiting the irritability of the stomach must be allayed by effervescing salines, and that of the bowels by very mild opiates, if the head is much affected, cold and evaporating lotions may be used Good air, thorough ventilation, and light farinaceous diet, with the above treatment, generally effect a cure, but the disorder is often very obstinate, and continues for three weeks or a month The *yellow fever*, or bilious remittent of hot climates and especially of the West Indies, is another form of this fever it appears to be produced by marsh miasma In all these fevers particular symptoms occasionally present themselves which require particular modes of treatment, and this must also be modified according to the inflammatory malignant nervous, or intermittent form which they may assume or pass into

REMONSTRANTS In Ecclesiastical History See ARMINIANS

REMPHAN An idol worshipped by the Israelites while in the wilderness, according to the language of St Stephen as recorded in the Acts, 'Ye took up the tabernacle of Moloch and the star of your god Remphan' [illegible] quotes the [illegible] of your Moloch and Chiun, your images Chiun and Remphan are therefore the same and both are thought to be personifications of Sirius the Dog star (*Enc Brit*) Chiun is supposed by some to be the same word as Chan or Khan Chagan Konig, 'king", Remphan or Raiphan, "high or exalted light"

RENAL GLANDS There is a glandular body upon each kidney of a somewhat triangular shape small in the adult but in the fœtus longer than the kidney, it is called the renal, or supra-renal, gland or capsule it has no excretory duct and its use is unknown

RENDERED In Architecture See RENDERED AND SET

RENDERED AND FLOATED In Architecture plastering of three coats on brickwork

RENDERED AND SET In Architecture a term used to denote plastering of two coats on naked brick or stone work If the work is to be of three coats, it is called *roughing in* *Pricking up* is the first of three-coat plaster on lath or on brickwork that has been previously rendered The materials for rendering and pricking up are the same

RENDERED FLOATED, AND SET FOR PAPER In Architecture, plastering of three coats, the first being lime and hair upon brickwork, the second, the same compound, with the addition of a little more hair and then *floated* with a long rule, the third *fine stuff* mixed with white hair

RENNET, or RUNNET The prepared inner membrane of the calf's stomach, which has the property of coagulating the albumen of milk and converting it into *curd and whey*

RENT (Lat reditus, Fr [illegible] terres) In Political Economy, and in [illegible] the sum paid by the farmers or lessees of lands to the landlords

In order to acquire clear and correct ideas with respect to the nature and origin of rent, it is necessary to discriminate between the sources whence it usually arises, that is, between the portion paid for the use of the natural and inherent powers of the soil, and the portion paid for the use of the buildings, fences, drains, roads, and other improvements made upon the soil Two farms may be naturally of about equal goodness, and equally well situated, but if little or no capital have been laid out on the one, while a great deal has been judiciously laid out on the other, they will let for very different sums It is usual, no doubt, to class all sums derived from land, whatever may be their origin, under the common name of rent, but it is obviously necessary, in an inquiry of this sort, to distinguish between the sums paid for the use of the land, and those paid for the use of the improvements, if there be any, made upon it Landlords are, for the most part capitalists as well as owners of the soil, and the sums paid to them by their tenants for the use of the capital expended upon the soil, though included under the term rent, are substantially and in fact profits, and depend wholly on the circumstances by which they are governed *Rent really, therefore, consists of that portion of the gross sum paid for land, that is, paid for the use of the natural and inherent powers of the soil, or that would be paid for the land supposing it to be in a state of nature, and without any improvement upon it* The owners of the soil receive this portion of their gross income not because they are capitalists, but because they are landlords And we shall now briefly endeavour to exhibit the origin of this payment, or of rent, in the scientific and restricted sense of the term

*Origin of Rent* — On the first settling of any country abounding in large tracts of unappropriated land, rent, in the sense now explained, is unknown, and for this obvious reason, that no person will pay rent for what may be procured in unlimited quantities for nothing In such countries, rent only begins to appear when the best of the unappropriated lands have become private property, and been occupied Suppose, however, this comes to be the case and that the population has increased, so that the demand for raw produce can no longer be supplied by the culture of the best lands under these circumstances, it is plain either that population must become stationary, or that the price of raw produce must rise so as to enable inferior lands to be cultivated No advance short of this will procure another bushel of corn, and competition will not, as will be immediately seen allow prices to rise permanently above this level Under the circumstances supposed, the inhabitants have but one alternative If they pay a price sufficient to cover the expense of cultivating secondary lands, they will obtain additional supplies, if they do not, they must be without them

Suppose now, that the price rises so as to pay the expense of raising corn on soils which, in return for the same expenditure that would produce 100 quarters on lands of the first quality, will only yield 90 quarters, it is plain it will then be indifferent to a farmer whether he pay a rent of ten quarters for the first quality of land, or farm the second quality which is unappropriated and open, without paying any rent If the population went on increasing lands which would yield only 80 70, 60, 50, &c quarters in return for the same expenditure that had raised 100 quarters on the best lands, might be successively brought under cultivation And when recourse has been had to these inferior lands, the corn rent of those that are superior would plainly be equal to the difference between the quantity of produce obtained from them and the quantity obtained from the worst quality under tillage Suppose for example, that the worst quality cultivated yields 60 quarters then the rent of the first quality will be 40 quarters, or 100 — 60, the rent of the second quality will in like manner, be equal to the difference between 90 and 60, or 30 quarters, the rent of the third quality will be equal to 80 — 60, or 20 quarters, and so on, the produce raised on the land last cultivated or by means of the capital last applied to the soil, being all the while sold at its necessary price or at that price which is sufficient merely to cover the cost of its production, including therein the ordinary rate of profit on the capital of the cultivators If the price were above this level agriculture would be [illegible] profitable business and tillage would be [illegible] extended if on the other hand, the price fell below this level, capital would be withdrawn from the soil, and the poorer lands thrown out of cultivation Under such circumstances it is clear that rent could not enter into the price of that portion of the necessary supply of produce raised by means of the capital last applied to the soil. Its price is exclusively made up of wages and profits The proprietors of the superior lands obtain rent, but this is the necessary result of their greater fertility The demand cannot be supplied without cultivating inferior soils, the produce of which must necessarily sell for such a price as will afford the ordinary rate of profit to their cultivators This price will, however, yield a surplus over and above the ordinary rate of profit to the cultivators of the more fertile lands, and it *is this surplus that forms rent*

In so far therefore, as rent is a return for the use of the soil and [illegible] of land or on improvements, it results not [illegible] from the necessity of resorting as population increases, to soils of a decreasing degree of fertility, or of applying capital to the old land with a less return It varies inversely as the produce obtained by means of the capital and labour employed in cultivation; increasing when the profits of agricultural labour diminish, and diminishing when they increase Profits are at their maximum in countries like Australia, Indiana, and Illinois, and generally in all situations in

which no rent is paid, and the best of the good lands only are cultivated, but it can be said that rents have attained their maximum so long as capital yields any surplus in the shape of profit

A quarter of wheat may be raised in Kent or Essex, or in the Carse of Gowrie, for a *fourth* or a *fifth* part, perhaps, of the expense necessary to raise it on the worst soils in actual cultivation in other parts of the country. The same article cannot, however, have two or more prices at the same time and in the same market. And it is plain that if the price be no [illegible] producers of the wheat raised on the worst soils will cease bringing it to market, and the required supply will no longer be obtained while if the price exceed this sum, fresh capital will be applied [illegible] competition will soon sink [illegible] is, to such a sum as will afford the common and ordinary rate of profit to the raisers of that portion of the required supply which is produced under the most unfavourable [illegible]

It is plainly, therefore, the same thing to the consumers whether, in an advanced stage of society, the excess of return over the cost of production on superior lands belong to a non-resident landlord or an occupier. It must belong to the one or the other. Corn is not high because rent is paid, but rent is paid because the demand [illegible] without cultivating soils of a diminished degree of fertility as compared with the best. Suppose there is in any country an effectual demand for ten millions of quarters of corn, that nine millions may be raised upon lands that yield a high rent, but that it is necessary to raise the other million on inferior lands which yield no rent, but only common and average rate of profit to the cultivators. Under these circumstances, it is clear that the relinquishing of the rents payable by the cultivators of the superior lands would be no boon to the cultivators of those that are inferior. It would not lessen their expenses, that is, it would not lessen the capital and labour employed by them in the production of that portion of the [illegible] and unless it did this [illegible] the demand not to decline that it could lower prices. Although therefore landlords were to give up the whole of the rents, their doing so would have no influence over prices. Such an act would turn farmers into landlords and landlords into beggars, but there its effect would stop. But the case is entirely different when the cost of production varies. If it diminish the competition of the producers will infallibly sink prices in the same proportion. If it increase no supplies will be brought to market, unless the price rise to a corresponding level. In no case, therefore, whether the demand be great or small, whether it be for one thousand or one million quarters, can the price of raw produce ever permanently exceed or fall below the sum necessary to pay the cost of producing that portion of the required supply that is raised on the worst land, or by means of the last capital laid out on the soil.

It has been objected to this theory that though it may apply in unappropriated countries like New Holland it will not apply in countries like England, where land is universally appropriated, and where it is alleged, the worst qualities always yield some small rent to the proprietor.

It may be observed of this objection, that even if it were well founded it would not practically affect the conclusions previously established. There are in England and Scotland vast tracts of land which do not let for 6*d* an acre, but to cultivate them would require an outlay of many thousands of pounds, and the rent would consequently bear so small a proportion to the expenses of production as to become altogether evanescent and inappreciable.

There can be no doubt, however, that there is in this and most other countries a great deal of land which yields no rent. [illegible] and Russia [illegible], and yet no one presumes to say that the laws and [illegible] govern rent in them are different from those which govern it in England and France. The poorest lands are always let in immense tracts. If it were attempted to let particular portions of these tracts separately no one would offer for them, but they appear to yield rent, because, though they really fetch nothing, the more fertile spots with which they are intermixed may, in most cases, be let for a larger or smaller rent. But though every rood of land in Britain paid a high rent, it might still be truly affirmed that such rent did not enter into the price of raw produce. The rent of a country consists of the difference, or the value of the difference, between the produce obtained [illegible] agency of the capital first applied to the land [illegible] is last applied to it. It would, as already seen, be exactly the same thing to a cultivator whether he paid a rent of ten quarters to a landlord for land yielding, with a certain outlay, 100 quarters of corn, or em[illegible] [illegible] person, it is obvious, would ever resort to those of inferior fertility, and, under such circumstances, the largest population might be supported on the smallest extent of land. But, such is not the law under which food is obtained, and the fact, that in the progress of society wastes are brought under cultivation, proves that additional capital and labour can be employed on the old land with the same advantage to the old land. The state of a country may be such, the demand for agricultural produce may be so great, that [illegible] same thing, [illegible] employed on land which yields only the ordinary rate of profit, whether it be employed on old or new land. And that there is every where a very large amount of capital employed in such a manner, is a fact of which there cannot be any doubt whatever. The owners and occupiers of land are influenced by the same principles in the employment of their capital and labour that influence other men. Like them they endeavour, in prosecuting their own interest, so to adjust the capital they employ that the last quantity laid out may yield the common and ordinary rate of profit, neither more nor less. Suppose, for example, that a landlord occupies a farm which he might let for 200*l* a year, producing, with a certain outlay of capital, 300 quarters of wheat. If the farm be managed with the requisite skill and attention, the wheat should at an average, sell for so much money as is equivalent to the rent, the expense of labour and the profit on the capital employed. Suppose now, that the landlord finds that by laying out additional capital on the farm it may be made to yield 10, 20, 50 or 100 quarters more, he will make the outlay provided the additional produce yield the ordinary rate of profit. He will not wait before commencing the improvement until prices rise to a still higher elevation. It will be quite enough to induce him immediately to set about it, that they are such as afford a fair prospect of realizing the usual return on the capital to be expended. He will in fact act exactly as the merchant or manufacturer acts who sends another ship to sea, or builds another cotton mill whenever he supposes that the capital so embarked will yield customary profits. And supposing that the farm is let to a tenant, he, it is obvious, will do the very same thing as the proprietor if he obtain so much more profit as will over and above the usual return suffice to [illegible] to the termination of h[illegible] this additional capital depends entirely on the circumstance of prices being such as will repay his expenses and profits, for he knows he will have no additional rent to pay. Even at the expiration of his lease the fact of an additional capital having been employed would not occasion any rise of rent unless in so far as some portion of it, by being permanently incorporated with the soil, may increase its productive powers, and were his landlord to require more rent because a greater moveable capital had been employed he would cease to employ it, since by the supposition he gets only the same profit he might get by employing it in any other department of industry.

If we reverse the previous suppositions and suppose that the owner of a farm finds that owing to a fall in the price of corn the capital employed in its cultivation does not yield the common and ordinary rate of profit he will then acting on the same principle that led him in the other case to increase the capital on the farm, withdraw a part or it may be the whole of such capital and supposing it to be let the rent would be proportionally reduced at the end of the lease, or sooner.

It is not to be supposed that we mean to affirm that these results follow immediately and without any difficulty, on a rise or fall of prices, on the contrary they take place only by degrees, and are often productive, on the one hand of peculiar advantages, and, on the other of peculiar sacrifices. But in purely theoretical inquiries, or such as have the establishment of principles for their object, such accidental circumstances may be overlooked, and it may, [illegible] be said that the last portion of capital [illegible] yields only the common and average rate of profit. If, on the one hand, it were to yield *more*, fresh capital would be drawn to [illegible] that whether the last quality of land taken into cultivation yield rent or not the last capital applied to the land yields only the common and average rate of profit, and, consequently, the price of the produce which it yields, and which determines the price of all the rest, is totally unaffected by rent.

It is farther said by those who have cavilled at this

theory, that it [illegible] bad land as the cause of rent [illegible] demand of the [illegible] being the rise of price consequent upon this increased demand that occasions the cultivation of bad lands, and the payment of a rent for those that are superior This, however, is at best more verbal trifling The demand of the population for corn elevates its price to such a height as is necessary to obtain the required supply, and may, therefore, be truly said to be the cause of its being produced, but rent [illegible] peculiar circumstances under which [illegible] produced Were it not that it is most frequent [illegible] supplies of corn, to [illegible] fertility, or to apply capital, with a less return, to the old land, rent would be altogether unknown, nor, though the demand for corn were increased in a tenfold proportion, would prices be permanently elevated It does, therefore, seem to be logically, as well as substantially correct, to affirm that the decreasing fertility of the soil is the immediate cause of rent, and that its amount is determined by the extent to which bad land is cultivated or good land forced

This analysis of the nature and causes of rent discovers an important distinction between agricultural, and commercial, and manufacturing industry In manufactures, the worst machinery is first set in motion and every day its powers are improved by new inventions, and it is rendered capable of [illegible] with the same [illegible] be assigned to the quantity of improved machinery that may be introduced as a million of steam engines may be constructed for the same or rather for a less proportional expense than is required for the construction of one, competition never fails to reduce the price of manufactured commodities to the sum for which they may be purchased, according to the least expensive method of production

In agriculture, on the contrary, the best machines or best soils are brought first into use, and recourse is afterwards had to inferior soils, or those requiring a greater expenditure to make them yield the same supplies It is true that improvements in the construction of farming implements, the discovery of more efficient manures and the introduction of more prolific crops and improved [illegible] in a high degree the [illegible] proportionally reduce the price of raw produce, but a fall of price, though permanent in manufactures, is only temporary in agriculture When the price of corn is reduced all classes obtain greater quantities than before in exchange for their products or their labour, hence the rate of profit, and consequently the accumulation of capital are both increased, and this increase by causing a greater demand for labour and higher wages leads in the end to an increase of population and a further demand for raw produce and an extended cultivation Agricultural improvements obviate sometimes for a lengthened period the necessity of having recourse to inferior soils, still however this effect cannot be permanent The stimulus which they at the same time give to population, and the natural tendency of mankind to increase up to the means of subsistence, is sure, in the long run to raise prices, and, by forcing recourse to poor lands, rents also

In illustrating this important distinction between agriculture and manufacturing industry Mr Malthus has set the theory of rent in a striking point of view 'The earth' he observes, "has been sometimes compared to a vast machine, presented by nature to man for the production of food and raw materials, but to make the resemblance more just, as far as they admit of comparison, we should consider the soil as a present to man of a great number of machines, all susceptible of continued improvement by the application of capital to them, but yet of very different original qualities and powers

"This great inequality in the powers of the machinery employed in procuring raw produce forms one of the most remarkable features which distinguishes the machinery of the land from the machinery employed in manufactures

"When a machine in manufactures is invented which will produce more finished work with less labour and capital than before, if there be no patent, or as soon as the patent is over, a sufficient number of such machines may be made to [illegible] the whole demand, and to supersede [illegible] the old machinery The natural [illegible] of [illegible] would be withdrawn from the market

"[illegible] on the [illegible] works of man, and we find by experience that these gifts have very different qualities and powers The most fertile lands of a country, those which, like the best machinery in manufactures, yield the greatest products with the least labour and capital, are never found sufficient to supply the effective demand of an increasing population The price of raw produce therefore naturally rises till it becomes sufficiently high to pay the cost of raising it with inferior machines and by a more expensive process, and, as there cannot be two prices for corn of the same quality, all the other machines, the working of which requires less capital compared with the produce, must yield rents in proportion to their goodness

"Every extensive country may thus be considered as possessing a gradation of machines for the production of corn and raw materials including in this gradation not only all the various qualities of poor land, of which a very large territory has generally an abundance, but the inferior machinery which may [illegible] good land is further and [illegible] produce As the price of raw produce continues to rise, these inferior machines are successively called into action, and as the price of raw produce continues to fall, they are successively thrown out of action The illustration here used serves to show at once the necessity of the actual price of corn to the actual produce, and the different effect which would attend a great reduction in the price of any particular manufacture and a great reduction in the price of raw produce" (*Inquiry into the Nature and Progress of Rent*, p 37)

It appears therefore, that in the earlier stages of society, and when only the best lands are cultivated, rent is unknown The landlords, as such, do not begin to share in the produce of the soil [illegible] to cultivate lands of an inferior [illegible] apply capital to the superior lands [illegible] turn Whenever this is the case, rent begins to be paid, and it continues to increase according as cultivation is extended over poorer soils, and diminishes according as these poorer soils are thrown out of cultivation Rent, therefore, depends exclusively on the extension of tillage It is high where tillage is widely extended over inferior lands, and low where it is confined to the superior descriptions only But in no case does rent enter into price, for the produce raised on the poorest lands of a country, or by means of the capital last applied to the culture of the soil determines the price of the entire crop, and this produce yields only the common and average rate of profit

*Influence of Situation on Rent*—In the previous statements we have to simplify the consideration of the question, omitted to notice the influence of situation on rent It is plain, however that this is a very important element in determining its amount, and that difference of situation has precisely the same sort of influence over rent as differences of fertility Thus, suppose two farmers employ equal quantities of capital, as 5000 quarters each, in the cultivation of farms of the same goodness,—the one situated in the immediate vicinity of London, and the other in Yorkshire, and suppose, farther, that London is the market to which the produce of both farms is sent and that the cost of conveying corn from Yorkshire to London is 5*s* a quarter under these circumstances, if the gross produce of each farm were 1000 quarters, of which the landlord received one fifth part, or 200 quarters, as rent, the farm near London would fetch 50*l* a year more than the farm in Yorkshire For, as the corn raised in the districts adjacent to London is not adequate for its supply, its price in the city must suffice to pay those who bring any portion of the necessary supplies from the greatest distance as well for the expenses of carriage as for those of production, and the farmer in the immediate vicinity, who gets this increased price for his produce, will have to pay a proportional increase of rent, in the same way that the occupier of good land has to pay an increased rent, when inferior lands are taken into cultivation

It would, on many accounts, be desirable readily to distinguish between that portion of the gross rental of a country which is to be considered as rent, properly so called, or as the remuneration paid to the landlords for the use of the natural powers of the soil, and that portion which is the return to or the interest upon the capital laid out upon houses, fences, drains, roads, and other improvements But how [illegible] and [illegible] by all practical men that [illegible] make such a distinction with any thing approaching to accuracy No two of the most expert agriculturists, supposing them to be desired to resolve the gross rental of a single improved farm into its constituent parts, would arrive at the same result Improvements become so much blended with the natural powers of the soil, that the influence of the [illegible] be separated from that of the other, and the [illegible] value of the two that can be estimated No doubt can, however, be entertained by any one who reflects for a moment on the vast sums, the many hundreds, or rather thousands of millions, that have been laid out upon the soil of Great Britain, that the payment made to the landlords for the use of its natural powers is inconsiderable, [illegible] with that made to them on account of improvements;

and hence the inequality and mischievous operation of taxes on rent Two landlords receive equal rents from their estates, but the rent of one is principally a consequence of natural fertility, while that of the other is derived principally from outlays of capital What, then could be more unfair than to subject them both to the same equal tax? And yet the amount of their rents is the only criterion to which recourse could be had in fixing the amount of the tax, for all the tax collectors in the world could not separate between what was really rent, in the scientific sense of the term and what was interest on capital Such a tax would oppose the most effectual obstacle to improvements Instead of carrying capital from other employments to the land it would henceforth be carried from the land to them The object would not then be to have an estate look well, but to have it look ill, and it may be said of estates as of individuals,

Pauper videri Cinna vult, et est pauper

The effects that were formerly produced by the *taille*, and that are now produced by the *contribution foncière* in France, and the fluctuating land taxes imposed in other countries abundantly confirm the truth of this statement Their influence has been most disastrous

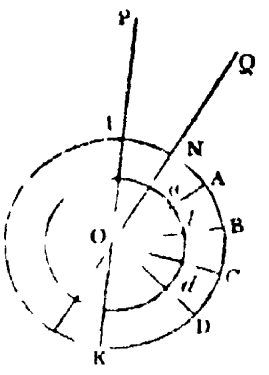
The theory of rent explained in this article was first promulgated and satisfactorily established in a tract on the corn laws, published at Edinburgh in 1777 by Dr James Anderson, a native of Hermandston in Mid Lothian, editor of the *Bee* and other publications But notwithstanding the clear and able manner in which he explained the theory and its ingenuity and importance, his elucidations do not appear to have attracted the least attention, and seem indeed to have been completely forgotten So much so was this the case, that when in 1815, Mr Malthus and Sir Edward West published tracts explaining the nature and origin of rent they were universally believed to be the authors of the theory Although, however, there is, we believe, no doubt as to their originality, still they were merely the expositors of a theory that had been clearly and ably explained above forty years previously to the publication of their tracts

RENT, in Law, is defined "a certain profit issuing yearly out of lands and tenements corporeal not necessarily, although by English usage generally consisting in money There are at common law three kinds of rents 1 Rent-service, having some incident of feudal service connected with it for which the landlord might distrain of common right 2 Rent-charge, where the owner of the rent had no future interest or reversion expectant on the land, as where one having parted with his land reserved a rent, with a clause of distress in the deed by which the land was *charged* with the payment of the rent 3 Rent seck, *redditus siccus*, which was rent reserved by deed without a clause of distress But the common remedy of distress was extended to all the divisions of rent by 4 G 2 c 28 (*See* DISTRESS) The ordinary remedy by action is in *debt* for the breach of an express contract, or *covenant* may be brought for the breach of a covenant to pay rent And these actions may be brought at any time within twenty years after the cause of action shall have accrued A 'fee farm-rent' is a rent issuing out of an estate in fee The common term "rack-rent' has no particular legal acceptation, and merely means a rent at or near the full value of the premises demised

REPE'AT In Music, a character 𝄇 denoting the repetition of the part which it bounds It is sometimes expressed by dots against the bar, and sometimes by the words *Da Capo*

REPEATING CIRCLE In order to diminish the effect of errors of graduation, and to obtain more accurate measurements by means of comparatively small and therefore portable instruments, a method of observing was invented, or rather brought into use, by Borda, which is now [illegible] in geodetical operations It consists in moving the telescope successively over portions of the graduated limb corresponding to the angle to be measured, and reading only the multiple arc, may be advantageously applied to circular instruments destined for very different purposes as, for example, to an instrument for the measurement of the zenith distances of stars or terrestrial objects, or the distance of two trigonometrical stations, in which case it is simply called a *repeating circle*, to a reflecting circle used for observations at sea, when it becomes a *repeating reflecting circle*, or to a theodolite, when it becomes a *repeating theodolite*

For the purpose of giving an idea of the principle of this method, we borrow the following illustration from Sir J Herschel —"Let P Q be two objects, which we may suppose fixed for purposes of mere explanation, and let K I be a telescope [illegible] O, the common axis of two circles A M L [illegible] A B C of which the former A M L, is absolutely fixed in the plane of the objects,




and carries the graduations freely moveable on the axis The telescope is attached permanently to the latter circle, and moves with it An arm, O *a* A, carries the index or vernier, which reads off the graduated limb of the fixed circle This arm is provided with two clamps, by which it can be temporarily connected with either circle, and detached at pleasure Suppose now the telescope directed to P Clamp the index O A to the *inner* circle, and unclamp it from the outer, and read off, then carry the telescope round to the other object Q In so doing the inner circle, and the index arm which is clamped to it, will also be carried round over an arc A B on the graduated limb of the outer equal to the angle P O Q Now clamp the index to the *outer* circle, and unclamp the inner, and read off [illegible] P O Q [illegible] error that of graduation, and that of observation, both of which it is our object to get rid of To this end transfer the telescope back to P *without* unclamping the outer circle, then having made the bisection of P, clamp the arm to *b* and unclamp it from B, and again transfer the telescope to Q by which the arm will now be carried with it to C over a second arc B C equal to the angle P O Q Now again read off, then will the difference between this reading and [illegible] one measure *twice* the angle P O Q affected with [illegible] observation, but only with the same error of graduation as before Let this process be repeated as often as we please (suppose ten times), then will the final arc A B C D read off on the circle be ten times the required angle, affected by the joint errors of all the ten observations, but only by the same constant error [illegible] which depends on the initial and final readings alone Now the errors of observation when numerous tend to balance and destroy one another so that, if sufficiently multiplied their influence will disappear from the result There remains then only the constant error of graduation which comes to be divided in the final result by the number of observations and is therefore diminished in its influence to one tenth of its possible amount, or to less if need be' (*Astronomy Cab Cyc* p 105)

When the repeating circle is used for measuring zenith distances it is constructed so as to be capable of being turned round on a vertical pivot, the direction of which passes through its centre and to which its plane is parallel and also of turning in its own plane about a horizontal axis The instrument being placed in the same vertical plane with the star, the telescope is directed to the star and the bisection made, the telescope which carries the verniers with it is then firmly clamped to the circle and the circle turned round 180° in azimuth about the vertical pivot If the circle be now kept fast, the telescope unclamped and carried round till the star is again bisected it is plain that the arc of the limb passed over by the verniers in consequence of this motion of the telescope will be double the zenith distance of the star The same process is repeated as often as may be thought necessary For the purpose of geodetical measurements the circle is usually furnished with two telescopes, one on the face and the other on the back, and so placed that the optical axes of both are exactly in the plane of the circle The circles used by Mechain and Delambre in the operations connected with the measurement of the French arc of meridian, were about 4-tenths of a mètre (nearly 16 inches) in diameter and were divided into arcs equivalent to about 32 sexagesimal seconds, which were subdivided into tenths by the verniers

The merit of first applying the ingenious principle of repetition to angular measurements belongs to Tobias Mayer, but it was Borda, as above stated, who first brought the instrument into general use

For a description of the repeating circle, its adjustments and the method of using it see Biot, *Astronomie Physique* tome i, Delambre, *Astronomie*, or *Base Metrique* tome i, Puissant, *Traité de Géodésie*, *Raper's Practice of Navigation*, &c The comparative advantages and defects of the instrument are very clearly stated in a paper by Troughton in the first volume of the *Memoirs of the Royal Astronomical Society*

REPE'TITIONS Applications to the surface of the body which [illegible] inwards

REPETITIONS POWER [illegible]

RE'PENT (Lat repo, *I creep*), in Zoology, is used in the same sense as creeping, and is applied to those animals which move with the body close to the ground, either without the aid of legs, or by means of more than four pairs of short legs

RE'PETEND In Arithmetic, that part of a *recurring decimal* which recurs continually and [illegible] called a simple repetend when there is but one figure as 2.33 and [illegible], and a compound repetend when there

are more figures than one in the repeating period, as 029029 . . ad inf It is usual to mark the first and last figures of the period by dots placed over them, thus the repeating decimal 0.0294 = 3, and 029

REPLE'VIN, *n* [ ] An action of tort, in which the plaintiff seeks the recovery of goods illegally distrained *See* ACTION

[illegible] In Law, the third stage in the [illegible] the plaintiff's answer to the defendant's plea *See* PLEADING

REPO'SE (Lat repono, *I lie down*) In the Fine Arts, the absence of that agitation which is induced by the scattering and division of a subject into too many unconnected parts, in which case a work is said to want repose Where repose is wanting from this cause, "the eye" says Sir Joshua Reynolds, "is perplexed and fatigued, from not knowing where to rest, where to find the principal action, or which is the principal figure, for where all are making equal pretensions to notice, all are [illegible]

REPRESENTATION (Lat representatio) In Politics, the part performed by a deputy chosen by a constituent body to support its interests and act in its name on a public occasion Thus a plenipotentiary represents the sovereign or the state which delegates him at a foreign court But the most ordinary use of the word is to express the principal function of the delegate of a constituency in a [illegible] Representation, in this sense, was unknown to political systems of the ancients, and seems to have originated in the necessities and usages of feudal times the lord not being able to levy aid from his vassals without their consent it became customary for these to delegate powers to individuals from among their numbers to attend his summons and confer with him respecting the aid required Hence in our own country the representation of county freeholders by knights, of communities by their chosen burgesses in parliament The most complete early model of a representative feudal assembly is to be found in the parliament of the Sicilies under the Suabian kings, but England is the only country in which it has expanded regularly into a legislature

The chief question in political science regarding the system of representation is, how far each delegate represents the opinions of the local body which sends him and is bound to act in obedience to their directions This was unquestionably the early notion of representation But the constitutional principle of English statesmen has been in general very different It is that each member represents not the local body, but the entire nation The ties which bind him to his constituents are altogether subordinate to those which attach to him in general character He is bound to sacrifice not only the wishes but the immediate and local interests of the body which sends him if they are in opposition to the general good of the country The most popular and best known exposition of this doctrine is perhaps to be found in Burke's famous speech to the electors of Bristol It follows as a corollary, that constituencies act unconstitutionally in demanding pledges of candidates for their representation as to the part which they are to take on particular questions But this, like other rules of constitutional conduct, must not be pressed too far Constituencies as well as representatives are bound to use their powers for the general good of the nation, and there may be occasions although rarely, on which those powers are best used by taking security of the representative that his conduct, on some very important and critical questions will be in accordance with what they deem the national view (See *Bentham's Rationale of Representation*)

REPRESENTATION In Painting and the other Arts, the transference to a plane of a solid mass, or the appearance of an object to the eye

REPRIE'VE (From the Fr reprendre, *to take back*) In Law the suspension of the execution of sentence on judgment in a criminal case for a certain time Reprieve at the will of the judge is arbitrary, and the latter has power to give it where he is dissatisfied with the verdict, in order to give time to apply to the crown for a pardon Reprieve is also [illegible], as a woman capitally convicted has a right to a reprieve during pregnancy, or when a party becomes insane between [illegible] execution

REPRISALS, LETTERS OF In National Law, the capture of property belonging to the subjects of a foreign power in satisfaction of losses sustained by a citizen of the capturing state (*See* LETTERS OF MARQUE) Letters of reprisal are grantable by the law of nations, where the subject of one state has been oppressed or injured by the subjects of another, and where justice has been refused on application by letters of request The mode of serving out letters of marque and reprisal in time of truce was regulated by statute 4 Hen 5 c 7, but has been long disused The power of granting letters of marque and reprisal is sometimes given by proclamation of the king in council to the lords of the admiralty



REPRISES In Law, deductions or payments out of the value of lands, such as rent charge or annuities

REPROBATION in Theology is a term commonly applied to the supralapsarian tenet of the consignment of all mankind to eternal punishment, with the exception of those whom God has arbitrarily selected for eternal happiness *See* ELECTION, PREDESTINATION

REPRODU'CTION (Lat reproduco, *I reproduce*) This word in Physiology, is sometimes used for generation, but it signifies properly the power which a fully developed organized being possesses to push forth and form anew parts of the body which have been cut off Vegetables possess this faculty in an eminent degree and animals have the power of reproduction in proportion as they resemble vegetables in the simplicity of their organization, thus the freshwater polype *Hydra viridis*, when divided into many pieces, reproduces all its characteristic organs out of each piece Worms and other Annelides can reproduce many segments of the body Snails can push forth new horns, and reproduce even a great part of the head Lobsters and spiders thus gain new claws or legs Newts and lizards reproduce their tails

REPTATION A mode of progression by advancing successively parts of the trunk which occupy the place of the anterior parts which are carried forwards, as in serpents also applied to the slow progression of those animals whose extremities are so short that the body touches the ground

REPTILES, *Reptilia* (Lat repo *I creep*) The name of a class of cold-blooded Vertebrate animals, including all those which have lungs and a heart composed of two auricles and one ventricle Those which retain their gills during the whole or a part of their existence are termed *Batrachians* or *Amphibia* the latter name Linnæus applied to the whole group, as well as to certain true fishes (*See* AMPHIBIANS, CHELONIANS, SAURIANS, OPHIDIANS and BATRACHIANS) Cuvier characterizing the class of reptiles as defined by him well observes, that as it is from respiration that the blood derives its heat and the muscular fibre its susceptibility of nervous irritation, the blood of reptiles is cold, and the muscular energy less than that of quadrupeds and much less than that of birds Thus we find their movements usually confined to crawling and swimming, for though at certain times several of them jump and run with considerable activity, their habits are generally lazy, their digestion excessively slow and their sensations obtuse In cold or temperate climates almost all of them pass the winter in a state of torpor Their brain, which is [illegible] small, is not so essentially requisite [illegible] of their animal and vital faculties as to the members of the two first classes their sensations seem to be less referred to a common centre for they continue to live and to exhibit voluntary motions long after losing their brain, and even after the loss of their head A communication with the nervous system is also much less necessary to the contraction of their fibres and their muscles preserve their irritability after being severed from the body much longer than those of the preceding classes their heart continues to pulsate for hours after it has been torn away, nor does its loss prevent the body from moving for a long time

The smallness of the pulmonary vessels permits reptiles to suspend the process of respiration, without arresting the course of the blood thus they dive with [illegible] and remain longer under water than either [illegible] or birds

No reptile hatches its eggs The young Batrachians on quitting the egg have the form and branchiæ of fishes and some of the genera preserve these organs even after the development of their lungs

The quantity of respiration in reptiles is not fixed, like that of the Mammalia and birds, but varies with the proportion of [illegible] compared to that of [illegible] Batrachians respire more than frogs &c, and hence a much greater difference of sensibility and energy [illegible] than can exist between one of the Mammalia or other, or between birds *See* ERPETOLOGY

REPU'BLIC (Lat respublica, *commonwealth*) That form of government in which the supreme power is vested in the people A republic may be either an aristocracy or a democracy the supreme power, in the former, being consigned to the nobles or a few privileged individuals, as was formerly the case in Venice and Genoa, while, in the latter it is placed in the hands of rulers chosen by and from the whole body of the people, or by their representatives assembled in a congress or national assembly The free towns of the Continent, Hamburg, Frankfort, Lubeck, and Bremen, are instances of this latter form of [illegible] but the most perfect example of it is to be found in the United States, and in some of the South American confederations In Switzerland, aristocracy is blended with democracy in the form of government Of the French Republic it is too soon to hazard any opinion

**REQUE'ST, LETTERS OF** In Ecclesiastical Law, an instrument by which the regular judge of a cause waives or remits his own jurisdiction, under the provisions of the statute of Citations 23 H 8 c 9, in which event the jurisdiction of the appellate court attaches

**RE'QUESTS, COURT OF** An ancient court of equity, inferior to the Court of Chancery, of which the lord privy seal was chief judge, taken away by 16 & 17 C 1 c 10 2 The Court of Conscience, or of Requests, [illegible] of small debts, was erected [illegible] jurisdiction between citizens and freemen in cases of debt or damages under 40*s*, extended in the reign of G 3 to 5*l* The local courts instituted in many parts of the kingdom for the recovery of small debts by summary process are hence called popularly Courts of Requests But the establishment and extension of the County Courts for the recovery of debts under 50*l* will it is presumed, ultimately supersede every other court in the kingdom established for similar purposes

**RE'QUIEM** (Lat) In the Roman Catholic Church, a mass performed for the repose of the souls of deceased persons It is so called from the prayer commencing "Requiem aternam dona iis Domine" The term is also applied to grand musical compositions performed on solemn occasions in honour of deceased civil or ecclesi[illegible] T[illegible]quiems composed by Mozart, [illegible] well known

**RESCRIPTS** (Lat *rescribo, I write back*) In the Civil Law, answers of popes and emperors to questions in jurisprudence proponnded to them officially Those of the Roman emperors constitute one of the authoritative sources of the civil law

**RESCUE** In Law in the more general sense, a species of resistance against lawful authority, as, by delivering one arrested out of the hands of those who have legal custody of him In a more restricted application, the term rescue means the taking away and setting at liberty, against law, any distress taken for rent, or services, or damage feasant

**RESEDACEÆ** (Reseda [illegible] A natural order of herbaceous or [illegible] ens, inhabiting Europe and Asia There are but three genera belonging to it, and of these but one species, the common *mignonette*, a Barbary plant, now an universal favourite for the sake of its peculiar fragrance, is the only species possessing any interest except to the botanist

**RESERVOIR** (Fr) A tank, or pond, in which water [illegible] is chiefly supplied with water by springs collected in a magnificent reservoir seven miles distant from the city The term is also applied to a place where water is collected and preserved for the more regular supply of a fountain or drinking trough in seasons when it is not naturally abundant

**RE'SIDENCE OF CLERGYMEN ON THEIR BENEFICES,** is enjoined by the common law of England, as well as by the canon law and many statutory provisions These last are now consolidated by 1 & 2 Vict c 106 Under that act, an incumbent is considered to be non resident if he is absent for one or more periods exceeding in the whole three calendar months in each year, and will be liable to the penalties unless he has obtained a licence for non-residence from the bishop, or is within any of the statutory exemptions The licence may be given where there is no house or fit place of residence [illegible] convenient house described [illegible] the act will be within three miles of the church, or within two of the chief [illegible] city market [illegible] who may not, however, be absent on account of their residence and performance of duty elsewhere for more than five months Licences for absence from the benefice may also be granted by the bishop, on petition, for a few other causes incapacity of mind or body, the dangerous illness of a wife or child, part of the family — in which case the licence is only for six months, and requires the archbishop's renewal, and in case a house convenient for residence cannot be procured within the benefice The penalties are fixed in a [illegible] fixtures of portions of the value of [illegible] be proceeded for in the bishop's court The bishop may also proceed by monition and sequestration

**RE'SIDUE** In Law, the remainder of a testator's estate after payment of debts and legacies If this remainder be bequeathed to any one, he is styled the residuary legatee If a legatee dies before the testator, the legacy is a lost or *lapsed* legacy and sinks into the residue and this provision of the law is extended to devises of real property by 7 G 4 and 1 Vict c 26 (the Wills Act) s 25 *See* LEGACY, WILL

**RE'SIN** (Gr ῥητίνη, from ῥέω, *I flow*) A proximate principle common in the vegetable kingdom, the ultimate components of which are carbon oxygen and hydrogen There are many varieties of resin Their general characters are fusibility [illegible], solubility in alcohol, insolubility in [illegible] into two distinct portions by the act[illegible] of hot alcohol They are valuable as ingredients in varnishes and several of them are [illegible] medicine They are often naturally blended with mucilaginous gum, in which case they constitute the series of *gum resins* The specific gravity of the resins varies between 1 0 and 1 4 They become negatively electric by friction The commonest resin in use, [illegible] distilling turpentine. [illegible] resin remains in the still

**RESI'STANCE,** in Mechanics, denotes generally a [illegible] to another force, so as to destroy [illegible] Resistance is sometimes considered as of two kinds, active and passive, the active [illegible] responds to the useful [illegible] the passive that which belongs to the inertia of the machine Thus, in raising water from a well, the active resistance to the force employed is measured by the quantity of water which is raised, and the passive resistance by the force required to overcome the weight of the bucket and the rope, the friction of the pulley on its axle &c

**RESISTANCE OF FLUIDS** In Hydrodynamics, the force with which a solid body moving through a fluid is resisted or retarded Of all the different kinds of resistance which manifest themselves among bodies, there is none of greater importance than this, on account of [illegible] MICS) The Newtonian theory of the resistance of fluids, which is given in the second book of the *Principia*, is founded on the assumption of the perfect intermobility of the particles of the fluid and the equal propagation of pressure in all directions These are, indeed, the characteristic properties of fluidity, nevertheless, the results of the mathematical theory differ so widely in many cases from actual experiment, that some philosophers have called in question the accuracy of the principles from which they are derived The theory however, notwithstanding its defects, furnishes some propositions of great practical use and, indeed forms the groundwork of all our knowledge on the subject We shall here give a general view of its leading principles

It is evident that a solid body, in moving through a fluid, must communicate a motion to the fluid particles with which it successively comes in contact Now, the quantity of motion communicated to the fluid is necessarily equal to that which is lost by the solid and may therefore be taken as the measure of the resistance To determine this quantity of motion let us conceive a cylindrical or prismatic body terminated by a plane perpendicular to its axis to be propelled through a non elastic fluid in the direction of its axis, so that the particles of the fluid strike against the plane perpendicularly and let A denote the area of the anterior surface of the body, $\varrho$ the density of the fluid and $v$ the velocity of the motion, during the small interval of time $dt$ Then the space described by the body in the time $dt$ is $v\,dt$, the volume of the fluid displaced in that time is $A\,v\,dt$, the mass of the fluid displaced is $\varrho\,A\,v\,dt$, and the momentum or quantity of motion imparted to the fluid is $\varrho\,A\,v\,dt \times v = \varrho\,A\,v^2\,dt$ Let R denote the resistance of the fluid, we have then

$$R = \varrho\,A\,v^2\,dt \qquad (1)$$

From this equation it appears that the resistance upon a plane surface moved perpendicularly through a non-elastic fluid at rest is proportional to the density of the fluid, to the area of the plane, and to the square of the velocity

We may deduce from equation (1) a measure of the force of resistance by comparing it with the pressure of gravity Let $h$ denote the height from which a heavy body must fall in order to acquire the velocity $v$ and let [illegible] $2gh$, and [illegible] this in equation (1), we get

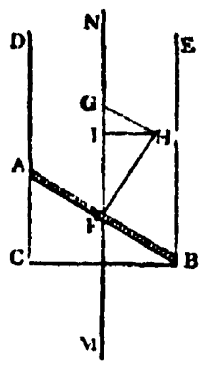
$$R = 2\varrho\,A\,h \times g\,dt \qquad (2)$$

Now since $g$ is the velocity generated by gravity in one second $g\,dt$ is the velocity generated in the time $dt$, and since $2\varrho\,A\,h$ expresses the mass of a prism of the fluid, having A for the area of its base and $2h$ for its altitude, $2\varrho\,A\,h \times g\,dt$ is the quantity of motion which the prism would acquire by the free action of gravity in the time $dt$, in other words, its weight We have, therefore, this proposition *The direct resistance of an unelastic fluid on any [illegible] a column of the [illegible] its altitude twice [illegible] ocity with which the surface moves* [illegible] Let W be the weight of the unit of [illegible], we have then

$$R = 2\,W\,A\,h \qquad (3)$$

The above measure of the force of resistance is deduced

on the supposition that the direction of the motion is perpendicular to the plane If the shock is received obliquely, the resistance will be greatly diminished Let




A B represent the profile of the plane, and M N the direction of the motion of the plane in stagnant water, or of a vein of fluid D C B E striking against the plane, supposed to be fixed Let F be the intersection of M N with A B, and draw B C perpendicular to M N Now, if A denote the area of the given plane A B, $v$ the velocity of the motion, and R the direct resistance due to the velocity $v$ (that is, the resistance which the plane would sustain if placed perpendicularly to M N), then (1) we have $R = \varrho A v^2 d t$ On F N take F G, to represent R This force F G may be resolved into two, F H perpendicular and H G parallel to A B, of which the latter produces no effect on the plane, hence the resistance is diminished, by reason of the oblique impact in the ratio of F H to F G, or of sin $i$ to 1 ($i$ denoting the angle of incidence A F N) But again, the absolute resistance is also proportional to the number of filaments which strike the plane, and it is obvious that the number which would strike it in the oblique position A B is less than the number which would strike it if directly opposed to the stream, in the ratio of B C to B A, or of sin $i$ to 1 Compounding this with the former ratio, the total diminution of resistance is as sin $^2 i$ to 1, that is to say, the absolute resistance or pressure in the direction F H perpendicular to the plane is R sin $^2 i$

It still remains to find the effective impulse or resistance in the direction of the motion Draw H I perpendicular to M N The force in the direction F H may be resolved into F I and I H, of which the effective part is F I Hence the effective impulse is to the absolute oblique impulse as F I to F H or as sin $i$ to 1, consequently the effective impulse on the plane in the direction M N is R sin $^3 i$ Let this be denoted by R′, we have then

$$R' = R \sin^3 i = \varrho A v^2 d t \times \sin^3 i \qquad (4)$$

If we denote by A′ the area of the projection of the plane A B upon a plane perpendicular to M N we have $A' = A \cos A B C = A \sin i$, and since $\varrho v^2 d t = 2 W h$, the above formula becomes, by substitution,

$$R' = 2 W A' h \sin^3 i \qquad (5)$$

From this last formula the effective oblique impulse in the direction of the stream upon any plane surface is easily computed For other surfaces than planes it is necessary to find an expression for the resistance on the differential element of the surface which may be regarded as coinciding with its tangent plane, and the sum of all the [illegible] surface of revolution we have

$$d A' = 2 \pi y d y \text{ and } \sin^2 i = \left(\frac{d y}{d z}\right)^2,$$

therefore,

$$R' = 4 \pi W h \int y \frac{d y^3}{d z^2}$$

Numerous experiments have been made for the purpose of ascertaining how far this theory of the resistance of fluids agrees with the actual facts or for forming an empirical theory for the guidance of the engineer Of the details of these experiments our limits will not permit us to give an account, but the principal experimenters and works to which we refer [illegible] Sir Isaac Newton (*Principia*, Book ii), Mariotte (*Traité des Mouvemens des Eaux*), Gravesande (*System of Natural Philosophy*), D Bernoulli and Krafft (*Comment Petropol*), Borda (*Mém de l'Acad des Sciences de Paris*, 1763 and 1767), Condorcet, D'Alembert and Bossut, by order of the French government in 1775 Bossut (*Hydrodynamique*), Du Buat (*Principes d'Hydraulique*), Robins (*Gunnery*), D [illegible] (*Traité de la Manœuvre des Vaisseaux*, Vince (*Phil Trans*), Hutton (*Tracts*), Beaufoy (*Nautical and Hydraulic Experiments*), Russel (*Trans of the Royal Society of Edin* vol xiv) &c The general results of the experiments may be stated as follows —

I The force of resistance on bodies moving in fluids is proportional to the square of the velocity at least within the limits of 2 to 10 feet per second This is in accordance with the theory

II The direct resistance on [illegible] at the same velocities is nearly in the [illegible]

III The resistances on surfaces moving obliquely do not by any means vary in the ratio of the squares of the sines of the angles of incidence, especially when the incidence is very oblique, and for such motions the theory must be entirely abandoned

The above results are, however, considerably modified by various circumstances, of which the principal are the following —

1 The form of the body The Newtonian theory takes account only of the anterior surface of the body, but it was clearly established by the experiments of Du Buat that the form of the hinder part is not less efficacious in modifying [illegible] having its prow and [illegible] plunged horizontally into a stream, will require, in order to keep it immoveable, a force in the direction of its axis equal to the difference of the real pressures exerted on its prow and poop If the fluid is at rest, this difference will be nothing, because the opposite dead pressures are equal, but in a stream there is superadded to the dead pressure [illegible] is employed in turning them into the trough behind the body, and consequently there is less pressure on the posterior surface than if the body were at rest in stagnant water, so that the body is impelled backwards This force is called by Du Buat the *non-pressure*, by Beaufoy the *minus pressure* Now, the whole impulse to be withstood if the body is in a stream, or the resistance to be overcome if it moves in stagnant water, is the sum of the active pressure on the fore part and the non pressure on the hinder part and this does not depend solely on the form of the prow and poop, but also, and perhaps chiefly, on the length of the body The non-pressure on a cube was found by experiment to be reduced to a fourth part, by making the length of the body triple of the breadth The mere lengthening of a ship, without changing the form of the prow or poop, increases the speed

2 Another circumstance which modifies the general results is the velocity of the body It was ascertained, by Mr Russel's experiments on canal boats, that the resistance does not follow the ratio of the squares of the velocities, excepting when the velocity is small and the depth considerable, but that the increments of the resistance are greater than those due [illegible] as the velocity approaches t [illegible] the depth of the fluid, and that immediately after passing this limit the resistance suffers a sudden diminution, and becomes much less than that due to the square of the velocity In a canal about five and a half feet deep this limit (which is the velocity of the wave generated by the motion of the body) was found to be from 11 to 12 feet per second, or [illegible] hour

3 A third c[illegible] the theory is the adhesion of the molecules of the fluid, which is most sensible when the motion is slow and the body small and very long In such cases, it becomes necessary to add a term depending on the first power of the velocity

4 The resistance is also influenced by the depth of the body under the surface of the water When the body is near the surface the resistance is greater than when it is at the depth of six feet When a body floats the fluid is heaped up, as it were, before the anterior surface, by which the resistance is increased

5 In elastic fluids, as the density increases with the pressure, the density of the fluid before the anterior surface increases with the velocity, and the increments of the resistance are greater than in the ratio of the square of the velocity In this case also we may conceive a velocity so great that the pressure on the posterior surface becomes negative as in the case of a cannon ball projected with a velocity greater than that with which air rushes into a vacuum When this takes place the fluid is not even in contact with the posterior surfaces of the ball and the character of the resistance is wholly changed *See* PROJECTILES

6 When a body moves in a fluid a portion of the fluid adheres to the body and accompanies it in its motion, whereby the form of the moving body is altered and the resistance increased The quantity of fluid thus dragged along is independent of the velocity, and was estimated by Du B[illegible] [illegible] in water [illegible] to 1 to 1 6 It [illegible] that the quantity [illegible] proportional to the bulk of the moving body Mr Baily (*Phil Trans* 1832) gives, as the mean results of his experiments on pendulums swinging in air the ratio 1 to 1 846 as the increase of the displaced fluid from this cause and remarks that the quantity appeared to depend on the form as well as magnitude of the moving body, but not on its weight or specific gravity This circumstance which considerably modifies the resistance though made known by Du Buat in 1786, was overlooked by other experimenters, until rediscovered by Bessel in 1826 when engaged on experiments to det[illegible] seconds' pendulum

From the [illegible] it be inferred that the resistance R opposed to any body moving through a fluid considered as a pressure of so many pounds weight, will be expressed by an equation of this form,

$$R = (m + n) W A h,$$

where W is the weight in pounds of the unit of volume of the fluid (one cubic foot), A the area of the greatest transverse section of the body expressed in square feet, $h$

the height in feet due to the velocity so that $h = v^2 - f$ and $m$ and $n$ numerical coefficients constant for bodies of similar figure but variable for bodies of different figures and to be determined by experiment for each kind of body, $m$ having reference to the impulse and pressure on the anterior surface and $n$ to the non pressure on the posterior part The following are a few of the cases for which values of $m$ and $n$ have been found

When a thin plate is directly opposed to the impulse of a stream, the value of $m + n$ appears to increase with the area If A is equal to a tenth of a square foot, $m + n = 1\ 4$, and if A = 1 square foot, $m + n = 1\ 9$ The value of $m + n$ for surfaces of larger dimensions has not been sufficiently determined For a prismatic body terminated by two planes, the pressure against the anterior force remains constant, but the non pressure, or value of $n$, diminishes as the length increases For a cube held fast in a stream, Du Buat found $m + n = 1\ 46$, and for a prism whose length was from three to six times the square root of its face, $m + n = 1\ 34$ But when the bodies moved in still water, he found, as for the thin plate, $m + n = 1\ 43$, for the cube, $m + n = 1\ 17$, and for the prism, $m + n = 1\ 10$

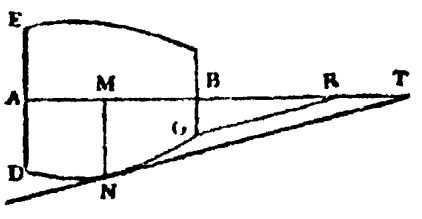
By means of these values the actual resistances are readily computed for each body, when the velocity is given Suppose the velocity to be 3 feet per second and the opposing surface in each case to be 1 square foot For $v = 3$, we have $h = 9 - 64 = 1406$ With respect to W, the weight of an imperial gallon of water, at temperature 62° and under the mean pressure, is 10 lbs avoirdupois, but an imperial gallon contains 277 27 cubic [illegible] stagnant water with a velocity of 3 feet per second, the absolute resistances in each case are as under —

For the thin plate $R = 1\ 43 \times 62\ 3 \times 1406 = 12\ 5$ lbs
For the cube $R = 1\ 17 \times 62\ 3 \times 1406 = 10\ 2$
For the prism $R = 1\ 10 \times 62\ 3 \times 1406 = 9\ 6$

The effect produced by the addition of a poop or prow was also determined by Du Buat The addition of a poop to a prismatic body whose length is four or five times its breadth only diminishes the resistance by a tenth part But when a prow consisting of two equal vertical planes making with each other an angle of 60°, was added the resistance was reduced to about a half On giving the prow the form of a semicylinder, the resistance was also reduced about a half The section of the prow being a triangle whose height was double the base or breadth of the prism, the resistance was reduced to two fifths In general a prow having a curved surface produces a greater diminution of the resistance than one of equal magnitude terminated by plane surfaces

For a sphere moving in water or in air with a moderate velocity, the experiments give $m + n = 0\ 6$, but this [illegible] in the [illegible] in the model of a ship moved in the direction of its axis gave $m + n = 0\ 16$ This may be considered as the value corresponding to the solid of least resistance For the effect with which solid bodies resist an effort tending to break or crush them see STRENGTH OF MATERIALS, and for the resistance of the atmosphere on a projectile, see GUNNERY, PROJECTILE

RESI'STANCE, SOLID OF LEAST In Mechanics the solid whose figure is such that in its motion through a fluid it sustains the least resistance of all others having the same length and base, or, on the other hand being stationary in a current of fluid offers the least interruption to the progress of that fluid In the former case, it has been considered the best form for the stem of a ship, in the latter, the proper form for the pier of a bridge The determination of the curve whose revolution gives the body having this property is a problem which is solved by the ordinary methods of maxima and minima when the law of resistance is assumed On the hypothesis that the resistance is proportional to the square of the velocity, Newton gave the following construction — Let a curve D G be so taken that if from any point N in it an ordinate N M be drawn perpendicular to the axis A B, and from a given point G the line G R be drawn parallel to the tangent N T at N, cutting the axis in R, then if $M N \cdot G R = G R^3 - 4\ B R \cdot B G^2$, the solid generated by the revolution of this curve about the axis A B will be the solid of least resistance (*Principia*, lib ii prop 34)




RI'SOLU'TION (Lat resolutio) In Medicine and Surgery, this term implies the cessation or dispersion of inflammatory action without the formation of an abscess or mortification

RESOLUTION In Music, the writing out of a canon or fugue in partition from a single line

RESOLUTION OF A DISCORD The descent by a tone or a semitone, according as the mode may require, of a discord which has been heard in the preceding harmony

RESOLUTION OF EQUATIONS The finding the values which the unknown quantity or quantities must have, so as to fulfil the conditions expressed in the proposed equation, viz of rendering the aggregate value of all the positive terms equal to the aggregate value of all the negative terms These values are called the *roots of the equation* *See* EQUATION

RESOLUTION OF FORCES *See* RESULTANT

RESOLUTION, or SOLUTION, in Mathematics, is the orderly enumeration of the things to be done to obtain what is required in a problem A problem may be divided into three parts, — the proposition, the resolution, and the demonstration

RE'SONANCE (Lat resonans) In Music, the returning of sound by the air acting on the bodies of stringed musical instruments

RESPIRA'TION (Lat respiro, *I breathe*) The function by which the nutrient circulating fluid of an organized body is submitted to the influence of air, for the purpose of changing its properties The great end which appears to be answered by respiration is the removal of carbon, in the form of *carbonic acid*, from venous blood This gas is accordingly found in the air which is expired from the lungs, and the blood, having lost its carbonic acid, at the same time loses its dingy hue, and acquires the florid red which characterizes arterial blood It has been shown by Dr Stevens that a peculiar attraction exists (not chemical) between oxygen and carbonic acid, which [illegible] nce of which [illegible] s it were, out [illegible] in the cellular structure of the lungs, while at the same time, a portion of oxygen, probably equal in bulk to that of the emitted carbonic acid, is absorbed by the blood, and contributes to its arterial characters The change from the arterial to the venous state, and consequently the formation of carbonic acid, appears to take place in the capillary junctions of the artery and vein, but how it is there effected we know not

From the quantity of carbonic acid emitted from the lungs in a given time, it has been attempted to ascertain the quantity of carbon which is thus thrown off, but the usual estimates upon this subject which place it at about 12 ounces in the 24 hours, are probably overrated, inasmuch as that quantity of carbon is more than exists in the food daily taken into the stomach If we average it at 6 ounces, it will probably be nearer the truth, and 6 ounces of charcoal are equal to 22 ounces of carbonic acid gas Besides carbonic acid, there is also a quantity of aqueous vapour thrown out with the expired air, this is probably chiefly produced by the superficial exhalents of the lungs, but it may also be partly derived from transpiration from the blood It has not been satisfactorily ascertained whether nitrogen is taken up by the blood as well as oxygen though experiments have rendered it probable that a portion of that component of the atmosphere is also absorbed

RESPIRATION OF PLANTS *See* BOTANY

RESPIRATOR An instrument fitted to cover the mouth over which it is retained by proper bandages It is constructed of a series of flattened silver or gilt wires, over and between which the air passes and repasses in the act of respiration and of speaking It is presumed that the warm air emitted from the lungs imparts its excess of temperature to the small metallic bars and that these in their turn impart heat to the cold air drawn through them at each inspiration, so that in this way the low temperature of the external air in cold weather is mitigated before it reaches the lungs, and its supposed noxious influence prevented When a handkerchief is tied over the mouth [illegible] the nose the extre [illegible] external air [illegible] before it reaches the lungs

RESPONDENTIA In Mercantile Law, a species of contract, which differs from bottomry, in that the loan is effected on the security of the freight, and not on that of the ship itself *See* BOTTOMRY

REST In Music, a pause or interval of time, during which there is an intermission of the voice or sound A rest may be for a bar, or more than a bar, or for a part of a bar only

RESTITU'TION, WRIT OF, in Law, lies where judgment has been reversed, to restore to the defendant what he has lost It can properly only be granted where the party cannot be restored by the ordinary course of law Restitution of goods [illegible] to the common law, but [illegible] it By the statute 7 & 8 G 4 c 29 s 57, it is now in the power of the court to award a writ of restitution of goods and chattels, and to restore them in a summary manner, where a thief or fraudulent taker has been indicted on the part of the owner and convicted Such restitution cannot be granted of a valuable security, where the property has passed into other hands by a bonâ fide trans-

action But a writ of restitution will reach goods stolen, although they have been sold in market overt Restitution can be had from the person in possession of the goods at the time of and after the felon's conviction

RESTORATION THE In English History is applied by way of eminence to the accession of Charles II to the throne after an interregnum of eleven years and four [illegible] memoration of the restoration of the monarchical form of government in these realms

RESULTANT, in Dynamics, is the force which *results* from the *composition* of two or more forces acting upon a body When the two forces act upon a body in the same line of direction, the resultant is equivalent to the sum of both; when they act in opposite directions, the resultant is equal to their difference, and acts in the direction of the greater If the lines of direction of the two forces are inclined to each other, then, on taking in each direction from the point where they intersect a straight line to represent each of the forces respectively, and constructing a parallelogram of which these lines are the sides, the resultant is represented both in intensity and direction by the diagonal [illegible] ssing through the point of intersection [illegible] this resultant with a third force, a new resultant will be obtained, and in this manner the resultant of any number of forces may be determined *See* COMPOSITION OF FORCES

RESURRECTION (Lat resurgo *I rise again*) The history of the resurrection of our Saviour is detailed in the separate narration of each of the four Evangelists and is also referred to and insisted on in the Acts of the Apostles, and in every one of the Epistles The importance of this history as an evidence of the truth of Christianity, is pointed out in a peculiar manner by Paley (*Evidences*, part 2 ch 8), namely that it was alleged from the beginning by all the propagators of Christianity and relied on as the great test of the doctrines which they taught, consequently, if the fact be untrue they must all have been either deceivers or deceived in a point on which it is morally impossible they could be so

RESUSCITATION (Lat resuscitare *to arouse*) This term is generally used to signify the restoring to animation of persons apparently dead The first and principal object in these cases is to aerate the blood by the artificial introduction of fresh air into the lungs, and to restore the natural function of respiration the lungs therefore, must be inflated, and proper stimulants applied when necessary, among these in cases of drowning and of apparent death from exposure to cold friction and warm bath are eminently important after hanging, the vessels of the brain often require to be unloaded by venesection in the jugular vein Electricity is sometimes resorted to, but generally hopelessly In all these cases no time should on any account be lost, as every thing depends upon *prompt* treatment as well as upon *proper* means and many lives have been lost for want of immediate aid, and skill in applying it The attempts to restore suspended animation should not be given up till unequivocal proofs of death are manifest (See DROWNING) The details of the management of different cases of apparent death are too extensive to come within our limits upon this subject the reader may advantageously consult *Taylor's Elements of Medical Jurisprudence*

RETAINER In old English Law a servant not dwelling in the master's house or employed by him in any distinct occupation but wearing his *livery* (i e hat, badge, or suit), and attending on particular occasions an important relic of the times of private warfare The giving liveries, or *retaining* this class of servants, was forbidden by many statutes with little effect The statutes themselves were repealed by 3 Car I c 1, but the usage had nearly ceased

RETAINER, or RETAINING FEE In the language of the Bar, a fee given to a counsel to secure his services, or rather, as it has been from engaging them [illegible] case expected to come on A *general* retainer is given by a party desirous of securing a priority of claim on the counsel's services for any case which he may have in any court which that counsel attends The effect of it is merely this, that if a counsel having a general retainer receive a special retainer on the other side, he cannot accept it until twenty-four hours after notice shall have been given of its arrival to the party so generally retaining him, when, if he does not receive a brief or a special retainer from the [illegible] The same word in its strict [illegible] the engagement of an attorney [illegible] enhances the [illegible] law between them

RETARDATION The act of hindering the free progress of a body and ultimately therefore, stopping it It arises from the opposition of the medium *in* which the body moves, or from the friction of the surface *upon* which it [illegible] See FRICTION, RESISTANCE

RETE MUCOSUM (Lat) The soft and apparently fibrous matter, or layer, situated between the cuticle and the cutis, it is the seat of the colour of the skin It is black in the negro, and the colouring matter is of such a nature as to admit of being bleached by the action of chlorine

RETIARIUS *Retiariæ* (Lat rete, *a net*) In Entomology, those spiders are so called which spin a web or net to entrap their prey

RETIARIUS (Lat rete, *a net*) The name of a class of Roman [illegible] in a peculiar way The retiarius was [illegible] a trident and net, with no more covering than a short tunic, and with these implements he endeavoured to entangle and despatch his adversary, who was called secutor (from sequi, *to follow*), and was a [illegible] and sword

RETICULE, [illegible] Zoology, when a surface has a number of minute impressed lines which intersect each other in various directions, like the meshes of a net

RETICULATED WORK In Architecture, that wherein the stones are square and laid lozengewise, resembling the meshes of a net This species of masonry is scarcely ever practised in the present day, but it was very common among the ancients

RETICULATUS, *Reticulata* (Lat reticulum, *a net*) The name of a section of Lithophytes, comprehending those in which the polype cells have a reticulate disposition on the surface of expanded plates

RETICULE In a telescope, a network of some fine fibres crossing each other at [illegible] field of view into a series of [illegible] been long used for observations on the quantity of the enlightened parts of a luminary during eclipses, and is found, under most circumstances, well adapted for the purpose when placed in a convenient position in respect [illegible] The term reticule is [illegible] kind of net-work, but now of every description of materials, used by ladies

RETICULUM (Lat) The name of the "honeycomb bag," or second cavity of the complex stomach of the Ruminant quadrupeds, so called because of the reticulate or honeycomb-like disposition of the mostly hexagonal cells which occupy its inner surface

RETINA (Lat rete) The pulpy expansion of the [illegible] of the eye it is the seat of vision

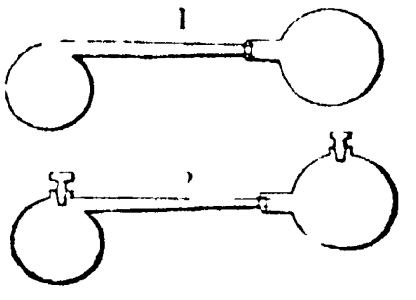
RETINASPHALTUM or RETINITE (Gr ρητινη, *resin*, and ασφαλτος *bitumen*, or *retinite*) A substance discovered by Mr Hatchett, associated with Bovey coal, and which has since been found in other coal strata When digested in alcohol it yields a portion of resin, and asphaltum remains, it appears therefore, to be a substance intermediate between resin and bitumen, and renders it probable that bitumens are of resinous origin

RETINITIS Inflammation of the retina

RETIPEDS *Retipedes* (Lat rete, and pes, *a foot*) The name given by Scopoli to one of the divisions of a binary arrangement of birds including all those which have the skin of the tarsi divided into small polygonal scales

RETIRED FLANK In Fortification, a flank having an arc of a circle with its convexity turned towards the place

RETORT A chemical vessel employed in a variety of distillations It is generally made of glass or earthenware, and sometimes is provided with a stopper so placed above the bulb as to enable substances to be introduced into it without soiling the neck, in this case it is called a *tubulated* retort A *receiver* is usually annexed to it for the purpose of collecting the products of distillation Fig 1 represents a plain retort and receiver, in fig 2 both are tubulated



RETOUCH [illegible] &c, a verb used [illegible] hand to a work which he had theretofore considered in a finished state

RETRACE In Painting &c, a verb used to denote the renewal of the outline of a drawing

RETRENCHMENT *See* FORTIFICATION

RETROCEDENT A term applied in Medicine to those diseases which move about from one part of the body to another, as *retrocedent gout*, when it leaves the toe for the stomach

RETROGRADATION [illegible] parent motion of a planet of the signs, or when the planet appears to move westward [illegible] the fixed stars *See* PLANET

RETURN in Law, in its most usual signification, is applied to writs The return to a writ is, properly speaking a recital by the sheriff or other officer to whom

it was directed of what he has done in execution of it; as, for example, in cases of civil process, that the defendant cannot be found (technically called non est inventus), has no goods within the sheriff's bailiwick (nulla bona) and so forth This is indorsed on the writ, and the writ is then delivered into the court whence it issued on the "return day," or day when the writ is returnable The remedy against the sheriff for a false return is by action on the case The return of members of parliament is, strictly speaking, the return by the sheriff, or other returning officer of the writ addressed to him, certifying the election in pursuance of it *See* PARLIAMENT

RETURN In Architecture a projecture in a building or wall is said to return when it projects in a different or oblique direction

REVEILLE (Fr *reveiller au matin*) The name given to the practice prevalent throughout all the European armies of beating the drum at daybreak, to awake the soldiers and put a stop to the challenging of the sentries The equivalent tune played on the bugle in the evening to summon the soldiers within their barracks, is called the *retreat*

REVELATION, in a theological sense, is a communication of truth made by God to man, but it is understood that those truths only are revealed which are communicated by direct and special means, that is, by divine inspiration Such fragments of the divine will and economy as are taught men by their own faculties and instincts are distinguished under the term *natural religion*

REVELS, MASTER OF THE, or LORD OF MISRULE The name of an officer formerly attached *pro tempore* to royal and other distinguished houses whose duty it was to preside over the Christmas entertainments This office was first permanently instituted in the reign of Henry VIII, and appears to have gone out of fashion towards the end of the 17th century

REVENDICATION A term of the civil law, signifying a claim legally made to recover property by one claiming as owner The right of property must, generally [illegible] of revenue corporeal [illegible]

REVENUE [illegible] the income of a state derived from the customs excise, taxation and other sources, and [illegible] national expenses [illegible] showing the revenue and expenditure of Great Britain will be found in the Parliamentary Papers printed every session

REVEREND (Lat reverendus) A title of respect given to the clergy In Roman Catholic countries the members of the different religious orders are styled *reverend* In England deans are [illegible] *reverend* and archbishops [illegible] the principals of the universities and the moderator of the General Assembly for the time being are styled *very reverend*

REVERSE In Numismatics, the opposite to the obverse or face of the coin or medal *See* OBVERSE, NUMISMATICS

REVERSION, in Law is defined to be the residue of an estate in lands tenements or hereditaments left in the grantor, to commence in possession after the determination of some particular estate granted by him

REVERSION OF SERIES, in Algebra is a method of expressing the value of an unknown quantity which is involved in an infinite series of terms, by means of another series of terms involving the powers of the quantity to which the proposed series is equal Thus, if the proposed series be

$$z = a x + b x^2 + c x^3 + d x^4 + \text{ad inf} \qquad (1)$$

and if we assume

$$x = A z + B z^2 + C z^3 + D z^4 + \text{ad inf} \qquad (2)$$

the original series will be reverted on determining the coefficients A B C D &c

The ordinary method consists in substituting the last series (2) and its powers for $x$ and its powers in the series (1), and equating the coefficients, whereby the values of A B, C, D, &c are obtained But this method, though given by Newton, by whom the problem was first proposed, becomes unmanageable after a few steps, and is moreover defective, inasmuch as it does not show the connection of the coefficients, nor the law by which they are formed A general formula was given by Arbogast (*Calcul des Derivations*), whereby they may be continued with comparatively little trouble to almost any extent The values of the first four coefficients are,

$$A = \frac{1}{a}, \quad B = -\frac{b}{a^3}, \quad C = \frac{2b^2 - ac}{a^5},$$

$$D = -\frac{5b^3 - 5abc + a^2 d}{a^7}$$

(See also *Woodhouse's Principles of Analytical Calculation*, arts 72 and 73; and the *Penny Cyclopedia*, where the values of the coefficients are given to eleven terms)

REVERSION, REVERSIONARY PAYMENTS In the doctrine of Annuities, a reversion is a payment which is not to be received, or a benefit which does not begin, until the happening of some event as the death of a person now living Payments which are received at the end of a specified period of time are called *deferred payments*

The present value of a sum of money to be received on the death of an individual of a given age depends evidently upon the chances which the individual has of surviving each future year of age, combined with the interest of money The method by which the value is calculated, from an observed or assumed law of mortality, has been explained under the term ASSURANCE, and for the sake of facilitating calculations of this kind which are of very frequent occurrence in the affairs of life, extensive tables have been published, computed from various hypotheses of mortality, and at different rates of interest Such tables are usually exhibited in the form of Annuity Tables, from which the solutions of all questions relating to assurances and reversions are easily deduced *See* ANNUITY and ASSURANCE

Let A denote the value of an annuity of 1*l* on a life of a given age V the present value of 1*l* to be received at the end of the year in which the life fails (the year being supposed to commence with the day on which the annuity is payable), $r$ the rate of interest, and $v = 1 - (1 + r)$, then

$$V = v(1 + A) - A, \text{ or } V = v - (1 - v) A$$

Suppose, for example that on the death of $A$, whose present age is fifty-five the sum of 5000*l* is to revert to $B$ or his assigns and that $B$ proposes to sell his interest in this reversion, and let it be proposed to calculate the sum which he ought now to receive allowing the purchaser interest at the rate of 4 per cent per annum In the table given under the term ANNUITY the value of an annuity of 1*l* on a male life aged fifty five is 11 0392 At 4 per cent we have $r = 04$, and $v = 1 - 1\ 04$, therefore $V = \frac{12\ 0392}{1\ 04} - 11\ 0392 = 5370$ This is the value of the reversion of 1*l* consequently $5000l \times 5370 = 2685l$ is the sum which $B$ should receive for his reversionary interest

When the reversionary benefit consists of an annuity to commence upon the death of an individual and to continue for a term of years certain its value is found by computing the value of the annuity for the assigned period and proceeding as in the above example, but when it consists of an annuity commencing upon the death of one individual, and terminable upon the death of another, it becomes necessary to have recourse to tables of annuities on joint lives Thus if $A$ becomes entitled upon the death of $B$ to an annuity of 1*l* for the remainder of his life the present value of the reversion or of $A$'s interest is equal to B — A B, where B denotes the present value of the annuity on the life of $B$, and A B the value of the annuity on the joint lives of $A$ and $B$, that is to continue only so long as both remain alive

The four following rules give the solution of all the cases of reversionary annuities which can arise when three lives are concerned and it is seldom that a case occurs in practice involving a greater number It is to be observed that the two letters A B standing together denote as above the value of an annuity on the joint lives of $A$ and $B$, B P that of an annuity on the joint lives of $B$ and $P$ A P Q that of an annuity on the joint continuance of the three lives $A$ $P$ $Q$, and so on Let R be the value of the reversionary annuity in each case

1 On a single life $A$, after the longest of two lives $P$ and $Q$, R = A — A P — A Q + A P Q

2 On the longest of two lives $A$, $B$ after a single life $P$, R = A + B — A B — A P — B P + A P B

3 On a single life $A$, after two joint lives $P$, $Q$, R = A — A P Q

4 On two joint lives $A$, $B$, after a single life $P$, R = A B — A B P

When reversionary benefits are contingent on lives failing in an assigned order as for instance an annuity to be received upon the death of $A$ provided he die while $B$ is living, the formula becomes more intricate, and could scarcely be explained without [illegible] inconsistent with the nature of this [illegible] formation on the subject see the Treatises of *Baily* [illegible] We may remark, however, [illegible] with this subject may be greatly [illegible] of an appropriate notation for examples of which see *De Morgan's Essay on Probabilities*, *Cabinet Cycl*, and *Hardy's New and General Notation for Life Contingencies* (1840), in which last work the solutions of all the cases of annuities and assurances which can arise, when not more than three lives are concerned, are arranged in a convenient table

REVE'TEMENT In Fortification, a strong wall of brick or stone [illegible] round the lower part of the rampart, to [illegible] and prevent it from falling into the ditch, as well as [illegible]

REVIEW [illegible] is assumed, by the [illegible] for periodical publications consisting of a collection of critical essays The *Journal des Savans*, commenced at Paris in 1665 by M de Sallo is commonly cited as the first review properly so called The most distinguished modern journals under the name of review in France are, the *Revue Encyclopédique* the oldest of them (now extinct), the *Revue Française*, and *Des Deux Mondes*, and the *Revue Britannique*, which consists of translations from the English In England the *Monthly Review* (established in 1749) was the [illegible] its kind The establishment of the *Edinburgh Review* in 1802, followed by that of the *Quarterly* in 1809, may be said to have commenced a new era in criticism from that time reviews have been adopted as the organs for conveying the opinions of sects and parties in religion and politics, as well as in literature All the leading works of this description (the *Edinburgh Quarterly*, *Westminster*, *British Quarterly*, *North British*, *Church of England*, and *Dublin*) now appear quarterly, or nearly so The management of reviews in England is in the hands of an editor, whose name, however, does not appear, the publisher being the party responsible The articles are also always anonymous the *Westminster* only, some time ago, adopted the practice of putting the initials of contributors, or initials assumed by them, at the foot of their papers All these reviews adhere to their designation, the articles admitted being in the form of *reviews* on some work or works specified at the head, [illegible] fact, the latter are often not even noticed [illegible] writer, his remarks being more in the form of a general essay than of a review In this way they serve the purpose of affording governments or political parties the means of making statements of facts or declarations of opinion, which do not involve them in the difficulties of direct responsibility and yet are generally understood to convey their sentiments The pay of writers in reviews is various, depending not only on the means of the review, but on the rules adopted by particular editors, for some have thought proper to equalize their rate of remuneration, others to retain in their own hands the power of estimating contributions according to their supposed value The French 'revues' are conducted on a different plan Articles in general have the name of the contributor attached, and the form of a "review" is not preserved tales, poetry, essays on the politics of the day, &c, [illegible]

But besides [illegible] established in the other European states, and in America, but this species of publication has taken the deepest root in Germany, where reviews may be said without exaggeration to appear daily, though none of them possess the influence of our *Edinburgh* or *Quarterly Review* The *Gottinger Gelehrte Anzeige* which is the oldest still exists and maintains a high character for ability and impartiality

REVIEW In Military language an inspection of the appearance and regular disposition of a body of troops assembled for that purpose

REVISE *See* CORRECTING

REVI'VOR, BILL OF, in Law, is a continuance of an original bill in a court of equity, when by death some party to it has become incapable of prosecuting or defending a suit or a female plaintiff has incapacitated herself by marriage from suing alone A bill "of revivor and supplement" continues a suit upon an abatement [illegible] arisen from some event subsequent [illegible] the suit

REVOCA'TION, POWER OF In Law, a power contained in a voluntary deed of conveyance to uses by which the grantor retains the liberty to revoke the uses granted by the deed Voluntary estates made with power of revocation are held fraudulent under stat 27 Eliz c 4 as against purchasers

RI'VOLUTE (Lat revolvo, *I roll back*) In Zoology, when a part is rolled outwards or backwards

REVOLU'TION In Politics, a word of somewhat indefinite meaning, but usually denoting an extensive change in the political constitution of a country accomplished [illegible] illegal means [illegible] is applied by way of eminence to the year 1688, universally regarded as the great era of English liberty, — when William III and Mary acceded to the throne on the forced abdication of James II

REVOLUTION In Geometry, the motion of a point or line about a centre

REVOLUTION, in Astronomy, is used to signify the period in which a planet, satellite, or comet returns to the place in its orbit from which [illegible]

REVOLUTION, FRENCH ERA OF THE In Chronology, this was substituted for the Christian era in all public acts and documents, by a decree of the National Convention in 1793, and fixed at the 22d September, 1792, the day of the foundation of the French republic It was abolished by Napoleon, and the Christian era restored in 1806

REX SACRO'RUM In Roman History, a priest appointed after the expulsion of Tarquin to superintend [illegible] had always been performed by [illegible] *Liv* ii 2)

RHABDOLOGY (Gr ῥάβδος, *a rod*, and λογος, *a* [illegible] given by Napier to a method of performing [illegible] a set of [illegible]

RHAB'DOMANCY (Gr ῥάβδος, and μάντεια, *prophecy*) Properly, divination by a rod or wand Some persons have been believed to be endowed by nature with a peculiar sense or perception, by which they are enabled to discover things hid in the earth, especially metals and water But a more prevalent opinion has been, that the discovery of these substances might be effected by means of a divining rod The divining rod is a branch of a tree, generally hazel, forked at the end, and held in a particular way, by the two ends, in the hands of the adept, and supposed to indicate the position of the substance sought by bending towards it with a slow rotatory motion, the adept, according to modern practice, being placed in contact with some metallic or other magnetic substance The art is said to be occasionally practised in the south of France and Italy, under the names of metalloscopy, hydroscopy, &c Campetti, an Italian, in the beginning of the present century, excited much attention by his professed powers of rhabdomancy

RHAMNA'CEÆ (Rhamnus, one of the genera) A natural order of arborescent or shrubby Exogens, inhabiting all parts of the world excepting the arctic regions The berries of various species of *Rhamnus* are violent purgatives, while the fruit of some, as the jujube, is harmless and eatable *Rhamnus frangula* yields the best kind of charcoal for gunpowder From the berries of *R infectorius* and others a yellow dye is obtained, but in general the species are neither useful nor ornamental They are all small-flowered polypetalous or apetalous plants, with four or five stamens alternating with the lobes of the calyx

RHAMPHA'STOS (Gr ῥαμφος *a beak*) The name of a genus of Scansorial bird (*Toucans*) in the system of Cuvier, distinguished by an enormous beak, nearly as thick and as long as the body in some species The compensation by which this disproportionate beak is rendered manageable and portable is an extremely light and cellular structure internally It is arcuated near the extremity, and in old toucans is irregularly indented along the edges The toucans are distinguished from the hornbills by the scansorial modification of their feet, in which two toes behind are opposed to two in front, and by their long, narrow, and ciliated tongue They are confined to the hot climates of America, where they live in small flocks feeding on fruit, insects, and the eggs and callow [illegible] other birds

RHAPO'NTIC IN A substance obtained from the *Rheum rhaponticum* in the form of yellow scales, insoluble in cold water and in ether and tasteless and inodorous It dissolves in 24 parts of boiling water, and in 2 of absolute alcohol

RHA'PSODIST (Gr ῥαπτω, *I sew or string together*, ᾠδη, *a song*) A class of persons who are said to have flourished in the age of Homer, whose occupation it was to compose or commit to memory poems, which they recited for the amusement of their auditors It has been supposed that by means of persons of this class the poems of Homer were preserved till the invention of [illegible] *Odyssey* by those who deny the individuality of Homer But the fact of the existence of such a class with higher pretensions than to the faculty of making short extemporaneous effusions is highly doubtful, as it rests mainly on the assumed fact that the art of writing was unknown in Ionia in the Homeric age

RHEA (Gr ῥεω, *I flow*) In Classical Mythology, [illegible] Cœlus and Terra, wife of Saturn, and mother [illegible] Juno Pluto &c She is frequently confounded with Ops, Terra, and Cybele For the particulars of her history, see SATURN

RHEA The name of a genus of Struthious birds, of which the three-toed ostriches of South America are the representatives

RHE'IN An inodorous bitterish substance of a yellow colour, obtained by gently heating powdered rhubarb with 8 parts of nitric acid of the sp gr 1 37, evaporating to [illegible] syrup, and diluting with cold water.

RHETORIC (Gr ῥητορικη [illegible] τεχνη *the rhetorical art*, [illegible] In the widest sense in which the [illegible] used by modern writers, the art of prose composition generally In the most restricted [illegible] of oratory, or of ad- [illegible] intermediate sense, in [illegible] employed, the art of

arg mentative compo ition This comes nearest to the ssification w ich Aristotle, the earliest extant writer of a formal treatise on subject when he def and employing topics topics or means of persuasion under three heads First, those which arise from the character of the orator himself, e the character in which, by what must be termed rhetorical artifice, he places himself before his hearers It is obvious that a speaker addressing an assembly, who is known by them to be actuated by honest motives and to understand the subject on which he speaks, advances by the mere possession of these adventitious attributes a long way towards the end and aim of oratory, viz persuasion Hence it is that Aristotle presents, as one of the chief branches of rhetoric, the art by which the speaker or writer, as it were, invests himself with these attributes, and thus ensures a more favourable reception to his argument The art of moving the passions by the use of such arguments and representations as are proper to in Aristotle s arrangement, to In his second division he treats of argument itself, considered with respect to its of form, and hence ancillary to or division of the subject exhibits the modes of persuasion arising from style, arrangement, delivery and action, and to this third branch writers who have treated of rhetoric in its more limited sense have usually confined themselves

As the work of Aristotle is the first so it is the only whom the art was much more diligently cultivated than among the moderns Public speaking was of infinitely greater importance in the classical commonwealths than in any modern state even in our own, where most sedulously studied and most valued it is but a subsidiary accomplishment The true momentum of decision that which convinces or dissuades lies in the pen of the writer rather than the voice of the orator, and whilst in the Grecian republics assemblies were actually swayed by oratory to determine on a particular course of action, its principal use now appears to be to arraign to vindicate or to explain the actions of individuals French oratory from the nature of its subject is and always was confined within narrow limits Probably pulpit oratory in modern Europe in society, answers most nearly to the classical notion of rhetoric, and had it ever been subjected to systematic rules, would have been found most nearly to conform to those which the ancients have left us Among the Romans oratory did not begin to be cultivated as a science until just at the period when its political importance was about to cease Rhetoric under the Roman empire was taught as a regular science, but its practical display was confined to the orators of the forum among whom the art gradually declined from the tendency of the civil law, during the last period of its development to conduct all process by written rather than oral method On the other hand the rules of declamations vogue during the decline of Roman literature and of panegyrical harangues The study of rhetoric in this perverted writing, schools of the Roman empire Some of the early Christian writers, especially Tertullian afford evident tokens of having acquired the art of composition under such discipline See ELOQUENCE

RHEU'MATISM (Gr *ρευματισμος*) A painful affection of the joints, attended and also affecting the muscular, textures It is occasionally accompanied by fever when it constitutes *acute rheumatism*, or *rheumatic fever*, in which case the joints are much swollen and excessively painful, the pulse frequent, but seldom hard, the perspiration usually abundant and acid, the tongue extremely foul and the bowels costive, headach is seldom complained of, and delirium very rare In this form of the disease its translation or metastasis to the heart is not uncommon The treatment consists in occasional venesection, in the use of purgatives and sudorifics and occasionally of tonics, more especially cinchona calomel and opium are also largely, and often very successfully employed *Chronic rheumatism* is not in general attended by any very re habits, when the health has been broken by previous disease or over exertion of body or mind Opium, especially in the form of Dover's powder, is generally necessary in this disorder to procure rest The bowels should be kept moderately active by warm purges, and tonics and alteratives cautiously administered A course of sarsaparilla is often extremely serviceable colchicum has been also tried but with most uncertain success

RHINOCEROS (Gr *ρις, a nose, κερας, a horn*) The name of a genus of Pachydermatous mammals, charac of the remarkable recurved horny process which rises from its upper mandible

RHINSBURGERS The name which sprung up in Holland in the seem to have separated from the church for the mere sake of separation, for they held all its doctrines, but rejected all discipline, no other profession being required from its members than a belief that Christ is the Messiah, and that the scriptures are inspired They allowed of no priests any member (women alone excepted) might preach and expound in their meetings, which were held in so called *colleges of piety* At one period they had formed eighteen of these in different towns, but from the large licence of the interpretation of scripture which they enjoyed several ran into enthusiasm, and having no principle of cohesion they soon fell to pieces, and are now completely extinct

RHIPIPTERANS *Rhipiptera* (Gr *ριπις, a fan, πτερον, a wing*) A name proposed by Latreille to supersede that of *Strepsiptera* by which Kirby designated a new order of insects which he had discovered The new name has nothing to recommend it since it signifies a character founded on the to other orders of insects

RHIZANTHS (Gr *ριζα, a root, ανθος, a flower*) A class of plants occupying a station between sexual and asexual species, and appearing to be an intermediate form of organization between Endogens and the lower orders of vegetation They agree with the former in the presence of sexes, and in their flowers having sometimes a ternary structure, but they have scarcely any spiral vessels and their seeds appear as far as they have been examined to consist of a mass of spores without a special embryo In their succulent texture in their colour, often in their putrid odour when decaying in the sporuliferous seeds and in their parasitical habits these plants resemble *Fungaceæ*, while in their flowers and sexes they accord with *Aroideæ*, or similar Endogens They are in all cases parasites and destitute of proper leaves, in lieu of which some of them have scales imbricated over their stems their parasitical habits, some are of the flowers of *Rafflesia arnoldi* are as much as nine feet in circumference

RHIZOMA In Botany See ROOTSTOCK

RHIZOSTOMES, *Rhizostoma* (Gr *ριζα* and *στομα a mouth*) A genus of *Medusæ* including those which have the absorbing orifices of their nutrient canals of small size and situated in great numbers on the branches of arms or peduncles extending from the centre of the inferior surface of the disk

RHODIUM (Gr *ροδον a rose*, on account of the rose-red colour of some of its salts especially of the chloride, when dissolved in water) A metal discovered in 1803 by Wollaston associated with palladium in the ore of platinum It is of a whitish colour very difficult of fusion, and very hard Its specific gravity is about 11, and its equivalent about 52 It has been used for the points of metallic pens

RHOMBOID In Geometry a quadrilateral figure which has its opposite sides equal When its angles are right angles it is called a *rectangle*

RHOMB SPAR A crystalline magnesian carbonate of lime

RHOMBUS In Geometry a plane figure bounded by four equal straight When its angles are right angles it becomes a square

RHONCUS (Gr *ρογχος*) A rattling or wheezing sound the term is chiefly applied to sounds occasioned by certain morbid states of respiration, as indicated by the stethoscope

RHUBARB The root of the *Rheum palmatum*, and perhaps some other species, cultivated in China for the supply of the drug market The varieties of rhubarb known in commerce under the names of Russian, Turkey, and Indian rhubarb are all derived from one source, but the select pieces are sold under the name of Russian and Turkey rhubarb, and those of somewhat inferior quality as East Indian To judge of the quality of rhubarb it should be cut or broken, when good it is of a mottled reddish or brownish red colour, that which is very pale or very dark coloured, and either so soft as to be spongy or hard and stony in texture, is bad Rhubarb is a valuable article of the materia medica, being an aperient, and at the same time a tonic and astringent The average dose of powdered rhubarb is twenty grains, which after its purgative operation leaves a certain astringent effect upon the bowels, hence its use in diarrhœa from two to five grains operates as a tonic and is very useful in some forms of dyspepsia A mixture of one part of rhubarb with two of powdered sulphate of potash is an excellent aperient for children It is oc- usion, but the powder plain, or peppermint, water, or in the form of pill.

**RHUMB** A circle on the earth's surface making a given angle with the meridian of the place, marking the direction of any object through which it passes The divisions on the compass card are called rhumbs. *See* MERCATOR'S CHART

**RHUMB LINE** In Naval Affairs, the track of a ship which cuts all the meridians at the same angle, called also the *loxodromic curve* This being the simplest curve, is the route universally pursued, but a ship sailing on this curve never looks direct for her port until it comes in sight *See* LOXODROMIC CURVE

RHYME (Gr *ῥυθμος*, *measure*, or Germ reim) In Poetry, [illegible] syllables [illegible] European languages There are rhymed verses in the Latin classical poets, where the jingle seems intentional, and more distinct examples of it in the fragments of Roman [illegible] which have come down to us But [illegible] the decay of the Latin language, when accent was substituted for metre in the rhythmical arrangement of the verse, rhyme made its way into the composition of church hymns &c It has been attempted, but with little success to deduce this innovation from the Goths, and from the Arabians, but the former, like the old Teutonic races probably used alliteration but no rhyme in their verses, and the latter could not have influenced European literature until a period long after that in which rhyme first appears A rhyme in which the final syllables only agree (*strain*, *complain*) is called a male rhyme, one in which the two final syllables of each verse agree the last being short (*motion ocean*), female, and the latter is sometimes extended in Italian poetry to three syllables (*fa more immemore*) when the verse is called *sdrucciolo* In English such a licence is hardly permissible except in burlesque poetry (see *Hudibras* and *Don Juan* for instances) By the strict rules of French prosody, the male and female species of rhymes must be alternately used however intricate the disposition of the verse may be, although the last short syllable is generally mute or very slightly sounded Rhymes which extend not only beyond the three last syllables but through the whole structure of the lines, are used in Arabian and Persian poetry Rhymes in which the consonants of the last syllable in each verse are identical (*dress address*) are vicious in English but rather admired in French poetry One more singularity of English poetry deserves notice while from the irregularity of our spelling many syllables rhyme with each other, although widely dissimilar in orthography (*woo pursue*), there are on the other hand rhymes which speak to the eye and not to the ear, i.e. in which the orthography of the rhyming syllables is the same, but the pronunciation different, as *wind*, *find*, *gone*, *alone* In the following triplet of Dryden, —

[illegible]
And thy blest Saviour's blood discharge the mighty sum —

it will be seen that the first and third lines rhyme in a [illegible] the last syllables are different [illegible] and second rhyme to the eye only, and not to the ear This is a licence only rendered admissible by precedent

**RHYNCHOPHORUS** *Rhyncophora* (Gr *ῥυγχος a beak* and *φερω I carry*) The name of a family of Coleopterous insects, comprehending those which have the head prolonged in the form of a snout or proboscis

**RHYTHM** (Gr *ῥυθμος*) The consonance of measure and time in poetry prose composition and music, and by analogy in dancing Each verse or each period may be considered as a whole within which the poetical rhythm is regular and exact within certain limited variations, the rhetorical less perfect, and the pleasure derived from it rather matter of taste and experience than of rule Those parts which receive the ictus or stress of the rhythm are termed *arsis* (elevation), the remainder form the *thesis* (depression), the former is frequently denoted to the eye by the accent marked when in a foreign or unknown word we wish to direct the voice in pronunciation to employ the correct emphasis The smallest rhythmical division is the foot, by which every union of arsis and thesis is understood A short syllable is an original unit of time, a long syllable contains two units The number of feet enumerated in classical writers on metre amount to twenty-eight, including all the varieties which may be formed out of two, three, or four syllables, long and short [illegible] two to eight units of time *See* FOOT, METRE

**RIAL** A gold coin current in the reigns of Henry VI and Elizabeth under the former its value was 10*s*, under the latter 15*s*

**RIBS** In Architecture [illegible] timbers to which, in an arched or coved [illegible] laths are nailed

**RIBS** A term for the timbers of a ship which spring from the keel, as the ribs of an animal from the back bone.

**RIBS** In Anatomy, the lateral appendages of a vertebra, especially when developed so as to encompass the trunk In the human subject there are twelve ribs

RICE *See* ORYZA

**RICE PAPER** This substance is said to be a membrane of [illegible] tree (*See* ARTOCARPUS) [illegible] small pieces, dyed of various colours, and is used as a material for painting upon, and for the manufacture of several fancy and ornamental articles It is sometimes erroneously stated to be prepared from rice (See Brewster, *Edinb Journ of Science*, vol ii)

**RICINIC ACID** One of the products obtained by distilling castor oil at a high temperature

RICKETS *See* RACHITIS

**RICOCHET FIRING**, in Gunnery, is a mode of firing with small charges from pieces of ordnance elevated at small angles, as from 3° to 6° It is a very destructive method, as the rebound causes the shot or shell to pass along a great space almost upon the ground, [illegible] it meets with in its way The word [illegible] is the sort of motion which is familiarly called ducks-and-drakes as applied to a flat stone thrown on the surface of the water under a very small angle

**RIDEAU** In Fortification, a small elevation of earth extending itself [illegible] to cover a camp from the [illegible] or to give other advantage to a post

**RIDER** A term used to signify any addition to manuscripts or other documents, inserted after their completion

**RIDGE** [illegible] in [illegible]

**RIDING** [illegible] three divisions of the county of York are so termed by a corruption of the Saxon word *thriding* or *trading* (third part)

**RIDOTTO** (Ital) A favourite public Italian entertainment consisting of music and dancing, held generally on fast eves

**RIFLE GUNS** Muskets or pieces of ordnance, whose barrels instead of being a clear cylinder inside, are furrowed with spiral channels The object is to give the ball a rotatory motion about an axis, in consequence of which it preserves its direction with much greater certainty than when fired from the common clear barrel *See* GUN

A body of men armed with rifles are called riflemen, but the term is most frequently applied to the military corps called the [illegible] and one battalion of the British army, which [illegible] are armed with rifles

**RIG** The peculiar manner of fitting the masts and rigging to the hull of any vessel, thus schooner rig ship rig, &c imply the masts and sails of these vessels without regard to the hull

**RIGGING** The system of cordage by which the masts are supported, and the sails extended or taken in The [illegible] is divided into *standing rigging* and *running* [illegible] It consists of the *pendants*, short strong ropes first put over the lower mast heads, and having thimbles for hooking tackles to the *shrouds*, *stays*, and *backstays* The lower rigging implies that of the lower masts, the topmast rigging that of the topmast, and so on The size strength number of ropes, &c of the rigging, are all matters determined by experience A complete description of rigging is to be found in the well known work of Darcy Lever

**RIGGING LOFT** The room or rooms in which the rigging is prepared

**RIGHT** In Geometry, a term sometimes used synonymously with straight, as *right line*, but generally as opposed to oblique Thus, a *right angle*, the angle formed by [illegible] lines perpendicular to each other, or in [illegible] *right cone*, *cylinder*, *prism*, *pyramid*, &c, figures whose sides are perpendicular to the plane of the base

*Right angled Triangle* A triangle having one right angle

*Right-angled Triangle* In Numbers A favourite speculation of the Platonic school of mathematicians was to find rational numbers which should designate the sides of a right-angled triangle Pythagoras gave the formulæ $n$, $\frac{n^2-1}{2}$, and $\frac{n^2+1}{2}$, where $n$ is odd Plato gave $2n$, $n^2-1$ and $n^2+1$, where $n$ is either odd or even Various other forms have been given by subsequent writers The determination of such sets of formulæ forms a branch of [illegible] Analysis

**RIGHT** In Geography, the position of the sphere when the equator cuts the horizon at right angles

**RIGHT ASCENSION**, in Astronomy, is the angle at the pole of the equator formed by two great circles, one of which passes through the first point of Aries, and the other through a celestial body, and is consequently measured by the arc of the equator intercepted between those circles *Right ascension* and *declination* are the

two co ordinates to which the positions of celestial objects are referred

RIGHT, DIVINE *See* DIVINE RIGHT

RIGHT OF PRO'PERTY (Lat jus proprietatis, Fr droit de proprieté) In Political [illegible] the right which states, bodies of individuals, and individuals have to the exclusive use and enjoyment of such lands, natural powers, and products as have been appropriated or set apart for any peculiar purpose

*Origin of this Right* — It would occupy the reader's time to no good purpose were we to state the different theories that have been advanced by jurists and writers on public law to account for the origin of this right * This, indeed, appears to us to be sufficiently obvious All the rude products furnished by nature have to be appropriated, and not one in a thousand, perhaps, of these products is, in its natural state, capable either of supplying [illegible] Hence the [illegible] appropriation of natural products, but in fashioning and preparing them so as to be useful, and hence, also, the origin of the right of property

If a number of individuals be set down together on the shore of an unoccupied and unappropriated island abounding with natural products, such as game, trees laden with fruit, &c, each will have quite as good a right as another to take the game or the fruit But those who do so, or who have through their skill and industry appropriated a portion of the common stock, will obviously be entitled to the exclusive use of such portion We shall not undertake to decide whether there be or be not a principle inherent in man that at once suggests to every individual that it is his duty not to interfere with what has been produced or appropriated by the labour of others, it is sufficient for us to know that the briefest experience would point out to every one the necessity of respecting this principle If A climb a tree and bring down fruit which as soon as he comes to the ground is taken from him by others he will not again engage in any similar undertaking till he be well assured that he shall be permitted exclusively to profit by what has been obtained through his sole exertions nor will others engage in any such undertaking without a similar assurance No doubt, therefore the right of property has had a very remote origin The necessity for its establishment is so very obvious and urgent that it must have been all but coeval with the formation of societies All have been impressed with the reasonableness of the maxim which teaches that products acquired by the *labour* of a man's body and the *work* of his hands should be considered as exclusively his own Even among the rudest savages the principle of *meum* and *tuum* is recognized, the bows and arrows of the huntsman and the game he has killed being regarded by him as his own, and his right to their exclusiv[illegible] The right of [illegible] rfected only by degrees, and is necessarily limited and adapted to the state of society at the time Thus among hunters the *feræ naturæ* on which they subsist not being bred under the care or inspection of individuals, are so long as they run wild in the forest, the common property of the tribe, and only become the property of individuals after they have been appropriated or caught by their labour or ingenuity As society advances the right of property expands The modern Tartars like the ancient Scythians estimate their wealth by the number of their cattle Their right to the animals which they have domesticated and reared is deemed sacred and inviolable, but the pasture grounds belong like the hunting grounds of the Indians to the whole society, and as the flocks are driven from one place to another, the grounds may be successively depastured by the cattle of every different individual The moment, however that men begin to renounce the pastoral for the agricultural mode of life a right of property in land began to be established The soil cannot be cultivated its fertility cannot be increased, nor can it be made to produce those crops which yield the largest supplies of food and other necessary accommodations, without continuous labour, and persevering attention

——— Pater ipse [illegible]
Haud fa nem [illegible]

[illegible] property in land Nothing, it is [illegible] any one to engage in a laborious employment, he would neither domesticate wild animals, nor clear and cultivate the ground, if, after months and years of toil, when his flocks had become numerous, and his harvests were ripening for the sickle, a stranger were allowed to rob him of the produce of his industry The utility, or rather necessity, of enacting [illegible] regulations, that should secure to every [illegible] peaceable enjoyment of the produce he had raised, and of the ground he had cultivated and improved, is, indeed, so very obvious, that it suggested itself to the first legislators [illegible] Book of Job places those who removed their neighbours' landmarks at the head of his list of wicked men, and the early Greek and Roman legislators placed these marks under the especial protection of the god Terminus and made their removal a capital offence (*Goguet, de l'Origine des Lois* lib i art 2) Society may thus be said to have grown out of [illegible] property in land "Had not," says Mr Justice Blackstone, a separate property in lands as well as moveables been vested in some individuals the world must have continued a forest, and men been mere animals of prey Whereas now, so graciously has Providence interwoven our duty [illegible] the [illegible] he hath scattered [illegible] as well over the face of the earth as within the bowels of it, and intersected every land with navigable rivers, and given others [illegible] had to civil society, which brought along with it a long train of inseparable concomitants, — states, government, laws, punishments and the public exercise of religious duties Thus connected together, it was found that a part only of society was sufficient to provide, by their manual labour, for the necessary subsistence of all, and leisure was given to others to cultivate the human mind, to invent useful arts, and to lay the foundation of society" (*Comment* book ii cap 1)

It is obvious, from what has now been stated that the law of the land is not as Dr Paley has affirmed, the real foundation of the right of property It has a much more remote and more solid foundation It grows out of the circumstances under which man is placed, and could not be overthrown or set aside without depopulating the earth and throwing mankind back into primæval barbarism The obvious utility of securing to each individual the peaceable enjoyment of the land he has enclosed and cultivated, and of the produce raised or acquired by his labour has undoubtedly formed the irresistible reason that has induced every people to make the right of property a part of the law of the land and to guard it by the strongest sanctions The security of property is, in truth the principal foundation on which society rests Until property had been publicly guaranteed men must have looked on each other as enemies rather than as friends The idle and improvident are always desirous of seizing on the earnings of the laborious and frugal, and if they were permitted to prosecute their attacks, they would by generating a feeling of insecurity, effectually check both industry and accumulation and sink all classes to the same level of hopeless misery as themselves The security of property is, if possible, still more necessary to accumulation than to production No man ever denies himself an immediate gratification when it is within his power unless he think that by doing so, his present forbearance will obtain for him a greater accession of comforts and enjoyments or that it will obviate some probable and considerable evil at a future period Where the right of property is vigilantly protected an industrious man who gains as much by one day's labour as is sufficient to maintain him two is not idle the second day, but accumulates the surplus produce above his wants as a capital, the increased consequence and enjoyments which the possession of capital brings along with it being in the great majority of cases, more than sufficient to counterbalance the desire of immediate gratification But, wherever property is insecure, we look in vain for the operation of the principle of accumulation 'It is plainly better for us," is then the invariable language of the people, to enjoy while it is in our power, than to accumulate property which we shall not be permitted to use and which will expose us to the depredations of those who exist only by the plunder of their more industrious neighbours"

The security of property is violated not merely when a man is deprived of the power of peaceably enjoying the fruits of his industry, it is also violated, and perhaps in a still more unjustifiable manner when he is prevented from using the powers with which nature has endowed him in any way, not injurious to others, he may consider most for his own advantage Of all the species of property which a man can possess, the faculties of his mind and powers of his body are most particularly his own He should, therefore, be permitted to enjoy, that is, to use or exert, these powers at his discretion And hence the right of property is as much infringed upon when a man is interdicted from engaging in a particular branch of business, as it would be were he unjustly deprived of the produce he had raised Every monopoly which gives to a few individuals the exclusive power of carrying on certain branches of industry is thus, in fact, established in direct violation of the property of every one else It prevents them from using their natural capacities, or powers, in the manner they may consider best, and as every man who is not a slave is justly held to be the best, and indeed only judge, of what is advantageous for himself, the principles of natural law

* The learned and curious reader may consult Puffendorff, lib iv c 4–6

and the right of property are both subverted by his exclusion from any employment In like manner, the [illegible] to force [illegible] in a particular way The property of a landlord is violated if he be compelled to adopt any system of cultivation, even supposing it were [illegible] he [illegible] is [illegible] to accept a lower interest for his stock than he might have obtained, and the property of the labourer is violated whenever he is obliged to engage in any particular occupation It follows, too, that every restraint on the freedom of commerce is an infringement of the right of property If I, the lawful [illegible] property is as much invaded as if I were debarred from making any direct use of the article Had this circumstance been adverted to, it is probable the restrictive system would not have made quite so much progress as it has done

*Effects of the Insecurity of Property* — The finest soil, the finest climate, and the finest intellectual powers, can prevent no people from becoming barbarous, poor and miserable, if they have the misfortune to be subjected to a government which does not respect and support the right of property All those vast and fruitful countries, comprising the fairest portion of the earth that stretch from the Black Sea to the Persian Gulph, and from the western shores of Morocco to the confines of China, once the seat of the most renowned empires, of arts and civilization are now through the want of security and freedom become the most deplorable spectacles of extreme misery "No care" says Mr Kinneir speaking of some of the most fertile provinces of Asia Minor "is taken to improve the land, nor can this be matter of surprise, when we reflect that the farmer is liable to be turned out at a moment's warning and is certain of being taxed or rather plundered, in exact proportion to the yearly produce of his farm It is not, indeed uncommon should there be a prospect of a plentiful harvest for the crops upon the ground to be seized by the pacha at a low valuation, and then put up to the highest bidder" (*Journey in Asia Minor &c* p 52) The same intelligent traveller observes in speaking of Syria, that the Grand Seignior is the lord of the soil and the *miri* or capitation tax is regularly paid into the public treasury The pachas derive their revenues from levying arbitrary contributions in money and in kind upon the merchants citizens villagers and cultivators of the land This unjust and uncertain mode of taxation is rendered still more afflicting by the manner of collecting it The troops and followers of the pacha a licensed banditti, disperse themselves over the country and villages, where they live at free quarters, and for every piastre that is received by their master at least three have been exacted from the unfortunate proprietor Under such a system neither agriculture commerce arms arts, nor sciences can ever make the least progress, and it is deeply to be lamented that no successful effort has hitherto been made to wrest so noble a country from those who are so unworthy to possess it (*Ibid* p 174)

Had it been possible for arbitrary power to profit by the lessons of experience it must long since have perceived that not only the wealth of its subjects but its own, would be most effectually increased by maintaining the security of property We [illegible] Turkey and Persia to establish [illegible] to secure to each individual the unrestrained power of disposing of the fruits of his labour and to substitute a regular plan of taxation in the room of the present odious system of extortion and tyranny, industry would gradually revive, capital and population would be augmented, and a moderate land tax or reasonable duties on a few articles in general demand would bring a much larger sum into the coffers of the treasury than all that is now obtained by force and violence The *stated* public burdens laid on the Turks Persians, &c, are light compared with those imposed on the English, Dutch and French But the latter know that when they have paid the taxes due to government they will be permitted peaceably to enjoy or to accumulate the residue of their wealth, whereas the subjects of eastern despotisms have, generally speaking no security that, the moment after they have paid their stated contributions, the pacha, or one of his satellites, may not strip them of every additional farthing they possess! Security is the foundation the principal element, in every well digested system of finance When maintained inviolate, it enables a country to support without much difficulty, a very heavy load of taxes, but where there is no security, where property is a prey to rapine and spoliation, to the attacks of the needy, the powerful, and the profligate, the smallest burdens are justly regarded as oppressive, and uniformly exceed the means of the impoverished and dispirited inhabitants

*Power of* [illegible] *operty* — T [illegible] of property [illegible] not only [illegible] should have the power freely to dispose of it during his lifetime, but also that he should have power to bequeath it to others in the event of his death *Nihil enim tam conveniens est naturali æquitate*, say the Roman jurists, *quam voluntatem Domini volentis rem suam in alium transferre, ratam haberi* (*Instit* lib ii [illegible]) It is evident that the being enabled to bestow our property on those who occupy the chief place in our affections must have a powerful effect in stimulating industry When a man is assured that he is not labouring for strangers that the fruit of his industry will not fall into the hands of an unknown successor, but will descend to his children or his friends he finds, as it were, his existence indefinitely extended, and continues with unimpaired energy to exert himself for the benefit of those who are to perpetuate his family and name and whose welfare perhaps, is as dear to him as his own The power of bequeathing property connects the future with the present, without it, no undertaking would be entered upon which did not promise an adequate return during the lifetime of the projector But in civilized societies the plans of the capitalist are not circumscribed by the brief duration of human life He plants forests by which he can never expect to be enriched, he raises edifices fitted and intended to outlive many generations, and executes innumerable improvements, of which posterity alone can reap the benefit And he does all this because he is permitted to name his successors, to transmit his property and effects to those with whom he is connected by the ties of kindred, affection or gratitude, and in whose welfare he feels a deep interest.

Numerous difficult and important questions have, however to be decided in framing regulations as to the bequeathing of property by will, and as our purpose at present is merely to point out the principle on which the power is conceded we shall defer the notice of the conditions which should limit its exercise to the article SUCCESSION LAW OF

*Property in Wild Animals* — It is clear from what has been previously stated and from the nature of the thing, that nothing can be made property unless it be susceptible of appropriation, and on this ground, it has sometimes been objected to the game laws that they have made a property of that which being incapable of appropriation should belong to the community, or to the captors In support of this view of the matter the rule of the Roman Law has been appealed to where it is laid down — *Feræ igitur bestiæ, et volucres et pisces, et omnia animalia quæ mari cælo et terra nascuntur, simul atque ab aliquo capta fuerint, jure gentium statim illius esse incipiunt, quod enim ante nullius est, id naturali ratione occupanti conceditur* (*Instit* lib ii tit i § 12) But it is distinctly laid down in the same article whence we have borrowed this paragraph that the proprietor of an estate has full power to prohibit any one from entering upon it to kill wild animals Without this proviso, there would not, in fact be any such thing as a real property in land and this is in truth, all that is meant when it is said that game is property A partridge or hare is mine so long as it remains on my estate but the moment it transfers itself to the estate of another it becomes the property of the owner of such estate Poachers are punished not because they have killed wild animals but partly and principally because in doing so they invade the right of property by killing it without leave on lands belonging to other parties, on which they had no right to enter, and partly because they have not paid the tax demanded by government from all who kill game

It is sometimes indispensable for the interests of society to appropriate the whole or a portion of the landed property of one or more individuals to some public purpose, as the formation of a road, a canal, &c But property should never be wantonly taken for such purposes, nor till the advantages to be obtained by its cession have been fully established before some competent tribunal, and when this has been done, full compensation should in every case be given to those who are thus called upon to give up their property for the promotion of the public interests

*Inconveniences of a Community of Goods* — Those schemes of policy that have been founded or projected either upon the principle of a communion of goods, or of an equal partition of the land among the different families belonging to the society, are bottomed on the most erroneous views, and would, if they could be acted upon, be an effectual bar to every improvement Those who have advocated these schemes, struck with the evils arising from the violations of private property to which the ill-regulated cupidity of some and the wretchedness of others are perpetually giving birth, seem to have thought that the crimes and disorders that were thus occasioned might be advantageously and completely got rid of by abolishing the right of property and obliging men to labour in common, and giving each in

idual an equal share of the produce raised by the nt labour of all They imagined that they would, in s way, eradicate that selfishness which was so fruitful source of mischief, that as no one could be either her or poorer than his neighbour, no one would be object of envy or attack, and that the principal rces of discord and crime being thus dried up men ers, and be But these pectations are wholly inconsistent with the nature of n, and cannot, therefore, be realized We might as ll attempt to eradicate the feelings of hunger, and thirst as of self-interest and if we could eradicate we should eradicate the principle which impels man labour, which prompts him to contrive, invent, and ass. There is plainly nothing blameable in our presence of ourselves to others The desire of aggrandizent becomes injurious only when proprietors and others endeavour to advance their own interests by acting ustly by their fellow-men, for, otherwise, it is the rce of all that is most advantageous to society And s mainly for the purpose of obviating this abuse, and protecting every one in the enjoyment of his property, t governments have been instituted *Hanc enim ob sam*, says Cicero, *maxime ut sua tuerentur, res-blicæ civitatesque constitutæ sunt Nam etsi duce uræ congregabantur homines tamen spe custodiæ um suarum urbium præsidia quæ rebant*

t is idle, therefore to think that the feelings of self-erest can ever be eradicated from the human breast that the adoption of the system of those who propose establish a communion of labou would be to give the principle of ection from what it takes when left to itself to der it a source of idleness and poverty, instead of our and wealth Suppose you have a community of housand individuals who live and labour in common this, as in all similar cases, it would be obvious to ry individual that if on the one hand, he made any usual exertions either of body or mind he would reap y the thousandth part of the advantages derivable n them, while, on the other hand it must be equally ious, that if he contrive to avoid performing his due re of work, or obtain more than his fair proportion its produce, he will be the *sole* gainer Under such umstances, it is clear not only that society could se no farther progress, but that it must gradually, not very slowly, retrograde The principle of self rest would not be annihilated, on the contrary it uld be as strong as ever, but inasmuch as no one ld henceforth expect to advance himself by industry nuity or frugality a regard for his own interest uld teach him to follow an opposite course and would llibly prompt him to labour as little and to consume as much as possible The evils produced by h a system would be so intolerable that it could not ontinued But if it were we should instead of the ustry invention and wealth produced by the establishment of private property and the consequent efforts ndividuals to advance themselves in the scale of society, have universal idleness indifference, and the most ct misery We should purchase an exemption from se crimes and disorders incident to an advanced stage ociety and which the adoption of good laws and a lant system of police go far to repress by the annihilation of every thing that raises civilized man above condition of the savage and by subjecting all classes he plague of universal poverty

*Inconveniences of Agrarian Laws* — The attempt to d a society upon an agrarian law or upon the principle of maintaining an equal division of land amongst different families of the society is as much opposed he nature of things as a communion of goods, but the system in other respects as advantageous as it he reverse it could not be maintained for any considerable period Though the first settlers of an unpied country were to adopt this plan, it would, in than a dozen years, be wholly subverted and there uld be the greatest inequality in their fortunes This uld arise from differences of strength talent, and con, from the varying numbers and conduct of children, the other unforeseen accidents and occurrences h are always affecting the circumstances of individuals It is absurd to suppose that an equality of con n could be maintained notwithstanding the operation of such powerful causes of derangement, without rting to the most atrocious system of tyranny, withequalizing the number of children, and abstracting a ion from the industrious and frugal to ow improvident But it is unnecessary to dwell on such crude absurdities The division of rich and poor is not, as some shallow sophists uld seem to suppose, artificial, it is as much rt of the order of Providence as the distinction of sexes Inequalities in the talents of the physical mental powers and dispositions of different individuals, and of the different circumstances under which they happen to be placed, and efforts to obliterate this distinction by encroaching on the rights of property, and enacting agrarian laws, or laws of a similar tendency, is to attempt to accomplish what is in its nature impracticable, at the expense of great and certain mischief and inconvenience

RIGHT, PETITION OF A declaratory enactment passed by the parliament of 1628, to which this name was given by the framers, who were desirous to imply by it that the franchises therein specified were not newly acquired, and that the law was merely explanatory of the ancient constitution It was calculated to protect the subject against forced loans, benevolences, taxes imposed without consent of parliament, arbitrary imprisonments, &c Much delay and some evasion took place before Charles I could be induced to give the royal assent to this measure

RIGHTS, BILL OF *See* BILL OF RIGHTS

RIGIDITY In Mechanics a resistance to change of form In all theoretical investigations respecting the application of forces through the intervention of machines, those machines are assumed (except cords) to be perfectly rigid so far as the forces employed are able to affect their integrity of form and structure Rigidity is often in the arts, called *stiffness*, and is opposed to flexibility

*The rigidity of cords* or the difficulty with which they are bent into any given curve, is the chief cause of the loss of power arising from their employment in machines The law of their loss of force may be thus expressed — The resistance arising from the stiffness of cords is as the weights which stretch the cords multiplied by the thickness of the cords and divided by the radii of curvature of the surfaces over which they pass It is, however necessary to state that experiments exhibit great discrepancies with this theoretical law

RIGORISTS In Ecclesiastical History, a name sometimes given to the extreme Jansenist party (See *Mosheim* vol v p 221 transl ed 1790)

RIMOSE (Lat rima *a cleft*) In Zoology when the surface of an animal or part resembles the bark of a tree having numerous minute narrow, and nearly parallel excavations which run into each other

RINFORZANDO (It *strengthening* In Music, a direction to the performer denoting that the sound is to be increased It is marked thus <, when the sound is to be diminished (*diminuendo*) this mark > is used

RING In Geometry the figure enveloping a sphere which moves with its centre always in a given curve most commonly a circle For the principal properties of this solid see Hachette *Geometrie Descriptive*

The term is also sometimes applied to designate the area of the space between two concentric circles

RING BONE In Farriery a callus growing in the hollow circle of the little pastern of a horse, just above the coronet

RING OF SATURN *See* SATURN

RINGS FAIRY This name is given to irregular circles in pastures and lawns on which *Agarics* spring up and which become much more verdant than the surrounding grass They are caused by the growth of the spawn of the *Agaric* which a common centre, and bears the fructification which is what appears above ground only at the circumference The verdure of the grass where these fungi grow seems to be caused either by their manuring the ground when they decay or by the nitrogen they give off, which is an active stimulant to vegetation The appellation of *fairy rings* was given to this phenomenon from their being regarded as the places where the fairies held their nocturnal revels

RING SAIL A small and light sail set on a mast on the taffrail Also a studding sail set upon the gaff of a fore and aft sail

RINGWORM This disease appears in circular patches upon the neck forehead or scalp, it begins with clusters of little pustules, which form scabs, leaving a red pimply surface and destroying the roots of the hair as it proceeds which it does if not prevented over the greater part of the head It is most common in children of a feeble flabby habit, but as it is communicable by contagion, it generally spreads rapidly in schools and families by the frequent contact of the heads of children, or by the use of the same caps, combs, towels &c, so that when it once appears the affected boys should be strictly removed from the others The treatment consists in shaving the head, and using frequent and regular ablutions in the first instance, sponging the part with weak soap and water, when the scabbing begins, other applications must be used, the selection of which must entirely depend upon the degree of irritation and other circumstances Solutions of nitrate of silver, sulphate of copper, iodide of potassium, or of iron, pitch and tar ointments, petroleum and naphtha, mercurial ointments of different kinds, and various others are used so numerous indeed are the remedies to which recourse has been had, that the obstinacy of the part, and the chronical and obstinate is the disease, that it is impossible to lay down any mode of treatment which can be considered

as approaching to a specific Except in particular cases no internal medicine has appeared to be of use

RI'OT, in Law, is said to be a tumultuous disturbance of the peace by three persons or more assembling together of their own au hority in order to assist each other against any one who shall oppose them in the execution of a private purpose, and afterwards executing the same in a violent and turbulent manner A rout is said to be a disturbance of the peace by persons assembled together to do a thing, which, if executed, would make them rioters, and making some motion towards that object, an unlawful assembly, a similar disturbance by persons who neither execute their purpose, nor make any actual motion towards the execution of it

RIPIE'NO (It *full*) In Music, a term signifying full, and is used in compositions of many parts, to distinguish those which fill up the harmony and play only occasionally from those that play throughout the piece

RIPPLE MARKS The peculiar undulated marks, which the receding waves leave on the sea beach, and which are occasionally found in some of the older strata of rocks, and are considered as announcing a similar action at a remote period The wind blowing over a sandy district sometimes occasions a similar appearance

RITORNE'LLO (It *a return*) In Music, properly a short repetition, such as that of an echo or of the last words of a song especially if such repetition be made after a voice by one or more instruments But by custom this word is now used to denote all symphonies played before the voices begin and which seem to prelude or introduce what follows

RI'TUAL (Lat ritus *a rite*) A book in which the different rites or services of the church are contained

RI'VER (Lat rivus) In Physical Geography an inland current of water, formed within a certain portion of the earth's surface by the confluence of brooks small streams or mountain torrents, and discharging itself into the ocean a lake marsh or other river There are few subjects in physical geography which present so wide a field for speculation as rivers whether we regard them in an historical, political economical or scientific point of view They are associated with the earliest efforts of mankind to emerge from a state of barbarism, but they are no less serviceable to nations which have reached the acmé of civilization In the earliest ages they were regarded with veneration, and became the objects of a grateful adoration surpassed only by that paid to the sun and the host of heaven Nor is this surprising, for in countries where the labours of the husbandman and shepherd depended for a successful issue on the falling of periodical rains, or the melting of the collected snows in a far distant country, such rivers as the Nile, the Ganges, and the Indus were the visible agents of nature in bestowing on the inhabitants of their banks all the blessings of a rich and spontaneous fertility, and hence their waters were held sacred and they received and to this day retain, the adoration of the countries through which they flow But it is by countries which have already made progress in civilization (to which indeed they largely contribute) that the advantages of rivers are best appreciated in their adaptation to the purposes of navigation, and in their application to the useful arts Like the veins and arteries of the human body which convey life and strength to its remotest extremities, rivers vivify, maintain, and excite the efforts of human industry, whether we regard them near their source as the humble instruments of turning a mill in their progress as facilitating the transport of agricultural or manufacturing produce from one district to another, or as enriching the countries at their mouths with the varied products of distant lands This has been so admirably expressed by Pliny that we cannot refrain from embodying his words in our pages 'The beginnings of a river' he says, 'are insignificant and its infancy is frivolous it plays among the flowers of a meadow, it waters a garden, or turns a little mill Gathering strength, in its youth it becomes wild and impetuous Impatient of the restraints which it still meets with in the hollows [illegible] is restless and fretful, quick in [illegible] in its course Now it is a roaring cataract, tearing up and overturning whatever opposes its progress, and it shoots headlong down from a rock, then it becomes a sullen and gloomy pool, buried in the bottom of a glen Recovering breath by repose, it again dashes along, till, tired of uproar and mischief, it quits all that it has swept along, and leaves the opening of the valley strewed with the rejected waste Now quitting its retirement [illegible] the world, journeying with more [illegible] through cultivated fields, yielding to circumstances, and winding round what would trouble it to overwhelm or remove It passes through the populous cities, and all the busy haunts of man, tendering its services on every side, and becomes the support and ornament of the country Increased by numerous alliances, and advanced in its course, it becomes grave and stately in its motions, loves peace and quiet, and in majestic silence rolls on its mighty waters till it is laid to rest in the vast abyss"

Most large rivers have their origin in very elevated mountains, or [illegible] of which chief [illegible] For full information on the various points involved in this subject [illegible] "Rivers" in the *Encyclopædia Londinensis*, we must confine our remarks to some of their most striking peculiarities, — *periodical inundations*, *occultations*, and *reappearance*

The *periodical inundations* of rivers depend on great falls of rain in mountainous regions or on the melting of snows in the neighbourhood of their source The period depends on the return of these seasons in different places Within the tropics the rainy season occurs usually about the time when the sun passes the meridian towards the tropics, and continues until his return to the same place The rise of the Orinoco commences in May its inundation begins in June, and the waters return to their channel in September, from which time they decrease until April of the succeeding year In the Lower Mississippi, whose inundations begin in March, and are at their height in June, are found those enormous rafts of driftwood (formed during the inundations), which sometimes extend for ten or twelve miles in one mass, rise and fall with the stream, yet have a luxurious vegetation on their summits The great rivers of Asia — the Ganges the Indus the Tigris, and Euphrates — have also their periods of inundation, depending on the circumstances determining the setting in of the rains on the mountains in which they originate In the Ganges the waters begin to increase in April, and at the end of July the country, for an hundred miles along its banks, presents the appearance of a vast lake interspersed with insulated villages and woods But of all inundations, those of the Nile are the most celebrated, nor is it possible to find any where among terrestrial objects a more striking instance of the stability of the laws of nature, than the periodical rise and fall of this mighty river We know by the testimony of antiquity that the inundations of the Nile have been the same with respect to their season and duration for three thousand years Indeed, their certainty regulates the public revenue, for when by means of nilometers it is ascertained that the waters promise an unusually prosperous season the taxes are proportionally increased Shortly after the commencement of the rains of Abyssinia in June the river begins to rise, and attains its greatest height in August At Cairo the greatest rise is twenty-eight feet but in the valley of the Nile with a mean breadth of three or four leagues it is only four feet It decreases gradually until the following May and as soon as the waters are within their usual channel the soil, moistened and enriched by the sediment deposited from the inundation is diligently cultivated by the natives Pliny thus speaks of the inundation — Justum incrementum est cubitorum 16, minores aquæ [illegible] recedendo [illegible] dant sitiente Utrumque reputat provinciæ In duodecim cubitis famem sentiant in tredecim etiamnum esurit quatuordecim cubita hilaritatem afferant quindecim securitatem sexdecim delicias" (*Hist Nat* lib v 9)

The [illegible] *reappearance* of some rivers have attracted every age nor has any satisfactory explanation been yet assigned for this extraordinary phenomenon In the Memoir of the Abbé Guettard the phenomenon in question is accounted for by the spongy nature of the soil through which such rivers flow thus the Guadiana, one of the largest rivers in Spain, suddenly disappears in the marshes near the village of Castillo de Cerera, and after pursuing a subterraneous course for twelve or fourteen miles bursts again into day Limestone districts afford many specimens of this phenomenon, one of the most striking of which is the occultation of the Rhone near the gorge called the *Perte* There are also some curious instances in Derbyshire and Yorkshire But no country surpasses Greece in the number of its subterraneous streams the peculiarities of which are often clothed in splendid mythological fictions by her ancient bards The waters of many valleys in the Peloponnesus have no other outlets than ζερεθρα, or chasms, which engulph them, such are the outlets of the valleys of Lerna Mantinea, Asæa, Stymphalus, Peneus, &c A familiarity with such phenomena, and a poetical temperament, readily led the ancient Greeks to conceive still more distant secret communications, and the imagination which peopled every grove, and animated every stream with presiding deities could easily reconcile itself to the story of the river god Alpheus, who was said to pursue his favourite nymph Arethusa beneath the bed of the ocean from Greece to the shores of Sicily (*Traill's Physical Geography*)

We subjoin, from Dr Traill's valuable Treatise on Physical Geography, a table showing the length of the course of twenty two of the principal rivers of the

world, and the area of their respective basins, together with their proportional lengths in English miles, a calculation which has been obtained by measuring them by lines being the distance between the most remote sources of the Thames which is assumed as unity, and its embouchure at the Nore

| Rivers. | Length | Length in English Miles | Proportional Magnitude of Basin | Area of Basin in English Miles |
|---|---|---|---|---|
| *Europe* | | | | |
| Thames | 1 | 180 | 1 | 5,500 |
| Rhine | 4⅜ | 810 | 12½ | 70,000 |
| Loire | 4 | 720 | 8⅝ | 48,000 |
| Po | 2½ | 400 | 5 | 27,000 |
| Elbe | 4½ | 820 | 9 | 50,000 |
| Vistula | 4⅜ | 760 | 13½ | 76,000 |
| Danube | 9⅝ | 1750 | 56 | 310,000 |
| Dnieper | 7⅝ | 1390 | 36 | 200 000 |
| Don | 7⅝ | 1350 | 37 | 205,000 |
| *Asia.* | | | | |
| Wolga | 14 | 2520 | 94 | 520 000 |
| Euphrates | 9⅝ | 1750 | 42 | 230 000 |
| Indus | 11½ | 2070 | 72½ | 100 000 |
| [illegible] | 10 | 1800 | 76 | 420,000 |
| Kur, or [illegible] eat River (Persia) | 21½ | 3870 | 138 | 760 000 |
| Amur (Chinese Tartary | 16 | 2880 | 164 | 900 000 |
| Lena Asiatic Russia | 13½ | 2430 | 174 | 960 000 |
| Obi ditto | 15 | 2700 | 236 | 1,300,000 |
| *Africa* | | | | |
| Nile | 18½ | 2330 | 90 | 500 000 uncertain |
| *America* | | | | |
| St Lawrence, including lakes | 22½ | 4050 | 109 | 600 000 |
| Mississippi | 19 | 3420 | 249 | 1 368,000 |
| Plata | 13½ | 2430 | 225 | 1,240 000 |
| Amazon, not including Araguay | 22¾ | 4095 | 395 | 2 177,000 |

For an account of the phenomena of the Australian rivers, which, in apparent contrariety to the laws of nature in other parts of the world become narrower the further they flow from their source, see the *Geog Dict*, art "Australia"

RIVER In Hydraulics, a current of water flowing in an open channel The velocity of a current of water flowing in an open channel depends on the volume of water, the form of the channel and its inclination and the determination of the relations subsisting among these three quantities is a problem of great practical importance the solution of which must be derived partly from experiment and partly from the general theory of the motion and resistance of fluids

If water, whether flowing in pipes or open channels suffered no resistance from the solid matter with which it comes in contact the velocity would depend solely upon the accelerating force of gravity and at any point of the channel would be in proportion to the square root of the difference of level between that point and the source But this velocity, if not constantly impeded would soon become enormous and render rivers the immediate instruments of devastation and ruin to the earth The Rhone, for example which receives its principal waters at an elevation of 900 feet above the level of the sea would enter the bay of Marseilles with a velocity of 164 miles in an hour, such being the velocity due to a heavy body falling from a height of 900 feet Even the Thames, which has a descent of only 100 feet, would acquire a velocity of 54 miles in an hour

The forces which tend to impede this constantly increasing velocity depend upon the quantity of surface exposed to friction and the velocity of the stream Let $l$ denote the length of a portion of the stream through which the velocity and the form of the channel remain the same, and $c$ the length of the line of intersection of the channel with a vertical plane perpendicular to the stream (*i e* the perimeter or boundary of the transverse section *minus* the superficial breadth), then the surface exposed to friction is represented by $c\,l$ With respect to the velocity, it is found by experiment that the resistance is expressed by a function of the velocity made up of two parts one depending on the velocity simply, and the other on its square Denoting, then, the friction or resistance by $f$, and the mean velocity by $v$, and assuming $m$ and $n$ two coefficients, to be determined by experiment, the resistance may be expressed by this formula —

$$f = (m\,v + n\,v^2)\,c\,l$$

Now the force which opposes the velocity is the resistance, and the force which tends to accelerate it is the component of the weight in the direction of the slope, and as the velocity of the portion under consideration is regarded as uniform, these two forces must be equal to each other Let $a$ denote the area of the transverse section of the stream, then the bulk is $a\,l$ and its weight $g\,a\,l$, the resolved part of which in the direction of the slope is $g\,a\,l \sin i$, where $i$ is the inclination of the surface to the horizon We have, therefore, $f = g\,a\,l \sin i$, or $(m\,v + n\,v^2)\,c\,l = g\,a\,l \sin i$, whence for any length $l$ for which the area of the section, the slope, and form of the channel remain unchanged, we have $(m\,v + n\,v^2)\,c = g\,a \sin i$

If we assume $R = a \div c$ (the area of the section divided by the length of its boundary diminished by the [illegible] This quantity R is what is usually called the *radius* of the section, and sometimes the *hydraulic depth* It is the depth which the river would take if it flowed in a rectangular channel whose breadth is equal to the bottom and sides of the actual bed

The constants $m$ and $n$ have been determined experimentally by Prony (*Récherches Physico-Mathématiques sur la Théorie des Eaux Courantes* Paris 1804) On reducing his measures to English feet and rejecting the term $m\,v$, which is small in comparison of $n\,v^2$, the formula becomes

$$v = 109\,53 \sqrt{R \sin i}$$

Eytelwein (*Handbuch der Mechanik fester Korper und der Hydraulik* Berlin 1801) gives $v = 94\,87 \sqrt{R \sin i}$ As a sufficiently near approximation, we may assume $v = 100 \sqrt{R \sin i}$, and if we denote the fall in feet each mile by $h$, we shall have $\sin i = h \div 5280$, and the formula will become on reduction $v = \frac{11}{8} \sqrt{R\,h}$ nearly This gives the velocity in feet per second To find the velocity in miles per hour, we must multiply by 3600, and divide by 5280 which gives $v = \frac{15}{16} \sqrt{R\,h}$, a formula found to be sufficiently conformable to experiments

From the above formula the mean velocity $v$ is given, when R and $h$ are determined, or [illegible] of the three quantities the mean [illegible] hydraulic depth and the fall, is determined in terms of the other two It is necessary to observe that the velocity is not the same in all the parts of the section of the stream The filaments of water in contact with the bottom and sides of the channel are arrested by the friction, and in their turn retard the filaments next above them in consequence of their adherence or viscidity, so that the filaments which suffer the least retardation are those at the surface and nearest the middle of the stream On the other hand the hydrostatic pressure tends to give the greatest velocity to the filaments which are deepest under the surface By the combination of these two causes the greatest velocity in an open channel of a symmetrical form is at the middle, and at a small depth under the surface

The mean velocity which has been denoted by $v$ is that which when multiplied by the area of the transverse section gives the total quantity of water which passes through the section in a given time Du Buat found that the greatest velocity is to the mean velocity of the whole section in the ratio nearly of 5 to 4, so that if the greatest velocity is experimentally determined, we may assume the mean velocity to be 4-5ths of the quantity given by the experiment It was found by Du Buat that if from the square root of the velocity in the middle of the stream expressed in *inches per second*, unity be subtracted, the square of the remainder gives the velocity at the bottom

Since the mean velocity of a river is proportional to the square root of the hydraulic depth (the inclination remaining the same) it follows that on contracting the channel the velocity will be increased When a river receives a permanent addition the first effect is to increase the velocity whereby the attrition on the sides and bottom is also increased, and the sides being generally of softer materials, the consequence is that the width and sometimes, though more rarely, the depth, is increased until the resistance is again equal to the accelerative force and the velocity becomes uniform

It is frequently of great importance to determine the whole quantity of water furnished by a river or, as it is called, the *discharge* For this purpose the figure of the bed must be accurately determined, which may be done by soundings This also gives the area of the section, and consequently the hydraulic depth The velocity at the surface may be determined by means of a float, or at a small depth under the surface by the instrument called *Pitot's tube* (see the term), or by measuring the force of the current by means of a dynamometer

See, in addition to the works above quoted, Bossut, *Traité d'Hydrodynamique*, Navier *Leçons sur l'Application de la Mécanique*, Belidor, *Architecture Hydraulique*

RIVOSE (Lat rivus, *a brook*) In Zoology, when the surface of an animal or part is marked with furrows which do not run in a parallel direction, and are rather sinuate

RIXDOLLAR (A corruption of Germ reichsthaler, or *dollar of the empire*) A silver coin of different values [illegible] see MONEY

ROACH The curve, or arch, which is generally cut

in the foot of some square sails, from one clue to the other, to keep [illegible]

ROAD, or ROADSTEAD A place of anchorage A vessel when at anchor is termed a roadster, in contradistinction to another under sail

ROADS, are pathways formed through a country, by which passengers and commodities may travel, or be transported, with more or less facility and expedition, from one place to another Roads are of various kinds, according to the state of civilization and wealth of the country through which they are constructed, and ac- [illegible] people, carried in direct lines over the natural surface of the country, passable only by foot passengers or packhorses, to the comparatively perfect modern road, carried on an artificial causeway, and reduced to a nearly level surface at enormous expense by means of vast excavations [illegible] viaducts tunnels, [illegible] skill and ingenuity of the civil engineer

*Advantages of Roads* — There is no expedient which more powerfully conduces to the advancement of a people in civilization or to the extension of their prosperity and national wealth, than the construction of good roads, connecting the various centres of commerce and of industry about which they may have collected themselves The invention of printing the expedient of money, the adoption of a uniform system of weights and measures, would severally be ineffectual, or productive of advantages of a very limited extent if the intercommunication of those whose feelings and ideas are expressed and conveyed in print, and among whom money is made to circulate, and whose commerce is stimulated and facilitated by the uniform module of quantity supplied by weights and measures were not facilitated and expedited by the means of conveyance supplied by roads Without roads the interchange of advantages, moral intellectual and physical, which now takes place in all highly civilized countries between the rural and the urbane population, could not be maintained, without them indeed large towns or cities could not continue to exist The supply of the population collected in such places with the various products of [illegible] to their physical existence, could no [illegible] on the other hand, would the rural population affording that supply be benefited by a return in exchange of the refinements of the town, and the various articles of luxury and necessity obtained by commerce from every part of the globe

But roads are not less necessary for the advancement of agriculture itself than for the due maintenance of the necessary relations between the towns and the country Without the aid of roads, it would be impossible to apply those arts to the soil by which increased powers of production are given to it Without roads the various kinds of manure by which the scientific farmer knows how to raise augmented crops could not be transported to his fields from the place, often distant and difficult of access where such manures are found Roads may then, in fact be considered as a system of veins and arteries by which all those principles necessary for the maintenance of the prosperity of a country are kept in circulation

*History of Roads* — The importance of roads to the welfare of nations was not unknown to the ancients The senate of Athens, the government of the Lacedemonians the Thebans, and other states of Greece bestowed much care upon them, but, as might naturally be expected the first great advances in the art of intercommunication by roads were due to a people essentially commercial The invention of paved roads is traced to the Carthaginians Rome ever awake to the advantages to be gained from [illegible] conquered people followed in the steps of the Carthaginians and vastly extended and improved their processes in the construction of roads

The Via Appia the Via Aurelia and the Via Flaminia were the first great monuments of the Roman people in this department of art Under Julius Cæsar the capital of the empire was made to communicate with all the chief towns by paved roads, and during the last African war, a road of this kind was constructed from Spain through Gaul to the Alps After this these great lines of communication were extended through Savoy, Dauphine, and Provence, through Germany, every part of Spain through Gaul [illegible] Asia Hungary, Mœsia and to the mouths of the Danube Neither did the interposition of seas obstruct the labours and the enterprise of this great people The lines of communication thus constructed to the shores of the continent of Europe were continued at corresponding points of the neighbouring islands and continents Sicily, Corsica, Sardinia England, Africa, and Asia were accordingly intersected and penetrated by roads, [illegible] on of the great European lines [illegible] were not mere paths prepared [illegible] set of horses and the wheels of carriages, formed upon the natural surface of the ground, but were constructed on principles in some respects as efficient as those which modern engineering has supplied forests were opened, mountains excavated, hill [illegible] valleys filled up, chasms and rivers bestridden by bridges, and marshes drained, to an extent which would bear no mean comparison to the result of the [illegible] of recent times

*English Roads* — The first roads of artificial construction [illegible] were those [illegible] by the Romans while it was a Roman province [illegible] and [illegible] road was carried through the country [illegible] and another nearly at right angles to it east and west These main lines were supplied with branches, extending in every direction which the conquerors found it expedient to render accessible to their arms The Roman road called Watling Street commenced from Richborough in Kent, the ancient Ruterpiæ, and being carried through London in a north-westerly direction, was continued to Chester The road called Ermine Street commenced from London, and passing through Lincoln was carried thence through Carlisle into Scotland The Foss Way passed from Bath, in a direction north-east, and joined the Ermine Street The road called Ikenald extended from Norwich, in a southward direction, to Dorsetshire

The example thus afforded by their conquerors was not followed by the Britons, who, unconscious of the many advantages attending facilities of intercommunication, relapsed into the barbarous neglect of roads, and while the Roman ways were allowed to fall into decay, new roads were not constructed For many centuries, such intercourse as was maintained between the various parts of this country took place almost exclusively by rude paths, capable of being passed on foot, or at best by horses, carried over the natural surface of the ground in straight directions from place to place Hills were surmounted valleys crossed and rivers forded, in the same manner as the savages of the most remote wilds of America now communicate with each other, or with the settlers It was not till the reign of Charles II that any attempt was made by the legislature to improve the roads of the country In the 16th year of the reign of that monarch, the first turnpike-road was established by law whereon toll was taken It passed through Hertfordshire Cambridgeshire and Huntingdonshire It was not however, till about a century from the present time, that any great or effectual attempts were made to establish a system of good roads through the country Till nearly the middle of the last century, most of the goods were conveyed from place to place in Scotland on packhorses Oatmeal, coals, turf, and even straw and hay, were conveyed in this way, but in carrying goods between distant places it was necessary to employ a cart, as all that a horse could carry on his back was not sufficient to defray the cost of a long journey The time that the carriers usually required to perform their journeys seems now almost incredible the common carrier between Selkirk and Edinburgh a distance of thirty eight miles, required a fortnight for his journey, going and returning The road for a considerable extent lay along the bottom of the district called Galt Water, the bed of the stream when not flooded, being the tract chosen as the most level and easiest to travel in

Nor were the means of travelling between large towns much better In 1678, a contract was made to establish a coach between Edinburgh and Glasgow, a distance of forty-four miles This coach was to be drawn by six horses, and the journey between the places, to and from, was engaged to be completed in six days [illegible] as late as the year 1750, the stage coach from Edinburgh to Glasgow took a day and a half to make the journey

In the year 1763, there was but one stage coach between Edinburgh and London, which started once a month from each place and took a fortnight to perform the journey At the present time after the lapse of not so much as eighty years there are seven coaches daily start from each of these cities for the other, besides several steam ships of enormous magnitude, which sail weekly from each place supplying all the accommodation and luxury [illegible] common [illegible] hours If each of the coaches be estimated as conveying ten passengers daily, the coaches alone would thus convey daily between these cities about 140 passengers, or above 4000 monthly If an equal number be estimated as conveyed by the steam ships, we should have the present intercourse in passengers between London and Edinburgh amounting to about 8000 monthly, whereas, in 1763, the number conveyed by stage coaches between these places monthly could not have exceeded [illegible] five and by all the means of conveyance then existing probably did not exceed fifty

It happens that the line of road now occupied by the Liverpool and Manchester Railway and its branches, and travelled daily by thousands [illegible] at a speed of twenty five miles an hour, [illegible] was, in the year 1770, travelled over by Mr Arthur Young, who has left us in his [illegible] of the state of the roads at the [illegible] the whole

range of language terms sufficiently expressive to describe this inferior road Let the most seriously disposed of all travellers who have ever journeyed, post or otherwise, this country road, find this would be the case, for a thousand to one they break their necks, or their limbs, by overthrows or breakings-down They will here meet with ruts, which I actually measured four feet deep, and floating with mud only from a wet summer What, therefore, must it be after a winter? The only mending it receives is tumbling in some loose stones, which serve no other purpose than jolting a carriage in the most intolerable manner These are not merely opinions, but facts, for I actually passed three carts broken down in these eighteen miles of execrable memory" With the exception of a few rare instances of important roads, constructed under special acts of parliament, the roads of England have not been constructed on any scientific principle, and are, in most cases, nearly coincident with the foot and horse paths adopted by the early inhabitants of the country These rude paths having been formed at an early period, the only roads of communication between the chief towns were gradually improved, so as to be capable of being travelled over by wheel carriages The natural surface [illegible] of grass or [illegible] cut up [illegible] from their excavation thrown into the valleys, or the roads were carried round them, at a later period fences were added, and thus, by slow degrees, the old horse path grew into the modern road How far removed from a truly good and scientific line of communication such a road must be, will be apparent to any one who considers what the principles ought to be on which a road should be laid down and constructed

*The Art of Road-making* —When it is proposed to construct a line of road extending between two places, the engineer upon whom such a duty devolves first makes himself well acquainted with the surface of the country lying between the two places so as to obtain an acquaintance with the face of the country somewhat approaching to that which would be supplied by a superficial model of it, which would exhibit all its inequalities and undulations of surface He is then to select what he considers all circumstances being taken into account, the best general route for the proposed road But previously to laying it out with accuracy it is necessary to make an instrumental survey of the country along the route thus selected, taking the levels from point to point throughout the whole distance, and making borings in all places where excavations are required, to determine the strata through which such cuttings are to be carried, and the requisite inclinations of the slopes or slanting sides as well of the cuttings as of the embankments to be formed by the material thus obtained It is also requisite in the selection of the route for the proposed road, to have regard to the supply of materials not only for first constructing it but for maintaining it in repair, thus the position of gravel pits and quarries in the neighbourhood of the proposed line and the modes of access to them, should be well ascertained

The results of such an investigation should be reduced to a plan and section, the plan of the road being on a scale not less than 66 yards to an inch, and the section not less than 30 feet to an inch

The loss of tractive power, and danger to travellers [illegible] it especially necessary [illegible] imposed upon the inclination of [illegible] line of road on which much traffic is carried on As, however, this reduction of hills in a country where much inequality of surface exists is attended with a considerable outlay of capital, the engineer will have to balance the cost of constructing a road having the best possible inclinations against the advantages to be obtained in the permanent working of the road, and if the expected traffic be not such as to yield advantages proportionate to the capital absorbed, greater rates of inclination must be allowed to the hills with a view to diminish the extent of the works and to render the expense of constructing the road proportionate to the traffic expected upon it

A dead level, even where it can be obtained is not the best course for a road, a certain inclination of the surface facilitates the drainage, and keeps the road in a dry state There is a certain inclination, depending on the degree of perfection given to the surface of the road, and on the structure of the carriages worked upon it, which cannot be exceeded without serious loss of tractive power, this inclination or acclivity is that in descending which at a uniform speed the traces slacken, or which causes the carriage to press upon the horses the limiting inclination with which this effect does not take place is called the *angle of repose*

On all acclivities less steep than the angle of repose, a certain amount of tractive force is necessary in the descent as well as in the ascent, and the mean of the two drawing forces, ascending and descending, is equal to the force along a level road Thus, on such acclivities as much power is gained in the descent as is lost in the ascent, [illegible] so as to impede their action, and their power is expended in checking the descent of the load, or, if this effect be prevented by the use of any form of drag or break, then the power expended on such drag or break corresponds to an equal quantity of mechanical power expended in the ascent, for which no equivalent is obtained in the descent

On well-constructed roads, with carriages such as now are generally used in England, the angle of repose may be taken at about one in thirty-six, and this is consequently an acclivity which ought not to be exceeded on roads over which much traffic is carried

The expedients by which the requisite inclinations are obtained on common roads are the same as those which are resorted to in the construction of railways *See* RAILROADS

The exact course of the road and the degree of its ac- [illegible] secondly, it should be hard, and the goodness of the road will be exactly in the proportion of the degree in which these qualities can be imparted to it, and permanently maintained upon it An [illegible] gineers until a very recent [illegible] smoothness of surface alone was sufficient for the perfection of a road and that, provided it could be made sufficiently durable, it was unimportant how soft or yielding the coating of the road might be This error, into which among others, Macadam himself fell, was based upon a neglect of one of the most important circumstances to be considered in the construction of a road The main object to be attained by all roads is the diminution of the resistance which a [illegible] power Other things being [illegible] apparent that this resistance would be diminished by increasing the smoothness of the road surface But roughness or unevenness of surface is not the only cause of resistance to the tractive power if two roads have their surfaces equally smooth and even but one is soft and elastic, so as to yield under the pressure of the wheel recovering its form as the wheel advances and the other is hard and unyielding, the resistance to the tractive power will be greater on the soft and yielding road than on the hard and unyielding road and this augmentation of resistance will be in proportion to the softness of the surface That this would be the case, admits of immediate demonstration on mechanical and mathematical principles, but, without resorting to these, it must be sufficiently apparent from the results of the most common experience A surface of velvet may be as smooth and even as a surface of ice, but if an ivory ball be rolled on the latter it will continue its motion much longer than on the former In fact, the wheels of a carriage in passing along a soft road sink into its surface as the ball would sink into the pile of the velvet and [illegible] in virtue of its elasticity the surface of the [illegible] the velvet may recover its smoothness after the pressure has been removed from it, still a resistance will be offered to the drawing or impelling power, which would not be produced by a hard and unyielding surface equally smooth

*Macadamization* — This process, which has received its name from Macadam to whose labours the improvement of the roads of England within the last half century owes so much, consists [illegible] broken with a hammer [illegible] uniform size This method, however is one which was long practised in various parts of Europe When the stones of which the road crust is to be formed are broken to the proper magnitude and form, they are spread over the surface of the road in a layer of 3 or 4 inches thick After this has been consolidated by carriages working upon it or by rollers, another layer of broken stones of equal depth is laid upon it, it is consolidated in like manner, and thus one layer is laid over another until an artificial crust is formed of broken stones of sufficient thickness to give the requisite strength to the road

A coating or road crust thus formed might be constructed on any substratum whatsoever, and a smooth and apparently good road would be obtained It was the practice of Mr Macadam to disregard the nature of the substratum, and he maintained that if it was not such a bog as would not allow a man to walk over it, he would even prefer it to a hard bottom

*Telford's System* — The improvement in road-making which consisted in a due attention to the substratum or foundation of the road, so as to give increased facility to the tractive power by [illegible] yielding, is due to the late Mr Telford [illegible] a description of the method of constructing such a road practised by that eminent engineer

Upon the level bed prepared for the road materials a bottom course or layer of stones is to be set by hand, in form of a close firm pavement The stones set in the

mal bile of the road should be 7 inches in depth, at 9 feet from the centre the depth should be 5 inches, at 12 feet, 4 inches, and at 15 feet, 3 inches, the entire width of the road being 30 feet These stones are to be set on their broadest edges lengthwise across the road, and the breadth of the upper edge should not exceed 4 inches All the irregularities of the upper part of this pavement are to be broken off by hammers, and all the interstices to be filled with stone chips firmly wedged or packed by hand with a light hammer, so that, when the pavement is finished, its cross section shall have a convexity of surface of about 4 inches in the centre above the extreme

6 inches, 4 must be first put on and worked down by carriages and horses over the whole of the road, care being taken constantly to rake in the ruts until the surface has become firm and the crust consolidated After this, the remaining 2 inches of stone may be put on, the whole of this stone, forming 6 inches of crust, is to consist of pieces broken as nearly as is practicable into a cubical form and of such size as to pass through a ring of 2½ inches in diameter The spaces on each side of the middle 18 feet are to be coated with broken stone or well-cleansed strong gravel up to the level of the footpath or other boundary of the road so as to make the whole convexity of the road 6 inches in the middle above the

materials thus

with a coating 1½ inch deep of good gravel, free from clay or earth

Such was the method practised by Mr Telford in the construction of great main roads such as that between Holyhead and Shrewsbury In the streets of towns, and other places where roads have to bear a still heavier traffic, such a road as that above described is found to be subject to a superficial wear, so rapid as to produce an intolerable quantity of dust in summer and of mud in winter In such places recourse has been generally had to pavement The first object to be secured for a durable pavement, as well as in other roads is to secure a good foundation The best method is to lay a foundation of gravel or broken stone the bed of which should be formed with a convexity sloping towards each side by a fall of about 1 in 50 After the materials for such foundation stone is put on the street should be open for carriages to pass over it until it is consolidated all ruts being carefully raked in The same process should be repeated with each successive layer, until a sufficiently solid foundation is obtained for the pavement On this foundation a pavement formed of blocks of stone is laid, the blocks being 10 inches in depth, from 10 to 15 inches in length, and from 6 to 8 inches in width Such is the structure which is requisite for the streets which are the main thoroughfares of a great city, a pavement with less strength of foundation, and formed of smaller blocks of stone, being used for the streets of less intercourse

The many inconveniences produced in the great thoroughfares of London such as Oxford Street Holborn Fleet Street the Strand, &c, by reason of the rapid wear of every kind of pavement hitherto adopted a suspension of the intercourse during the frequent repairs, the dust in summer and the mud in winter produced by a surface of broken stones, and the intolerable noise produced by every species of stone pavement have lately excited much inquiry as to the possibility of a road having sufficient strength for

sufficient durability to prevent the inconvenience of the frequent suspension of intercourse by the necessity of repairs, and presenting a surface which, while it would be free from the noise of a stone pavement, would not be attended with the inconvenience of dust and mud produced by a surface of broken stone This problem was supposed to be in a great degree solved by the adoption of a pavement of wood A short piece of Oxford Street was thus paved in the beginning of 1839 After a trial of several months

out the

pavement was adopted in several other thoroughfares of London The idea of a wooden pavement is not new In the northern parts of Germany and in Russia such pavements have been long in use, some of the main streets of Petersburgh and Vienna have long been paved in this manner A few years ago a series of experiments were made at New York, to determine the best description of paving for a street One of the methods adopted was a tesselated pavement, formed of hexagonal blocks of pine wood, measuring 6 inches on each side of their transverse section, and 12 inches in depth From the manner in which the timber is cut its fibres are vertical, and therefore the tendency to wear from vertical pressure is small The blocks are coated with pitch or tar, forming a smooth upper surface

Various methods were adopted for laying the wood pavements of London, but though every process that ingenuity could devise has been attempted, none of them have been found to answer the purposes of the public, and there appears, on the whole, to be sufficient to justify a well-grounded expectation that, however desirable, wood pavements will never supersede any others for the great thoroughfares of towns

Concerning the formation of roads of various kinds, their drainage, fencing, their management, repairs, &c, much might be said, but the limits which must be imposed on this article compel us to refer the reader for these details to Sir Henry Parnell's *Treatise on Roads* See also the *Encyclopédie*, article "Chemin," Bergier, *Histoire des Grands Chemins de l'Empire Romain*, *Annales des Ponts et Chaussées*, Anderson's *Commerce*, M'Culloch's *Treatise on Commerce*, *Library of Useful Knowledge*, Mr Telford's *Reports*

ROASTING, in Chemical Metallurgy, means the protracted application of heat to metallic ores, below their

generally resorted to to expel volatile matters, especially sulphur, arsenic, carbonic acid, water, &c

ROB A term of Arabic origin, applied by old pharmaceutical writers to thin extracts or inspissated juices

ROBBERY (from the Germ rauben, *to rob*), in Law, is defined a felonious taking of money or goods of any value from the person of another, or in his presence, against his will, by violence or putting him in fear, and this, whether the fear be of injury to the person's property or character But it is necessary that the fear be of immediate injury not of some future injurious results, and then the money must, generally speaking be taken immediately upon the threat made, and not afterwards given from fear of consequences But the *extortion* of money by threat to accuse of an infamous crime was made robbery by 7 & 8 G 4 c 29 The law on the subject is now collected in the recent statute 1 Vict c 29, and robbery is capital only when the robber "at the time, or immediately before or after," stabs, cuts, or wounds any person

ROBES, MASTER OF THE An officer in the

this office which has always been one of great dignity, is performed by a lady, who enjoys the highest rank of the ladies in the service of the queen

ROC or RUKH The well known monstrous bird of Arabian mythology, of the same fabulous species with the simurg of the Persians In the notes to vol iii of Mr Lane's edition of the *Arabian Nights' Entertainments* are some curious extracts from the writers of old voyages of that nation, showing that the tale was either founded on, or supported by the wonderful accounts of travellers Even Sinbad's well known adventure, when his crew broke the roc's egg and were attacked in consequence by the enraged pair of birds is borrowed from the serious narration of Ibn-El-Wardee The roc is also described by Marco Paulo (Marsden's transl, p 707) The size of this famous monster is, of course, described with all the luxuriance of oriental imagination Ibn-El-Wardee makes one of its wings 10 000 fathoms long Mr Lane appears to think that this extravagant fiction was suggested by the condor, but the size and power of that bird are

the common accounts The

seems a better archetype of the rukh In a drawing from an illuminated Persian MS which Mr Lane has copied, the roc, or rather simurg which is represented as performing the slight

with

and

Persian mythology it is the phœnix of

age of 1700 years (See the note to *Southey's Thalaba*)

ROCELLIC ACID An acid obtained from the *Rocella tinctoria*

ROCHELLE SALT The tartrate of soda and potassa It is a double salt, composed of 2 equivalents of tartaric acid (66 × 2) = 132 1 equivalent of potassa = 48, and 1 of soda = 32 Its crystals, which are large and

72 of water

ROCK See GEOLOGY

ROCK CORK A variety of asbestos which see

ROCK CRYSTAL A common mineralogical term applied to crystallized silica it is also called *quartz*

ROCKET In the Military Art a very destructive species of fire-work the best kind of which was invented by the late Sir William Congreve, and called after him The body of the machine is cylindrical, the head conical It is filled with very inflammable materials, on the combustion of which, as in the common sky rocket, the body is impelled forward with a continual acceleration

ROCKING LOGGING STONES See GEOLOGY

ROCK SALT Common salt found in masses or beds in the new red sandstone, as in Cheshire and elsewhere See GEOLOGY

ROCK SHELLS The common name of certain Uni-

valves, characterized by the long straight canal which terminates the mouths of their shells *See* MUREX

ROCKWORK In Architecture, masonry wrought in imitation of rough stone, in various arrangements, and chiefly used in basements of buildings

ROCKWORK, in Gardening, is applied to a quantity of stones, fragments of rock, or even vitrified bricks, piled together in such a manner as to form a nidus for the growth and display of alpine plants When the pieces of rock are of such forms as can be connected together so as to [illegible] of stratification, that mode of arranging them must be adopted, and the soil and plants may be placed in vertical, oblique, or horizontal fissures or on ledges, according to the lines of stratification When, however, as is most frequently the case, land or water-worn stones are used, they may be distributed over a mound of earth, not uniformly, but in groups with smooth surfaces of soil between in the manner that may be observed in nature, where stones of different sizes are seen rising out of the surface of a green hill or hillock When agglutinated masses of vitrified bricks are used, either alone or mixed with land stones of different sizes, they may be distributed over a mound, or along a bank of soil, in such a manner as to produce a varied surface, without attempting to imitate nature, and with interstices between them for inserting the plants Imitations of conical hills, caverns, precipices and even the Alps, on a small scale have been made in rockwork but these, and all other imitations of nature, require to be designed and directed by the eye and mind of an artist In general the piles of stone called rockwork, in botanic and flower gardens, might with more propriety be called heaps of stones

ROD A measure of length otherwise called a *pole* It is 5½ yards, or 16½ feet, and four of these make the *Gunter's chain*

RO'DENTS, *Rodentia* (Lat rodo *I gnaw*) The name given by Cuvier to the *Glires* of Linnæus an order of Unguiculate Mammals comprehending those which have two long chisel shaped incisors in each jaw, and no canines but a vacant interspace between the incisors and the molars, the lower jaw is articulated by a longitudinal condyle, in such a way as to allow of no horizontal motion except from back to front, and *vice versa* as is requisite for the action of gnawing The molars also have flat crowns, whose enamelled eminences are always transverse so as to be in opposition to the horizontal motion of the jaw, and to increase the power of trituration The genera in which these eminences are simple lines and the crown is very flat are more exclusively frugivorous, those in which the eminences of the teeth are divided into blunt tubercles are omnivorous while the small number of such as have no points more readily attack other animals, and approximate somewhat to the Carnaria The form of the body in the Rodentia is generally such that the hinder parts of it exceed those of the front, so that they rather leap than walk In some of them this disproportion is even as excessive as it is in the kangaroos In the whole of this class the brain is almost smooth, and without furrows, the orbits are not separated from the temporal fossæ which have but little depth, and the eyes are altogether lateral The inferiority of these animals is visible in most of the details of their organization Those genera, however which possess stronger clavicles have a certain degree of dexterity, and use their fore feet to convey their food to the mouth

[illegible] A term that has passed into [illegible] from Rodomont a boisterous character in the *Orlando Furioso*,—signifying a boastful [illegible]

[illegible] osseous fishes which are developed simultaneously and in great numbers are so called

ROESTONE A granular limestone, or oolite, which see. See also GEOLOGY

ROGA'TIONS (Lat *rogo, I ask*) In the Ritual public supplications or litanies were anciently so termed until the latter designation began to supersede every other (Palmer, *Orig Liturgicæ*, vol i p 270) In the Calendar, the three Rogation days are the Monday Tuesday and Wednesday next before Ascension day

ROGUE'S YARN A yarn of a different twist and colour from the rest, and inserted in the royal cordage, to identify it in case of its being stolen

RO'LLERS The name given by seamen to unusually heavy waves, which set in upon a coast or island without wind They are frequent at Ascension

RO'LLING, in Mechanics, is when all the parts of the surface of one body come into successive contact with those of another, and under such conditions as that at every instant the portion of the two surfaces which *have been* in contact [illegible] When this condition is not fulfilled [illegible] said to slide upon the other The [illegible] rolling is much less than in that of sliding, and hence the advantage of wheels to all kinds of carriages *See* FRICTION

ROLLING In Naval language, the lateral oscillation of a vessel This motion, which is often very great when the vessel is running before the sea, endangers the masts, strains the sides and loosens the decks at the waterways, it is also liable to cause the guns to break adrift When the centre of gravity is too low, the oscillations begin and end violently The changes in the stowage necessary to modify the nature or extent of the roll are made by seamen from experience not knowledge

ROLLING PENDULUM A cylinder caused to oscillate in small spaces on a horizontal plane Its mathematical [illegible] but it has been applied [illegible]

ROLLING PULLEY [illegible] pulley hooked to the weather quarter of a yard, and to a lashing or strap round the mast near the slings or parral of the yard, the object of it is to keep the yard constantly over to leeward thereby depriving it of play and friction when the ship rolls to windward

ROLLS, MASTER OF THE A high officer of the Court of Chancery, second only to the lord chancellor He is appointed by the crown by letters patent, and holds his office for life The master of the rolls administers justice in a separate court called the Rolls He has the power of hearing and determining originally the same matters as the lord chancellor, excepting cases of lunacy and bankruptcy, but all orders and decrees pronounced by the master of the rolls must be signed by the lord chancellor before they are enrolled The master of the rolls is also the chief of the twelve masters in Chancery and chief clerk in the Petty Bag Office he is the keeper, also of all the records of the Court of Chancery after the decrees and orders have been enrolled, and on that account he was anciently styled *guardien des rolles* The master of the rolls ranks immediately after the chief justice of the King's Bench his salary, by the stat 6 Geo 4 c 84, is 7000*l* a year

Before the passing of the act 3 & 4 W 4 c 94 the master of the rolls did not hear motions, pleas or demurrers, and whatever was presented for his decision, other than the hearing of causes was brought before him by petition By the above-mentioned act however, this was altered and motions pleas and demurrers are now heard by him in the same manner as by the other equity judges By the act 1 & 2 Vict chap 94 entitled 'An Act for the better Custody of the Public Records' the master of the rolls for the time being is entrusted with the custody both of the public records and those of the common law courts and Court of Exchequer

ROMAN ALUM An alum extracted from the volcanic rocks of the Solfaterra near Naples it crystallizes in opaque cubes and appears to contain more alumina than the common octoedral alum

RO'MAN ARCHITECTURE *See* ARCHITECTURE

RO'MAN CATHOLICS ROMANISTS OR PAPISTS The names by which Protestants designate the members of the large and ancient church which regards the bishop or pope of Rome as its infallible spiritual head, and assumes to itself the title of the Catholic or universal A rapid review of the external fortunes of this system as connected with the holy see will be found in the article PAPACY, the principal doctrines also by which it is distinguished are detailed under the several heads (*See* TRANSUBSTANTIATION, MASS PENANCE PURGATORY, &c) It will be sufficient in this place to point out the general [illegible] which have been erected

II Romanists [illegible] that the Scriptures is not sufficient for its own interpretation The books which compose the canon of the New Testament are they conceive, desultory and incomplete, being many of them written for special occasions, at a period considerably later than the foundation of the religion in various districts in some of which whole generations of believers may have passed away without having seen or heard of their precious contents It is not to be supposed, however, that doctrines so important as those shadowed forth in the Epistles of St Paul or the Gospel of St John, could have been left untaught to the churches which flourished before their publication or beyond their reach It must be admitted therefore, they argue, that the first preachers of Christianity must have been commissioned and instructed to deliver these same doctrines orally; and it is affirmed that several important doctrines are imperfectly developed in Scripture, and would not be understood, except for some such illustration by the way, the result of which is conveyed in the creeds of the first centuries It is also affirmed that the practice of the primitive church, the infallibility of which is assumed, authenticates various articles of Roman belief, of which only very slight hints are to be found in Scripture, and such, perhaps, as would [illegible] ed but for this very evidence from [illegible] of argument is admitted also by [illegible] facts alleged [illegible] article of belief without pointing out some support ground for it in Scripture, although the only shadow of

proof of this kind is in some cases to be found nowhere but in the writings which Protestants esteem apocryphal But while Protestants may refer to the practice of the primitive church, and the traditions which must have circula
of the
times,
witnesses to consider any one system *deduced therefrom* as infallibly right The Romanists, on
taching more importance to this kind
labouring under the same difficulty in discriminating between genuine and corrupt traditions, take refuge in the idea of a spiritual head of the church, an authorized interpreter of tradition, an infallible expounder of the faith,
St Peter at Rome,
main
have been advanced from this source have always been those of the Catholic Church, and always authentic In later times, however, a question has been much agitated respecting the relative authority of popes and councils, the superiority of each has been maintained by different classes of theologians, and it is certain that in some cases the decisions of popes have been ultimately reversed by councils It is clear that there cannot be anywhere an authority competent to settle the question, but it is believed that the opinion now generally acquiesced in is, that the two are co-ordinate powers, and that infallibility resides in the decrees of a *pope in council*

ROMA'NCE In literature, a work of fiction in prose or verse, containing the relation of a series of adventures, either marvellous or probable A tale confined to the latter class of events has, indeed, been considered to be more strictly designated by the term *novel* (*See* NOVEL) But as our nomenclature for works of fiction is not very precise or accurate, the name romance is very frequently used to comprehend both

The term romance is derived from the class of languages in which such fictitious narratives in modern times were first widely known and circulated These were the tongues derived from the Latin Italian Spanish French, which were all Roman dialects in contradistinction to the European languages of Teutonic origin But the 'langue Romane' more properly signifies the dialect of southern France, Catalonia, &c, of which the Provençal was a variety

The famous *Milesian Tales* of antiquity are thought to have been, in classical times the class of writings nearest approaching to our modern romances All the original Greek compositions of this kind have perished But we have, in the *Golden Ass* of Apuleius a Latin imitation of these, written in the later times of the Roman empire It contains a series of wonderful adventures, sorceries transformations love religion &c, and although it has been asserted that the romance, in its proper sense was unknown to the ancients it would be difficult to say in what respect except the total absence of chivalrous sentiment which is of modern growth, this curious fragment differs from those later inventions which we have agreed to call by that name

The same may be said and with even greater strictness of the Greek pastoral romances, a class of works appr
period, of which the famous *Daphnis and*
is the first known specimen They contain narratives of amours adventures &c, usually intermixed with some supernatural interference, and they have th
of a modern novel — a pair of lovers by whom the
heroine whose attachment is generally brought to a happy termination

The earliest modern romances were collections of chivalrous adventures, chiefly founded on the lives and achievements of the warlike adherents of two sovereigns, one of whom perhaps had only a fabulous existence, while the annals of the other have given rise to a wonderful series of fables — Arthur and Charlemagne These romances were metrical compositions in that branch of the modern French language termed the *langue d'oil*, which prevailed throughout the north of France, and especially in Normandy Besides these, a great variety of smaller tales, some chivalrous some marvellous some simply ludicrous, termed *fabliaux* exist in the same language The date of these compositions extends from the 12th to the 15th centuries

From the hands of these rhymers the tales of chivalry passed first into those of prose compilers who reduced them into a form
resembling that of our modern romance The French prose romances of chivalry, still confined to the same classes of subjects, belong to the 14th and 15th centuries
in two different countries to two
works of imagination In Italy, the poets termed Romanzieri taking the adventures of the knights of Charlemagne as their subject, transferred the rude conceptions of their predecessors into one of the most finished and enchanting forms of poetry to which modern fancy has given birth Boiardo, in the latter half of the 15th century was the first of these poets, and the names of Pulci Ariosto and Tasso, three of the greatest in Italian literature, grace their long catalogue In Spain and Portugal a new
was called
resembles in character the French romances of chivalry, but narrates the exploits of a new and entirely imaginary hero *Amadis* was finished, and a long list of similar romances added to it, by subsequent Spanish and Portuguese writers In these, while adventures became more and more marvellous, the fanciful spirit of chivalry was more and more carried into wild exaggeration They became, however, so popular as to be transplanted into most European languages, and even in France to supersede the heroic tales of Arthur and Charlemagne They declined with the advance of a better taste in literature after the art of printing had been for some time introduced, and were finally driven out of fashion by the wit of Cervantes, whose *Don Quixote* is aimed in great measure
them

Meanwhile, a new species of fiction had acquired vogue in Italy, to which
This was the amorous
*Decameron* of Boccaccio contains the earliest, and by far the most popular collection The stories were derived from many originals, but especially from the *fabliaux*, of which mention has been already made The Italian Novellieri are extremely numerous, but their compositions are always short, and would, in our modern language be designated by the term *tale*, rather than novel or romance They flourished in the 15th and 16th centuries From these, again, was derived the comic satirical tale of Spain,
and longer class of composition of which *Lazarillo de Tormes* and *Guzman d'Alfarache* are the best known specimens But in these which were also caricatures of the chivalrous romances a long course of independent exploits of the hero formed the substance of the work, and not a story possessing an individual point and interest

*Don Quixote* of which the first part was published in 1609 was the joint result of the romances of chivalry, which it was intended to ridicule, and of the romances of low life of whose character it contains a large intermixtu
(Cervantes had more in view, perhaps
of his writing), than the direct delineation of manners and occurrences, such as we now expect in a novel, yet it may be fairly said that his immortal work is the first of its kind in which human nature is brought on the stage alike unadorned and undegraded neither exaggerated by the ridiculous costume of chivalry, nor lowered by the familiar buffoonery of a comic tale While therefore, it has been the source of numerous imitations in its satirical character, its wide popularity has produced much more lasting effects in another manner it gave the first example of a work of fiction in which the grave and gay events of life might be mingled together and in which, also, the views and sentiments of the author might be conveyed through the medium of fictitious personages and events.

On the other hand the chivalrous romance had been seized, at an earlier period, by a very different genius from that of Cervantes, and applied to another object The fictions of Rabelais (the *Histories of Gargantua and Pantagruel*) cannot be termed romances, but their popularity was so great, that France was inundated for more than a century afterwards with Rabelaisian tales, and many of the elements of the modern low romance, comic hyperbole, eccentric humour, and much freedom and grossness of delineation, have been undoubtedly derived to us from Rabelais and his admirers Swift and Sterne were both essentially imitators of this singular genius

In the 17th century, Le Sage naturalized the Spanish romance in France His works present a singular mixture of different styles, although all derived from the same country In *Gil Blas* for example (if that work be not actually of Spanish origin), we have something of the humour of *Don Quixote*, the form as well as much of the substance of *Guzman d'Alfarache*, &c, and much intermixture of
of love and intrigue which, coming originally from the Italian novellieri, had acquired
passing through the hands
is, moreover, a touch of French taste and philosophy such as afterwards, when mixed with satire gave birth to the modern philosophical tale or romance, of which Voltaire's writings contain the best known specimens

After Le Sage, a new class of romances suddenly grew into fashion in France, the heroic,
from an earlier source, the pastor
century Of these, the *Clelie* ar
Mademoiselle Scudery
popular examples, although they have long ceased to be read This species of composition was, in fact, a revival of the old chivalrous romance, without its supernatural marvels, but with even greater exaggeration of sentiment Its temporary success is rather to be attributed to a caprice of fashion than to the natural progress of taste It was not, however,

wholly without its use as it called back some degree of sentiment and high feeling into the romance which was in danger of degenerating wholly into comic cant

During the 18th century, the romance and novel enjoyed a popularity both in England and France, which threw all other species of fictitious literature into the shade It would be impossible to continue [illegible] the various species which grew into vogue by the success of distinguished writers in each respective branch In England Richardson transferred into ordinary life somewhat of the refined sentiments which distinguished the heroic romance, and thus formed the basis of the modern English novel, properly so called or novel of manners His *Pamela* appeared in 1740, his last work, *Sir Charles Grandison*, in 1753 Fielding and Smollett, about the same time, revived the old comic romance, adapted to English scenes and characters Sterne did the same by the humorous or Rabelaisian style of writing but added an intermixture of pathos which had certainly never been joined before with [illegible] To these four writers Goldsmith added his *Vicar of Wakefield* confessedly an independent original almost all the English fictitious prose literature of the last century which is not imitated from foreign works may be said to owe its existence In France Marivaux, Prévost and with a worse taste than theirs, the younger Crebillon formed the national manner in this class of writing for some time Their productions have much of the same character with those of Richardson, but a far lower tone of morality and less life like description But the popularity of the famous *Nouvelle Heloise* gave a new turn not only in France but over Europe to the public taste in this branch of writing Marivaux and Prevost may be said to have been Rousseau's models, as to the externals of his great romance, but its tone and sentiment are peculiarly its own In France, after many inferior imitators Madame de Stael the first of female novelists must be classed as the best and latest disciple of the school of Rousseau In Germany his style had even greater success, and he may be said to have called into life at once the taste and the power of that people and literature for fictitious composition Wieland Kotzebue Goethe (*Sorrows of Werther* and *Wilhelm Meister*) are all though with much originality of their own essentially followers of Rousseau La fontaine and many other inferior writers more direct imitators

In our own times while the novel of manners continues to maintain its empire in popular estimation another species of romance—the historical—has likewise acquired [illegible] which even more [illegible] The historical romance in which fictitious scenes and personages are made to serve as vehicles for the historical portraiture of past times had, especially in Germany been cultivated with success before the writings of Sir Walter Scott but it is to his adoption of this branch of composition and the extraordinary talent which he devoted to it that its present popularity and universal imitation are entirely owing

ROMANCE'RO In Spanish the general name for a collection of the national ballads or *romances*, so called from the Roman or Romanic tongue which in the early part of the middle ages seems to have been the common appellation of all the dialects spoken from the Alps to the western extremity of the Mediterranean The *Romancero General*, the most celebrated of these collections was published in 1604 14

ROMANE SQUE (Fr) In Painting appertaining to fable or romance In historical painting it consists in the choice of a [illegible] than one founded on fact The [illegible] from *romantic*, because the latter may be founded on truth, which the former never is

*Romanesque*, in Literature is applied to the common dialect of Languedoc and some other districts in the south of France, which is a remnant of the old *Romance* language, now nearly extinct This term must not be confounded with *Romaic*, which is used to signify the [illegible] of modern Greece

RO'MAN ORDER *See* COMPOSITE ORDER

RO'MAN SCHOOL This school of painting, which, like the Florentine, addressed itself to the mind, is formed upon antique models Its style was poetical, embellished with all the grander pathos, and freedom from common matters, that the happiest imagination could conceive In touch its masters were easy, correct in drawing, learned and full of grace In composition it is sometimes whimsical, yet always elegant The heads of the figures are always drawn with great respect to truth and expression and it exhibits great intelligence in contrasting attitudes It is in colouring that it displays the greatest marks of negligence, whilst in draperies it is eminently successful At the head of this school was Raffaelle, and among its other principal masters were Giulio Romano, Zuccaro, M A Caravaggio, Baroccio, Andrea Sacchi (perhaps the best colourist of this school)

ROMA'NTIC, ROMANTICISM By *romantic* is [illegible] the wonderful and [illegible] beautiful which [illegible] Antiquity was a stranger to this feeling nor had the classic languages any term to express it The Germans

Almost all authors concur in the difficulty of giving a precise signification to the term *romantic* The *Dictionnaire de l'Academie Francaise* says, "Le romantique est un genre [illegible] On dit encore des [illegible] qui blessent les [illegible] regles de composition et de style établies par l'example des auteurs classiques" This definition, though far from being precise, is perhaps the best that has hitherto been given, and instead of attempting to rival it, we shall content ourselves with placing it before the reader

The term *romanticism*—an offshoot of romantic—is of recent invention, and is applied chiefly to the fantastic and unnatural productions of the modern French school of novelists, at the head of which are Victor Hugo, Balzac, "George Sand" &c, and their imitators in France and other countries

ROMAN VITRIOL Sulphate of copper, or blue vitriol

ROMANZIE'RI In Italian Literature, a series of poets who took for the subject of their compositions the chivalrous romances of France and Spain, and, with one or two exceptions only those relating to the exploits of Charlemagne and his fabulous Paladins The earliest of these poets flourished in the latter end of the 15th century Bojardo although not absolutely the first in order of time is considered as having laid the groundwork, in his *Orlando Innamorato*, of the edifice of fiction raised by his successors Pulci in the [illegible] was the first who allied the romantic [illegible] of chivalry with light and humorous satire Berni remodelled the work of Bojardo Ariosto in the *Orlando Furioso* carried this species of poetry to the highest degree of perfection These are the four principal Romanzieri but many other poets of the same school flourished until the end of the 16th century Tasso composed one of his early poems (*Il Rinaldo*) on the common model In the beginning of the 18th century the Abate Lorti-guerra compiled his *Ricciardetto* a poem of a semi burlesque character intended originally as a parody but completed as a serious composition, and thus closes the list of the Romanzieri All these poets adopted the ottava rima invented by Boccaccio (*see* OTTAVA RIMA) In their poems the thread of the main narration is frequently interrupted by a multiplicity of minor adventures and intrigues, and this complication of plot appears to have constituted one of the characteristic features of the chivalrous epic In most of them (from the time of Pulci) each book begins with a sort of prologue more or less connected with the subject which follows and these prologues form perhaps the greatest charm of the poem of Ariosto effecting the transitions from one subject to another by means of some touch of pathetic or elevated reflections or of light humour and playful satire generally in the form of an address to the supposed audience the poem being framed on the model of a tale recounted by a minstrel to an assembly of knights and ladies

ROMA'NZOFFITE A mineral from Finland of a brown colour, it is a triple silicate of lime, alumina, and iron

RONDEAU (Fr) In French Poetry a little poem of thirteen verses, divided into three unequal strophes, with two rhymes (eight lines masculine and five feminine, or *vice versa*) The two or three first words of the first verse serve as the burden and recur in that shape after the eighth and thirteenth verses There are also double rondeaux and single rondeaux, the latter an obsolete, but easier kind of verse In Music the term *rondeau* is applied to a light air in which the first strain forms the burden and as such is frequently repeated It is also written *rondo*

RO'NDEL In Fortification, a small round tower, erected in some particular cases at the foot of the bastion

ROOD (Ang Sax rode, *beam*, used for the Cross) The crucifix, sometimes also the image of a saint, was so called in old English churches Roods were set in shrines or tabernacles and the place where they stood was called the rood-loft, which was commonly over or near the passage out of the body of the church into the chancel They were all ordered to be taken down in 1548 (Burnet, *Hist of the Reformation*, vol ii book i), but restored for a short time under Queen Mary (*Archæologia*, vol i)

ROOD A square measure, the fourth part of a statute acre, and equal to 40 perches or square poles

ROOF In Architecture, the [illegible] of a building containing the timber work [illegible] of slate lead tile or other material Carpenters, however, restrict their use of the word [illegible]

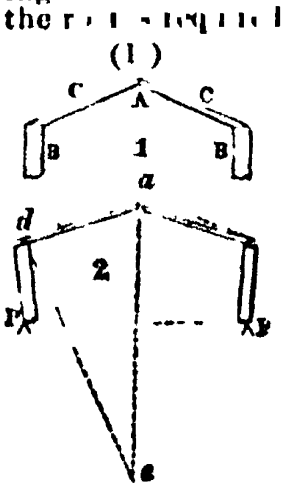
The inclination of the sides [illegible] the species of covering to be the same in all, depend very

much on the temperature of the country to which it is to be adapted In the southern countries of Europe roofs do not require much elevation, whilst as we proceed [illegible] with greater pitch In the warm, [illegible] buildings require nothing more than a terrace for their covering, but in the temperate climates, wherein the latitude exceeds 42 degrees, experience shows that the flat covering of a building cannot be practised with any expectation of durability The rains of hot climates are violent, whilst the cold temperate climates are searching In the more northern latitudes the moisture, the driving nature of the rain, and, in addition, the duration of the snow on the roofs, require, it is obvious, a more considerable inclination Such materials as lead, copper, zinc, and the like, which, supposing them one piece, as, in fact, when used, they ought to be, are not fair examples from which to draw inferences in the theory whereof we speak, for, if well executed, they must either of them be considered as one homogeneous piece but in the case of tiles, [illegible] is far different With [illegible] of this subject, we will [illegible] the inclination of a roof to be zero at the equator if we add to it an inclination of three degrees for every climate from the equator to the polar circle, each climate being taken at 2° 42′ 30″, we obtain results which show that the roofs and pediments of temples of antiquity must have been well studied in that useful point of view which regarded their durability and impenetrability by rain The *Encyc Met* we believe to have been the first instrument of promulgating this curious theory, and believing in it as we do, we can, if it be not true only use the Italian saying, "si non è vero, è ben trovato" The theory would give an inclination to roofs at Athens of 16½ degrees, and they are very nearly so inclined, the temple of Minerva being 16 degrees and that of the temple of Pretheus 15½ degrees In Rome, according to this theory the inclination of a roof, and consequently pediment, should be 22 degrees, and experience finds it varying from 23 degrees to 24½ The advocates for the propriety of strictly copying Greek forms and details under the latitude of London will, if they have studied the æsthetics of the art, find no little difficulty in establishing their doctrines, after weighing this matter impartially But our limits prevent further observation, we will merely subjoin a table conformable to the theory —

| Place | Latitude to nearest Minute | Length of longest Day | Inclination of Roof supposing Covering to be Roman Tiles |
|---|---|---|---|
| Carthagena | 37° 36 | 14h 12m | 19° 12 |
| Palermo | 38 7 | 14 18 | 19 18 |
| (Latitude of Athens is 38° ) | } | - | (see above) |
| Lisbon | 38 42 | 14 50 | 20 0 |
| Madrid - - | 40 25 | 15 0 | 21 0 |
| Naples - | 40 50 | 15 2 | 21 12 |
| Rome - - | 41 54 | 15 10 | 22 0 |
| Paris - | 48 50 | 16 6 | 27 36 |
| London - | 51 31 | 16 34 | 30 24 |
| Amsterdam - | 52 22 | 16 44 | 31 24 |
| Edinburgh - | 55 57 | 17 32 | 36 12 |
| Petersburgh - | 59 56 | 18 44 | 43 24 |

A roof, as respects its construction involves some knowledge of mathematics Of the general principles on which its proper construction depends we shall here subjoin some account The obvious mode of covering a building with a greater or lesser inclination of the sides of the roof as required by the climate, is to place two equal rafters C C upon the walls B B as in the subjoined diagram (fig 1) meeting at the apex A, where we will suppose them so connected with a hinge as to be inseparable, but capable of descending by their gravity, as shown in No 2 The walls are considered as solid masses, moveable on points P If the walls be not of sufficient weight the thrust that will be exerted on them by the tendency of the rafters to spread at their feet will throw the walls out of an upright, as in No 2, and the whole assemblage will be destroyed By the laws of mechanics it is known that the horizontal thrust thus acting on the walls is proportional to the length of a line *de* drawn at right angles to the rafter, intersecting a vertical line drawn from the apex, which it is manifest must increase as the roof becomes flatter To counteract the thrust above mentioned nothing more is necessary than to tie together the feet of the rafters, as in the following diagram [illegible] *beam* If the extent be not very great, the rafters may be kept from spreading by a minor

(1)

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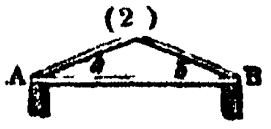
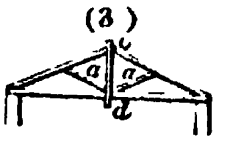



tie, as at *a b*, called a *collar* Beyond certain lengths or spans however, it will occur to the reader that a tie-beam will itself have a tendency to bend or sag, as the workmen call it, in the middle, [illegible] contrivance becomes n [illegible] diagram below (fig 3), marked *c d* this is called a *king post*, or more properly *king piece*, inasmuch as it does not perform the office of a post, but rather of a tie, for it ties up the beam to prevent its bending If the rafters be so long as to be liable to bend, two pieces *a a* called *struts*, are introduced, which, having their footing against the sides of the king post, act as posts to support or *strut up* the rafters at their weakest points The piece of framing thus contrived is altogether called a *truss* It is obvious that by means of the upper joints of the struts we obtain more points of support (fig 4), or rather suspension, and that but for the compressibility of the timber, there would be no limit to the space which a roof might be made to cover This compressibility takes place at those points where the fibres of the wood are pressed at right angles, or nearly so, with their direction, and many ways are adopted for avoiding this inconvenience There is a species of roof, dependent in construction on the principles we have just described, which we shall here briefly notice, and whereof the following is a diagram (fig 5) This roof has three points of [illegible] A, B A the posts A A [illegible] *queen posts*, the collar A B A is here a *straining piece*, instead of a tie, as it was in the example of ties first noticed, its operation being exactly the reverse of a tie The *curb* or *mansard* roof is one in which a story is obtained, as may be seen in the annexed diagram (fig 6) Its principles are the same as those already mentioned, and do not here require further notice In the execution of roofs the expense of trussing every pair of rafters would be unne- [illegible] would be expedient, it is therefore the custom to place these *principal* parts of a roof at certain intervals, which, however should never exceed ten feet The rafters which are actually trussed are called *principal rafters*, and by the intervention of the *purlins* A in the diagram (fig 7) are made to bear the smaller or common rafters, which are notched down on it These common rafters are received by or pitch upon a plate B called a *pole-plate*, and the principal rafters, which fall on the tie beam, are ultimately borne by the wall-plate C When beams, in either roofs or floors are so long that they cannot be procured in one piece, two pieces to form the required length are *scarfed* together, by indenting them at their joints and bolting them together, of which practice two modes are here subjoined (fig 8)

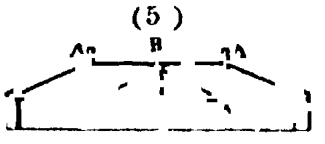
(3)




(4)



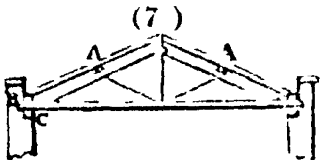
(5)



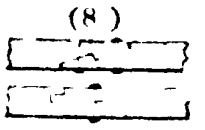

(6)



(7)




(8)



ROOK The name of a well-known species of crow (*Corvus frugilegus*, Linn), resembling in size and colour the carrion crow but differing in having the base of the bill whitish and scurfy, and bare of feathers. 'This," says Montague "is acquired by the bird's habit of thrusting its bill into the ground after worms and various insects The rook is content with feeding on the insect tribe particularly the larvæ of the cock-chaffer and while following the plough to remove from the newly-made furrow this destructive grub, it more than repays the husbandman for the grain which it may afterwards pick up The rook is gregarious at all seasons resorting constantly to the same trees every spring to breed when the nests may be seen crowded one over another upon the upper branches It lays four or five eggs much like those of the crow, of a greenish colour spotted and blotched with dusky After their young have taken wing, they all forsake their nest-trees, returning to them again in October to roost, but as winter comes on, they generally select more sheltered places at night in some neighbouring wood, to which they fly off together' (Montague *Ornithological Dictionary*) The wood or grove of tall trees in which rooks congregate and build their nests, is called a rookery

ROOT In Arithmetic, a number which being multiplied into itself any number of times produces another number, called a *power*, of which power the original number is the root The root takes the name of the power whose root it is Thus, it is called the *square root*, if the power is a square, the *cube root*, if the power is a cube, and so on

Root That part of the central axis of a plant which is formed by the descending fibres, and whose function is

to attract liquid food from the soil in which it is mingled It differs from the stem in not having leaves or buds upon its surface, and in its tendency to burrow under ground, retreating from light nevertheless some kinds of roots are exclusively formed in air and light, as in the ivy, and other such plants

ROOT OF AN EQUATION, in Algebra, signifies the value of the unknown quantity which enters into the equation *See* EQUATION

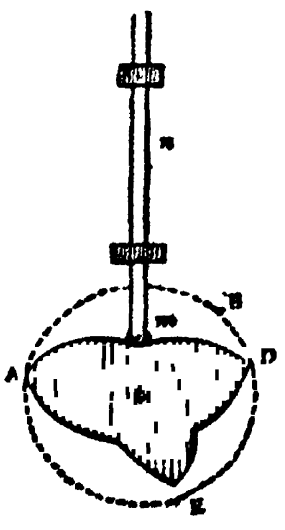
ROO'TSTOCK In Botany, a prostrate rooting thickened stem, which yearly produces young branches or plants It is common in *Iridaceæ* and Epiphytous *Orchidaceæ* [illegible] h the root [illegible] of it

[illegible] a ) A large and important natural order of plants, the species of which are for the most part inhabitants of the cooler parts of the world They are in some cases trees, in others shrubs, and in a great number of instances herbaceous perennial plants, scarcely any are annuals No natural orders contain more species of general interest, in the beauty of their flowers or their perfume there is the rose itself, and various species of the genera *Rubus*, *Spiræa*, *Potentilla*, *Geum*, and *Pyrus* The apple, pear, plum, cherry, peach, nectarine apricot, and similar valuable fruits are the produce of others The white thorn, with all its numerous exotic allies, belongs to the genus *Cratægus* As medicinal plants, some are of considerable importance The root of *Potentilla reptans*, *Geum urbanum*, and others, is powerfully astringent, the bark of *Prunus coccomilia* has some reputation as a febrifuge, an Abyssinian plant called *Brayera anthelmintica* has energetic vermifugal qualities, and finally, prussic acid is obtained from the leaves and seeds of the almond peach, plum, and other related species This important assemblage of plants is distinguished by having several petals, separate carpels, distinct, perigynous numerous stamens, alternate leaves, and an exogenous mode of growth

RO'SARY (Lat rosarium *a rose-bed* ) A Roman Catholic devotional practice, which consists in reciting 15 times the Paternoster, or Lords Prayer, and 150 times the Ave Maria or angelical salutation, but as the computation is made by means of beads the string of beads used for this purpose has acquired the popular name of a rosary The rosary is thus three times the ordinary chaplet It is instituted in honour of the fifteen principal mysteries in the life of our Saviour and the Virgin Mary Some have attributed its institution to St Dominic, [illegible] x part 2 c 4 ) giv [illegible] of the Rosary falls on the first Sunday in October Its name was changed by Gregory XIII from that of St Mary of the Victory given by Pius V on its original institution in honour of the battle of Lepanto, which took place on that day

ROSE (Lat rosa ) In Botany, the English name for the well-known and universally cultivated flower of the genus *Rosa* (*See* ROSACEÆ ) It would occupy too much space to point out even cursorily the various ceremonies in which this flower plays a distinguished part, suffice it to say, that in the earliest ages it was regarded with even more favour than at the present times and both at public and private festivals was considered an indispensable ingredient (See the *Damen Lexicon* ) In architecture, the sculptured representation of this flower is found in the centre of each face of the abacus in the Corinthian capital, and is called the rose of that capital Roses are also used to decorate the caissons in the soffits [illegible]

ROSE ENGINE In Mechanics an appendage to the turning lathe, by which a surface of wood or metal, as a watch-case is engraved with a variety of curved lines The assemblage of these lines presenting some resemblance to a full-blown rose is called by the French *rosette*, and hence the engine by which the ornament is produced is called a rose engine The mechanism by which the figures are produced is sometimes called a *camb*, and may be described as follows "A wheel upon the axle C turns uniformly in the direction A B D E A rod *m n* moves in guides, which only permit it to ascend and descend perpendicularly Its extremity *m* rests upon a path or groove raised from the face of the wheel, and shaped into such a curve that as the wheel revolves the rod *m n* shall be moved alternately in opposite directions, through the guides, with the required velocity The manner in which the velocity varies will depend on the form given to the groove or channel raised upon the face of the wheel;




and this may be shaped so as to give any variation to the motion of the rod *m n* which may be required for the purpose to which it is to be applied " (*Lardner's Mechanics, Cab Cyclopedia*, p 250 )

The purpose of the machine is therefore to convert a uniform rotatory movement into a varied rectilinear and alternating movement It is also used in machinery for spinning and for lace making

ROSEMARY (Lat rosmarinus *sea dew* ) is the name given to a small evergreen [illegible] of the Labiate order, which inhabits rocky hills in the neighbourhood of the Mediterranean, and which is commonly cultivated in our gardens It has very narrow green leaves turned back at the edge and hoary underneath The flowers are of a dull leaden blue, or even white It has been employed in infusion as a remedy for headache, and is extensively employed [illegible] the growth [illegible] green colour to these preparations It is also said to be one of the ingredients in Eau de Cologne Narbonne honey is also said to owe its peculiar flavour to bees feeding on the blossoms of the rosemary The grey [illegible] rich with dew drops, on the rocky coasts of [illegible] are said to justify the singular name that has been given to the plant It is the λιβανωτὶς στεφανωματικὴ of Dioscorides

ROSE-NOBLE A gold coin of the value of 6*s* 8*d*, first coined in the reign of Edward III

ROSEO'LA, called from its rose colour a *rash*, frequently symptomatic of different febrile complaints, of disordered stomach and bowels of teething and of any constitutional irritation Acidulated drinks, mild aperients and sudorifics, and strict attention to the diet, with caution against the application of or exposure to cold so as to cause a retrocession, are the principal points to be attended to

ROSES, FESTIVAL OF A rural festival of some parts of France, in which the best-behaved maiden of the town or village (called *La Rosiere*) is annually crowned with roses in the church whither she is conducted with great pomp by the villagers These festivals were originally celebrated on the 8th of June at Salency a village of Picardy under Louis XIII, but they were afterwards introduced into Surene near Paris whence they extended to many other places, and have latterly even penetrated to Moravia The Persians have also an annual festival of roses which consists of bands of youth parading the streets with music and offering roses as the Italians during the carnival *confetti* to all they meet for which they receive a trifling gratuity

ROSES WHITE AND RED In English History, the well-known feuds that prevailed between the houses of York and Lancaster are so called from the emblems adopted by their respective partisans, the adherents of the house of York having the white those of Lancaster the red rose as their distinguishing symbol These wars originated with the descendants of Edward III and after extending over a period of more than eighty years during which England formed an almost uninterrupted scene of bloodshed and devastation were finally put an end to by the victory of Henry Tudor, earl of Richmond, over Richard III in 1485, the victor uniting in his own person the title of Lancaster through his mother and that of York by his marriage with the daughter of Edward VI Since that period the rose has been the emblem of England as the thistle and shamrock (see those terms) are respectively the symbols of Scotland and Ireland

ROSETTA STONE (so called from Rosetta, a village of Egypt where it was discovered by the French) The name given to the celebrated stone now in the British Museum which has played so distinguished a part in all modern hieroglyphical researches It is a piece of black basalt three feet in length, and about two feet and a half in breadth and contains parts of three different sculptured inscriptions one in sacred characters, or, as they are termed, *hieroglyphics*, the second in enchorial characters (*i e* in those of the country or in modified conventional hieroglyphics), and the third in Greek From the last, or Greek inscription, it appears that the inscriptions are either entirely or substantially identical, and form a royal decree which was ordered to be sculptured in the languages above specified The inscriptions are a good deal mutilated, particularly the hieroglyphical, but they are still sufficiently distinct to allow the hieroglyphical and enchorial characters to be compared with each other and the Greek As the discovery of this stone presented to the learned the first opportunity of viewing the Greek in juxtaposition to the Egyptian language, great hopes were entertained that a key would thereby be obtained to the [illegible] of the numerous monuments of ancient Egypt It would appear, however, from the investigations of Dr Young and Champollion, whose attention has been deeply engrossed with this subject, that the Greek does not faithfully represent the enchorial text, but gives merely its substance According to the Greek inscription, the stone was erected in the reign of Ptolemy Epiphanes

(A C 1041) whose benevolence it describes, and enume rates his victories and the principal political transactions of his reign See HIEROGLYPHICS

ROSICRUCIANS A sect of visionary speculators who existed in Germany about the beginning of the 17th century They ascribed indeed a much higher antiquity to themselves, but it is probable that if any body of philosophers who adopted this title ever existed in reality, they were the alchemists, fire philosophers, or Paracelsists of the 16th century, who adopted this mode of giving vogue and fashion to their tenets Germany was inundated with tracts, from 1600 to 1630 purporting to come from supporters or from enemies of this sect, in which their opinions and intentions are canvassed, but generally in a wild and unintelligible manner From one of these, a *Treatise on the Laws of the Rosicrucians*, by Ritter von Maier (1618), we learn that the fraternity had six fundamental laws —1 That their chief end and object was to cure the sick without fee or reward 2 That in travelling they were to change their habits and dress, so as to accommodate themselves to those of the countries in which they sojourned 3 To meet once a year on a certain day and at a certain place, kept secret from the rest of the world 4 To fill up vacancies in their body by electing fresh members 5 To use the letters R C as their common symbol 6 That the fraternity should remain undivulged for one hundred years from its foundation It appears probable that the device of the rose issuing out of the cross which was the same with Martin Luther's seal, was adopted for the purpose of attracting the notice of the religious the rose was explained to represent the blood of Christ It would appear from these laws that some species of secret Freemasonry was intended, and the Rosicrucians have been by some connected with the Freemasons, but there is in point of fact, no evidence that any such society existed at all, and the name and other circumstances were probably only the device of some alchemists who usually conveyed their own notions under cover of symbolical language Andrea, a German scholar is stated in the *Conversations Lexicon* to have been the original propagator of the reports concerning the Rosicrucian society The Rosicrucians have been also connected in various ways, by public opinion with the Cabalists Illuminati, &c, and the division of spiritual beings inferior to the angels into sylphs and gnomes which furnished Pope with the machinery of the *Rape of the Lock* is of Rosicrucian or Cabalistic origin It is found in that singular work, the *Comte de Gabalis* which obtained a sudden popularity in the beginning of the last century in which the author professes himself a member of the Rosicrucian fraternity (See Mosheim, *Eccl Hist* vol v)

ROSIN See RESIN

ROSTELLUM (Lat rostrum) An elevated and rather thickened portion of the stigma of Orchidaceous plants, from which the peculiar gland separates by which the pollen masses of some species of that order are eventually held together It was formerly supposed to be the point through which impregnation is effected, but this is now known to have been an error

ROSTELLUM The name of the mouth of the louse and similar Apterous insects, in which the ordinary trophi are replaced by an exarticulate retractile tube from which a retractile siphuncle is protruded The uncinated proboscis of the tape-worms (*Tæniæ*) is also so called

ROSTER, in Military affairs, is applied to the plan or table by which all military duty is regulated

ROSTRULUM (Lat dim of rostrum) in Entomology is the name of the oral instrument of the flea and other *Aphanipterans*, in which the ordinary trophi are replaced by a bivalved beak, between the valves of which there are three lancet shaped instruments

ROSTRUM (Lat) Literally the prow of a ship, but metaphorically applied to the pulpit or pleading place in the Roman forum which was decorated with the prows of vessels taken from the enemy (See *Niebuhr's Roman History*)

ROT A term applied to a well-known disease peculiar to sheep It is often called *great rot*, and *hydrophic rot*, &c, but it is more popularly known by the single term of rot Many causes have been assigned for it, as the *Fasciola hepática*, or fluke worm, some particular plants eaten as food, ground eating, snails, and other ingesta but as most of the supposed deleterious herbs have been tried by way of experiment and have failed to produce the disease so it is attributable to some other cause Neither is there satisfactory reason to suppose that the fluke worm is the original cause of it, but a consequence, since we know that the biliary vessels of other animals, as horses, asses, &c often have them and above all, because that they are not always present in the rotted subject From long experience, and the almost invariable effect produced by a humid state of atmosphere, soil, and product, we are warranted in concluding these are the usual and primary agents perhaps the saturated food itself is sufficient to do it The morning dew has been supposed equal to it Bakewell, when his sheep were past service, used to rot them purposely, that they might not pass into other hands This he always readily did by overflowing his pastures. But great differences of opinion exist as to the quantity, form, and varieties of moisture productive of this fatal disease It is said that land on which water flows, but does not stagnate, will not rot, however moist, but this is contradicted by the experience of Bakewell, who used merely to flood his lands a few times only to rot his sheep It is also said they are safe from rot on Irish bogs, salt marshes, and spring-flooded meadows, which experience seems to verify It is also said that the very hay made from unsound land will rot, but this wants confirmation When salt marshes are found injurious, it is only in years when the rain has saturated or rather super saturated such marshes That putrid exhalations unaccompanied with moisture can occasion rot wants confirmation also, for these commonly go together, and it is difficult to separate their effects It is not, perhaps, the actual quantity of water immediately received by land, but the capacity of that land to retain the moisture, which makes it particularly of a rotting quality

The signs of [illegible] sufficiently familiar to persons about sheep They first lose flesh, and what remains is flabby and pale, they also lose their vivacity The naked parts, as the lips, tongue, &c, look livid, and are alternately hot and cold in the advanced stages The eyes look sad and glassy, the breath is fetid, the urine small in quantity and high coloured and the bowels are at one time costive, and at another affected with a black purging The pelt will come off on the slightest pull in almost all cases The disease has different degrees of rapidity, but is always fatal at last This difference in degree occasions some rotted sheep to thrive well under its progress to a certain stage, when they suddenly fall off, and the disease pursues the same course with the rest Some graziers know this crisis of declension, as it has been called and kill their sheep for market in the immediate nick of time with no loss In these cases, no signs of the disease are to be traced by ordinary inspectors, but the existence of the flukes, and still more a certain state of liver and of its secretions, are characteristic marks to the wary and experienced

The treatment of rot is seldom successful unless when it is early commenced, or when of a mild nature A total change of food is the first indication and of that to a dry wholesome kind all the farinæ are good as the meals of wheat barley oats peas, beans, &c Carrots have done good, mixed with these broom, burnet, elder, and melilot, as diuretics have also been recommended, but it is necessary to observe that there is seldom any ventral effusion bu [illegible] omplaint As long as the [illegible] the cure may be hoped by a simple removal of the cause, which has been shown to be a variable temperature, with excessive moisture of pasturage, which may also be aided by such remedies as assist the action of the biliary system Salt acts in this way, and thus salt mashes are good salt may also be given in the water Salt appears the principal ingredient in Flesh's patent restorative for sheep; for it states it to be composed of turpentine, sal ammoniac turmeric, quicksilver, brimstone, *salt* opium, alkanet root, bark antimony, camphor, and distilled water, but of this medley none of the articles can be in sufficient quantity to prove useful but the salt In the more [illegible] when the liver has become [illegible] ent to rub the belly of each sheep with half a drachm of mercurial ointment every other day for a week Give also the following every morning —Watery tincture of aloes, half an ounce, decoction of willow bark four ounces, nitric acid, twenty-five drops (*Loudon's Ency of Agriculture*)

ROT In Timber See DRY ROT

ROTATION (Lat rota *a wheel*) In Mechanics, the motion of a solid body about an axis Rotatory motion is distinct from progressive motion though both are frequently found to coexist in the same body The planets, for example, at the same time that they have a progressive motion in their orbits, revolve also about axes passing through their respective centres of gravity It is the rotatory motion of the earth about its axis which produces the alternations of day and night, and a slow but constant change of position in that axis, arising from the attraction of the sun and [illegible] gives rise to the astr [illegible] precession of the equinoxes

The determination of the circumstances of the rotation of a planet about its axis is a problem of physical astronomy, not less interesting or important than that of the planet's motion in its orbit It was, in fact, long considered as the more difficult problem of the two, but, according to the methods of modern analysis, both form a part of the same theory, and their solutions are deduced from the same general equations of motion

In relation to practical mechanics, the problem of rotation is also of great importance, inasmuch as it comprehends the methods of computing the performance of

machines, the forces necessary to overcome their inertia, a[illegible] relations and most advantageous disposi[illegible] several parts, in order that the required e[illegible] produced by the smallest expenditure of [illegible] jury to the machine itself [illegible] to the motion of bodies about axes, the terms *moment* [illegible] *angular velocity*, are of consta[illegible] fore important to keep in view the exact meaning of those terms

The *moment of a force* exerted in turning a body about an axis, is the product obtained by multiplying the force into the perpendicular from the axis upon the line of its direction; or it is the force multiplied into the leverage. Thus, if F be the force supposed to act in a plane perpendicular to the axis, and $h$ a line drawn from the axis perpendicular to the direction of the force, the moment of the force is $Fh$. But as force is measured by the velocity which it communicates to a [illegible] this is usually expressed by $MVh$, where V is the velocity which the force F communicates to the mass M, when directed to its centre of gravity, in the time which is assumed as unity.

The *moment of inertia* of a body in respect of a given axis, is the sum of all the products obtained by multiplying each element into the square of its distance from the axis. Thus, if $m$ be one of the constituent elements of the body, and $r$ the distance of $m$ from the axis, then the moment of inertia is $\Sigma r^2 m$, the summation denoted by $\Sigma$ being extended to every element $m$. *See* MOMENT.

The different particles of a solid body revolving about an axis move with a velocity proportional to their respective distances from the axis, and the velocity of the particle whose distance from the axis is unity is the *angular velocity* of rotation. If this be denoted by $\omega$, then the velocity of a particle whose distance from the axis is $r$ will be $r\omega$.

These definitions being premised, we may now state a few of the more remarkable properties of rotatory motion. If the motion is produced by impulse, and the moving body is not acted upon by accelerating forces so that the velocity is uniform, the fundamental theorem (which is easily deduced from the property of the lever) is,

$$\text{angular velocity} = \frac{\text{moment of impelling force}}{\text{moment of inertia}}$$

In the case of a body turning about a fixed axis, it is supposed that the impelling force acts in a direction perpendicular to the plane passing through the axis of rotation and the point at which the force is applied. If the impelling force is not perpendicular to this plane, it must be resolved into two parts, one of which is perpendicular to the plane, and the other parallel to it; and it is only the former part which tends to produce rotation, the latter being destroyed by the resistance of the axis.

When all the different particles of a body are acted upon by accelerating forces (as in the case of a pendulum drawn aside from the position of rest and abandoned to the action of gravity), the angular velocity becomes a variable quantity, and is expressed by this formula,

$$\frac{d\omega}{dt} = \frac{\text{moment of the impelling forces}}{\text{moment of inertia}},$$

where $d\omega$ is the element of the velocity, and $dt$ the element of the time. The moment of the impelling forces is computed from this expression, $\Sigma m v h$, where $m$ is the mass of an element of the body, $h$ its distance from the axis of rotation, and $v$ the velocity due to the accelerating force. From the above formulæ, it is obvious that the computation of the moment of inertia must enter into every question connected with rotatory motion.

*Principal Axes.* — Generally speaking, any change which is made in the position of the axis about which a body revolves must be accompanied with a change in the moment of inertia. Hence, if a point (which is not the centre of gravity) be taken in a solid body, all the axes which pass through that point (and they may be infinite in number) will have different moments of inertia, and there must exist one in respect of which the moment is a maximum, and another in respect of which it is a minimum. Those axes in respect of which the moment of inertia is a maximum or minimum are called the *principal axes of rotation*.

If for any point taken in a solid body, we proceed by the usual methods of maxima and minima to find the position (relatively to the principal lines of the body) of that line or axis about which the moment of inertia is the greatest or least possible, the analysis leads to a cubic equation, of which all the three roots are real. Hence, for every point of a body, however irregular, there are *three* principal axes. Further examination shows that these axes form a system of straight lines at right angles to each other. One of them is such that the moment of inertia with respect to it is the least possible; with respect to another, the moment is the greatest possible; and although with respect to the third the moment is not, strictly speaking, the greatest or least, yet it possesses this characteristic of maxima and minima, that its differential coefficient is nothing, or its value is not affected by a very small change in the position of the axis.

If the form and structure of the revolving body be such that the moments of inertia about two of the principal axes are equal, then every line in the plane of those axes passing through their points of intersection will be a [illegible] spheroid of revolu[illegible] the principal axes, the two others are in the plane of the equator, and consequently equal, and it is obvious from the symmetrical form of the body that every equatorial diameter will have the same moment of inertia, or be a principal axis. If all three principal axes are equal, as in the case of a sphere when the point in which the axes meet is the centre, then every line passing through the same point is a principal axis. From this it follows that with respect to any point taken in a solid body there are either three principal axes, or else an infinite number.

It is a property of the principal axes, that if a body begins to revolve about any one of them it will continue to revolve about the same axis uniformly and perpetually, unless the motion is deranged by the action of a disturbing force. The centrifugal forces about a principal axis exactly counterbalance each other, and the axis remains unmoved without the aid of any support. There is, however, an essential difference in this respect between one of the axes and the two others. If a body begins to revolve about an axis very near to one of the axes for which the moment of inertia is the greatest or least possible, the axis of actual rotation will continue to oscillate about that principal axis, never deviating from it beyond certain narrow limits, and the angular velocity will only suffer small periodic alterations; but if the body begins to revolve about an axis which is very near to the intermediate principal axis, the axis of rotation will deviate from the principal axis indefinitely, and the velocity of rotation will not remain constant. Hence the rotation about two of the principal axes is stable, about the third unstable.

When a solid body revolves about a fixed axis, there are certain points in the body having determinate situations with respect to the axis of rotation and centre of gravity, which on account of their remarkable properties, require to be distinguished. Thus, in computing the effects of machinery, it is often necessary to determine the situation of the point at which if the whole mass of the revolving body were concentrated the rotatory effect would remain unaltered. This point is called the *centre of gyration*. The *centre of oscillation* of a body suspended by an axis is the point at which if all the matter were collected the oscillations would be performed in the same time. The *centre of percussion* is the point at which if the body encountered an immoveable obstacle the motion would be arrested without producing any strain on the axis. For the properties of these centres and the method of computing their positions, see CENTRE.

*Motion of a Body entirely free.* — If a body is retained by no fixed point, but is at liberty to move in any direction, and if a force be applied to it in a direction which passes through its centre of gravity, all the points of the body move forward in straight lines parallel to each other and to the direction of the impelling force. But if the direction of the force does not pass through the centre of gravity, the body will acquire two motions — one progressive, and the other rotatory, and these two motions are entirely independent of each other, that is to say, each is performed exactly in the same manner as if the other did not exist. The progressive motion is the same as if the direction of applied force had passed through the centre of gravity, and the rotatory motion communicated to the body is the same as if the centre of gravity had been a fixed point. In consequence of this property the general problem of determining the motions of a body subjected to the action of given forces resolves itself into two, of which the first is to determine the motion of the centre of gravity of the moving body, and the second to determine at every instant the position of the axis and the velocity of rotation.

In the solution of the latter problem the following elegant theorem, first given by Euler, is of important use. — When a [illegible] centre of [illegible] the body revolve about another axis also passing through its centre of gravity, the body will revolve about neither, but on a third axis, which lies in the same plane with the other two, and so situated as to divide the angle which they contain into two parts, such that the sines of the parts are to each other in the inverse ratio of the angular velocities with which the body would have revolved about the said axes respectively. It is evident that this conclusion will hold good if the angular motions about both axes are impressed simultaneously, and as the velocity about the new axis may in like manner be compounded with another velocity about a different axis, it follows that if several angular motions about given axes are impressed on a body at the same time, the position of

the resultant axis and the velocity of rotation may be readily computed

If the primitive axes are at right angles to each other, then the square of the resultant is equal to the sum of the squares of the component velocities about the primitive axes These properties form the theory of the composition of rotatory motion For their demonstration the reader may be referred to *Airy's Mathematical Tracts*, "Precession" and "Nutation," or to the article "Rotation," in the new edition of the *Encyclopædia Britannica*

The principal application of the theory of the rotation of bodies entirely free is to the planets, and particularly the earth It is to be observed, however, that the change which is continually taking place in the position of the terrestrial axis of rotation is only in respect of fixed points in space, for it can be shown that since the earliest recorded astronomical observations, the position of the poles of rotation on the earth's surface has undergone no alteration whatever

The principal works on the subject are *Euler's Theoria Motus Corporum Solidorum*, 1765, Vince, *Phil Trans*, 1780, Frisi, *Opera*, tom ii, 1783 *Atwood's Treatise on the Rectilinear Motion and Rotation of Bodies*, 1784, *Landen's Mathematical Memoirs*, 1789, Laplace, *Mecanique Celeste*, Lagrange, *Mécanique Analytique*, Poisson, *Traité de Mécanique*, &c

ROTATION OF CROPS In Agriculture and Gardening, it is found that the same annual crop cannot be advantageously cultivated on the same soil for more than one or two years, and hence one kind of crop is made to succeed another And the number of cultivated crops being limited, when the whole course has been gone through once it is again repeated, and hence the origin of the word *rotation* But as the same number and kind of crops are not always grown in regular succession but a change is frequently made according to general principles the term used in that case is *succession of crops* The principle on which the succession of crops is founded is that every kind of plant not only extracts nourishment from the soil but exudes into it excrementitious matter which is found injurious to that species though it may prove nutritious to another species As a general principle of guidance in determining the succession of crops it is considered advantageous that a crop cultivated for its leaves or roots should succeed one cultivated for its ripened seeds, that the cereal grasses should be succeeded by leguminous plants, taprooted plants or plants bearing tubers by fibrous rooted plants, and plants which form a compact covering on the surface, such as corn and legumes sown broadcast by plants which only partially cover the surface such as crops grown in rows sufficiently wide to admit of cultivation between It may also be adopted as a rule, that where land is to be subjected to a crop of the same plants for a number of years, as in permanent pasture the plants composing the crop should be of several different kinds by which means the excrementitious deposit of one species becomes the nutriment of another Hence the propriety of sowing clover, ribwort and other taprooted dicotyledonous herbage plants [illegible]

ROTATORIUS, *Rotifera* (Lat rota, *a wheel*) Wheel animalcules See ROTIFERS

ROTIFERS, *Rotifera* (Lat rota and fero, *I carry*) The name of a class of highly organized Infusorial animals, outwardly distinguished by certain ciliated appendages at the anterior part of the body which seem to move in a rapid rotatory manner, and by their superior size They are commonly termed 'wheel animalcules'

ROTTENSTONE An earthy mineral found near Bakewell in Derbyshire, in Wales and at Albany in New York [illegible] and consists according to R P [illegible] carbon, and 4 silica It resembles tripoli

ROUBLE A Russian silver coin of different values It was first struck at Moscow in 1654 Catherine II caused some gold coins to be struck with this name, but they are no longer current See MONEY

ROUE In the *beau monde*, a person devoted to a life of pleasure and sensuality, but not so completely vitiated in his character and manners as to be excluded from society The term is said to have been first used in this sense by Philip of Orleans the regent of France

ROUGE A species of lake prepared from the dried flowers of the *Carthamus* [illegible] Rouge is the only cosmetic which [illegible] hout ultimate injury to the complexion

ROUGH CAST In Architecture, the plastering of walls with mortar and fine gravel, left rough without any [illegible]

ROUGHING IN See RENDERED AND SET

ROUGH STUCCO In Architecture, stucco floated an [illegible] degree with water

ROUND [illegible] operty of a circle, sphere, or right cylinder, and indeed of any solid of revolution, though [illegible] confined to the sphere and cylinder

ROUNDEL In Heraldry, an ordinary in the form of a circle It is improper to say a roundel or, gules, &c., describing it by its tincture unless first, in case of counterchange, secondly where the roundel is of fur, or of equal tinctures, as a roundel ermine, a roundel checky of or and azure, &c, otherwise, roundels have distinguishing names, according to their tinctures A roundel or is called a *bezant* [illegible] ns of the Greek or Byzantine empire a [illegible] a *plate*, gules, a *torteau*, a kind of cake, azure, *hurt*, a species of flower; vert *pomme*, [illegible] purpure, *golpe* A field or charge, with [illegible] roundels, is said to be *bezanty*, *platy* &c according to the tincture

ROUNDELAY In Poetry, is properly a short poem of thirteen verses, eight in one rhyme, and five in another. *See* RONDEAU

ROUND HEADS A nickname given to the Puritans at the time of the civil wars by the Cavaliers, from the close black skull-cap [illegible] gown to the ears, which was then worn by [illegible] persons or more probably, from the custom that prevailed among them of wearing the hair closely cut to the head

ROUND ROBIN (Fr rond ruban) A phrase originally derived from a custom of the French officers, who, on signing a remonstrance to their superiors, wrote their names in a circular form, so that it might be impossible to ascertain who had headed the list It is now used to signify any act by which a number of individuals bind themselves to pursue a certain line of conduct

ROUND TABLE, KNIGHTS OF THE The name given to the famous order of knights that existed in England under the reign of King Arthur, by whom it was founded The members of this order are said to have been forty in number, and derived their name from a huge round marble table round which they were accustomed to sit Their adventures form the [illegible] of much of the early romantic poetry and [illegible] land, and our own times have been peculiarly fertile in clearing away much of the obscurity in which the well-known names of Tristram, Lancelot, and other members of this order were enveloped Sir W Scott's labours in this field are too well known to require any remark (See *Schlegel's History of Literature*, which gives a masterly sketch of the influence of the Round Table on the romantic poetry of that and succeeding ages)

ROUP A Scotticism for auction

ROW To propel a boat by oars Rowing is reckoned the most favourable application of human strength, the whole force is however not effective on the oar, as the part inside the actual fulcrum, which is in the water, acts as a backwater Some nations take short strokes, which they rise up in making, the English prefer a long stroke sitting which to say the least saves much exertion As the theory of rowing involves the resistance of fluids, it is necessarily defective

ROYAL In Naval affairs, the sail above the top-gallant sail The term *royal* is also applied, in artillery, to a kind of small mortar

ROYALISTS The name applied originally to the adherents of the Bourbon family after the revolution of 1792 but now in common use to designate the party attached to the claimants of the Spanish and Portuguese thrones

ROYAL OAK *Robur Carolinum* In Astronomy, a constellation formed by Halley in the southern hemisphere See CONSTELLATION

ROYALS The name given by way of eminence to the *first* regiment of foot in the British service it is supposed to be the oldest regular corps in Europe (*James's Military Dict*

RUBEFACIENTS (Lat rubefacio, *I make red*) Substances which when applied to or rubbed upon the skin induce a redness or blush upon the part, not followed by blister

RUBELLITE Red schorl or tourmaline There is a magnificent group of [illegible] Brit h Museum from the cab [illegible] Mr Greville

RUBEOLA The measles This disease is preceded by fever, with swelling and inflammation of the eyes, an [illegible] and about the fourth day there is an [illegible] red points, perceptible to the touch, which continues for four or five days, and then goes off with desquamation of the cuticle, but the fever, cough, soreness of the eyes and irritable state of bowels are apt to continue for some time after the entire disappearance of the eruption The most alarming cases are those in which the inflammatory symptoms and fever run very high, and which sometimes require bleeding, or blisters and cupping upon the chest, or in which there is a putrid tendency with a dark livid colour

RUBEZAHL The name of a famous spirit of the Riesengebirge in Germany who is celebrated in innumerable sagas, ballads, and tales, and represented under the various forms of a miner, hunter, monk, dwarf, giant &c He is said to aid the poor and oppressed, and shows benighted wanderers their road, but wages incessant war with the proud and wicked The origin of the name is obscure (See the *Tales of Musæus*)

RU'BICEL A term applied to the Brazilian ruby

RU'BRIC (Lat ruber, *red*) In the language of the old copies of manuscripts and of modern printers, any writing or printing in red ink The date and place on a title page being frequently in red ink, the word *rubric* has come to signify the false name of a place on a title page Many books printed at Paris bear the *rubric* of Genoa, London, &c But the most common use of the word is in ecclesiastical matters In MS Missals, the directions prefixed to the several prayers and offices were written or printed in red ink, and hence, the *rubric* familiarly signifies the order of the liturgy, in Roman Catholic countries as well as in England

RU'BY A crystallized gem of various shades of red, found chefly in the sand of rivers in Ceylon, Pegu, and Mysore Among lapidaries, the scarlet-coloured is sometimes called *spinelle ruby*, the pale or rose red, *balass ruby*, and the yellowish red, *rubicelle* It is inferior in value and beauty to the red sapphire, or oriental ruby of the jewellers It consists of 83 alumina, 9 magnesia, and 7 or 8 chromic acid, the latter gives its colour

RUDDER A heavy flat piece or frame of wood, hung upon the stern post by means of pintles and gud- [illegible] The rudder is [illegible] the tiller which enters the rudder head In vessels drawing much water the rudder is deep and narrow, in flat bottomed vessels, it is shallow and broad When carried to a considerable breadth, as in the Chinese vessels it is pierced with holes which preserves an increased leverage with a diminished direct resistance from the water

When the rudder is broken off by the ship getting aground, or by a heavy sea, a temporary one is made by a topmast and other spars placed parallel, and loaded at the bottom with pigs and ballast, and confined to the stern post by hawsers leading on each side of the keel

RUDDER COAT A covering of tarred canvass loosely put round the rudder head to keep the water from entering by the aperture, while it admits of the rudder being turned freely round

RUDDER PENDANTS Strong pieces of rope ending in chains, by which the rudder, if unshipped, is held to the ship's quarter

RUDDER SHOCK A piece of wood fitting between the head of the rudder and the rudder hole to prevent the play of the rudder in case of the tiller being removed

RUDE'NTURE (Fr) In Architecture, the rope or staff with which the lower parts of the flutings of columns are often filled *See* CABLING

RUDIA'RIUS (Lat) The term applied to a discharged gladiator The word is derived from the staff (*rudis*) which was given him in token of his dismission

RUDO'LPHINE TABLES A set of astronomical tables computed by Kepler, and founded on the observations of Tycho Brahe They were called the *Rudolphine Tables* in honour of Rudolph II, emperor of Bohemia who, upon the death of Tycho in 1601 conferred upon Kepler the title of imperial mathematician and undertook to defray the expenses of their preparation Owing to various causes the work was not completed until 1627, when the tables were published at Ulm They are the first that were ever calculated on the hypothesis that the planets move in elliptic orbits and they contributed greatly to the progress of modern astronomy For a detailed account of this very remarkable production, see Delambre, *Astronomie Moderne* tom i p 557

RUFF The name of the male of the *Machetes pugnax*, which is distinguished at the breeding season by a ruff or tuft of wide spreading feathers projecting behind the eyes and from the upper part of the neck The female is called the *reeve* *See* MACHETES and TRINGA

RULE, in Arithmetic, denotes a certain prescribed series of numerical operations, adapted to discover from the given conditions to which an unknown number is subjected what that number is They are generally distinguished by particular names, according to the purposes for which they are given, or the particular nature of the business for which they are required, as the rules of interest, the rules of fellowship, &c

RULE In a monastic sense, a system of laws or regulations by which monasteries and other religious houses are governed, and which the monks nuns, and novices vow at their entrance to observe *See* ORDERS, MONASTIC

RULE In Law, an order of one of the three superior courts of common law Rules are either general or particular, the former being such orders relating to matters of practice as are laid down and promulgated by the court for the general guidance of the suitors the latter are such orders as are confined to the particular case in reference to which they have been granted *See* COURTS OF LAW, and PLEADING

RULE OF THREE, in Arithmetic, is the rule by which when three numbers are given a fourth is to be found, so that the four shall be in direct or inverse proportion as the case may require

RULES In the Fine Arts, those laws and maxims founded on the general and fundamental truths of nature by which artists are guided in their compositions

RULES, BRASS Pieces of brass of different thicknesses made letter high, to print with They are made in lengths of fourteen inches, but of late years lengths half as long again have been made One of the edges is bevelled so as to print a fine line, and when a thicker line is required the bottom edge is placed uppermost, which is the full thickness of the brass, by this means lines of different thicknesses are obtained, and also double lines, a thick one and a fine one, when required. They are used for column lines in table work, to separate matter that requires to be distinct, and to be placed round pages

In cases where diagrams are required, and there is no engraver within reach, they may be formed by a clever workman with brass rule Of late years many ingenious and elaborate imitations of architectural drawings of buildings, with pillars, &c have been made with brass rule, and in this department of art Mr Ebenezer Parkes, of Fetter Lane, has displayed great skill and ingenuity

RULE, CARPENTER'S A folding ruler, generally used by carpenters and other artificers, having a variety of scales adapted to facilitate the calculations of most frequent occurrence by inspection Sometimes it has a sliding piece in one of its legs by which its use is greatly extended *See* SLIDING RULE

RULE, GAUGING is a rule adapted in the same manner to discover the contents of casks and other vessels It is used by the officers of excise in surveying the articles in the process of manufacture liable to duties *See* GAUGING

RUM A spirituous liquor distilled from the fermented juice of the sugar cane or from molasses Its flavour is due to the presence of a peculiar volatile oil its average proportion of alcohol fluctuates between 50 and 56 per cent The rum consumed in the United Kingdom is entirely the produce of the West Indies, and to a great extent of Jamaica, and for this preference it is indebted partly to its superior quality, and partly to its being protected against rum of East India produce by a differential duty of 6*s* per gallon, the duty on West India rum being 9*s* that on East India rum being 15*s* per gallon The quantity of rum entered [illegible] for the years 1839-40, averaged 2 [illegible], the duty on it for the three years 1837 38-39, averaged 1 372 540*l*, and in 1840 the gross amount was 1 154 544*l* The consumption of rum in this country has long been gradually declining

RU'MEN (Lat) The name of the paunch or first cavity of the complex stomach of the Ruminant quadrupeds

RU'MINANTS *Ruminantia* (Lat rumino, *I chew the cud*) The name given by Cuvier to the *Pecora* of Linnæus an order of Ungulate Mammals including those which have a complicated stomach of four cavities so disposed as to allow of rumination and a cloven hoof

RUMINA'TION (Lat rumino) The act by which food once chewed and swallowed is a second time subjected to mastication Digestion is always preceded by this action in the order of Mammals, hence called 'Ruminants,' [illegible] in any other animal The [illegible] of the Ruminant is specially organized for rumination, consisting of four distinct cavities all of which communicate with a muscular canal at the termination of the œsophagus Hard, solid or coarsely masticated food, passes from the beginning of the muscular canal into the first cavity of the stomach called the *rumen*, or paunch Water is received into the second cavity, called the *reticulum*, and almost exclusively occupies the honeycomb cells of that cavity, it is gradually mixed with the coarsely divided food which is undergoing mastication in the rumen When this is sufficiently advanced, a portion of the mass is received into the muscular canal at the termination of the œsophagus, it is there moulded into a ball and propelled by a rapid and inverted action of the muscles of the gullet into the mouth where it is more perfectly masticated, mixed with fluid, and again swallowed It now passes directly into the third stomach, called the *psalterium* from the broad leaf like plates of membrane with which it is occupied Here the superfluous fluid, which otherwise might have too much diluted the gastric [illegible] and passes [illegible] or [illegible] called the *abomasus* In the camel tribe, water cells are developed at the sides of the rumen, in addition to those of the reticulum, and the psalterium is not separated by any contraction from the abomasus

RUMP PARLIAMENT In English History, after the dissolution of Richard Cromwell's parliament, and his own demission of the protectorate, a council of officers, at whose head were Desborough, Lambert, and others having seized [illegible] visable to call [illegible] the Long Parliament, which had been dismissed by Oliver It

was assembled in May, 1659; and consisted of little more than seventy members those who had been excluded not [illegible] This body soon be- [illegible] and Royalist parts of the nation, and by its own assumption of power displeased the officers who had called it again into being It acted, however, with some vigour and determination, and defeated a variety of royalist conspiracies, but having ventured so far as to cashier Lambert and others of the leading officers, the troops again surrounded Westminster Hall, and expelled it, on the 13th October in the same year But Fleetwood, [illegible] the army, being unable to keep [illegible] government, the officers once [illegible] ament to sit again, which it did on the 26th of December It once more assumed absolute authority, but General Monk took part against it On his invitation a good many of the excluded members went to the house (Feb 21) and thus placed the Independents, who had hitherto ruled it, in a minority, [illegible] its former acts, the parliament [illegible] its nickname from being, as it were the remnant and fag-end of the old Long Parliament and was treated by the nation with general contumely and derision But it cannot be denied that, utterly unable as it was to command the divided nation, it showed boldness and vigour in its conduct, which, with a little more popularity, would probably have ensured great successes Vane and Hazlerig were [illegible]

RUNCINATE (Botany, hooked back, or curved in a direction from the apex to the base, as the lobes of the leaf of the dandelion

RUNES (Germ Runen), are properly the signs or letters of the ancient alphabet peculiar to the northern nations (Germans and Scandinavians) Schlegel deduces this alphabet from the Phœnicians (*Lectures on Ancient and Modern Literature*) Others have supposed it to have been derived from that of the Hebrews, but it originally consisting only of sixteen letters has been urged as an argument against this hypothesis The runen inscriptions found in Germany (especially Northern Saxony) are thought by some to have tokens of an origin somewhat different from the Scandinavian (*Grimm on the German Runes* 1821) The antiquity of both has been much disputed Of those found in Gothland it is said that the oldest are not earlier than A D 1200 the latest 1449 1300 stones with Runic inscriptions have, it is said been discovered in Sweden, many in Denmark, none in Lapland or Finland Runic staves are massive sticks, generally of willow inscribed with Runic characters [illegible] of magical import (See *Conv Lexicon*)

RUPEE A coin of different values, current in different parts of the East Indies See MONEY

RUPIA (Gr ῥυπος) An eruption of flattish vesicles succeeded by an ill-conditioned [illegible] which concretes into thin scabs easily [illegible] and regenerated, they generally occur as a consequence of poor diet and weak habit of body Light nutritious food, tonics, and alteratives are the remedies

RUPTURE See HERNIA

RURAL ECONOMY The general management of territorial property, either by the proprietor or his agent On a small scale the agent is termed a bailiff or farm servant, and on a large scale a land steward or factor The duties of the latter are to collect the rents, and see that the different clauses in the leases by which the tenants hold their lands are fulfilled and of the former, to cultivate the land in such a manner as to produce the greatest profit, or to fulfil the intentions of the proprietor as to the kind of produce which he considers it desirable to obtain See AGRICULTURE

RUST, in its ordinary acceptation, is the reddish peroxide which is found on the surface of iron when exposed to moisture

RUST In Horticulture See MILDEW

RUSTIC (Lat rus) In Architecture, a term applied to work jagged out into an irregular surface Work also which is left rough, without tooling

RUTACEÆ (Ruta, one of the genera) A natural order of plants, composed principally of trees and shrubs inhabiting the warmer parts of the world, seldom of herbaceous plants The species are sometimes very ornamental, especially those belonging to the genera *Correa*, *Boronia*, and *Diosma*. Some, as the common rue, the bucku plant, &c, are remarkable for having a powerful, peculiar, unpleasant odour, and antispasmodic quality, and a few have a febrifugal bark The *Dictamnus albus*, or *Fraxinella*, is extremely fragrant, and gives off an inflammable vapour

RUTILITE. (Lat. rutilus, *red*) Native oxide of titanium

RYACOLITE (Gr. ῥυαξ, *a stream*, and λιθος, *a stone*) A name given to glassy felspar

RYE (Ger *roggen*; Du *rogge* according to some, is a native of Crete, but it is very doubtful if it be found wild in any country It has been cultivated from time immemorial, and is considered as coming nearer in its properties to wheat than any other grain It is more common than wheat in many parts of the Continent, being a more certain crop, and requiring less culture and manure It is the bread corn of Germany and Russia In Britain it is now very little grown, being no longer a bread corn, and therefore of less value to the farmer than barley oats, or peas

RYOTS (Arab *a subject*) The name given to the cultivators of the soil in Hindostan Their social condition presents many singular and interesting features, to some of which we shall here advert In all eastern countries the rulers may be said to be the proprietors of the soil, but in India the *cultivators* have a perpetual, hereditary, and transferable right of occupancy, so long as they continue to pay the share of the produce of the land demanded by the government The value of this right of occupancy to the rural population depends on the degree of resistance which they have been able to oppose to the exactions of arbitrary governments In Bengal and the adjacent provinces of India, from the peculiarly timid character of the inhabitants, and the open and exposed nature of the country, this resistance has been trifling indeed, and consequently the value of the right of occupancy in the peasant, or ryot, has been proportionally reduced This, also, may be considered, though with some modifications, as being nearly the condition, in this respect, of the inhabitants of every part of the great plain of the Ganges, comprising more than half the population of Hindostan But where the country is naturally difficult, the people have been able more effectually to resist the encroachments of the head landlord, or state and to retain a valuable share in the property of the soil This has been particularly the case along the ghauts as in Bednore Canara, Malabar, &c, the inhabitants of which provinces not only lay claim to a right of private property in the soil, but have been generally ready to support their claim by force of arms There can be no question, indeed that the same modified right of property formerly existed every where, and it is indeed impossible that otherwise the land should ever have been reclaimed from the wilderness But in those parts of India which could be readily overrun by a military force, the right of property in the soil has long been little else than the right to cultivate one's paternal acres for behoof of others the cultivators reserving only a bare subsistence for themselves

Under the Mogul emperors the practice in Bengal was to divide the gross produce of the soil, on the *métayer* principle into equal shares, whereof one was retained by the cultivator, the other going to government as rent or tax The officers employed to collect this revenue were called *zemindars*, and in the course of time their office seems to have become hereditary It may be remarked that in Persian, zemindar and landholder are synonymous, and this etymology, coupled with the hereditary nature of their office which brought them exclusively into contact with the ryot or occupier, as well as with [illegible] led many to believe that the zemindars were [illegible] the owners of the land, and that the ryots were their tenants This, however, it is now admitted on all hands was an incorrect opinion The zemindars in reality were tax-gatherers, and were, in fact obliged to pay to the government *nine tenths* of the produce collected from the ryots, retaining only one tenth as a compensation for their trouble, and, so long as the ryots paid their fixed contribution, they could not be ousted from their possessions, nor be in anywise interfered with

But notwithstanding what has now been stated, the perpetual or zemindary settlement, established by Lord Cornwallis in Bengal, in 1793, was made on the assumption that the zemindars were the proprietors of the soil His lordship, indeed, was far from being personally satisfied that such was really the case, but he was anxious to create a class of large proprietors, and to give them an interest in the improvement and prosperity of the country It is clear however, that this wish could not be realized without destroying the permanent rights of the ryots, for, unless this were accomplished, the zemindars could not interfere in the management of their estates The interests of the zemindars, and the rights of the ryots, were plainly irreconcileable, and it was obvious that the former would endeavour to reduce the latter to the condition of tenants at will But this necessary consequence was either overlooked or ineffectually provided against The zemindars became, under condition of their paying the assessment or quit-rent due to government, proprietors or owners of the land. The amount of the assessment was fixed at the average

RYSTIDOSIS (Gr ῥυσις, *a furrow*) A disease of the eye, in which the cornea appears shrunk and puckered It is produced by a wound, or by a deficiency of the aqueous humour, which happens from old age or fevers, or occasionally from the action of an extremely arid atmosphere After death it is produced by the evaporation of the aqueous humour through the cornea, and the consequent shrinking of that membrane.

of what it had been for a few years previously, and it was [illegible] and invariable at that amount. [illegible] to arrear with government, his estate might be either sold or resumed

That the assessment was at the outset, and still is too high cannot well be doubted; and it must ever be matter of regret that the settlement was not made with the ryots or cultivators, rather than with the zemindars, but, notwithstanding these and other defects, the measure was, on the whole, a great boon to India Until the introduction of the perpetual system into Bengal, the revenue was raised in it, as it continues to be in the rest of India down to the present day, by a variable as well as a most oppressive land-tax We all know what a pernicious influence tithe has had in this country, but suppose that, instead of amounting to 10, tithe had amounted to 50 per cent of the gross produce of the soil, it would have been an effectual obstacle to all improvement, and the country would now have been in about the same state as in the days of Alfred, or of William the Conqueror

In France, Italy, and other parts of Europe, where the *métayer* system is introduced, the landlord seldom or never gets half the produce, unless he also furnish the stock and farming capital, and, in most cases, the seed But in India neither the government nor the zemindars do any thing of the sort they merely supply the land, which is usually divided into very small portions mostly about six, and rarely amounting to twenty-four acres A demand on the occupiers of such patches for half the produce is quite extravagant, and hence the excessive poverty of the people, which is such as to stagger belief Still, however, the perpetual system is vastly preferable in principle, and also in its practical influence to any other revenue system hitherto established in India It set limits to fiscal rapacity, and established, as it were a rampart beyond which no tax-gatherer dared to intrude The enormous amount of the assessment, and the rigour with which payment was at first enforced, ruined an immense number of zemindars But their lands having come into new and more efficient hands a better system of management was introduced, and the limitation of the government demand gave a stimulus to improvement unknown in any other part of Hindostan This, in fact, was the grand desideratum A land-tax, that may be increased should the land be improved is all but certain to prevent any such improvement being made This has been its uniform operation in every country in the world that has had the bad fortune to be cursed with such a destructive impost But a heavy land-tax, provided it be fixed and unsusceptible of increase, is no bar to improvements, unless in so far as it tends to deprive the proprietors and occupiers of land of the means of making them There is, in such a case no want of security, and the cultivator is not deterred from attempting improvements, or of bringing superior enterprise and industry to operate on his estate by the fear that the tax will, in consequence, be increased

The truth of what is now stated has been fully evinced in Bengal during the last twenty or thirty years, for both the population and the land revenue of that part of our Indian empire have greatly increased A great deal of waste land has been cultivated and various works have been undertaken that would not be so much as dreamed of in any other part of our empire in the East But with all this, there has been but little if any, improvement in the condition of the people of Bengal under our government They, in fact are practically excluded from at least all direct participation in the benefits resulting from the limitation of the assessment They have merely exchanged one taskmaster for another It is their landlords who have been the great gainers The occupiers still, generally speaking hold under the *métayer* principle, paying half or even more of their produce as rent, so that their poverty is often extreme, and their condition not infrequently inferior even to that of the hired labourer, who receives the miserable pittance of two annas, or about 3*d* a day as wages

It seems however as if here were [illegible] attending the government of India [illegible] talents and the best intentions [illegible] legislate for that [illegible] most pernicious projects [illegible] carried into effect by Lord Cornwallis in Bengal was keenly opposed by Lord Teignmouth, Colonel Wilkes, Mr Thackeray, Sir T Monro, and others, whose opinions on such subjects are certainly entitled to very great respect, and it would seem that the Board of Control became, at length, favourable to their views In consequence of this change of opinion it was resolved to introduce a different system under the superintendence of its zealous advocate, Sir Thomas Monro, into the presidency of Madras, or Fort St George This new system has received the name of the *ryotwar* settlement It proceeds on the assumption that government possesses the entire property of the soil, and may dispose of it at pleasure no middlemen or zemindars are interposed between the sovereign and the cultivators, the ryots being brought into immediate contact with the collectors appointed by government to receive their rents It is impossible for us to enter into the details of this system which are completely developed [illegible] we beg to refer the reader to Hamilton's account of it in the *Encyc Brit*, art "India, British"

RY'TINA (Gr *ῥυτις, a furrow*) The name of a genus of herbivorous Cetaceans, of which a species inhabiting the coasts of Kamschatska (*Rytina stelleri*), with a wrinkled and furrowed integument, is the type

## S.

S A sibilant articulation, found in all the languages of which we have any knowledge S may be regarded as a species of semivowel, from its forming a kind of imperfect sound without the aid of any of the vowels, and from its peculiar quality of being able to be sounded before all the consonants, it has been termed by grammarians *suæ potestatis litera* It is susceptible of numerous interchanges both in the ancient and modern languages As an abbreviation, S is used for *socius, societas, south, solo*, &c

SA'BAISM, or SABE'ISM (From the Heb zaba, *lord*, whence Sabaoth &c, or *army, the host of heaven*) The religion which has for its objects of worship the sun, moon, and other heavenly bodies This belief prevailed in very remote ages in the Asiatic countries between the Euphrates and the Mediterranean, and Chaldæa the native land of astronomy, was its most celebrated seat Many allusions are made to this species of worship in the Old Testament, especially in the invectives of the prophets against the various forms of idolatry borrowed by the Jews from their heathen neighbours (See *Sale's Preliminary Discourse to the Koran*) There is a valuable memoir on the Sabaism of the ancient Persians by Foucher, *Mem de l'Ac des Inscr* vol xxv p 100 See also *Russell's Connexion of Sacred and Profane History*, vol i

SABA'OTH A Hebrew word, signifying hosts or armies It occurs in the New Testament as a designation of the Almighty (the Lord of Sabaoth)

SABA'SIA In ancient Mythology, festivals in honour of various divinities entitled Sabasii here, in of which term is not clear Mithras the sun, is called Sabasius in ancient monuments whence the word seems to have some connection with the root of Sabaism (see above), but Bacchus was also thus denominated, according to some, from the Sabæ a people of Thrace and the nocturnal Sabasia were celebrated in his name Jupiter *Sabazius* is thought to be the same as *Jehovah*, the Phœnician word tsebaoth signifying kids as the Greek αἴξ a goat But there is probably, some more general oriental meaning which has not yet been reached

SABBATA'RIANS In Ecclesiastical History, various sects have been so called, particularly a subdivision of the Anabaptists in the 16th century, who observed the Jewish sabbath The *Sabbatians* of the 4th century were followers of Sabbatius, a Novatian bishop, who attempted to introduce some Jewish observance into the church They are said to have had the singular peculiarity of abhorring the use of the *right* hand, whence they were called Ἀριστεροι or left-handed

SA'BBATH A Hebrew word signifying *rest*, applied by the Jews to the seventh day of their week (our Saturday) on which they were commanded to abstain from all manner of work, because "in six days God created the heavens and the earth, and rested the seventh day" The universal practice of the Christian church from the earliest period in conformity to what may be gathered from some passages in the Acts of the Apostles, has set apart the first day of the week (Sunday) for the especial worship of God, in memory of the resurrection of our Lord on that day The obligation upon which the observance of Sunday rests has been placed upon different grounds The most prevalent opinion supposes the commandment given to the Jews originally to be of universal obligation, as far as the observance of one day in seven But there have been many divines in all ages who have held that all the formal obligations of Judaism, as well those of the commandments as those of the Levitical law, were abrogated on the advent of our Saviour, and consider the consent of the church and the practice of the Apostles to be the only sufficient authority for this observance It is upon this principle that the Continental churches hold themselves justified in indulging in all sorts of worldly recreation on Sundays, after the services of public worship are concluded Archbishop Whately has recently drawn attention to the subject by his able arguments against the popular opinions on which the observance of the Sabbath is made to rest

The name *Sabbatarians* was given to some early sects of [illegible] Christians, who insisted on the observance of the Sabbath (Saturday) under the new dispensation

SABBA'TICAL YEAR Every seventh year among the Jews so called because on that year the land was allowed to rest and the people were supported by the tripled produce of the year preceding (Exod xxiii 10 Levit xxv 3 20)

SABE'LLIANS Heretics of the 3d century, followers of Sabellius, whose system [illegible] doctrine of the Trinity by [illegible] sole person, and the Son [illegible] emanations from him Thus they compared the Divinity to the sun, of which the Father would be analogous to the substance, the Son to the light, and the Holy Ghost to the heat This scheme has been known in later times as that of the Modal Trinity, and some divines of the orthodox English church have found themselves entangled in it, when attempting to explain accurately the mysterious doctrine to which it refers On the other hand, their opponents have been led inadvertently in some cases, to make too formal a distinction of the Three Persons, and have thereby subjected themselves to the charge of Tritheism (See *Mosheim*, transl ed 1790, vol i p 305)

SA'BIANS A Christian sect, also called Christians of Saint John, thought by some to be the remnant of the Jewish Hemerobaptists found in Persia and Arabia, principally at Basra (See *Mem de l'Ac des Inscr* vol xii, and *Mosheim*, vol iv)

SA'BLE A small quadruped allied to the martin-cat, celebrated for the fineness and rich colour of its fur of which the hairs turn with equal ease in every direction A single skin of the darker colour though not above four inches broad has been valued as high as 15*l* The sable (*Mustela zibellina* Linn) is principally a native of the northern regions of Asia it is hunted and killed for the Russian market either by a single ball a blunt arrow, or traps, by exiles or soldiers sent for that purpose in the deserts of Siberia The skin is in the highest perfection from November to February A nearly allied animal, called the 'fisher,' inhabits North America, and is similarly sought after and destroyed for its fur

SABLE In Heraldry, black derived, probably from the fur of the animal sable One of the colours or tinctures employed in blazonry It is equivalent to diamond among precious stones Saturn among planets In engraving it is represented by vertical and horizontal lines [illegible] each other

SACCHARIC ACID (Lat saccharum *sugar*) An uncrystallizable acid product formed along with oxalic acid during the action of nitric acid on sugar

SACCHAROID (Lat saccharum, and Gr εἶδος *form*) A texture resembling that of loaf sugar, is said to be [illegible]

SACCHAROMETER (Lat saccharum and Gr μέτρον *a measure*) An instrument for determining the specific gravity of brewers and distillers worts

SACCHARUM See SUGAR

SACCHOLACTIC ACID (Lat saccharum and lac *milk*) An acid obtained by digesting sugar of milk in nitric acid It is identical with that obtained from gum and termed *mucous acid*

SA'CER MO'RBUS (Lat *sacred disease*) One of the [illegible] nated

SACK (Fr *vin sec*, from which the term is generally supposed to be derived) A Spanish wine of the dry kind The important part which it plays in Shakspeare is well known Falstaff calls it *sherry sack* which means sherry sack, so called says Blount in his *Glossographia* from Xeres a sea town of Cordubia where that kind of sack is made At a later period sack seems to have been used as a general term for all kinds of sweet wines, and it has been conjectured that, instead of being a corruption of the French *sec*, as above noticed it derives its name more probably from a common practice of the Spaniards of putting their sweet wines into *sacks* made of goat skins and thus transporting them from one place to another

It may be interesting to observe, that the term *sack* in the sense of a *bag*, is found in all the European and many Asiatic languages

SACKBUT A wind instrument of the trumpet species, but differing from the common trumpet in form and size It is of low or bass pitch, and is drawn out or shortened by the means of sliders, according to the acuteness or gravity of the tone to be produced It is, in fact, the trombone of the Italians

SA'CRAMENT (Lat *an oath*) The military oath taken by every Roman soldier, by which he swore to obey his commander and not desert his standard

SACRAMENT In Theology a word which does not occur in scripture, nor possesses any exact equivalent there, but employed very early by writers in theology to signify certain distinctive ceremonies of the Christian faith Our Saviour appointed the baptism of believers as an initiatory rite, he also commanded the observance of the supper of the Lord to be held in remembrance of him These, then, are the badges by which Christian men are known, and by which they make profession of their belief The expressions of scripture moreover, with which the appointment of the ceremonies is attended have been [illegible] and [illegible] much controversy concerning them The one called the second birth the other is said to be the communion of the body and blood of our Saviour Christ, and the mysteries which seem to be concealed under these terms have been made the subjects of various interpretations According to the general consent of ancient orthodoxy the sacraments have in themselves a peculiar [illegible] The Romish church is accused of holding the extreme opinion that this grace is conferred *ex opere operato*, by the mere act the recipient remaining passive, that they fail of operation only where he is under the influence of positive sin, but that the administration of the Eucharist to a dying man unconscious of the whole proceeding, would have the same effect as if he received it in the most holy frame of mind The English church requires the worthy acceptation of the person himself, as is expressly stated, with a tacit reference to this superstitious notion, in its twenty fifth article It guards at the same time, against the idea very [illegible] churches abroad and [illegible] words with which the article begins —"Sacraments ordained of Christ be not only *signs* or *tokens of Christian* men's profession, but rather they be certain sure witnesses and effectual signs of grace and God's will towards us, by the which he doth work invisibly in us and doth not only quicken, but also strengthen and confirm our faith in him"

The question as to the number of such ceremonies must be settled by the definitions of a sacrament which theologians shall propound It is agreed that a sacrament is a federal rite, instituted by Christ or the Apostles, with a direct appointment of *matter* by which some interior meaning is signified and the *form* of manner of its application This definition is conceived by Protestants to restrict the number to two only the Romanists extend it to seven adding to Baptism and the Lord's Supper Confirmation Penance, Orders, Matrimony, and Extreme Unction

SA'CRED WAR The most remarkable known by this name in classical history is that which commenced with the seizure of Delphi by the Phocians, B C 357, and was ended by the conquest of the Phocians by Philip of Macedon B C 346, according to the chronology of Clinton (*Fasti Hellenici*)

SA'CRIFICE Generally any offering made to the Deity but more properly that of a victim upon an altar, accompanied by customary ceremonies and forms of prayer with the idea of gratifying God and averting his displeasure In the scriptures we meet with offerings, both of fruits and of animals antecedent to any command or institution of God, such as those of Cain and Abel, of Noah and the Patriarchs many of which, nevertheless, are described as acceptable to him In the Levitical Law, however sacrifices are ordained by divine appointment, and a question arises as to the probability of a similar command having been in fact given to our first parents The universality of the practice undoubtedly requires either the supposition of an original revelation, or the discovery of a common principle impelling all men alike to the adoption of what at first sight seems to militate against our ideas of reason and the absurdity of which has, we know been represented in the strongest light by the sages of all nations at a certain period of the intellectual development of each Those divines who consider the appointment to have emanated directly from God conceive it to have been, from the first typical of the last and greatest sacrifice —that of our Saviour on the cross It may fairly be asked of those who look for logical reasons for all divine appointments whether upon human principles it is not [illegible] that the sacrifice [illegible] been predetermined the notion should be familiarized to us first by ordaining a previous practice, or that, the practice existing and having a meaning of its own in all minds, the new revelation should be accommodated to our notions by adopting that very practice for its foundation? If, on the other hand, we follow the general current of modern opinion upon this subject, and inquire for some general principle of our nature to account for the universal reception of the ideas, we may discover it perhaps in the perpetual sense of obligation with which the enjoyment of prosperity is properly accompanied, and which in some minds takes the form of [illegible] the devotion to the giver [illegible] which we are ourselves gratified, and in others becomes an uneasy scruple, and suggests the voluntary surrender of a part with a view to the more secure enjoyment of the remainder

SACRILEGE (Lat *sacrilegium*) The profanation of anything or place consecrated to the service of God.

SACRISTY (Lat *sacer sacred*) In Architecture,

an apartment attached to a church, in which the consecrated vessels of the church, and the garments in which the [illegible]

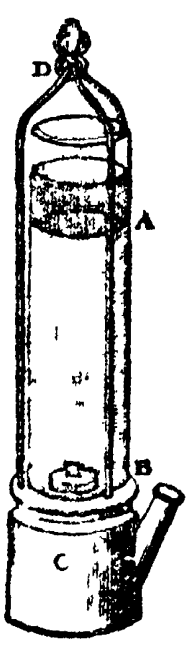
SACRUM [illegible] pelvis, articulated to the last lumbar vertebra, and firmly united on each side to the hip bones, below, the *os coccygis* is attached to it It probably derives its name from having been offered by the ancients in sacrifices In young subjects it is composed of five or six pieces united by cartilage but in more advanced age it becomes one bone

SADDER A work in the modern Persian tongue, comprising a summary of various parts of the *Zendavesta*, or sacred books of the ancient Persians (which see) The authority and character of the Sadder are supposed to be very small some attribute it to the Parsees, and give it an antiquity of several centuries, others consider it a more modern forgery (See *Mem de l'Ac des Insc* vol xxxviii)

SA'DDLE In Sea Language, a lump of wood acting as a seat or rest to the heel of a boom, and shaped accordingly

SA'DDUCEES A peculiar sect of religionists among the Jews It is remarked that during the time that prophets are recorded to have arisen among the Jews, there is no account of the existence of any sects among them they frequently fell away into total idolatry, but whenever recalled from that corruption, they appear to have reverted in a body to the pure religion of their ancestors, and never to have been separated in religious distinctions among themselves The most ancient sect was that of the Sadducees whose founder, Sadok, lived about 250 years B C He appears to have restricted the providence of God to the distribution of the temporal rewards and punishments which form the main feature of the old dispensation In the time of our Saviour his followers entirely rejected the doctrine of a resurrection They were assimilated also to the Epicureans in maintaining the perfect freedom of human actions, and like those pagan philosophers were few in number and only of the highest and most literary classes They were distinguished also from the Pharisees by the rejection of traditions and by strict adherence to the written law alone (See *Milman's Hist of Christianity* vol i p 75 211)

SAFETY LAMP A lamp invented by Sir H Davy which is so constructed as to burn without danger in an explosive atmosphere Flame may be considered as vapour or aeriform matter in a state of intense ignition, the temperature therefore of flame is always very high It is however independent of its luminosity, for some of the dimmest flames, those of pure hydrogen gas and of alcohol for instance are those which are hottest, and that this is so may be shown by projecting into them finely powdered substances such as magnesia or lamp black, or by holding in them fine platinum wire when the intensity of their temperature is rendered evident by those substances becoming white hot And whenever flames emit much light they derive that property from the presence of finely divided matter diffused through them thus, the intense brilliancy of the flame of phosphorus appears to depend upon the particles of incombustible phosphoric acid diffused through it, and the bright light emitted by a gas flame depends upon finely divided charcoal, which is ignited by the gas and at the same time burned The correctness of this *theory of flame* is shown by the circumstance of its being extinguished by cooling, and this is best effected by causing it to pass through a piece of fine wire gauze, which when held [illegible] of the flame extinguishes [illegible] he inflammable vapour or [illegible] or carbon pass through but in passing are so far cooled as to be extinguished, they may however, be re[illegible] above the wire [illegible] merely acts by its cooling power, is shown by the flame passing through it when it acquires a white heat or when its meshes are not fine enough to exert a due cooling power, it is also found that very hot flames such as that of hydrogen, will pass through tissues which are impervious to flames of a lower temperature, such as that of a common candle or a gas flame (*See* FLAME) The application of these principles to the con[illegible] [illegible] — [illegible] rounded by a cylinder of wire gauze A B (doubled at A where it is to become hottest, and protected by the stout wire frame D), and burns within it, the air having free ingress and egress When it is immersed in an explosive atmosphere, such as that of a coal mine infested by fire damp, the inflammable gas enters from without and burns *in* the cage, but, in consequence of the cooling power of the wire gauze, no flame can pass *outwards* so as to ignite the surrounding atmosphere the miner, therefore, is warned of his danger by the [illegible] of the lamp As [illegible] the external [illegible] but upon the approach of the fire damp the flame is more or less enlarged, and in the most explosive condition of the surrounding air the cylinder appears filled with a blue lambent flame, which flickers within it, the wick of the lamp appearing for the time extinguished It is, however, rekindled as the air becomes more pure; or should the fire damp greatly predominate, it may be entirely extinguished Before this happens, however, the miner is duly apprised of his danger, and has time to retreat (See *Davy on the Safety Lamp*)




SAFFTY VALVE *See* STEAM ENGINE

SA'FFLOWER The dried flowers of the *Carthamus tinctorius*, or bastard saffron, used as a dye stuff, and in the preparation of the [illegible]

SAFFRON The [illegible] the *Crocus sativus* The stigmata of this purple crocus are of a deep orange colour and when in quantity have a peculiar and very characteristic odour, they are used in medicine, chiefly as a rich yellow or orange colouring matter Saffron is now chiefly imported from the south of Europe, especially Spain, it was formerly cultivated in this country in the vicinity of [illegible] in Cambridgeshire [illegible] petals of other [illegible]

SAGA The general name of those ancient compositions which comprise at once the history and mythology of the northern European races Their language is different from the modern Danish, Swedish, and Norwegian and is more powerful and expressive than either of these later dialects Of the mythological sagas the most famous are the saga of Regnar, Lodbrok, the Hervarar saga, the Voluspa saga and the Wilkina saga The historical are very numerous, the Jomsvikingia saga and the Kaflinga saga comprehend much of the early annals of Norway and Denmark, the Eyrbiggia saga is the chief historical document of ancient Iceland It is, however to be remembered, that the chief object of the relators is the interest of the narrative, so that as mere histories they are of imperfect value Many of them are collected in the great work of Snorre Sturleson called *Heimskringla* The most classical period of these compositions is considered by antiquaries to fall within the 12th and 13th centuries

SAGAPENUM A fetid gum resin brought from Persia and Alexandria probably the produce of a species of *ferula* It is occasionally used in medicine as a nervine and stimulating expectorant Its odour somewhat resembles that of assafœtida but it is much weaker

SA'GGER A clay used in making the pots in which earthenware is baked, and which are called *saggers* or *seggers*

SAGGING TO LEEWARD A Nautical term denoting the movement by which a ship makes considerable lee-way

SAGITTA (Lat *arrow* or *dart*) One of Ptolemy's 48 constellations in the northern hemisphere *See* CONSTELLATION

SAGITTA A term used by the older writers on trigonometry to denote the *versed sine* of an arc, from its resemblance to an arrow standing on the chord of the double arc

SAGITTA'RIUS (Lat *the Archer*) One of the twelve constellations of the zodiac It is represented on celestial globes and charts by the figure of a centaur in the [illegible] arrow from his bow

SAGITTAL (Lat sagitta, *an arrow*) In Zoology a part of an animal is so called when it is triangular and hollowed out at the base, with posterior angles

SA'GO A species of feculæ or starch obtained from the cellular substance of an East Indian palm tree, the *Sagus farinifera* It is usually granulated, and known in the trade under the name of *pearl sago*

The tree, when at maturity is about 30 feet high, and from 18 to 22 inches in diameter Before the formation of the fruit the stem consists of an external wall about 2 inches thick, the whole interior being filled up with a sort of spongy medullary matter When the tree attains to maturity, and the fruit is formed, the stem is quite hollow Being cut down at a proper period, the medullary part is extracted from the trunk, and reduced to a powder like sawdust The filaments are next separated by washing The meal is then laid to dry, and being made into cakes is baked and eaten For exportation, the finest sago meal is mixed with water, and the paste rubbed into small grains of the size and form of coriander seeds This is the species principally brought to England, for which market it should be chosen of a reddish hue, and readily dissolving in hot water into a fine jelly Within these few years, however, a process has been invented by the Chinese for refining sago, so as to give it a [illegible] so cured is in the highest [illegible] markets It is a light, [illegible] It is sent from the islands [illegible] where it is granulated [illegible] by the Chinese The export

trade to Europe and India is now principally confined to that settlement (*Ainslie's Mat Indica*, *Crawfurd's East Archip* vol i pp 383—393, vol iii p 348, *Bell's Review of the Commerce of Bengal, &c*)

The consumption of sago has undergone an almost incredible increase within the last twenty years, which is wholly ascribable to the reduction in the interval of the oppressive duties by which the article was formerly loaded — (*Papers published by the Board of Trade*)

SAGUM The military dress of the Roman magistrates and dignitaries, a cloak fastened at the breast with a clasp The same name was given to the ordinary dress of several barbarous nations Thus Tacitus says of the Germans *paludamentum vestagum*, and Varro and Diodorus Siculus present us the costume of the Gauls

SAHLITE In Mineralogy a variety of augite from the silver mine of Sahla in Sweden

SAIL A surface obtained by canvass, mat, or other material, by the action of the wind on which, when extended, the vessel is moved A sail extended by a yard hung (*slung*) by the middle and balanced, is called a *square sail* a sail set upon a gaff or a stay, is called a *fore and aft sail*, which terms refer to the position of the yard, gaff, or stay, when the sail is not set The upper part of every sail is the *head* the lower part the *foot*, the sides in general are called *leeches*, but the weather or side edge of any but a square sail is called the *luff*, and the other edge the *after leech* The upper two corners are *earings*, but that of a jib is the *head*, the lower two corners are in general *clues*, the weather clue of a fore and aft sail, or of a course while set, is the *tack* The edges of a sail are strengthened by a rope called the *bolt rope* The ropes at the upper and lower edges are the head and foot ropes of the sail The canvass or sail-cloth is made in *bolts*, and the qualities are numbered from No 1 which is the strongest, and is used for storm sails, to No 8, which is used for the smallest sails, as small studding sails &c, which the seamen commonly call *flying kites* The cloths in a square sail are seamed vertically, in a fore and aft sail they are parallel to the after leech In this way the strain of the sheet diffuses itself over the canvass both along and across the cloths Discussions have, however, arisen as to the best mode of seaming When a seam opens, the sail often splits Captain Cowan took out a patent for *horizontal* seaming, he remarks (*Essay on the Construction of Sails &c*) that such sails when they split remain full and are less liable to blow away, and that they also were found to last much longer The plan, however has not been approved *Diagonal* seaming which has also had its advocates is defective in principle, for it must bring the strain of a sheet either on a single cloth, or entirely across the stitches

Sails take their names from the mast, yard or stay upon which they are stretched Thus the principal sail extended upon the main mast is called the *main sail*, the next above, which stands upon the main top mast is the *main-top-mast sail*, above which is the *main-top-gallant sail*, and above all, the *main royal* In like manner, there are the *fore sail*, the *fore top sail*, the *fore-top-gallant sail* and the *fore royal*, and similar appellations are given to the sails supported by the *mizzen* or after mast The *main-stay sail main top-mast stay-sail* &c, are between the main and fore masts, and the *mizzen stay sail mizzen top-mast stay-sail* &c are between the main and mizzen masts Between the foremast and bowsprit are the *fore stay-sail*, the *fore-top-mast stay-sail*, the *jib*, and sometimes a *flying jib* and *middle jib* Square sails extended by yards under the bowsprit and jib-booms are called *sprit sails*, and the *studding sails* are those which are extended upon the different yards of the main mast and fore mast

To *make* sail, is to set sail To *shorten* sail is to take in some sail To *loose* sails, is to spread or hang out the sails that had been furled to air them or for the purpose of setting afterwards To *strike* sail, is to lower the yard or gaff of a sail when set, in token of salute

The common theory of sails which assumes the impact of columns of air is radically defective, for it is a fact familiar to sailors that the reef points, or any light stuff by accident in the same situation, hang vertically in the hollow of the sail, as in a calm, thereby proving that the sail is filled with a mass of air, quiescent or nearly so, and maintained in a state of statical pressure, whereas if the common theory were true, the points would lie flat to the canvass, as weeds are pressed against the bank of a stream Hence it follows that (as practical men believe who have not mixed with their practice the fragments of imperfect theories) there is a certain extent of hollow or *belly* which increases the effect of the sail It of course adds to the effect of sails to wet them, by swelling the threads and closing the pores this practice is often resorted to in chase

SAILING In Navigation, the art of directing a ship on a given line laid down in a chart It is called *plane sailing* when the chart is constructed on the supposition that the earth's surface (or rather the surface of the ocean) is an extended plane, and *globular sailing*, when the chart is a globular chart, or constructed on the supposition that the earth is a sphere See NAVIGATION

SAILING ORDER, or ORDER OF SAILING Any determinate order preserved by a squadron of ships It usually implies 1, 2, or 3 parallel columns, but is at the disposition of the admiral

SAINFOIN (*Hedysarum onobrychis*) A plant of the family of the *Leguminosæ* It will not thrive well except when the soil or subsoil is calcareous, and is consequently not generally met with in this country, though it is extensively cultivated on the Cotswold Hills, and on the chalk soils of Dorset, Hants, Wilts, &c It generally remains for eight or ten years, — a much longer period than it does in France It is made into hay, the after crop eaten by cattle

SAINT JOHN KNIGHTS OF, or HOSPITALLERS A military order of religious persons They derived their name from a church and monastery dedicated to St John the Baptist, founded at Jerusalem about 1048 by merchants from Amalfi, the brotherhood of its members [illegible] and sick [illegible] brotherh[illegible] the 12th c[illegible] chaplains [illegible] was bound to defend the church against the infidels It possessed various possessions and settlements at different times in different parts of the East In the 13th century, being driven from Palestine, the knights of this order fixed their principal seat first in Cyprus, and afterwards at Rhodes where they remained from 1309 to 1522, when the island was captured by Solyman II After several changes of settlement, they were fixed in 1530 by Charles V at Malta and its dependent islands whence they took the name of Knights of Malta Here they maintained themselves until 1798, when the island was taken by Napoleon The order however, continued to subsist, notwithstanding the loss of its sovereign possessions both in Malta and Tuscany the seat of the chapter is now at Ferrara Before the French Revolution the number of knights was estimated at 3000 The temporal powers of the order were chiefly concentrated in the hands of the grand master, but he was in fact, controlled by the governors of the eight languages These were of Provence Auvergne, France, Italy, Aragon, Germany Castile, and England The lands were divided into priories commanderies, and bailliages The spiritual power was exercised by the chapter, consisting of [illegible] The knights were under the [illegible] Protestants were not bound to celibacy They were required to be necessarily of good descent, but those whose proofs of noble ancestry were unquestionable were termed *cavalieri di giustizia* while others who could not show such proofs might be admitted on account of their merits as *cavalieri di grazia* See HOSPITALLERS

SAINTS (Lat *sancti*, *holy persons*) Pious men, who, according to a custom early prevalent among Christians, were commemorated with honour after their death in the services and ceremonies of the church This distinction was originally applied to the apostles and eminent martyrs and confessors, whose places of burial were regarded with pious affection by the faithful in the neighbourhood, and memorials or relics of whom were carefully cherished among them The observance of particular days in the honour of the saints was also a very early custom, but the natural feeling which prompted this and other tributes of gratitude and respect towards them became gradually corrupted The intercession of the saints was supposed to have power with God, and individuals put themselves under the especial patronage of one or more amongst the number which in later times was vastly augmented, giving to them the honour and worship due to God alone, and conceiving themselves sufficiently protected by the influence of their prayers It was affirmed that miracles were performed at their tombs and by their relics, and the greatest rivalry and contention arose between the votaries of the shrines of different saints, and sometimes those of the same For the manner of enrolment among the number of saints, see art CANONIZATION (See *Bingham and Palmer's Origines Liturgicæ* as to the progress of the invocation of saints in the church, vol i 76, &c)

SAINT SIMONIANS The [illegible] followers of [illegible] He was born in 1760, [illegible] series of unsuccessful commercial enterprises, in which [illegible] having been unfortunate [illegible] a variety of [illegible] which he was constantly publishing [illegible] he lived, however, a few years longer, and died in 1825, leaving his papers and projects to Olinde Rodriguez St Simon's views of society and [illegible] riety of wor[illegible] the *Nouveau*[illegible]

Rodriguez This book does not contain any scheme for the foundation of a new religion, such as his disciples afterwards invented It is a diatribe against both the Catholic and Protestant sects for their neglect of the main principle of Christianity, the elevation of the lower classes of society, and inveighs against "l'exploitation de l'homme par l'homme," the existing system of individual industry, under which capitalist and labourer have opposite interests and no common object The principle of association, and just division of the fruits of common labour between the members of society he imagined to be the true remedy for its present evils After his death these ideas were caught up by a number of disciples and formed into something resembling a system The new doctrine of St Simonian *family* was chiefly framed by Rodriguez Bazard Henry, Chevalier and other men of talent After the revolution of July, 1830, it rose rapidly into notice the sympathy between the notions which prevailed and those entertained by many of the people favourable In 1831, the society had about 3000 members a newspaper (the *Globe*) and large funds The views of the St Simonian family were all directed to the abolition of rank and property in society, and the establishment of associations (such as the followers of Mr Owen in this country have denominated co-operative), of which all the members should work in common and divide the fruits of their labour But with these notions, common to many other social reformers, they united the doctrine that the division of the goods of the community should be in due proportion to the merits or capacity of the recipient Society was to be governed by a hierarchy consisting of a supreme pontiff apostles, disciples of the first second and third order It was not until about this period (1830) that they began to invest these opinions with the form and character of a religion, but shortly after having done so they went into great extravagances There was a disunion among them as to the fittest person to preside in the society, and consequently Messrs Bazard and Enfantin divided, for some time the duties and dignity of the "Supreme Father," as he was termed But on the 19th Nov 1831, Bazard and many others left the society of which Enfantin remained the supreme father Their doctrines and proceedings now became licentious and immoral to the last degree On the 22d Jan 1832 the family was dispersed by the government Enfantin and Rodriguez were tried on various charges and imprisoned for a year The former afterwards collected again a part of the society at Menilmontant, but it broke up for want of funds Some former members of the St Simonian association are now in places of rank and consideration, and others have founded new schools of Socialism and Communism of whom Louis Blanc, Cabet, and Proudhon are the leading names

SALAMANDER *Salamandra* (Gr σαλαμανδρα) The name of a genus of Batrachian reptiles, now limited to the terrestrial species of long-tailed Caducibranchiate Batrachians or those which lose their gills before arriving at maturity but retain their tails This appendage is changed in the progress of growth in the true salamander to a rounded form The female brings forth young which are hatched in the oviduct, and the sexes frequent the water at the season of reproduction *See* BATRACHIA and TRITON

SAL AMMO'NIAC Muriate of ammonia, hydrochlorate of ammonia A compound of 17 of ammonia and 37 hydrochloric acid Its name is derived from the Temple of Ammon, in Egypt, where it was prepared by burning camels' dung it is now largely manufactured in this country *See* AMMONIA

SALEP *See* SALOP

SAL GEM Common salt

SALICA'CEÆ (*Salix*, the principal genus) A natural order of Achlamydaceous Exogens, distinguished by a two valved capsule and numerous seeds tufted with long hairs The genus *Salix* comprehends the plants called osiers, sallows and willows, and is of great economical value, not only for the purposes of the basket-maker, but because several species have a bark which has been found by Davy to contain as much tannin as the oak, and a crystallizable principle called *salicine* has been found by others, which, according to [illegible] distress of a fever with the same, [illegible] and bile The poplars, aspens and abele trees also form a part of this order

SA'LICIN A bitter [illegible] from willow bark It exists [illegible], and a similar substance has been extracted from the bark of the poplar, especially of the *Populus tremula* Its ultimate elements are carbon hydrogen, and oxygen, so that it differs from the vegeto-alkalis in containing no nitrogen

SA'LIC LAW The law of that community of the nation of Franks which inhabited the country between the Meuse and the Rhine —the law of the Ripuarian Franks governing those who dwelt between the Rhine and the Loire The origin of the name Salian, given to this portion of the Franks and their law, is uncertain some derive it from the river Saale, in Saxony, on the banks of which they suppose them to have inhabited before the period of their emigration westward The body of law in question was republished and corrected by Charlemagne in 798 and is still preserved both in the earlier and in the remodelled shape The most celebrated portion of it is contained in the title 62 *De Alode*, where it is declared that "no portion of the inheritance in Salic land (terra salica) can fall to females, but that the whole must pass to the males" What those lands were which are intended by the term Salic, has afforded room for infinite discussion among French antiquaries It is supposed by Ducange that they were those lands which were acquired by Franks at the period of the conquest, and held by military service only But it seems that the exclusion of females was only to take place where males were to be found in the same degree of kindred to the ancestor However this may be, the fundamental law which excludes females from succession to the crown of France received in very early times, the appellation of the Salic law and was [illegible] lawyers to be derived from the [illegible] code It was, indeed a custom prevalent from the earliest times, as we learn from Tacitus among the Germanic tribes It was observed in France under the first race, but the first occasion on which it was publicly canvassed was in 1316, when Jeanne the daughter of Louis Hutin, was excluded from the crown in favour of Philip V her uncle In 1328 it was contested by Edward III, who claimed by a prior title to Philip of Valois if females were admissible, being the son of Isabella sister of Louis Hutin From this pretension arose the wars between England and France which occupied the whole of the following century In 1593 the famous arret of the parliament of Paris was pronounced by which all treaties made to transfer the crown to a foreign dynasty were declared null, as contrary to the 'Salic' and other fundamental laws The same law has been recognized in all countries of which the crown has devolved upon the royal house of France and forms now the foundation of the pretensions of the Infante Don Carlos to the throne of Spain It was also considered as established in those great fiefs of the crown of France which had been granted to princes of the blood by way of apanage, and by this means on the death of Charles duke of Burgundy leaving a daughter only the dukedom of Burgundy proper reverted to Louis XI as a male fief (See *Mem de l Ac des Inscr* vol xx *Meyer's Origines Judiciaires*, *Hallam's Middle Ages*)

SALICOQUES The French term for the family of Macrourous or long tailed Crustacea of which the shrimp (*Crangon vulgaris*) is the type

SA'LIENT (Lat *salio I leap*) In Heraldry, a term used to describe a beast when represented as leaping or springing

SALIENT ANGLE In Geometry and Fortification, an angle of a polygon projecting *outwards* in reference to the centre of the polygon An angle pointing *inwards* is called a *re entering angle* All the angles of any regular figure, as the triangle, square hexagon, &c, are salient

SALIENTIA (Lat *salio, I leap*) The third order in the Mammalogical system of Illiger, including the Marsupial genera *Hypsiprymnus* and *Halmaturus* or the potoroos and kangaroos, whose progression is by successive leaps

SALIFEROUS ROCKS The new red sandstone system of some geologists *See* GEOLOGY

SALIFIABLE BASE This term, which is of frequent occurrence in chemistry is chiefly applied to those metallic oxides which combine in definite proportions with the acids, so as to form distinct salts ammonia, and the vegeto-alkalis are also, upon the same principle, salifiable bases

SA'LII The Roman flamens or peculiar priests of Mars They were twelve in number and were instituted by Numa to guard the *ancile* or sacred shield of Mars They used on solemn occasions to proceed through the city dancing, whence they derived their name (from *salire* to dance)

SALI'VA (Lat) The fluid secreted into the mouth by the salivary glands, its principal use is to lubricate the parts, and to assist in rendering the food of a proper consistency to be swallowed

SALIVA'TION The excessive flow of saliva which is produced by the continuous use of mercury and of some other remedies

SA'LIX (Lat *a willow*), is a genus of plants consisting of numerous species, all either trees or bushes, occurring abundantly in all the cooler parts of the northern hemisphere Some of them, like *S alba*, acquire the dimensions of the largest forest trees, others are lost among the grass with which they grow, as *S herbacea* The [illegible] plants that grow [illegible] are the only trees on Melville Island, [illegible] having

been a willow (*Salix arctica*) Few extend into warm regions, the *Salix babylonica*, or weeping willow, being [illegible] Their timber, when they form [illegible] and unfit for purposes of con- [illegible] sed for turnery, and for coarse in-door purposes Many species have long flexible shoots, and are called osiers, under which name they are extensively employed by the workers in wicker, others are not flexible, but form small trees or rough bushes, named sallows The latter, called *Saules marçeaux* by the French, yield the best kind of charcoal for military purposes, they are all, however, burnt for the preparation of this substance The bark of *S helix fragilis pentandria*, and others, has been found useful in intermittent fevers and as these maladies are most common in the low marshy places where salices abound it has been supposed that they are the means which the Creator has given us for protecting ourselves against such disorders The species intermix very freely, [illegible] and hybrids, which have led botanists to create a prodigious number of false species

SALLY PORTS, in Fortification, are underground passages leading from the inner works to the outward ones, for the troops to sally out They are otherwise called *postern gates*

SA'LMON (Lat salmo) The excellent and highly valuable fish so called in England is the *Salmo salar* of Linnæus, not of Rondeletius Both species exist in our rivers, the latter having been recognizably and accurately defined under the name of *Salmo eriox* or bull trout, which it is to be hoped will be retained for this species, as it will strengthen that the name of *Salmo salar* may have been applied by the older ichthyologist

The normal locality of the salmon is at the mouth or estuary of the larger rivers, which in the season of sexual excitement, they ascend, sooner or later, in the summer months, according as circumstances may influence their coming into breeding condition At first they ascend only so far as the tide wave reaches and retire with the ebb, but as the quantity of roe and milt increases the instinct which teaches the fit locality for oviposition becomes more imperative, and few are the natural obstacles which the salmon does not overcome in its endeavour to reach it

The great value of the fish renders an accurate knowledge of it, under the disguise of its immature form and markings, of the highest importance, but the difficulties which attend the observation of the migratory inhabitants of the water have only very lately been overcome in the present instance The proof that the small Salmonoid fish, called the parr is as many naturalists had suspected the young of the salmon has been elicited by the careful and repeated observations and experiments of Mr Shaw of Drumlanrig of which the following condensed account is taken from the *Transactions of the Royal Society of Edinburgh*

In the river Nith Dumfries the salmon oviposits in the month of January On the 10th of January Mr Shaw observed a female salmon of about 16 lbs weight and two males of at least 25 lbs, engaged in depositing their spawn The spot which they had selected for that purpose was a little apart from some other salmon which were engaged in the same process, and rather nearer the side of the stream, although still in pretty deep water The two males kept up an incessant conflict during the whole of the day for possession of the female and in their struggle frequently drove each other almost ashore and were repeatedly on the surface displaying their dorsal fins and lashing the water with their tails —The female throws herself at intervals of a few minutes upon her side and while in that position by the rapid action of her tail she digs a receptacle in the gravel for her ova a portion of which she deposits, and again turning upon her side she covers it up by the renewed action of the tail, thus alternately digging depositing and covering the ova until the process is completed by the laying of the whole mass an operation which generally occupies three or four days The embryo fish, conspicuous by the two dark eye specks and the vascular vitelline sac, presented some appearance of animation in the ovum on February 26th that is, forty-eight days after having been deposited, and on 8th April, or 90 days after impregnation of the ova, the young were excluded The head is large in proportion to the body, which measures $\frac{5}{8}$ths of an inch in length; the vitellicle is $\frac{2}{8}$ths of an inch in length, and resembles a light red currant, the tail is margined like that of the tadpole, with a continuous fin running from the dorsal above to the anal beneath The vitelline sac and its contents are absorbed by the 30th May, or in about fifty days, until which time the young fish does not leave the gravel The terminal fringe like fin now begins to divide itself into the dorsal, adipose, caudal, and anal fins, and the transverse bars on the sides of the body make their appearance At this period the young salmon measures an inch in length, and is very [illegible] in the shallows of its native stream till the following spring, when it has attained the length of from three to four inches, and is called the "May parr" they now descend into deeper parts of the river, but remain there over the second winter In April, the caudal, pectoral, and dorsal fins assume a dusky margin, the lateral bars begin to be concealed by a silvery pigment, and the migratory dress, characteristic of the salmon fry or smolt, is assumed The fish now begin to congregate in shoals, and to migrate seaward

The full grown salmon averages a weight of between 25 lbs and 35 lbs, but instances are recorded of their attaining to 55 lbs 60 lbs, 70 lbs 74 lbs, and 83 lbs The last-cited weight was that of a female salmon, which came into the possession of Mr Groves, the fishmonger, in Bond Street, about the season of 1821, it was a short fish for the weight, but of very unusual thickness and depth When cut up, the flesh was fine in colour, and proved of [illegible] See FISHERIES

SA'LMONOIDS *Salmonidæ* A family of soft-finned Abdominal fishes, of which the salmon is the type, having their upper jaw formed in the middle by the intermaxillary, and at the sides by the maxillary bones, both of which support teeth, they are also characterized by a posterior small adipose dorsal fin and the body is covered with regular cycloid scales They pass, by almost imperceptible gradations, into the Clupeoid or herring family, with which they have been united by M Agassiz to form a common group termed *Halecoids* Those species of Salmonoids which like the Clupeoids, inhabit the sea, not only approach the land, but ascend the rivers to near their source, in order to deposit their ova.

SALOON, or SALOON (It salone) In Architecture a large state apartment, or, as its name imports, a great hall, or one for the reception of works of art and [illegible] up through two stories of a house *Salon* [illegible] to the reunions of the French capital, which have always exercised considerable influence upon the country in all that relates to fashion, literature, and even politics M Guizot's admirable little work upon the Salons of Paris is well known It was recently well reviewed in the *Journal des Debats*

SA'LOP The prepared root of the *Orchis mascula* It consists principally of a modification of gum, much resembling *tragacanth* with a small quantity of starch, it is sometimes used as an article of food

SALP, *Salpa* (Lat salpa *a stock-fish*) A name applied to a genus of soft shelled or tunicated Acephalous Mollusks which float in the sea, protected by a transparent gelatinous coat, perforated for the passage of water at both extremities

SA'LPINX (Gr σαλπιγξ, *a trumpet*) The Eustachian tube or channel of communication between the mouth and ear

SALT SEIGNETTE Tartrate of potassa and soda See ROCHELLE SALT

SALT (Lat sal Germ salz) This term, though in ordinary language limited to common salt, or sea salt, is applied in chemistry to all combinations of acids with alkaline or salifiable bases The term has also been extended to certain binary combinations of chlorine, iodine, bromine and fluorine with the metals, and these have been called *haloid salts* (from αλς, *sea salt* and ειδος, *form*) inasmuch as modern chemistry has taught us that sea salt belongs to this class Certain definite combinations of the sulphurets with each other have of late been called *sulphur salts* but the former appellation of *double sulphurets* is perhaps, more properly applicable to such compounds

Sea salt is a compound of 1 equivalent of sodium = 24, and 1 of chlorine = 36, its equivalent, therefore is (24 + 36) = 60 and it is a chloride of sodium The circumstances which gave rise to the notion of its containing muriatic acid and soda and being therefore a muriate of soda will be apparent by reference to the article MURIATIC ACID For rock-salt *see* GEOLOGY

The nomenclature of salts has reference to the acids which they contain, *sulphates*, *nitrates*, *carbonates*, &c, implying salts of the sulphuric, nitric, and carbonic acids The termination *ate* implies the maximum of oxygen in the acids, and *ite* the minimum thus the salts of sulphurous and nitrous acids are called *sulphites* and *nitrites* When salts contain 1 equivalent of acid and 1 of base, they are called *neutral salts*, where 1 equivalent of acid is combined with 2 of base they are termed *basic salts subsalts* or *disalts*, and where there are 2 equivalents of acid and 1 of base, the salt is a *sup risalt*, or *bisalt* Thus the terms *subacetate* and *diacetate of lead* are synonymous, so are *supercarbonate* and *bicarbonate of potash* Many salts are *hydrous*, that is they contain a definite proportion of water of crystallization, others are destitute of water and are dry or *anhydrous salts* Some salts attract moisture when exposed to air, and are said to *deliquesce*, others suffer their water to escape and become opaque, or pulverulent these are called *efflorescent salts*

Salt is, next to bread, the most important necessary of life It is one of the most important British minerals,

and is procured in immense quantities, both from fossil beds and brine springs, in Cheshire and Worcestershire Previously to the discovery of the fossil beds during the 16th century, and subsequently a good deal of salt continued to be made by the evaporation of sea water in salt pans, at Lymington and many other places, but the works at these places are now all but abandoned, while not only has the quality of the article in question become greatly improved but instead of being imported as formerly, it is now largely exported The consumption of Great Britain only, exclusive of Ireland, amounts to about 180,000 tons, and [illegible] to about 300,000 tons per year, of [illegible] Canada, the Low Countries, Russia, Prussia and Denmark are the chief consumers Previously to 1823, an oppressive tax of 15*s* per bushel or about thirty times the original cost price of the article, was imposed on salt, but in that year it was reduced to 2*s*, and two years subsequently was totally repealed During the existence of the duty, the retail price of salt was 4½*d* it is now only ½*d* per lb

In ancient Rome, salt was subjected to a duty *vectigal salinarum* (see Burman, *Dissertatio de Vectigalibus Pop Rom* c. 6), and it has been heavily taxed in most modern states The *gabelle*, or code of salt laws formerly established in France was most oppressive From 4000 to 5000 persons are calculated to have been sent annually to prison and the galleys for offences connected with these laws the severity of which had no inconsiderable share in bringing about the Revolution

SA'LIATORY (Lat salto *I leap*) In Zoology the extremities of an animal which by their form and proportions are adapted for leaping are called *pedes saltatorii*, as the hind legs of the kangaroo, cricket &c

SA'LTIGRADES *Saltigrada* (Lat saltus *a leap* and gradi *to walk*) The name of a tribe of spiders which [illegible] by their [illegible] from a distance

SA'LTIRE In Heraldry [illegible] in the form of a cross of Saint Andrew formed by two bends dexter and sinister crossing each other [illegible] (swords, batons, &c) placed in saltire are said to be borne *saltire wise*

SALT MARSH Land under pasture grasses or herbage plants subject to be overflown by the sea or by the waters of estuaries or the outlets of rivers, which in consequence of proximity to the sea are more or less impregnated with sea salt

SALT MINE *See* GEOLOGY

SALT OF LEMONS Binoxalate of potassa is usually sold under this name and is used for the removal of iron-moulds and other stains from linen, it is generally effectual, and does not corrode

SALT OF SORREL Oxalate of potash

SALTPE'TRE (Lat sal *salt* and Gr πετρα, *a stone*, from its being found in certain stony soils) Nitrate of potash An anhydrous salt composed of 1 equivalent of nitric acid = 54 and 1 of potassa = 48 *See* NITRE

SALT, SPIRIT OF *See* MURIATIC ACID

SALT SPRINGS *See* GEOLOGY

SALU'TES In Military and Naval Discipline, an exhibition of respect performed in different ways according to circumstances In the army the officers salute their superiors by dropping the point of their sword In the navy, the usual mode of salutation is by firing a certain number of guns, which is regulated according to the rank or station of the individual (See *Miles's Epitome of the Naval Service of England*, 1841)

SA'LVAGE, in Mercantile Law, is defined to be a compensation to be made by the shipowners or merchant to other persons by whose assistance the ship or lading may be saved from impending peril or recovered after actual loss Salvage may become due—1 On rescue from perils of the sea In this case, the salvor or rescuer has a lien on the goods preserved until a recompence is made him The amount of this recompence may be fixed by a jury, but if the salvage happen at sea, or between high and low water mark, the court of admiralty has also jurisdiction to fix the amount on suit brought, and by 12 Anne, st 2 c 18, and other statutes summary powers for the same purpose are given to inferior officers in certain cases 2 On rescue from the hands of enemies In this case, the old law was, that if a ship was retaken from enemies before it was taken home or condemned by the captor, the original owner could recover her on payment of salvage to the recaptor, but if retaken at a later period, she became lawful prize to the recaptors But by 13 G 2 c 4 s 18, and other statutes the right of the original owner has been extended to all cases of recapture Salvage, on recapture by a king's ship, was fixed, in 1798 [illegible] by a [illegible]

SALVATELLA (Lat [illegible] *I save*) [illegible] terminating in the fingers It was formerly regarded as [illegible] on the health when opened

SAL VOLATILE Carbonate of ammonia The term is often applied to a spirituous solution of carbonate of ammonia flavoured with aromatics

SAMANÆ'ANS, SARMA'NES, GERMA'NES Names given by different classical writers to a sect of philosophers of India Clement of Alexandria derives the name from Gr σεμνος, *venerable* But it is more probably oriental, the word schamman, in India, signifying a philosopher The Samanæans are particularly distinguished by those who mention them from the Brahmins Saint Jerome and Clement of Alexandria represent them as priests of Buddha, and the same name appears in the *Cha-Men* of the Chinese, and *Sammono-Codom* of Siam (*See* BUDDHISTS) There is a memoir on the subject by M de Guignes (*Mem de l Ac des Inscr* vol xxvi See also *Hist de l'Acad des Inscr* vol xxxi, and *Mem* vol xl)

SAMA'RA An indehiscent superior fruit, being a few-seeded indehiscent, dry nut, elongated into wing-like expansions, as in the fruit or "key" of the ash tree, &c From this root is formed the word *samaroid*, expressing a resemblance to a samara

SAMA'RITANS The inhabitants of the city and district of Samaria to the north of Judea The city was the capital of the kings of Israel, and after the captivity of that portion of the Jewish nation a colony of Cuthites, who are supposed to be Scythians, was settled in the country by the kings of Assyria It is stated that they were instructed in the Jewish religion by a priest who was sent to them for that purpose by Esarhaddon, in order to avert the anger as was supposed of the god of the country The Samaritans professed belief in the Pentateuch only but no idolatrous practices are imputed to them, and it was probably their spurious origin which excited against them the jealousy and affected contempt of the Jews to which many passages of the New Testament so pointedly refer

SA'MIAN EARTH and STONE A species of marl from the island of Samos

SA'MSON'S POST A strong pillar resting on the kelson and supporting a beam of the deck over the hold, and thus acting to keep the cargo in its place Also a temporary or moveable pillar carrying a leading block for various purposes

SA'MUEL BOOKS OF Two canonical books of the Old Testament The first twenty four chapters of the first book contain all that relates to the prophet Samuel himself beginning with the government of Eli The second book, together with the remainder of the first carries on the history of the Jews to the death of David It is traditionally said that the prophet Samuel composed the first part, and the prophets Gad and Nathan the remainder

SANCTIFICATION, in Theology denotes the state of those Christians who having lost the inclination to vice have become pure and holy, and wholly devoted to works of goodness This state is produced by the special operation of the Holy Ghost and ensues upon *justification*, which see

SA'NCTUARY (Lat sanctus *holy*) The innermost chamber of the tabernacle and in after times of the temple among the Jews in which was kept the ark of the covenant and which was regarded as the especial residence of the Most High It is also called the Holy of Holies and was never entered except once a year, and then only by the high priest on the day of the great expiation of the sins of the people For the mystical signification of this act, see Hebr ix 24

By the Roman Catholics the part of the church immediately round the altar is called the sanctuary, which is supposed in many respects to bear an analogy to that of the Jews

From the time of Constantine downwards, certain churches have been set apart in many countries to be an asylum for fugitives from the hands of justice This seems to have been originally intended only to prevent sudden violence and to give time for the regular administration of the law and perhaps in the case of certain delinquencies for the intercession of the church But in England, particularly down to the Reformation, any person who had taken refuge in a sanctuary was secured against punishment if within the space of forty days he gave signs of repentance and subjected himself to banishment

SAND (Germ) Finely divided silicious matter constitutes common river and sea sand, particles of other substances are often blended with it, and sometimes it becomes calcareous from the prevalence of carbonate of lime

SA'NDALS [illegible] Jews, Greeks, and [illegible] with a hollow part at one extreme, to embrace the ancle and leave the upper part of the foot bare Originally sandals were made of leather, [illegible] articles of great luxury, being [illegible] or other precious stuff, and most beautifully ornamented

SANDARAC The resin of *Callitris quadrivalvis* is [illegible] powder of this resin is sometimes used under the name of *pounce*, to prevent ink from sinking into paper

SANDEMANIANS In Ecclesiastical History the [illegible] Robert Sandeman, who published [illegible]

in 1757 in a series of letters They are of a highly Antinomian character, and their distinguishing opinion is well expressed in Sandeman's epitaph, where "the ancient faith," for which he "long [illegible] is said to be "that the bare work [illegible] out a deed or thought on the part of man, is sufficient to present the chief of sinners faith according to them being only a simple assent to the testimony concerning the Redeemer The real founder of the Sandemanians was John Glass, the father-in-law of Sandeman The adherents of the former have retained the name of Glassites, but are confined entirely to Scotland, from which church their founder originally dissented, whereas the followers of Sandeman have extended to England and America as well as Scotland This sect has never been numerous, and it is now, we believe, nearly extinct

SA'NDERLING The name of a small wading bird, a species of *Tringa* (*Tr arenaria* Ill ) which frequents many of our shores, but is not a plentiful bird

SANDIVER The impurities which collect upon [illegible] sion in the furnace are so called

SA'NDPIPER A name applied to different species of the genus *Tringa* but properly restricted to the *Tringa hypoleucos* of Linnæus, which is the type of the subgenus *Totanus*

SA'NDSTONE Stone composed of agglutinated grains of sand, which may be calcareous or siliceous *See* GEOLOGY

SA'NGIAC A Turkish officer, governor of a sangiacate, or district forming part of a pachalic There were two hundred and ninety such districts in the Turkish empire before the recent losses of territory on the side of Greece and the Caucasus

SANGUISO'RBEÆ (from the name of the genera) A [illegible] ubby Exogens, usually combined with *Rosaceæ* as a sub order, but apparently distinct, on account of the constantly apetalous flowers, indurated calyx, and solitary or almost solitary carpels Their general character is that of astringency Burnet, the *Sanguisorba officinalis*, is sometimes grown as a pasture plant

SANGUISU'GES *Sanguisuga* (Lat sanguis *blood*, and sugo *I suck*) The name of a family of Hemipterous insects including those which suck the blood of animals also applied to a family of Abranchiate Annelidans of which the leech (*Sanguisuga medicinalis* Sav ) is the type

SA'NHEDRIM (Heb ) The highest judicial tribunal among the Jews consisting of seventy one members, including the high priest Its origin is referred by some writers to the institution by Moses of a council of seventy persons on the occasion of a rebellion of the Israelites in the wilderness (See *Milman's Hist of Christianity* i 339 &c )

SA'NIES (Lat ) A thin, unhealthy, purulent discharge from wounds or sores

SANSCRIT The learned language of Hindostan The literal meaning of the word Sanscrit is *polished*, and it is used by grammarians in the sense of "regularly inflected or formed" (*Colebrooke's Remains*, vol ii p 2) And it is a question whether in its present form it was ever a *spoken* language although the theory of Schlegel is, that it was imported by the conquering or Brahminical caste It constitutes the most ancient literature of the Hindoos, and is radically connected with the various dialects of Hindostan so that they may be regarded as more or less deflected from it Colebrooke however is of opinion that 'there seem [illegible] doubting that it was once universally [illegible], and he says that 'those who are learned in Sanscrit at the present day, deliver themselves with such fluency as is sufficient to prove that it may have been spoken in former times with as much facility as the contemporary dialects of the Greek language, or the more modern dialects of the Arabic tongue" Nine tenths of the Hindustani' it is said may be traced to the Sanscrit, the remaining tenth is thought to be perhaps founded on the old "Hindi" language, which Sir W Jones thought anterior to it, [illegible] have been introduced by conque[illegible] age In the Hindoo drama, the gods and saints are made to speak in Sanscrit, while women, benevolent genii &c speak another dialect, and the lower personages a third (See also *Professor Wilson's Hindoo Theatre*, Introduction ) The attention of European inquirers was directed to the Sanscrit and its cognate language by Sir William Jones Since his time the study has made great progress in England, where it has been especially furthered by the labours of Houghton, Wilkins, and Wilson, and more [illegible] re Frederic Schlegel (*Sprache, &c der Indier* 18[illegible] was the first to excite the spirit of investigation He was followed by his brother A W Schlegel (who edited the *Bhagavat Gita*, translated into English by Mr Wilkins), and many others Among recent German philologists, Bopp deserves the highest name for his researches in this direction (See *Quart Rev* vol xlv &c , where it is said that in the course of thirty years nearly 70 works on and translations from the Sanscrit have appeared ) The intimate connection of Sanscrit with the principal varieties of the Caucasian speech and especially the Zend, Greek and Sclavonic, has [illegible]

SANSCULOTTES [illegible] A name first given in ridicule to the Jacobins and other extravagant patriots in the French Revolution, and afterwards assumed by them as a title of honour, like the old nickname of "gueux" *the* [illegible] which the revolters of the Netherlands p[illegible]ed themselves We have never been able to ascertain the real history of this famous appellation but we believe that Camille Desmoulins was one of the first who rendered it popular his blasphemous application of it at his trial is well known It acquired great celebrity after the "journee" of the 20th June, 1792 when one of the principal standards borne by the insurgents was a pair of black breeches, with the inscription, "Tremblez, tyrans! voici les Sans-Culottes" Subsequently the French nation adopted it with the utmost gravity in the original Republican calendar The five supernumerary days (the twelve months containing thirty a piece) were named Sansculottides, and were festivals dedicated to 'Genius," "Labour' "Actions," 'Rewards' "Opinion" In Leap years there was to be a sixth Sansculottide, the festival of the Revolution Future generations will find some difficulty in believing the narrative of the ludicrous farces with which national caprice interspersed the [illegible] of the French Revolution

SA'NTALIN The colouring matter of red sandal or saunders wood from which it is separated by digesting the rasped wood in alcohol, and then adding water to the tincture, it falls in the form of a bright red precipitate, soluble in alcohol and in alkaline solutions

SA'NTONIN A proximate vegetable principle, obtained from the seed of the *Artemisia santonica* It is white, crystallizable bitterish, and very little soluble in water but more so in alcohol

SAP The fluid which is absorbed by the roots from the earth then sent upwards into the stem and afterwards conveyed from the leaves, where it is assimilated and altered to the bark In its crude state it consists of little except water holding earthy and gaseous matter in solution especially carbonic acid, but [illegible] through the tissue of the stem it dissolves the [illegible] meets with in its course and thus acquires new properties, so that by the time it reaches the leaves it is entirely different from its state when it first enters the root The course taken by the sap in its passage through the stem is by the whole of the tissue included within the bark provided it is all permeable but as in many plants the central part of the stem becomes choked up with solid matter deposited in the tissue, it usually happens especially in trees that the course of the sap is confined to the outer part of the wood hence called sapwood It is not certainly known through what kind of tissue the upward motion of the sap takes place but it is probable that it is carried onwards through all the tubes and vessels of the wood and their intercellular passages The dotted vessels of the wood seem more especially destined to fulfil this office when the sap is in rapid motion, but as they afterwards become empty while the ascent of the sap continues there can be no doubt that the woody tubes or pleurenchyma offer the most constant means by which the sap is conveyed In Fortification, *sap* is a trench or approach made under cover of gabions, &c

SAPAN WOOD A dye wood produced by certain species of (*Cæsalpina* It has long been used in India, and resembles Brazil-wood in its colour and properties

SAP GREEN The inspissated juice of the berries of the buckthorn (*Rhamnus catharticus*) It is used by [illegible] pigment

SAPHENA [illegible] *ible*) The large vein of the leg which ascends over the external ancle

SAPINDA'CEÆ (Sapindus one of the genera) A natural order of exotic trees and shrubs, the larger part of which occur in South America They usually have compound leaves and inconspicuous flowers resembling those of European maples, and many of them are climbing plants The order is poisonous in various degrees, nevertheless, the arillus of [illegible] fruit in Africa and the West [illegible] *akee* The most singular property observed in the order is that of having an astringent quality, and forming a lather when agitated in water whence the name of the ty[illegible] sapo, *soap*

SAPONIN A peculiar substance contained in the root of the *Saponaria officinalis* It is the cause of the lather which that root forms with water

SAPOTA'CEÆ (Sapota, the name of one of the species) are a small natural order of Exogenous trees, inhabiting the West Indies and other tropical countries They in some cases produce eatable fruits, known by the colonial names of [illegible] apple Surinam medlar, &c Their juice is acrid like milk, and unlike the secretions of most lactescent families of plants may be used for alimentary purposes The fruit of some

yields a greasy substance; whence one of them, *Bassia*, ha[illegible] or butter tree in Africa

SA[illegible] a term applied to the *cyanite*

SAPPERS AND MINERS, ROYAL The name given to the non-commissioned officers and privates of the corps of Royal Engineers Their duties consist in building fortifications, in executing field works, and in performing similar operations under the direction of their superior officer They were first embodied at the end of the American war, under the name of "Royal Military Artificers," and after being formed into independent companies, were stationed at Portsmouth, Chatham and some other military and naval arsenals In 1812 they received their present designation, and at the same time, an institution was formed at Chatham for instructing the men in all the duties of military engineering This corps consists of 13 companies, each of 68 men some of which are employed in the colonies, others in the mechanical operations connected with the survey at present carried on by the Board of Ordnance, and others remain at Sandhurst and Addiscombe, to execute the various military works undertaken for the instruction of the cadets of these seminaries

SA'PPHIC The name given to a species of verse, from Sappho the famous Greek poetess by whom it was said to be invented It consists of eleven syllables of five feet, of which the following is a plan —

$$-\cup|-\cup|-\cup\cup|-\cup|-\cup|$$

This measure was afterwards introduced into Latin, and received as the reader is aware great improvements in the hands of Horace and Catullus The rules for the composition of Greek are much less strict than those for the composition of Latin sapphics The sapphic strophe consists of three sapphic verses followed by a *versus Adonicus*, or Adonian verse, which see This species of verse has been successfully imitated in German and English

SA'PPHIRE (Gr σαφειρος) A very hard gem, consisting [illegible] It is of various colours [illegible] called the sapphire, the *red* the oriental ruby, the *yellow* the oriental topaz

SAPRO'PHAGANS, *Sarcophaga* (Gr σαρξ, *decomposing matter* and φαγω *I eat*) The name of a tribe of Coleopterous insects comprising those which feed on animal and vegetable substances in a state of decomposition

SA'PWOOD is the external part of the wood of Exogens which from being the latest formed is not filled up with solid matter, or with the colouring principles which are deposited in wood after a certain time For these reasons sapwood is that through which the ascending fluids of plants move most freely, and not being solidified by the earthy and other substances eventually incorporated with wood, is quickly decomposed when exposed to the action of air and moisture Hence for all building purposes the sapwood is brought to be removed from timber The sapwood or unsolidified wood of all trees is much the same in its power of resisting decomposition, that of the oak and lignum vitæ perishing as quickly as poplar and other valueless timber, and chemists have ascertained that if the hardest heartwood is reduced [illegible] condition of sapwood by the abstraction of [illegible] solidification all those properties which give heartwood its value are destroyed

SA'RABAITES A kind of oriental monks or cœnobites, described by Cassian in his *Institutions*, and supposed to be the same with those called Remoboth by St Jerome (Epist xviii) and Faustus and characterized as vicious and ignorant They seem to have been seceders from the ordinary monastic life who formed a species of society rather resembling that of the Moravians of the present day, and without community of goods (*Waddington's Hist of the Church*, ch xix)

SA'RABAND (Span) In Music, a composition in triple time very similar to a minuet When denoting music for the dance, it is to the same measure which usually terminates when the beating hand rises being thus distinguished from the *courant*, which ends when the hand falls

SARCOCE'LE (Gr σαρξ *flesh*, and κηλη, *a tumour*) A tumefaction of the testicle

SA'RCOCO'LLA (Gr σαρξ and κολλα *glue*) The concrete juice of the *Penæa sarcocolla*, a plant growing in the northern parts of Africa It somewhat resembles gum arabic, but it is soluble in alcohol, and its aqueous solution is precipitated by tannin

SA'RCOLITE (Gr σαρξ and λιθος, *a stone*) A variety of zeolite of a flesh colour

SARCO'LOGY (Gr σαρξ, and λογος *a discourse*) The history or doctrine of the fleshy parts of the body

SARCO'PHAGUS (Gr σαρξ and φαγω, *I consume*) In Antiquities, a stone receptacle for a dead body [illegible] lapis Assius, stone of [illegible] have been prepared [illegible] antiquity [illegible] this purpose, on account of its supposed property of corroding dead bodies, so as to consume them entirely in forty days, which, together with other incredible qualities, is ascribed to it by Theophrastus and Pliny. One of the most celebrated specimens of [illegible] rt is the great sarcophagus taken by the B[illegible] in 1801, commonly called that of Alexander it is deposited in the British Museum. Dr Clarke, the traveller, wrote an essay to prove that the Macedonian conqueror had really been entombed in it, but this opinion seems unfounded

SARDO'NIC LAUGH A convulsive laugh, said to have been first observed in those who ate the herb *sardonia*, which grows in Sardinia

SA'RDONYX (Gr) A reddish yellow or orange coloured chalcedony or carnelian, it is often blood red by transmitted light

SA'ROS An ancient astronomical period, the origin and exact length of which are unknown, though they have been the subject of much disputation George Syncellus, who wrote in the [illegible] a passage from Berosus, reported [illegible], which mention is made of three periods, — the *Sossos*, the *Neros*, and *Saros*, and the Saros is stated to be 3600 years According to Lalande (*Astronomie* § 1572), Syncellus also cites Ananus and Panodorus, who assigned the lengths of these periods as follows — the Sossos, 60 days, the Neros, 600 days, and the Saros, 3600 days or 9 common years 10 months, and 11 days Legentil after Fugeres, supposes the Saros to be 10 years, Freret supposed it to be 10⅓ years, Giraud 360 Julian months which make 3711 lunations, or 31 years Suidas states that the Saros was a period of lunar months equal to 18⅓ years, and Halley (*Phil Trans* No 194) adopting the same notion and supporting himself by a passage in Pliny, supposes it to be identical with the lunar period of 18 years, or rather of 223 lunations which corresponds almost exactly to 242 *nodical* revolutions of the moon (*see* MOON), and consequently brings back the eclipses in the same order But Goguet (*Origine des Loix, &c*) remarks, that the statement of Suidas is not supported by that of any ancient author and that there is no reason to suppose that Pliny in the passage in question had the Saros in view By some authors the Saros has been confounded with the *Metonic cycle*

SARRACENIACE (Sarracenia one of the genera), are curious herbaceous plants inhabiting the bogs of North America and having their leaves hollowed out into tubes or pitchers open at the upper end Their flowers are something like those of *Papaveraceæ*, to which they are doubtless allied

SARSAPARI'LLA The root of the *Smilax sarsaparilla* Several varieties of this drug are imported from South America that which is now generally preferred is the reddish fibrous root known in the market under the name of *Jamaica* or red sarsaparilla What is termed *Lisbon* sarsaparilla is less fibrous, and more mealy and white in the interior This root, though long employed in medicine seems only lately to have been properly estimated It was formerly regarded as a specific in syphilis but this opinion is now given up, and it is used as a powerful and valuable alterative medicine in many disorders of debility, but more especially in those cachectic habits which present symptoms formerly mistaken for venereal — such as pains of the bones nodes of the periosteum loss of strength and flesh and other characters of what is sometimes called a broken constitution In these cases a course of sarsaparilla has often effected a cure especially if resorted to in time, when all other remedies and more especially mercurials, had failed It must be taken in pretty large doses that is, in quantities not less than an ounce to an ounce and a half a day and persevered in for six eight, or ten weeks, or a quantity of extract or syrup or other preparation equivalent to that weight of the dried root a concentrated liquid extract and a syrup, are now prepared, which are the best forms They are apt to disagree with weak stomachs but generally, by proper management and perseverance this difficulty may be got over Where it agrees, the strength is gradually regained the pains and other symptoms abate and vanish, and the only other effect observed is, either that the bowels are rather more open than usual, or the flow of urine or the perspiration increased

SARTO'RIUS MUSCLE (Lat sartor, *a tailor*) A muscle of the thigh attached at the upper extremity to the edge of the anterior superior spinous process of the ilium and at the lower to the inner side of the head of the tibia It is concerned in bending the leg obliquely inwards and in crossing the thighs, thence called sartorius, or the *tailor's muscle*

SASH (Fr chassis) In Architecture, a piece of framing for holding the squares of glass in a window It is of two sorts — viz that called the French sash, which is hung like a door to the sash-frame, and that in which it moves vertically by a weight on each side, to which it [illegible] running over pulleys at the top of the sash-frame When in a window both the upper and lower sashes are moveable the sashes are said to be double hung, and single hung when only one of them moves

**SASH-FRAME** In Architecture, the wooden frame into which the sashes are fitted

**SA'SSAFRAS** The wood of the *Laurus sassafras*, a native of North America, and growing abundantly upon the banks of the river Sassafras whence its name It has a warm aromatic flavour and the decoction is directed to be sparingly used in cases of stone in the bladder (hence its name has by some been derived from saxum, *a stone*, and frangere, *to break*) It has also been extolled as an alterative and in rheumatic and cutaneous affections but is now scarcely ever employed except as an ingredient in the compound decoction of sarsaparilla

**SA'SSOLIN** Native boracic acid, from the vicinity of Sasso in Florence

**SA'TAN** A Hebrew word signifying enemy or adversary, and used as such, without any reference to the Evil Power itself, in one or two passages of the Old and New Testament The equivalent term in Greek for this word is διάβολος, literally *one who accuses or calumniates*, whence the word *devil* is derived

**SATELLITE** (Lat satellites *an attendant*), in the Solar System, is the attendant of a planet, a body which revolves about the planet, and follows it in its orbit round the sun Hence the satellite is sometimes called a secondary planet, or merely a *secondary*, the planet about which it revolves being the *primary*

The planets which are accompanied by satellites are the Earth, Jupiter, Saturn, Uranus, and Neptune The Earth has one satellite, namely, the Moon Jupiter has four, Saturn seven, Uranus six, and Neptune probably two For the Earth's satellites see MOON

*Satellites of Jupiter* — These bodies were first observed by Galileo and their discovery followed immediately that of the telescope With a telescope of ordinary power they may be seen (unless when eclipsed by the shadow of the planet, or concealed behind its disc), on any clear [illegible] the planet and arranged [illegible] h they appear to oscillate backwards and forwards with different velocities and performing unequal excursions, so that their arrangement with respect to the planet or *configurations* are constantly changing Sometimes they are observed to pass before Jupiter, in which case they cast a shadow on his disc like a small round black spot, whence they are inferred to be opake bodies illuminated by the sun at other times they pass behind the planet and are concealed from our view, and all these phenomena occur in regular order and, with respect to each satellite, after the same intervals of time

An attentive examination of the apparent motions of the satellites soon renders it evident that they revolve round Jupiter in small but unequal orbits the planes of which are nearly coincident with that of the equator of the planet which is inclined in a small angle to the ecliptic Observation also shows that the motions of the satellites about their primary are regulated by the same laws as are observed by the planets in their revolutions round the sun The orbits are ellipses of small eccentricity, of which Jupiter occupies one of the foci, the areas described by the radius vector are proportional to the times of description, and the squares of the periodic times are respectively proportional to the cubes of the mean distances Thus Jupiter and his satellites form a system in miniature entirely analogous to that of the sun and planets

The satellites [illegible] as the *first second*, *third*, and *fourth*, [illegible] respective distances from Jupiter the first being that which is nearest the planet The following table shows their mean distances (in terms of the equatorial radius of Jupiter) times of revolution, masses as compared with Jupiter, and diameters in English miles —

| Satellite | Mean Distance | Periodic Time | Mass | Diameter in Miles |
|---|---|---|---|---|
| | | Days | | |
| 1 | 6 04855 | 1 76914 | 0 000017 | 2508 |
| 2 | 9 62347 | 3 55118 | 0 000023 | 2068 |
| 3 | 15 35021 | 7 15455 | 0 000088 | 3377 |
| 4 | 26 99835 | 16 68877 | 0 000043 | 2890 |

The mean distances are found by measuring the angular distances from Jupiter at the time of the greatest elongations, and the masses were determined by Laplace from the theory of gravitation On account of the minuteness of their apparent diameters it is difficult to determine their true diameters with precision The second, which is the smallest, at the mean distance of the planet subtends an angle of rather less than 1″, and the third, which is the largest an angle of less than 1 5″ (*Memoirs Royal Astronomical Society*, vol iii p 301)

Small as the satellites of Jupiter are in comparison of the primary planet, they are in themselves bodies of considerable magnitude As compared with the Earth their diameters may be approximately stated as follows —That of the first rather less than $\frac{1}{3}$, of the second $\frac{1}{4}$, of the third $\frac{1}{3}$ and of the fourth rather more than $\frac{1}{3}$ The third is about the size of Mars These four moons must present to the inhabitants of Jupiter a spectacle of endless variety

Although their orbits are doubtless elliptical, the eccentricities of the first and second are so small as to be insensible to observation That of the third is sufficiently sensible, and that of the fourth still greater but [illegible] The direction of the motions in [illegible] orbits is from west to east, according to the general analogy of the planetary system, [illegible] and as the [illegible] which [illegible] moon, each of them revolves about its axis in the same time as that in which it completes a sidereal revolution about the planet

From the preceding table it will be seen that the periodic time of the first satellite is nearly half of that of the second, and that of the second nearly half of that of the third The mean angular motions of these three satellites, therefore, form very nearly the progression 1, 2, 4, so that the mean motion of the first satellite, added to twice that of the third is very nearly equal to three times the mean motion of the second Another equally [illegible] that the mean longitude of the first, *minus* [illegible] of the second, *plus* twice that of the third, is always very nearly equal to two right angles. These two results subsist equally in respect both of the sidereal and synodical motions and longitudes, and it follows as a consequence of the last, that for a great number of years at least the three first satellites cannot be eclipsed at the same time, for in the simultaneous eclipses of the second and third the first will always be between the Sun and Jupiter and *vice versâ*

On account of the shortness of the periods of revolution, the eclipses of the satellites (especially of the first) take place very frequently, and they are phenomena of considerable importance in astronomy, from their affording signals by means of which the differences of terrestrial longitudes are determined, in the same manner as in the case of an eclipse of the moon The method however, is not capable of the same precision as is afforded by lunar observations

The eclipses of Jupiter's satellites have also an historical interest from having led Rœmer to the important discovery of the successive propagation and velocity of light When Jupiter is [illegible] with the sun, and his distance from the earth consequently *less* than his distance from the sun by the whole radius of the earth's orbit the eclipses are observed to happen about 16m 26sec earlier than they happen when the planet is in conjunction and its distance from the earth *greater* than its distance from the sun by the same quantity This phenomenon can only be explained [illegible] that light occupies 16m 26 sec in [illegible] orbit, and consequently 8m 13 sec in coming from the sun to the earth, which gives a velocity of about 192 000 miles in a second The theory, with its consequences, has been amply confirmed by Bradley's discovery of the aberration *See* ABERRATION

*Satellites of Saturn* — Saturn as already mentioned, is accompanied by eight satellites at present known One of them, by far the largest was discovered by Huygens in 1655 Four others were first seen by Dominic Cassini about twenty years afterwards, the two interior ones, which can only be seen under very peculiar circumstances and with the aid of the most powerful telescopes, were discovered by Sir William Herschel, in 1789, and an eighth was discovered by Mr Lassell in England and Mr Bond in America in 1848 Their theory has been little studied but the third law of Kepler is found to be preserved The planes of their orbits coincide nearly with that of the ring, with the exception of the seventh, which makes an angle with that plane of about 3 or 4 degrees The orbit of this last is sensibly elliptical, the eccentricity being 049 Owing to the obliquity of the orbits to Saturn's ecliptic, the satellites are not eclipsed in every revolution but (with the exception of the two interior ones) only fall into the shadow of the planet at the times when the ring is seen from the earth nearly edgewise The following table shows their mean distances from Saturn in terms of the equatorial radius of the planet, and their periods of sidereal revolution —

| Satellite | Mean Distance | Periodic Time | | |
|---|---|---|---|---|
| | | d | h | m |
| 1 | 3 351 | 0 | 22 | 38 |
| 2 | 4 300 | 1 | 8 | 53 |
| 3 | 5 284 | 1 | 21 | 18 |
| 4 | 6 819 | 2 | 17 | 45 |
| 5 | 9 524 | 4 | 12 | 25 |
| 6 | 22 051 | 15 | 22 | 41 |
| 7 | | | | |
| 8 | 64 359 | 79 | 7 | 53 |

[illegible] just to skirt the exter[illegible]th, like the satellites of [illegible] ges in the intensity of

its light, whence it is inferred that it revolves on its axis in the same time in which it completes its orbital revolution

*Satellites of Uranus* —Sir John Herschel remarks that [illegible] obtain a sight of, of any in our system Their existence was first discovered by Sir William Herschel, who suspected their number to be six, but he was only able to obtain micrometrical measures of the distance of two of them Of the remaining four, two were rediscovered in the year 1847, one of them almost simultaneously by Mr Lassell and M Otto Struve, the other by Mr Lassell alone In the year 1851, Mr Lassell announced the discovery of two others, but they do not appear to have been seen by any other observer See Sir J Herschel's *Outlines of Astronomy*, and *Monthly Notices of the Royal Astr Soc*, vols x and xi) Sir W Herschel's observations are given in the *Phil Trans* for 1788 and 1797, and again in the vol for 1815 They were made between the years 1787 and 1798, and from the latter period until 1828 the planet having been unfavourably situated, these satellites remained unobserved, and had even fallen out of notice Between the latter year and 1834 a series of observations, recorded in the *Memoirs of the R Astr Society*, vol viii, were made by Sir John Herschel for the purpose of verifying his father's results, which with respect to two satellites, were confirmed in the amplest manner The periodic times deduced from his observations are respectively 8 d 16 h 56 m 31 3 sec, and 13 d 11 h 7 m 12 6 sec The orbits are nearly circular and almost perpendicular to the ecliptic, being inclined to that plane at an angle of 78° 58′, and what is extremely remarkable, as contrary to the otherwise unbroken analogy of the solar system, the motions of the satellites in their orbits are retrograde from east to west

The [illegible] of the orbits have remained sensibly unchanged since their discovery, including a space of time during which Uranus has performed four-fifths of a revolution round the sun Whenever the earth passes through the planes of the orbits, the latter are projected into straight lines or very long ellipses, and at such seasons the satellites become invisible

SATIN A closely woven silk generally dressed with gum, especially when intended for ribands dresses &c

SATIN SPAR A fibrous variety of carbonate of lime assuming a silky appearance when polished

SATIRE in literature has been defined a representation of vice, or of the ridiculous either in the form of discourse or put in dramatic action The word satire must not be confounded as to its etymology with the satyri of the Greeks which were burlesque dramatic pieces in which the persons represented a band of satyrs (*See* DRAMA) The modern word satire Latin satira is derived from the *lanx satura* —a dish full of various fruits and herbs which was carried in procession at the feasts of Ceres Whence the word came to signify a poem full of miscellaneous matter without orderly method, and in this sense only it was probably employed by Lucilius, the first writer of satires although the title so usurped by him was afterwards only applied to poems of a similar character with his own viz containing moral reflection, interspersed with critical touches directed against real or imaginary persons

Satire in the literary sense of the word, as designating a species of composition, is usually confined to a species of poetry, but prose works, of which the contents are of a satirical character, are often comprehended under the same appellation Dramatic writings also are not satires in the stricter sense of the word although their contents be of a satirical character According to their subjects, satires are divided into political and moral, and these again severally subdivided into personal and general Political satires, in almost every language have been nearly confined to prose, the moral satire alone has found its appropriate vehicle in verse The only Greek satirist, of whom any fragments have reached us, was Archilochus, and his attacks were evidently directed against individuals [illegible] essed a vein of satirical power, both [illegible] and ludicrous strain, which has never been surpassed, and his dramas contain not only sarcasms on individuals, but also political and ethical lessons of the highest value But the moral satire, properly so called, was invented by the Romans, not only in form, but in substance also, and by them carried to perfection, and it is remarkable that the only species of Roman poetry which has any degree of originality is that which would seem to have accorded the least with the grave and austere turn of the genuine Roman character

Of the three Roman satirists whose works have reached us, Horace, the earliest, excels in conveying moral and prudential lessons in beautiful and precise language, in light allusions to the follies or excesses of his time; sometimes, though rarely assuming the comic character, but [illegible] the indefinable quality termed [illegible] shown by any other classical writer, with the exception of Aristophanes. Whether the various personages introduced by Horace, for the most part rather as examples to be shunned than as individuals to be held up to laughter or contempt, were intended to represent to his readers, by allusions now undiscernible, actual characters known to them, is a matter not easily ascertainable The same may be said with respect to Juvenal, whose selected victims are for the most part exalted or notorious personages of the ge- [illegible] own; and it is not [illegible] en conjectured, that their names were intended to conceal those of cotemporaries of his own Juvenal, without either wit or humour, excels in the deep tones of moral indignation befitting the scandalous excesses of the times in which he lived his exalted notions of virtue, and even of sanctity, are so far superior to the ordinary standard of moral excellence to be drawn from classical writers, that it has been conjectured that he, as well as Persius, had made some acquaintance, either directly or indirectly, with the lessons of Christianity Persius, although he occasionally rises into very elevated flights of poetry, does not afford many examples of the peculiar excellences of the satirist

In the literature of the modern nations, the fate of satire has been similar to that which has befallen many other species of composition The name and form of the ancient satire have been preserved by many writers, who have produced, for the most part, little besides cold or exaggerated imitations of antiquity But the true spirit of satire in its moral beauty, its humour, and its delicate irony has been inherited by others, who had too much originality of thought to tie down their genius to an antiquated form of writing Thus in France Boileau is or was generally cited as the prince of satirists his satires are closely formed on the model of Horace and are elegant and correct in style Besides him Regnier and many other writers have adopted the same line But the true satirists of France are Rabelais in his inimitable romances, Montaigne the essayist, endowed with much of the delicate and harmless sarcasm of Horace, and in later times, Voltaire So in England, although we possess satirists of considerable merit who have adopted the form of the ancient satire our true national satirists are to be found among our essayists and novel writers Bishop Hall in the reign of Elizabeth, and Donne in that of James published collections of satires directed partly against the actual follies or vices of their times, but too closely paraphrased for the most part from the Latin to admit of much original observation Withers among our early satirists, is the only other writer who is at all remembered Among our modern poets Pope founded his satires on the model of those of Horace and of some of his English predecessors His style and train of thought were rather French than Roman His works of this description are, in point of form mere imitations, but they are admirable for their point and the beauty of the verse and not unfrequently contain pungent personal allusions without which unfortunately a professed satirist can attract little notice and produce little effect Johnson in his two well-known imitations of Juvenal, Churchill and Young are the latest writers of any note who have composed in the form of the ancient satire But of all these writers, not one possesses a genuine or national character, except perhaps Churchill while Swift, Fielding, &c are in our literature, what Horace and Juvenal were in those of the Romans, —the painters of [illegible] and the representatives of public opi [illegible] ecting them The literary satire may perhaps be mentioned as a separate species of composition containing either rules of writing, or critical observations on the defects of individual writers Some of Horace's satires and epistles (as well as his *Ars Poetica*) [illegible] others partially, to this class, and h [illegible] series of similar productions down t [illegible] *'s and Scotch Reviewers* of Lord Byron (See as to the Roman satire, *Quart Rev* vol lii, *Mem de l'Ac des Inscr* vol xxxix)

SATRAP The title given by the Greek writers to the governors of provinces under the Persian kings before the conquests of Alexander The satrapies of that empire are enumerated by Herodotus The name is thought by some to be derived from a Persian word, signifying "fixed star" (*Mem de l'Ac des Inscr* vol xxxi)

SATURDAY The seventh day of the week, held by the Jews as their sabbath It was dedicated by the Romans to Saturn, whence its name

SATURN An Italian deity having many points of similarity with the Grecian Kronos (Κρονος), with whom he is accordingly frequently identified He seems to have been [illegible] of which his wife Tellus, Ops, [illegible] presided over tillage, of which the sickle he carried was the symbol The treasury at Rome was in his temple

The Grecian Kronos was the youngest son of Heaven and Earth, and the father of Jupiter, Juno, Neptune, and

Pluto He usurped the sovereignty and was in his turn deposed and imprisoned by Jupiter His reign was celebrated by the ancient poets as the golden age

The whole history of Saturn is probably allegorical He married Rhea with whom he [illegible] (*Rhea*, *flow*, the supposed flowing of the waters for the production of life), Queen of Heaven, by whom luminaries [illegible] Rhea flowing), and of his devouring his own progeny, are corroborative of this conjecture

Niebuhr regards Saturn and Ops as the god and goddess of the earth, its vivifying and its receptively-productive powers (*Rom Hist* vol i p 66, Cambr transl) Creuzer makes Saturn the great god of nature, in many respects assimilated to Janus He is the god who suffices for himself the god who is satisfied with his own powers (*Symbol*, par Guigniaut, vol iii p 499) Hence the derivation of the name from the Latin satur, *full, satisfied*

SATURN One of the principal planets in the solar system, and the sixth in the order of distance from the sun Though less brilliant than Venus and Jupiter, Saturn is still a conspicuous object in the heavens and [illegible] tracted the attention of astronomers [illegible] of the science

Saturn revolves at the distance of about 890 millions of miles from the sun, the mean radius of his orbit being 9 538786 times that of the earth's orbit, and the period of his sidereal revolution is 10759 2198171 mean solar days, or about 29½ years The orbit is nearly circular, its eccentricity being only 0 061505 (half the major axis being unity) and it is inclined to the ecliptic in an angle which, at the beginning of the present century, was 2° 29′ 35″ 7, and is subject to a decrease of 0 155″ annually

The diameter of Saturn at his mean distance from the earth subtends an angle of about 16 2″, whence his true diameter is 9 982 times that of the earth or about 76068 miles, and consequently his volume is nearly a thousand times that of the earth From the theory of his perturbations, his mass compared with that of the sun is found to be 000284738, whence his density is inferred to be to that of the sun as 95 to 100, or about ⅛th of the density of the earth

From the observation of certain dark spots on his surface, Saturn is found to revolve about an axis in 10 hours 29 m 16 8 sec This rapid rotation of so large a body gives rise to a great centrifugal force at the equator of the planet, and accordingly his form is that of a spheroid considerably flattened at the poles, the ratio of the polar to the equatorial diameter being nearly that of 11 to 12 The inclination of his equator to the plane of the ecliptic is 31° 19′, or nearly 28° 19′ to the plane of his orbit

When seen through a good telescope, the disc of Saturn appears striped with dark belts somewhat similar but broader and less strongly marked than those of Jupiter From their parallelism to his equator, it is inferred that they subsist in his atmosphere and are probably determined by currents similar to our trade winds

Saturn is attended by eight satellites, but the two nearest the planet can only be seen in certain favourable circumstances, and with telescopes of the very highest power *See* SATELLITE

*Saturn's Rings* — Saturn presents a phenomenon to which there is nothing analogous in the rest of the solar system This consists of two conspicuous rings, flat, broad, and very thin, lying in the same plane and concentric with each other and with the planet, and of an interior ring recently discovered The outer ones are separated from the body of the planet by an interval equal to about two and a half times the diameter of the earth and from each other by a much smaller interval The plane in which they lie is inclined to the ecliptic in an angle of 28° 40′, and hence they present themselves obliquely to the earth, under the form of an ellipse, the breadth of which, when greatest, is nearly equal to half the length The following are the dimensions of this extraordinary appendage, as given by Sir John Herschel (*Outlines of Astronomy*, 1849), from the micrometrical observations of Struve, with the exception of the thickness of the rings which was deduced from his own observations —

| | Miles |
|---|---|
| Exterior diameter of exterior ring - - = | 176418 |
| Interior diameter of exterior ring - - = | 155272 |
| [illegible] - - = | 151690 |
| [illegible] - - = | 117339 |
| [illegible] - - = | 79160 |
| Interval between the planet and interior ring = | 19090 |
| Interval of the rings - - - - = | 1791 |
| Thickness of the rings not exceeding - = | 250 |

As the plane of this double ring maintains its parallelism during the revolution of the planet the angle under which it is presented to the sun is continually changing and hence the varieties which take place in its apparent form and magnitude The points in which it intersects the ecliptic are in 170° and 350° of longitude, consequently whenever the planet comes into either of those longitudes (and it must pass through both in each revolution), the plane of the ring passes through the sun, and only the thin edge is illuminated In this case, the whole quantity of light which is reflected from it is insufficient to render it visible, and it entirely disappears, [illegible] On the 2 April, 1848, [illegible] inches in aperture and 20 feet in focal length" A little before or after the planet is in this position, the ring is seen as a fine straight line of light drawn across the disc of the planet, and projecting on each side like *ansæ* or handles As the planet continues to recede, the sun's rays fall upon the ring more obliquely, and the luminous line gradually opens out into an ellipse, which becomes wider and wider until it attains its maximum, when the longitude of Saturn is 80° or 260° In following out these phenomena, it is, however, necessary to take into account the position of the earth relatively to the sun and the plane of the ring, for it is evident, in the first place, that the ring will only be visible when the sun and earth are both on the same side of it, and, in the second place that it will become invisible when its plane passes through the centre of the earth, as none of the light reflected from its sides can then reach us On this account the disappearance of the ring is frequently double The successive disappearances of the ring form a period of about 15 years, or half the time of Saturn's revolution in his orbit, and the two sides of the ring have alternately fifteen of our years of sunshine, and fifteen years of darkness

The singularity of Saturn's appearance was first noticed by Galileo to whom the planet appeared *triple* or as a large body placed between two small ones The explanation of the phenomena by means of the ring was first given by Huygens [illegible] they observed numerous [illegible] that instead of two there must be a number of concentric rings In 1850 a third ring interior to the two others, and a second division near the inner edge of the inner ring, was observed both in America and this country, and the same phenomenon appears to have been previously noticed by Galle, at Berlin The new ring is very faint and dusky, but of its existence there can now be no doubt

That the ring is composed of solid ponderous materials is inferred from the circumstances of its casting a dark shadow on Saturn on the side nearest the sun, and receiving the shadow of the planet on the opposite side The ring must therefore be under the influence of the planet's attraction, and also liable to be deranged by the disturbing action of the satellites the largest of which does not move in the same plane Hence it is an interesting problem in physical astronomy to determine the conditions under which its equilibrium is maintained Laplace has shown, from the theory of gravitation, that in order to maintain the stability of the ring, it is necessary that the planet's attraction be counteracted by a centrifugal force arising from a very rapid rotation of the ring in its own plane Observation has confirmed the result of theory, for from the motions of certain dusky spots on its surface it has been found that the ring revolves in 10 hours 29 m 17 s, which is very nearly the period assigned by Laplace, and that in which a satellite would revolve at a distance equal to that of the middle of the ring Laplace also showed that in order to resist the tendency to subversion of the equilibrium, it is necessary to suppose the ring to be of unequal density or thickness in its different parts, so that the centre of gravity may not coincide with the centre of figure, for if it were perfectly similar [illegible] be disturbed by the slightest [illegible] satellite, and as it would have no tendency to recover itself, it would ultimately be precipitated on the planet This inequality of form would seem to be indicated by observation, for it has been noticed that the two arms of the ring sometimes appear to be dissimilar According to Bessel, the mass of the ring is equal to about the 1-118th part of that of the planet

SATURNA'LIA, the festival of Saturn, was celebrated at Rome about the middle of December, and occupied at different times one, three, and five days It was a season of complete liberty and rejoicing No business was done friends visited and made presents to each other, and, what was most remarkable, slaves were permitted to jest with their masters, and were even waited [illegible]

[illegible] classical Mythology divinities or rather supernatural per[illegible], arms, and bodies of men, and the lower parts of goats They were under the peculiar government of the god Bacchus Some antiquaries have fancied that the notion of satyrs arose from the introduction of ourang outangs by the real Bacchus, on his return from his conquest of India, and derive the name from the Heb sahurim, *hairy men*, Bacchus, according to tradition, having remained some time in Palestine during his return In the same

way we may perhaps account for St Augustin's story of a satyr having been seen and caught in his own time in the deserts of Africa In Greek Dramatic Literature the name satyr is applied to a theatrical piece, in which the chorus consisted of satyrs [illegible] burlesque character, [illegible] to us, the *Cyclops* of Euripides It was usual for the tragedian to present at the same time three tragic pieces and one satyr, forming a tetralogy In Zoology the ourang-outang (*Simia satyrus* Linn) is sometimes called satyr

SAUCISSON In Fortification a long roll or bag filled with gunpowder for the purpose of firing a mine The term is also applied to a fascine, longer than the common ones, used for raising batteries and repairing breaches

SAU'NDERS or SANDAL WOOD The white or scented sandal wood is the produce of the *Santalum album* It is brought from the East Indies When distilled with water it yields a thick essential oil, smelling something like roses Red saunders or sandal is the wood of the *Pterocarpus santalinus*, also a native of India Its colouring matter is insoluble in water but soluble in alcohol, and is used to impart a red tinge to certain tinctures The resinous exudation of this tree constitutes one of the [illegible]

SA'URIANS, *Sauri* [illegible] name of an order of reptiles [illegible] covered with scales and have four legs, as the crocodile and lizard The mouth of the saurians is always armed with teeth, and their toes are generally furnished with claws, they have all a tail more or less long, and generally very thick at the base A few species, exceptions to the general character, have only two legs The most gigantic and singular species of the Saurian order are now extinct

SAUSSURITE A variety of nephrite named in honour of Saussure, who discovered it on the banks of the lake of Geneva in rounded masses

SAVA'NNAHS The [illegible] of plains watered by [illegible] savannahs are greatly diversified in appearance, but they have some general features, which the reader will find systematically described in Mr Flint's work on America

SAVINGS BANKS *See* BANK, SAVINGS (See also Dégerando, *De la Bienfaisance Publique*, vol iii l 2 ch 4)

SAXIFRAGA'CEÆ (Saxifraga one of the genera) A natural order of herbaceous Exogens, chiefly inhabiting the mountainous regions of Europe and the northern parts of the world They are nearly allied to *Rosaceæ* from which they differ in having polyspermous, didymous, partially concrete carpels, and albuminous seeds and in wanting stipules The root of *Heuchera Americana* is a powerful astringent, whence it is called in North America alum root, other species are pretty herbaceous plants non [illegible] interest

SAXON [illegible] *See* ARCHITECTURE

SAXON BLUE A solution of indigo in concentrated sulphuric acid it is much used as a dye stuff

SCABI'NUS The Latinized form of the old German word schoppe, in French échevin Judicial officers of various descriptions in the middle ages bore this title especially in the "communes," or municipalities See as to its history, *Meyer's Instit Judiciaires*, *Mem de l'Ac des Inscr* vol xxxvii

SCA'BROUS (Lat scaber, *rough*) In Zoology, when a surface is rough to the touch, from granules scarcely visible

SCA'FFOLDING, in Architecture, is the temporary combination of timber-work, by the means of upright poles and horizontal pieces on which latter are laid the boards for carrying up the different stages or floors of a building and which are *struck* or removed as soon as they have answered their purpose The scaffolding used for carrying up buildings on the Continent has always been more scientifically and solidly constructed than that used in this country But great improvements have latterly taken place, and there seems to be a prevalent notion here, in the profession, that for large buildings a little more skill should be displayed than that which emanates from the combination of uninstructed Irish labourers

SCAGLIO'LA (It) In Architecture, a composition, sometimes called also *Mischia*, from the mixture of colours employed in it, being made to imitate marble The Florentines claim the invention of this art, but it had been practised in Lombardy previous to its introduction at Florence Lanza says that it was invented by Guido Sassi, who died at the age of 65, in 1649, at Carpi, in the state of Modena, and that he commenced by executing cornices and other members of architecture which had all the appearance of the finest marbles whereas its introduction at Florence was not till the middle of the 18th century Scagliola is composed of gypsum or sulphate of lime, calcined and reduced to a fine powder, with the addition of which to water a fine paste is made. When columns are made with this composition, a frame or cradle is first formed, with [illegible] and hair, raised [illegible] On this, when [illegible] pure gypsum, calcined and passed through a sieve and, as wanted, mixed with glue or isinglass, it is floated with wooden moulds of the proper form, during which operation the colours, by which the imitation is obtained, are put on When this is set the work is smoothed with pumice-stone with one hand of the workman, while the other is employed in washing it with a sponge and water It is then polished with tripoli, charcoal, and a piece of fine linen, and afterwards with a piece of felt dipped in oil and tripoli, and finished off with pure oil laid on with cotton wool

SCALD (*Skálld*) signifies in the ancient Norsk language a poet In the old northern literature, those mythological poems of which the writers are known are properly called songs of the Scalds, while those of unknown authors are [illegible] Tacitus that the ancient [illegible] sses of poems which were found at a later era in Scandinavia, namely, relating to the gods, to heaven, and to historical subjects The Scalds whose remains have come down to us are very numerous Their poems are partly alliterative and partly rhymed, and this latter circumstance seems to indicate works of comparatively recent date The historical value of their poems is considerable, but they are written in a peculiar vein of exaggeration and in a metre [illegible] which appears to [illegible] the poetical art of the north (See EDDA SAGA) The most complete list of the Scalds, and commentary on Scaldic poetry is to be found (according to the *Conversations Lex*) in the *Fundgruben des Orient* vol i

SCALE (It *scala*, *a ladder* or *series of stairs*) In Music a progressive series of sounds rising in acuteness or falling in gravity from any given pitch to the greatest practicable distance through such intermediate degrees as create an agreeable and perfect succession, wherein all the harmonical intervals are conveniently divided See the words DIATONIC and CHROMATIC

SCALE In Mensuration a line or rule of a definite length divided into a given number of equal parts, and used for the purpose of measuring other linear magnitudes It becomes a *standard scale* when all its divisions have been examined and compared with some *standard measure* (See MEASURE) The scales of thermometer [illegible] from some arbitrary point or zero (as [illegible] the temperature of freezing water) from which the heat is counted upwards or downwards in degrees which are also arbitrary

The term *scale* is also applied to a mathematical instrument consisting of an assemblage of lines and figures engraved on a plane rule by means of which certain proportional quantities or arithmetical results are obtained by inspection Of these the principal are the *plane scale*, the *diagonal scale*, *Gunter's scale*, &c For the construction and uses of these various scales, see *Robertson's Description and Use of Mathematical Instruments*

In Arithmetic, *scale* signifies the order of progression on [illegible] scale, [illegible] BINARY ARITHMETIC, NOTATION

SCALE in Zoology is properly applied to the plates, generally thin, small, and imbricated, which defend the skin of fishes They are substances of different texture which are developed beneath the true epiderm, and appertain to the system of the rete mucosum The so-called scales of serpents and other reptiles are modifications of the epidermis, and are sometimes termed "scutes" Fishes have been [illegible] to the structure of their scales See [illegible] CYCLOID, GANOID, PLACOID

SCALE'NE (Gr σκαληνος) In Geometry a scalene triangle is a triangle of which the three sides are unequal A cone or cylinder is also said to be scalene if its axis is inclined to its base, but in this case the term *oblique* is more frequently used

SCALE'NUS A muscle of the neck, situated between the transverse processes of the cervical vertebræ and the upper part of the neck

SCALPEL (Lat scalpare, *to carve*) A dissecting knife

SCALPRUM (Lat *a knife*) In Mammalogy, the [illegible] incisor teeth

SCAMMONY, in Pharmacy, is the gum-resin of the *Convolvulus scammonea*, chiefly imported from Aleppo and Smyrna in packages, called *drums*, weighing about 100 pounds each It is of a dark olive colour, and when wetted and rubbed should easily form a milky solution it is very apt to be adulterated, and an article entirely fictitious is often sold under the name of scammony Scammony is an excellent drastic purge, and is generally administered in combination with other purgatives in doses of three or four grains

SCANDALUM MAGNATUM In Law, an action

which still lies, although for a long period it has never been resorted to, on the stat 2 Ric 2 stat 1 c 5, and statute of Westminster the First, 3 E 1 c 34, for words spoken in derogation of a peer, a judge, or other great officer of the realm, which need not be such as would be actionable at common law in the case of a private person "The Duke of Richmond v Castellow," in the eighth year of Queen Anne, seems to have been the last instance

SCANSO[illegible] *scansores* (Lat scando, *I climb*) Climbing birds The name of an order of birds, including those which have the toes arranged in pairs, two before [illegible] foot which is ad-

SCANT In Naval language, the term applied to the wind when it is barely fair

SCANTLING (Fr echantillon) In Architecture, the measures of breadth and thickness of a piece of timber or other material It is also the name of a piece of timber when under five inches square

SCANTLING In Naval Architecture the scale or dimensions of the breadth and thickness of the timbers Thus two ships of different sizes may have the same scantling

SCAPE In Botany, a peduncle, which, in plants destitute of a stem, rises above the [illegible] and bears the flowers upon its apex, as in cowslip [illegible] of *Scapellus*

SCAPEMENT, or ESCAPEMENT *See* HOROLOGY

SCAPHITE (Gr σκαφη, *a boat*) A genus of cliptical-chambered shells belonging to the family of Ammonites, having the inner extremity coiled up in whorls embracing one another, and the outer extremity continued nearly in a horizontal plane, and then folded back, so as sometimes to touch the spire of the opposite end of the shell The transverse plates are numerous, and are pierced by a marginal siphuncle at the back of the shell, and their edges are deeply cut and foliated These beautiful shells, which thus resemble the ancient form of a boat, are almost peculiar to the chalk formation

SCAPOLITE A mineral originally from Arendahl in Norway, the crystals of which are often collected in groups of parallel diverging or intermingled prisms, hence its name from σκαπος *a rod* and λιθος, *a stone*

SCAPULA (Lat *the shoulder*) In Comparative Anatomy the bone which passes from the shoulder joint in a direction towards the vertebral column It is broad and flat, [illegible] sometimes subquadrilateral, in the Mammalia, narrow and commonly sabre shaped, in birds, narrow and straight in Saurian reptiles, a round, strong and straight column, in Cheloman reptiles, variously shaped, and articulated to the back of the skull in most fishes

SCAPULARS, or SCAPULAR FEATHERS, in Ornithology, are those which take their origin from the shoulders and cover the sides of the back

SCAPULARY A portion of the dress of the monastic orders, consisting of two bands of woollen stuff of which the one crosses the back or shoulders and the other the stomach According to the Abbe Fleury (*Mœurs des Chretiens*), the scapulary originated with St Benedict and was a large and heavy covering of the shoulders, worn by the early monks in their rural labours for the convenience of carrying loads, and to protect the tunic Simon Stock an Englishman, general of the Carmelites in the 13th century, first introduced under the authority of a vision, the notion that the scapulary is an especial sign of devotion to the Virgin Mary Since that time it has been not an uncommon superstition that whoever dies wearing it is sure of salvation The scapulary of [illegible] two little pieces of stuff on which [illegible] is embroidered

SCAPUS (Lat *stalk*) In Ornithology, the stem or trunk of a feather, including the hollow base or quill "calamus," which is inserted into the skin, and the solid exserted stem supporting the barbs, or rachis

SCAPUS In Architecture, the same as the *shaft* of a column, which see

SCARABÆIDANS, *Scarabæidæ* (Lat scarabæus, *a beetle*) The name of a family of Coleopterous insects, of which the genus *Scarabæus* is the type, it corresponds with great [illegible] *Lamellicorns* See that word

SCARABÆUS [illegible] ics The use and meaning of the scarabæus, as a symbol, are, as yet among the mysteries of [illegible] s, it is said, found in [illegible] with the seeds of life, because [illegible] by it forms a ball of earth in which to deposit its eggs It is also called a type of the sun However this may be, it was habitually worn by the ancient Egyptians and Etrurians as an amulet According to Mrs Hamilton Gray (*Tour to the Sepulchres of Etruria* 1840), several different styles of the scarabæus are traceable The ancient Egyptian scarabæus was plain, or inscribed with characters, and was made of opaque stone, basalt or porphyry The Etrurian scarabæus (found in quantities in the sepulchres) was of semitransparent stone, cornelian, onyx, sardonyx, agate, or jasper It is almost always engraved, generally with the figure of a god or genius, supposed to be the chosen protector of the individual who wore it sometimes with whole scenes, such as the labours of Hercules, race- &c [illegible] with Etruscan words or names, and occasionally with Egyptian divinities,—Isis or Horus Lastly, the modern Egyptian scarabæus of Roman times was generally of precious or semi-precious stones, and rudely engraved, and seems to belong to an age when the religious use of the scarabæus was forgotten, and it was retained only as an ornament In the Etruscan scarabæi themselves, according to the same authoress, there are three distinct styles of art remarkable,—the rude or native Etruscan, the Grecian, and that of a period of decline

SCARAMOUCH (Ital scaramuccia, *skirmish*) A personage in the old Italian Comedia dell' Arte, dressed in the Spanish or Hispano-Neapolitan costume, and representing a military personage, a poltroon and braggadocio, who [illegible] ended by receiving a beating from the hands of [illegible] The most celebrated Scaramouch of the Italian theatre at Paris was Tiberio Fiurelli, a Neapolitan, who had the honour of making Louis XIV laugh when an infant, and whose agility was such that he was able, according to his biographer, to give a box on the ear with his foot at the age of 80

SCARFING In Architecture, the formation of a beam out of two pieces of timber, usually employed when it cannot be conveniently procured in one length It is usually performed by indenting the pieces where they are joined to each other, and bolting them together in

[illegible] epidermis *See* SKIN

SCARIFICATOR An instrument used in cupping, it consists of 10 or 12 lancets, which are discharged through apertures in its plane surface by pulling a kind of trigger, so that in passing they make a number of incisions in the part to which the [illegible] applied

SCARLATINA, or SCARLET FEVER This highly contagious disease assumes two forms In the one it comes on with the usual symptoms of fever, such as languor, chills and heat, thirst, nausea and vomiting, and on the third or fourth day a scarlet efflorescence appears upon the skin which in three or four days ends in the cuticle peeling off in branny scales the febrile symptoms and soreness of the throat if any had been observed, then give way and the patient gradually recovers It is, however, not uncommonly followed by dropsical swelling of the body, which is but of short [illegible] In the other form of this disease the [illegible] symptoms are at first more alarming there is bilious vomiting, great soreness and ulceration of the throat, quick and small pulse laborious breathing, and the eruption, instead of mitigating the symptoms, is accompanied by the [illegible] dangerous increase The body becomes swollen and the nose and eyes inflamed, the breath grows fœtid, and the inflammation of the throat terminates in greyish sloughs, which give it a speckled appearance Under an aggravation of such symptoms, the patient is cut off, or his recovery is very slow, and dropsical swellings and glandular tumours follow, and leave him in a very precarious state It occasionally happens that the putrid symptoms run very high, the rash is livid, and accompanied by petechiæ, the breath highly fœtid, the throat gangrenous, and other symptoms announce a highly malignant form of the disease

In the milder form of scarlet fever, the bowels should be cleansed by saline aperients, and the patient kept in a moderate temperature, as near 60° as possible, and in a clean and open room If the throat is much affected, an [illegible] the heat of the body is much above the [illegible] or very distressing, sponging with cold w[illegible] resorted to has proved eminently useful [illegible] gargles must be used for the throat, and [illegible] with light preparations of bark and tonic [illegible] of the eruption, are required Where the malignant symptoms run high, cordial tonics, acids, wine, and the other treatment of putrid fevers must be adopted

Scarlet fever is distinguished from measles by the greater extent and want of elevation of the eruption, and by its not congregating into semilunar patches, nor is there the cough, and running from the eyes and nose, which usher in the measles It seizes those of all ages, but children and young persons are most subject to it; and [illegible] all seasons of the year, but in autumn [illegible] It may attack the same person more than once

SCARP In Fortification, the interior slope of the ditch *See* ESCARP

SCELIDES (Gr σκελος, *a leg*) In Mammalogy, the lower, posterior, or pelvic extremities

SCENE In Dramatic Literature (from the Gr σκηνη, *a booth*), dramatic representations having it is supposed, originally taken place on spots of ground shaded with boughs of trees The imaginary place in which the ac-

tion of the play is supposed to pass, also a division of a drama properly speaking, whenever the action changes to a new scene or place But in the French theatre, and those framed on its model (in which unity of place is observed), every entry of an actor constitutes a new scene On the English stage, the subdivision called a scene is extremely arbitrary, the scenes in most plays being far more numerous than the actual changes of scene while at the same time the French rule is not observed and actors enter in the middle of a scene The scenes in a play are numbered as subdivisions of the act *See* ACT

SCENE PAINTING A department of the art of painting governed by the laws of [illegible] the peculiar exigences of a theatre [illegible] in water colours, and admits of the most striking effects, which indeed, in scene painting, is almost all that is required

SCENERY The appearance of a place or of objects, or the representation of a spot wherein an action is performed *See* LANDSCAPE

SCE'PTICISM (Gr σκεπτομαι, *I examine*) In the History of Philosophy, a name given to that tendency of thought or system of doctrines the object of which is, by denying the existence of all grounds of knowledge, to introduce universal doubt and suspension of assent Schools of scepticism have existed at several different periods in the progress of philosophical inquiry The first who received or adopted the name was Pyrrho, a contemporary of Alexander the Great, and his successors, who taught in Athens about the year 300 B C Our chief notices of his opinions are derived from the writings in verse, of his disciple Timon, preserved to us by Sextus Empiricus He was led to his sceptical views partly by the contradictions observable in the impressions on our senses, and partly by the incompatibility of the principles of different schools with each other To a complete suspension of judgment in speculation (στοχη) he united a corresponding state of indifference in feeling (αταραξια), and made virtue and happiness to consist in the absence of mental perturbation Either he or his scholars endeavoured to present a synopsis of their sceptical views in ten general forms or commonplaces, all of which however, may be included in one or other of the two sources of doubt mentioned above

The school of Pyrrho seems to have expired with his disciple Timon, though many of his views were espoused and maintained by the later academy (*See* ACADEMICS) About the middle of the third century of the Christian era we meet with a school to which the name of the later sceptics has been assigned This sect seems to have originated with one Ænesidemus a physician It was in

[illegible]

their practice The grounds of this scepticism have been recorded by Sextus Empiricus It regarded not so much the validity of the notices given by the senses (to which their empirical method imposed on them a necessity of [illegible] as a formal form and method of [illegible] as utterly void, inasmuch as the conclusion must have been contained in the induction on which the major proposition was founded Perfect induction was impossible, imperfect was unsatisfactory They also attacked, with considerable acuteness, the received doctrines of cause and effect, and of the nature of God, chiefly in opposition to the Stoics, the most dogmatical of the ancient sects Their morality like their speculative creed was a system of mere sensualism This school may be considered as the last purely Grecian sect After them an oriental element was introduced into philosophy, which materially altered its character and bearing The most celebrated sceptics of modern times are, Montaigne (A D 1580), Glanville, an Englishman, who flourished about the period of the Restoration, Bayle, and Hume Of these Mr Hume has the merit of producing the most systematic and comprehensive scheme of scepticism the world has yet seen According to this philosopher, all the objects of consciousness may be reduced to two classes —1 the impressions on the senses, and, 2 ideas, or copies of those impressions, which differ from their originals only in being less vivid All knowledge, save that of mathematical relations, consists in the arrangement of these impressions according to the order of their succession Of the connection between any two links of this succession we know nothing, that to which we give the name of causation being, in fact, nothing more than habitual sequence relatively to the phenomena, and custom, or often-repeated association, in relation to ourselves All inquiry into things in themselves, or their grounds — in other words, all metaphysical speculation, is consequently founded on delusion The writings of David Hume, which contain his sceptical speculations, are his *Treatise on Human Nature*, and the early part of the second volume of his *Essays* (See *Ritter*, book x ch 1)

SCE'PTRE (Gr σκηπτρον, *a staff to lean on*) A well-known emblem of sovereignty Achilles, as is well known, swears by his staff or sceptre in the first book of the *Iliad* Tarquin the elder first assumed the sceptre among the Romans According to Justin, it was originally a spear The sceptre of the Merovingian kings, as represented on monuments is a rod probably of metal, of the height of the bearer, and slightly curved like a crosier

SCHAA'LSTEIN A mineralogical synonym of *table spar* (tafel-spath of the Germans) It occurs in grey laminated masses or concretions, chiefly at Dognatscha in the Bannat

SCHEELE'S GREEN A green pigment obtained by mixing arsenite of potassa with sulphate of copper It is an arsenite of copper

SCHEE'LIUM A name [illegible] applied to tungsten, in honour of Scheele, who [illegible]

SCHELLING, THE PHILOSOPHY OF, teaches the identity or *indifference* of the ideal and real Its author Frederick Wilhelm Joseph von Schelling, was born January 27th, 1775, and studied successively at Tubingen Leipzig, and Jena In the latter place, he was a pupil of Fichte Schelling lived till 1841 at Munich, under the patronage of the King of Bavaria, who ennobled him and advanced him to the dignity of geheimerath, or privy councillor, but at the period above mentioned he accepted of an invitation from the Prussian monarch to reside at Berlin where his lectures excited the most lively interest among the Prussian literati, though we believe he has not given them to the public

It is extremely difficult to understand the true import and significancy of any particular system of philosophy, if it is considered in itself, and apart from its connection with the general history of philosophy which, from its earliest origin to its latest development will be found to constitute a close and compact whole This general truth is particularly applicable to the philosophical development of Germany, the unity of whose literary pursuits [illegible] want of a true political unity [illegible] views and opinions, from Leibnitz and Spinosa to the philosophers of the present day is easily traceable, but it will be sufficient for the elucidation of Schelling's philosophy to begin with the critical theory of Kant The transcendental idealism of this philosopher formed the transition from the empiricism of the eighteenth century and effected as it were, a compromise between the scepticism of Hume and the realism which it succeeded to Without denying or asserting the existence of a material world Kant was content with confessing an ignorance at all events of its nature He taught that all that man can know of outward objects is that they furnish the material ground of his conceptions, to which the mind furnishes, on its part the form, in congruity with its original and connatural laws Of things themselves or as Kant calls them of phenomena man absolutely knows nothing, all that he can do is to note the modes under which they appear to him But while the criticism of the pure reason seemed to lead to a speculative idealism that of the practical reason appeared to possess a mystical tendency The principles of the latter work may thus be summed up —A consideration of the exigencies of man's moral nature enforces the validity of those ideas of God, immortality, and a future state of retribution, which the speculative reason does indeed project but cannot legitimate The latter tendency of the Kantian philosophy was worked out by Hamann and Herder, but found its culminating point in Jacobi's Philosophy of Faith (*Glauben's Philosophie*) which had many adherents in Germany, and extensively influenced the prevailing ideas of philosophy According to Jacobi the end and aim of true philosophy is a knowledge of God Now the pursuit of this object must set out from feeling and intuition, for there is no speculative method which can give a demonstration of God, for God is infinite but the understanding finite, and all mediate knowledge by reasoning which is a procedure of the intellect, cannot attain to the infinite Reasoning, moreover, cannot do more than establish the correspondence of certain identical propositions from which it passes, step by step, and on the presumption of whose truth it proceeds The element, therefore of all human knowledge is faith, an original instinct of man's nature, which immediately reveals to him the divine, and, in spite of any suspicions of the validity of sensuous testimony, enforces a belief in the existence of an external world The philosophical merits of Jacobi consist in this, that he did not, with Kant, regard God as a mere abstraction, but as a living spirit, whose presence is manifest within man himself, and further In the way that he insisted on the validity of the immediate perceptions of consciousness, in opposition to the absolute authority of the finite understanding However, true philosophical science cannot admit of any such contrariety of intellect and feeling, and to establish their identity, or at least to combine them in unison, was the problem which Fichte attempted to solve But the predominant character of the latter's

philosophy lies in the way in which he carried, to its extreme result, the idealistic tendency of Kant In the *Wissenschaftslehre* we have a system of pure and absolute [illegible] world is here [illegible] only so far as it is necessarily conceived by us, so that the external world is purely a creation of our conceptions, and the real is a product of the ideal To use the language of Fichte, — the ego is absolute, and posits itself, it is a pure activity As its activity however, has certain indefinable limits, when it experiences this limitation of its activity it also posits a non-ego, and so originates the objective world The ego, therefore, cannot posit itself without at the same time projecting a non-ego, which [illegible] mere creation of the ego [illegible] reflection, by which Fichte attained to this speculative result, he combined for practical ends the authority of immediate consciousness As, he argued, it is from the impulse of the ego to activity that the non-ego arises, the absolute ego is also in the same relation to the intelligent ego as a cause is to its effect But although the absolute practical ego is absolutely free, and the sole principle of all reality, so as to posit the world in opposition to itself, and to be its cause it has, nevertheless, a subjective limit to its operation This is the idea of duty which the consciousness immediately announces to man as an unconditional authority and obligation, which, however is not subversive of the freedom of the ego but is simply an impulsive motive to its activity Now, so far as the ego attempts to realize this duty it tends to a moral order He who does his utmost to establish this moral order, comes near to the Deity, and enters upon his true and proper life

Such was the point to which speculation had attained when Schelling appeared as a philosophical writer The subjective thought had been made the supreme and only principle, before which all objective entity was driven into the back ground, and the subjectivity of the idea was the only real existence acknowledged For this subjective idealism Schelling however did but substitute an objective idealism by giving objectivity to the idea itself and declaring every entity to be also rational thought Kant had spoken of the objective as unknowable, Fichte had denied its existence and Schelling identified the ideal and the real Fichte had confined himself to giving a derivation of nature and its laws out of an absolute and spontaneous activity of the ego Schelling maintained that not only must the laws of consciousness be immediately cognizable in the objective world as laws of nature, but conversely also the laws of nature must be immediately demonstrable in the consciousness as laws of the subjective Man finds himself in nature and nature in himself Besides Fichte's method therefore, of descending from the ego Schelling held it to be necessary to ascend from nature up to ego The former method is given in his transcendental philosophy the latter in the *nature philosophy* which make up his system of identity The general principles of this system are as follows — That true and perfect science which it has always been the object of philosophy to realize must be one which has its authority in itself, embraces all things and is perfectly correspondent to its object, for truth is impossible without a perfect agreement of the knowing and the known Now as all philosophy must proceed on the assumption that the cognizant mind is capable of true cognition it follows that the knowing subject cannot, in its essence be opposed to the object known, and that consequently it must be possible to know the real essence of things The essence, therefore of that which thinks and that which exists, of thought and entity, soul and body is one and the same By means of this essential oneness or in the terminology of Schelling, of this absolute identity and indifference of thought and being, the ideal and real, and in consequence of the mind being in substance at least, homogeneous with things without it, the former is capable of representing in cognition the latter such as they are in truth and in their essence The knowledge thus gained is a pure intellectual intuition, it is not mere reflection which, by its nature cannot go beyond its data Rising above phenomena to the ideas of the absolute, which is their identical origin it is able to apprehend the essence of things However, it is by reflection that man becomes conscious of these ideas through the aid of the senses, and this art of unfolding ideas by reflection constitutes Dialectics One of the duties of this art is to trace the identical principle in its [illegible] to determine every branch of knowledge [illegible] not only to the fundamental idea of the truth [illegible] The true method of philosophy is the method of construction, and without it no safe step can be taken in speculative science. This method is to become fully conscious of the laws of mind, which are inherent in it, and, agreeably to them, to shape every special science conformably to the existence of things By such a method philosophical science is possible, and this is a science of the existent agreeably to the ideas (*Wissenschaft von Ideen*), that is, a science of God, and of his relation to the world, and of man and nature According to the *nature philosophy* the Absolute, or God, is both thought and [illegible] either unity or difference, out of which all contrariety has proceeded, and into which it will again return As the Absolute is the sole and eternal essence of all things, every true entity, and therefore nature also, is divine, without a participation in which there can be no existence In the eternal generation of things, the Absolute has revealed itself in infinite ways in space and time This revelation is a living development of the infinite according to certain contraries of the subjective and the objective, the ideal and the real These contraries strive to combine together in different proportions, and so acquire different names, according to the varying preponderance or polarity of the ideal and real Things, consequently, are not different in their essence, but merely quantitatively or in degree The preponderance of the objective constitutes unconscious nature, that of the subjective is spirit The more complete the combination of these contraries, the more perfect are the objects The most perfect union of them, or their absolute indifference, is found in the universe, and this complete identification and reunion of them is the full revelation of God Man, lastly, is a copy of the universe *microcosm* in so far as in a manner of his own, he unites together the ideal and the real

The philosophy of Schelling appears then, to be directly opposed to that of Kant, from which, however, it is directly descended not only in the nature of the knowledge which it assumes to be possible, but also with respect to the objects of that knowledge In its essence it pretends to give a true image of the object known, and embraces, therefore, both nature and the world of man and spirits In its method of exposition, also, it pretends to imitate the true course of the development of nature, in which every thing passes by coherent and successive steps (or *powers*, A A¹ A², &c ) from the undeveloped to the developed and the perfect, and, beginning from the lowest grades of entity, passes to its higher developments

Such is an outline of the system of Identity, as propounded by Schelling upwards of forty years ago, and which has exercised so important an influence on the mind of Germany There is, however, good reason to believe that the opinions of its author have been materially modified in the interval, and though, influenced by some singular feeling of reserve, which may, in fact, be said to have characterized him throughout life, Schelling has hitherto refrained from embodying his *new* views in any distinct or tangible form, yet the unaccountable leniency with which he [illegible] in the celebrated *Vorrede* to Beckers [illegible] of *Cousin's Vorrede* and the covert but ill concealed hostility therein displayed to some of the principles on which both his own system and that of Hegel are based (see *infra*), coupled with the (unacknowledged it is true, but still sufficiently authentic) revelations of some of his most distinguished pupils, — all these circumstances have given rise to the supposition that the long silence which he has maintained towards the public would be broken by a recantation of his *old*, and his avowal of a *new* system This conjecture was materially strengthened by his call to Berlin in 1841, and the rumours which have reached us of the nature of his lectures leave little doubt of the fact, though his present views have not been sufficiently developed to warrant us in hazarding an opinion respecting them

A brief statement of the manner in which the theory of Schelling was further modified by Hegel may be well appended here and will complete it as a general view of the modern philosophy in Germany In the *Encyclopædia of Philosophical Sciences*, which Hegel published in 1817 at Berlin, and designed as a manual for the use of his class he gives a general view of his system, and clearly exhibits its ultimate tendency "Logic," he says, "is the basis of ontology" The idea in itself and potentially is the primary substance, but *in actu* it passes into the real The ideal is to be examined, 1st, subjectively, as it exists in the mind 2d objectively or in *other*, *i e* in its outward manifestation, and 3d, absolutely as it is realized in art religion and philosophy Schelling had made triplicity [illegible] to be the law which the principle of identity follows in its outward development [illegible] conspicuous [illegible] he makes thought [illegible] *thought* which is independent [illegible] language of Hegel, of *all contents*, [illegible] determined, [illegible] determined The last is the concrete, which is a self-developing and organical system, containing in itself all *momenta* or germs of further development Philosophy is the right evolution of this concrete, and its true method is the dialectical momentum The history of philosophy, apart

from its accidental media of schools and professors, is nothing less than the actual development of philosophy itself The several systems successively recorded are b [illegible] the latest system [illegible] ones Thus the the [illegible] Hegel are essentially based on the same principle the absolute identity of thought and being According to the former the mind is in full possession both of truth and reality the knowledge of which it attains by self-conscious ess in the intellectual intuition For the latter, Hegel substituted his *dialectical momentum*, or the logical development of the idea Generally Hegel stood in the same relation to Schelling as Wolff did to Leibnitz The cold and rigorous formalism of Fichte was displaced by Schelling for a loose and illogical style of political enthusiasm Hegel, however rightly insisted on the necessity of a scientific and systematic form as an indispensible condition of an exact science of truth (Michelet *Geschichte der letzten Systeme der Philosophie in Deutschland*, Jacobi *Briefe uber die Lehre des Spinosa*, Fichte, *Die Wissenschaftslehre*, *Die Bestimmung der Menschen*, Schelling, *System des transcendentalen Idealismus*, *Bruno Oder iiber die gottliche und natürliche Princip der Dinge*, Hegel, *Phenomenologie des Geistes*, *Encyclopædie der Philosophischen Wissenschaften* For some of the more recent views attr [illegible] see *Stahl's Philosophie des Rechts* [illegible] *Ansicht &c &c*)

SCHEME (Gr *σχημα*) A plan or representation of any geometrical or astronomical figure, a diagram

SCHE'RIF (Arab *lord* or *master*) A title given in the East by prescriptive usage to those who descend from Mahomet through his son-in-law and daughter, Ali and Fatima They are also called Emir and Seid, and have the privilege of wearing the green turban (See EMIR) The chiefs of Mecca and of Medina who are always supposed to belong to this sacred family, are styled the sheriffs of those cities

SCHERO'MA A dryness of the eye arising from a deficiency in the secretion of the lachrymal glands

SCHIAH See SUNNIAH

SCHILLER SPAR (Germ schillern *to change colours*) A mineral of a pearly lustre and changeable hues Hornblend and Labradorite are varieties of it

SCHI'RRUS (Gr *σκιρρος*) An induration of a gland, forming an indolent tumour not readily suppurating, and at first unattended by discoloration of the skin

SCHISM (Gr *σχιζω I cleave*) Separation from the true church of which as of heresy it may be said that Christians are not agreed whether the mere act constitutes the crime, or whether it is only a wilful and obstinate separation that deserves to be so denominated The chief schisms enumerated by Roman Catholic authorities are those of the Novatians the Donatists the Luciferians the Greek church and the Protestants The great schism of the West in the 14th century holds also an important place in the history of the Papacy See ANTIPOPE

SCHI'SMA (Gr *σχισμα*) In Music an interval equal to half a comma, therefore eighteen of them are required to make a complete tone

SCHIST (Gr *σχιστος*) A Geological term adopted from the German, and applied to the varieties of slate hence also the t [illegible] which have a slaty tex [illegible]

SCHI'ZOPODS (Gr *σχιζω I divide* and *τους a foot*) The tribe of long tailed Decapod Crustaceans including those which have the legs slender and filamentous, accompanied by an external articulated branch as long as the limbs, which thus appear doubled in number fitted for swimming, and not cheliferous the eggs being carried beneath them and not under the tail The opossum shrimps (*Mysis*) are examples of this tribe

SCHO'LARSHIP See BURSARS

SCHOLA'STIC PHILOSOPHY That method of philosophizing which arose in the schools and universities of what are commonly called the dark ages The father of the schoolmen was John Scotus Erigena a native of Ireland, who lived in the ninth century He first introduced among his contemporaries from what source is unknown, the philosophy of Aristotle which he combined with the doctrine of the new Platonists, and out of the combination constructed a complete system of Pantheism These speculations were at first regarded by the church with an evil eye, nor was it [illegible] following century that they were applied [illegible] and supporting the leading facts of [illegible] I was probably the necessity which was felt of combating heretics with their own weapons, that caused the universal adoption of the Aristotelian philosophy by the great religious authorities of the day It is at any rate certain, that the subtlety and ingenuity of the early schoolmen were confined to the task of co- [illegible] the doctrines of the Church [illegible] by that system The scholastic philosophy may be said to have expired with the conclusion of the 14th century, at least as to its influence on the leading minds of the age Four distinct periods have been observed in the course of [illegible] the first [illegible] and Archbishops Lanfranc, Anselm, and Hildebert The second era commences with the rise of the sect of Nominalists, the founder of whom was Johannes Roscellinus, and their most distinguished member the celebrated Peter Abelard The third period is marked by the introduction into Europe of the writings of the Arabian philosophers, and the translation into Latin of the versions of Aristotle's writings, with the complete ascendency of realism (which see) and the now undisputed supremacy of Aristotle The greatest names in this period, which embraces nearly all the 13th century are those of Albertus Magnus, Thomas Aquinas, and Duns Scotus, with the respective followers of the two latter, the Thomists and Scotists The glaring realism of Scotus roused the independent spirit of an Englishman, William of Ockam to a closer investigation of the internal conditions of thought, and in him led to what may be considered a transition state between the formation of the old schoolmen and the tendency towards nature and experience which distinguishes modern speculations The acuteness of this man restored the victory to the Nominalists His nominalism, however differed from that of Roscellinus and Abelard in the admission that 'universals' have a foundation of reality in the subjective conditions of the intellect though not in outward nature, whereas according to the former a general term was a name only,—a "flatus vocis" An excellent account of the leading principles of the scholastic philosophy and the mode of its combination with the Catholic doctrines is to be found in Dr Hampden's *Bampton Lectures* (Oxford, 1833) The learned author however does not sufficiently explain the points in which the scholastic notion of Aristotle's philosophy deviates from the genuine doctrines of that profound thinker especially with regard to the doctrine of *emanation* a purely oriental dogma grafted on the Grecian philosophy of the new Platonists of the Latin empire (See *Tennemann's Geschichte der Philosophie*)

The scholastic theology to adopt the definition of Mr Hallam (*Introduction to the Literature of Europe in the 15th 16th and 17th Centuries*) was, 'in its general principle an alliance between faith and reason, an endeavour to arrange the orthodox system of the church, such as authority had made it, according to the rules and methods of the Aristotelian dialectics, and sometimes upon premises supplied by metaphysical reasoning' The scholastic philosophy according to the same author, 'seems chiefly to be distinguished from this theology by a larger infusion of metaphysical reasoning, or by its occasional inquiries into subjects not immediately related to revealed articles of faith There can be no doubt that the sudden rise and expansion of the scholastic method was favourable to the growth of mental vigour and illumination, since it substituted ra [illegible] though on premises for the most part [illegible] mere acquiescence in authority which had distinguished the theology and the scanty remnant of philosophy which subsisted in the ages immediately preceding France, Germany England and at one period Spain were the principal seats of the scholastic controversies in Italy they had less influence Our own island has indeed the honour of having produced an unusual proportion of the chief names in this department of literature The best know [illegible] are Duns Scotus before mentioned, and W [illegible] one of the last of the distinguished schoolmen who flourished in the 14th century In the 14th century the dialectic method of the schools was applied by some learned legists to the science of jurisprudence Bartolus and Baldus have the highest reputation among the scholastic jurists

SCHO'LIASIS (Gr *σχολη leisure*) The name given to the old grammarians or critics who used to write annotations on the margin of the manuscripts of the classical authors of antiquity, called scholia; the fruits as it were of leisure

SCHO'LIUM (Lat) In Geometry, an explanatory observation or excursive remark, on the nature and application of a train of [illegible]

SCHOOLS FREE [illegible] Free schools are such as afford a gratuitous or nearly gratuitous education, to the children of the place from whatever source the funds be derived, endowed schools those of which the funds arise out of royal or private endowment The greater portion of these in England, are also grammar schools, viz schools in which elementary education in the classical languages is afforded according to the intentions of the founder A few among these have acquired, in popular phraseology, the designation of public schools Most of these schools were founded or endowed in the century and half following the Reformation Nearly 500 are described by Mr Carlisle in his work on these institutions

SCHOOLS INFANT, are said to owe their origin to

Mr. Robert Owen of New Lanark They have now been in operation since the year 1820 Their number is roughly estimated at 150 in England, 70 in Scotland, and 50 in Ireland, each school having on an average about 100 scholars, generally between two and seven years of age.

SCHOOLS, NATIONAL After public attention had been drawn to the advantages of Dr Bell's system of mutual instruction in schools chiefly through the activity of Mr Lancaster two societies were formed in England for carrying it into general operation The British and Foreign School Society dates D sentors in 1805 the National Society in connection establishment, a few years later The instruction of the former, in religion, is confined to those points in which all are agreed, that of the latter is founded on the liturgy and catechism of the established church The schools of these two societies are now extensively spread over the face of the kingdom The education given by them is nearly gratuitous, but certain small payments are in some cases exacted Mr Hill, in his work on the state of education in 1839 estimates the children attending schools of the former union at 60,000 or 80 000, and those of the National Schools at about 170,000, but these calculations seem to be founded chiefly on probabilities The same writer estimates the average length of education in these schools at about two years for each child Reading, writing and arithmetic, with religious knowledge according to the principles of the respective institutions, form the amount of education generally given, but in some schools geography, and even the elements of geometry, are taught, and attempts have been made to add instruction in various branches of manual industry Each society has a model school and establishment for training teachers That of the British and Foreign is in the Borough Road the principal one of the National in the Sanctuary, Westminster, but it has others in different places

SCHOOLS, NORMAL Schools for the education of persons intended to become schoolmasters, teachers, or professors in any line Normal schools form a regular part of the establishments for education in many Continental states, especially in Germany The normal school of Paris was suppressed in 1821 but revived a few years afterwards under the name of preparatory school and has now (since the event of 1830) resumed its original title

SCHOOLS OF ART See these under the heads Dutch School, Flemish School, &c

SCHOOLS, PUBLIC This is a name of not very definite application by which a certain number of schools are designated, conferring a classical education having on the average a larger number of boys, and frequented by the children of persons of rank and wealth The principal are, 1 The three colleges two of royal and one of private foundation — Eton Winchester, and Westminster 2 Some or all of the great metropolitan endowed schools, —Charter House, St Paul's, Merchant Tailors, Christ's Hospital (although the last is no longer frequented except by children of the less wealthy classes) 3 Certain endowed grammar-schools in the country raised by fashion and old reputation to the rank of public, — Harrow Rugby, Shrewsbury, and perhaps two or three more, but extremely arbitrary

SCHOOLS, SCOTCH PAROCHIAL In the reign of James IV (1494), the Scottish legislature enacted that all barons and substantial freeholders should send their children to school from the age of six to nine years, and afterwards to the academical institutions But it was not until 1615 that the foundations of the present system were laid by an act *empowering* the bishops, together with a majority of the landlords, or heritors," to establish schools in every parish In 1696 by another statute, the establishment of such schools was *directed* The appointment of the schoolmaster was vested in the heritors and minister, the burden of the expense of erecting the school and a dwelling house for the master, and paying [illegible] nor more than [illegible] former The general supervision of the schools was intrusted to the presbyteries in which they were situated Besides the salary (which has been raised to a maximum of 34*l* 4*s* 4½*d*, and minimum of 25*l* 13*s* 3⅓*d*), the master is supported by trifling fees from the scholars Reading, writing, [illegible] the branches of practical mathematics and even a slight amount of classical learning, have been usually taught in these parish schools Such is a short outline of the system, of the results of which, in the general education and morality of the poorer classes, Scotland has been so justly proud

SCHOOLS, SUNDAY First set on foot by Mr Robert Raikes of Gloucester According to Mr Hill, in his recent work on national education, the number of children at present frequenting Sunday schools varies from 800,000 to 900,000 The average length of a Sunday-school education he estimates at four years, the education given is almost uniformly confined to reading alone, but many Sunday schools appear to have evening schools connected with them, open two or three times a week, [illegible]

SCHOONER A small sloop-built vessel, with two masts of considerable length and rake, with small topmasts and fore and aft sails A schooner carries a square fore topsail and topgallant sail

SCHORL (Swed scorl, *brittle*) A mineral usually occurring in black prismatic crystals, it is brittle, and has much lustre, and becomes electric by heat and friction [illegible]

SCIÆNOIDES The name of a family of Acanthopterygian fishes, of which the genus *Sciæna* is the type This family is nearly allied to the Percoids, but both the vomer and palatine bones are without teeth, the bones of the head are generally cavernous, and the muzzle more or less enlarged and obtuse

SCIATICA (Gr *ισχιον, the hip*) A rheumatic affection of the hip joint

SCIENCE (Lat [illegible] in its most comprehensive sense, is [illegible] knowledge of many, methodically digested and arranged so as to become attainable by one The knowledge of reasons and their conclusions constitutes *abstract*, that of causes and effects and of the laws of nature *natural* science The term science is however, more particularly used in contradistinction to *art* and *literature* As distinguished from the former, a *science* is "a body of truths, the common principles of which are supposed to be known and separated so that the individual truths, even though some or all may be clear in themselves, have a guarantee that they could have been [illegible] either with certainty or with such [illegible] the subject admits of, by other means than their own evidence" (*See* ART) As distinguished from *literature*, science is applied to any branch of knowledge which is made the subject of investigation with a view [illegible] first principles (*See* LITERATURE) [illegible] will be found under their particular heads

SCILLITIN The bitter principle of the squill (the bulb of the *Scilla maritima*), to which its medical properties of an expectorant and diuretic are referable It is a white substance of [illegible] appearance

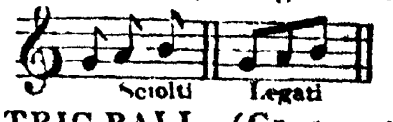
SCINCOIDS, *Scincidæ* A family of Saurian reptiles of which the genus *Scincus* is the type They have short [illegible] the body and tail are covered with [illegible] like tiles, they have no impressed lateral line and the toes are margined

SCINTILLATION (Lat scintilla, *a spark*) In Astronomy the term applied to the *twinkling* or tremulous motion of the light of the larger fixed stars, by which they appear as if the [illegible] were not continuous but [illegible] each other at intervals with a sort of vibratory movement The planets [illegible] Venus sometimes, have not this [illegible] and they are thus readily distinguished [illegible] of first magnitude It arises from the extreme smallness of the apparent diameters of the fixed stars, and depends in some measure on the state of the atmosphere In countries where the atmosphere is very pure and dry and at considerable altitudes, the scintillation is observed to be much diminished, and the stars shine with a steady clear light

SCIOGRAPHY (Gr *σκια, a shadow*, and *γραφω, I describe*) In Painting, &c, the art of casting and delineating shadows with truth, and upon mathematical principles

SCION (Lat scindo, *I cut off*) The first young shoot produced during the year by a tree, or, more commonly, a part of a branch prepared for the purpose of being grafted upon some other tree

SCIOLTO (It *free*) In Music, a term which, applied to counterpoint, signifies that it is free from syncopated or tied notes, or that it is not constrained by general rules When applied to notes, it signifies that they are not tied together




SCIOPTIC or SCIOPTRIC BALL (Gr *σκια, shadow*, and *οπτομαι, I view*) A name sometimes given to a mechanical contrivance, used in the *camera obscura*, for the purpose of giving motion to a lens in every direction

SCIRE FACIAS, in Law, is a judicial writ, which lies in various cases, most commonly to call on a party to show cause to the court whence it issues why execution of judgment passed should not be made out It is not granted until a year and a day after judgment given

SCISSEL The clippings of various metals produced in several mechanical operations connected with their manufacture The slips or plates of metal out of which circular blanks have been cut for the purpose of coinage are called [illegible]

SCIURINÆ *Sciuridæ* Squirrel tribe The name of a family of Rodents of which the genus *Sciurus* is the type They are distinguished by their very narrow

lower incisors, and by their long and bushy tail They have four toes before, and five behind Th[illegible] the fore foot is sometimes marked by a [illegible] molars are tuberculated

SCLE'RODERMS, *Sclerodermi* (Gr σκληρος, *hard*, and δερμα, *skin*) A name given by Cuvier to a family of Plectognathic fishes comprehending those which have the skin covered with hard scales

SCLE'ROTICA (Gr σκληρος) One of the membranes [illegible] Eye

SCOLOPA'CIDÆ (Gr σκολοπαξ, *a woodcock*) Snipe tribe The name of a family of wading birds, of which the genus *Scolopax* is the type The snipes proper have a straight beak the nasal furrows extending to near its point, which is a little inflated externally so as to extend beyond the lower mandible The point is soft and very sensible

SCOLOPE'NDRÆ (Gr σκολοπενδρα) The generic name of the Centipedes

SCO'MBEROIDS *Scomberoides* Mackerel tribe The name of the family of fishes of which the genus *Scomber* is the type They are characterized by having a smooth body covered with small scales, and a very powerful tail and caudal fin and include species of the greatest utility to mankind in consequence of their abundance and flavour

SCO'NCES In Fortification small forts for the defence of a pass, river or other place

SCO'PA (Lat *a little brush*) In Mammalogy a fasciculus of long flaccid hairs which may grow from any limited part of the body or extremities

SCO'PIPEDS *Scopipedes* (Lat scopæ *a broom*, and pes *a foot*) The name of a tribe of Melliferous insects including those which have the tarsi of the posterior feet furnished with a brush of hairs

SCO'RPIO In Astronomy, the eighth sign of the zodiac, and one of the ancient zodiacal constellations When this constellation rises Orion sets, hence the mythological fable of the death of Orion who perished by the sting of a scorpion *See* CONSTELLATION

SCOT (Sax sceat *part* or *portion* in the sense of contribution) This old word has passed into various ordinary expressions such as "scot free &c, and at one time found its way into the Italian language (Dante *Purgatorio*) In English law it is still retained in the phrase 'inhabitant paying scot and lot' which has long been held to mean paying parochial rates and constitutes one of the old rights of voting in various boroughs existing before the Reform Act

SCO'TER A name of the black duck or black diver (*Anas nigra*, Linn), now the type of the subgenus *Oidemia* Flem

SCO'TIA (Gr σκοτια *darkness*) In Architecture the name of a hollow moulding chiefly used between the tori in the bases of columns It takes its name from the shadow formed by it, which seems to envelop it in darkness It is sometimes called a casement, and often, from its resemblance to a common pulley *trochilus*

SCO'TISTS An old scholastic sect followers of Duns Scotus, "the subtle doctor" one of the leading champions of Realism in the 13th century He held that the "universal" existed not *'in posse'* only but *'in actu,'* not depending in anywise on the conditions of the understanding, but presented to it as an outward reality In this respect his realism differs from that of his predecessor, Thomas Aquinas, whose doctrines he combats in other respects *See* THOMISTS

SCOTODI'NIA (Gr σκοτος, *darkness*, and δινος, *giddiness*) Giddiness, with imperfect vision

SCRIBDS (Etym uncertain) In Architecture, wooden rules for running mouldings Also the extreme guides on the margins of walls and ceilings for floating to by the aid of the rules They are always necessary for running a cornice when the ceiling is not floated

SCREEN (Fr escran) In Architecture a partition usually wrought with rich tracery, placed behind the high altar of a church, and also before small chapels and tombs Sometimes, as at Easter, they are placed temporarily at the sides of choirs

SCREW In Mechanics, one of the six mechanical powers consisting of a spiral ridge or groove, winding round a cylinder so as to cut every line on the surface parallel to the axis in the same [illegible] The screw may be formed either [illegible] the cylinder, in the former case [illegible] or *male* screw in the latter, the *interior* or *female* screw The [illegible] of the screw resembles that of the wedge, or inclined plane, but as the cylinder has always a handle attached to it, the screw is a real [illegible] of the inclined plane and lever, and if the direction of the power be parallel to the base of the cylinder and perpendicular to its radius, an equilibrium is produced when the power is to the resistance or pressure as the interval between the adjacent threads is to the circumference described by the point to which the power is applied Hence the mechanical advantage afforded by the screw is proportional jointly to the fineness of the threads and the smallness of the cylinder relatively to the length of the lever or handle It is to be observed, however, that by diminishing the distance between the threads, or diminishing the diameter of the cylinder we diminish also, in both cases the strength of the screw and hence there is obviously a limit to the increase of power But the action is greatly increased by means of the contrivance called a *double screw*, or, from the name of its inventor, *Hunter's screw*, which consists in the combination of two screws of unequal fineness of thread, one of which works within the other In this case the power does not depend upon the interval between the threads of either screw, but on the difference between the intervals in the two screws, and may be increased to almost any extent

The *endless screw* consists of a screw combined with a wheel and axle in such a manner that the threads of the screw work into the teeth fixed on the periphery of the wheel Suppose the power applied to the handle of the screw, and the weight attached to the axle of the wheel, then there will be equilibrium when the power is to the weight as the distance between the threads multiplied by the radius of the axle is to the length of the lever or handle, multiplied by the radius of the wheel

The *water screw* or *screw of Archimedes* is formed by winding a flexible tube round a cylinder in the form of a screw If the machine thus constructed be placed obliquely so as to make with the vertical an angle equal to that which the spiral makes with the lines parallel to the axis of the cylinder there will be in each convolution of the spiral a part parallel to the horizon If any body then be placed within the spiral at this part, it will remain at rest, and if the screw be turned the body will ascend because the part of the screw behind it becomes more inclined than the part before it and it is consequently urged forward This simple but ingenious contrivance is usually employed for the purpose of raising water to a small height but it may be employed to raise any substance that can pass within the tube and it is evident that the action may be increased by placing several tubes or spiral channels (for they may be formed of wood or iron) on the same cylinder The principle has been recently applied to the propelling of steam-vessels

The *micrometer screw* is a contrivance adapted to astronomical or optical instruments for the purpose of measuring angles with great exactness The very great space through which the lever of the screw passes in comparison of that which is described by the cylinder in the direction of its length renders the screw of immense use in subdividing space into minute parts

As a mechanical power the screw has innumerable applications, but it is employed with most effect in all cases in which a very great pressure is required to be exerted within a small space and without intermission Hence it is the power generally used for expressing juices from solid substances for compressing cotton and other goods into hard dense masses for the convenience of carriage for coining stamping printing &c

SCRIBES The copyists and at the same time the interpreters of the law, in the later periods of the Jewish history They were held in great honour among that people, and ranked with the priests themselves in their estimation In the New Testament we find them generally referred to in connection with the Pharisees, to which sect they appear generally to have belonged, and with whom they coincided in temper and sentiments Some ancient writers conceive the scribes to have formed peculiar sects in themselves, but there is no authority for this opinion

SCRIBING (Lat scribo *I write or scratch*) In Architecture, fitting the edge of a board to another board in the same plane as the edge In joiner's work, it is the fitting one piece of wood to another so that their fibres may be respectively at right angles

SCRIPTURES The Holy Scriptures, or writings of the Old and New Testament The Canonical Scriptures, which, having been duly authenticated, are inserted in the canon or rule by which the faith of a believer is determined [illegible] BIBLE NEW TESTAMENT, OLD TESTAMENT

SCRIVENER (From the Lat scribo, *I write*, apparently through the Spanish escribano) Money scriveners, in old English usage, were parties who received money to place it out at interest, and supplied parties who wished to lend money on security Money brokers and attorneys who practise in this manner have been held to be within the statutes relating to scriveners In this sense, the word is obsolete The last [illegible] is said to have been a person of the name of Jackson a cotemporary of Dr Johnson, [illegible] remains to attest [illegible]

SCROFULA [illegible] originally termed χοιρας, or *swine disease*, by the Greeks, and later nosologists have translated it by the term scrofula It consists in [illegible] especially about the neck, which when they suppurate discharge a white curdled matter, unlike healthy pus Scrofula is not co-

tagious, but often an hereditary disease, and dependent upon a peculiar predisposition in the constitution its first appearance is usually between the third and seventh years of the child's age, and it seldom shows itself after the age of puberty It is most common among delicate children with fair complexions, and those disposed to rickets It is rare in warm climates, and seems to be favoured by cold and variable countries It is promoted by every thing that debilitates, and when its exciting causes are by any accident not brought into action, it may even remain dormant through life, and not show itself till the next generation In mild cases the glands, after having suppurated, slowly heal, in others the eyes and eyelids are inflamed, and the [illegible] the disease gradually extending [illegible] bones, and producing a hectic and debilitated state, under which the patient sinks, or it ends in tuberculated lungs and pulmonary consumption In the treatment of the mild and simpler forms of scrofula the diet should be nourishing and invigorating, and a dry situation and sea air are to be sought for, great attention should be paid to the clothing so as to avoid colds and coughs, and tonics and gentle stimulants with mild narcotics, and occasionally the alkalis should be prescribed Iodine has sometimes appeared of much service but it requires the greatest circumspection in its internal use, it may be applied externally as may also sea water and other saline lotions Chalybeates and mercurials are frequently prescribed, and much benefit has in some instances, been derived from a course of sarsaparilla

SCROPHULARIA'CEÆ (Scrophularia one of the genera) A natural order of herbaceous or shrubby monopetalous Exogens inhabiting all parts of the world except the coldest The stamens are either didynamous or unsymmetrical, nevertheless the affinity of the order is undoubtedly with *Solanaceæ* through the medium of the tribe *Salpiglossideæ*, so that it becomes necessary to separate them by a mere artificial distinction considering as *Solanaceæ* such genera as have a plaited corolla and five stamens and as *Scrophulariaceæ* all those in which the fifth stamen is wanting, or the æstivation of the corolla imbricated They are generally acrid bitterish plants The leaves of some are purgative and even emetic, a property so much increased in digitalis that its effects become highly dangerous, and nearly all the tribe turn black in drying Many of the genera such as digitalis, calceolaria, &c, are valued by gardeners for their beautiful flowers

SCRU'PLE A denomination of weight the third part of a dram and equal to twenty grains See WEIGHTS

SCRU'TINY (Lat scrutor, *I examine*) In the Primitive Church an examination in the last week of Lent of the catechumens who were to be baptized on Easter day, used chiefly in the ancient church of Rome In parliamentary language, an examination of the votes given at an election by an election committee at which the bad given on both sides are rejected and the poll corrected accordingly is called a *scrutiny*

SCUD The name given by seamen to loose vapoury clouds driven swiftly along by the winds *To Scud* signifies to run directly before the wind in a gale As the object is to keep before the sea, the fore sail or fore top sail is set the latter or the maintop sail is often necessary as the fore sail is often becalmed from the height of the waves

SCU'DO See MONEY

SCULL An oar so short that one man can work a pair It most generally implies an oar placed over the stern of a boat, and worked from side to side the blade, which is turned diagonally, being always in the water In China where the method is well understood, large boats are impelled by a single scull with considerable velocity

SCU'LPTURE (Lat sculpo, *I carve*) The art of carving in wood stone or other materials The origin of sculpture is so remote, that at this period there neither exists the probability of [illegible] it being satisfactorily deduced, [illegible] of that nation in which it first appeared Though idolatry may have favoured its early advances and rendered it powerful assistance, we are not indebted to it [illegible] for its invention In Egypt, indeed, it [illegible] its progress was impeded by the restraints and shackles with which religion invested it "The monstrous shapes and sorceries" of "fanatic Egypt" clearly barred its perfection in the country, where a bird's head was combined with the body of a lion, and cats' and wolves' heads were joined to the divine form of man It was in Greece only that the unnatural junction of the two noblest animals was successful, and grace and dignity resulted from the attempt in creation of a centaur The first artist on record as a sculptor is Bezaleel, who, with Aholiab (see Exodus, xxxi), formed the cherubim that covered the mercy-seat; but, previous to these, the art of moulding and working in metal was long known The presents to Rebekah consisted of jewels of silver and gold, Judah gave to Tamar his signet and his bracelets, in Egypt "Pharaoh took off his ring from his hand and put it upon Joseph's hand" Then, as to the art of moulding or carving, from the use of idols, we know it must have existed in Asia, and in Egypt from the time of Abraham and Jacob The *teraphim*, which Rachel stole from her father (Gen xxxi v 19 30) were, according to the best [illegible] household [illegible] of the Romans many centuries afterwards The commandment will doubtless occur to the reader "Thou shalt not make to thyself any graven image" as well as the address of Moses to the Israelites, "For ye know how we have dwelt in the land of Egypt, and how we came through the nations which ye passed by, and ye have seen their abominations, and their idols of wood and stone silver and gold, which were among them"

Some of the most extraordinary specimens of early sculpture on record are described by Diodorus as the works of Semiramis, but they are too wonderful to allow of our implicit reliance on the author She is said to have had representations in brick on her palace of every sort of animal in relief These were afterwards so coloured to nature as [illegible] of life In the midst of them was [illegible] piercing a tiger with a dart, and near her Ninus killing a lion with his lance In another part of the same palace were placed the statue of Jupiter Belus, those of Ninus, Semiramis, and the principal officers of the state the whole executed in bronze We are also told that, by command of this princess a temple was raised at Babylon, on the top whereof three massive statues were placed of Jupiter, Juno, and Rhea That of Jupiter was forty feet in height Stupendous as these works are stated to have been, we gather from the same author an account of the execution of one which throws them into insignificance One of the sides of the mountain Bagistan was extremely rough and steep, and seventeen stadia in height, this she caused to be reduced to a smooth surface, and then sculptured into a figure of herself attended by one hundred of her guards It is to be observed that Diodorus relates this story on the authority of Ctesias Doubtful as it is, the same sort of scheme was proposed to Alexander by the architect Dinocrates as related by Vitruvius in the preface to one of his books

Of the sculpture of the Persians little notice is necessary In the article PAINTING we have mentioned that it was contrary to the tenets of their religion to make in any way representations of the human form In Persepolis there are however some extraordinary sculptures, [illegible] able resemblance to the style of the [illegible] reliefs in the palace of Thebes, allowing [illegible] of dress, but they contain nothing in science or imitation particularly worthy of our notice The earliest sculpture to which we can refer, and on which we can reason [illegible] Egyptians Herodotus tells us, that they erec[illegible] temples to the gods and carved the figures of animals in stone The abundance and variety of the specimens still in existence of their sculpture, minute and colossal domestic and religious prove them to have been a nation with prodigious resources and distinguished for their wisdom and affection for the arts The greater portion of their sculpture seems to have been sacred, that is, representations of the divinities and their attributes and qualities In respect of the dimensions of some of their statues, Herodotus mentions one before the temple of Vulcan at Memphis, and another at Sais, placed there by king Amasis, each of the height of seventy-five feet The part of the sphinx, near the great pyramid still out of the sand, that is from the throat upwards, rises to the height of twenty-five feet At Thebes the sitting statues of Memnon the mother and the sons of Osymandyas, are each fifty eight feet high A long catalogue might be added to these we will however only add, that in the British Museum is a closed hand which must have been part of a statue sixty-five feet high Grace of form, elegance, and symmetry, are not to be found in Egyptian sculpture The faces of their statues have a resemblance to the Chinese, and their bodies are formed with large bellies They generally stand equally poised on both legs, having one foot advanced, the arms either hanging down straight on each side, or if one be raised, it is at a right angle across the body Some of their statues are seated, and some are kneeling, the position, however, of the hands is rarely different from what we have described The faces of them are generally flat, the brows eyelids, and mouths formed of simple curves slightly marked and with little expression The tunics and draperies are frequently without folds

The arts of Egypt seem to have been in a progressive state of improvement from about or before the period of Moses to the invasion and subjugation of the country by Cambyses, a thousand years afterwards Winckelman thinks that there were two distinct styles, the first ending with the conquest just mentioned, and the second commencing at that period, and ending after the time of Alexander the Great In the first of these styles [illegible]

ser bes the forms as straight stiff, and ungraceful The [illegible] figures have the legs always parallel, the feet are squeezed together and the arms fixed to the sides In the females the left arm is generally folded across the breast and the draperies exhibit very [illegible] In the second style the hands become more elegant, the feet are placed at a greater distance from each other, the arms hang more freely, and the figure is generally clothed with a tunic robe and mantle The material usually employed [illegible] sometimes formed of different materials from the statues themselves Small figures are frequently found, to which the name of penates has been given, they are sometimes composed of wood, sometimes of baked earth, and some are covered with a green enamel

"Winckelmann, says Flaxman in his Second Lecture on Sculpture "has remarked that the Egyptians executed [illegible] better than the human figure, for which he gives [illegible] two following reasons [illegible] that they were [illegible] to represent the [illegible] in their persons [illegible] needless hypothesis, for there are statues in the Capitoline Museum with as great a breadth and choice of grand parts, proper to the human form as ever they represented in their lions or other inferior animals In addition to these observations on Egyptian statues, we may remark, the forms of their hands and feet are gross, they have no anatomical detail of parts and are totally deficient in the grace of motion This last defect in all probability was not the consequence of a superstitious determination to persist in the practice of their ancestors, it is accounted for in another and better way' This 'better way' of the professor is from their being deficient at the time in geometry which, *he* says 'will naturally account for that of motion in their statues and relievos which can only [illegible] and with all respect for the splendid talents of the professor, whose own knowledge of geometry from his curious definition of the centre of [illegible] we apprehend to have been [illegible] her prefer the hypothesis of Winckelmann The Egyptian bassi-relievi are usually sunk from the surface of the material employed, which practice most probably obtained from their being cut in very hard stone such as granite or basalt, and from the distance they were usually placed above the eye In the first case, cutting the ground away from the figure would have occupied quite as much time as cutting the figure itself, in the second case the [illegible] breadth of shadow and [illegible] to the [illegible] These bassi-relievi or hieroglyphics when found on the walls of tombs relate the profession actions and funeral of the deceased, on those of palaces, the wars [illegible] phs processions, trophies, with the [illegible] domestic employments of kings, on those of temples they were the records of theology, and on obelisks they are hymns to the gods, or eulogies of their kings

The only correct notions that can be obtained on the subject of Phœnician sculpture is from a contemplation of the medals of the Carthaginians, who were a colony from Phœnicia, though perhaps these may mislead us The Phœnicians, known by the name of Canaanites in Scripture, were at a very early period advanced in civilization When Moses sent out the spies to search the land of Canaan, they returned with an account, 'that the people be strong that dwell in the land, and the cities are walled and very great" It was from Chaldea, according to the authorities cited by Jacob Bryant, that the arts of [illegible] having first been transplanted [illegible] their own persons, they were, unlike the Egyptian races, themselves models for their artists, and their situation and character were favourable to the progress of the art Their extraordinary and successful spirit of commerce led to its cultivation, and some of the statues that decorated their temples were celebrated in history Winckelmann is of opinion that the Etrurians, or ancient Tuscans, carried sculpture to a certain degree of perfection much earlier than the Greeks The same Dicæarchus has the reputation [illegible] Etrurians, for, in order to escape the resentment of Minos king of Crete, he is reported to have taken refuge in Sicily, whence he passed over into Italy Etrurian art proves that the first attempts towards sculpture were in clay, whereof innumerable specimens have been found in Rome and its environs, and as the Romans in the early period of their existence as a people were entirely ignorant of the arts, no doubt is left of these specimens being the work of the Etrurians or Volscians Clay was for a long time the only material used — 'nulla signa, [illegible] and Pliny and Varro tell us that [illegible] Jupiter Capitolinus, the quadriga on the top of his temple, and all [illegible] before the temple of Ceres was [illegible] of [illegible] Men of the [illegible] a resemblance to those of Greece [illegible] thought it probable they must have been brought from that country, or from Magna Græcia into Etruria, about the period of the conquest of Greece by the Romans, when Italy became almost saturated with the magnificent spoils of art which that country yielded The Etruscan sculpture is in two distinct styles of art In the first or earliest style, the general lines, or contours, are exceedingly stiff and straight, and the attitudes exhibit anything but a feeling of ease in the figure the form of the head is entirely devoid of beauty, the outlines not well rounded, their figures are almost invariably too slender, the form of the head is [illegible] the chin piked, the eyes flat, with some degree of tendency towards squinting All these defects indicate an infant state of the art, and it is not extraordinary to see the very same defects in the works of the Gothic sculptors The second style of Etruscan art is conjectured by Winckelmann to be contemporary with the age of Phidias, but it is to be observed that this conjecture is in no way borne out or supported by proof In this style the joints are strongly marked, the muscles raised the bones perfectly distinguishable and considerable knowledge of the science of anatomy is displayed The statues of the gods are executed [illegible] of great power without [illegible] The attitudes, however are far from natural, and the action constantly overstrained To this Millin adds a third period in the history of Etruscan art, commencing at the conquest of Greece by the Romans at which time the Etruscan artists became acquainted with the works of the Grecians and, adopting their style became at first their imitators and afterwards their rivals To the Italian artists of this period Horace is supposed to allude in one of his satires In concluding this succinct account of the sculptures of Etruria to exhibit the extent to which it was cultivated it is only necessary to state on the authority of Pliny that when the Romans conquered Volsinium, one of the twelve cities of Etruria they carried away from that city alone about 2000 statues

Before turning to the sculpture of the Greeks we may notice as bearing some resemblance to the Egyptian sculpture, that of the Hindus It is not, however, intended to compare the one with the other, for the latter is far more deficient than the former both in science and resemblance to nature The stupendous excavations at Ellora, which have been mentioned in the article ARCHITECTURE and those at Elephanta and other parts of India, are well known by representations which have been published in this country They are by some considered of very high antiquity and are decorated profusely with mythological sculpture whereof the subjects are symbols, [illegible] trines The reader who is desirous of further information on this subject may profitably consult *Moore's Hindu Pantheon* which contains upwards of 1500 outlines of Hindu painting and sculpture faithfully delineated from the originals

As we have seen the first dawn of the art was on the soil of Phœnicia and Egypt we have now to trace it to its meridian splendour on the shores of Greece In Egypt the forms of the human figure and its "face divine," far removed from beauty and intellectual expression, a burning climate, and institutions inimical to improving on the model, restrained the art within very narrow bounds, whereas in Greece the beautiful forms of the male and female models, the genial and delicious climate, were among the leading physical causes of the supereminent success of the Greeks With them, says D'Agincourt, "au lieu de noirs scarabees, du chacal, ou de la hyène feroce, du hideux crocodile, c'etoient les diligentes ouvrières du mont Hymette, le noble coursier, le taureau vigoureux, le cerf agile, l'elegant et doux chevreuil, qui peuplaient les rives émaillees de ses fleuves ses riantes collines, ses forets ombragees With them unlike the attachment to the combinations of human with the brutal forms of Egypt, the softest desires, the noblest and livelie[illegible] [illegible] in [illegible] of [illegible] public games, at which all men of consideration and celebrity, and of whatever rank, contended for honours, and the beauty of form to be seen at them, which was an unceasing object of contemplation, raised them into a nation of connoisseurs No [illegible] sculptor his works with the practice of former ages Egypt [illegible] with artisans, Greece with artists

Greek sculpture has usually been arranged under three epochs, which we shall here enumerate We of course pass over the rude and unfashioned representations of the

[illegible] which Parrhasius took [illegible] stone though regarded [illegible] the last with the greatest reverence, and to be seen as late as the time of Adrian at Thebes, Argos, and other cities, and which, indeed, were rather symbols than representations Neither do we think it here necessary again to touch upon the works of Dædalus and Endæus, about which we can now form no just conception, except that the material they employed was wood About 775 B C, Dipœnis and Scyllis the Cretan became celebrated for their marble statues, which retained much of the ancient style in the advancing position of the legs, the general form of the figure, and particularly in the vertical folds of drapery, whose edges were zigzag Soon after this period sculpture received the most elaborate finishing though the character of the face and limbs was not much changed from the tasteless and barbarous style of former times Flaxman conjectures that the colossal busts of Hercules and Apollo in the British Museum may have been the works of Dipœnis and Scyllis It is not difficult to conceive the progressive improvement in an art so much cultivated, between the time of which we are now speaking and the first epoch in which Ageladas, the master of Polycletus, appeared Ageladas with whom has been confounded Hiadis or Geladas, the master of Phidias, was a native of Argos, and cotemporary with Pisistratus It was at this period that art approached the personification of ideal beauty by the choice of forms from many models, so that the excellence found in each might be combined in one Its cultivation had become an object of necessity in most of the Grecian states induced greatly by a practice introduced about this era, of honouring with a statue every individual who had received three crowns in the public games Such a custom afforded the [illegible] some of the most [illegible] which were afterwards deduced those canons of proportion on which all future art has been unable to improve Within the interval of which we have just spoken appeared the sculptor Callimachus, to whom Vitruvius assigns the merit of having invented the Corinthian capital (See ARCHITECTURE) "The better drawing of the figure, with a more careful attention to its parts more precision and variety of attitude, a less elaborate curling and dressing the hair, the form of the figure better shown through [illegible] all certain signs of a near approach to [illegible]

The second epoch of sculpture among the Greeks was in the age of Phidias, who flourished about 490 years before the Christian era — a period peculiarly splendid in history as abounding with statesmen warriors, artists, philosophers, and poets, among whom will doubtless occur to the reader the names of Socrates Plato, Pericles, Miltiades Cimon Themistocles and Xenophon The emulation among such rare talents as then appeared was highly favourable to the growth and perfection of genius Athens destroyed by the army of Xerxes, rose under the auspices of Pericles in renewed and far greater grandeur Phidias the pupil of Hiadis the Argive, though by some it is thought that honour belongs to Hippias, was employed by Pericles in the superintendence of the public works, and the admiration of his powers was so universal with the ancients, that Quintilian says, speaking of his Athenian Minerva and Olympian Jupiter at Elis "Cujus pulchritudo adjecisse aliquid etiam receptæ religioni videtur ideo magestas operis deum æquavit Plutarch affirms that Callicrates and Ictinus executed the work of the Parthenon and this, as far as relates to the latter is confirmed by Pausanias The statue however, of Minerva, of ivory and gold, within the temple was the work of Phidias himself, and, excepting his Jupiter at Elis, his most celebrated production, some have doubted that Phidias himself ever worked in marble, but although his chief material was bronze when he did not use ivory it is certain that he occasionally wrought in marble The great reputation of Phidias was founded upon his representations of the gods, excelling more in them than in human forms, and in his works in ivory it is said he was unrivalled Polycletus, the scholar of Ageladas above mentioned, and cotemporary of Phidias, assisted in the perfection of style of the second epoch He was of Sicyon, and especially celebrated for his Doryphoros, or lance-bearer, and his Diadumenus, or youth binding a fillet round his head The first was so esteemed by artists, that it was called the "canon," from which they studied their proportions There is, however, some doubt whether it be this or another statue to which this honour was paid The cotemporaries of these great [illegible] Gorgias, Lacon, Myron, P[illegible] In a passage of Pliny, Al[illegible] Nestocles, and Hegias, who are called the rivals of Phidias The name of Colotes is preserved as another of his scholars

The third epoch is that in which we become acquainted with the names of Praxiteles and Lysippus, and in which what Winckelman calls the *fine style* was introduced The graces of youth and beauty were the delight of Praxiteles, and in his marble statues at the Ceramicus of Athens, he is said to have excelled himself His Venus of Cnidos was so endowed with charms, that her suitors were seaborne from all quarters to pay homage at her shrine This statue, which had been rejected by the Coans on account of its being naked, was refused to Nicomedes by the citizens of Cnidos in payment of a debt of immense amount It remained at Cnidos in the time of the Emperor Arcadius, about 400 A D Flaxman in his Lectures observes of it, that it "seems to offer the first idea of the Venus de Medicis, which is likely to be the repetition of another Venus, the work of this artist" A satyr, Cupid, Apollo (the lizard-catcher), and Bacchus leaning on a fawn are known works of this master Cotemporary with Praxiteles was Lysippus, so celebrated for the group of horses still to be seen in the front of St Mark's church at Venice This epoch, though that which Winckelman calls of the fine style, is not in grandeur comparable to its predecessor The refinement of art was carried almost to its utmost limit greater delicacy [illegible] indeed have been and was introduced [illegible] forms, but in dignity and simplicity of feeling it is inferior to the extraordinary productions of the age of Phidias After this period several of the finest groups and statues were nevertheless executed one of them, the Laocoon (*see* LAOCOON) is in a very high class of art, and perhaps not inferior to any group known The principal schools of sculpture were Athens and Rhodes, from which latter school came the Laocoon, the Torso Farnese, and the Colossus To what extent the Rhodians were sculptors may be conjectured from the circumstance of the Romans carrying off from this little island 3000 statues After the death of Alexander the Great, 324 years before Christ, the arts of design seem to have declined from their meridian excellence Apelles found an asylum in Egypt with Ptolemy, a prince whose liberality induced artists to repair to his dominions, and whose example in this respect was followed by his successor, but under the detestable tyranny of the seventh of that dynasty, the artists abandoned Alexandria altogether The alternate favour and disgrace which they experienced under the kings of Syria and those of Bithynia and Pergamus, was repeated in Sicily under Agathocles and Hiero II, till the taking (212 B C) of Syracuse by Marcellus, who was the first to appreciate Greek statues as invaluable ornaments to the eternal city

At the conclusion of the Macedonian war, 500 marble and bronze statues graced the triumph of the conquerors Mummius and Scylla left no place unstripped of all in the shape of art upon which they could lay their hands, and within a very comparatively circumscribed period Rome became the rendezvous of all artists who had any pretensions to talent for it was the only place in which they could obtain employment

The Romans had no natural taste in the fine arts, nor [illegible] lus characterized the art in its early age by the line,

Stabat in exigua ligneus æde deus,

and even to its last hour it may be truly averred that sculpture never shone in Rome except with a borrowed light Volsinium one of the twelve cities of Etruria (the modern Bolsena), was called the city of artists, and it was this depot which for a long time supplied the Romans with architects, painters and sculptors and taught the Romans at an early period what little they knew of art Before the 5th century of its existence the use of marble was scarcely known in Rome, but in the 6th the Romans began to spread themselves towards the regions inhabited by Greeians and imbibed a taste for the expensive materials used by that nation

The year 146 B C was signalized by the entire reduction of Greece under the dominion of the Romans Sixty-six years previously a dawn of luxury and taste had opened at Rome by the introduction, through Marcellus, of statues from Syracuse, but though the increasing luxury of the Romans created a constant demand for fresh objects of the art, its history in the city is but a melancholy continuing decline of it, its energies and beauties being destined to expire among the people of a strange land The only occupation then left for Greek artists was to be found in Rome, whither they were invited, and where abundance of them were to be seen Among them Pliny (l xxxv c 12 and xxxvi c 5) mentions the name of Pasiteles, a sculptor, who wrote five volumes, containing a catalogue raisonnée of the finest works of art known in his time Pasiteles excelled as a modeller in metal The silver statue he executed of Ro[illegible] [illegible] celebrated Archesilaus [illegible] sculptor, all Athenians were among [illegible] cotemporaries in the Augustan age [illegible] first of these who excelled [illegible] marble is extolled by Pliny for his care in modelling before he began upon the block He was the friend of Lucullus, for whom he executed a group,

described by Varro, representing a lioness with cupids sporting round her, and endeavouring to force her to drink Still, however, the passion for ancient Greek statues prevailed with the Romans Martial says, in speaking of a statue of Hercules,

> Non est firma recens res nostri gloria coli
> Nobilis Lysippi munus, opusque vides —(Lib ix Ep 45)

Under Augustus the art had not been entirely divested [illegible] at after his time it partook [illegible] his successors as they appeared Licentious and obscene under the sway of the vicious, debauched, and cruel Tiberius, under Caligula it [illegible] that ancient Greek statues of [illegible] o make room for the head of [illegible] (to whom, however, we per- [illegible] Apollo of the [illegible] were found in [illegible] extravagant, that some of the statues of Lysippus were actually gilt It has been conjectured that the Apollo and gladiator above mentioned were part of the spoils from the temple at Delphi The reigns of the three emperors that succeeded Nero were of such short duration, that had they been so minded they had not sufficient time to inflict any very serious injury on the arts Vespasian, whose only blemish was avarice, which is even extenuated by the laudable and patriotic use he made of his revenues cultivated the arts as well as literature The Temple of Peace which was really a temple of the arts, was by him decorated with the choicest specimens of Greek painting and sculpture The reigns of his son Titus and of Trajan were also favourable to sculpture The latter was the patron of Apollodorus, from whose hand is the sculpture on the column that bears the emperor's name and records his military exploits Trajan moreover, had the liberality and good [illegible] erect statues in honour of the eminent men of his time All works of this period were, however, rather architectural than sculptural such as temples palaces, triumphal arches, &c, and the sculpture chiefly in request was for their decoration, a want certainly not calculated to retrieve the art from its sinking state but rather to encourage bold and offhand execution at the expense of simplicity and expression Adrian was so great a lover of the arts that he did not think it beneath his character as emperor himself to exercise those of painting and sculpture for his amusement He not only restored the principal buildings at Athens but extended his fostering care to the temple of Jupiter at Olympia where he caused to be erected a colossal statue of the [illegible] The statue of Antinous so gene- [illegible] work of this reign Antoninus and [illegible] appointed by Hadrian as his successors, under them the art revived for a time and has acknowledged her gratitude to the last by his bronze statue at the Capitol The former crowded with the choicest specimens of sculpture he could procure his villa at Lanuvium How sculpture was encouraged at this time may be gathered from the innumerable busts of these emperors that have reached us Commodus had likewise been honoured with a multitude of statues but these upon his death were decreed by the senate to be all destroyed Only thirteen years afterwards under Septimius Severus, the decay of the art became very manifest its decline cont [illegible] reign of Alexander Severus, though two [illegible] ich were discovered a few years since, are not without merit During the next half century, the rapid succession of twenty emperors scarcely one of whom died a natural death, gave to sculpture little chance of a revival In fact by the end of the 4th century it was extinct, of which no other proof is necessary than the arch of Constantine and the statues of that prince, through whose removal of the capital of the empire to Constantinople Rome no longer swayed the sceptre of the fine arts If the Romans do not deserve the admiration in which the Greeks are held for their knowledge of the fine arts, they deserve our gratitude for [illegible] the noblest pr [illegible] two epochs under which the taste of the Romans for the fine arts may be classed the first beginning with the capture of Syracuse by Marcellus and ending at the time of Julius Cæsar, the second, that of the Augustan age, in which all the polite arts flourished

From the 4th to the 13th century, if there were materials sufficiently authentic, the history of the arts, as we have shown also in the articles ARCHITECTURE and PAINTING, is such a blank as to be scarcely worth the trouble of tracing In the 13th century, however, the clouds of darkness began to separate, opening a dawn for their revival in the 14th, which was soon afterwards to bring on the blaze of day We shall divide our account of the art from this period into three epochs

*First Epoch* — The Roman power having been entirely destroyed in the West of Europe, Italy became divided [illegible] d principalities, whereof the chief were [illegible] and Pisa, these being the earliest in [illegible] liberty The last, however, was foremost in founding a school of native art The Pisans, who possessed considerable extent of coast had beaten the Saracens in Africa, Sardinia, Majorca, Minorca, and Sicily, and had thus ac [illegible] which they commenced the erection of their cathedral, which was finished in 1092, about seven years after that of St [illegible]

and the cause of religion found employment for the talent they produced It has been conjectured that Buschetto, whom the majority of writers and weight of argument prove to have been a Greek, though thought by some to have been an Italian, was the founder of the school at Pisa The reputation of this school was raised to the greatest height by the [illegible] Nicolo de Pisa, the pride and glory of the [illegible] y, and the first who on its restoration gave dignity and importance to sculpture That the Grecian [illegible] Pisans had acquired soon enabled [illegible] between them and the style of Buschetto, is evident from some remains of his work in the Campo Santo In 1225 he was employed at Bologna in decorating the sarcophagus of St Dominic, in which his admiration and successful imitation of the antique shine forth He was afterwards engaged on the bas-reliefs of the pulpits at Pisa and Sienna, and on the façades of the cathedrals at Orvieto and Lucca The time of his death is uncertain Giovanni the son of Nicolo, succeeded his father, to whom in some respects he was more than equal Their figures, especially those of their draped females, are elegant, and exhibit "an originality of idea and a force of thought seldom met with when schools of art are in the habit of copying from each other" The school of Pisa is not limited to the two we have just named Arnolfo the Florentine, the brothers Agostino and Agnolo, and Andrea Ugolino, all deserve to be recorded Andrea executed in bronze the oldest gate of the baptistry at Florence, on which is represented the life of St John This work is designed with much grandeur and simplicity and almost if not quite equal to his master, but in his marble statues he is inferior Giovanni da Balduccio, scholar of Nicolo or Giovanni was of this epoch his first works were at Milan, where afterwards, in 1339 he executed the mausoleum of St Peter the Martyr In the 14th century Giotto esta- [illegible] blish pre- [illegible] the art Of it was Orgagna, a name ever to be remembered for his celebrated loggia at Florence who was also eminent for his works in sculpture A school at Sienna, towards the end of this century produced Jacopo della Quercia, whose principal works were at Bologna Lucca, and especially Sienna where a fountain which he designed was so admired that he acquired the name of Jacopo della Fonte From his hand is the bas relief in the façade of San Petronio at Bologna The 15th century was a splendid era for the production of every thing that was great and intelligent, and most especially for the art of sculpture The love of liberty and knowledge seemed to animate the whole of the Italian republics, and as if the republic of the arts were not excluded from the common sentiment no individual master seems so to have outstripped his rivals as to have impressed the art with his own particular style

This period brings us to the *second epoch*, at the beginning whereof we find six great artists engaged in a competition for executing the bronze doors of the baptistry at Florence in which after a year's trial, Lorenzo Ghiberti bore away the palm from his rivals Among these was Donatello, a Florentine, one of the most distinguished restorers of the art Some of his works 'says Flaxman, no incompetent judge both in bronze and marble, might be placed beside the best productions of ancient Greece without discredit' His alto relievo of two singing boys in the Duomo at Florence is in point of character, sentiment drawing, and drapery, of extraordinary beauty The marble statue he executed of St George standing upright equally poised on both his legs, with his hands resting on the shield before him, so excited the admiration of Michael Angelo, that after contemplating it in deep silence for a considerable length of time, he suddenly exclaimed "March" Lorenzo Ghiberti, the contemporary and as we have before mentioned, successful rival of Donatello, in the gates (1401) to the baptistry of San Giovanni, has immortalized himself by that work, [illegible] be [illegible] appella [illegible] of t [illegible] Gates of [illegible] years of his [illegible] of Reynolds, remains one of [illegible] modern art The subjects are from the Old and New Testaments, and the complaint of Reynolds is, that "the [illegible] so large a portion of the [illegible] remained but secondary objects, entirely contrary to the principle of the ancients" Brunelleschi the intimate friend of Donatello, known better by his high acquirements as an architect, was not less a sculptor of consi- [illegible] at Florence, in the church of St Maria [illegible] mirable crucifix by him in wood In

1450, Andrea Verrocchio and Dom[illegible] found amongst the first rank [illegible] The former of these two, the master of Pietro Perugino and Leonardo da Vinci, executed at Venice the famous figure of Bartolomeo Cogleone da Bergamo on horseback The latter was the master of Michael Angelo da Buonarotti, whom we have once more (*see* ARCHITECTURE and PAINTING) to introduce to the reader's notice as the most eminent of modern sculptors as well as of architects and painters The miraculous works of this extraordinary man seem rather the result of inspiration than of genius, and with him is introduced

The *third epoch*, in which the perfect restoration of the art was accomplished The historian of the painters sculptors, and architects wrote the life of Buonarotti while he was yet living, and thus apostrophises for his so doing —"Let none be surprised that I have here written the life of Michael Angelo, who is yet living Indeed it cannot be expected that he will ever die, and therefore it has appeared to me proper to do him this little honour, for when in common with other men his life shall pass away, he will be immortal in his immortal works, the fame of which, as long as the world lists, will live with glory in the mouths of men and in their records, in contempt of envy and despite of death" Michael Angelo was nobly descended, and at the early age of 15 was patronized by Lorenzo de Medici, who took him into his house, and whilst living continued his friend His career in sculpture was commenced b[illegible] Bacchus, and young fawn the colossa[illegible] of a Madonna sitting with the dead Christ on her knees, works which raised him immediately above his contemporaries It is not our purpose here to touch upon the productions of Michael Angelo in the other two arts which occupied a great portion of his time, and which it appears he afterwards regretted for Condivi his biographer, observes, "Che mi rammenta udirlo dire che quando [illegible] (the basso relievo of the battle of Hercules with the Centaurs,) vede, cognosce quanto torto egli abbia fatto alla [illegible] prontamente l'arte della scultura [illegible] gr used to the papal chair employed Michael Angelo on a mausoleum, which it was intended to place under the centre of the dome of St Peter's It was projected on a most magnificent scale, but being subjected to many delays and the pope dying, only one of its sides was completed which was afterwards erected in the church of St Pietro in Vincola by order of his nephew In this monument is found the celebrated Moses and some other statues, two of which in the present day are in the gallery at the Louvre It is mortifying to know that a large portion of this artist's time was wasted at the quarries of Pietra San[illegible] quet of the underlings of Leo X [illegible] Medici in 1523 engaged him on the sacristy and library of San Lorenzo In the Capella dei Depositi [illegible] the statues of Lorenzo and Giuliano di [illegible] and in Roman military habits the former is conceived with a simplicity worthy of the highest era of Grecian art The recumbent statues of Daybreak and Night under the statue of Giuliano in the same chapel are grand and mysterious the characters and forms bespeak the same mighty hand and mind evide[illegible] ceiling of the Sistine Chapel and last [illegible] this mighty master was doomed to experience ill treatment from his employers, his last years having been attended with mortification and chequered with vexation and trouble Universal in his accomplishments, he was mainly useful in defending the city of Florence when it was besieged by the Prince of Orange Having arrived at the advanced age of eighty and withdrawn from all employment except the conduct of the works at St Peter's, which he returned to prevent the intrigues for marring his design from being successful he gratified the pious inclination of his mind and derived amusement in his leisure hours from working on an enormous block of marble a group of four figures, consisting of the dead body of our Saviour, supported by Joseph of Arimathea attended by the two Marys, a composition of infinite grandeur and pathos which he lived not to finish His death occurred on the 15th of December, 1563 almost 90 years of age "Michel" says Ariosto "più che mortal Angel divino" Besides the honour he conferred on seven popes [illegible] e was the friend of Soliman emperor of [illegible] I king of France the emperor Charles V the princes of the republic of Venice, those of Italy, partic[illegible] duke of Tuscany reigning at the time of his death His body [illegible] he church of the Holy Apostles at [illegible] meditated a magnificent tomb to his memory, was privately removed to Florence, w[illegible] it with every [illegible] ceremony to [illegible] by all the members of [illegible] corated for the occasion [illegible] examples of p[illegible] The [illegible] re was pronounced by B[illegible] Fenth Lecture on Sculpture [illegible] thus —

The character and works of Michael Angelo have been dwelt on at greater length because as his merits and [illegible] powers [illegible] beyond the last [illegible] of human [illegible] had [illegible] attained to so much greater perfection [illegible] the [illegible] of art Vasari, the friend and [illegible] perspective of [illegible] harmony of h[illegible] facility of execution in painting and sculpture, besides his mathematical and mechanical attainments in architecture and building, together with the many and prodigious works he accomplished demonstrate how greatly he contributed to the restoration of art" After this epoch, or perhaps almost belo[illegible] to it appeared Giovanni da Bologna, a sculptor of extraordinary merit, and eminent particularly for his works in bronze and marble His Venus coming from the Bath is delicate and graceful, and the group of the Rape of the Sabines in the grand piazza at Florence is extremely well composed, and possesses a fine undulation of line The Mercury he executed, rising to fly, is energetic and [illegible] There are many small works extant by this [illegible] Benvenuto Cellini, one of [illegible] that ever existed [illegible] He was chiefly [illegible] metals, but was frequently employed on large figures and groups, of which the Perseus holding the head of Medusa in his left hand at Florence is a splendid instance of his talent Other real disciples of the great Tuscan master were Raphael di Monte Lupo, his favourite pupil, who assisted in the execution of the two statues of the Virtues on each side of the Moses, Nicolo di Tribolo, who made the bronze gates of the cathedral at Bologna, Giovanni dell Opera who received that name from the prolific chisel he wielded, and Vincenzo Danti Of this class also are Baccio Bandinelli, a man of considerable talent, but of course greatly inferior to Michael Angelo though he set himself up as a rival and competitor, Baccio di Monte Lupo, who in one his works executed the crucifix in the church [illegible] Santa Lorenzo Andrea Contucci, a clever and occasionally successful imitator of Michael Angelo, and founder of the school of Loretto, Francesco Rustici, a pupil of Leonardo da Vinci but whose works evince a devotion to the style of Michael Angelo Buonarotti, and who introduced it into France, and Jacopo Tatti, commonly called Sansovino, who was the head of the Venetian school of sculpture As an architect he was an artist of surprising talents as is manifest from his works at Verona, his sculpture, however, is deficient in purity, though not in richness of composition His principal pupils were Danese Cattaneo and Alessandro Vittoria The principles of the school were diffused through Italy, and were equally to be seen in Lombardy and Naples In the latter city the principal masters were Marliano Nola and Girolamo St Croce At Milan were Agostino Busti and Guglielmo della Porta whose reputation was raised by the statues executed by him on the tomb of Paul the Third at St Peters These have been esteemed as among the best examples of modern sculpture Torregiano who also belongs to this period, was of a vagabond disposition but a man of genius, he was invited over to England where he wrought upon the tomb of Henry VII at Westminster, for which he received the sum of 1000*l* From Benvenuto Cellini we learn that he was handsome but of consummate impudence, having the manner of a bravo more than of a sculptor, and to crown all what with his strange gestures, shrill voice, and a certain trick of knitting his brows he was enough to frighten any one who came in contact with him When he quitted England he visited Spain, says Vasari, and, distinguishing himself by many [illegible] sion in marble from the Duke [illegible] Christ of the size of life, with great assurances that he should be rewarded according to his merit The duke being a grandee of the first class the sculptor considered he should be proportionately rewarded After considerable study and application the work was finished to his own satisfaction, whereon with impatience to possess himself of the treasure, the duke forthwith sent for it, and to display his generosity to the greatest advantage, two of his servants were loaded with the money in payment for it The bulk was pleasing in appearance to the artist, but upon being opened the bags were found to contain only brass [illegible] pounds to the trifling sum of thirty ducats Vexation and disappointment roused the indignation of Torregiano, who, looking on the present more as an insult than a reward due to his merit, snatched up his mallet, and heedless of the perfect workmanship with which it had been finished as well as the sacred character of the subject broke it in pieces, and sent the lacqueys away with their load of brass to recount the tale to their master The grandee, enraged at the merited indignity with which the artist had treated him, and it may be horrified at the sacrilegious nature of the [illegible] the Inquisition as an infidel and a [illegible] pleaded the right of an author over [illegible]

the holy office of its victim by starving himself to death in his prison. This occurred in 1522, at which time he was fifty years old. In England we also had Giovanni da Padua in the following reign.

Spain produced some celebrated sculptors in the 16th century, their first native artist being Berruguette, a pupil of Vasari and Buonarotti. Berruguette's disciple Paul de Cespides is reputed the greatest sculptor that Spain ever produced.

It does not appear that Germany produced any sculptors of eminence before the 17th century. But in France, Jacques d'Angoulême, who had been at Rome, where he had a competition even with Buonarotti, Jean Gougeon, who finished the Fountain of the Innocents at Paris in 1550, and was one of the victims in the massacre on St Bartholomew's Day, Jean Cousin, whose works, though deficient in force and truth, yet exhibit much grace and delicacy, and German Pilon, whose details remarkable for [illegible] —are [illegible] that come [illegible] in which all the works of sculpture that were produced are so many testimonies of the influence which the genius of Michael Angelo exerted over the arts.

At the commencement of the 17th century, Bernini, a native of Naples, bor[illegible] before unknown [illegible] for becom[illegible] himself by [illegible] caprice [illegible] effaced all [illegible] narcotic [illegible] on the paintings of the Bolognese school, his affected style, the violent expression in which he delighted, are the marks of [illegible] whose only aim was to be striking. He [illegible] with his works and corrupted it with his taste till his death in 1680. The most celebrated cotemporaries of Bernini were Alguardi and Fiammingo. The latter is much esteemed for his representations of youth, and particularly of infants. At Naples he executed a concert of cherubs and two infants on a monument at Rome which are his most admired works; the latter was particularly admired by Rubens, who says of it, "Nature rather than art appears to have sculptured them, and the marble is softened into life." Rusconi in Italy succeeded to Bernini, and was the artist most in request at the b[illegible] the 18th century. His greatest work was at S. Giov[illegible] Laterano, where he was assisted by Monnot, Le Gros, Moraldi, Mor[illegible] [illegible] the former [illegible] in short, the art seemed to have departed, though men whose names are not worth recording, with all the pretensions of artists, still hovered about the scenes of its former glory.

In France, Anzirevalle Adrian, Della Bella, and Pacca [illegible] the interval up to [illegible] —one extremely [illegible] the remaining period of that monarch's [illegible] were Gerardon, born at Tr[illegible], P[illegible]orn at Marseilles in 1622, the latter of whom, from his fiery and energetic style, received the appellation of the Michael Angelo of France. These two were [illegible] head of the school of the succeeding sculptors of France, among whom was Falconet, celebrated for his writings, and for the equestrian statue he executed at St Petersburg of the Czar Peter. The unfortunate Louis XVI previous to the Revolution, was a great patron of sculpture, and had [illegible] ost eminent cha- [illegible] of the day had executed some of them before the dreadful period which stopped in France for a time the cultivation of the arts. The school of Pigal was of considerable extent and influence. Michel, Bocquet, Moette, Chaudet, and Le Brune being members of it, and within a generation of the present [illegible] or nearly so with these in Germany, were Rauchmuller of Vienna, Schluter of Berlin, Millich, Bartel, and others, subsequent to whom are Ohnmacht, Sonnenschein, and Nahl, all sculptors of much reputation. Our knowledge of Spanish sculptors is so limited, from their reputation not travelling away from their own country, and in it indeed [illegible] except in Madrid and the chief [illegible] employment for them is the decoration of churches, [illegible] e interest would be created by [illegible] In England, up to a la[illegible] were foreigners. Cibber, Ro[illegible] had the sway [illegible] of their genius, especially of the second [illegible] of some of our churches. The art, however, seemed to be near its dissolution, when Antonio Canova in 1757 revived in Rome [illegible] rity without which [illegible] artist was born [illegible] at Possagno, a village among the Asolani hills, at the foot of the Venetian Alps. Pietro, his father, and Pasino, his grandfather, were sculptors, whose labours were chiefly confined to the churches of the district. Deprived of his father when only three years of age, he was indebted to his grandfather for the early instruction and employment of the chisel in which he acquired great reputation at a very [illegible] [illegible] of the patrician Giovanni Falliero, who was [illegible] him placed with Torretto, one of the best Venetian [illegible] of that day. Torretto soon afterwards died, and young [illegible] [illegible] under Torretto's nephew, Ferrari. [illegible] through the trammels of the art as it was then practised, and the rapidity of his progress having induced his patron to find a more appropriate theatre for the exercise of his powers, the young artist was sent to Rome in December, 1780, soon after which time the Venetian government granted him a pension of 300 ducats for three years. At this period the fashionable sculptors of Rome were Agostino Penna, Pacili, Bracci, Sibilla, and others, whose [illegible] already forgotten, so that in the way [illegible] had little to excite his talents. Before the period had expired for which his pension was granted, the zeal of Volpato had been successful in procuring for him the commission to execute the monument of Clement XIV (Ganganelli). Thus was afforded to the young sculptor an opportunity of exhibiting his powers to a public who were fortunately capable of appreciating his merit. Before the expiration of the 18th century he had produced an amazing quantity of works, at which time it was not the practice (one afterwards introduced by him) to employ inferior workmen to reduce the block to the last shape of the superficies. The enumeration of his works would occupy much more space than can be here assigned to them; they were generally deficient in energy, but abounding in grace and elegance, and in his monumental sculpture there is vast originality of invention, whilst it is free from extravagance. His females are voluptuous but not offensively so, his execution of them exquisite. In the monument executed in memory of the archduchess Christina of Austria there is a pathos in the composition, [illegible] the chain of nature [illegible] Canova died at Venice on the 13th of October 1822, and his remains were removed to his native place, in which he had erected at his own expense a splendid church. Albert Thorwaldsen, a cotemporary of Canova, but much his junior, a native of Denmark, has by his great though irregular and erratic genius raised himself to eminence in Rome as well as in his own country. His powers in basso-relievo are great, but in extending the principles of the art we cannot assign to him a niche in the temple of fame by the side of the man whose merits we have just discussed.

In England the respectable artists Bacon, Banks, and Nollekens were followed by Flaxman,—a name honourable to the arts of this country. Intense feeling and simplicity characterize all his works, and in epic sculpture we think he very far surpassed Canova. He was born at York in 1755 and died in 1826. The lectures which he delivered as professor of sculpture at the Royal Academy have been published. In the present day we apprehend the sculpture of our country supported as it is by the talents of Westmacott, Lough, Rennie, Chantrey, and many others will bear comparison with those of any other country in Europe.

SCULPTURE, PRACTICE OF. What has been said under the article PRACTICE OF PAINTING, relative to anatomy, comparative anatomy, symmetry, invention, expression, and drapery, equally applies to the art of sculpture, and need not be here repeated. We shall, therefore, merely state the different methods practised in producing a work in this art.

A model as large as the intended figure or group is first made in clay. It is placed on a stand called the sculptor's easel, and the general form is got out with the hand and fingers, small box wood tools being made use of to touch the parts that the fingers cannot reach. The clay is kept moist, to prevent its shrinking, till the model is completed. The model is then moulded in plaster of Paris before it begins to dry, whence a matrix is formed, into which plaster is introduced, and the matrix being broken away from it, the model in clay is thus transferred into one of plaster. This becomes the standard from which the artist takes all the measurements for the figure he is about to execute. The block of marble and the model being now placed on stands, with a graduated rod, which moves on a frame perpendicular to it, and has a point attached to it which can be made to advance and recede at pleasure, certain prominent points are selected and marked in the model, and their distance measured on the frame longitudinally and vertically, and also the distance that the point on the rod is advanced or receded to touch a given point. This being found on the outside of the rough block, the particular point is drilled down to as great a distance as was measured in the model. This operation being repeated for a great number of points, the surface is worked away to all the several points found as above, till at last it begins to assume the general form of the model. As the sculptor

approaches the surface which is to be left when finished, more caution and finer tools become necessary, till at length it is brought into a state for his finishing touches The process which we have described of bringing the shapeless block into something like the form it is ultimately to bear, and which is an operation purely mechanical, is performed by inferior workmen, by which the artist's labour and time are much spared It is only with [illegible]

SCUPPER [illegible]

SCURVY [illegible] in our navy, is now of very rare occurrence It generally appears connected with debilitating causes, and especially unwholesome food, want of exercise, and by cold and moisture It begins with indolence, sallow looks, and loss of strength and spirits, the gums become spongy, the teeth loose, the breath fœtid eruptions appear on different parts of the body, and at length the patient sinks under general emaciation, diarrhœa and hæmorrhages In the prevention and cure of this disease, much effected by attention to diet and cleanliness Fresh vegetables, farinaceous substances, and brisk fermented liquors good air and due exercise, are among the principal remedial means Acids, and especially lemon juice, have been much extolled, but the researches of Dr Stevens have rendered [illegible] of acid diet somewhat doubtful

SCUTATE (Lat scutum *a shield*) In Zoology, when a surface is protected by large scales

SCUTELLUM (Lat scutum) A term used by Gærtner to denote the small cotyledon on the outside of the embryo of wheat inserted a little lower down than the other more perfect cotyledon, which is pressed close to the albumen

SCUTIBRANCHIANS, *Scutibranchiata* (Lat scutum, branchiæ *gills*) A name given by Cuvier to an order of heteropodous Gastropodous Mollusks, including those which have the gills covered with a shell in the form of a shield

SCUTIGERS, *Scutigera* (Lat scutum, gero, *I carry*) The name of a genus of unequal-legged Chilopodous Myriapods, which frequent houses and outbuildings in the South of Europe and prey upon insects, wood-lice, and other small creatures

SCUTIPEDS, *Scutipedes* (Lat scutum, *a shield*, pes, *a foot*) The name given by Scopoli to one of the divisions in his binary system of ornithology, including those birds which have the anterior part of the leg covered with segments of unequal horny rings terminating on each side in a groove

SCUTTLE An opening in the ship's side or deck to admit light or air, or for communication

*To scuttle the decks*, implies to cut holes to let the water down from them into the hold, as in the case of shipping a heavy sea, or of fire

*To scuttle a vessel*, is to cut a hole in her for the purpose of sinking her

SCUTTLE-BUTT A cask of water with a large hole in it placed for use in a ship

SCUTUM (Lat) The shield of the Roman heavy-armed legionaries was made of wood, defended with plates of iron, and covered with leather It was either oval (ovatum), or of semi cylindrical shape (called imbricatum) Polybius appears to make the latter sort 4 feet long, and it is evident that it covered a great part of the body In the centre was a boss of brass or iron projecting from the shield From this classical word is derived the modern term *esquire*, through the middle ages Lat scutifer *shield-bearer*

SCYLLA In Mythology, the daughter of Nisus king of Megara, who threw herself into the sea for love of Minos, king of Crete, and was turned into a bird Also a poetical monster, half man half dragon, who inhabited the coast of Italy opposite Charybdis, according to the well-known legend in the *Odyssey* The modern town of Scilla stands near the cave dreaded by the [illegible] the habitation of this monster

SCYPHUS (Gr σκυφος, *a cup*) The cup of a narcissus Also, in Lichens, a cup like dilatation of the podetium bearing shields upon its margin

SCYTALE (Gr σκυτος, *a skin*) An instrument used by the Lacedæmonians for the conveyance of secret instructions to their commanders The construction of it was as follows —When a general was sent out, a black rod was given him, while another of exactly similar dimensions was preserved at home When instructions were to be sent out, a strip of parchment was wrapped round the rod, and on the folds the orders were written, which accordingly could not be interpreted unless the parchment were rolled on a similar rod

SEA In Geography, a part of the great ocean *See* OCEAN TIDES

SEA The term used by sailors for a single wave, or for general agitation. In a *long sea*, the waves are distant, in a *short sea*, they are closer and more irregular A *cross sea* is composed of waves moving in different directions

SEA ANEMONE. The name of a highly organized Polype of the genus *Actinia*

SEA BOAT A term applied by seamen to a vessel, as respects [illegible] weather

SEA DEVIL [illegible] name of a large cartilaginous fish of the Ray tribe the type of the genus (*Pteroptera*, Cuvier, also applied to the angler (*Lophius piscatorius*, Linn)

SEAL (Lat sigillum) In Gem Sculpture, a stamp cut or sunk on stone, capable of yielding an impression to any soft substance When a gem is selected for cutting, it is put into the hands of the lapidary to reduce it to shape and smoothness It is then fixed with mastic to a piece of wood to serve as a handle, and the subject is sketched upon it with a copper point or a diamond The tool is a lathe somewhat resembling a turning lathe, into the end of the spindle whereof points, knobs, or circles can be inserted The gem is then applied to the end of one of these tools according to the nature of the cutting required, wetted with emend dust and olive oil, and by frequent working the subject is wrought Frequent impressions are of course taken during the progress, to show the excesses or defects These, however, are not necessary in working cameos, because the prominences are obvious to the eye The tools are soft iron or copper, and the powder of the ruby, or other hard stones, is often substituted for diamond powder

SEAL In Zoology, the English name for a genus of Marine Carnivorous Mammiferous Quadrupeds, otherwise called *Phocidæ* The variety of seals is very great, and they are found in vast numbers in the seas round Spitzbergen, and on the coasts of Labrador and Newfoundland As it frequents the British shores, it is well known, and has been repeatedly described Seals are principally hunted for their oil and skins When taken in the spring of the year, — at which time they are fattest, — a full-grown seal will yield from 8 to 12 gallons of oil, and a small one from 4 to 5 gallons The oil, when extracted before putrefaction has commenced, is beautifully transparent free from smell, and not unpleasant in its taste The skin when tanned, is extensively employed in the making of shoes, and when dressed with the hair on, [illegible] of trunks, &c *See* FISHERIES

SEAL [illegible] charters, commissions, grants of land franchises liberties &c, letters patent and letters close of the king pass the great seal The usual course is, that a grant or letters patent pass by bill, which is prepared by the attorney or solicitor general under warrant from the king It is then subscribed at foot with the sign manual, and sealed with the privy signet In this stage it is next, in some cases, taken directly to pass the great seal In other cases, an extract of the bill is taken to the keeper of the privy seal, who makes out a writ or warrant thereupon to the chancery, where it passes the great seal Then the sign manual is a warrant to the privy seal and that to the great seal There are, however some grants which only pass through certain offices as the Admiralty or Treasury, under the sign manual, requiring neither privy nor great seal The keeper of the great seal has, by 5 Eliz c 18, the same place and jurisdiction as the lord chancellor of England since that statute therefore, both offices cannot exist at the same time in different persons, which was not unfrequently the case before

SEALING-WAX The wax used for sealing letters, legal instruments, &c The best *red* [illegible] by melting in a very gentle heat 48 parts [illegible] with 19 of Venice turpentine and 1 of Peruvian balsam, 32 parts of the finest cinnabar, thoroughly levigated, are then stirred in, and the whole well mixed When it has cooled down, it is either rolled into sticks, or shaped in brass moulds The best *black* sealing wax is a mixture of 60 parts of shell lac and 30 of ivory black, it may be perfumed with a little Peru balsam or styrax The earliest application of sealing-wax to its present use seems to have been made about the year 1553 The first printed account of it is said by Berzelius to have appeared in 1563 The great seals applied in tin boxes to certain legal documents are made of a mixture of 15 parts of Venice turpentine, 5 of olive oil, and 8 of wax melted together, and coloured with red lead

SEAL, PRIVY All charters, pardons, &c, which require the great seal, pass first through the hands of the keeper of the privy seal, and other instruments of less consequence pass the privy seal only A warrant to issue money out of the king's coffers under the privy seal, is sufficient The keeper of the seal is now an [illegible] with the title Lord Privy Seal By 2 W 4 [illegible] of clerks of the signet and privy seal are to be abolished as soon as vacancies occur in them.

SEAMAN A man brought up to the sea, and capable of discharging the duties of that life A complete seaman is called an *able seaman*, and is rated A B, one less competent, an *ordinary seaman*, and a man fresh from [illegible] The [illegible] of the *Commercial* [illegible] wages, and in short all the statistics of seamen.

SEAMS The spaces between the edges of planks when in a ship are caulked and then covered with pitch

SEAMS In Geology, thin layers which separate thicker strata

SEAMEW A name for the gull *See* LARUS

SEARCH WARRANT [illegible] of the peace, under 7 & 8 G 4 [illegible] stolen, or respecting which other offences specified in the act have been committed The warrant is granted on the oath of a credible witness, that he has "reasonable cause to suspect" the goods to be in the possession and on the premises of a certain individual

SEA SICKNESS Nausea and retching, which attack most persons on first going to sea, sometimes continuing only a day or two, but often lasting the whole of a long voyage The most effective antidote, or remedy consists in lying in the horizontal position In some persons its violence is prevented by small doses of opium, or by soda water, or saline draughts in the act of effervescence, liniments and plaisters containing opium applied to the pit of the stomach are also recommended, as mitigating, or even preventing this most annoying malady The violence of the [illegible] not only varies in different individuals at different times, but the same person who escapes in one voyage shall suffer severely in another The cause of sea sickness is probably referable to the influence of the motion of the vessel upon the circulation of the blood it has been compared to the sickness occasioned by swinging For some ingenious observations upon this subject, see Dr Wollaston's Croonian Lecture, in the *Philosophical Transactions* for 1810

SEASONS (Fr saisons) The four quarters of the year, — spring, summer, autumn, winter The seasons are considered as beginning respectively when the sun enters the signs Aries, Cancer, Libra, and Capricorn, so that the *spring* season commences about the 21st of March, *summer* about the 22d of June *autumn* about the 23d of September, and *winter* about the 23d of December

SEA UNICORN The name of the narwhal (*Monodon monoceros* L)

SEA URCHIN The name generally applied to the different species of *Echinus*

SEBA'CEOUS GLANDS Small cuticular glands which secrete a greasy matter, serving to protect and soften the skin or cuticle

SEBA'CIC ACID One of the acids produced during the [illegible] of fat

SECALE [illegible] The ergot or clavus of rye *See* ERGOT

SE'CANT (Lat seco, *I cut*) in Trigonometry is a straight line drawn from the centre of a circle to one extremity of an arc, and produced until it meets the tangent to the other extremity The secant of an arc is a third proportional to the cosine and the radius, hence, if the radius be taken as unit the secant is the reciprocal of the cosine *See* TRIGONOMETRY

SECI'DERS *See* BURGHERS

SE'COND in the Sexagesimal Arithmetic, is the 60th part of a minute, or *prime* Thus a degree of a circle and an hour of time are each divided into 60 minutes and each minute into 60 seconds In the old treatises on astronomy, the seconds are sometimes denominated *second minutes* (minutæ secundæ), while the minutes being the first division of the unit, are the *primes* (minutæ primæ) Following out the analogy the sixtieth part of a second was called a *third*, but this term is not found in modern works It was formerly usual to denote minutes and seconds, both of time and arc by the characters ' and '', but these are now generally used only to indicate minutes and seconds of arc those of time being indicated respectively by the abbreviations *m* and *sec*

SE'COND In Music, a musical interval, being the difference between any sound and the next nearest, whether above or below it It may be either major or minor

SE'CONDARIES, or SECONDARY QUILLS (*Secondariæ*, Linn) The large feathers of the wing which arise from the bones of the antibrachium or fore-arm, and principally from the ulna are so called

SECONDARY CIRCLES in Astronomy are great circles of the sphere perpendicular to another great circle, which is regarded as [illegible] through the poles [illegible] are the circles on which the latitudes of celestial objects are measured

SE'CONDARY ROCKS or STRATA A series of stratified rocks with certain characters, by which they are distinguished as a class from the *primary* rocks, which underlie them, and from the *tertiary* rocks, which [illegible] *See* GEOLOGY

SECONDCOAT In Architecture, either the finishing coat, as in laid and set, or in rendered and set, or it is the floating when the plaster is roughed in, floated, and set for paper

SE'COND SIGHT (called in Gaelic Taischitaraugh, from taisch *an unreal* or *shadowy appearance*). A well-known Highland superstition. In all ages the idea has prevailed that persons endowed with the power of divination did not only foretel by instinct, but had sometimes an actual and mysterious vision of distant or future events as in the lines of Lucan which describe the presage before the battle of Pharsalia

> Fugarunt si vera fides memor imbus, augur
> Concussos
> Vertisse deos et turres maxima, dixit
> Impia [illegible]

But the peculiarity of the Highland superstition seems to consist in this, that persons were supposed to be endowed with the faculty who were in no other respect feared or reverenced for their supernatural powers it was regarded as a mere natural power, like superior sharpness of sight or hearing The inhabitants of the Western Islands were thought to be peculiarly gifted with it It could not be exerted at pleasure, the power came on [illegible] and often to his extreme terror [illegible] certain rules were in fashion for the interpretation of the visions, such, for instance as that mentioned by Sir W Scott, that if a seer saw a figure with its back to him, on altering the position of his own plaid if the figure appeared with its plaid similarly arranged the vision regarded the seer himself Martin, in his *Description of the Western Islands*, seems to have brought this superstition into notice in England It is well known how Johnson undertook the defence of it in his *Journey to the Western Islands*, but in despite of evidence which neither Bacon Boyle, nor Johnson were able to resist, the *taisch*, with all its visionary properties seems to be now universally abandoned to the use of poetry The exquisitely beautiful poem of *Lochiel* will at once occur to the recollection of every reader (Notes to the *Lady of the Lake*) It is finely described by Collins in his ode on the *Superstitions of the Highlands* But the classical bard of the second sight is Sir Walter Scott (See especially his noble ballad *Lord Ronald* the character of Allan Maclister in the *Legend of Montrose* &c &c) How far the belief in second sight is preserved at the present day, we cannot tell Mr Logan in his *Scottish Gael* only says, "It is not so prevalent as formerly" (Vol II 310)

SE'CRETARY An officer employed in writing letters despatches &c under the orders of his superior The title of secretary was first used to denote a public minister in France where the three clerks of the privy council were also termed secretaries as early as the 14th century

SE'CRETARY LORD A high officer in the kingdom of Scotland [illegible] the great prothonotary in foreign courts The office was kept up after the Union, but has been disused since 1746

SE'CRETARY OF STATE One of the highest officers of the British crown This office however is comparatively modern in point of importance the secretary of state having been originally what his name implies a mere servant of the privy council There was only one until the reign of Henry VIII, who added another, but their functions were limited to preparing business for the council board, which they attended afterwards with their proposals Under Elizabeth they became members of the council Queen Anne raised the number to three, by the appointment of a secretary for Scotch affairs — an office which did not long continue, and one for the American department was appointed in the reign of George III but abolished in 1782 At present there are three secretaries of state 1 The Secretary for the Home Department 2 The Colonial Secretary 3 The Secretary for Foreign Affairs In each of these departments there are two under secretaries, one of whom remains in office on a change of ministry The clerks in the Home Office are divided into senior and junior, but no such distinction obtains in the other two Each of the principal secretaries has 6000*l* a year The Alien Office is annexed to the Home Department the State [illegible] all the departments [illegible] is the custody of the privy signet, and the Privy Signet Office in which grants, letters &c, sealed with the privy signet, are made out is in his department The principal secretaries are always ex officio cabinet ministers Their position in the English government is in fact, identical with that of the ministers of home and foreign affairs, &c, in France and other Continental countries The Secretary at War is attached to the War Office His salary is 2480*l*, and he is also frequently, though not always a member of the cabinet The secretary of state for Ireland is also keeper of the privy seal of that part of the kingdom, and chief secretary of the lord lieutenant His office is divided into two departments, military and civil, in each of which an under-secretary is placed Like the secretary at war, he is, though more rarely, sometimes a member of the cabinet

SECRETION (Lat secretio) The process by which substances are separated from the blood in animals, or from the sap of vegetables

In some cases a secretion appears to be a mere separation [illegible] by it, from the blood, but in others the process is much more elaborate and intricate A highly complicated glandular structure is requisite, and the proximate or ultimate elements of the blood are arranged into new combinations, so as to constitute a new and distinct product, of which no traces are to be found in the healthy blood The animal secretions are arranged by Bostock under the heads aqueous, albuminous, mucous, gelatinous, [illegible] Exhalations, as from the skin, the surfaces of the closed cavities of the body, and the lungs, 2 Follicular secretions, which are either cutaneous or mucous, and, 3 Glandular secretions, such as milk, bile, urine, saliva, &c *See* PHYSIOLOGY and BOTANY, &c

SECT A term used in ordinary language to signify any body which separates from the established religion of a country In this sense, the word appears to be derived from Lat seco, *I cut*, sectarians being, as it were, *cut off* from the general mass But on the other hand, the term was anciently applied to the *followers* of some distinguished leader in which sense the idea of *cutting* [illegible] and the word then seems to be derived from Lat sequor, *I follow* The chief sects, both of philosophers and religions, will be found noticed under their respective heads

SECTION (Lat sectio), in Geometry denotes the line formed by the intersection of two surfaces and likewise the surface formed when a solid body is cut by a plane When a plane is cut by a plane the section is a straight line, when a sphere is cut by a plane the section is a circle, and when a cone is cut by a plane the section may be a triangle, a circle, an ellipse an hyperbola or a parabola which five figures are consequently called the *conic sections* (See CONIC SECTIONS) Vieta gave the name of *angular sections* to the branch of analysis which has for its object the investigation of the sines and chords of the multiples and submultiples of a given arc On this subject the student may consult the work of Poinsot entitled *Recherches sur l Analyse des Sections Angulaires*, Paris, 1825 — *Section of a Ratio*, and *Section of a Space*, are terms that were employed by Apollonius of Perga who wrote two books with those titles, the former of which was restored by Dr Halley, and the latter by Willebrord Snell

SECTION In Architecture, the projection or geometrical representation of a building supposed to be cut through so as to exhibit its interior

SECTOR (Lat) In Geometry the *sector of a circle* is a portion of the area of the circle bounded by two radii and the intercepted arc Sectors of different circles are said to be *similar* when the sides or radii include equal angles The area of a sector is equal to that of a triangle whose base is equal to the length of the contained arc, and altitude equal to the radius of the circle

SECTOR A mathematical instrument of considerable use in making diagrams laying down plans &c Its principal advantage consists in the facility with which it gives a graphical determination of proportional quantities, and hence it is called by the French *the compass of proportion*

The instrument consists of two rulers (generally of brass or ivory), representing the radii of a circular arc and moveable round a joint, the middle of which forms the centre of the circle From this centre there are drawn on the faces of the rulers various scales, the choice of which, and the order of their arrangement may be determined by a consideration of the uses for which the instrument is chiefly intended The scales usually put on sectors are of two kinds — single and double, that is to say, such as are drawn only on one of the limbs and such as are drawn on both limbs The first kind however (comprising, for example a line of inches, of chords, sines, logarithms, &c) are not peculiar to the sector but are merely placed there for convenience, and may be used whether the instrument is shut or open Of the lines repeated on both limbs the principal are the following — 1 A line of equal parts, by which, with a pair of compasses, we are enabled on the principle that similar triangles have their homologous sides proportional, to find a third proportional to two given lines, a fourth proportional to three given lines, to diminish a line in any given proportion &c 2 A scale of chords, which enables us to protract an angle of any given number of degrees, to find the degrees which any given angle contains, to cut off an arc of any magnitude from the circumference of a given circle, &c 3 Scales of sines, tangents, and secants, whereby the lengths of those trigonometrical lines corresponding to a given arc of a circle of any radius are determined 4 A line of polygons, whereby the proportional length [illegible] regular polygon (of not more than [illegible] sides, to the radius of the circumscribing circle is found

The sector may be used in trigonometry for obtaining a rough solution of all the cases of right-angled plane triangles, and it is also conveniently applied to the construction of various geometrical problems For a description of its several uses see *Robertson's Treatise of such Mathematical Instruments as are usually put into a Portable Case*

SECTOR In Astronomy, an instrument constructed for the purpose of determining with great accuracy the zenith distances of stars passing within a few degrees of the zenith, where the effect of refraction is small *See* ZENITH SECTOR

SECULAR EQUATION SECULAR INEQUALITY [illegible] In Astronomy, any deviation from the mean motion or mean orbit of a celestial body is called an *inequality*, and the numerical expression of the magnitude and period of the inequality is called an *equation* The equations representing the motions of the bodies of the solar system are of two kinds, *periodic* and *secular* the first being those which pass through all their changes and return to the same state in a comparatively short period of time, and the second such as change their values so slowly that the variation only becomes sensible after the lapse of centuries and require for the accomplishment of the series of their changes a length of time which in some cases astronomers have not yet ventured to calculate Thus the lunar *evection* which depends on the position of the transverse axis of the moon's orbit in respect of the line of the syzygies is a periodic inequality passing through all its different values [illegible] but the acceleration of the moon's mean motion depending on a slow variation of the eccentricity of [illegible] is a *secular* inequality, amounting only to about 10 seconds in a century The secular inequalities are in fact periodic as well as the others, but they proceed so slowly that the observations of many hundreds or even thousands of years would be insufficient to make known their periodicity The discovery of their true nature is one of the results of the theory of gravitation

SECULAR GAMES In Antiquity, were games celebrated once in a hundred years They lasted three days and three nights during which period sacrifices were offered up and theatrical shows exhibited, and combats in the circus, &c took place Valerius Publicola, the first consul created after the expulsion of the kings, A U C 245 was the first who celebrated them at Rome Some authors maintain that the *seculum*, or age, consisted of 100 and others of 110 years, but it is certain several Roman emperors did not allow so long an interval as either period to elapse Thus Augustus celebrated secular games A U 736 Caligula 61 years later and Domitian 26 years afterwards on which occasion Tacitus assisted in the capacity of juris decemvir According to Zosimus the emperor Septimus Severus was the last who celebrated them but other writers have stated that under the emperor Philip A U 1000, these games were held with more magnificence than had ever been before witnessed They were celebrated, in all eight times

The original seculum of the Etruscan augurs is said by some to have been measured by the longest life of those who were born at its commencement, and they had a peculiar tradition, that the duration allotted to nations was measured by a certain number of these secula (Plutarch *Sylla*, Censorinus, *De die Natali*)

SECULARIZATION In Politics the appropriation of church property to secular uses In most European states such appropriations have taken place on a great scale within the last century In [illegible] eat secularization has been that made [illegible] IN VIII

SECULAR POEMS, in Antiquity, were those recited at the celebration of the secular games Of this species of poem the Sapphic Ode of Horace, at the end of his book of *Epods* is a noble specimen Several editions of Horace give the name *secular poem* to the 21st Ode of the first book (See *Niebuhr's Rome*, 2d edition, p 288)

SECULAR REFRIGERATION The periodical cooling and consequent consolidation of the crust of the globe a term used by geologists in reference to the supposed central heat and even fluidity of the globe, and to the phenomena of its [illegible]

SECULAR YEAR [illegible], kept once in a century

SECUNDINE (Lat secundus) In Botany, the outermost but one of the enclosing sacs of the ovulum, [illegible] considers [illegible] Schleider says it is the first, and that the primine or first integument of Mirbel is formed afterwards

In Zoology the foetal membranes collectively are sometimes termed *secundines*

SECURIFERS [illegible] (Lat securis, *a hatchet*, [illegible] *terebrantia*, or boring Hymenopterous insects, comprising those in which the females have a saw shaped or hatchet-shaped terebra or appendage to the posterior part of the abdomen, for the purpose of preparing a place to receive the eggs, and of depositing them therein

SECURIPALPS, *Securipalpi* (Lat *securis*, *a hatchet*, *palpo I feel*) The name of a family of Coleopterous insects, comprehending those in which the maxillary palps terminate in a joint which is elongated and hatchet-shaped.

SE'DATIVES. (Lat *sedo*, *I assuage*) Medicines which assuage pain generally by inducing sleep and diminishing irritability

SI'DENTARIES *Sedentaria* (Lat *sedeo I sit*) The name of a section of cephalous (*branchiferous*) conchifera those which remain nearly stationary during the greater part of their existence with valves of unequal size

The name of the *Sylvia phragmitis*

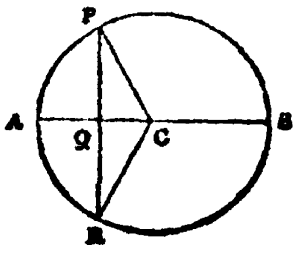
Bech It is a species of warbler very abundant in this country about the middle of April and emigrates in September It frequents the sedgy banks of rivers, and constructs a nest composed of a little moss intermixed with dry stalks, lined with dry grass and occasionally a few hairs It lays five or six eggs of a light brown colour, mottled with darker shades of the same It is sometimes called *reed bunting*

SEDITION (Lat *se*, *apart*, and *ire*, *to go*) In Law, a general and not strictly technical word comprising, in common language, offences against the state which do not amount to high treason The distinction between the two offences was not very accurately adhered to or defined until later times Sedition is of the like tendency with treason, but without the *overt acts* which are essential to the latter Thus, there are seditious assemblies, seditious libels, &c, as well as direct or indirect threats and acts amounting to sedition, all punishable as misdemeanours The acts 39 G 3 c 79 (by which the famous Corresponding Societies were suppressed) and 57 G 3 c 19 were passed to prevent seditious meetings and assemblies

SEE (Lat *sedes*, *a seat*) The name usually given to the diocese of a bishop in England It was originally applied exclusively to the papal chair at Rome but it has long been used in its present wide signification

SEED, is the reproductive part of a plant resulting from impregnation, and containing the embryo or rudiment of a future plant, or, in other words it is the ovulum in its most perfect and finally organized state It is a form of reproductive matter peculiar to flowering plants, its equivalent in flowerless plants being the spore It is commonly said that as the seed is the part intended by nature to multiply the races of plants special contrivances are provided for ensuring its dispersion and migration from place to place, such for instance as being discharged with force by the sudden explosion of the case or seed-vessel in [illegible] that render [illegible] to a certain [illegible] vessels, as in the instance of the dandelion the ash tree, the sycamore &c in these latter cases the part to which the name of seed is given is a true pericarp or seed vessel On the other hand, many kinds of seed vessels, such, for instance, as those of corn, of labiate and boraginaceous plants, &c, are miscalled seeds, or naked seeds

SE'GMENT (Lat) In Geometry a part cut off from a figure by a line or plane The segment of a circle is a part of the area comprised between an arc and its chord In [illegible] different circles are said to be *similar* when [illegible] have the same ratio to the circumferences of their respective circles or when they contain the same number of degrees The area of a circular segment may be found as follows —Let P R be the chord of a circle whose centre is C, and let A B be the diameter perpendicular to P R, and meeting it in Q, and put $x = A Q$ $y = P Q$, $z = A P$ $r = A C$ the radius, and $\pi = 3.14159$ the ratio of the circumference to the diameter Now the area of the segment P A R is evidently equal to the difference between the sector A P C R and the triangle P C R, but the area of the sector $= r z$ (the radius into half the arc), and the triangle $= y (r - x)$, therefore the segment $= r z - r y + y x$ When the radius of the circle and the chord of the segment (that is $r$ and $y$) are known, this expression is easily calculated from a table of sines, for the angle A C P is found from its sine $= y \div r$, and when the angle is given the arc is obtained from this proportion, $z$ : $\pi r$ :: A C P : [illegible] With respect to $x$, we have from the property of the circle $x = \sqrt{(r^2 - y^2)}$




The superficial and solid contents of a segment of a sphere are found thus —Let S be the spherical surface of the segment of the sphere whose centre is C by the plane P Q R The symbols having the same values as above, the circumference of the circle P Q R is $2 \pi y$, and the differential of the surface is $d S = 2 \pi y d z$ But from the nature of the circle, $y d z = r d x$, hence $d S = 2 \pi r d x$, and $S = 2 \pi r x$, so that the surface of the segment is found in terms of the radius of the sphere [illegible]

Let [illegible] the area of the circle [illegible] the segment $= \pi y^2 d x = 2 \pi r x d x - \pi x^2 d x$, whence $U = \pi x^2 (r - \frac{1}{3} x)$

SEGNO (Ital *a mark*) In Music *See* AL SEGNO

SEGUE (It *it follows*) In Music, a word which, prefixed to a part, denotes that it is immediately to follow the last note of the preceding movement When minims crotchets, &c are subdivided by a stroke drawn through their tails so as to make them into abbreviated groups the term indicates that the following notes are divided similarly to those first marked

SEIDLITZ WATER The mineral water of Seidlitz, a village of Bohemia sulphate of magnesia sulphate of soda, and carbonic acid, are its active ingredients It is often taken as an agreeable and effective aperient The article sold under the name of *Seidlitz powders* is intended to produce the same effect though very different in composition These powders are generally sold in different coloured papers one blue, containing 2 drachms of the potassa-tartrate of soda mixed with 2 scruples of bicarbonate of soda, the other red, containing 35 grains of finely powdered tartaric acid The former powder is dissolved in half a pint of water and the latter in a separate [illegible] ons are then mixed, and taken [illegible]

SEIGNORY (Fr seigneurie) In Lower Canada, the right of feudal superiority in real estate The term fief is applied both to the land held of a seigneur and to the dominium directum, or right of direct seigniory, reserved to him who has granted the land in fief The king has the paramount seigniory in all the feudal lands By 6 G 4 c 59 persons holding fiefs or seigniories may on application to the king obtain a commutation and release of feudal burdens, and the fief or seigniory may be regranted in common socage The land held in seigniory is said to amount to more than 10,000 square miles

SEIGNORAGE An ancient prerogative of the crown whereby it claimed a per-centage upon every ingot of gold or silver brought to the mint to be coined Upon gold it amounted under Edw III to 5s per lb weight, of which a fifth was appropriated to the master of the mint upon silver it varied from 1s to 1s 3d &c, but the amount varied in different reigns The term *seignorage* is used in common language to [illegible]

SEISIN in the Common Law of England, signifies possession either actual (seisin in deed) or in law as where lands have descended to a party who has not entered into actual possession of them, or is by wrong dissessed of them

SEISMO'METER (Gr σεισμος, *an earthquake*) An instrument for measuring the shock of earthquakes and other concussions (*Edin Phil Trans* vol xv p 219)

SE'JANT In Heraldry a term employed to describe beasts when represented in a sitting posture *Sejant-rampant* sitting with the two fore feet lifted up &c

SELACHIANS *Selachi* (Gr σελαχος *a species of scaleless fish*) The name given by Cuvier to the tribe of [illegible] rays and sharks

SELENE [illegible] Greek Mythology, the goddess of the moon Her Latin equivalent was *Luna* She was represented sometimes as the wife, the sister and the daughter of Helios the sun, and was identical with Artemis or Diana which see

SELENITE (Gr σεληνιτης) One of the mineralogical synonyms of crystallized sulphate of lime

SELENIUM (Gr Σεληνη *the moon*) A substance discovered in 1818 by Berzelius In its general chemical habitudes it bears a resemblance to sulphur It has hitherto been obtained in very small quantity, and generally occurs in some of the varieties of iron pyrites It is a brittle opaque substance, tasteless and inodorous, having something of the appearance of lead but of a deep red colour when reduced to powder Its specific gravity is about 4 3 At 212° it becomes soft and tenacious and at 220° is perfectly liquid, at 650° it boils and sublimes It is insoluble in water, and unaltered by air, and when heated by the blowpipe, so as to become oxidized, it exhales a strong odour of horse radish Its equivalent is about 40 It forms an oxide and two acids, the *selenious acid* being a compound of 1 equivalent of selenium and 2 of oxygen and the *selenic acid* of 1 and 3 It also combines with hydrogen, forming the *hydroselenic acid*, a gaseous compound of 40 selenium + 1 hydrogen Its odour at first resembles sulphuretted hydrogen, but it [illegible] productive of certain forms of the epidemic disorder [illegible]

SELENOGRAPHY (Gr Σεληνη, *the moon*, and [illegible] description of the surface of the moon, as geography is a description of the surface of the earth.

**SELEUCIDÆ, ERA OF THE** In Chronology, the era of the Seleucidæ, otherwise called the Macedonian era, dates from the epoch of the first conquests of Seleucus Nicator in Syria, about 311 years before Christ It was followed generally by the Greek colonies bordering on the Levant, and by the Jews till the 15th century, by whom it was called the *era of contracts* There is considerable difference of opinion among authors respecting the month and day on which the year of this era commenced, so that it is frequently not possible to fix the correspondence of dates, but according to the computation most generally followed, the year 312 of the era of [illegible] 1st of September in the Julian [illegible] ear of our era Hence to reduce a Macedonian date to the common era, subtract 311 years and 4 months

SE'LLA TURCICA A cavity in the *sphenoid* bone it is surrounded by the four clenoid processes, and contains the pituitary gland

SE'LLI The priests of Jupiter who delivered his oracles at the sacred grove of Dodona in Epirus

SE'LTERS or SELTZER WATER A mineral water from Seltzer, about ten miles from Frankfort on the Maine It is an agreeable beverage, from the quantity of free carbonic acid which it contains and which covers its slightly saline taste Common salt with the carbonates of magnesia, lime, and soda, are the saline ingredients

SE'LVAGE A piece of very flexible kind of rope, composed of yarns not twisted together, but laid parallel, and confined by external marline

SE'MAPHORE (Gr σημα, *a sign* and φερω, *I bear*) A term mostly used synonymously with *telegraph* but which as its derivation imports may be applied to any means whatever employed to communicate intelligence by signals *See* TELEGRAPH

SEME' (Fr *semé*) In Heraldry a term employed to describe a field or charge powdered or strewed over with figures such as stars, billets crosses &c

SEMEIO'TIC (Gr σημειον *a sign*) That which relates to the signs or symptoms of diseases

SEMI-ARIANS A branch of the Arian heresy who denied the ὁμοουσιον or [illegible], the Son with the Father, but admitted the ὁμοιουσιον or *similarity of substance* (*See* art ARIANS and Mosheim *Eccl Hist* vol i trans 1790, p 41 *See* HOMOOUSIANS)

SE'MIBREVE (*i e* half a breve) In Music a note whose length is half that of a breve It is the integer whose fractions and multiples express the time of other notes *See* MUSIC

SE'MICIRCLE In Geometry, the half of a circle, or the figure bounded by the diameter and half the circumference

SEMICO'LON *See* PUNCTUATION

SEMICU'BICAL PARABOLA In Analysis a curve of the second order defined by this property that the cubes of the ordinates are proportional to the squares of [illegible] abscissæ or by the equation $y^3 = ax^2$ [illegible] evolute of the common parabola

SE'MIDIAMETER In Geometry half of the diameter, or the part of the diameter of any figure comprehended between the centre and the extremity of the diameter

SEMIDIAPA'SON (Gr) In Music a defective octave, or one diminished by a minor semitone

SE'MIDIAPE'NTE (Gr) In Music, the same as [illegible] which see

SEMIDIATE'SSARON (Gr) In Music, a defective fourth, properly called a *false fourth*

SEMIDI'TONO (Gr) In Music, the same as a *minor third*

SEMIME'TAL A term applied by the old chemists to the brittle metals

SEMIMI'NIMA In Music, a half minim or crotchet

SE'MINYMPH Lyonnet so calls the nymphs of those insects which undergo but slight changes in passing to the perfect or imago stage

SEMIO'PAL A siliceous mineral nearly resembling the common opal

SEMIPA'LMATE (Lat semi, *half*, and palma, *a palm*) In Zoology, when the toes are connected together by a web extending along only their proximal half The term *semi* being frequently used in the composition of zoological terms with the same meaning, it is only requisite to refer to the term to which it is prefixed

SEMI-PELA'GIANS A sect who differ from the Pelagians, from whom they [illegible] the necessity of the divine grace towards the practice of virtue, but at the same time to allow that this grace may be obtained by an effort of the human will (*See* CALVINISTS, PELAGIANS, &c, and Mosheim, *Eccl Hist* vol ii trans 17[illegible] p [illegible])

SE'MIQUADRATE or SEMIQUARTILE. In the language of Astrology [illegible] distant from each other [illegible] 45 degrees *Semiquintile* and *semisextile* have a similar meaning, the first denot[illegible] [illegible] that [illegible]

SE'MIQUAVER In Music, a note whose duration is half [illegible] quaver

SEMISOPRO (It) In Music, a small pause equ[illegible] [illegible] part of a bar in common time

SEMITONE (Gr) In Music, the half of a tone, though, [illegible] speaking, this is not a proper definition of it, musical semitones are of three sorts,—greater, lesser, and natural In keyed instruments which have their sounds fixed, the semitones afford the means of a new sort of scale between the different tones, by which their defects are partially remedied

SEMIVO'WEL, is said of those consonants which, like vowels, can be pronounced independently, or without the aid of any other letter To this class belong *b, d, c, g, k, p, s t v, x*, and *z*

SEMO'NES, in Roman Classical Antiquity, were deities holding [illegible] between the twelve supreme gods and [illegible] class belonged such gods as Vertumnus, Priapus, the Fauns, Satyrs, &c The word *semones* is a contraction of Lat semi, *half*, and homo, *man*

SEMUNCIA A small Roman coin, equivalent to half an ounce being 1-24th of the Roman pound

SENA'RIA (Lat) In ancient Architecture, the pipes of aqueducts, whose diameter was an inch and a half or six quarters, when they were seven quarters they were called *septenaria*, and so on, according to the number of quarters of inches in their diameter

SE'NATE (Lat senatus, *i e assembly of elders*) The deliberative assembly of the Roman people The members of this council were originally chosen from the patricians and were probably single representatives of each of the houses of that order a plebeian senator is first mentioned A U C 355 At the foundation of the city their number was 100, which was doubled on the admission of the Sabines, and increased to 300 by Tarquinius Priscus, but the more ancient members and those admitted by this last king were distinguished by the titles of *patres majorum* and *patres minorum gentium*, or senators of the greater and of the lesser houses respectively In the last ages of the republic the members of the senate amounted to above 400, and were still further raised by the emperors to 1000 The members of the senate were originally chosen by the kings, and afterwards the election fell into the hands of the consuls, military tribunes, and finally of the censors, but the fact of having held certain magistracies, as the quæstorship and all superior posts gave [illegible] [illegible] privilege Under the regal government the [illegible] [illegible] of such affairs as the king proposed to them, and he was said to act according to their counsel On the establishment of the republic the whole power of the state was thrown into its hands, the different magistrates using the authority they enjoyed merely as its delegates The first constitutional check imposed on it was the power of intercession or negativing their proceedings, granted to the tribunes of the commonalty Still while Rome was free the authority of the senate though subordinate to the assembly of the people remained very great It assumed the guardianship of public religion, the management of the [illegible] [illegible] [illegible] of governors to the provinces [illegible] [illegible] [illegible], the direction of diplomatic affairs, and many other functions of importance Under the emperors its power became, in general, little more than nominal, yet the assembly still existed till the occupation of Italy by the Goths in the 13th century after the foundation of Rome and in the last ages of its existence, after the seat of empire had been transferred to Byzantium, it seems to have been the centre of what remained of the old national spirit After that time its existence as a council ceased, though the name of senator was still retained by some noble families of Rome as an empty but high sounding title The senatorial badges were the laticlave or tunic with a purple band, black buskins reaching up to the middle of the leg and a silver crescent on the foot

The affairs of the Italian and provincial towns of the Roman empire, in imitation of the capital, were administered by senates See as to these provincial senates, or curiæ, *Savigny's Hist of the Roman Law*, vol i

SENATE In many republican constitutions of modern times, the upper house of the [illegible] [illegible] assembly has been so called The senate of the United States (*see* CONGRESS) is composed of two members for each state of the Union The senators are chosen by the state for six years [illegible] [illegible], besides its legislative functions, is also [illegible] executive council assisting the president [illegible] necessary for the ratification of treaties appointing ambassadors, judges of the supreme court heads of departments in the administration &c It is also the high court of impeachment for public functionaries

SE'NEGA ROOT The root of the *Polygala senega*. Rattlesnake root It is brought from North America. it has a peculiar pungent flavour, and promotes the flow

of saliva. In large doses, it nauseates and purges It is occasionally used in stimulating gargles, and in America, as an antidote probably a very inefficient one,—to the effect of the bite of the rattlesnake

SE'NEGIN The bitter acrid principle of the *Polygala senega* or rattlesnake root

SE'NESCHAL A French title of office and dignity, derived from the middle ages, answering to that of steward, or high steward, in England They were originally the lieutenants of the dukes and other great feudatories of the kingdom, sometimes termed bailiis, or bailiffs When the kings recovered the rights of suzerainty, and especially the judicial authority, in those provinces which had been previously governed by these great nobles, the bailiffs and seneschals continued as royal judges and superintendents, both military and financial, but their powers like those of the dukes and counts whom they succeeded, were gradually encroached on by the crown

SENNA LEAVES The leaves of the *Cassia senna* They are imported from Alexandria, whither they are brought from Upper Egypt They are largely mixed with the leaves of the *Cynanchum oleafolium* or *Argel*, which are thick, and not ribbed like the genuine senna leaves, and which have a disagreeable taste, and render the use of senna leaves are distinctly ribbed thin generally pointed and when chewed have a peculiar nauseous flavour and yield a dark brown infusion It is a griping, nauseating and somewhat drastic purge and a most valuable addition to or vehicle for, other purgatives

SE'NSES (Lat sentio *I feel*) The faculties are so called by which we become acquainted with the properties and states of external things They are five in number —sight hearing taste touch and smell for the physiology of which the reader is referred to the articles, such as EYE, EAR, SMELL &c See also NERVOUS SYSTEM We can only here advert to the fact that the late Dr Thomas Brown of Edinburgh and Sir C Bell have propounded the novel doctrine of a sixth sense called the *muscular* sense (our whole muscular frame being supposed to be endowed with a distinct order of sense), —a doctrine which had also found numerous supporters but to which Mr Whewell has recently declared his adherence in his *Philosophy of the Inductive Sciences* &c This part of the subject is ably treated in the *Edin Review* vol lxxiv

SENSITIVE PLANT This name is generally applied to a small annual called *Mimosa pudica* inhabiting the tropics of America It has a stem about a foot and a half high, covered with stiff hairs, the leaves are bipinnate in six or eight pairs, and the flowers are collected in [illegible] It derives its name from the irritability of its leaves, which collapse and fold up when touched or even when irritated by casting on them the focus of a burning glass, or by exposing them to the vapour of hydrocyanic acid The cause of this irritability has been investigated by Dutrochet (*Mémoires pour servir à l'Hist Anat et Phys des Végétaux* &c vol i 534) who refers the phenomenon to the action of endosmose and to the operation of a "fibrous tissue capable of moving inward under the influence of [illegible] Without attempting to analyze the speculations which however curious can scarcely be said to throw much new light upon the subject, it will be sufficient to explain the nature of the phenomena themselves When the leaf of a sensitive plant is at rest it consists of many leaflets spreading flat, and connected in pairs along the sides of certain common leaf-stalks When one of these leaflets is irritated the pair to which it belongs rise upward and apply their faces to each other, this is rapidly followed by the same action in the succeeding leaflets and in the course of a few seconds the whole of the leaflets are in a state of collapse, then the leaf itself suddenly bends downwards and if the plant is in very good health the shock thus communicated to one leaf will extend to those immediately above and below it After a time the leaf resumes its original position Upon the approach of night that is to say, upon the withdrawal of light the leaf falls of itself into the same state without any special irritation This kind of irritability is by no means confined to the *Mimosa pudica*, on the contrary, some other species of the same genus, as the *M dormiens*, *sensitiva casta*, *arenaria pectinata* &c possess the same property as is indicated by their names And in the Leguminous order, it is also found beyond the genus *Mimosa*, as in the *Hedysarum gyrans*, whose three leaflets are in a continual state of dancing or balancing during the day In fact the folding their leaves at night, which is universal in all the compound-leaved species of this order, [illegible] Nor is such irritability confined to this order, the ternate and pinnate leaved species of *Oxalis*, the *Diandra muscipula*, and numerous others [illegible]

SENSUALISM [illegible] that theory which resolves all our mental acts and intellectual powers into various modifications of mere sensation The best known, and the most elaborate attempt of this kind which has been made in modern times, is that of Condillac, who conceived that he was following out the principles of Locke into their legitimate consequences For this belief it cannot be denied that there exists at least plausible ground Locke does indeed draw a distinction between sensation and reflection, as separate sources of "ideas," but his account of reflection is so vague and its existence appears so unphilosophical a supposition as to justify the attempt to reduce it to mere revived sensation The writings of Condillac may be regarded as a fair *reductio ad absurdum* of the theory which attempts to explain the existence of our mental phenomena independently of conditions in the mind itself The theory opposed to sensualism is called *intellectualism*

SENTENCE In English Law the decree or judgment [illegible] of a convicted person

SENTRY (It *I perceive*) The name given to a soldier when placed on guard In all the countries of Europe, sentries are relieved every two hours

SE'NZA (It *without*), in Music, signifies without, as *senza stromenti*, without instruments, *con è senza violini*, with and without violins

SE'PALS The divisions of that portion of a flower called the *calyx*

SE'PARATISTS A religious sect which originated in Dublin about the year 1803 Their principle like that of most sects at their commencement, was to return more nearly to what they conceived to be the primitive form of Christianity There is nothing very peculiar in their tenets, beyond their withdrawal from the fellowship of other Christian bodies In the year 1833 an act of parliament was passed for their relief in the matter of oaths

SE'PARATISTS, or MOTAZALITES The name of one of the chief heretical sects of the Mohammedans They were the followers of Wasel Ebn Orta who dissented from the main body of the Mohammedans about the 40th year of the Hegira Their leading tenets consisted in rejecting the eternal attributes of God, in denying the great doctrine of predestination, so zealously cherished by all the orthodox Mussulmans, and in asserting the free agency of man This sect is said to have been the first inventors of scholastic divinity, and are subdivided into several inferior sects, which mutually brand one another as infidels (*Sale's Koran* Preliminary Discourse, vol i p 212) The great opponents of the Separatists were the Sefatians who maintained the eternal attributes of God (hence they were called *Sefati*, or Attributists), but who afterwards adopted a belief in the outward resemblance of God to created beings This sect was afterwards subdivided into various sects, the chief of which were the Asharians Moshabbehites Kerammians, Jabarians, and Morgians for an account of which the reader is referred to the *Preliminary Discourse* above mentioned

SEPIA In the Fine Arts a species of pigment prepared from a black juice secreted by certain glands of the *sepia* or cuttlefish which the animal ejects both to darken the water when it is pursued, and as a direct means of annoyance That this juice was used as ink by the ancients is well known

> Tunc queritur, crassus calamo quod pendeat humor,
>
> [illegible]
>
> *Pers* Sat III

Compare Pliny (*Nat Hist* l ii c 29) where he says that it was the property of this fish when it was enclosed by a net to shed a black juice, which so darkened the water that the fisherman could not see it All the varieties of the sepia yield this juice, but the *Sepia officinalis* which is so common in the Mediterranean, is chiefly sought after, from the profusion of colour which it affords It is insoluble in water, but is extremely diffusible through it and is very slowly deposited When prepared with caustic lye, it forms a beautiful brown colour with a fine grain, and has given name to a species of drawing now extensively cultivated for landscapes and other branches of the fine arts The honour of the invention of the sepia drawing is due to Professor Seidelmann of Dresden, who discovered it at Rome in 1777

SEPIADÆ (Gr σηπια) Cuttle fish tribe The name of the family of Decapodous Dibranchiate Cephalopods of which the cuttle fish (*Sepia officinalis*) is the type They are characterized by the [illegible] of a shell, in the form of a friable calcareous plate, imbedded in the back part of the mantle, and of which the mate[illegible]

SEPIOLA (Lat sepia, *a cuttle fish*) The name of a genus of Decapodous Dibranchiate Cephalopods, of which the species are of small size, and are characterized by short, rounded, advanced subdorsal fins, and a short internal horny style

**SE'PIUM.** The bone or internal shell of the cuttle-fish

**SE'POY** (A corruption of the Indian word sipahi, *soldier*) The designation of the native troops in the service of the East India Company They were so called as early as 1708 (see *Mill's British India*, book iv ch 1), although at that period they do not seem to have been as yet disciplined in the European fashion, nor, indeed, until long after other European powers had set the example (See the *United Service Journal* for 1836 vol i p 461, where there is a valuable paper on the "History and Character of the Indian Army") The first Sepoys (says the author) who were raised and regularly disciplined by the English, seem to have been carefully chosen either from among the Mohammedan portion of the population, or from among the higher castes of Hindoos, a considerable proportion of the latter being Rajpoots the most warlike of Indian races But the necessities of the service have subsequently introduced a greater mixture in their ranks The character of the Sepoys as soldiers has been the subject of much discussion According to a writer in the same periodical (1831, vol iii p 3) "the Sepoys have justly been celebrated for excellent qualities as for instance patience and fortitude under difficulties and privations But on the other hand, if we analyze the account of the wars in which they have been employed, we shall find that they seem to possess passive rather than active courage, for instance that in line they will remain steady under fire in a broken or close country, however where skirmishers and small detachments are necessarily most employed they are found w[illegible] Officers however disagree even from this [illegible] At all events their fidelity and respect for their officers have generally been found of the highest and most durable character, the famous mutinies of Vellore in 1806 and Barrackpore in 1824 having been both, it is generally thought provoked by the mismanagement of their superiors Some indeed allege that these qualities received a severe shock in 1796, when a considerable alteration was made in the organization of the Indian army and a larger proportion of British officers introduced so that the internal economy of their battalions ceased to be superintended by their own subadars The Sepoys of Madras says Sir J Malcolm (*Quarterly Rev* vol xviii) still remember with pride the campaigns of Clive and Coote which are far beyond the memory of the present generation The native Indian cannot rise higher than the rank of ensign or cornet The native cavalry is of more recent introduction and seems scarcely to merit the praise of steadiness which all agree in bestowing on the infantry (See also *Williams's Indian Army*, Alison *Hist of the Revolution* chap li Sir J Malcolm's *Political History of India*, vol ii chap x)

**SEPS** (Lat *a species of serpent*) The name of a genus of Saurian reptiles which have a long round serpentiform body and four very short legs each terminated in the common seps (*Seps chalcides*) by only three toes

**SEPTA'RIA** Nodules of indurated and slightly ferruginous marl with interior fissures generally filled with some crystallized mineral such as carbonate of lime quartz, sulphate of baryta, &c thus dividing the section of the nodule into *septa* or distinct partitions When calcined and reduced to powder these septaria furnish the valuable mortar called *Roman* or *Parker's cement*, which has the property of hardening under water

**SEPTE'MBER** (Lat septem, *seven*) so called from its being the seventh month in the Roman year as established by Romulus, which began with March is the ninth month in the calendar of Numa Several of the Roman emperors gave names to this month in honour of themselves, but, unlike the month of August whose ancient name of Sextilis has been quite merged in that of Augustus the name of September has outlived every other [illegible]

**SEPTEMBRISTS** The name given to the agents in the dreadful massacre which took place in Paris on September 2 1792 during the French Revolution The numbers that perished in this massacre have been variously given but the term has become proverbial throughout Europe for all that is bloodthirsty and malignant in human nature

**SEPTE'MVIRI EPULONUM** Certain priests in ancient Rome were so called, whose duty consisted in preparing the sacred feasts at games, processions, and on other solemn occasions They were assistants to the *pontifices*, certain of whose privileges, such as the right of [illegible] enjoyed Their office was [illegible] at first they were only three in number, which was increased to seven, it is supposed, by Sylla

**SE'PTIC** (Gr σηπτος, *putrid*) A term applied by the old chemists and physiologists to certain substances supposed to promote putrefaction

**SEPTUAGE'SIMA** (Lat *seventieth*) In the Ecclesiastical Calendar, the third Sunday before Lent, the first Sunday in Lent being termed Quadragesima (fortieth), the three preceding ones Septuagesima, Sexagesima and Quinquagesima

**SEPTUAGINT** (Lat *seventy*) The Greek translation of the Old Testament made at Alexandria for the advantage of the Jews of Egypt who had lost the use of the Hebrew language According to the old tradition, this version was the work of [illegible] who were shut up in [illegible] Ptolemy Philadelphus, and there completed the whole translation alone, in which, upon examination they were all found to agree to a letter,—a prodigy which established the inspiration of the work It is supposed, however, by modern critics, that this version of the several books is the work not only of different hands, but of separate times, although the general design may have been that which we have mentioned The authority of the Septuagint, as compared with the Hebrew text, from which it differs in many points, has been the subject of much controversy It is from this version that the authenticity of the Apocrypha which are not found in the Hebrew is asserted by Roman Catholic writers The quotations of the Old Testament which are found in the New are for the most part given in the words of the [illegible] (See *Prideaux Connection*)

**SEPTUM** (Lat *a partition*) In Botany, any partition separating a body into two or more cells in a direction parallel with the longer axis Partitions parallel with the shorter axis are called *phragmata*

**SEPTUM** In Anatomy the plate or wall which separates from each other two adjoining cavities, as the septum transversum, or diaphragm, between the chest and the abdomen, the septum narium, between the two nasal passages, the septum ventriculosum in the brain, and in the heart, &c The partitions of chambered shells are also called *septa*

**SE'PULCHRE** *See* TOMB

**SE'PULCHRE, SAINT, HOSPITALLERS OF** An order of knighthood, originally instituted in Palestine, afterwards established in France by Louis VII, and united by Pope Innocent VIII to that of Malta, but the order still continued to exist in France, and was taken under protection by Louis XVIII in 1814

**SE'PULCHRE RITES OF** (Lat sepelio, *I bury*), signify literally the ceremonies performed in depositing the bodies of the dead *in the earth*, but the expression is applied in a more extended signification to all ceremonies of this kind whether they consist in *interment*, *incremation* or *embalming* A veneration for the dead has characterized the history of every age and country, and the different kinds of funeral rites that prevail among different nations are intimately connected with their religious feelings, and form important testimonies at once of their modes of thinking and degrees of civilization The three chief modes of treating the dead that have prevailed from the earliest ages down to the present times are burning interment, and embalming*, and all these modes were accompanied by ceremonies differing according to the genius or taste of the different people but bearing in [illegible] such strong features of resemblance as seem clearly to indicate the universality of the feeling which led to their adoption The peculiar solemnities of the Greeks and Romans, among whom both incremation and interment prevailed though the former was by far the most frequent, need not be detailed in this place Among the Romans, the importance of burial to the dead may be gathered from the belief, that the souls of the unburied wandered a hundred years on the borders of the Styx before they were admitted to the infernal regions The practice, peculiar to the Egyptians of embalming their dead, has been noticed under MUMMY, and the custom still prevalent in India—which it may be truly said monopolizes the cruelties of funereal observances—of immolating women on the funeral pile of their husbands, will be found under SUTTEE The practice of interment has been adopted by all the nations that have embraced Christianity See CEMETERY

[illegible]

**SEQUESTRATION** [illegible] execution for debt in the case of a beneficed clergyman, issued by the bishop of the diocese on the receipt of a writ to that effect The profits of the benefice are paid over to the creditor until his claim is satisfied *Sequestration* is also, in Chancery, the setting aside from both parties the matter in controversy

**SEQUESTRATION** In Scottish Law—1. A species of diligence (i e a process), used where two or more creditors are in competition for the property of a land estate, the

* The singular usage adopted by the followers of Zoroaster and still preserved in Thibet, is worthy of [illegible] from an idea that the pure elements of earth and fire would be contaminated by being made the instruments of dissolution, the corpse is laid upon a [illegible] and enclosed within massy walls and towers to the wolves and the vultures (*Schlegel's History of Literature*)

owner of which is in insolvent circumstances, or where the right to a land estate is the subject of litigation In these cases the court may, on application, sequestrate the rents, and employ a factor to collect them 2. Sequestration is also the process whereby the whole estate both heritable and moveable, of a bankrupt, is distributed equitably amongst his creditors It is granted on application to the court of session by the bankrupt, with the concurrence of one or more creditors, or on their application, and on citation of the bankrupt, and is analogous to a fiat in bankruptcy in English law

SE'QUIN (Ital zecchino, derived from zecca, *a mint*) The gold pieces of Venice were originally so called, afterwards the name was extended to other gold coins in use in the Mediterranean, as those of the Pope, the Sultan Florence, and Genoa *See* MONEY

SERAGLIO An Italian corruption of the oriental word *serai* The palace of the Turkish sultan in Constantinople is thus designated by European writers "The principal gate of the seraglio is the Bab Humayun, or Sublime Gate whence the ordinary title of the Turkish government is derived

SERAPHIM or ILLUS ORDER OF THE An ancient Swedish order of knighthood instituted in 1334, but dormant from the period of the Reformation until 1748 The number of knights besides the king and members of the royal family is limited to twenty four

SE'RAPHINE A keyed musical wind instrument of the organ species adapted to the size of a chamber

SE'RAPHIS or SERAPHIM (Heb *to purify*) In the Celestial Hierarchy, the angels of the highest rank They are represented as surrounding the throne of God, whose messengers they are and being more immediately inspired with the Divine love which they communicate to the inferior inhabitants of heaven They are almost invariably spoken of in connection with the *cherubim* whom they resemble both in rank and attributes

SERA'PIS An Egyptian deity The image and worship of this god were brought from Sinope in Pontus to Alexandria, in the last year of Ptolemy Soter, in consequence, it is said, of a vision of Ptolemy I According to some accounts this image was a statue of Jupiter, but however this may have been, Serapis was clearly as Sir G Wilkinson expresses it (*Anc Egypt* iv 360) 'at most a Græco-Egyptian deity' And there is no foundation for the notion entertained by some early Christian fathers, that he represented the Patriarch Joseph (which they supported by an argument drawn from the ornament in the shape of a bushel which the images of this god usually bore on the head), or for that of some modern antiquaries that it was another name for Apis (*Plut de Is et Osir Quart Rev*, July, 1840)

SE'RASQUIER The name given by the Turks to the commanders in chief of the [illegible] compounded 'two Persian words signifying [illegible] *chief of the head*'

SERENA'DE (Span *serena*, [illegible] *clear, serene*) [illegible] air on a *serene* evening but it is now universally applied to a musical performance made by gentlemen in a spirit of gallantry under the windows of ladies whom they admire This practice, which was formerly very general in Spain and Italy has latterly fallen greatly into disuse in these countries, but it is still very common in the German university towns where the students are in the habit of assembling in the evening under the windows of a favourite professor, and offering him a musical tribute

SERENE SERENE HIGHNESS, SERENITY (Germ durchlaucht) Title of courtesy in European etiquette of considerable antiquity Before the dissolution of the German empire Serene and Most Serene Highness were the appropriate addresses of princely houses holding immediately of the empire Since that period the rules of princely etiquette have become more uncertain, but it appears to be the general principle that these titles belong of right to members of the families of sovereign houses in the confederacy and also to members of ci-devant sovereign houses *now mediatized*, and that sovereign princes can moreover concede these appellations to princes not sovereign within their own dominions, but not so as to give them a title to it out of them But the distinctions as to the mode in which these titles are to be employed in addressing superiors, equals and inferiors are extremely complicated

SERF (Lat *servus*) The French name for the lowest class of slaves in the dark ages those who were incapable of holding property attached to the land and liable to feudal services of the lowest description In England this appears to have been the general character of the condition of the *villeins*; but in France and Germany Mr Hallam thinks that the villeins, properly so called, were a superior class, only bound to fixed payments and duties in respect of their land (*Middle Ages*, chap. ii part 2 *See* VILLEIN) The emancipation of this class in France was extremely gradual Louis Hutin enfranchised [illegible] by edict in 1315; but it does [illegible] immediately into execution, and a limited kind of servitude existed in some places down to the Revolution The "serfs," or "gens de main morte" on some estates (*e g* in part of Champagne and Nivernois), could not leave their habitations, and might be followed by the lord in any part of France for the *taille*, or villein tax, which in some localities was not permanent but *a volonté* (See, as to the [illegible] a memoir by Duprey, *Hist de la Serf*

SERGE A thick woollen, extensively manufactured in Devonshire and other English counties

SERGEANT *See* SERJEANT

SERIES (Lat *order*), in Arithmetic and Algebra, is a progression of numbers or quantities which succeed each other according to some determinate law Thus, the progression of the natural numbers 1, 2, 3 4, 5, &c constitutes a series, the law of which is, that any term is greater by unity than the preceding As the law which connects the terms may be varied in an infinite number of ways, it follows that series may have an infinite number of different forms thus, an *arithmetical* series is one in which each term differs from the preceding by a constant number or quantity, a [illegible] in which each term is a multiple [illegible] constant factor

The usual form of a series is a set of terms connected by the signs + or — When the number of terms is greater than any assignable number, the series is said to be *infinite*

A *converging series* is one in which the successive terms become less and less, each being smaller than that which immediately precedes it

A *diverging series* is one in which any term is greater than the preceding

A *recurring series* is one in which each term is a certain constant function of two or more of the preceding terms Thus $1 + 3x + 4x^2 + 7x^3 + 11x^4 +$ &c, is a recurring series every term being formed in the same manner from the two immediately preceding This series is formed by the expansion by division of the algebraic fraction $\frac{1 + 2x}{1 - x - x^2}$

An *exponential series* is one whose terms depend on exponential quantities [illegible] *logarithmic series* is one whose terms depend on logarithms and a *circular series* one whose terms depend on circular functions, as sines, cosines &c

The *general term* of a series is a function of some indeterminate quantity $x$ which, on substituting successively the numbers 1, 2, 3, &c for $x$, produces the terms of the series

In general the principal questions which arise respecting series are to find the sum of all the terms, or of a given number of them, and the exposition of the methods which have been invented for this purpose forms an extensive and important part of every treatise on the calculus The student may be recommended in particular to Euler's *Introductio in Analysin Infinitorum*, and *Calculus Differentialis*, and the third volume of Lacroix's *Calcul Differentiel et Integral*

SERJEANT (Lat *servientes*) Serjeant at law is the highest degree in the common law, and all must proceed through this degree before attaining the dignity of judge The Court of Common Pleas is open to serjeants only for the purpose of pleading This exclusive privilege was attempted to be taken away in 1834, and for five years the court was thrown open But after solemn argument it was decided by the privy council that this enlargement was unwarranted, and the former practice again prevails Serjeants at law are now made by the king's writ commanding them to take their degree No precise time seems now necessary to permit a barrister to become a serjeant (See Serjeant Manning's learned work *Servientes ad Legem*)

SERJEANT In the Army a non commissioned officer, both in infantry and cavalry regiments whose duty it is to form the ranks and to instruct recruits in discipline On parade they act as fuglemen, in going through the evolutions The serjeant-major is a non-commissioned officer who acts as assistant to the adjutant, but originally he was a field officer, corresponding in rank to the modern major Colour-serjeants are certain non-commissioned officers appointed to attend the officers who have charge of the colours of the regiment

SERJEANT, KING'S One or more of the serjeants-at law, whose presumed duty is to plead for the king in cases [illegible] as indictments for treason, &c

SERJEANTS-AT-ARMS Officers whose duty is to attend the person of the king, the lord-high-steward when sitting in judgment on a traitor, &c The whole [illegible] (13 R 2) to thirty. [illegible] belonging to attend at the houses of parliament during their sittings, and each has a deputy In the House of Lords, the practical maintenance of decorum below the bar, near the throne, and in the gallery, devolves upon the gentleman and

yeoman usher, with their assistants; so that "the serjeant at arms attending the House of Lords" has less responsible duties to perform than those which devolve upon "the serjeant attending the House of Commons" both, however, execute the commands of the house to which they belong, as regards the apprehension or custody of all persons committed by order of parliament In the House of Commons, the serjeant-at-arms is an officer of considerable importance, enjoying large emoluments, assisted by a deputy and several subordinate officers During the sittings of the house he occupies a chair below the bar, and he directs a large proportion of the arrangements connected with the maintenance of order in the approaches to the house and the offices adjacent He is at once the executive and the ceremonial officer of the lower house, but his discretionary powers are not extensive, for almost all his more important duties are performed under the immediate direction of the house itself, communicated through the speaker The office is usually held by a gentleman of the military profession, seldom under the rank of a field officer

SERJEANTY, GRAND AND PETTY In English Law, feudal tenures Tenure by grand serjeanty was where the tenant held land of the king by service, to be performed in his own person, in his wars, &c, such as to bear a banner or spear, or to assist at his coronation Tenure by petit serjeanty was where the owner was bound to contribute some small thing towards military service, &c, such as a sword, dagger, bow, or spear Tenure by grand serjeanty was preserved by stat 12 C 2 which abolished the other feudal tenures and still subsists in some cases, as, for instance the family of Dymoke hold the lands of Scrivelsby by the service of attending as champions at royal coronations

SERMON In Ecclesiastical usage The use of the sermon or homily as a portion of the communion service is said to be of remote antiquity This ancient custom fell into partial disuse during a great part of the middle ages The Homilies of Ælfric, archbishop of Canterbury in the 10th century were long used in the English church, but these became antiquated, and in the year 1281, says Mr Palmer (*Orig Liturg* vol ii ch 4) preaching seems to have been generally omitted In that year Archbishop Peckham ordered in his Constitutions, that four sermons should be delivered during the year But for some time prior to the Reformation preaching was again coming more into use and the publication of homilies by authority seems to have completely restored the ancient practice See HOMILY

SERON A buffalo's hide, used for packing drugs and other articles

SERO'SITY (Lat serum) The liquid which exudes from the serum of the blood when it is coagulated by heat It is water holding some of the salts of the blood and a trace of albumen in solution

SE'RPENS or SERPENS OPHIUCHI In Astronomy, one of the ancient constellations in the northern hemisphere

SERPENT In *Zoology*, a general name for the species of the order *Ophidia*

Serpents are divided into spurious or *Pseudophidians* and true or *Ophidians* proper The *Pseudophidians*, although presenting the well marked external characters of the order, retain an imperfect pelvis a small sternum scapulæ, and coracoids or clavicles, hidden beneath the skin, whereby, as well as in the structure of the skull, they approach the Saurian order The common blind worm (*Anguis fragilis*) is a native representative of the *Pseudophidian* family

The true serpents have neither sternum nor vestige of the scapular arch they have no third eyelid nor tympanum, but the auditory ossicle exists beneath the skin, and its handle passes behind the tympanic bone Several species retain a vestige of hind-limbs, which in some even shows itself externally in the form of a small hook The chief subdivisions of the true *Ophidians* are — the *Amphisbænæ*, the *Typhlopes*, the *Roles* (*Tortrix*), the *Boas*, the *Pythons*, the *Coluberes*, the *Acrochords*, — all which tribes are non-venomous The *Pseudoboas*, *Rattlesnakes Trigonocephali* and *Vipers* are the venomous tribes, and are distinguished by having the superior maxillary bones short and moveable supporting fewer teeth than in the non venomous serpents, and having the first of the short series larger than the rest, sometimes the only conspicuous fang, and traversed by the duct of a poison-gland, around which duct the tooth is, as it were longitudinally folded, so as to appear perforated by a canal The last tribe of true serpents includes the *Hydrophides*, or sea snakes, which have likewise a poison-gland and duct, the latter being inclosed by the last instead of the first of the maxillary series of teeth The tail of the sea-snakes is flattened vertically, and forms their chief organ of swimming No species of this family has yet been discovered which exceeds seven feet in length

The remains of an extinct genus of serpents (*Palæophis*), indicating species of from ten to twenty feet in length, have been discovered in the Eocene tertiary formations in Suffolk Kent and Sussex (See Mr Owen's Paper in the *Geological Transactions*, 2d Series, vol vi p 209)

In antiquity the serpent played an important part By some nations it was regarded as the emblem of cunning, deceit, and wickedness (compare the narration of the fall of man in Genesis with the Persian saga of Ahreman and Ormuzd), by others, such as the Egyptians and Phœnicians, it was looked upon as a good genius (*αγαθοδαιμων*), and worshipped as the emblem of fertility, while by the Greeks and Romans, whose mythology originated undoubtedly from Egypt and the East, it appeared under a variety of symbolic representations With the latter the serpent was the well known emblem of the healing art, and in the present time a serpent with its tail in its mouth is regarded as an emblem of eternity The serpent appears also to have held a place in the Scandinavian mythology, where it was regarded as a symbol of the human passions In the early ages of the Christian church, a sect of the Gnostics, also worshipped the serpent whence they were called Ophites from Gr *οφις*, *a serpent* (See *Mosheim's Geschichte der Schlangenbrüder der ersten Kirche*)

SERPENT (So called from its form) A musical brass wind instrument, serving as bass to the horns or cornets It is most generally covered with leather, and has three parts, — a mouth piece, neck, and tail The compass is two octaves, produced by six holes stopped with the fingers

SERPENTARIUS One of the ancient northern constellations, represented on the globes by the figure of a man grasping a serpent (*serpens*) in his hand *See* CONSTELLATION

SERPENTINE A magnesian rock of various colours, and often speckled like a serpent's back *See* GEOLOGY

SERPIGO *See* RINGWORM

SERPULIANS *Serpulæ* (Lat serpo, *I creep*) The name of a family of Cephalobranchiate Anellidans, inhabiting cylindrical and tortuous calcareous tubes, generally parasitic on shells

SERRATE (Lat serra, *a saw*) In Zoology, when a part is cut into teeth like a saw, or is armed with teeth whose sides are unequal

SERRICORNS, *Serricornes* (Lat serra, *a saw*, cornu *a horn*) The name of a family of Coleopterous insects, comprehending those which have serrated or saw-shaped antennæ

SERTULA'RIA (Lat sertum, *a wreath*) The name of a genus of compound tubular Polypes, restricted, in modern zoology to those species in which the cells are arranged on two sides of the stem, either opposite or alternate

SERUM (Lat) The fluid which separates from blood [illegible] *See* BLOOD

SERVANT [illegible] the [illegible] in the [illegible] [illegible] vocate [illegible] following years

SERVITES (Servants of the blessed Virgin) A religious order instituted in Tuscany in A D 1233, under the rule of St Augustin The monks wore a black habit, in commemoration of the widowhood of the Virgin (*Mosheim* cent xiii part 2)

SERVITOR (Lat) An undergraduate who is partly supported by the college funds is so called at Oxford The servitors at Oxford are the same class as the sizars at Cambridge

SERVITUDE in the Civil Law, is divided into real or predial mixed, and personal the first being the subjection of an inheritable thing to certain duties or services towards another inheritable thing, the second, that of an inheritable thing towards a person, the third, that of a person towards a person or thing, *i e* slavery, whether by dependence on a person or on the soil The word *servitude* is equally applicable to the duty or burden, and to the right of exacting it [illegible] enjoys on the land of B, and [illegible] to permit that right to be exercised, are both designated by the term *servitude*, the first active the latter passive Real servitudes are numerous, and fall into several classes or divisions They are for example either *visible*, such as the right to light and air, sewers, &c, or *latent*, such as the right of way right of drawing water, &c, which appear only when they are exercised They were also divided by the Romans into urban, which affected dwellings in the city, and rustic, appertaining to land and farm building Of mixed servitudes only three species were recognized by their writers on jurisprudence — usufruct, use and habitation

SESAMOID BONES (Gr *σησαμον a seed or grain*, and *ειδος, form*) Small bones found at the articulations of the great toes, and occasionally at the joints of the thumbs Little tendinous ossifications are sometimes met with in other parts, especially in the advanced age of laborious persons

**SE'SAMUM.** (Gr *σησαμον.*) A genus of plants of the natural family *Pedaliæ* They are supposed originally to have been natives of India, but are now cultivated in many countries Their seeds, which are employed as an article of diet, and yield an oil of a very fine quality, form an extensive article of commerce in the East All the species are annuals The term *sesame* has long been familiar to all the readers of the *Arabian Nights' Entertainments*

SESIA (Gr *σης a moth*) The name of a genus of Lepidopterous insects

SESQUI, Lat, applied to words, signifies one integer and a half, as sesqui granum, *a grain and a half*, &c In Chemistry this term is used to designate compounds in which an equivalent and a half of one substance are combined with one of another, thus sesquicarbonate of soda is a salt composed of one equivalent and a half of carbonic acid with one of soda

SESQUI In Music, a whole and a half, which joined with *altera*, *terza*, *quarta* &c, is much used in the Italian music to express a set of ratios, particularly the several species of triple time

SESQUI In Geometry, the expression of a ratio in which the greater term contains the [illegible] a certain aliquot part of the less over [illegible] remaining is half the less term, the ratio is called *sesquialtera*, if the [illegible] be a third of the less term (as in the [illegible] ratio is called *sesquitertia*, and so on These terms are nearly obsolete *Sesquiduplicate*, however, sometimes occurs in modern treatises, and signifies the ratio in which the greater term is twice and a half times the less, as the ratio of 10 to 4, or of 15 to 6

SESSILIS (Lat *sedeo, I sit*) The name of a division of [illegible] comprehending those species which are not suspended by a pedicle

**SE'SSION COURT OF** The supreme civil court of Scotland having jurisdiction in all [illegible] whatever nature It was constituted by the Scottish parliament in 1537 It was intended to supply place of [illegible] especially of [illegible] the lords of session, who [illegible] the titles of the judges Originally it consisted of seven laymen and eight churchmen, including the president In 1640 however, an act was passed providing for the exclusion of churchmen from the court, and though repealed in 1661, the principle laid down in it has ever since been acted upon Other important improvements were introduced at different periods, particularly after the Revolution, when the right of appeal from the court to parliament was, for the first time recognized At the Union power was given to all individuals who considered themselves aggrieved by judgments of the Court of Session to appeal to the H of Lords, and it is a curious fact that at this moment, and for a lengthened period the principal judicial business of the H of Lords has consisted in hearing [illegible] cotch appeals Originally and down to [illegible] fifteen judges sat together in the court but in that year an act was passed dividing the court into two chambers, the lord president presiding in the first division of seven judges, and the lord justice-clerk in the second of six, the two remaining judges trying cases in the first instance, or, as it is technically termed sitting as lords ordinary Since then the number of judges has been reduced to thirteen, four belonging to each of the divisions, and five acting as lords-ordinary The judges were at first chosen by the Scotch parliament, but since 1554 they have been appointed by the crown They are either, as already stated, called lords of session, or senators of the college of justice, which last embraces the whole body of barristers (advocates) and attorneys or solicitors who practise before the court They must be twenty-five years of age and by the Treaty of Union, no person can be named to the office unless he have served as an advocate or principal clerk of session for five years, or as a writer to the signet for ten The salaries of the ordinary judges have recently been raised to 3000*l* a year each, those of the lord justice-clerk and lord president being respectively 4000*l* and 4500*l*

[illegible] the Court of Session [illegible] as a standing or perpetual jury [illegible] introduction of petty juries into the trial of civil cases in Scotland being only of very recent date, as well as of limited application It was, in fact, unknown till 1815, when a special or jury court was instituted, for the trial of cases involving questions as to the value of property, or damages, or the determination of some fact But in 1830 this court was suppressed, and the Court of Session now avails itself of the assistance of petty juries in the trial of the above description of cases *See* JUSTICIARY, COURT OF

**SE'SSION OF PARLIAMENT** The period between its meeting and prorogation All the acts passed in a session are legally considered as forming a single statute, each separate act being designated as a chapter, and its subdivisions as sections *See* PARLIAMENT

**SESSIONS OF THE PEACE** In English Law, the term "Session of the Peace" is applied to designate a sitting of justices of the peace for the execution of those duties which are confided to them by their commission, and by charter or statute Such are, — 1 A petty (or petit) session, which is a private meeting of two or more justices of the peace for the execution of some power vested in them by law, many acts of parliament requiring the concurrence of a plurality of justices, and there being other occasions on which, although not strictly necessary it is considered usual and expedient One of the most important instances of the first kind is the holding parties to bail against whom a charge of felony has been entertained 2 A special session, which is principally distinguished from the former by being public, instead of on the private motion of the justices it being necessary that notice should be given to every magistrate of the division Special sessions are held to grant licences execute the provisions of the Highway Act appoint overseers of the poor, and for many other purposes 3 Quarter sessions (See that article; and see JUSTICE OF THE PEACE)

**SESTE'RTIUM** (Contracted from mille sestertiorum) The sum of 1000 sestertii, usually estimated at about 8*l* English

**SESTE'RTIUS** A sesterce, a Roman silver coin, equal in value to two *asses* and a half, or nearly twopence of English money

**SE'TA** (Lat) is a term used by botanists in various senses It is the stalk [illegible] capsule, or sporangium of mosses, [illegible] of grasses, when it proceeds from the extreme point of a palea or glume, sometimes the glandular aculeus of roses, and also the abortive stamens or rudimentary perianth of Cyperaceous plants

**SETACEOUS** (Lat seta) In Entomology, the antennæ which resemble a bristle are so called

**SE'T FAIR** In Architecture, the coat of plaster used after roughing in and floated, or pricked up and floated It should be well trowelled, to answer well for colour

**SETHIANS** In Ecclesiastical history, a sect of Christian heretics who sprung up in Egypt in the second century, strongly imbued with the principles of Gnosticism, but whose chief peculiarity consisted in their belief in the identity of Jesus Christ with Seth the son of Adam, whence they derived their name They continued to exist about 200 years, during which period they had many followers

**SE'TICERS,** *Setocera* (Lat seta, *a bristle*, Gr *κερας*, *a horn*) A term applied by Latreille to a family of Lophyropodous Crustaceans, including those in which the superior antennæ are long and setaceous

**SE'TIGERS** *Setigera* (Lat seta, *a bristle*, gero, *I carry*) The name of a tribe of Anellidans, including those which, like the earthworm, are provided with bristles for progressive motion The *Setigera* are the first tribe of the Abranchiated order of Anellidans

**SE'TIREMES** (Lat seta *a bristle*, remus, *an oar*) A name given by Kirby to the natatory legs of certain aquatic insects, which are fringed with bristles

**SE'T OFF** In Law, a species of defence to a civil action, by which a party acknowledges the justice of the plaintiff's demand but sets up a demand of his own against the plaintiff sufficient to counterbalance either the whole or a part of it

**SE'TON** (From Lat seta, *a bristle*, because bristles or horse hairs were formerly used to keep open the wound) A seton is an artificial ulcer, made by passing a skein of thread under a portion of the skin by means of an instrument called a seton needle the thread is occasionally anointed with irritating substances, in order to keep up a discharge from the sore

**SETOSE** (Lat seta, *a bristle*) In Zoology, when a surface is beset with stiff scattered hairs

**SE'TTING** In Architecture, the quality of hardening in plaster Also the laying of stones in walls or vaults

**SE'TTING COAT** In Architecture, the best sort of plastering on ceilings or walls, in inferior work it is made of *fine stuff*, and when the work is very dry a little sand is used A setting coat may be either a second coat on laying or rendering, or a third upon floating The term *Finishing* denotes the third coat, where stucco is used [illegible] where the work is for paper

**SETTLEMENT** In Law, the right which an individual [illegible] to claim relief or assistance under the statutes for the relief of the poor [illegible] parish or district to which he legally belongs, and in which he is said to have the settlement

The law of settlements has recently undergone considerable alterations by the Poor Laws Amendment Act, 4 & 5 W 4 cap 76 But that act does not, except in certain cases, take away settlements already possessed by virtue of the law as it previously stood under a great variety of enactments It is, consequently, necessary to consider in how many modes a settlement may now be legally acquired, and, also, what modes of settlement were recognized before the passing of the act in question

The first species of settlement is by birth; all persons who have not obtained a settlement elsewhere by other means being legally settled in the parish or district wherein they were born. Before the passing of the late act, bastard children were deemed to be settled in the parish where they were born: they now have, and follow, the settlement of their mother until they attain the age of sixteen, or acquire settlements in their own right 2 Settlement by parentage All legitimate children are settled in the parish where their parents are settled, until they become emancipated Emancipation takes place on attaining the age of twenty-one, if living separate from the parents, or marriage, or [illegible] settlement in the party's own right, or [illegible] other relation inconsistent with the notion of a subordinate situation in the parental family 3 Settlement by marriage A woman acquires the settlement of her husband, and after his death she retains his last settlement unless she acquires a new one for herself 4 Settlement by apprenticeship Is acquired by a person who has been bound an apprentice and has inhabited, under such apprenticeship in a town or parish, the place where he has resided the last forty days being that in which he is settled Actual service with the master is not necessary, but if he have served elsewhere, it must be with the master's permission [illegible] in the sea service or fishing trade does [illegible] recent act, confer a settlement 5 Settlement by renting a tenement A person *bonâ fide* occupying and renting a tenement, at the rent of 10*l* per annum at least, for the term of a year, the rent for a year having been actually paid (and the tenement having been actually occupied by him for a year also), acquires a settlement by dwelling forty days in the parish in which such tenement is situated Since 4 & 5 W 4, no settlement can now be acquired by renting a tenement, unless the person occupying it has been rated to and has paid the poor's rate for one year at least 6 Settlement by estate A person having, by descent or devise, &c, an estate in lands or tenements, either freehold, copyhold, or for years, acquires a settlement in the parish in which it is situate by forty days' residence But no such settlement is acquired by the purchase of an estate, unless bought for 30*l* at least, *bona fide* paid And, by the late act no person possessing such a power of acquiring a settlement shall retain it longer than he shall inhabit within ten miles of the parish 7 Settlement by being charged with and paying parish taxes and levies in respect of a tenement of the value of 10*l*, such as poor rate, church rate, or land tax These are now the only modes of acquiring a settlement but two more must be mentioned, by which a settlement could formerly be acquired, as the settlements so gained still continue in force 1 By hiring and service This could be obtained by any unmarried person lawfully hired into any parish or town for the space of a year, provided he continued in service under such hiring for the space of a year, and resided in the parish forty days 2 By executing an office This was obtained in any place by executing any public annual office

Poor people coming from one parish to another, and [illegible] in the latter, may, if [illegible] be removed by an order of two justices to that in which they were last legally settled, and all persons who think themselves aggrieved by such order of removal (usually the parish to which the removal takes place) may appeal against such order to the next general or quarter sessions of the peace It is doubtful, indeed, since the statute 4 & 5 W 4, whether any but the parish can appeal The parish appealing is bound to give sufficient notice of the intended appeal, and also (since the stat 4 & 5 W 4) to state in writing the legal grounds on which the order is contested The sessions must either quash or affirm the order of the justices, and the order of the sessions can only be quashed by the Court of King's Bench, either on a special case, granted by the sessions, for the reference of a point of law to the superior court, or on certiorari, for [illegible] he order

A *certificate* [illegible] by the churchwardens and overseers, that a particular person is legally settled in their parish A certificate-man cannot gain a settlement in the parish to which the certificate is directed, except by renting a tenement of the annual value of 10*l* See POOR LAWS

SETTLEMENT, ACT OF In English History, the statute 12 & 13 W 3 c 2, by which the crown was limited to the Princess Sophia, duchess dowager of Hanover (youngest daughter of Elizabeth, queen of Bohemia, who was daughter to James I), and the heirs of her body being Protestants,—on the failure of issue of the Princess Anne and next in succession The duchess [illegible] and her son, George I, [illegible] throne

SHELF In Architecture the horizontal projection [illegible] where the thickness of [illegible] stories

SE'VENTH. In Music, an interval, whereof there are four species First, the defective seventh, consisting of three tones and three greater semitones. Second, the minor seventh consisting of seven degrees and six intervals diatonically taken, four being tones and the rest greater semitones Third the major seventh being only a major semitone less than the octave Fourth the extreme sharp seventh, which is only a comma less than the octave

SEVEN YEARS' WAR In History a war carried on in Germany between two alliances, headed respectively by Austria and Prussia, from the year 1756 to 1763, when it was ended [illegible] signalized chiefly [illegible] of Frederick II [illegible] principal ally throughout the struggle was England, while he was, at one period, assailed by the forces of Austria, France, the Empire, Sweden, and Russia When the forces of the Prussian sovereign had been almost annihilated by this coalition, the death of the Russian empress, Elizabeth, caused the withdrawal of Russia from the alliance of his enemies, and thus brought about the termination of the war without material advantages gained by any party

SEWER In Architecture, a subterraneous conduit, or channel, to receive and carry off the superfluous water and filth of cities The sewers of Rome have been the models of those of the modern cities of Europe They are as old as the elder Tarquin The *cloaca* had, between the Quirinal, Capitoline and Palatine hills, many branches, which joining in the Forum, now the Campo Vaccino, were received for conveyance into the Tiber by a larger one, called the *cloaca maxima* It must be admitted, however, that it is erroneous to designate the Roman cloacæ by the term sewers They were rather drains made to carry off the stagnant water of the pestilential marshes which occupied much of the low ground near the Tiber, and the spaces between the Aventine, Palatine and Capitoline hills The height and width of the cloaca maxima are equal, each measuring 13½ feet

SEXAGE'SIMA (Lat *sixtieth*) In the Calendar, the eighth Sunday (nearly sixty days) before Easter

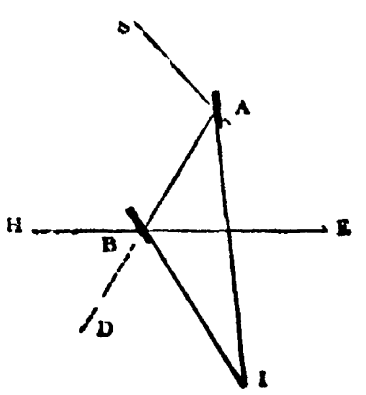
SEXAGE'SIMAL ARITHMETIC A method of computation proceeding by sixties (as the common arithmetic proceeds by tens), and used by the ancient Greek astronomers for facilitating arithmetical calculations, particularly division and the extraction of roots, operations which when performed on numbers expressed by the complicated Greek notation are attended with great [illegible]

SEXAGESIMAL FRACTIONS, are such as have 60, or some multiple of 60, for their denominator Fractions of this kind were anciently the only fractions used in astronomy, and they are still retained in the division of the circle, and of time, where the degree, or hour, is divided into 60 minutes, the minute into 60 seconds, and so on

SE'XTANS, or SEXTANT In Astronomy, one of the constellations formed by Hevelius It is placed across the equator, and on the south side of the ecliptic

SE'XTANT (Lat sextans, *the sixth part*, the limb of the instrument being the sixth part of a complete circle) An instrument for measuring the angular distances of objects by reflexion The sextant is capable of very general application, but it is chiefly used as a nautical instrument for measuring the altitudes of celestial objects and their apparent angular distances It is an instrument of the utmost importance in navigation

The principle of the sextant, and of reflecting instruments generally, depends upon an elementary theorem of catoptrics, viz if an object be seen by reflexion from two mirrors which are perpendicular to the same plane, the angular distance of the object from its image is dou-

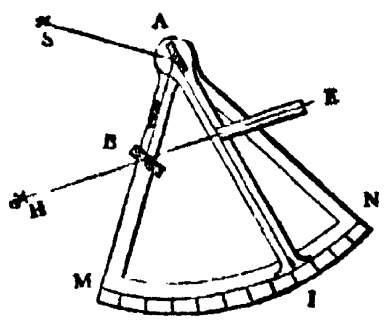



[illegible] the angle A I B, a ray of light coming from the sun and falling upon the mirror A in the direction S A, will be reflected in the line A B, and falling upon B, it will again be reflected in the direction B E Let A B be produced to D, and S A prolonged to meet B E in E [illegible] incidence and reflexion are always [illegible] we have D B E = 2 D B I, [illegible] 2 B A I, D B E = B A E + B E A, and D B I = B A I + B I A, consequently B A E + B E A = 2 B A I + 2 B I A, and therefore, since B A E = 2 B A I, we have also B I A = 2 B I A, that is to say, the angular distance between the object S and its image seen by the eye at I, in the direction E B H, is the double of the in-

clination of the mirrors It may be remarked, that the place of the image, as seen from E, is independent of the situation of the mirrors on the plane so long as the line of the intersection of their planes and their inclination to each other remain constant

From what has been now said, it may be seen that if a convenient method could be devised for measuring the inclination of two mirrors perpendicular to the same plane, when they are so placed that the image of an object S is brought to coincide with an object H seen directly we should at once have a reflecting instrument for measuring angular distances Such instruments are the *sextant*, the *quadrant* the *reflecting circle*, respectively so called from the extent of the arc which the graduated limb embraces

The contrivance adopted for this purpose in the sex-




plane of the sector of a circle A M N, and the frame of the mirror A to a radial bar A I revolving in the plane of the sector round a pin passing through the centre Both frames are generally supplied with the means of adjusting the planes of [illegible] capable of being turned by a delicate motion a small way round a pin passing through the frame of the sector

The arc or *limb* M N of the sector is graduated, and the revolving radius or *index* carries at its extremity a vernier scale, applying to the graduations on the limb, and subdividing them into such smaller portions as may be desired

The method of finding the zero point of the limb may be understood generally from the following considerations —The angle E (see the first figure) being double the angle I, it follows that when the mirrors are parallel or the angle I is nothing, the angle E is nothing also, and S and its image will appear as one object, the one exactly covering the other It is therefore only necessary to turn round the radial bar which carries A till the image of a distant object seen by reflexion from B is in accurate conjunction with the object itself, seen directly and the point on the limb at which the index then stands is the zero point of the arc If it is not also the zero of the numbered graduations, its distance from the numeral zero is called the *index* error of the instrument, and is to be applied as a correction [illegible] In general the [illegible] marked is when [illegible], so that the angle read from the instrument is not the inclination of the mirrors, but the distance of the object from its image In this class of instruments therefore 90° are indicated by an arc of 45° 120° by an arc of 60°, &c

The mirror A is completely silvered behind, but B is silvered on that half only which is next the plane of the instrument, the upper part being left clear, that objects, such as H, may be seen *through* it, as well as the images of others, as S, by reflexion *from its surface* The mirror B is so placed by the maker that when A is parallel to it, the index which carries A either exactly or nearly corresponds with the zero of the divisions as they are numbered on the limb When the index has been set by hand nearly in the position requisite for measuring any proposed angle, it is clamped to the limb by a screw acting on a spring and moved slowly by a tangent screw till it attains accurately the required position

Such being the general principles of the instrument, we shall now briefly describe the different parts of it as constructed by the best makers, and the methods of adjusting and observing with it

The only important object to be aimed at in the frame is to combine lightness with sufficient strength The frames are generally of brass, and cast in one piece from a model, but the late Mr Troughton introduced thin double frames parallel to each other, and connected by pillars These frames are very light, but it may be doubtful whether they sufficiently fulfil the condition of strength

In all good instruments the index is strengthened by an *arc bar* [illegible] The graduations are made on a slip of [illegible] ina, which is *let in* to a groove in the [illegible] s of this kind are now all graduated by [illegible]

The frame of the [illegible] supported by three feet, one near each end of the limb, and the third at the centre, where it serves also as a sheath to cover the central pin (with its fastening screw) round which the index revolves A handle parallel to the frame is attached to the back of it, to hold the instrument by when observing

The revolving mirror A is attached by three screws to the head of the index In common instruments only two of these screws are fastening screws, and the third is used as an *adjusting* screw for placing the mirror perpendicular to the plane of the instrument But in the better class of instruments all three are *fastening* screws, the maker himself placing the mirror in its perpendicular position

The other mirror, B, is attached to the frame of the sector, and in some instruments is incapable of lateral motion being only provided with the means of placing it perpendicular to the plane of the instrument, so that the position of its plane with [illegible] be regarded as permanent [illegible] effected by a screw, which sometimes acts on the frame, and in some instruments directly on the mirror, on which it presses by means of a spring In other instruments the frame of this mirror turns round an axis passing through the frame of the instrument, so that when the index is set to zero on the limb, B can be set parallel to A and the index error, therefore, reduced to nothing This mirror B is called the *horizon glass* by seamen, and the adjustment we have been speaking of is called the *parallel adjustment* of the horizon glass It is a most important adjustment and one that requires continual attention being liable to be altered by very trifling causes

In common quadrants, a sight vane with two holes is placed [illegible] B [illegible] same distance from the [illegible] reflecting part of the mirror [illegible] the unsilvered part But the best instruments, instead of the sight vane, are furnished with telescopes, which screw into a socket attached to a piece of brass passing through the frame of the instrument, and by means of a screw the socket can be raised or depressed, so that the telescope can be placed with more or less of the object-glass opposite the silvered or the unsilvered part of the index glass as the varying brightness of the objects observed may render necessary

The telescopes are of two kinds One, a direct telescope, which is simply an opera glass, and having a narrow field of view, is generally used in the more ordinary sort of observations, such as observing altitudes The other is an inverting or astronomical telescope, which has a large field of view, and is that which dexterous observers use exclusively It is commonly supplied with two eye-pieces, one of considerable power, and chiefly for determining the index error, and the other for observing with In the frames of each eye piece are two pairs of wires each pair perpendicular to the other, dividing the field of view into nine spaces of which that in the middle is square, and it is important that in all observations made with this instrument the contact of the image seen by reflexion, and of the object seen directly, should be made as near the middle of this square as possible, at any rate at the same distance as the centre of the square from the plane of the instrument

It is essential, also that the telescope should be parallel to the plane of the instrument, and in the collar into which the telescope is screwed there are two screws for making this parallel adjustment The adjustment is not very liable to alter but no careful observer will omit to examine it at every convenient opportunity

Both the mirrors are supplied with coloured glasses of different degrees of shade, framed and placed in such a position that they can be turned down before the mirrors, either singly or combined The eye pieces of the telescopes [illegible] coloured shades, set in caps, which [illegible] eye-piece They are used in taking the index error by means of the sun and in observing the sun's altitude from an artificial horizon

*Adjustment of the Sextant* —1 To set the index glass, when it admits of adjustment, perpendicular to the plane of the instrument

Place the index about the middle of the limb, and looking obliquely into the index glass, the part of the limb will be seen by reflexion in the glass as well as directly If the part of the limb seen directly and its image in the glass appear as one continued frame, the mirror is in adjustment, but if the reflected image appears to incline downward, it shows that the face of the glass inclines backward from the perpendicular, if upwards, that it inclines forward and the adjustment must be made by the screw supplied for the purpose

2 To set the horizon glass perpendicular to the frame [illegible]

Having [illegible] adjusted the index glass, or seen that it is in adjustment, screw the telescope into its socket, adjust the eye-piece to distinct vision, screw the dusk shade cap on the eye end of the telescope, or turn down shades before the mirrors, and looking towards the sun, bring the index near to zero move it steadily backwards and forwards, and the reflected image of the sun will be seen to pass over his disk, as viewed directly If the two circular disks accurately cover each other in passing the perpendicular adjustment of the horizon glass requires no adjustment but if they pass a little aside of each other [illegible] two [illegible] lines appear on each [illegible] the mirror B must be turned by the appropriate screw

till the disks accurately cover each other when the adjustment will be complete This adjustment may also be effected by making a bright star and its image coincide with each other [illegible] to say [illegible]

3 To set the telescope parallel to the plane of the instrument This adjustment is effected by two screws in the collar which attaches the telescope to the arch of the sextant, and diametrically opposite each other and perpendicular to the plane of the instrument By tightening the upper one the object end of the telescope is inclined towards the instrument, and the contrary effect is produced by tightening the lower one To make the adjustment, turn round the eye piece of the telescope till two of the wires in its focus appear parallel to the plane of the instrument (and of this the eye can judge with sufficient accuracy), then take two objects, as two bright stars, or the sun and the moon, whose distance in either case should not be less than 90°, in order that any error in the adjustment may become more apparent, and bringing the image of one of the objects in accurate contact with the other object on the wire next the instrument, *instantly* bring them to the other wire, and if they are also in accurate contact upon that wire, it may be concluded that the axis of the telescope is parallel to the plane of the instrument If the objects are the sun and moon, and they separate at the farther wire it shows that the object end of the telescope inclines towards the plane of the instrument, and the contrary if they overlap, and the error must be corrected by turning the proper screws in the collar

The above are all the adjustments which this class of instruments admits of, and they are essential to every instrument of the kind We have now only to state how, in practice, the index error of the instrument may be most conveniently and accurately determined

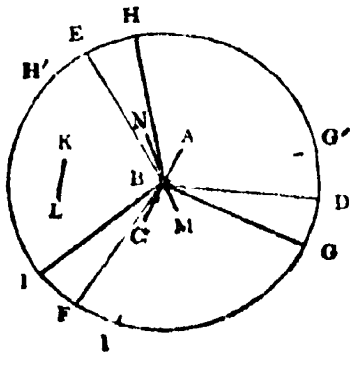
Having effected the perpendicular adjustment of the horizon glass by the method above explained, bring the border of the sun's reflected image to coincide with the sun seen directly both on the right and left side, and reading the index at both observations, if one reading is on the left and the other on the right of zero, *half the difference is the index error*, and the fourth part of the sum is the sun's semidiameter, but if both readings are on the same side of zero, *half the sum is the index error*, and the fourth part of the difference is the semidiameter No instrument-maker however, will leave the index error so large that the readings for the sun's diameter will be both on one side of zero

*The Reflecting Circle* depends on the same principles as the sextant, from which it differs chiefly by having the whole circle graduated In some instruments of this kind the angle is measured by repetition See REPEATING CIRCLE

But the only instrument of this kind that can be now said to be in general use in this country is Troughton's reflecting circle, in which by means of three equidistant indexes, and by observing alternately with the face of the index direct and reversed, *six times* the required angle is obtained, without reference to the index correction After what has been said above on the principles of reflecting instruments generally the following short account of this instrument will be sufficient

All the indexes move round together, and, of course, the apparent [illegible] require to [illegible] index, and which, for the sake of convenience, stands at or near zero on the limb when the revolving and fixed mirrors are parallel

In the annexed figure let B D B F, and B Γ, be the positions of the indexes when the revolving mirror is parallel to the fixed one K L, and let A C and M N be two positions of the revolving mirror when it is equally inclined to K L Then the arcs D G D G', F H, E H', F I, Γ I', passed over by B D, B F, and B F, will be all equal, and if, when the mirror has the position M N, the face of the instrument be reversed, M N and K L will have the same relative position to each other that A C and K L have, and consequently if an object is seen by reflexion from A C and K L it will also, when the instrument is reversed, be seen by reflexion from M N and K L to an eye placed in the same situation Hence the degrees on the arcs G G', H H', I I', which are the differences of the readings of the observations in the direct and reversed positions, are each the measure of double the distance of the object from its reflected image The degrees [illegible] the circle from 0 to 720°, and the [illegible] nearly at equal distances from each other, it is customary in practice to read the degrees, with the minutes and seconds, from the leading index only, and to read only the minutes and seconds at [illegible] xes.




SEXTILE ASPECT, in Astrology, is the aspect of two planets when they are distant from each other the sixth part of a circle, or sixty degrees

SEXTON (Lat. sacristanus, sacrista) A church officer who is properly the keeper of holy things belonging to divine worship, and said to be the same with the *ostiarius* in the Romish church A sexton is usually [illegible] he minister or others, [illegible] case a mandamus lies to restore him to his office

SFORZA'TO (It. *forced*) In Music, a term written over a note to signify that it is to be played or struck louder than the rest

SFUMA'TO (It. *smoky*) In Painting, a term applied to that style of painting wherein the tints are so blended that the outline is scarcely perceptible, the whole presenting an indistinct misty appearance Guercino's works present some of the most examples of the style

SGRAFI'TTO (It. *scratched*) In Painting, a species of painting in which the ground is prepared with dark stucco, on which a white coat is applied, which last being removed with an iron instrument, the chipping it away opens to the black ground and forms the shadows, giving it the appearance of a chiaro-scuro painting The principal pictures of P [illegible] in this manner, which [illegible] extremely durable, though it must be conceded the appearance is rather harsh

SHABRACK The cloth furniture of a cavalry officer's [illegible] The term is of Hungarian origin

SHADDOCK The fruit of the *Citrus decumana* it is a species of orange

SHA'DOW In Optics, a portion of space from which light is intercepted by an opaque body As the rays of light proceed in straight lines, every opaque object on which light falls is accompanied with a shadow on the side opposite to the luminous body, and the shadow appears more intense in proportion as the illumination is stronger, because any object placed within it contrasts more strongly with the surrounding objects on which the light is suffered to fall

As every point of a luminous body is a separate focus of illumination, it follows that an opaque object illuminated by the sun, or any other source of light which is not a single point must have an infinite number of shadows, though not distinguishable from each other, and hence the shadow of an opaque body received on a plane is always terminated by a *penumbra* or partial shadow, the extent of which is greater in proportion to the magnitude of the luminous body the distance of the opaque body from the plane on which the shadow falls and the degree of obliquity with which the luminous rays fall on the plane

Shadows are said to be *right* or *versed*, according to the position of the planes on which they are thrown The shadow of an upright body projected on the plane of the horizon is a right shadow, and that of a body on a vertical plane to which the body is perpendicular as that of a bar of iron fixed perpendicular in a wall, is a versed shadow In both cases the length of the shadow is to the height of the opaque body as the cosine to the sine of the angle which the luminous ray makes with the plane The ancient geometers availed themselves of this property of shadows to measure the altitudes of objects

*Coloured Shadows* — In certain states of the atmosphere the shadows of opaque objects projected on a white surface are frequently observed, about the time of sunrise or sunset to be of a blue colour This curious observation appears to have been first made by the celebrated painter Leonardo da Vinci, and is also noticed [illegible] until about a century later, when it again occurred to Buffon [illegible] coincidence about the time [illegible] on a white wall about 30 or 40 feet distant to be coloured with a light green inclining to blue The next morning, at sunrise he repeated the observation, but instead of finding the shadows green, he found them blue, or rather the colour of lively indigo Afterwards he often observed the shadows both in the [illegible] but always observed them to be bl[illegible] and he remarks that any one may see a blue shadow, if he will hold his finger before a piece of white paper at sunrise or sunset. The phenomenon has since been frequently observed, [illegible] he aerial colour of the at[illegible] the [illegible] (*Priestley's History of Light &c*, 1762) For remarks on [illegible] borders [illegible] *Red Shadows*, and other optical phenomena of the same kind see Prof Forbes's Report on Meteorology in the *Report of the British Association for* 1840

SHADOW In Painting, the form which a solid object projects on a surface or surfaces by being interposed

between the surface or surfaces and the sun, or other luminous body the doctrines whereof have received the name of *scenography* *Shade* a term applied to that portion of [illegible] to the luminous body [illegible] that part of a column between the base and capital, sometimes called the *trunk* of the column The shaft of a column always diminishes in diameter from about a third of its height Sometimes it has a slight swelling (*see* ENTASIS) in the lower part of its height In the oldest Doric columns, the diminution was so considerable as to give the column a conical appearance In the Doric edifices at Athens, the upper diameter is not more than a quarter less than the lower diameter, in the temples of Jupiter Nemeus, between Argos and Corinth, not more than a fifth less In Ionic and Corinthian columns, the difference of the upper and lower diameters varies from a fifth to a twelfth The ancients seem to have regulated the [illegible] by the [illegible] the height [illegible] the [illegible] to be [illegible] and [illegible] expressed in terms of the lower diameter

SHAFT In Mines A shaft or pit is a prismatic or cylindrical hollow space, the axis of which is either vertical or much inclined to the horizon The dimension of the pit, which is never less than 32 inches in its narrowest diameter, amounts sometimes to several yards its depth may extend to 1000 feet, and more Whenever a shaft is opened, means must be provided to extract the rubbish which continually tends to accumulate at its bottom, as well as the waters which may percolate down into it, as also to facilitate the descent and ascent of the workmen For some time a wheel and axle erected over the mouth of the opening, which serve to elevate one or two buckets of proper dimensions, may be sufficient for most of these purposes, but such a machine becomes ere long inadequate Horse-whims, or powerful steam-engines, must then be had recourse to, and effectual methods of support must be employed to prevent the sides of the shaft from crumbling and falling down. (*Ure's Dict of Arts, &c*)

SHAG The English name of a species of cormorant *Phalacrocorax graculus*, Linn

SHAGREEN [illegible] to have been prepared [illegible] species of whale It is prepared from horse or ass skin, a granular appearance being given by embedding in it whilst soft, the seeds of a species of chenopodium, and afterwards shaving down the surface it is dyed with the green produced by the action of sal ammoniac on copper filings It was formerly much used for watch, spectacle, and instrument cases, and was made chiefly in Astracan

SHAH (In Persian, *prince*) The title given by European writers to the monarch of Persia, who in his own country is designated by the compound appellation of *Padishah* [illegible]

SHAH NAMAH (*The Book of Kings*) The most ancient and celebrated poem in the modern Persian language, by the poet who received as a title of honour the name "Firdousi" (*of Paradise*), by which he is known Its date is supposed to be about A D 1000 A complete translation into English in four volumes, was published by Capt Macan Calcutta 1829

SHAKE In Music, a quick alternate repetition of the note above with that over which the mark *tr* is placed, commonly ending with a turn from the note below

SHAKERS In Ecclesiastical History, a sect said to have originated by a secession from the body of Quakers, in 1747, in Lancashire, who received their nickname from the peculiar contortions of body which they adopted in their religious exercises Anne Lee, the great female leader of this sect, joined the society in 1758, and con[illegible] England, went, with a few followers, to New York in 1774, and died ten years afterwards, at which time her sect had made great progress in America She was considered as the woman spoken of in Revelations The sect appears to have fallen into obscurity although a few congregations still remain

SHALE A crumbling variety of slate

SHA'MANISM, or SCHAMANISM A general name applied to the idolatrous religions of a number of barbarous tribes comprehending those of Finnish race the Ostiaks Samojedes and other inhabitants of Siberia as far as the Pacific ocean These nations generally believe in a supreme Being but to whom they attribute little share in the immediate government of the world they pay [illegible] kinds of [illegible] to [illegible] benevolent [illegible] to [illegible] appear to be very certain and [illegible] [illegible] last [illegible] those tribes which [illegible] [illegible] Russia [illegible] Saint [illegible] [illegible] the Samoiedes [illegible] [illegible] religion [illegible] [illegible] [illegible] [illegible] These [illegible] are called [illegible] [illegible] [illegible] [illegible]

dards, but nothing certain can be averred on the subject Wener and M'Culloch, however, adopt the opinion that the shekel used differed from both of these (See Ar. Fr. Delitzsches *Realwörterbuch*, art "Sekel")

SHEKINAH The Jewish name for the Divine presence, which rested, in the shape of a cloud, over the "propitiatory" or "mercy seat" as it is rendered in our translation (Leviticus, xvi 2) The Jews reckon it among the five particulars which were present in the first temple, and wanting in the second (See *Prideaux' Connection*, i 3) On this account God is so often said in Scripture to "dwell between the cherubim," that is, between the images of cherubim on the mercy seat (1 Sam iv 4, Psalm lxxx 1. &c See also *Mem de l'Ac des Inscr* vol xxxviii)

SHE'LDRAKE The common name of the species of duck called *Anas tadorna*, which is the type of the subgenus *Tadorna* of Ray and modern ornithologists This elegant species frequents many parts of our coast, and remains throughout the year The female commonly selects a rabbit-hole in which to deposit her eggs, which are sometimes as many as sixteen in number The sheldrake feeds on small fish, marine insects, and sea-weed

SHELL The hardening principle of shell is generally carbonate of lime nearly pure The animal principle, in the porcellaneous shells, is a small quantity of soluble gelatine, in the mother of pearl shells it is albuminous The latter, therefore, when steeped in dilute muriatic acid, leave a membranous or cartilaginous residue, but the former are entirely soluble For the form structure, and mode of growth of shell, see CONCHOLOGY

SHELL In Artillery a hollow sphere of iron, which being filled with gunpowder and fired from a mortar, bursts into pieces, when the powder is exploded, and produces a very destructive effect [illegible] a hole in the shell of about [illegible] by means of a fuze The fuze is a wooden tube made to fit the hole, and filled with a composition of sulphur saltpetre, and mealed powder, and is cut of such a length that the shell is calculated to explode just before or immediately after it reaches the ground

SHELL MARL A deposit of clay and other substances, mixed with shells, which collects at the bottom of lakes

SHE'RBET (a word borrowed from the Persian), signifies a favourite beverage in the East, bearing some resemblance to our lemonade made of water, lemon-juice, and sugar, with the addition of some other ingredients such as rose water, to give it a delightful perfume

SHE'RIFF (originally shire-reeve from the Saxon, meaning the reeve or governor of the shire), is the title of that functionary who acted at first only as the deputy of the earl, hence styled in Lat *vice-comes*, but has long been the chief civil officer in each county, where he is styled bailiff of the crown and where he is specially entrusted with the execution of the laws and the preservation of the peace for which purposes he has at his disposal the whole civil force of the county — in old legal language the *posse comitatus* The most ordinary and important functions of the sheriff, which he universally exercises by a deputy, called under sheriff, for whose conduct he is responsible, consist 1st, In the execution [illegible] by the judges on circuit [illegible] county 2 In the holding of the sheriff's court The sheriff himself only executes in person such parts of his office as are either purely honorary such as attendance upon the judges on circuit (for whose lodging he is also bound to provide), or as are of some dignity and public importance, such as the presiding over elections and the holding of [illegible] power to call at any time [illegible] to the jurisdiction of the sheriff [illegible] would only hold pleas of debt or damages under the value of 40*s* except in replevin, or actions by virtue of a particular writ termed a *justicies* But it is now enacted, by 3 & 4 W 4 c 42, that in any action depending in a superior court for a debt or demand, not exceeding 20*l*, it shall be lawful for the court to direct that the issue joined shall be tried before the sheriff of the county in which the action is brought *See* COURTS

Sheriffs were originally chosen by the freeholders of the county except in [illegible] where the office was hereditary as it still is in Westmoreland The system of popular election was abolished in the reign of Richard II, and sheriffs have long been appointed by the crown upon presentation of the judges, in a manner partly regulated by law, partly by custom, but sheriffs may also be nominated by the crown without recommendation of the judges, and are then familiarly styled *pocket sheriffs* Those appointed in either way are bound under a penalty of 500*l* to serve the office except in specified cases of exemption or disability The description given of the office as it is in England applies to Ireland without variation, except as to the time of its origin

SHE'RIFF DEPUTE In Scotland, the principal sheriff of a county He is named by the crown must be an advocate of three years standing, and receives a salary varying from 300*l* to 1200*l* per annum He is entitled to name sheriff substitutes, executes writs returns juries, &c, decides on claims for enrolment in the county lists of parliamentary voters, and exercises a certain criminal jurisdiction He holds also civil courts for the recovery of small debts, and a court of record, the jurisdiction of which extends to all personal actions, and possessory actions for the recovery of real property

SHE'RRY A Spanish wine made from the grapes of Xeres in Andalusia Genuine sherry is a rich dry wine, containing from 20 to 23 per cent of alcohol there are many varieties, and it is extensively imitated and adulterated *See* WINE

SHEW-BREAD In the Old Testament The name given to the twelve loaves of bread, one for each of the twelve tribes of Israel, which were appointed to be placed every Sabbath "on the pure table before the Lord," for the sustenance of the priests They appear to be the same with that which is called "shew-bread" in 1 Sam 21, where the act of David in taking these loaves for the [illegible] self and his followers is related

SHIBBOLETH (Heb *a flood*) The name given to a sort of test or criterion by which the ancient Jews sought to distinguish true persons or things from false The term originated thus — After the battle gained by [illegible] Judges xii) the [illegible] of the river, and on an Ephraimite attempting to cross, they asked him if he was of Ephraim If he said no, they bade him pronounce the word *Shibboleth*, which the Ephraimites from inability to give the aspirate called *Sibboleth*, and by this means he was detected and instantly thrown into the river In modern times this word has been adopted into the language of politics, in which it signifies those political opinions on which all the members of a party are agreed, or the watch-word by which it is intended to unite them

SHIELD (Germ schild) A well-known piece of defensive armour very extensively used before the invention of gunpowder and still employed by many nations [illegible] which in ours is made in perfect progress It would be [illegible] to detail the various materials and shapes of which it has been constructed at different periods The ancient Greek shield, as described in Homer, was large and massive, sufficient to cover the man from the face to the knee, composed of leather, inlaid in some instances with metal That of the Roman legionary was four feet high and two and a half broad, formed of wood covered with leather, and strongly guarded with bosses of iron or bronze The ancient Britons and other nations [illegible] basket like shields, often of [illegible] called the parma or lighter [illegible] The Norman shield, as used in England down to the time of Henry II, was "of the form called kite or pear shape," flatter at first, afterwards approaching to the semi cylindrical Heraldic devices were first borne on it so far as is distinctly ascertained, in the reign of Henry II (*Pictorial Hist of England* i 640) In that of Edward IV the shield had become triangular the point of the triangle was rounded off about the end of the 14th century Afterwards the shape of the shield, as worn by knights, became more and more fantastic In actual service it fell gradually into disuse sword and buckler fight the favourite pastime as well as warlike practice of former days, became obsolete after the rapier and dagger had been introduced in the reign of Elizabeth The Highlanders carried the target with the broad sword to a much later period

SHIELDS In Botany, little coloured cups or lines with a hard disk, surrounded by a rim, and containing the fructification of lichens

SHILLING An English silver coin equal to twelve pence, or the twentieth part of a pound sterling Among the ancient Saxons, the value of the shilling was only five pence, it afterwards underwent many alterations, containing sometimes sixteen pence, and often twenty pence The period when it obtained its present value is assigned to the reign of Edward I Many other countries besides England have a coin of this name, of these, perhaps the Hamburgh schilling is the best known Its value is 1*d* English

SHI'LOH (Heb differently rendered — *Son*, *He who is sent*, or *the Sent*, or *the Peaceable*, or *the Prosperous*) The name given to the Messiah by Jacob in his prophecy, Genesis xlix 10

SHINGLE (Germ, or perhaps from Lat scindendo) The coarse gravel, or accumulation of small stones, found on the shores of rivers or the sea: in the latter case the term *sea-beach* is applied

SHI'NGLES A corruption of the French word *cengle*, which means *a belt* This eruptive disorder is generally ushered in with febrile symptoms, followed by an itching or tingling sensation of some part of the body, occasioned by patches of little red pimples, forming in the course of twenty-four hours small transparent ve-

sicles; these succeed each other till they at length form a kind of belt round some part of the trunk or abdomen they often form small ulcerations and scabs, continuing their progress for three or four weeks This disorder is not contagious and generally very slight, but in irritable habits the itching occasions want of rest and fever, and it is sometimes attended by a deep-seated pain of the affected part The cause of shingles is generally obscure though it may sometimes be referred to indigestion and suppressed perspiration young persons are most subject to it Gentle aperients and diaphoretics strict attention to the diet and occasional anodynes are the only internal remedies generally required and externally a little cold cream or fresh spermaceti ointment or the occasional application of a very weak Goulard's lotion, is all that is necessary

Shingles In Architecture, small slabs of wood, or quartered oaken boards, used instead of slates or tiles for covering churches or spires They are sawn to a certain scantling, or rather cleft to about an inch thick at one end, and shaped like wedges, four or five inches broad and [illegible]

SHIP A general term for all large vessels, but restricted by seamen to such only as have three complete masts, *i e* lower, top, and top-gallant masts As we cannot here give a complete description of so complex a fabric, and as the reader will have become familiar with the forms of ships from prints, we shall merely attempt to convey some general ideas on the subject After the hull has been completed a slight account of the construction of which has been given under Naval Architecture, the ballast which is necessary in most ships to keep them upright when under sail, and which is in men-of-war in iron pigs, is spread over the bottom of the hold chiefly towards the middle of the length The masts are then taken in On the ballast are laid loose pieces of wood, called *dunnage*, on which rest the iron tanks containing the water to drink, or water casks The hold in large ships is divided by partitions into the fore, main, and after holds At the fore extremity, in men-of-war are the gunner's, boatswain's, and carpenter's store rooms, containing arms, supplies of rope, bolts pump gear, and other materials of the fittings, or for repairs In this part also is the fore powder magazine, when there are two In the fore hold are stowed water wood for firing and separated by a strong partition, coals In the main hold are stowed water, stores, chain cables, &c In the after hold are the provisions, and, in the *spirit room*, the spirits here also is the powder magazine In the narrow and shallow after extremity is stowed the bread or biscuit The spare sails are kept in a place called the *sail room*, over the fore hold The hemp cables are kept in the cable tiers on a deck over the main hold These decks immediately over the holds constitute generally the fore and after *cock pits* In large ships the whole deck is called the *orlop* deck On the *lower* deck which is next above the former, the men mess and sleep In frigates, and smaller vessels, this deck is a little below the water, in two and three deckers, it is three or more feet above the water, and is the lower gun deck

In merchant ships the arrangements depend, of course on the size of the vessel and the nature of the cargo In all these vessels, however, the place allotted to the crew is in the fore part, and is called the *fore peak* Ships are, in general, constructed for the purposes of burden expedition, and war, the latter class which must possess also, in part, the qualities of the other two exhibit the finest models The largest ships, of 120 guns, carry three complete rows or tiers of heavy cannon (32-pounders), and are thence called three deckers, of late years some still heavier guns have been introduced Each deck has from 15 to 17 guns on each side The middle of these decks is called the *middle* deck, and the deck next above this, or which is next below the uppermost deck, the *main* deck Guns are also carried on the upper deck, of which the fore part is called the *forecastle*, and the part abaft the main mast the *quarter* deck The deck over this last, extending from the after extremity to a little before the mizzen mast, is called the *poop* The after parts of these decks from [illegible] the mizzen mast are the cabins of the admiral captain and the officers, the latter being called the *ward room* in ships of the line and the *gun room* in frigates The length of a ship of the largest class is about 200 feet at the water line, extreme breadth 54 feet, and draught of water about 26, and the height of the truck above the water 210 feet The whole weight of such a ship with her crew and provisions is about 4000 tons of which the hull or shell is about half The men, with their effects, amount to 100 tons; and the guns, arms, and powder, to 500 tons The 32 pounder (long gun) and carriage weigh 7 [illegible], and the carronade one third of this Two deckers carry from 70 to 90 guns In bad weather the ports of the lower deck are defended by heavy lids called *ports* which are firmly secured from within the guns being then run in and secured from motion Frigates carry one tier of guns on the main deck, besides guns on the upper deck, vessels of the lower classes carry their guns on the upper or open deck

Fine [illegible] ships have gone upwards of 13 knots (or sea miles [illegible]) an hour, in a squall and upwards of 10 knots on a bow line, that is, the sails being sharply trimmed when the direction of the wind makes an angle of about 67° with that of the ship's head

The [illegible] are Bouguer, *Trait du Navire*, [illegible] *Théorie de la Construction* [illegible] *Manœuvre* [illegible] *Vaisseaux*, [illegible] *Examen Maritime* [illegible] *Naval Architecture* [illegible] in *Charnock's Marine Architecture*, and many other works contained in any good catalogue, under the heads Naval Architecture, Seamanship, especially in *Darcy Lever's Seamanship*, &c But the subject has as yet been but imperfectly treated, and many points of great practical importance, and unconnected with the particular properties of fluids, have not been discussed

SHIP, ARMED In [illegible] a private vessel occasionally [illegible] government in time of war, armed and equipped like a regular ship of war, and commanded by an officer of the navy, with the rank of master and commander

SHIP-BUILDING *See* Naval Architecture

SHIP MONEY The celebrated tax imposed by Charles I without authority of parliament, which proved one of the most immediate causes of the discontents that ended in the great rebellion This device was first put in practice in 1634 It was by a writ, directed to the sheriff of every county, to provide a ship for the king's service, accompanied by written instructions appointing a sum of money to be levied instead This writ was framed by Attorney-General Noy The tax was paid for about four years without opposition, when the question of its legality was raised by the refusal of Hampden to pay his share It was argued before the judges in the Exchequer Chamber of whom a great majority gave judgment for the crown The act "whereby all the proceedings in the business of ship money were adjudged void and disannulled, and the judgments enrolments, and entries thereupon vacated and cancelled," was one of the first proceedings of the Long Parliament (See *Clarendon*, books i iii)

SHIPS REGISTRY OF In Commercial Navigation, the registration or enrolment of ships at the custom house, so as to entitle them to be classed among, and to enjoy the privileges of British-built ships

The registry of ships appears to have been first introduced into this country by the Navigation Act (12 Car 2 c 18 anno 1660) Several provisions were made with respect to it by the 7 & 8 Will 3 c 22, and the whole was reduced into a system by the 27 Geo 3 c 19

It may be laid down in general that a vessel, in order to be admitted to registry and consequently to enjoy the privileges and advantages that exclusively belong to a British ship must be the property of his Majesty's subjects in the United Kingdom or some of its dependencies, and that it must have been built in the said United Kingdom &c or been a prize vessel legally condemned, or a vessel legally condemned for a breach of the slave laws

The great and perhaps the only original object of the registration of ships was to facilitate the exclusion of foreign ships from those departments in which they were prohibited from engaging by the navigation laws, by affording a ready means of distinguishing such as were really British It has also been considered advantageous to individuals by preventing the fraudulent assignment of property in ships, but Lord Tenterden has observed, in reference to this supposed advantage, that "the instances in which fair and honest transactions are rendered unavailable, through a negligent want of compliance with the forms directed by these and other statutes requiring a public register of conveyances, make the expediency of all such regulations considered with reference to private benefit only a matter of question and controversy" (*Law of Shipping* part I c 2)

SHIPWRECK in the open sea, arises from the water leaking in at the bottom of a ship faster than the pumps can discharge it, or from the sea coming over one of the decks, and getting below in great quantity, or from the vessel being overset by the wind In the labouring of a weak ship in a heavy sea the seams of the sides and bottom open, and the caulking works loosen When the loss of a mast occurs, the ship is often left entirely to the action of the waves People unused to the sea look with admiration on the strength and solidity of a ship, but those who have experienced the violent shocks of the waves and are conversant with the effects of incessant agitation upon any fabric, and the straining effects of the masts and sails on the hull, are rather surprised that such a machine should hold together for so many years

When the ship is wrecked near the shore, the object is to land the crew The first method proposed was, we

believe, Bell's, in 1791 A mortar was fired from the ship, carrying a shell with a rope attached, by which communication with the shore might be established. Captain Manby, in 1808, employed the mortar on shore, where alone it is obvious its action could be depended upon, and these arrangements have since been adopted for sending the rope or hawser on board ships in distress, which had been found the chief difficulty

SHIRE A territorial division (From the Anglo-Saxon scyran, *to divide*, whence the verb *to sheer*) In modern language, shire is synonymous with county, but some smaller districts in the north of England retain the provincial [illegible] as Richmondshire, in the North [illegible] Hallamshire, or the manor of Hal [illegible] ling, which is nearly coextensive with the parish of Sheffield *See* COUNTY

SHIRE CLERK An officer appointed by the sheriff to assist in [illegible] ounty court

SHIRE [illegible] Shire Meeting, *see* sheriff's court

SHOOTING STARS Well-known meteors, of which the origin and nature are involved in great obscurity, and which have, of late years, excited extraordinary interest by their periodical appearances in unusually great numbers

*Phenomena of Shooting Stars* — The apparent magnitudes of these meteors are widely different The greater part of them resemble stars of the 3d 4th, 5th, and 6th magnitudes, but some occur which surpass stars of the 1st magnitude, and even exceed Jupiter and Venus in brilliancy In some of them the globular form can be [illegible] hese are, in every respect similar to [illegible], and, in fact it is impossible, from their appearance to make any distinction between the larger [illegible] and the smaller individuals of the class of meteors to which the name of fire-balls is usually [illegible] FIRE-BALLS [illegible] equally numerous in every cl[illegible] to have no influence upon their number They are observed at all times of the year, but, generally speaking they appear to be more abundant in the end of summer and autumn than at the other seasons

Some of the shooting stars leave a luminous train behind them, which marks their path through the sky with a milk-white light These trains for the most part disappear in a few seconds, but sometimes they continue longer, and even for several minutes In the case of actual fire-balls Dr Olbers observed trains which continued from six to seven minutes, and Brandes in one instance estimated that fifteen minutes elapsed between the extinction of the fire-ball and the disappearance of the luminous train The trains in general assume the form of a cylinder, the interior of which is void of luminous matter, and not unfrequently before their disappearance, they take a curved form The most probable explanation is, that they are caused by a gaseous matter left behind by the meteor and bent by currents of air

The older philosophers had formed various theories to explain these remarkable phenomena By some they were supposed to be the products of an oily sulphurous vapour existing in the atmosphere which being disposed in thin layers, and becoming inflamed by some means would exhibit the appearance of a clear brilliant spark passing rapidly from one point to another About the middle of the last century when the effects and phenomena of electricity began to be better understood, Beccaria and Vassalli, among others, regarded the shooting stars as merely electrical sparks, an hypothesis which was soon shown to be untenable At a later period when the inflammable nature of the gases became known, Lavoisier, Volta, Herbert, Toaldo Gren and others referred these meteors to hydrogen gas, which, by reason of its inferior density they supposed must be accumulated in the higher regions of the atmosphere Dalton, however, showed that such accumulation cannot take place, inasmuch as all the gases which constitute the atmosphere must be equally diffused through its whole extent, according to the law of Mariotte Deluc maintained that certain phosphoric exhalations generated in the earth, and becoming inflamed in the sky formed the true essence of the shooting stars

In this state the subject remained when Chladni published his celebrated work on the causes of the masses of iron and other similar substances found in Siberia by Pallas, in which he clearly established, by comparing [illegible] ide of observations, [illegible] their origin beyond [illegible] are masses of nebulous matter moving in space with planetary velocities, which, when they come in the way of the earth in its revolution about the sun, and enter the atmosphere, are inflamed by its resistance and friction, and become l[illegible]inous sometimes so as to [illegible] masses of stone and iron on the ground Halley, Wallis, Pringle Maskelyne and others, had previously assigned a cosmical origin to these meteors, but without suspecting that masses of stone and iron fell from them The close resemblance which the greater part of the shooting stars present to fire-balls at once induced Chladni to consider these phenomena also as cosmical, that is to say, as small masses of matter [illegible] originating in our atmosphere but entering it from without and which are either [illegible] in it, or become extinguished when they have passed beyond it

These conclusions, however, required to be confirmed by a more accurate investigation of the phenomena, for as yet no exact determination had been made of the actual average heights of the shooting stars above the earth, or of their orbits, velocities, or magnitudes In the year 1798 this important but difficult inquiry was undertaken by Professors Brandes of Leipsig, and Benzenberg of Dusseldorf (both at that time students in Gottingen) Having selected a base line (about nine miles in length), they placed themselves at its extremities and [illegible] observed all the shooting stars which [illegible] through the heavens on a celestial map, and noting the instants of their appearances and extinctions by chronometers previously compared The differences of the paths traced on the maps afforded data for the determination of the parallaxes [illegible] and the lengths of the [illegible] between September and November, the whole number of shooting stars seen by both observers was 402, of these 22 were identified as having been observed by each in such a manner that the altitude of the meteor above the ground at the instant of extinction could be computed The least of the altitudes was about 6 English miles Of the whole there were 7 under 45 miles, 9 between 45 and 90, 6 above 90, and the highest was above 140 miles There were only two observed so completely as to afford data for determining the velocity The first gave 25 miles, and the second from 17 to 21 miles in a second The most remarkable result was, that one of them certainly was observed not to *fall* but to move in a direction away from the earth

By these observations a precise idea was first obtained of the altitudes distances and velocities of these singular meteors A similar but more extended plan of observation was organized by Brandes in 1823, and carried into effect at Breslau and the neighbouring towns by a considerable number of persons observing at the same time on concerted nights Between April and October about 1800 shooting stars were noted at the different places, out of which number 62 were found which had been observed simultaneously at more than one station in such a manner that their respective altitudes could be determined and 36 others of which the observations furnished data for estimating the entire orbits Of these 98, the height (at the time of extinction) of 4 were computed to be under 15 English miles, of 15 between 15 and 30 miles of 22 between 30 and 45, of 33 between 45 and 70, of 1 between 70 and 90 and of 11 above 90 miles Of these last two had an altitude of about 140 miles, one of 220 miles one of 280, and there was one of which the height was estimated to exceed 460 miles

Of the 36 computed orbits, in 26 instances the motion was downwards, in one case horizontal, and in the remaining 9 more or less upwards The velocities were between 18 and 36 miles in a second The trajectories were frequently not straight lines but incurvated sometimes in the horizontal and sometimes in the vertical direction and sometimes they were of a serpentine form The predominating direction of the motion of the meteors from north-east to south-west contrary to that of the earth in its orbit, was very remarkable, and is important in reference to their physical theory

A similar set of observations was made in Belgium in 1824 under the direction of M Quetelet, the results of which are published in the *Annuaire de Bruxelles* for 1837 M Quetelet was chiefly solicitous to determine the velocity of the meteors He obtained six corresponding observations from which this element could be deduced, and the results varied from ten to twenty-five English miles in a second The mean of the six results gave a velocity of nearly seventeen miles per second, a little less than that of the earth in its orbit

Another set of [illegible] observations was made in Switzerland on [illegible] A circumstantial account of which is given by M Wartmann in *Quetelet's Correspondance Mathématique* for July, 1839 M Wartmann and five other observers provided with celestial charts, stationed themselves at the observatory of Geneva and [illegible] observation were made at Planchettes [illegible] miles to the north east of [illegible] In the space of [illegible] and a half hours, the number of meteors observed by the six observers at Geneva was 381, and during five and a half hours the number observed at Planchettes by two observers was 104 All the circumstances of the phenomena — the place of the apparition and disappearance of each meteor, the time it continued visible, its brightness relatively to the fixed stars whether accompanied with a train, &c — were carefully noted, and the trajectories projected on a large

planisphere The extent of the trajectories described by the meteors was very different varying from 8 to 70 of angular space The velocities appeared also to differ consi- . . . . . . M Wart- . . . . . . . ne comparison of the simultaneous observations, that the average height above the ground was about 50 miles, and hence the relative velocity was computed to be about 240 miles in a second But as the greater number moved in a direction opposite to that of the earth in its orbit the relative velocity must be diminished by the earth's velocity . 19 miles in a second . This still leaves upwards of 420 miles per second for the absolute velocity of the meteor, which is more than eleven times the orbital velocity of the earth, seven and a half times that of the planet Mercury and probably greater than that of the comets at their perihelia

Such are the principal facts which have yet been established respecting the heights, velocities, and orbits of the shooting stars, and it is from these chiefly that we are enabled to form any probable conjectures respecting their origin . . . . . . . . . . fire-balls, both . . . . . presenting absolutely the same appearances we may assume them to be of the same nature, and that whatever has been proved respecting fire-balls will apply equally to the larger shooting stars Whether the meteoric appearances to which the latter term is applied may not include objects of totally different natures, is a question admitting of doubt It is possible that among the shooting stars there may be objects which are merely electric sparks, or which have their origin in spontaneously inflammable gases, known or unknown, existing in the atmosphere, but the greater part of them must be considered as identical with fire-balls

*Physical Theory of the Shooting Stars* — Some philosophers, as already stated, have ascribed an atmospheric origin both to the shooting stars and fire-balls, but the observations of Brandes, and more particularly those of Wartmann which prove that they move at altitudes far beyond the limits which can be assigned with any probability to our atmosphere have rendered this supposition altogether untenable Another hypothesis respecting their origin is that they are bodies projected from craters from volcanoes in the moon Dr Olbers was the first, perhaps, who showed the possibility of this hypothesis On computing the forces necessary to overcome the moon's attraction, he found that a body projected from the moon with a velocity of about 8500 feet in a second would not fall back on the lunar surface, but recede from it indefinitely, and that in order to reach the earth it is only necessary that the projectile should have the velocity of 8300 feet, which is quite conceivable being only about four or five times that of a cannon ball The hypothesis of the lunar origin of meteoric stones was adopted by Laplace, Berzelius Benzenberg and others, but the observed velocities of the shooting stars have rendered this origin extremely improbable with respect to them In order to enter our atmosphere with a velocity of 20 miles in a second, it may be shown that if they come from the moon they must have been projected from the lunar surface with a velocity of about 120,000 feet in a second, which may be regarded as altogether impossible

It thus appears that those shooting stars and fire-balls which have the planetary velocity of from 20 to 40 miles in a second, cannot with any probability be regarded as having their origin in the moon Whether any individual bodies moving with a smaller velocity may have a lunar origin is a question which cannot be decisively answered. "To me," says Dr Olbers, "it does not appear at all probable, and I regard the moon, in its present circumstances, as an extremely peaceable neighbour, which, from its want of water and atmosphere, is no longer capable of any strong explosions"

The hypothesis first suggested by Chladni is that which appears to have met with most favour, having been adopted by Arago and other eminent astronomers of the present day to explain the November phenomena It consists in supposing that, independently of the great planets, there exist in the planetary regions myriads of of small bodies which circulate about the sun, generally in groups of zones, and that some of these zones intersect the ecliptic, and are consequently encountered by the earth in its annual revolution The principal difficulties attending this theory are the following — First, that bodies moving in groups in the circumstances supposed must necessarily move in the same direction, and consequently when they become visible from the earth, would all appear to emanate from one point and move towards the opposite Now, although the observations seem to show that the predominating direction is from north-east to south west, yet shooting stars are observed on the same nights to emanate from all points of the heavens, and to move in all possible directions Secondly, their average velocity, especially as determined by Wartmann greatly exceeds that which any body circulating about the sun can have at the distance of the earth Thirdly, from their appearance, and the luminous train which they generally leave behind them, and which often remains visible for several seconds, sometimes for whole minutes, and also from their being situated within the earth's shadow, and at heights far exceeding those at which the atmosphere can be supposed capable of supporting combustion, it is manifest that their light is not reflected from the sun, they must therefore be self-luminous, which is contrary to every analogy of the solar system Fourthly . . . . . . so near the earth . . . . . . of them would inevitably be attracted to it, but of the thousands of . . . which have been observed, there is no authenticated instance of any one having actually reached the earth Fifthly, instead of the meteors being attracted to the earth, some of them are observed actually to rise upwards, and to describe orbits which are convex towards the earth, a circumstance of which, on the present hypothesis, it seems difficult to give any rational explanation

From the difficulties attending every hypothesis which has hitherto been proposed it may be inferred how very little real knowledge has yet been obtained respecting the nature of the shooting stars It is certain that they appear at great altitudes above the earth, and that they move with prodigious velocity, but every thing else . . . is involved in profound mystery From . . . facts, M Wartmann thinks that the most rational conclusion we can adopt is, that the meteors probably owe their origin to the disengagement of electricity, or of some analogous matter, which takes place in the celestial regions on every occasion in which the conditions necessary for the production of the phenomena are renewed

The presumptions in favour of the cosmical origin of the shooting stars are chiefly founded on their periodical recurrence at certain epochs of the year, and the extraordinary displays of the phenomena in various years on the nights of the 12th or 13th of November We shall here merely state the principal circumstances accompanying those of 1799, which put the notion of a *lunar* origin entirely out of the question

On the morning of the 12th of November, 1799, before sunrise, Humboldt and Bonpland then on the coast of Mexico were witnesses to a remarkable exhibition of shooting stars and fire balls They filled the part of the heavens extending from due east to about 30° towards the north and south They rose from the horizon between the east and east-north east points, described arcs of unequal magnitude, and fell towards the south, some of them rose to the height of 40° all above 25° or 30° Many of them appeared to explode but the larger number disappeared without emitting sparks some had a nucleus apparently equal to Jupiter This most remarkable spectacle was seen at the same time in Cumana, on the borders of Brazil, in French Guiana in the channel of Bahama, on the continent of North America, in Labrador, and in Greenland, and even at Carlsruhe, Halle, and other places in Germany many shooting stars were seen on the same day At Nain and Hoffenthal in Labrador, and at Neuhernhut and Lichtenau in Greenland, the meteors seem to have approached the nearest to the earth At Nain they fell towards all points of the horizon, and some of them had a diameter which the spectators estimated at half an ell (See *Humboldt's Recueil des Voyages* &c vol ii )

Under the term FIRE BALLS the reader will find an account of a not less stupendous exhibition which took place in North America on the night of the 12th of November, 1833 In 1834, a similar phenomenon occurred on the night of the 13th of November, but on this occasion the meteors were of a smaller size In 1835, 1836, and 1838, shooting stars were observed on the night of November 13th in different parts of the world, but though diligently looked for on the same nights in 1839 and 1840, they do not appear to have been more numerous than on other nights about the same season of the year

The second great meteoric epoch is the 10th of August, first pointed out by M Quetelet, and although no displays similar to those of the November period have been witnessed on this night, there are more instances of the recurrence of the phenomena In the last three years (1838, 1839, 1840) shooting stars were observed in great numbers both on the 9th and 10th, but they appear in general to be unusually abundant during the two first weeks of August The other periods which have been remarked are the 18th of October, the 23d or 24th of April, the 6th and 7th of December, the nights from the 15th to the 20th of June, and the 2d of January

Halley first suggested the idea that the shooting stars may be observed as signals for determining differences of longitude by simultaneous observations and Maskelyne in 1783 published a paper on the subject, in which he calls the attention of astronomers to the phenomena, and distinctly points out this application The idea was revived by Benzenberg in 1802, but so long as they were

regarded merely as casual phenomena, it could scarcely be hoped that they would be of much use in this respect to practical astronomy As soon, however, as their periodicity became probable, the phenomena acquired a new interest, and some recent attempts to determine longitudes in this manner have proved that the method is not to be disregarded (*Monthly Notices of the R Astr. Society for January* 1841)

See an interesting paper on this subject by Dr Olbers, in *Schumacher's Jahrbuch* for 1837, also the *Annuaire du Bureau des Longitudes* for 1836, *Mem de l'Academie de Bruxelles* for 1838, *Schumacher's Astronomisches Nachrichten*, vols xvi and xvii, and the various Scientific Journals

SHORING In Architecture and Engineering, timber or other material placed in such a direction as to prop up a wall or other heavy body

SHOT Any kind of missile discharged by an instrument of war usually of metal for fire-arms

SHOT LOCKERS Long pieces of wood pierced with holes in which the shot are placed, along the sides and round the hatchways

SHOU'LDER In Fortification, the angle of a bastion formed between the face and flank

SHOVELLER The name of a species of duck, remarkable for the length and terminal expansion of the bill, whence the name of *Spathulea*, proposed for the subgenus of which it is the type It is the *Anus clypeata* of Linnæus

SHRA'PNELL SHELLS, in Gunnery, are shells filled with a quantity of musket balls, which, when the shell explodes, are projected about 150 yards further They are fired from guns, mortars, and howitzers and have been found most effective A six-pounder spherical case contains twenty-seven musket balls, which when the shell explodes, do as much injury as an equal number (Navy Encyc)

SHREW *See* SOREX

SHRIKE A name for the *butcher birds*, or species of *Laniarus*

SHRINE (Lat scrinium, *a desk or cabinet*, whence also *screen*) Properly, the receptacle of the remains or relics of a saint Shrines are of two sorts portable, used in processions, called in Latin *feretra*, and fixed in churches The appropriate place for shrines, in the churches of the middle ages was generally in the eastern part, in the space behind the high altar Such is the situation of the celebrated shrine of the three kings of Cologne, and such was that of the shrines at St Alban's, Canterbury, Durham and Westminster, before the Refo[illegible] (Brand vol i)

SHROUDS Large ropes supporting a mast laterally, they take the names of their respective masts, as the lower main shrouds, &c

SHROVE TUESDAY The Tuesday after Quinquagesima Sunday, and immediately preceding Ash Wednesday, so called from the Sax shriven, *to confess*, because on that day confession was made preparatory to the fast of Lent. The custom of ringing the bells for this occasion was long retained in many parishes, particularly [illegible] pancake bell" [illegible] beyond the dinner on pancakes which followed it See *Brand's Popular Antiquities*, for an account of the various shrovetide or carnival amusements of this country

SHRUB A small low dwarfish tree, which, instead of one single stem, frequently puts forth from the same root several sets or stems

*Shrub* is also the name given to a species of sweet wine or liqueur, of which rum forms the chief ingredient

SHUTTLE An instrument used by weavers, which guides the thread it contains, so as to make it form the woofs of stuffs, cloths, linen, and other fabrics, by throwing the shuttle alternately from left to right and from right to left across between the threads of the warp, which are [illegible] in the middle of [illegible] or chamber, in which is enclosed the *spoul*, which is part of the thread destined for the woof

SHWAN PAN The calculating instrument of the Chinese It is similar in shape and construction to the Roman abacus, and is used in the same manner *See* ABACUS

SI In Music, the name for the seventh sound, added by Le Maire, a Frenchman, at the latter end of the 17th century, to the six ancient notes, ut, re, mi, fa, sol, la, of Guido, by means whereof, some authors say, much inconvenience in the ancient gamut is avoided

SIALAGOGUES (Gr σιαλον, *saliva*, and αγωγος, *a leader*) Medicines which increase the flow of saliva

SIBI'RITE A mineral [illegible] of rubellite or red tourmaline the finest specimens of which have been found in Siberia

SI'BYL The name given to certain prophetic women said to have lived in early ages in Greece and Italy. Some authors recount as many as ten of them The most celebrated were the Sibyl of Cumæ fabled to have been consulted by Æneas and the prophetess who offered her books to Tarquin the Proud (see, among many authorities the *Mém de l'Ac des Inscr* vol xxiii)

SI'BYLLINE BOOKS Documents supposed to contain the fate of the Roman empire Nine of them are said to have been offered by an old woman called Amalthæa to Tarquin the Proud, but Tarquin refusing to give the price she asked, she went away, and burnt three of them Returning with the remainder, she offered them to the king on the same terms as before, and on his second refusal departed again, and returned with three, which she still offered at the same price as the original nine The king, struck with her conduct, at last acceded to her offer, and entrusted the care of the books to certain priests (the quindecemviri) They were preserved in a stone chest beneath the temple of Jupiter Capitolinus, and were consulted in times of public danger or calamity. They were destroyed by the fire that consumed the Capitol in the Marsic war After this calamity, ambassadors were sent to collect such fragments of Sibylline prophecies as they could pick up in various countries; and from the verses thus collected Augustus formed two new books, which were deposited in two gilt cases in the temple of the Palatine Apollo Sibylline verses are often quoted by Christian writers, as containing prophecies of Christianity, but these are spurious, a forgery of the 2d century

SICILIAN VESPERS In Modern History, the name commonly given to the great massacre of the French in Sicily, in A D 1282 They were the soldiers and subjects of Charles of Anjou, who had made himself master of the island after the defeat and death of Conradin The insurrection broke out on the evening of Easter Tuesday, whence the name Its consequence was the expulsion of Charles, and the islanders placed themselves under the protection of the king of Arragon

SIDE'REAL (Lat sidus, *a star*) Something relating to the stars

The *sidereal day* is the time in which the earth makes a complete revolution on its axis in respect of the fixed stars or any fixed point in space (*See* DAY) "If the sidereal day be taken equal to 24 sidereal hours, the mean solar day will be equal to 24 h 3 m 56 55 sec of those hours, and if the mean solar day be taken equal to 24 mean solar hours, the sidereal day will be equal to 23 h 56 m 4 09 sec of those hours Or, in all cases, if we wish to determine in sidereal time, the value of any given interval expressed in mean solar time, and *vice versa*, we shall have

sidereal time = 1 00273791 × mean solar time,
mean solar time = 0 99726957 × sidereal time"

(*Baily's Astronomical Tables*, 1827)

The *sidereal year* is the time in which the earth performs a complete revolution, relatively to the fixed stars, in its orbit, [illegible] 365 d 6 h 9 m 9 [illegible] sec longer than the tropical year *See* YEAR

SIDE'ROCALCITE (Gr σιδηρος, *iron*, Lat calx, *lime*) The name given by Kirwan to the *brown spar* of Werner

SIENITE, or SYENITE (From Syene in Egypt, whence the Romans obtained it for architectural purposes) A granitic aggregate of quartz, felspar, and hornblende *See* GEOLOGY

SIERRA A Spanish term, signifying a chain of hills, and prefixed to the names of several places in Spain and other parts discovered or colonized by the Spaniards

SIESTA (Span) The name given to the practice indulged in by the Spaniards, and the inhabitants of hot climates generally, of resting two or three hours in the middle of the day, when the heat is too oppressive to admit of their going from home

SIGILLA'RIA Fossil plants found in the coal formation

SIGN In Algebra, a symbol indicating an operation to be performed, or a relation subsisting between two quantities Of the former kind, those most commonly used are, + for addition, − for subtraction, × for multiplication, — for division, $\surd$ for the square root, $\sqrt[3]{}$ for the cube root, $\sqrt[n]{}$ for the *n*th root, &c The signs denoting a relation are, = equal to, > greater than, < less than, &c

SIGN In Astronomy, a portion of the ecliptic or zodiac, containing thirty degrees, or a twelfth part of the complete circle The first commences at the point of the equator through which the sun passes at the time of the vernal equinox, and they are counted onwards, proceeding from west to east, according to the annual course of the sun, all round the circle The names of the twelve signs, in the order in which they follow each other, with the characters by which they are indicated on globes, and in the almanacs and books, for short are as follows — *Aries* ♈, *Taurus* ♉, *Gemini* ♊, *Cancer* ♋, *Leo* ♌, *Virgo* ♍, *Libra* ♎, *Scorpius* ♏, *Sagittarius* ♐, *Capricornus* ♑, *Aquarius* ♒, *Pisces* ♓

It is to be remarked, that the above are also the names

of the twelve constellations of the zodiac, and in ancient times (above 2000 years before our era) the places of the signs and the constellations were coincident, but owing to the motion of the earth's equator, by which the equinoctial points are carried backwards on the ecliptic about 50" annually, the intersections of the ecliptic and equator, and consequently the commencement of the signs, now correspond to different stars, the first point of the sign Aries being at present near the beginning of the constellation Pisces On this account care must be taken not to confound the signs of the zodiac, which are fixed in respect of the equinoxes, with the constellations, which are moveable in respect of those points *See* CONSTELLATION

The *ascending signs* are the six beginning with Capricornus, through which the sun passes while advancing from the winter to the summer solstice, and is, consequently, acquiring altitude with respect to inhabitants of the northern hemisphere The other six, beginning with Cancer, are called the *descending signs*

SIGNALS, NAVAL imply a system of symbols addressed to the eye, as flags, boards, lights &c for establishing communication at distances too great for the voice Guns are also used for the same purposes The first signals seem to have been merely distinguishing flags for certain ships [illegible] by James II [illegible] on the part of the ship at which they were exhibited, a condition very detrimental to the use of signals at sea A code composed of *numeral* flags and pendants [illegible] in which each symbol had a number assigned to it, seems to have been the first step towards a general system, as before this plan each admiral instituted his own code In 1815, Sir Home Popham's code was adopted This added several *literal* or alphabetical flags and pendants which greatly extended the means of communication, but necessarily rendered the signals indistinct, and their purports deceitful in many cases, from the increased difficulty of distinguishing each flag from the rest In 1826, in consequence of some plans having been submitted by admirals for a more efficient system, the code now in use, which is considered as an improvement on its predecessor, was adopted In 1828 Admiral Raper published his code, which was one of those under consideration The principle of this system which is undeviatingly adhered to, is, that the manner of combination of the flags and pendants of which the signal is composed [illegible] their order or arrangement, points out the subject of the signal, or, as the author terms it the *point of service* to which the signal relates, while the *numbers* of the individual symbols indicate the number of the signal in its class The numbers are denoted, as usual by the colours, but when these fail, from haze or distance the [illegible] *numeral distant signals* From the small number of symbols [illegible] complete numeral signals), the precision obtained from classification by which the simplicity of each signal is proportioned to its importance and [illegible] the time often wasted in vain attempts [illegible] the precise disposition of the colours of each flag, this system has been considered by some competent judges as the sole thoroughly efficient method

In the merchant service, signals are of less extensive utility than in the royal navy, their chief employment being to express the names of vessels, latitude and longitude, and a few other such particulars, and it were much to be desired that governments would agree to establish universal signals [illegible] of general interest The code in use is Captain Marryatt's

Ingenious systems have been published by Lieut C Phillips, R N, for the ships of all nations, and also by Admiral Sir C Ekins, entitled *Universal Signals* the symbols being black and white only From what little acquaintance we have had with foreign signals, we consider them by no means in advance of our own

SIGNATURE (Lat signatura) In Music the flats and sharps placed after the clef, at the beginning of the staff, which affect, throughout the movement, all notes of the same letter

SIGNATURE In Printing, a letter of the alphabet placed at the bottom of the first page of each sheet of a work, to denote, alphabetically, the order of the sheets

It is customary to commence with B on the first sheet of the body of the work, and to go regularly through the alphabet, with the exception of the letters J, V, and W, which are never used as signatures; and which had, in fact, no existence in the alphabet at the time of the invention of printing, I, expressing both I and J, U, both U and V, and VV, the double letter W If the work extend to more sheets in number than there are letters in the alphabet, the succeeding sheets go on with a second alphabet, which commences with A, and both the letters are usually given, in this manner, A A, or A a, and sometimes, to avoid the repetition, thus, 2 A If a third alphabet be necessary it is always, at the present day, placed with the letter before it, as ∂ A

The printer's first alphabet consists of twenty two letters and the second and succeeding ones of twenty three

As a guide to the bookbinder there are other signatures used in a sheet besides the first In a sheet of octavo the first page has B, the third has B 2, the fifth has B 3 and the seventh has B 4 in a sheet of twelves they are carried to B 6, B 5 being the first page of the offcut, and however numerous the pages may be in a sheet with one signature, when they are all inserted they are continued to the last odd page before the middle of the sheet, but never carried beyond the middle In general they are all omitted except the two first, to show the first fold of the paper, and the first on the offcut Small capitals are more frequently used for signatures than large capitals, as disfiguring the foot of the page in a slighter manner Sometimes figures are used instead of letters but not often, the Gentleman's Magazine is an instance (*Savage's Dict of Printing*)

SIGNET, THE PRIVY One of the king's seals in England, used in sealing private letters and grants under the sign manual It is in the custody of the Secretary of State for the Home Department (*See* SEAL, SECRETARY) The signet in Scotland is the seal by which the king's letters and writs for the purpose of justice are now authenticated Hence the title of clerks to the signet, or writers to the signet, whose business is nearly the same with that of attorneys in England They were anciently clerks in the office of the Secretary of State by whom writs were prepared, and when the signet became employed in judicial proceedings they obtained a monopoly of the privileges of acting as agents or attorneys before the Court of Session

SIGN MANUAL The royal signature, superscribed at the top of bills of grants or letters patent, which are then sealed with the privy signet or great seal, as the case may be, to complete their validity But there are some grants which pass through certain offices, as the Admiralty or Treasury under the sign manual only

SIGNOR The Italian term equivalent to the English *Lord Sir* or *Mr* the French *Monsieur*, and the German *Herr* [illegible] recently the appellation of the chief council [illegible] Venice Genoa and Lucca

SILENACEÆ (Silene one of the genera) An order of Polypetalous Exogenous plants with opposite undivided leaves and a stem with tumid nodes The principal part of the order consists of uninteresting weedy plants, but it also contains the genera *Dianthus* of which the garden pink clove, and piccotee are species, the *Agrostemma Saponaria* and some other plants cultivated for their beautiful flowers

SILENTIARY Among the Romans, the title or office of a class of slaves attached to wealthy houses In the court of the emperors there was a body of officers attached to the household styled silentiaries Thence the title came to functionaries of higher authority, and was borne by cabinet secretaries in the Lower Empire and in the courts of Charlemagne and other western potentates who derived their code of ceremonial from Byzantium Members of the privy council seem to have been sometimes called by this name under the Plantagenets in England

SILENUS (Gr Σιληνος) A Grecian divinity the foster-father and attendant of Bacchus and likewise leader of the satyrs This deity was remarkable for his wisdom his drunkenness being regarded as inspiration He was represented as a robust old man in a state of intoxication and riding on an ass with a cup in his hand Silenus says Mr Bryant, is only a corruption of a masculine form of Σεληνη *the moon* By some speculative mythologists the drunken companion of Bacchus is converted into a sage who was honoured as a dæmon after his decease (*Theopompus in Ælian*, cited in Bryant *Anc Mythol* vol iii p 328) There was an order of priests called Sileni, of the same class with the Curetes

SILEX or SILICA (Gr χαλιξ, *a pebble* or *stone*) The earth of flints This important substance constitutes the characteristic ingredient of a great variety of siliceous minerals, among which rock-crystal, quartz chalcedony, and flint may be considered as silica nearly pure It also predominates in many of the rocky masses which [illegible] the [illegible] has none of the ordinary or more obvious acid properties yet as it combines in definite proportion with many salifiable [illegible] and its various compounds have been denominated *silicates* When pure and colourless rock-crystal is heated red hot and quenched in water, it becomes opaque and friable and if in this state it be reduced to powder, it presents one form of pure silica If in this state (in which it is perfectly insoluble in water) it be fused with three parts of carbonate of potash, it forms a glass which is soluble in water, and from this solution (formerly called *liquor of flints*) the concentrated acids throw down the silica in the form of a *gelatinous hydrate*, but if the solution be diluted, and the acid gradually added, the alkali may be

perfectly neutralized without any deposition of the silica, which, therefore, is thus exhibited in a very soluble state when however it is evaporated to dryness, the silica is rendered insoluble as before This solubility of hydrated silica, whilst when dry it is perfectly insoluble, may serve to explain the occasional occurrence of silica in mineral waters and its deposition in various chalcedonic incrustations But silica presents another very remarkable character, which is, that if we reverse the above proportions, and fuse together a mixture of one part of carbonate of potash and three of powdered rock-crystal or calcined flint, we then obtain a transparent and fusible compound, which is insoluble in water, and which, in fact, is glass

*Plate glass* and *window glass*, or, as it is commonly called, *crown glass*, are silicates of soda or potassa, and *flint glass*, of which our common glass utensils are made, is a similar compound, with a large addition of silicate of lead *See* GLASS

Silica, in its ordinary or *anhydrous* state is insoluble in all acids except the *hydrofluoric* which immediately acts upon it, and forms an extraordinary gaseous compound, the *fluosilicic* acid Silica was long considered as an elementary form of matter, but Sir H Davy found that when the vapour of potassium was brought into contact with pure silica heated to whiteness, silicate of potassa was formed, and a dark-coloured matter separated which was afterwards found to be the base of silica, and to which the terms *silicium* and *silicon* have been applied It is probably not metallic, and bears a greater analogy to boron than to any known principle Silicon is a nonconductor of electricity incombustible in air and oxygen, and not acted upon by any single acid, but it is readily soluble in a mixture of the nitric and hydrofluoric acids It is, however, rapidly oxidized by and burns vividly at a temperature below redness, when in contact with fused soda or potassa The exact equivalent of silica has not been very satisfactorily determined, but we are probably not very incorrect in regarding silica as a compound of equal weights of silicon and oxygen In that case if it be regarded as a protoxide, it is obvious that 8 will be the equivalent of its base, and silica will consist of 8 silicon + 8 oxygen, and be represented by the equivalent 16 But if silica be regarded as a compound of 1 atom of silicon and 3 atoms of oxygen and Berzelius has shown that some analogies favour this view, then 24 will be its equivalent, and 48 that of silica The *chloride of silicium* and its *bromide* are limpid fuming liquids, the former very volatile The *sulphuret* is a white earthy-looking substance

**SILHOUETTE** In the Fine Arts a name given to the representation of an object filled in of a black colour and in which the inner parts are sometimes indicated by lines of a lighter colour and shadows or extreme depths by the aid of a heightening of gum or other shining medium This sort of drawing derives its name from its inventor Etienne de Silhouette, the French minister of finance in 1759 Representations of this sort may be well enough taken from the shadow of a person thrown on a piece of paper placed against a flat surface or wall The likeness may be still better taken, if on a reduced scale, by means of the instrument called a pantograph

The invention of what is called a *silhouette* is however ascribed to a remote period, being said to have been the method whereby the daughter of a Greek potter drew the outline of her lover's portrait on a wall and has been placed at the time of the renewal of the Olympic games shortly before the expulsion of the Bacchiades from Corinth, about 776 B C It is to be observed that Sicyon and Corinth were the first cities in which painting flourished, and that Crato of Sicyon Philocles of Egypt and Cleanthes of Corinth, were considered the inventors of *monochromes*, or silhouettes, as they have been more recently called, which were applied to large objects The Etruscan vases furnish to an amazing extent, and in boundless variety, some of the most beautifully drawn and elegant monochromes or silhouettes that have ever been executed

**SILICIFICÆ** Substances petrified or mineralized by siliceous earth

**SILICULA** (Lat siliqua, *dim*) A fruit exactly similar to that called a siliqua, except that it is shorter, and contains fewer seeds It is never more than four times as long as broad, and usually much shorter

**SILIQUA** (Lat) A one or two celled, many-seeded, linear fruit, dehiscent by two valves separating from a replum, the seeds are attached to two placentæ adhering to the replum and opposite to the [illegible] of the stigma

**SILK** (Lat sericum, from Seres, the supposed ancient name of the Chinese) A fine glossy thread or filament spun by various species of caterpillars or larvæ of the *Phalæna* genus Of these, the *Phalæna atlas* produces the greatest quantity, but the *Phalæna bombyx* is that commonly employed for this purpose in Europe The silkworm, in its caterpillar state, which may be considered as the first stage of its existence, after acquiring its full growth (about three inches in length), proceeds to enclose itself in an oval shaped ball or cocoon, which is formed by an exceedingly slender and long filament of fine yellow silk emitted from the stomach of the insect preparatory to its assuming the shape of the chrysalis or moth In this latter stage, after emancipating itself from its silken prison, it seeks its mate, which has undergone a similar transformation; and in two or three days afterwards, the female having deposited her eggs (from 300 to 500 in number) both insects terminate their existence According to Reaumur, the *phalæna* is not the only insect that affords this material, — several species of the *aranea*, or spider, enclose their eggs in very fine silk

*Raw silk* is produced by the operation of winding off, at the same time several of the balls or cocoons (which are [illegible] in hot water, to soften the natural gum on the [illegible] on a common reel, thereby forming one smooth even thread When the skein is dry, it is taken from the reel and made up into hanks, but before it is fit for weaving, and in order to enable it to undergo the process of dyeing, without furring up or separating the fibres, it is converted into one of three forms, — viz *singles*, *tram*, or *organzine*

*Singles* (a collective noun) is formed of *one* of the reeled threads, being twisted, in order to give it strength and firmness

*Tram* is formed of two or more threads twisted together In this state it is commonly used in weaving, as the *shoot* or *weft*

*Thrown silk* is formed of two, three or more singles, according to the substance required, being twisted together in a contrary direction to that in which the singles of which it is composed are twisted This process is [illegible] and the [illegible] was originally performed [illegible] where it was kept a secret for a long period Stowe says it was known in this country since the 5th of Queen Elizabeth, "when it was gained from the strangers," and in that year (1562), the silk throwsters of the metropolis were united into a fellowship They were incorporated in the year 1629, but the art continued to be very imperfect in England until 1719 (See *post*)

*Historical Sketch of the Manufacture* — The art of rearing silkworms of unravelling the threads spun by them, and manufacturing the latter into articles of dress and ornament, seems to have been first practised by the Chinese Virgil is the earliest of the Roman writers who has been supposed to allude to the production of silk in China and the terms he employs show how little was then known at Rome as to the real nature of the article —

> Velleraque ut foliis depectant tenuia Seres.
> *Georg* book ii lin 121

But it may be doubted whether Virgil do not, in this line refer to cotton rather than silk Pliny however has distinctly described the formation of silk by the *bombyx* (*Hist Nat* lib xi c 17) It is uncertain when it first began to be introduced at Rome, but it was most probably in the age of Pompey and Julius Cæsar the latter of whom displayed a profusion of silks in some of the magnificent theatrical spectacles with which he sought at once to conciliate and amuse the people Owing principally no doubt to the great distance of China from Rome and to the difficulties in the way of the intercourse with that country, which was carried on by land caravans, whose route lay through the Persian empire, and partly perhaps, to the high price of silk in China, its cost when it arrived at Rome was very great, so much so, that a given weight of silk was sometimes sold for an equal weight of gold! At first it was only used by a few ladies eminent for their rank and opulence In the beginning of the reign of Tiberius, a law was passed —*ne vestis serica viros fœdaret* — that no man should disgrace himself by wearing a silken garment (*Tacit Annal* lib ii c 33) But the [illegible] Heliogabalus despised this law and was the first of the Roman emperors who wore a dress composed wholly of silk (*holosericum*) The example once set, the [illegible] of wearing silk soon became [illegible] the wealthy citizens of Rome and the [illegible] According as the demand for [illegible] increased [illegible] were made to import larger quantities, and the price seems to have progressively declined from the reign of Aurelian That this must have been the case, is obvious from the statement of Ammianus Marcellinus, that silk was, in his time (anno 370), very generally worn, even by the lowest classes *Sericum ad usum antehac nobilium, nunc etiam* [illegible] (Lib xxiii c 6) [illegible] Roman empire in return for silk, now become indispensable to the western world, till the 6th century About the year 550, two Persian monks, who had long resided in China, and made themselves acquainted with the mode of rearing the silkworm, encouraged by the gifts and promises of Justinian, succeeded in carrying the eggs of the insect to Constantinople Under their direction they were hatched and fed, they lived and

[illegible] a sufficient number of but[illegible] to propagate the race, and mulberry trees were planted to afford nourishment to the rising generations. A new and important branch of industry was thus established in Europe Experience and reflection gradually corrected the errors of a new attempt, and the Sogdiote ambassadors acknowledged in the succeeding reign, that the Romans were not inferior to the natives of [illegible] and the manufactu[illegible] vol vii p 99 )

Greece, particularly the Peloponnesus, was early distinguished by the rearing of silkworms, and by the skill and success with which the inhabitants of Thebes, Corinth, and Argos carried on the manufacture Until the 12th century, Greece continued to be the only Europ[illegible] these arts were practised, but the [illegible] Roger, king of Sicily, having, in 1147, [illegible] and Thebes, carried off large numbers of the inhabitants to Palermo, who introduced the culture of the worm and the manufacture of silk into Sicily From this island the art spread into Italy, and Venice, Milan, Florence, Lucca, &c were soon after distinguished for their success in raising silkworms, and for the extent and beauty of their manufactures of silk (*Gibbon*, vol x. p 110, *Biographie Universelle*, art "Roger II")

The manufacture of silk appears to have been introduced into Spain at a very early period by the Moors, particularly in Murcia, Cordova, and Granada "The last town, indeed, possessed a flourishing silk trade when it was taken by Ferdinand in the 15th century The French having [illegible] with workmen from Milan, commenced, in [illegible] manufacture, but it was not till 1564 that they began successfully to produce the silk itself, when Traucat a working gardener at [illegible] formed the first nurseries of white mulberry trees and with such success that in a few years he was enabled to propagate them over many of the southern provinces of France Prior to this time, some French noblemen on their return from the conquest of Naples had introduced a few silkworms with the mulberry into Dauphiny, but the business had not prospered in their hands The mulberry plantations were greatly encouraged by Henry IV, and since then they have been the source of most beneficial employment to the French

James I was most solicitous to introduce the breeding of silkworms into England, and in a speech from the throne he earnestly recommended his subjects to plant mulberry-trees, but he totally failed in the project This country does not seem to be well adapted to this species of husbandry, on account of the great prevalence of blighting east winds during the months of April and May, when the worms require a plentiful supply of mulberry-leaves. The manufacture of silk goods, however, made great progress during that king's peaceful and pompous reign In 1629 it had become so considerable in London, that the silk throwsters of the city and suburbs were formed into a public corporation So early as 1661 they employed 40 000 persons The revocation of the edict of Nantes, in 1685, contributed in a remarkable manner to the increase of the English silk trade, by the influx of a large colony of skilful French weavers, who settled in Spitalfields The great silk-throwing mill mounted at Derby, in 1719 also served to promote the extension of this branch of manufacture, for soon afterwards, in the year 1730, the English silk goods bore a higher price in Italy than those made by the Italians, according to the testimony of Keysler It would be impossible, within our limits, to give an account of the gradual progress of the silk manufacture from that period down to the present time Upon this subject, the reader will find ample details in the *Commercial Dictionary*, meantime we may remark that a great revolution was effected in the manufacture in 1825 Previously to that epoch [illegible] enactments with respect to it were the [illegible] and impolitic that can well be imagined The importation of foreign silks was prohibited under the severest penalties, but the advantage that this prohibition was believed, though most [illegible] on the manufacturer, would [illegible] circumstances, have been more than [illegible] of oppressive duties on the raw material This vicious system was productive of a twofold mischief, for, by teaching the manufacturers to depend on custom-house regulations for protection against foreign competition it made them indifferent about new discoveries and inventions while, owing to the exorbitant duties on the raw material, and the want of improvement the price of silks was maintained so high as to restrict the demand for them within comparatively [illegible] limits In 1825, however, a new and more reasonable order of things was introduced The duties on the raw material were greatly lowered; at the same time [illegible] were allowed to be imported on [illegible] of 30 per cent *ad valorem* This new system was vehemently opposed at its outset, and it was confidently predicted that it would occasion the ruin of the manufacture, but the result has shown the soundness of the principles on which it was bottomed The manufacturers were now, for the first time, compelled to call all the resources of science and ingenuity to their aid; and the result has been that the manufacture has been more improved during the last twenty-five years than it had been in the whole previous century, and that it has continued progressively to increase These duties have again been [illegible] 10 Vict c 23 [illegible] manufactured silks being charged at [illegible] and upwards, or [illegible] weight [illegible] imported for home consumption in 1850 was nearly 5,000,000 lbs The total number of individuals directly engaged in the manufacture has been estimated at upwards of 207 000 but we incline to think that this is very decidedly beyond the mark The value of the silks annually produced may, perhaps, be estimated at from [illegible] to 12,000,000*l*

SILL (Sax syll) In Architecture the horizontal piece at the bottom of a framed case, such as that of a door or window This word is also used to denote the bottom piece of a quarter partition *Ground sills* are those timbers on the ground on which are placed the posts and superstructure of a timber building

SILLIMANITE A mineral named after Professor Silliman, from Saybrook in Connecticut, it is of a brown or dark grey colour, and composed of silica and alumina, with a trace of oxide of iron

SILT The name given to the sand, clay, and earth which accumulate in running waters

SILURIAN The name given by Murchison to a series of rocks forming the upper subdivision of the sedimentary strata found below the old red sandstone, and formerly designated the *grey-wacke series* These strata are well developed in that part of England and Wales formerly included in the ancient British kingdom of the *Silures* See GEOLOGY

SILURIDANS *Siluridæ* (Lat silurus, *a sheath-fish*) The name of the family of fishes of which the genus *Silurus* is the type, and which includes the electric silurus (*Malapterurus electricus*) They are chiefly distinguished by the want of true scales, having merely a naked skin, or large osseous plates A strong osseous spine forms the first ray of the dorsal and pectoral fins, except in the genus *Malapterurus*

SILVANUS A rural Italian deity, so called from Lat sylva *a wood* He also presided over boundaries

SILVER (Germ silber) A white, malleable, ductile, and tenacious metal, of a brilliant lustre when polished, and soft when pure Its specific gravity is 10 5 It is not altered by air or moisture, but is blackened or tarnished by sulphuretted hydrogen When melted in open vessels it has the curious property of absorbing oxygen, which it gives out when it congeals This is the cause of the appearance of granular crystallization which silver assumes when hastily cooled [illegible] of copper entirely prevents the effect [illegible] which act upon silver are the nitric and sulphuric The nitric acid dissolves silver without the aid of heat nitrous gas is evolved, and a dense colourless solution obtained, from which tabular crystals of nitrate of silver may be procured by evaporation These crystals are anhydrous and consist of 118 oxide of silver and 54 nitric acid, the equivalent of silver being 110 When melted, and cast into sticks or quills, they form the *lunar caustic* of the surgeons Any gold which the silver might have contained, being insoluble in nitric acid, remains in the form of a black powder, and this simple process enables us readily to separate those metals Silver is not attacked by cold sulphuric acid, but when granulated silver is heated in concentrated sul-

[illegible] the oxide of [illegible] and [illegible] forming a sulphate of silver [illegible] anhydrous [illegible] crystals In this case, the gold also [illegible] as sulphuric is much cheaper than nitric acid, it is used for the separation of those metals upon the large scale The solutions both of the nitrate and sulphate of silver are decomposed by the immersion of several of the other metals Copper is generally used for the purpose, which, when immersed in the solution of silver, causes its separation in the form of a grey metallic powder which is sometimes technically called *water silver* Chlorine and all the soluble chlorides, when added to solutions of silver occasion a white curdy precipitate which is distinguished by the rapidity with which it [illegible] by exposure to light The substance thus formed is a chloride of silver composed of 110 silver + 36 chlorine, the equivalent of chloride of silver being 146 It is not decomposed by heat alone, but when carefully melted it concretes into a horny substance, formerly called *luna cornea* Chloride of silver may be easily decomposed either by mixing it in a moist state with zinc filings or [illegible] soda or potash in either [illegible] The insolubility of chlo-

ride of silver renders a solution of nitrate of silver an admirable test of the presence of common salt or other chlorides in mineral waters, and, on the other hand, a solution of common salt is used to detect silver when in solution A solution of [illegible] nitrate of silver in an ounce of water, [illegible] sap green or Indian ink, forms marking ink, and when written upon linen, previously prepared by the application of a weak solution of carbonate of soda with a little gum in it, soon forms black indelible letters When a dilute solution of silver is mixed with alcohol an effervescence ensues, and *fulminating silver* is precipitated This most dangerous compound (a peculiar cyanate of silver) ought never to be meddled with in quantity, and always with [illegible] upon the [illegible] rubbed, or heated

The numerous uses and applications of silver are well known In its pure state it is too soft for coin, plate, and most ornamental purposes, and is therefore, in such cases, alloyed with copper, by which, in proper proportion, its colour is not materially impaired, and it is considerably hardened The standard silver of our coin is an alloy of 11 oz 2 dwts of pure silver, and 18 dwts of copper, to the pound Troy, and this weight is coined into 66 shillings

Silver is found *native*, and in the state of *sulphuret*, constituting the varieties of black and vitreous silver ore It also occurs in combination with several other metals, and more especially with the sulphurets of lead, so that the lead of commerce is seldom quite free from traces of silver, and many such lead ores are worked as ores of silver

SIMARU'BA The bark of the root of the *Quassia simaruba*, a native of the West Indies This is a tough, fibrous, bitter bark, the infusion is occasionally used in medicine as a tonic

SIMARUBA'CEÆ (Simaruba, one of the genera) A natural order of arborescent or shrubby Exogens inhabiting the tropics The species are intensely bitter The wood of quassia is well known A plant called *Paraiba* in Brazil, the *Simaruba versicolor* of St Hilaire, possesses such excessive bitterness that no insects will attack it, and *Picræna excelsa* is another species of the order, which is employed in medicine for the same property

SI'MIA (Lat simus *flat-nosed*) The generic name applied by Linnæus to all the Quadrumanous Mammals except the lemurs The Linnean *Simiæ* are divided into numerous subgenera to none of which the name *Simia* is now applied except by some modern naturalists to the orang-utans (*Simia satyrus* and *S. morio*)

SI'MILAR (Lat similis *like*) In Geometry similar rectilineal figures are such as have their several angles respectively equal, each to each and their sides about the equal angles proportional The areas of two similar figures are to each other as the squares of their homologous sides *Similar segments of circles* are such as contain equal angles *Similar curves* are curves whose equations are of the same form and the ratio of the constants in those equations equal Hence all circles are similar, and all parabolas are similar, because in both cases, only one constant enters into the equation of the curve *Similar solids* are such as are contained by the same number of similar planes, similarly situated, and having like inclinations to one another Such solids are to one another as the cubes of their homologous sides

SI'MILE (Lat *like*) In Rhetoric, the same as *comparison* which see

SIMI'LITER (Lat *in like manner*) In Law, the technical designation of the form by which either party, in pleading, accepts the issue tendered by his opponent The one having concluded his plea, replication, &c., by [illegible] by "putting himself [illegible] that the truth of the facts may be inquired of by a jury, the other adds the similiter, which is in the form,—"And the said A B as to the plea, &c of the defendant (or plaintiff) above pleaded, and whereof he hath put himself upon the country, doth the like" *See* PLEADING

SIMI'LITUDE [illegible] signifies the relation of [illegible] to each other

SIMONIANS The name given to the followers of Simon Magus who pretended to be the great virtue and power of God sent from heaven to earth Their system was a medley of the philosophy of Plato, the mythological fables of the heathens, and of Christianity The sum of their doctrines as [illegible] by their founder, was, that from the Divine Being [illegible] fountain of light, flow various orders of eternal natures, subsisting within the plenitude of the Divine essence, that beyond these in the order of emanation are different classes of intelligences, to the lowest of which belongs the human soul; that matter is the most remote production of the emanative power, which, on account of its infinite distance from the fountain of light, possesses [illegible] malignant qualities, which appear the [illegible]



are the cause of evil, that it is the great design of philosophy to deliver the soul from its imprisonment in matter, and restore it to that divine light from which it was derived, and that for this purpose God had sent us one of the first *æons* into the world He believed also in the transmigration of [illegible] of the body (*Encyc B* [illegible] length the opinions of [illegible] entitled to, but considering that it was the first heresy in the Christian church, a resumé of its views was consi[illegible]

[illegible] *see* SAINT SIMONIANS

SI[illegible] lawful contract for the presenting a clergyman to a benefice When such presentation is made corruptly, for money, gift, or reward, by stat 31 Eliz c 6 such presentations are void, and the crown shall present for that turn And by 12 Ann 8 t 2 c 12 if any one, for money or profit, procures in his own name the next presentation to any living ecclesiastical, and is presented thereupon, the contract is simoniacal The term is derived from Simon Magus, who was punished, as is related in the Acts, for attempting to obtain the gifts of the Holy Spirit by bribing the apostles It is generally remarked, however, that the practices against which our laws are directed bear no precise [illegible]

SIMOON, or SIMOOM A hot arid wind which blows in Arabia, Syria, and the adjacent countries, and chiefly about the time of the equinoxes The simoon, which is identical with the *khamsin* of Syria and the *samiel* of the Turks, and resembles in many respects the *sirocco* and *sorana* of other countries, derives its qualities from blowing over sandy deserts heated intensely by the sun Sometimes it blows in squalls, bearing along with it quantities of burning sand and dust In the desert it is greatly dreaded, and the only chance of safesty the traveller has is to fall down with his face close to the ground, and [illegible] drawing breath [illegible] Bruce, Volney, Charlind Malcolm, and other travellers

SIMPLI'CIMANES, *Simplicimani* (Lat simplex, *simple*, manus, *a hand*) A name given by Latreille to a tribe of Caraboid beetles comprehending those in which, in the male, the two anterior tarsi are dilated

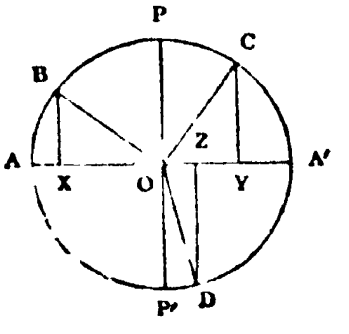
SIMPLI'CITY (From Lat simplex) In the Fine Arts that quality in works of art through which the elements whereof it is composed are arranged in the most natural order, and in which the ideas and images are presented to us so that [illegible] by the accessories, and [illegible] in due subordination to the whole Simplicity is the reverse of excess and exaggeration, and may be properly called a negative quality in art

SI'NAPISIN A peculiar principle extracted from mustard seed (*Sinapis alba*) It is a white crystallizable inodorous substance, of a bitter taste accompanied by the flavour of mustard It is supposed to contain sulphur, carbo[illegible]

SI'NAPISM [illegible], *mustard*) A mustard poultice

SI'NCIPUT The anterior region of the upper part of the head, from the vertex to the eyes in Mammals, and from the vertex to the base of the beak in birds

SINE (Lat sinus *the bosom*) In Trigonometry the sine of any arc of a circle is the straight line drawn from one extremity of the arc perpendicular to the radius passing through the other extremity Thus, in the circle A B C D let O A and O B be two radii and let B X be perpendicular to O A, then B X is the sine of the intercepted arc A B In like manner, if C Y and D Z be perpendicular to A O, or its prolongation O A', then C Y is the sine of the arc A B C, or of A' C, the supplement of A B C, and D Z the sine of A C D, or of A' D




Draw the diameter P O P', and suppose the arc A B to increase from 0 to 360° It is evident that as the arc A B increases from A to A P, or from 0 to 90°, the sine B X increases from zero to O P, [illegible] to the radius, and hence the ra[illegible] *totus*, or whole sine Between P and A the sine again diminishes as the arc is increased and vanishes at A' [illegible] P' it again increases till it becomes equal [illegible] and from this position decreases until it again vanishes at A Hence it appears that the origin being supposed at A the sine is positive in the first and second quadrants, or from 0 to 180°, and negative in the third and fourth, or from 180° to 360°

If [illegible] be described about the same centre O the two lines O A and O B would intercept on it an arc similar to A B, and if, also, we suppose the radius of this second circle = 1, and denote the inter-

cepted arc by $\phi$; then we shall have evidently sin $\phi$ : 1 :: BX : BO, or sin $\phi = \frac{BX}{BO}$ But the arc whose radius is 1 is the measure of the angle at the centre, therefore the sine of the angle AOB is the ratio of BX to BO, or AO This definition of the sine of an angle is adopted in some of the best recent works on trigonometry

The sine of an arc is the half of the chord of the double arc Ptolemy, in the graphical constructions in the *Analemma*, makes use of the semichords instead of the chords, but the introduction of the sines into trigonometrical calculation was an importa it i provement of which the credit appears to be due to the Arabian astr omer Albategnius (Delambre, *Astronomie du Moyen Age*, p 12) The term *sine* has been variously derived, the Arabic name is *gib*, or *dgib*, signifying *a fold*, of which *sinus* is the Latin translation (*Hutton's Mathematical Tables*)

For the analytical expressions of the sines of the sums and differences of two arcs, of multiple arcs, and of the lines, see TRIGONOMETRY

SINECURE Politics, an office without any duties attached to it The term is properly ecclesiastical and applied to a benefice without care of souls, in which sense it is also still employed

SINE DIE (Lat *without day*) In Legal and Parliamentary Usage, an adjournment or prorogation *sine die* means without any specified day for resuming the subject or reassembling

SINGULAR TERM In Logic, a term which stands for one individual A singular proposition is one which has for its subject either a singular term or a common term limited to one individual by a singular sign *See* TERM, PROPOSITION

SINISTER (Lat literally *left*) is used in its ordinary signification for unlucky, though the Romans in the rites of divination attached to it the opposite meaning Thus *avis sinistra* or a bird on the left hand was esteemed a happy omen, and *intonuit laevâ* it thundered on the left hand, indicated the same *Sinister* in Heraldry, is used to designate the left-hand side or part

SINKING FUND A provision made by parliament consisting of the surplusage of other funds intended to be appropriated to the payment of the national debt *See* FUNDS

SINOPLE In Heraldry, the Continental designation for the colour green, by English heralds called *vert* The name is said to be derived, through the importation of the Crusades, from the town of Sinope, in Asia Minor

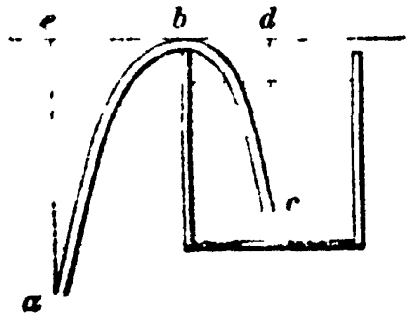
SINTER A German word implying a *scale* (*Calcareous sinter*) is a variety of carbonate of lime composed of successive concentric layers *Silicious sinter* is a variety of common opal

SINUOUS (Lat sinuosus) In the Fine Arts of a serpentine or undulating form

SINUS (Lat) The veins of the dura mater of the brain are called *sinuses*

SIPHON (Gr σιφων, *a tube*) In Zoology the name of the membranous and calcareous tubes which traverse the septa and the interior of Polythalamous shells Also applied to the tubular prolongations of the valves of Bivalve Molluscous animals, and to the mouth of certain Suctorious Crustaceous, and Apterous insects

SIPHON, or SYPHON In Hydraulics a simple and well known instrument, chiefly used for the purpose of drawing off liquids from casks The siphon is simply a bent tube, *a b c* having one end longer than the other To use the siphon, the tube is in the first place filled with the liquid and the open end *a* stopt by the hand, or by a cock,




in which state the liquid will not flow from the other extremity The end *c* is then immersed in the liquid, and the stop removed from *a*, upon which if *a* be at a lower level than *c*, the liquid will immediately begin to flow out at *a*, and will continue to flow until the vessel is drained down to the level of *c*

The principle of the siphon may be explained as follows — The lowest section of the fluid within the tube at the extremity *c* is subjected to two unequal pressures in opposite directions first the pressure due to the weight of the liquid in the branch *b c*, which pressure is equal to the [illegible] external liquor at *c*, which is equal to the atmospheric pressure, or the weight of a column of liquid of about 34 feet in height, together with the weight of the column reaching from *c* to the surface of the liquid in the vessel, which, however, we may leave out of consideration Hence, if the line *c d* be less than 34 feet (if the liquid be water the last pressure will preponderate and the liquid will be forced in at the tube by a pressure equal to the weight of the atmosphere diminished by the weight of a column of the fluid equal to *c d* In like manner, the pressure upon a section of the liquid at *a* is equal to the weight of the atmospheric column diminished by the weight of a column of the fluid equal in height to *a e* If, therefore, *a e* be greater than *c d* the pressure at *c* will be greater than the pressure at *a*, and the liquid will be forced through the tube

From this explanation it is obvious that the limits within which the siphon can act are determined by the specific gravity of the fluid Water cannot be raised by the siphon [illegible] nor mercury to a greater height than [illegible] It is also obvious that the comparative diameters of the two branches, and their oblique lengths, are of no importance, the action depending only on the difference of their perpendicular heights

Sometimes the siphon is made with both branches equal, and turned up at the extremities, in which case, so long as the extremities are kept on the same level, it will continue always full and ready for use This form of the instrument is called the *Wurtemberg siphon*, from its having been first used at that place

SIPHONAPTERANS, *Siphonaptera* (Gr σιφων, α priv and πτερον *a wing*) A name given by Latreille to an order of insects, including those Apterous species which have a mouth in the form of a siphon

SIPHONIFERS, *Siphonifera* (Gr σιφων, Lat fero, *I bear*) A name given by D'Orbigny and Lerussac to an order of Cephalopods, including all those species which have a siphon contained within a polythalamous shell

SIPHONOBRANCHIATES, *Siphonobranchiata* (Gr σιφων, and βραγχια, *gills*) The name of an order of Gastropods, including those in which the branchial cavity terminates in a tube or siphon more or less prolonged by which the respiratory current of water is received and expelled

SIPHONOPHORES *Siphonophora* (Gr σιφων, and φερω, *I bear*) A name given by Eschscholtz to an order of Acalephes, to which he refers those species that have no central nervous system but simply isolated tubes

SIPHONOSTOMES *Siphonostoma* (Gr σιφων, and στομα *a mouth*) The name of a family of Crustaceans, including those which have a siphon shaped mouth [illegible] By M de Blainville the term is applied to those Gastropods which have the opening of the shell [illegible]

SIPHORHINIANS *Siphorhina* (Gr σιφων and ρις, *a nose*) A name applied to a tribe of swimming birds, including those which have the nostrils prominent and tubular

SIPUNCLE *Sipunculus* The name of a genus of worms which burrow in the sands of the sea shore, and are classed with the *Echinoderms* by Cuvier, and with the *Entozoa* by M de Blainville They differ from the soft bodied *Echinoderms* chiefly in the absence of ambulacral pores

SIR The term used in England, either out of respect or formality, in addressing any one More particularly, it is [illegible] appellation of knights and baronets, [illegible] names it is prefixed The derivation of this word has greatly puzzled etymologists The Latin herus *master* (whence the German herr), and senior whence *signior sire, sir*, and the Gr κυριος, *lord* are specimens of the origin which has been assigned to this term The second is undoubtedly correct Since the 16th century the word *sire* has been used in prose only in addressing sovereign princes

SIREN The generic name of certain Perennibranchiate reptiles which have only one pair of feet, and retain the external gills, they are peculiar to the southern provinces of the United States

SIRENE In Acoustics, an instrument for determining the velocity of aerial vibration, corresponding to the different pitches of musical sounds "In this elegant instrument the wind of a bellows is emitted through a small aperture, before which revolves a circular disc pierced with a certain number of holes, arranged in a circle concentric with the axis of rotation, exactly equidistant from each other, and of the same size, &c The orifice through which the air passes is so situated that each of these holes, during the rotation of the disc shall pass over it, and let through the air, but the disc is made to revolve so near the orifice that in the intervals between the holes it shall act as a cover, and intercept the air If the holes be placed obliquely, the action of the current of air alone will set the disc in motion, if perpendicular to the surface, the disc must be moved by wheel-work, by means of which its velocity of rotation is easily regulated and the number of impulses may be exactly counted The sound produced is clear and sweet, like the human voice. If, instead of a single aper-

ture for [illegible] where the several, so disposed in a circle of equal [illegible] with [illegible] the holes of the [illegible] pass [illegible] sounds of one pitch, and being heard together will reinforce each other The sirene sounds equally when plunged in water and fed by a current of that fluid as in air thus proving that it is the number of impulses only and nothing dependent upon the nature of the medium in which the sound is excited that influences our appreciation of its pitch" (Sir John Herschel's Treatise on Sound, *Encyc Metropolitana*)

The sirene, as thus described was invented by Baron Cagniard de la Tour An instrument on the same principle, and for the same purpose, had formerly been devised by Professor Robison, but the construction was much less elegant and commodious A current of air passing through a pipe was alternately intercepted and permitted to pass by the shutting and opening of a stop cock

SI'RENS (Gr Σειρῆνες, probably from *σειρα a chain*, to signify their attractive power) Melodious divinities, who dwelt on the shores of Sicily and so charmed passing mariners by the sweetness of their song that they forgot their homes and remained there till they perished of hunger Their history has been variously described According to Homer in the *Odyssey*, as Ulysses and his companions were on their [illegible] Æaea, they came first to the isl[illegible] it they passed in safety, for, by the directions of Circe, Ulysses stopped the ears of his companions with wax, and had himself tied to the mast before approaching the island, so that, although when he heard the song of the Sirens he made signs for his companions to unbind him, they only secured him the more closely in compliance with his previous instructions Thus he listened to the songs of the Sirens, and escaped notwithstanding Hence it was feigned that they threw themselves into the sea from vexation at the escape of Ulysses, an oracle having predicted that they should live only so long as their strains had power to arrest all who heard them But according to other poets, they threw themselves into the sea from rage and despair on hearing the more melodious song of Orpheus Originally there were only two Sirens, but their number was afterwards increased to three, and their names are given with great variety See the speculations of Bryant on the subject, *Anc Mythol* ii 277, and iii 237

SI'RIUS (called also *Canicula*, or *Canis Candens* the [illegible] the first magnitude in the constel[illegible] or the Great Dog and the brightest in the heavens The Egyptians observing that the Nile [illegible] ing of this star paid it [illegible] from *Seirs*, one of the appellations of the Nile

SIROCCO (Ital) A soft relaxing wind chiefly experienced in the south of Italy, Malta and Sicily It blows from the south east or south and having been heated over the sandy deserts of Libya it becomes occasionally moist in its passage across the Mediterranean and oppresses the inhabitants of the above named countries with excessive languor and a sinking of the mental energies The setting in of the sirocco is followed by a considerable rise of the thermometer and is attended with a haze which obscures the atmosphere See SIMOON

SIRVE'NTII In the Literature of the Middle Ages, as [illegible] the Troubadours, [illegible] phes of a peculiar construction See TROUBADOUR

SI'STRUM (Gr σιστρον from *σειω to shake*) A kind of timbrel, which the Egyptian priests of Isis used to shake with their hands at the festivals of that goddess

SISYPHUS In Ancient Mythology one of the descendants of Æolus respecting whom a variety of opinions prevails By some he is said to have resided at Ephyra in the Peloponnesus, others maintain that he was a Trojan prince, who was punished for betraying state secrets, while others allege that he was a notorious robber, slain by Theseus Be this as it may all the ancient poets are agreed that he was distinguished for his craftiness and cunning, and that his punishment in Tartarus for his crimes committed on earth consisted in rolling a huge stone to the top of a high hill, which [illegible] and thus rendered his labour incessar[illegible] phus is supposed to be derived from Gr σισοφος (by a common duplication for σοφος, *wise*), and to signify *over-wise*

SI'TTA (Gr σιττα) The name of a bird in Aristotle, which Gesner determined to be the nuthatch Linnæus retains the term for the genus of which the nuthatch (*Sitta Europæa*, L) is the type

SIVA In Hindoo Mythology a title given to the Supreme Being, considered in the character of the avenger or destroyer Sir William Jones has compared Siva to Jupiter, but he appears to sha[illegible] attributes of Pluto Under the name of Mahadeva, I is exhibited also as a type of reproduction to destroy, according to the Vedantas of India, the Sufis of Persia, and even to many European schools of philosophy being only to generate or reproduce under another form *See* VISHNU BRAHMA

SIVALIK [illegible] Siva and Gr [illegible] The [illegible] in fossil remains in the tertiary strata of the Sivalik Sub-Himalayan range It surpassed all known ruminants in size, and had four horns

SIZARS [illegible] At Oxford the [illegible] denominations of servitors, &c They are such as have certain allowances made in their [illegible] college bills), through the benefactions of founders or other charitable persons In college phraseology, a size is a portion of bread, meat, &c allotted to a student, and hence the name sizar The sizars at Cambridge are almost entirely on the same footing with independent students, at Oxford they are somewhat lower, and some relics of their [illegible] colleges [illegible] off [illegible]

SIZE A sort of varnish, paint, or glue, used by painters, and in many other trades It is made of the shreds and parings of leather, parchment, or vellum, boiled in water and strained

SKE'LETON (Gr σκελλω, *I make dry*) The dead [illegible] framework of an animal body, which, [illegible] setting of different parts, may be joined together by [illegible] which [illegible] a natural [illegible] and [illegible] which it is form [illegible] ized animals, as the *Polygastria* and *Polypi*, the skeleton, when it exists, commonly consists of a single piece In the *Polygastria* it is external, in the form of a case, and consists of pure silex In [illegible] sometimes internal, [illegible] bonate of lime or with a small additional proportion of phosphate of lime and these earths are combined with a greater or less proportion of gelatinous animal matter In the *Isis* the skeleton consists of numerous separate calcareous joints, connected together by portions of uncalcined gelatin In many of the Lithophytous *Polypes* innumerable minute spiculæ, of various but definite forms are scattered through the fleshy investment of the main internal skeleton In the *Echinoderms* the skeleton is external as regards the viscera, but is covered by an organized skin It is chiefly remarkable for the great number of pieces of which it is composed, and the regular and beautiful forms in which they are combined, it likewise supports numerous tubercles or spines it is composed of carbonate and phosphate of lime, with a gelatinous basis In *Insects* the skeleton is partly internal, but chiefly external, and the hardening material is a peculiar animal principle, called "chitine" In cabinets of dried insects it is the natural skeleton that is preserved In *Crustacea* the skeleton, which bears the same relative position to the animal as in insects, is rendered denser and more brittle by being consolidated with the carbonate and phosphate of lime In the *Mollusca* the skeleton is generally external but sometimes internal it is hardened by the carbonate of lime with a very slight trace of the phosphate of lime, and constitutes the shell The beauty, durability, and variety of form of [illegible] the shells [illegible] of collectors, and the subject of a distinct branch of natural history under the name of 'Conchology" The skeleton of mollusks is either in one piece as in the univalve mollusks, or in two pieces, as in most bivalves, or in many pieces as in the multivalve chitons, and others In the *Cephalopods* besides the shell, which offers re[illegible] [illegible] [illegible] condition In the Vertebrate animals, there is always an internal skeleton destined to protect the central part of the nervous system, and to form the fulcrum and support of the locomotive members In a few fishes it is cartilaginous, in the rest of the Vertebrates it is osseous, or consolidated by a large proportion of phosphate and a small proportion of carbonate of lime, and some other hardening salts (See BONE.) This is termed the "endo-skeleton" In most [illegible] as the crocodilians and in the [illegible] the Mammalia, osseous plates are developed in the substance of the skin, these are analogous to the skeleton of most of the Invertebrate animals, and form a more or less complete protecting case called the "exo-skeleton"

SKETCH (It schizzo) In Painting, &c, the first delineated [illegible] the artist's conception of a subject, in which are [illegible] the fire and enthusiasm with which the subject is expressed and felt

SKEW BACK In Architecture the sloping abutment in brickwork [illegible] masonry for the ends of the arched head [illegible]

SKEW BRIDGE In Engineering, the name given to a kind of bridge introduced upon railroads, when the

railway intersects any existing c[illegible] at right angles Such bridges were c[illegible] before railroads were introduced, but their general introduction has rendered the use of skew bridges universal in cases where it may be necessary or unavoidable to preserve as straight or direct a line as possible The *Ency Britannica* contains an elaborate article upon this subject

SKIN The external covering of the body It is divisible into three parts or membranes The exterior is called the scarfskin or cuticle it is an albuminous membrane Immediately underneath it is a thin layer of soft or pulpy matter, called the *rete mucosum* (mucous network), which is the seat of colour it lies upon the *cutis*, or true skin, which is a gelatinous texture

SKIP (Fr esquiver) In Music a passage from one sound to another by more than a degree at one time

SKIRTING In Architecture, the narrow vertical board on the floor round the sides of an apartment

SKO'LEZITE (Gr σκωλης *twisted*) A mineral which occurs crystallized and massive It is colourless and translucent, and when heated before the blowpipe shrinks up into wormlike contortions

SKO'RODITE (Gr σκοροδον, *garlic*, in allusion to its odour when heated) An arseniate of iron

SKO'RZITE A mineralogical synonym of a variety of epidote, from Skorza

SKULL The bony case which contains the brain it forms the forehead, and every part of the head except the face It consists of eight bones, namely the frontal and occipital bones, upon its fore and back part, the two temporal and two parietal bones forming the temples and the sides of the skull, and the sphenoid and ethmoid [illegible] of the orbits and nose

SKY[illegible] a species of the genus *Alauda* (see that word), the *Alauda arvensis* of Linnæus

SKY SAIL A small sail sometimes set above the royal

SLAB LINE A small rope leading through a block under the lower yards, and thence to the foot of the sail, f[illegible]

SL[illegible] he size of an egg

SL[illegible] or vitrifiable compounds which are produced during the reduction of metallic ores by v[illegible] of large smelting w[illegible] he slags which are abundantly produced, are sometimes used as building mate[illegible] They often co[illegible] metal

SLA'NDER In Law, a malicious defamation of a man by words spoken It is not actionable unless it impute some crime punishable by law, or some infectious disease, such as leprosy or the like which may have the effect of excluding from society the person slandered or be uttered concerning him in his trade or business in such a way as to impair his means of livelihood or lastly, unless it be attended with special damage In this case, such special damage must be incurred upon the [illegible] If special damage be not proved by the plaintiff he will not, in any action for words spoken, when the verdict is under 40 shillings be allowed more costs than damages A defendant cannot be proceeded against criminally for words spoken unless they have a direct tendency to a breach of the peace, as by containing a challenge to fight, or are of a seditious or grossly immoral character, or are spoken of a magistrate in the execution of his duty

SLAIE See Groove

SLA'VERY properly so called is the establishment of a right which gives to one man such a power over another as makes him absolute master of his life and property But the condition of a slave is susceptible of innumerable modifications, and there are few nations whether of ancient or modern times, among whom slavery has been long established that have not enacted certain laws for limiting the power of a master over his slave Slavery has existed from the earliest periods of authenticated history and its origin has generally been ascribed to a state of war In the rudest stages of society the difficulty of subsistence was so great that the lives of captives were seldom spared, but as society advanced and luxuries began to be introduced, the aid of labourers became requisite and it was found more profitable to employ than to slay a captive Thus the Latin word servus, *a slave*, appears to have been derived from servo *I preserve*, and to have meant a person whose life was preserved on condition of giving his labour to his conqueror, so that a state of slavery, how repulsive soever to our present feelings, probably formed at one time an important mitigation of the horrors of barbarism But in proportion as society rose in the scale of civilization, the state of slavery sprung from a variety of causes Thus, in several countries, those who had been convicted of crimes were often doomed to perpetual slavery, and as a necessary corollary of this principle of slavery, it was laid down as a fundamental regulation, that slaves could only beget slaves, and hence the principle of hereditary bondage It would be foreign to the purpose of this work to enter into details upon the different phases which slavery has exhibited in the various countries in which it has existed or to point out the malignant influence it has exercised upon the character of every nation among whom it has been tolerated Upon this subject the reader will find ample details in the third volume of the *Cours d'Economie Politique* of M Storch, Paris, 1823, and with regard to slavery as practised among the Romans he may consult with advantage the elaborate little volume of Mr Blair on this subject The species of slavery which existed during the feudal ages, and which is still to be found in some European countries, will be found noticed under the heads SERF, SERVITUDE, and VILLEIN, in this work, and for some details of negro slavery, see *infra*, and NEGROES

The British legislature, as is well known, passed an act in 1834 for the emancipation of Negro slaves throughout our dominions, by which after passing through a preliminary term of compulsory apprenticeship they were eventually raised to the [illegible]

SLAVE TRADE [illegible] carried on by [illegible] coasts of Africa and the American settlements, abolished, as far as Great Britain is concerned, in 1808

The European slave trade is, however, generally supposed to have been commenced by the Portuguese about the end of the 15th century About 1508 the Spaniards began to import Negroes into America, to supply the place of the Indians, whose numbers were rapidly diminishing under the severity of the toil to which they were exposed by their conquerors Sir John Hawkins one of Queen Elizabeth's most famous captains, seems to have been the first Englishman of note who embarked in this traffic having been concerned in the sale of Negroes to the Spaniards in the West Indies In the same reign the African Company was first chartered, for the purpose of trade with Guinea This company carried on a trade in Negroes with the English settlements in America from the beginning of the 17th century to the year 1732 when that traffic was abandoned by it, and chiefly carried on from that time by private traders It was not until the latter end of the 18th century that the atrocities of this trade began to engage the attention of parliament In 1788 an act was passed to regulate it, and after twenty years animated discussion, it was at last totally abolished in 1807 The United States of America and Denmark had preceded us in this righteous act (See *Clarkson's History of the Abolition of the Slave Trade*)

The slave trade is now prohibited by the laws of most European nations, except Portugal, and by the law of that country it can only be carried on within certain geographical limits Nevertheless it is extensively carried on by contraband dealers, and no measure can be reasonably expected to put a stop to it short of its being declared* piracy by the common consent of civilized states To obtain this result ought to be one of the most prominent objects of English diplomacy both for the sake of humanity, and in order to protect the interests of our own colonies, which suffer severely from competition with those European possessions into which an unlimited importation of slave labour takes place But it must be admitted that Sir Fowell Buxton, whose name ranks so high among the opponents of the slave trade appears to confess that even this measure would prove ineffectual, from the difficulty of execution. We can do no more here than advert to the scheme proposed in 1840, received with acclamation by a great portion of the public, and taken up by government of establishing a legitimate trade with central Africa by the channel of the Niger We can only say that those who expected the slightest effect to be produced on the progress of this abominable traffic by any such measure, must have estimated both end and means in a very different manner from ourselves, but the utter failure of the expedition, owing to the destructive influence of the climate, within a few months after it reached its destination, but too soon justified our misgivings, and the general opinion seems to be that henceforth those who may induce their fellow-countrymen to embark in a similar adventure will [illegible] very serious responsibility According to some recent [illegible] carried from their homes in Africa to supply the American markets, including those who perish by the way There can, however, be no doubt that this estimate is very greatly [illegible] average number of slaves carried from Africa during the ten years ending with 1850 can have been as high as [illegible] year and now, no doubt, even this exportation will be very materially reduced The principal import-

* This most desirable act was accomplished in 1842; the whole of the European states having [illegible] to enforce the strictest measures in regard to the *right of search*, and to regard those engaged in the trade as pirates

ing countries are Cuba, Portorico, and Brazil Publications on the slave trade are so numerous, that it is difficult to make a selection for purposes of reference Perhaps (after *Clarkson's History*) the student could not find the account of its progress better given than in successive numbers of the *Edin Review* especially vols xxi xxiii xxix xxxvi , though it must be admitted that there is in these and most works on the subject, a strong tendency to exaggeration There is a good article on the international law of the slave trade in the *Law Magazine* for August 1841

SLEEP (Germ schlaf) That state of the body in which the functions of sensation and volition are suspended, while the vital functions retain their usual activity the operations of the mind, if not at perfect rest, are [illegible] with external objects

How [illegible] natural sleep usually comes on with a peculiar sense of [illegible] lassitude, gaping, and desire of rest, [illegible] and there is general muscular relaxation The sense of hearing is that which is longest retained, and we generally hear what is going on about us, and even feel inclined to take occasional part in conversation long after the eyes are closed

The quantity of sleep required by different individuals is various, from six to nine hours being the average proportion Indolent listless persons, and especially those who indulge in the luxuries of the table, and are in good health, [illegible] t to ten hours daily, [illegible] and who live abstemiously, will be satisfied with four or five hours of sleep and such persons are generally more disturbed by dreams than the former Very young children sleep away much of their time, and so also do many old persons Sleep is often prevented by intense thought, by anxiety, and other mental affections, and also by hunger, and by the application of cold to a part of the body When a person has been over-fatigued by bodily exertion, sleep is also often courted in vain, and there are many stimuli by which its accession at the usual times is prevented or retarded, such as strong tea coffee, small doses of opium, and several other articles of medicine and diet Bodily exercise and mental tranquillity, a full meal, the absence of [illegible] other disturbing causes, are circumstances favourable to sleep, but in all these respects various habits often greatly interfere, and persons accustomed to very active lives when suddenly deprived of their usual occupations often sleep worse than before, indolence becoming an apparent stimulant A distended stomach keeps some individuals awake, and others cannot sleep in a dark room, or in the quiet of [illegible] have been used to a night lamp, and to [illegible] arriages over a London pavement

[illegible] cause of sleep has been discussed by several eminent physiologists, but without any very satisfactory results it is, in fact, as entirely beyond our grasp, as are the other functions of the nervous system *See* DREAMS

SLEEPER In Architecture, a piece of timber whereon are laid the ground joists of a floor *Sleepers* are also pieces of timber, now rarely used, in foundations crossed by planks, &c , and at right angles to them, where the soil is bad Formerly the term was used to denote the [illegible] rafters of a roof

SLICKENSIDE A provincial term applied by the Derbyshire miners to a species of galena, or sulphuret of lead

SLIDE In Music, a grace used in the German school, [illegible] small notes moving by degrees

SLIDING KEEL is a narrow oblong frame or platform, let down vertically through the bottom of a small vessel, like a deepening of the keel throughout a portion of her length Its use is, like that of the leeboard, to sustain the vessel against the lateral force of the wind

SLIDING RULE A mathematical instrument or scale, consisting of two parts, one of which *slides* along the other, and each having certain sets of numbers engraved on it, so arranged that when a given number on the one scale [illegible] on the other, [illegible] two numbers is obtained by inspection The numbers may be adapted to answer various purposes, but the instrument is chiefly used in gauging, and for the mensuration of timber

SLING (Ger schlinge) A weapon made of a strap and two strings, by means of which a stone or other missile is projected with much greater velocity than [illegible] by the hand without such assistance The [illegible] which the projectile is discharged is the same as that with which it is whirled round in a [illegible] before the [illegible] Goliath [illegible] pon of offence in the earliest ages

SLIPS In Geology, masses of strata separated vertically or askant

SLOAM Layers of clay between those of coal

SLOOP A vessel with one mast like a cutter, but having a jib stay, which a cutter has not Also the general name of ships of war below the size of frigates

SLOPS Clothes and bedding supplied from the ship's stores to the seamen, but [illegible]

SLOUGH A surgical [illegible] separation which ensues between dead and living parts

SLUE In Naval language, *to slue* is to turn a cylindrical piece of timber, as a mast or boom, about its axis, when [illegible] out of its place

SLUICE (Lat clausus, *shut up*) In Hydraulics, a frame of timber, stone, or other solid substance, serving to retain and raise the water of a river or canal, and, when necessary, to give it vent

SLUR In Music, an arch ⁀ connecting two or more notes not on the same degree, indicating to the performer that in playing they are to be united as much as possible

SMACK A vessel with one mast, commonly rigged as a sloop, and used in the coasting trade, or as a tender in the royal navy The vessels of this name that have long plied between Leith and London are well known, and have always been noted for their security

SMALLPOX Called also *Variola* from varius, *changing colour*, because it changes and disfigures the skin There are two forms of this disease generally called by medical men the *distinct* and the *confluent*, in the former the pustules are separate, in the latter they coalesce *Distinct smallpox* begins with the usual symptoms of inflammatory fever, that is, pains in the back and loins, sickness, drowsiness, headach, pain upon pressure about the region of the stomach, and in infants one or more [illegible] the [illegible] About the end of the third day little red [illegible] much resembling flea bites, make their appearance upon the face and head, which spread during the fourth day over the breast, body, and limbs, about the fifth day a small circular vesicle forms upon each little point, depressed in the centre, surrounded by an inflamed [illegible], and containing a colourless fluid [illegible] the eruptive fever disappears about the sixth day the throat becomes sore and the saliva is [illegible], and about the eighth day the face is swollen, and the pustules round, prominent, and prevalent, about the eleventh day the pustules attain their full size (about that of a pea), and the matter which they contain becomes opaque and yellow, and a dark central spot appears on each, the swelling of the face subsides, and is transferred to the hands and feet, and more or less secondary fever now ensues After this the pustules become rough, break, and scab over, and a dark brown spot remains for some days, and if the pustules have been large an indentation is left the remaining symptoms gradually subside, and about the seventeeth or eighteenth day the secondary fever disappears

*Confluent smallpox* is ushered in by a fever of a typhoid rather than of [illegible] symptoms are [illegible] there is diarrhœa, and in adults salivation The eruption is very irregular in its progress and appearance, and usually preceded by red patches upon the face, from which the pustules emerge on the second day in the form of clusters somewhat resembling measles Their progress is rapid, but instead of being circular and well-defined, they are flat and irregular in shape, and contain a brownish fluid very unlike pus the intermediate spaces between the clusters are generally pale and flaccid The tumefaction of the face and running of saliva are greater than in the distinct species, and the fever does not cease upon the appearance of the eruption, but about the ninth day it generally becomes aggravated, the eruption livid, and accompanied by petechiæ or purple spots, and about the eleventh day from the commencement of the disease it often terminates fatally

This disease is the effect of a specific contagion, and is produced either by inoculation, or by exposure to the effluvia from persons suffering under it in the latter case it is usually called the *natural smallpox* When the distinct smallpox goes regularly through the stages above described it is rarely dangerous, except from mismanagement, but it often leaves a tendency to inflammatory disorders, and in a scrofulous habit it excites that disorder into activity Any of the symptoms which have just been described as characterizing confluent smallpox are alarming, so is a sudden disappearance of the eruption, or change in its appearance, followed by depression or delirium In treating the distinct smallpox the febrile symptoms are to be moderated by cool air, saline and mild acid and diluting drinks, and very gentle aperients. Bleeding and purging are in almost all cases to be decidedly avoided Great irritability may occasionally be [illegible] by [illegible] of opium and camphor, which is preferable, by [illegible] of the [illegible] This will also check diarrhœa, should it supervene The confluent form generally requires more or less of the treatment which is adopted in low or putrid fever Obstinate vomiting, which is sometimes [illegible] but alarming symptom is best counteracted by the same draught in the act of effervescence with a few grains of aromatic confection, and a few drops of tincture of opium

SMALT (Germ schmalz) A fine blue colour used

in painting and [illegible] upon earthenware and applied to several other purposes in the arts. The finest smalt is made by [illegible] by which a very [illegible] when fused [illegible] Common smalts are prepared by fusing mixtures of zaffre, sand and pearlash

SMARAGD (Gr. σμαραγδος) In modern times used as a synonym of emerald (which see), but applied by the ancients to various other precious stones, such as fluor spar, green vitrified lava, green jasper, and green glass. The passage of Pliny (*Nat. Hist.* xxxvii. 5) in which Nero is said to have been in the habit of viewing the gladiatorial combats *in a smaragd*, is generally understood to signify a smooth polished mirror made of some of the above substances, but it has been maintained that the emperor was short-sighted, and used a concave eyeglass formed of the smaragd. The smaragd is found in various parts of Europe, Asia, and America, but particularly in the Ural mountains, and in the mines of Chili and Mexico.

SMART TICKET. A certificate of a seaman's having received a wound or hurt.

SMELL. This sense resides in the mucous or pituitary membrane which lines the nostrils, and the surface of which is more or less convoluted or extended in various orders of animals. In the human subject this membrane is highly vascular, and largely supplied especially in its upper parts, with nervous filaments or ramifications of the olfactory trunk, which has its origin, by three distinct roots, from the posterior, inferior, and internal parts of the anterior lobe of the brain, and proceeding towards the perforated plate of the ethmoid bone, divides into the small threads just mentioned.

The physiology of odours is a curious and intricate subject requiring much more experimental investigation than it has hitherto received. Air is the great vehicle by which their various influences are transmitted in the act of inspiring to the olfactory surfaces, and for the diffusion of most odours a certain degree of humidity in the air [illegible] There is scarcely any sense [illegible] of which varies so much in different individuals as that of smell, some being painfully alive to those odorous influences which are not even perceived by others. An obtuseness of this sense is also very frequent, and its almost entire absence by no means uncommon, this is especially the case in certain catarrhal complaints and in some other affections of the lining membrane of the [illegible].

SMEW. The name [illegible] called *Mergus albellus* by Linnæus. *See* MERGUS.

SMILA'CEÆ (Smilax one of the genera), form a small natural order of Endogenous plants with weak or twining stems and reticulated leaves not distinguishable from those of Dioscoreæ. The drug called sarsaparilla or sarza, is the root of various species inhabiting South America, and is held in high esteem for its diuretic, de[illegible]

SMOKE (Ger. Smoke) Smoke has been defined as the visible effluvium or sensible exhalation of any thing burning. The term is commonly applied to those results of the combustion or ignition of pit coal which escape from chimneys and which constitute a serious and well known evil and nuisance in large towns manufacturing districts, and almost every where where large quantities of coal are consumed. Coal is often a very complex substance, but, putting aside its occasional and adventitious [illegible] and oxygen may be regarded as its [illegible] constituents, and the results of its *perfect* combustion would therefore be carbonic acid, steam and nitrogen. These substances would constitute invisible and incombustible gases and vapour, and would therefore escape from the chimney top and blend with the atmosphere, without being perceived. But it unfortunately happens that [illegible] which coal is burned its combustion is far from being perfect, and that besides the above-mentioned products inflammable gases and vapours, together with [illegible] very finely divided carbon, constitute black and brown smoke, are vomited forth from the chimney shaft, not only contaminating the air, and making all neighbouring objects black and dirty but [illegible] fuel, so that the smoke of [illegible] is not a [illegible] but a very expensive one, and ought to be put down by legislative enactments, several of which have been from time to time suggested, but unfortunately never enforced, and are at this moment a mere dead letter.

The neglect which this subject has encountered has arisen [illegible] of the thing and inculcating [illegible] of combustion, and of [illegible] and the systems of construction [illegible] furnaces, the fireplaces, new methods of stoking and [illegible] new kinds of fuel, and it is astonishing to observe the obstinacy and perverseness which prevail in these respects [illegible] masters as well as the men. There is a [illegible]

which no doubt has had its influence in retarding the adoption of means for diminishing the smoke nuisance, which is the shoals of quacks and ignorant empyrics and impostors who have embarked in these speculations, so that till stringent and coercive measures are adopted in regard to it, founded upon scientific and rational principles, we must be content to continue breathing a tainted air, which fouls the organs of respiration, encrusts our buildings and covers our books, pictures, and every article of furniture with an enamel of soot, and which dims the atmosphere to such an extent as materially to shorten the duration of metropolitan daylight.

That all these evils may be got rid of admits of no doubt, and ultimately with economy and convenience, though the first introduction of the remedies will probably be attended by many practical difficulties, and considerable inconvenience and expense. One remedy and the most obvious, consists in the substitution of coke, anthracite, and certain other smokeless fuel, for the bituminous and eminently smoke-generating varieties of coal now in common use. Another is, the construction of fireplaces and furnaces which shall not indeed burn smoke, but prevent its formation. It must be allowed that there are many practical difficulties in the way of the application [illegible] of the invention or [illegible] of these contrivances, but experience has shown that none of these are of such a nature or magnitude that they may not be overcome by perseverance and skill. They all merge into one common principle, that of mixing air with the combustible vapours and gases generated by the action of heat on pit coal, so that by virtue of a due supply of oxygen they may be made to burn with flame, and become entirely converted into incombustible and transparent invisible vapours and gases, instead of being, as they now are, only partially burned, by which their carbon is precipitated, and escapes, together with the other imperfectly consumed matters, into the air. The foundation of a *practical* inquiry into the subject of the prevention of smoke has been laid by Mr C. W. Williams of Liverpool (*Essays on the Combustion of Coal and Prevention of Smoke*). The theoretical details are essentially blended with the whole doctrine of heat, but the [illegible] will be found in Sir H. Davy's *Researches into the Philosophy of Flame*.

SMOKE SAIL. A small sail hoisted before the funnel of the galley when the ship is at anchor head to wind, to screen the quarter deck from the smoke.

SMORZATO (It. *extinguished*) In Music, a term denoting that the violin bow is to be drawn to its full extent [illegible] lighter till the sound is nearly lost.

SMUGGLING. The offence of defrauding the revenue by the introduction of articles into consumption without [illegible] It may be common [illegible] e or customs revenue.

*Origin and Prevention of Smuggling.* — This crime, which occupies so prominent a place in the criminal legislation of all modern states, is wholly the result of vicious commercial and financial legislation. It is the fruit either of prohibitions of importation or of oppressively high duties. It does not originate in any depravity inherent in man, but in the folly and ignorance of legislators [illegible] does not take [illegible] of a high duty on any article occasions a universal desire to escape or evade its payment. Hence the rise and occupation of the smuggler. The risk of being detected in the clandestine introduction of commodities under any system of fiscal regulations may always be valued at a certain average rate, and wherever the duties exceed this rate smuggling immediately takes place. Now, there are plainly but two ways of checking this practice — either the temptation to smuggle must be diminished by lowering the duties, or the difficulties in the way of smuggling must be increased. The first is obviously the more natural and efficient method of effecting the object in view, but the second has been most generally resorted to, even in cases where the duties were quite excessive. Governments have uniformly almost consulted the persons employed in the collection of the revenue with respect to the best mode of rendering taxes effectual, though [illegible] their prejudices and peculiar habits [illegible] them from forming a sound opinion on such a subject. They cannot recommend a reduction of duties as a means of repressing smuggling and increasing revenue, without acknowledging their own incapacity to detect and defeat illicit practices, and the result has been, that instead of ascribing the prevalence of smuggling to its true causes, the officers of customs and excise have almost universally ascribed it to some defect in the laws, or in the mode of administering them, and have proposed repressing it by new regulations and by increasing the number and severity of the penalties affecting the smuggler. As might have been expected these attempts have, in the great majority of cases, proved signally un-

successful And it has been invariably found that no vigilance on the part of the revenue officers and no severity of punishment, can prevent the smuggling of such commodities as are either prohibited or loaded with oppressive duties The smuggler is generally a popular character, and whatever the law may declare on the subject, it is quite ludicrous to expect that the bulk of society will ever be brought to think that those who furnish them with cheap brandy, geneva, tobacco, &c are guilty of any very heinous offence

"To pretend," says Dr Smith, "to have any scruple about buying smug[illegible] goods [illegible] manifest encouragement to the [illegible] laws, and to the perjury which almost always attends it, would, in most countries be regarded as one of those pedantic pieces of hypocrisy, which, instead of gaining credit with any body, seems only to expose the person who affects to practise them to the suspicion of being a greater knave than most of his neighbours By this indulgence of the public, the smuggler is often encouraged to continue a trade which he is thus taught to consider as in some measure innocent, and when the severity of the revenue laws is ready to fall upon him, he is frequently disposed to defend with violence what he has been accustomed to regard as his just property, and from being at first rather imprudent than criminal, he at last too often becomes one of the most determined violators of the laws of society" (*Wealth of Nations*, vol iii p 491)

To create by means of high duties an overwhelming temptation to indulge in crime, and then to punish men for indulging in it is a proceeding completely subversive of every principle of justice It revolts the natural feelings of the people, and teaches them to feel an interest in the worst characters—for such smugglers generally are,—to espouse their cause, and avenge their wrongs A punishment which is not proportioned to the offence, and which does not carry the sanction of public opinion along with it, can never be productive of any good effect The true way to put down smuggling is to render it unprofitable, to diminish the temptation to engage in it, and this is not to be done by surrounding the coasts with cordons of troops by the multiplication of oaths and penalties and making the country the theatre of ferocious and bloody contests in the field, and of perjury and chicanery in the courts of law, but by repealing prohibitions, and reducing duties, so that their collection may be enforced with a moderate degree of vigilance, and that the forfeiture of the article may be a sufficient penalty upon the smuggler It is in this and in this only, that we must seek for an effectual check to illicit trafficking Whenever the profits of the fair trader become nearly equal to those of the smuggler, the latter is forced to abandon his hazardous profession But so long as prohibitions or oppressively high duties are kept up, or, which is in fact, the same thing, so long as *high bounties* are held out to encourage the adventurous, the needy, and the profligate to enter on this career, we may be assured that armies of excise and custom house officers backed by the utmost severity of the revenue laws, will be insufficient to hinder them (For full particulars respecting the law of smuggling &c see the *Com Dict*)

SMUT A disease incidental to corn crops by which the farina of the grain in the whole body of the seed is converted into a black soot-like powder If an ear of corn affected by this disease be smartly struck with the finger, the powder will be dispersed like that of the fungus known as *Lycoperdon bovista* the common puff ball found in pastures, but darker, and if a portion of the powder be moistened and examined with the microscope, it will be found to consist of innumerable minute transparent globules Some attribute the smut to the richness of the soil, and others consider it as a hereditary disease transmitted by one generation to another through the seed Willdenow and Mirbel regard [illegible] but Bauer believes it to be a proper d[illegible] a morbid swelling of the ear Some cultivators steep the grain of smutty corn in a weak solution of arsenic before sowing, but others deny the efficacy of this preparation Smutty grain is separated from such as may be used for [illegible] r by being rapidly whirled [illegible] brushes, or by steeping in water, when the smut from its lightness floats on the surface. The safest mode for the farmer to pursue is never to sow grain from a field in which the smut has prevailed

SNAKE ROOT This term is applied to the root of the *Aristolochia serpentaria* a native of Virginia it is a fibrous, aromatic, and bitterish root The infusion is occasionally used as a tonic and diaphoretic in typhoid fevers it is a good adjunct to Peruvian bark, and to quinia

SNAKE WOOD The wood of the *Strychnos colubrina* Supposed to be an antidote to the poison of certain snakes

SNEEZING A convulsive action of the respiratory organs, brought on by irritation of the nostrils Violent fits of sneezing have occasionally attacked persons, and are even said to have proved fatal, recourse must in such cases be had to soothing the nasal membrane by the application of warm milk and water, or decoction of poppies

SNIPE The common name of the *Scolopax gallinago* Linn This [illegible] Great Britai[illegible] higher grounds, in ordinary seasons it frequents marshes Its principal food is worms in quest of which it penetrates the soft earth with its long and slender bill, which is especially organized for that purpose

SNOW (Ger schnee) Congealed water, which falls from the bosom of the atmosphere Very little is yet known respecting the formation of this meteor It has not been ascertained, for instance, whether the clouds which produce it are composed of vesicular vapours, or of frozen particles, nor whether the flakes are completely formed before they begin to descend, or receive an increase in passing through the lower strata of the atmosphere The temperature of the flakes, and the circumstances which determine their form and volume, are likewise unknown The only observations which may be considered as in any degree complete are with reference to the different forms which the flakes assume This subject was considered by Kepler, Hooke, Cassini, Muschenbroek, and many others, but the most interesting series of observations we possess are those of Scoresby (*Account of the Arctic Regions*, 1820), who has reduced the different forms into classes, and given a number of excellent representations of the flakes in different states Generally speaking, when examined with the microscope they present modifications of stelliform and hexagonal crystals, and frequently they consist of a star of six rays formed of prisms united at angles of 60°, from which other prisms shoot at similar angles, giving the whole an appearance of exquisite beauty and great regularity The variety of modifications is probably owing to the state of the atmosphere when the snow is formed If the crystallization takes place when the air is calm, the crystals will be regularly formed on the contrary they will be irregular and imperfect when the air is much agitated Sometimes the flakes present no traces of crystallization

Snow is much less dense than ordinary ice The bulk of a given weight of ice is only about a ninth part greater than that of the water from which it is formed, while the bulk of new-fallen snow is ten or twelve times greater than that of the water obtained by melting it

At moderate elevations above the sea and in the mean latitudes, snow most frequently falls after some days of pretty hard frost, and when the temperature of the air, though still a few degrees above the freezing point is sensibly mitigated On this circumstance is founded the remark that it cannot snow in very severe cold, and though the remark does not always hold good it will do so generally, for two reasons —in the first place the air which comes from very cold regions contains a small portion of watery vapour, and secondly, because the formation of clouds by diminishing the radiation, necessarily mitigates the severity of the cold

As snow can only be formed when the temperature of the atmospheric strata containing the aqueous vapour is below the freezing point, it is obvious that if the snow in falling passes into strata of a higher temperature, it will be melted before arriving at the surface of the earth Hence it follows that it never snows in the torrid zone, nor in the heats of summer, excepting on the tops of very elevated mountains

*Red Snow*—It had been remarked by the ancients that snow sometimes assumes a red tint, and Pliny ascribes the cause to age—*Ipsa nix vetustate rubescit* Many modern observers have described and examined this curious phenomena, which appears to be met with in all parts of the world Saussure observed red snow on the Bevern in 1760, and on St Bernard in 1778, and [illegible] Ross in Baffin's Bay, Parry Franklin, and Scoresby collected it in still [illegible] and it has been found abundantly in New S[illegible] 70° south Among the Alps it is generally found in low sheltered spots, and penetrating to the depth of two or three inches, or rather the strata in which it is found (for it occurs overlaid at considerable depths) seldom exceed two or three inches in thickness The colouring matter of this singular substance has been examined by Wollaston, R Brown, De Candolle, Thenard, Bauer, &c Dr Wollaston first remarked that it is composed of minute spherical globules, which have a transparent envelop, and are divided into seven or eight small cells filled with a species of red oil insoluble in water Mr R Brown and De Candolle supposed the globules to be a kind of algæ Mr Bauer (*Phil Trans* 1820) found the globules to be exactly identical in snow collected in Baffin's Bay and New Shetland, and he supposed them to be small mushrooms of the genus *Uredo*, forming a peculiar species, to which he gave the name of *Uredo nivalis*

*Snow Line, or Limit of Perpetual Snow* — Since the [illegible] there must be in every latitude a certain limit of elevation at which the air attains the temperature of freezing water This limit is called the snow line, or line of perpetual congelation, and the mountains which rise above it are covered with perpetual snow Within the tropics the temperature varies little throughout the year, and hence the snow line is distinctly marked, but in countries remote from the equator the limit of congelation rises in summer and descends in [illegible] of considerable breadth [illegible] is of course the summer [illegible] snow line, however, is not dependent upon latitude alone; but also on the configuration and aspects of the mountain chains, the extent and temperat[illegible] plains, the quantity of snow that [illegible] mate of a country chain, for example the limit of perpetual congelation on the northern side is at an elevation exceeding [illegible] feet that on the southern side, [illegible] exposed to the sun, a circumstance which Humboldt ascribes to the radiation from the great plain of Thibet, the [illegible] that exceed [illegible] ence, therefore, can be placed on any general rule for estimating the height of the snow line, and it affords an exceedingly fallacious indication of the altitude of mountains The following table is given by Humboldt in his *Fragmens Asiatiques*, p 349 The elevations stated are the heights of the line of perpetual [illegible] level of the sea, and the measures [illegible] feet

| Mountain Chains | Latitude | Elevation |
|---|---|---|
| | | Feet |
| Cordilleras of Quito | 0° — 1½° S | 15,730 |
| [illegible] | 16 — 17½ | 17,060 |
| [illegible] | 19 N | 15,030 |
| Himalaya { Northern side | 31 | 16,940 |
| Himalaya { Southern side | 31 | 12,170 |
| Pyrenees | 43 | 8,950 |
| Caucasus | 43 | 10,870 |
| Swiss Alps | 46 | 8,760 |
| Carpathians | 49 | 8,500 |
| Altai range | 50 | 6,395 |
| Norway { Interior | 70 | 3,518 |
| Norway { Coast | 71½ | 2,302 |

(See, in addition to the works already cited Humboldt, *Mémoire sur la Limite de Neige perpetuelle dans les Montagnes de l'Hémisphère Méridional*, and the *Annales de Chimie*, vol xx)

SOAP (Gr σαπων, Lat sapo) This useful compound is obtained by the action of alkaline upon oily substances There are, accordingly, a great variety of soaps, but those commonly employed may be considered under the heads of, 1 Fine [illegible] 2 Coarse household soaps, [illegible] terials used in the manufacture of white soaps are generally olive oil and carbonate of soda the latter is rendered caustic by the operation of quicklime, and the solution thus obtained is called *soap ley* The oil and a weak ley are first boiled together, and portions of stronger ley are gradually added till the soap produced by the mutual action of the oil and alkali, begins to become tenacious and [illegible] the water, some common salt is then added to promote the granulation and perfect separation of the soap the fire is then drawn and the contents of the boiler allowed to remain for some hours at rest, so that the soap may more completely collect When it is perfect it is put into wooden frames or moulds, and when stiff enough to be handled, it is cut into oblong slices and dried in an airy room Perfumes are occasionally added, or various colouring matters stirred in whilst the soap is semifluid to give it a mottled appearance The Spanish soap is *marbled* by stirring into it a solution of sulphate of iron, which is decomposed by the soap and black oxide of iron separated in streaks and patches through the mass The action of the air converts the exterior into red oxide, while the interior long retains its black colour hence a slice of this soap presents a black mottled centre, surrounded by a reddish external layer

Common household soaps are made chiefly of [illegible] tallow or if potash is used, a large [illegible] salt is made to harden the soap, which [illegible] by the transference of soda The new soap has a [illegible] of rosin added to it [illegible] potash instead of soda [illegible] soap used in London is a compound of this kind, it has a tenacious consistence, and appears granulated Soap is soluble in pure water and in alcohol, the latter solution *jellies* when [illegible] known under the name [illegible] evaporated the soap remains in a gelatinous state, which forms, when dry, the article sold under the name of *transparent soap*

The earths and common metallic oxides form *insoluble soaps*; and [illegible] when earthy and [illegible] It is the sulphate of lime and carbonate of lime in common spring water which thus render it unfit for washing, and give it what is termed *hardness*, and, upon this principle a spirituous solution of soap is a simple and valuable test of the fitness of any river or spring water [illegible] soft waters [illegible] but [illegible] before [illegible] and when we wash or shave with hard water, the separation of the insoluble calcareous soap is extremely disagreeable it adheres to the skin, and soils instead of cleansing it

The chemical nature of soap has been laboriously examined by Chevreul who has shown that the alkali in the process of saponification converts the oil into peculiar *acids*, as he terms them, the elain of the oil forming *oleic acid*, and the stearine *margaric acid* so that soluble soaps are oleates and margarates of soda and potash He has enumerated several other fatty acids similarly produced

All new soaps contain a considerable portion of adhering water, [illegible] dry place, [illegible] and hence the dealer in soap [illegible] keeps it in a damp cellar, that it may [illegible] weight by evaporation or as it is said, sometimes immediately [illegible] dissolve it, but keeps it [illegible]

Soap may be considered as a necessary of life, in all civilized countries its consumption is immense According to Pliny, the invention of soap must be ascribed to the Gauls, by whom, he says, it was composed of tallow and ashes though the German soap was considered the best Hence the Lat sapo, which by a slight transposition of letters has become *soap*, is probably derived from the old German sepe (now written *seife*) The great seats of the soap manufacture in Great Britain are Liverpool, London, Runcorn, Bristol [illegible] Brentford, Hull, and Glasgow Thus, of [illegible] [illegible] 13,546,119 [illegible] [illegible] 0 [illegible] 24 lbs, [illegible] Brentford, [illegible] Glasgow, 5,858,844 lbs The quantity of soap manufactured in Great Britain during the three years ending 1851 averaged 2,000,000 cwt The manufacture of hard soap in Great Britain is subject to a duty of 1½*d* per lb, that of soft soap to a duty of ½*d* per lb

SOAP STONE [illegible] ttite

SOAVE, SOA [illegible] In Music, a term denoting to the player that the music to which it is prefixed is to be executed with sweetness

SO'BRIQUET In French, a burlesque appellation or *nickname* The word has been variously derived from the Lat subridiculum, subrusticum, and the Gr υβριστικον, &c There is a curious dissertation in vol xiv of the *Histoire de l'Academie des Inscrip* on the authority of these appellations in history

SO'CAGE (Mod Lat socagium, from the Anglo-Saxon soke, or *jurisdiction*) denotes, according to Blackstone in its original a [illegible] tenure by any certain and determinate service The sokemen at and immediately before the Norman conquest appear to have been in the lowest ranks of free cultivators of the land, [illegible] with the villein in a law of Edward [illegible] the time when the works of Bracton and the author of *Fleta* were compiled, socage had come to signify any tenure not military or quasi-military; [illegible] either where military services were due (tenure in chivalry or by knight service), or other services of an honorary kind such as by the French feudal law were due on what were called imperfect fiefs (tenure by grand serjeanty) Socage therefore, comprehended various descriptions of tenure, and has been generally divided into *free* and *villein* socage In free socage, the services were certain, and, in the feudal sense, not base or dishonourable, as the payment of an annual rent, and none of the feudal incidents of wardship, &c were demandable in respect of lands so held, although certain aids and reliefs were peculiar to socage as well as to knight service By the stat 12 C 2 c 24, when military tenures were abolished, all sorts of tenures held of the king and others (except frank-almoign, copyhold, and the honorary part of grand serjeanty) were turned into tenure by free or common socage Villein socage was a species of tenure in lands held of the king by certain villein services, but certain and determinate, from which mixed species of tenure arose that in ancient demesne. Lands so held are deemed to be in certain respects copyhold, and these were within the exceptions of the statute 12 Charles 2, and still subsist.

**SOCIETY** (Lat *socius a companion*) The term usually applied to an association formed for the promotion of some object either literary religious, benevolent political or convivial Associations formed for commercial purposes are usually styled *companies*, which see Literary societies extend their attention to all the sciences and literature generally, or to particular divisions of each The chief literary societies of Europe have been noticed under ACADEMY The purposes for which *benevolent* and *religious* societies are formed will be best inferred from the titles which they severally bear Societies for the *temperance* societies are established with a view to promote sobriety, *mendicity* societies for the relief of the indigent, &c There is no feature, perhaps, which distinguishes a civilized from a savage state more than the establishment of such societies and in this view England has a right to claim a place in the foremost ranks of civilization, [illegible] of the many institutions It would be impossible in this place to give even the names of the chief societies of this nature scattered throughout the country, but the reader will find an account of them in the various reports published from time to time by their respective directors, and embodying a mass of information respecting them at once amusing and instructive

Societies formed for *convivial* or *political* purposes are most usually denominated *clubs*, — a term which may be truly said to be exclusively English, and which embraces so many complex ideas that it is all but impossible to reduce it within the limits of a precise definition The origin of clubs may be said to date from the end of the 17th century It would be superfluous to call to the reader's remembrance the beau ideal of a club which Addison has drawn in the *Spectator*, — the Kit Kat club, which numbered among its members all the most distinguished persons of the day, the Scriblerus club, of which Swift, Harley, Pope, Gay and Arbuthnot were members, or that still nearer our own times originally held at the Essex Head, which was ennobled by [illegible] Burke, Reynolds, Goldsmith Wyndham and Fox They were originally instituted solely for convivial purposes, but in the course of time the term *club* was successively adopted by various political associations, both in this country and on the Continent Since the commencement of the present century, the chief clubs have been either of an avowed political character, as the Carlton Boodle and the Reform clubs, or devoted exclusively to certain classes, as the United Service, the Oxford and Cambridge, or open to all gentlemen on election without [illegible] party or profession as the Athenæum, [illegible] There are about forty clubs in the metropolis They consist each of a limited number of members, varying from 1000 to 1500 who are admitted by ballot, and pay from ten to twenty five guineas on their admission, and an annual subscription varying from five to ten guineas We need scarcely add that the club houses are, generally [illegible] edifices, which add much to the [illegible] the streets and squares in which they are situated

The latest application of the term *club* has been made by several literary societies [illegible] club of London, the Bannatyne of Edinburgh, and the Maitland of Glasgow,—which were formed for the purpose of [illegible] which would not otherwise have [illegible] securing rare productions from oblivion by reprinting them from scarce and valuable editions

**SOCINIANS** The followers of Socinus, the uncle and the nephew, both of the same name, and celebrated for similar opinions concerning the nature of Christ The nephew, Faustus Socinus was the principal founder of the sect He was an Italian, born at Siena in 1539 who, after publishing a treatise upon the nature of the Saviour, desired to be admitted into a society of Unitarians already existing in Poland Their opinions do not appear to have precisely corresponded with his and admission was refused him, and he died without seeing during his lifetime the institution of any distinct congregation, but the views which he disseminated in his writings were gradually referred to and adopted by many ministers [illegible] especially in Poland, where [illegible] others published a Socinian system of theology, comprised in the *Bibliotheca Fratrum Polonorum*

Since the death of Socinus, the theologians who have asserted the mere humanity of Christ have been generally denominated Socinians The doctrines, however, to which that appellation can with strictness be applied are not precisely equivalent to those of the modern Unitarians The Socinian denies the existence of Christ previous to his birth of the Virgin Mary he allows, however, that that birth was miraculous, and considers the Saviour as an object of peculiar reverence and an inferior [illegible] By the term Mediator, as applied to Christ, he understands that in establishing the new covenant he was the medium between God and man; and of his sacrifice he says that as the Jewish sacrifices were not made for the payment of sins, but for the remission of them, so also the death of Christ was designed for the remission of sins through God's favour, and not for the satisfaction of them as an equivalent (See *Mosheim*, vol iv transl 1790, p 485 &c art "Unitarians")

**SOCK** (Lat soccus) The name given to the peculiar kind of shoe worn by the ancient Roman comedians, hence used metaphorically for comedy itself *See* BUSKIN

**SO'CLE** (It zoccoli, *a shoe*) In Architecture, a square member, whose [illegible] used instead of a pedestal for the reception of a column [illegible] cornice.

[illegible] extensive sense, is used to comprehend the whole development of [illegible] from Socrates to the Neo Platonists far just, as all the schools of this period, with the single exception of the Epicurean, called themselves by the name of Socrates, and arrogated to themselves the merit of exclusively propagating the true doctrines of Socrates But in a narrow and more proper signification it signifies the peculiar direction and method which Socrates gave to philosophical inquiry Rightly to understand this, a brief retrospect of the previous state of philosophy is requisite By the due course of things, the Ionian and other earliest philosophers of Greece directed themselves to the study of external nature, which as the outward condition of man's existence, attracts and constrains his attention, and so becomes the root and source of his intellectual life also In this state of mental development man is led to identify himself with the physical objects which are around him, and to form a single and exclusive science, — that of universal nature But on a wider range of observation, man began to perceive that his faculty of reason is not a physical power, but different in kind and peculiar to himself And so the belief in the affinity of man to the powers of the surrounding world was gradually weakened Philosophy, then, had now arrived at the point where either the distinction of the ethical and the physical must be set forth in clear evidence, or else, by adhering to the previous direction of thought the light which had been, however unconsciously, kindled must be obscured and extinguished To the latter result the labours of the Sophists directly tended, for Archelaus the physiologist, had opened the way, by his disquisitions into the nature and constitution of law and custom, in which, starting from a physical point of view, he declared reason to be simply a power of nature, and right to have no other foundation than might Such attempts however, served to stimulate rather than to repress that inquiry into the nature of the moral and rational, as distinct from the physical while other considerations were at this period establishing them as independent sciences But to admit the claims of both as two conflicting sciences, with equal pretensions to universality, was inconsistent with the unifying tendency of philosophy, and a more scientific range of thought was required adapted to reconcile and combine their opposite conclusions Such a view could only be presented by logical or dialectical investigations, which from the nature of science itself, might show that it is essential to the completeness and perfection of science that it should embrace both nature and reason at once It is this perception of the unity of science which constitutes the true merit of Socrates as a philosopher In all the accounts of him which either Xenophon or Plato furnish, we invariably discern the attempt at least, to embrace every question within the [illegible] prove that every species [illegible] to be a necessary member [illegible]

It was not the object of Socrates [illegible] fectly evolved system of doctrine, so much as to awaken by his discourses a new and more comprehensive pursuit of science, which, no longer one-sided and confined to special branches of inquiry but convinced of its universality, should direct itself to all that is knowable But beneath this conviction of the universality of science, and the oneness of its object-matter, we distinctly trace that division of the latter into dialectics, physics, and ethics, which his successors more distinctly established To these heads, therefore, without expressly ascribing them to Socrates, it will be convenient, for the purpose of classification, to refer his several doctrines

Under the head of dialectics, we have, on the testimony of Aristotle (*Met* xiii 4), to ascribe to Socrates two of the very first principles of science,—the inductive method of proof, and the definition of ideas The object which Socrates had in view by the latter was, by the definition of ideas, to determine what the thing is in itself, or its essence As to the former, we are told by Xenophon that when Socrates wished to come to a decision on any point, his investigations proceeded from propositions generally received as true, and if we are told that he often preferred to take up trifling and improbable po-

sitions, it was from a conviction that every thought, however imperfect as a work of reason, must necessarily involve the idea of certainty Another feature of the Socratic method was to place the particular idea to be examined in a great variety of combinations, a procedure which is evidently based on a conviction of the connection of all scientific thought, and implying that every particular thought must if it contain any degree of certainty, maintain its validity under every possible combination Such was the true Socratic method of dialectics, which derived its name from the *form* of dialogue (διαλεγεσθαι) in which it was accidentally worked out, while, on the other hand the term *Socratic method* has, in modern times, been confined to [illegible] than this outward form of [illegible] question and answer, to the exclusion of its essential character Socrates, indeed, did not evolve any systematic doctrine of the form and subject-matter of science He was satisfied with exercising his disciples in its form, and with infixing on their minds the pregnant truth, that the legitimacy of every branch of knowledge must be tested by its agreement with all others, and that every thought of man must give account of itself, and have its root in the knowledge of the soul and the divine nature

This knowledge was the end of his physical inquiries which were based on the general principle that all the objects of nature are only so far worthy of inquiry as they exhibit traces of intelligence and design The self-knowledge which the Delphian oracle had enjoined upon him Socrates held to be impossible, while man is ignorant of the universal principle whence are the issues of [illegible] and consequently, of the system of nature in the midst of which man is placed In order to oppose the atheism which prevailed in his day Socrates examined the causes of the existing unbelief and referred to the proofs of divinity which the wise order of natural things exhibits As the prevailing scepticism had its origin in the denial of whatever is unseen and imperceptible to the outward senses he argued that the soul which is the ruling principle within man is yet not discernible, but still its existence is admitted and it participates in the divine nature Whoever therefore can get rid of the weak desire of seeing the Deity under some palpable form, may easily recognize his operations within his own mind, where God has implanted a consciousness of his presence But he further held that not only man, but the whole universe, is under the rule of an intelligent governor, that all is formed for some wise end and affords evidence of that supreme reason from which man's rational soul derives and has its being In the consideration of individual things, not less than of the universe, the sole question with Socrates was to establish intelligence as the ruling principle of all This affords an explanation of his low estimate of the existing physiology, which has not unfrequently been objected to him His contempt for it was grounded on the same reason as Bacon's aversion for the schoolmen It stopped at secondary causes, and did not remount to the one first cause, which Socrates believed could only be found in [illegible] things for the best [illegible] did not entirely neglect the marks of design which may be discovered in the universe, still they confounded nature with intelligence Socrates, on the contrary, laboured to show that reason is above nature, and that the natural is merely subservient to intellectual ends Whatever is without reason is contemptible, and the corporeal is of no value except so far as it ministers to the rational soul Into the nature of the divine essence he did not inquire but was content with asserting the principle that the Deity is the supreme reason, and must be honoured by man as the source of all things, and of all phenomena, and as the end of all human endeavours Lastly, from the divinity within man, the intelligence visible in the universe and the worthlessness of body, except as an instrument of reason, Socrates deduced the immortality of the soul as a necessary consequence

The object-matter of Socrates' disputations exhibit a great preference of ethical to physical topics This may partly be explained by the fact, that in ethics a scientific spirit of inquiry had yet to be awakened, while physics had been long in extensively cultivated Partly, also, it had its origin in the mental state of Athens at this period The art of sophistry, which Socrates was seeking to overthrow, was based on the monstrous dogmas, that there is no truth for man, that he is the wisest who, rejecting all hope of it, is skilful enough to hide from others his own ignorance and incapacity by an ingenuous display of artifices and forms Successfully to combat these pernicious views, an appeal must be made to those general principles of belief which are implied in and indispensable to the right conduct of life, a strong hold must be taken of what is fixed and indestructible in man in his moral convictions But, content with thus awakening man to a consciousness of the moral destiny of man, and his moral responsibility, he did not seek to construct an elaborate system of ethics Having projected the ideal of science, both in its extent and form, he contributed little to its realization, either as a whole, or in its parts A few propositions are necessary, however, to exhibit the true spirit of the Socratic ethics Man naturally strives after happiness, but in this we must distinguish between accidental good fortune (*συντυχια*), and that which results from science and industry (*ευπραξια*) The essence, therefore, of the moral act consists in the freedom of man All virtue is one, and no act performed without a clear perception of its nature and tendency is either good or evil There is no merit in a virtuous action unless it has been undertaken as such, intentionally and knowingly, the will being determined thereto by the notion of good But this natural sense of right may be overborne by a stronger motive This innate perception of good, therefore, like all other human faculties, stands in need of education to expand and strengthen it Virtue may be taught, since it consists in the science of good

SOD The [illegible] of the soil pared off with a portion [illegible] turf

SO'DIUM [illegible] This important and useful [illegible] Sodium was discovered by Davy in 1808 It is a metal much resembling potassium in its general characters It is soft, malleable, fusible at 190°, and burns when heated in contact of air When thrown upon water it does not burn but floats about upon the surface, and rapidly disappears, being converted into soda, which is dissolved in the water and gives it an alkaline reaction The specific gravity of sodium is 0·97 By the quantity of hydrogen evolved during the action of sodium on water, we learn that soda or oxide of sodium consists of 1 equivalent of sodium = 24, and 1 of oxygen = 8 The equivalent of soda, therefore, is 32 The commercial demands for soda are chiefly supplied from two sources the combustion of marine vegetables, such as common sea-weed and the *Salsola soda* which furnish the impure alkalies called *kelp* and *barilla* and the decomposition of common salt or rather perhaps of sulphate of soda obtained by the decomposition of salt by sulphuric acid Carbonate of soda forms large rhombo prismatic crystals, composed of 32 soda + 22 carbonic acid + 90 water They fuse in their water of crystallization at about 150°, and it may be entirely expelled by exposure to heat They effloresce when exposed to air Sulphate of soda, or Glauber's salt is the result of the action of sulphuric acid upon common salt (See MURIATIC ACID) It consists of 32 soda + 40 sulphuric acid, and the crystals are constituted of 72 dry sulphate and 90 water they are efflorescent, and soluble in about 3 parts of cold water When sodium is introduced into chlorine it immediately combines with it to form chloride of sodium or common salt, if heated in the gas, it burns very vividly 24 parts of sodium combine with 36 of chlorine to form 60 parts of this important and well known compound (*See* SALT) When chlorine gas is passed into a weak solution of caustic soda it is absorbed, and a useful bleaching and disinfecting solution is obtained which has been called *Labarraque's soda liquid*

SO'DALITE A mineral composed chiefly of silica, alumina and soda

SODA WATER This common and refreshing beverage is, as usually prepared, a supersaturated solution of carbonic acid gas in water True *soda water* was formerly prepared (and is still by some manufacturers) for medical use, chiefly as a remedy for heartburn, and certain forms of dyspepsia and calculous complaints, and consisted of one two, or three drachms of carbonate of soda dissolved in a pint of water highly impregnated with carbonic acid This is often a valuable remedy, but would sometimes be attended by mischievous results, especially if indulged in to the extent to which some persons pursue the use of soda water The mere aqueous solution of carbonic acid, which is made by forcing the gas into water by a condensing pump, and under a pressure of six or eight atmospheres is an agreeable and gen[illegible] harmless diluent

SOD BURNING Burning of turf taken from the surface of worn-out pasture lands for the sake of the ashes as manure, &c

SODIUM *See* SODA

SOFFIT (It soffitta, *overlaid*) In Architecture *See* LACUNAR

SO'FI A Persian word, which is employed to designate religious persons, otherwise termed Dervishes It is probably a corruption of the Greek sophos, *wise* Sofi was the surname borne by the ancestors of the kings of Persia of the race preceding that which now occupies the throne, and Shah Ismael Sofi the first monarch of that race, also bore it, hence by European writers of the 16th and 17th centuries it was used erroneously as a title of the king of Persia

SO'FISM [illegible] The [illegible] the class of [illegible] name is ind[illegible] living together in a monastic way, and professing an

ascetic life But the tene[illegible] noted by the name of Suflsm are those [illegible] is said to be gaining ground extensively in oriental c[illegible]tries especially among the educated classes of M[illegible] These tenets, like [illegible] of the Quietists [illegible] tian sects of mystics, are founded on a notion of the union of the human soul with the divinity by contemplation and the subjugation of the appetites, but, as has been too frequently the case among Christians also, they have afforded a cover for the most licentious lessons of refined debauchery In the last volume of Mr Buckingham's *Oriental Travels*, containing a narrative of his journey in Mesopotamia, will be found a singular account of one of these [illegible] his doctrines and conduct The principles of S[illegible] also to have a remarkable affinity in some [illegible] those pantheistic notions which are prominent in the system of the Bramins, and seem to form the very foundation of the still more widely extended religion of Buddha

SOFTENING In Painting, the blending of colours into each other

SOIL The primitive earths in a state of mixture with organized matter fit for the growth of plants The surface of the earth in every country on which plants have grown and decayed is properly denominated soil, while the earth at a foot or more beneath the surface, commonly called subsoil, is comparatively without organized matter, and is therefore properly denominated earth, clay, sand, gravel, lime, or mixed earth, rocks, or stones, as the case may be

SOIRÉE (Fr soir, *evening*) The term originally given by the French to certain evening parties held for the sake of conversation only, music, dancing, and similar entertainments being excluded, but the word has been since introduced into all the languages of modern Europe and is now employed to designate most descriptions of evening parties in which ladies and gentlemen are intermixed, whatever be the amusements introduced It is frequently applied in England to the public meetings of certain societies held for the advancement of their respective objects, at which tea and other refreshments are dispensed during the intervals of business

SOKE A territorial division now subsisting in Lincolnshire This term, according to the etymology given by Bracton, designated a precinct in which a particular lord exercised justice

SOL In Music, the fifth note of the gamut

SOLANA'CEÆ (Solanum, one of the genera) A natural order of herbaceous or shrubby Exogens inhabiting all parts of the world excepting the arctic regions They are chiefly known from *Scrophulariaceæ* by their curved or spiral embryo the plaited estivation of the flower and the flowers being usually regular, with the same number of stamens as lobes The first of these characters however is not of universal importance, the plaited corolla and symmetrical flowers are better marks of distinction This order contains nightshade, henbane, mandrake tobacco, stramonium the potato and the tomato, the leaves of all which are narcotic and exciting, but in different degrees,—from *Atropa belladonna* which [illegible] tobacco which [illegible] of these symptoms, henbane and stramonium,—down to some of the Solanum tribes, the leaves of which are so inert as to be used as kitchen herbs Even in the potato plant the narcotic acrid principle is found in the stem and leaves, and even in the rind of the tuber But the principal part of the latter consists of starch, and the small quantity of deleterious matter being volatile and near the surface, is readily driven off by the heat used in cooking

SOLA'NIA The active principle of the *Solanum dulcamara*, or woody nightshade It is a white alkaline substance, insoluble in water but soluble in alcohol its combinations with the acids are bitter

SOLA'NO A hot oppressive wind which occasionally blows in the Mediterranean, and particularly on the eastern coast of Spain The solano is a modification of the sirocco

SOLA'NUM TUBERO'SUM The botanical name for the plant of which the potato is the root The potato, which is at present to be met with everywhere in Europe, and forms the principal part of the food of a large proportion of its inhabitants was entirely unknown in this quarter of the world till the latter part of the 16th century It is a native of America, but whether of both divisions of that continent is doubtful (Humboldt, *Nouvelle Espagne* [illegible] it was first introduced [illegible] in 1545, others, that it was introduced by Sir Francis Drake, in 1573, and others, again, that it was for the first time brought to England from Virginia by Sir Walter Raleigh, [illegible] have arisen from confusion [illegible] potato (the *Solanum tuberosum* of Linnæus) with the sweet potato (*Convolvulus batatas*) The latter was introduced into Europe long before the former, and it seems most probable that it was the species brought from New Granada by Hawkins Sweet potatoes require a warm climate, and do not succeed in this country, they were, however, imported in considerable quantities, during the 16th century, from Spain and the Canaries, and were supposed to have some rather peculiar properties The [illegible] of [illegible] like confections, [illegible] roots On t[illegible] are really indebted for the potato (as well as for tobacco) to Sir Walter Raleigh, or [illegible] planted in Virginia Gerarde, an o[illegible], mentions in his *Herbal*, published i[illegible] planted the potato in his garden at L[illegible], and that it succeeded there as well as in its native soil, Virginia, whence he had received it Potatoes were at first cultivated by a very few, and were looked upon as a great delicacy In a manuscript account of the household expenses of Queen Anne, wife of James I, who died in 1618, and which is supposed to have been written in 1613, the purchase of a very small quantity of potatoes is mentioned at the price of 2*s* a pound The Royal Society, in 1663, recommended the extension of their cultivation, as a means of preventing famine Previously, however, to 1684 they were raised only in the gardens of the nobility and gentry, but in that year they were planted, for the first time, in the open field in Lancashire,—a county in which they have long been very extensively cultivated

Potatoes, it is commonly thought, were not introduced into Ireland till 1610, when a small quantity was sent by Sir Walter Raleigh to be planted in a garden in his estate in the vicinity of Youghal Their cultivation extended far more rapidly than in England, and have long furnished from 3-5ths to 4-5ths of the entire food of the people of Ireland!

Potatoes [illegible] till 1728, w[illegible] a person of the name of Prentice, a day labourer at Kilsyth who died at Edinburgh in 1792

The extension of the potato cultivation has been particularly [illegible] ty years The quantity that is no[illegible] supposed to be from 10 to 12 times as great as the quantity raised at the end of the American war, and though the increase in England has not been nearly so great as in Scotland, it has been greater than during any previous period of equal duration The increase on the Continent has been similar Potatoes are now very largely cultivated in France, Italy and Germany, and, with the exception of the Irish, the Swiss have become their greatest consumers They were introduced into India some sixty or seventy years ago, and are now successfully cultivated in Bengal, and have been introduced into the Madras provinces Java the Philippines and China But the common potato does not thrive within the tropics, unless it be raised at an elevation of 3000 or 4000 feet above the level of the sea so that it can never come into very general use in these regions This, however, is not the case with the sweet potato, which has also been introduced into tropical Asia, and with such success, that it already forms a considerable portion of the food of the people of Java, and some other countries So rapid an extension of the taste for, and the cultivation of an exotic, has no parallel in the history of industry it has had, and will continue to have, the most powerful influence on the condition of mankind But upon this part of the subject we must refer the reader for full particulars to the *Com Dict* art 'Potatoes," from which the above historical sketch has been taken

SOLAR CYCLE A period of twenty-eight years *See* CYCLE

SOLAR SYSTEM, in Astronomy consists of the sun, and all the celestial [illegible] whose motions are controlled by its gravitation, viz the planets, satellites, and comets *See* SUN PLANET &c

SO'LDER Plumbers' solder is an alloy of three parts of lead and one of tin, it is more fusible than lead, and readily adheres to clean surfaces of that metal when it is fused Fine solder is a mixture of two parts of tin and one of lead, it fuses at 360° It is used in the process of tinning copper Hard soldering, or brazing, by which two surfaces of copper are made to adhere, is done by fusing together brass and zinc When this solder is used, [illegible]

SOLDIER [illegible] *one who serves for pay*) In general language, a person equipped and maintained by the state for the [illegible] defending it from foreign aggression, of putting down internal commotion, or, in short, of protecting its interests either at home or abroad, according to instructions issued by the civil government *See* ARMY, ENLISTMENT, &c

SOLEA (Lat *a slipper*), in Mammalogy, is the [illegible] hoof

[illegible] genus of flat fishes (*Pleuronectidæ*), characterized as follows —' Both eyes on

the right side, the mouth distorted on the side opposite the eyes; small teeth in both jaws, but confined to the under side only; [illegible] dorsal and anal fins extending [illegible] common sole (*Solea vulgaris*, Cu[illegible] and in enormous quantities, along our coasts, principally from Sussex to Devonshire, and excepting towards the latter end of February, and the beginning of March, when the soles are spawning, and are rather soft and watery, they are [illegible] for the table throughout the year

SOLECISM In Rhetoric and Grammar (Gr *σολοικισμος*, said to be derived from the name of a town in Cilicia, whose inhabitants spoke a barbarous Greek), a violation of the idiomatic rules of grammar or construction in writing or speaking a language Quintilian distinguishes solecism from barbarism, the latter word being applied to the erroneous use of single words

SOLENACEANS *Solenacea* (Gr *σωλην*, *a tube*) The name of a family of Dimiary Bivalve Mollusks, of which the razor shell (*Solen*) is the type, they are distinguished by the great length of the respiratory tubes, whence their name

SOLENOID (Gr *σωλην* and *ειδος*, *appearance*) In Electro-Dynamics, a name given by Ampère to a system of small electrical currents, equal and equidistant and returning into themselves the planes of which are normals to any given line, whether a straight line or curve upon which their centres are situated, and which forms the axis of the *solenoid* (Despretz, *Traité de Physique*, 1836)

SOLFATARA A volcanic vent emitting sulphur and sulphurous compounds The term is borrowed from Solfaterra, the celebrated mountain of Naples called by [illegible] *græt Campi*

[illegible] In Music, the system of arranging the scale by the names ut, re, mi, fa, sol, la, by which musical students are taught to sing these notes being represented to the eye by lines and spaces, to which the syllables in question are applied (See art Music, under which will be found a diagram of the scale under the arrangement in question)

SOLICITOR The professional [illegible] admitted to practise in the court of Chan[illegible] to conduct of suits, &c, who are styled attorneys in the courts of common law (*See* ATTORNEY) The *solicitor-general* is an officer of the crown, who holds by patent, and ranks next to the attorney-general, with whom he is, in fact, associated in the management of the legal business of the crown and public offices He receives some particular fees on pleadings and on the enrolment of patents, &c; but the division of business between him and the attorney-general is chiefly regulated by usage founded on convenience He is the officer on whom generally devolve the maintenance of the rights of the crown in revenue cases, patent causes, &c The earliest date at which the name of this officer occurs, so far as is known, is the year 1461 In Scotland the term solicitor is synonymous with attorney in England They are inferior to the *writers to the signet*, and practise in the inferior courts

SO'LID In Physics, the term *solid* is applied to that condition of matter in which the attractive forces of the molecules are greater than the repulsive and the molecules consequently c[illegible] with [illegible] or less force The other states of [illegible] in which the attractive and repulsive forces are balanced, and the *gaseous*, in which the repulsive prevail

SOLID In Geometry, a magnitude which has three dimensions, length breadth and thickness The boundaries of solids are surfaces *Regular solids* are those which are terminated by regular and equal planes They are five in number, viz the tetraedron, the hexaedron, the octaedron, the dodecaedron, and the icosaedron *See* PLATONIC BODIES

SO'LID ANGLE, in Geometry, is an angle made by the meeting of more than two plane angles which are not in the same plane in one point

SO'LID PROBLEM In Geometry, a problem which cannot be constructed by the intersections of circles and straight lines [illegible] the description [illegible] gebraic solution of a solid problem leads to a cubic or biquadratic equation Problems which admit of being constructed by the intersection of two circles, or of a straight line and circle, are called plane problems, and [illegible]

SOLIDUNGULATES [illegible] Lat solidus, *solid*, [illegible] Mammals, including those with only a single hoof on each foot, as the horse, ass, &c

SOLI'LOQUY *See* MONOLOGUE

SO'LIPEDS Synonymous with *Solidungulates*, which see

SOLLE'CITO (It *afflicted*) In Music, a term denoting that the movement to which it is affixed is to be performed in a mournful manner It also means that the music is to be performed carefully

SO'LO (It *alone* In Music [illegible] or part of a movement, in which only one voice or instrument is employed

SOLSTICE (Lat *solstitium*) The time at which the sun is at its greatest distance from the equator, and which [illegible] This happens at midsummer and midwinter, or when the sun arrives [illegible]

SOLSTITIAL POINTS [illegible]

SOLUTION [illegible] Mathematics, the construction of a proposed problem, or the expression of its conditions by an equation which gives the [illegible]

SOMMITE [illegible] name of the *nephelin* of Somma and Vesuvius *See* NEPHELINE

SOMNAMBULISM (Lat somno ambulare, *to walk in one's sleep*) This is a species of dreaming, in which the bodily as well as the mental functions are affected There are many remarkable cases of this kind on record, some of which would appear perfectly incredible, were they not attested not only by credible, but by competent and scientific witnesses Somnambulism has been defined as 'a state in which the mind retains its power over the limbs, but possesses no influence over its own thoughts and [illegible] the body executing those [illegible] of which are [illegible] walking' Dr Abercromby in his excellent *Inquiries concerning the Intellectual Powers and the Investigation of Truth* observes in regard to this singular affection that although the mind is fixed upon its own impressions in ordinary dreaming, the bodily organs are more under the control of the will, so that the individual acts under the influence of his erroneous conceptions, and holds conversation in regard to them He is also, to a certain degree, susceptible of impressions from without, through his organs of sense, not however, so as to correct his erroneous impressions but rather to be mixed up with them Dr Abercromby observes, that the first degree of somnambulism generally shows itself by a propensity to talk during sleep, the person giving a full and connected account of what passes before him in dreams, and often revealing his own secrets or those of his friends Walking during sleep is the next degree, and that from which the affection derives its name He gets out of bed, often dresses himself, and goes out of doors, walks frequently over very dangerous places in safety, sometimes he gets out of a window, walks along a parapet, gets to the roof of the house and returns through similar risks to his apartment On awaking in the morning he is either utterly unconscious of having stirred during the night, or remembers it as a mere dream These cases are comparatively common, but sometimes the transactions of the somnambulist are carried much further he will mount his horse and ride or go to his usual occupations, such as threshing, saddle-making playing on musical instruments, composing verses and so forth

Although somnambulists are generally insensible to any thing that is said to them, they are sometimes capable of holding conversation, especially in those cases where the affection occurs, as it sometimes does, in the daytime In these attacks the individuals are generally unconscious of external impressions, or at all events extremely confused in their notions of external things They frequently speak intelligibly, but in reference to the impressions which are present in their own minds They sometimes repeat poetry and other matters of which they were supposed to be perfectly ignorant, or they hold conversations with imaginary beings, or relate circumstances which were supposed to have been entirely unnoticed or forgotten Some have been known to sing in a style superior to any thing to which they could attain when awake, and there are, says Dr Abercromby, some well-authenticated instances of persons in this condition expressing themselves correctly in languages with which they were imperfectly acquainted

For the details of individual cases of this extraordinary disorder, we must refer to Dr Abercromby's instructive volume already quoted, and the authorities therein cited It is impossible to give any explanation of the extraordinary condition of the faculties which such cases exemplify, or to point out any general plan of treatment applicable to them

The more ordinary cases of somnambulism are sometimes cured by tying the patient to some part of the bed, or by securing the doors and windows, so that after ineffectual attempts to make his escape he is induced to return to bed, and remains quiet The state of the stomach and bowels, and of the nervous system, requires careful examination and proper treatment in some cases intestinal worms appear to have been connected with nocturnal disturbances bearing a close analogy to somnambulism, and which have disappeared after the successful operation of vermifuge remedies

SOMNUS, in Classical Mythology, the poetical god of sleep, is the son of Erebus and Nox, or of Nox alone He dwells with his brother Death in a palace at the

western extremity of the earth Homer makes Juno seek him in the isle of Lemnos, whither he had repaired for love of the nymph Pasithea Ovid makes him dwell in a cavern among the Scythians or Cimmerians; Statius in Æthiopia.

SONA'TA (It sonare, *to sound*) In Music, a composition executed wholly by instruments It is generally a free composition for exhibiting the composer's powers, without confining him within the rigid rules of counterpoint or measure

SO'NNET (It sonetto) In Poetry, a short composition of fourteen or fifteen lines, deca or endecasyllabic, rhymed according to an intricate but not always precisely similar arrangement It is the oldest form in which the Italian language was used, but was, at a still earlier period, employed, although not commonly, by the Provençal poets In Italy, Dante and the Tuscan poets his contemporaries brought the sonnet into public esti- [illegible] symbolical nature, though generally, in their outward signification, breathing the spirit of romantic and chivalrous love By Petrarch, in the course of the same century, the sonnet was carried to perfection in point of form and polish, although applied by him, as it had been by his predecessors, almost exclusively to the subject of his figurative and mystical passion Since the time of Petrarch the sonnet has been a favourite form of composition in Italy, [illegible] occasional poetry In France [illegible], or rather the French sonnet is a different poem, less regular in its construction than the Italian In Germany and England the comparative poverty in rhymes of their respective languages has rendered it unusual, but Milton has given to it a dignity peculiarly his own, together with much of the melody and tenderness which characterize his Italian models The proper sonnet is divided into two quatrains, with four lines and two rhymes each, and two terzines, each with three lines and a single rhyme Pieces of a similar metrical structure in octo-syllabic lines are termed by the Italians Anacreontic sonnets It is sometimes said that there is "hardly an educated Italian who ha[illegible]"

[illegible], from σοφος, *wise*) A Greek word, originally signifying a person of talent and accomplishments It was afterwards restricted to a bad sense, and applied to a class of men who arose in Greece in the fifth century B C and taught the youth in the principal cities various arts and acquirements for hire It has hence come to be the general designation of all such as cultivate any branch of science or philosophy with a view to outward advantages, careless of the truth of what they advance except in so far as true to those purposes The first Greek who [illegible] name of *Sophist* was Protagoras a native of Abdera, who flourished about the year 440 B C, and obtained numerous pupils and auditors, especially in Athens Of those who followed the same occupation the most celebrated were Hippias of Elis, Gorgias of Leontium, Prodicus of Ceos, and Euthydemus of Chios, with his brother Dionysiodorus None of the writings of these men have survived, but we have abundant notices in the writings of their contemporaries, especially Plato, Xenophon, and Aristophanes, of the nature and tendency of the doctrines and principles which they communicated to the youth of Greece Of the truth of these accounts the Grecian history of the latter part of the fifth century furnishes us with a melancholy testimony It is, indeed, to the changes which had begun to take place in the internal and external relations of the Greek states, that the prevalence and success of the Sophists are mainly to be attributed The changes in the distribution of property which these revolutions rendered necessary excited the passions and gave scope to the energies of the young and enterprising, at the same time that the political alterations tended to shake men's confidence in those moral principles which among the Greeks were intimately bound up with their civil institutions We accordingly find the leading feature of the sophistic doctrine to be a dislike to every thing fixed and necessary, in ethics as well as philosophy Prescription was represented as the sole source of moral distinctions, which must consequently vary with the character and institutions of the people The *useful* was held to be the only mark by which one opinion could be distinguished from another An absolute standard of truth is as absurd a notion in speculation as an absolute standard of morals in practice that only is true which seems so to the individual and just as long as it so seems Man is the measure of all things" These and similar doctrines they maintained with great subtlety and acuteness, and found numerous disciples among those who were well prepared for the admission of tenets which swept away at once all the remnants of those prejudices which might still interpose a barrier between their passions and their gratification Considered as a link in the chain of philosophical development, the Sophists were doubtless the involuntary cause of the greater depth and soundness of the subsequent Grecian philosophy The success which they had found in demolishing the systems of their predecessors proved the necessity of laying the foundations of human knowledge deeper than heretofore had been done and it is thus to the Sophists that we may attribute the more critical and cautious spirit which distinguishes the doctrines of Plato [illegible] *de Ld de Insv* xc xiii xxxii, *Ld Review*, vol xxxiv)

SOPORI'FICS (Lat sopor, *sleep*) Medicines which induce sleep

SO'PRA (It *above*) In Music, a term frequently used for description, as *nella parte di sopra*, in the higher or upper part, *di sopra*, above, *contrapunto sopra il soggetto*, counterpoint above the subject &c

SOPRA'NO (It sopra) The upper or treble part in composition

SO'RBIC (ACID) The acid of the berries of the *Sorbus aucuparia*, or mountain ash It is identical with the *malic acid*

SORBO'NNE A college at Paris for the study of theology, so called from the village of Sorbonne, in Champagne, where its founder, a priest named Robert, was born about the beginning of the 13th century He made a provision for the instruction of sixteen poor clerks in theology, and his college is said to be the first example of what was afterwards the common character of all the [illegible] the institution of a cœnobium for regular [illegible] The college of the Sorbonne was adorned with various new edifices and enriched with a library by Cardinal Richelieu [illegible] His monument in the church is considered a chef d'œuvre of French art. (See Mosheim, *Eccl Hist* vol iii transl 1790, p 53 &c) This great college of theology exercised a high influence in ecclesiastical affairs, and on the public mind, especially in the 16th and 17th centuries, insomuch that the sceptical wits of the 18th usually employ the name as synonymous with the spirit of bigotry itself Its proverbial celebrity for acuteness in theological disquisition is attested by the lines of our own Butler —

> For he a rope of sand could twist
> As true as learned Sorbonist

SO'RCERER (Lat sortitor, from sors, *a lot*; whence *sorcery*) Properly one who [illegible] or divination by lot (which see), but in the language of the middle ages, one [illegible] powers (*see* MAGIC), especially by the aid of evil spirits. The *sorcerer* of the middle ages was, generally speaking, a personage of distinction while the *witch* was degraded and loathsome The species of sorcery which is still practised in the East, especially in Egypt, by means of the magic mirror, has recently attracted much attention The most complete account of it will be found in *Lane's Modern Egypt*

SORDINI In Music *See* CON SORDINI

SORE'DIA In Botany heaps of powdery bodies found in lichens lying upon any part of the surface of the thallus

SO'REX (Lat sorex, *a field-mouse*) A Linnæan genus of the order *Bestiæ*, now forming an extensive tribe of [illegible] of Cuvier [illegible] original generic term is confined to the shrews or shrew-mice, which are the type of the family (*Soricidæ*), and are characterized by having the two superior middle incisors curved and indented at the base, the two inferior incisors prolonged and procumbent Behind the upper pair of incisors there are five little conical teeth on each side, and two similar teeth behind the lower pair of incisors the molars, which are beset with sharp cusps, are four on each side above, and three below The true shrews are further characterized by lateral, and sometimes anal and femoral scent-glands The principal genera, now distinct, which would have ranked with the Linnæan *Sorex*, are *Myogale Condylura Talpa Gymnura, Macroscelis*, [illegible] *Crossopus Crocidura* [illegible] to the family of hedgehogs and [illegible] moles

SORE'DIUM (Gr σωρος *a heap*) The small heaps of reproductive granules found growing upon the fronds of Pol[illegible]

SORI'TES (Gr σωρος *a heap*) In Logic, an abridged form of stating a [illegible] of which the conclusion of each is a premiss of the succeeding one e g A = B, B = C, C = D, therefore A = D This is a sorites, consisting of two distinct syllogisms, which, drawn out at length, would stand thus A = B, B = C, therefore A = C, and A = C, C = D, therefore A = D

SO'RREL, SALT OF Binoxalate of potash

SO'RTES HOME'RICÆ VIRGILIANÆ SANCTORUM, &c A species of sortilege or divination was practised in antiquity by opening at random a favourite author, and applying the first passage which met the eye to the circumstances of the inquirer as an oracular answer termed by the Greeks στοιχειομαντεια They

chiefly used Homer for this purpose Thus Socrates when in prison, hearing the line of Homer repeated,

ἡμαρ τὴν τριτατῳ, Φθιην ἐρίβωλον ἱκοιμην,

interpreted it to foretel his own death within three days, by a play on the word Phthia Among the Romans, Virgil was chiefly consulted, and many celebrated instances are preserved Adrian, when desirous to know on what terms he stood with his patron the emperor T [illegible] opened at the verses re[illegible] incanaque menta Regis Romani," &c , and thence drew the augury of [illegible] elevation to the empire Alexander Severus also, according to Lampridius, obtained a similar presage from the lines "Excudant alii spirantia mollius aera" &c The anecdote of the ominous passage discovered by Charles I and Lord Falkland when opening Virgil in the public library at Oxford, is well known (see *Welwood's Memoirs*) In Christian times, the Sortes Sanctorum came in fashion They were obtained by consulting the inspired writings in the manner before described, sometimes, also, the inquirer went into a church while service was performing, and drew a [illegible] the first words he heard In this way, [illegible] directed to adopt a life of solitary devotion These practices became the occasion of much superstition They are [illegible] o Januarius, [illegible] with evident credulity [illegible] by early ecclesiastical writers Gregory of [illegible] other similar stories has one of the French prince Meroveus, which shows the ceremonious manner in which they were sometimes performed That prince having fled to the basilica of St Martin, placed separately on the saint's tomb the Psalms the book of Kings, and the Gospels and, spending three days and nights at the tomb in fasting and devotions on the fourth day he opened these sacred books, from each of which he drew a discouraging prediction Elections to the episcopal offices, and other solemn proceedings seem to have been sometimes decided in the same manner in the dark ages And after this abuse had ceased, it was long a common practice, on the consecration of a bishop after the book of the Gospels had been laid on his head, to consider the first verse which offered itself [illegible] his behaviour and the fortunes of [illegible] the death of Albert bishop of Liege, was intimated by the ominous occurrence of the passage respecting the execution of John the Baptist, and that prelate was [illegible] put to death by Henry VI The Sortes Sanctorum had been however, forbidden by the council of Vannes in the 5th century, and that anathema was repeated on many later occasions, in which the consulting of the scriptures is classed with other profane and magical modes of divination There is an essay on Sortes in the *Mem de l Ac des Inscr* vol xix *See* STICHOMANCY

SORTIE or SALLY In Military language a term borrowed from the French to signify a sudden attack made by the inhabitants of a besieged city upon the besiegers

SORTILEGE (Lat sors *lot*, lego *I collect*) Divination by lots A very ancient mode of exploring future events, and which has been supposed by superstitious persons in modern times to derive countenance from various incidents in sacred history, especially the choice of St Matthias by lot to the place of an apostle (Acts, i 26) The different modes in which sortilege has been practised will be found detailed under that word, in a learned article in the *Enc Metropolitana*, and *see* SORTES

SOSPI'RO (It *a sigh*) In Music, the same as Rest, which see

SOSTEN'UTO (It *sustained*) In Music, a term which, affixed to a note, indicates that it is to be held out [illegible] manner

SOTHIC YEAR In Chronology, the Egyptian year of 365 days (said to have been introduced into Greece by Orpheus) was so called from Sothis, the Dog-star, at whose heliacal rising it was supposed to commence (*Bryant's Ancient Mythology*, vol iv)

SO'TTO (It *below*) In Music, a term frequently used for description, as *sotto il sogetto*, below the subject, *nella parte di sotto*, in a lower part

SOUND (Fr son) The sensation produced by the vibrations of the air or other medium with which the organ of hearing is in contact The doctrine of sound is usually treated under the head *acoustics*, a branch of physics which has for its object the determination of the laws by which the peculiar motions which give rise to the sensation of sound are produced in bodies and conveyed to our ears, and the manner in which they act on those organs, in other words to explain the origin, propagation and perception of sound

Although strictly speaking, sound is only a sensation excited in the auditory organ, yet in treating of the subject it is usual to transfer the name from the sensation to the motion which gives rise to it We shall therefore speak of sound as [illegible] it proceeding from the *sounding* body, and speak of a body as sounding when its particles are in that state of vibration which is requisite for making an impression on the ear, either immediately or through the medium of some other elastic substance

*Phenomena of Sound* — In order that a body may produce sound it is necessary that its particles be in a state of rapid vibration and in order that these vibrations may be communicated to the auditory organ, it is necessary that air or some elastic medium be interposed between the vibrating body and the ear Hauksbee having suspended a bell under the receiver of an air-pump, found the sound become feebler in proportion as the air was removed, and again become stronger as the air was readmitted and also that when the bell was suspended in a vessel full of air, and placed under the receiver, no sound was transmitted when the air between the vessel and the receiver was exhausted This experiment has been repeated by Biot, with a more perfect apparatus, and with every attention to the circumstances by which it is influenced, and it was found that when the exhaustion was complete no sound was perceptible, even when the ear was brought close to the receiver Hence it appears that sound cannot be communicated through a perfectly void space But although air is the medium through which sound is usually communicated, this only happens because it is the medium with which the ear is usually in contact, and many other media are found by experiment to perform the office even more perfectly Franklin having plunged his head under water, caused a person to strike [illegible] together beneath the surface, and at more [illegible] heard the blows distinctly Colladon by plunging a few feet into the water a thin tin cylinder closed at the lower end, but having the upper open to the air, was enabled to hear the sound of a bell struck under water at the distance of 2000 6000 and even 12,000 metres (about 9 miles), namely, across the whole breadth of the lake of Geneva from Rolle to Thonon The conducting power of wood along the fibres is very remarkable Let a person bring his ear close to the end of a fir deal however long, and he will distinctly hear the slightest scratch made with the point of a pin at the other end although the sound may be so feeble as to be inaudible to the person who makes it Miners at work in one shaft often hear the sound of the pickaxe in another through the solid rock, and in general all solids tolerably compact are good conductors of sound

Sounds are propagated to great distances and with remarkable distinctness over a surface of water, or ice, or frozen snow In the account of Parry's third polar expedition it is stated that two persons could hold a conversation across the harbour of Port Bowen, a distance of 6696 feet or about a mile and a quarter Instances are also recorded of sounds propagated to almost incredible distances over land Derham relates the following — Guns fired at Carlscroom were heard across the southern extremity of Sweden, as far as Denmark, a distance of 120 miles Dr Hearn a Swedish physician relates that he heard guns fired at Stockholm at the distance of 30 Swedish or 180 English miles the cannonade of a seafight between the English and Dutch, in 1672, was heard across England as far as Shrewsbury and even in Wales, a distance of upwards of 200 miles from the scene of action

The diminution of the intensity of sound in rarefied air is rendered manifest not only by experiments with the air pump, but also by the phenomena observed at [illegible] the atmosphere Saussure relates that [illegible] Mount Blanc the report of a pistol was not louder than that of a small cracker in the plain below, and Gay Lussac, having ascended in a balloon to an altitude of nearly 23,000 feet, far above the clouds and away from all solid substances, observed the intensity of the sound of his voice to be greatly enfeebled

It is matter of familiar observation that sounds are not propagated through the air instantaneously but occupy a sensible portion of time in passing from one station to another, greater in proportion as the stations are more remote The blow of a hammer on an anvil is not heard by an observer at some distance, until a sensible time has elapsed after the hammer has been seen to descend, and the flash of a gun fired a mile off is seen several seconds before the report is heard But all sounds, whatever be their loudness or pitch are propagated with the same velocity through the same medium In listening to the music of a concert, the sounds follow each other in the same order and at the same intervals, and the same measure and harmony are perceived, at whatever distance the hearer may be from the orchestra Biot caused several airs to be played on a flute at the end of a pipe 3120 feet long, which were distinctly heard at the other end [illegible] in the order or interval [illegible] could not have been the case if there had been the smallest difference in the velocity of their propagation

Numerous experiments have been made for the purpose of determining the actual velocity of sound through the

atmosphere The usual mode of making the experiment is to observe the interval between the flash and the report of a cannon fired at a known distance In this manner the Florentine academicians in 1660, found the velocity to be 1148 English feet per second These experiments were repeated in France in 1698, by Cassini, Huygens, Picard, and Roemer, who found 1172 feet, and Flamsteed and Halley at the royal observatory of Greenwich, from experiments made at the distance of 3 miles, found the velocity to be 1142 feet per second This result was confirmed by Derham (*Phil Trans* 1708), who found the same velocity by a mean of observations made at more remote distances In 1737 the Academy of Sciences of Paris directed farther experiments to be made by Cassini de Thury, Maraldi, and Lacaille, and on this occasion the experiments were for the first time made so as to eliminate the effect of the wind by reciprocal observations, that is to say, by firing cannon at both ends of the line, either simultaneously or at short intervals They also appear to have been the first who observed and recorded the temperature of the air at the time of the experiment, a very essential element, as will presently be seen The result at which they arrived gave the velocity equal to 1106 English feet per second, at a temperature between 4° and 6° of Reaumur, or between 41° and 44½° of Fahrenheit When the proper reduction is made for temperature, this agrees very nearly with the best modern observations

Numerous experiments were made in different countries in the course of the 1st century (viz by Bianconi in Italy, in 1740, by Condamine at Quito and Cayenne, in 1740 and 1744, by Mayer in 1778, and Muller in 1791, in Germany, by Espinosa and Bauza in 1794, at Chili), but as the observers had not the means of determining minute intervals of time with the precision which has been attained in more recent experiments, and besides neglected some circumstances which influence the result, it is unnecessary to state the details

Since the beginning of the present century the velocity of sound has been measured in various countries, in Germany, by Benzenberg at Dusseldorf in 1809 and by Myrbach and Stampfer at Saltzburg in 1822, in France by directions of the Bureau des Longitudes in 1822, in Holland, by Moll, Vanbeck and Kipp in 1823, in England by Dr O Gregory at Woolwich in 1824 in the East Indies by Mr Goldingham in 1821, and at Port Bowen in the polar regions, by Parry and Foster, in 1825 The results of these measurements when reduced to the same temperature, agree very nearly with one another, but the experiments made in France and Holland are by far the most circumstantial and satisfactory In the French experiments two stations in the neighbourhood of Paris were chosen Villejuif and Montlehery, and the signals were made by firing a gun from each station alternately, at an interval of five minutes The observers at Villejuif were Prony, Arago, and Mathieu, and at Montlehery, Humboldt, Gay Lussac, and Bouvard The observations commenced at 11 o clock on the nights of the 21st and 22d of June and were continued on both nights during two hours, but in many instances the reports were not heard, at least by all the observers The intervals between the flashes and reports were observed by means of stop watches of a peculiar construction, which permitted the seconds to be divided and noted The mean of all the observations gave 54·6 seconds for the time which sound took to travel from the one station to the other The distance between the stations was afterwards determined by Arago, and found to be 9549·6 toises (11⅛ miles), whence the velocity is 174·9 toises, or 340·88 metres in a second But this is the velocity belonging to the mean temperature, which was 16° centigrade (61° Fahrenheit) and corresponds to a velocity of 331·12 metres (1086·1 English feet) in the temperature of freezing water The details of these experiments are given in the *Connaissance des Temps* for 1825

In the Dutch experiments a clock with a conical pendulum was used, which gave the means of determining the time to the hundredth of a second by suddenly arresting the motion of the index without stopping the clock As in the French experiments, guns were fired from each extremity of the line, but instead of being fired alternately [illegible] so that a very small [illegible] the state of the atmosphere or the wind was entirely eliminated The state of the hygrometer was also observed The interval between the stations was 57839 feet (nearly 11 miles), and the mean of all the experiments reduced to the freezing temperature, and for dry air, gave for the velocity of sound 1089·42 feet in a second The details are given in the *Phil Trans* for 1824

Dr Gregory's observations are given in the *Transactions of the Royal Irish Acad* and *Phil Soc* for 1824 The signals were not reciprocal, but the velocity of the wind was measured by an anemometer, and allowed for The distances were also very much smaller (varying from 2700 to 13460 feet) nevertheless the results agree very well with those above mentioned Mr Goldingham's experiments at Madras are much less certain, his method consisted in taking a mean of the velocities observed daily in calm weather, during a long time, by the firing of the morning and evening guns at two stations visible from Madras [illegible] to be reduced (*Phil Trans* [illegible] are given in *Gilbert's Annalen*, new series [illegible] and those of General Myrbach in the *Jahrbuch des Polytek Instituts zu Wien* vol vii The experiments of Parry and Foster are given in detail in *Parry's Journal of a Third Voyage, &c* The mean result deduced by Dr Moll (*Phil Trans* 1828) gives the velocity equal to 1085·2 feet in a second, at the temperature of 17·7° Fahr, which corresponds to 1092 feet at 32°, but the circumstances were unfavourable The following table exhibits in one view the results of the principal experiments now described The numbers are taken from a more extended table given by Sir John Herschel in the *Ency Metropolitana* art "Sound," to which admirable treatise we refer the student for information on all points connected with this important subject

| Date of Observation | Observer | [illegible] | Freezing water |
|---|---|---|---|
| 1809 | Benzenberg | 29764 | 1093 |
| 1821 | Goldingham | 29547 | 1086·7 |
| | | 13932 | |
| 1822 | Myrbach | 32615 | 1092·1 |
| 1822 | [illegible] | 61064 | 1086·1 |
| 1823 | [illegible] | 57839 | 1089·42 |
| 1823 | Dr Gregory | from 2700 to 13460 | 1088·05 |
| | | Mean of the whole | 1089·2 |

These results agree remarkably well with each other, the greatest deviation from the mean being less than 4 feet, and the mean of the whole being almost identical with the determination of Moll and Vanbeek "We may therefore," says Sir John Herschel, "adopt 1090 feet without hesitation (as a whole number), as no doubt within a yard of the truth and probably within a foot" This is the velocity with which sound travels in dry air, at the temperature of freezing water But the velocity increases with the temperature (as will be shown presently), at the rate of 1·14 foot, very nearly for each degree of Fahrenheit's scale Hence at the temperature of 62° (the standard temperature of the British metrical system), the velocity is 1124⅓ feet We may therefore assume the velocity of sound at this standard temperature, as determined by the best experiments, to be 1125 feet per second

*Theory of Sound* — It has already been stated that sound is produced by the vibrations of the molecules of a solid body communicated to the atmosphere or other elastic medium, and conveyed by it to the ear The physical theory of sound, therefore resolves itself into two parts 1st the state or condition of the vibrating body, and 2d the mode in which this mechanical action is propagated through the medium to the organ of sense

*State of Sonorous Body* — In order that a body may give out sound, its particles must be put into a state of rapid vibration If the frequency of the vibrations is under a certain limit, no sound will be produced, above that limiting velocity of vibration, sound is produced, and experience shows that the quality of the sound becomes more and more acute as the vibrations are more rapid, until a second limit of velocity is attained, beyond which the human ear is affected with no sensation of sound To prove this experimentally let a thin plate of tempered steel have one of its ends firmly fixed in a vice, and let the other end be drawn a little aside from the position of rest As soon as the force by which the plate is bent is removed, the plate commences a series of vibrations, which become smaller and smaller until the position of rest is again attained But the vibrations are all performed in equal times, and if sufficient length is given to the plate, they take place so slowly as to admit of being accurately counted On shortening the plate, they become more rapid, and long before they attain that degree of rapidity which is necessary for the production of sound, it becomes impossible to count them directly, but it is demonstrable that when a plate of metal of equal thickness throughout is made to vibrate in the manner now supposed, the time of a vibration is directly proportional to the square of the length of the plate, and consequently the number of vibrations in a given time is inversely as this square, so that if the number in a second corresponding to any length of the plate has been counted, the number corresponding to any other given length can be readily computed In this manner it has been found that a metallic plate begins to sound when the number of vibrations in a second is 32, and at this velocity of vibration, the sound

which it gives is of the same pitch as that of an organ pipe 32 feet in length, open at both ends (By *vibration*, we here understand the passage of the plate from the extreme excursion on one side of the position of rest to the opposite, and not the going and returning, or complete vibration)

[illegible] velocity at which sound ceases to be appreciable, is not so easily determined Until recently it has been usual to fix it at 8200 vibrations in a second, but M Savart has discovered that by increasing the amplitude of the vibrations, acute sounds may be distinguished at a velocity of 24,000 vibrations in a second, and it is possible that the limit may still be considerably above this number By means of an ingenious apparatus, Savart has succeeded in determining the number of vibrations producing a sound of any given pitch with great exactness

Several other means exist of determining the absolute number of vibrations in a given time, corresponding to different musical sounds, of which one of the most certain, and most frequently had recourse to, depends on the mathematical relation subsisting between the time of vibration, the length of the cord, and the tension of vibrating cords Let $n$ denote the number of vibrations in a second, $g$ the accelerating force of gravity (32 feet in a second), $l$ the length of the cord, $w$ its weight, $t$ its tension (or the weight by which it is stretched), then a formula equivalent to the following was demonstrated by Brook Taylor (*Methodus Incrementorum*, p 93) —

$$n = \sqrt{\frac{g\,t}{l\,w}}$$

In this formula $g$ is known and $t$, $l$, and $w$ are measurable quantities, so that $n$ is completely determined, but a more convenient expression is obtained by substituting the diameter and density of the cord for its weight. Let $r$ be the radius of the cord, $\delta$ the density of its matter, and $\pi$ the ratio of the circumference to the diameter, or $\pi = 3\,14159$, then $w = \pi\,\delta\,g\,r^2\,l$, and the above formula becomes

$$n = \frac{1}{r\,l}\sqrt{\left(\frac{t}{\pi\,\delta}\right)}$$

From this it results that the number of vibrations in a second is proportional directly to the square root of the tension of the cord, and inversely to its length, to its thickness or diameter, and to the square root of its density

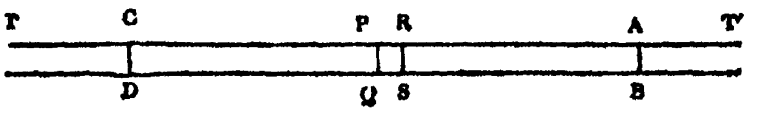
In the *Memoirs of the Berlin Academy* for 1822 and 1823, are given the results of a great number of experiments made in this manner by M Fischer, for determining the velocity of vibration corresponding to different musical sounds The rapidity of vibration giving the diapasons (that is, the concert pitches) of various orchestras at Berlin was found to be as follows — Berlin Theatre 437 32, Great French Opera 431 34, Feydeau 427 61, Italian Theatre 424 17 vibrations per second The reach of the voice of a man usually extends from $sol_1$ to $fa_3$ in the musical gamut, and that of a woman from $re_3$ to $la_4$ Taking the diapason of the Italian Opera as the standard, the rapidity of vibration corresponding to these several notes is as follows — $Sol_1$ 190 8, $fa_3$ 678 4, $re_3$ 572 4, $la_4$ 1606 vibrations per second But the voices of some singers reach much higher than $la_4$ and consequently the rapidity of vibration with respect to them will be higher in proportion

Some of the most acute sounds, or highest tones which the ear can distinguish [illegible] and their corresponding [illegible] or 15000 vibrations in a second When we reflect how extremely probable it is that the tympanum of the ear vibrates in unison with the sounds that affect it, we cannot fail to be struck with admiration of the wonderful delicacy of [illegible] which possesses the power of [illegible] vibration, from 32 times in a second up to 24,000, the number found by Savart to be sensible The limits, however, at which very acute sounds cease to be audible appear to vary considerably in respect of different individuals, some being altogether insensible to sounds which painfully affect others (See a very [illegible] on sounds inaudible to certain ears by D Wollaston in the *Phil Trans* for 1820)

The mathematical problem to determine the vibrations of a stretched cord is one of very great difficulty After exercising the talents of Dr Brook Taylor D'Alembert Euler, Daniel Bernoulli and others it was completely solved by Lagrange, in the first volume of the *Turin Miscellanies*, and all the deductions from theory are found to be confirmed by experiment The subject of the vibrations of solids has been recently examined experimentally by M Savart, and the results given in a series of most important memoirs communicated to the French Academy of Sciences, and printed in different volumes of the *Annales de Chimie* *See* VIBRATION

*Propagation of Sound* — In order to convey an idea of the manner in which the vibratory motions of a sonorous body are communicated to the atmosphere or other elastic medium, let us conceive a tube, T T', of an indefinite

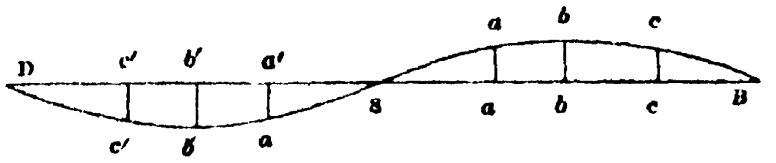
(1)




length, and open at both ends, to be filled with air of a uniform temperature and density throughout Let us also suppose a piston, P Q, which closely fits the tube, and is moveable within it along the direction of the axis, to be [illegible] osition P Q to R S; and the distance P R be supposed one foot and the time in which the piston moves from P Q to R S to be one second Now assuming the air within the tube to have been in a state of rest before the piston began to move, let us consider what will be its state at the instant when the piston arrives at R S If the air in the tube were acted upon as a perfectly hard body, any motion communicated to the particles at one extremity would be instantaneously conveyed to the other, and when the piston arrived at R S a quantity of air, equal to that which [illegible] P Q and R S, would be expelled at T', and all the particles within the tube would come to rest at the same time with the piston But in consequence of the compressibility of the air the motion is not communicated to the distant particles instantaneously, but only after a sensible interval of time, and we may conceive the tube to be so long that when the piston has arrived at R S no air has yet been propelled from the tube at T' In fact, the disturbance or compression of the particles, which takes place at the instant the piston begins to move, is propagated along the tube with a certain determinate velocity, depending on the elasticity of the air, and when the piston reaches R S will only have reached [illegible] Let A B be the section [illegible] pression has reached at the instant the piston comes to R S, then, at the instant of time on which we have to fix our attention, the column of air between R S and A B will be in a state of compression and between A B and the end of the tube at T' it will still remain in its natural state The column of air between R S and A B, which is thus modified by the stroke of the piston, is called a *wave of condensation*, and A R its *length* of the wave [illegible] R A, it will readily be seen that they are not subjected to the same degree of compression through its whole length Conceive the wave to be divided into a very great number of thin layers by sections parallel to R S or A B, and that the piston, in passing from the position P Q to R S, has produced the effect, not instantaneously, but by a great number of successive small impulses At the instant the piston comes to R S the disturbance has by hypothesis been propagated only to A B, and consequently the particles in the infinitely thin layer next to A B have suffered only the slightest degree of compression, or that caused by the first impulse of the piston In the second layer next to A B the molecules of air are in a state of greater compression, inasmuch as they have sustained not only the compression due to the first impulse of the piston, but also that which is due to the second, the effect of which is propagated to them at the same instant at which the effect of the first is propagated to A B In like manner, the compression in the third layer preceding A B is greater than in the second, and so on to the middle of the wave [illegible] [illegible] [illegible]

as the air within the tube on that side must be rarefied, instead of being compressed as the motion of the piston from P Q to R S (fig 2) may be a section of the tube, so that the column C R is equal to R A, then, as the velocity of propagation depends only on the nature of the medium, it is obvious that at the instant in which the piston arrives at R S the disturbance of the molecules will only have extended to C D The whole column between C D and R S will be rarefied by the withdrawal of the piston of air between P Q and R S, but the rarefaction will be greatest at the middle of the column, for the very same reasons that the condensation is greatest at the middle of the column between R S and A B If, therefore, we represent the rarefaction by

(3)

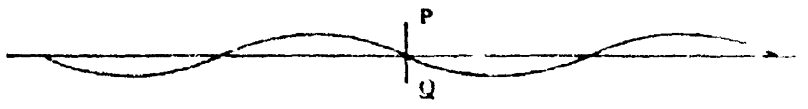



*negative* ordinates, $a'a'$, $b'b'$, $c'c'$, &c (fig 3), the state of the column of air between A B and C D (and this is all which is modified by the passage of the piston from P Q to R S) will be represented by the double curve D $b'$ S $b$ B, the small part between P Q and R S being neglected as insensible There are thus two distinct waves or undulations caused by the motion of the piston the wave S B *before* the piston is called the *condensed wave*, and S D *behind* the piston is called the *rarefied wave* But some writers on acoustics consider both these [illegible] and therefore understand by the term wave the whole mass of particles between C D and A B (fig 1) which have been disturbed by the motion of the piston from P Q to R S

As every thin stratum of air in the tube, by reason of its elasticity communicates to the stratum before it the impulse which it has received from the one behind it, all the particles will successively be affected in the same manner, and at the end of a second interval, equal to that in which the piston has passed from P to Q the motion will be communicated over another space equal to R A, or the wave will have moved forward its whole length, retaining always the same form, and, supposing the piston to have in this second interval remained at rest at R S, all the particles in the space R A will have returned to their original state of quiescence

If, instead of supposing the piston to remain at rest at R S, we suppose it to be drawn back, in the second interval of time, to its original position at P Q then all the phenomena now described will be repeated in the reverse order, that is to say, the compressed wave will be to the left of the piston, and the rarefied wave to the right, and the state of the particles within the tube, with respect to their compression, as modified by the advance and subsequent retreat of the piston (the complete vibration), will be represented as under (fig 4)

(4)




We have now only to suppose this forward and backward motion of the piston to be performed with the same rapidity as the vibrations of an elastic plate or stretched cord and the phenomena now described will give an idea of the mode in which sound is transmitted through the atmosphere

From this illustration (imperfect as it is) of the nature of the motions communicated to the air by the vibrating body, it is easy to see that the particles of air in the tube do not change their places *inter se*, but acquire a vibratory motion, backwards and forwards, along the length of the tube It is also obvious that the vibrations of the air through which sound is transmitted must be precisely equal in number to those of the sounding body, and as soon as the vibrations cease those of the air cease likewise But so long as the body vibrates, or the reciprocal motion of the piston is continued with the same velocity, a continued musical sound will be heard, and this will be precisely the same at whatever part of the tube the ear is situated, all the waves being [illegible]

It is also evident that sound is propagated not only in straight lines like light but in every possible direction Air being equally elastic in all directions, each point of a sonorous wave may be regarded as a new centre, from which [illegible] on all sides A sound heard from the opposite side of a mountain is not conveyed through the mountain, but through the air in curved or crooked lines along secondary rays

Sounds differ from one another in three respects,— [illegible] The pitch, or tone, depends [illegible] or, which comes to the same thing, on the number of vibrations in a given time (for the velocity being constant, the length of the wave multiplied by the number of vibrations in a given time is constant) The gravest tone which the ear can distinguish corresponds to a wave of about thirty-two feet in length and the most acute to one of about half an inch Two sounds, however different in loudness or quality, are always in perfect unison when the undulations by which they are conveyed are precisely of the same length The intensity or loudness does not depend on the length of the wave, but on the degree of compression which the air receives, that is, on the violence of the impulses, or the length of the stroke of the piston in the above illustration The *quality* of sound (the *timbre* of the French authors) is less easily explained It probably depends on the greater or less abruptness of the impulses, or of the changes of velocity and density of the strata of air between the two extremities of the wave

*Theoretical Determination of the Velocity of Sound* — The investigation of the velocity of sound through the atmosphere (or any gaseous medium) is based upon this fundamental proposition of dynamics viz that the velocity of the pulses in an elastic medium is as the square root of the elasticity divided by the density of the medium Let $v$ = [illegible] $d$ = the density, and the proportion [illegible] $\sqrt{\ }$ [illegible] Make $g$ = the measure of gravity [illegible] inches per second $w$ = weight of the unit of volume of air, $h$ = height of the homogeneous atmosphere (i e of a column of air of the same density throughout, and whose weight exercises on the base a pressure = $e$), we have then $e = h\,w$, $d = w - g$, and the above equation becomes $v = \sqrt{(g\,h)}$ But this is the velocity which a heavy body acquires by falling in vacuo from a height = $\frac{1}{2}\,h$, therefore, the velocity with which sound is propagated through the air is the same as that which a heavy body would acquire by falling [illegible] but from a theory wholly inapplicable The correct demonstration was first given by Lagrange

In order to convert this formula into numbers, it is necessary to determine $h$ Let $b$ = the standard height of mercury in the barometer, and $m$ = the ratio of the density of mercury to the density of atmospheric air under the same pressure, then $h = m\,b$, and the velocity becomes $v = \sqrt{(g\,m\,b)}$ At the temperature of freezing water (32° Fahr), and under a barometric pressure of 29 927 inches, the value of $m$ is found by experiment to be 10,466 But we have also $g$ = 386 29 inches, whence at that temperature $v$ = 10,998 inches, or 916 feet

[illegible] proportional to the square [illegible] by the density an alteration in the height of the barometer, while the temperature remains the same, will produce no change in the velocity, for an increase of pressure, and consequently of elasticity, is accompanied by a proportional increase of density An increase of temperature, however, by increasing the elasticity without changing the density, is accompanied by an augmentation of velocity The correction for a difference of temperature is found as follows Let $t$ denote the number of degrees of temperature on Fahrenheit's scale above 32°, and $a$ a constant coefficient, then the elasticity at [illegible] being $e$, the elasticity [illegible] $a\,t$) But the value of $a$ is found by experiment = 00208, therefore the elasticity is $e\,(1 + 00208\,t)$, and the formula for the velocity becomes $v = \sqrt{g\,m\,b\,(1 + 00208\,t)}$, or, in- [illegible] $\sqrt{g\,m\,b} = 916\,(1 + 00104\,t)$

[illegible] at the freezing temperature, thus deduced from theory, falls short of the experimental velocity (which has been shown [illegible] by 173 feet, or about a sixth part of [illegible] This discrepancy was remarked by Newton, who attempted to account [illegible] by supposing the spherical molecules of air to be [illegible] through which sound is propagated instantaneously, but the true solution of the difficulty was reserved for Laplace The explanation given by Laplace [illegible] takes place in [illegible] heat, which the [illegible] tube, and modifies the law of the elasticity, and accelerates the velocity On substituting it is to calculation be found that the formula for the [illegible] must be multiplied by a certain factor, [illegible] the quotient which is found by dividing [illegible] expresses the specific heat of the air (or other gas) under a constant pressure by that which expresses its specific heat under a constant volume. Let $k$ = this factor, then Laplace's formula for the velocity of sound is

$$v = \sqrt{g\,m\,b\,(1 + 00208\,t)\,k}$$

The value of $k$ for atmospheric air, as determined by Dulong (*Ann*, vol II p [illegible]), is 1 421, hence $\sqrt{k}$ = 1 192, and the formula in numbers is

$$v = 916 \times 1\ 192\,(1 + 00104\,t) = 1092 + 1\ 14\,t,$$

which is almost identical with the experimental determination

*Velocity of Sounds through Liquids and Solids* — The

following general formula for the velocity with which sound is propagated through elastic compressible bodies whether liquid or solid, as found by Laplace — Let $b$ denote (as before) the standard height of the barometer, D the density of mercury at the freezing temperature, $d$ the density of the medium, and $c$ the *compressibility* of the medium, that is, the diminution of bulk it sustains by an additional pressure equal to one atmosphere, then the formula is $v = \sqrt{\frac{g\,b\,D}{c\,d}}$, or, (since $g = 386.29$ inches, $b = 29.927$ inches, $D = 13.568$), $v = 396.04\ \sqrt{(1 \div c\,d)}$ inches, or $33\ \sqrt{(1 \div c\,d)}$ feet per second Applying this to the case of water, we have $c = .00049589$ (Herschel, *Ency Metrop*), and $d = 1$, whence $v = 4687$ feet per second This result agrees very nearly with the velocity determined by Colladon and Sturm by direct experiment on the propagation of sound through the lake of Geneva, [illegible] em being 1435 mètres [illegible] from the theoretical velocity only by 21 feet,—a space described by the aqueous pulse in the 200th part of a second

By the above formula the velocity of sound through any medium of which the compressibility is known is readily computed [illegible] Chladni the velocities of sounds in different [illegible] of air being taken as unity are as follows — Tin = 7½ silver = 9 copper = 12, iron = 17, glass = 17, baked clay = 10 12, woods of different kinds = 11-17 But the velocity of propagation through cast-iron tubes was determined experimentally by Biot, and found to be only about 10½ times its velocity in air (See *Herschel's Treatise on Sound*, Chladni *Traité d' Acoustique*, Biot *Traité de Physique*, Pouillet, *Elémens de Physique*, Lamé *Cours de Physique* &c)

SOUND In Geography, a strait or inlet of the sea, applied specially to the strait which connects the German Sea with the Baltic

SOUND BOARD A thin board placed over the head of a public speaker to strengthen or extend the sound of his voice

SOUTH One of the four cardinal points of the compass, the direction in which the sun always appears at noon to the inhabitants of the northern hemisphere [illegible]

SOUTHCOTTIANS In Religious History the followers of Joanna Southcott whose singular life and influence, although now nearly forgotten deserve to be kept in record as examples of the contagious effects of fanaticism She was born at Gittisham, in Devonshire in 1750, and seems to have first persuaded herself of her miraculous calling in 1792 From that time she was in the habit of publishing pamphlets in an enthusiastic strain, travelled the west of England preaching and prophesying, with a select body of followers and gradually collected about her a considerable number of disciples She came to town about 1803, when she announced a meeting which [illegible] for the purpose of [illegible] her mission Several [illegible] 1804, and many persons [illegible] attested their belief in her pretensions [illegible] came the founder of a church, which had a chapel in Duke's Place, where service was performed by a Mr Tozer a Dissenting clergyman of Exeter, who followed her to London At last she announced her supernatural pregnancy and this strange announcement took great hold [illegible] in consequence of Dr Reece and four [illegible] having declared their belief that she was actually pregnant in her 65th year The excitement produced in London, in the summer of 1814 by the whole affair, was to be paralleled only by that which other delusions as absurd and impious have at different times occasioned Her death in December of that year, did not undeceive her disciples even when her body was opened, four days after it, and no trace discovered to verify her assertions, many of them continued to proclaim their belief in her future reappearance Her sect continued to exist for many years, nor are we aware that it is yet extinct Many of its followers wore [illegible] and a peculiar costume

SOVEREIGN In Politics, a person, or body of persons, [illegible] rests in every state As [illegible] jurisdiction of that person or body within the limits of the state is absolute and uncontrolled by any foreign authority The states which composed the German empire were termed, in the language of politics, "mi-souverains," because their sovereignty was qualified by their subordination in some respects to the imperial authority The same term should seem applicable to the several states in the American Union which are [illegible] termed sovereign, as on some of the subjects [illegible] power of their legislatures [illegible] subordinate to that [illegible] congress of the sovereign body [illegible]

SOVEREIGN An English coin of the value of twenty shillings, the standard weight of which is 5 pennyweights and 3·27 grains, [illegible]

SOWING [illegible]



of producing plants The operation of sowing is generally performed in spring in order that the plants may have the advantage of the coming summer The seed is [illegible] a sowing machine Some seeds which are of large size are planted singly The covering of seeds is greater or less, according to their size and the texture of the soil Where the soil is somewhat firm, and the seed is pressed into it by a roller or by other means, and where the climate is moist, very little covering is necessary, but where the soil is loose, and the climate dry and warm, the covering should be twice or thrice the thickness of seeds As the seeds of plants are the natural food of birds, insects, and vermin, in a state of culture artificial protection is required from their natural enemies

SOWING MACHINE A machine for depositing seeds in the soil, either equally over its surface or in rows The simplest machine, and perhaps the most efficient for sowing seeds broadcast, is a hollow cylinder pierced with holes about the average size of the seed to be sown This will deposit them at a greater or lesser distance asunder, according to the velocity with which it is turned round Machines for sowing seeds in rows are termed drills *See* DRILLS

SPA A place celebrated for its mineral waters, situate about seven leagues from Aix-la-Chapelle The term is now generally applied to places at which there are mineral springs

SPACE (Lat *spatium*), signifies generally extension in all directions Sometimes it has a less general signification, thus Euclid says two straight lines cannot inclose a space, that is an area

SPACE In Music the void between the lines in a musical staff The spaces are four in number, and the lines five

SPADIX A form of inflorescence in which the flowers are [illegible] and a fleshy rachis, and enclosed within a kind of [illegible] called a spathe, as in palms and araceous plants

SPAHI'S or SIPAHIS A part of the Turkish cavalry were so called The word has the same derivation with *Sepoy*

SPAN, in ordinary language signifies a measure taken from the space between the thumb and the middle finger both being extended In Architecture and Engineering it is applied to the extent or spread of an arch between its piers or abutments

SPANDREL (It *spandere*, *to spread*) In Architecture the space about the flanks or haunches of an arch or vault above the intrados, and not higher than its crown

SPANKER or DRIVER The name of the gaff sail set on the mizzen mast of a ship

SPANNER An iron instrument used in the manner of a lever to tighten the nuts upon screws There is usually a notch at either end of the spanner, to suit nuts and screw-heads of different sizes

SPAR (Germ spath) A mineralogical term applied to certain crystallized substances which easily break into cubic or prismatic or other fragments, with polished surfaces, hence also the term *spathose*, applied generally to minerals of a sparry fracture

SPAR, FLUOR, or DERBYSHIRE Fluoride of calcium *See* FLUOR SPAR

SPAR, HEAVY Sulphate of baryta *See* BARYTA

SPAR ICELAND Rhomboidal carbonate of lime

SPAROIDS *Sparoides* The name of a tribe of Acanthopterygian fishes, of which the genus *Sparus* is the type The palate is edentulous, but the jaws are generally well armed with teeth sometimes these are all [illegible] In some species, the anterior teeth are shaped according to the [illegible] posterior ones are grinders, in others [illegible] resemble the human incisors The genera of sparoid fishes are chiefly founded on these distinctions

SPARROW-HAWK The name of the *Falco nisus* of Linnæus, *Accipiter fringillarius* of Ray, which latter name is retained in modern ornithology for the subgeneric denomination of this small Raptorial bird

SPARS In Architecture, a term used in the provinces to denote the common rafters of a roof, as distinguished from the principal rafters

SPASM [illegible]

SPATANGUS [illegible] The name of a genus of *Echinidæ*, or sea-urchins, having the mouth situated laterally, and but four rows of pores

SPATHE In Botany, a large and coloured bracten situated at the base of a spadix, enclosing the latter, and supposed to perform the office of corolla

SPATULATE (Lat spathulum, *a broad knife to spread salve with*) In Zoology, when a substance or part of an animal is flattened, and broader and rounder at the apex, narrow at the base

SPEA'KER The presiding officer in each house of parliament is termed The Lord chancellor keeper of the great seal, or other person, holding the king's commission to act as speaker of the House of Lords and if there be no such, it is said the House may elect He can speak and vote on any question The speaker of [illegible] Formerly, [illegible] *Parliaments*, [illegible] under the [illegible] The speaker [illegible] The speaker cannot speak or vote except in a committee, when he is out of the chair, or in case of an equality of voices, when [illegible] out new writs for the election of members when seats are vacant This power he exercised only by virtue of orders of the House of Commons, until the passing of the stat 10 G 3 c 41, by which he was enabled to issue the [illegible] a recess *See* PARLIAMENT

SPEAKING TRUMPET *See* TRUMPET

SPE'CIALTY In Law any instrument in writing under seal Specialty creditors are those who have their debts secured to them by deed, in opposition to creditors on simple contract The advantages of the former security are, that it has priority in the distribution of assets, and that specialty debts in general are not presumed satisfied until after the lapse of twenty years whereas simple contract debts are barred in six by the Statute of Limitations

SPECIE A term used for gold and silver coin, in contradistinction to *paper money*

SPE'CIES (Lat) In Logic, a predicable which is considered as expressing the whole essence of the individuals of which it is affirmed The essence of an individual is said to consist of two parts 1 The material part or genus, 2 The formal or distinctive part or difference The genus and difference [illegible] up in logical language, the species *e g* [illegible] is compounded of the genus "animal," and the difference having two legs" It is obvious that the names *species* and *genus* are merely relative and that the same common terms may in one case, be the species which is predicated of an individual, and in another case the individual of which a species is predicated *e g* the individual, Cæsar belongs to the species man, but man, again, may be said to belong to the species animal, &c, as we contemplate higher and more comprehensive terms A species in short when predicated of individuals, stands in the same relation to them as the genus to the species and when predicated of other lower species it is then in respect of these, a genus, while it is a species in respect of a higher genus [illegible]

[illegible] genus, the lowest of all, which can be predicated of nothing, the "infima species" The difference which, together with the genus, makes up the species, is termed the "specific difference" *See* PREDICABLE LOGIC

SPECIFIC In Medicine, this term is applied to remedies the effects of which upon particular diseases are little liable to fallacy and uncertainty, hence cinchona is called a specific in certain forms of intermittent fever, and mercury in syphylis, &c A *specific character* is that which peculiarly and certainly distinguishes one [illegible] another

SPECIFIC GRAVITY *See* GRAVITY

SPE'CTACLES An optical instrument, consisting of two lenses set in a frame, for assisting or correcting the defects of imperfect vision The lenses are convex or concave, according to the nature of the defect to be remedied In old age the pupil of the eye becomes flat, and the rays of light are consequently not refracted sufficiently in passing through it to meet on the retina and produce distinct vision This defect is remedied by a convex lens, which produces a slight convergency of the rays before they enter the eye Short-sighted people, on the contrary, require concave lenses, because, in their case, the indistinctness of vision proceeds from too great a curvature of the pupil which causes the rays to meet in a point before they reach the retina —a defect which is remedied by giving the rays a slight divergency before they enter the eye

Spectacles appear to have been first used about the latter end of the 13th century, but the date and author of the invention are not certainly known and have been much disputed It seems most probable that the first hint of their construction and use was taken either from the writings of Alhazen, who lived in the 12th century, or of Roger Bacon who died about 1292 A passage in the *Opus Majus* of the latter renders it certain, at least, that he was acquainted with the use of crystalline lenses in magnifying minute or distant objects (See *Smith's* [illegible] "Works" art 85—90)

SPECTRA *Spectra* A name given by Stoll and





Latreille to Orthopterous insects, comprehending a linear and attenuated body, like the ghost of an insect

SPECTRUM (Lat *spectrum*, *image*) In Optics, the name given to an elongated image of the sun or other luminous body, formed on a wall or screen by a beam of undecomposed light received through a small hole, and refracted by a prism [illegible] different colours and fixed in [illegible] the solar spectrum see CHROMATICS, and for the refrangibility of the different rays REFRACTION

SPE'CULUM (Lat speculum, *a mirror*) In Optics, the term *speculum* is usually appropriated to reflectors formed of polished metal, while the term [illegible] to signify a reflector of glass For the [illegible] and laws of reflexion of spherical specula, see REFLEXION, and for a description of the method of casting and polishing the specula for reflecting telescopes see Sir W Herschel's Description of his Telescope in the *Phil Trans* for 1795, Brewster's edition of *Ferguson's Lectures*, and Lord Oxmantown's Account of Experiments on the Reflecting Telescope, in the *Phil Trans.* for 1840

SPE'CULUM METAL, with which mirrors for reflecting telescopes are made, is an alloy of two parts of copper and one of tin, its whiteness is improved by the addition of a little arsenic

SPELL (Ang Sax spel, *story* or *tale*) Any form of words written or spoken, supposed to be endowed with magical virtues This superstition seems common to every race of man, but it was more peculiarly prevalent among the ancients The lines of Horace—

> Sunt verba et voces, quibus hunc lenire dolorem
> Possis, &c —

probably refer to the belief in the efficacy of magical words in alleviating pain and disease There is an amusing article upon this subject in the *Encyclopædia Metropolitana*

SPELTER The commercial term for zinc

SPERMACETI This substance concretes or crystallizes spontaneously out of the oil of the spermaceti whale It is purified first by pressure, then by fusion and boiling with a weak alkaline ley When melted in masses it concretes in crystalline plates of a silvery lustre and unctuous feel It fuses at about 100° It dissolves in boiling alcohol, and as the solution cools it separates in brilliant scales, to which Chevreul has given the name of *cetine*

SPERMIDIUM (Gr σπερμα *a seed*) A kind of small seed vessel, resembling a seed, and more commonly called an *akenium*

SPHACELUS *See* GANGRENE

SPHÆRISTERIUM (Gr σφαιρα *a sphere or ball*) In ancient Architecture, a circular court for playing tennis, or other exercises *See* BALL

SPHENE Native silico-calcareous oxide of titanium

SPHENOID BONE (Gr σφην, *a wedge*) One of the bones of the head, so called from its being wedged in as it were amongst the other bones It is of a most irregular shape and very complicated in its processes and connections with the other bones When removed, it is something of the figure of a bat with its wings extended It is connected with all the bones of the skull and with those of the palate, cheeks, and upper jaw

SPHERE (Gr σφαιρα) In Geometry a solid body described by the revolution of a semicircle about its diameter, or it may be defined to be a body bounded by a surface of which every point is equally distant from a single point within the surface called the centre of the sphere It is [illegible] denote the radius of the sphere, and $x$, $y$, $z$ the rectangular co ordinates, the origin being at the centre the equation of the surface is $x^2 + y^2 + z^2 = r^2$

The following are some of the principal properties of the sphere —1 The surface of the sphere is equal to [illegible] of a [illegible] 2 The curve surface of any zone, or portion contained between two parallel planes is equal to the curve surface of a cylinder of the same height with the height of the zone, or the distance between the planes and of the same diameter with the sphere Hence it follows that the whole surface of the sphere is equal to the curve surface of the circumscribing cylinder 3 The solid content of a sphere is equal to that of a pyramid whose altitude is the radius, and whose base is equal [illegible] and hence the content of the [illegible] duct of its radius into its surface 4 The sphere is equal to two thirds of [illegible]

Let $s$ denote [illegible] its superficies, $c$ its solid content, and $\pi$ the ratio of the semicircumference to the radius = 3 14159, then [illegible] area of a circle of which $r$ is the radius is $\pi r^2$ The [illegible] spheres above stated give the relations which follow, viz

$$\text{Surface} = s = 4\pi r^2 = 12\ 56637 \times r^2,$$
$$\text{Content} = c = \tfrac{4}{3} r s = \tfrac{4}{3} \pi r^3 = 4\ 18859 \times r^3.$$

If we suppose the diameter = 1, and consequently $r = \frac{1}{2}$, these relations become $s = \pi$, $c = \frac{1}{2}\pi$

SPHERE In Astronomy, the concave expanse of the h[illegible] which having [illegible] to the [illegible] spheres to the [illegible] wh[illegible] sphere [illegible] the earth which is placed at the centre The ancients gave the name of sphere to the orbits of the several heavenly bodies, thus the sphere of Jupiter, the sphere of Saturn, the sphere of the fixed stars In the Ptolemaic astronomy, the different spheres were supposed to be solid and transparent moving about their common centre independently of each other, and each carrying its appropriate body along with it

SPHERE, in Geography, denotes a representation of the earth on the surface of a globe, which has also represented on it an assemblage of circles [illegible] the positions of the equator, ecliptic, [illegible], &c The ancients gave different appellations to the sphere, according to the inclination of the earth's axis to the horizon When the poles are in the horizon, it was called a *right sphere*, when the poles are in the zenith and nadir a *parallel sphere*, and in every other position, an *oblique sphere*

SPHE'RICAL Relating to a sphere Thus, a *spherical angle* is an angle formed on the surface of a sphere by the intersection of two great circles, or circles whose planes pass through the centre, and a *spherical triangle* is a triangle formed by the intersecting arcs of three such circles For the properties of spherical triangles, see TRIGONOMETRY

SPHE'RICAL EXCESS, in Trigonometry, is the sum by which the three angles of any triangle on the surface of a sphere or spheroid exceeds two right angles Let the three angles of a spherical triangle be denoted respectively by A, B C and let E represent the spherical excess, then by the above definition $E = A + B + C - 180^\circ$ Now, in any spherical triangle the sum of the three angles is always greater than two and less than six right angles, consequently E may have any value not exceeding four right angles

In Geodesy the angles of each triangle are determined by instrumental measurement, and are consequently subject to the errors of observation But in order to compute the sides of the triangle with the requisite accuracy, it is necessary that the amount of the error in the sum of the three angles be known, and it is therefore necessary to determine the spherical excess independently of extreme precision in the values of the angles Let S denote the area of the triangle $r$ the radius of the sphere, and $\pi$ the ratio of the circumference to the diameter (= 3 14159), then, by trigonometry,

$$S = \frac{A + B + C - 180^\circ}{180^\circ} \times r^2 \pi,$$

whence, since $E = A + B + C - 180^\circ$ we have

$E = \frac{S \times 180^\circ}{r^2 \pi}$ in degrees, or $E = \frac{S \times 648000''}{r^2 \pi}$, expressed in seconds In any triangle that can be measured on the surface of the earth S is very small in comparison of $r^2$ and E is therefore a very small quantity seldom amounting to more than five or six seconds (though in some of the large triangles of the British survey where the sides were nearly 100 miles in length, it amounted to upwards of 30″), and therefore an approximate knowledge of the value of S, and of the radius $r$ within the limits of any probable error, will suffice to give E correct to the 100th part of a second Hence, for computing the value of E, the triangle may be considered a plane one and the value of S computed from approximate values of two of its sides and the included angle If, therefore, $a$ and $b$ denote the number of feet [illegible] A and B respectively, we [illegible] $\frac{a\,b}{\quad}$, if we also assume $m = 648000 - 2r^2\pi$ (where $r$ is expressed in feet), the logarithm of E in seconds will be found from this formula,

$$\log E = \log a + \log b + \log \sin C + \log m$$

For the middle of England, the radius of an arc intersecting the meridian at an angle of 45° is 20,941 000 feet, nearly Assuming this to be the value of $r$, then $\log m = 9\ 62860$

SPHE'RICS In [illegible] properties of the sphere [illegible] body, and, in particular, of [illegible] on its surface See TRIGONOMETRY

SPHE'ROID (Gr [illegible] and [illegible] form) In Geometry, a solid generated by [illegible] about one of its axes If the generating figure be revolved about its major axis the [illegible] if about its minor axis, the [illegible]

Let 2 be the axis of revolution [illegible] and 2 $b$ the diameter of the [illegible] perpendicular to the axis then the origin of the co-ordinates being at the centre and $x$ being taken on the semi-axis $a$, the equation of the surface of the spheroid is

$$\frac{x^2}{a^2} + \frac{y^2 + z^2}{b^2} = 1$$

Let $k^2$ denote the ratio of the difference of the squares of $a$ and $b$ to the square of $a$, that is, make $a^2 k^2 = a^2 - b^2$, and put $\pi = 3\ 14159$ then the whole surface S of the spheroid is expressed by the following series, in which the upper signs are to be used if the spheroid is oblong (that is if $a$ is greater than $b$), and the under signs if the spheroid is oblate viz

$$S = \pi a b \left(1 \mp \frac{1}{2\ 3} k - \frac{1}{2\ 4\ 5} k^2 \mp \frac{3}{2\ 4\ 6\ 7} k^3 - \&c\right)$$

The solid content of any spheroid, whether oblate or oblong, is equal to two thirds of its circumscribing cylinder, and is therefore equal to $\frac{4}{3}\pi a b^2$ And since the content of a sphere, of which the radius is equal to $a$, is $\frac{4}{3}\pi a^3$, it follows that the content of the spheroid is to the content of a sphere whose diameter is equal to the axis of revolution as $b^2$ $a^2$

The oblate spheroid being the figure assumed by the earth and the other planets its properties are of great importance in astronomy and geodesy Newton demonstrated that the attraction of a sphere on any exterior body is the same as if all the matter in the sphere were collected into a point at the centre, but this property does not hold true of spheroids, and the calculation of the effects of attraction is thereby rendered greatly more difficult See GRAVITATION

In geodetical operations it is necessary to have regard to the curvature of the spheroidal surface of the earth [illegible] the elements of the spheroid (that is, the polar and equatorial axes to be known the curvature of the surface at any place of which the latitude is given is determined by the [illegible]

Let $a$ be half the [illegible] is $b$ [illegible] the equator, $e$ the ellipticity, or a number such that $b = a(1 + e)$ (*see* ELLIPTICITY) and $l$ the given latitude Also, let $r$ be the radius of curvature in the direction of the meridian, $r'$ the radius of curvature in the direction perpendicular to the meridian and R the radius of curvature of a normal section, making with the meridian an angle = $\theta$, then

$$r = a(1 - e + 3e \sin^2 l) \qquad (1)$$

$$r' = a(1 + e + e \sin^2 l) \qquad (2)$$

$$R = \frac{r\,r'}{r \sin^2\theta + r' \cos^2\theta} \qquad (3)$$

Dividing the numerator and denominator of this last expression by $r'$, substituting $1 - \sin^2\theta$ for $\cos^2\theta$, and converting the result into a series, of which it is sufficient to retain only the two first terms, we obtain the following, which is more convenient for calculation,

$$R = r\left(1 + \frac{r' - r}{r'} \sin^2\theta\right)$$

SPHEROMETER (Gr σφαιρα, and μετρον, *measure*) In Physics, an instrument [illegible] great precision the thickness of [illegible] ture of optical glasses, &c

SPHE'RULITE A term applied by some mineralogists to a variety of obsidian or pearlstone, which occ[illegible]

(Gr σφιγμος, *the pulse*) An [illegible] pulsations

SPHINCTER (Gr σφιγγω *I close*) A term applied by anatomists to several muscles which close or contract the orifices which they surround

SPHINX A fabled monster, half woman and half lion said by the Grecian poets to have infested the city of Thebes devouring its inhabitants till such time as a riddle it had proposed to them should be solved This was done by Œdipus, who slew the sphinx, and was by the gratitude of the Thebans chosen their king The Grecian sphinx was probably borrowed from Egypt, where the enormous figure, now half buried in the sand, was probably the archetype of the more elegant monster of Greece This figure is close to the Pyramids of Ghizeh and was disinterred by the late Mr Belzoni, but has been again nearly covered It has been said (on the authority of Pliny) that the sphinx represented the Nile in a state of flood, that event regularly occurring under the signs of the Virgin and Lion But others contend that the original Egyptian sphinx was male (Androsphinx), like the specimen described by Herodotus, book ii (*Wilkinson's Manners and Customs of the Ancient Egyptians*) B[illegible] greater part of [illegible] of Luxor (1500 in a single avenue) are said to be female (*Libr of Entertaining Knowledge*) Sphinxes are also represented with the heads of rams and hawks (Criosphinx, Hieraco-sphinx) The Egyptian sphinx had wings, these appendages were added by the Greek artists

SPHRAGI'STICS (Gr σφραγις, *a seal*) The science of seals, their history, peculiarities, and distinctions, especially with a view to the means which they afford of ascertaining the age and genuineness of documents to which they are affixed Ancient seals were chiefly impressed on common wax of different colours, [illegible] This [illegible] who

published a work on the subject in 1709 Gercken's treatise, styled *Anmerkungen über die Siegel zum Nutzen der Diplomatik* (Augsburg, 1781), will be found a

[illegible] (It *divided*) In Music, a term indicating that every note is to have its distinct sound When used in relation to instruments played with a bow, it is to be understood that every note is to have a bow distinct from the preceding or succeeding one

SPI'DER *See* ARACHNIDÆ

SPIKE In Botany, a form of inflorescence in which all the flowers are sessile along a common axis, as in *Plantago*

SPI'NDLE In Geometry a solid generated by the revolution of a curve line about its base or double ordinate The solid generated by the revolution of a curve about its axis is called a *conoid* In Mechanics, *spindle* denotes the axis of a wheel or roller

SPINE *See* VERTEBRÆ

SPINEL'L (Fr spinelle) A subspecies of the ruby It is of various colours, such as red, brown yellow, and sometimes blue, its colouring matter is sometimes oxide of chromium, but generally oxide of iron It usually contains from 80 to 84 per cent of alumina, and from 8 to 10 of magnesia

SPINELLANE A term applied by some mineralogists to a dodecaedral variety of zeolite of a blueish or brownish colour, found near Andernach on the Rhine Its essential components are silica alumina and soda

SPINES Branches that, being imperfectly formed, lose their power of extension, become unusually hard, and acquire a sharp point They are very different from aculei, or prickles, which are a kind of hardened hair In leaves, they are processes formed either by an elongation of the woody tissue of the veins, or by a contraction of the parenchyma In the former case they project beyond the surface or margin of the leaf as in the holly, in the latter case, they are the veins themselves become indurated, as in the palmated spines of *Berberis vulgaris*

SPINE'T A musical stringed instrument with a key-board &c, similar in construction to a harpsichord, from which, indeed, it little differs, except in being much smaller Its general form is that of the harp, and it was originally called the *couched harp*

SPINNERS or SPINNERETS In Entomology, organs with which insects form their silk or webs In spiders they consist of two retractile pieces issuing from anal protuberances and giving out the threads

SPINNING *See* COTTON MANUFACTURE

SPINNING JENNY *See* COTTON MANUFACTURE

SPINO'ZISM In Philosophy, the system of Benedict Spinoza a Jew of Amsterdam, born in 1634, which is developed in his work on ethics In it he deduces by strictly mathematical reasoning from a few axioms the well known principles that 'there can be no substance but God, whatever is is in God and nothing can be conceived without God" Hence his scheme is called with justice Pantheistic In fact as Mr Hallam observes, 'he does not essentially differ from the Pantheists of old He conceived, as they had done that the infinity of God required the exclusion of all other substance, that he was infinite *ab omni parte*, and not only in certain senses" 'It was one great error of Spinoza" says the same writer, "to entertain too arrogant a notion of the human faculties, in which by dint of his own subtle demonstrations he pretended to show a capacity of adequately comprehending the nature of what he denominated God And this was accompanied by a rigid dogmatism, no one proposition being stated with hesitation, by a disregard of experience, at least as the basis of reasoning, and by a uniform preference of the synthetic mode" [illegible] p 243 &c, and see *Bucke* [illegible] *Stewart's Introduction to* [illegible] *Britannica*)

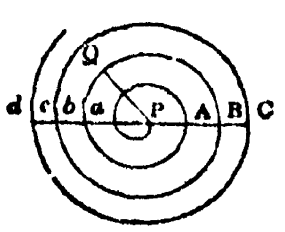
SPINTHERE A mineral of a greenish grey colour, found in the department of the Isere in France

SPI'RACLES, or SPIRACULA (Lat spiro, *I breathe*) In Entomology, the breathing pores of insects are so called

SPIRAL In Geometry, the name given to a class of curves distinguished by this general property, that they continually recede from a centre or pole, while they continue to revolve about it Spirals receive different names from the properties by which they are characterized, or

[illegible]

may be supposed to be generated as follows —If a straight line P A B C turn uniformly about its extremity P, a point in the straight line which advances from P with a uniform motion and arrives successively at *a*, A, *b*, B, *c*, C, *d*, will describe the spiral The point P is called the pole, and the portion of the revolving line intercepted between the pole and any point of the curve is the radiant [illegible] Let Q be any point in the spiral the line P Q = *u* drawn to the pole is the radiant vector and the angle P A Q = $\theta$ described by the revolving line while the describing point advances from P to Q, then, since from the definition the radiant *u* and the angle $\theta$ are both proportional to the time they are proportional to each other, and the polar equation of the equable spiral is $u = a\theta$, where *a* is a constant If [illegible] when the revolving line has made a [illegible], or when $\theta = 2\pi$, then $a = r - 2\pi$, and the equation becomes $u = \frac{r}{2\pi}\theta$




Some of the principal properties of this spiral are the following —1 The area of the spiral P *a A b* Q is equal to $\frac{u^3}{6a} = \frac{\pi u^3}{3r}$ If $u = r$, this becomes $\frac{1}{3}\pi r^2$, or the area generated while the revolving line makes one revolution is equal to a [illegible] whose radius is *r* If $u = 2r$, the expression for the area becomes $\frac{2}{3}\pi(2r)^2$, and the spiral area is therefore the third part of a space that is double of a circle described with a radius $= 2r$ And generally the whole area generated by the radiant, from the beginning of the motion till after any number of revolutions, is equal to the third part of a

[illegible]

lutions is of unit 2 The arc of the spiral between its origin and the radiant *u* is equal to that of a parabola whose *latus rectum* is 2 *a* included between the vertex and an ordinate $= u$, and the corresponding area of the spiral is equal to one half the corresponding area of the parabola 3 The subtangent to any point Q of the spiral is equal to the arc of a circle described by the radiant P Q, and hence at the termination of the first, second, third fourth, &c revolutions, the corresponding subtangents are as the series of square numbers, 1, 4, 9, 16, &c, for the second, third, fourth, &c the subtangents are equal to 2 3 4, &c circumferences, whose radii are at the same time doubled tripled, quadrupled &c

The equable spiral was proposed by Conon to Archimedes who in his treatise Περὶ Ἑλίκων, has investigated its quadrature and some of its chief properties

The *hyperbolic spiral* belongs to a class of spirals of which the general equation is $u = a\theta^{-n}$ If we suppose $n = 1$, we have $u = a\theta^{-1}$, or $u\theta = a$, which is the equation of the hyperbolic spiral, and from which it follows that if from a point in a straight line, given by position arcs be described of a given length and having each one extremity in the given straight line the locus of their other extremities will be in the spiral

This curve was proposed by James Bernoulli, and has been called the hyperbolic spiral from the analogy between its polar equation and the equation to rectangular co ordinates of the common hyperbola, when referred to its asymptotes, namely, $x y = A$, a constant area

[illegible] *spiral* differs from the equable spiral in [illegible] the point which describes the curve, instead of advancing equably along the uniformly revolving straight line, is carried along it with a velocity increasing in proportion to the distance from the centre This curve which was noticed by Des Cartes, has many remarkable properties, of which the more abstruse were investigated by James Bernoulli *See* LOGARITHMIC SPIRAL

For the investigation of the properties of spirals, see *Leslie's Geometrical Analysis*, *Peacock's Examples of the Differential and Integral Calculus*, *Maclaurin's Fluxions*, &c

SPI'RAL VESSELS, in Plants, are membranous tubes with conical extremities, lined in the inside by a fibre twisted spirally, and capable of unrolling with elasticity, their function is that of the conveyance of air They are found in almost any part of plants except the bark, but are most abundant in leaves and flowers, and least common in the stem and root, except in the medullary sheath of the former

SPIRE (Gr σπεῖρα, *a twisting*) In Architecture, among the ancients, the base of a column also the astragal or torus of the base In modern architecture, it is an erection above the tower of a church, which diminishes gradually as it rises, sometimes rising in the form of a plain slender pyramid, polygonal on the plane

SPI'RIFER The name of a genus of extinct Palliobranchiate mollusks, characterized by the shell having two internal calcareous spiral appendages

SPI'RIT OF WINE *See* ALCOHOL and FERMENTATION

SPI'RITO, SPIRITO'SO (It *spirit, with spirit*) in Music, denotes, when affixed to a movement, that it is to be

[illegible]

lation, as brandy, rum, geneva, whisky, &c, are comprised under this designation The manufacture of spirits is placed under the surveillance of the excise, and a very large revenue is obtained from it Ordinary spirits con-

tain from 50 to 52 per cent of alcohol, spirits of wine, from 62 to 67 per cent., rectified spirits from 82 to 85 per cent. spirit proof By the expression that a spirit is any number, say ten, over proof, is meant that 100 gallons of the spirit would bear the addition of ten gallons of water to reduce it to proof strength, or it would form 110 gallons of proof spirit, *i e* spirit of density 0 918653 The term ten under proof, means that ten gallons of water must be taken from [illegible] of the spirit to raise it to proof, or that [illegible] contain only 90 gallons of proof spirit. The total number of proof gallons distilled in the year ending Jan 1851 was 25,844,887, of which 5,913,424 gallons were distilled in England 11,638,429 in Scotland, and 8,293,034 in Ireland The amount of gallons on which duty was paid for consumption, was 23,862,585 The higher duty of 7*s* 10*d* per gallon has to be paid on the transfer, the duty in Scotland is 5*s* 8*d* per gallon, in Ireland 2*s* 8*d* per gallon

Table of the Foreign and Colonial Spirits imported, exported and retained for Home Consumption in the Year ending Jan 5 1851

| United Kingdom | Imported | Retained for Home Consumption | Exports |
|---|---|---|---|
| | *Proof Galls* | *Proof Galls* | *Proof Galls* |
| Rum - - | 1 190 000 | 2 900 000 | 1,187,000 |
| Brandy - - | 3,237,000 | 1,860 000 | 876 000 |
| Geneva - | 337,000 | 45,000 | 280 000 |
| Other spirits - - | 381,000 | 12 000 | 11 600 |
| Total - | 8 145,000 | 4,800 000 | 2,160 600 |

SPIRIT LEVEL A glass tube nearly filled with spirit of wine, and hermetically sealed at both ends The exact horizontal position of its axis is ascertained by the air-bubble being at equal distances from the middle point in the length of the tube The level is used for determining the relative heights of ground at two and more stations

SPIRITUALISM [illegible] Materialism That [illegible] soul, or self, that which is called the external world being either a succession of notions impressed on the mind by the Deity or else the mere product of the mind itself The first is the spiritualism of Berkeley, the second, which may be called pure egoism that of Fichte

SPIRULIDÆ The name of a family of Dibranchiate Cephalopods, of which the genus *Spirula* is the type They are chiefly characterized by having a spiral discoid chambered shell developed in the substance of the mantle instead of a calcareous or horny plate

SPLANCHNO'LOGY (Gr σπλαγχνον, *an entrail* and λογος *a discourse*) The doctrine of the viscera

SPLAYED (*Displayed, spread out*) In Architecture, a term used to denote an angle which is cut off, or oblique

SPLEEN A spongy viscus, of an oval form the use of which is unknown, placed in the human subject in the left hypochondrium, between the eleventh and twelfth false ribs *Spleen* is also used for a species of hypochondriasis to which the English are said to be particularly open

SPLENI'TIS Inflammation of the spleen

SPLE'NIUS A flat muscle situated between the back of the ear and the lower and posterior part of the neck

SPLENT COAL An inferior kind of cannel coal from the Scotch collieries

SPLICE In Naval language, to join the end of a rope with the end or bight of another, by untwisting the strands of both and laying them up again involved

To *splice the main brace* a term applied to an extra allowance of spirits in cases of cold or wet

SPLINT A piece of wood or pasteboard, so shaped as to support a broken or debilitated limb

SPLINTERY That fracture of minerals which is nearly even, but exhibits small splinters or scales thicker at one extremity than the other, and adhering by their thicker ends to the broken surface

SPODUMENE A mineral found in laminated masses, hard, brittle, translucent, and of various shades of green or grey It was first discovered at Utoe, in Sweden It consists of silica and alumina, with 8 to 10 per cent of lithia Before the blowpipe, it exfoliates into little scales of an ash colour hence its name, from σπόδιος *[illegible]*

SPOLIATION, WRIT OF [illegible] obtained by one of the parties to a suit in the ecclesiastical courts suggesting that his adversary has wasted the fruits of a benefice, or received them to his prejudice The suit founded on this writ lies for one incumbent against another, where they both claim by one patron, and the right of [illegible]

SPO'NDEE (Gr [illegible] In Greek and Latin Poetry, the [illegible] two long syllables It was so called because it was originally employed in the hymns sung in honour of the gods during the offering up of a sacrifice, for which it was admirably fitted from its grave structure *Spondaic verse* is an hexameter line, in which the two last feet are spondees; instead of the usual termination, a dactylus and a spondee

SPO'NDYLUS (Lat spondylus, *a spindle* or *shell fish*) The name of a Linnæan genus of the Vermes Testacea comprehending the spring oysters, characterized by having a strong tooth on each side of the depression lodging the elastic ligament [illegible] hinge of the shell The genus is included [illegible] Ostracea immediately of the Acephalous Testacea by Cuvier, and has been subdivided by Lamarck into the genera *Spondylus* proper and *Plicatula* Some of the species of *Spondylus*, as the water-clam (*Sp varius*), form a series of chambers by secreting successive layers of calcareous shell at a distance from each other, the last chamber containing a quantity of fluid, which escapes by very slow evaporation through the pores of the calcareous shell

SPONGE (Fr eponge, Germ schwamm), is a cellular fibrous tissue produced by small animals, almost imperceptible, called Polypi by naturalists, which live in the sea This tissue is said to be covered in its recent state with a kind of semifluid thin coat of animal jelly, susceptible of a slight contraction or trembling on being touched, which is the only symptom of vitality displayed by the sponge After death this jelly disappears and leaves merely the sponge, formed by the combination of a multitude of small capillary tubes, capable of [illegible] thereby [illegible] the bottom of the sea, and abound particularly upon the shores of the islands in the Grecian Archipelago [illegible] analogous in their origin to coral sponges are [illegible] in their nature, the former being composed almost entirely of carbonate of lime, while the latter are formed of the same elements as animal matters, and afford on distillation a considerable quantity of ammonia

Dilute sulphuric acid has been recommended for bleaching sponges after the calcareous impurities have been removed by muriatic acid Chlorine water answers better

The sponges of commerce are usually prepared before they come to the market, by being beaten and soaked in dilute muriatic acid with a view to bleach them and to dissolve any adherent portions of carbonate of lime Three kinds are found commonly in the market, and known as the Turkey the variety of the same, which is very rare, and the West Indian On exa[illegible] sponge of commerce with a power of [illegible] the fleshy matter will be distinctly observed having in its interior gemmæ which are considered to [illegible] are occasionally given off from the [illegible] the mass of sponge consists of [illegible] or fibres various in size The spiculæ are not found within these, but in the large and flattened fibres, and varying in number from one to three or more, imbedded in their substance Sometimes one spiculum projects a half or more from the side of the fibre, and is then only covered with the animal matter at the base, or half way up The fibres of the West Indian species of sponge have been clearly proved to be solid In the rare variety of [illegible] which ants [illegible] such in size, and not imbedded in horny fibre but in a separate sheath This true vascular tissue performs very important functions in the economy of the animal during life In some of the tubes of sponge [illegible] the largest of which [illegible] the smallest the 50,000th of an inch They were accidentally perceived to move from right to left (See a Paper read by Mr Bowerbank at a meeting of the Microscopical Society in 1841)

SPONGE TENT, is formed by dipping sponge into hot melted wax plaister, and pressing it till cold between two iron plates it is then cut into pieces, and used for dilating wounds

SPO'NGIÆ The name of a class of aquatic Zoophites composed of the different genera and species of sponge

SPO'NGIOLE In Botany, the lax cellular tissue and mucus situated at the extremities of roots, having the property of absorbing fluid like a sponge, whence the name

SPO'NSIONS In International Law, acts and engagements made on behalf of states by agents not specially authorized, or [illegible] the authority under which they [illegible] to be made [illegible] so called by writers on this branch of jurisprudence Such conventions must be confirmed by express or tacit ratification, the latter of which is implied from the fact of acting under it as if bound by its stipulations, but mere silence is not, in general held equivalent to ratification Such are the official acts of [illegible] generals suspending or limiting hostilities, [illegible] surrender cartels of exchange, &c (See Grotius, *De Jure Bel et Pac* lib iii,

Vattel, liv II, Wheaton, *On International Law*, vol I p 291)

SPONSORS In the Roman Catholic, Greek, Lutheran, and Calvinistic Churches on the Continent, and in the Church of England, the name given to the parties who at the baptism of infants make a profession of the Christian faith in their name, and guarantee their religious education (See *Neander's Church History*, vol I part 2) In the Presbyterian Church, baptism is administered without sponsors

SPOONDRIFT The light spray blown off the waves in a violent wind

SPORADIC (Gr σπειρω, *I sow*) A term applied to such diseases as attack a few persons at a time

SPORANGIUM (Gr σπορα, *a seed*, and αγγειον, *a vessel*) The case in which the reproductive matter of ferns, mosses, and many other Cryptogamic plants is enclosed Sporangiolum is the same part, when so small as to be microscopic

SPORIDIA (Gr σπορα, and ειδος, *form*) A term used in describing Algæ and Characeæ, to denote the granules which resemble sporules, but which are of a doubtful nature Also in describing Fungi, to indicate the immediate covering of the sporules

SPORIDIOLA The sporules or reproductive granules of Fungi

SPORIUM, SPORTULA In Roman Antiquities It was an ancient usage in Rome for rich men to distribute victuals on certain occasions among their poor clients, each of whom attended for the purpose with a wicker basket (sportum) Afterwards this dole was generally commuted for money, and the sum thus distributed, about 100 quadrantes, or eighteen pence English, was called *sportula*

SPORULES or SPORES (Gr σπορα, *a seed*) The reproductive bodies of Asexual or Cryptogamic plants differing from seeds in not being generated by impregnation, and in having no definite and predetermined points of growth, but springing forth into young plants from any part of their surface

SPOTS ON THE SUN See SUN

SPRING In Astronomy, one of the four seasons of the year For the northern hemisphere the spring season begins when the sun enters Aries the first of the northern signs, or about the 21st of March, and ends at the time of the summer solstice See SEASONS

SPRING In Mechanics a piece of mechanism formed of tempered steel or some other elastic substance applied mostly for the purposes of producing resistance or of preventing a shock from the collision of hard bodies or of giving motion to mechanism by its effort to unbend itself For the law of the force exerted by a spring, see ELASTIC CURVE

SPRING In Natural History See FOUNTAIN

SPRING In Naval language, a rope or hawser by which a ship is held at one part, as the bow or quarter in order to keep her in a particular position, or to turn her in a short compass

SPRINGING In Architecture, the lower part of an arch, or that part from which it rises

SPRING TIDES The tides at the times of the new and full moon At these times the sun and moon are in a straight line with the earth and their joint effect in raising the waters of the ocean is a maximum, and the tides are consequently the highest See TIDES

SPRIT SAIL This is generally a four cornered fore-and-aft sail, supported diagonally by a piece of wood called the sprit Ships formerly carried sails on their sprit sail yards

SQUADRON in Military affairs signifies a body of cavalry, averaging from one to two hundred men In naval matters it is applied to a detachment of ships employed on a particular expedition

SQUALL The Sea term for a gust of wind, or for a short temporary increase in the force of the wind

SQUAMA (Lat *a scale*) The bracteæ of an amentum, also used occasionally for any kind of bracted or rudimentary leaf which has a scaly appearance

SQUAMMIPENNES (Lat squama penna, *a fin*) The name of a family of Acanthopterygious fishes comprising those which have the dorsal and anal fins covered with scales

SQUAMOUS (Lat squama, *a scale*) In Zoology, when a surface is covered with small scales

SQUARE In Geometry a four-sided rectilineal figure, of which all the angles are right angles, and all the sides equal

SQUARE MEASURES The squares of the lineal measures *See* MEASURE

SQUARE NUMBER in Arithmetic, is the product of a number multiplied by itself Thus, the squares of the natural numbers, 1, 2, 3, 4, 5, &c, are respectively, 1, 4, 9, 16, 25, &c The square numbers are the first series of figurate numbers derived from the progression 1, 3, 5, 7, 9, &c., in which the common difference of the terms is 2 (*See* FIGURATE NUMBERS) Among the properties of square numbers the following may be mentioned —Every odd square number is of the form $8n+1$, or when divided by 8 leaves 1 for the remainder Every even square number is of the form $4n$, or is divisible by 4 Every square number ends with one or other of the following digits, 0, 1, 4, 5, 6, 9 No number of the form $2n^2+3n$ is a square

SQUARE RIGGED The term for a vessel carrying *square sails*, which are extended by yards suspended horizontally, or slung by the middle

SQUARE ROOT In Arithmetic, the square root of any number is the number which being multiplied into itself produces the given number Thus 12 is the square root of 144, $\frac{1}{3}$ is the square root of $\frac{1}{9}$, and 05 the square root of 0025 When the given number is not an exact square, the root may be found to any degree of approximation by the process for extracting the square root, which is taught in every book of common arithmetic *See* QUADRATIC EQUATION

SQUILL The root of the *Scilla maritima* Squills are imported from the Levant, they have a nauseously bitter and very acrid flavour and are generally cut into slices and dried for pharmaceutical uses There are two varieties, the red and the white, which, however, do not appear to differ materially in composition In large doses squill is purgative and emetic, but it is chiefly employed in smaller doses as a powerful expectorant, and as a diuretic in combination with other remedies Half an ounce of oxymel of squills is sometimes prescribed as an emetic in cases where the bronchiæ are much loaded with viscid mucus, and in the chronic coughs of old people

STABAT MATER DOLOROSA The first words of a celebrated Latin hymn of the church, in rhymed lines of all varieties without metre, said to have been composed by a Franciscan monk named Jacopone, in the 14th century It has been set to music by nearly all the greatest composers, but the best known of all their compositions is that of Pergolesi, commenced by him when nearly on his deathbed, and finished by another hand The stabat mater is performed in the ecclesiastical services of the Roman church during Holy Week

STACCATO (It *separated*) In Music, a term denoting that the notes to which it is affixed are to be detached in a striking way from each other, being much like *spiccato*, which see

STACK Corn in the sheaf piled up in a circular or rectangular figure, brought to a point or ridge at top, and afterwards thatched to protect it from the influence of the weather, and more especially from rains The term is also sometimes applied to hay piled up in the same manner, which, however, in most places, is called a *rick* The foundation of a corn stack is commonly made on a platform of wood or iron, raised on props to protect it from the moisture of the soil, and also from rats and mice, in which respect stacks of corn differ from ricks of hay, which are built always on the ground

STADIUM (Gr σταδιον) A measure of length in use among the ancient Greeks and some other nations, the precise value of which is unknown, though there are some data from which a rough approximation to its value may be made The most ancient measurement of an arc of the terrestrial meridian is that of Eratosthenes, and the result gave the length of the circumference of a great circle = 250 000 stadia But the circumference of the earth's equator is known to be nearly 25,000 English miles, whence supposing the measurement of Eratosthenes to be correct, a stadium is the tenth part of an English mile Posidonius found by another measurement the circumference of the earth to be 240,000 stadia on the same supposition of an accurate determination, this gives about 9½ stadia to the English mile But it is to be remarked that little dependence can be placed on these ancient measurements, for Ptolemy estimated the circumference of the earth at 180,000 stadia which is only 3-4ths of the result found by Posidonius The stadium is, however, supposed to have been different at different places (See Paucton, *Metrologie*, also the *Quarterly Review*, No 5) The best account of the stadium, and the ancient mode of measuring distances, is to be collected from the various memoirs of Danville, in the *Mem de l Acad des Inscr* vols xxiv xxviii xxxvi, and *Histoire de l Acad* vols xxvii xxxi

STADIUM In Ancient Architecture, an open area used for exercises by the Grecian youth With the Romans it was much in the form of the circi, but most of the Grecian stadia were enclosed by merely an earthen mound Vitruvius informs us that its length was much greater than its breadth, the lists were formed by a bank or terrace Though the stadium mostly formed part of a gymnasium, it sometimes formed a separate structure, and was built at great cost and with considerable elegance, witness that on the Corinthian Isthmus mentioned by Pausanias, as well as that of Herodes Atticus at Athens, [illegible] and constructed of Pentelic [illegible] By [illegible], mention is made by that author of several others

**STA'DTHOLDER** (Dut stadhouder, *city-holder*) The name formerly g[illegible] the military forces in [illegible] lands William I Prince of Orange had been made [illegible] Holland, [illegible] Independ[illegible] goodwill of those provinces After his death the Earl of Leicester was declared stadtholder by the States General, while some of the separate provinces [illegible] son of their former governor [illegible] afterwards the office was conferred and withdrawn by the several provinces at many different times, although always confined to members of the house of Orange William IV Prince of [illegible] hereditary stadtholder [illegible] French conquest, in 1814 the head of the house of Orange was raised to the throne by the title of King William I —a title retained by his successors The power of the stadtholder varied in different provinces, and at different periods

**STAFF** In Music, the five lines and spaces between them on which music is written

**STAFF** In Architecture *See* RUDENTURE

**STAFF** In Military affairs those officers attached to the commander of an army to assist him in carrying his plans into execution They consist of a quartermaster-general [illegible] majors of brigade &c The importance of [illegible] selection of a staff is ably demonstrated in the preface to *James's Military Dictionary*

**STAFF ANGLE** In Architecture, a square rod of wood standing flush with the wall on each of its sides, at the external angles of plastering on the inside of apartments to prevent the angles thereof being broken or damaged

**STAIRS** In Architecture steps for ascending from the lower to the upper part of a house When these are enclosed with walls or balustrades, with landing-places for communication between the several stories of a building, the whole is called a staircase Vitruvius makes no mention of staircases in his Treatise on Architecture, and indeed with the ancients they formed no feature in the interior, being generally on the outside of the houses Those of which traces remain are narrow, and so inconvenient that in some cases the steps are 1 foot in height In modern architecture they are often constructed with great display of skill and magnificence, and are no small test of the skill and power of the architect Those stairs which proceed in a right line of ascent are called *flyers*, when they wind round a solid or open *newel* they are called *winders* *Mixed stairs* are such as partly wind and partly fly

**STALACTITES** Conical concretions of carbonate of lime attached to the roofs of calcareous caverns and formed by the gradual dropping of water holding the carbonate in solution from σταλασσω, *I drop*

**STALAGMITE** Stalactical formations of carbonate of lime found upon the floors of calcareous caverns

**STALK** In Architecture an ornament resembling a stalk in the Corinthian capital from which the volutes and helices spring It is sometimes fluted

**STALL** In Architecture a seat raised on the sides of the choir or chancel of a church, mostly appropriated to a dignitary of a cathedral or collegiate church Sometimes stalls are placed near the high altar, for the priest and deacon or subdeacon to rest whilst the service in certain parts is carried on by the choristers In churches of the kinds named there is generally a series of them At St George's Chapel Windsor [illegible] to every Knight of the Garter [illegible] installation

**STALLAGE** In Law, a duty paid for the liberty of setting up moveable stalls or tables, or the like, in a fair or market due to the owner of the soil as such to set up stalls without whose licence is trespass When the stalls are fixed into the ground, the duty is termed *pickage*

**STALL-FEEDING** Cattle kept in stables and tied up [illegible] which have their food brought to them, [illegible] The advantages of this mode of fattening cattle are very great, both to the farmer or feeder and to the public, because much less food is wasted, and a much greater quantity of manure is produced The disadvantages are, that more manual labour is required for cutting and carrying the food from the field to the stable, and that the flesh of the animals for want of exercise in the latter, is not considered so wholesome or high-flavoured as that of cattle which have pastured at large To remedy this defect of stall-feeding, the most enlightened farmers, instead of rendering their cattle fixtures by tying them up to stakes, put two or three together in small yards, with a shed at one end, in which they can take exercise, shelter, or repose, according to their inclination By this mode an equal quantity of manure is produced with less labour, and the flesh of the cattle is reckoned wholesome When herbage plants or grasses are [illegible] over once or twice [illegible] the course of a season [illegible] by the bite of [illegible] of vegetable produce is found to be much greater, be[illegible] given to cattle in racks, in stables, sheds, or small courts, much less of it is wasted than if it were eaten on the spot where it grew Hence any given surface of cultivated land will produce a much greater quantity of butcher meat under crops to be mown than under herbage to be pastured, and stall-feeding, therefore, is one of the greatest modern improvements that has been introduced into husbandry There can be little doubt that, with the progress of rural improvement, it will ultimately become universal, and then, and not till then, will the butcher meat of warm climates be equal to that of such climates as that of Britain In warm climates, at present, cattle cannot be fattened by pasturing

**STAMENS** [illegible] They [illegible] consist each of a filament, the anther, and the pollen, of which the two latter are essential, and the former not They are a modified form of the petal and are placed next it on the inside next the centre of a flower Independently of their [illegible] they are much used as [illegible] in systematical botany

**STAMEN** (Lat stamen) Those bodies which are supposed to be, in *Hepaticæ*, and other Cryptogamic plants the equivalent of anthers in more perfect plants

**STAMP DUTIES** Duties imposed on pieces of parchment and paper on which many species of legal instruments are written, on newspapers, advertisements, cards, dice, &c The stamp duties have been consolidated and altered by a great variety of acts of parliament, and by 4 & 5 W 4 c 60 the boards of stamps and taxes are united into a single one

The manner in which the stamp duties on legal instruments are chiefly secured is by prohibiting the reception of them in evidence, unless they bear the stamp required by the law Should the instrument, after being stamped and executed be altered a restamping will in certain cases be requisite thus a mere mistake may be altered without a stamp, but any change in the terms of a contract, or any fresh conveyance by indorsement on a former one, requires a fresh stamp The objection to an instrument arising from the want of a stamp must be taken at the trial before the instrument is read, but it is sufficient for the purpose of evidence that the instrument when produced on the trial should be properly stamped, although it may not have been stamped when it was executed, except in cases where the commissioners of stamps are prohibited by express enactment, from affixing in this manner a subsequent stamp When an instrument has been lost, and it is proposed to give secondary evidence of its contents, it is necessary first to give evidence that it was duly stamped, but this fact may be presumed from circumstances and where an instrument is withheld by an adversary after notice to produce, it is always taken as against him that it is so stamped An unstamped instrument, though inadmissible in evidence of its contents, may yet be received in evidence for collateral purposes Thus in indictment for forgery of an instrument the instrument may be produced, although unstamped, and an agreement, although unstamped, is admissible for the purpose of proving [illegible] (See *Starkie on Evidence*)

**STANCHIONS** The Sea term for upright supports in general

**STAND** A Sea term, used variously, as, for example, a sail is said to *stand* well or ill A ship is said to *stand* towards or from the shore or any object (for *to sail*) To *stand on*, to continue the course To *stand by*, to be ready

**STANDARD** In Botany, [illegible] the uppermost petal of that form of corolla which [illegible] from its fancied resemblance to a butterfly

**STANDARD** *See* BANNER, FLAG

**STANDARD OF MONEY** *See* MONEY

**STANISLAUS, SAINT** A Polish order of knighthood, founded by Stanislaus, king of Poland, in 1765, renewed by the emperor Alexander in 1815

**STANNARIES** (Lat stannum, *tin*) The stannary courts of Devon and Cornwall are courts of record for the administration of justice among the tinners They are held before the lord warden and his substitutes The privileges of the tinners were confirmed by 33 E 1. The appeal from the lord warden lies to the [illegible] of the Prince of Wales, and [illegible] to the sovereign

**STANNIC ACID** Peroxide of tin

**STANZA** (Ital stanza, *station*) In Poetry, a series or number of verses connected with each other in a poem, of which the metre is constructed of successive series similar in arrangement The stanza, however, must be understood to form a shorter division than the classical strophe, to which this definition would be equally applicable The term is of Italian origin, and

signifies literally a *station* or *resting place*: it is so called from [illegible] *rima*, [illegible] by a [illegible] decasyllabic, [illegible] RIMA) The Spenserian stanza (which was perhaps invented by the poet from whom it derives its name, but certainly first applied by him to the construction of a regular poem) consists of eight deca-syllabic verses and an Alexandrine at the end, the first and third verses forming the first rhyme, the second, fourth, fifth, and seventh another, and the eighth and ninth a third rhyme Lord Byron has given both to the Ottava and the Spenserian stanza in English verse a peculiar and original character

STANZA [illegible] rtment or division in a building [illegible] of the Vatican, for instance, are called the *stanze* of the Vatican

STAPES A stirrup One of the bones of the internal ear is so called, from its shape

STAPHYLO'MA (Gr *σταφυλη a grape*) A disease of the eyeball, in which the cornea becomes opaque and tumid, [illegible] sometimes resembling a grape in shape, [illegible] increases to a great extent, and requires to be removed by an operation

STAPLE [illegible] m [illegible], but it is now applied to the chief commodities either grown or manufactured in any country

STAR (Gr *αστερ*, Ger stern) In a popular sense, the term star is used to designate any celestial body whatever, including the planets, but in astronomy it is [illegible] shining bodies which are situated [illegible] olar attraction and consequently do not participate in the motions of the solar system

One of the first results of the observation of the heavens was that the stars maintain always the same positions relatively to each other Hence they were called *fixed stars* in distinction to the *planets* or *wandering stars*, which are constantly changing their places in the firmament The fixity of the stars is indeed not absolute, for modern observations have detected some changes of relative position among them, but these changes are so minute that in general they only become sensible after the lapse of a number of years by a comparison of positions determined with the most perfect instruments at the beginning and end of the interval They are consequently altogether inappreciable to unassisted vision and the discovery of their existence has not rendered a change of language necessary astronomers still speak of the *fixed stars*

*Apparent Magnitude of the Stars* — The first circumstance which arrests the attention of the observer of the stars is the great differences of their relative brightness [illegible] tion in this respect and for the convenience of description and reference, astronomers divide them into classes or orders, which are called magnitudes A few of the most brilliant are denominated stars of the *first magnitude*, those of an inferior degree of brightness are of the *second magnitude*, and so on down to the 6th or 7th which are [illegible] still continued among those which are only visible in the telescope, and magnitudes from the 8th to the 16th are familiar to those who are in the practice of using powerful instruments It is, however, to be remarked, that this classification is not based on any photometrical determination, but is entirely arbitrary "Of a multitude of bright objects says Sir John Herschel, 'differing pro- [illegible] r and ar- [illegible] necessity [illegible] on An order of succession *must* exist, and it is a matter of absolute indifference where, in that infinite progression downwards from the brightest to the invisible, we choose to draw our lines of demarcation All this is matter of pure convention Usage has however, established such a convention, and although it is impossible to determine exactly or *à priori*, where one magnitude ends and another begins and although different observers have differed in their magnitudes yet on the whole, astronomers have restricted their first magnitudes to about 15 or 20 principal stars, their second to [illegible] or 60 next inferior, their third to about 200 yet smaller, and so on, the numbers increasing very rapidly as we descend in the scale of brightness the whole number of stars already re- [illegible] g [illegible] t [illegible] p 374)

[illegible] to [illegible] situated, astronomers, in the earliest ages of the science, had recourse to the method of forming them into groups, to which they gave the name of *constellations*, or *asterisms* (*see* CONSTELLATION), and distinguished the different groups one from another by appellations borrowed in general from mythology, and suggested by vague resemblances or fanciful analogies, the origin of which it is now difficult or impossible to trace A few of the brightest stars received particular names, some of which, conferred by the Greeks and Arabs, have been preserved, as Sirius, Rigel, Aldebaran, Arcturus, Capella, &c, but it is obvious that this nomenclature could not be carried to any great extent The system which has prevailed in modern times, and been generally adopted by astronomers in their charts and catalogues, was invented by Bayer, whose *Uranometria* [illegible] charts of all the constellations, was first [illegible] Augsburg in 1603 It consists in distinguishing the stars belonging to each constellation by the letters of the alphabet beginning with the brightest, which is called $\alpha$ The next brightest is called $\beta$, the next in order of brightness $\gamma$, and so on, and when the letters of the Greek alphabet were exhausted Bayer had recourse to the Roman and then to the Italian It is to be observed, that the order of the letters indicates only the relative brightness of stars in the same constellation without reference to other parts of the heavens Admitting the principle, it might have been simpler to have employed the ordinal numbers 1, 2 3, 4 &c for distinguishing individual stars But great perplexity is caused by the irregular forms of the constellations, whose numerous contortions and interlacings with each other baffle the efforts of memory, and which seem, as Sir J Herschel remarks, "to have been purposely named and delineated to cause as much confusion as possible"

*Distribution of the Stars* — The stars are very irregularly distributed over the celestial sphere In some regions spaces of considerable magnitude occur in which scarcely a single star is to be seen, while in others they are crowded together, so as to present to the unassisted eye the appearance of a confused mass of light A great and rapid increase of number is in general perceptible as we approach the borders of the Milky Way, where they appear when viewed through a powerful telescope, to be crowded almost beyond imagination (*See* MILKY WAY) Besides the general increase which takes place towards this region, there are in several parts of the heavens patches or clusters of stars, where great numbers are condensed into a very narrow space A telescope turned upon the Pleiades shows fifty or sixty large stars crowded together within a small [illegible] from the rest of the h [illegible] ( [illegible] Berenices is a similar group though more diffused Another occurs in the constellation Cancer, and is called Præsepe or the Beehive, from the great number of stars it presents in the telescope In the sword-handle of Orion there is also a group of the same kind, but in which the individual stars can only be distinguished in a telescope of considerable power, and in various parts of the heavens there are found luminous spots in which no star can be distinguished with ordinary telescopes, but which when viewed through very powerful instruments, are found to consist of stars crowded together so as to occupy almost a definite outline Many of them, says Sir J Herschel 'are of an exactly round figure and convey the complete idea of a globular space filled full of stars, insulated in the heavens, and constituting in itself a family or society apart from the rest, and subject to its own internal laws It would be a vain task to count the stars in one of these *globular clusters* They are not to be reckoned by hundreds, and on a rough calculation, grounded on the apparent intervals between them at the borders (where they are not seen projected on each other) and the angular diameter of the whole group, it would appear that many clusters of this description must contain at least ten or twenty thousand stars compressed and wedged together in a round space, whose angular diameter does not exceed 8 or 10 minutes, that is to say, in an area not exceeding the tenth part of that covered by the moon' (*Astronomy*, p 400)

*Number of the Stars* — Hopeless as any attempt to count the number of the 'starry host" may appear to be, it has nevertheless been sometimes made Of the stars visible to the naked eye at any one time, the number probably does not exceed a few thousands, but in the [illegible] W Herschel [illegible] 40 degrees in [illegible] Milky Way, the number which passed through the field of his telescope in a single hour amounted to 50,000 On account of their irregular distribution this estimate furnishes a very imperfect datum for inferring the whole number in the sphere, but it has [illegible] 75 millions may be vis [illegible] Bar Zach, indeed, was of opinion that there may be 1000 millions in the entire heavens But it is abundantly obvious that all estimates of this sort are nothing better than fanciful conjectures, and instead of a limit being found to the number of the stars, there is an infinitely greater probability that if an observer could transport himself to the remotest visible star, he would there behold a firmament not less rich than the one he left

behind "Every [illegible] Herschel, "in the dimensions [illegible] which successive improvements in optical science have attained, has brought into view multitudes innumerable of objects invisible before, so that, for any thing experience has hitherto taught us, the number of the stars may be really infinite, in the only sense in which we can assign a meaning to the word" (*Astronomy* p 373)

*Parallax and Distance of the Stars* — The distance of the fixed stars from the earth has in all ages been an object of interest and inquiry The element from which the distance can be deduced is the annual parallax, or the angle subtended by the diameter of the earth's orbit at the distance of the star (*see* PARALLAX), but this distance is so great that if we except one or two instances, perhaps still doubtful, all the attempts of astronomers to determine it have hitherto been fruitless The instance in which the observations have *most probably* shown the annual parallax to have a measurable value is that of the double star 61 Cygni, observed by Bessel at Konigsberg in 1839 and 1840 The value of the parallax obtained by this celebrated astronomer was 0 3483″ (a little more than the third part of a second) from which it results that the distance of the star is 592,000 times the mean radius of the earth's orbit, a distance so enormous that light, which is propagated with a velocity of 192 000 miles in a second, would require 9¼ years to traverse it (*Monthly Notices of the Royal Astr Society* May, 1840) Now there is every reason to believe that this is one of the nearest of the fixed stars, and it is no extravagant supposition that there may be others still visible which are a thousand times more remote If therefore one of these were annihilated some ten thousand years would elapse before its extinction could be perceived at the distance of the earth

*Proper Motions of the Stars* — On comparing the places of the stars determined by recent observations with the positions assigned to them in the older catalogues, it is found that many of them have undergone a very sensible displacement Within the last fifty years the double star 61 Cygni above mentioned, has moved through 4′ 23″ of right ascension, and as the motion appears to be uniform, its rate is therefore about 5 3″ annually Another star (μ Cassiopeiæ) has an annual proper motion of 3 74″ The number of stars in which such motion has been detected though of smaller amount than in the above instances, is very considerable Out of 2959 stars in the catalogues of Bradley and Piazzi, Bessel [illegible] a proper motion of not less than 0 2″ [illegible] the existence of such changes in the places of the stars gives rise to some interesting speculations relative to the constitution of the universe That the stars gravitate to each other like the bodies of the solar system is rendered certain from the phenomena of binary stars and when we admit the prevalence of this force among them we are led to suppose a centrifugal force to be necessary to counteract the tendency to a general collapse produced by their mutual gravitation Hence we conclude that the proper motions must be performed in circular or elliptic orbits round some very remote centre, and as every appearance leads us to suppose the stars to be bodies of the same nature as our own sun, it becomes extremely probable that the sun with its attendant system is transported through space with a similar motion Now the translation of the solar system would necessarily give rise to an apparent change of the positions of the stars, for in consequence of the diminution of distance, they must appear to recede from that point of the heavens towards which the sun's motion is directed, and to converge and become more condensed in the region diametrically opposite Sir William Herschel was of opinion that this is what actually takes place, and that a general recess of the principal stars from the point occupied by ζ Herculis is already indicated by the catalogues, and consequently that the solar system is carried forward in the direction of that star It seems, however to be the opinion of astronomers at present that the observations are not yet sufficient to establish the certainty of this motion, but whether the supposition shall be confirmed or not, it is evident that the proper motions which have been remarked cannot be all accounted for in this way They appear indeed to be subject to no one assignable law, but to be directed to many different and even opposite points of space It is a curious circumstance, and was first noticed by Bessel, that a large proportion of the stars which have a proper motion are double stars In the *Memoirs of the Royal Astron Society* vol ii, a list is given of all the stars whose proper motions, as determined by [illegible] Mayer with [illegible] in right as [illegible]

*Variable and Periodic Stars* — The proper motions are not the only indications of the existence of active forces in the stellar regions Many stars have been observed whose light appea[illegible] increase and diminution of [illegible] instances to a complete [illegible] Of [illegible] kind one of the most remarkable is the star *Omicron* in the constellation Cetus [illegible] Ceti which has a period of about 334 days At its greatest brightness it is a star of the second or third magnitude and continues in this state about a fortnight, when its light begins to wane, and at the end of three months it becomes for some time invisible to the naked eye Algol, in the constellation Perseus appears [illegible] about 3½ hours it is reduced to the fourth magnitude it then begins to revive and in the space of 3½ hours more it is restored to its original state thus accomplishing its period in about 69 hours The star δ Cephei has a period of about 5 days 8½ hours, and β Lyræ one of 6 days 9 hours A star in the breast of the Swan has a period of about 15 years, during five of which it is invisible Various other similar instances have been remarked, and recently Sir John Herschel has pointed out α Cassiopeiæ and α Orionis (the latter of the first magnitude) as variable stars (*Monthly Notices of the Royal Astr Society*, May 1839, and June 1840)

Several hypotheses have been suggested to account for these variations [illegible] about axes of rotation like the sun and the planets, and that [illegible] Mayer supposed that their surfaces were not flat, and that the variations of light were produced by the alternate [illegible] made by the flat sides with the visual ray Others, again, have imagined that the partial obscurations may be occasioned by dark bodies or [illegible] splendour have entirely disappeared no stars being now found in the places which they are set down as having occupied Others have suddenly shone forth with extraordinary brilliancy, and after a longer or shorter period have gradually died away and become extinct A phenomenon of this kind about 125 years B C induced Hipparchus to undertake the formation of his catalogue In the year 389 of our era a star suddenly blazed forth near α Aquilæ and remained for three weeks as bright as Venus and then disappeared But one of the most remarkable instances is that of the star which appeared in 1572, and was observed by the astronomer Tycho Brahe It suddenly shone forth in the constellation Cassiopeia, attained a splendour equal to that of Jupiter and Venus when nearest the earth and could be seen by the naked eye at mid-day Its brightness gradually diminished, and at the end of sixteen months it disappeared and has never been seen since During the period of visibility, its apparent place remained unchanged All the phenomena attending it are fully described by Tycho in his work entitled *De Nova Stella Anni* 1572 A similar phenomenon occurred in the year 1604, in the constellation Serpentarius of which an account is given by Kepler (*De Stella Nova in Pede Serpentarii* Pragæ, 1606) For various other instances of a similar kind, and also of stars set down in the catalogues but which cannot now be found the reader is referred to *Lalande's Astronomie*, tome i p 259

*Double and Multiple Stars* — Many of the stars which appear to the naked eye or in telescopes of feeble power, merely as bright points, are found when observed with high magnifying powers, to be composed of two, and some of them of three or more stars, in close juxtaposition This appearance may arise from the circumstance of two stars being situated in nearly the same line of view, for it is evident that two stars thus placed would appear as a double star, however great the real distance between them may be It was suggested by Galileo that the variations (if sensible) of the apparent distance between two contiguous stars would furnish a good method of determining the annual parallax, and a series of observations on double stars was undertaken by Sir William Herschel with a view to this question The result, however, was a discovery of a very different kind, for instead of finding an alternate increase and decrease of the apparent distance between the two stars, which would be the consequence of an annual parallax he observed in some instances a regular progressive change from year to year in one direction By reason of the slowness of the apparent motion, a considerable interval elapsed before he was able to determine its laws, but it was explicitly announced by him in 1803 that there exist sidereal systems composed of two stars, one revolving round the other, or both about a common centre Subsequent observations have fully confirmed this discovery, and in some instances even the ellipticity of the orbits and the periods of revolution have been determined Some of these binary systems, as they are called have periods of great length, but in such cases the periods, being computed from observations extending over only a small part of the orbit, and liable besides to considerable uncertainty, cannot be held to be determined with much precision Thus, the period of Castor has been computed by Sir J Herschel to be 252 years, and by Mr Hind to be 632

years A period of 629 years was assigned to γ Virginis, but Sir J Herschel has found that the observations are better represented by an orbit in which the time of revolution is 182 years The period of 61 Cygni is supposed to be about 500 years There are others, however, having much shorter periods, and which have already been observed through their entire orbits The star η Coronæ, for example, has a period of little more than 43 years, and has consequently completed nearly two revolutions since its discovery as a double star by Sir William Herschel in 1761, ζ Ursæ Majoris has a period of about 58½ years, and 70 Ophiuchi one of about 80 years Since the time of Sir William Herschel, the observations of double stars has been a subject of much attention, and catalogues containing some hundreds have been published, giving the apparent distances of the two bodies, and their angles of position, or the direction of the straight line which joins them, by comparing which with future observations their orbits and periods will become known (Herschel and South, *Phil Trans* 1826, Herschel, *Memoirs of the* [illegible] ruve, *Catalogus Stel* [illegible] Petropoli, 1837, Herschel, *Outlines of Astronomy*, 1849)

About 40 or 50 of the double stars are already known to form binary or revolving systems, and there are others presenting phenomena still more remarkable Struve has enumerated 52 triple stars, and systems have been observed compounded of five and even more stars, all appearing to revolve about a common centre

Some of the binary systems afford curious instances of contrasted colours the colour of the smaller star being frequently complementary to that of the larger In such instances the larger star is usually of a ruddy or orange hue and the smaller one blue or green Sir J Herschel thinks it probable that the colour of the small star is the effect of the brighter light of the large one, for it is a general law of optics that when the retina is under the excitement of any bright coloured light feebler lights for the time appear coloured with the complementary tints This opinion seems strengthened by the fact that though insulated stars of a red colour almost as deep as that of blood appear in many parts of the heavens, no green or blue star (of any decided hue) has been noticed unassociated with a companion brighter than itself

*Intrinsic Light of the Stars*.—On account of the distance of the stars, it is not possible to form any idea of their actual magnitude, for when viewed through good telescopes they appear simply as luminous points without any sensible disks Their light may, however, be compared with that of any other luminous object and Dr Wollaston found by photometrical experiments the light of Sirius the brightest of the fixed stars, to be to that of the sun in the ratio of 1 to 20,000 000 000 Now the proportion of light received from any luminous body being inversely as the square of its distance it follows that the sun would require to be removed to 141,400 (the square root of the above number) times its actual distance, in order that its light should be equal to that of Sirius But the parallax of Sirius, if sensible at all is undoubtedly less than 1″, whence it is easily calculated that the distance of Sirius cannot be less than 200 000 times the distance of the sun from the earth from this it follows that the light of Sirius cannot be less than the double of that emitted by the sun Dr Wollaston, assuming a smaller and more probable limit of the parallax supposes the light of Sirius to be equal to that of fourteen suns (*Phil Trans* 1829, *Herschel's Astronomy* p 380)

*Recent Remarks on the Distance Magnitude, &c of the Stars*.—Argelander of Bonn, has given a catalogue of the stars visible to the naked eye, in which they are divided into six orders of magnitude, the faintest stars, or those just perceptible by the naked eye being considered as the smallest of the sixth magnitude If we suppose six concentric spheres to be described about the sun, with radii such that the first contains all the stars of the first [illegible] those of the first and second magnitudes [illegible] those of the three first magnitudes, and so on, and if we also suppose the *mean* distance of the stars of the first magnitude to be unity, then, according to the computation of Struve (founded necessarily on certain hypothetical assumptions respecting the distribution of the stars in space), the mean distances of the stars of the different orders of magnitude, and the radii of the spheres circumscribing them, are as follows —

| Magnitudes | Mean Distance | Radius of Sphere. |
|---|---|---|
| 1 | 1 0000 | 1 2638 |
| 2 | 1 8031 | 2 1408 |
| 3 | 2 7639 | 3 1961 |
| 4 | 3 9057 | 4 4374 |
| 5 | 5 4545 | 6 2093 |
| 6 | 7 7258 | 8 8726 |

[illegible] gnitudes, the data for comhave been furnished by Bessel's zone observations Struve finds the radii of the circumscribing spheres to be as follows. For those of the seventh magnitude [illegible], for those of the eighth 21 8115 of the ninth 31 7300, and lastly he concludes that the smallest stars observed by Sir William H[illegible] foot reflector are at an average [illegible] 25 67 times more distant than the smallest stars visible to the naked eye (*E'tudes d'Astronomie Stellaire*, p 81) See SUPPLEMENT

The observation of the places of the stars has formed the principal business of the astronomer in all ages, for as it is to them that the motions of the planets and all the other bodies of the solar system are referred, the knowledge of their exact relative positions is the foundation of all our astronomical theories, and of all the applications of the science to the practical purposes of geography and navigation The discovery of their proper motions could only be made after instruments and methods of observation and theory had been brought to a state of great perfection, and is consequently of recent date For our knowledge of binary and other systems of connected stars, and in general of the facts which have been brought to light respecting the constitution of the heavens, we are chiefly indebted to the two Herschels, and so distinguished have been the discoveries of these illustrious astronomers in this department of observation that it is now usually called the Herschelian branch of Astronomy *See* ASTRONOMY, NEBULA

STARBOARD The right-hand side of a ship, looking forwards

STARCH (Germ starke) Starch is one of the commonest proximate principles of vegetables It is characterized by its insipidity, and by insolubility in cold water, in alcohol and in ether It dissolves in, or at least forms a gelatinous compound with water, heated to 175°, and this solution, even when much diluted, is rendered blue by iodine This admirable test of the presence of starch is not effective in hot solutions, and by boiling the blue colour disappears but returns in them on cooling as they cool It is [illegible] *starch* commercially applied to that obtained from wheat, which for this manufacture is ground and diffused through vats of water, where it undergoes a [illegible] smell After [illegible] the albumen of the grain is thus separated in the form of a viscid scum, the starch being in the form of a finely divided white powder, is gradually further separated by washing in large quantities of water, from which it is ultimately allowed to settle, and put into boxes lined with linen to drain, it is then cut into squares, which are dried first in airy chambers upon porous bricks and afterwards rolled up in papers and *stove* dried, it is in this latter operation that the starch acquires that peculiar columnar texture and fracture which is well exhibited in opening a paper parcel as it comes from the stove A little *smalt* is generally added to the starch, by which it acquires a very pale blue tint, and is better adapted to conceal or cover the yellow tint acquired by worn linen Starch may be obtained from many other grains, and from potatoes and several other esculent vegetables *Arrow root* is the starch of the *Maranta arundinacea*, *sago* of the *Sagus farinifera*, an East Indian palm tree, and *tapioca* and *cassava* of the *Jatropha manihot* Viewed under the microscope, the varieties of starch exhibit a more or less distinct globular appearance and are said to be made up of little spherical particles of soluble starch, enveloped in an insoluble membrane, which protects the interior from the action of cold water, but which is broken or burst by hot water In the process of germination, and by various chemical agents, starch may be converted into a species of gum and of sugar

STAR CHAMBER, COURT OF (Curia camera stellatæ, from the ornaments of [illegible] in which at one period it sate), was [illegible] council itself, "sitting in the st[illegible] exercising important criminal jurisdiction, and administering equitable relief It is mentioned as early as the reign of Edward III In the third year of Henry VII an act was passed giving determinate criminal powers, extending chiefly to state offences and misdemeanors of a public kind, to the court of star chamber The judges were four high officers of state, with power to join a bishop and a temporal lord of the council, and two justices of the courts of Westminster, to their number. They proceeded by bill and information without the assistance of a jury The sittings of the privy council itself, as a criminal court, [illegible] doned, and its powers tr[illegible] This court continued to exercise very extensive jurisdiction, both in [illegible] during the reig[illegible] until it was finally dissolved by 16 Car[illegible] together with what remained of its cognate jurisdictions (See COUNCIL PRIVY)

STARKEY'S SOAP A compound of turpentine, or oil of turpentine, and alkali

STAROST A title under the Polish republic enjoyed by noblemen who were in possession of certain castles and domains called starosties These were grants

of the crown, and only conferred for life, but generally renewed after the demise of a possessor to his heirs

STARSTONE. A very rare variety of sapphire which when cut and viewed in a direction perpendicular to the axis, presents a peculiar reflection of light in the form of a star

STA'TER. (Gr στατηρ.) An ancient Greek measure of value. It was undoubtedly a coined piece of money at an early period. The common gold currency in the republican times of Greece consisted of staters. The Attic golden stater weighed two drachms and is estimated at twenty silver drachms, but the value of the coin struck by different states with this denomination varied greatly.

STATES or ESTATES. In modern European History (French états, Germ. stande), those divisions of society, professions or classes of men which have partaken, either directly or by representation, in the government of their country. Their number has varied in different countries. In France, and most other feudal kingdoms, there have been three estates (nobles, clergy, commonalty), members of the ancient national assemblies. Hence the well-known appellation *tiers etat* (third estate) for the last. In Sweden there are at this day four, nobility, clergy, citizens, peasants. In most countries the ancient system of assemblies convoked from separate estates disappeared by the progress of the government in the 16th and 17th centuries, and in monarchical constitutions the legislative power, ment, by king, lords, and commons or analogous powers, has prevailed. But the states have been reconstituted of late years in some German monarchies, as Hanover and the electorate of Hesse Cassel, &c.

STATES-GENERAL. In French History, assemblies which were first called A.D. 1302, and were held occasionally from that period to the year 1614, when they were discontinued, till they were summoned again at an interesting period, viz. in the year 1789. These states-general, however, were very different from the ancient assemblies of the French nation under the kings of the first and second race. There is no point with respect to which the French antiquaries are more generally agreed than in maintaining that the states general had no suffrage in the passing of laws, and possessed no proper jurisdiction. The whole tenor of the French history confirms this opinion. *See* ASSEMBLY, DIRECTORY.

STATICS (Lat. stare, *to stand*). The branch of Mechanics which has for its object the investigation of the conditions of equilibrating forces, or the conditions under which several forces applied to a rigid body mu-

principles on which the theory of equilibrium may be grounded: these are 1. The principle of the lever, 2. The principle of the composition of forces, and 3. The principle of virtual velocities.

*Principle of the Lever.* — The equilibrium of a straight horizontal lever, loaded at its extremities with weights which are reciprocally proportioned to their distances from the fulcrum, was demonstrated by Archimedes (*see* LEVER), and it is easy to extend this principle to the bent lever, when the fulcrum is at the angular point, and to show that if the two arms be urged in opposite directions by two forces perpendicular to the arms and reciprocally proportioned to their lengths, there will be equilibrium. Now, it is an axiom in statics that a force may be regarded as acting at any point whatever in the line of its direction, and hence it follows that any two forces applied at any points whatever in a plane which is only moveable round a fixed point, and having any directions whatever in that plane, will be in equilibrium

for the perpendiculars may be regarded as the arms of a bent lever having the fixed point for its fulcrum. This general principle, which is also called the *principle of moments*, suffices for the resolution of all the problems of statics, and is indeed the only one which was rigorously demonstrated previous to the discovery of the composition of forces, that is to say, previous to the publication of the *Principia* in 1687.

*Composition of Forces.* — The second general principle consists in this, that any two forces acting together upon the same point of a body, are equivalent to a single force represented in intensity and direction by the diagonal of a parallelogram, of which the two given forces are repre- sented by the sides. This equivalent of the two forces is called their resultant, and as the resultant may be combined with a third force acting on the same point, and the resultant of this combination with a fourth, and so on, it follows that any number of forces applied to the same point have a single resultant, or may be replaced by a single force. (*See* FORCE.) This principle was not known to the ancients. Galileo demonstrated that a body moved by two uniform velocities, the one vertical and the other horizontal, must acquire the velocity represented by the hypothenuse of the right-angled triangle whose sides represent respectively the two velocities. This is a particular case of the principle. Newton proved it to be true generally, and substituted the composition of forces for that of motions, and in the second corollary to the third law of motion, he shows that

may easily be deduced from it. The *Nouvelle Mécanique* of Varignon, published in 1725, contains the first complete theory of the equilibrium of forces in different machines, deduced solely from the principle of the composition of forces. The simplicity of the principle, and the facility of its application to all questions connected with equilibrium, caused it to be almost immediately adopted, and it is the basis of all the modern treatises of statics.

*Virtual Velocities.* — The third general principle on which the conditions of equilibrium may be made to depend consists in this, that forces acting in opposite directions destroy each other when they are inversely proportional to the velocities which they would respectively communicate to the body in the first instant of its motion, if the equilibrium were destroyed. This principle applies almost self-evidently to the conditions of equilibrium of the lever, pulley, and other simple machines. Its generality was first remarked by John Bernoulli. It has been adopted by Lagrange as the basis of his *Mécanique Analytique*, and it has the advantage over the others of being capable of representation in a single general formula which includes the solution of every question that can be proposed relative to the equilibrium of forces. Lagrange however, remarks that it is not sufficiently self-evident to be erected into a primitive principle, but it may be regarded as a general expression of the laws of equilibrium deduced from the two former. *See* VIRTUAL VELOCITY.

The general problem of statics may be thus enunciated. — *To find the equations of equilibrium of a body urged by any number of forces having any directions whatever in space.* We shall briefly indicate the steps by which the equations which express the conditions of equilibrium are obtained, adopting the principle of the composition of forces.

1. A force which acts on any point of a solid body may be regarded as applied at any point in the line of its direction, as all the different points of the line are invariably connected as is the case with any two points of a rigid body. This, as already stated, may be assumed as an axiom.

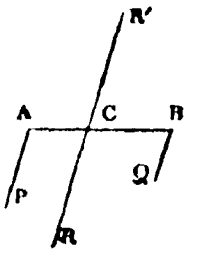
2. If a material point is urged by two forces acting in the same straight line, and in the same direction, the effect will be the same as if the point were urged in the same direction by a single force equal to their sum, and if the two forces act in opposite directions the effect will be the same as if the two forces were replaced by a single force equal to their difference acting in the direction of

which the others are

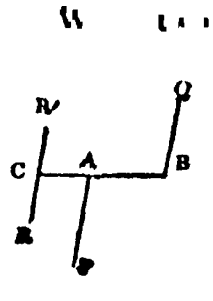
and as a third force may be compounded with the resultant of two, another with the new resultant, and so on, it is obvious that any number of parallel forces acting on a point have a single resultant.

3. It has been shown in the article FORCE (p. 462) that a force acting in any direction can always be decomposed into three others respectively parallel to three straight lines given in space, provided no two of these lines be parallel. Hence it follows that whatever be the number or the direction of the forces which act upon a solid body, they may be all replaced by three sets of parallel forces acting in given directions. We have therefore only to consider the theory of parallel forces.

4. When two parallel forces P and Q acting in the same direction, are applied to the extremities of a rigid straight line A B, the resultant R will be equal to their




parts in C, so that the distance of the points of application from C are reciprocally as the forces, or so that A C : C B :: Q : P. Thus, if A P and B Q be taken to represent the forces, and C R the resultant, we have C R = A P + B Q, and the two forces will be in equilibrium with a force C R', equal to C R, and acting in




When the forces P and Q act in opposite directions, and are applied to the extremities of the line A B, there are two cases for consideration. If P and Q are unequal, they have a resultant which is parallel to their direction, equal to their difference, and applied at a point C in A B produced, which is such that A C : C B :: Q : P, or A C : A B :: Q : P − Q, and the two forces represented by A P and B Q will be in equilibrium with a force C R' equal and opposite to C R. If the two forces P and Q are equal, the point C, determined as above, is at an infinite distance, and

the resultant In this case, therefore, the forces P and Q cannot make equilibrium with any single force

The system of two equal and parallel forces applied in opposite directions at the extremities of a right straight line is very important in statics For the sake of facilitating calculation the forces are transferred to other points of their direction so that the line joining the new points of application shall be perpendicular to the direction of the forces Under this form, the system has been designated by the French mathematicians a *couple*, and its consideration has introduced great simplicity into the theory of equilibrium We shall here state the principal properties of couples, referring for the details of demonstration to the *Elémens de Statique* of Poinsot

6 Def —A couple is a system of two equal parallel forces acting in opposite directions, and applied perpendicularly to the extremities of an inflexible straight line of a given length

7 It is obvious from the definition that the efficacy of a couple depends on two things, the intensity of the forces, and the length of the straight line or lever to the extremities of which they are applied Now the force multiplied into the leverage is the *moment*, or the measure of the effect produced Let the force be denoted by F, and the length of the straight line by $a$, then F $a$ is the statical moment of the couple And if there be another couple F′ $a'$, such that F F′ $a'$ $a$, then F $a$ = F′$a'$, or the statical moments of the two couples are equal and the one may be substituted for the other without disturbing the conditions of equilibrium

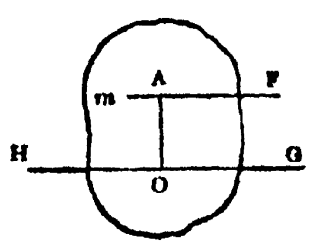
8 Any couple applied to a solid body may be transported, parallel to itself to any position in its own plane or in any other parallel plane, and it may be turned round through any angle in those planes without altering in any manner its effect on the body to which it is applied, provided the new points of application are invariably connected with those to which the couple was originally applied

9 Two couples situated any where in the same plane, or in parallel planes, may be composed into a single couple equal to their sum, if they tend to turn the body in the same direction, or equal to their difference if they tend to turn it in opposite directions Hence, by successive composition any number of couples acting in parallel planes may be replaced by a single couple, the statical moment of which will be equal to the difference between the sum of the moments of all the couples tending to turn the body in one direction, and the sum of the moments of those which tend to turn it in the opposite

10 Two couples situated any where in two planes which intersect each other may always be compounded into a single couple and if we represent the moments of the two couples respectively by two straight lines making an angle equal to that of the two planes and complete the parallelogram the moment of the resulting couple will be represented by the diagonal and the plane of the resulting couple will divide the angle formed by the plane of the component couples into two parts respectively equal to the parts into which the diagonal divides the angle of the parallelogram From this it is obvious that by successive composition any number whatever of couples, applied in any manner to a solid body, may be replaced by a single couple

11 Reciprocally any couple may always be resolved into two others situated in given planes, provided these planes and the plane of the proposed couple meet in the same or in parallel straight lines

12 From the principles above stated, we draw this important conclusion,—viz that when a solid body is urged by any number of forces having any directions whatever, the whole may be reduced to one force and to one couple For let $m$ be one of the points of a solid body, and conceive a force F represented in intensity and [illegible] line $m$ [illegible] Take O any point whatever in the solid body or invariably connected with it, and draw O A perpendicular to $m$ I, and conceive the force F to be applied at A in the same direction $m$ F Now suppose another force G represented by O G, equal and parallel to $m$ F, to be applied at O, and let a third force H represented by O H, equal to O G, but acting in the opposite direction, be also applied at O These two auxiliary forces will not alter the statical condition of the body, because the one exactly destroys the effect of the other But the system of three forces F, G, H may now be conceived as consisting of a single force G applied at O, and of a couple formed by the two forces F and H applied at the extremities of the lever O A Let O A be denoted by $a$, then the statical moment of this couple is F $a$, and by

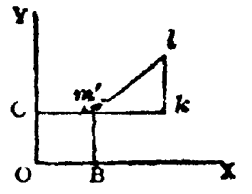



(9) we may conceive it to be moved in its own plane until the centre of the arm O A coincides with the point O.

[illegible] O will have a single resultant R applied at the same point, and all the couples having their centre at O may be compounded into a single couple, which has its centre at the same point (9) Therefore, finally, the whole of the forces acting on the solid body may be reduced to one force and to one couple, and in order that the body may remain at rest, it is necessary that the efforts of the resulting force and the resulting couple be severally destroyed It is to be observed, that the resultant R cannot destroy the couple, or be in equilibrium with it, and, in general, the resultant and the couple will be situated in different planes

From this it appears that the conditions necessary for the equilibrium of a body urged by a number of forces are these —1 That the resultant of all the forces at the point O be nothing, and 2 That the moment of the couple be nothing When the first of these conditions is satisfied, there can be no progressive motion, and when the second is satisfied, there can be no rotatory motion about an axis In order to express these conditions by equations an expression for the single resultant, and an expression for the single couple, must be deduced from the conditions of the proposed problem, and the results severally made equal to nothing We shall now show the general forms of these expressions, and for simplicity we shall first suppose all the forces to act in the same plane

Let there be any number of forces F′, F″, F‴, &c applied respectively at the points $m'$, $m''$, $m'''$, &c of a system of points invariably connected, and suppose all the points to be in one plane, and all the forces to act in the same plane, but to have any directions whatever in that plane From a point O taken arbitrarily in the plane draw the rectangular axes O X, O Y, then, whatever the direction of the force F′, it may be resolved into two forces respectively parallel to these axes Let the force F′ be represented in intensity and direction by the line $m' l$, and let X′ = $m' k$ be its component parallel to the axis O X, and Y′ = $k l$ its component parallel to O Y In like manner let X″ and Y″ be the components of a second force F″ resolved in the same manner, X‴, Y‴ those of a third F‴ and so on, then, instead of the system of forces F′ F″, F‴, &c, we shall have two groups of parallel forces namely, X′, X″ X‴, &c parallel to O X, and Y′, Y″, Y‴, &c parallel to O Y




Now if $x'$ and $y'$ be the co ordinates of the point $m'$, so that $x'$ = O B and $y'$ = O C ($m'$ B and $m'$ C being respectively perpendicular to O X and O Y), then (12) the force X′ may be replaced by an equal force applied at O, and by a couple whose statical moment is X′ × O C = X′ $y'$ In like manner the force Y′ may be replaced by an equal force applied at O, and by a couple whose statical moment is Y′ × O B = Y′ $x'$ Each of the remaining forces X″, X‴, &c Y″, Y‴, &c may evidently be replaced in a similar manner But it is evident that the group of forces X′, X″, X‴, &c applied at O may be represented by a single force X equal to their sum (those which fall to the right of the axis O Y being considered as positive and those which fall in the opposite direction as negative), and those of the group Y′, Y″, Y‴, &c by a single force Y (having due regard to the signs), and the first condition of equilibrium requires that we have X = 0 Y = 0 (for the resultant of X and Y can only be nothing when these quantities are severally = 0), that is to say, we must have the two following equations —

$$\left.\begin{aligned} X' + X'' + X''' + \&c &= 0 \\ Y' + Y'' + Y''' + \&c &= 0 \end{aligned}\right\} \qquad (a)$$

With respect to the two sets of couples X′ $y'$, X″ $y''$, &c, Y′ $x'$, Y″ $x''$ &c, since they are all situated in the same plane, it follows from the principle stated in (9) that they may all be compounded into a single couple whose statical moment is equal to the sum of the statical [illegible] couples and since the second [illegible] that the moment of this resultant couple be nothing, the following equation must be satisfied —

$$X'y' + X''y'' + \&c - Y'x' - Y'x'' - \&c = 0 \qquad (b)$$

The effort exerted by each of these separate couples is to turn the system round an axis passing through the point O, and perpendicular to the plane X O Y, and the sum of the efforts being nothing, there is consequently no rotatory motion communicated

The equations which have now been obtained for the equilibrium of a system of forces all acting in the same plane are easily rendered general Let F′, F″, F‴, &c

be the forces, having any directions whatever in space, applied to the points of a solid body, through a point O in the body, or invariably connected with it, draw three rectangular axes, O X, O Y, and O Z, and let each of the forces F′ be resolved into three others parallel to [illegible] X′, Y′, Z′, then the [illegible] requires the three equations,

$$\left.\begin{aligned} X' + X'' + X''' + \&c &= 0 \\ Y' + Y'' + Y''' + \&c &= 0 \\ Z' + Z'' + Z''' + \&c &= 0 \end{aligned}\right\} \quad (c)$$

With respect to the couples arising from [illegible] resolved forces from their [illegible] point O, it is [illegible] the forces are now in [illegible] planes, X O Y, X O Z, and Y O Z, the couples may all be transferred to those three planes, therefore, by the same reasoning as above, it is easy to see that in each plane there will be two sets of couples tending to turn the body about an axis perpendicular to that plane. Thus, in the plane X O Y, there will be, as before the two sets of couples X′ y′, X′ y″, &c., Y′ x′, Y″ x″, &c., and, similarly, in the plane X O Z there will be the two sets X′ z′ X″ z″, &c., Z′ x′ Z″ x″, &c., and in the plane Y O Z the two sets Y′ z′, Y″ z″, &c., Z′ y′, Z″ y″ &c. Now supposing all these couples compounded into one, it is manifest that the moment of this resulting couple can only be nothing when the sums of the moments of the couples in each plane are respectively nothing; hence we have this second set of equations,

$$\left.\begin{aligned} X' y' + X'' y'' + \&c - Y' x' - Y'' x'' \&c &= 0 \\ Y' z' + Y'' z'' + \&c - Z' y' - Z'' y'' \&c &= 0 \\ Z' x' + Z'' x'' + \&c - X' z' - X'' z'' \&c &= 0 \end{aligned}\right\} \quad (d)$$

These two systems of equations (*c*) and (*d*) contain the conditions necessary for the equilibrium of any solid body. When the first system (*c*) is satisfied there can be no progressive motion, and when the system (*d*) is satisfied, there can be no rotation about an axis.

These two systems of [illegible] under a different form. Let [illegible] angles which the direction of the force F′ make with lines parallel to the three axes O X, O Y, O Z, we shall then have for the components of the force F′,

$$X' = F' \cos \alpha', \quad Y' = F' \cos \beta', \quad Z' = F' \cos \gamma'$$

Do. [illegible] in respect of the force F″ [illegible] $\alpha''$, $\beta''$, $\gamma''$ [illegible] similar expressions for the components of that force, and so on. Hence the six equations (*c*) and (*d*) become

$$\left.\begin{aligned} F' \cos \alpha' + F'' \cos \alpha'' + \&c &= 0 \\ F' \cos \beta' + F'' \cos \beta'' + \&c &= 0 \\ F' \cos \gamma' + F'' \cos \gamma'' + \&c &= 0 \end{aligned}\right\} \quad (c')$$

$$\left.\begin{aligned} &F' (y' \cos \alpha' - x' \cos \beta') + F'' (y'' \cos \alpha'' - x'' \cos \beta'') + \&c = 0 \\ &F' (z' \cos \beta' - y' \cos \gamma') + F'' (z'' \cos \beta'' - y'' \cos \gamma'') + \&c = 0 \\ &F' (x' \cos \gamma' - z' \cos \alpha') + F'' (x'' \cos \gamma'' - z'' \cos \alpha'') + \&c = 0 \end{aligned}\right\} (d')$$

Our limits will only permit of our giving a general indication of the manner in which the above equations are applied to the solution of particular problems.

1. If the body is retained by a fixed point we have only to assume the fixed point as that in respect of which the [illegible] are made. The effort of the [illegible] forces will then be annihilated by the [illegible] there will be equilibrium, when the three equations (*c′*) are satisfied, or if the three equations (*d′*) are satisfied.

2. If the body is retained by two fixed points the line which joins them will constitute a fixed axis in the body. On taking the point O anywhere on the axis the resultant of the forces applied at O will again be destroyed by the resistance of the axis, but in order that equilibrium may take place, it is not now necessary that the resulting couple be nothing, — it is sufficient that it be situated in any plane which contains the axis, for when this condition is fulfilled its arm coincides with the axis and is fixed, and consequently the effect of the forces applied at its extremities will be annihilated.

3. Lastly, if the body, in other respects free, be subjected to touch an invariable plane, it is not necessary for equilibrium that the equations (*c′*) be satisfied, it will be sufficient if the resultant of the forces be perpendicular to the plane, provided it also fall within the interior of the space which limits the points of contact of the body with the plane, for in this case it will be destroyed by the plane's resistance. The second system of equations (*d′*) must, however, be satisfied, since the resistance of the plane can only generate a normal resistance, which, therefore, is incapable of destroying the action of the couple.

Of all the forces which act upon bodies, that which most frequently comes under our observation is terrestrial gravity, under the influence of which all bodies, when unsupported, fall to the ground in vertical lines. A solid





body acted upon by gravity presents the case of an infinite number of connected points urged by parallel forces; for though gravity is directed towards the centre of the earth, yet, by reason of the great magnitude of the earth in comparison of such bodies as usually come under consideration, the direction of the forces acting on the different points may all be regarded as parallel. All these forces have therefore a single resultant, which, in respect of every particular body, [illegible] point, called the centre of gravity. [illegible] of the centres of [illegible] on statics. For the general formulæ, see CENTRE OF GRAVITY. (See Poinsot, *Eléments de Statique*, Biot, *Notions de Statique*, Poisson, *Traité de Mécanique*, Lagrange, *Mécanique Analytique*, *Whewell's Mechanics*, and [illegible] under the term MECHANICS.)

STATION (Lat. *stare*, *to stand*.) In Astronomy, a planet is said to be at its *station*, or to be *stationary* when its motion in right ascension ceases, or its apparent place in the ecliptic remains for a few days unaltered. The real motions of the planets are always in the same direction from west to east, but owing to the motion of the earth from which they are seen, their *apparent* motions though generally from west to east, or direct, are sometimes from east to west, or retrograde, and in changing from one of these directions to the other the planet appears for some short time to stand still. The distance of the earth and of a planet from the sun being given, and also their periodic times, the determination of the arc of retrogradation, or the times at which the planet will appear stationary, is an easy problem, but to the ancient astronomers who were unacquainted with the relative distances of the planets, and who, moreover, supposed the earth to be the centre of motion, the phenomena of the stations and retrogradations occasioned great embarrassment, and the principal object of the various systems which were propounded previous to that of Copernicus was to give a satisfactory explanation of them. See PLANET.

STATION in Surveying is the place selected for planting the instrument with which an angle is to be measured.

STATION in the Church of Rome, is applied to certain churches in which indulgences are granted on certain days.

STATION is applied to those resting-places on railways at which a halt is made for the purpose of receiving or letting down passengers or goods. The last stations on a railroad are called the *termini*.

STATIONARY ENGINE, in contradistinction to 'Locomotive Engine,' expresses a steam engine in a fixed position which draws loads on a railway by a rope or other means of communication extended from the *station* of the engine along the line of road.

On railways worked by locomotive engines, inclined planes sometimes are constructed of an acclivity too steep to be worked with advantage by these machines; such a plane occurs on the London and Birmingham railway, between the passenger station at Euston Square and the depot and station for goods at Camden Town. Similar inclined planes are constructed on the Liverpool and Manchester railway between the quay at Liverpool and the station at Edge Hill, and between the passenger station at Lime Street and the same place. In these cases a stationary engine is placed at the summit of the inclined plane, by the power of which acting on a rope carried along the plane the trains of carriages and waggons are drawn to the summit.

But it is not only on planes whose acclivity forbids the advantageous application of locomotive engines that stationary engines are used as the [illegible] power on railways. In some situations, where the railway is sufficiently level, [illegible] rence to locomotive power. Thus [illegible], from the India House in London [illegible], [illegible] acclivities do not exceed sixteen feet per mile, is worked throughout its entire length by stationary power.

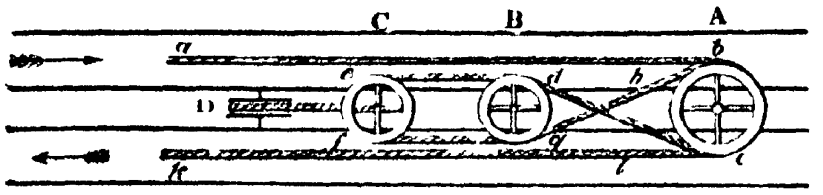
When a line of railway is to be worked by stationary engines the whole line is resolved into a succession of stages of certain lengths at the end of each of which a stationary steam engine is placed, or, more generally, *two* such engines are provided in order that the occasional suspension of one for the purpose of repairs may not interrupt the traffic of the road. The power of these engines is applied to give motion to a drum, or cylinder, or wheel, on which a rope is wound. This rope extends [illegible] the road by [illegible] and at short intervals from [illegible] by which its friction and consequent wear and resistance are diminished.

There are several methods by which the stationary engine is made to draw the train by a rope.

The plan adopted by Mr Stephenson to draw the trains of goods from the quay at Liverpool to the station at Edge Hill up [illegible] inclined plane of about a mile in length, is by [illegible] rope. At the foot of the machine a wheel is laid down in a horizontal position, revolving on a ver-

tical axis have a groove on the circumference of a proper magnitude to receive the rope The diameter of this wheel is equal to the distance between the centres of the two lines of rails so that when the rope is extended between each line it will fall into the groove at the end of [illegible] wheel which [illegible] to the [illegible] the rope being brought round the groove of the wheel for half its circumference, is carried up each line of rails midway between the rails

At the summit of the plane, a similar wheel is similarly placed, round which the rope is conducted, but, instead [illegible] which the necessary tension is given to it Let A repre-




sent the great wheel at the top of the plane, and let *a b* represent the rope passing up the plane between one line of rails and falling into the groove of the wheel at *b* It is carried round the wheel A to *c*, and thence passes diagonally to *d*, where it falls into the groove of a smaller wheel B, from whence it is carried to *e* and half round another wheel C, equal to B, and from *f* it is conducted to *g*, where it falls again into the groove of the wheel B, from whence it passes diagonally to *h*, and half round a second groove in the great wheel A to *i k*, from whence it is carried down the other line between the rails

The steam engine is thrown into connection with the axle of the wheel, to which it imparts continued revolution The adhesion of the rope to the grooves makes this motion cause the rope to be drawn in the direction of the arrows Any train of carriage therefore attached to the rope *a b* would be drawn in one direction, and a train attached to *i k* would be drawn in the other direction The tension of the rope is regulated by a weight suspended by a rope passing over a vertical wheel D and attached to the axle of the wheel C This weight hangs in a pit, and continually draws the wheel C from the wheel D By this means however the rope may vary its length by moisture or other hygrometric causes, it will necessarily have the same tension

The new tunnel at Liverpool, extending from the engine station at Edge Hill to the passenger station at Lime Street, is differently worked but also by an endless rope The distance from the Lime Street station being 2200 yards a horizontal shaft is extended across the whole width of the two lines of railway at Edge Hill The extremities of this shaft are continued on either side into two buildings, where stationary engines are erected A motion of revolution may be given to the shaft by either of those engines separately or by both of them simultaneously Upon the shaft, and in the centre of one of the lines of railway, a grooved wheel 19½ feet in diameter, is fixed with its plane vertical The rope, which constantly ascends the plane between the rails of the line appropriated to ascending trains passes over this wheel, and being brought under it is returned nearly to the point where it first comes upon it It is there conducted into the groove of another wheel 4 feet in diameter, placed in front of the greater wheel By this arrangement the rope embraces nearly the whole circumference of the greater wheel and an adhesion is obtained sufficient to draw a load of one hundred tons up the plane After the rope passes over the smaller wheel it is carried [illegible] running [illegible] wheel is drawn by a weight similar to that described in the preceding case, by which a uniform tension is given to the rope After passing round this horizontal wheel, the rope is then directed to the centre of the other line of railway by two other horizontal wheels, and, after passing down the plane is conducted by two other horizontal wheels at Lime Street into the centre of the ascending line, along which it is conducted, as already described, to the large shaft wheel at the top of the plane

By either of the contrivances here described a railway of any extent may be worked by stationary engines driving endless ropes, and as the rope is at the same time moving in contrary directions along the two lines of railway, trains may be drawn by the same engine at the same time in contrary directions In case of such a rope being applied to an inclined plane, the weight of the descending train would act upon the ascending train leaving the moving power to act against the difference of their weights only If, in such a case, the descending load were greater than the ascending load the latter would not only descend by its gravity without any moving power, but would draw the ascending load up A plane worked in this way without an engine is called a self-acting plane Railways composed of self-acting





planes are very frequent in mining districts, where the level at which the mineral product is obtained is much more elevated than that at which it is shipped The weight of the mineral itself is, in such cases, used as the moving power, the loaded waggons in their descent drawing the empty waggons in the contrary direction

When an endless rope is not used, the power of the engine is applied to a drum or cylinder, called a rope-roll, on which the rope is coiled In such cases, the rope being carried along the line of rails, has its extremity attached to the train to be drawn, and the engine, as it works, turns the rope-roll on which the rope is gradually coiled, and the train is thus drawn towards the engine When the train has arrived there, the whole of the rope will be coiled on the rope-roll In order to move the train in the other direction, a similar engine is placed at the other extremity of the railway along which the train is moved, and the train is drawn back by the other engine in the same manner But, in order to unroll the rope from each rope-roll, the train, in returning, is made to draw the rope after it Thus the two engines reciprocally draw the train backwards and forwards between them, each engine, while it draws the train in one direction, unrolling the rope from the rope-roll of the other

There are various other expedients that have been [illegible] of the principle of one or other of these here described. The speed attainable by such means was formerly very limited, but the application of ropes and the machinery connected with them has been much improved, and if it were otherwise desirable a line of railway could now be worked at an average speed of from fifteen to twenty miles an hour by a series of stationary engines and ropes Nor would it be necessary in passing each station to stop the train expedients being devised by which the train may be transferred from one rope to another without [illegible]

STATIONERY The name given to all the materials employed in the art of writing but more especially to those of pens, ink and paper The term *stationery* is derived from the business of booksellers having been anciently carried on entirely in stalls, or *stations* The Stationery Office in London is the medium through which all government offices, both at home and abroad, are supplied with writing materials, and at the same time it contracts [illegible] and other matters had before [illegible] It consists of a comptroller, a storekeeper and about thirty clerks and other subordinate officers, and has a branch establishment at Dublin

STATION POINTER An instrument used in maritime surveying, for expeditiously laying down on a chart the position of a place from which the angles subtended by three distant objects, whose positions are known, have been observed It consists of three scales, which move about a common centre, two of them carrying each a divided circular arc and the third two verniers adapted to the arcs, by means of which the scales can be opened so as to form two angles of any magnitude Suppose the angles of the scales to be adjusted to the two measured angles and the instrument to be laid on the chart, so that the edges of the three scales coincide with the positions of the observed objects the centre marks the position of the spot from which the objects were observed (See *Simms's Treatise on Mathematical Instruments*, p 98)

STATIONS In [illegible] Roman statio, *a sola[illegible]ra* The weekly fasts of Wednesdays and Fridays These were omitted between Easter and Whitsuntide They terminated at three in the afternoon, hence sometimes called *semi-jejunia* Saturday was made a station day by the council of Elvira, which, it is said, led to the gradual neglect of the Wednesday station in the Western church (*Riddle's [illegible]*)

STATISTICS [illegible] The name given to the [illegible] state or condition of a country [illegible] in relation to its extent population, industry, wealth, and power

By a statistical account of a country, we mean a work describing its situation and extent, its natural and acquired capacities of production, the quantity and value of the various articles of utility and convenience existing and annually produced in it, the number and classes of its inhabitants with their respective incomes, its institutions for the government, improvement, defence, and maintenance of the population, with a variety of subsidiary statements and details A science embracing so great a variety of objects is not easily defined or limited, nor is it possible to draw any distinct line of demarcation between what should be left out of statistical works, and what should be included in them Much must always depend on the object in view, and on the good sense and discrimination of the author Statistics has many features in common with geography and politics, and embraces that sort of mongrel science

[illegible] been called political arithmetic Some authors, and, among others, Mr Macculloch, contend that any description, however brief, of the territory of a country is foreign to statistics* and belongs exclusively to physical geography But this is evidently a most erroneous statement How can we acquire any accurate or comprehensive knowledge of the capacities of production enjoyed by a country if we be unacquainted with its situation [illegible] and native products, and with its facilities for bringing them to market and exchanging [illegible] ng alien to, this [illegible] the science, and [illegible] ver well it might [illegible] e considered as a complete statistical work Those topographical details which are essential in a geographical work would, however, be totally out of place in one devoted to statistics One of the principal objects of the latter is to exhibit [illegible] the national wealth, its amount [illegible] ese would not be in any respect promoted by indulging in topographical details Hence, in statistical works, a short notice of the principal divisions of the country, with [illegible] climate, soil, [illegible] products [illegible] the method of holding and occupying lands, manufactures, and population, is generally sufficient This much, however, cannot be dispensed with It is the foundation on which all the rest of the building is to stand, and the completeness of the other, and more elevated parts, will generally depend more on the compactness and solidity of [illegible] se

[illegible] as to the mode in which statistical treatises should be drawn up, as with respect to the topics they should embrace Some contend that their object is limited to an exposition of the state of a country, province, or place, at some given period, and that, historical and theoretical discussions [illegible] excluded The Germans, who are supposed to be the great authorities in statistical matters mostly compose their works on this plan, but it, notwithstanding appears to us to be radically objectionable, and to be calculated to deprive the science of all that is most interesting and instructive Nor need we travel beyond the sphere of German statistical works for ample proof of what is now stated They are in fact with few exceptions, the most worthless rubbish imaginable We have accounts, sometimes accurate and sometimes not but usually put forward with equal confidence, of a variety of minute facts, but as we have no explanation of the circumstances under which they originated they communicate, even when accurate little useful information, and it would not be more idle to attempt to form any notion of St Peter's or St Paul's from an account of the number of tons of stone, brick and mortar in each than it would be to attempt to form any opinion of the state of Prussia, Austria, or any other German state, from the details respecting it supplied by German statistical writers They tell us, for example, that so many looms were at work in such a town or place at such a time, but the chances are, not a word will be said as to whether the number of looms was increasing or diminishing, and supposing that were stated, it is all but certain that not a word will be said explanatory of the causes by which this result has been brought about, though these [illegible] facts [illegible] times more importance than anything else [illegible] plan of statistics presents us with a skeleton, instead of a living animated body It is of importance, no doubt, to know the amount of population, the sum paid in taxes, the rate of wages, &c in a country or district [illegible] and but it is only by comparing these statements with [illegible] of the same sort, applying to different epochs, that we learn whether such country be advancing or retrograding and it is only by comparing details peculiar to one country with those peculiar to another that we learn in what respects they agree and differ, and that the attention of the politician and economist is called to those circumstances that retard the progress of the one [illegible] that of the other Those who make a practice of publishing would call this *comparative statistics* and would contend that it should not be mixed up with descriptive statistics But to be really good, and possessed of interest enough to make it be read, a work must embrace both They should not be so intermixed as to create confusion, but unless they be combined in due proportions, the principles on which the comparisons are made expounded, and the circumstances that produce the discrepancies pointed out, and their influence correctly appreciated, no details, however accurate, can be of much value It is the easiest thing possible to pile figures on figures, but unless deduced from correct data, they serve only to mislead, and they do this the more easily, that they have a scientific air about them, and that most people shrink from the irksome task of examining whether tabular statements be correct or not There is nothing, indeed, about which one should be so sceptical as the greater number of what are called statistical facts and details, or with respect to which a sound and searching criticism is so necessary The reader would do well generally to look with suspicion and distrust on most statements, how imposing soever they may appear, unless he be informed of the sources whence they have been derived, and of the principles on and the mode in which they have been compiled

It would be easy to illustrate what has now been said by references to the statements in parliamentary and other official documents, many of which are altogether false, while many more from the condition to which they apply not being clearly set forth, are, though not absolutely incorrect fitted only to mislead

Perhaps the least valuable book ever published on any important subject was that of Dr Colquhoun *On the Wealth and Resources of the British Empire* It is, from beginning to end a tissue of extravagant hypotheses, exaggeration, and absurdity Nothing was too difficult for this intrepid calculator Under his transforming hand every thing was reduced to figures, and matters as to which it is impossible to obtain any certain information, and of which he knew nothing, were set down as if they had been ascertained with absolute precision! And yet the most extravagant of his statements were for a while regarded as well-established truths The book obtained an extensive circulation, it was translated into German, and the German doctors continue to refer to it as if its authenticity were alike unquestioned and unquestionable

In justice, however, to the German writers on statistics, it should be stated that the circumstances under which they are placed do not really admit of their publishing the best class of works In Prussia, Austria, and most German states, the press is subject to a rigorous censorship, and no statements of a political kind are allowed to be published that might give offence to government, or that would be likely to call the attention of the reader to the defects in the organisation of the state This sufficiently accounts for the absence of such discussions in German works, and their anti-critical character But this certainly is no reason why the writers of other nations not laid under any restraints, should adopt such emasculated works as models for their treatises

Indeed it would seem to be considered by some writers that every thing in statistics may be estimated in figures, and exhibited in tabular statements! But the truth is, that but a few of the more prominent facts, in regard to the situation of any great country can be so exhibited A grand object in every good statistical work should be, not merely to state what is, but *why it is,* to trace and exhibit causes as well as effects, to show how advantageous results may be best brought about, and how those of an opposite character may be best avoided

It may be [illegible] ld encroach on the province of [illegible] economist But, in our estimation, a certain admixture of politics and political economy is indispensable to statistics Without such admixture most statistical works are little better than worthless if they are to be excluded, a good almanac may be taken as the model of a good statistical work

Arthur Young, in his *Travels in France*, Townsend, in his *Travels in Spain* and Volney, in his *Syria and Egypt*, indulge largely in discussions that depend more or less on politics and political economy But, nevertheless no one can doubt that the books in question belong to the class of travels, of which, indeed, they are among the very best specimens And why should it be otherwise with statistical works? If their writers know what they are about, they will use political science not to supersede but to illustrate, explain, and give utility to their statistical details

A really good statistical work can only be compiled by a writer who to great talent and good sense adds the most extensive information, and hence the extreme rarity of such works, but when properly executed they are alike instructive and interesting *Est enim cognitio reipublica et privato homini et publico utilissima et maxime necessaria,* [illegible] *nitionem reipublicæ* [illegible] *esse quam studiosus colamus et prosequamur, non est, quod jure negare vel adeo dubitare possimus* (Mone, *Hist Statisticæ*, p 4)

The reader will find in Mr [illegible] *stics of the British Empire*, and Mr [illegible] *of the Nation*, a full account of all [illegible] upon the moral and social condition of the people of this country

* The word "Statistics" was first introduced by Professor Achenwall [illegible], and [illegible] exhaustive description of any state or states, their political and social organisation, their progress in civilisation and their economical resources at any given time, calculated to furnish materials for an estimate of their power and character But the word was long tabooed by the learned as of doubtful purity even so late as the beginning of this century, [illegible] to his Geography, apologises for [illegible]

STA'TUARY (From statue) The art of carving or [illegible]

STATUE (Lat statua, *I set up*) In sculpture a representation in [illegible] marble or bronze, or in [illegible] of a man or other animal There are various species of statues —1 Those smaller than nature 2 Those of the same size as nature 3 Those larger than nature 4 Those that are three or more times larger than nature, and are called *colossal* The first were by the ancients confined to men and gods generally The second were confined to the representation of men celebrated for their learning and talents, who had rendered service to the state, and were executed at the public expense The third were confined to kings, emperors, and when more than twice the size of nature, to heroes The fourth species were confined to statues of the gods, or of kings and emperors represented under the form of gods *Equestrian statues* are those in which the figure is seated on a horse *See* SCULPTURE

STA'TUS QUO In Politics, a treaty between two or more belligerents, which leaves each party in possession of the same territories, fortresses, &c as it occupied before hostilities broke out, is said to leave them "in statu quo ante bellum," in the same state as before the war

STATUTE (Lat statuo, *I establish*) An act of parliament made by the king by and with the advice of the lords and commons But some ancient statutes are in the form of charters or [illegible] in the crown, and in which the consent of the lords and commons is not expressed 1 As to the time from which statutes run, if no time was expressed for the operation of a statute to commence it was of force anciently from the first day of the session and consequently had a retrospective operation By 33 G 3 c 13 it now has force from the day on which [illegible] statutes are divided into public and private [illegible] which rests rather on conventional usage and difference in the formalities of passing them, than on any principle, and public acts themselves may be either local or general There may be a private clause in a general act Statutes are also said to be *declaratory* of the law as it stood at their passing, *remedial*, to correct defects in the common law subdivided into *enlarging* and *restraining*, and *penal*, imposing prohibitions and penalties But these again, are rather distinctions of an arbitrary character than of any legal effect although some legal maxims have been founded on them, e g that penal statutes or clauses in statutes, are to be construed strictly remedial statutes liberally &c A few other rules laid down by learned authorities in the construction of statutes are, — that they are to be construed out of the words themselves according to the true intent of the makers, that when the words of a statute are doubtful general usage may be called in to explain them, that the purview of the whole act is to be considered and not particular words or clauses only, that doubtful words are to be construed with reference to the object of the act, that the *preamble*, or recital at the commencement is to be considered as it generally indicates the evil which it was meant to remedy, and consequently affords an insight into the meaning of the framers, that repeal of former statutes by implication shall not be favoured, &c Statutes are numbered according to rather an inconvenient arrangement the entire acts of one session are considered as forming two collections or volumes, one of public and one of private acts, each act forming a distinct chapter," and subdivided into sections

STAUROLITE (Gr σταυρος, *a cross*, and λιθος *a stone*) The mineral called *cross stone*, *harmotome* and *Andreasbergolite* It is a silicate of baryta and alumina, with traces of lime and potash and forms small quadrangular prisms crossing each other the most characteristic [illegible] Andreasberg, in the Hartz

STAUROTIDE (Gr σταυρος, *a cross* and ειδος, *form*) A name given by H [illegible] to the prismatic garnet, [illegible] and six-sided prisms, sometimes crossing each other at right angles It is a silicate of alumina and lime, with the oxides of iron and manganese It occurs in primary rocks and is distinguished from garnet by its form and difficult fusibility

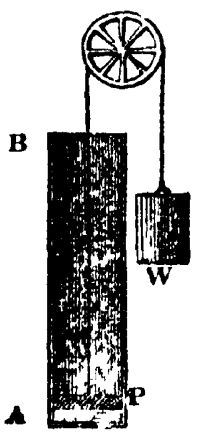
STAY A strong rope from the mast head, leading forward to support it from falling aft It takes the name of the mast, as the fore stay, main-topmast stay, &c *To stay*, means to tack To be *in stays*, is to be in the act of tacking To *miss stays*, signifies to fail in at- [illegible]

[illegible] The elastic fluid into which water is converted [illegible] of heat

All [illegible] exposed to a sufficiently high temperature, are converted into vapour The mechanical [illegible] gases in general [illegible] to be considered, in the case of steam, is the elastic pressure When a vapour or gas is contained in a close vessel, the inner surface of the vessel will [illegible] rising from the *elasticity* of the fluid [illegible] by the mutual repulsion of the particles, which gives them a tendency to fly asunder, and causes the mass of the fluid to exert a force tending to burst any vessel within which it is confined This pressure is uniformly diffused over every part of the surface of the vessel in which such a fluid is contained it is to this quality that all the mechanical power of steam is due

To render the chief properties of steam intelligible, it will only be necessary to explain the phenomena which attend the conversion of water into vapour by the continued application of heat, under the various circumstances of external pressure which present themselves in the processes of nature and art

Let A B be a tube or cylinder, the magnitude of whose base is a square inch, and let a piston P move steam-tight in it, let it be imagined that under this piston, in the bottom of the cylinder, there is an inch depth of water, which will therefore be in quantity a cubic inch, let the piston be counterbalanced by a weight W acting over a pulley which shall be sufficient to counterpoise the weight of the piston and its [illegible] to the weight W [illegible] from time to time [illegible] led to any required [illegible] circumstances here supposed, the piston being in contact with the water, and all air being excluded from beneath it, it will be pressed down by the weight of the atmosphere, which we shall assume to be 14¾ lbs Let it be also supposed that a thermometer is placed in the water under the piston, and that the tube A B is transparent so that the indications of the thermometer may be observed The temperature of the water under the piston being reduced to that of melting ice, which is 32° of the common thermometer, let the flame of a lamp be applied under the tube, and let the time of [illegible] be noted If the thermometer be now observed it will be seen slowly and gradually to indicate an increasing temperature of the water, the piston maintaining its position in contact with the water unchanged [illegible] temperature will continue until the thermometer stands at the temperature of 212 Let the time be then noted It will be found that after that epoch the water will cease to increase in temperature notwithstanding the continued application of the lamp the thermometer not rising above 212 But another effect will begin to be [illegible] ted, the piston P will be observed gradually to rise, leaving a space apparently vacant between it and the water The depth of the water will, however be at the same time gradually diminished, and the diminution of its depth will be found to bear constantly the same proportion to the ascent of the piston This proportion will, under the circumstances here supposed, be that of 1700 to 1 If the application of the lamp be continued, and the tube have sufficient length the water will, after the lapse of a certain time altogether disappear from the bottom of the tube, and when that occurs the piston will have risen to the height of 1700 inches, being 1700 times the original depth of the water




The tube will now, to all appearance be empty, but if the apparatus were weighed, it would be found to have the same weight as at the commencement of the experiment The water, therefore, must still be contained in the tube, though it has assumed an invisible form To demonstrate its presence, let the lamp be removed, immediately the piston will begin to descend, and the inner surface of the tube will be covered with a dew, which speedily increasing, will fall to the bottom in drops of water The piston meanwhile will continue to move downwards, sweeping before it the water from the sides of the tube, and at length will recover its first position, having under [illegible] inch of water

In the above [illegible] the piston is produced by the elastic force of the steam, into which the water was gradually converted by the lamp The space between the piston and the water during its ascent, though apparently empty, was filled with steam, which like air and most other gases, is a colourless and invisible fluid The proportion of the elevation of the piston to the diminution of depth of the water being 1700 to 1, proves that the water in passing into steam increases its volume in that proportion When the water [illegible] the height of the piston from the [illegible] 1700 inches, and as the tube under the piston was then filled with the steam into which the water had been converted, it is apparent that the cubic inch of water, in this case, was converted into 1700 inches of steam

The pressure of the atmosphere above the piston was, in this case overcome by the elastic force of the steam, and the piston, [illegible] that pressure upon it, was raised to a height of 1700 inches In the evaporation, therefore,

of this cubic inch of water, a mechanical force has been evolved equivalent to 14¾ lbs raised to the height of 1700 inches.

From the moment at which the water began to be converted into steam the thermometer having thus attained 212°, ceased to rise Nevertheless the application of the lamp was continued, and therefore the same quantity of heat per minute was still supplied to the water Since the water did not increase in temperature, it may be asked what became of this continued supply of heat received from the lamp? It may be said that it was imparted to the steam into which the water was converted, but if the thermometer were raised out of the water, and held in the steam between the water and the piston, it would still indicate the same temperature of 212° We thus arrive at the fact that notwithstanding a large supply of heat imparted to water during its evaporation, that heat is sensible neither in the water itself nor in the vapour into which the water is converted

The quantity of heat which is thus absorbed in converting water into steam is easily determined, the interval of time being noted which elapsed between the first application of the lamp and the moment at which the thermometer ceased to rise Let us suppose that interval to be an hour, the interval being also noted between the moment the thermometer ceases to rise and the process of evaporation begins, and the moment at which the last particle of water disappears from the bottom of the tube and the evaporation is completed, it will be found that this interval is 5½ hours, and in general, whatever may be the length of time necessary to raise the temperature of the water from 32° to 212°, 5½ times that interval will be necessary for the same source of heat to evaporate the same quantity of water It follows therefore, that *to evaporate water under a pressure of 14¾ pounds per square inch requires 5½ times as much heat as is necessary and sufficient to raise the same water from* [illegible] 2°

Since the difference between 212° and 32° is 180°, and since 5½ times 180° is 990° it follows that to convert the water into steam after it has attained the temperature of 212°, as much heat must be supplied to it as would be sufficient, if it were not evaporated, to raise it 990° higher The heat thus absorbed in evaporation, and not sensible to the thermometer, is said to be latent in the steam, and the phenomena which have been just described form the foundation of the whole theory of *latent heat* That this [illegible] actually contained in the steam [illegible] thermometer admits of easy demonstration, by showing that it may be reproduced by converting the steam into water If a cubic inch of water, in the form of steam at the temperature of 212°, be introduced into the same vessel with 5½ cubic inches of water at the temperature of 32°, the steam will be immediately converted into water, the temperature of the 5½ inches of ice-cold water will be raised to 212°, and there will be found in the vessel 6½ cubic inches of water at 212° Thus, while the steam, in reassuming the liquid form, has lost none of its temperature, it has nevertheless given up as much heat as has raised 5½ cubic inches of water from 32° to 212° It is therefore demonstrated that this quantity of heat was actually in the steam, and that it was its presence there in the latent state by some agency not yet explained, that conferred upon the water in the vaporous form the property of elasticity

We have here supposed that the pressure under which the water in the tube was evaporated was the mean pressure of the atmosphere, or 14¾ lbs per square inch Let us now suppose that the piston resting on the water is loaded with a force of 14¾ lbs besides the pressure of the atmosphere, which may be done by taking 14¾ lbs from the [illegible] If the same process be followed as before, it will now be found that the thermometer will not cease to rise when it has attained 212°, nor will the piston then begin to ascend The thermometer will, on the other hand, continue to rise until it has attained 250° It will then, as in the former case, cease to rise, the piston will ascend, and the water will begin to be converted into steam, the proportion, however, between the ascent of the piston and the diminished depth of the water, or, in other words, between the volume of steam produced and the volume of water producing it, instead of being 1700 to 1, will now be about 900 to 1, being little more than half the former proportion The force against which the elasticity of the steam, in the present case, acts, is 29½ lbs, and this force is raised about 900 inches by the evaporation of a cubic inch of water In the former case a force of 14¾ lbs being half the present force, was raised to 1700 inches by the evaporation of the same quantity of water, so that in each case the mechanical effect produced is very nearly the same

If the pressure under which the evaporation is carried on were further varied, it would be found that with every increase of pressure the temperature at which the evaporation [illegible] steam produced by a cubic inch of water would be less [illegible] increase of pressure under which the evaporation is made, and that the diminution of volume would be nearly, but not in quite so great a proportion, as the increase of pressure In like manner, if the pressure be diminished the volume of steam produced by a cubic inch of water will be augmented in nearly, but not quite so [illegible] of pressure. [illegible] the mechanical effect evolved by the evaporation of a given volume of water under different pressures is very nearly the same, greater pressures, however, having a slight advantage over lesser ones

It has been seen that 14¾ lbs are raised to a height of 1700 inches by the evaporation of a cubic inch of water under the pressure of 14¾ lbs per square inch. Now, 1700 inches are nearly equal to 142 feet and 14¾ lbs. raised 142 feet is equivalent to [illegible] raised one foot, which is equal to very nearly 2100 lbs raised one foot To use round numbers, it may then be stated, that by the evaporation of a cubic inch of water a mechanical force is produced equivalent to a ton weight raised a foot high, and that this force is very nearly the same whatever be the temperature or pressure under which the evaporation takes place

From what has been above explained, it is apparent that the quantity of sensible heat in steam is augmented with every increase of pressure under which the evaporation is carried on, but if the interval of time be observed which elapses between the first application of the lamp to the ice-cold water in the experiment above described, and the moment at which the last particle of water disappears by evaporation from the bottom of the tube it will be found that this interval is nearly the same, whatever be the temperature or pressure under which the evaporation takes place It follows that the actual quantity of heat necessary to convert ice-cold water into steam is nearly the same, whatever be the pressure of the steam, but as the temperature of steam increases and diminishes as the pressure is increased or diminished, it follows that this given quantity of heat is differently distributed between sensible and latent heat in steam of different pressures As the pressure is increased the sensible heat is augmented and the latent heat undergoes a corresponding diminution, and *vice versâ* The sum of the sensible and latent heats is, in fact a constant [illegible] nearly so, the one being always increased at the [illegible] the other It has been shown that in converting water at 32° of temperature, and under a pressure of 14¾ lbs per square inch, into steam, it was necessary first to give it 180° additional sensible heat, and afterwards 990° of latent heat the total heat imparted to it being 1170° The actual temperature to which water would be raised by the heat necessary to evaporate it, if its evaporation could be prevented by confining it in a close vessel, will be found by adding 32° to 1170° It may, therefore, be stated that the heat necessary for the evaporation of ice cold water is as much as would raise it to the temperature of 1202°, if its evaporation were prevented If the temperature of red hot iron be, as is supposed, about 1200°, and if all bodies become incandescent at the same temperature, it follows that to evaporate water it is necessary to impart to it as much heat as would be sufficient to render it red hot if its evaporation were prevented As the mechanical effect evolved by water evaporated is at all pressures [illegible] same, and as the quantity of heat necessary [illegible] evaporation is also nearly the same, it follows that the same quantity of fuel employed in the evaporation of water is productive of very nearly the same mechanical effect, whatever be the pressure of the steam

Since water, in passing into steam, suffers a great enlargement of volume, steam, on the other hand, in being converted into water undergoes a corresponding diminution of volume It has been seen that a cubic inch of water, [illegible] ills into 1700 cu [illegible] that if a close [illegible] cubic inches of such steam, be exposed [illegible] to take from the steam all its latent heat, the steam will be reconverted into water, will shrink into its original dimensions, and will leave the remainder of the vessel a vacuum This property of steam has supplied the means, in practical mechanics, of obtaining that amount of mechanical power which the properties of the atmosphere confer upon a vacuum If by any means whatever the space in a cylinder under the piston be rendered a vacuum, the atmospheric pressure will take effect above the piston, and will urge the piston downwards with a force amounting to about 15 lbs on each square inch on the surface of the piston To render steam available for this purpose, it is only necessary to inject it into the cylinder until it expels from the cylinder all the atmospheric air or other uncondensable gases which the cylinder [illegible] when that is effected, the pure steam [illegible] the cylinder being suddenly condensed by the application of cold, leaves the cylinder a vacuum, and gives effect to the atmospheric

pressure above the piston, as before explained This is, in fact, the principle of the atmospheric engine, which is the species of engine which remained in use up to the time of Watt

In the mechanical operation of steam, which has been already explained, the pressure, density, and temperature of the steam are supposed to remain the same during its action, and the mechanical effect is produced by the continual increase of volume produced by evaporation represented in the figure is moved upwards, not by any change in the temperature, density, or pressure, but by the increased volume acquired by the continual production of steam It has been proved that by this process alone the evaporation of a cubic inch of water, whatever be the pressure under which it takes place, evolves a mechanical force equivalent to a ton weight raised a foot high But if, after this evaporation has been completed, the steam be separated from the water which produced it, and the load on the piston be gradually diminished, the steam will expand by moving the piston upwards in virtue of its excess of pressure, and this expansion will continue until the pressure of the steam shall be reduced to equality with the load on the piston All mechanical effect developed in this process is due to the steam itself, independently of any further evaporation

To make this important quality of the expansive action of steam understood, let us suppose the piston loaded with a pressure equal to four times that of the atmosphere, the density of the atmosphere itself If the water under the piston be evaporated under this pressure, it will have a temperature of about 292°, and by its evaporation the piston will be raised 40 feet This will, therefore, be the whole mechanical effect arising from the immediate evaporation of the water But when the evaporation has been completed, and the piston, with its load of four atmospheres, stands suspended at 40 feet above the bottom of the tube let a pressure equal to that of one atmosphere be removed from the piston The remaining pressure of three atmospheres being less than that of the steam below the piston, the piston will be raised, and will continue to rise until it has attained a height of about 50 feet, and the temperature of the steam thus expanded will fall to about 275°, and its pressure being reduced to that of three atmospheres it will cease to rise By this process therefore a mechanical force has been obtained from the steam equal to the weight of three atmospheres raised 10 feet in addition to the effect obtained by immediate evaporation, but the expansive action does not stop here Let it be supposed that the piston is again relieved from the pressure of another atmosphere, the superior pressure of three atmospheres below will cause it to rise, and it will ascend to the height of about 75 feet, the temperature of the steam falling to about 250°, and its pressure being reduced to two atmospheres A further mechanical effect equivalent to the weight of two atmospheres raised to about 25 feet has thus been obtained, and it is evident that by constantly the piston, and adding from a given amount of evaporation, to an extent which is only limited by practical circumstances which restrain the application of this expansive principle Since the cost of producing steam as a mechanical agent depends chiefly on the quantity of fuel necessary to effect the evaporation of a given volume of water, it follows that all the mechanical effect obtained by this principle of expansion is so much power added to the steam without further expense Its importance, therefore, will be obvious in the economy of steam power For the manner of rendering it available in steam machinery, see STEAM ENGINE

The temperature and pressure of steam produced by immediate evaporation when it has received no heat save that which it takes from the water, have a fixed relation one to the other If this relation were known and expressed by a mathematical formula the temperature might always be inferred from the pressure, or *vice versâ* But physical science has not yet supplied any principles by which such a formula can be deduced from any known properties of liquids In the absence therefore of any general relation established by direct reasoning empirical formulæ have been proposed which express with more or less precision this relation in different parts of the thermometric scale These formulæ have been constructed so as to give results which nearly agree with the results obtained by experiment One set of experiments to ascertain the relative bulks of steam and water was made by Watt at an early period of his career, and these experiments were subsequently repeated by his assistant Southern, with great care and skill Southern's formula for determining the pressure of steam of any given temperature is probably more widely identified than any other with engineering calculations, as it is sufficiently accurate for practical purposes His formula is as follows, — If F represent the elastic force of the steam in inches of mercury, and $t$ its corresponding temperature in degrees of Fahrenheit's thermometer,

Then $$F = \left\{\frac{t + 51\,3}{135\,767}\right\}^{5\,13} + 0\,1$$

The numerical process indicated by this formula being somewhat complicated, may for greater convenience be performed by logarithms, as follows —

*To find the elastic force of steam in inches of mercury by Southern's formula*

RULE — *To the given temperature in degrees of Fahrenheit's thermometer add 51 3, then from the logarithm of the sum subtract the logarithm of 135 767, multiply by the index 5 13, and to the natural number answering to the sum add the constant fraction 1 10th The result will be the elastic force of the steam in inches of mercury*

One of the most important courses of experiment which have been made upon this subject is that undertaken by a committee of the French Institute, consisting of MM Prony Arago Dulong in consequence of an application from government to the academy to point out the best means of preventing accidents from the bursting of the boilers of steam engines The experiments were conducted chiefly by Arago and Dulong, and were certainly not only extremely delicate as to their management but the most hazardous which science and art owe to the courage and zeal of philosophers Steam was produced of a sufficient pressure to force a column of mercury up a glass tube to the height of nearly 43 feet, an atmosphere being measured by a column of mercury measuring 29 922 inches This exhibits the temperatures and steam, as determined by these experiments, up to fifty atmospheres

| Pressure in Atmospheres | Temperature | Pressure in Atmospheres | Temperature |
|---|---|---|---|
| 1 | 212° | 13 | 380 66° |
| 1½ | 2[illegible]1 | 14 | 386 94 |
| 2 | 2[illegible] | 15 | 392 86 |
| 2½ | 263 8 | 16 | 398 48 |
| 3 | 27[illegible]2 | 17 | 403 83 |
| 3½ | 28[illegible] | 18 | 408 92 |
| 4 | 293 7 | 19 | 413 78 |
| 4½ | 300 3 | 20 | 418 46 |
| 5 | 306 5 | 21 | 422 96 |
| 5½ | 311 24 | 22 | 42[illegible] 28 |
| 6 | 320 36 | 23 | 431 42 |
| 6½ | 326 26 | 24 | 435 56 |
| 7 | 331 7 | 25 | 439 34 |
| 7½ | 3[illegible] 86 | 30 | 457 16 |
| 8 | 341 78 | 35 | 472 73 |
| 9 | 350 78 | 40 | 486 59 |
| 10 | 358 88 | 45 | 499 14 |
| 11 | 366 85 | 50 | 510 6 |
| 12 | 374 | | |

The last six temperatures in the above table are deduced by calculation from the formula $e = (1 + 0\,7153t)^5$, in which $e$ expresses the elasticity in atmospheres, and $t$ the temperatures in centigrade degrees, beginning from 100°, and proceeding upwards The methods employed in this magnificent course of experiments will be found detailed in the *Annales de Chimie et de Physique*, tome xlii p 71

A very valuable series of experiments upon this subject was also undertaken by a committee of the Franklin Institute in America The more material results of these experiments are exhibited in the following table —

| Pressure in Inches of Mercury | Temperature in Degrees of Fahr | Pressure in Inches of Mercury | Temperature in Degrees of Fahr |
|---|---|---|---|
| 30 | 2[illegible]5 | 180 | 315 50° |
| 4[illegible] | 2[illegible]5 | 195 | 321 |
| 60 | 2[illegible]0 | 210 | 326 |
| 7[illegible] | 2[illegible]4 | 22[illegible] | 331 |
| 90 | 2[illegible] | 240 | 336 |
| 105 | 28[illegible] | 255 | 340 5 |
| 120 | 2[illegible]5 | 270 | 345 |
| 135 | 2[illegible]5 | 285 | 349 |
| 150 | 30[illegible] | 300 | 352 5 |
| 165 | 310 | | |

A column of mercury two inches in height will balance a pressure of 0804 lbs on the square inch

These calculations are expressed with considerable accuracy by the following formula, which gives the pressure in lbs per square inch instead of in inches of mercury — If P be the pressure in lbs per square inch and $t$ the temperature under which the steam is generated expressed in degrees of Fahrenheit, then

$$P = (0\,460467 + 0\,00521478\,t)^6$$

Formulæ for determining the pressure of steam at different temperatures have been given by Young, Tredgold, Biot, Navier, Roche, and many others, but these formulæ it is needless to recapitulate here, as they do not add to our knowledge of the subject, but tend rather to perplex it We cannot however, in this enumeration omit a notice of the experiments recently made in France by M Regnault to determine the pressure of steam at

different temperatures, those experiments being remarkable for the great accuracy with which they were performed M Regnault has shown that the total amount [illegible] weight of steam increases with [illegible] with a pressure of 14 7 lbs upon the square inch, the sensible heat of the steam is 212° the latent heat [illegible], and the sum of the latent and sensible heats 1178°, whereas, in steam of 90 lbs upon the square inch the sensible heat is 320 2°, the latent heat 891 4°, and [illegible] heats 1211 6° There [illegible] the total heat of a pound of water raised into steam of 14 7 lbs pressure and that of a pound of water raised into steam of 90 lbs pressure, so that the high steam if expanded into low will have an excess of temperature beyond that necessary for the maintenance of the vaporous form, or, in other words, will be in the state of surcharged steam Surcharged steam, or steam to which more heat is imparted than is necessary for the maintenance of the vaporous form, conforms under the same physical laws as air and other permanent gases And with all gases, when the temperature is constant, the pressure varies simply as the density, or inversely as the volume When the pressure is constant the dilatation is uniform with uniform additions of heat, and is at the rate of $\frac{1}{490}$ of the volume at 32° for every additional degree of temperature When the volume is constant the increase of pressure is $\frac{1}{490}$ of the pressure, at 32° for each additional degree of temperature In the Edinburgh New Philosophical Journal for July, 1849, a formula is given by Mr Rankine which educes results very nearly corresponding with those which M Regnault obtained by experiment, and from this formula, therefore the most material of M Regnault's results may be obtained Mr Rankine [illegible] 462 28° of [illegible] that scale, as a new *absolute zero*, and he supposes the boiling point of the water to have been adjusted under a pressure of 29 922 inches of mercury; so that 180° of Fahrenheit may be exactly equal to 100° of the centigrade thermometer. The formula is applicable for finding the elasticity of other vapours besides that of water; but three constants, $\alpha$, $\beta$, $\gamma$, have to be determined for each fluid by experiment If P be the pressure of the steam and $t$ the point of absolute zero, as explained above, then the formula for calculating the pressure from the temperature is

$$\text{Log } P = \alpha - \frac{\beta}{t} - \frac{\gamma}{t^2},$$

and the inverse formula for calculating the temperature from the pressure is

$$\frac{1}{t} = \sqrt{\frac{\alpha - \text{Log } P}{\gamma} + \frac{\beta^2}{4\gamma^2}} - \frac{\beta}{2\gamma}$$

The values of the constants have been derived from M Regnault's experiments and they are as follows —

$$\text{Log } \beta = 3\,4403816, \quad \text{Log } \gamma = 5\,5926244, \quad \frac{\beta}{2\gamma} = 0{\cdot}0035189$$

$$\frac{\beta^2}{4\gamma^2} = 0\,000012364$$

The value of $\alpha$, other things being the same, depends upon the measure of elasticity adopted If it be inches [illegible] of $\alpha$ will be 6 426121, if it be pounds [illegible] square inch, the value of $\alpha$ will be 6 117817

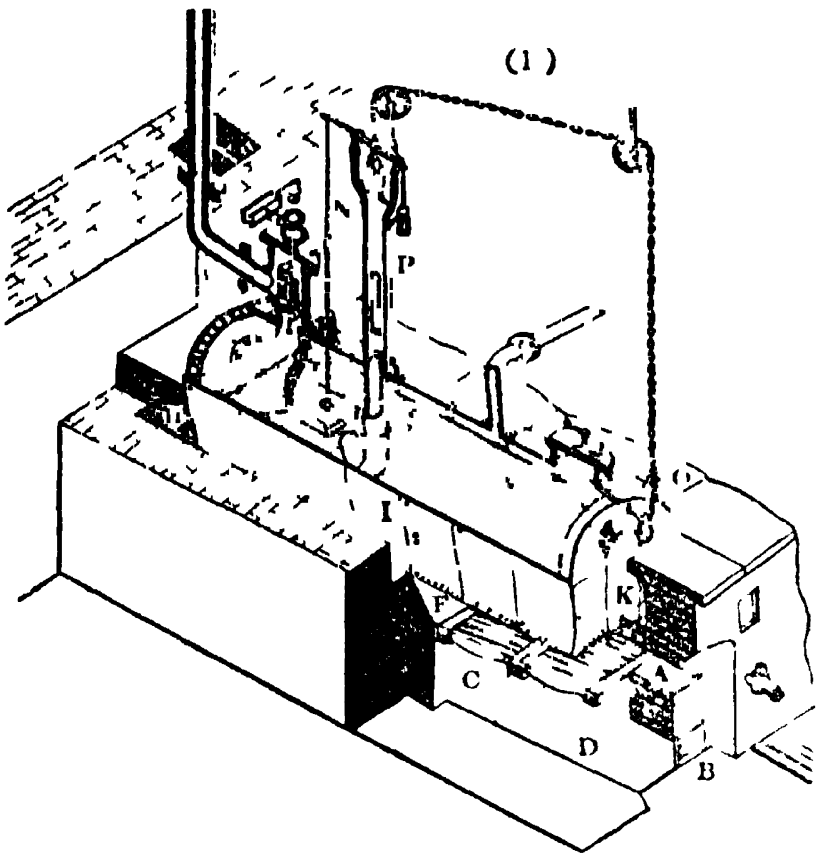
The following table is derived from M Regnault's experiments, with the addition of a column showing the volume of the steam relatively with the volume of the water from which it is generated, computed by Mr D K Clark, and given in his work on Railway Machinery In this table we have the total pressure of the steam in lbs per square inch, its relative volume as compared with that of the water from which it is produced, its tempera-

| Total Pressure per Square Inch | Relative Volume | Temperature | Total Heat | Weight of One Cubic Foot | Total Pressure per Square Inch | Relative Volume | Temperature | Total Heat | Weight of One Cubic Foot |
|---|---|---|---|---|---|---|---|---|---|
| *Lbs* | | *Fahr* | *Fahr* | *Lbs* | *Lbs* | | *Fahr* | *Fahr* | *Lbs* |
| 15 | 1669 | 213 1 | 1178 9 | 0373 | 81 | 355 | 312 8 | 1209 4 | 1756 |
| 16 | 1572 | 216 3 | 1179 9 | 0397 | 82 | 351 | 313 6 | 1209 7 | 1776 |
| 17 | 1487 | 219 5 | 1180 9 | 0419 | 83 | 348 | 314 5 | 1209·9 | 1795 |
| 18 | 1410 | 222 5 | 1181 8 | 0442 | 84 | 344 | 315 3 | 1210 1 | 1814 |
| 19 | 1342 | 225 1 | 1182 7 | 0463 | 85 | 340 | 316 1 | 1210 4 | 1833 |
| 20 | 1280 | 228 0 | 1183 5 | 0487 | 86 | 337 | 316 9 | 1210 7 | 1852 |
| 21 | 1224 | 230 6 | 1184 3 | 0510 | 87 | 333 | 317 8 | 1210 9 | 1871 |
| 22 | 1172 | 233 1 | 1185 0 | 0532 | 88 | 330 | 318 6 | 1211 1 | 1891 |
| 23 | 1125 | 235 5 | 1185 7 | 0554 | 89 | 326 | 319 4 | 1211 4 | 1910 |
| 24 | 1082 | 237 9 | 1186 5 | 0576 | 90 | 323 | 320 2 | 1211 6 | 1929 |
| 25 | 1042 | 240 2 | 1187 2 | 0598 | 91 | 320 | 321 0 | 1211 8 | 1950 |
| 26 | 1005 | 242 3 | 1187 9 | 0620 | 92 | 317 | 321 7 | 1212 0 | 1970 |
| 27 | 971 | 244 4 | 1188 5 | 0642 | 93 | 313 | 322 5 | 1212 3 | 1990 |
| 28 | 939 | 246 4 | 1189 1 | 0664 | 94 | 310 | 323 3 | 1212 5 | 2010 |
| 29 | 909 | 248 4 | 1189 7 | 0686 | 95 | 307 | 324 1 | 1212 8 | 2030 |
| 30 | 881 | 250 4 | 1190 3 | 0707 | 96 | 305 | 324 8 | 1213 0 | 2050 |
| 31 | 855 | 252 2 | 1190 8 | 0729 | 97 | 302 | 325 6 | 1213 3 | 2070 |
| 32 | 830 | 254 1 | 1191 4 | 0751 | 98 | 299 | 326 3 | 1213 5 | 2089 |
| 33 | 807 | 255 9 | 1192 0 | 0772 | 99 | 296 | 327 1 | 1213 7 | 2108 |
| 34 | 785 | 257 6 | 1192 5 | 0794 | 100 | 293 | 327 8 | 1214 9 | 2127 |
| 35 | 765 | 259 3 | 1193 0 | 0815 | 101 | 290 | 328 5 | 1214 2 | 2149 |
| 36 | 745 | 260 9 | 1193 5 | 0837 | 102 | 288 | 329 1 | 1214 4 | 2167 |
| 37 | 727 | 262 6 | 1194 0 | 0858 | 103 | 285 | 329 9 | 1214 6 | 2184 |
| 38 | 709 | 264 2 | 1194 5 | 0879 | 104 | 283 | 330 6 | 1214 8 | 2201 |
| 39 | 693 | 265 8 | 1195 0 | 0900 | 105 | 281 | 331 3 | 1215 0 | 2218 |
| 40 | 677 | 267 3 | 1195 4 | 0921 | 106 | 278 | 331 9 | 1215 2 | 2230 |
| 41 | 661 | 268 7 | 1195 9 | 0942 | 107 | 276 | 332 6 | 1215 4 | 2258 |
| 42 | 647 | 270 2 | 1196 3 | 0963 | 108 | 273 | 333 3 | 1215 6 | 2278 |
| 43 | 634 | 271 6 | 1196 8 | 0983 | 109 | 271 | 334 0 | 1215 8 | 2298 |
| 44 | 621 | 273 0 | 1197 2 | 1004 | 110 | 269 | 334 6 | 1216 0 | 2317 |
| 45 | 608 | 274 4 | 1197 6 | 1025 | 111 | 267 | 335 3 | 1216 2 | 2334 |
| 46 | 595 | 275 8 | 1198 0 | 1046 | 112 | 265 | 336 0 | 1216 4 | 2351 |
| 47 | 584 | 277 1 | 1198 4 | 1067 | 113 | 263 | 336 7 | 1216 6 | 2370 |
| 48 | 573 | 278 4 | 1198 8 | 1087 | 114 | 261 | 337 4 | 1216 8 | 2389 |
| 49 | 562 | 279 7 | 1199 2 | 1108 | 115 | 259 | 338 0 | 1217 0 | 2406 |
| 50 | 552 | 281 0 | 1199 6 | 1129 | 116 | 257 | 338 6 | 1217 2 | 2426 |
| 51 | 542 | 282 3 | 1200 0 | 1150 | 117 | 255 | 339 3 | 1217 4 | 2446 |
| 52 | 532 | 283 5 | 1200 4 | 1171 | 118 | 253 | 339 9 | 1217 6 | 2465 |
| 53 | 523 | 284 7 | 1200 8 | 1192 | 119 | 251 | 340 5 | 1217 8 | 2484 |
| 54 | 514 | 286 9 | 1201 1 | 1212 | 120 | 249 | 341 1 | 1218 0 | 2503 |
| 55 | 506 | 287 1 | 1201 5 | 1232 | 121 | 247 | 341 8 | 1218 2 | 2524 |
| 56 | 498 | 288 2 | 1201 8 | 1252 | 122 | 245 | 342 4 | 1218 4 | 2545 |
| 57 | 490 | 289 3 | 1202 2 | 1272 | 123 | 243 | 343 0 | 1218 6 | 2566 |
| 58 | 482 | 290 4 | 1202 5 | 1292 | 124 | 241 | 343 6 | 1218 7 | 2587 |
| 59 | 474 | 291 6 | 1202 9 | 1314 | 125 | 239 | 344 2 | 1218 9 | 2608 |
| 60 | 467 | 292 7 | 1203 2 | 1335 | 126 | 238 | 344 8 | 1219 1 | 2626 |
| 61 | 460 | 293 8 | 1203 6 | 1356 | 127 | 236 | 345 4 | 1219 3 | 2644 |
| 62 | 453 | 294 8 | 1203 9 | 1376 | 128 | 234 | 346 0 | 1219 4 | 2662 |
| 63 | 447 | 295 9 | 1204 2 | 1396 | 129 | 232 | 346 6 | 1219 6 | 2680 |
| 64 | 440 | 296 9 | 1204 5 | 1416 | 130 | 231 | 347 2 | 1219 8 | 2699 |
| 65 | 434 | 298·0 | 1204 8 | 1436 | 132 | 228 | 348 3 | 1220 2 | 2735 |
| 66 | 428 | 299 0 | 1205 1 | 1456 | 134 | 225 | 349 5 | 1220 6 | 2771 |
| 67 | 422 | 300 0 | 1205 4 | 1477 | 136 | 222 | 350 6 | 1220 9 | 2807 |
| 68 | 417 | 300 9 | 1205 7 | 1497 | 138 | 219 | 351 8 | 1221 2 | 2846 |
| 69 | 411 | 301 9 | 1206 0 | 1516 | 140 | 216 | 352 9 | 1221 5 | 2885 |
| 70 | 406 | 302 9 | 1206 3 | 1535 | 142 | 213 | 354 0 | 1221 9 | 2922 |
| 71 | 401 | 303 9 | 1206 6 | 1555 | 144 | 210 | 355 0 | 1222 2 | 2959 |
| 72 | 396 | 304 8 | 1206 9 | 1574 | 146 | 208 | 356 1 | 1222 5 | 2996 |
| 73 | 391 | 305 7 | 1207 2 | 1595 | 148 | 205 | 357 2 | 1222·9 | 3033 |
| 74 | 386 | 306 6 | 1207 5 | 1616 | 150 | 203 | 358 3 | 1223 2 | 3070 |
| 75 | 381 | 307 5 | 1207 8 | 1636 | 160 | 191 | 363 4 | 1224 8 | 3263 |
| 76 | 377 | 308 4 | 1208·0 | 1656 | 170 | 181 | 368 2 | 1225 1 | 3443 |
| 77 | 372 | 309 3 | 1208 3 | 1675 | 180 | 172 | 372 9 | 1227 7 | 3623 |
| 78 | 368 | 310 2 | 1208 6 | 1696 | 190 | 164 | 377 5 | 1229 1 | 3800 |
| 79 | 364 | 311 1 | 1208 9 | 1716 | 200 | 157 | 381 7 | 1230 3 | 3970 |
| 80 | 359 | 312 0 | 1209 1 | 1736 | | | | | |

ture, its total heat, or in other words the sum of its latent and sensible heats, and finally the weight of a cubic foot of the steam at the several pressures or densities enumerated The steam is supposed in every case to be saturated with water

STEAM BOILER A vessel in which water is converted into steam for the purpose of supplying steam engines, or for any other purposes for which steam is used in the arts, or in domestic economy

*Waggon Boiler* —The most common form of boiler used for land engines is that called the *waggon boiler*, an isometric view of which is given in the cut The




steam used in these boilers does not exceed the pressure of the atmosphere by more than 5 lbs per square inch, and the sides and ends, though not so favourable to strength as the cylindrical form, are sufficiently strong for this pressure In a boiler of this form the air and smoke pass through flues that are carried round the external shell, but in some waggon boilers there is a flue which passes through the centre of the boiler

The grate and a part of the flues are rendered visible in the figure, by the removal of a portion of the surrounding masonry in which the boiler is set The interior of the boiler is also shown by cutting off one half of the semi-cylindrical roof The door by which fuel is introduced upon the grate is represented at A A door is also represented at B leading to the ash-pit but in land boilers doors are not commonly applied in this situation The fire-bars at C slope downwards from the front at an angle of about 20°, giving a tendency to the fuel to move towards the back of the grate The ash pit D is constructed of such a magnitude form, and depth, as to admit a current of atmospheric air to the grate bars sufficient to sustain the combustion

The fuel, when introduced at the fire door, is laid on that part of the grate next the fire door which is called the *dead plate* There it is submitted to the process of coking, by which the gases and volatile matter are expelled from it and being carried by a current of air admitted through small apertures in the fire-door over the burning fuel in the hinder part of the grate, the gases are burnt When the fuel in the front of the grate has been thus *coked* it is pushed back, and a fresh feed is introduced upon the dead plate The coal thus pushed back soon becomes vividly ignited, and by continuing this process, the fuel spread over the grate is maintained in the most active state of combustion in the hinder part of the grate By such an arrangement the smoke produced by the combustion will be burnt before it enters the flues The flame and heated air proceeding from the fuel to the back of the furnace pass over the fire bridge [illegible] being [illegible] the flue, pass below the concave base of [illegible] Its bottom flue is very nearly equal in width to the base of the boiler, the space left near the [illegible] the flame and heated air rise to the [illegible] by the effect of their high temperature, and *lick* the bottom from the fire-bridge to the further end

The flue rises at the back of the boiler, and returns along the side from H to I, but in the larger class of waggon boilers it [illegible] the form of a square or cylindrical [illegible] the boiler before it winds round the outside. In this instance it passes in front of the boiler at K to the opposite side along which it is again carried from the front to the back of the boiler. At the back it finally turns upwards to the base of the chimney By this arrangement the flame and heated air are made to circulate round the boiler, and the length and magnitude of the flues should be such that when it arrives at the chimney its temperature shall be reduced, as nearly as is consistent with the maintenance of the draught, to the temperature of the water with which it is in contact

The proper level of the water within the boiler is maintained by means of a balanced buoy or float communicating with the rod N which is attached to a lever set on the top of the stand pipe P The top part of this pipe is widened out so as to form a small cistern into which the water for replenishing the boiler is pumped by the engine, and a valve in the bottom of the cistern, when opened by the lever [illegible] the rod N as the float subsides from [illegible] water level, admits a sufficiency of feed water to replace the water removed by evaporation When there is already a sufficiency of water in the boiler the valve in the feeding cistern remains closed, and the excess of water in such a case runs to waste through an overflow pipe provided for that purpose

In marine and locomotive boilers the use of a float for regulating the admission of the feed water is inapplicable, and there the attendant has from time to time to adjust a cock in the feed pipe, so as to admit the proper quantity of water To enable him to know at what level the water stands within the boiler a succession of cocks, [illegible] is attached to the boiler, rising one [illegible] and the highest of these cocks when [illegible] of the boiler in such a manner, that its upper extremity communicates with the steam within the boiler, and its lower extremity with the water The water consequently stands in the tube at the same level as in the boiler, and the height of the water in the boiler is thus rendered visible Cocks are provided at the top and bottom of the tube so that if the tube happens to be broken the issue of the steam or water may be prevented

The [illegible] is a valve, [illegible], which closes, to a greater or less extent, the opening of the flue, in the manner of a sluice A damper of this kind is seen at O, and it is counterpoised by a weight in the stand-pipe P, by means of a chain passing over pulleys When the pressure of the steam in the boiler rises beyond the desired point, the water is forced up by it into the pipe P to a more than usual height The weight in P being thus floated up, the damper at O preponderates, and partly closes the flue, whereby the intensity of the draught through the furnace is diminished and less steam is raised To enable the superfluous steam to escape from the boiler, which if suffered to accumulate would burst it, one or more valves opening upwards and loaded by a weight or spring to a sufficient degree to balance the pressure of the steam is applied This species of valve is called the safety-valve and a valve of this kind is seen in the figure affixed to the top of the boiler near N a pipe proceeds from the safety-valve, which conducts the waste steam into the atmosphere

The dimensions of a boiler should be determined by the demand made upon it for steam by the engine, and a large engine therefore requires a large boiler, or it may be several boilers, to supply it adequately with steam Mr Watt found by experiment that about a cubic foot of water must be evaporated from the boiler in the hour for every horse power of his engine, and he also found that it required about a square yard or nine square feet of the surface of the boiler to be exposed to the fire and flame to evaporate a cubic foot of water in the hour To evaporate this quantity of water, from 8 to 10 lbs of coals were required to be consumed, spread over about three quarters of a square foot of grate-bars The proportions assigned to waggon boilers by scientific writers have heretofore been very conflicting, but Mr Bourne has put an end to these discre[illegible] in his work on the steam engine, [illegible] settled for each size of boiler by Watt, and which have been employed by Boulton and [illegible] upwards of fifty years with remarka[illegible] These proportions are given in the following page

*Cylindrical Boilers* — The usual pressure of steam employed in waggon boilers is from 3 to 5 lbs per square inch In many engines, however, and especially in those which work expansively, it is found expedient to use steam of a [illegible] To sustain this pressure waggon boil[illegible] adapted, and hence a new class of boilers has been introduced of a cylindrical form, and which are therefore [illegible] These boilers can withstand [illegible] without danger The construction of these boilers in their subordinate features is very various The smaller

# STEAM BOILER.

## Proportions of Boulton and Watt's Waggon Boilers.

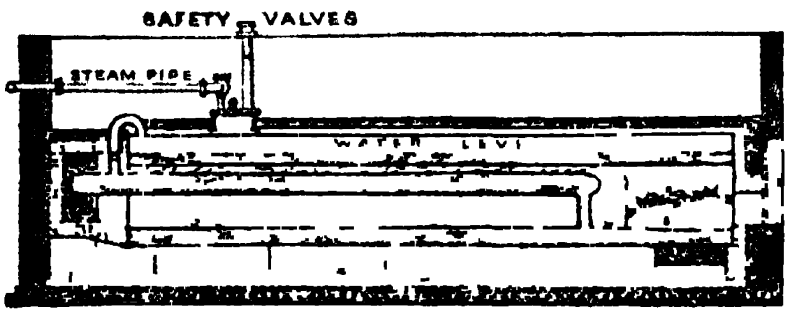
| Horse Power | Length, in Feet and Inches. | | Breadth at Water Line. | | Height. | | Height of Water | | Radius of Crown | | Heating Surface | Height of Flue round Boiler. | | Width of Flue round Boiler | | Heating Surface per Horse Power | Steam Space in Cubic Feet | Water Space in Cubic Feet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ft | in | Ft. | in | Ft. | in | Ft | in | Ft | in | Sq ft | Ft | in | Ft | in | Sq ft. | | |
| 2 | 4 | 6 | 3 | 2 | 4 | 1 | 2 | 6 | 1 | 7 | 30 | 1 | 9 | 0 | 9 | 15 | 17½ | 37 |
| 3 | 5 | 3 | 3 | 4 | 4 | 4 | 2 | 8 | 1 | 8 | 38 | 1 | 10 | 0 | 9 | 13 | 22½ | 40 |
| 4 | 6 | 0 | 3 | 6 | 4 | 7½ | 2 | 10 | 1 | 9 | 46 | 1 | 11 | 0 | 10 | 11 | 23½ | 56 |
| 6 | 7 | 0 | 3 | 9 | 5 | 1½ | 3 | 3 | 1 | 10½ | 64 | 2 | 4 | 0 | 10 | 10 7 | 34½ | 76 |
| 8 | 8 | 0 | 4 | 0 | 5 | 6 | 3 | 6 | 2 | 0 | 83 | 2 | 9 | 1 | 0 | 10 2 | 50 | 103 |
| 10 | 9 | 0 | 4 | 3 | 5 | 9½ | 3 | 8 | 2 | 1½ | 100 | 3 | 1 | 1 | 0 | 10 | 64 | 134 |
| 12 | 10 | 0 | 4 | 6 | 6 | 0 | 3 | 9 | 2 | 3 | 118 | 3 | 2 | 1 | 1 | 9 8 | 72 | 162 |
| 14 | 10 | 0 | 4 | 9 | 6 | 2½ | 3 | 10 | 2 | 4½ | 138 | 3 | 5 | 1 | 1 | 9 8 | 80 | 205 |
| 16 | 11 | 9 | 5 | 0 | 6 | 6 | 4 | 0 | 2 | 6 | 156 | 3 | 7 | 1 | 2 | 9 7 | 97 | 238 |
| 18 | 12 | 8 | 5 | 2 | 6 | 8 | 4 | 1 | 2 | 7 | 176 | 3 | 9 | 1 | 2 | 9 8 | 106 | 270 |
| 20 | 13 | 6 | 5 | 4 | 6 | 10 | 4 | 2 | 2 | 8 | 201 | 3 | 11 | 1 | 2 | 10 | 114 7 | 299 |
| 30 | 16 | 0 | 5 | 6 | - | | 4 | 9 | 2 | 9 | 297 | 4 | 0 | 1 | 4 | 9 8 | 190 | 282 |
| 45 | 19 | 0 | 6 | 0 | - | | 5 | 6 | 3 | 0 | 438 | 4 | 9 | 1 | 3 | 9 6 | 268 | 342 |

class of boilers usually consist of a cylindrical vessel with hemispherical ends set over a furnace, and the smoke is conducted along the sides of the boiler before it escapes into the chimney Sometimes the smoke is also conducted through a flue immerged in the water of the boiler, and in the larger class of boilers the furnace is very commonly situated within the boiler

Cylindrical boilers with internal furnaces are open to several objections One of these is, that it is difficult to stay the sides of the furnace and as the diameter of the boiler is necessarily considerable its strength is correspondingly impaired In order that the boiler may be worked with safety the crown of the furnace must always have a considerable depth of water upon it, and by maintaining this depth the water-level is raised so high up into the boiler-crown, and is therefore narrowed so much, that the steam in its escape is likely to carry a considerable quantity of water with it, thereby diminishing the efficiency of the engine, and occasioning a waste of fuel It appears to be very much preferable to place the furnace in a separate chest at the end of the boiler like the fire-box of a locomotive The sides of the furnace may then be efficiently stayed, and the furnace-crown may be kept as low as appears desirable without contracting the ash-pit, or the furnace itself This is the practice pursued in many of the boilers constructed in America, but the American boilers are very often dangerous from the iron being too thin of which they are composed

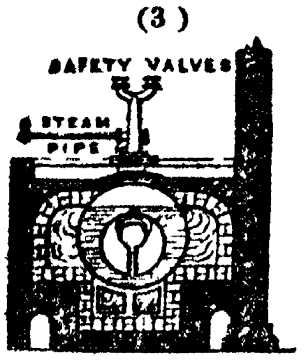
*Cornish Boilers* — The boilers used at the mines in Cornwall come properly under the denomination of cylindrical boilers But [illegible] they are reputed to effect [illegible] circumstances, have caused them to be regarded as a distinct class of boilers A very good example of a Cornish boiler is represented in figs 2 and 3, fig 2 being

(2)




a longitudinal section of a Cornish boiler, and fig 3 a transverse section The furnace is placed not beneath the boiler but within it, and the flame and hot air pass through a central flue to the end of the boiler They next pass along the boiler sides, and finally beneath the boiler bottom, before they escape to the chimney A brick wall is built at the back end of the fire bars, to form the termination of the furnace This wall is called the furnace bridge Behind the bridge a pipe containing water extends horizontally within the flue, communicating at the one end with the bottom part of the boiler, and at the other end with the top part of the boiler The hot air impinging upon this pipe causes the water within it to boil, and a constant circulation of the water is maintained within it This boiler like the waggon boiler, is set in brickwork, and it is also covered over with a brick arch, for the purpose of retaining the heat But a vacant space is left between this brick arch and the top of the boiler for the purpose of enabling the boiler to expand without disturbing the brickwork

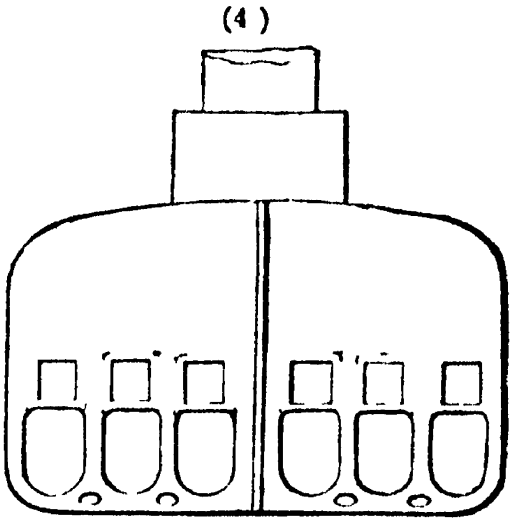
(3)




One of the most remarkable peculiarities of the Cornish boilers is the slowness of the combustion in the furnaces, and the large amount of heating surface allowed for the evaporation of the water Thus, in certain experiments upon Cornish, waggon and locomotive boilers, recorded in Mr Bourne's work upon the steam engine, it was found that the number of pounds of fuel burned upon each square foot of fire-grate in the hour was, in the Cornish boiler, 3 46 lbs , in the waggon boiler, 10 75 lbs , and in the locomotive boiler, 7 1 33 lbs The number of square feet of heating surface of the boiler employed to evaporate a cubic foot of water in the hour was, in the Cornish boiler, 69 58 square feet, in the waggon boiler, 9 96 square feet, and in the locomotive boiler, 6 06 square feet The number of cubic feet of water evaporated by 112 lbs of fuel was, in the Cornish boiler 18 87 lbs , in the waggon boiler, 13 91 lbs , and in the locomotive boiler, 11 14 lbs The modern Cornish engines perform five or six times the work that Watt's original engines performed but the Cornish boilers are not very much more efficient than Watt's original waggon boilers The reason for the superior performance of the Cornish engines must therefore be sought in the engine itself, and it is known to be mainly due to the adoption of a large amount of expansion in using the steam The Cornish engines and boilers are invariably clothed in a very efficient manner to prevent the dispersion of the heat and in all cases this practice is a beneficial one But the radiating surfaces of the Cornish engines and boilers being large relatively with the power, clothing will accomplish a greater benefit in their case than in the case of boilers with a more rapid combustion, and engines making a higher speed

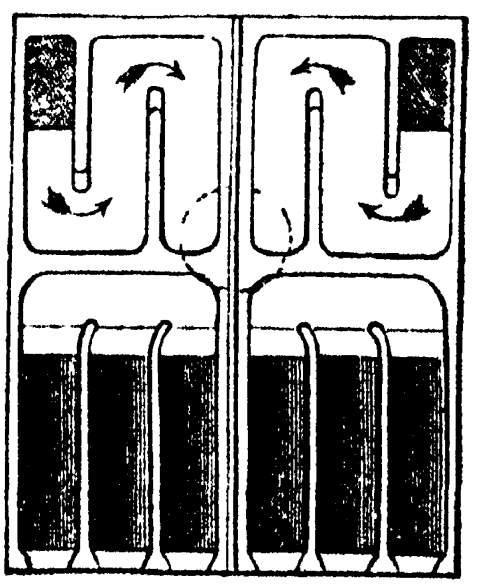
*Marine Boilers* Boilers set in brickwork being ineligible in steam vessels, a distinct class of boilers has

(4)



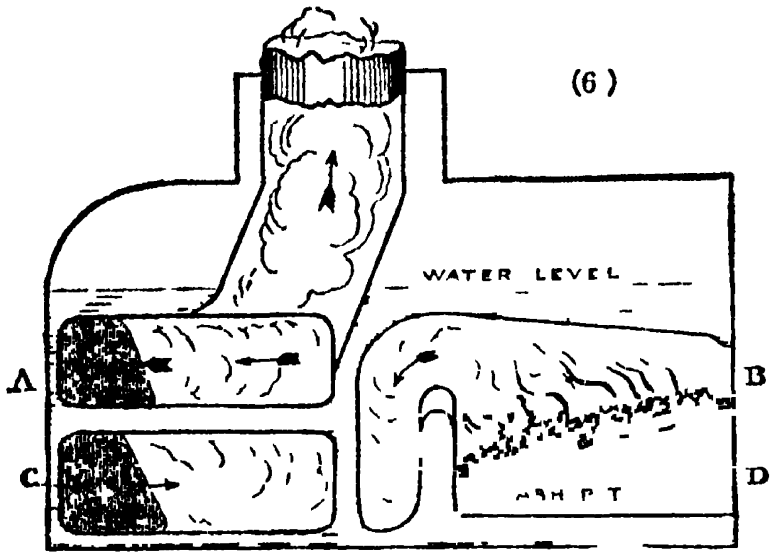
been called into existence to meet the exigencies of steam navigation In these boilers the fire and smoke come

(5)

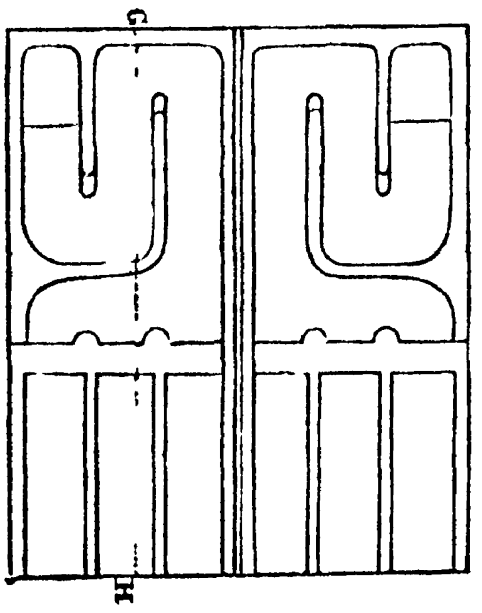


into contact only with metallic surfaces surrounded by water Marine boilers consist of a series of large iron vessels, in which are set a number of metallic furnace chambers, connected with metallic flues winding within the boiler, or with a number of short metallic tubes of small diameter which deliver into the chimney Boilers with large flues winding within them are termed *flue boilers*, and boilers in which the heat is communicated by means of a faggot of small tubular flues passing through the water are called *tubular boilers* In figs 4, 5, 6, 7, and 8, representations are given of the flue boilers of the steam ship Phœnix Fig 4 is a front elevation of these boilers, fig 5 a horizontal section through the line A B, seen in fig 6, and fig 7 a horizontal section through the line C D, seen in fig 6 Fig 6 is a perpendicular section through the line G H, seen in fig 7 It will be obvious from these figures, that the boiler

(6)



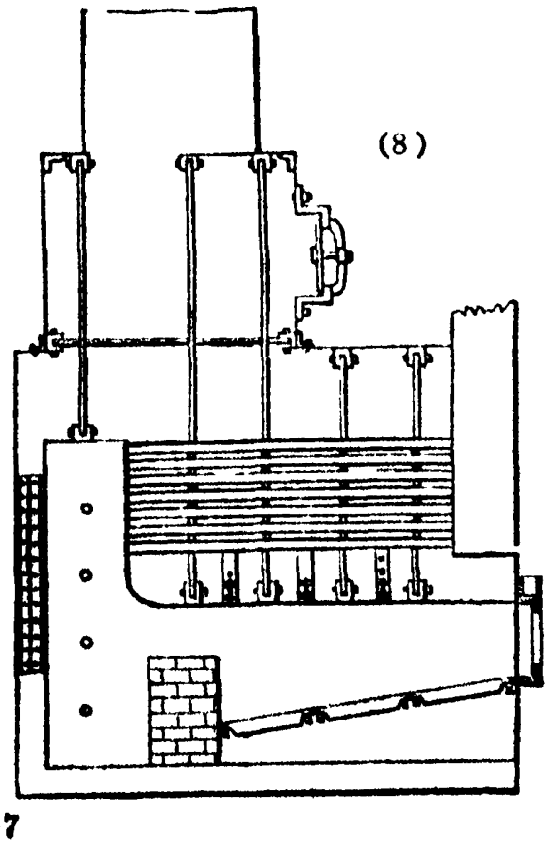

consists of two portions placed side by side, and each containing three furnaces The smoke from each group of three furnaces passes into one flue which winds until it reaches the corner of the boiler, as shown in fig 7 The




(7)

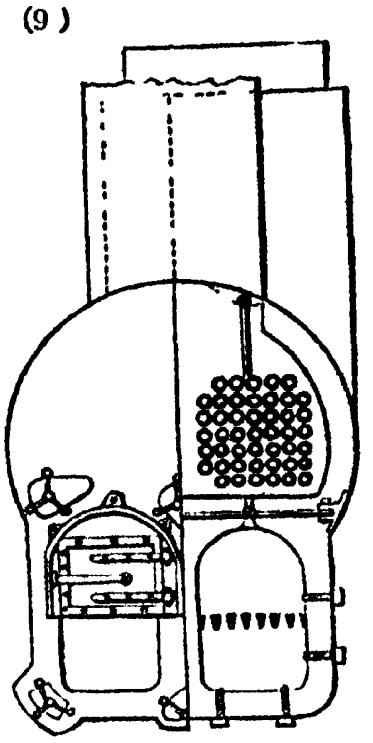
flue then ascends perpendicularly upwards, and winds in a similar manner through an upper tier of flues until it finally reaches the chimney in the centre of the boiler, represented by the dotted circle, in fig 5

(8)



Figs. 8 and 9 are representations of one of the tubular boilers of the steam vessel Tagus, fig 8 being a longitudinal section made perpendicularly through the boiler, and fig 9 an end view, with one half cut transversely through the furnace and boiler This vessel, which is of 280 horses power, has four such boilers There are two furnaces in each boiler, and the smoke and flame, after passing over the furnace bridge, ascends into a bundle of small brass tubes, and passes through them on its way to the chimney Upon the top of the boiler a chest is placed to serve as a receptacle for the steam, which there deposits any particles of water that may happen to be mixed with it Iron rods pass perpendicularly and horizontally within the boiler to strengthen it, and to enable it to withstand a considerable pressure Nearly all marine tubular boilers are formed on this general type Sometimes the boiler shell is square instead of waggon-formed, and has more furnaces set within it, but these differences are not very material Tubular boilers are now very largely employed in steam vessels They were

(9)



patented by Mr Bourne in 1838, but first came into general use about 1844 They are lighter than flue boilers, and occupy less space, and if they are properly constructed they are not difficult to keep in repair

Another variety of tubular boilers patented some years since by the Earl of Dundonald has been occasionally employed in Sweden, Russia, and America, and also in this country In these boilers the tubes are set in a vertical position in a suitable chamber, and the tubes contain the water within them, from which the steam has to be raised The smoke and hot air proceeding to the chimney impinges upon the metallic surfaces presented by this forest of vertical tubes, and steam is generated within the tubes which escapes through the water covering their upper ends into the steam space of the boiler Upon the whole, this species of boiler appears to be the one most likely to come into use for marine purposes The vertical tubes being open at both ends are easily cleared of deposit the weight of the boiler [illegible] that of the species of tubular boiler [illegible]

*Proportions of Marine Boilers* — Marine boilers are commonly proportioned according to the nominal power of the engines they are employed to drive But this is not a proper practice Their dimensions should be determined by the number of cubic feet of water they are required to evaporate in the hour, and not by the nominal power To evaporate a cubic foot of water per hour in *flue boilers* the following are the proper proportions — heating surface 8 square feet, fire grate 70 square inches, sectional area of flue 13 square inches, sectional area of chimney 6 square inches, area over furnace bridges 14 square inches, area of flue to area of fire grate as 1 to 5 4, total heating-surface in feet divided by the area of flue in feet 1 88th To evaporate a cubic foot of water per hour in *tubular boilers*, the following are the proper proportions — heating surface 9 square feet, fire grate 70 square inches, sectional area of tubes 10 square inches, sectional area of back uptake 12 square inches, sectional area of front uptake 10 square inches, sectional area of chimney 7 square inches, ratio of length of tube to diameter 1-28th to 1-30th, ratio of length of tube to area of tube 1-12th to 1-15th, cubical content of boiler, exclusive of steam chest, 6 5 cubic feet, cubical content of steam chest 1 5 cubic feet

The amount of mechanical power produced by a cubic foot of water evaporated per hour in the boiler depends very much upon the manner in which the steam is used in the engine In the original engines of Watt a cubic foot of water evaporated in the hour produced only steam sufficient for one horse power, but in modern marine engines, which work to some extent on the expansive principle, from 1½ to 1¾ horses power are produced by the evaporation of a cubic foot of water per hour — a [illegible] 55,000 lbs. [illegible] Horse Power, in the Supplement)

*Incrustation of Marine Boilers* — One of the greatest inconveniences attending the original application of the steam engine to the navigation of the ocean arose from the rapid accumulation of salt within the boiler in consequence of the necessity of feeding the boiler with salt water from the sea. In the early voyages of the

City of Edinburgh steamer between London and Leith the water in the boiler was found to have acquired nearly the same amount of concentration that exists in a salt pan, and it became necessary [illegible] placed at the bottom of the [illegible] sing, in order that it might be emptied of its contents and be refilled again with water To remedy this inconvenience Messrs Boulton and Watt, by whom the machinery of the City of Edinburgh was made, applied a pump to the boiler, which should continually draw off a portion of the over-salted water, and by adjusting the dimensions of this pump to the dimensions of the feed-pump in a certain proportion, the boiler might be worked with water in any state of concentration that might be judged most convenient It was soon found, however, that the employment of pumps for the extraction of the over-s[illegible] the boiler would itself [illegible] opened with the sea, a [illegible] communication are now very generally employed These cocks are termed blow-off cocks

Sea-water contains about $\frac{1}{33}$ of its weight of saline ingredients, and it is found that when the density of the water is increased by evaporation until it contains $\frac{4}{33}$ of its weight of saline ingredients, some of those ingredients begin to be deposited upon the flues forming upon them a stony crust which retards the transmission of the heat It is hence very important that the water in marine boilers should never contain more than $\frac{4}{33}$ of salt, and it is easy to keep the water below this point of concentration by blowing out a sufficiency of the over salted water and filling up the boiler with the fresher water of the hot well or the sea Hydrometers are now very generally provided in steam vessels to enable the engineer to determine the density of the water, and in every case it is right to practise blowing out to such an extent as will prevent the formation of saline or stony encrustations upon the flues It is better also to blow the water out from the top of the boiler than from the bottom The substance which forms a scale upon the flues exists in the first place in the state of an impalpable powder, which is ballooned up to the surface of the water by the steam If it be there collected and ejected from the boiler no scale will be formed, whereas if it descend upon the flues it is there hardened by the heat into a stony scale which it is afterwards difficult to remove

*Corrosion of Marine Boilers* — Marine boilers last for a much less time than land boilers, and the cause of their rapid decay is internal corrosion This corrosion has its seat chiefly in the interior of the steam chest and upon the inner surface of the top of the boiler, and Mr Bourne, in his work upon the steam engine, has suggested that this corrosive action is mainly imputable to the existence of surcharged steam within the boiler It appears inadvisable therefore to carry the roof of the chimney through the steam space, as is generally done in marine boilers, but it should be carried to the outside of the boiler beneath the level of the water, and be then carried up outside

*Boiler Explosions* —The explosion of a boiler generally arises from one of two causes — either from the strength of the boiler being inadequate to bear the pressure accidentally or perhaps habitually put upon it, so that it at last gives way, — or from the flues having been suffered by an improper subsidence of the water to become red hot, when they cease to be able to sustain the pressure to which they are exposed A marine boiler may also burst if the water within it be suffered to attain such a point of saturation that salt is deposited to a great thickness upon the flues, for the metal composing the flues being in such a case unable to transmit the heat to the water with sufficient rapidity, may become red hot and may thereby lose the strength necessary to withstand the pressure of the steam Nearly all explosions, however, are traceable either to an undue pressure in the boiler or to a deficiency of water Sometimes the safety-valve becomes deranged when the steam is unable to escape from the boiler The occurrence will always become discoverable by a reference to the steam gauge, — a syphon tube containing mercury affixed to the boiler, and which shows by the position of the mercury the pressure of the steam If the steam becomes dangerously high the mercury will be blown out of the steam-gauge, and all the gauge-cocks should then be opened, and the blow-through valve [illegible] to let the steam [illegible] ive become red-hot from a deficiency of water, on no account must more water be added, but the pressure of the steam must be *gradually* reduced, and the fires should be immediately raked out To reduce the pressure of the steam suddenly would cause a sudden ebullition which might carry the water over the red-hot flues, and perhaps cause the [illegible] le

*Power of various Kinds of Coal in Boilers* —In a boiler so proportioned that a pound of the best Welsh coal will evaporate 9 493 lbs. of water, a pound of anthracite will evaporate [illegible] of water, a pound of the best small Newcastle coal, [illegible] and a pound of Newcastle [illegible] one pound of Welsh and Newcastle mixed half and half [illegible], a pound of Derbyshire, 6 772 lbs and a pound of Brown coal, Northumberland, 6 lbs Cannel coal nearly equal in evaporative power A pound of wood, in its [illegible] evaporates about 4 72 lbs of water, and a pound of turf 5 45 lbs

*Proper Method of feeding Furnaces* —The coals should be broken up into small pieces and sprinkled thinly and evenly over the fire, [illegible] fire should be without any holes or uncovered places in it, as the efficacy of the fuel would be greatly diminished by the cooling effect of the cold air which would enter thereby The absolute thickness of the stratum of incandescent fuel should be regulated to a considerable extent by the quality of the draught through the furnace If the stratum of coal be thick while the draught is sluggish, the carbonic acid resulting from combustion combines with an additional atom of carbon in passing through the fire, and is converted into carbonic oxide, which carries off a portion of the fuel to waste whereas, if the stratum of coal is thin, while the draught is very rapid, an injurious refrigeration is occasioned by the large excess of air beyond that necessary for combustion, which passes through the fire For further information about steam boilers see *A Treatise on the Steam Engine, by the Artizan Club*, *A Treatise on Steam Boilers, by R Armstrong C E*, *A Catechism of the Steam Engine, by J Bourne, C E*, and *The Steam Engine Explained, by Dr Lardner*

STEAM CARRIAGE A name usually applied to locomotive engines adapted to work on common roads

The principle of the construction of these engines is, in its general conditions, similar to that of the locomotive engine used on railways (*see* LOCOMOTIVE ENGINE), but the engine adapted to common roads must be lighter than the locomotive engine, and must also have wheels with very wide tires, which will not sink deeply into the ground

Although the attempt made to adapt the steam engine as an accessory power on common roads has not hitherto been productive of any practical result of a permanent nature this has not arisen so much from the inability of steam power to accomplish the traction of carriages upon common roads as from other circumstances At the time when the construction of railways throughout the country was extensively undertaken and when the great power and economy of the locomotive engine upon them was demonstrated by the results of the traffic on the Liverpool and Manchester railway, several projects for the application of the locomotive engine on common roads were in progress and were attended with effects which presented a fair prospect of ultimate success The establishment of the great lines of railway communication throughout the kingdom however, by engrossing the traffic of all those districts in which the locomotive engine on common roads promised greatest advantage and on which if any where, it would have taken the place of horse power, discouraged speculators and most of the projects which had been in progress fell to the ground Many of these projects no doubt were very crude and imperfect, for the construction of engines adapted to the common road had not, to any considerable extent, yet fallen into the hands of efficient practical engineers But enough was accomplished to show that the steam engine may be employed advantageously in substitution of horses in drawing carriages upon common roads in all cases where there is a considerable traffic, and where a competing railway does not exist

The engine in steam carriages generally acts either directly on the wheels and causes them to revolve and thereby propels the carriage, or it acts on cranks formed on the axle of the wheels and the wheels being keyed upon the axle are compelled to revolve with it In either case, the revolution, whether of the wheels or the axle, is produced by a connecting rod jointed on the end of the piston rod, and receiving motion from the piston rod The wheels are generally driven by two pistons working in two cylinders, so that one is at its dead point when the other is in the position most favourable for its action The arrangement of this part of the machinery being similar to that of the railway locomotive, need not be here more fully described

The steam carriages of different projectors differ one from another, chiefly in the boilers, and in the apparatus for generating the steam and admitting it to the cylinder Mr Gurney's boiler consisted of a series of strong iron tubes placed side by side, so as to form the bars of the grate of the furnace These were connected with another system nearly at right angles to them, forming the back of the furnace, and these again with a third system, forming the roof of the furnace The tubes forming the grate bars had their ends inserted in a strong iron cylinder, [illegible] extended across [illegible] the furnace under the fire-door, and the tubes

forming the roof of the furnace were inserted in a similar cylindrical vessel extending in like manner across the front of the furnace *above* the fire door These two cylinders were likewise connected by upright cylinders of less diameter placed at each side of the fire-door This system of tubes and cylinders being filled with water the heat of the furnace acting on the tubes surrounding the fireplace, and the heated air and flame being afterwards conducted above the tubes forming the roof of the fireplace before it escaped into the chimney, steam was produced in the tubes, which by its lightness passed from them to the cylindrical vessel extending over the fire-door From that vessel the steam passed into a larger cylindrical vessel above it, called a *separator*, its purpose being to disengage the pure steam from the spray of water with which it is generally mixed when it first escapes from the boiling water in a state of violent agitation

In these engines the draught of the furnace was produced by projecting the waste steam into the chimney, but instead of dismissing it directly from the eduction pipe of the cylinder to the chimney, it was conducted to a receptacle called a *blowing box* This box served the same purpose as the [illegible] It received the steam from the cylinder [illegible] but it let it escape into the chimney in a continued stream by a number of small jets A regular draught was by this means produced, and no noise was perceived, which, if it had existed to any serious extent, would have frightened the horses on the road

A steam carriage constructed by Mr Gurney, weighing 35 cwt , working for eight hours was found according to Mr Gurney's statement, to do the work of about thirty horses The engine was placed on a carriage separate from that which bore the passengers and the one drew the other after it in the same manner as the railway engine draws its train Mr Gurney stated that the weight of an engine sufficient to draw after it a carriage containing eighteen passengers would be about a ton, so that the gross weight of the whole the engine and carriage for passengers taken together would not exceed that of a common stage coach and four horses But there is every reason to believe that this estimate is below what could be realised permanently in practice

In the steam carriage proposed by Mr Hancock and which was worked for some time on the New Road and other roads about London, the engine and passengers were placed in the same carriage In the boiler the subdivision of the water, so as to expose a sufficient surface to the action of the fire was accomplished by dividing a case or box by a number of thin plates of metal like a galvanic battery, the water being allowed to flow between every alternate pair of plates, the intermediate spaces forming the flue through which the flame and hot air pass In fact a number of thin plates of water are exposed on both sides to the most intense action of flame and heated air, so that steam of a high pressure is produced in great abundance, and with considerable rapidity The plates forming the boiler were bolted together by strong iron ties, extending across the boiler at right angles to the plates The distance between plate and plate was two inches, and each chamber formed, in point of fact, a separate boiler

There were ten flat chambers of this kind for water and intermediately between them ten flues Under these flues was the fire grate, six square feet in magnitude The water spaces were filled to about two thirds of their depth with water, and the other third was left for steam The water chambers throughout the whole series communicated with each other at top and bottom and were held together by two large bolts By releasing these bolts at any time, the chambers fell asunder, and by screwing them up, they might be all made tight again

These boilers were constructed to bear a pressure of 400 or 500 lbs per square inch, but the safety valve was screwed up to a pressure not exceeding 100 lbs per inch There were 100 square feet of surface exposed to the fire The stages which the engine performed were eight miles, after which a fresh supply of water and fuel was taken in

One of the most judiciously constructed steam carriages intended to be used upon the common road was the production of Mr Summers, of Southampton The boiler of this carriage was composed of vertical tubes, within which the water circulated and the heating surface when thus arranged, was found to be exceedingly efficient The weight of this carriage was about 3 tons, the surface of the boiler exposed to the action of the fire and flame was 245 square feet, and the usual working pressure of the steam was about 250 lbs on the square inch, but the boiler was made capable of [illegible] pressure of 740 lbs on the square inch [illegible] two driving cylinders, each 7½ inches in diameter and 18 inches stroke Mr Summers, in his evidence given before the House of Commons in 1831, states that his carriage has ascended hills rising one foot in six, and has run upon level roads at a speed of thirty miles an hour. Mr. Summers also states that he considers merchandise may be transported more cheaply by steam carriages than by horse carriages or waggons, even at the lowest rates of speed, and also more cheaply than by railway, if regard be had to the original expenditure This, however, is manifestly a question of the amount of traffic If there be much traffic, a railway will be able to carry [illegible] coach on the common road [illegible] steam coach may be profitable when a railway is unable to realise a remunerative return Both expedients may be made perfectly efficient, and the amount of traffic must determine which expedient of transport is to be preferred

In the early career of steam locomotion upon roads and railways much [illegible] from fractures in the [illegible] the boiler, and the shaking [illegible] bolt keys and other similar instruments of adjustment The progressive improvements introduced into the locomotive engines upon railways have reduced these evils to a small amount, and these improvements may now be applied to steam carriages intended to maintain communication upon the common road, whereby those carriages will be placed in a better position than they originally occupied They must be made stronger than heretofore, they must possess a powerful [illegible] and be supported by wide wheels, they should also possess a [illegible] gear for overcoming heavy acclivities and [illegible] they should be supported upon [illegible] For further details about steam carriages, see the *Report from the Select Committee of the House of Commons upon Steam* [illegible] a *Treatise on Elemental Locomotion*, [illegible] C E , *The Mechanics' Magazine*, and the *Foreign Quarterly Review*

STEAM ENGINE A machine in which the mechanical power developed in the evaporation of water is rendered available as a moving power Steam engines vary much in magnitude, form, and proportions, as well as in the details of the machinery by which the power of the steam is adapted as a prime mover The forms of steam engine, and the mode of its application to transport by [illegible] articles [illegible] see STEAM NAVIGATION

*History of the Steam Engine* — Various attempts at the mechanical application of steam on a small scale were made at very early periods in the history of mechanical science Hero of Alexandria has left a description of a small machine, in which a motion of continued rotation was imparted to an axis by the reaction of steam issuing from lateral orifices in arms placed at right angles to the revolving axis The date of this invention is about a century before the birth of Christ Branca, an Italian engineer, about the beginning of the 17th century proposed to move a wheel by a blast of steam blown [illegible] and about the same period De [illegible], described a machine by which a column of water might be raised by the pressure of steam confined in a vessel above the water to be elevated There is nothing, however, in the descriptions and developments which these projectors have left to demonstrate that they were acquainted with those physical properties of elasticity and condensation (*see* STEAM) on which all the power of steam, as a mechanical agent, depends In the middle of the 17th century, or somewhat later, the celebrated Marquis of Worcester published in his work called *A Century of Inventions*, a description of a steam engine to be worked by steam of high pressure, which, though [illegible] its details, is still such as it [illegible] written by any one unacquainted [illegible] of steam Towards the close of that century, Papin, a French engineer, who was professor of mathematics at Marbourg directed his attention to the properties of steam, and conceived the idea of obtaining a moving power by introducing a piston into a cylinder and producing a vacuum under it by the gradual condensation of steam by cold But the steam was also to be generated in the cylinder by the [illegible] a fire, and it was not to be condensed by [illegible] of cold substances to the cylinder, but was to cool gradually of its own accord The details of the project were altogether so imperfect as to render it useless in practice There is no evidence of Papin having carried his idea even so far as the construction of a model until after machines worked by steam had been constructed elsewhere, and he then relinquished his own project in favour of that of Savery

The first actual working steam engine of which there is any detailed account was constructed by Thomas Savery, an Englishman, to whom a patent was granted for it in the year 1698 Savery reproduced the method of forming a vacuum by the condensation of steam, apparently without being aware of the paper written by Papin He combined this with the elastic pressure of steam as applied by Lord Worcester, and constructed an

engine, which, for a time, was used to a considerable extent for raising water Savery's steam engine consisted of a strong iron vessel formed in the shape of an egg, having a tube or pipe at the bottom, which descended to the place from which the water was to be drawn, and another at the top, which ascended to the place to which it was to be elevated This oval vessel was filled with [illegible] which the atmospheric air [illegible] filled was first blown out of it When the atmospheric air was thus expelled, and nothing but pure steam was left in the vessel, the communication with the boiler was cut off, and cold water was poured on the external surface of the vessel The steam within it was thus condensed and a vacuum produced and the water was drawn up from below in the usual way by suction The oval steam vessel was thus filled with water, a cock at the top of the lower pipe was then closed and steam was introduced from the boiler into the oval vessel above the surface of the water This steam, being of high pressure, forced the water up the ascending tube from the top of which it was discharged, and the oval vessel being thus again filled with steam, the vacuum was again produced by condensation, and the same process was repeated By using two oval steam vessels which would act alternately one drawing water from below while the other was forcing it upwards, an uninterrupted discharge of water was produced

Owing to the danger of explosion, from the high pressure of the steam which was used, and from the enormous waste of heat by unnecessary condensation these engines [illegible] was introduced consisting of [illegible] piston being connected to one of the ends of a great beam, hung like the beam of a pair of scales, while to the other end of the beam the pump rods of the mine were attached The cylinder was close at the bottom and open at the top and when the steam from the boiler was introduced beneath the piston, the pump rods being heavier than the piston preponderated and the piston ascended to the top of the cylinder The ingress of steam from the boiler was then stopped, and the steam within the cylinder being gradually condensed the piston descended and made a stroke This machine was invented by Newcomen a blacksmith, and Cawley, a glazier, at Dartmouth, in Devonshire In the first engine constructed by them the condensation was effected by the affusion of cold water upon the external surface of the cylinder which was introduced into a hollow casing by which it was surrounded The discovery of condensation by jet within the cylinder one of the most important steps in the improvement of the steam engine was accidental It happened that a small hole occurred in the bottom of the cylinder of an engine by which the water let in to cool its external surface oozed in forming a little jet The effect was a much more rapid and perfect condensation than ever was or could be effected by external cold Thenceforward the method of condensation by jet was adopted, and has ever since been used

In the early atmospheric engines the cocks by which the steam was admitted and condensed, and by which the injected water and condensed steam were drawn off were worked by hand, and as the labour was light and monotonous and required no skill, boys were employed for the purpose, called *cock boys* It happened that a cock boy, by name Potter, having an itch for play, and endowed with more ingenuity than [illegible] that by tying strings to the cocks, and [illegible] with the working beam above the cylinder, regulating the action by carrying them under or over certain pipes, he could make the beam, as it ascended and descended, open and close the cocks more regularly and effectually than he found himself able to do This he accordingly accomplished and was habitually absent from the engine-house, enjoying himself with his playfellows, when his employers were giving him credit for most extraordinary industry and regularity [illegible] his duties The engine, in fact by [illegible] tripled its work Thus by the ingenuity of a child, the steam engine was first endowed with the qualities of an automaton which have ever since rendered it an object of admiration and interest The engine thus endowed with new powers, was subsequently greatly improved in its details by Beighton and by Smeaton As thus improved, it held its place as the great instrument for the drainage of mines until the epoch which was [illegible] by the inventions and discoveries of [illegible], even still be seen in use at coal mines, and in other situations where coal is cheap In these early engines the cylinder was open at the top, and the piston was pressed down by the weight of the atmosphere They were therefore called *atmospheric engines*

Watt was a mathematical instrument maker in Glasgow, and, being employed by the university of that place, it chanced, about the year 1763, that the model of an atmospheric engine used at the lectures of the professor of natural philosophy required some repairs, to make which it was placed in the hands of Watt. In the [illegible] which it became his duty to make with this [illegible] was struck with the fact that the quantity of steam it consumed for each stroke of the piston was many times more than the contents of the cylinder The large quantity of water necessary to be injected in order to complete the condensation also excited his surprise This led him to make [illegible] which he soon [illegible] important with the evaporation of water He made a near approximation to the proportion of the volume of steam to that of water He ascertained with great precision the latent heat of steam, and consequently determined the quantity of water necessary to condense any given quantity of steam Filled with astonishment at these results, and more particularly at the nature of latent heat, and at the great amount of the latent heat of steam he repaired to Dr Black, then professor of natural [illegible] and communicated to him [illegible] He then, for the first time learned Black's celebrated theory of latent heat, and found that he had himself thus accidentally discovered one of the most striking facts on which that theory rested

Considering the atmospheric engine in an economical point of view, Watt was forcibly impressed with the waste and expense which appeared to arise in the unnecessary consumption of steam involved in its operation In the theory of that engine, one cylinderful of steam ought to be sufficient for each stroke of the piston Watt, on the other hand, found that the actual consumption was at the rate of four or five cylinderfuls per stroke On examination, he discovered the source of this waste to arise from the necessity, in order to make the piston ascend, not only to condense the steam but to cool the whole mass of the cylinder down to 100°, and, to make the piston descend it was necessary not only to fill the cylinder with steam, but to raise the temperature of the cylinder and piston from 100° to 212° He soon perceived that this enormous waste of fuel was the inevitable consequence of condensing the steam in the cylinder

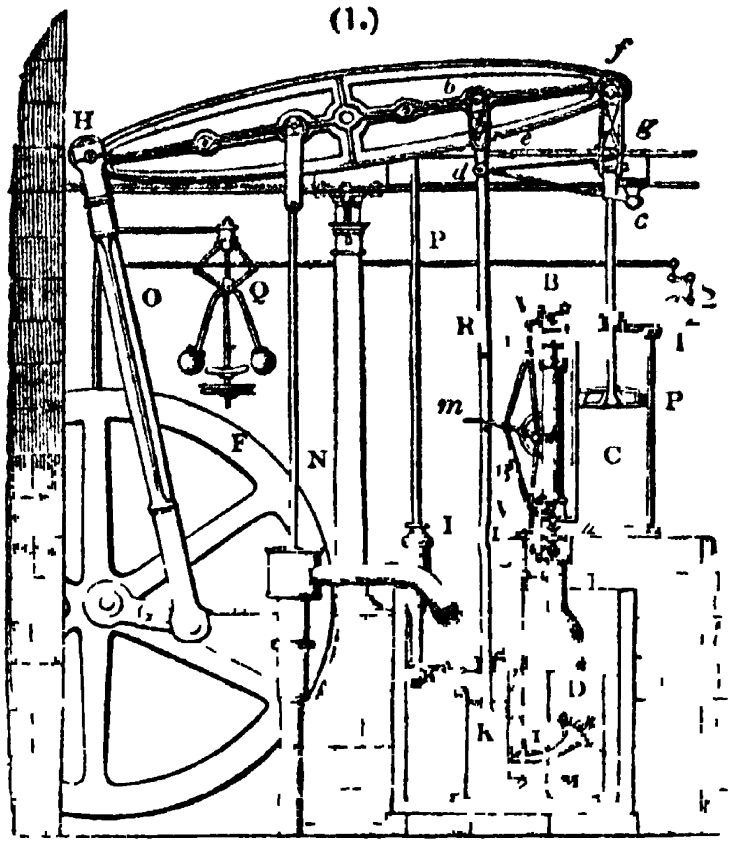
Reflection on these circumstances happily led him to the idea of condensing the steam in a separate vessel, which should be kept immersed in a cistern of cold water, and in which a jet of cold water might be kept constantly playing, with the addition of a pump to draw off the injected water and condensed steam from such vessel In fact all the details of the steam engine as already described were soon carried into practical effect, and engines constructed according to these principles Instead of causing the piston to descend by the pressure of the atmosphere, as in the old atmospheric engine it was forced down in Watt's engines by means of steam and a lid was applied to the top of the cylinder through a steam-tight hole in which the piston rod passed to connect itself with the working beam

*Single acting Condensing Steam Engine* — When the steam engine is applied to the purpose of pumping water, which in the first periods of its invention was its only practical application the force which it exerts is only required in raising the pump rods with their load of water their own weight being more than sufficient for their descent As the pump rods are attached to the end of a working beam hung upon an axis, the force of the steam is required to draw up that end by drawing down the end at which the steam piston is attached The steam, therefore, being only required to press the piston downwards is admitted above the piston while the space in the cylinder below the piston is kept in free communication with the condenser The operation of the valves by which the steam is admitted and withdrawn is precisely the same as in the double-acting engine, which will presently be described and to which reference may be made for a fuller explanation of the action of the machine When the piston has reached the bottom of the cylinder, the valves for admitting and withdrawing the steam being closed, a valve called the equilibrium valve is opened, by which a free communication is made between the top and bottom of the cylinder by this means the steam which fills the upper part of the cylinder, being allowed to flow equally to the lower part, will press with the same force on both sides of the piston, and will therefore have no tendency whatever to move it Under these circumstances the preponderating weight of the pump rods suspended from the other end of the beam will draw the piston to the top of the cylinder, while it is ascending the steam which was above will pass through the equilibrium valve below it, and when the piston has reached the top of the cylinder, the cylinder under the piston will be filled with the same steam which previously had driven the piston down In order to accomplish the next down stroke, the equilibrium valve is closed, and the upper inlet valve and lower outlet valve are opened, the steam pressure acts above the piston, while a vacuum is produced below it, and the piston consequently descends

*Double-acting Condensing Steam Engine.* — This form

of engine is that which is almost invariably used as a moving power in all manufactures in this country It consists of a cylinder represented in the figure in section at C, in which a solid piston P is driven upwards and downwards by the force of steam supplied by a boiler placed near the engine. *See* STEAM BOILER.

(1.)




T [illegible] which, by [illegible] moves a *crank* and *fly wheel*, from which the machinery to be worked directly receives its motion Steam is supplied from the boiler to the cylinder by the steam pipe S The *throttle-valve* T in that pipe, near the cylinder, is regulated by a system of levers connected with the *governor* Q This governor is an apparatus consisting of two heavy balls attached to the ends of rods which are kept revolving on a vertical shaft by a cord or band or by a train of cogged wheels connected with the fly wheel The velocity with which the balls of the governor revolve is therefore always proportional to that of the fly-wheel, and of the machinery driven by it If by reason of too rapid a supply of steam an undue speed be imparted to the fly-wheel, the balls are whirled round with a corresponding velocity, and by reason of their centrifugal force they recede from the vertical spindle round which they turn, and acting thereby on the system of levers which connect them with the throttle-valve T, they partially close the latter, check or diminish the supply of steam to the cylinder, and moderate the velocity of the machine If, on the other hand the motion of the engine be slower than is requisite, owing to a deficient supply of steam through S then the balls, not being sufficiently affected by centrifugal force fall towards the vertical spindle, and acting on the system of levers in the contrary way they turn the throttle valve T more fully open, and admit a more ample supply of steam to the cylinder, so as to increase the speed of the engine to the requisite extent

The piston P is accurately fitted to the cylinder and made to move in [illegible] is surrounded T [illegible] compartments, between which there is no communication by which steam or any other elastic fluid can pass A case B B′ placed beside the cylinder contains the valves by means of which the steam which impels the piston is admitted and withdrawn as the piston commences its motion in each direction The *upper steam box* B is divided into three compartments by two valves, above the upper steam-valve V is a compartment communicating with the steam pipe S Below the exhausting valve E is another compartment communicating with a pipe called the *eduction pipe*, which leads downwards from the cylinder to a vessel called the condenser which we shall presently describe By this eduction pipe the steam is withdrawn from the cylinder after it has driven the piston By the valve V a communication may be opened or closed between the boiler and the top of the cylinder, so as to admit or intercept the supply of steam from the one to the other By the valve E a communication may be opened or closed between the top of the cylinder and the condenser, so that the steam in the top of the cylinder may either be permitted to escape into the condenser or confined in the cylinder The continuation S′ of the steam-pipe leads to the *lower steam-box* B′, which like the upper is divided into three compartments by two valves V′ and E′ The upper compartment communicates with the steam-pipe S′, and the lower with the eduction-pipe By means of the valve V′ steam may be admitted from the steam-pipe S′ to the bottom of the cylinder, and by means of the valve E′ this steam may be permitted [illegible]

The four valves V, E, V′, and L are in the engine represented in the figure connected by a system of levers with a single handle or *spanner m* which being pressed upwards or downwards opens and closes the valves in pairs Thus when it is pressed *down* the levers connected with it raise the upper exhausting valve E and the lower steam valve V′, and close the upper steam valve V and the lower exhausting valve E′ On the other hand, when the spanner *m* is pressed *up* it opens the upper steam valve V and the lower exhausting valve V′, and at the same time closes the upper exhausting valve E and the lower steam valve V′

The cylinder is closed at the top, and the piston-rod P being accurately turned, runs in a steam-tight collar furnished with a stuffing box, by means of which it is surrounded by a packing of hemp and constantly lubricated with melted tallow A funnel is screwed on the top of the cylinder, through which by opening a stop-cock, melted tallow is permitted to fall from time to time on the piston so as to lubricate it

The condenser D is submerged in a cistern of cold water at its side there enters a tube I′, governed by a cock I, which being opened or closed to any required extent a jet of cold water may be allowed to play in the condenser This jet throws the water upwards towards the lower orifice of the eduction pipe L′ From the bottom of the condenser D proceeds a tube having a valve M in it opening outwards, this tube leads to the *air-pump* K′, which is a pump submerged in the same cistern with the condenser, worked by a piston having a valve in it opening upwards The piston-rod R of the air-pump is carried upwards, and attached at *d* to a system of jointed rods called the *parallel motion*, to which is also attached at *g* the great steam-piston rod On the rod of the air-pump is placed projecting pins, which as it alternately ascends and descends strike the [illegible] *m*, and thereby open and close the valves V, V′, L, L′, in pairs, as already described

The upper [illegible] by a valve o [illegible] k, called the *hot well*, for a reason which will presently appear A pump L, called the hot-water pump, descends into the hot well, and is worked by the great working beam to which its rod is attached

If the machine thus arranged continued to be worked for any length of time, the cistern of water in which the condenser and air pump are immersed would become warm, and the condenser would be rendered incapable of doing that for which alone it is useful, viz of reducing the steam to water *by cold* To prevent this a pump N is provided called the *cold-water pump*, by which a supply of cold water is constantly kept flowing into the cistern, the heated water being at the same time allowed to escape by a waste pipe By this means the temperature of the water in the cold cistern is kept so low as to be capable of effectually condensing the steam

The piston being supposed to be at the top of the cylinder, the spanner *m* will be raised by the lower pin on the air-pump rod and the valves V and E′ will be opened, and at the same time the other pair of valves V′ and E will be closed Steam will therefore be admitted above the piston, and the steam which had previously filled the cylinder below the piston will be drawn off to the condenser It will there encounter the jet of cold water, which is kept constantly playing there by keeping the cock I sufficiently open It will thus be immediately reduced to water or condensed (*see* STEAM), and the cylinder below the piston will remain a vacuum The steam therefore, admitted from the steam-pipe through the open valve V to the top of the cylinder will press the piston to the bottom of the cylinder As it approaches that position the spanner *m* will be struck downwards by the upper pin on the air-pump rod, and the valves V and E′ previously open will be closed, while the valves V′ and E previously closed will be opened The steam which has just pressed down the piston, and which now fills the cylinder above the piston, will then flow off through the open valve E by the eduction-pipe to the condenser, where it will be immediately condensed by the jet of cold water which constantly plays there, and steam from the boiler admitted through the open valve V′ will fill the cylinder below the piston and press the piston upwards When the piston has reached the top of the cylinder the lower pin on the air-pump rod will have struck th [illegible] *m* upwards, and will thereby have [illegible] s V and E and opened the valves V and [illegible] will then be in the same situation as in the commencement, and will again descend, and so will continue to be driven upwards and downwards by the steam

While this process is going on in the cylinder a quantity of warm water is formed in the condenser, by the

mixture of condensed steam with the cold water admitted through the condensing jet I'. It has been shown (*see* STEAM) that any quantity of water in the state of steam, being condensed by cold water, will raise nearly six times its own weight of cold water from the freezing to the [illegible] which is rendered sen- [illegible] But since the jet of cold water, instead of being at the temperature of melting ice, is at the common temperature of the atmosphere say 50°, and it is necessary to reduce the temperature of the water in the condenser to at least 100° (otherwise steam would be produced by it, which would seriously resist the motion of the piston), and to reduce water from 212° to 100° by mixture with water at 50° would require a quantity of the latter about twice the former, it follows that the quantity admitted through the jet must be more than twenty times the quantity which passes through the cylinder in the form of steam

The warm water which is thus formed in the condenser, if allowed to accumulate there, would soon choke it up and stop the action of the machine To prevent [illegible] when the air-pump piston [illegible] uum, and the *foot valve* M being relieved from all pressure, the weight of the water in the condenser forces it open and the warm water flows from the condenser into the lower part of the air-pump, from which its return to the condenser is prevented by the closed valve When the air-pump piston descends, its pressure on the liquid under it will force open the valve in it, through which the warm water will pass, and when the piston descends to the bottom of the pump-barrel the warm water which was below it will pass above it and cannot return, as the valves which open upwards will be kept closed by its weight When the piston next ascends it will raise the water thus collected above it, and will throw it through the valve into the hot well K

The hot-water pump L is usually a suction and forcing pump, and draws up the warm water from the hot well and drives it through a pipe called the feed pipe to a cistern placed over the boiler, from which the boiler derives its feed of water *See* STEAM BOILER

The system of jointed rods *c d e f g*, called the parallel motion, has for its object the maintenance of the rods of the steam piston and air-pump in a truly vertical position The steam-piston rod imparts motion to the beam, and the air-pump rod receives motion from it The beam, however, moving as it does alternately upwards and downwards on an axis every point on it must move alternately in the arc of a circle whose centre is in the axis of the beam If the ends of the rods of the steam-piston and air pump were immediately attached to the beam they would move therefore not in truly vertical straight lines, but in the arcs of circles, and by reason of the curvature of such arcs they would be alternately reflected to the right and to the left Such an effect would be quite incompatible with that smoothness and precision which are essential to the effective action of the steam engine By the parallel motion the ends of these piston rods are not immediately attached to the working beam, a rod *c d*, called the *radius rod* moves on a fixed centre *c* attached to the framing of the engine, a bar *d b* connects the other end of this radius rod with a pivot *b* on the beam, so that as the beam ascends and descends the pivots *b* and *d* each move in an arc of a circle, and these pivots [illegible] [illegible] tralized at its middle point *e*, which neither deviates to [illegible] is in a vertical straight [illegible] the air-pump piston is attached

At the end of the beam to another joint *f* is attached a bar *f g*, equal to *b d* connected by pivots with another bar *d g* equal in length to *b f*, so as to form the jointed parallelogram *b d g f* By this arrangement as the beam ascends and descends, the point *g* is moved in a manner altogether similar to the point *e*, only that it moves through a greater space in the proportion of the distance of *g* from the axis of the beam to that of *e* from the same point The point *g* therefore to which the steam-piston is attached, is moved upwards and downwards in a truly vertical straight line while the end *f* of the beam with which it is connected is moved upwards and downwards in the arc of a circle

When the piston is at the top of the cylinder the crank G placed on the axis of the fly-wheel F is at its lowest position, and when the piston is at the bottom of the cylinder it is in its highest position In each of these positions the action of the steam on the piston could not impart any motion to the crank, for the connecting rod O being then in line with the crank any force given to it, being necessarily exerted in the direction of its length, [illegible] pressure or strain on the crank-pin [illegible] dency to turn the crank round the axis of the fly-wheel In these positions the machine is therefore placed in a dilemma, in which the moving power ceases to have any influence on the object it is intended to move

The machine is extricated from this dilemma by the inertia of the fly wheel, that wheel being a large mass of matter, having once received a certain velocity of rotation on its axis, has a tendency to retain such motion, and [illegible] therefore, the crank arrives at either of the positions above mentioned and the moving power ceases to be effective, the inertia of the fly-wheel causes it to continue its motion, and the crank is immediately turned out of the extreme position it had assumed, and thrown into a position in which the power of the piston on it becomes effective

The functions of the fly-wheel are, however, not confined to carrying the machine thus through the dead points by the energy of the force it has received from the piston when the crank was in a more favourable position, it likewise equalises by the same property the unequal effect of the crank It is only when the crank forms a right angle with the connecting rod that it is fully effective, and as that angle changes [illegible] until at length the leverage is reduce [illegible] extreme positions just mentioned When the crank is in and near the position in which it is rectangular to the connecting rod, its action is shared between the fly-wheel and the machinery driven by the engine, a part being engaged in accelerating and therefore giving momentum to the fly-wheel As it passes towards the dead point this momentum taken up by the fly-wheel is given back to the crank in aid of the moving power, at those positions of the crank where the effect of the moving power upon it becomes enfeebled In this manner the fly-wheel in the steam engine becomes a perfect equaliser of the mechanical action of the machine

To the working end H of the beam is attached the *connecting rod* O formed of cast iron, the lower end of which is attached to the crank G by a pin On the axis of the crank is placed the fly wheel and connected with its axle is the governor Q already described The manner in which the crank affects the connecting rod at the dead points produces an effect of great importance in the operation of the engine When the crank approaches the lowest point of its play, and at the same time the piston is approaching the top of the cylinder, the motion of the crank pin becomes nearly horizontal, and consequently its effect in drawing the connecting rod and the end of the beam downwards, and the piston upwards is extremely small The consequence of this is, that as the piston reaches the top of the cylinder its motion becomes very rapidly retarded, and as the motion of the crank pin at its lowest point is actually horizontal, the piston is brought to a state of rest by this gradually retarded motion A similar effect is produced at the other dead point The motion of the engine is consequently very smooth and free from shocks and jerks by which, if they existed its durability and also its eligibility as a prime mover would be materially impaired

Such, then, is the engine of Watt Notwithstanding the manifest advantages attending these improvements the mining and manufacturing interests were slow and reluctant in their adoption of them and, at the end of twenty years from the date of his first improvement, Watt and his partners found that the manufacture of the steam engine had not only not been a source of commercial profit but had entailed upon them a loss of capital to the amount of about 50 000*l* An application was made to parliament on this ground, for an extension of the patent, which was, after much opposition, granted till the year 1800 Various improvements in the more minute details of the machinery of the engine succeeded this, and Watt lived to reap an ample reward for his ingenuity and perseverance, and to be acknowledged as one of the greatest benefactors of the human race

The engine, as applied to drainage and to manufactures has received no important improvement in its principle since it was dismissed from the hands of Watt Those principles which he suggested and applied have been carried out to their fullest extent, and the efficiency of the engine has been proportionally increased thereby Modern engines it is true, as applied to manufacturing purposes, are very different in some of their details from the form of engine just described For example the valves, instead of being moved by means of pins or tappets on the air-pump rod, are now moved by an eccentric, and sliding or sluice valves are also very generally used Sometimes the beam is discarded altogether, and in the construction of the parts malleable iron is now much more largely employed But all these modifications merely affect the detail, and any one who perfectly understands the operation of Watt's engine will have no difficulty in understanding the mode of action of any other variety of engine that has been introduced since his time

*Expansive Engine* — As the operation of the steam engine has been explained, the power which moves the piston is the [illegible] with which vapour is produced in the boiler Each quantity of water which is

successively evaporated obtains the same force in the form of steam, by pressure, as the original an equal quantity of steam previously contained in the boiler; and it is the force with which the steam is thus pressed forward that [illegible] But it has been shown that the steam may be employed as a mechanical power with [illegible] the expansive power of the steam separated from the water be used This is accomplished by closing the valve through which steam flows from the boiler to the cylinder before the piston has completed its stroke [illegible] piston has advanced [illegible] valve be closed The steam which is then acting upon the piston will still urge it forward, but as the piston advances, this steam assuming a proportionally augmented volume, will acquire a proportionally [illegible] pressure, so that through the remaining half of the stroke the piston will be urged by a pressure progressively decreasing and at the termination of the stroke it will be a little less than half the force with which the piston was impelled while the steam valve was open

Since the force of the steam from the moment the steam valve is closed is thus continually diminished, its moving power might be so much attenuated that it would be incapable of overcoming the resistance so as to complete the stroke, this would happen if the steam were cut off when only a small fraction of the stroke has been made, unless the pressure of the steam while the valve is open exceeds the resistance in a proportionate degree It is for this reason that the expansive principle cannot be brought into operation to any considerable extent, unless steam be used of a greater pressure than is commonly adopted in low-pressure engines It is also apparent that with an equal volume of cylinder, greater length of stroke, or greater velocity of motion, should be given when the expansive principle is used

The mechanism by which the expansive principle is brought into practical operation consists merely in the adaptation of valves or slides which shall stop the admission of steam when the required fraction of the stroke has been made by the piston, but which shall leave the communication with the condenser open till the stroke is completed If separate valves be used, this is accomplished by adapting the pins or other mechanism by which they are worked to open and close them independently of each other at the proper times If slides be used it is effected by regulating the form and movement of the slide, so as to cover and uncover the passages to the cylinder at the proper times Each species of valve, and each form of slide or cock, has its own peculiar provisions for accomplishing this, the details of which the limits of this article do not enable us to explain

At the time of this invention the steam engine had never been used, except for the purpose of raising water [illegible] Although Watt, [illegible] with which it might be adapted as a general moving power, his first efforts were to get it adopted in the mining districts for drainage His first engines were, accordingly, single-acting or pumping engines, and it was not until about the year 1784 that he took a patent for the double-acting engine, the structure and mode of action of which has now been described

*Cornish Engines* — The Cornish pumping engines are for the most part single-action engines They are constructed of enormous power, and carry out the expansive principle to a great extent In Cornwall engines are [illegible] of mines with cylinders from 7 to 8 feet in diameter, and from 10 to 12 feet stroke Steam having a pressure of from 20 to 50 lbs per square inch, and upwards, is used for impelling them, and is cut off at a third, a fourth, and sometimes even at a twelfth, of the stroke. A system of careful inspection has been for some years established by the mining companies, with a view to the improvement of the efficiency of the engines, and monthly reports of the performance of the engines have been regularly published The effect of this has been to stimulate the activity and skill of all concerned in the manufacture and working of these machines, and a rapidly progressive improvement in them has taken place The efficiency of these engines is estimated by the number of pounds weight of water which they are capable of elevating one foot high by the combustion of a bushel of coals This has been termed the *duty* of the engine In 1769, when Mr Watt first directed his attention to the steam engine, Smeaton computed the [illegible] duty of the engines then in use was at [illegible], from that time to the year 1800, a period of thirty years, Mr Watt's improvements [illegible], and the duty was gradually [illegible] very nearly quadrupled. In 1813, the system of inspection just mentioned was commenced, and the average duty was the same as in 1800 From this time to 1826, the engines underwent a progression of slow but steady improvement, and the duty was increased to 30 millions This state of improvement continued, and, in 1828, the average duty had risen to nearly 37 millions The increase since that time has been slower the average [illegible] for the last few years has been from 60 to [illegible], but in a well-conducted experiment it was found that by the combustion of a bushel of coals an amount of mechanical power was produced which raised the inconceivable load of 125 millions of pounds weight one foot high Thus, by the improvement of Watt and their immediate consequences, the power of the steam engine was, within the space of seventy years [illegible] The [illegible] structure [illegible] differ in nothing from that of double-acting condensing engines except in the absence of [illegible] to say, the condenser, [illegible] water pump The steam [illegible], instead of being conducted to a cold vessel to be condensed, is simply allowed to escape into the atmosphere, and is commonly conducted into the chimney of the furnace

The operation of such a machine is extremely simple The valves by which the steam is admitted to, and allowed to escape from, the cylinder are exactly similar to those of the double-acting engine In the down stroke of the piston the upper steam valve being open admits steam from the boiler above the piston, and the lower exhausting valve allows the steam below it to escape through a tube into the atmosphere It is evident that, in such a machine, the piston is always resisted by the pressure of the escaping steam As such escape cannot be effected except by steam of greater pressure than that of the atmosphere, it follows that the piston is always resisted by a force somewhat greater than the atmospheric pressure The steam which urges the piston is therefore only effective by the excess of its pressure above that of the escaping steam, and hence it is the more economical course in non condensing engines to employ steam of as high a pressure as is convenient, — the counteracting pressure of the atmosphere being relatively smaller in such a case All locomotive engines are [illegible] and the waste steam is invariably projected [illegible] chimney in locomotive engines, and thereby greatly increases the intensity of the draught

[illegible] non-condensing engines must, of [illegible] have a pressure considerably exceeding that of the atmosphere, and have been generally called *high pressure engines*, while those which condense the steam have, on the other hand, been called *low-pressure engines* These terms are not, however, correctly expressive of the nature of these engines respectively Many engines in which condensation is used, especially those in which the expansive principle is applied with much effect, are worked with steam of a high pressure, not unfrequently with a [illegible] to from two to three atmospheres It [illegible] not correct to call such machines low-pressure engines It is, however, true that engines worked without condensation must of necessity, be worked by steam of a pressure which is [illegible]

*Rotatory* [illegible] is applied to an engine in which a motion of rotation is produced immediately by the action of the steam, without the intervention of such mechanism as the working beam, crank, and fly-wheel This is usually effected by a piston which instead of moving longitudinally in the cylinder, revolves within the [illegible] with the geometrical [illegible] The mechanism is so contrived that this piston shall revolve in steam-tight contact with the sides and ends of the cylinder, [illegible] continually presses it [illegible], [illegible] other side shall continually escape to the condenser, if it be a condensing engine, or to the chimney if it be a non-condensing engine, — a moveable division of some kind or other being necessarily interposed between the steam and vacuum to enable this to be done Most of the contrivances for rotatory engines which have been suggested differ one from the other only in the mechanical expedients by which these ends are attained Such machines are very numerous and various, but as none of them have yet been found to be attended with sufficient practical advantages to force them into any use beyond the experimental trials of their inventors, it is sufficient here to have indicated the general principle of their structure

*Marine Engines* — The manner in which the steam engine is rendered an instrument for the propulsion of vessels must, in its general features, be so familiar to every one as to require but short explanation A shaft is carried across the vessel, [illegible] and on either side beyond the timbers, [illegible] of this shaft on the outside of the vessel are attached a pair of wheels, constructed like under shot water wheels, having fixed upon their rims a number of flat boards called *paddle boards* As the wheels revolve, these paddle boards strike the water, driving it in a direction contrary to

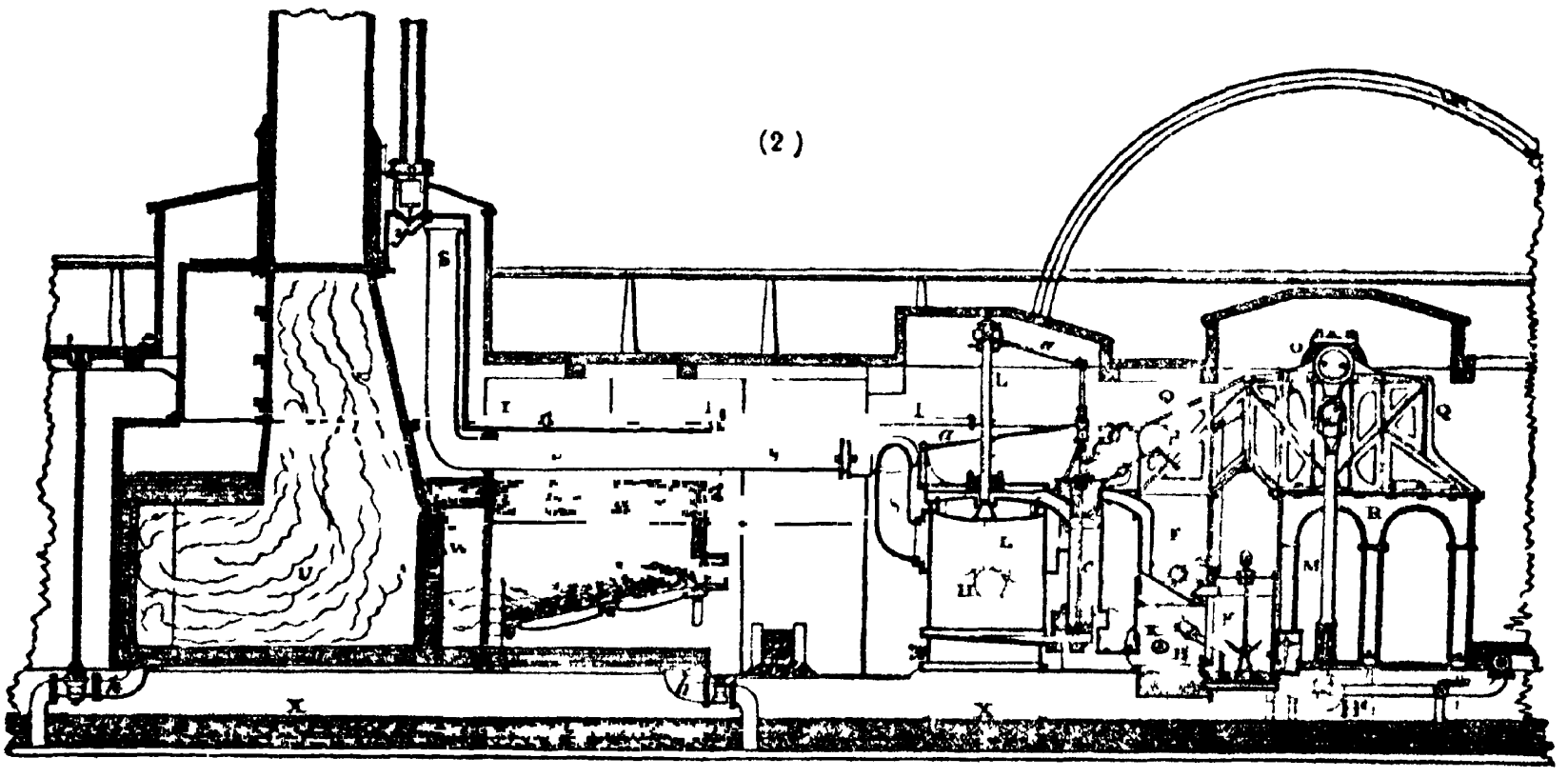
that in which it is intended the vessel shall be propelled The moving force imparted to the water thus driven backwards, by reaction on the vessel propels it On the paddle shaft are fixed two cranks, placed at right angles one to the other, so that whenever one of them is thrown [illegible] on the other is horizontal [illegible] strong iron rods called *connecting rods*, which are themselves either driven directly by the pistons of two steam engines, or are worked by those pistons, thus the medium of working becomes similar to those used in the ordinary land engines The two cranks being placed at right angles, it follows that when one piston is at top or bottom of its [illegible] by it into the highest or [illegible] be at the middle of its stroke, and the crank driven by it will be in the horizontal position One of the pistons is therefore always in a position to produce the most advantageous effect on the crank at the moment that the other piston loses all power over the crank driven by it, and in the same manner it may be seen that while the power of one piston is augmented from zero to its greatest effect, the power of the other is decreasing from its greatest effect to zero Thus the combined action of the two pistons is nearly uniform in its efficiency If one engine only were used the motion of the wheels would be unequal, being most rapid when the piston is at the middle of the stroke, and slowest at the extremities

The steam engines used for navigation may be either condensing engines or non condensing engines If the latter are employed, steam must be used having a pressure above the atmosphere of from 30 to 50 lbs per square inch. Boilers in which steam is produced under this pressure are considered in Europe so unsafe, that non-condensing engines with low-pressure boilers are almost universally used for navigation. In America, however, high-pressure boilers with non-condensing engines are extensively used

The arrangement of the parts of marine engines is different in several respects from land engines. Steam vessels being generally employed to navigate the open seas, and being therefore subject to the vicissitudes of tempestuous weather, the machinery must be protected by being placed below the deck The space allotted to it being thus limited, great compactness is necessary The paddle shaft being very little below the deck, the working beam and connecting rod could not be placed so conveniently as [illegible] If a beam engine therefore be employed, two beams are so placed that one comes on each side of the cylinder, and is driven by the piston by means of a cross head attached to the piston rod, from the ends of which rods, called side rods, are carried downwards to the ends of the beams From the other ends of the beams the connecting rod is presented upwards towards the crank

*Side-Lever Engines* — Marine engines are of various forms, but perhaps the most usual form is the side-lever [illegible] fig 2 in which is represented in section a side-lever marine engine with its boiler, as placed in a steam vessel The sleepers of oak supporting the engine are represented at X, the base of the engine is secured to these by bolts






passing through them and the bottom timbers of the vessel S is the steam pipe leading from the steam chest in the boiler to the slides *c* by which it is admitted to the top and bottom of the cylinder The condenser is represented at B and the air-pump at I The hot well is seen at F from which the feed is taken from the boiler L is the piston rod connected with the beam H working on a centre K, near the base of the engine The other end of the beam H drives the connecting rod M, which extends upwards to the crank, which it works upon the paddle shaft O *a a* are the rods of the parallel motion The framing by which the engine is supported is represented at Q R

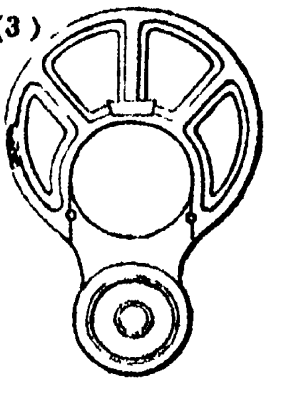
The beam exhibited in the figure is shown in dotted lines, as being on the further side of the engine A similar beam similarly placed, and moving on the same centre, must be understood to be at this side, connected with the cross head of the piston in like manner by a parallel motion, and with a cross tail attached to the lower end of the connecting rod and to the opposite beam The eccentric which works the slides, is placed upon the paddle shaft O, and the connecting arm which [illegible] when the engine [illegible] of the boiler grate and flues is represented at W U The safety valve *y* is enclosed beneath a pipe carried up beside the chimney, and is inaccessible to the engine-man The cocks for blowing out the salt water from the boiler (a process explained under the head STEAM BOILER) are represented at *h*, and the feed pipe at I

The nature and operation of the several parts just mentioned will be understood by reference to the explanation of the structure and operation of the double acting land engine, for, in fact, the marine engine, such as is here represented, is nothing more than a double-acting condensing steam engine, adapted in its form to the circumstances in which it is used in navigation

Since, however, the double-acting land engine, which has been described, is not provided with a slide-valve worked by an eccentric, it will be proper to explain the form and mode of action of those important parts of the machine

An eccentric is a disc of metal perforated with a hole for the reception of the crank shaft, but this hole is not in the middle of the disc The edge of the disc is encircled by a ring of brass from which a rod proceeds to the connections of the slide valve, and it will be obvious that by the revolution of the shaft this rod will be drawn backwards and forwards, in the same manner as if it were connected with a crank in the shaft An eccentric, indeed, is virtually a short crank with a very large crank-pin, and a crank of the same length as the distance from the centre of the shaft to the centre of the disc which constitutes the eccentric, would give precisely the same motion that is given by the eccentric itself The form of eccentric usually employed in steam vessels is represented in fig 3 A balance-weight is applied opposite to the heavy part of the eccentric, in order that the eccentric may stand in any position on the shaft, and a projecting piece of metal is fixed upon the shaft, which, when it comes in contact with a similar piece of metal upon the

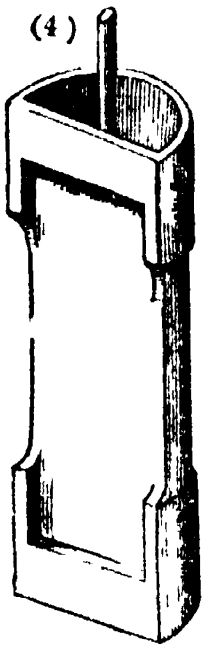
(3)



eccentric, carries the eccentric round with the shaft. Should it be necessary to reverse the engine there is another piece of metal upon the opposite side of the shaft which also comes into contact with the stop upon the eccentric and the projecting side of the eccentric [illegible] cessary it should do to communicate a reverse motion to the valve

The species of valve usually employed in side-lever marine engines is the D-valve, so called because it is half a cylinder, and its cross section therefore resembles the letter D Of this species of valve there are two varieties, the long D and the short D In the long D the waste steam escapes from one of the ports of the cylinder through the centre of the valve In the short D there is no central passage in the valve, but the valve consists of two short and closed portions connected together by one or more rods The long D valve has obtained the widest acceptation A valve of this kind is represented in fig 4 The flat projecting part of the valve moves upon similar flat parts on the front of the cylinder, and when the valve is in the middle of its stroke the flat projecting portions accurately close the ports or passages by which the steam enters and leaves the cylinder The round part of the valve opposite to each cylinder-port is made tight by the application of a hemp packing, placed in the casing by which the valve is surrounded, and between the upper and lower packing steam is admitted to circulate round the valve —the steam-pipe from the boiler having its debouche in the valve-casing If now the valve be in its middle position, so as to cover accurately both of the cylinder ports it will be clear that if it be drawn upwards steam will be allowed to enter from the valve casing above the piston and at the same time any steam or vapour will be allowed to escape from beneath the piston into the central part of the valve which communicates with the condenser by means of a pipe penetrating [illegible] either above the upper packing or [illegible] r packing If the valve be forced below its middle position the contrary operation will be produced, and by moving the valve up and down, therefore, which is done by the eccentric the piston is pressed up and down in the [illegible] manner required In some steam vessels valves are employed which differ considerably in construction from the D valve, but the limits of this article prevent these various kinds of valves from being described

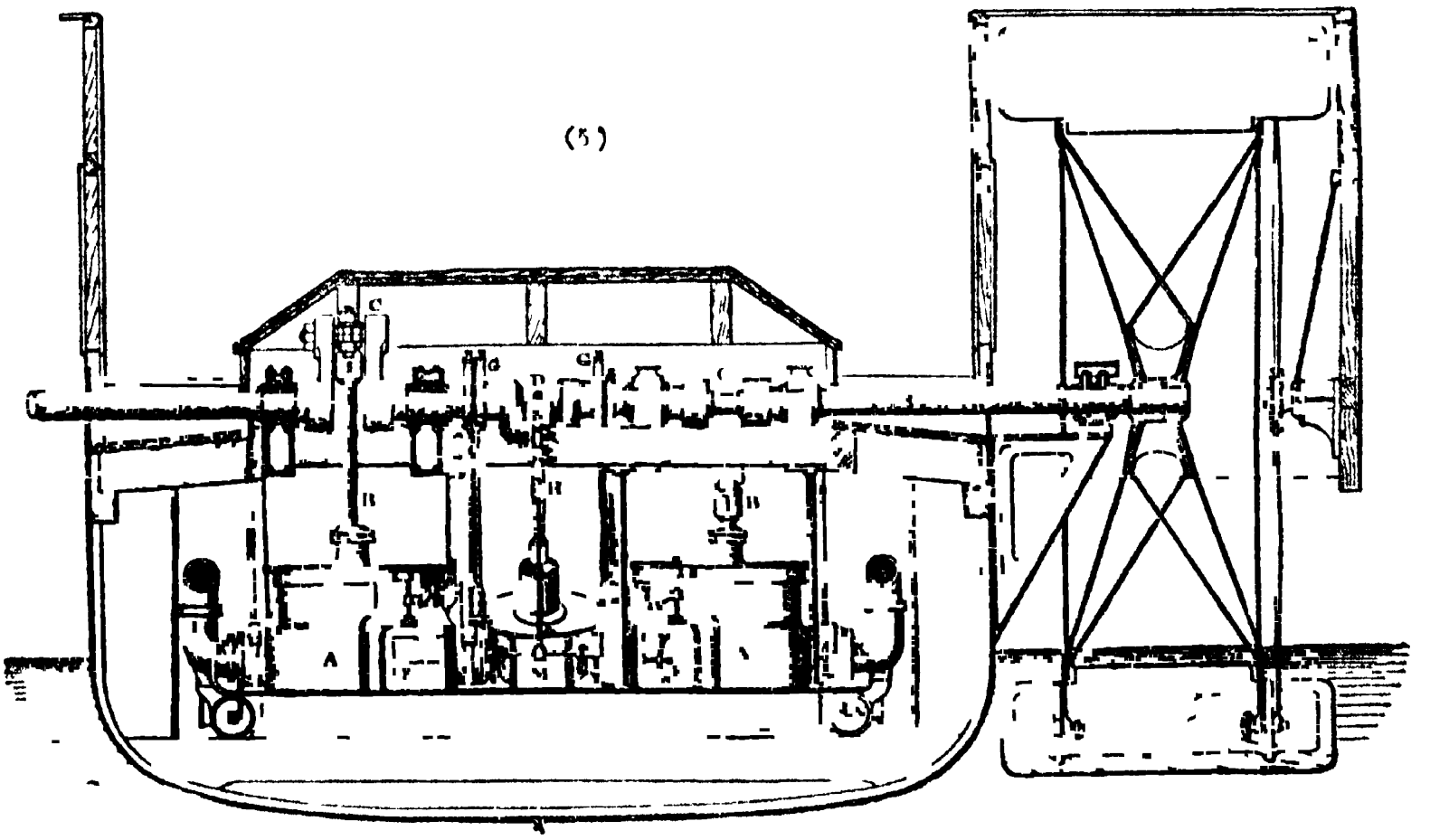
(4)



*Oscillating Engine* — Side-lever engines occupy an inconvenient amount of space in steam vessels and also exhibit a needless complication of parts The strain has to be transmitted, not merely through the piston-rod and crank shaft, but also through the cross head and cross tail, side rods and connecting rod, and the side levers or beams This multiplication of the moving parts obviously increases the risk of fracture, and the side-levers themselves are peculiarly susceptible of accident from this cause, since by the properties of a lever of this class, the stress or strain upon the beam at the main centre or pivot is twice greater than the strain upon the piston, and since also the beams are generally made of cast-iron for facility of manufacture These defects of the side-lever engine have caused a new species of engine to be introduced, called the oscillating engine, because the cylinder vibrates or oscillates somewhat in the manner of a pendulum In this engine the top of the piston rod is coupled immediately with the crank pin, and as the piston-rod moves up and down in a line coincident with the axis of the cylinder, while the crank pin revolves in a circle, it is necessary that the cylinder should be able to vibrate laterally, to enable the motions of the piston-rod and crank pin to be reconciled with one another The cylinder is consequently provided on each side with a short hollow pivot, or trunnion on which it swings, and through one of these trunnions the steam enters the cylinder from the boiler, while through the other the steam escapes from the cylinder to the condenser The alternate introduction of the steam above and below the piston is governed by a slide-valve attached to the cylinder, and swinging with it, or, in large engines, two valves may be employed for this purpose, and by their suitable attachment to the cylinder they will balance one another

In steam vessels in which oscillating engines are employed the cylinders are set immediately beneath the cranks, and the engines occupy but little more in the length of the vessel than the diameter of the cylinder. In the shaft which connects the engines together, and which is called the *intermediate shaft*, a crank is forged, and this crank in its revolution gives motion to the pistons of one or more air-pumps The general nature of the arrangements at present employed in vessels of the most improved class, will be readily understood by

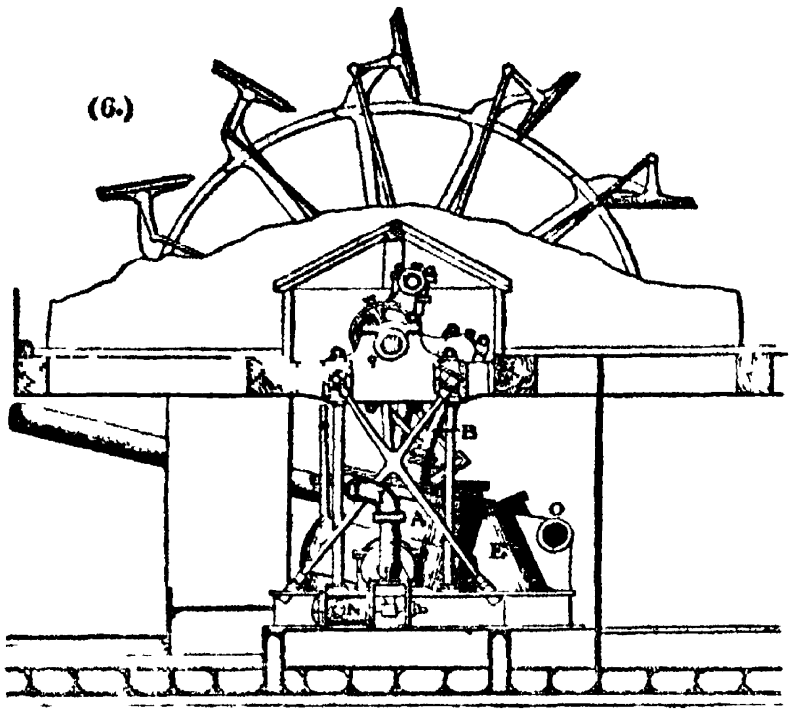
(5)



a reference to fig 5, which is a transverse section of the steam yacht Peterhoff, constructed for the Emperor of Russia by Messrs Rennie, and to fig 6, which is a side view of the engines of the same vessel A, A are the cylinders B, B are the piston-rods, which [illegible] the cranks C, C, D is a [illegible] for working the piston bucket of the air-pump E, F, F are the slide valves by which the admission of the steam to the cylinders is regulated, G, G are double eccentrics on the intermediate shaft, whereby the valves F, F are moved The purpose of the double eccentrics is, to enable the link motion [illegible] n account of which see the article [illegible] H is a handle whereby the engines may be stopped, started, or reversed I, I are the steam pipes leading to the steam trunnions K, K, on

which, and on other trunnions connected with the pipe M, the cylinders oscillate N, N are pumps the pistons of which are attached to the trunnions, and are worked by the oscillation of the cylinders O is the waste water

(6.)




pipe, through which the water which has accomplished the function of condensing the steam is ejected overboard The same letters refer to the same parts in the two figures, and the second figure [illegible] ment necessary for feathering the f[illegible] wheels

*Feathering Paddle Wheels* — In one variety of paddle wheel the float boards which act upon the water are fixed in a radial position, like the buckets of an undershot water wheel, as has already been explained, and this species of wheel is largely employed, both in the case of river and sea going vessels Latterly however, paddle wheels with moveable floats of the kind represented in the preceding engravings have obtained a marked preference, and vessels fitted with such wheels are found to realise a considerably increased performance It will be remarked that each float is hung upon an axis, whereby the inclination at which it enters or leaves the water may be altered, and by means of levers attached to the floats, and which are acted upon by rods converging to a centre eccentric to the shaft a feathering motion is imparted to the floats by the revolution of the wheel In river vessels the use of feathering wheels enables a small diameter of wheel to be employed without loss from angular impact, and with wheels of a small diameter, the engines may be worked with a greater speed, whereby they will exert more power In the case of sea going vessels the diameter of the paddle wheels cannot be materially reduced, whatever species of wheel is employed, for if the wheels were made very small they would be immerged to the centre, or be out of the water altogether if any considerable roughness of the sea occurred, nevertheless, feathering wheels are advantageous in the case of ocean vessels also, as they act more beneficially than common radial wheels when deeply immersed, and with variable [illegible] therefore, they maintain a greater average efficiency There are objections, however incident to the [illegible] feathering wheels which go far to balance these advantages They are expensive both to make and to maintain The wear and friction in such a multitude of joints is very considerable, and if any of the arms get adrift or break, they will be whirled round like a flail, and may perhaps cut through the paddle box, or even the vessel If the injury be of such a nature that the wheels cannot be turned round (and this has sometimes happened) it will follow that the engines will be virtually disabled until the obstruction can be cleared away, and if the weather be very stormy, or the vessel be in a critical situation, she may be lost in consequence of her temporary de[illegible] ment [illegible] whole, therefore, the application of [illegible] vessels intended to perform [illegible] seas appears to be of doubtful advantage In short trips, and in situations where the wheels can be carefully examined at short intervals, the risk is not so great, but in that case nearly the same benefits will be attained by increasing the length of the paddle floats, and giving the wheel less dip There is no material difference between the performance of a feathering wheel and that of a radial wheel, if the two wheels be of the same diameter, and if they have both a light dip with long narrow floats And as in sea going vessels the wheels must necessarily be of considerable diameter, and as the [illegible] ing to prevent the other circumstances conducive to efficiency from being observed, it follows that in ocean vessels radial wheels would be about as efficient as feathering wheels but for the circumstance of a variable immersion It is not necessary however, that there should be much variation in the immersion of large vessels be employed or if coal is more frequently taken on board during the voyage, and as neither of these alternatives is attended with the risk incident to the use of feathering wheels, they appear to be entitled to that preference which ultimately they are likely to obtain

*Proportions of Marine Engines* [illegible] the piston-rod is [illegible] of the [illegible] the crank pin is made about one-seventh of the diameter of the cylinder The diameter of the paddle shaft must have reference, not merely to the diameter of the cylinder, but also to the length of the stroke of the piston, or what is the same thing, to the length of the crank If the square of the diameter of the cylinder in inches be multiplied by the length of the crank in inches, and the cube root of the product be extracted, then that root multiplied by 242 will give the diameter proper for the shaft in inches at the smallest part The diameter of the trunnions is regulated by the diameter of the steam and eduction pipes, and these are each usually about one-fifth of the diameter of the cylinder, but it is better to make the steam trunnion a little less and the eduction trunnion a little more, than this proportion The steam and eduction pipes, where they enter their respective trunnions, are kept tight by a packing of hemp which is compressed by a suitable ring or gland tightened by screws In land engines, the air-pump and condenser are each made about one-eighth of the capacity of the cylinder, but in marine engines they are made somewhat larger

*Proportions of Paddle wheels* — The diameter of paddle wheel proper to introduce into a steam vessel depends mainly upon the variation of immersion which she is required to undergo In river steamers, where there is little variation of immersion the wheels should be small in diameter If a line be taken in the length of each float, so that the mean pressure of the water against the float is the same above the line that it is below it, then this line will constitute a *centre of pressure*, and in determining the velocity of the wheel it is the velocity of the centre of pressure which should be regarded In all cases the centre of pressure must move more rapidly through the water than the vessel, and the difference between the velocity of the wheel and the velocity of the vessel is termed the *slip* of the wheel The slip which usually occurs in steam vessels is one-third or one-fourth of the velocity of the wheel, and an imaginary circle described upon the arms of the wheel at that point at which the velocity is the same as that of the ship, is termed the *rolling circle* The rolling circle should fall about the level of the water As a general rule, the larger the paddle floats are made the more efficient will be the performance of the wheel as is more fully explained in the article on the SCREW PROPELLER, in the Supplement In radial wheels, the usual practice is to introduce one float for every foot the wheel has of diameter, so that the floats are about three feet apart In feathering wheels the floats are usually set somewhat further asunder The best average distance appears to be about four feet measuring from the centre of one float to the centre of the next, but this proportion varies somewhat with the diameter of the wheel

*Relations of Power and Speed* — With any given type of vessel and any given power of engine, it is possible to predict with very considerable accuracy, the speed which a steam vessel will attain First, a co-efficient must be found which when introduced into the computation will give a result answering to that derived from experiment, and this co-efficient will vary with the shape of the vessel In the case of sea going vessels of good average form, the co-efficient is 800, and in the case of very sharp river vessels it is 1000 Multiply this co-efficient by the number of actual horses power exerted by the engine (*see* HORSE POWER in the Supplement), and divide the product by the number of square feet in the transverse section of that part of the vessel lying beneath the water Extract the cube root of the quotient, which will be the speed which the vessel will attain in statute miles per hour It is possible to make steam vessels too sharp to attain a minimum resistance, since the increase of length consequent upon increased sharpness, involves a larger amount of rubbing surface in the bottom of the vessel, and the loss due to the increased friction may more than compensate for the benefit accruing from the finer lines

*Circumstances conducive to the Efficiency of Marine Engines* — Supposing the boiler to be properly proportioned, it is necessary to see that the flues are kept clean, that blowing off be sufficiently practised, and that the furnaces are fed with coal in a regular manner — the coal being distributed evenly over the grate without allowing any holes to exist in the fire The boilers should be covered with felt to prevent the radiation of the heat, and over the felt sheet lead should be spread, soldered at the

pipes should be covered with felt and then wrapped round with canvas The cylinders should also be covered with felt, round which staves of wood may be placed, which should be hooped like a cask The felt proper for this purpose is thick and soft, and is made expressly for the retention of heat. The steam should be used with a considerable pressure, and be worked expansively; but very little advantage will be derived from so using it expansively in steam vessels, unless the cylinders be clothed very effectually, so as to prevent the dispersion of the heat It appears probable, that some species of condenser which condenses the steam by mixing the water with water from the sea, for the only impediment to the use of steam of a considerably higher pressure in steam vessels is, the liability of the boiler to become encrusted with salt, when it might become red-hot in some part, and perhaps burst, and this risk the use of fresh water in the boilers would prevent A species of condenser, called Hall's condenser, which operated on the principle of a still, was at one time in pretty extensive use in steam vessels, but it was unskilfully applied in most cases, and the main benefit — the ability to use steam of a higher pressure — was not simultaneously obtained In Hall's condenser, the steam passed into a multitude of copper pipes, immerged in a cistern of cold water, and the steam being thus reconverted into water was returned by a pump to the boiler In another species of condenser suggested by Symington a jet of cold water was to be employed, as is the present practice, but the fresh water with which the vessel started instead of being discharged into the sea, was transmitted through a number of pipes which were kept cool by the sea water, and was returned to the condenser after having suffered sufficient refrigeration It appears highly probable that one or other of these projects will be revived to meet the existing exigencies of steam navigation The urgent demand for speed necessitates the employment of a large amount of power, which in its turn involves a large consumption of fuel To reduce the consumption of fuel, without reducing the power, engines operating more expansively must be employed, but steam of a higher pressure is necessary for the satisfactory operation of such engines and fresh water in the boilers is conducive to safety where a considerable pressure is employed With the existing pressures fresh water in the boilers is not material It is of course necessary with every kind of engine to see that there are no air leaks, or steam leaks, for the efficiency of the engine would be thereby impaired, or the consumption of fuel increased

For further information on the Steam Engine, see the *Treatise on the Steam Engine by the Artizan Club*, *A Catechism of the Steam Engine, by J Bourne, C E*, or *The Steam Engine explained by Dr Lardner*

STEAM GUN A contrivance by which balls, or other projectiles used in warlike operations, may be projected by the expansive force of steam

This invention, which is due to Mr Jacob Perkins so well known for various ingenious and useful contrivances in the mechanical arts, having been first brought forward since the general peace which succeeded the battle of Waterloo has never been submitted to any decisive test of experience either in military or naval operations and consequently has not received the benefit of that stimulus to improvement which is always so necessary to bring mechanical contrivances of a novel kind to perfection, and which can only be derived from their practical application on a large scale Of the probable or possible utility of the steam gun nothing therefore can be inferred from that safest source of information — experience, and we are left to judge of it by the general properties of vapour and by the experiments on a small scale to which it has been submitted

If a strong close iron vessel, having two valves, one opening inwards and the other outwards — the latter being loaded with some definite pressure — be *completely* filled with water, such a vessel may be heated to the temperature corresponding to the pressure with which the valve is loaded without causing any portion of the water in it to be converted into steam To render the effect more easily understood, let us suppose that the valve is loaded with a pressure of fifty atmospheres. The temperature of water evaporated under that pressure being 510° (*see* STEAM), the vessel may be raised to any temperature not exceeding 500°, without having any of the water contained in it converted into steam If the temperature to which the water is raised be 500°, and a cubic inch of water at common temperatures be forced into the vessel through the valve which opens inwards, water being sensibly incompressible, a cubic inch of water at 500° will be forced out at the valve which opens outwards. This water, being no longer subjected to the pressure which kept it in the liquid state, will suddenly expand and flash into steam, which at first will have a pressure of 50 atmospheres but as it expands will have its pressure diminished in nearly the same proportion as the volume into which it swells shall be increased. Since, however, 500° is not sufficient heat to enable the whole of the water thus ejected to pass into steam (*see* STEAM) that part of it which will assume the vaporous form will take the requisite amount of latent heat from the sensible heat of that portion which remains in the liquid state As this latter portion will still retain a considerable temperature, it may be conducted to a vessel containing the feed for the heated vessel just mentioned, from which it will be again forced into that vessel

Such was the principle of Mr Perkins's *generators*, by which term he denominated those close vessels in which water was raised to a high temperature without being converted into steam

Now if the valve through which the heated water is ejected be supposed to be in communication with the barrel of a gun or piece of ordnance, in the same manner as the barrel of an air gun is in communication with the hollow metallic ball in which air is compressed, a ball may be projected by the expansive force of the water ejected from the valve, in the same manner exactly as the ball of an air gun is projected by the expansive force of the compressed air

As the water may be ejected from the valve either in a constant stream or by a rapid succession of jets, the balls may be discharged from the barrel as rapidly as it is possible for them to be brought under the action of the steam, and since the heating of the barrel only tends to increase the elastic force of the steam, there appears to be no other practical limit to the action of such an engine of offence except that which may be imposed on the heating power applied to the generator

Of the abstract principle of applying steam in this manner as an offensive engine there can be no doubt. Both theory and experiment conspire to establish it, but of the comparative efficacy, convenience, and economy of it compared with gunpowder, many doubts will present themselves to all who duly reflect on the circumstances by which the innovations are surrounded The necessity of using a steam generator of any kind obviously limits the application of such an instrument to particular cases, and even in those special cases the necessity of employing a generator or boiler which shall be capable of ready conduction of the heat to the water, with great strength and solidity in the heating vessel, must continue to be regarded as a weighty difficulty Without a very high pressure of steam the ball cannot acquire an adequate momentum with any ordinary length of gun, or any ordinary bore and the use of steam of a very high pressure is dangerous and inconvenient By greatly increasing the length of the gun the pressure of the impelling fluid may be lessened, but this expedient is also inadmissible and the most promising method of enabling the steam gun to come into practical operation appears to consist in increasing the bore of the gun very much, and in using either hollow shot, bullets with a piston wadding or some other form of projectile which will receive the impulse of the steam upon a large surface which is left behind when the ball leaves the gun

STEAM NAVIGATION The art of propelling vessels by the instrumentality of the steam engine Vessels so propelled are called steam vessels, and the navigation of seas or rivers by steam vessels is termed steam navigation The propelling instrument, by means of which the steam engine acts upon the water, may either be the paddle wheel (see STEAM ENGINE), or the screw (see SCREW PROPELLER in the SUPPLEMENT), and the vessel is forced forward by the backward pressure of the paddle boards or screw upon the water just as a boat is forced forward by the reaction of the oars, or as the body of an aquatic bird is propelled by the action of the feet The pressure with which the vessel is forced forwards is in all cases the same as that with which the water is forced backwards, and this pressure will remain unchanged whether the surface pressing the water be large or small, being dependent altogether upon the power of the engine, other things being equal But if the propelling surface be large the water will be moved backwards through only a small distance, while the vessel is moved forward through a great distance, whereas if the propelling surface be small, then with only the same forward motion of the vessel there will be a larger backward motion of the water, and more steam will be expended in producing the same result

*History of Steam Navigation* — Vessels propelled by paddle wheels driven by oxen were employed by the Carthaginians and were introduced by them into Sicily, from which country the Romans obtained a knowledge of that method of navigation In 1543, Blasco Garay, a sea captain in Spain, exhibited to Charles V a vessel propelled by wheels of this kind which were driven by steam, but it is not known in what way the steam acted so as to produce motion. In 1618, and again in 1630,

patents were granted in England to David Ramsey for propelling vessels by fire or steam Various projects [illegible] after this time by [illegible] mberlaine, Bushnell, [illegible] Dickens, Allan and [illegible] pamphlet descriptive of his mode of propulsion and of which the main features were a paddle wheel placed at the stern and driven by an atmospheric engine within the vessel In 1787 Mr Patrick Miller, of Dalswinton in Scotland, published a pamphlet descriptive of a new species of vessel he had invented, which was to be driven by paddle wheels, but these wheels were to be worked by manual labour by means of capstans With a vessel constructed by Mr Miller upon this plan, it was found that a considerable speed was attainable, but the operation of turning the capstan was found to be very laborious, and it occurred to Mr Taylor, a tutor in Mr Miller's family, that a steam engine might be applied to perform this work Mr Taylor, having shown that such an engine might be introduced without setting the vessel on fire, was commissioned by Mr Miller to order an engine of an acquaintance of Taylor's, called William Symington, a young engineer of much ingenuity This engine was made and introduced into a pleasure boat, which was many times tried successfully on the lake of Dalswinton Mr Miller then built a vessel on a larger scale, the engine of which was made at Carron This vessel was tried on the Forth and Clyde canal in 1789, and realised a speed of nearly seven miles an hour Nothing further was done in the matter, however till 1801, when Symington received an order from Lord Dundas to construct a steam vessel for the Forth and Clyde Canal Company Watt's patent having by this time expired, the engine was made upon his plan and the performance of the vessel was satisfactory in every respect From an impression however, that the waves which were created would injure the banks of the canal, this new method of propulsion was not further pursued

In 1801, shortly after this vessel was completed she was visited by Robert Fulton, a native of America, at whose desire Symington caused the vessel to be put in operation in order that he might witness her performance Symington's belief was that the speed of the vessel was impaired by the narrowness of the canal and Fulton, in reference to this remark observed, that such an objection could not have existence in the great rivers of North America, where vessels of such a character would confer important advantages Shortly after this time Fulton commissioned Boulton and Watt to construct for him an engine which was to be put on board a vessel in America This vessel was to be propelled by paddle wheels in the manner previously practised in Scotland The name of this vessel was the Clermont, she was launched and tried in 1807 and performed her [illegible] duties in a satisfactory manner Numerous vessels resembling the Clermont were soon after this time built in America In 1812 Mr Henry Bell, of Helensburgh on the Clyde, constructed the Comet the first vessel that was employed for commercial purposes in Europe Numerous other vessels resembling the Comet were soon after this built in the Clyde, and steam navigation before long came into general use in all parts of the kingdom Mr David Napier, of Glasgow, who had constructed the boiler of the Comet, and who soon signalised himself in this department of engineering, was the first person who sent steam vessels to sea He established lines of communication between Greenock and Belfast, and subsequently between Dublin and Holyhead, and between Dover and Calais The method of combining two engines with their cranks set at right angles with one another was a suggestion of Mr Watt's When the City of Edinburgh constructed by Boulton and Watt, was set to run between London and Leith it was found that the sea water in a voyage of this length acquired such a degree of concentration that it was no longer fit for the production of steam The vessel had, therefore, to be stopped in the middle of the voyage, the water let out of the boiler into the hold, and a fresh supply of water to be introduced from the sea To remedy this inconvenience, Boulton and Watt applied *change pumps* to the vessel, which by continually removing a portion of the super-salted water during the voyage prevented an injurious concentration from being attained They afterwards superseded the change pumps by *blow-off cocks*, which on being turned at intervals allowed a portion of the super-salted water to escape overboard, and this is the expedient for preventing an accumulation of salt in the boiler which is still generally employed

The side lever form of engine still largely employed in steam vessels, was settled by Boulton and Watt at an early period in the history of steam navigation The oscillating engine was invented by their foreman, Mr Murdock, towards the close of the last century, but it is mainly from the admirable manner in which the details of

[illegible] been carried out by Messrs. [illegible] obtained such favourable ac- [illegible] rs for marine purposes were [illegible] 1838, but were first practically introduced by Messrs Penn and Son and Messrs. Miller and Ravenhill about 1844

*Ocean Steam Navigation* —Lines of steam navigation now connect together nearly all the countries of the world In the case of coasting voyages, the establishment of railways is gradually bringing about the supercession of paddle vessels by screw vessels with auxiliary power (see SCREW PROPELLER in the SUPPLEMENT), but for all purposes of swift ocean voyaging, paddle vessels appear to be the best adapted. Lines of steam communication now proceed from this country, not merely to the principal countries of Europe, but to North and South America, the West Indies, the Cape of Good Hope, the East Indies, and China, and contracts have been concluded for their extension to Australia. The various companies carrying on these lines of communication receive large yearly payments from the government for the conveyance of the mails, without which the existing measure of efficiency in the vessels could not be maintained, and it may be taken as an axiom in steam navigation, that no line of distant communication in which a high rate of speed is necessary can be profitable unless supported by a government subvention Some of the vessels now [illegible] navigation are of [illegible] power The actual power of such vessels should be at least three times the nominal and this makes the actual power of the largest about 3600 horses Some of these vessels are considerably more than 300 feet in length In sea-going steam vessels from 18 to 19 miles an hour is the utmost speed that has yet been attained

*River* [illegible] Trade [illegible] nt of steam navigation [illegible] not considerable, the rivers being only in a few cases, or through an inconsiderable part of their length, of sufficient volume to enable navigation to be carried on upon them Upon the Thames and also upon the Clyde there are considerable numbers of river steamers, which are well adapted to the functions they have to perform, but in no case are these vessels of large dimensions or great power In America, however, where the rivers are of a far larger volume than in this country, and perform a far more important part in the means of internal communication, there are river steamers of nearly 400 feet in length, and with paddle wheels 50 feet in diameter, and some of these vessels are said to have attained a speed of 24 miles an hour The engines are usually set upon the deck and are formed in the same manner as a common land engine—the beam being poised high in the air and the connecting rod extending from the beam down to the crank The river steamers of America more nearly resemble arks than ships as they are built with several decks or stories resting on the hull, which is always made very sharp, so as to enable a high rate of speed to be attained A pressure of 50 lbs per square inch is commonly maintained in these engines if condensing The stroke of the piston is always very long relatively with its diameter, the steam is of considerable pressure, and is used to a considerable extent expansively. The engines are of rude construction compared with English engines but they are cheap and answer their intended purpose Upon the Mississippi and its tributaries most of the engines are high-pressure with the cylinders lying horizontal as in locomotive engines and accidents by explosion and fire are of frequent occurrence Some of these engines are worked with steam of 250 lbs pressure upon the square inch The muddiness of the water of the Mississippi causes it to froth very much and the boilers to prime, unless steam of a high pressure be employed, which, as it occupies a less volume, occasions less agitation in the water as it rises to the surface The cabins of American steamers are in nearly all cases very handsome and spacious, the boilers are usually disposed at the sides of the vessel behind the paddle boxes so that the cinders fall into the river, and the steering wheel is placed on the upper deck near the bow and communicates with the rudder at the stern by means of iron rods or chains

*Steam Navigation upon shallow Rivers* —The shallowness of many of the rivers of the continent on which it became important to establish steam navigation, has led to the introduction of very light vessels upon them Upon the upper part of the Rhine, and upon the Moselle, there are vessels plying which draw only 11 inches of water Upon the Loire there are vessels plying which draw only from 8 to 10 inches of water, and upon the Red River, a tributary of the Mississippi in America, there are vessels plying which are [illegible] to draw only 7 [illegible] These vessels of course do not carry [illegible] Mr Bourne has proposed a species of steam train for navigating the rivers of India, consisting of a steamer of high draught towing a train of

shallow barges in which cargo would be deposited; and he reckons that by this simple expedient he would be able to open up ten thousand miles of river, now inaccessible, to commercial intercourse by steam Each of the proposed barges would carry 50 tons of cargo on a draught of 12 inches of water, and it is considered that a steam vessel of suitable construction would be able to draw five of these barges behind her at an average speed of 8 or 10 miles an hour Mr Bourne in his Report upon the navigation of the rivers of India, has very clearly pointed out the necessity of employing vessels of a very light draught in the navigation of shallow rivers, not [illegible] possible [illegible] For if the bottom of any vessel of considerable draught approaches near the bottom of the river, a great declension in the speed will immediately ensue, in consequence of the difficulty with which the water closes in at the stern, owing to the friction presented by the river bed It is consequently necessary to the efficiency of any scheme of steam navigation proposing to maintain a considerable rate of speed upon shallow water, that the draught of the vessel employed shall be considerably less than the depth of the water The vessel should be also of great length, and should be trimmed by the head, so that the bottom may rise out of the water altogether at the stern These objects are attained, and are reconciled with the necessary degree of strength, by Mr Bourne's articulated steam train, by means of which shallow and shifting rivers, like those of India, may be navigated at a speed adequate to most of the locomotive wants of any country in a primitive state A very long and shallow vessel laden with cargo would break if she grounded on an uneven place, but a train of barges will be exempt from this accident, will also be able to turn with facility in the river bends, and will be able to realise all the benefits which a very long and shallow vessel could attain

*Steam Navigation upon rapid Rivers* — A method of towing barges by steam has for some years past been in successful operation upon the Rhone which appears likely to be of service in all cases where rapid rivers have to be ascended with heavy loads Upon the paddle shaft a toothed drum is fixed which engages an endless chain that passes round a great wheel like the fly-wheel of an engine, but armed with projecting spikes that runs along the bottom of the river This wheel is placed at the lower extremity of a wooden frame hinged at its upper end so that it can rise and fall with the irregularities of the river bed, and this wheel being put into revolution with about one-third of the speed of the paddles, drags the vessel up against the stream The paddles are thrown out of action when this wheel is in operation, but the paddles are used in descending the river, at which time the great wheel which rises through a well in the centre of the vessel is lifted out of the water

*Comparative Eligibility of Wooden and Iron Steamers* — The increasing dearth of oak and other timber in this country suitable for ship-building and the increasing cheapness of iron owing to the successive improvements which are being made in its manufacture, bring with them the inevitable condition that iron vessels must supersede wooden vessels for all the ordinary purposes of commercial intercourse In some respects iron vessels are better than wooden vessels, and in other respects worse They are stronger [illegible] getting on rocks or shoals [illegible] duction of water-tight bulkheads dividing the vessel into several distinct compartments, are more free from bilge water and from rats, are not attacked by the white ants or by the dry rot, and do not involve the same expense for caulking and repairs For all purposes of river navigation, and also for coasting navigation, especially if the vessels require to enter tidal harbours, iron vessels are unquestionably the best adapted, but when dispatched upon long voyages to tropical countries iron vessels are attended with inconveniences which do not attach in the same degree to wooden vessels Of these the most serious is fouling Sea weeds and shell fish attach themselves to the bottom of the vessel beneath the water and they not merely impede the progress of the vessel, but some species of shell fish corrode the iron into holes Iron vessels, moreover, are both hotter in warm climates than wooden vessels, and colder in cold climates In some cases too in which iron vessels have been employed in [illegible] it has been found that the rapid radiation of heat at night from the hull has caused a deposit of dew upon the surface of the iron within the vessel, and this dew has trickled down within the hold and damaged the cargo Such an accident, however, it is obvious, might be prevented by putting a few battens along the vessel's sides so that the cargo would not press against the surface of the iron, and the dew might then trickle down without producing any injurious effect

The only effectual expedient that has yet been discovered for preventing the fouling of iron ships is the application of a partially soluble poisonous paint to the bottom of the vessel, as first proposed by Mr Robert Mallett of Dublin [illegible] poison [illegible] time prevent [illegible] marine plants or animals, but if the body of the paint be insoluble the poison on the surface will be speedily dissolved out, leaving a film presented to the water in which there is no poison, and to this film the sea weeds and barnacles will adhere By giving a slight solubility, however, to the body of the [illegible] poison [illegible] The necessary degree of solubility is given to the paint by adding to it a certain proportion of soap A paint compounded on Mr Mallett's principle is manufactured by Mr Peacock of Southampton, and this paint has been found to be highly efficient in preventing marine adhesions, even in the most unfavourable circumstances in which iron vessels can be placed In the case of iron vessels which do not pass into warmer latitudes than that of Great Britain, it will be sufficient to coat the bottom with red lead paint, and the only growth which, under these circumstances, will take place is some long grass, which will show itself near the water line, but which may easily be scrubbed off with a brush

Much conflicting testimony has been given touching the comparative advantages of wood and iron for the construction of war steamers, but before any conclusive judgment on this subject can be arrived at, further experiments are needed to develope more fully the good and bad qualities of each material In a wooden vessel a hole made by a ball contracts, and nearly closes of its own accord, whereas in an iron vessel the hole is always as large as the ball, and sometimes much larger But by applying to the interior of the vessel near the water-line a thick layer of a substance called kamptulicon, consisting of ground cork and Indian rubber, the hole made by a shot will be effectually closed by this substance, so as to prevent the water from entering It has yet to be ascertained moreover, whether a [illegible] will not be given to the side of an iron vessel that any ball or projectile would glance off without entering it at all

*Proper Mode of constructing Steam Vessels and Ships* — Vessels of every kind should be so built as to realise the maximum of strength with the minimum of materials, and as they are weakest in the direction of their length, they should be built on [illegible] beam In other words [illegible] is nearly as possible on the proportions of the Menai tubular bridge to which end the main-deck should be nearly as strong as the bottom There are too many ribs in iron vessels One rib for every beam is sufficient, and beam and rib should be formed into a continuous outline Iron vessels should have iron decks formed in a piece with the sides and the deck and the bottom should be brought into equilibrium, so that the one would crush at the instant the other would tear Vessels constructed upon this principle would be much stronger than common vessels [illegible] and they would also better resist twisting and all other strains to which vessels are exposed

*Mode of determining the best Form of Hull* — It is easy to tell the comparative facility with which bodies of different forms pass through the water, by ascertaining the weight necessary to draw each at a given velocity, but although this information is arrived at, it nevertheless remains uncertain whether any of these forms is the best for the velocity in question This problem Mr Bourne many years ago proposed to solve by placing in a running stream, or by drawing with a given velocity through stationary water some substance which would be moulded by the action of the water itself and as those parts which were struck most forcibly would be driven most in the [illegible] face, and the total resistance would thus become a minimum The shape proper for different proportions of breadth to length, and also for different velocities, would thus be arrived at, and by making a few experiments with larger models, the law would be discovered of the influence of size upon the results obtained

*Secrets of Efficiency in Steam Vessels* — The first condition of efficiency in a steam vessel is, that the hull shall be of such a form as to pass through the water with the least possible resistance, and in order that it may be so, it may be accepted as a general rule that there should be no straight lines in it A wall sided vessel will realise a less speed than if the breadth were somewhat extended, so as to take away the flatness of the sides, and at the same time she will be less able to bear fore and aft canvass from the deficient stiffness due to her deficient breadth The paddle boards should be large relatively with the propelling power employed, and if of the common radial kind should be [illegible] and narrow, rather than short and deep [illegible] should be made with steam casings or jackets, and then the steam may be worked expansively with advantage through a considerable part of the stroke The boilers should be capable of being worked with safety with a considerable pressure

of steam, and should have abundant heating surface, so that an adequate supply of steam may at all times be maintained, even with flues not quite clean, and coal not of the best quality It is a rare thing for steam vessels to have adequate boiler power There is consequently a frequently recurring difficulty in keeping the steam up to the proper pressure, and much fuel is wasted by the frequent stirring of the fire, owing both to the refrigeration caused by the cold air which enters through the open furnace door, and to the loss of small coals through the bars of the grate Feathering paddle-wheels increase the amount of work done by a given expenditure of fuel, but there is also an increased consumption of fuel incident to their use They enable a smaller wheel to be employed, so that the engine works faster, whereby an increased power is exerted, and the vessel goes at a greater speed than before But about the same quantity of coals is relatively with these coals consumed in working the [illegible] ary wheel with fixed floats, provided the floats be long and narrow with little immersion, and that the wheel is of considerable diameter Upon the whole, feathering wheels appear to be advisable in the case of river steam vessels, or vessels which permit frequent inspection and repairs, but not in the case of vessels called upon to perform ocean voyages of great length, and subject to violent vicissitudes of wind and sea All vessels intended to be fast should have engines which work well up to their power, and in order to do this they must employ a considerable pressure of steam. To enable this necessary pressure to be employed with safety, the boilers must be strong, and they should be tested once a year by forcing them full of water with the deck pump to make sure that the gradual progress of decay has not left any weak place which renders the pressure they carry no longer safe

*Secrets of Economy in Steam Vessels* — The main secret of economy in steam vessels is to make as large use as possible of the sails, and the object of the commander should be to maintain a speed which shall be as nearly as possible of a uniform rate When therefore a favourable wind occurs the steam should be shut off from the engines to such an extent that the speed is not materially increased, and, on the contrary when a calm or adverse wind occurs such an increased supply of steam should be given to the engines that the speed of the vessel is not materially diminished When the wind alone suffices to give a good speed to the vessel, the engines, even though worked at their utmost power, will not increase the speed very much, and it will be better in such a case to save the fuel, as the voyage cannot be materially abbreviated by any increase that can be given to the speed It is mainly therefore by varying the amount of expansion used in the engines according to the resistance to be overcome, that fuel in steam vessels is to be economised, and at the same time the other conditions necessary to efficiency must be observed The effectual clothing of the boilers and the engines, so as to prevent the dispersion of heat by radiation, is of course to be attended to, and care must also be taken in the selection of the coal Welsh coal has greater evaporative efficacy than any other, and is therefore best (For further information respecting Steam Navigation, see *Treatise on the Steam Engine, by the Artizan Club*, *Catechism of the Steam Engine, by J Bourne, C E*, and *Treatise on the Screw Propeller, by J Bourne, C E*)

STEARIC ACID (Gr στεαρ, *fat*) One of the acids produced in the process of saponification by the action of alkalies upon *stearine*

STEARINE (Gr στεαρ) That part of oils and fats which [illegible] temperatures

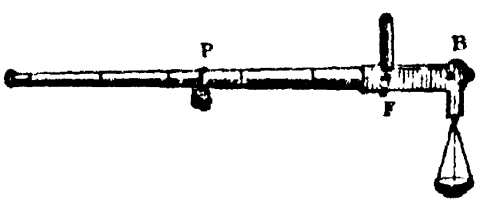
STEATITE (Gr στεαρ) A soft mineral of an unctuous or soapy feel, hence called *soapstone* It is a hydrated silicate of magnesia and alumina

STEATOMA (Gr στεαρ A tumour, the contents of which are of the appearance and consistency of hard fat

STEEL (Germ stahl) This most useful and curious substance is a compound of iron and carbon their relative proportions vary in steel [illegible] s, but in that used for ordinary purposes [illegible] exceeds 2 per cent [illegible] it Certain kinds of iron [illegible] manufacture, but this relates entirely to its purity, which is the essential requisite Steel is made by a process called *cementation*, which consists in filling a proper furnace with alternate strata of bars of the purest malleable iron and powdered charcoal [illegible] the air is carefully excluded from the boxes [illegible] the whole kept for several days at a great [illegible] process carbon, probably in the state of vapour, penetrates, and combines in the above small relative proportion with the iron the texture of which, [illegible] s surface acquires [illegible] of steel falls [illegible] and more sonorous and elastic and susceptible of a higher polish and has less tendency to rust At a red heat it admits of hammering into various forms, and of being welded or united by the blows of the hammer to another piece of steel or iron Blistered steel, rolled or beaten down into bars, forms *shear steel*, and if melted, cast into ingots, and again rolled out into bars, it forms *cast steel*, which, when well prepared has the great recommendation of perfect uniformity of texture and a fine and close grain The peculiarities of steel upon which its high value in the arts in great measure depends are its property of becoming, by sudden quenching in water, when at a bright red heat, extremely *hard* and of being [illegible] ened down to any requisite degree by the application of a certain temperature, which may be indicated by a thermometer, commonly [illegible] different [illegible] heated steel The process is called *tempering*, and the workman is sometimes guided in the extent to which it is carried by the *colour* of the polished surface of the heated steel, which is at first rendered of a pale straw tint, then yellow, brownish, purple and blue as the temperature rises from one extreme to the other The latter colour indicates extreme softness and elasticity, such as belongs to watch springs, some sword blades &c, pale straw indicates great hardness, as for razor blades, yellow is somewhat softer, and shows a fit temper for penknives, and the incipient blues announce the temper that belongs to coarser cutting instruments, and to table knives, any of which, made of hard steel, would soon get spoiled and notched, but the edges of which, when duly tempered, resist breaking on the one hand, and bending on the other. When a large mass of steel is hardened by quenching in water, it undergoes a certain degree of expansion, so that the specific gravity of hard steel is somewhat less than that of soft It has been attempted to improve the quality of steel for certain purposes by adding to it small [illegible] hence the term *silver steel*, &c, have on the whole proved superior to well made common steel There is a kind of steel imported from India, known under the name of *wootz*, the [illegible] which is celebrated for the tough [illegible] of its edge It appears probable that its peculiarities depend upon the presence of a little aluminum When the surface of some kinds of steel is washed over with a weak acid, it acquires a peculiar mottled or *damasked* appearance, as if its texture consisted of an intimate mixture of two different kinds of steel or of fine fibres of steel and iron Steel, alloyed with a little nickel, often puts on this appearance, but these and some other imitations of the celebrated *Damascus* sword blades have not led to any important improvements in the manufacture of our cutting instruments (See Stodart and Faraday, *Phil Trans* 1822)

STEEL ENGRAVING The art of engraving on steel See ENGRAVING

STEEL YARD A balance by which the weights of bodies are determined by means of a single standard weight The instrument, which is represented in the annexed figure, is a lever having unequal arms The load whose weight is to be determined is suspended from the extremity B of the short arm, and in weighing the constant weight or counterpoise P is slid along the longer arm [illegible] Divisions [illegible] weight B corresponding to each position of P




In the Roman steel yard, or *statera*, the lever was so constructed that the centre of gravity was brought immediately over the point of support, and the system being accordingly balanced upon its fulcrum F, the effect of the weight of the lever was neutralized The longer arm was then divided into parts each equal to the shorter arm, and those again equally subdivided Suppose now the length of the shorter arm, or the distance F B, to be one inch, and the [illegible] P to be one pound, then if P be placed [illegible] of five inches from F, it will make equilibrium with a load of five pounds suspended from B, for, from the property of the lever, when the equilibrium is established the weight P is to the load at B as the distance of B from F is to the distance of P from F Whatever proportion, therefore, F P has to F B the same proportion has the weight suspended from B to the constant weight P

The steel yard in common use is constructed somewhat differently, the beam being seldom made so as to balance itself on the fulcrum F, but the error that would arise on this account is compensated by beginning the divisions at that point where the weight P being placed the equilibrium is established If, therefore, when P is removed the longer arm preponderates, the divisions commence from a point between F and B For the purpose of increasing the range, there are also in general two fulcra, from either of which the beam may be suspended, and two corresponding scales of division are marked on opposite sides of the longer arm

For weighing heavy loads the steel yard is a convenient instrument but for smaller weights it is susceptible of less accuracy than the common balance. It should be con-

structed so that the point of support F, and the point of suspension at B, may be in the same straight line with the divisions of the beam

STEEL YARD, MERCHANTS OF THE A company of London merchants to whom the *steel yard* (see above) was assigned by Henry III A D 1232 They were all foreigners, chiefly Flemish and German, and were long the only exporters of the staple commodities of England

STEINING or STEANING In Architecture, the brick or stone wall or lining of a well

STEEPLE [illegible] usually attached [illegible] in which bells are frequently but not always suspended

STEER To keep the ship on a given direction This is done by moving the rudder by the tiller, which last is moved from that side to which the ship's head is required to be moved

STEERAGE The steering of the ship Also a place below in the fore part of ships, is distinguished from the *chief* [illegible] is of uncertain acceptation

STEGANOGRAPHY (Gr στεγανος, *covered*, and γραφω, *I write*) The art of writing in cypher *See* CYPHER

STEGANOPODS (Gr στεγανος, *covered*, πους, *a foot*) The name of a family of web-footed birds (*Natatores*) in the system of Illiger, [illegible] species in which all the four toes are connected by the same web It corresponds with the genus *Pelecanus* of Linnæus

STEINHEILITE A mineral of a blue colour, a variety of *iolite*

STELA (Gr στηλη, from ἱστημι *I stand*) In Architecture, a small column without base or capital, usually with an inscription to record an event, or to perpetuate the memory of some deceased person The ancients also used [illegible] There are several specimens [illegible] M

STELLATÆ In Botany a natural order of Exogens, also known under the name of *Galiacea*, which see

STELLERIDANS, *Stellerida* (Lat stella *a star*) Star fishes The name of the family of Echinoderms of which the genus [illegible] is the type

STELLIONATE In the Roman law, a general term comprehending all sorts of fraud committed in matters of agreement which were not designated by any more special appellation The name is said to be derived from *stellio*, a lizard because the fraudulent man is comparable to that animal for versatility and address The six common species of stellionate enumerated by Roman writers were, 1 When one sells the same thing to two purchasers, 2 When a debtor pledges to his creditors something which does not belong to him, 3 When one abstracts or damnifies something which he has pledged to creditors, 4 Collusion by two parties to the prejudice of a third 5 When a vendor substitutes an object of less value for that which he has engaged to sell, 6 A wilful false declaration in an instrument

STEM In Music the upright or downright line added to the head of a musical note, the head being that part filled in black or left open, as the case may be

STENELYTRANS *Stenelytra* (Gr στενος *narrow*, ελυτρον, *a sheath*) The name given by Latreille to a family of Coleopterous insects, comprehending those in which the elytra become narrow at the posterior part of the body

STENOGRAPHY (Gr στενος, and γραφω *I write*) The art of short hand, otherwise termed *tachygraphy* This art has been practised from remote antiquity, and is said to have originated in the hieroglyphics of the Egyptians Numerous systems of stenography have been invented in more recent times many of them of great simplicity, but it would be out of place here to enter into any details respecting them

STEP A block of wood, or in large ships of late years a strong solid platform upon [illegible] the keel of the mast It was found [illegible] mast, yards, &c added to the enormous force upon the rigging, especially during strong winds, forced the keel down

STEPPES (Russ) The name given to the vast system of plains peculiar to Asia, synonymous with the prairies of North America and the Llanos of South America The steppes of Russia are not unlike the heaths of Germany, being in part susceptible of cultivation and [illegible] numerous herds of nomadic tribes

STERCORANISTS In Eccl [illegible] nickname which seems to have [illegible] Western church, in the 5th and 6th [illegible] held the opinion that a change to [illegible] stance of the consecrated elements, so as to render the divine body subject to the act of digestion (See *Mosheim*, vol [illegible] 1796 p 342)

STEREL MINTHANS *Sterelmintha* (Gr στερεος, *solid*, and ελμινς, *an intestinal worm*) The name of a class of internal parasitic animals or Entozoons, comprising those which are composed of a solid parenchymatous substance, in which the nutrient and generative canals are simply excavated and not freely suspended in [illegible]

STEREOGRAPHIC PROJECTION (Gr στερεος, *solid*, γραφειν *to describe*) The projection of the sphere upon the plane of one of its great circles, the eye being situated at the pole of that circle *See* PROJECTION

STEREOGRAPHY In the Descriptive Geometry, the [illegible] of solids on a plane

STEREOMETER (Gr στερεος, *solid*, μετρον, *measure*) In Hydrodynamics an instrument invented by M Say, a French officer of engineers, for determining the specific gravity of liquid bodies, porous bodies, and powders as well as of solids The instrument may be described as follows —Let A E be a glass tube, about three feet long, and open at both ends, the upper part A B being about 4-10ths, and the lower 2-10ths of an inch in diameter The upper edge is ground smooth, so that it can be shut air-tight by a piece of ground plate glass, and the upper part A B communicates with the lower by a very narrow slit at B, which allows air to pass, but prevents the passage of sand or water In using the instrument, a powder (for instance) is placed in the tube A B and the lower part B E is plunged in water or other fluid, till the fluid rises exactly to B The ground glass cover is then placed upon the mouth A, and there is now no air in the tube except what is mixed with the powder Supposing the barometric pressure to be 30 inches, let the tube be elevated until the mercury stands within it at a point C, 15 inches above its surface in the open vessel, and it is manifest that the air within the tube is pressed with exactly half an atmosphere It consequently expands to twice its original bulk, and hence the tube A B now contains only half the quantity of air it contained at first The part B C must therefore contain the other half or the air in B C is equal to the air mixed with the powder in A B, and being half the original quantity under half the original pressure, it fills the same space which the whole occupied previous to the expansion Let the powder be now removed from A B, and the process repeated when the tube is filled with air The quantity of air being now greater, will, when expanded to twice its bulk, fill a larger space than B C, and the mercury will rise only to some point D, but as the expanded air occupies exactly the same space in B D or B C as the whole occupied in A B under twice the pressure, it follows that the cavity C D = B D − B C is equal to the bulk of the solid matter in the powder If, therefore, we now find the number of grains of water which would fill the part C D, we determine the weight of water equal in bulk to the solid matter in the powder, and by comparing this with the weight of the powder, we obtain its specific gravity (*Ency Brit* art Hydrodynamics)




Say's stereometer was first described in the *Annales de Chimie* for 1797 An instrument on exactly the same principle was afterwards brought forward by Sir John Leslie under the name of a *conniometer*

STEREOTYPE (Gr στερεος, *solid*, and τυπος *a figure*) Masses of letters, called letter-press plates, of the size of a page, cast from a plaster mould, in which an exact representation of the types has been made, and thus form-

[illegible] with the impression of whole blocks, it may be said that in its progress towards perfection it has again reached the same point by the introduction of stereotype plates The origin of the more modern invention is involved in greater obscurity than might at first sight appear probable from its comparatively recent date By some writers the merit of the invention is ascribed to the Dutch, who had adopted the plan of printing with solid or fixed types in the 17th century, but it was not till the end of the last, and the commencement of the present century, that the process was perfected and generally introduced In this useful invention, the most prominent names are those of [illegible] Tulloch and Foulis of Glasgow and Didot Paris and Wilson and Earl Stanhope in London The process of stereotyping is very simple A page of any work proposed to be stereotyped is set up with moveable types in the ordinary way A plaster cast is then taken from it, which, being first dried, is immersed in fluid metal The cast or plate, after being sufficiently cooled, is then withdrawn from the mould, and at a subsequent stage, carefully examined with a view to removing any imperfections previous to its being printed from The plaster used for forming the mould is [illegible] mixed with water to the consistence of cream After the form of types has been surrounded with a brass frame, and slightly oiled on the surface, the fluid plaster is poured upon it, and by the application of a brush, made to fill every cavity of the letters, the superfluous portion being cut off When the plaster has set sufficiently hard, it is by means of the frame lifted off the face of the type and detached from it It is then

baked to dryness in an oven; and when quite hot it is placed in an iron box, or casting pot, which has also been heated in an oven The box is now plunged into a large pot of melted type metal, and kept about ten minutes under the surface, in order that the weight of [illegible] all the finer parts of the [illegible] cooled, the mould is broken and [illegible], and [illegible] of the plate turned smooth on a lathe, or planed by a machine (*Conversations-Lexicon*)

STERLING The legal description of the English current coin, of which the most probable derivation is from *Easterling*, the popular name of the Baltic and German traders who visited London in the middle ages, but in what manner it came to be so applied is unknown Camden says from [illegible] artists in coining The silver penny was [illegible] Esterling

STERN In Naval affairs, the after extremity of a vessel

STERNA A genus of web footed birds, having a bill as long as or longer than the head, almost straight, compressed, and pointed, the mandibles of equal length, the upper one slightly inclined towards the point, nostrils pierced towards the middle of the bill, legs small, naked to above the knee, three anterior toes, united by an indented web the hind toe free, wings very long and pointed, tail more or less forked From the two latter characters, the species of *Sterna* are sometimes called "sea swallows" their proper English name is 'tern"

STERNOPTI (Gr στέρνον *sternum*, and ὄψις, *pointed*) The name of a tribe of Coleopterous insects comprehending those in which the sternum is prolonged into a point at both extremities

STERNUM (Lat sternum, *the breast bone*) In Comparative Anatomy the simple or compound bone which completes the [illegible] cage anteriorly and serves as a medium of union to a greater or less number of the ribs The sternum is not present in the skeleton of Fishes Amphibians, or Ophidians In Saurians the anterior portion is generally expanded, to be joined to the broad coracoids and clavicles In Chelonians this part of the skeleton is remarkably developed and very complex and constitutes the greater part of the plastron or floor of their defensive osseous case In Birds also, it is more or less complex at the beginning of its development, but the different ossifications are soon blended together, and form a single broad bone principally remarkable for the keel-like process developed from the middle line of its under surface This keel is subservient to the attachment of the muscles of the wing, and bears a direct proportion to the powers of flight, except where the wings, as in the penguin are used as fins In the Struthious birds, the keel of the sternum is wanting

In Mammalia, the sternum is generally simple and consists of a single chain of ossicles, except in the orang utang and occasionally in man, where a double series of ossifications are originally developed in the body of the bone, but which afterwards become confluent The upper portion, or *manubrium sterni*, remains long distinct from the main body of the sternum, in man, the cartilaginous appendage of the lower edge of the sternum is called xiphoid or ensiform

STETHOSCOPE (Gr στῆθος *the chest*, and σκοπέω *I explore*) A cylinder of cedar wood, about 12 inches long and 1 in diameter, perforated throughout its length and divided into two parts for the convenience of using the whole or half its length The end of each part terminates in a funnel shaped cavity Its use is adverted to under the head AUSCULTATION

STEWARD, LORD HIGH was anciently the first officer of the crown in England with the Latin title of Magnus Seneschallus The office was at one period annexed to the lordship of Hinkley in Leicestershire held by the family of De Montfort, but on the rebellion and fall of that noble house, it was in effect abolished as a permanent dignity, and is now only revived *pro hac vice* on the occasion of a coronation, or the trial of a peer In the former case, the lord high steward's commission is to settle matters of precedence, &c, in the [illegible] to preside in the House of Lords

STEWARD LORD, OF THE HOUSEHOLD An officer of the king's household England, in Norman French, Seneschal He is steward of the marshalsea or court of the household, an office which he performs by deputy In his department is the counting house where the expenses of the king's household are taken, within which [illegible] court which has [illegible] in the king's palaces and verge of the court

STHENIC DISEASES Those which are the result of inflammatory or increased action, as opposed to asthenic or diseases of debility

STIBIUM An [illegible]

STICHOMANCY (Gr στίχος, *a line*, and μάντεια, *prophecy*) Divination by lines or passages in books taken at hazard Among the Romans, verses from the Sibylline books were written on slips of paper, which were thrown into a vessel, and future events were conjectured from the interpretation of one of these slips drawn out at hazard Of the same kind were the *Sortes Virgilianæ*, *Homericæ*, &c, a sort of literary superstition by which the works of authors were consulted, and the meaning of a line casually taken assumed as indicative of the fate of the person discovering it Verses of the Bible selected in this way by chance have been, and are still, frequently taken by the superstitious as oracular This sort of divination has been [illegible] *sortes biblicæ* It was condemned [illegible] in 465, and other early synods, but was long afterwards practised in France at the elections of bishops, abbots &c The custom of drawing by lots verses from the Bible on such occasions is said to have prevailed as late as 1740, in the cathedrals of Ypres, St Omer, and Boulogne *See* SORTES, SORTILEGE

STICK, GOLD The colonels of the two regiments of Life Guards are so called whose duty it is to be in immediate attendance on the sovereign on all state occasions These colonels do duty for a month alternately; the one on duty being called the *gold stick in waiting* The field officer of the Life Guards, when on duty, is called *silver stick* The term originated in the custom of the sovereign presenting the colonel of the Life Guards with a gold stick on [illegible]

STIGMA [illegible] An impression such as that made [illegible] hot iron Stigmatizing was a common practice among the ancients to mark their slaves as property, and it is pursued at the present day among slave-drivers It was customary also to stigmatize the votaries of some of the gods with some recognized emblem of their divinity, such as the ivy of Bacchus, trident of Neptune &c, or with the initial of their names, or some mystical number It is supposed that reference is made to this practice by St John, Rev ch 13 *See* TATTOOING

STIGMA In Botany, the upper extremity of the style without a cuticle, in consequence of which it has almost uniformly a humid and papillose surface It is the part upon which the pollen falls and where it is stimulated into the production of the pollen tubes, which are indispensable to the act of impregnation

STIGMATA In Theological language, the marks of the wounds of our Saviour The text at the end of the Epistle to the Galatians, "From hence let no man trouble me for I bear in my body the marks of the Lord Jesus" seems to have given rise to the superstitions promulgated in the [illegible] church respecting the impression of the stigmata on favoured saints, of which the legend of St Francis of Assisi affords the most remarkable instance

STILE In Architecture, the vertical piece in framing or panelling *See* RAIL

STILL (Lat stillare, *to drop*) An apparatus for the distillation of liquids upon the large scale It includes the *body* or *boiler*, which is usually set in brickwork over a furnace, and to which is annexed the *head*, forming the communication between the boiler and *condenser* or *worm pipe*, from the extremity of which the distilled liquid passes in successive drops, or a small continuous stream, into the *recipient* There are an infinite variety of stills adapted to particular purposes, of which the most important are the distillation of spirituous liquors (*See Ures Dict of Arts &c*)

STILT BIRD The name of the *Himantopus melanopterus* [illegible] It has very long and slender legs

STINKSTEIN A bituminous carbonate of lime, which exhales a fetid odour when rubbed

STINT In Coal Mines, a measure of work used under ground, 2 yards long and 1 broad, which each miner clears before he removes to another place, and which is proved by a boy appointed for the purpose, who is colloquially called "the judge"

STIPEND (Lat stipendium), signified originally the pay of soldiers In a legal sense it is applied to the salary or allowance given to some person for transacting the business of another, but in Scotland the term is almost exclusively confined to the provision made by law for the established clergy *See* PRESBYTERY

STIPPLING In Engraving, the method of producing shadows by means of dots of greater or less size, according to the intensity of shadow required By this method the resemblance to chalk drawings is produced

STIPULA In Botany, a small appendage situated upon each side of the base of a petiole, most commonly of a less firm texture than the latter, and having a subulate termination the word is also used in describing *Hepaticæ*, to denote the appendages which are occasionally present at the bases of the leaves, but of which they seem rather to [illegible]

STOCK DOVE [illegible] *Columba Ænas* by Linnæus

STOCK EXCHANGE The name given to the system whereby the purchase, sale, and "carrying over"

[illegible] -ted by certain parties called [illegible] be explained and discussed [illegible] — viz first, the parties engaged in stock transactions, whether brokers or jobbers, secondly, money and time bargains [illegible] the [illegible] and regulations by which these operations are conducted

The Clearing-house [illegible] Lombard Street affords the greatest facilities to the transactions of the Stock Exchange, inasmuch as, without its intervention, difficulties and embarrassments would present themselves in the final settlement or adjustment of those transactions of an almost insurmountable character By means of this clearing-house, all the great monetary transactions of the day are brought to a close by 5 o'clock in the afternoon, whereas in the ordinary mode of paying or receiving money whether in notes or hard cash, their settlement might not be finally effected for several days afterwards, to say nothing of the security afforded to all parties concerned by the operation of the clearing-house

The members of the Stock Exchange are divided into two distinct classes —viz the brokers, and the jobbers It is the business of the brokers to receive and to execute the orders of merchants, bankers, capitalists and private individuals, who are "out of the house," the Stock Excha[illegible] wn members honoured with [illegible]

The jobbers [illegible] he "house," and ready to act upon the orders thus received by the brokers And here it may be as well to explain the nature and character of the business transacted by these jobbers, who, being men possessed of more or less capital, endeavour to turn it to account in the manner we are about to explain It is their business to be always prepared to make a price to the brokers whenever the latter present themselves the readiness which they display in offering to do business to large amounts at the apparently small difference of 1 8th per cent would appear extraordinary, were it not that they are so numerous that an eager competition is excited amongst them for the favours of the brokers When one of the latter appears in the market, he is surrounded by a knot of jobbers, who announce themselves ready to buy or sell whatever amount of stock he has to deal in at a price varying only 1 8th per cent For instance if a broker has to do business in 5000*l* Consols (the market price being about 90) the jobber offers to buy his 5000*l* at 90 or to sell him that amount at 90⅛, without being in the slightest degree aware whether the orders of the broker are to buy or to sell, and thus taking upon himself the risk of selling that which he does not possess, or of buying what he does not intend to keep, his only object being to undo his bargain, at a difference of 1 8th per cent, or even less, with another broker, who may have to effect an operation the very reverse of the other, which 1 8th or even 1-16th constitutes his profit

Without the intervention of the jobber, therefore, it will be seen that there would exist a vast difficulty in effecting the transactions which daily take place The jobbers are, in fact, the "middle men" who stand in the house in the character of dealers, always ready to buy or sell, thus obviating the necessity of the broker s going in quest of a second broker, with whom he might transact his business, or, in other words, whom it might suit to buy what the other broker had to sell or *vice versa* Again, even if one were at hand he might not be able to concur in the actual amount of stock which the other wished to deal in, whereas the jobber is ready to do business to any amount, even to the smallest fraction, and hence a great deal of time is saved It often happens that a broker who has to dispose of shares not currently dealt in is frequently obliged to wait for months before he can find a purchaser, whereas, in the case of stock the jobbers offer themselves as buyers or sellers at a moment s notice, and thus offer facilities for transactions in the public funds which could not be effected without them

Having thus endeavoured to explain the difference between broker and jobber, and confined our attention hitherto to money transactions, we next proceed to describe the nature of "time bargains," which form so essential a feature in stock business Indeed the very existence of the Stock Exchange as at present constituted, depends upon speculations in time bargains, for where there exists a body of 600 members, the actual *bonâ fide* busi[illegible] ployment for t[illegible] the national de[illegible] and sales of stock made for a certain fixed period, regulated by the committee There can be little doubt that they had their origin in the business which has always been transacted in the funds during the periods when the stocks are shut For instance, Consols usually close about the beginning of June and December, that is to say, the transfer books at the bank are shut for the space of five or six weeks, in order to afford time for the preparation of the dividend warrants, which are paid in the following July and January Hence it is clear that a person wishing to buy or sell that particular stock during the period referred to would be unable to effect his object, but in order to secure the price of the day, he buys or sells the stock "for the opening" that is for actual transfer on the day on which the transfer books are re-opened This mode of doing business is legitimate enough, but this practice has no doubt given rise to operations of the greatest magnitude, founded, not on actual necessities, but merely on speculation, and this method being found convenient for one period, has been continued on other occasions, without, however, possessing the same pretext for its adoption Periodical dates have consequently been fixed upon by the committee, similar to the "opening," at intervals of about six weeks, making altogether about eight "settling days," as they are called, in the course of a year On these settling days are arranged and adjusted all the bargains made during the preceding six weeks for that particular day, those who sold stock having to deliver it on the one hand and those who purchased having to accept and pay for it on the other But as the majority of the speculators have no intention of doing either the one or the other, their bargains having been of a purely speculative character, founded on their anticipations of a rise or fall in the value of the securities, so whatever difference may exist between the price at which a party commenced his speculation and that at which he finally closed it is settled on this important day, and his operations most likely not having been confined to the same jobbers, but having been effected with several, it becomes necessary to balance them with the parties concerned, and much the same process takes place on this occasion as that practised at the bankers' clearing-house, by establishing balances between each other Whatever balance remains unsettled is adjusted by the name of the *bona fide* purchaser of the stock (who intends to pay for it) being passed from one broker, or jobber, or speculator to another, until it comes into the hands of the party who intends to deliver or transfer the stock, by which means all the intermediate persons through whose hands it passes (the price given by the purchaser being marked on the ticket) are enabled to close their accounts with each other at that particular price, and to pay and receive the difference accordingly In short, all transactions kept open [illegible] the [illegible] day *must* then be closed, and the party who delays this operation until the last moment is often exposed to [illegible] the difficulty of finding others who, having [illegible] accounts, are unable or unwilling to enter into a fresh transaction on this "day of reckoning," whereby he is compelled to pay something extra in the price to those who have it in their power to afford him this facility, in order to enable him to settle his account

But as many of the bargains made for this particular day are really *bona fide* transactions the stock bought and sold being, in point of fact, delivered by the actual holder and taken by the new purchaser, let us briefly explain how this is effected. This process is one of daily occurrence and is not necessarily confined to a settling day although on such occasions it usually amounts to a considerable item, from [illegible] extended over a wider period In either case however the following is the way in which the matter is settled between the broker and his principal who has sold stock — The broker usually passes his check for the proceeds of the sale to his principal, taking the precaution of crossing it, *i e* writing a banker s name across the check When, however, Bank of England notes are demanded in lieu of crossed checks (as is sometimes the case), the bargain is made accordingly in this case, the jobber who buys the stock provides them either by borrowing of those who happen to have large balances at their bankers', or from their own private bankers The notes so borrowed by the jobber are then paid over to the broker, and by him to his principal This operation is, however, seldom resorted to by men of business where there is no reason to doubt the credit of the party drawing the check

The jobber, on the other hand, having sold the stock to some other broker, who buys for his principal, receives in return his check, so that, by this simple process of passing four checks, — viz that of the purchaser to his broker, that of the broker to the jobber, that of the jobber again to the broker who first sold the stock, and that of the latter to his principal, — the whole transaction is completed

To advert to another technical peculiarity appertaining to the Stock Exchange, which may appear puzzling to the reader, the use, [illegible] of the terms "bull" and "bear" A *bull* is one who speculates f[illegible] [illegible] w[illegible] [illegible] Consols for the settling [illegible] "for the account" with [illegible] during the intervening period at a higher price The "bear" on the other hand, would sell [illegible] stock (which, however, he does

not possess) "for the account," with a view of buying them in for the p [illegible] at a lower price than [illegible] during "one account," vast profits may be realized, or equal losses sustained, by these gambling operations

The transactions in the foreign market are carried on much in the same way as in that of the English stocks, with the exception that the settling days are much more frequent, occurring as they do once in every fortnight The foreign house is quite of modern origin, but it is subject to the same rules and regulations as the English with a few exceptions The dealings are there carried on in all the foreign stocks, as well as in [illegible] and other shares The jobbers are dist [illegible] in the English [illegible] there is nothing to prevent them from [illegible] if they possess sufficient intelligence to enable them to give their attention in two places at once

In connection with time bargains may be noticed that important branch of business which goes under the [illegible] ation," or "carrying over" [illegible] interest for money borrowed or lent on security of stock The rate of this continuation or interest varies according to the abundance or scarcity of money, and the nature of the security offered For instance, on British stocks even when money is very scarce, it seldom exceeds the rate of 5 per cent per annum from one account to another, whereas in the foreign market, where the security consists of foreign bonds of various and doubtful descriptions, it ranges from 5 to 10 per cent, or even more on particular occasions when it reaches 10 per cent per annum

There are several causes which tend to produce this extraordinary variation in the rates of continuation, for in the case of Consols, which constitute the only stock for speculation in time bargains in the English market, the price varies so little in comparison with the value of the stock in the course of an "account," that the security is considered good in itself, and therefore no extra charge is superadded by the party who lends his money This is not the case with regard to foreign stocks, which are constantly fluctuating in value, a fact to be accounted for by the extremely precarious nature of this description of property Most of the bonds in circulation in the foreign house have ceased to bear any interest whatever and many of them bear upon them the marks of their shame and disgrace in the shape of the arrears of interest, called *coupons*, overdue for several years It is not therefore to be wondered at that foreign securities of this description do not command the same credit as our own English stocks, and it must hence follow, as a matter of course that parties who wish to raise money upon them must consent to pay a higher rate of interest for the accommodation

A great deal of business is transacted in this way and some brokers who possess the means of obtaining large sums of money without much difficulty devote their entire attention to it The process by which the operation is effected is simple, both in the English and foreign market The present rate of continuation in the Consol market is 9-16ths per cent until the opening, and if a person, we will suppose, wishes to lend money on that stock, from the shutting (on the 2d of December) to the opening (on the 14th of January 1842) his broker procures him 1,000*l* Consols as security, for which he furnishes the money at the actual price of the day, which is 90, making 900*l*, and resells at the same time the said 1000*l* stock for the opening (on the 14th of January) at $90\frac{9}{16}$, making 906*l* 12*s* 5*d*, and thereby leaving a difference in his favour of 5*l* 12*s* 6*d* for the loan of 900*l* d r n, th a [illegible] forty-four days, which will be found to be at the rate of 3*l* 3*s* 8*d* per cent per annum On foreign securities the principle is the same Supposing he lends on the security of Spanish bonds, he receives as security 5100*l*, for which he pays on the 30th of November, at the price of $24\frac{1}{2}$ per cent, 1249*l* 10*s*, but sells it to the same party for the 15th of December (the next settling day) at $24\frac{9}{16}$, producing 1252*l* 13*s* 9*d*, leaving a difference in his favour of 3*l* 3*s* 9*d*, or 1-16th upon the stock bought and resold, which, for fifteen days, is equal to 1-8th per cent per month, or 12-8ths per cent, per annum, equal to 76*l* 10*s*, being at the rate of about 6*l* 2*s* 6*d* per cent per annum interest This calculation is made upon the current rate of interest for the "continuation" of that stock on the 30th of November, which was considered as extremely low

The continuation on shares, in which a great deal of business is also done, varies but little from the above, but a difficulty here arises, which offers a great obstacle to the lending of money for short periods

The *stamps* which by law are necessary for the due transfer of property of this description, and without which transfer there could be no security to the lender of money, are so onerous, and press so heavily on all *bona fide* transactions, that notwithstanding the many attempts made at various times to evade them, they operate materially against the parties who lend money upon them, and in fact, neutralize all profit for short periods

Persons who have sold shares or stock, if they are not [illegible] with their brokers, [illegible] the interest of the [illegible] copies of profit to obtain interest for it until they actually deliver the stock On the other hand, speculators for the rise are by this means able to carry over their purchases from one account to another, and although it may appear strange that they should be paying at the rate of 5 and even 10 per cent per annum interest on a stock which, in the instance of Consols, pays them only 3 per cent, and in that of Spanish pays them actually nothing, still, when viewed solely in the light of speculations, the rise in either security, if it take place, will more than compensate for this apparent inconsistency

The proceedings of the Stock Exchange are regulated by a committee consisting of thirty members, who are elected from the general body every Lady day, each member having one vote They take care that the rules and regulations enacted for the admission and expulsion of members, and for the settlement of disputes, are properly observed, and although some of their laws are at variance with the established laws of the country, they are not so strictly enforced by the committee as to bring them into collision with the courts of justice they fully answer the purpose for which they were intended, and all members previously to their admission subscribe to the conditions there laid down

All members, on being admitted, are obliged to produce three securities of 300*l* each for the first two years of their probation, which 900*l* becomes forfeited in the event of their failure, and goes to the creditors of the new member In consequence of their being interdicted from engaging in any other business, on becoming members of the Stock Exchange they are no longer subject to the bankrupt laws, and therefore, in the event of failure, all their assets are secured to the creditors *in* the house, to the exclusion of those *out* of it This rule is enforced in order to secure the house from the loss which would ensue to its members were the legal creditors (if any existed) to step in and lay claim to their property

The tendency of the above regulation is to insure honesty amongst its members Should any principal have reason to complain, he has only to appeal to the committee, who instantly take cognizance of the matter, and subject it to the strictest investigation Defaulters whose conduct has been dishonourable are punished, and an example is made of them by publicly affixing their names in the house on what is termed the *black board* this is the heaviest disgrace which a member can possibly experience (For this elaborate account of the procedure of business in the Stock Exchange, we are indebted to the *Times* of 1841)

STOCKS A well known kind of punishment The practice of confining men by the legs was so common as to have given the ordinary name to a chain of any kind in several languages *e g* Gr πέδη Lat *compes*, Engl. *fetter*, all from πους, *foot* The stocks in England have been, generally speaking, rather used for restraint than punishment, constables being empowered to put disorderly persons into them, but it is likewise ordered by some statutes as a punishment on conviction It is now almost disused, though, we believe, not entirely in remote districts

STOICS A celebrated sect of antiquity, so called from the *stoa* or *porch* in Athens which was the scene of the discourses of their founder Zeno of Cittium (B C 300). The Stoics are proverbially known for the sternness and austerity of their ethical doctrines, and for the influence which their tenets exercised over some of the noblest spirits of antiquity To give a connected and systematic account of the philosophical principles on which they grounded their moral precepts is a less easy task than, from the notoriety of the latter in some of their main features, might have been anticipated Their speculations were not confined to ethical subjects, but aimed at embracing the whole circle of human knowledge, physics, theology, and logic, no less than morals and politics Their system, as far as we can gather from the notices preserved by [illegible] hers, appears to be an attempt to [illegible] pantheism and a materialist psychology with a logic which seeks the foundations of knowledge in sensible experience, and a morality which claims as its first principle the absolute freedom of the human will Of the mode in which they combined dogmas apparently so inconsistent into a philosophical whole, we have accounts sufficient to inspire us with respect for the earnestness and strength of character possessed by the leaders of their sect, and with [illegible] We [illegible] a narrow and controv [illegible] but comprehensive [illegible] sophical writings of their great predecessors, of Plato, and, in a still more eminent degree, of Aristotle The

philosophy of the Stoics was essentially polemical On every side it presented an armed front to an opponent It sought to confute the academic scepticism by the strenuous assertion of the truth of sensible perceptions, and the validity of the judgments to which they lead by a vigorous protest in favour of the common sense of mankind as opposed to the theories of the schools Sensation, they affirmed, is not merely a passive affection of the mind, it becomes, under certain conditions, perception or *comprehension* (κατάληψις) —a faculty whereby the mind reaches beyond itself, and *lays hold*, as it were, on outward being From the acquisitions of sensible experience are formed conceptions and judgments of successive stages of generality, which it is the province of the reason to construct into philosophical system Such is the stoical logic, which is consequently a *material*, and not, as with Aristotle, a *formal* science An equally controversial bearing is perceptible in the remainder of [illegible] critus, which accounted for all physical phenomena by the varieties in size and figure of the ultimate atoms of which all substances are the aggregate The fortuitous concretions which thus became the first cause of all things, had attracted the partialities and won the assent of a sect averse in all things equally to limitation or constraint The Stoics espoused the opposite doctrine of a one all-pervading substance, a permeating ether, a creative fire the source of life and law to the material universe On this they built their doctrine of a universal providence, excluding chance in the least things as in the greatest, and directing all events by irresistible necessity to the promotion of perfect good The same hypothesis furnished them with a ground for the first principle of their ethical doctrines "Live according to nature" is, with the Stoics the expression of the coincidence which ought to exist between the human will and the universal reason, which, as we have seen, they identified with the life and power of nature This coincidence is virtue, the only good, as vice, its opposite, is the only evil All things else are in themselves indifferent, being approved or disapproved only by comparison Virtue is the perfect harmony of the soul with itself, vice is, in its essence, inconsistent and self contradictory The wise man, the ideal of human perfection, is absolutely, and without qualification, free His actions are determined by his free will with a power as irresistible as that by which universal nature is guided and animated In the one no less than in the other, freedom and necessity are one

In these doctrines the controversial character to which we have adverted is sufficiently obvious Much, however that is exaggerated and paradoxical both in the tenets of the Stoics and in those of their opponent Epicurus is to be accounted for by a reference to the political circumstances of the age in which both lived The pressure of public calamity and the utter extinction of national life in Greece while they precluded all healthful exercise of the duties of a citizen —duties which had entered so largely into the calculation of the earlier Greek moralists,—would drive the more virtuous and thoughtful part of mankind to seek in the development of the individual life for that satisfaction which they sought elsewhere in vain It is easy to conceive that the same circumstances which would recommend to minds of a certain order the good-humoured apathy and the tranquil voluptuousness of the garden, might with men of sterner temperament be the occasion of drawing forth all the energies of their will and of placing those energies at once in distincter consciousness to themselves, and in sharper antagonism with the evil that surrounded them In the declining period of the republic, as well as in the darkest periods of the empire, we find the noblest Romans seeking for consolation in the doctrines of one or the other of these rival sects Brutus, Seneca, Epictetus, and the philosophic emperor Aurelius, are among the names of the most celebrated Roman Stoics Little, however, was done by the Romans to advance the speculative part of the stoical philosophy, which was indebted for its systematic form to Cleanthes and Chrysippus

The chief sources of information concerning the doctrine of the earlier Stoics are the philosophical works of Cicero, for their logic, the *Academic Questions*, for their ethics, the treatise *De Finibus*, and the *Tusculan Questions*, and for their theology and physics, the books *De Natura Deorum*, and *De Fato* See also *Diog Laert* l vii Plutarch, *Adv Stoicos*, &c , Ritter, *Hist of Ancient Philos* xi part 5

STO'LA (Gr στολη) A dress of which the name was borrowed by the Romans from Greece, but acquired in their language a peculiar signification, being the habit appropriated to women It was a long vest coming down to the ankles worn within doors, and covered by the palla when they went out, as described by Horace, *Sat* l i 2 —

Ad talos stola demissa et circumdata palla

Common prostitutes, at least in the age of Horace, were not permitted to wear this distinguishing garb of the Roman lady The stole is a robe worn by deacons in the Roman Catholic church *See* VESTMENTS

STOLE, GROOM OF THE An officer of the king's household in the lord chamberlain's department He is first lord of the bedchamber, his title is derived from the [illegible] occasions He originally performed likewise the office of the king's shirt on of a morning, which in his absence, devolved on another lord of the bedchamber

STO'MACACE (Gr στομα, *the mouth*, and κακος, *evil*) A fetor of breath, arising from ulcerated gums Mouth-washes, with tincture of myrrh and borax and the internal use of tonics, are the remedies which relieve it

STO'MACH, *Stomachus* (Gr στομα, *the mouth*, and χεω, *I melt*, from its receiving the contents of the mouth and melting them down into nutriment) The human stomach is a somewhat oblong and rounded membranous bag, situated in the epigastric region It is largest on the left side (or cardiac end, and gradually diminishes towards the right or lower orifice, which is called the *pylorus* Like the intestines the stomach has three coats or membranes, connected together by cellular membrane The exterior or peritonæal coat is a dense firm membrane, the internal or villous coat is soft, mucous, and vascular, the central coat is muscular, and the glands of the stomach are situated between it and the villous coat The stomach is largely supplied with nerves which come from the eighth pair and sympathetic They are chiefly from the cæliac and are accompanied by veins which empty themselves into the vena portæ The lymphatics of the stomach proceed directly to the thoracic duct *See* ANATOMY and DIGESTION

STOMACH PUMP A small pump or syringe with two apertures the valves of which are so arranged as to admit of liquids being drawn out of, or injected into the stomach, by means of a flexible tube

STO'MAPODS *Stomapoda* (Gr στομα, *a mouth*, πους, *a foot*) The name of an order of the class *Crustacea*, comprehending those in which the maxillary feet are formed like the first four thoracic feet

STO'MATA Passages through the epidermis of plants, [illegible] which [illegible] stances and lies over a cavity in the subjacent tissue They are universally regarded as spiracles or breathing pores

STONE BORERS, called also *Lithophagi* Molluscous Bivalves which, by means of a fleshy foot, on which they turn as on a pivot, perforate or bore into rocks

STONE CHAT A species of warbler, forming the type of the genus *Saxicola* of Bechstein It is the *Sylvia rubicola* of Latham, *Motacilla rubicola* of Linnæus Also called the "chick stone"

STONE CURLEW The name of a large species of plover, the *Œdicnemus crepitans* of Temminck It appears in England at the latter end of April, frequents open hilly situations, makes no nest, but lays two eggs on the bare ground, and emigrates in small flocks about the end of September

STONE GALLS A technical term applied to nodules of clay occurring in sandstone, they often fall out on exposure to weather, and render the stone unfit for architectural purposes

STONE IN THE BLADDER *See* CALCULUS

STOO'KING [illegible] of corn in stooks, t [illegible] formed soon after the corn is cut, it being previously tied into bunches or sheaves

STOOL The root of a timber tree, which throws up shoots Coppice wood consists chiefly of the shoots sent up by the roots of stools of trees or shrubs which have been cut over by the surface In general all Dicotyledonous trees are endowed by nature with the property of sending up shoots from the stump or stools; but this is not the case with most of the Gymnosperms or Coniferous trees A wood of pines or firs, therefore, when once cut down, can never be renewed, except by seeds

STO'RAX [illegible] exudation from the *Liquidambar* [illegible] It is generally much adulterated

STORK An English name [illegible] the *Ciconia* of modern ornithologists [illegible] (*Ciconia alba*) is that species which visits [illegible] England

STORM The causes of those violent commotions of the atmosphere to which we give the names of storms, tempests, hurricanes, tornados, &c , are involved in great obscurity, chiefly from the difficulty of obtaining a precise knowledge of the various circumstances with which they are accompanied In order to ascertain the general laws of these phenomena [illegible] to determine, in a great [illegible] the place and time at which the storm begins and ends, the path it describes, the extent of atmosphere disturbed, the di-

rection and force of the wind and the barometric pressure at every part of the disturbed column during the whole time of its continuance But several of these points could only be determined from the comparison of a great number of simultaneous observations on that tract of the earth's surface over which the storm passes, while from the nature of the thing to be observed, it is evident that a few insulated observations is the most that can be expected in almost any case Besides, a storm for the most part passes over some part of the sea, where, unless a ship unfortunately happens to be caught in it no observation can be made, or even evidence be obtained of its existence

It is in the torrid zone that storms display the greatest violence, and rage with most destructive fury In our latitudes they are comparatively rare, and in the polar regions they seldom amount to more than a strong wind

Until recently it was generally believed that during a hurricane the wind at every part of the agitated mass blows in a rectilinear and parallel direction, and a storm was considered to be sufficiently explained when it was described as a wind blowing with a velocity of 100 or 120 miles in an hour A comparison of the recorded accounts of [illegible] storms has of late yea[illegible]eous, and that the phenomena are considerably more complicated

Franklin appears to have been the first who remarked that storms travel in a direction opposite to the actual movement of the wind at the time the storm is raging, and he ascribed the phenomenon to a great but partial rarefaction of the air, arising from the sudden precipitation of vapours, or other causes, the consequence of which would necessarily be a simultaneous rush from all quarters to fill up the vacuity, and the mass of air being thus set in motion by a sort of aspiration, the gale will be first felt at those places towards which it blows (*Letters and Papers on Philosophical Subjects*) In a work on winds and monsoons published in 1801, Colonel Capper was led, from a comparison of the details respecting the hurricanes at Pondicherry and Madras in 1760 and 1773, to remark that these hurricanes must have been whirlwinds, whose diameter could not exceed 120 miles and that the velocity of the wind at any point was due to the rotatory velocity of the vortex He also supposed that, besides the gyratory movement which forms the characteristic of the whirlwind, a storm has probably also progressive motion Colonel Capper's speculations however appear to have met with little attention until the subject was taken up by Mr Redfield of New York who, in a series of papers published in the American journals diligently collected and examined a great number of observations relative to the storms of the West Indies and North American coasts and arrived at similar conclusions The following general phenomena appear to be established —1 The severest hurricanes originate in tropical latitudes to the north or east of the West Indian Islands 2 They cover simultaneously an extent of surface from 100 to 150 miles in diameter, acting with diminished violence towards the exterior, and increased energy towards the interior of that space 3 The tract over which the hurricane passes is not a straight line South of the parallel of 30° north latitude, it proceeds in a westerly course inclined to the north, but [illegible] rather abruptly [illegible] incline gradually more to the east The average progressive velocity appears to be from fifteen to twenty five miles per hour 4 The duration of a storm at any particular place depends of course on the extent of the mass of agitated air, and the progressive velocity, and storms of smaller extent move with even greater rapidity than large ones 5 The direction of the wind in a hurricane is not in the direction of its progress When the progressive motion of the storm is westward, the wind at the commencement is from a northern quarter, and during the latter part of the gale from a southern quarter of the horizon When the progressive motion is eastward the phenomena are reversed, the wind blows at first from a southern quarter, and towards the end of the gale from a [illegible]

[illegible] particularly the last, Mr Redfield concludes that the great body of the storm whirls in a horizontal circuit round a vertical or somewhat inclined axis of rotation, which is carried forward with the storm, and that to a spectator placed at the centre the direction of the rotation is invariably from *right to left* It is to be understood, however, that the phenomena now described and the conclusions drawn from them apply only to the northern hemisphere

Another fact deserving of attention is, that the barometer, in all latitudes, sinks during the first half of the storm [illegible] This phenomenon is ascribed to the effects of the centrifugal force of rotation, and such is the regularity of its occurrence, that it has been [illegible] self a strong proof of the rot[illegible]



Colonel Reid of the engineers having been officially employed to repair the government buildings at Barbadoes [illegible] by the great hurricane of 1831, was led to investigate the subject generally, and in his work, entitled *An Attempt to develop the Laws of Storms, &c*, he has collected and given the results of an immense number of details, obtained from an examination of ships' [illegible] and other sources These results [illegible] all respects the conclusion Mr [illegible] the gyratory motion of the [illegible] progressive motion in a curve line, first westward, and then towards the north and east, the position of the vertex of the curve at or near the 30th degree of latitude, and the fall of the barometer during the first half of the storm, and its rise during the second Colonel Reid has also given an account of several great hurricanes in the southern hemisphere, from which it appears that the southern storms [illegible] the northern, but in a reverse [illegible] f the rotation is from *left to right*, the centre of the gyrating mass advances first eastwards, then turns towards the south, and falls off towards the south-west and west, the vertex of the curve being at the [illegible]th degree of south latitude In the northern hemisphere the West Indies and Atlantic coast of North America appear to be the places where storms most frequently rage, in the southern, the focus of storms appears to be placed near the Mauritius

The uniformity of the direction of the rotatory motion of [illegible] he [illegible] Mr Reid [illegible] retical considerations respecting the origin of storms, which he supposes to be produced by the mingling and collision of two atmospherical currents near the outer border of the trade winds, namely, the superior or equatorial stream and the polar stream which counterbalance the trades On looking at the curves representing the paths of the hurricanes on the charts projected by Mr Redfield and Colonel Reid it is difficult not to believe that the direction of their progressive motion is mainly determined by the configuration of the American continent

The fact of the whirling character of storms has been controverted by Mr Espy another American writer on the subject who advocates Franklin's theory of progressive motion in radial lines Mr Espy states, that on comparing simultaneous observations in the middle of storms and all round their borders, he found that the wind blows *inward* on all sides of a storm towards the central parts, — towards a point, if the storm be round, [illegible] teen storms, without finding a single exception to the general rule Professor Bache of Philadelphia maintains the same opinion and has described a tornado which occurred at New Brunswick in 1835, in which he could find no proof of rotation, the objects thrown down by the wind being all directed to a centre It is not improbable that there may be hurricanes of both characters An outline of Mr Espy's theory is given in the *Report of the British Association for* 1840

Independently of the interest which attaches to the subject in a meteorological point of view, a knowledge of the general laws which regulate the phenomena of storms would be of immense importance, inasmuch as it would enable the navigator to avoid those tracts of the ocean in which they chiefly prevail at particular seasons, or at least, if surprised by a storm, to steer on the course by which he may soonest escape from it or fall into its wake On either theory the direction of the wind at the commencement of the gale must indicate, with considerable certainty, the quarter in which the storm is raging with great [illegible] In addition to the works already [illegible] *Journal* from 1831, Prof Forbes's Reports on Meteorology in the *Reports of the British Association* for 1832 and 1840, and the *Edin Review*, vol lxviii) See also WIND

STO'RTHING The parliament of Norway It is elected once in three years, and sits every year for the despatch of business The election is double, every qualified person (an owner or liferenter of land paying taxes in the country, and every one possessing land or houses of 150 rix dollars value in towns) joining in the election of councillors who elect out of their own body the representatives of the country These must be from 75 to 100 in number The storthing, when elected divides itself into two houses one fourth, chosen by the rest, joining the lagthing, or upper house, the remainder the odelsthing, or lower house The storthing has the usual powers of a legislative assembly in a constitutional country, and the king has only a suspensive veto, which if the storthing passes a law three times in six successive years, becomes of no effect

STORY In Architecture, a subdivision of the height of a house, comprehending the height ascended by one fli[illegible]

STORY POST In Architecture, a vertical post to support a floor or superincumbent wall.

**STOVE** (Dutch, *stove*) A receptacle for the combustion of fuel for the purpose of heating houses, &c The common fire-grate for the combustion of coal, with its various appendages is generally called a *stove*, hence *register stoves*, *Bath stoves*, &c These are often, and indeed generally, very ineffectively constructed, and calculated to consume a large quantity of fuel, with a proportionate waste of heat They are generally intended to diffuse warmth principally or entirely by *radiation*, and should be placed as near the ground as possible, while the different parts into the contact of which the burning fuel is brought should be of fire-brick, or some similar composition, which is a bad conductor but a good radiator of heat It is manifest that in our common fire-[illegible] volume of hot air which passes up [illegible] available as a source of heat, hence, [illegible] where greater economy of fuel is studied, the fireplace is frequently closed in, and contained in an iron box which projects into the room while the heated air before it finally enters the chimney is made to circulate through tubes or pipes, to which it communicates much of its excess of heat, and these again impart it to the surrounding air What are termed *German stoves* are usually made upon such principles, and in them the fuel is often introduced and the air required for the support of its combustion admitted, on the outside of the room in which the stove with its flues and heating surfaces is placed

In *Arnott's stoves* the heat is similarly but more scientifically economized There is only enough air admitted to keep up the slow combustion of the fuel and the heat is communicated to the radiating surfaces of the stove, so that before the air which has passed through the fuel finally enters the chimney it has been deprived of the greater part of its available heat These stoves are also so constructed as, by means of thermometric or self-acting registers to adjust with much nicety the supply of air, so that neither more nor less may enter than is required to maintain the combustion of a given quantity of fuel

In *Feetham's air-stoves* the common open fire is retained, but the heat is to a certain extent economized by by causing the hot air before it enters the chimney to communicate a portion of its heat to an iron box, over which a current of air passes and is sent warm into the room

It is manifest that our common open fires must act as powerful ventilators, and that the large quantity of air which is driven up the chimney must be supplied in some way or other through the apartment in which the fire is burning This supply of air is generally left to chance, and finds its way into the room by crevices in the doorways and window sashes or between the boards of the floor or any similar accidental passage through which it can make its way, and as in London at least, the air always abounds in fuliginous particles these are carried in along with it and show its track by the blacks which it deposits If this supply of air is inadequate and it generally is so in new and well built houses, in consequence of the tightness of the doors, windows, and floors the chimney of necessity smokes, and the door or window requires to be left open to prevent such an effect This evil may usually be effectually prevented by admitting fresh air from without through some proper and adequate channel, and various ornamental or concealed apertures may be contrived for the purpose, in the best arrangement of which, however much practical as well as theoretical skill is often essential

When rooms are warmed by German or Arnott's stoves, the ventilating powers of which are very inferior to the open grate, *ventilation* requires to be strictly attended to Where buildings are warmed by currents of hot air sent up from stoves on the basement story great attention should also be paid to ventilation, and in such cases the leading object should be to send in a large volume of air very moderately heated (to about 100°), rather than a small quantity of very hot air the latter does not readily mix with the surrounding cold air, but forms a distinct and rapidly ascending column which does not diffuse itself where most wanted, and it is apt to have a disagreeable and burned odour, arising from the charring of the particles of organic dust which are carried with the air over the too highly heated surfaces of the stove or flues A little aqueous vapour, sent in along with the warm air by placing a saucer of water in some convenient situation, is often effectual in preventing the disagreeable sensation occasioned by respiring too dry an atmosphere

STOVE In Horticulture, a structure in which plants are cultivated that require a considerably higher temperature than the open air in Britain and similar climates There are two or three kinds of stoves, but the principal are the dry stove and the damp stove The dry stove is a structure, the atmosphere of which is heated to the temperature of from 55° to 60° during winter, in which are chiefly cultivated succulents, such as the different species of *Cereus*, *Cereus*, *Stapelia*, *Euphorbia*, *Mesembryanthemum*, and other succulents having similar habits. During winter these plants require very little water, and during summer they require intense heat and abundance of air and water during bright weather The damp stove, sometimes also called the bark stove, requires a temperature of between 60° and 70° during winter, with a proportionate increase during summer, accompanied, in both seasons, with a high degree of atmospherical moisture This moisture is produced partly by evaporation from the bark bed in which the plants are plunged, but chiefly by watering the floor of the house, and by syringing the plants During summer the plants in the bark stove require all the high [illegible] which the atmosphere in this country is capable of producing, together with abundance of air, as in the dry stove Both stoves are heated by smoke flues, or by hot water or steam, circulated in metallic or other tubes The plants cultivated in the moist stove are exclusively those of the tropics, and those which require the highest degree of heat are chiefly Monocotyledonous plants, such as the *Scitamineæ*, which include the ginger, plantain, banana, sugar cane, palms, *Orchidaceæ*, [illegible] the yam [illegible] and other [illegible] plants The bark bed is chiefly employed for producing a uniform degree of moisture and heat to the roots, and also as a reservoir of heat for the atmosphere of the house in case of any diminution from the flues, water or steam pipes, or the sun Stoves of every description require a constant degree of attention from the gardener throughout the year, more especially such as are devoted to the palms, the banana, the pine apple, and the *Orchidaceæ*

STRABI'SMUS (Gr στραβίζειν, *to squint*) An unnatural obliquity in the axis of the eye arising from various causes It may often be, to a great extent overcome, especially in children, by blindfolding the sound eye, presuming one only to be affected In very bad cases, especially those of squinting inward and such are by far the most common an operation which has lately been introduced is often effectual in greatly relieving the deformity, it consists in dividing the internal rectus muscle of the eyeball which is done by a proper scissors without externally wounding the eyelid

STRAIGHT ARCH In Architecture, the arch over an aperture whose intrados is straight, but with its joints drawn concentrically as in a common arch

STRAIGHT JOINT FLOOR In Architecture *See* FLOOR

STRAI'NING PIECE In Architecture, a piece of timber, whose office is to prevent the farther approach of two pieces of timber in a framework, such is the collar in a queen post roof *See* ROOF

STRAIT in Geography, signifies a narrow pass or frith separating one country from another

STRA'MONY or THORN APPLE The *Datura stramonium* an indigenous narcotic plant, the seeds and leaves of which are used in medicine The dried leaves are occasionally smoked, like tobacco, for the relief of spasmodic asthma, and an extract of the seeds is used as a sedative in some painful chronic affections *See* DATURA

STRA'NGURY (Gr στραγξ, *a drop*, and ουρον, *urine*) A difficulty in voiding urine

STRATH, in Scotland is generally understood to signify a valley of considerable size, whose appellation is determined by some river running through it, or some particular characteristic

STRA'TUM When different rocks lie in succession upon each other, each individual forms a *stratum* *See* GEOLOGY

STREAK The appearance which arises from scratching a mineral with the point of a knife The streak is *similar* when the colour of the scratch is the same as that of the mineral, but *dissimilar* when the colour varies

STREAM TIN Native oxide of tin, or tinstone, which is found in rounded particles and masses, mixed with other alluvial matters The finest grain tin is procured from this ore

STRE'LITZ (Rus plural strelitzy, said to be derived from strelat, It strale, *an arrow*) A soldier of the ancient Muscovite militia was so called The strelitzy were [illegible] and [illegible] the empire and, like the Turk [illegible] terrified with its governmen [illegible] during the absence of the Czar Peter I, who, on his return, cashiered the corps altogether

STRENGTH in Mechanics, is used in the same sense as force or power Thus strength of animals is the muscular force or energy which animals are capable of exerting, strength of materials is the resistance which bodies oppose to a force acting upon them

*Strength of Animals* — It is obviously a matter of much importance to be able to estimate with tolerable accuracy the effort which an animal of the average [illegible] capable of exerting, and [illegible] is subject to

variation from so great a number of circumstances, both physical and mechanical that the results given by different authors present very little agreement with each other, though they are of great value as affording data for determining the modes in which animal labour is most advantageously employed

The force which an animal is capable of exerting against an obstacle is greatest when the animal stands still When it begins to move, a considerable part of its strength is expended in the transference of its own body, and the greater the velocity with which it moves the less will be the load which it is capable of transporting There must, also be a certain velocity at which it can only move when it carries no load Now, if from the total effect of the muscular force exerted we subtract the part which represents the transference of the weight of the animal's body the remainder, which is called the *useful effect*, will be obviously measured by the load which the animal is capable of transporting to a given distance in a given time, therefore, putting $w$ = the weight $v$ = the velocity, and $t$ = the time, the useful effect is represented by the product $w\,v\,t$, and will be greatest when this product is a maximum In order to determine this maximum it is necessary to establish a relation between $w$ and $v$ (for the time $t$ may be taken as unity) The empirical formula given by Euler for representing the relation between the load and the moving power in machines generally may be adopted for this purpose as it has been found to agree tolerably well with experiment Let P denote the power of the animal or the greatest load it is capable of moving and $c$ the greatest velocity with which it can move unloaded, then the equation between $w$ and $v$ is $w = P\left(1 - \frac{v}{c}\right)^2$, and the product $w\,v$ becomes a maximum when $3v = c$, or $v$ is one third of $c$ *See* MACHINE.

In order to compare the effects produced by different animals, or by the same animal under different circumstances it is usual to express the effect numerically in terms of some conventional unit, which as being the measure of a force, is called the *dynamic unit* Thus, in the product $w\,v\,t$ we call $w = 1$ lb $v = 1$ foot and $t = 1$ minute, the measure of the force will be the effort necessary to raise or transport a pound through one foot of space in one minute of time For example Desaguliers asserts that a man can raise a hogshead of water 10 feet high in a minute Now a hogshead of water, vessel included weighs about 550 lbs, and 550 lbs raised through 10 feet must require the same exertion of muscular force as 5500 lbs raised through one foot, therefore the useful effect, which in this case is the whole effort as the man stands still is expressed by 5500 dynamic units and may thus be compared with any other effort which is capable of being similarly expressed Instead of a pound, a foot and a minute we might assume a hundred weight a yard a day or any other denominations that may be convenient

*Strength of Men* — The measure of human force has been the subject of numerous experiments, principally by Desaguliers, Lahire, Guenyveau Coulomb Schulze Buchanan, &c, whose results may be found in most treatises on practical mechanics These results differ very widely, as indeed might be expected considering the very great differences of the force which different individuals are capable of exerting — differences which depend not only upon age constitution, and habit, but even upon climate, temperature, and food

Of the different modes of estimating human strength the most practically useful is the observation of the average effect produced daily by a labourer who continues his exertions for a number of successive days We shall state a few of the results, and for the sake of comparison reduce them to dynamic units, assuming the unit to be 1000 lbs avoirdupois transported to the distance of one foot in one minute

According to Coulomb, a man walking on a level road may travel at the rate of 30 miles per day or 264 feet per minute, and continue his exertions 10 hours a day Taking the weight of the man at 150 lbs, the quantity of action is 23760 dynamic units

If instead of walking on a level road he mounts a stair, the velocity is reduced to 26 4 feet per minute, and the labour can be continued only 8 hours a day In this case, the effect produced is 1901 dynamic units

A man walking on a level road, and carrying on his back a weight of 90 lbs travels at the rate of a mile and a half per hour, or 132 feet per minute, and continues his exertions 7 hours per day The *useful effect* is consequently 4989 dynamic units

A man climbing a stair and carrying on his back a load equal to his own weight or 150 lbs proceeds at an average rate of only 7 feet per minute during 6 hours a day The useful effect is consequently 378 dynamic units

A labourer transporting materials in a wheelbarrow, and returning unloaded for a fresh burden, transports a load of 130 lbs with a velocity of 90 feet per minute, working 10 hours a day The useful effect is consequently [illegible]

The power which a man exerts in dragging a load has been variously estimated Schulze estimates the absolute effect, or that which the man can exert for a short time without moving as equal to a pressure of about 107 lbs, Bernoulli at 75 lbs, and Guenyveau found the absolute force of traction, when exerted by means of a rope passing over the shoulder, to be from 110 to 132 lbs Allowing the accuracy of Euler's formula above given, and assuming the action to be a maximum when the velocity is 2 miles per hour, we shall have $c = 6$, and if we also assume the absolute force P = 72 lbs, then the formula will become $w = 2(6 - v)^2$, in which $w$ represents the number of [illegible] to the force developed when the velocity [illegible] Thus when $v = 0$, we have $w = 72$ lbs, when $v = 2$, we have $w = 32$ lbs, and when the velocity is 4 miles per hour, the force of traction becomes 8 lbs In the extreme cases the formula is inaccurate, but for moderate velocities it affords a tolerable approximation

The greatest velocity with which a man can walk for a length of time, having no load to drag, is, according to Schulze, 5 37 feet per second, according to Bernoulli, 6 56 feet, according to Guenyveau, from 6 56 to 9 84 feet per second or from 4½ to 6¾ miles per hour

According to Mr Buchanan (*Repertory of Arts*, vol xv) the effective strengths of men in working a pump, in turning a winch in ringing a bell, and rowing a boat are respectively as the numbers 100 167 227, 318 The last is one of the most advantageous modes in which human force can be exerted

Porters in London carry from 200 lbs to 300 lbs at the rate of 3 miles per hour, chairmen walk at the rate of 4 miles an hour with a load of 150 lbs each and it is said that an Albanian porter will carry from 700 to 900 lbs, [illegible] The [illegible] the comparative strength of [illegible] countries with Regnier's dynamometer, are given by M Peron [illegible] 71 4; France 69 2, Timor, 58 7, Van Diemen's Land, 51 8, New Holland 50 6

*Strength of Horses and other Quadrupeds* — Of all animals employed as first movers, the horse is beyond question the most useful, and that whose labour is susceptible of the most numerous and varied applications It is therefore very important to ascertain his average force [illegible] estimates have been [illegible] of performing and of his absolute muscular power For the purpose of determining the latter, the dynamometer may be conveniently used, but as the action of the animal is very quickly reduced by continued exertion it is more usual to estimate it according to the amount of daily labour performed Desaguliers and Smeaton estimate the strength of a horse as equivalent to that of five men, the French authors have commonly stated it as equal to that of seven men, and Schulze makes it equal to that of fourteen men in drawing horizontally According to Desaguliers a horse's power is equivalent to 44 000 lbs raised 1 foot high in one minute, Smeaton makes this number 22 916 Hachette 28 000, and Watt 33 000 This last estimate is what is commonly understood by the term *horse power* as applied to steam engines

The quantity of action which a horse can exert diminishes as the duration of the labour is prolonged Tredgold gives the following table showing the average maximum velocity with which a horse unloaded can travel, according to the number of hours per day —

| Time of March in Hours | Greatest Velocity per Hour in Miles | Time of March, in Hours | Greatest Velocity per Hour, in Miles |
|---|---|---|---|
| 1 | 11 7 | 6 | 6 0 |
| 2 | 10 1 | 7 | 5 5 |
| 3 | 8 5 | 8 | 5 3 |
| 4 | 7 3 | 9 | 4 9 |
| 5 | 6 6 | 10 | 4 6 |

The useful effect a horse is capable of producing depends much on the manner in which his strength is applied One of the best modes is to make him draw a loaded carriage The carriers in Scotland usually transport in a single horse cart weighing about 7 cwt the load of a ton and travel at the rate of 22 miles per day Neglecting the weight of the animal and of the cart, and supposing the journey to be accomplished in 10 hours, the useful effect reduced to dynamic units (1000 lbs one foot in one minute) is 260,198 dynamic units

[illegible] drawing in a [illegible] travels at the [illegible] hours per day Here the useful effect is 200,046

A horse harnessed in a coach, and drawing a load of 770 lbs avoirdupois, goes at a trot at the rate of 433 feet per minute, during 4½ hours per day The useful effect is consequently 90,020

A horse carrying on his back a load of 264 lbs can travel at the rate of 216½ feet per minute, 10 hours a day The useful effect is 34,294 dynamic units Going at a trot with double the load during 7 hours a day and carrying a load of 176 lbs, the useful effect is 43,057

A horse harnessed in a mill, going at a pace of 195 feet per minute, and exercising a force equal to a pressure of 99 lbs, during 8 hours a day, produces a useful effect represented by 9266 dynamic units

On the strength of mules, oxen, and the other animals employed in industry, there are few correct observations The following are the principal results The useful effect of the daily labour of [illegible], Coulomb's estimate as unity, then the [illegible] the labour of some of the other animals applied in the same manner are thus estimated —

For carrying loads in a horizontal plane

| | | |
|---|---|---|
| Strength of a man | 1 | (Coulomb) |
| — of a horse | 4 8 | (Brunacci) |
| — of a horse | 6 1 | (Wesermann) |
| — of a mule | 7 6 | (Brunacci) |

For transporting burdens with a wheel carriage

| | | |
|---|---|---|
| Man with a barrow | 1 | (Coulomb) |
| Horse in a 4 wheel waggon | 17 5 | (Wesermann) |
| Horse with a cart | 21 3 | (Brunacci) |
| Mule with a cart | 23 3 | (Brunacci) |
| Ox with a cart | 12 2 | (Brunacci) |

The above comparisons are probably nearer the truth than the following which are usually quoted from Hassenfratz (*Encyclopedie Methodique*) —

In carrying loads on a horizontal plane

| | | | |
|---|---|---|---|
| Strength of a man | 1 | Strength of a dromedary | 25 |
| — of a horse | 8 | — of an elephant | 147 |
| — of a mule | 8 | — of a dog | 1 |
| — of an ass | 4 | — of a reindeer | 3 |
| — of a camel | 31 | | |

In drawing a [illegible] horizontal plane

| | | | |
|---|---|---|---|
| Strength of a man | [illegible] | of an ox | 4 to 7 |
| — of a horse | 7 | — of a dog | 0 6 |
| — of a mule | 7 | — of a reindeer | 0 2 |
| — of an ass | 2 | | |

On the subject of animal power and the best modes of its employment reference may be made to the following works — Coulomb *Sur la Force des Hommes* (*Mem de l'Acad*), Prony *Architecture Hydraulique*, Hachette *Traité des Machines*, Guenyveau *Essai sur la Science des Machines* Coriolis *Calcul de l'Effet des Machines* Borgnis *Traite de la Composition des Machines* Wesermann *Taschenbuch für Strassen und Wegbaubeamte*

STRENGTH OF MATERIALS The force with which a solid body resists an effort to separate its particles or destroy their aggregation can only become known from experiment, nevertheless if we assume an hypothesis to represent the manner in which the elementary particles are arranged and cohere general formulæ may be deduced which will [illegible] of bodies of different [illegible] to the action of forces applied in different manners and will consequently be of great use in practical mechanics

There are four different ways in which the strength of a solid body may be exerted first in resisting a longitudinal tension, or force tending to tear it asunder secondly, in resisting a force tending to break the body by a transverse strain, thirdly in resisting compression or a force tending to crush the body, and fourthly in resisting a force tending to wrench it asunder by torsion We shall consider these separately

1 *Long. and Tension* — The resistance opposed by a solid body to a longitudinal strain is usually termed the *absolute strength* or force of direct cohesion, of the body Two points may be proposed for investigation first, to determine the quantity by which a body of a given length is stretched or elongated under the action of a given force or weight, and secondly, the effort required to separate the parts or produce rupture Experiments have usually been directed to the last of these only, but the first may be determined indirectly from experiments on flexure In bodies of a fibrous structure, as the woods, the cohesive force differs greatly, according as the effort is applied in the direction of the fibres or at right angles to it When the strain is exerted in the direction of the fibres, the cohesive force obviously depends on two circumstances only — the strength of each fibre and their number, and in general in bodies of the same substance and structure, the strength is proportional to the transverse area of the body, and to a certain constant which must be determined by experiment

Suppose the body to be a prism or cylinder, and let A be the area in square inches of a section perpendicular to its length, or to the direction of the force, W the weight in pounds which produces rupture and s the absolute strength of the substance or the weight in pounds which would overcome the cohesive force of a rod whose transverse section is one square inch, then $W = s A$, or $s = W - A$ In a rectangular beam whose breadth and thickness are respectively $a$ and $b$, we have $A = a b$, whence $W = s a b$, $s = W - a b$ In a cylindrical rod whose radius is $r$, we have $A = \pi r^2$ ($\pi = 3.14159$), whence $W = s \pi r^2$, and $s = W - \pi r^2$

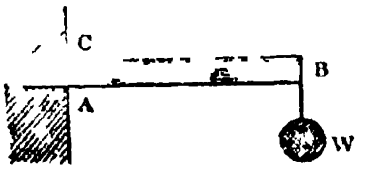
Under the term COHESION we have already given a table of the [illegible] of [illegible] for [illegible] woods and metals For [illegible] the [illegible] to *Barlow's Treatise on the Strength of Timber* &c 1837, but a much more ample collection of experimental results will be found in the work of Navier, *Resumé des Leçons, &c., sur l'Application de la Mécanique à l'Etablissement des Constructions et des Machines* We may remark, that although the longitudinal tension is with respect to mechanical action, the simplest of all the strains to which a solid body can be subjected, it is the most difficult to submit to experiment, by reason of the enormous forces required to produce rupture, and, in the case of fibrous bodies, the difficulty of applying those forces in the direct line of the fibres If the fibres are not all subjected to the same strain, it is obvious that the direct cohesion will be estimated at less than its real value, and, as Mr Barlow remarks, it is probably owing to this circumstance that so little agreement is found in the results of experiments

2 *Transverse Strength* — When a body suffers a transverse strain, the mechanical action which takes place among the particles is of a more complicated nature Galileo was the first who attempted to give a rational explanation of this action and to submit the strength of the materials used in the mechanical arts to the measures of geometry and arithmetic He assumed that all solid bodies are composed of numerous small parallel fibres, perfectly inflexible and inextensible, and that when they break the several fibres give way in succession, the body turning on the last which give way as on a hinge, and the strain on each fibre previous to the rupture being proportional to its distance from the quiescent fibres From this it follows that the resistance of a beam to a transverse strain is in the compound ratio of the strength of the individual fibres, the area of the cross section, and the distance of the centre of gravity of the cross section from the points round which the beam turns in breaking

The first who attempted to submit the theory of Galileo to actual experiment was Mariotte, whose results were published in his *Traite sur les Mouvements des Eaux*, 1680 These experiments attracted the attention of Leibnitz who, in the *Acta Eruditorum* for 1684 pointed out defects of the theory and proposed a different hypothesis Leibnitz assumes that every body before it breaks admits of a certain degree of extension, and consequently the fibres are neither inflexible nor inextensible He further assumes a principle first proposed by Hooke, namely, that the strength of each fibre under the action of a straining force varies with the degree of extension, or is proportional to the distance of the fibre from the fixed point about which the beam is supposed to turn In this hypothesis, the beam is [illegible] to turn about its upper or lower edge or [illegible] excepting the quiescent ones, are in a state of tension, although it had been remarked by Mariotte (and is indeed sufficiently obvious), that when flexure takes place part of the fibres only are in a state of tension, another part being compressed so that the line about which the beam turns is somewhere within the section of fracture Professor Robison appears to have been the first who distinctly knowed that the position of the *neutral axis* is a necessary datum in the solution of the problem

Although it cannot be doubted that the hypothesis of Galileo is at variance with the precise fact yet it is found to be sufficient for practical purposes, and indeed the results which it gives appear to agree nearly as well with experiment as those which are derived from a more refined theory and more elaborate calculations It has, therefore, on account of its great simplicity, been very generally adopted by writers on mechanics We shall here briefly state the principal results

Suppose a prismatic beam A B to have one end firmly fixed in a wall, and a weight W to be suspended from the other end, the beam lying horizontally According to the hypothesis, the fibres are inflexible and inextensible, so that no bending takes place, and when the rupture commences the fibres first give way at the upper side C, and the beam turns about A as upon a hinge The two forces brought into action are, therefore, the weight W acting at the end of the lever A B, and the resistance of the particles in the section A C, and at the instant previous to the rupture the two forces are in equilibrio, or their respective moments of rotation are equal Now, the resistance of any fibre in the section A C is the absolute strength of the fibre multiplied into its distance from the point A, therefore the [illegible] beam is found by multiplying [illegible] the area into its distance from the point A, and into the abso-



lute strength, and taking the sum of all the products But this is equivalent to the product of the area of the section by the distance of its centre of gravity from A, and by the absolute strength, hence if we put A = the area of the section, $c$ = the distance of its centre of gravity from the lowest point, $s$ = the absolute strength of the unit of surface, the resistance to fracture is $s\,c\,A$ Let W = the breaking weight in pounds and $l$ = A B, the length of the beam then the moment of the force tending to produce fracture is $W\,l$, and the equation of equilibrium is $W\,l = s\,c\,A$, whence $W = s\,c\,A - l$, or $s = W\,l - c\,A$

In a rectangular beam whose breadth is $b$, and thickness or depth $d$, we have $A = b\,d$, $c = \frac{1}{2}d$, whence $W = s\,b\,d^2 - 2\,l$, or the strength of the beam is directly as its breadth and the square of its depth, and inversely as its length

In a square beam $b = d$, whence $W = s\,b^3 - 2\,l$

In a square beam whose diagonal is vertical, we have $A = a^2$, and $c = \frac{1}{2}a\sqrt{2}$, whence $W = s\,a^3\sqrt{2} - 2\,l$ The beam ought, therefore to be stronger in this position, but this result of the theory is contradicted by experience

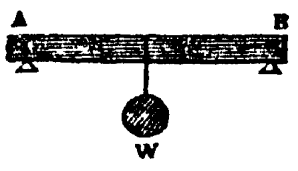
If the beam be cylindrical, and $r$ be the radius of its section, then $A = \pi r^2$, and $c = r$, whence $W = \pi\,s\,r^3 - l$

In a cylindric tube, the radii of whose external and internal surfaces are respectively $r$ and $r'$ we have $A = \pi\,(r^2 - r'^2)$ $c = r$, whence $W = \pi\,s\,r\,(r^2 - r'^2) - l$

From the two last cases it may be shown that the strength of the tube is to the strength of the same quantity of matter formed into a solid cylinder in the ratio of $r$ to $\sqrt{(r^2 - r'^2)}$, so that a tube may be much stronger than the same quantity of matter in a solid form This principle furnishes an explanation of many facts in the economy of nature To obtain the greatest strength with the least possible weight, the bones of animals and the quills and feathers of birds have the form of hollow tubes and the same arrangement is observed in many of the vegetable [illegible] *culms*

In the preceding formulæ the weight of the beam is neglected as [illegible] comparison of the weight applied, [illegible] beams of the same substance the strength increases as the square of the depth, while the weight increases as the cube, there is consequently a limit, which if a beam of a given shape and of a given materials were to reach it could only bear its own weight and would be broken by any further increase

Suppose a beam A B to be laid horizontally on two props and to be broken by a weight placed at equal distances between them, the pressure will be equally shared between the props, and since by the hypothesis fracture takes place without bending, the effect will be the same as if the beam had been fixed at the middle and each end acted upon by a force equal to half the weight but directed upwards The breaking weight is consequently double of that which would be required to break a beam of half the length having one end fixed in a wall, or the transverse length of the beam when supported at one end is [illegible] the same beam supported at [illegible] weight suspended from its other extremity In this case therefore, when the beam is rectangular $W = 2\,s\,b\,d^2 - l$, when the beam is square, $W = 2\,s\,b^3 - l$, when cylindrical $W = 4\,\pi\,s\,r^3 - l$, and so with the other cases




When the horizontal beam, instead of being merely supported, is firmly imbedded in a wall at each end the resistance will be equal to that of the same beam merely supported at each end, added to the resistance of two beams of half the length fixed at one end only, and acted upon by half the weight For it is manifest that three fractures must take place — one in the middle, and one at each end, and the strain in the middle is equal to that of the supported beam, which has just been shown to be $2\,s\,b\,d^2 - l$, and that at each end is one fourth of this or $\frac{1}{2}\,s\,b\,d^2 - l$, therefore the whole weight W, under which if suspended from the middle the beam will give way, is $W = 3\,s\,b\,d^2 - l$

On the same principle it may be shown that when a beam is supported at both ends, the weight which it is able to bear at any point is inversely as the rectangle under the segments into which it is divided by that point Hence a beam supported at both ends is weakest in the middle, the rectangle under the segments at that point being a maximum It also follows that when the pressure is equally distributed over the whole beam, twice the weight will be required to break it

When the beam, instead of being laid horizontally, is inclined, its strength is increased in the ratio of unity to the square of the cosine of the angle of inclination This consequence of the theory, however, can obviously hold only within certain limits, inasmuch as it would give the strength equal to infinity when the inclination is a right angle, or when the load is applied endwise

In the hypothesis of Galileo, from which the preceding results have been deduced, the beam is supposed to be absolutely inflexible, which is not the case with any material substance, and although the results are sufficiently accurate in their application to architectural or mechanical purposes, yet in the comparison of experiments to determine the ultimate strength of different substances it becomes necessary to take the elasticity and consequent incurvation into the estimate Mr Barlow, assuming that the flexure takes place only at the section of fracture, and that the fibres remain inextensible in every other point, deduces the following formulæ for the transverse strain, which agree very well with the experiments

As before, let $l$ denote the length, $b$ the breadth, and $d$ the depth of the beam all in inches, and let $\Delta$ be the angle of deflection, W the breaking weight, and S the resistance of a rod whose section is one square inch, W and S being expressed in pounds, then,

1 When the beam is fixed at one end and loaded at the other, $S = W\,l \cos \Delta - b\,d^2$,

2 When the beam is supported at each end, and loaded in the middle, $S = W\,l \sec \frac{1}{2}\Delta - 4\,b\,d^2$,

3 When the beam is fixed at each end and loaded in the middle, $S = W\,l \sec \frac{1}{2}\Delta - 6\,b\,d^2$

The angle of deflection [illegible] secant in the ordinary applications may be considered as equal to unity and if we also write $\frac{1}{2}s$ instead of S in the above formulæ they will become the same as those deduced from the hypothesis of Galileo

The preceding results have reference to the absolute strength of the beam, or to the weight which it can just support without being broken, but it is also very important to know the amount of deflection which a given weight will produce in a beam of a given material and of given dimensions Suppose a prismatic beam to be firmly fixed at one end, and to have a weight suspended from the other then if we adopt the hypothesis that the extension of the fibres at each point is proportional to the straining force, the curvature at the different points and the law of the action which takes place may be deduced from the properties of the elastic curve (*See* ELASTIC CURVE) The following results of theory are confirmed by the experiments of Dupin and Barlow

1 The deflections of a beam loaded with different small weights are proportional to those weights 2 The deflection, *cæteris paribus* is directly as the cube of the length, inversely as the cube of the depth, and inversely as the breadth Hence if $l$ denote the length, $b$ the breadth, $d$ the depth and $k$ the deflection (that is, the distance to which the loaded end of the beam is drawn below the horizontal line) all expressed in inches, and if $w$ be the weight in pounds which the body can support without its elasticity being impaired, then $k$ is proportional to $w\,l^3 - b\,d^3$, or if we assume E as the constant modulus of elasticity $E = w\,l^3 - k\,b\,d^3$

The deflection of a beam fixed at one end and loaded at the other is double that of a beam of twice the length supported at both ends and loaded at the middle with a double weight supposing the strain to be the same in both cases, consequently when the weights are the same, the deflection in the first case is to that in the second as 1 [illegible] 1, and when the [illegible] the deflections (which [illegible] be to each other as 32 1 In the case of the beam supported at both ends, the formula therefore becomes $E = w\,l^3 - 32\,k\,b\,d^3$

From the table of *data* given by Barlow (*Strength of Timber* p 150) we extract the following mean results of experiments (on beams supported at both ends), made in the dock yard at Woolwich, for determining the elasticity and strength of various species of timber

| Description of Wood | Elasticity $E = \frac{w\,l^3}{32\,k\,b\,d^3}$ | Strength $S = \frac{W\,l}{4\,b\,d^2}$ |
|---|---|---|
| Teak | 301800 | 2162 |
| Foon | 211200 | 2221 |
| English Oak | 109200 | 1181 |
| Ditto, another specimen | 181400 | 1672 |
| Canadian Oak | 268600 | 1766 |
| Ash - - | 209600 | 2026 |
| Beech | 169200 | 1556 |
| Elm | 87180 | 1013 |
| Dutch Pine | 153200 | 1632 |
| New England Fir | 273900 | 1102 |
| Riga Fir | 166100 | 1108 |
| Mar Forest Fir - | 108700 | 1262 |
| Larch | 131600 | 1149 |
| Norway Spar | 182200 | 1474 |

From the mean of a number of experiments by Tredgold the values of E and S for rectangular cast iron bars, were found to be E = 2254000, S = 7620

3 *Resistance of Bodies to Forces tending to crush them* — The resistance of a body to a crushing force might be supposed, *a priori*, to follow the same law as the absolute force of cohesion, and consequently to depend only upon the area of the section and the force of aggregation of the

particles It is found however by experiment, that the thickness of the body (or length if the force is applied endwise) has an important influence on the amount of pressure it is capable of bearing Very thin plates are readily crushed, and the resistance appears to increase with the thickness up to a certain maximum, after which it diminishes The theory of the resistance of pillars, which is of great importance on account of its application to architectural purposes was investigated by Euler, and, according to the hypothesis adopted by him, the strength varies directly as the fourth power of the diameter or side, and inversely as the square of the length This is confirmed by the recent experiments of Mr Hodgkinson (*Phil Trans* 1840) in respect of pillars of wrought iron, or timber, but in the case of pillars of cast iron, the powers of the diameter and length were somewhat different Mr H[illegible] of experiments that a sol[illegible] whose transverse section is one square inch, is destroyed by a weight of 98922 lbs, or 44 16 tons Assuming this as a unit of measure, he gives the following formula (as [illegible] in which $s$ is the strength or weight in lbs that would crush the pillar $d$ the diameter, and $l$ the length, viz $s = 98922 \times d^{3\cdot55} - l^{1\cdot7}$ This formula applies to pillars of which the lengths are twenty-five times the diameter and upwards and which are perfectly flat at the ends When the ends of a pillar are rounded so that the load bears only on the middle fibres, the strength is greatly reduced In pillars whose length is thirty times the diameter or upwards Mr Hodgkinson found the strength of those with flat ends to be about three times greater than the strength of others of the same dimensions with round ends, the mean ratio being 3 167 In shorter pillars the ratio was not constant The strength of a pillar is slightly increased by placing discs on the ends to increase the bearings

Mr Hodgkinson gives the following results of his experiments on the resistance to a crushing force of short pillars of some of the most common descriptions of wood, the force being applied in the direction of the fibres

| Description of Wood | Strength per Square Inch, in lbs |
|---|---|
| Alder | 6831 to 6960 |
| Ash | 8083 — 9563 |
| Bay | 7518 — 7718 |
| Beech | 7773 — 9303 |
| English Birch | 3207 — 6402 |
| Cedar | 5674 — 5803 |
| Red Deal | 5718 — 6486 |
| White Deal | 6781 — 7293 |
| Elder | 7151 — 9073 |
| Elm | 10331 |
| Fir (Spruce) | 6199 — 6819 |
| Mahogany | 8198 — 8198 |
| Oak (Quebec) | 4231 — 5082 |
| Oak (English) | 6184 — 10058 |
| Pine (Pitch) | 6790 — 6790 |
| Pine (Red) | 5365 — 7218 |
| Poplar | 3107 — 5114 |
| Plum (Dry) | 8241 — 10193 |
| Teak | 12101 |
| Walnut | 6083 — 7227 |
| Willow | 2898 — 6128 |

The results in the first column were deduced in each case from experiments upon cylinders of wood turned to one inch diameter and two inches long, flat at the ends The wood was moderately dry The second column gives the mean strength from similar specimens after being turned and kept dry in a warm place two months longer The great difference in the strength frequently seen in the two columns shows strongly the effect of drying upon [illegible] weight of 93,000 lbs upon a square inch, and will bear 10,000 lbs without permanent alteration

4 *Strength of Iron* The resistance which bodies oppose to a force tending to wrench them asunder has frequently been made the subject of experiment The following results, showing the comparative strength of various metals, as ascertained by resistance to torsion, is given by Mr Rennie For the law according to which the elasticity is evolved in the case of slender metallic wires or threads of fibrous substances, when the twisting force is less than is necessary to produce a permanent change of structure, we refer to the term TORSION

| | |
|---|---|
| Lead | 1000 |
| Tin | 1438 |
| Copper | 4312 |
| Brass | 4698 |
| Gun metal | 5000 |
| Swedish iron | 9500 |
| English iron | 10125 |
| Cast iron | 10600 |
| Blister steel | 16688 |
| Shear steel | 17063 |
| Cast steel | 19562 |

Mr Banks (*on the Power of Machines*) states, as the mean result of several experiments, that a bar of cast iron, one inch square, is wrenched asunder by a weight of 631 lbs avoirdupois, applied at the extremity of a lever two feet in length Other experiments on the force of torsion are given by G Bevan (*Phil Trans* 1829), and Savart (*Annales de Chim[illegible]*

For further [illegible] addition to the works already [illegible] Barlow, Girard, *Traité Analytique de la Résistance des Solides*, Tredgold, *Elementary Principles of Carpentry* and *Practical Essay on the Strength of Cast Iron*, Banks, *Treatise on the Power of Machines*, Hodgkinson, *Transactions of the British Association*, vol vi, and *Phil Trans* 1840, &c

STREPSI'PTERANS, *Strepsiptera* (Gr στρεπτος, *twisted*, πτερον *a wing*) The name given by Kirby to the order of insects which he discovered to possess rudimental elytra in the form of linear and spirally twisted scales

STRETCHER In Architecture, a brick or stone laid horizontally with its length in the direction of the face of a wall

STRETCHING COURSE In Architecture a course in which the bricks or stones are laid horizontally with their lengths in the direction of the face of the wall. *See* HEADERS and HEADING COURSE

STRI'TTO (It *narrow*) In Music, a term indicating that the measure to which it is affixed is to be performed short and concise, hence quick. It is the opposite of *largo*

STRI'ATI (Lat stria, *a groove*) In Zoology, when a surface is painted or impressed with several narrow transverse streaks

STRIGÆ (Lat) In Architecture, the flutings of a column

STRIGI'DÆ The name of the family of Nocturnal Raptores of which the owl (*Strix*) is the type

STRING BOARD In Architecture, a board with its face next the well-hole in a wooden staircase, which receives the ends of the steps

STRING COURSE In Architecture a course running quite along the face of a building, the projecture whereof is small in proportion to its height

STRO'BILE, or STRO'BILUS, is the fruit of the fir tree to which the common name of cone is assigned It may be defined to be a spike of very imperfect flowers subtended by bracts, which are woody, pressed close to each other and in many cases consolidated

STRO'MBUS The name of a shell-fish in Pliny This term was applied by Linnæus to a genus of the Vermes Testacea characterized by the form of the shell, of which [illegible] and produ[illegible] Mollusca to which this character is applicable form a group of Pectinibranchiate Gastropods in the system of Cuvier, which has been subdivided into the genera *Strombus* proper, *Pterocera*, Lam, &c

STRO'NGYLUS A genus of intestinal worms in Rudolphi's classification, characterized by having a cylindrical body the anal extremity of which, in the male, is surrounded by a kind of pouch of a varied shape, from which is protruded a small filament or spiculum, probably subservient to generation. The mouth is orbicular, sometimes armed with spines, as in the *Strongylus armatus* which infests the mesenteric arteries of the horse and ass producing aneurisms, sometimes the mouth is surrounded by tubercles or papillæ, as in the *Strongylus gigas* which is sometimes found in the kidney of the human subject

STRO'NTIA An earth contained in a mineral, generally of a pale green tint and radiated crystalline texture, found at Strontian in Argyleshire It [illegible] strontia Strontia is the oxide of a [illegible] properties of which are very imperfectly known, called strontium, the equivalent of strontia, or oxide of strontium (composed of 44 strontium and 8 oxygen), is 52 It has a caustic taste, an alkaline reaction, and a degree of solubility in water intermediate between lime and baryta The salts of strontia are generally obtained by dissolving the natural or artificial carbonate in the acids, those which are soluble give the flame of burning bodies a fine rose red colour the nitrate of strontia is used for this purpose, and with beautiful effect, in theatrical exhibitions and fire-works The sulphate of strontia is found native it is an insoluble white powder when artificially prepared Some of its native varieties have a pale blue tint, whence the term *cœlestine* A colourless prismatic crystalline variety, of great beauty, is found associated with the native sulphur of Sicily

STRO'NTIANITE Native carbonate of strontia

STRO'PHE (Gr στροφη, *a turning*) A division of a Greek choral ode answering to a stanza The name is derived from στρεφω, *to turn*, because the singers turned in one direction while they recited that portion of the poem, they then turned round and sung the next portion, which was of exactly the same length and metre as the preceding, and was termed the antistrophe (ἀντι-

[illegible] from an [illegible] The [illegible] follow[illegible] by a single-branched [illegible]

STROPHIOLATED [illegible] *Formula*, which see

STROPHU'LUS (Lat ) The *red gum*, an eruption peculiar to infants

STRUMA (Lat ) In Anatomy, an enlarged gland

STRUMA In Botany, a swelling that is present in some leaves at the extremity of the petiole, where it is connected to the lamina, as in *Mimosa sensitiva* The term also used in describing mosses to denote a dilatation or swelling that is at times present upon one side of the base of the theca

STRUT In Architecture, a piece of timber obliquely placed from a king or queen post to support a rafter [illegible] *See* ROOF

STRUTHIO NIDI (Struthio, *an ostrich*) The name of a family of terrestrial birds, incapable of flight, with very short or rudimental wings, and long and strong legs, including the ostrich and other congeneric species which constitute the order *Cursores* of Kirby, and the family *Brevipennes* in the system of Cuvier

STRYCHNIA A poisonous vegetable alkaloid, discovered in 1818 by Pelletier and Caventou in the seed of the *Strychnus ignatia* and *Nux vomica*, and also in the upas poison It is almost insoluble in water, but very soluble in boiling alcohol from which it is deposited by careful evaporation in small white crystals It is so virulently poisonous that half a grain blown into the throat of a rabbit occasioned death in five minutes, its operation is accompanied by lock jaw and by other tetanic affections The chemical equivalent of strychnia is about 238 It probably consists of 30 atoms of carbon, 16 hydrogen, 3 oxygen and 1 nitrogen

STUBBLE The root ends of stalks of corn left in the field standing as they grew after the corn has been reaped by the sickle or scythe In some parts of the country only a small portion of the straw is cut off with the ears of corn, and the stubble in that case is a foot or eighteen inches in length, but in others the corn is cut as close to the surface as possible, in which case the stubble is quite short In general long stubble is a symptom of bad farming, because a quantity of straw is in this case left waste in the field, which might have been carried home and rotted into manure

STUCCO (Ital ) In Architecture a term applied to many sorts of calcareous cements The sense in which it is most commonly used in this country is to denote the third coat of three coat plaster consisting of fine lime and sand The better sort is hand-floated twice and well trowelled There is a species called bastard stucco in which a small portion of hair is used (*See* FINISHING) Rough stucco is merely floated and brushed with water, but the best is trowelled stucco

STUDDING SAILS called also Steering Sails, are narrow sails set temporarily at the outer edges of the square sails

STUFA (Ital ) A jet of steam issuing from a fissure in the earth these jets are not uncommon in volcanic districts

STUFF A Commercial term applied to various woven fabrics, it especially signifies a light woollen cloth formerly much used for curtains and bed furniture

STURGEON (Lat sturio, from the German stoer *a sturgeon*) The type of a genus of Cartilaginous fishes, with free gills having the body more or less covered with bony plates in longitudinal rows The mouth is placed beneath the snout is small and edentulous, but is protractile Soft feelers or cirri are attached beneath the snout The bodies of the vertebræ retain the primitive condition of an undivided gelatinous cord The sturgeons ascend the larger rivers of Europe in great abundance, and are the objects of important fisheries The flesh of most of the species is wholesome and agreeable food, their ova are converted into caviar, and their air bladder affords the finest isinglass

The sturgeon which is occasionally captured on our east coast is the *Accipenser sturio* of Linnæus *See* ACCIPENSER

STURIONIANS, *Sturiones* (Lat sturio, *a sturgeon*) The name of the family of Cartilaginous fishes of which the sturgeon is the type

STY A little boil or tumour projecting from the edge of the eyelid

STYLAGA'LMAIC (Gr στυλος, *a column*, and αγαλμα *an ornament*) In Architecture, a term used to denote figures which perform the office of columns *See* CARYATIDES

STYLE (Lat stylus, or stilus ) A kind of pencil made use of by the Romans for writing on waxed tablets It was made of brass or iron, with one end sharp for writing, and the other broad and smooth to make erasures with, hence to *turn the style* is a phrase used by ancient writers, signifying to make corrections

In Literature the word style may be defined to mean the distinctive manner of writing which belongs to each author, and also to each body of writers, allied as belonging [illegible] to its [illegible] from all others The style of an author is made up of various minute particulars, which it is extremely difficult to describe, but each of which adds something to the aggregate of qualities which belong to him Collocation of words, turn of sentences, syntax, rhythm, the relation, abundance, and the character of his usual figures and metaphors, the usual order in which thoughts succeed each other, the logical form in which conclusions are generally deduced from their premises, the particular qualities most insisted on in description, amplification and conciseness, clearness and obscurity directness and indirectness, exhaustion, suggestion suppression, — all these are features of style, in the largest sense of the expression, in which it seems to comprehend all peculiarities belonging to the manner in which thought is communicated from the writer to the reader Excellence of style, particularly of the rhetorical parts of style, was more cultivated by the ancients than the moderns, and less, perhaps at the present day, than at any former period since the English language began to be written in prose with correctness and elegance Since the period when Bolingbroke Junius, Johnson, Gibbon, and Burke became established as models, a certain superficial sameness of style wanting in the roughness and vulgarity, but also in the force and individuality of old English composition seems to prevail to such an extent as to render modern writing extremely monotonous and artificial But it should never be forgotten that whatever quality may command a temporary popularity no work, either in poetry or prose, has ever permanently maintained its hold on public admiration without excellence of style

STYLE, in the Calendar is a manner of reckoning time The reformation of the calendar by Julius Cæsar consisted chiefly in restoring the equinox to its proper place in the month of March This reformation took place in A U C 707 which year was made to consist of fourteen months, in order to fill up the deficiency which had been produced by the former method of computing and was styled the 'year of confusion' By the Julian calendar an intercalary day was added to every fourth year (leap year) In consequence of this erroneous intercalation the equinox receded a day in about 130 years, and, in the beginning of the sixteenth century, the vernal equinox fell on the 10th instead of the 21st of March The calendar was reformed by Gregory XIII in 1577 By this reformation ten days were dropped in the year 1582 the 5th of March being reckoned immediately after the 4th, and it was arranged that every 100th year (which by the former calendar was a leap year) should be a common year, except the fourth, so 1600 remained a leap year, but 1700, 1800 were common years, and 1900 will be a common year likewise, after which the cycle of four centuries will again commence The Gregorian calendar was immediately adopted in Catholic countries, but by Protestant nations the old style was for a long time continued It was at last made to *New Style* in 1752 by statute after [illegible] of Parliament, of which a curious notice will be found in *Lord Chesterfield's Letters* Previously to this time dates according to the old style are frequently denoted by the initials O S, or thus, $\frac{10\text{th}}{22\text{d}}$ of January, 1750, the upper line denoting the old and the latter the new style This mode of dating will still be found in the despatches and public papers of Russia and Greece, which are the only European states in which the Julian year is still in use The time of the two styles now varies thirteen days For further information on this subject see CALENDAR

STYLE in Dialling, is the gnomon which projects the shadow on the plane of the dial *See* DIAL

STYLE, in Botany, is that elongation of the ovarium which supports the stigma It is an extension of the midrib of the carpellary leaf or is formed by the rolling up of the attenuated extremity of the latter

STYLE In the Fine Arts, the mode in which an artist forms and expresses his ideas on and of a given subject It is the form and character that he gives to the expression of his ideas, according to his particular faculties and powers Style may be almost considered as the refinement of *manner* (*see* MANNER) it is a characteristic essence by which we distinguish works of one master from another From [illegible] this word has passed into the theoretic language of the fine arts, and as in that we hear of the *sublime*, *brilliant*, *agreeable*, *historic*, [illegible] and other styles, so we have almost the same terms applied to styles of art Indeed this is not wonderful, since the principles of taste, in both the one and the other, are founded in nature; and it is a well known saying that poetry is a speaking picture This word is improperly used as applied to colouring and harmony of tints we speak of the style of a design, of a composition, of draperies, &c, but not of the style of colouring, but rather the *method*

or *mind* [illegible] word by Sir Joshua Reynolds is as [illegible] painting is the same as in writing,—a power over materials, whether words or colours, by which conceptions or sentiments are conveyed But we can scarcely consider this definition sufficiently general

STYLITE (Gr στυλος, *a column*) The title given to a peculiar class of anchorites from the places on which they took up their solitary abodes, being the tops of various columns in Syria and Egypt This strange method of devotion took its rise in the [illegible] and continued to be practised by [illegible] for a great length of time The most famous among them was one St Simeon, in the 5th century, who is said to have lived thirty-seven years upon various columns of considerable height in the neighbourhood of Antioch

STYLO Names compounded of this word apply to the muscles attached to the styloid process of the temporal bone

STY'LOBATE (Gr στυλος, *a column*, and βασις *a base*) In Architecture, a term signifying the uninterrupted base below a range of columns

STY'PTICS (Gr στυφω *I restrain*), in Medicine and Surgery are remedies used for checking a flow of blood

STYRAX See STORAX

STYX (Gr Στυξ) In Mythology, a nymph the daughter, according to Hesiod of Oceanus and Thetis, but other mythologists relate the genealogy differently She dwelt in a rock palace in the infernal regions, from whence one of the infernal rivers burst forth This river, Styx, was one of the ten arms or branches of Oceanus The gods of Olympus swore by the water of Styx, and a deity who took this oath in vain was banished from the heavenly mansions for ten years, to endure various torments The river Styx has been sought for in various places, but the most remarkable stream of the name was in Arcadia It forms a terrific waterfall

SU'BALTERN (Lat sub *under*, and alter, *other*) Literally an inferior officer but generally applied to all officers under the rank of captain

SUBBRA'CHIANS, *Subbrachia* (Lat sub and brachium *the arm*) The name of the order of Mala[illegible] [illegible] [illegible] [

terms *entail*, *remainder*, *executory devise*, &c Substitutions were of two classes 1 *Vulgar* or common, by which a [illegible] devisee to receive the succession [illegible] or unwilling to do so 2 *Fidei-commissary* in which the second devisee was named to receive the succession *after* the first *See* FIDEI-COMMISSUM

SUBSTITUTION, in the language of Algebra, signifies the replacing of one quantity by another which is equal to it, but differently expressed

SUBSTITUTION, CHORD OF In Music, a name given to the chords of the sixth major [illegible]

SUBSTRA'TUM A stratum lying under another The term *subsoil* is generally applied to the matters which intervene between the surface soils and the rocks on which they rest, thus clay is the common substratum or [illegible]

SUBSTYLE In Dialling, is the straight line formed by the intersection of the face of the dial with the perpendicular plane which passes through the gnomon *See* DIAL

SUBTA'NGENT, in Geometry, is the part of the axis of a curve [illegible] between the tangent and the ordinate The general expression for any curve whose equation is $y = f(x)$, being a function of $x$ the abscissa) is $y\frac{dx}{dy}$

SUBTE'NSE (Lat sub and tensus) A term sometimes used in Trigonometry to denote the chord of an arc *See* CHORD

SUBTRA'CTION (Lat subtraho *I draw away*) In Arithmetic, the taking of one number or quantity from another in order to find their difference The operation is precisely the reverse of addition

SUBULICORNS, *Subulicornes* (Lat subula, *an awl*, cornu, *a horn*) The name of a family of Neuropterous insects, including those which have awl shaped antennæ

SUBU'LIPALPS *Subulipalpi* (Lat subula and palpus, *a feeler*) The name of a section of Carabod beetles, including those which have the exterior palps or feelers awl-shaped

SUCCEDA'NEUM A medicine or remedy substituted for another

SUCCE'SSION, APOSTO'LICAL In Theology By these words is meant the uninterrupted succession of priests in the church by regular ordination, from the first commission given by our Saviour to the Apostles, and recorded in the Gospels, down to the present day And the doctrine of "the apostolical succession" as it is popularly called, means the belief that the clergy so regularly ordained have a commission from God to preach the gospel, administer the sacraments, and guide the church, that through their ministration only we can derive the grace which is communicated by the sacraments It follows, of course, that those sects of Christians which have no regular succession (having seceded from Romanism without retaining ministers regularly ordained, or having subsequently interrupted the succession, that is, all Protestant bodies, except the church of England) have, properly speaking neither church nor sacraments since they possess no apostolical authority

This doctrine was, by admission on all hands, of very great antiquity in the church, but whether that antiquity is primitive or not, is matter of discussion at the present day The arguments from Scripture cannot alone be relied upon by either party As to the historical part of the question, those Epistles of Ignatius which the learned have in the most part agreed to regard as genuine (commonly called the Greater), are much referred to by the maintainers of the doctrine in support of it They do not, indeed, declare it in express terms, but the strict and repeated injunctions to honour and obey the bishop and presbytery, together with some insulated expressions (such as, "If a man be not within the altar, he faileth of the bread of God," &c), have been thought important in the controversy, and, as Mr Keble observes, "the discovery of those remains probably lent considerable force to the course of opinions among the clergy of England in favour of the doctrine in the 17th century"

At the Reformation it was almost entirely lost sight of, and that the succession was actually preserved in England is rather owing [illegible] In fact, the Romanists contest the validity of English ordinations, partly on the ground that the succession was actually interrupted at the accession of Elizabeth, but there is no need to discuss an historical question on which there seems to be [illegible] The church of England [illegible] her articles; and the language of art 19, although not excluding it, is plainly not such as would have been used by framers who wished to inculcate it Many expressions of her services, borrowed as they are from ancient liturgies, more or less distinctly point towards it. The first school of Anglican divines did not rely on it in their controversy with Puritanism They rather rested their argument on the fact, that the church *had* in early times appointed the episcopal government and regulated ordination and that it could not, therefore, be wise or prudent to swerve from it It was at this point that Hooker took up the subject Whether he actually held the tenet or no, has been much controverted His recent editor (Mr Keble) contends that he did, but, at the same time, admits that there is a marked difference between his language and that of the succeeding school of Laud, Hammond and Leslie (Preface to *Hooker*, p xxxv) Under that school, it became the rallying point of high churchmen, and was zealously maintained by the divines of that section of the church down to and long after the Revolution But since that time, without being renounced, it had certainly long ceased to be brought prominently forward in ecclesiastical controversy, until within the last seven or eight years

In fact the opposite ground had been constantly taken by ordinary Protestant reasoners, both in and out of this [illegible] their contests with the church of Rome [illegible] as is well known argues against the Romanist tenet that 'succession is a certain and perpetual mark of the true church," by maintaining that it is impossible to prove it, that is, that it is impossible that any individual can feel certain that *his* orders were derived by regular succession from the Apostles If we assume, with the Romanist, *à priori*, that the church must have regular succession because of Christ's promise to it then there is no room for such doubts, but if we are endeavouring to insist on the fact of succession as a test of the truth of a church, then it cannot be denied that this argument presents difficulties not easily surmounted

SUCCESSION, LAW OF In Political Economy, the law or rule according to which the succession to the property of deceased individuals is regulated Generally speaking this law obtains only in cases where a deceased party has died intestate or in cases where the power of bequeathing property by will is limited by the legislature It is plain that in cases of intestacy, where the deceased either leaves a number of descendants, or where he leaves no direct descendants, the law, in order to prevent endless disputes and litigation must interfere to regulate the succession to the property, and it will necessarily follow that the succession will be determined in different countries by local circumstances, depending partly on the peculiar state and institutions of each country and on the views entertained by its legislators of what is just and proper and most conducive to the public advantage Hence it is to no purpose in a matter of this kind to look for any general or fixed principles The succession to the property of those dying intestate, and the power of bequeathing property by will or testament depend wholly on the rules and regulations enacted in each country, and these necessarily vary with the varying circumstances of different countries and conditions of society

In most countries a preference has been given, in [illegible] will in favour of male heirs, and in some countries, and especially in modern times, a marked predilection has been shown in favour of the eldest son or, as it is usually termed in favour of the [illegible] Among the Jews the eldest son [illegible] share of the paternal inheritance, but among the Greeks, Romans, and our Saxon ancestors, all inheritances, whether consisting of land or moveables, [illegible] some cases among all the male [illegible] among all the children, whether male or female The growth of the feudal system appears, however to have put an end to this rule of inheritance in most European nations When titles of nobility were created, it was necessary to limit their descent to the eldest son, and it was also necessary that the estate required to maintain the dignity of the possessor of the title should descend according to the same rule of primogeniture And even when estates were not held by noble proprietors, various inconveniences were found to result from their partition, in the division of military services, the number of infant tenants incapable of performing any kind of duty, and, more than all the rest (though its importance was the [illegible] of the land, in emancipating the younger sons from the control of their parents, in tempting them to remain at home and to indulge in the pleasures and idleness of a country life, and lastly, in overspreading the country with a proud [illegible] Inconsequence, the old rule of [illegible] was changed in most countries [illegible] Kent and a few other places [illegible] estate descends [illegible] afterwards seen, notwithstanding the statements of Adam

Smith and others to the contrary, that this rule, though not without its disadvantages, is, on the whole, the best that can be devised

Females being incapable of performing any personal feudal service, it is the common rule, when a person seised of an estate dies intestate leaving only daughters, that they should succeed as co-heiresses Such is the law of England, and when thus limited, little harm can ensue from the subdivision that is thus occasioned

It has, speaking generally been the usual practice in cases of intestacy to divide the money or other moveable property in equal portions among the children or kinsmen of the deceased, without respect to sex or seniority This, however, though a general, is by no means to be regarded as a constant rule Thus, in the case of the Jews, daughters were excluded from all participation in the inheritance, and, apparently, were left to depend on the bounty of their father's heirs (Michaelis, *Law of Moses*, i 420) In Athens, also, daughters inherited nothing when there were sons alive, and when there was no son, and a daughter succeeded to the inheritance, she was bound to marry her nearest relation, so that the property might not be taken out of the family (Michaelis, *ubi supra*) In Rome, however, all sorts of property were divided equally between sons and daughters And as the inconveniences found to result in modern times from the splitting of landed property do not follow at all, or in anything like the same degree, from the subdivision of moveable property, it is the practice in this and most modern countries to admit females of the same propinquity to share in the succession to such property, when left intestate, equally with males, excluding all preference on account of primogeniture

These notices, brief and imperfect as they necessarily are, will probably be sufficient to give the reader a general idea of the rules that have been most commonly followed in regulating the succession to property in cases of intestacy, or where there is no power to bequeath property by will or testament Inasmuch, however, as this power exists to a greater or less extent in most civilized countries, we shall now proceed shortly to state some of the more important principles and limitations that either have been or should be attended to in the construction of such documents

*Bequeathing of Property by Will* —The power of bequeathing property by will or testament (*libera testamenti factio*) is not usually recognized in the earlier stages of society A man's property is then, for the most part divided in equal shares among his children who succeed to it as matter of right, and in their default it is inherited by his surviving relations, or nearest of kin But experience begins at length to manifest the inconveniences resulting from the enforcement of this strict rule of succession, and power is, in consequence given to persons possessed of property to make testaments, or to dispose of a part at least of their personal or real estate by will At first however this power is usually confined within very narrow limits, being in general restricted to the making of alterations in the shares falling to the children or kinsmen of the testator, that is, to the increasing of the portion of some to the diminution of that of others Thus in Athens, there was no power to devise property from the natural heirs previously to the age of Solon, and that legislator confined the privilege to those who died without leaving issue In Rome three centuries elapsed before a citizen could dispose of his property by a deed *mortis causa*, except in an assembly of the people, and in that case his will as Montesquieu has remarked, was not really the act of a private individual, but of the legislature "With us in [illegible] times, a man could only dispose of one [illegible] his moveables from his wife and children, and in general no will was permitted of lands till the reign of Henry VIII and then only of a certain portion for it was not till after the Restoration that the power of devising real property became so universal as at present" (*Blackstone*, book ii cap i) In Scotland, down to a comparatively recent period almost all landed property was inalienable from the lineal heir

Not only, however, is the power of testators usually augmented as society advances, but in some countries they are permitted to exercise a nearly absolute control over the disposal of their property, and even to bequeath the whole, or the greater part of it to strangers, to the exclusion of their children and relations as is substantially the case at this moment in England This, however, is an extension of the power of bequeathing, as to the policy of which much difference of opinion is entertained It is contended that no one who has any property to dispose of should be allowed to throw his children destitute upon society, that the fear of total disinheritance should not be rendered an instrument of tyranny in the hand of fathers, and that before allowing a man to leave any portion of his fortune to strangers, he should be compelled to make an adequate provision for the individuals he has been the means of bringing into the world, and to whom, independently altogether of any considerations of personal merit or demerit, he is under the most sacred obligations But [illegible] ned that this is a question of con- [illegible] nicety and with respect to which it does not [illegible] possible to come to any conclusion that will not be liable to [illegible] on the whole it would seem that the reasoning of those who argue in favour of the unlimited power of bequeathing to strangers is the most satisfactory and convincing or if any restriction be laid on this, it would appear to be enough to enact that parents possessed of property should be obliged to appropriate a portion thereof sufficient to bring up and educate their children till they come to maturity, or be in a condition to provide for themselves, when all compulsory obligations on the part of the parents should cease [illegible] in the people It is plain, however, that if it interfere to regulate the disposal of property, it must unavoidably do this if it be enacted that how undutifully soever a man's children or relations may have behaved, they shall notwithstanding be entitled to the whole or a certain proportion of his fortune this will, in the first place, render every one less anxious about the accumulation of that wealth which he is not to be permitted to dispose of at pleasure than he would otherwise be [illegible] In the second place the securing of a certain provision for children, independently of their conduct, must in so far render them independent of their parents, and weaken that parental authority, which, though occasionally abused, is yet, in the vast majority of instances exercised in the mildest and most indulgent manner, and with the best effect The more, therefore, that this subject is inquired into, the more, we apprehend it will be found that it is always the safest policy to abstain as much as possible from making the relations of private life the object of legislative enactments The humanity of the law is but a sorry substitute for parental affection If children be ordinarily well-behaved, if they be not extremely deficient either in filial affection or common prudence we have, in the principles and instincts inherent in our nature, a sufficient security that but few parents will be found disposed to leave their property to others to their exclusion The interference of the legislature in their behalf appears therefore to be, speaking generally, quite unnecessary In countries like England and Holland, in which the greatest latitude is given to the power of bequeathing the instances are extremely rare in which an affectionate and dutiful family have suffered from [illegible] permitted to leave [illegible] be most impolitic to attempt to obviate an evil of such rare occurrence by exempting children from the constant influence of a salutary check on their vicious propensities, and compelling a man to bestow on profligacy, extravagance and idleness that property which is at once the fruit and the appropriate reward of virtue, economy, and industry

The advantages resulting from the unrestrained power of bequeathing property by will are so striking as hardly to require to be pointed out Perhaps, however, we may be excused for laying the following passage, from the valuable though little known work of M Luzac, *De la Richesse de la Hollande*, before the reader It strongly corroborates what has now been stated "La liberté de tester, celle de disposer à volonté de ses biens par un acte de dernière volonté peut encore etre mise au nombre des causes, qui ont contribué à animer l'industrie des habitans Quelque indifférent que l'on soit sur le partage des biens que l'on laisse en mourant, l'idée de pouvoir en faire jouir ceux qu on veut en gratifier, est sûrement un aiguillon qui doit exciter au travail, ou du moins prevenir qu on se dégoute d'accumuler des richesses Pourquoi travaillerai-je à augmenter ma fortune si je suis obligé de la laisser à ceux qui ne m'en sauront aucun gré et qui ne la meriteront pas? *La liberté de disposer librement de ses biens par testament, est peut-être la principale cause que les fortunes des particuliers sont plus considérables en Hollande que par tout ailleurs*" (i 304)

*Entails* —The recognition of the right to bequeath property to any particular heir has, in several countries, been followed by an acknowledgment of the right of the proprietor of an estate to name an indefinite series of heirs, and to prescribe the conditions on which they shall be entitled to hold the property This right is founded by lawyers on the maxim of the civil law, that every one has the absolute disposal of his own property *unusquisque est rei suæ moderator et arbiter* This, however, is not a natural but a civil right, and it is not to be judged of by referring to abstract or imaginary principles, but by its practical operation and real influence over the condition and interests of society To enter into an examination of the advantages and disadvantages incident to the practice of entailing, would far exceed the narrow limits within which an article of this description must be confined, but we may, notwithstanding, glance at one

or two of the principal topics that should be attended to in forming a correct conclusion as to the influence of entails

In the first place, it is alleged in their favour that they stimulate exertion and economy, that they hold out to honest industry and ambition the strongest and safest excitement, in the prospect of founding an imperishable name and a powerful family and of being remembered and venerated by endless generations as the chief and benefactor, and in the second place that as they entails form the only solid bulwark of a respectable aristocracy and prevent generations from being ruined by the folly or misfortunes of an individual

Now it is true that the prospect of founding a powerful family and of securing property, accumulated by means of laborious and successful exertion and economy from the risk of being squandered by the inconsiderate projects or extravagance of any future individual, must act as a very powerful spur to the industry and ambition of the *original founder* of a family But here the beneficial influence of the system stops, its operation on the subsequent holders of the property is entirely different An heir of entail is in a great measure emancipated from the influence of parental authority, his chance of succeeding to the property of his ancestors does not depend on the circumstance of his having deserved it, of his being industrious or idle, dissipated or sober The succession to entailed estates is not regulated by the principle of *detur dignior* Their occupiers have no power to change the established order of succession, they cannot exclude the worst to make room for the best of their descendants, but must submit to see the properties of which they are in possession descend, as in fact, they not unfrequently do, to the most worthless and undutiful of their children or relations Granting, therefore that the institution of entails has a tendency as it undoubtedly has to make *one generation* active frugal and industrious, it is clear to demonstration that it must exempt every succeeding generation that is, every succeeding heir of entail from feeling the full force of some of the most powerful motives to such conduct A system of entail makes the succession to property depend, not on the good or bad conduct of the individual but on the terms of a deed written a couple of centuries, perhaps before he was in existence Its effect is, therefore, to substitute a species of fatalism in the place of an enlightened discrimination to throw property indifferently into the hands of the undeserving and the deserving, and it is plainly impossible it can do this without weakening the motives which stimulate men to act the part of good citizens [illegible] ening those of an opposite description fore, we refer, as we ought, to the decisive criterion of public utility, it is immediately seen that the industry of *one* generation is not to be purchased by the idleness of *all* that are to come after it, and that it is not much less injurious to allow an individual to appoint his remotest heirs, than it would be to deprive him of the power of nominating his immediate successors

As to the second point, there can be no doubt that a system of entail affords the best attainable security for the permanence of property in particular families, and as individuals possessed of property [illegible] ing with more independence, and [illegible] biassed by purely selfish considerations than those who are comparatively poor, it would seem that the privilege of executing a perpetual entail of a certain amount of property might, with propriety be allowed to noble families Indeed, we are disposed to think that in the case of such families it would be advantageous to carry this principle a good deal farther, and that no individual should be advanced to the peerage unless he were able to establish a *majorat*, or to entail such an extent of landed property on the heirs of the title as might be sufficient to secure them, supposing they acted with ordinary prudence, from falling into a state of poverty, and becoming mere dependents on the crown But though the power of entailing were conceded to noble families vested with the prerogative of hereditary legislation, it might be confined within certain limits, and made to vary with the entailer's rank in the peerage Neither is there the shadow of a reason, on political grounds, for conceding this power to others A system of perpetual entails in a general point of view, certainly injurious, and though constitutional considerations may require the privilege to be granted, under proper modifications, to a particular class, they can never require that it should be granted to all. It is not possible to interfere to protect the families of the commons from the casualties to which they are subject, by sanctioning a system of perpetual entail, without producing mischievous results It is the duty of government to adopt such regulations as may [illegible] effectually call forth industry and economy among [illegible] but it is no part of its duty to inquire whether the frugality of those on the box, and the extravagance of those in the coach, bid fair to make them change places, and still less to attempt to prevent it by throwing artificial ramparts round the property of the latter

In Scotland the practice of entailing has been carried to a very great extent, and in some counties hardly an acre of land is now to be met with that is not burdened with the fetters of a perpetual entail, chalking out an endless succession of heirs Latterly, indeed, the system has been so far modified by the interference of the legislature, that money is allowed to be be raised on the security of entailed estates for the effecting of necessary improvements, and certain provisions may made for widows and younger children In consequence of these modifications, and of the abolition of the practice of letting entailed lands by fine, the practice is by no means so injurious as it has been supposed and as it has been frequently represented Still however there can be no doubt of its extreme inexpediency in a public point of view, though, owing to the number of third parties interested in the succession to entailed estates, the question as to the abolition of entails is one of the greatest difficulty

In England, on the other hand, it seems as if the legislature had hit the happy medium between giving too much and too little power to those who have accumulated property over its disposal by will An English gentleman may entail an estate on such heirs as are in existence when the deed is executed, or till the first unborn heir be 21 years of age, but here the destination stops, and the heir in possession has then the absolute disposal of the property This gives to every one that degree of power over his property which is required to inspire him with the desire of accumulating a fortune, at the same time that it takes from him the power of legislating for future ages, or of creating rules to be obeyed in all time to come

*French Law of Succession* — We have already seen that it has been the practice in most countries, as society advanced, to relax the restraints imposed in early and less enlightened ages on the bequeathing of property by will But the modern legislators of France have followed a different course, and have confined the power of testators within the narrowest limits They have, in fact gone far to make that rule of the Roman law, as to equal [illegible] the children, that obtained in case [illegible] rative rule of succession to all property, whether landed or moveable

According to the new French law a person with one child must [illegible] at pleasure of a moiety of his property, the child inheriting the other moiety as matter of right, a person having two children is only allowed the absolute disposal of a third part of his property, and those having more than two must divide three fourths of their property equally amongst them, one fourth part only being left at their own disposal The property of those dying intestate is equally divided amongst their descendants, without respect of sex or seniority

This law was intended to subvert the foundations of that feudal aristocracy whose ascendency had been very prejudicial to France, and as the influence of an aristocracy must always be mainly dependent on the magnitude of their property, it was certainly well fitted to accomplish its object It is seldom, however, that a law adapted to a particular emergency may be maintained with advantage as a general rule of national policy, and it would be singular were a device originally fallen upon for the express purpose of splitting estates found beneficial for regulating the succession to property in a great kingdom Considered in a general point of view, this law seems infinitely more objectionable than a system of perpetual entail By interfering to so extreme an extent in the disposal of a man's property, it must plainly lessen the motives to accumulation, while, by rendering all the children in a great measure independent it weakens the parental authority and has the same injurious operation in reference to an entire family that the law of entail has in reference to a single child When the property of the father must be divided, all his descendants are aware, from their earliest infancy, that they are, without any peculiar merit or exertion on their part, to obtain a certain provision, and can any one doubt that this sort of certainty must tend to paralyse their efforts, and to render the younger children at least less enterprising than they would be, did they know that their condition in society was to depend principally on themselves, and that they had no security other than their own deserts, for obtaining any thing from their parents? But even these do not seem to be its worst effects The inevitable tendency of this, and of every similar system, is to occasion too great an increase of agricultural population, at the same time that it operates to reduce landed property into such minute portions as neither to afford sufficient employment to the families occupying them nor to allow of their being cultivated and improved in the best and most efficient manner The strong predilection entertained by the great bulk of the children of persons engaged in the business of agriculture for the pursuits of their fathers has been remarked by every

one in any degree familiar with rural affairs, and it is obvious that the existence of a law making the division of estates compulsory affords the greatest facilities for gratifying this inclination It will give to many, who might otherwise have been obliged to emigrate, or to resort to some other employment, the power of continuing in that line of life in which they have been educated, and which is endeared to them by those early associations [illegible] conduct [illegible] the share of the paternal property falling to each of the children be insufficient to enable them to maintain themselves in nearly [illegible] of the more adventur[illegible] to sell their portion, and to engage in other pursuits But experience shows that, in the great majority of cases, they continue to reside on the little properties obtained from their ancestors, and the fair presumption seems to be, that the process of division and subdivision will continue, until the whole land has been parcelled out into patches, and filled with an agricultural population, destitute alike of the means and the desire of rising in the world

It is no doubt true that the condition of the agriculturists of France, at this moment, is decidedly superior to what it was previously to the Revolution But it cannot be truly affirmed that this improvement has been in any respect owing to the law of equal inheritance It has taken place, not in consequence of that law, but in despite of it The abolition of the feudal privileges of the nobility and clergy, and of the gabelle, corvees and [illegible] and imposts, was of [illegible] and farmers, and, in [illegible] part of the property of the church and of the emigrants came into their hands at very low prices, so that small properties were augmented, and fresh energy given to agricultural pursuits Still, however, it is certain that the rapid subdivision of landed property, and the continually increasing excess of the agricultural population caused by the law of compulsory succession, have gone far to neutralize the effects of these advantageous circumstances, and form at this moment one of the most deeply seated evils in the social condition of the people of France

In every respect, therefore, this law would seem to be most inexpedient, and certainly the experience of France does not tend in any respect to shake our belief in the wisdom of those who contend that the interference of the legislature in respect to wills should in all ordinary cases be confined within the narrowest limits, and that in this as in most other things, their object should rather be to prevent abuses than to enact rules for the guidance of individuals in the distribution of their property under ordinary circumstances

*Bequeathing of Property for Charitable Purposes* — In the article FOUNDATIONS in this work, we have briefly glanced at some of the more prominent considerations that should be attended to in the endowment of hospitals, and in the appropriation of property for purposes of public utility No doubt it is of the greatest importance in a national point of view, that property should be bequeathed for such objects, and it would be easy to show that England has derived, and is deriving, the greatest advantage from the bequests of private individuals for the promotion of education, the support of the poor, and other charitable purposes Still, however, it seems abundantly obvious that such bequests should in all cases be subject to the control of the state It is difficult indeed, or rather impossible perhaps to define *à priori*, how far interference should be carried in such cases, but that, speaking generally, it is indispensable even to the proper carrying out of the views of the testators, is abundantly obvious

To regard the instructions in the wills of those who have established foundations as immutable laws, which are in no case to be altered is, in truth, to permit the ignorance, folly, or presumption of an individual to become a standard for all future ages, and to regulate the studies and the institutions of a more advanced and enlightened period by his crude conceptions and views Surely, however, it is needless to say, that no select number of men, and still less individuals, should be allowed to erect themselves into infallible legislators for every succeeding generation The regulations of the great Alfred and the other benevolent individuals who founded the Universities of Oxford and Cambridge may have been [illegible] but had they [illegible] now have been filled with [illegible] lecturers on the Ptolemaic system of the world and the infallibility of the Pope!

It is impossible to doubt the pious and benevolent views of many of those who, in the middle ages, left their property to monastic institutions, but still less is it possible [illegible] applauding the conduct of the reformers, who diverted this property to other purposes, and who justly considered that the terms of a will dictated in a comparatively barbarous period should not be permitted to consecrate and hallow a system which had become [illegible] and productive only of injurious consequences

The establishment of foundling hospitals is another instance of the same kind They were projected and have been kept up, with the best intentions, but it admits of demonstration, and is [illegible] admitted, that they have been [illegible] parably greater amount of crime and of [illegible] they have obviated

Even as respects the educational foundations established in many parts of England, no one can doubt that their utility is in very many instances greatly narrowed, and in not a few wholly nullified, by the injudicious rules laid down for their government, and, in fact, there is nothing that stands in greater need of revision and amendment than the constitution and administration of foundations

SUCCESSION In Civil Law In that jurisprudence, and those modern systems which are derived from it, there is no distinction between moveable and immoveable property, considered as a subject of succession Succession whether of real or personal property, is either *ab intestato*, or by testament The order of succession [illegible] DESCENT), is [illegible] Nov. 118 127, &c ) It admits three classes of successors, — descendants, ascendants, and collaterals, who are preferred in that order in the succession, so that if a man leave any descendants, all ascendants and collaterals are excluded, and ascendants exclude collaterals, except brothers of the whole blood and their children The children of the deceased partake equally Stepchildren [illegible] to the succession of their step parents Children [illegible] issue of several marriages, succeed equally to the property of their father, but severally to the property of their respective mothers Grandchildren take *per stirpes*, or by right of representation, *i e* if a child die in the parent's lifetime his children divide his share equally Among descendants, he or she of the nearest degree is [illegible] Brothers [illegible] parents, but it is doubtful whether or no more distant ascendants divide with them Succession among collaterals is said not to extend beyond the 10th degree The wife (by *Novell*, 53 c 6 ) succeeds, under certain circumstances, to a fourth

SUCCINEA (Lat succinum, *amber* ) A genus of freshwater Gastropods, so called from the transparent texture and amber colour of the shell Of this genus two species (*Succinea amphibia*, Drass, and *Succ[illegible]nga*) are British and to be found occasionally in the river Wandle and in Greenwich marshes

SUCCINIC ACID (Lat succinum ) An acid obtained among the products of the destructive distillation of amber, when pure it is a white crystalline substance Its salts are termed *succinates*, of these the *succinate of ammonia* is occasionally used as a test for iron It precipitates the peroxide of that metal in the form of a brown insoluble succinate

SUCCINITE (Lat succinum ) An amber-coloured garnet

SUCKING PUMP, or SUCTION PUMP The common construction of the pump, in which the two valves open upwards *See* PUMP

SUCTO'RIANS, *Suctoria* (Lat sugo, *I suck* ) The name of a tribe of Cartilaginous fishes, comprehending those which like the lamprey, have a circular mouth adapted for suction

SU'ET The fat situated about the loins and kidneys, which is harder and less fusible than that from other parts of the same animal That of the ox and sheep is chiefly used, and when melted out of its containing membranes it forms tallow, and is largely used in the manufacture of candles and the ordinary soaps Beef and mutton suet when fused concrete at a temperature of about 100 Like other kinds of fat, it is a compound of carbon oxygen and hydrogen

SUFFETES (Said to be from the Phœnic schopetim ) Certain Carthaginian magistrates, whose office bore considerable analogy to that of the Spartan kings and Roman consuls Their number was two, and they were elected annually from the noblest families of the state The functions of the suffetes seem principally to have been confined to the management of civil affairs Thus it was their province to assemble the senate and preside in it, and also to propose the subjects of debate, and collect the votes, but there are instances recorded of suffetes leading the armies of their country All the cities of note in the Carthaginian dominions had likewise their suffetes; but these, of course, were [illegible] with municipal authority (See *Mem de l'Acad des Inscr* vols xxxiv xxxviii )

SUFFRAGAN In Ecclesiastical Usage, every bishop is said to be suffragan, relatively to the archbishop of his province, thus the bishop of Carlisle is suffragan to the

archbishop of York, &c, either on account of the suffrages given them in the provincial synods, or because they can not be consecrated without the *suffrage* or consent of the archbishop Regular bishops ordained to assist a bishop in his spiritual functions, are also commonly, but rather improperly, styled suffragans, a title adopted by the stat 26 H 8 c 14

SU'FFRAGE *See* PARLIAMENT

SUFFRAGO (Lat suffrago *the pastern*) In Mammalogy and Ornithology, the joint of the tibia with the tarsus

SUFFRUTICOSI (Lat suffrutex, *an undershrub*) Any plant which is not exactly either a shrub or an herbaceous plant, that is, which has not hard woody twigs and complete buds like the one nor perishable succulent twigs like the other Lavender is an instance of a suffruticose plant

SU'GAR. (Fr sucre Germ zucker) The great commercial demand for sugar is almost exclusively supplied from the sugar cane (*Arundo saccharifera*) which contains it in greater quantity and purity than any other plant, and consequently affords the greatest facilities for its extraction A large quantity of sugar is contained [illegible] which it may be economically obtained, it has also been extracted from grapes [illegible] well known, is contained abundantly in many [illegible] and esculent vegetables It is, however, [illegible] so pure or in such quantity as to admit of ready separation

The process, as carried on in our West India islands, consists in pressing out the juice by rolling mills, and carefully evaporating it till it has acquired the proper consistency for crystallizing, [illegible] this operation, to neutralize any free acid and to facilitate the separation of certain vegetable matters which in consequence of the action of the lime, rise more readily to the surface, and admit of being skimmed off When duly concentrated, the syrup is run off into shallow wooden coolers, where it concretes, it is then put into barrels with holes in the bottom through which a quantity of treacle or molasses gradually drips, and the remaining sugar acquires the granular crystalline state, it is packed into hogsheads, and comes to us under the name of *raw* or muscovado sugar The following is a sketch of the process by which raw sugar is purified in this country Raw sugar is chosen by the refiner by the sharpness and brightness of its grain, it is put into a copper pan or boiler, previously charged with a certain quantity of lime water, with which a portion of bullocks blood has been well mixed by agitation and is suffered to stand a night to dissolve Early in the morning fires are lighted under the pans, and when the liquid boils the coagulated albumen of the blood rises to the surface and carries the impurities of the sugar with it The liquid is kept gently simmering and continually skimmed till a small quantity taken out in a metal spoon appears perfectly transparent this generally takes from four to five hours The clear syrup is then run off into a cistern, the pans are reduced to half their former size by taking off a moveable front, and a smaller portion of the purified syrup returned into each, the fires are now increased, and the sugar made to boil as rapidly as possible, till a small quantity taken on the thumb is capable of being drawn into threads by the fore-finger, the fire is then damped, and the boiling syrup carried off in basins to the *coolers*, a fresh quantity is then pumped into the pans and evaporated as before In the coolers the sugar is violently agitated with wooden [illegible] granulated It is upon this agitation [illegible] fineness of grain in the refined sugar principally depend, the crystals are thus broken down whilst forming and the whole converted into a pretty [illegible] mass, which permits the coloured liquid saccharine matter to run off, and which would be combined with the solid if it were suffered to form into larger crystals This granular texture likewise facilitates the percolation of water through the loaves in the after process, which washes the minutely divided crystals from all remaining tinge of molasses That this is the real theory of the whitening of sugar by the process of refining appears from a comparison with the process for making *sugar candy* In this the raw material is cleared and boiled as above, but instead of being put into [illegible] poured into pans, [illegible] to which the crystals attach themselves, these are set in a stove, and great care is taken not to disturb the liquid, as upon this depends the largeness and beauty of the candy In this state it is left for five or six days exposed to a heat of about 95°, when it is taken out and washed with lime water This takes off the molasses from the outside, but a great quantity is combined in the crystal, and the consequence is that candy is never whiter than the sugar it is made from When the sugar has attained the granular state in the coolers, as above described, it is poured into conical earthen moulds which have been previously soaked a night in water, in these it is again stirred, for the purpose of extricating the air bubbles, which would otherwise adhere to the surface and render it rough, when sufficiently cold, the loaves are carried to some of the upper floors of the manufactory, and the paper covers being removed from their points, they are set with their broad ends upward upon earthen pots The first portions of the liquid molasses soon run down, and leave the sugar much whitened by the separation, afterwards, pipe-clay mixed with water to the consistence of cream is put upon the base of the loaves to the thickness of about an inch, the water from the clay gradually filters through the loaf and carrying with it all remaining tinge of molasses, runs to the point the clay being of no other use than to retain the water and prevent its too rapid percolation, by which too much of the solid sugar would be dissolved This process called *claying*, is repeated four or five times, according to the nature of the sugar and the degree to which it has been refined When the loaves are thus cleansed from all relics of colour they are suffered to remain some time for the water to drain off, when this is completed, they are set with their points upwards, when all remains of it are equally diffused throughout, they are then *stove-dried* at a temperature between 95 and 100 The syrup, or [illegible] pots, is mixed with the raw sugar [illegible] it is divided according to its fineness, the first runnings which are the foulest, being reserved for the coarsest loaves, while the last, being little else than clear syrup, is boiled into loaves of the same fineness as those from which it ran The lowest syrups are boiled into what is called *bastard sugar*, from which the molasses runs with very little mixture of solid sugar this it is which is sold under the name of *treacle*, being quite incapable of further crystallization The average produce of 100 cwt of raw sugar treated as above is 63 lbs of refined, 18 of bastard, 17 of molasses, 4 loss in dirt, &c

Mr Howard, in his patent process for the refining of sugar introduced a variety of modifications and improvements the principal of which depended upon boiling under diminished atmospheric pressure, so that no part of the syrup was liable to be burned or otherwise injured by heat, he also employed recently precipitated aluminous earth to abstract part of the colouring matter, well burned charcoal, especially animal charcoal, has been found very serviceable for the latter purpose, and a number of other improvements in and modifications of the process of refining have more lately been adopted

The chemical characters of sugar are well defined, especially those of the crystallizable or cane sugar Its specific gravity is about 1 6 It dissolves in all proportions in water, is less soluble in alcohol, and is recognized by its purely sweet taste It is blackened by sulphuric acid, and when about one part of this acid is added to two of thick syrup, the mixture presently boils up into a black frothy mass, which is little else than carbon, acid, and water In respect to ultimate composition, sugar belongs to that important class of proximate vegetable principles which are theoretically regarded as compounds of carbon and water, that is, of carbon and of oxygen and hydrogen in the same [illegible] proportions as they exist in water The following [illegible] results of Dr Prout's analysis of the finest loaf sugar in a dry and pure state, with its probable atomic constitution —

| | Atoms | Equiv | Theory | Expt |
|---|---|---|---|---|
| Carbon - | - 9 | 54 | 42 86 | 42 85 |
| Hydrogen - | - 8 | 8 | 6 35 | 6 35 |
| Oxygen - | - 8 | 64 | 50·79 | 50 80 |
| | 1 | 126 | 100 00 | 100 00 |

Several other varieties of sugar have been chemically examined, such as grape sugar, honey sugar, mushroom sugar manna liquorice sugar, &c

*Consumption and Supply* — Sugar is to be ranked rather as a necessary than as the most desirable of luxuries, and a larger sum is, we believe expended on sugar in this country than on any other article except flour and butcher's meat The sugar consumed in England is all derived from the *Arundo saccharifera*, or sugar cane, and was, for a great length of period, almost wholly supplied by our colonies in the West Indies, but latterly we have derived very extensive supplies from the Mauritius and India Foreign sugar is virtually excluded from our markets by the prohibitory duty with which it is loaded

Besides the West Indies, South America, especially Brazil, the East Indies, the Mauritius, Java, Siam, the Philippine Islands, &c are the countries which export by far the largest supplies of cane sugar, though it either is or may be produced in most tropical countries, and it is also cultivated to some extent in some countries within the temperate zone During the last war, when the nations of the Continent experienced very great difficulty in getting supplies of sugar from tropical countries, attempts were made to raise it at home from beet-root; and this sugar being exempted from the heavy duty laid on colonial sugar, its culture has latterly

been very greatly extended, especially in France But the general opinion seems to be, that were beet-root sugar subjected to the same duty as colonial sugar, its culture would be greatly restricted We subjoin

An Account of the Quantities of [illegible] Description, Sorts, and Countries [illegible] Duties [illegible] from each Country, and the Amount of Duties received thereon, in each Year, from 1814 to 1833, both inclusive; also the average Price of Muscovado Sugar in Bond, &c

| Years | Quantities entered for Consumption | | | | Nett Revenue from Duties on Sugar | Average Prices of British Muscovado Sugar |
|---|---|---|---|---|---|---|
| | [illegible] | East India | Foreign | Total | | |
| | *Cwts* | *Cwts* | *Cwts* | *Cwts* | £ | *L s d* |
| 1814 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1 [illegible] per cwt |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

For an account of the rates of duty, which are very complicated, see TARIFF, in *Commercial Dictionary*

SUICIDE, or SELF-MURDER (Lat suicidium) Few chapters in the history of the human mind are more singular than that of suicide, as showing the kind of honour in which a practice so unnatural has attained in the feelings of many nations The rank which religious suicide has held from immemorial antiquity, and still holds in the opinion of the Hindoos, has been too often described, and is too familiar in its most notorious and painful instances to need more than adverting to on the present occasion It is said that the practice is condemned by their older books, if so, the traditionary sentiments of the people have been formed on some different model The suicides of the Hindoos have proceeded partly from fanaticism partly from an apathetic philosophy, those of the ancient Scandinavians, esteemed equally honourable from the overflow of courage in warriors, who could endure any evil except the approach of helpless and unwarlike old age

Among the Greeks the first inquirers who reasoned out the principles of human life and action by a train of philosophical investigation, singularly vague and discrepant opinions on this subject seem to have prevailed, as might have been expected from a people to whom religion furnished so very few fixed data of reasoning and by whom abstract truth was pursued with such unequalled ingenuity and earnestness Socrates the great master of ethics, was emphatic in his condemnation of suicide Plato speaks in a more dubious strain writing as a lawgiver, he reprobates it, and in his arguments on the subject is to be found the well-known illustration which has figured ever since in all such discussions, in which he compares it to the desertion by a soldier of his post, yet he expressly excepts from his censure those cases in which it is committed under the pressure of unmitigable calamity Pythagoras, at an earlier period denied its lawfulness (See *Athenæus*, [illegible]) In the later days of Greek philo- [illegible] was most notorious for its tenets on this subject, Zeno and Cleanthes its great masters having both put an end to their own lives as Democritus had done before them, from the mere tedium of old age

Cum jam matura vetustas
[illegible]

The argument of an Epicurean philosopher on the topic may be collected from *Cic Tusc Disp* v 41, and, indeed, may be compressed in the pithy Greek motto for a drinking party, Ἡ πίθι ἢ ἄπιθι—*drink, or begone* "Stoical academics' (says Dr Moore in his *Essay on Suicide*, i 233), "if such an expression be warrantable would plead a dismission whenever their dignity was affronted or their glory diminished, whilst Epicurean academics would care nothing about such matters, as long as their personal indolence and tranquillity were not superseded" The influence of Greek philosophy had, as is well known, a great [illegible] tendency [illegible] which [illegible] Rome [illegible] later [illegible] Roman death," as it is emphatically called, was not really a national habit; the older manners of the commonwealth repudiated it, its prevalence was owing to foreign doctrines, acting on minds affected by the violent passions, engrossing luxuries, and rapid vicissitudes of fortune which distinguished that momentous era Virgil returns to the Pythagorean view, and, without inveighing against suicide, represents it as a sad and mournful death, the perpetrators of which are doomed to a long and shadowy existence,—without torment, but without enjoyment, one which they would willingly exchange for the bitterest poverty and labour in the celestial light of day Perhaps the courtier-poet was a little affected by the feelings of those in power, who loved to have contented, orderly, and not too irritable subjects, and disliked the fashion among the noble Romans of escaping in this manner from tyranny and persecution At a later period suicide committed by criminals under accusation was made criminal by the Roman law This was with a view to preserve the forfeiture of the criminal's property to the government Suicide, as such, does not seem to have been the subject of legislation

Although Christianity was not slow in effecting a reform in the feelings of mankind on this important subject, yet some relics of the ancient sentiments lingered awhile, even in the minds of enlightened believers The fanatical Donatists were greatly addicted to suicide, and are justly condemned on this account among others by the early writers of the church Nor did these latter ever esteem suicide lawful, even under the severe persecutions to which the church was subjected, except perhaps in one case—when committed by virgins to preserve their chastity The cherished sentiments of the fathers of the church on this subject rendered them not only lenient to such victims of honour but some of them have even gone so far as to commend them Augustine with his usual strong sense of moral right, only pities them, and expressly classes all suicide as homicide (*De Civ Dei*, l i c 19) There was, at an early period, no commemoration for the souls of suicides in the early church And the council of Braçara, A D 563, refused them Christian burial, a measure which has been pretty generally adopted throughout Christendom

There have been a few paradoxical writers who have contended in favour of the lawfulness of suicide, arguing on Christian premises In *Hume's Essay on Suicide* this ground is taken, with the author's usual adroitness in pointing out supposed deficiencies in the scheme of Revelation A more remarkable instance is Dr Donne's Βιαθανατος, or, a declaration of that paradox or thesis, that self homicide is not so naturally sin that it may never be otherwise It is remarkable however, less from the force of the argumentation, than the circumstance that a man [illegible] could have [illegible] arguments those derived from the silence of [illegible] subject, [illegible] others seem very puerile. [illegible] them seriously refuted, at much length, by the painstaking Dr Moore, in his *Essay* [illegible] which we have taken mos[illegible] To say the truth, his refutation is in some instances as weak as any part of Donne's paradox

Among the writings of another class of thinkers, the reasonings *pro* and *con* urged by Rousseau in the *Nouvelle Heloise* are well known Though there is little convincing in the logic of the antagonist of suicide, yet the side he takes is made to appear the generous and noble one, and in this case, as in several others, Rousseau must be owned to have done service to the cause of morality, considering the incredible influence which he exercised on the fervid heads and hearts of his time It is remarkable that Lord Edward, in the work above

alluded to, is made to admit one exception in favour of suicide, in the case of acute and irremediable pain Madame de Stael, in her *Essay on the Influence of the Passions*, advanced a sort of defence of suicide, in her later work (*Reflexions sur le Suicide*, published in 1810) [illegible]

In discussions on the subject of proneness to suicide in particular classes or nations, it is impossible to disconnect it from that of insanity, because the miserable delusions of that disease constantly impel their victim to its commission In societies, therefore, where insanity is most common, the number of suicides will be greatest It does not follow that the number of suicides committed by persons not insane will also be greatest in such communities that is when we disregard the refinements of those who profess to consider suicide itself as a proof of greater or less derangement of the mental functions What we mean by the suicide of a sane person is the suicide of one of whose insanity there is no evidence except such as may be considered to arise from the act itself Considered in this light, the tendency to deliberate suicide has been almost epidemic in many communities Nor does it arise from similar causes or in similar states of society Among the old Scandinavians as at this day with some tribes of savages, it was the offspring of the intolerance of fierce dispositions of the helplessness of age and disease It prevails, too, sometimes in effeminate communities, where there is little zest or excitement in life, with mean habits little self-respect and much apathy thus it is extremely common in China, even it is said among the lower classes, notwithstanding the proclamations, full of ethical saws, which the magistrates issue against its commission [illegible] disposed, the act is generally deliberate and not connected with insanity, so, again, where it results from a cold temperament, and a sarcastic and contemptuous view of life, which was the notion formerly entertained by foreigners of the English mania for suicide a notion which probably had not much foundation in truth at any time Sixty years ago Mercier (*Tableau de Paris* vol iv) thought it prevailed less in England than France At present, in communities civilized on the European model it would probably be found that the number of suicides was pretty nearly in proportion to that of insane persons, and that the same causes which produce mental disturbance lead likewise to self murder Perhaps the principal predisposing influences as they affect society in the mass, may be reduced to four —the spirit of mercantile speculation leading to sudden and overpowering vicissitude of prosperity and want, mental excitement produced chiefly by misdirected education literature and philosophy, absence of self-restraint especially on religious principles, and intemperance in spirituous liquors Either of these causes alone may be sufficient for example, in various parts of northern Germany and in Geneva, where there is little of commercial movement, and where the body of the people are orderly and well-conducted, suicide is nevertheless extremely common among the educated classes, and may be referred almost wholly to mental excitement But where they all combine, the effect is fearful, as may be witnessed in the great cities of France and the United States On the other hand, suicide is rare in nations where fatalism prevails, as among the Turks and Spaniards, in nations in which a love of order is joined with an unrefined mental organization and great love of physical enjoyment such as the south Germans, and to a certain extent the Italians The following table exhibits some of the results given by M Quetelet, from researches extending over a number of years [illegible] of doubt as to the [illegible] returns in many countries

**Number of Suicides annually compared with the Population**

| | |
|---|---|
| Russia | 1 in 49,182 |
| Austria | — 20,900 |
| France | — 18 000 |
| Pennsylvania | — 15,875 |
| Prussia | — 14 404 |
| New York (State) | — 7,797 |
| City of London | — 5,000 |
| City of Berlin | — 2,941 |
| City of Geneva | — 2,941 |
| City of Paris | — 2,400 |

With regard to classes the [illegible] probably d[illegible] tion fro[illegible] however [illegible] no sovereign, at least in modern times, was ever known to commit self murder There is a remarkable paper in the first volume of the *Journal of the I[illegible] Society*, showing its prevalence amor[illegible]

this city The suicides in the Dragoon Guards and Dragoons are said to amount to one twentieth of all the deaths, while among the members of the Equitable (to make the comparison with a body of grown-up persons) they are only 1 in 110

With respect to the causes of suicide, some curious results have been obtained by statisticians, but, in giving them, we must profess our doubts concerning the value of such statements, from the very vague data on which they must necessarily be founded It appears from a classification of 134 suicides committed in ten years at Geneva (by M Prevost, in the 15th vol of the *Annales de Hygiene*), that the following causes produced them —

| | | | |
|---|---|---|---|
| Disease | 34 | [illegible] | 10 |
| Mental alienation | 24 | [illegible] | 6 |
| Pecuniary misfortunes | 19 | [illegible] | 6 |
| Domestic chagrins | 15 | [illegible] | 4 |
| Melancholy, cause unknown | 13 | Mysticism | 2 |

Comparing these with other accounts, it would seem that love produces at Paris $\frac{1}{28}$ of the suicides committed, at Geneva $\frac{1}{9}$, at Petersburg $\frac{1}{2}$ if Mr Schon is to be believed, a singular contrast to the commonly supposed effects of climate Domestic griefs at Paris (from 1794 to 1823), $\frac{1}{9}$, at Geneva the same Misconduct at Paris, $\frac{1}{23}$, at Geneva $\frac{1}{13}$ at Petersburg $\frac{1}{8}$ Gambling at Paris $\frac{1}{33}$, at Geneva $\frac{1}{11}$ Some of these results in Paris and Geneva, are certainly remarkable for their correspondence (See an essay of M Brouc, in the 16th vol of the *Annales de Hygiene* already cited The reader may consult also M de Villeneuve Bargement, *Econ Politique Chrétienne*)

The following statement is extracted from the official tables of revenue, trade, and population for 1839 —

Number of suicides in England and Wales during the year ended 30th of June 1838 Males 701, Females, 307

The Ages of 1011 Suicides

| | | | |
|---|---|---|---|
| Between 10 and 15 | 8 | Between 50 and 60 | 221 |
| — 15 — 20 | 73 | — 60 — 70 | 141 |
| — 20 — 30 | 191 | — 70 — 80 | 84 |
| — 30 — 40 | 172 | — 80 — 90 | 14 |
| — 40 — 50 | 217 | — 90 | 2 |

From this it appears that the greatest number of suicides (relatively to the numbers living) are between the ages of fifty and sixty (which appears from M Prevost's calculations to be also the case at Geneva), the tendency to suicide regularly increasing up to the latter age Between seventy and eighty the number is still very considerable

| The Season of the Year | Males | Females |
|---|---|---|
| January February March | 163 | 66 |
| April May June | 210 | 94 |
| July August September | 214 | 73 |
| October November December | 164 | 74 |
| | 751 | 308 |

Thus the proportion of male to female suicides is 2½ to 1 at Geneva exactly the same (95 to 38) The subject must not be dismissed without noticing the great increase of suicide which most observers represent to have taken place in the last twenty years especially in the large towns of northern Europe But there must be a certain degree of doubt how much of the apparent increase is owing to more accurate observations

The total number of suicides committed in London during the five years ending 1840 amounted to 1211 Of these 819 were males and 392 females, the proportion of females to males being about 48 per cent, and the age at which there was the greatest number of suicides was from 35 to 40 (See two interesting papers on *The Statistics of Suicide* by Mr Jopling, in Nos 4 and 5 of the *Assurance Magazine* from which various conclusions may be deduced at variance with the prevalent opinions on this subject)

*Suicide* is ranked by the English law as a peculiar species of felony, and like other felonies, cannot be committed by persons under the age of discretion, or insane From very ancient times (see *Bracton*) the law imposed the forfeiture of personal property as a consequence of it, and a felo de se (as a wilful suicide is termed) forfeits all chattels, real and personal But the offence was never attended with corruption of blood or the forfeiture of lands of inheritance, so that the will of a felo de se stands good as to realty In order to vest these chattels in the crown, the fact of self murder must be proved by an inquisition which the coroner is the proper officer to hold In addition, the law formerly required that a self-murderer should be buried in a highway, with a stake driven through his body Now, by 4 G 4 c 52 his remains are to be privately buried at night in the churchyard But the canon law (confirmed by the rubric in the Common Prayer Book) forbids the performance of Christian rites over them

**SUIT** In Law, the same as *action*, which see

**SULCATE** (Lat sulcus, *a furrow*) In Zoology, when a surface is deeply impressed with longitudinal parallel lines

**SU'LPHATES** Salts consisting sulphuric acid, green vitriol is a *sulphate* of the protoxide of iron Glauber's salt is a *sulphate* of soda

**SU'LPHITES** Salts [illegible]

**SU'LPHOCYANIC ACID** [illegible] was discovered in 1808, by Mr Porrett, who ascertained it to be a [illegible] sulphocyanuret, hydrogen and azote It is best formed by distilling a strong solution of sulphocyanuret of potassium with phosphoric acid, when [illegible] The strongest [illegible] boils at 217°, and [illegible] It gives a very characteristic deep red solution with persalts of iron, with a salt of copper it gives a white precipitate It is composed of

| | Atoms | Equiv |
|---|---|---|
| Sulphur | 2 | 32 |
| Cyanogen | 1 | 26 |
| Hydrogen | 1 | 1 |
| | 1 | 59 |

*Sulphocyanuret of potassium* is obtained by mixing equal weights of powdered sulphur and ferrocyanate of potassa and keeping them in fusion for half an hour in a flask, when cold, reduce the mass to powder and digest it in water filter the solution, and add a sufficiency of liquid potassa to throw down the iron

**SU'LPHONAPHTHA'LIC ACID** A compound of sulphuric acid and naphthaline, discovered by Mr Faraday (*Phil Trans* 1826)

**SU'LPHOSINA'PISIN** (Lat sulphur, and sinapi, *mustard*) A crystallizable substance obtained from mustard seed, it appears to contain sulphur, carbon, hydrogen and nitrogen

**SULPHOVI'NIC ACID** *Œnothionic Acid* An acid formed by the action of sulphuric acid upon alcohol From Mr Hennel's experiments (*Phil Trans* 1826 and 1828) it appears to be a compound of

| | Atoms. | Equiv |
|---|---|---|
| Sulphuric acid | 2 | 80 |
| Quadri-hydrocarbon | 1 | 28 |
| | 1 | 108 |

**SU'LPHUR** *Brimstone* A yellow brittle mineral product found in various parts of the world but apparently most abundant in volcanic regions Europe is chiefly supplied with it from the south of Italy and from Sicily It most commonly occurs massive, but it is sometimes met with crystallized in the form of an oblique rhombic octoedron Fine specimens of this description are seen in our mineral cabinets and bear a high price A considerable quantity of sulphur is also obtained from some of its metallic combinations, such as the sulphurets of copper and of iron These ores are heated, or roasted as it is termed, in furnaces so constructed that the sulphur vapour may be condensed and from time to time collected, this when purified by fusion is cast into moulds, and forms common or *roll brimstone* Small quantities of sulphur also occur in several animal and vegetable products, and are frequently recognized by the odour of sul[illegible] in which they evolve during putrefac[illegible] non-conductor of electricity, insipid and inodorous, unless rubbed or heated when it evolves a sulphurous smell Its specific gravity is 1 99 It melts at about 216°, and when heated to about 250° it becomes a limpid, amber-coloured liquid, if the heat be raised to about 450°, it again becomes viscid and deeper coloured, at 480° up to its boiling point it acquires rather more fluidity, at about 600° it rises rapidly in vapour, and in close vessels condenses in the form of a fine yellow powder, composed of crystalline grains in this state it is called *flowers of sulphur* The earthy and metallic impurities which, with a portion of sulphur remain in the subliming vessel were formerly called *sulphur vivum* When sulphur in its viscid state of fusion is poured into water it becomes a ductile mass, which slowly hardens, and which is often used for taking impressions of seals and medals When sulphur is in the form of vapour it is of a dense orange colour; its specific gravity in that state is about 6 6, and 100 cubic inches of it should therefore weigh about 200 grains

There is another form of sulphur which is sometimes called *milk of sulphur* (lac sulphuris), and which is a *hydrate of sulphur*; it is obtained by precipitating sulphur by muriatic acid from [illegible] solutions When sulphur which has been melted is allowed to cool slowly its latter portions exhibit prismatic crystals and very beautiful specimens of [illegible] crystallization

of sulphur may be obtained by melting a few pounds of it in a crucible or ladle, and when partially cooled [illegible] inverting the vessel so that [illegible] may run out, on breaking the mass when cold, the cavity will be found lined with [illegible]

[illegible] combinations and uses, are given under the heads of SULPHURETTED HYDROGEN, and of SULPHURIC and SULPHUROUS ACIDS

Sulphur is insoluble in water, it dissolves in boiling oil of turpentine, and is deposited often in crystals as the solution cools It is also soluble in alcohol, if both substances be brought together in the state of vapour It combines also with chlorine, bromine, and iodine Its native combinations with the metals form some of the most important ores It is from the sulphurets of lead and of copper that the commercial demands for these valuable metals are almost exclusively supplied

Sulphur is of great importance in the arts It is used extensively in the manufacture of gunpowder, and in the formation of sulphuric acid, or oil of vitriol It is also used in medicine, and for other purposes of the arts The entries for home consumption in 1838 and 1839 amounted at an average to 695,056 cwt a year The duty on refined or roll brimstone varies from 6*s* to 9*s* 9*d* a cwt, whereas on rough it is only 6*d*, so that the imports consist almost wholly of the latter The largest portion by far of the imports come from Italy, or rather Sicily The price of rough brimstone in bond in the London market usually varies from 6*l* 10*s* to 7*l* 10*s* a ton

**SU'LPHURETS** Compounds of sulphur with electropositive or inflammable bodies The most common ores of copper and of lead are *sulphurets* of those metals

**SULPHURETTED HYDROGEN,** *Hydro-sulphuric Acid* A [illegible] 1 atom of sulphur = 16 + 1 atom [illegible] equivalent, therefore, of sulphuretted hydrogen is 17 This gas was first examined by Scheele in 1777 It may be obtained by acting upon sulphuret of antimony by muriatic acid, or upon protosulphuret of iron by diluted sulphuric acid, and is immediately recognized by its peculiar fetid odour, which is so diffusible that a single cubic inch of it escaping into the atmosphere of a large room is soon every where perceptible by its smell It is very deleterious to respiration 100 cubic inches weigh [illegible] gravity compared with air being [illegible] pared with hydrogen as 17 to [illegible] a pressure of 17 atmospheres at 50° Water agitated with this gas takes up its own volume, and acquires a bitterish nauseous flavour, and the odour which characterizes Harrowgate and Aix-la-Chapelle waters, and which derive their chief peculiarities from the presence of this gas Sulphuretted hydrogen extinguishes flame, but is itself inflammable in the contact of air, burning with a blue flame and depositing during its slow combustion a portion of its sulphur When mixed with excess of oxygen and inflamed, it explodes, and the mixture is converted into sulphurous acid and water One volume of the gas requires one volume and a half of oxygen for its entire combustion and the results are water, and 1 volume of gaseous sulphurous acid [illegible] chlorine and by iodi[illegible] down its sulphur and combine with its hydrogen It is unequivocally recognized by its peculiar odour and by its blackening the salts of lead Sulphuretted hydrogen, diluted with 20,000 measures of pure hydrogen, sensibly blackens a piece of paper which has been dipped into a solution of acetate of lead white lead is also immediately discoloured by it, hence the mischief which it does to white paint and to pictures The aqueous solution of sulphuretted [illegible] litmus, and inasmuch as it combines with [illegible] bases, it is properly considered as a weak acid

**SULPHURIC ACID,** *Oil of Vitriol* This most important acid was discovered by Basil Valentine towards the end of the 15th century It was formerly obtained by the distillation of green vitriol and from its oily appearance it acquired the name, which it still bears, of *oil of vitriol* In this country it is procured by burning a mixture of 7 or 8 parts of sulphur with 1 of nitrate of soda or of potash The mixture is burned in a furnace so contrived that a current of air carries the products of the combustion into a large leaden chamber, the bottom of which is covered to the depth of a few inches with water The principal products of the combustion of the above-mentioned mixture of nitre and sulphur are sulphurous and nitrous acids, and these, together with atmospheric air and aqueous vapour, form the contents of the chamber

The sulphurous and nitrous acids, with a portion of water combine to form a white crystalline substance, which, upon falling into the water of the chamber, is instantly decomposed The nitrous acid imparts oxygen to the [illegible] into sulphuric

acid, whilst the nitrous will have ... oxygen reverts to the state of nitric acid which is ... into the air of the chamber, from which it immediately again abstracts oxygen and becomes nitrous acid ... again ready to acidify a new portion of sulphurous acid The oxygen, therefore, is thus indirectly transferred to the sulphur, or to the sulphurous acid from the atmosphere through the medium of the attractive power of the nitric oxide for that element, and the circumstance of this process being repeated ... by the same portion of nitrous gas, ... quantity of nitre required in this curious process

When the water in the chambers is rendered sufficiently acid which is judged of by its specific gravity it is drawn off into leaden boilers, where it is evaporated down to a certain density, after which, as it would then act upon the lead, it is transferred to platinum ... with still-heads, and ... concentration ... siduary water ... at great risk and inconvenience, in glass retorts its present improvement shows a ... of platinum, which is not act ... id Of late, sulphuric acid has been largely manufactured from the sulphur obtained by roasting common pyrites (sulphuret of iron), one of the objections to which is, that it almost always contains more or less arsenic by which the ... is therefore contaminated The acid made ... sulphur is indeed not always free from this mischievous impurity

Sulphuric acid is a limpid colourless fluid, of a specific gravity of 1 8 It boils at 620°, it freezes at 15° But the temperature at which the diluted acid congeals is singularly modified by the quantity of water which it contains When of the specific gravity of 1 78 (which may be regarded as a compound of 1 atom of dry acid and 2 of water), it freezes at 40° and remains solid for a long time at several degrees above that point if the density be either diminished or increased, a greater cold is required to congeal it

It is acrid and caustic ... acid in all its characters, even when largely diluted Its attractions for bases is such that it separates or expels all other acids more or less perfectly from their combinations Its affinity for water is such that it rapidly absorbs it from the atmosphere, and when mixed with water much heat is evolved thus by suddenly mixing 4 parts of the acid and 1 of water at 60°, the temperature rises to 300° Its attraction for water also causes the sudden liquefaction of snow, and if mixed with it in due proportion an intense cold is the consequence It acts energetically upon animal and vegetable substances generally charring them and often, as in the case of *sugar*, with singular rapidity

This acid, as it usually occurs in commerce, under the name of *concentrated sulphuric acid*, is a compound of 1 atom of anhydrous acid and 1 of water The anhydrous sulphuric acid is constituted of 16 sulphur (1 atom) and 24 oxygen (3 atoms), its equivalent, therefore, is 16 + 24 = 40 this is the composition of the acid as it exists in the *anhydrous sulphates* The strongest liquid acid consists of 40 of the dry or anhydrous acid (1 atom) and 9 water (1 atom), and is therefore represented by the equivalent 40 + 9 = 49

Sulphuric acid is an article of great commercial consumption, its purity and value are judged of by its specific gravity Upon this subject Dr Ure's tables may be consulted, which show the quantity of real or *dry*, and of commercial acid, in diluted acid of all densities

By the term real, dry, or anhydrous sulphuric acid, we mean that which exists in the sulphates, and which may be obtained in a separate state by ... of iron, or green vitriol, at a high temperature ... comes over a dense brownish liquid, which emits vapour when exposed to air, and has hence been termed *fuming sulphuric acid* On putting this into a retort to which a receiver surrounded by ice or snow is carefully adapted, and heating it gently a vapour passes over, which condenses into a white crystalline solid, this, which is *anhydrous* or *glacial* sulphuric acid, liquefies at about 70° and evaporates at about 112° Yet, when combined with such portion of water as constitutes the ... liquid acid, it is one of the most fixed of fluids It ... when dropped into water in consequence of the great heat evolved

The ready test of sulphuric acid is a soluble salt of baryta, the solution of chloride of barium is generally used which, when dropped into any solution of free or combined sulphuric acid, announces its presence by a white cloud, or precipitate of *sulphate of baryta* which is insoluble in nitric acid this precipitate when collected, and well washed and dried, consists of 77 baryta and 40 sulphuric acid, so that 117 is its equivalent, and this weight indicates 40 of the dry acid In the same way sulphuric acid and the sulphates, are tests of baryta

SULPHURIC ETHER See ETHER

SULPHUROUS ACID This acid consists of 16 sulphur + 16 oxygen; its equivalent being 32. It is obtained by heating sulphuric acid in contact with certain metals, which abstract an atom of its oxygen, such, for instance, as silver or mercury It is also formed by burning sulphur in oxygen gas One volume of water takes up about 30 volumes of sulphurous acid gas, so that it requires to be collected and preserved over mercury or in dry stoppered phials It has the well known suffocating odour of burning sulphur, and is possessed of considerable bleaching powers, so that the fumes of burning sulphur are often used to whiten straw, and certain silk and cotton goods, and when certain flowers, such as violets, dahlias, &c, are exposed to such fumes, or to sulphurous acid, their colours are mostly destroyed Upon other colouring matters it has little effect 100 cubic inches of sulphurous acid gas weigh between 67 and 68 grains, its specific gravity compared with atmospheric air being 2 22 It extinguishes flame, and kills animals When subjected to the pressure of about two atmospheres, or when cooled down to 6° it assumes a liquid form, and in this state it evaporates with such rapidity at common temperature as to produce a most intense degree of cold, so that by its aid chlorine may be liquefied and mercury frozen It combines with bases, and produces a class of salts called *sulphites*, they are characterized by emitting sulphurous acid when acted upon by sulphuric acid, and by becoming converted into sulphates by oxidizing agents

SU'LPHUR SALTS Chemists have lately applied this term to the *double sulphurets* The sulphurets of the most electro-positive metals have been termed *sulphur bases*, such as the protosulphuret of potassium, sodium, barium, &c, whilst the sulphurets of arsenic, antimony, &c, the bisulphuret of carbon, and sulphuretted hydrogen have been called *sulphur acids*, and the compounds resulting from the union of a sulphuret of the former with one of the latter class are *sulphur salts*

SU'LTAN (Sultaun) In Arabic, *mighty* Various Mohammedan princes are styled by this title besides the Ottoman emperor or grand sultan, to whom it is commonly given by Europeans but whose peculiar title of Padishah is more dignified The princes of the deposed family of the khan of the Crim Tartars are also styled sultan so also the pacha of Egypt in that country, although not by the court of Constantinople

SUMACH (Eng and Fr) The powder of the leaves peduncles, and young branches of the *Rhus coriaria* and *Rhus cotinus*, shrubs which grow in Hungary the Bannat, and the Illyrian provinces Both kinds contain tannin, with a little yellow colouring matter and are a good deal employed for tanning light-coloured leathers, but the first is the best With mordants, it dyes nearly the same colours as galls In calico-printing, sumach affords with a mordant of tin, a yellow colour, with acetate of iron, weak or strong, a gray or black, and with sulphate of zinc, a brownish yellow A decoction of sumach reddens litmus paper strongly, gives white flocks with the proto-muriate of tin, pale yellow flocks with alum, dark blue flocks with red sulphate of iron, with an abundant precipitate In the south of France, the twigs and leaves of the *Coriaria myrtifolia* are used for dyeing, under the name of *redoul* or *rodou* The imports for home consumption amount to about 200,000 cwt a year

SU'MMER One of the four seasons of the year. The summer season, for the northern hemisphere, begins when the sun reaches the tropic of Cancer, and ends at the following equinox

SUMMER (Quasi trabs summaria, *an upper beam*) In Architecture, any large piece of timber supported on two strong piers or posts, and serving as a lintel to a door, window &c

SU'MMONS, WRIT OF In Law By the Uniformity of Process Act, 2 W 4 c 39 s 1, it is provided that wherever (in personal actions) it is not intended to hold the defendant to special bail, or to proceed against a member of parliament under 6 G 4 c 16, this writ or process, shall be the commencement of the action It may issue from either of the four superior courts of common law, and a copy of the writ must be personally served on the defendant against whom it is intended to proceed The duration of a writ of summons is four calendar months, inclusive ... tinued by ... mons T ... to recover a debt), with other requisite particulars, must be indorsed on the writ of summons If the defendant do not appear either personally or by his attorney in answer to the writ, the plaintiff may enter an appearance for him in the proper court, and proceed to declare as if he had appeared

SU'MPTUARY LAWS (Lat sumptus, *expense.*) Laws intended to restrain the expenditure of citizens Ancient legislation abounded in them Thus, among the Romans, the Lex Orchia limited the number of guests at a feast, the Lex Fannia restricted the cost of an ordinary entertainment to ten *asses*, and so forth There were anciently many laws in England to restrain excess

in apparel, but they were all repealed by 1 J 1 c 25 It is said, however, that an ancient statute, 10 E 3. st. 3., which orders that no man shall be served at dinner or supper with more than two courses, remains unrepealed It is truly said by Montesquieu, that sumptuary laws are of all laws the most inefficacious and most constantly violated

**SUN** (Ger sonne ) In Astronomy, the central body of our system, about which all the planets and comets revolve, and by which their motions are regulated and controlled In Physics, the sun is the source of light and heat, and therefore the primary cause of all the motions and changes effected on the surface of the earth by those great agents of nature

*Apparent Magnitude of the Sun* —The sun presents to the naked eye the appearance of a luminous circular disc, subtending an angle of rather more than half a degree But on measuring accurately the diameter of the disc it is found to be not always the same, but subject to an annual variation In fact, as the earth describes an ellipse, of which the sun occupies one of the foci, its distance from the sun is constantly changing, and the variation of the [illegible] meter is a necessary consequence of [illegible] When the earth is in its perihelion, or point of its orbit nearest to the sun, the sun's apparent diameter is 32′ 34 6″, and when the earth is at its aphelion, or most distant point, the apparent diameter is 31′ 30 0″ These values are given in the Nautical Almanac, and are derived from Bessel's value for the mean distance, 32′ 1 8″, derived from transits taken between the years 1820 and 1828

*Distance of the Sun* — The sun's true distance is found from his horizontal parallax This is so small a quantity that it would scarcely be possible to determine it in the usual way by observations made on opposite sides of the earth, but the astronomical phenomena of the transits of the planet Venus over the sun's disc afford the means of determining it with the utmost precision From such phenomena the parallax has been found to be only 8 6″, that is to say, if an observer could be placed at the centre of the sun, the earth's semidiameter would be seen by him under an angle of 8 6″ From this it follows that the mean distance of the sun from the earth must be at least equal to 24,047 times the earth's radius, and as the radius of the earth is nearly 4000 miles, it follows that the sun's true distance from the earth must be about 96,000,000 miles See PLANET

In order to obtain a more distinct idea of this enormous distance, we may compute the time in which it would be passed by some of the swiftest motions with which we are acquainted A 24 lb cannon ball fired with a charge of 8 lbs of gunpowder, is projected with a velocity of about 1600 feet in a second Supposing it were to continue to move towards the sun with the same uniform velocity, it would require ten years to reach its surface A body travelling with the velocity of sound would require about five years to pass from the sun to the earth Light itself, which travels with the astonishing velocity of 192 500 miles in a second, only reaches the earth eight minutes and eighteen seconds after leaving the sun s surface

Knowing the distance and apparent diameter of the sun it is easy to compute its real dimensions A body which subtends an arc of 32′ 2″ of a circle, whose radius is 96,000,000 miles, must have a real diameter of about 892,000 miles, which therefore is the diameter of the sun Or, since the true diameter of the sun must have to the diameter of the earth the same ratio which the sun's apparent diameter as seen from the earth has to the earth's apparent diameter as seen from the sun that is a ratio of 32′ 2″ to 17 2″, or of 111 8 to 1, it follows that the sun [illegible] nearly 112 times the diameter of the [illegible] volume of the sun must be 1 397 415 (the cube of 111 8) times, or, in round numbers, 1 400 000 times the volume of the earth The mean distance of the moon being rather less than 60 times the earth's radius, if the sun's centre were placed at the centre of the earth its surface would be at twice the distance of the moon's orbit, and the volume of a sphere whose radius is equal to that of the moon's orbit would only be an eighth part of the volume of the sun The sun s volume is 500 times greater than the volumes of all the planets taken together

*Mass and Density of the Sun* —The magnitude and distance of the sun are determined by direct observation, his mass as compared with that of the earth is deduced from the law of universal gravitation The earth revolves round the sun at a given distance, and in a given time, and from these data the centrifugal force becomes known But the force which counteracts this centrifugal force, and compels the earth to move in its elliptic orbit, and prevents it from flying off in a tangent to that orbit, is the sun's attraction Hence the solar attraction is equal to the centrifugal force But the earth's attraction at its surface is a known force, being that which causes a heavy body to fall through $16\frac{1}{10}$ feet in a second of time, and consequently, from the known law of diminution proportionally to the inverse square of the distance, the earth's attractive force at any distance from the surface also becomes known. Now, on comparing the centrifugal force due to the earth's motion in its orbit with the force of terrestrial gravity on a body at the distance of the sun it is found that the former exceeds the latter in the ratio of [illegible] to 1 But when the distance is the same, the attractive forces of two bodies are directly as their masses or quantities of ponderable matter, and hence the sun's mass is 354936 times greater than that of the earth It is also found to be about 800 times greater than the aggregate of the masses of all the planets and satellites

The density of a body is directly as its mass, and inversely as its volume If, therefore, we call the density of the earth 1, the ratio of the density of the sun to that of the earth will be as 354936—1397415 to 1, or as 0 254 to 1, whence the sun's density is about one fourth of that of the earth

In order to compare the force of solar gravity at the sun's surface with that of terrestrial gravity at the earth's surface, we must recollect that the attraction of a body on an [illegible] the mass of the attracting body [illegible] distance of the point from its centre Hence, since the sun's mass is 354936 times that of the earth, and the radius (or distance of the surface from the centre) 111 8 times that of the earth, if A denote the force of solar gravity at the sun's surface, and B that of terrestrial gravity at the earth's surface, then

$$A \quad B \quad \frac{354936}{(111\ 8)^2} \quad \frac{1}{(1)^2},$$

or A is to B as 27 9 (nearly) to 1 A body, therefore, which at the earth's surface weighs one pound, would weigh 27 9 pounds if carried to the surface of the sun "An ordinary man would not only be unable to sustain his own weight on the sun, but would be literally crushed to atoms under the load " (*Herschel's Astronomy* )

*Rotation of the Sun* —The sun's surface, when viewed through the telescope, is frequently diversified with a number of dark patches or *spots*, which being observed from day to day are found not to remain in the same place, but to move across the surface, without, however, changing their relative positions These phenomena are accounted for by supposing the sun to have a rotatory motion about an axis from west to east From observations by Delambre, Bianchi Laugier &c the period of rotation is found to be about 25 days, and the sun's equator is inclined to the ecliptic in an angle of about 7° 20′, and intersects it in a [illegible] 21′ with the line of the equinoxes The observations of the [illegible] but the *fact of* [illegible] from west to east, or in the same direction as the earth and all the other planets, is established

*Spots of the Sun* —The solar spots, to which allusion has just been made as furnishing the elements of the sun s rotation, present very remarkable appearances, and have been the subject of numerous theories respecting the nature and physical constitution of the sun They began to attract attention soon after the discovery of the telescope, and their phenomena are described with sufficient accuracy by Hevelius and Scheiner In form they are exceedingly irregular, and, when watched attentively for some time, are observed to enlarge and contract, and to change perpetually their form and outline Frequently they disappear without approaching the edge of the disc and break out suddenly in places where none were seen before Sometimes a spot has been seen to break up into several parts, and the fragments to separate from each other, as if acted upon by an explosive force The *nucleus* of a spot is perfectly black, and sharply defined, and is surrounded by an *umbra*, or border of a fainter shade In the neighbour[illegible] numerous, [illegible] luminous than the general surface of the sun, called *faculæ*, are frequently seen. Among these faculæ spots are often observed to break out, and when this does not happen they are generally succeeded by spots [illegible] brightness of the antecedent [illegible] spots is generally confined to the equatorial parts of the sun, within about 30° of the equator, beyond which they are rarely seen, in the polar regions never

The magnitude of the spots and the scale on which their movements are performed, are not the least remarkable circumstances connected with the phenomena At the distance of the sun, a line which subtends an angle of one second is equal to about 460 miles, and a circle of that diameter has an area of about 166,000 miles, and this is the smallest space which can be distinctly discerned on the sun's disc But a spot was observed by Mayer having a diameter equal to 1 20th of the diameter of the sun, or upwards of 90″, and consequently (supposing it to be circular) covering an area of 1520 millions of square miles, — upwards of 30 times the whole surface of the earth

Numerous hypotheses have been formed respecting

the solar spots Scheiner supposed them to be planets revolving at no great distance from the sun's surface Galileo and Hevelius conceived them to be a sort of *scoriæ* or *scum* formed at the surface of the sun, and floating in an ocean of liquid matter Lahire supposed them to be protuberant parts of solid, opaque, and irregular masses, floating in the fluid matter of the sun Dr Wilson, of Glasgow, accounted for the spots by supposing the sun to consist of a dark nucleus, covered to a certain depth by luminous matter, through which cavities or gulfs are made by volcanic or other actions and permit the dark nucleus to be seen Lalande suggests that the spots or opaque bodies may be merely the summits of mountains, usually covered by the igneous fluid but which, by the flux and reflux of the fluid, sometimes protrude beyond its surface, and thus become visible (*Astronomie* art 3240) The most probable view, however, is that taken by Sir William Herschel who considers "the luminous strata of the atmosphere to be sustained far above the level of the solid body by a transparent elastic medium, carrying on its upper surface (or rather at some considerably lower level within its depth) a cloudy stratum which being strongly illuminated from above, reflects a considerable portion of the light to our eyes, and forms a penumbra, while the solid body shaded by the clouds reflects none The temporary removal of both the strata, but more of the upper than the lower, he supposes effected by powerful upward currents of the atmosphere, arising perhaps, from spiracles in the body, or from local agitations" (*Sir J Herschel's Outlines of Astronomy*, p 229)

*Physical Constitution of the Sun* — Respecting the physical nature of the enormous mass of matter which controls the motions of all the bodies of the solar system, and supplies them with light and heat we can only form conjectures, guided in a feeble degree by the phenomena of the spots According to the hypothesis broached by Sir William Herschel, as stated in the above quotation, there are two regions of solar clouds the inferior stratum being opaque and probably resembling our own atmosphere, while the upper stratum is the repository of light and heat, which emanate from it in all directions This upper luminous stratum he supposed to have an altitude of between 1840 and 2765 miles above the surface of the sun The lower stratum by reflecting a considerable portion of the rays which fall upon it from the luminous clouds above, not only increases the quantity of light which the latter send forth into space but serves as a canopy to screen the surface of the solid body of the sun from the scorching effects of the surrounding regions of light and heat, and he supposed its density might even be such as to maintain a temperature at the actual surface of no greater elevation than is consistent with the support of animal life But whatever may be the state of the temperature at the actual surface of which only casual glimpses are obtained through openings in the luminous clouds, it is difficult to conceive that the luminous matter can be otherwise than in a state of the most intense ignition "That the temperature, says Sir John Herschel at the visible surface of the sun cannot be otherwise than very elevated much more so than any artificial heat produced in our furnaces or by chemical or galvanic processes, we have indications of several kinds 1st, From the law of decrease of radiant heat and light which being inversely as the squares of the distances, it follows that the heat received on a given area exposed at the distance of the earth and on an equal area at the visible surface of the sun, must be in proportion to the area of the sky occupied by the sun's disc to the whole hemisphere, or as 1 to about 300 000 A far less intensity of solar radiation collected in the focus of a burning-glass, suffices to dissipate gold and platina in vapour 2dly, From the facility with which the calorific rays of the sun traverse glass — a property which is found to belong to the heat of artificial fires in the direct proportion of their intensity 3dly, From the fact that the most vivid flames disappear, and the most intensely [illegible] black spots upon the disc of [illegible] and the eye" (*Outlines of* [illegible]

[illegible] probability to the supposition that the luminous matter which surrounds the body of the sun has a temperature far exceeding any which can be produced by artificial means, but the sciences of light and heat are not yet sufficiently advanced to enable us to arrive at any certain conclusions on the subject, or to form other than purely conjectural hypotheses respecting the nature and constitution of the sun "The great mystery," continues Sir John Herschel, "is to conceive how [illegible] (if such it be) can be kept up For [illegible] chemical science here leaves us completely at a loss, or rather seems to remove farther the prospect of probable explanation If conjecture might be hazarded, we should look rather to the known possibility of an indefinite generation of heat by friction or to its excitement by the electric discharge, [illegible]

solid or gaseous, for the origin of the solar radiation" (P 238)

Considering the enormous and incessant emanation of light and heat from the sun the question has often arisen whether the volume of the sun undergoes any diminution [illegible] curren[illegible] volume would be sustained, but if, according to the hypothesis of Newton, light is produced by the actual emission of luminous particles, a diminution of volume would appear to be a necessary consequence Observation, however, can afford us no information on this head, for, supposing an actual diminution to be going on at such a rate as to lessen the diameter by two feet in 24 hours (which, having regard to the sun's magnitude may be considered [illegible] 3000 years would elapse before the [illegible] apparent diameter would [illegible] supposed the sun to [illegible] by comets precipitating themselves into it from time to time

*Atmosphere of the Sun* — The existence of a solar atmosphere was inferred by [illegible] of the intensity of radiation [illegible] By reason of the globular figure of the sun, a much larger portion of the surface towards the border is comprehended under a given visual angle than at the centre, and as every point of the surface must be supposed to radiate equally in all directions it follows that the intensity of light near the border should be greater than at the centre in proportion to the greater extent of surface comprised under the same angle Bouguer's observations, however led him to infer that the light from the centre of the disc had a greater intensity than that which proceeded from the borders — a circumstance which would be explained on the supposition of its being absorbed in a greater proportion by having to traverse a greater extent of atmosphere The more delicate experiments of Arago do not seem, however to support Bouguer's conclusions The existence of a solar atmosphere is however, indicated by the ring of light and the singular red protuberances that have been seen in solar eclipses, and especially in that of 1851, and, perhaps, still more unequivocally by the phenomenon of the zodiacal light See ZODIACAL LIGHT

*Sun's Position and proper Motion in the Heavens* — The discoveries in sidereal astronomy which have been made in modern times all tend to establish the hypothesis of a similarity of condition and a community of nature between the sun and the fixed stars The prevalence of gravitation among these remote bodies following the same law as is observed in the solar system, is no longer a matter of speculation, the proof being afforded by the elliptic orbits described by so many of the double stars about their common centre of gravity With respect to the place which the sun occupies in the heavens we have, says Sir J Herschel (*Mem Royal Astron Society* vol xi), almost ocular evidence that our system is excentrically situated within the nebula of the *Milky Way* and nearer to its southern than to its northern portion It was also an opinion of Sir William Herschel now confirmed beyond contradiction that the sun like many of the fixed stars has a proper motion in space in consequence of which it is at present advancing towards a point of the heavens within the constellation *Hercules* Yet, though the *fact* that the sun has a proper motion in space may be regarded as certain, many centuries of observation may be required to enable astronomers to detect its laws, or even to arrive at any definite conclusions respecting the [illegible] centre about which it is performed (*See J Herschel's Astronomy*, Lalande, tom iii, Biot, *Astronomie Physique*, Laplace *Système du Monde*, Delambre *Astronomie*, Argelander, Struve, and Galloway *on the Proper Motion of the Solar System*, Main, *on the Proper Motions of the Stars in Greenwich* [illegible] *See* STAR

SUNDAY The first day of the week, is said to derive its name from the Saxons, who consecrated it to the sun in heathen times The solemnisation of this day dates from the earliest age of the Christian church in memory of the death of Christ, and of the descent of the Holy Ghost, both of which events took place upon it The Jewish Christians retained at the same time their Sabbath, the last day of the week, but this practice became obsolete early at least in the Western church The Sunday was at first distinguished merely by peculiar prayers and passages of the Scriptures It does not appear to have been strictly observed as a day of cessation from labour before the reign of Constantine By the decree of that emperor (A D 321) public business and military exercises were suspended The Council of Laodicea (A D 360) forbade labour in general terms, and the laws of Theodosius (circ A D 420) sanctioned this interdiction by civil penalties *See* SABBATH

SUNDAY LETTER *See* DOMINICAL LETTER

SUNNIAH (Arab *a troop*, or *band*) The name given to the sect commonly considered as orthodox among the Mussulmans by the followers of Ali The

latter believe that the sovereign imânship, or imaginary dignity which conveys supremacy over all the faithful, belongs of right to the descendants of Ali son-in-law of Mohammed The schism between these two sects has subsisted from the earliest times of Mohammedanism, when Ali having become fourth caliph after the death of Othman, a rebellion was raised against him by Maaniah, founder of the Ommiad race of caliphs, about the year 1000 of the Christian era The division took place between the two parties in the court of the caliph Moll l' Mah, which resulted in the Schiite party becoming pre-eminent in Persia, the Sunniahites in T[illegible] Mohammedan countries

SUOVETAURILIA (Lat. sus, *a swine*, ovis, *a sheep*, and taurus, *a bull*) In Roman History, a quinquennial sacrifice, which consisted of the immolation of a sow, a sheep, and a bull, hence the name *See* LUSTRATION

SUPERCARGO The person in a merchant ship appointed to superintend all the commercial transactions of the voyage is so called

SUPERDOMINANT (Lat super, *above*, and dominus *governing*) In Music In the descending scale, the sixth of the key

SUPERROGATION WORKS OF In Theology It is a belief countenanced by many tenets of the church of Rome, that men may acquire merit in the eyes of God by good works beyond what are necessary for salvation This notion is said by Protestants to have been first known about the 12th or 13th century to have been founded upon what the Roman Catholics call "counsels of perfection," that is, rules which do not bind under the penalty of sin, but are only useful in carrying men to a higher degree of perfection than is requisite for Christians This doctrine is condemned by the church of England in her 14th article

SUPERFICIAL MEASURE The measure of surfaces or areas, also called square measure *See* MEASURE

SUPERFICIES The exterior face of any body *See* SURFACE

SUPERIOR In Scottish Law, one who has made an original part of heritable property with reservation of rent and service The grantee is termed *vassal* the interest of the grantor is *dominium directum* that of the grantee *dominium utile*, or, the former superiority, the latter property The reunion of these two rights in the same person is termed *consolidation*

SUPERLATIVE In Grammar, the name vulgarly given to the third degree in comparison, formed in the Teutonic languages by the additional syllable est

SUPERSEDEAS In Law, a writ that lies to stay various ordinary proceedings, as to stay an execution after a writ of error has been allowed and bail put in, to set aside erroneous judicial processes, and, in certain cases [illegible] oners

SUPERSTITION (Lat superstitio from super, *above*, sto, *I stand* the steps of the derivation are extremely obscure) This word like many others, has, in common language, both a subjective and objective sense, that is, we speak of superstition as a habit in the mind, and we also speak of a particular tenet or a particular observance, as "a superstition" Every belief, 1 in the existence of particular facts or phenomena, produced by supernatural agency, which existence is not demonstrated by experience nor asserted in Revelation, 2 in causation not demonstrated by experience or asserted by Revelation, *i e* of the *direct* agency of supernatural power in producing results which can either be proved to proceed from secondary causes, or by reasonable analogy must be inferred so to proceed, — is, in common language superstition An instance of the first species is the belief in the existence of imaginary beings ghosts, spectres, &c, of the second, the belief that epileptic fits are produced by witchcraft, — that meteorological phenomena hitherto imperfectly explained, such as wind or lightning, are produced without the intervention of regular physical causes by the immediate act of [illegible] The word is almost always used in a [illegible] like the Greek δεισιδαιμονία, that is, the belief which we regard as *superstitious* concerns the agency of the Deity or [illegible] For example, we do not generally [illegible] animal magnetism, [illegible] superstitions, these are persuasions respecting certain occult powers of nature undemonstrated (that is, in the case of most believers) by experience, they are *superstitions* in the mode in which they are generated and affect the mind, but not in point of subject matter On the other hand, there is much carelessness in the application of the word to religious tenets, where these flow necessarily from the belief in certain other truths as revealed for example, no Christian esteems it superstition to believe that a dead man was, in a certain instance, restored to life, although nothing can be in itself more incredible, because it is asserted in writings which he considers as revealed, and the power of working miracles is expressly claimed in that revelation But some Christians place faith in the declaration of their church, just as all Christians do in Scripture, and justly that faith by argument addressed to the reason. How, then, can they be accused of superstition in believing the truth of [illegible] however [illegible] in themselves, which [illegible] and approved for example, many of the miraculous legends commonly received in the Romish church Those who do not adhere to that church may stigmatize it as superstitious, but they can [illegible] belief which leads the Roman Catholic to address his prayers to Saints, or the Virgin, a superstition *in him*

SUPERTONIC (Lat super, *above*, and tonus, *a tone*) In Music the second above the key note From its being a comma higher in the major scale than in the relative [illegible] it is often considered inevitable sound

SUPINATION The act of turning the palm of the hand towards the [illegible] as in supporting the plate

SUPINES In Grammar certain forms of the Latin verbs The supine in *um* (of which the form is the same as the neuter of the past participle, as *amatum* in the verb *amo*) serves generally, in conjunction with another verb, to express an *intended* action, as "Lusum it Mæcenas," 'Neque vos ultum injurias hortor," in both which cases it would be expressed by the infinitive in modern languages, in the Greek, either by the infinitive, or more accurately by the infinitive used as a noun with a preposition The existence of the other supine (in *u*) is doubted by some grammarians The name is said to have been given to signify their character, neither passive nor active

SUPPLEMENT In Geometry and Trigonometry, the supplement of an arc or angle is what must be added to it in order to make a semicircle, or 180°

SUPPLEMENT In Literature, an addition made to any work or treatise, in the view of rendering it more complete

SUPPLY In Parliamentary language, the sum granted to the sovereign by parliament for defraying the expenses of the current year The known or probable amount of the different branches of the year's expenses is stated to the House of Commons in a committee of supply by the chancellor of the exchequer and, after these have been voted by the committee, they are formally granted by an act of parliament, called the Appropriation Bill The granting of the annual supplies is a peculiar [illegible] of the House of Commons which never permits [illegible] or amendment (except merely verbal) to be made by the House of Lords in the bills passed for this purpose

SUPPLY In Political Economy *See* POLITICAL ECONOMY

SUPPORT In Architecture *See* POINTS OF SUPPORT

SUPPORTERS In Heraldry, the figures placed on each side of a shield The device of supporters probably originated from the practice of knights at tournaments having their armorial shields fixed or hung near the place of justing, and guarded by pages or other retainers standing on the side of them dressed in various fanciful accoutrements, although some consider it as entirely a modern invention, or ornamental addition by painters and limners who found a vacant space on each side of the escutcheon which they filled up by imaginary figures [illegible] were at first exclusively [illegible] particular rank, and some [illegible] are said to be still entitled to them [illegible] By modern English heraldry, the grant of supporters is limited to sovereigns and princes of the blood royal, [illegible] of the Bath knights bannerets [illegible] (by their patents of creation), and to such persons as receive them by special license from the king It is said by heraldic writers that females cannot assume supporters, but this prohibition seems to be habitually infringed in practice

SUPPOSED BASS In Music, the bass of a chord when it is not the root of the common chord or harmonic triad It is also sometimes called the inversion of the accompaniment

SUPPOSITION (Lat suppositum) In Music, the use of two successive notes of equal value as to time, one of which [illegible] the other a concord [illegible] accented part [illegible] their proper preparation and resolution, and they are called *passing notes* Discords on the unaccented part of the measure are allowable by conjoint degrees, and it is then not required that the harmony should [illegible] the accented part This transient use followed by concords is what we, after [illegible] here are several kinds

SUPPOSITORY A pill or bolus introduced into the rectum, where it gradually dissolves Opium is sometimes usefully applied in this way to allay irritation of the bladder [illegible] bearing parts

SUPPRESSION A figure in Grammar is sometimes so called by which words are omitted in a sentence, which are nevertheless to be understood as necessary to a perfect construction as, for instance, in most languages, the repetition of a noun is avoided where it is coupled with a pronoun in one branch of the proposition, *e g*

"this (horse) is my horse," or "this horse is mine" (horse) *See* ELLIPSIS

SUPPURATION The process by which pus or matter is formed in inflammatory tumours

SUPRACRETACEOUS ROCKS A Geological term applied to certain rocks or strata lying above the chalk, they have also been called *tertiary strata* *See* GEOLOGY

SUPRALAPSA'RIANS Those who assert that the fall of Adam, with all its pernicious consequences, was predestinated from all eternity, and that our first parents had no liberty in the beginning *See* CALVINIST

SUPRANA'TURALISTS A name given of late years to the middle party among the divines of Germany, to distinguish them from the *Rationalists* who exclude all supernatural manifestations from religion, and from the [illegible] party, whose tenets are of a more strict [illegible] Illuminés the spirit of which is said to have given way to the [illegible] is termed) in religious matters, so far as to explain away the doctrine of original sin and other tenets which we are accustomed to consider as fundamental others approximate to what are regarded as orthodox Protestant [illegible]

SUPREMACY, OATH OF An oath denying the supremacy of the pope in ecclesiastical or temporal affairs in England, which by many statutes is required to be taken, along with the oath of allegiance by persons in order to qualify themselves for office, &c By 10 G 4 c 7 s 10 Roman Catholics are qualified for all offices (with the exception named in the act), on taking a declaration, which is substituted for the former oaths

SURAES A name given in Persia to buildings constructed for the accommodation of travellers They are synonymous with *khans* or *caravanseras*, which see

SURBASE (Fr) In Architecture the upper base of a room, or rather the cornice of the dado

SURD In Arithmetic and Algebra, a magnitude which is inexpressible by rational numbers Thus the square root of 2 the cube root of 5, &c are numbers which cannot be expressed exactly in the ordinary notation, and are represented by prefixing the radical signs indicating the operation, viz $\sqrt{2}$, $\sqrt[3]{5}$ Such quantities are otherwise called *incommensurable*

SURFACE A mathematical surface or superficies is defined by Euclid to be that which has only length and breadth This definition excludes a *line*, which has length only, and a solid, which has length breadth, and thickness As a line is generated by the motion of a point, so a surface is generated by the motion of a line If the generating line be a straight line and move subject to the condition of having always two consecutive positions in the same plane, the surface generated is *developable*, and can be stretched out on a plane, as the surface of a cone, a cylinder, &c But if the generating straight line is constrained to move so that no two of its consecutive positions are in the same plane, the surface cannot be developed on a plane Such a surface is called by the French geometers *surface gauche*

SURMOUNTED In Architecture a term used to denote an arch or dome which is higher than a semicircle

SURMOUNTED In Heraldry a term used when one figure is laid over another *e g* a pile surmounted of a chevron

SURNAME In modern European usage, the family name of an individual, but often used for any distinguishing name (*See* NAME) According to Ducange, the use of surnames in France began about the year 987, when the barons adopted the practice of designating themselves by the names of their estates And this has been the general, though by no means the uniform origin, of family names in the nobility of Europe, some having been derived from badges, cognizances the nicknames applied to individuals, &c Among the commonalty of this country surnames are said not to have been general before the reign of Edward II It will be found on examination that a great number of them originate in the still older custom of adding to the son's Christian name that of the father by way of distinction, many more from the names of trade, and many more from accidental distinctions, as of size or colour, probably applied in the first instance to the founder of the family

SURPLICE [illegible] (from pelisse *skin*) This ecclesiastical vestment is stated by Mr Palmer (*Orig Liturg* ii 320) to have been at one time not different from the alb It now has wider sleeves, a difference which is thought to have originated in some distinction between the dress of a superior and inferior order of clergy It dates from the 12th century The vehement objections entertained by the Puritans of the 16th century to its use are well known *See* VESTMENTS

SURRENDER In Law 1 A deed by which the tenant of a particular estate conveys his interest to tenant in remainder, a reversion immediately expectant on the determination of that estate 2 A surrender of copyhold or customary estates is the yielding up of such estates by the tenant into the hands of the lord for purposes expressed in the surrender By this means are accomplished conveyances of copyhold lands, the lord being in general bound to admit the party in whose favour the surrender is made *See* COPYHOLD

SURROGATE (Lat surrogatus) In Law, one substituted for or appointed in the room of another It is commonly used in the ecclesiastical courts as the description of an officer who acts as deputy for the bishop's chancellor

SURSOLID In Arithmetic, the fifth power of a number If 2 be the root, the sursolid is $2 \times 2 \times 2 \times 2 \times 2 = 32$

SURTURBRAND A species of peaty bituminous coal found in Iceland It resembles Bovey coal

SURVEYING (Fr survoir, *to overlook*) In Practical Mathematics, the art of determining the boundaries and superficial extent of a portion of the earth's surface The object of a survey may be either to ascertain the contents of a field or portion of land, or to determine the relative distances and bearings of the most prominent objects of a country for the purpose of con- and dimensions [illegible] view to deduce [illegible] the earth by comparing the [illegible] n given points with their astronomical positions In all cases the operation is conducted on the same principles but while the first requires [illegible] up a detail of the merest elements of arithmetic [illegible] ments the last cannot be accomplished with the aid of instruments of the most refined description, and processes of calculation deduced from mathematics of the highest order

In measuring land all the lines and the surfaces whose contents are to be found are reduced to the same horizontal plane, on the principle that as plants shoot up vertically no greater number can be produced on the slant side of a hill [illegible] the area covered by its horizontal base When lines actually measured are not horizontal, they are therefore multiplied by the cosines of their respective inclinations to the horizon

The English standard unit of land measure is the acre, which contains four roods, and a rood is subdivided into 40 poles or perches, each pole containing 30¼ square yards (*See* MEASURE) But though roods and poles are the legal subdivisions of the acre and the terms continually occur in all descriptions of the contents of land, in practice a decimal division is followed, which is greatly more convenient for calculation For the linear measurements a chain is employed consisting of 100 links, and its whole length is such that one *square chain* is equal to the tenth part of an acre But the acre containing 4840 square yards, the square chain consequently contains 484 square yards, and the length of the chain is the square root of 484, that is 22 yards, whence its 100th part, or one link, is 7 92 inches In order to avoid decimal fractions, surveyors usually set down all the measures in links, and when the contents of a field are cast up in square links, it is only necessary to mark off the five last figures as decimals in order to have the contents in acres, the number of square links in an acre being $100 \times 100 \times 10 = 100{,}000$

The measurement of angles being in general an operation much less liable to error than the measurement of [illegible] with the surface to be measured is of [illegible] to shorten surveys or will avoid taking further use of the chain than is necessary for obtaining the data requisite for a trigonometrical computation The most convenient instrument, and that which is almost universally employed in land surveying for the measurement of angles, is the theodolite which, from the nature of its construction, gives the angles reduced to the plane of the horizon, and consequently renders a computation for that purpose unnecessary (*See* THEODOLITE) As auxiliary to the theodolite, and for the purposes of sketching and filling in the details of a map, the *plane table* and the *prismatic compass* (see the terms) are used, and in order to determine the bearings of the several objects observed from any station with reference to the cardinal points of the horizon, a compass and needle accompany the theodolite

It frequently happens in surveying that triangles are to be measured whose sides contain very acute or obtuse angles In such cases a small error in the angular mea- [illegible] will lead to very erroneous results and for [illegible] triangle, to the greatest measure- [illegible] of the triangle a perpendicular let fall upon it from the opposite angle, the area being half the product of the side into the perpendicular. For the purpose of tracing the perpendicular, the simple cross-staff may be employed, but the instrument called the *optical square* (which is merely a small shallow circular box containing the two principal glasses of the sextant fixed at an angle of 45°) will effect the purpose with greater accuracy The method of using it is obvious If [illegible] line [illegible] with another object seen by reflexion, then a straight

line drawn to C from the point at which he stands when the coincidence takes place will be perpendicular to A B The box sextant might evidently be employed for the same purpose

Since every plane figure may be resolved as composed of [illegible] the theory of land surveying enables us, by the measurement of the angles of plane triangles, to find the area of a tract of country, by measuring the length of at least one side and the angles, together with any two of its other parts, the remaining parts and the area are computed by the rules of trigonometry As usual, let the sides of a triangle be denoted by $a$, $b$, $c$, and the angles respectively opposite by A, B, C, and let $s = \frac{1}{2}(a+b+c)$, then the area is found by either of the three following formulæ $\sqrt{\{s(s-a)(s-b)(s-c)\}}$, $\frac{1}{2}ab \sin C$, $\frac{a^2 \sin B \sin C}{2 \sin A}$ (*See* TRIGONOMETRY)

In surveying an estate, the usual practice is to measure round it with a chain and observe the several angles with the theodolite, and if the boundaries are very irregular a straight line is run between two points so as to cut off one or more of the bendings, and the perpendiculars or *offsets* from the straight line to each bending are measured with a rod or offset staff, the most convenient length of which is 10 links By this means the spaces included between the actual boundaries and the assumed straight lines are computed, and the sides and angles of the interior polygon being known, its area may be formed without resolving it into triangles *See* POLYGON

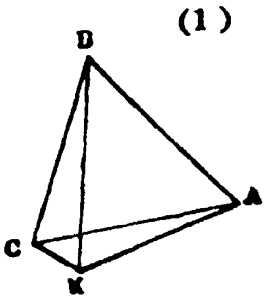
*Trigonometrical Survey* — When a survey is to be effected on a large scale as for making a geometrical map of a country or for measuring an arc of the terrestrial meridian, not only is minute accuracy required in all the practical parts of the operation, but it becomes necessary to have regard to the curvature of the earth's surface, the [illegible] tion, altitude above the sea, [illegible] of which the influence is sensible in the practice of ordinary surveying Trigonometrical measurements of this kind have been executed in various countries (*See* DEGREE) The first which was undertaken in our own country was that of General Roy, begun in 1783, for the purpose of connecting [illegible] posite Dover, and consequently for determining the difference of the meridians of the two observatories by actual measurement This gave rise to a more important operation, namely a general survey of the kingdom, which was begun in 1791 under the direction of the Board of Ordnance, and has been carrying on up to the present time A brief description of the methods employed in conducting the different parts of this splendid national undertaking will probably be the best means we could adopt to explain the nature and objects of an accurate trigonometrical survey

*Measurement of Base* — This is the fundamental, and probably the most difficult part of the whole operation, and requires to be executed with the most minute accuracy, as any error committed in its determination will affect all the distances deduced from it, and be multiplied in the ratio of these distances to the length of the base First of all, a suitable piece of ground, on which a straight line of not less than 5 or 6 miles can be laid down, must be selected and carefully levelled, and a measuring apparatus employed, of which the length is exactly known in units of a standard scale General Roy's base on Hounslow Heath was first measured with deal rods, but as these were found to be affected by the hygrometrical changes of the atmosphere it was again measured with glass tubes 20 feet in length, furnished with a peculiar apparatus for making the contacts In the subsequent measurement of the same line for the ordnance survey, two steel chains of 100 feet in length, made by the celebrated Ramsden, were made use of One of these was used as a measuring chain, the other was kept for the [illegible] in being compared with it [illegible] In the act of measuring, the chain was laid in a trough supported on trestles, and was stretched with a weight of 56 lbs The same apparatus was employed in measuring five other bases in different parts of the country, for the purpose of verifying the accuracy of the work For the measurement of the Lough Foyle base in the survey of Ireland, Colonel Colby employed a compensating [illegible] bars of different metals, so arranged [illegible] tween two points viewed by compensation microscopes [illegible] The [illegible] that of the Irish base about 8 miles. — See *Account of [illegible] Lough Foyle Base*, published in 18[illegible] [illegible] The next step in the operation is to divide the country [illegible] into a series of connected triangles The choice of the stations which form the angular points must depend in some measure on the nature of the country; but where circumstances admit of a selection being made, it is very important to form the triangles so that the small unavoidable errors of observation shall produce the least errors possible in the results The conditions required for this purpose are most nearly fulfilled by making the triangles as nearly as possible equilateral — (*Gallo [illegible] of the most probable Errors of [illegible] the Indian Survey*, *Mem Royal Ast Soc* vol xv)

*Signals* — Various plans have been adopted in the construction of the signals required at the stations at which the instrument is successively set up At first flag-staffs were chiefly used, carrying lamps and concave reflectors for night observations Such signals could be seen in the telescope of the great theodolite at distances of 20 or even 24 miles Bengal lights, fixed in small sockets were used for more distant stations In the mountainous countries of Scotland and Ireland, and where the sides of the triangles generally exceeded 50 and sometimes even 100 miles in length, conical piles of stone were erected on the tops of hills, and although these signals are attended with this disadvantage, that they can only be seen when [illegible] and the surveying parties have [illegible] to remain weeks on the summits of the mountains before a single observation could be made yet from the steadiness of the object observed they are found on the whole to be preferable to any night signals that have hitherto been tried When the theodolite is to be set up at a station which has been already observed from another, the pile is thrown down and the instrument placed exactly over its centre The heliotrope, and small plane mirrors, have likewise been [illegible] employed with success (On this subject, see Mr Dalrymple's paper in the *Phil Trans* for 1826)

*Reduction to Centre of Station* — In observing the angles at any st[illegible] ment is [illegible] condition was rigidly adhered to in the ordnance survey of Britain by erecting signals on purpose, but where the saving of expense is an object it will often be convenient to take advantage of spires, towers, &c, in which case the instrument cannot always be placed in the required position In such circumstances, the observation is made at a point near the station and the angle at that point subtended by two remote objects is reduced to that which would have been observed if the instrument had been placed exactly at the centre of the station The reduction is made as follows — Let C (fig 1) be the centre of the station, A, B the two remote objects observed, and suppose the instrument to be set up at a point K near to C, then the angle actually measured is A K B, while that which is to be determined is A C B Put C A = $b$, C K = $d$, the angle B A C = A, A C B = C, A K B = K, B K C = $k$, then the difference between C and K expressed in seconds of a degree is

(1)




$$C - K = \frac{d \sin (A - k) \sin K}{b \sin A \sin 1''}$$

The distance C K or $d$ is measured, C A or $b$ is found approximately [illegible] A C B with the approximate v[illegible] ([illegible]), and the angles A, K, $k$ are given by observation The formula is not quite exact, but sufficiently so for all ordinary cases

*Reduction to the Horizon* — Another indispensable condition is, that the angles observed at each station be reduced to the plane of the horizon When the theodolite is employed for measuring the angles, this reduction is effected by the instrument itself, but when the angles are measured [illegible] reduction is necessary [illegible] be in the same horizontal plane with the instrument, which will rarely happen Suppose the observer stationed at A, and let B and C be the distant objects Let the angular elevation of B above the horizontal plane (which is found [illegible] be $\beta$ seconds, and [illegible] of C be $\gamma$ seconds, also let A′ be the horizontal projection of the angle A, and suppose A − A′ = $x$ seconds, then

$$x = \left\{\left(\frac{\beta+\gamma}{2}\right)^2 \tan\left(\frac{A}{2}\right) - \left(\frac{\beta-\gamma}{2}\right)^2 \cot\left(\frac{A}{2}\right)\right\} \sin 1'',$$

which gives the correction to be subtracted from the observed angle A in order to have the corresponding angle A′ If one of the objects B or C be depressed, the arc of depression, $\beta$ or $\gamma$, must be regarded as a negative quantity

*Spherical Excess* — The sum of the three angles of any spherical triangle exceeds [illegible] by a quantity which is called the spherical excess and which we shall denote by E If the observations could be made with absolute accuracy [illegible] on the [illegible], the difference of their

sum from this quantity is the aggregate error of the three observed angles, and must be distributed among those angles so as to render the sum precisely 180°+E before the sides are computed. It is therefore necessary to determine E. Let S denote the area of the triangle in square feet, r the number of feet in the radius of the earth, and $\pi = 3.14\ldots$, then E is given in seconds by this formula (*see* SPHERICAL EXCESS),

$$E = \frac{S \times 648000''}{\pi r^2}$$

(Si[illegible] that in every case which can arise in practice the area of the triangle must be a very small quantity in comparison of $r^2$, so that in order to f[illegible] to compute S with great preci[illegible] value will be obtained by calculating one of the unknown sides as if the triangle were a plane one, and computing the area from the formula $S = \frac{1}{2} a b \sin C$.—(*Measurement of Lough Foyle Base*, p. 126.)

With respect to r, which is here taken to represent the radius of curvature of the surface [illegible] any arc on the earth's surface varies not only with the latitude of the place of observation, but also with the direction of the arc in respect of the meridian. For the present purpose it would be sufficiently accurate to assume r as the radius of the meridian, but as the radius of the perpendicular and oblique arcs is required in other parts of the computation, we shall here state the formulæ from which they are computed. Let R be the radius of curvature of the [illegible] R the radius of the circle perpendicular to the meridian, and r the radius of a great circle making [illegible] let p denote half the [illegible] feet (Airy's value), and e the ellipticity or the difference between the equatorial and polar axes divided by the polar axis (= 1—301 026 = 003322), then

$$R = p\,(1 - e + 3e \sin^2 l)$$

$$R' = p\,(1 + e + e \sin^2 l)$$

$$r = R\left(1 + \frac{R' - R}{R'} \sin^2 \theta\right)$$

Since the inclination $\theta$ is different for each of the sides of the triangle a mean value of r may be found by making $\theta = 45°$, in which case $\sin^2 \theta = \frac{1}{2}$, and as the curvature varies very little through a considerable extent of country the same value of r may be used for all the triangles within a zone of two or three degrees of latitude. Suppose, then, the value to be computed for the mean latitude of a chain of triangles, the formula for the spherical excess will be $E = \frac{a b \sin C \times 648000}{2 \pi r^2}$, and on assuming the constant $648000 - 2\pi r^2 = m$, the formula for computation will be

$$\log E = \log a + \log b + \log \sin C + \log m$$

It is proper to remark that in general E is a very small quantity. When the sides of the triangles are about 20 or 30 miles, it will seldom exceed 4 or 5 seconds of a degree, but in some of the great triangles connecting Ireland with the west coast of Scotland its value was found to exceed 30 seconds.

Having computed the spherical excess E, make $e = A + B + C - (180° + E)$, (A, B, C being the observed horizontal angles), then e is the error of the sum of the observed angles, and if there be no reason for supposing that any one of the angles has been less accurately determined than the others, the error e must be equally divided among them, or a third of e must be added to or subtracted from each [illegible] excess or defect and th[illegible] which the [illegible] for computation be A′, B′, C′, we have

$$A' = A + \tfrac{1}{3}e,\quad B' = B + \tfrac{1}{3}e,\quad C' = C + \tfrac{1}{3}e$$

*Calculation of the Sides.* — The angles being thus corrected for errors of observation, it now remains to compute the two [illegible] The computation may [illegible] spherical trigonometry, but a better method, practised by Delambre and [illegible] horizontal angle the corresponding chords of the terrestrial arcs and [illegible] triangle as a plane one. In this manner the chords of the spherical arcs are found, whence the arcs themselves are easily obtained. The reduction of a horizontal or spherical angle to the corresponding chord angle is made as follows. — Let A be the observed spherical angle, b and c the lengths of the containing sides com[illegible] which may be explained [illegible] and A − x the angle [illegible] by [illegible] the sides b, c, then

$$x = \frac{1}{16}\left(\frac{b+c}{r}\right)^2 \frac{\tan \frac{1}{2}A}{\sin 1''} - \frac{1}{16}\left(\frac{b-c}{r}\right)^2 \frac{\cot \frac{1}{2}A}{\sin 1''}.$$

This [illegible] the reduction x expressed in seconds, [illegible] chord angle A − x. If we now denote by x′ and x″ the corresponding corrections for the other angles B and C, the sum of the three corrections will evidently be the difference between the sum of the three spherical angles of the triangle and the sum of the angles of the plane triangle formed by the chords, or 180°, and consequently

$$x + x' + x'' = E,$$

so that the spherical excess is obtained from the reduction, and does not require to be previously computed.

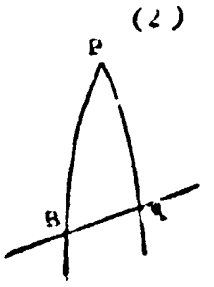
The three chord angles A − x, B − x′, C − x″, being computed from the above formula, the difference between their sum and 180° gives the error of the three observed angles, and must be apportioned among the three chord angles, so that their sum shall be precisely 180°. With these corrected angles the chords of the spherical sides are computed as in plane trigonometry, and the arcs are then found from the chords from the following formulæ, where a′, b′, c′ are the chords of the three terrestrial arcs a, b, c, namely,

$$a = a' + \frac{a'^3}{24 r^2},\quad b = b' + \frac{b'^3}{24 r^2},\quad c = c' + \frac{c'^3}{24 r^2}$$

*Legendre's Theorem.* — A third method of computing the [illegible] discovered by Legendre, and is demonstrated in his *Éléments de Géométrie* [illegible] triangle on the surfa[illegible] of the spherical excess be deducted, the sines of the angles thus diminished will be proportional to the lengths [illegible] sides, and consequently the sides may be [illegible] the triangle were rectilineal." This is the easiest method of any, and in fact, if the three angles are assumed to have been equally well determined, the previous computation of the spherical excess is not necessary for the calculation of the sides, though it will be required for estimating the relative accuracy of the observations. The method of proceeding is this. — Let A, B, C be the three observed angles, and let $\delta = A + B + C - 180°$, then, from each of the three observed angles subtract $\frac{1}{3}\delta$, and with the angles thus reduced compute the sides as in a plane triangle from the formula $b = a \sin (B - \frac{1}{3}\delta) - \sin (A - \frac{1}{3}\delta)$. The sides thus determined are equal to the geodetical lines, or the spherical arcs on the ground.

*Latitudes, Longitudes, and Azimuths.* — When the sides of all the triangles have been computed the distances between the stations become known, but in order to complete the survey, it is still necessary to determine the astronomical positions of the principal stations, and the bearings of the sides of the triangles with respect to the terrestrial meridians. For this purpose the latitude and longitude of one of the stations, and the azimuth of another as seen from it, must be found by astronomical methods (*see* LATITUDE, LONGITUDE, AZIMUTH), but when this has been done these elements may be computed for each of the other stations in the chain of triangles provided the dimensions and ellipticity of the spheroid are assumed to be known. The formulæ for computation are the following. —

(2)




Let A and B (fig. 2) be two stations, A P and B P the meridians passing through A and B and meeting in the pole P, and let the azimuths at each station be counted from the south towards the west. Assume

$l = 90° - A P$ = latitude of A,
$l' = 90° - B P$ = latitude of B,
$A = 180° - P A B$ the azimuth of B as seen from A,
$B = 180° + P B A$ the azimuth of A as seen from B,
$P = A P B$ the difference of the longitudes of A and B,
$d$ = length of the geodetical line A B in feet,
$R'$ = radius of the circle perpendicular to the meridian at A in feet,
$e$ = the ellipticity as above defined = 003322,

then,

$$l' = l - \left\{\frac{d \cos A}{R' \sin 1''} + \frac{d^2 \sin^2 A \tan l}{2 R'^2 \sin 1''}\right\}(1 + 2e \cos^2 l)$$

$$P = \frac{d \sin A}{R' \cos l' \sin 1''}$$

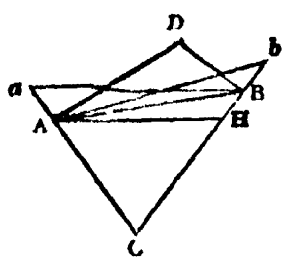
$$B = 180° + A - P\frac{\sin \frac{1}{2}(l + l')}{\cos \frac{1}{2}(l - l')}$$

These formulæ are theoretically sufficient to give the elements in question, but as some uncertainty must exist as to the [illegible] of the earth and a small error in this respect will affect the convergence of the meridians and produce a considerable error in the computed longitudes.

and azimuths, it is necessary, [illegible] a survey over a considerable tract of country to [illegible] by determining the direction of the meridian at different stations by astronomical observations

*Calculation of Altitudes* — The only element which remains to be determined [illegible] is the relative altitudes of [illegible] cipal points At every station the elevation or depression of each of the others observed from it is measured with the the [illegible] earth, and the [illegible] sary in order [illegible] or of distance from the centre of the earth

(3)




Let A and B (fig 3) be two stations, C the centre of the earth, and let *b* be the position of B as seen from A elevated by refraction, and *a* that of A as seen from B Make C H = C A, then H B is the true difference of altitude of A and B, or the quantity to be determined from observation Join A H, A B, A *b*, and draw the horizontal lines A D and B D, which will be respectively perpendicular to C A and C B Assume in seconds,

*d* = D A *b* the observed depression of B,
*d'* = D B *a* the observed depression of A,
C = A C B the angle measured by the arc A B,
*ε* = the mean refraction
*φ* = B A H the [illegible] then B H will be found by the [illegible] —

$$\varepsilon = \tfrac{1}{2}\left\{C - (d + d')\right\} \quad \varphi = \tfrac{1}{2}C - (d + \varepsilon)$$

$$B\,H = A\,B \times \varphi \sin 1''$$

Thus B H is found in terms of A B and the reciprocal observations at A and B The mean refraction *ε* is also determined at the same time, but if this be assumed to be known, the observation of depression at one of the stations would be sufficient to give the difference of elevations The two quantities *d* and *d'* have been both assumed to be depressions, if one of them is an elevation, it must be taken with the negative sign

See the *Trigonometrical Survey of England and Wales*, Delambre, *Base du Systeme Metrique*, Puissant, *Traité de Geodesie*, Id *Nouvelle Description Geometrique de la France*, *Encyc Brit* art "Trigonometrical Survey"

SURVIVORSHIP in the doctrine of Life Annuities, is a reversionary benefit contingent upon the circumstance of some life or lives *surviving* some other life or lives or of the lives signed order For the solut [illegible] which can be put relative to the values of annuities and assurances in every order of survivorship where there are only three lives see the treatises of Baily and Milne, or the *Essay on Probabilities* by Professor De Morgan, in the *Cabinet Cyclopædia*

SUSPENSION BRIDGE In Architecture a bridge in which the roadway, instead of being carried over the support [illegible] points by chains or [illegible] principle has recently been carried to a great extent in this country, as in the case of the Menai bridge, but its application is old, and has long been practised among people who have attained very little if any skill in the arts *See* BRIDGE

SUSSEX MARBLE A variety of limestone which constitutes one of the fresh-water deposits of the Wealden group, it abounds in shells of *Paludinæ* a genus of fresh-water Univalves It occurs in layers varying from a few inches to upwards of a foot in thickness the layers being separated by seams of clay or of friable limestone

SUTTEE (More correctly written Sati or Satee, in Sanscrit, *pure*) A word applied by the Brahmins to various rites of religious purification but more especially, by usage, to the voluntary self-immolation of widows on the funeral pile of their husbands This is nowhere commanded in the religious books of Hindoostan, although it is spoken of, in common with many other acts of similar fanaticism as highly meritorious The English government, up to a late period had only interfered to ensure, as far as possible, that the sacrifice should be voluntary on the part of the sufferer which [illegible] presence of a government officer Thus [illegible] became frightfully common in Bengal [illegible] vinces in the present century At [illegible] 1829, they were abolished in the [illegible] Lord W Bentinck (See *Forbes's* [illegible] 26, *Heber's Journal*, i 70, and many other authorities) There is [illegible] account of a suttee in Bali, an island in which the Hindoo religion now prevails, in *Crawford's Ind Archipelago*, book vi ch 2

SUTURE, in Mammalogy, is the line formed by the [illegible] ing series of hairs of the integument [illegible] it is the line at which the elytra meet, and are sometimes confluent

SUTURE, in Anatomy, means the junction of bones by their serrated or teethed margins the bones of the skull are so united

SWAB A large bundle of old yarns hung by the middle, and swung right and left to dry the decks

SWALLOW A name equivalent to the subgeneric term *Hirundo*, appropriated in modern Ornithology to [illegible] swifts

SWAMP Ground habitually so moist and soft as not to admit of being trod on by cattle, but, at the same time, producing particular kinds of trees, bushes, and plants A swamp differs from a bog and a marsh in producing trees and shrubs, while the latter produce only herbaceous plants and mosses

SWAN Of the [illegible] there are three British species [illegible] the wild and the tame swan These form the type of the subgenus *Cygnus* The wild swan and Hooper ought perhaps to be regarded as the only true native species The tame swan (*Cygnus olor*) is superior in bulk to either of the wild species, and is at once [illegible] by a large black callous knob on the bas Both the wild species are peculiarly characterized by convolutions of the windpipe, extending in the mature bird through the whole length of the keel of the sternum These convolutions are horizontal in the *Cygnus Bewickii*, and vertical in the *Cygnus ferus*

SWARD Green turf, that is, the surface of land under pasture grasses A fine sward may be called the characteristic feature of British landscape, not being found in the same degree of perfection in any other country, not even in Ireland

SWEDENBORGIANS Those persons who on religious subjects receive the testimony of Swedenborg, a Swedish nobleman who died in 1772 In his work entitled *Arcana Cœlestia*, and in his *Apocalypsis Revelata*, Swedenborg professes to make known what he calls the Science of Correspondences, or that analogy between spiritual and natural things according to which he says the Word of God is written Thus Jerusalem signifies not only the chief city of Palestine, but the Lord's church and more specifically the religious doctrines by which persons are united into a church Hence the new Jerusalem, seen by John descending from God out of heaven, signifies a new church, or a new development of pure doctrines from the holy Word, which will eventually regenerate the world In these doctrines may be considered as most prominent the [illegible] of the Lord Jesus Christ as the one [illegible] is centred the divine trinity and the necessity for [illegible] th faith, or in other words for the kee [illegible] commandments in which is included the performance of every duty The admirers of Swedenborg who form a separate religious body have places of worship in London and other towns of England and are greatly increasing in America, but besides these it is said that there are many, among both clergy and laity, who receive the views of Swedenborg [illegible] it

SWELL In Music, a set of pipes in an organ acted upon by a key board and capable of being increased in intensity of sound by the action of a pedal, which allows of its being thereby gradually augmented *See* ORGAN

SWIMMERS The web-footed or aquatic birds (*Natatores*, Ill, *Palmipedes* Cuv) are so called, also a tribe of spiders (*Aranеidæ natantes*) which live in water, and there spin and spread abroad filaments to entrap their prey

SWINE POX The *chicken pox*, which see

SWINESTONE Fetid or bituminous limestone, which exhales a disagreeable odour on friction

SWING The ship at anchor is said to swing when she changes her position at the turn of the tide

SWIVEL In Gunnery, a small cannon, so called from its being fixed in a *swivel*, by means of which it may be directed to any object Swivels are chiefly used at sea, and are placed on the ship's side, stern, or bow, and also in the tops

SWORD OF STATE Four swords are used at the coronation of a British sovereign 1 The sword of state properly so called 2 The curtana (curtus, *shortened*), the sword of mercy, which is pointless it is mentioned by Matthew Paris 3 The sword of spiritual justice 4 The sword of temporal justice These three are carried [illegible] he is girt with the first

[illegible] OF THE A Swedish military [illegible] instituted by Gustavus Vasa

[illegible] term used metaphorically to designate an effeminate voluptuary, [illegible] inhabitants of Sybaris, formerly a town [illegible] on the gulf of Tarentum whom a devotion to sensual pleasures had so enfeebled that they became an easy prey to the Crotonians,

sum from this quantity is the aggregate error of the three observed angles, and must be distributed among those angles so as to render the sum precisely $180^\circ + E$ before the sides are computed. It is therefore necessary to determine E. Let S denote the area of the triangle in square feet, $r$ the number of feet in the radius of the earth, and $\pi = 3.14159$; then E is given in seconds by this formula (*see* SPHERICAL EXCESS),

$$E = \frac{S \times 648000''}{\pi r^2}$$

(648000 being the number of seconds in 180°). In order, therefore, to compute E we must previously know the values of S and $r$. Now with respect to S it is to be observed that in every case which can arise in practice the area of the triangle must be a very small quantity in comparison of $r^2$, so that in order to find E it is not necessary to compute S with great precision. A sufficiently near value will be obtained by calculating one of the known sides as if the triangle were a plane one, and computing the area from the formula $S = \frac{1}{2} a b \sin C$. (*Account of the Measurement of Lough Foyle Base*, p. 126.)

With respect to $r$, which is here taken to represent the radius of curvature of the surface of the triangle in question, it is to be remarked that by reason of the ellipticity of the earth the radius of curvature of any arc on the earth's surface varies not only with the latitude of the place of observation, but also with the direction of the arc in respect of the meridian. For the present purpose it would be sufficiently accurate to assume $r$ as the radius of the meridian, but as the radius of the perpendicular and oblique arcs is required in other parts of the computation, we shall here state the formulæ from which they are computed. Let R be the radius of curvature of the meridian at latitude $l$, R′ the radius of the circle perpendicular to the meridian, and $r$ the radius of a great circle making an angle $= \theta$ with the meridian; also let $p$ denote half the [illegible] of the earth = 20,853,810 feet (Airy's value), and let $e$ denote the difference between the equatorial and polar axes divided by the polar axis (= 1 − 301 026 = 003322); then

$$R = p\,(1 - e + 3e \sin^2 l)$$

$$R' = p\,(1 + e + e \sin^2 l)$$

$$r = R\left(1 + \frac{R' - R}{R'} \sin^2 \theta\right)$$

Since the inclination $\theta$ is different for each of the sides of the triangle, a mean value of $r$ may be found by making $\theta = 45^\circ$, in which case $\sin^2 \theta = \frac{1}{2}$; and as the curvature varies very little through a considerable extent of country, the same value of $r$ may be used for all the triangles within a zone of two or three degrees of latitude. Suppose, then, the value to be computed for the mean latitude of a chain of triangles: the formula for the spherical excess will be $E = \frac{a b \sin C \times 648000}{2\pi r^2}$, and on assuming the constant $\frac{648000}{2\pi r^2} = m$, the formula for computation will be

$$\log E = \log a + \log b + \log \sin C + \log m$$

It is proper to remark that in general E is a very small quantity. When the sides of the triangles are about 20 or 30 miles, it will seldom exceed 4 or 5 seconds of a degree, but in [illegible] Ireland with the [illegible] found to exceed 30 seconds.

Having computed the spherical excess E, make $e = A + B + C - (180^\circ + E)$, (A, B, C being the observed horizontal angles), then $e$ is the error of the sum of the observed angles, and if there be no reason for supposing that any one of the angles has been less accurately determined than the others, the error $e$ must be equally divided among them, or a third of $e$ must be added to or subtracted from each angle according as the error is in excess or defect, and the results will give the angles free from [illegible]. Thus, if the angles for example A, B, C have

$$A' = A + \tfrac{1}{3}e,\quad B' = B + \tfrac{1}{3}e,\quad C' = C + \tfrac{1}{3}e$$

*Calculation of the Sides.* — The angles being thus corrected for errors of observation, it now remains to compute the two unknown sides of the triangles. The computation may be made by the ordinary rules of spherical trigonometry, but a better method, practised by Delambre and [illegible], is to compute the chords of the terrestrial arcs, and then calculating the triangle as a plane one. In this manner the chords of the spherical arcs are found whence the arcs themselves are easily obtained. The reduction of a horizontal or spherical angle to the corresponding chord angle is made as follows. — Let A be the observed spherical angle, $b$ and $c$ the lengths of the containing sides computed approximately as above explained, $r$ the radius of curvature at the [illegible] angle contained [illegible]

$$x = \frac{1}{16}\left(\frac{b+c}{r}\right)^2 \tan \tfrac{1}{2}A \sin 1'' - \frac{1}{16}\left(\frac{b-c}{r}\right)^2 \cot \tfrac{1}{2}A \sin 1''.$$

This formula gives the reduction $x$ expressed in seconds, and consequently the chord angle $A - x$. If we now denote by $x'$ and $x''$ the corresponding corrections for the other angles B and C, the sum of the three corrections will evidently be the difference between the sum of the three spherical angles of the triangle and the sum of the angles of the plane triangle formed by the chords, or 180°, and consequently

$$x + x' + x'' = E,$$

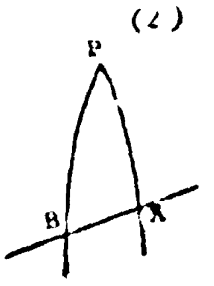
so that the spherical excess is obtained from the reduction, and does not require to be previously computed.

The three chord angles $A - x$, $B - x'$, $C - x''$, being computed from the above formula, the difference between their sum and 180° gives the error of the three observed angles, and must be apportioned among the three chord angles so that their sum shall be precisely 180°. With these corrected angles the chords of the spherical sides are computed as in plane trigonometry, and the arcs are then found from the chords from the following formulæ, where $a'$, $b'$, $c'$ are the chords of the three terrestrial arcs $a$, $b$, $c$, namely,

$$a = a' + \frac{a'^3}{24 r^2},\quad b = b' + \frac{b'^3}{24 r^2},\quad c = c' + \frac{c'^3}{24 r^2}$$

*Legendre's Theorem.* [illegible] computing the sides [illegible] surveys on the Continent, is derived from a theorem which was discovered by Legendre, and is demonstrated in his *Eléments de Géométrie*: "If from each of the angles of any small triangle on the surface of a sphere or spheroid one third of the spherical excess be deducted, the sines of the angles thus diminished will be proportional to the lengths of the opposite sides, and consequently the sides may be computed as if the triangle were rectilineal." This is the easiest method of any, and in fact, if the three angles are assumed to have been equally well determined, the previous computation of the spherical excess is not necessary for the calculation of the sides, though it will be required for estimating the relative accuracy of the observations. The method of proceeding is this. — Let A, B, C be the three observed angles, and let $\delta = A + B + C - 180^\circ$, then, from each of the three observed angles subtract $\frac{1}{3}\delta$, and with the angles thus reduced compute the sides as in a plane triangle from the formula $b = a \sin (B - \frac{1}{3}\delta) - \sin (A - \frac{1}{3}\delta)$. The sides thus determined are equal to the geodetical lines, or the spherical arcs on the ground.

*Latitudes, Longitudes, and Azimuths.* — When the sides of all the triangles have been computed the distances between the stations become known, but in order to complete the survey it is still necessary to determine the astronomical positions of the principal stations, and the bearings of the sides of the triangles with respect to the terrestrial meridians. For this purpose the latitude and longitude of one of the stations, and the azimuth of another as seen from it, must be found by astronomical methods (*see* LATITUDE, LONGITUDE, AZIMUTH), but when this has been done these elements may be computed for each of the other stations in the chain of triangles, provided the dimensions and ellipticity of the spheroid are assumed to be known. The formulæ for computation are the following. —



(2)

Let A and B (fig. 2) be two stations, A P and B P the meridians passing through A and B and meeting in the pole P, and let the azimuths at each station be counted from the south towards the west. Assume

$l = 90^\circ - A P$ = latitude of A,
$l' = 90^\circ - B P$ = latitude of B,
$A = 180^\circ - P A B$ the azimuth of B as seen from A,
$B = 180^\circ + P B A$ the azimuth of A as seen from B,
$P = A P B$ the difference of the longitudes of A and B,
$d$ = length of the geodetical line A B in feet,
R′ = radius of the circle perpendicular to the meridian at A in feet,
$e$ = the ellipticity as above defined = 003322,

then,

$$l' = l - \left\{\frac{d \cos A}{R' \sin 1''} + \frac{d^2 \sin^2 A \tan l}{2 R'^2 \sin 1''}\right\}(1 + 2e \cos^2 l)$$

$$P = \frac{d \sin A}{R' \cos l' \sin 1''}$$

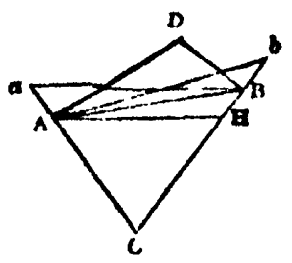
$$B = 180^\circ + A - P\frac{\sin \frac{1}{2}(l + l')}{\cos \frac{1}{2}(l - l')}$$

These formulæ are theoretically sufficient to give the elements in question, but as some uncertainty must exist as to the ellipticity of the earth and a small error in this respect will affect the convergency of the meridians and produce a considerable error in the computed longitudes

and azimuths it is necessary, in carrying a survey over a considerable extent of country, to check the azimuths by observations of the sun or stars at different stations by means of chronometers

*Calculation of Triangles* — The triangles when all the angles have been measured, and one side, remains to be determined, are usually solved by means of the relative altitudes of the principal points At every station the elevation or depression of each of the others observed from it is measured with the theodolite, but owing to the curvature of the earth, and the refraction of light, a calculation is necessary in order to determine their true differences of level, or of distance from the centre of the earth

(3) Let A and B (fig 3) be two stations, C the centre of the earth, and let *b* be the position of B as seen from A elevated by refraction, and *a* that of A as seen from B Make C H = C A, then H B is the true difference of altitude of A and B, or the quantity to be determined from observation Join A H, A B A *b*, and draw the horizontal lines A D and B D, which will be respectively perpendicular to C A and C B Assume in seconds,




$d$ = D A *b* the observed depression of B,
$d'$ = D B *a* the observed depression of A
C = A C B the angle measured by the arc A B,
$\epsilon$ = the mean refraction
$\phi$ = B A H the angular difference of altitudes,

then B H will be found by the following formulæ —

$$\epsilon = \tfrac{1}{2}\left\{C - (d + d')\right\} \quad \phi = \tfrac{1}{2}C - (d + \epsilon)$$

$$B H = A B \times \phi \sin 1''$$

Thus B H is found in terms of A B and the reciprocal observations at A and B The mean refraction $\epsilon$ is also determined at the same time, but if this be assumed to be known, the observation of depression at one of the stations would be sufficient to give the difference of elevations The two quantities $d$ and $d'$ have been both assumed to be depressions, if one of them is an elevation, it must be taken with the negative sign

See the *Trigonometrical Survey of England and Wales*, Delambre, *Base du Systeme Metrique*, Puissant, *Traité de Geodesie*, Id *Nouvelle Description Geometrique de la France*, *Encyc Brit* art Trigonometrical Survey"

SURVIVORSHIP in the doctrine of Life Annuities is a reversionary benefit contingent upon the circumstance of some life or lives *surviving* some other life or lives or of the lives [illegible] to some assigned order For the solution of the questions which can be put relative to the values of annuities and assurances in every order of survivorship where there are only three lives see the treatises of Baily and Milne or the *Essay on Probabilities* by Professor De Morgan, in the *Cabinet Cyclopædia*

SUSPENSION BRIDGE In Architecture, a bridge in which the roadway, instead of being carried over the supporting points is suspended from them [illegible] points being chains or other flexible materials The principle has recently been carried to a great extent in this country as in the case of the Menai bridge, but its application is old, and has long been practised among people who have attained very little if any skill in the arts *See* Bridge

SUSSEX MARBLE A variety of limestone which constitutes one of the fresh water deposits of the Wealden group, it abounds in shells of *Paludinæ* a genus of fresh-water Univalves It occurs in layers varying from a few inches to upwards of a foot in thickness the layers being separated by seams of clay or of friable limestone

SUTTEE (More correctly written Sati or Satee, in Sanscrit, *pure*) A word applied by the Brahmins to various rites of religious purification but more especially, by usage, to the voluntary self immolation of widows on the funeral pile of their husbands This is nowhere commanded in the religious books of Hindoostan although it is spoken of in [illegible] acts of similar fanaticism as [illegible] The English government, up to a late period, had only interfered to ensure, as far as possible, that the sacrifice should be voluntary on the part of the sufferer, which was done by the presence of a government officer Thus legalized, suttees became frightfully common in Bengal and the [illegible] provinces in the present century At length in December 1829, they were abolished in the British dominions by Lord W Bentinck (See *Forbes's Oriental Memoirs* ii 26, *Heber's Journal*, i 70, and many other authorities) There is a curious account of a suttee in Bali, an island in which the Hindoo religion now prevails, in *Crawford's Ind Archipelago*, book vi ch 2.

SUTURE, in Mammalogy, is the line formed by the incumbent series of coronal [illegible] series of hairs of the [illegible] line at which the [illegible]

SUTURE, in Anatomy, means the junction of bones by their serrated or teethed margins the bones of the skull are so united

SWAB A large bundle of old yarns hung by the middle and swung right and left to dry the decks

SWALLOW A name equivalent to the subgeneric term *Hirundo*, appropriated in modern Ornithology to the British species called bank chimney, and window swallow and to foreign allied forms dismembered from the swifts

SWAMP Ground habitually so moist and soft as not to admit of being trod on by cattle, but, at the same time, producing particular kinds of trees, bushes, and plants A swamp differs from a bog and a marsh in producing trees and shrubs, while the latter produce only herbaceous plants and mosses

SWAN Of [illegible] are three British [illegible] wild and the tame swan These form the type of the subgenus *Cygnus* The wild swan and Hooper ought perhaps to be regarded as the only true native species The tame swan (*Cygnus olor*) is superior in bulk to either of the wild species, and is at once [illegible] by a large black callous knob on the base [illegible] Both the wild species are peculiarly characterized by [illegible] and vertical in the *Cygnus ferus*

SWARD Green turf, that is, the surface of land under pasture grasses A fine sward may be called the characteristic feature of British landscape, not being found in the same degree of perfection in any other country, not even in Ireland

SWEDENBORGIANS Those persons who on religious subjects receive the testimony of Swedenborg, a Swedish nobleman who died in 1772 In his work entitled *Arcana Cœlestia*, and in his *Apocalypsis Revelata*, Swedenborg professes to make known what he calls the Science of Correspondences, or that analogy between spiritual and natural things according to which he says the Word of God is written Thus Jerusalem signifies not only the chief city of Palestine, but the Lord's church, and more specifically the religious doctrines by which persons are united into a church Hence the new Jerusalem, seen by John descending from God out of heaven, signifies a new church, or a new development of pure doctrines from the holy Word, which will eventually regenerate the world In these doctrines may be considered as most prominent the acknowledgment of the Lord Jesus Christ as the one God in whom is centred the divine trinity, and the necessity for uniting charity with faith, or in other words for the keeping of the divine commandments in which is included the performance of every duty The admirers of Swedenborg who form a separate religious body have places of worship in London and other towns of England and are greatly increasing in America, but besides these it is said that there are many, among both clergy and laity, who receive the views of Swedenborg without avowing it

SWELL In Music, a set of pipes in an organ acted upon by a key board, and capable of being increased in intensity of sound by the action of a pedal, which allows of its being thereby gradually augmented *See* Organ

SWIMMERS The web-footed or aquatic birds (*Natatores* Ill, *Palmipedes*, Cuv) are so called, also a tribe of spiders (*Dranetidæ natantes*) which live in water, and there spin and spread abroad filaments to entrap their prey

SWINE POX The *chicken pox* which see

SWINESTONE Fetid or bituminous limestone, which exhales a disagreeable odour on friction

SWING The ship at anchor is said to swing when she changes her position at the turn of the tide

SWIVEL In Gunnery, a small cannon, so called from its being fixed in a *swivel* by means of which it may be directed to any object Swivels are chiefly used at sea, and are placed on the ship's side, stern, or bow, and also in the tops

SWORD OF STATE Four swords are used at the coronation of a British sovereign 1 The sword of state properly so called 2 The curtana [illegible] *short sword*, the sword of mercy, which is pointless [illegible] mentioned by Matthew Paris 3 The sword of spiritual justice 4 The sword of temporal justice These three are carried [illegible] he is girt with the first

SWORD OF THE [illegible] A Swedish military order of knighthood, instituted by Gustavus Vasa

SYBARITE A term used metaphorically to designate [illegible], so called from the inhabitants of Sybaris a town of Italy on the gulf of Tarentum, whom a devotion to sensual pleasures had so enfeebled that they became an easy prey to the Crotoniana,

a people comparatively insignificant in point of numbers, by whom their city was levelled to the ground, B C 310

SYCEE SILVER The only approach to a silver currency among the Chinese In it the government taxes and duties and the salaries of the officers are paid, and it is also current among the merchants in general The term *sycee* is derived from two Chinese words *se sze* "fine gloss silk," which expression is synonymous with the [illegible] This silver is formed into [illegible] called shoes), which are stamped [illegible] *office* that issues them and the dates of their issue The ingots are of various weights, but most commonly of ten taels each

Sycee silver is divided into several classes according to its fineness and freedom from alloy The kinds most current at Canton are the following, —

1 Kwan heang The hoppos duties or the silver which is forwarded to the imperial treasury at Pekin It is of 97 to 99 touch On all the imperial duties a certain per centage is levied for the purpose of turning them into Sycee of this high standard and of conveying them to Pekin without any loss in the [illegible] The [illegible], however in all probability, increases the per-centage far above what is requisite, that he may be enabled to retain the remainder for himself and his dependants

2 Fan hoo, or fan foo the treasurer's receipts, or that in which the land tax is paid This is also of high standard, but inferior to the hoppos duties, and being intended for use in the province and not for conveyance to Pekin, no per-centage is levied on the taxes for it

3 Yuen paon, literally "chief in value" This kind is usually imported from Soochan in large pieces of 50 taels each It does not appear to belong to any particular government tax

4 [illegible] "salt duties" It is difficult to account for these being of so low a standard, the salt trade being entirely a government monopoly

5 Muh tue, or wuh tue, the name of which signifying "uncleansed or unpurified," designates it as the worst of all It is seldom used except for the purpose of plating (Prinsep's "Useful Tables," *Appendix to Journal of Asiatic Society* [illegible] Calcutta, 1834)

SYCOMA (Gr *συκον, a fig*) A fig-shaped tumour

SYCOPHANT (Gr *συκοφαντης* from *συκον a fig, φαινω, I discloss*) It was [illegible] by the laws of Athens at one period to [illegible] public informers who gave notice of [illegible] this fiscal law were extremely unpopular, and hence the word came into use to signify an informer or false accuser generally, in which sense it is constantly used by Aristophanes and the orators. In modern languages it has acquired the sense of a mean flatterer

SYCO'SIS A tubercular eruption upon the scalp, or bearded part of the face It sometimes forms a very troublesome impediment to [illegible]

SY'ENITE A granitic rock from *Syene*, or *Siena* in Egypt It often has the appearance of a variety of granite *See* GEOLOGY

SY'LLABLE (Gr *συλλαβη*, from *συλλαμβανω, I collect*), is defined by Girard, the celebrated French grammarian, 'a simple or compound sound, pronounced with all its articulations by a single impulsion of the voice' The principal difficulty in arranging the syllabic construction of language is to ascertain in what cases two or more consonants following each other may be joined in a syllable, which can only be done by [illegible] the mechanism of speech (See a learned article on this subject in the *Encyclopédie*)

SY'LLABUS (Gr *συν* and *λαμβανω*) A compendium or abridgment, or a table of contents, as a syllabus of lectures &c

SYLLEPSIS (Gr *συλλεψις, connection or bringing together*) In Grammar sometimes called subst[illegible] A name given by some writers to that idiom of the Greek and Latin languages whereby an adjective predicated of a masculine and feminine substantive is made to accord in gender with the former *e g* "rex et regina beati"

SY'LLOGISM (Gr *συλλογιζομαι, I collect*) In Logic, an argument stated in the correct logical form, consisting of three propositions, distinguished by the property that the conclusion necessarily follows from the premises, so that if the premises [illegible] must be true also (*See* PROPOSITION, LOGIC) As often as the mind observes any two notions to agree with a third, it immediately concludes that they agree with each other as A is equal to B, B is equal to C, therefore A is equal to C Or, if it finds that one of them agrees and the other disagrees with the third [illegible] disagree with each other In [illegible] it produces a syllogism with an affirmative conclusion in the latter a syllogism with a negative conclusion

Syllogisms are variously divided by some into simple, complex and conjunctive &c, by others categorical, the Oxford system of logic [illegible] conditional, &c But the categorical syllogism, consisting of three categorical propositions, is the simplest form of reasoning, and that to which all other forms can be reduced

The following are the two canons by which the validity of a categorical syllogism is explained — 1 If two terms, *i e* notions expressed in language (*see* TERM), agree with one and the same third they agree with each other 2 If one term agrees and another disagrees with a third, the two first disagree with one another Hence are deduced the six following rules

1 Every syllogism has three terms only; viz the middle term, and the two extremes The subject of the conclusion is called the minor term, its predicate the major term the middle term is that with which they are respectively compared 2 Every syllogism has three propositions only the major premiss in which the major term is compared with the middle, the minor premiss, in which the minor term is compared with the middle, the conclusion in which the major and minor terms are compared together 3 The middle term must be in logical language distributed (*i e* taken in the premises) *i e* it must be the subject of a universal, or the predicate of a negative (*see* PROPOSITION), otherwise it may happen that one of the extremes is compared with one part of it, and the other with another part 4 No term must be distributed in the conclusion which is not distributed in one of the premises, otherwise the whole term would be employed in the conclusion, where part only are employed in the premiss this error is called an illicit process of the major or minor premiss 5 From negative premises you can infer nothing, *i e* if two terms disagree with a third, you cannot conclude either their mutual agreement or disagreement 6 If one premiss be negative the conclusion [illegible] for if one term disagree with the [illegible] necessity also disagree with the other The other rules are corollaries deducible from these six

The *mood* of a syllogism [illegible] of three propositions in their [illegible] quantity and quality By reference to the head PROPOSITION, it will be seen that arbitrary symbols are adopted in logic to mark the quality and quantity of propositions thus A stands for a universal affirmative, E represents a universal negative I particular affirmative O particular negative These four letters will afford sixty-four different combinations of three letters, but of these the greater part will afford syllogisms erring against some one or more of the rules previously laid down thus E E E would be at once inadmissible, as exhibiting two negative premises, — against rule 5 By an accurate examination it is found that eleven moods only will afford correct syllogisms A A A, A A I, A E E, A E O, A I I, A O O I A I I A O, E I O, I A I O A O

The figure of a syllogism consists in the situation of the middle term with reference to the major and minor terms 1 The first figure is where the middle term is the subject of the major premiss, and predicate of the minor 2 Where the middle term is the predicate of both premises 3 Where it is the subject of both 4 Where it is the predicate of the major and subject of the minor Multiplying the moods by the figures, we should have forty four different syllogisms But it will be found, on examination, that five moods in each figure (twenty in all) would err against some one or other of the rules before laid down *e g* I A I is an allowable mood in the third figure, but, in the first, it would have an undistributed middle Of the twenty-four remaining, five are unnecessary, *i e* they are moods in which a particular conclusion only is inferred from premises which would warrant a universal The nineteen remaining are expressed in the following mnemonic lines —

Fig 1 4 moods BA*rb*A*r*A, c*E*l*A*r*E*n*t*, d*A*r*I*I, f*E*r*IO*que* prioris
Fig 2 4 moods C*E*s*A*r*E, c*A*m*E*st*r*E*s, f*E*st*I*n*O, b*A*r*O*k*O*, secundæ
Fig 3 6 moods [illegible] d*A*r*A*p*t*I d*I*s*A*m*I*s, d*A*t*I*s*I*, f*E*l*A*p*t*O*n*, B*O*k*A*r*d*O, f*I*r*I*s*O*n, habet quarta insuper addit
Fig 4 5 moods B*r*A*m*A*nt*Ip, c*A*m*E*n*E*s, d*I*m*A*r*I*s, f*E*s*A*p*O, f*r*E*s*I*s*O*n*

One mood in each figure may be given by way of example The letter M designates the middle term; the letter preceding the proposition its quantity and quality

1 A All excess (M) is sinful
A All gluttony is excess (M) therefore
A All gluttony is sinful (A syllogism in Barbara)
2 A Every [illegible] expedient is lawful (M)
E [illegible] is [illegible] (M) therefore
E Nothing unjust is expedient (A syllogism in Camestres)
3 A All conquerors (M) are cruel
I Some conquerors (M) are just therefore
I Some just men are cruel (A syllogism in Datisi)

4. A. Whatever is expedient is conformable to nature (M).
E. Whatever is conformable to nature (M) is not hurtful therefore
E. What is hurtful is not expedient. (A syllogism in Camenes)

It will be observed that in all these instances the major premiss is presumed to precede the minor; but although this is the most convenient form of reasoning the minor premiss is, with equal validity, made the first in the series *e g*

Brutus is an honourable man
Honourable men affirm the truth, therefore
Brutus affirms the truth

This is a syllogism in Barbara, with the minor premiss placed before the major

The fourth [illegible] to be inverted and unnatural, and [illegible] res, with their fourteen moods, furnish almost every argument which is employed, however far it may be removed in appearance, through the intricacy of language, from the syllogistic form But all arguments may be brought, by an ingenious process termed *reduction*, into one or other of the four moods of the first figure

In reducing a syllogism, the premises may be illatively converted (*see* ILLATIVE CONVERSION), or transposed, since the force of the argument can be altered by neither of these processes By employing this liberty, we deduce either the same conclusion with the original, or another conclusion from which the original conclusion follows by illative conversion We have not space to explain, by examples, these various processes The letters which compose the names of the [illegible] last figures are reduced into those of the first The first letter indicates [illegible] the same [illegible] reducible into Barbara, *m* indicates that the premises are to be transposed, *s* and *p* that the proposition denoted by the vowel immediately preceding is to be converted, — *s* simply, *p* per accidens, *k*, which occurs only in Baroko and Bokardo, indicates that the proposition denoted by the vowel immediately before it must be left out and the contradictory of the conclusion (*see* CONTRADICTORY) substituted, which is termed the *reductio ad impossibile*

A hypothetical syllogism is one in which the conclusion is deduced from an hypothetical premiss (called the major) and a categorical premiss (called the minor) It is of two kinds, — conditional and disjunctive the first subdivided into constructive and destructive

1 Conditional constructive
If the demand increases, the supply will increase
But the demand increases,
[illegible]

2 Conditional destructive
If [illegible] is flourishing
But agriculture is not flourishing,
Therefore the country is not flourishing

3 Disjunctive
Either A is B or C is D
But A is not B,
Therefore C is D

It is evident that a disjunctive syllogism may easily be reduced to a conditional (See the *Compendium of Logic* by Dean Aldrich, commonly used at Oxford, and the Treatise of Archbishop Whately)

SYLPH (Gr *σιλφη, a kind of insect*) The name given to the spirits of air in the fantastic nomenclature of the Rosicrucians and Cabalists (See those articles) The use which Pope has made of this fancy in his *Rape of the Lock* is well known He seems to have borrowed it from the enigmatical romance called the *Count de Gabalis*

SYMBOL (Gr *συμβολον*, from *συν, together*, and *βαλλω, I throw*) A word of many meanings, although now commonly used in one only 1 The primary meaning of the verb *συμβαλλειν* expresses the act of several in constituting or throwing together portions to form a whole Hence *συμβολον* signified a treaty or agreement (*Arist Polit*) And it seems to be in this sense that the creeds are termed by early ecclesiastical writers symbols either because (as Augustine says) all the fundamental doctrines of Christianity are *collected* in them, or from the old traditionary story, related by Rufinus, that the creed called the Apostles' was formed by each of them contributing a sentence (*See* CREED) 2 The mind may be said to put together (*συμβαλλειν*) outward appearances, and collect from them the notion of a thing signified by them, and hence the outward appearances themselves [illegible] *symbols*, signs, or emblems [illegible] is termed *conjecture* (Lat [illegible] the standards of military bodies were called [illegible] Greeks symbols, as likewise omens and portents, and expressions or figures denoting a received meaning, as the Pythagorean symbols. In this sense, the early Christian church called all rites, ceremonies, and outward forms bearing a religious meaning, by the general name of symbols; the sacraments themselves, and the sacramental elements, the Cross, and, in later times, images and pictures Symbols, properly so called, must be distinguished from types, *i e* phenomena, manifestations recorded in the Old Testament, of which the full meaning is developed by correlative manifestations in the New, and from mere symbolical attributes such as the figures usually introduced in company of the four Evangelists [illegible] is contained the creeds and confessions such as the three creeds, received by all, the Confession of Augsburg, received by the Lutherans, the articles of the Church of England, &c The Germans call the study of the symbols and mysterious rites of antiquity, and also the study of the history and contents of Christian creeds and confessions of faith, by the name of Symbolics (mythological or theological) *Marheineke's Institutiones Symbolicæ*, of which the first edition appeared in 1812, is one of their most distinguished works in the latter class

SYMMETRICAL SOLIDS In Geometry, a name given by Legendre to solids which, though equal and [illegible] afford an example of symmetrical solids The equality of plane figures is proved by showing that they may be made to coincide, but [illegible] evident that this mode of proof cannot be extended to all solids

SYMMETRY In the Fine Arts *See* PROPORTION

SYMPATHY (Gr *συμπασχω, I suffer with*) In Moral Philosophy, the quality of being affected by feelings common to our fellow-men In his *Theory of Moral Sentiments*, Dr Smith maintains that sympathy is the real foundation of morals (*See* VIRTUE) For a succinct statement of this theory, see "The Life of Dr Smith," prefixed to M'Culloch's edition of the *Wealth of Nations*, p iv In the Fine Arts, the term signifies conformity of the parts to each other, but in Painting it is more usually applied to the effective union of colours

SYMPHONY (Gr *συν, with*, and *φωνη, voice*) In Music, a composition which, from the etymology of the term, evidently implies that the voice anciently formed an essential part of its construction In the present day, however, the term is otherwise applied, and is exclusively used for a piece in which instruments only are engaged It is, in fact, a composition for a perfect instrumental orchestra, which, until the beginning of the eighteenth century, was unknown The *Concerti grossi* of Corelli were the first of the species, which was carried out to a greater extent in the works of Geminiani and Vivaldi, but it does not seem to us that before the time of Haydn it can be said to have assumed the form which the name now imports There is, perhaps, no musical composition in which the power of the author is so completely developed as in a symphony The musician in it becomes a poet, or perhaps rather a painter Scenes and the passions are represented therein by a combination of musical sounds, in illustration of which we need only cite that splendid work of Beethoven, known to all under the name of *Il Pastorale* The general form of the symphony may be thus described — It opens with a short, serious, slow movement, this is followed by and forms a contrast to one of spirit and of a lively nature, then comes an andante varied, or [illegible], a minuet with its trio follow [illegible] closes with a lively rondo, or a finale of rapid motion

SYMPHYSIS (Gr *συμφυειν, to grow together*) A term applied to the junction of certain bones, or to joints as the *symphysis of the pubes*

[illegible] (Gr *συμπιεζω, I compress*; *μετρον measure*) An [illegible] Mr Adie of Edinburgh for measuring the [illegible] atmosphere by the compression of a column of gas It consists




[illegible] having an enlarged portion or bulb of about 2 inches in length and half an inch in diameter at each end The top at A is hermetically sealed, and [illegible] be stopt by a cork [illegible] A *m* is filled with some permanently elastic gas different from common air (hydrogen gas is found to answer best), and the lower *m B n* with a fixed oil, or some fluid which does not act upon the gas and is not acted upon by air

The tube being opened at C, the oil is exposed to the pressure of the atmosphere, and stands at a height *m*, corresponding to the difference of the pressures of the atmosphere and of the column of enclosed gas Consequently as the atmospheric pressure becomes greater the gas will be compressed, and the column of oil will rise The change in the bulk of the gas occasioned by a change of pressure is measured by a scale, which is formed experimentally, and of which the divisions are entirely arbitrary

But as the bulk of the enclosed gas is altered by any change of temperature as well as of pressure, it is necessary to apply a correction on this account For this purpose a common thermometer is attached to the instrument to indicate the temperature, and the principal or barometric scale, which measures the compression of the gas, is made to slide upon another scale divided so as to represent the change of bulk in the gas produced by a change of temperature under the same pressure, and corresponding to the graduation of the thermometer In making an observation, the temperature is first observed by the thermometer, an index or pointer, which is fixed to the top of the sliding scale, is then set opposite to the degree of temperature on the fixed scale and the number the sliding scale opposite the top of the column of oil gives the pressure of the air in inches of the mercurial barometer

The principle of the syphon tube is that of the *manometer* or air barometer which was long ago proposed by Hooke, and Mr Adie's great improvement consists in the substitution of a gas for common air, which has the defect of being absorbed by the enclosing fluid It is a valuable instrument at sea, as it is not affected in any degree by the motion of the ship, and it possesses several advantages over the barometer in its convenient size its greater portability and in being less liable to accident (See the *Edinburgh Encyclopedia*, art "Meteorology *Edin Phil Journal* No I, *Edin Journal of Science*, No xi)

SYMPO'SIARCH (Gr συμποσιον, *feast* and αρχω *I rule*) The ruler or master of a feast, one selected by the consent of the party to be their president for the occasion, whom the Greeks sometimes called βασιλευς The word rendered "governor of the feast" in John, ii 8, is αρχιτρικλινος Some think that a priest or Levite was chosen to fill this office in Jewish feasts

SYNE'RESIS (Gr συναιρω *I contract*) Otherwise called *Crasis* (Gr κρασις *mixture*) In Grammar the contraction of two syllables into one by the formation of a diphthong or by rendering one of them mute as, Atreides for Atreides *See* METAPLASM

SY'NAGOGUE (Gr συναγω, *I assemble*) The religious assemblies of the Jews are so called by Hellenic writers The Jews had no synagogues it is thought before the Babylonish captivity They were first formed after the return of the Jews to the Holy Land The rule was, that a synagogue was to be erected in any place where there were ten persons of full age and free condition ready to attend the service of it Others, however consider the ten *batelnim*, to use the Hebrew word, to have been ten elders, or stationary men of the synagogue (See *Lightfoot*) The service performed in the synagogues consisted, and still consists, of prayers the scriptures and preaching The prayers are contained in the Liturgy the scripture consists of three lessons certain selected passages from Deuteronomy and Numbers, the law and the prophets The third part of the service is mentioned in several places in the narratives of the life of our Saviour, and the Acts Luke iv 16 Acts xiii 5 The times of the synagogue service were three days a week (Monday, Thursday and Saturday), besides the holydays The ministration of the synagogue was not confined to the order of priests, the elders, or "rulers of the synagogue," were persons qualified, and duly admitted, of all tribes (Prideaux, *Connection*, vol i)

SYNALÆ'PHA (Gr συν, *together*, αλειφω *I anoint*, from the melting together of two sounds) In Classical Prosody, the usage by which, when a word ends with a vowel, with the letter *m*, and the next begins with a vowel, the final syllable of the one runs into the first of the other This, in Latin verse, also takes place when the last letter is *m*, but the usage in this instance is called *ecthlipsis*, or elision The synalæpha is commonly, though not with equal regularity adopted in Italian and Spanish poetry, and is not unfrequently attempted especially by Milton, in our own, in French it extends only to the e mute at the end of words

SYNARTHRO'SIS (Gr συν, *with*, and αρθρον, *a joint*) The immoveable connection of one bone with another

SYNCA'RPOUS (Gr συν, and καρπος, *fruit*) In Botany, a term applied to the carpels of a compound pistil when they are completely united into an undivided body; as in the orange

SY'NCATEGOREMA'TIC (Gr συν, and κατηγορημα, a word employed together with categorematics or terms) In Logic, a word which cannot be employed by itself as a term, but requires to be conjoined with another or others for that purpose Such are adverbs, prepositions, nouns in other cases besides the nominative, &c *See* TERM

SY'NCHONDRO'SIS (Gr συν, and χονδρος *a cartilage*) The junction of one bone with another by an intervening cartilage

SYNCHRONISM (Gr συν, and χρονος, *time*) The tabular arrangement of history according to dates, by which contemporary persons and things in different countries are brought together

SYNCLINAL See ANTICLINAL.

SYNCOPATION In Music *See* DRIVING NOTES

SYNCOPE (Gr συν, and κοπτω, *I cut*) A figure of Grammar, by which one or more letters are omitted in the middle of a word, as in the Latin *litus* for *littus* *See* METAPLASM

SYNCOPE In Pathology, fainting A disease in which the circulation and respiration temporarily cease, or become extremely feeble

SYNCOPE In Music *See* LEGATO

SY'NCRETISM (Gr συν, and κρασις, *mixture*) In Philosophy, the blending of the tenets of different schools into a system A party among the Platonists at the revival of letters, to which belonged Ammonius, Pico della Mirandola, Bessarion, and other distinguished men, have received the name of Syncretists

SY'NCRETISTS In the history of the partisans of Calixtus, a [illegible] century who endeavoured to form a comprehensive scheme which should unite the different professors of Christianity The opinions of Calixtus raised a strong controversy in the Lutheran church A new confession of faith was drawn up in Saxony for the purpose of excluding his partisans As doctrines, however, they did not long survive his death although not without effect on the spirit of the age (*Mosheim*, cent xvii sect 2)

SYNDA'CTYLES *Syndactyli* The name of a tribe of Perching birds, those which have the external and [illegible] as far as the second joint

SYNDESMO'SIS (Gr συνδεσμος, *a ligament*) The union of one bone with another by means of ligament

SY'NDIC (Gr συν *with*, δικη, *justice*) A title given at different times to various municipal and other officers The syndics of cities in Provence and Languedoc, under the old French government, were officers delegated by the municipality as agents or mandatories Such were also the syndics of [illegible] of a bankrupt under [illegible] or syndics of the number

SYNE'CDOCHE (Gr συν *with* or *in out*, and δεχομαι, *I receive*) In Rhetoric a figure by which the whole is put for a part or part for the whole It is a species of trope (*See* TROPE) There are six ordinary instances of synecdoche 1 When genus is put for species (as 'being' in the sense of 'man') 2 When species is put for genus 3 When the essential whole is put for one of its parts 4 When the matter, or form, is put for the whole being 5 The whole for a part 6 The part for the whole

SYNE'CHIA (Gr συνεχω, *I adhere*) A disease of the eye in which the iris adheres to the cornea, or to the capsule of the crystalline lens

SYNE'RGISTS (Gr συνεργιζω, *I co-operate*) A name given to a party in the Lutheran church in the latter end of the 16th century Those who were thus called appear to have held the doctrine that the divine grace requires a correspondent action of the human will in order to become effectual, which, or something resembling it, is termed semi-pelagian in early ecclesiastical history Some sentiments expressed by Melanchthon, towards the close of his life, seem to have introduced it into that church

SYNEURO'SIS (Gr συν, and νευρον, *a nerve*, or *ligament*, or *membrane*) The union of one bone with another by means of [illegible] membrane

SYNGNA'THIANS *Syngnathi* (Gr συν, *with*, γναθος *a jaw*) The name of a family of Lophobranchiate fishes including those in which the lengthened jaws are united by a surrounding integument so as to form a tubular mouth the genus *Syngnathus* or pipe fish, is the type *Syngnatha* is a name given by Dr Leach to an order of Myriapodous insects

SY'NGRAPHA (Gr συν, and γραφω, *I write*) In Dutch [illegible] the creditor and debtor, and [illegible] was kept by each

SYNIZE'SIS (Gr συν, *I meet*) An obliteration of [illegible] pupil

SYNOCHA (Gr συνεχω *I continue*) A continued inflammatory fever The term *synochus* is applied to continued fevers, which are in their symptoms intermediate between *synocha* and *typhus* They are also called *mixed fevers*

SY'NOD (Gr συνοδος, employed in that language to [illegible] Among the [illegible] council and a synod, the former [illegible] assembly of the episcopal, [illegible] the latter the convention of [illegible] cese under its bishop or archbishop

SYNOD In the Scottish Kirk an assembly composed of two or more presbyteries It consists of every parish minister within its limits and of the elders who have been appointed to represent the different sessions in the presbyteries There are sixteen synods in Scotland *See* PRESBYTERY

SY'NOD OF DORT. *See* DORT, SYNOD OF.

SYNO'DIC. (Gr. *συν, together, ὁδος, pathway*) In Astronomy, the synodic revolution of a planet (or the moon), with respect to the sun, is the time between two consecutive conjunctions or oppositions. The duration of this period is easily found when the difference between the mean motion of the planet and sun in a given interval of time is known, for this difference is to add as the given interval to the synodic revolution. The *synodical month* is the period of the moon's synodic revolution, and is the same with *lunar month* or *lunation*. *See* MOON.

SY'NONYMS. (Gr. *συν*, and *ονομα, a name*) Words of the same language which have a similar signification. Strictly speaking, words having exactly the same signification are not to be found in any language, unless one [illegible] words may be frequently used for one another, and this interchange produces a pleasing variety in composition, necessary in poetry. Synonyms form an important object of philological study, demanding, on the part of the inquirer, great knowledge of the principles of language. The chief works on this subject are the *Onomasticon* on Greek, Dumesnil on Latin, Blair, Crabbe, and Taylor on English, Stosch and Ebernard on German, and Giraud, Beauzée, Roubaud, and Guizot on French synonyms.

SYNO'PSIS. (Gr. *συν, together, ὀψις, view*) A collective view of any subject, as a synopsis of astronomy, theology, &c.

SYNO'VIA. (Gr. *συν*, and *ωον, an egg*) The fluid which lubricates the cartilaginous surfaces of the joints. It [illegible] white of egg.

SY'NTAX. (Gr. *συν, with, τασσω, I arrange together*) In Grammar and Rhetoric, the disposition of the words and members of a sentence in the grammatical arrangements proper to the language. *See* GRAMMAR.

SY'NTHESIS. (Gr. *συν, with, τιθημι, I place*) In Geometry and Logic, the method [illegible] out from some principle established [illegible] sition already demonstrated, and ascends through a series of propositions to that which is enunciated. Synthesis is also called the direct method or *composition*, and is the reverse of analysis or resolution. It is the method followed in *Euclid's Elements*. For the sense in which analysis and synthesis were understood by the ancient geometricians, see ANALYSIS.

SYNTHESIS. In Chemistry, those chemical operations by which compounds are obtained by the union of the separate component parts are called *synthetic*. The term is especially used in opposition to *analysis*. Thus I decompose water *analytically* by resolving it into oxygen and hydrogen gases, and *synthetically*, by recombining those gases so as again to produce the water which had previously been decomposed, the terms *synthesis* and *analysis* being, in fact, synonymous with *composition* and *decomposition*.

SY'PHILIS. (Probably from Gr. *σιφλος, unclean*) The venereal disease.

SYRINGE. In Hydraulics, a machine consisting of a small cylinder with an air-tight piston or sucker, which is moved up and down in it by means of a handle. The lower end of the cylinder terminates in a small tube through which a fluid is forced into the body of the cylinder by the atmosphere [illegible] the handle is drawn up, a [illegible] by pushing the handle in the opposite direction. The syringe acts on the principle of the sucking pump. The syringe is also used as a pneumatic machine for condensing or exhausting the air in a close vessel, but for this purpose it must be furnished with two valves. In the condensing syringe, the valves open downwards and close upwards, in the exhausting syringe they are closed downwards and opened upwards. *See* AIR GUN and AIR PUMP.

SY'RMA. (Gr. *συρμα*, from *συρω, I draw*) A long garment, so called from its train reaching the ground. It was the proper dress of actors in the classical tragedy.

SYSSARCO'SIS. (Gr. *συν, with*, and *σαρξ, flesh*) The junction of bones by intervening muscles.

SYSSI'TIA. (Gr. *συσσιτια, common messes*) An institution of some ancient states, particularly Lacedæmon and Crete, by which the male freemen had their meals together in common messes, instead of eating with their families in private.

SYSTEM. (Gr. [illegible] *I set, I* Astronomy, [illegible] ment of the [illegible] motions are explained [illegible] Ptolemy, Copernicus, Tycho Brahe, see ASTRONOMY.

System, in the Arts. Arts, a collection of the rules and principles upon which an art is works.

System. In Music, an interval composed, or supposed to be composed of several lesser ones, as an octave, which is a system. *See* DIASTEM.

SY'STOLE. (Gr. *συστελλω, I contract*) In Greek and Latin prosody, a licence by which a long syllable is used as short. *e g*

Matri longa decem tulerunt fastidia Menses.

SYSTOLE. The contraction of the heart.

SY'STYLE. (Gr. *συν, with*, and *στυλος, a column*) In Architecture, the arrangement of columns in such a manner that the [illegible]

SY'ZYGIES. (Gr. *συζυγια, union, conjunction*) In Astronomy, the places of the moon or planets when in conjunction or opposition with the sun.

# T.

T, the nineteenth letter in the English alphabet, belongs to that order of consonants called *dentals*, or *palato-dentals*, and is susceptible of numerous interchanges, both in the [illegible] the Roman tribunes indicated their assent to the decrees of the senate by subscribing T. The sound of *th* is peculiar to the English language.

T BANDAGE. A bandage so named from its shape; it is used to support the dressings after certain surgical operations. (See *Cooper's Surgical Dictionary*.)

TABA'RD. A sort of tunic, or mantle, covering the body before and behind, reaching below the loins, but open at the sides from [illegible] an ordinary article of dress [illegible] in the middle ages. It was a [illegible] military, afterwards by other cla[illegible] coats of arms blazoned before and behind, is the state dress of heralds to this day. It is the dress worn by the knaves in cards. Long tabards reaching to the mid-leg, were a peculiarly English fashion.

TABASHEER. A Persian word signifying a light white porous substance found in the joints of the bamboo. It consists almost entirely of silica. It is said to be used medicinally in the East Indies, but its virtues must be merely imaginary.

TA'BBY. (Ital. tabino.) A term formerly applied to certain figured silks and other goods upon which an irregular pattern had been stamped, either by the pressure of engraved rollers, or by folding the stuffs in such a way as to produce, by the mutual pressure of their fibres, an inequality of surface, which, by reflected light, gives rise to the appearance called *watering*.

TABELLION. (Lat. tabula, from the tablets on which they wrote.) In the Roman empire, officers who had charge of public documents were so called, they were also secretaries, or registrars, and in some cases judges. (See Savigny, *Hist. of the Roman Law*, vol. i.) The notaries were their assistants. In France, the titles of "Tabellion" and "Greffier" were confounded, and Henry IV. united the functions of tabellion with those of notary, but the old title seems still to be retained (or was until the Revolution) in some few places.

TA'BERNACLE. (Lat. tabernaculum.) A Latin word signifying a *tent* or *cabin*. The tabernacle which was carried from station to station by the Jews during their wanderings in the desert, was a tent of sails and skins stretched upon a framework of wood, and divided into two compartments, the outer, named *the Holy*, being that in which incense was burned, and the shew bread exhibited, and the inner, or *Holy of Holies*, in which was deposited the ark of the covenant. (Exod. xxvi. xxvii. See *Index Volume*, vol. i.)

The feast of Tabernacles was one of the three principal festivals among the Jews. It commenced on the 15th of the month Tisri, corresponding with the 30th of September, and lasted seven days, during which the people dwelt in booths formed of the boughs of trees. It was instituted in commemoration of the habitation of their ancestors in similar dwellings during the forty years of their pilgrimage in the wilderness. (See Leviticus, xxiii.)

TA'BES. (Lat.) A wasting away of the body; emaciation, atrophy.

TA'BLATURE. (Lat. tabula, *a table*) In Music, the use of the letters of the alphabet, or any other character, for expressing the notes or sounds of a composition. It is not now a usual mode of writing. In its stricter and more original sense it is a mode of writing music for a particular instrument on parallel lines (of [illegible] ents a string of the instrument) by [illegible] tters of the alphabet. Thus A de[illegible] is to be struck open, B that one of [illegible] on the first stop, C on the second, D [illegible] on through the octave.

TABLE. [illegible] [illegible] [illegible] place [illegible] [illegible] ex[illegible] [illegible] [illegible] [

some given law expressed by a mathematical formula Of this kind are the logarithmic tables, tables of the powers or roots of the different numbers; of the sines, cosines, and other angular functions, of astronomical refractions, of the equations of the planetary orbits, &c Tables of this sort, by exhibiting at once to the eye all the different values [illegible] endless labour in [illegible] portance in every branch of natural philosophy The logarithmic tables, for example, form the universal instrument of astronomical calculation, and it may be safely affirmed that without them the computations necessary for determining the places of the different bodies of the solar system and rendering astronomy a science of practical utility would be altogether impossible

*Table* is also used in a popular sense to denote a collection of particulars brought under one view Thus, in history, we have chronological tables, in statistics, tables of mortality at different ages, &c The mere titles of the useful tables which have been formed in the various departments of knowledge would fill a large volume

TABLEAUX VIVANTS (Fr *living pictures*) The name given to an amusement in which groups of persons dressed in appropriate costume are made to represent some interesting scene in the works of distinguished painters or authors It is thus managed —The room in which the spectators are placed being darkened, the group assume their respective attitudes behind a frame (or some other contrivance intended to represent it) covered with gauze, and candles being so placed as to reflect light upon the group from above, the illusion is complete These representations are not unfrequently resorted to in England, but their home is chiefly in France and Germany where they form an important feature on all festive occasions They owe their present popularity to the celebrated M Handel Schutz, whose genius for imitation and declamation was unrivalled in Germany (See the *Damen Lexicon*) Tableaux are often employed to represent some scene in which a riddle is concealed

TA'BLE LANDS In Physical Geography, the name [illegible] plains with steep acclivities [illegible] from other plains which are either not much elevated above the sea, or rise by imperceptible degrees Some of these are very extensive and retain a general level of several thousand feet above the sea Sometimes they are bordered with chains of mountains much less elevated on the side towards the table land than in the opposite direction and sometimes they have surfaces much undulated or broken The chief table lands are in Central Spain Southern Africa Central Asia, Persia, Southern India, Mexico and the Southern Andes (See *Traill's Physical Geography*, p 25 *et seq*)

TABLE SPAR, TABULAR SPAR *Schaalstein* of Werner A greyish white mineral, which occurs in masses and in granular concretions it is a silicate of lime.

TABLETS In Roman Antiquities pieces of ivory, metal, stone, or other substance used in judiciary proceedings, or in the passing of laws

TA'BOR (Fr tabourine) A small drum

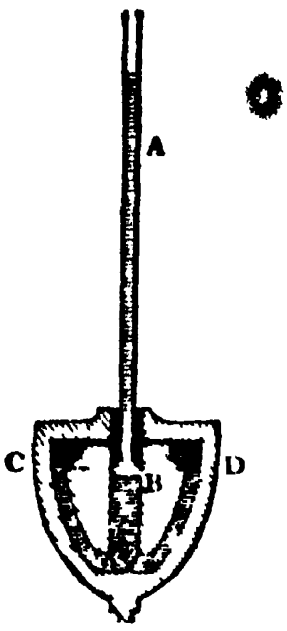
TA'BORITES, or THABORITES The denomination of one of the parties into which the followers of Huss, in Bohemia, separated after the death of their leader They were so called from Tabor, a hill or fortress of Bohemia, upon which they [illegible] which they maintained against the civil and ecclesiastical power At their head stood John Ziska von Brockznow, who was distinguished at once for his indomitable courage and his remorseless cruelty After various fanatical exhibitions which were met by their adversaries with determined hostility the latter and more quietly disposed portion of the Taborites formed themselves into a religious society under the denomination of the Bohemian Brethren They established several Christian communities, elected their own bishops, priests and elders, drew up a rigorous plan of ecclesiastical discipline, and sent forth missionaries to various parts, though with little success Though harassed by persecutions, they continued to augment their numbers, and at the end of the 15th century they counted about 200 communities of adherents. At the end of this period the distinctive name and opinions of the Taborites were lost among the [illegible] corruptions which formed [illegible] in Germany (See CALIXTINES, HUSSITES) An interesting picture of the horrors of the bloody religious war in which this sect was engaged at the period of its institution is to be found in the historical romance of Herlossohn, called *The Last Taborite* (*Der Letzte Taborit*)—a work well worthy of being translated into English

TABULA'TUM (Lat) In Ancient Architecture a term used to denote the floors ceilings and other wood work in a house occasionally also it was applied to balconies and projections of that nature

TA'CAMAHAC (An Indian word) A brownish aromatic resin formerly used in medicine, supposed to be the produce of the *Populus balsamifera*

TACIT (Lat *tacere, silent*) In Music, a term denoting that through the movement to which it is affixed [illegible] part that part is to lie still or be silent during its performance

TACHOMETER (Gr *ταχος, speed*, and *μετρον, measure*) A contrivance invented for the purpose of indicating minute variations in the velocity of machines When a vessel containing a fluid is whirled rapidly round a vertical axis the centrifugal force produced by the whirling motion causes the fluid to recede from the axis, and to rise on the sides of the vessel, so that the surface of the fluid assumes a concave parabolic form, and the distance to which the centre of the surface falls below its original level is proportionate to the velocity of rotation, and subject to corresponding variations Any method, therefore, of measuring or rendering visible the depression of the central surface will indicate the variations of velocity The method usually adopted is the following —A glass tube A, open at both ends, and expanding at one extremity into a bell B is immersed with its wider end in mercury contained in a cup C D The tube is so suspended as to be unconnected with the cup This tube is then filled to a certain height, A, with spirits tinged with [illegible] render [illegible] cup is




attached to a spindle turned by the machine Now as the cup is whirled round by the spindle, the level of the mercury in the bell falls, and the spirit therefore descends in the tube As the motion is continued, every change of velocity causes a corresponding change in the level of the mercury, and consequently also in the height of the spirits in the tube at A, and as the capacity of the bell B is much greater than that of the tube A a very small change in the level of the mercury causes a considerable change of the height of the spirits in the tube (*Cabinet Cyclopedia*, art 'Mechanics,' p 235)

TACHYDROMIANS *Tachydromia* (Gr *ταχυς, swift* and *δρομος a course*) The name of a family of wading birds [illegible] The term [illegible] Latreille and to a family of Dipterous insects by Mirgen

TACHYDROMUS (Gr *ταχυς*, and *δρομος, a course*) A subgenus of *Lacertidæ*, differing from the true lizards in having a very long body and tail, with their fore legs very distant from the hind legs and the back covered with scales similar to those on the belly They are found in the Indian islands and China and run with great velocity, whence their name of swift lizards

TACHYGRAPHY, or TACHEOGRAPHY (Gr *ταχος quick* and *γραφω, I write*) One of the many names of Greek derivation which have been given to the art of short hand

TACK The weather clue or corner of a course, as also of any sail set with a boom or gaff and of a flag Also, the rope by which such clue is extended thus, the *main tack* is the rope by which the tack or weather clue of the mainsail is drawn down to the ship's side

A ship is said to be on the *starboard tack* when she is close-hauled, having the wind on the starboard side, and on the *larboard tack*, when the wind is on the larboard side *To tack* is to change from one tack to the other by turning the vessel round with her head to the wind

TACKLE The Sea term for a pulley composed of two or more blocks The rope is called the *fall* The term appears to have been derived thus —Gr *τροχαλια*, Lat trochlea, Ital taglia, Dutch tankel (See *Willis's Principles of Mechanics*, p 198)

TACTICS In a general sense, the evolutions, manœuvres, and positions which constitute the main spring of military and naval finesse

The expression *naval tactics* is commonly understood to relate to the attack or defence of fleets or single ships, but as tactical manœuvres are necessarily practised also [illegible] number of ships together, and in the [illegible] single ships, whether for hostile purposes or not, the subject, in fact, includes all considerations relative to the closing or separating of vessels at sea We can of course here merely attempt to convey such general notions on the subject as may assist the reader in the study of it

The subject of tactics, as applied to war naturally divides itself into two parts, viz disposing the fleet for closing with or avoiding the enemy and bringing on the engagement [illegible]

can be made the subject of fixed rules, but the manner of bringing on the action with the whole or part of the fleet, the choice of the weather or lee *gage* (as the windward or leeward position is called), under given circumstances of weather locality, armament, relative numbers discipline &c must depend on the experience, skill and *coup d'œil* of the commander in chief

The evolutions by which the ships of the fleet pass from one position to another are given in all works on naval tactics, and those in most common use are often contained in Signal Books, both English and foreign Though the evolutions really necessary are but few, in foreign works, they are multiplied to an inconvenient, if not impracticable extent The opinions of officers and writers have differed on many points of great importance, such as the position of the commander-in-chief, the tacking or wearing of the fleet together, or in succession, and also in the general disposition of the fleet

In regard to the action itself, it appears it was the custom formerly to enemy's whole fleet, ship to ship in most cases, easily avoided, and actions were consequently often indecisive The circumstance of Lord Rodney's passing through the French fleet on the 12th of April 1782, seems to have drawn attention strongly to the principle of portions which might be suggesting the breaking of the enemy's line on this occasion having been attributed to Mr Clerk of Eldin, author of a work on Tactics which appeared at the time, has become the occasion of much controversy, but the manœuvre had been already treated in French and Spanish works on Tactics One of the most striking applications of the principle was exhibited in Lord Nelson's attack at the battle of the Nile Among the works on Tactics may be noticed here, *Tactique Navale*, by the Count Morogues which was considered an improvement on Le Pere Hoste's work, *Tactica Naval*, by Salazar, and Mr Clerk of Eldin's *Naval Tactics* above quoted Much information is contained in Admiral Elkins's *Naval Battles*, and remarks on the tactics of single actions are found in Sir Howard Douglas's *Naval Gunnery* Some other works on the subject will be found in any good catalogue of naval books

TA'CTION (Lat tango, *I touch*) In Geometry, the same as Tangency or touching See TANGENT

TÆNIA (Gr ταινια, *a fillet*) An intestinal worm, commonly called the *tape worm* When this worm infests the bowels it often produces a variety of anomalous symptoms, and is very difficult to get rid of The most effective remedies are purges and especially oil of turpentine, half an ounce of which is taken in the morning, fasting, mixed with a little barley water If it does not purge briskly, a dose of castor oil may be taken after it, or the oil of turpentine repeated If any portion of the tape worm remains in the intestines, the symptoms are apt to recur, so that much attention is requisite to ensure its total evacuation

TÆNIA In Architecture, the lintel above the architrave which separates it from the frieze in the Doric order

TÆNIOIDS, *Tænioides* (Gr ταινια, *a riband*, ειδος, *form*) The name given by Cuvier to a family of Acanthopterygious fishes, comprehending those which have a flattened riband shaped body, also the name of a family of Sterelminthoid intestinal worms, of which the tape worm (*Tænia*) is the type

TA'FFETY A thin glossy silken fabric, formerly much used in England It is extensively used on the Continent for window curtains

TAFFRAIL The uppermost rail of a ship's stern

TAGES In old Italian divinity, who is represented to have sprung as a beautiful boy from the earth which a Tuscan ploughman had furrowed too deep The first act of this earth-born god was to foretel from the wings of birds what was to happen to the peasants by whom he was quickly surrounded, and hence he was worshipped as the inventor of augury (See AUGURS) A collection of his prophecies was made and preserved in the sacred records of Etruria

TA'GLIA (Ital) In Mechanics, the name given to a "The taglia consists of in one common block, and also of a system of moveable pulleys in a separate block, to which the weight is attached, with one string going round all the pulleys, and having one of its ends fixed to a point in the system, and the other end going from one of the fixed pulleys drawn by the power" (*Leuturoff's Mechanics*, by Cresswell) Sometimes several taglias are combined, so that one acts upon the other, the system is See PULLEY

TAGLIACOTIAN OPERATION The operation for the restoration of the nose *Rhinoplastic* of the French The merit of inventing this operation is usually given to Tagliacotius a Venetian surgeon, who wrote upon the subject in 1598, and proposed the replacement of the deficient organ by an artificial nose cut out of the skin of the shoulder or arm A supposed modern improvement consists in having recourse for the new materials to the skin of the forehead, out of which a triangular piece is so cut that it may retain connection at its apex, which is downwards, and so admit of being twisted or turned down to form the artificial nose by adhesion to the recently cut surfaces of the truncated organ It appears that this operation was practised in India from time immemorial, and that it was also not uncommonly resorted to by the Italians, and especially the Romans, among whom the loss of the nose was a punishment of not unfrequent infliction (See *An Account of Two Successful Operations for restoring a lost Nose*, by J C Carpue, Lond 1816, *Liston's Practical Surgery*, Lond 1837, and *Cooper's Surgical Dictionary*)

TA'GUS (Gr ταγος) In ancient Greek History, the title of the president of the Thessalian confederacy

TAIL In Architecture, the bottom or lower end of any member as of a slate or tile A *tail trimmer* is that next the wall into which the ends of joists are fastened to avoid the flues Used as a verb, *to tail in* any thing is to fasten it by one of its ends into a wall

TAILLE In ancient French Jurisprudence, any imposition levied by the king or any other lord on his subjects There is some obscurity about the derivation of this word It is commonly deduced from talcæ, *tallies*, little pieces of wood with which reckonings were made But whether these were not so called from their use in *telling* or counting (Germ zahlen), does not appear Again, it is apparently connected with the Germ zoll, Engl *toll*, but these words are derived by some, through the Ital tolta, from the Lat tollere, *to raise* Perhaps the whole series of words is from the same original root, but it is not easy to trace the affinities The *Royal Taille*, in old France, which was the impost commonly understood under the general name, was a personal or rather mixed constitution, from persons not noble or ecclesiastical or enjoying certain other exemptions imposed according to their supposed ability measured by their goods In the respect in which it fell on the agricultural class from which it was chiefly levied, it is described by Adam Smith as 'a tax on the supposed profits of the farmer, which they estimate by the stock which he has upon the farm' (Book iii ch 2) In Languedoc, and one or two other districts, the taille was real, i e imposed on land and goods This tax was rendered annual and permanent in 1445 The 'real' taille is now replaced by the 'contribution foncière," and the personal by the "contribution personnelle et mobiliaire"

TAILLOIR (Fr) In Architecture, the same as *abacus*, which see

TAILZIE, or ENTAIL (Fr tailler, *to cut off*), in Scottish Law, signifies in general, any deed whereby the legal course of succession is cut off, and an arbitrary one substituted But, more strictly, a deed of tailzie is one framed in terms of the statute 1685, c 22, and intended for the purpose of securing the descent of an heritable estate to the series of heirs and substitutes called to the succession by the maker of the tailzie The principal difference between Scottish and English entails lies in the absence of any provision in the law of the former country, similar to the fictions of fines or recoveries in the latter, whereby parties in possession were enabled to cut off the entail Several statutes have been passed since that of 1685 to give heirs of entail in possession certain liberties which they could not otherwise possess, as, to sell superiorities (2 G 2 c 50, 51), to grant leases for 31 years, 14 years, and a life or two lives, and building leases for 99 years, and (10 G 3 c 51), redeem the land tax (48 G 3 c 151), make provisions for wives and children (5 G 4. c 87)

TALAPOINS The title, in Siam, of the priests of Fo, who are called in China, Seng, in Tartary, Lamas; and by Europeans, Bonzes

TALC A soft unctuous mineral of an unctuous feel, often used for drawing lines on wood, cloth, &c., which are not so easily effaced as those of chalk Talc is employed in the composition of *rouge végétal* The Romans prepared with it the natural blue, by combining it with the colouring fluid of particular kinds of testaceous animals Talc is met with in Aberdeenshire, Perthshire, and Banffshire in Scotland and in various parts of the Continent, where rocks of serpentine and porphyry occur The talc brought from the Levant or Continent is called in commerce Venetian talc Several varieties are found in India and Ceylon

TA'LCITE In Mineralogy, a synonym of *sacrite*; which see

TA'LENT (Gr ταλαντον) A Grecian weight, which was much used in the computation of money. It contained 60 minæ, but its value varied in different states The Attic talent was equivalent to about 198*l* of English money, the Æginetan to 331*l* (See as to the Attic talent, *Boeckh*, i 25, *Gibbon's Miscellan Works* iii 410)

**TA'LES** In Law If by reason of challenges or other causes a sufficient number of jurors do not appear at a trial, either party may pray a tales, that is, may pray that the sheriff supply the deficiency (4 c 50, the judge at the trial) to supply the number of qualified men who happen to be present (tales circumstantibus) to be joined with the other jurors to make up the twelve In practice this seldom arises, except in the case of special jury trials, when the talesmen are taken from the common jury panel in the same court *See* JURY

**TALIO'NIS LEX** (Lat) A punishment in which a person convicted of a crime suffered exactly in the same manner as he had offended thus an eye was required for an eye and a tooth for a tooth This mode of punishment was established by the Mosaic law, and was in some cases imitated by the Romans

**TA'LISMAN** (From the Arabic, dual of the noun telesm, Gr τελεσμα, in the sense of an astrological wonder, or effect of the stars) Among the Eastern nations, a figure cut in metal, stone, &c, supposed to have been made with particular ceremonies, and under particular astrological circumstances, and to possess various virtues, but chiefly that of averting disease or violent death from the wearer In a more general sense, any portable object endowed with imaginary influence in controlling evil spirits, &c has been so designated The term is frequently used as synonymous with amulet (which see), but, strictly speaking, the latter is not believed to possess such extensive powers as the talisman (See a curious article in the *Enc Metropolitana*)

**TA'LLAGE** (from the Fr taille), in the language of the old English law, is said to be a general name for all taxes by Sir E Coke *See* TOLL, TAILLE

**TA'LLOW** (Germ talg) The fat obtained by melting the suet of the ox and sheep, and straining it so as to free it from membrane

Tallow is an article of great importance It is manufactured into candles and soap, and is extensively used in the [illegible] various processes of the arts Besides the supplies of native tallow, we annually import a very large quantity, principally from Russia The exports of tallow from Petersburgh amount, at an average, to between 3,500,000 and 4,000,000 poods, of which the largest portion by far is brought to England the remainder being exported to Prussia, France the Hanse Towns, Turkey, &c

**TALMUD** The traditionary or unwritten laws of the Jews It is called *unwritten*, to distinguish it from the textual or *written* law, and, is in fact, the interpretation which the rabbins affix to the law of Moses, which embodies their doctrine, polity, and ceremonies, and to which many of them adhere more than to the law itself

The word is derived from Heb lamad, *he taught* The Talmud, therefore, is a book or volume, which contains such doctrines and duties as are *taught* to the Jews by their own authorized *teachers*, the ancient rabbins

There are two Talmuds, that of Jerusalem and that of Babylon, not to mention those of Onkelos and Jonathan, which are rather paraphrases than volumes of traditionary doctrines

The Talmud of Jerusalem consists of two parts — the *Gemara*, and the *Mishna* The *Mishna* signifies a doubling or reiteration, the *Gemara*, a work brought to perfection or completed, — from the Chaldee *gamar* to finish or complete The Gemara and the Mishna together, strictly speaking, form the Talmud, but the rabbins are wont to designate the Pentateuch of Moses the *first* part of the Talmud, and which is simply the law The *second* part is the *Mishna*, which is a more extensive explication or amplification of the law, and the *third* part, the *Gemara* as finishing, and completing it

The Mishna is the work of Rabbi Judah Hakkadosh, 120 years after the destruction of the temple of Jerusalem It is written in a tolerably pure style, and its reasonings are much more solid than those of the Gemara, which the Jewish doctors, it is stated, have stuffed with dreams and chimeras, and many ignorant and impertinent questions and disputations The Gemara was written about 100 years afterwards by Rabbi Jochanan, the rector of the school at Tiberias These two works form the Jerusalem Talmud

But the Talmud of Jerusalem is less esteemed than the Talmud of Babylon formed by Rabbi Asa or Aser, who had an academy for forty years at a place called Sura, near Babylon, where it was [illegible] Babylonish Talmud It is this Talmud which the Jews frequently consult, and it is esteemed [illegible] Jews who live beyond the Euphrates, from the circumstance that it was compiled at Babylon Rabbi Asa was called to his fathers before the celebrated commentary of the Mishna was completed but it was finished by his disciples (some say his children) about 500 years after Christ With the exception of the sacred authors, these Talmuds, after the Chaldee paraphrases, are the most ancient books of doctrine possessed by the Jews

A [illegible] in the year 1238 detected several errors [illegible] which he laid before Pope Gregory IX, who required the archbishops of France and the kings of Spain and Portugal to seize and burn all such books of the Jews and twenty cartloads of Hebrew books were accordingly burnt in France alone

Pope Paul IV and Clement VIII also signalized themselves in destroying all the Talmudic books that could be found, and many thousand volumes of the Talmud were by their orders juridically condemned to the flames These acts, worthy of Roman pontiffs might have suggested that famous list, entitled *Libri Prohibitorum*, which afterwards received much augmentation, and among the many *heretical* works enumerated might be found [illegible] *Spectator*

The Talmud of Jerusalem was printed in one vol folio, and that of Babylon in twelve and fourteen vols folio, which we find in a bookseller's catalogue thus described, "Talmud Babylonicum Hebraicum integrum ex Sapientum Scriptis et Responsis compositum a Rab Aser, additis Comment Rab Sal Jarchi, et Rab Mosis Ma[illegible] Hispani [illegible] Mant[illegible]" Extracts [illegible] and dissertations of the Jews, and selections from the Talmud, were written by Peter Stehelin and W Wotton, the former entitled *Traité sur les traditions des Juifs, avec des dissertations sur quelques passages du Talmud et autres Rabbinical Writings*, 2 vols 8vo 1742, the latter, *Miscellaneous Discourses relating to the Traditions and Usages of the Scribes and Pharisees in our Saviour's Time*, 2 vols 8vo 1718 (See the *Enc Metropolitana*, Wolff, *Bibl* ii 658, Eisenmenger, *Das Entdeckte Judenthum*, Remarks on the study of it in *Quart Rev* vol xlvii)

**TA'LON** (Fr) In Architecture, the same as *ogee*, which see

**TA'LPA** In Surgery a tumour under the skin or cuticle commonly called a *mole*

**TA'LUS** The sloping heap of fragments accumulated at the foot of a steep rock The term talus has also been applied [illegible] one of the bones of the ankle

**TA'MARIND** (Arab tamar hindy, *Indian date*) A large tree of the Leguminous order, whose pods supply the subacid preserve commonly sold in the shops under this name The pods in their natural state are acid, and acquire their sweetness by the sugar in which they are packed after their hard brittle shell has been taken off The tree itself is a native of both the East and West Indies

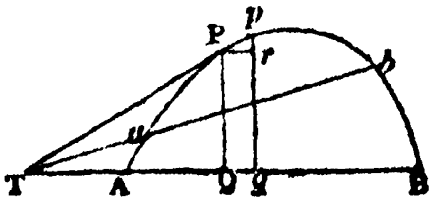
**TA'MARIX** (Tamarisia the people among whom it grows) is a name given by botanists to some shrubs of slender growth clothed with very small green leaves and long spikes of pink flowers, the natural country of which seems to extend from Spain to Delhi, occupying a band of ten or twelve degrees of latitude They are in this country merely ornamental plants, but in Syria and the adjoining countries they secrete a kind of manna, which some authors have asserted was the manna of scripture, but this opinion is not regarded as well founded

**TAMBOURI'NE** (Fr tambour) A musical instrument of procession of the drum species, being a cylinder of about 6 inches wide, in which bells are suspended It is covered at one end with parchment, after the fashion of a drum

**TA'MPING** A term used by miners to express the filling up of a hole bored in a rock for the purpose of [illegible]

**TANGENCIES** (Lat tango, *I touch*) In the ancient Geometry the *problem of tangencies* was one of the six branches of the geometrical analysis created by Apollonius of Perga Its general object was to describe a circle passing through given points, and touching straight lines or circles given in position the number of data in each case being, of course limited to three Of the treatise of Apollonius some lemmas only were preserved in the mathematical collections of Pappus; from which the treatise was restored by Vieta, of whose restoration there is an English translation by Lawson, with the addition of a supplement by Fermat, on Spherical Tangencies The principal cases of the problem of plane tangencies are given and neatly demonstrated, in *Leslie's Geometrical Analysis*

**TA'NGENT** (Lat tangens, from tango, *I touch*) In Geometry, the tangent to a curve is a straight line which meets or touches the curve without intersecting it The nature of the tangent may be explained as follows. — Let A P B be an arc of a curve, and let the straight line T A B intersect it in two points, A and B Conceive the straight line to revolve about the point T When it comes into the position T *a b* the intercepted arc *a* P *b* is shorter than A P B, or the points *a* and *b* have approximated Let the motion of the line about T still be continued, and the length of the intercepted



arc of the curve will become less and less, until the straight line comes into the position T P, when the two points *a* and *b* coalesce, or rather their distance becomes smaller than any assignable quantity In this ultimate position, the direction of the vanishing arc is that of the tangent, or the element of the arc coincides with the tangent.

From this it is easy to deduce an expression which determines the direction of the tangent at the point P Let A be the origin of the [illegible] ordinates, the abscissa being measured on A B Through P draw the ordinate P Q, and taking P *p* an indefinitely small element of the curve, draw *p* [illegible] *p*, and P *r* parallel to A B, also [illegible] A B produced in T The line Q T is called the subtangent, and the point P being assumed, it is only necessary to determine T, or the distance Q T, in order to have the tangent P T Now the triangles P *p r* and P Q T are similar, whence *p r* : *r* P :: P Q : Q T, but by the principles of the infinitesimal calculus *p r* = *d y*, *r* P = *d x*, and we have also P Q = *y*, therefore *d y* : *d x* :: *y* : Q T, that is, the subtangent $Q T = y \frac{dx}{dy}$

*See* DIFFERENTIAL CALCULUS, p 343

This is the general formula for the subtangent of any curve at the point whose co-ordinates are *x* and *y*, and therefore the position of the tangent can always be determined when the relation between *x* and *y* is defined by an equation, by differentiating that equation

One of the earliest uses which was made of the differential calculus was to find the positions of tangents to curve lines, and hence the calculus itself in its early period, was often denominated the *method of tangents* When the equation of the curve is given, it is easy to find [illegible] but the inverse problem to determine the equation of the curve when its subtangent at any point is given, requires an integration, and is consequently in general, attended with much greater difficulty The first problem was called the *direct* and the second the *inverse* method of tangents The terms are synonymous with differential and integral calculus

Euclid has shown that no straight line can be drawn between a circle and its tangent which does not cut the circle This property is true of all other curves, and the contact of a curve with its tangent is called a contact of the first order *See* CONTACT ANGLE OF

TANGENT, in Trigonometry, is the straight line which touches a circular arc at one of its extremities, and is terminated by the production of the radius passing through the other extremity The arc and its tangent have always a certain relation to each other, and when the one is given in parts of the radius the other can always be computed by means of an infinite series Let $\phi$ denote an arc and tan $\phi$ the tangent of the arc $\phi$, we have the following series —

$$\phi = \tan\phi - \tfrac{1}{3}\tan^3\phi + \tfrac{1}{5}\tan^5\phi - \tfrac{1}{7}\tan^7\phi + \&c$$

$$\tan\phi = \phi + \frac{\phi^3}{3} + \frac{2\phi^5}{3\ 5} + \frac{17\phi^7}{3^2\ 5\ 7} + \frac{62\phi^9}{3^3\ 5\ 7\ 9} + \&c$$

The tangents were introduced into trigonometry by the Arabians, and the introduction has been of the most important use in simplifying calculations For the manner of using the sines cosines tangents, and other angular functions, see TRIGONOMETRY

TANISTRY An ancient Irish custom of descent defined as "descent from the oldest and worthiest of the blood" (See *Sir J Davies's Cases before the Irish Judges*, 1762) [illegible] but this seems [illegible] also *Quart Rev* vol lvi p 223)

TANK In the Navy a case of sheet iron about 4 feet square, and containing about 2 tons Bilge tanks are of various forms in order to employ the vacant spaces near the sides in small vessels Iron tanks have for many years been used in the navy from their incomparable superiority over casks in keeping the water sweet

TANK In Gardening, a cistern or reservoir, made of stone or timber or some other material, used in collecting and preserving water during a scarcity or drought Tanks are sometimes built in the ground and lined with [illegible] (*Loudon's Encyc of Gardening* p 603)

TANNERS BARK The bark of oak chestnut, willow, larch, and other trees, which abounds in tannin, and is used by tanners for preparing leather After being exhausted of the tanning principle by being chopped into small pieces or bruised, and steeped in water it is laid up in heaps to dry, and sold to gardeners for the purpose of producing artificial heat by fermentation in pits or beds, in bark stoves or other out-houses, or pits *See* STOVE

TANNIC ACID This term has been especially applied to a substance obtained by Pelouze by acting upon bruised galls by common ether, it is a white uncrystalline powder, very astringent, little soluble in water, and reddening litmus When [illegible] exposed to air it becomes converted into [illegible] It is extremely astringent, and appears to be the active principle of tanning substances (tannin) in general Its equivalent, deduced from the analysis of the neutral *tannates*, appears to be 426 Its ultimate elements are 30 atoms of carbon, 18 of hydrogen, and 24 of oxygen

TANNIN The pure astringent principle of vegetables, upon which the [illegible] into leather depends Its [illegible] of producing a dense whitish precipitate in a strong solution of animal jelly, such, for instance, as isinglass It may be obtained tolerably pure by infusing bruised grape seeds in cold water, or more circuitously by adding acetate of copper to filtered infusion of galls washing the precipitate, and decomposing it (diffused through water) by sulphuretted hydrogen On evaporating its [illegible] [illegible] [illegible]

Reichenbach, who has obtained from it six distinct substances, which he terms *paraffine*, *eupion*, *kreasote*, *picamar*, *capnomar*, and *pittacal*.

TAR, MINERAL. A variety of bitumen, much resembling petroleum

TA'RANIS. In Mythology, a Celtic divinity, confounded by Latin writers with their Jupiter He was regarded as the evil principle, and worshipped with human sacrifices; whence the verse of Lucan,—

Et Taranis Scythicæ non mitior ara Dianæ.

(See *Mem de l'Acad des Inscr* vol xxiv)

TARANTULA (So called from Taranto in Sicily) The name of a Labrician genus of Pedipalpous Pulmonary Arachnidans, infesting the torrid regions of Asia and America. The group is now divided into the genera *Phrynus* and *Thelyphonus* The term is also applied to a genus of spiders found in some parts of Sicily, whose bite produces a train of symptoms long believed to be curable only by music From this word is derived the term *tarantelle* the national dance of the Sicilians

TARDIGRADES (*Tardigradus* [Lat *tardus* slow, gradior *I march*]) A family of Implete Mammalia comprising those which are remarkable for the slowness of their motions when upon the ground, as the sloths

TARDO (*It slow*) In Music, a term denoting that the movement to which it is affixed is to be performed slowly It is nearly the same in signification as *largo*

TARE In Commerce an abatement or deduction made from the weight of a parcel of goods on account of the weight of the chest cask, bag &c in which they are contained Tare is distinguished into *real tare customary tare* and *average tare* The first is the actual weight of the package, the second its supposed weight according to the practice among merchants and the third is the medium tare, deduced from weighing a few packages and taking it as the standard for the whole In Amsterdam and some other commercial cities tares are generally fixed by custom, but in this country the prevailing practice, as to all goods that can be unpacked without injury, both at the custom house and among merchants, is to ascertain the real tare Sometimes however, the buyer and seller make a particular agreement about it

TARE In Agriculture *See* VETCH

TA'RGUM A Hebrew word denoting a paraphrase of some portion of scripture in the Chaldean language of which there are ten in existence the two principal ones being those of Jonathan (or rather the Pseudo Jonathan) an author who wrote a paraphrase or rather a commentary, upon the Greater and Lesser Prophets about thirty years B C, and of Onkelos upon the Pentateuch which is considered the most valuable of all and is referred to the first century of our era Two others are supposed to be of considerable antiquity The remaining six are comparatively modern (See *Enc Metr*)

TA'RIFF A table alphabetically arranged specifying the various duties, drawbacks, bounties &c charged and allowed on the importation and exportation of articles of [illegible]

TARPAWLING A [illegible] or tarred canvass cover generally

TARRAS, or TERRAS A volcanic product which, mixed with mortar gives it the property of hardening under water Several argillo-ferruginous minerals possess this property, and are often indiscriminately used under this term

TARSE, *Tarsus* (Gr ταρσος, *sole of foot*) In Mammalia, signifies the collection of small bones between the tibia and metatarsus, or those which constitute the first part of the foot In Birds, it is sometimes applied to the third segment of the leg which is rarely fleshy or feathered, and corresponds with the tarsus and metatarsus conjoined In Insects, it signifies the aggregate of minute joints which constitute the fifth principal segment of the leg or the foot

TA'RTAR (Gr ταρταρος *infernal*, because it is the sediment or dregs of wine) The substance which concretes upon the inside of wine casks It is called red and white *argol*, according to the wine from which it is obtained. When purified it is often called *cream of tartar* it is a bitartrate of potash

TARTAR EMETIC A double salt, consisting of tartaric acid in combination with potassa and protoxide of antimony *See* ANTIMONY

TARTARIC ACID [illegible] of tartar This acid is contained in grapes [illegible] in tamarinds and several other fruits It is usually obtained from purified tartar 4 parts of powdered tartar and 1 of chalk are mixed in hot [illegible] of [illegible] combines with the [illegible] the tartaric acid being thereby liberated by decomposition When pure it forms white crystals composed of one equivalent of dry acid and one of water (66 + 9 = 75) The anhydrous tartaric acid, as it exists in the dry tartrates (tartrate of lead, for instance), is composed of

| | | Atoms. | Equiv. | |
|---|---|---|---|---|
| Carbon | | 4 | 24 | 36 36 |
| Hydrogen | | 2 | 2 | 3 03 |
| Oxygen | | 5 | 40 | 60 61 |
| | | 1 | 66 | 100 00 |

TARTAR OF THE TEETH This substance, which occasionally concretes upon the teeth, consists, according to Berzelius, of

| | |
|---|---|
| Salivary mucus | 13 5 |
| A [illegible] matter soluble in muriatic acid | 7 5 |
| Phosphate of lime (earthy phosphates) | 7 9 |
| | 100·0 |

TA'RTARUS (Τάρταρος, called also the house of Hades by the Greeks, and Orcus by the Latins), was the name of the infernal regions, over which Pluto or Hades had dominion

TARTRATES Salts in which the tartaric acid is combined with bases

TARTROVI'NIC ACID An acid composed of tartaric acid in combination with the elements of ether

TARTUFFE A common French nickname for hypocritical pretenders to devotion It is derived from the celebrated comedy of Molière of which the hero is so called Whether Molière invented or took it from the popular language of the time, does not appear some say that he intended to attack Louis XIV 's confessor, Père la Chaise, whom he had once seen eating truffles with peculiar *goût*, and thence the name The play was written in 1664 but not acted till 1669, great difficulties being thrown in the way by the authority the clergy and the papal legate On one occasion it was prohibited when the curtain was on the point of rising and Molière announced to the public its disappointment in the well-known equivocal words 'Monsieur le président ne veut pas qu'on le joue' When it last succeeded through the influence it is said, of the king himself it had a run of three months with unparalleled success, and the eager attention [illegible] at once [illegible] of those who profess a religious character In England, this play has been made more than once to serve the popular passions of the day Cibber translated it and made the hero a [illegible] and the play is still acted under the name of *The Hypocrite* in which the Tartuffe is a methodistical divine

TASTE That power of the mind which is conversant about the beautiful both of nature and of art In the Latin language the same metaphor obtained a very wide application and the term sapientia was employed to signify quickness and correctness of judgment generally Shaftesbury's use of the term is nearly as extensive, being applied by him to manners morals, and government, and to wit ingenuity and beauty In its modern use it is restricted to those objects which fall within the province of imagination Now although imagination derives its objects pre-eminently from those of the sight and hearing, and although the epithet *beautiful* is, for the most part, confined to these yet the mental power which judges of them borrows its name from a third sense The reason of this is satisfactorily shown by Coleridge (*Literary Remains* vol i) The senses, he observes, are either purely organic, or mixed The former present their objects to the mind distinct from its perception of them, while the latter invariably blend the perception of the object with a certain consciousness of the percipient subject To the latter class belong the touch the smell, and the taste Of these taste and smell differ from the touch as adding to that reference to our vital being which is common to the three a degree of enjoyment or otherwise, while the taste is distinguished from the smell only by its more frequent and dignified use in human nature By taste then, as applied to the fine arts, we must be supposed to mean an intellectual perception of any object blended with a distinct reference to our sensibility of enjoyment or dislike

In the same essay Coleridge gives another and a wider definition of taste, as "a metaphor taken from one of the mixed senses, and applied to objects of the more purely organic, and of *our moral sense* when we would imply the coexistence of an immediate personal dislike or complacency" Now, by the constitution of man's nature, every exertion of human activity in the pursuit of the good, the beautiful, and the true, combines a sense of pleasure, or the contrary, with the perception of their [illegible] in fact would [illegible] dest [illegible] While, however, in the case of the true, this coexistent pleasure has not received any distinctive appellation, and while [illegible] pre- [illegible] [illegible] [illegible]

But taste, like all other metaphorical terms, is extremely inaccurate; and by directing attention exclusively to this element of pleasure, it has led to a very inadequate conception of the true nature of the faculty which it designates. [illegible] *Inquiry into the Idea of Beauty and Virtue* [illegible] a peculiar and a sense which, similarly to the other senses, procures a pleasure totally distinct from a cognition of principles, or of the causes, relations, and usages of an object; that beauty strikes at first sight, and that knowledge the most perfect will not increase the pleasure which it gives rise to; and lastly, that all the diversity of sentiments excited in different minds by the beautiful arise solely from the modifications of the sense by association, custom, example, and education. Among the [illegible] of the theory of a moral taste we may reckon Hume, Akenside, Blair, Lord Kames, and Beattie.

Blair accordingly defines taste to be the power of receiving pleasure from the beauties of nature and art; while Akenside describes it as "certain internal powers feelingly alive to each finer impulse." Dr Beattie (*Essay on Poetry and Music*) supposes taste to have its origin in a mutual harmony and sympathy between the soul in its first formation and the rest of nature, which experience may confirm, but no perverse habits subdue. In the *Essay on the Delicacy of Taste*, Mr Hume talks of it as a natural sensibility; while in the *Essay on the Standard of Taste*, he seems to admit of no other criterion than the decisions of a due and sufficiently extensive experience. Lastly, Lord Kames declares a taste in the fine arts to be nearly allied to the moral sense; but yet, like morals, capable of being raised to a rational science by an examination of the sensitive branch of the human constitution, and an enumeration of the objects which are either agreeable or disagreeable by nature.

But taste is not only a sensitive, but also a cognitive faculty. When a beautiful object is presented to the mind, not only does it make on it a delicious impression of pleasure, but the mind in the first place passes judgment upon it, and declares it to be beautiful, that is, conformable to a standard called the beautiful. In this complex operation of taste the judgment is the antecedent, and the pleasure the consequent. When the impassible judgment has passed sentence upon the object, then the sensibility is awakened to certain sentiments, which are, as it were, the echo of the reason. (Cousin, *Sur le Vrai, le Bien et le Beau*.)

Thus, too, Ancillon (*Mélanges Littéraires, &c.*):—"The impression which an object makes on the senses is insufficient to give rise to the sentiment of the beautiful. The impression on the senses is but the occasion on which the taste declares that the idea which it impressed on the sensible object, and which that object expresses, is the idea of beauty." To this view of taste we may refer the opinions of Addison and Burke. According to the latter, taste is that faculty or those faculties of the mind which are affected with, or form a judgment of, the works of imagination and the elegant arts; while Addison connects the emotion of pleasure with the power of distinguishing the beauties and imperfections of an author. To this class also we must refer the views of Sir Joshua Reynolds, Dr Gerard, and Mr Alison. According to the latter, taste is that faculty of the human mind by which we both perceive and enjoy whatever is beautiful and sublime in the works of nature and art; the perception of these two qualities being attended with an emotion of pleasure distinguishable from every other pleasure of our nature. In the sketch of his proposed work, which unfortunately he has never completed, he intended to show the nature of the [illegible] refutation of the theory of Hutcheson, [illegible] it has no resemblance to a sense, and that it is not even a separate and peculiar faculty, but admits of being ultimately resolved into more general principles of our mental constitution. If taste were only a sense, it would be difficult to explain the fact, that amidst the inexhaustible variety of sensations which different minds experience from the beautiful, there nevertheless reigns a certain unanimity in men's judgments with respect to it, which cannot have any other source than the identity of reason in the human species. The sense of pleasure, however, is still a necessary and essential element of the faculty of taste. Without it we should be condemned to a perfect uniformity of sentiment in the presence of the beautiful, in the same manner as the absence of judgment would reduce us to an endless diversity.

The same conclusion will follow from an examination of some of the principal definitions of beauty. According to St Austin (*Ep.* 18), "unity is the universal form of [illegible] *De [illegible] Bello*), "beauty [illegible]." De Crousaz ([illegible]) [illegible] consist in variety, unity, regularity, order, and proportion. Winckelmann and Sulzer agree also in making unity and multiplicity to be essential constituents of the beautiful. And lastly, [illegible] unity in the Italian schools of painting, [illegible],"—variety in unity, which is nearly identical with Hutcheson's explanation of it,—uniformity in variety. The justness of these views will readily appear, if we consider that while variety satisfies the demands of the imagination by affording the gratification most conformable to its nature and laws, unity is necessary for its being apprehended by the judgment, and in order to its appreciation as a work of art.

A few definitions of beauty remain to be noticed, which apparently favour the theory of Hutcheson. According to Burke (*On the Sublime and Beautiful*), and Price (*Essay on Beauty*), beauty consists in such qualities as induce in us a sense of tenderness and affection. Alison declares that the qualities of matter are neither beautiful nor sublime in themselves, but only such so far as they are signs or expressions of qualities capable of producing emotion. Wieland [illegible] of an *agreeable* variety [illegible] the beautiful pleases irrespectively of any idea of utility, or of any conception of design, simply by the correspondence of the object and and the sensitive organ.

The emotions of taste are usually distinguished into those of the sublime and beautiful. [illegible] seems with justice to have denied the existence of any intrinsic difference between them. According to Burke, indeed, the terrible is a fruitful source of the sublime; and this idea does not seem capable of being made an ingredient of the beautiful. In the same way, on the other hand, there are ideas eminently beautiful which can never give rise to an emotion of sublimity. Nevertheless, this does not constitute an essential difference between the two. It is with reference to their several effects upon the imagination that they may perhaps be most correctly distinguished. Considered in itself, a beautiful object ought to present the greatest possible unity combined with the greatest possible variety; and considered in the effect it produces on the mind, its beauty consists in the free, facile and harmonious play of the imagination. On the other hand the [illegible] lost and overpowered in the contemplation [illegible], which in its infinity presents at once unity and variety.

TASTO (It. *the touch*.) In Music, a term used in conjunction with *solo*, to signify that the instruments that can accompany by chords are only to play single sounds till the direction is contradicted by the word *accordo* or *accompanimento*.

TATTA (Indian.) A bamboo frame or trellis, over which water is suffered to trickle with a view of cooling the air as it enters the windows or doors.

TATTOOING. The name given to a practice common to several uncivilized nations, which consists in puncturing the skin and rubbing a dye or gunpowder into the wounds, by means of which certain figures are represented on the face and other parts of the body on which the operation has been performed.

TAURUS (Lat. *the Bull*.) In Astronomy, the second in order of the twelve zodiacal constellations. There are several remarkable stars in this constellation: Aldebaran, of the first magnitude, in the eye; the well-known cluster called the Pleiades, in the neck; and the Hyades, in the face. See CONSTELLATION, ZODIAC.

TAUTOCHRONE (Gr. ταυτος, *the same*, and χρονος, *time*), in Mechanics, is a curve [illegible] having this property, that a heavy body descending [illegible] by the action of gravity will always arrive at the lowest point in the same time wherever the point from which the body begins to fall be taken in the curve. Huygens first showed that this is a property of the common cycloid when the motion takes place in a vacuum, and gravity is supposed to act in parallel straight lines. (See CYCLOID.) Newton and Hermann also determined the tautochrone in a vacuum, when gravity is supposed to be directed towards [illegible] wise showed that the cy[illegible] when the resistance is proportional to the velocity (*Principia*, b. ii. prop. 26), and Euler first determined the nature of the curve when the resistance is proportional to the square of the velocity (*Mechanica*, vol. ii.). See also Joh. Bernoulli, *Opera*, vol. iii.

TAUTOLOGY (Gr. ταυτὸ, *the same thing*, and λογος, *discourse*.) In Rhetoric, a vicious diction, by which the same idea is expressed in two or more different words or phrases, apparently intended to convey different meanings.

TAWING. The art of preparing certain kinds of leather by imbuing the skins with saline, oily, and other matters. See LEATHER.

TAXATIO ECCLESIASTICA. A name given to several public records. The oldest is that of Norwich, made in 1253, for the purpose of assessing the first fruits and tenths of ecclesiastical benefices; sometimes called Pope Innocent's valor, that pontiff having made a present of them [illegible] Henry III. All taxation was regulated by this assessment until the reign of Henry VIII., when the *Valor Ecclesiasticus*, sometimes called the *King's Books*, was compiled by his commissioners.

TAXATION. A tax is a rate or duty laid by government on the incomes or property of individuals, or on the

products consumed by them; the produce of such duty or rate being placed at the disposal of government

A tax may be either general or particular, that is, it may either affect all classes indiscriminately, or only one or more classes.

Taxation (Lat taxatio) is the general term used to express the aggregate of particular taxes It is also the name given to that branch of the science of political economy which explains the mode in which the revenue required for the public service may be most advantageously raised

It would be quite superfluous to enter into a lengthened argument to show the utility or rather [illegible] of raising a revenue for the use of the public [illegible] *quies gentium, sine armis, neque arma, sine stipendiis, neque stipendia, sine tributis haberi queunt* (*Tacit Hist* iv cap 74) It is admitted on all hands that security from foreign invasion, the speedy and impartial administration of justice, and the maintenance of good order and tranquillity are absolutely indispensable to the successful exertion of industry and to the advancement of society And when such is the case, no individual can justly complain that he is made to contribute, in the same proportion to his means as others, for the attainment of such objects, or, which is the same thing that he is made to pay his fair share of the sum required to procure the services of the soldiers and sailors necessary to repel hostile aggression, and to support the various institutions and public functionaries required to maintain internal peace to promote prosperity and to protect every citizen in the undisturbed enjoyment of his property and rights In most countries the public has frequently had to contribute larger sums than have been required for the ends of good government But abuses of this kind obviously originate either in the misconduct of administration, or in the defective political organization of the states in which they occur, and do not, therefore properly come within the scope of our inquiries In treating of taxation, the object of the political economist is not to inquire whether the revenue raised by the state exceed its necessary wants, or whether it be judiciously expended, but to point out the effect of taxation on individual and public wealth and, by analyzing the various methods in which a revenue may be raised and comparing them together to show which is most advantageous, or rather which is least injurious But as such inquiries, were they prosecuted at any considerable length, would involve discussions nowise suited for a work of this kind, and far exceed its limits, we must confine ourselves to a few observations illustrative of the principles that should be especially kept in view in the imposition of taxes

Taxes may be either direct or indirect, that is they may be either imposed on the incomes or property of individuals, or on the articles on which these incomes or property are expended But before proceeding to inquire into the nature and influence of different taxes it may be proper to premise the maxims laid down by Adam Smith with respect to taxes in general inasmuch as they are drawn up with singular judgment and comprehensiveness

First Maxim —" The subjects of every state ought to contribute towards the support of the government, as nearly as possible in proportion to their respective abilities, that is, in proportion to the revenue which they respectively enjoy under the protection of the state The expense of government to the individuals of a great nation is like the expense of [illegible] to the joint tenants of a great estate In the [illegible] or neglect of this maxim consists what is called the equality or inequality of taxation "

Second —" The tax which each individual is bound to pay ought to be certain and not arbitrary The time of payment, the manner of payment, the quantity to be paid, ought all to be clear and plain to the contributor and to every other person When it is otherwise, every person subject to the tax is put, more or less, in the power of the tax-gatherer, who can either aggravate the tax upon any obnoxious contributor, or extort, by the terror of such aggravation, some present or perquisite to himself The uncertainty of taxation encourages the insolence and favours the corruption of an order of men who are naturally unpopular, even where they are neither insolent nor corrupt The certainty of what each individual ought to pay is, in taxation, of so great importance, that a very considerable degree of inequality, it appears, I believe from the experience of all nations, is not so great an evil as a very small degree of uncertainty "

Third —" Every tax ought to be levied at the time and in the manner in which it is most likely to be convenient for the contributor to pay it A tax upon the rent of land or of houses, payable at the same term at which rents are usually paid, is levied at the time when it is most likely to be convenient for the contributor to pay, or when he is most likely to have wherewithal to pay. Taxes upon such consumable goods as are articles of luxury are all finally paid by the consumer, and generally in a manner that is very convenient for him He pays them by little and little as he has occasion to buy the goods, and as he is at liberty, too, either to buy or not to buy as he pleases, it must be his own fault if he ever suffers any considerable inconveniences from such taxes "

Fourth —" Every tax [illegible] to take out and to keep [illegible] as little as possible, over and above what it brings into the public treasury of the state " (*Wealth of Nations*, M'Culloch's ed 1 vol 8vo p 371)

It may be, and in fact often has been supposed, that direct taxes, or taxes laid on property or income, or both, would have the advantage of corresponding better with the first of Smith's maxims than any other description of taxes, by making individuals contribute to the wants of the state proportionally to the revenue which they enjoy under its protection, and so, no doubt, were it possible to assess them fairly, such would be the case But the obstacles in the way of their fair and equal assessment are such as can never be overcome, and the truth is, that [illegible] theoretically [illegible] can be imagined We may get a pretty accurate notion of the income derived from lands, houses, funded property, and mortgages, but all beyond this is mere guesswork There are no means by which to ascertain the amount of farming capital, stock in trade, the profits derived from them, or the incomes of professional men No inquisition into the private affairs of individuals can ever discover these particulars There is nothing, in fact, to depend upon in such cases but the declarations of the parties and we need not dwell on the impolicy of any system of finance that sets the duty and the interests of the contributors in opposition and makes them profit by concealing or perverting the truth Besides, although these preliminary and insuperable difficulties were overcome and we learned the capital and incomes of different parties we should have other and greater difficulties to surmount before the tax could be fairly assessed The same deduction should not be made from incomes derived from sources that are not equally lasting To assess them on a just principle the present value of different incomes, or their value reduced to a perpetuity, would have, in the first place to be determined

But it may be unhesitatingly affirmed that to do this upon a large scale would be quite impracticable It is clear therefore that taxes on income or property should not be introduced except as a *dernier resort*, as a means of filling the coffers of the treasury when the other and more legitimate sources of revenue are insufficient, and when as in the late war, money must be had at all hazards

It is besides absurd to suppose as has been done, that the burdens that at present fall on the labouring classes could be sensibly reduced by repealing the duties on tea, sugar, soap, &c, and imposing in their stead taxes on property Suppose that the attempt were made, and observe what the result must be A manufacturer employs a certain number of men, who pay 1000*l* a year in taxes on commodities Now if the taxes that are at present paid by the labourers be repealed, those that fall on their employers must be equally increased, so that the manufacturer in question will have 1000*l* more to pay in taxes after the change takes place, and will of course have 1000*l* less to lay out on wages It is consequently contradictory and absurd to suppose that you can improve the condition of the labouring classes by repealing the taxes that fall on them to lay them on capitalists

Direct taxes on property have been the curse of every country into which they have been introduced, and are at once a consequence and a cause of a low and impoverished state of society To evade them, people that are not poor counterfeit poverty, some of the most powerful incentives to industry and economy are in consequence destroyed at the same time that inferior stock, machinery, &c are made use of Such taxes are besides most unpopular, as well from their requiring an odious though ineffectual inquisition into the affairs of individuals, as from their being direct So much is this the case that we are well convinced that the raising of eighteen or twenty millions by taxes on income would be felt to be a much greater burden, and would really be far more injurious than the raising of fifty or sixty millions by well-devised indirect taxes such as the greater number of those that now exist in England

Luckily however indirect taxes have almost invariably been the greatest favourites both of princes and subjects, and there are many solid reasons why this should be the case The burden of direct taxation is palpable and obvious It admits of no species of disguise or concealment, but makes every one fully sensible of the exact amount of income taken from him by government Every one, however, is extremely averse from parting with property, unless he obtain some more acceptable equivalent in its

stead; and as the benefits derived from the institution of government are neither [illegible] to be easily and readily fel[illegible] of the people there is, in the great majority of cases, a [illegible]nclination to pay a large amount of direct [illegible] it is that governments have so generally had recourse to indirect taxes Instead of exciting the prejudices of interested parties by openly demanding a specific portion of their incomes, they have taxed the articles on which these incomes are usually expended This ingenious plan conceals the amount of taxation, and makes its payment appear in some measure voluntary The tax being generally paid, in the first instance, by the producers, [illegible] the natural price of the [illegible] demand being made upon them for the tax, it escapes their recollection, and the article which they receive seems the fair equivalent of the sacrifice made in acquiring it Such taxes have also the advantage of being paid by degrees, in small portions, and at the time when the commodities are wanted for consumption, or when it is most convenient for the consumers to pay them

That indirect taxes labour under some considerable disadvantages is obvious, but these have been much exaggerated It is alleged in the first place that taxes on commodities necessarily alter the natural distribution of the capital and industry of a country, and force them into less advantageous channels, because, where a tax is laid on a particular class of commodities, the producers, in order to raise the price proportionally to the tax, diminish the supply in the market by transferring a portion of the capital employed in the production of the taxed commodities to some other business But it is to be observed that this effect, if it be sensible at all, [illegible] when a duty is first imposed, and that [illegible] the duty is blended with the cost of production, and has no further influence over the distribution of capital It is also true, that, provided the tax be not oppressive, or so high as to drive capital wholly from the business, it acts as a stimulus to invention, and makes those engaged in the business exert themselves, by new efforts of ingenuity and economy, to find out means of paying the tax without adding to the price of the articles produced, or withdrawing any portion of their capital from the business In many instances these efforts have been completely successful, and in some instances the influence of the tax has been more than neutralized by the exertions made to defeat it

Taxes on commodities being almost always paid by the producers before they are sold to the consumers, they not only, it is said, increase prices by the whole amount of the duties, but also by the profits due to the manu[illegible]

[illegible]

its influence in this respect has been greatly over-rated by M Say, M Sismondi, and others The latter has calculated that a tax of 4000 francs, paid originally by a manufacturer whose profits were 10 per cent, would, if the manufactured commodity only passed through the hands [illegible]

[illegible]

ceeds on the supposition that he who first advanced the tax would receive from the next manufacturer 4400 francs, and he, again, from the next, 4840 francs, so that at each step 10 per cent on its value should be added to it "But," as Mr Ricardo has justly observed "this is to suppose that the value of the tax would be accumulating at compound interest, not at the rate of 10 per cent per annum, but at an absolute rate of 10 per cent at every step of its progress M Sismondi's statement would be correct if five years elapsed between the first advance of the tax and the sale of the taxed commodity to the consumer, but if one year only elapsed, a remuneration of 400 francs, instead of 2734, would give a profit at the rate of 10 per cent per annum to all who had contributed to the advance of the tax, whether the commodity had passed through the hands of five manufacturers or fifty" (*Principles, &c* 3d edit p 459)

It is certainly true that duties on commodities encourage smuggling "They tempt," says Dr Smith, "persons to violate the laws of their country who are frequently incapable of violating those of natural justice, and who would have been [illegible] lent citizens, had not the laws [illegible] that a crime which nature never meant to be so" (P 378) In consequence of this tendency, duties on commodities require the employment of a number of revenue officers, and as they expose the producers of the taxed articles to considerable inconvenience and hardship from domiciliary visits they are [illegible] by the necessity of making a corresponding addition to the price of the goods But this, after all, is not so much a consequence of duties on commodities, as of their abuse, or of their being carried to an oppressive extent So long as they are confined within reasonable limits, the temptation which they create to engage in smuggling transactions may be very easily obviated; and it has been shown over and over again that duties so restricted are uniformly more productive than those which are carried to such a height as to hold out any great encouragement to smuggling

It may also be said that duties on commodities do not fall on individuals in proportion to their means of paying them, and that while they press with undue severity on persons with large families or who occupy prominent stations they [illegible] direct wealth wrought by rich miners and those in the more [illegible] walks of life But in taxation we have only a choice of difficulties However desirable, it is, as already seen, quite impossible to tax individuals in proportion to their incomes, and as any attempt to impose an equal income tax would not only be sure to fail, but would be attended with the most disastrous effects, resort must necessarily be had to the best practicable taxes, that is, to duties on commodities. And it does not really appear that such duties can be considered as unequal If duties be laid on sugar or wine, those who abstain from their use will, of course, escape them, but those who use such articles have no good right to complain of this, seeing that they may also, by exercising the same self-denial as the others, exempt themselves from the duties

Taxes on commodities are most commonly divided into two great classes, [illegible] external or frontier, and the other [illegible] first class, [illegible] portation into a country, and sometimes also on native commodities when exported The second class, which are here called excise duties, are charged on certain articles produced [illegible] intended for home consumption [illegible] great sources of indirect taxation, duties are [illegible] laid on the paper or other materials necessary to the completion of deeds and other contracts, on the liberty to use certain articles and to exercise certain privileges, &c

*Customs duties* formed an important branch of the public revenue of most ancient states, and in modern times they have been very extensively imposed In England they have been charged from a very remote period, and though inconsiderable at first, they have increased with the increase of civilization and commerce, till they have long formed one of the most copious sources of the public revenue The [illegible] were collected for the first time in a book of rates, [illegible] published in the reign of Charles II, but there is hardly a year in which the customs duties [illegible] cations It is now [illegible] acts imposing or varying the customs duties before they become inoperative, so extremely numerous, and tariffs, or tables of duties, drawbacks, &c, are annually published for the convenience of merchants and others

Owing principally to the vast increase of the commerce, wealth, and population of the country, but partly also to the increase of the rates, the progress of the customs duties has been quite extraordinary The revenue derived from the customs duties in 1596, in the reign of Elizabeth, amounted to no more than 50,000*l* In 1613, it had increased to 148,075*l*, of which no less than 109 572*l* was collected in London In 1660, at the Restoration, the customs produced 421,582*l*, and at the Revolution, in 1688, they produced 781 987*l* During the reigns of William III and Anne, the customs revenues were considerably augmented the nett payments into the exchequer in 1712 being 1 [illegible] 422*l* During the war terminated by the peace of Paris in 1763 the nett produce of the customs revenue of [illegible] nearly 2,000,000*l* In 1792, it [illegible] at the close of the war [illegible] France, it amounted to [illegible] and [illegible] the customs revenue of the United Kingdom amounted to 22 015,754*l*, of which [illegible] 12 031 501*l*

[illegible] duties were charged [illegible] duties, whether exported or imported, the duty on wool sent to the Netherlands, France, &c being formerly, in fact, the principal item in the customs revenue But for a long time past customs duties have been almost exclusively laid on imported articles, those laid on exports being, in most instances, imposed rather to check or prevent the exportation of the articles, than in the view of raising revenue.

Customs duties, when judiciously imposed, and confined within reasonable limits, are perhaps the least exceptionable of all taxes (*See* CUSTOMS) But if they be carried to such a height as [illegible] stimulate smuggling they [illegible] very purpose for which they are intended Our finance ministers have not, however, been sufficiently alive to this obvious consideration There can be no articles better fitted to bear customs duties than tobacco and spirits, but the duties with which they are loaded are so extravagantly high that they occasion a great deal of smuggling, with its accompanying crime and demoralisation, and [illegible] more productive were they [illegible] existing duties on brandy and geneva are, perhaps, the very worst in our tariff, but

they would be about the very best were they reduced from 22*s* 6*d* to 8*s* or 10*s* a gallon.

As already stated, the customs revenue of 1840 amounted to 23,341,813*l*, and we hesitate not to affirm that no equal amount of revenue was ever raised in any country, or in any period of time, with so little difficulty and inconvenience. The assessed taxes, exclusive of the land tax produced in 1840, 2,191,404*l*, and which only fall heavily on the wealthy, no one can doubt that their payment produced more irritation, and was regarded as a greater burden by the public than the payment of the customs duties, though the latter [illegible] seven times as great an amount of money into the treasury.

The excise revenue for 1840 was collected in Great Britain at a charge of 4*l* 18*s* 10*d* per cent on its gross produce, and in Ireland, at a charge of 10*l* 8*s* 3*d* on ditto.

*Excise Duties.* — The next great branch of the public revenue consists of inland or excise duties, that is, as already seen, of duties charged on certain commodities produced or manufactured at home.

Excise duties were introduced into England by the Long Parliament in 1643, being then laid on the makers and venders of ale, beer, cider, and perry. The Royalists soon after followed the example of the Republicans both parties declaring that the excise should be continued no longer than the [illegible] of the war. But it was found too productive a source of revenue to be again relinquished, and when the nation had been accustomed to it for a few years, the parliament declared, in 1649, that the "impost of excise was the most easy and indifferent levy that could be laid upon the people." It was placed on a new footing at the Restoration, and notwithstanding Mr Justice Blackstone says that "from its first original to the present time its very name has been odious to the people of England" (*Com.* book i. c. 8), it has continued progressively to gain ground, and it is at this moment imposed on several most important articles, and furnishes nearly a third part of the entire public revenue of the kingdom. *See* EXCISE DUTIES.

Some excise duties that were justly objected to have been repealed within these few years, and with the exception of the duty on glass, which interferes injuriously with the manufacture, we are not sure that there is one of the existing duties that can be fairly objected to on principle, though the rate of duty might, in some instances, be advantageously reduced. We subjoin an account of the articles subject to excise duties in Great Britain in 1850, with the nett produce of the duties in the same year:

| Articles | Nett Revenue | | |
|---|---|---|---|
| | *l* | *s* | *d* |
| Hackney carriages - - | 79,208 | 3 | 0 |
| Hops - - - | 307,077 | 2 | 2½ |
| Licences - - - | 1,029,398 | 10 | 5½ |
| Malt - - | 5,169,371 | 9 | 9½ |
| Paper - - - | 809,241 | 5 | 2½ |
| Post horse duty - | 112,027 | 3 | 3½ |
| Post horse licences - - | 4,935 | 3 | 6 |
| Railways - - | 251,214 | 16 | 0½ |
| Stage carriages - - | 192,079 | 16 | 8 |
| Soap - - - - | 1,065,571 | 10 | 4½ |
| Spirits - - - | 4,808,811 | 5 | 1½ |
| Total - - | 13,853,436 | 14 | 8 |

It has been said that the excise duties "greatly raise the cost of subsistence to the labouring classes." But this assertion has really no solid foundation. We have seen above that, in 1850, the excise duties in Great Britain produced 13,853,437*l*. Now of this sum the duties on spirits, malt, and licences, produced 10,998,580*l*. In fact, the only excise duty that can be said to fall on a necessary of life is that on soap, which produced in 1850 (in Great Britain) 1,065,572*l*, and as the population of Great Britain amounts at present to about 21,000,000, the soap tax, at an average, does not impose a burden of above 1*s* a year on each individual! If we estimate its annual pressure on a labouring family of five persons at 3*s*, we shall not be within, but rather beyond the mark. In Ireland there is no tax on soap.

The duties on glass were lately the most objectionable, and various reductions were made in their amount. But in their amended state they interfered most materially with the processes carried on in the manufacture, and, by obstructing the introduction of new discoveries, and improved methods, enhanced the price of the article in a greater degree than might have been inferred from the amount of the duty. In consequence they were finally repealed in 1845.

The only taxes in the departments of customs and excise, or of the revenue generally, that can be truly said to fall on articles necessary to the labourer are, besides soap, those on tea, sugar, and one or two more. It is pretty certain that the duty on tea, which is the most [illegible] might be materially reduced without affecting the revenue, and the presumption is that it will be so reduced. The duty on sugar, which enters so largely into most descriptions of food is now very moderate, and the trade [illegible] they were [illegible] the pressure of exigencies, the duties on spirits obstruct a pernicious habit, and should not be given up. They are the best of all possible duties, and the only thing to be attended to in their imposition is, not to carry them to such a height as to defeat their operation by encouraging smuggling. We have yet to learn, supposing they are not carried beyond this limit, that a single good objection can be made to these duties.

The obscurity and complexity of the excise laws have been justly complained of, in this respect, however, they have been materially improved of late years, and the statutes under which they are collected are now, for the most part, sufficiently perspicuous, and easily understood.

The capacity of a tax on a commodity to raise a revenue depends partly on the nature and extent of the demand for the taxed article, and partly on the means of preventing its being smuggled or the duty evaded. Every tax, by raising the price of the article on which it is laid, has a tendency to bring it within the command of a smaller number of purchasers, and to lessen its consumption. An individual who might be able and disposed to pay 1*s* a bottle of duty on wine might neither have the means nor the inclination to pay 2*s* or 3*s*, and instead of being augmented the revenue might be diminished by such an increase of duty. And hence, whenever the duties on commodities are raised beyond certain limits, — which, however, it is impossible to define *a priori*, seeing that they necessarily vary according to the description of commodities charged with duties, the varying tastes and circumstances of society, and the means of counteracting smuggling, — they depress consumption to such an extent as to become less productive than if they had been lower.

Variations in the amount of the duties affecting commodities have exactly the same effect on their price, and consequently on their consumption, as corresponding variations in the cost of production. But it is clear that any reduction in the price of articles the necessary cost of which is very considerable, and can therefore be used only by the rich, would not so powerfully increase their consumption as an equal reduction in the price of cheaply produced commodities in general demand. Thus, a reduction of 25 or even 50 per cent in the price of coaches, would not add greatly to the demand for them, for notwithstanding this reduction, they would still be luxuries for which none but the rich could afford to pay. But a reduction of 25 or 50 per cent in the price of tea, sugar, beer, gin, or any article in general demand, would extend its consumption in a much greater ratio. The reason is plain. The lower classes form by far the most numerous portion of society, the articles referred to, and others of the same description, are highly esteemed by them, and are, even at their present prices, extensively consumed. But a reduction of a half, or even a fourth from their price, would add prodigiously to the demand for them. It would enable their present consumers to use them in larger quantities, while it would at the same time bring many of them fully under the command of a very large class by whom they are now used as luxuries only on rare occasions. The history of taxation in this and other countries fully confirms this statement. When carried beyond due limits, taxes [illegible] to be productive, and recover that [illegible] by which they are reduced. There is much truth in the shrewd remark of Dr Swift, that in the arithmetic of the customs two and two do not always make four, but sometimes only one. In 1808 the duty on coffee was 1*s* 7½*d* per lb, the quantity [illegible] 1,069,691 lbs, [illegible] 1*s* 4*d*. In the course of the year the duty was reduced to 7*d* per lb, and next year no fewer than 9,251,837 lbs were entered for home consumption producing a nett revenue of 245,886*l*. The coffee duty was subsequently lowered to 4½*d*, and the quantity entered for consumption is now (1852) about 32,000,000 lbs, and the revenue about 640,000*l* a year.

The history of the duties on tea, spirits, wine, sugar, and indeed of every other article in extensive demand, is precisely similar. When carried to an oppressive height, the duty either occasions the use of the article to [illegible] which is the most common case, it makes [illegible] through clandestine channels in defiance of the law. But when the duty is moderate, a taste for the article is diffused, and the profits to be made by trampling on the law not being sufficient to remunerate the smuggler, he is forced to abandon his hazardous occupation, and the article is wholly supplied through legitimate channels. After the various disastrous consequences entailed on the country by the exorbitant height to which many duties were carried previously to 1825, and the signal advantages that have resulted to the revenue and the public from [illegible], it may be hoped that the principle now established will meet with more attention in future.

# TAXATION.

The attempts that have been made in Great Britain and elsewhere to suppress smuggling, and at the same time to maintain exorbitant duties, have [illegible] failed It has been invariably found that [illegible] the law, nor vigilance on the part of the officers, can prevent the smuggling of commodities loaded with excessive duties At this moment it is supposed that from [illegible] to 600,000 gallons of foreign brandy and geneva find their way into our market without paying any duty, in defiance of the coast guard, and of all the other machinery for keeping them out Large quantities of tobacco are also smuggled In fact, there are no means of effectually putting down smuggling other than a reduction of duty The very severity of the laws prevents their execution It creates a sympathy in favour of the smuggler, it stimulates the trader to corrupt the officer to conceal a fraud, and it makes the officer overlook what he might otherwise [illegible]

*Stamp Duties*.—These form the next most important branch of the public revenue, after the customs and excise They are mostly laid on the parchment or paper on which certain deeds, contracts, receipts, acquittances, bills of exchange, newspapers, policies of insurance, indentures of apprenticeship, &c are written or printed, and derive their name from the parchment or paper being impressed with a stamp stating the amount of the duty When imposed on fair principles and not carried to too great a height, stamp duties seem to be one of the most legitimate sources of revenue They assist in authenticating legal instruments, and render it much more difficult than formerly to forge deeds of any standing It is needless, perhaps, to say, that if stamp duties be carried to such a height as to oppose any serious obstacle to the free circulation of property, or to the execution of necessary deeds, they become exceedingly injurious Perhaps the duty on fire insurance is the most objectionable of the existing stamp duties It amounts to *3s* per cent on all property insured, whereas the premium paid to insurance offices, for common risks, is no more than *1s 6d* per cent, or only half the duty Thus, if a person wish to insure 1000*l* on a dwelling-house, a shop, warehouse, or other commonly hazardous property, he pays 15*s* to an insurance office as an indemnification for the risk, and 30*s* to government for leave to enter into the transaction So exorbitant a duty cannot be too severely condemned It discourages that providence and foresight the encouragement of which ought to be an object with all prudent governments, and it is the principal cause that much property is not insured at all, and that what is insured is seldom sufficiently covered Every individual, in fact, who insures any commonly hazardous property is obliged to pay three times as much as the risk is really worth Under such circumstances, the wonder certainly is, not that a great deal of property is uninsured, but that such is not the case with a great deal more Seeing the vast importance of insurance, it may well be doubted whether it ought to be charged with any duty, however slight But were the duty fixed at *5d* per cent, or at half the premium, its influence in repressing insurance would not be very sensible, and the increase of business to which such a reduction of the duty would lead would be so very great, that we have little doubt that in a few years the reduced duty would yield nearly as large a revenue as is derived from the present exorbitant duty

The duties on legacies and on the probates of wills, are included under the head of STAMP DUTIES, of which they are very important items These duties affect only personal or moveable property The first or legacy duty, varies according to the propinquity of the successor, being 1 per cent on property devolving on children and lineal heirs, 3 per cent on property devolving on brothers and sisters, 4 per cent on property devolving on cousins, and 10 per cent on property devolving on strangers The probate duty varies [illegible] the amount of property in the will The duties on stage and hackney coaches, gold and silver plate, &c, come under the head of STAMPS

*Land Tax*.—The existing land tax originated in 1692, being intended to replace the subsidies and such like grants previously made to the crown According to the valuation at which it was assessed, it was found that a charge of 1*s* per pound on the rental of the country produced 500,000*l* [illegible] e in this valuation [illegible] ted, usually amounted [illegible] In 1798, it was made perpetual at that rate, leave being at the same time given to the proprietors to reduce it

The land tax has always been very unequal When imposed, the proprietors friendly to the Revolution returned their estates at a much higher value than those [illegible] districts of the country have, in some instances, tended to correct the inequalities [illegible] imposition of the tax, but their general effect has been to increase them.

*Assessed* [illegible] revenue [illegible] horses, carriages, armorial bearings, game, &c The window duty, that used to be one of the principal items in the assessed taxes, has been recently repealed. A hearth tax, or duty proportioned to the number of fire places in a house, was established in this country at a very early period, but owing to its being necessary to the assessing of the tax that the government officers should be admitted to view the inside of each house, the hearth tax became exceedingly unpopular, and was repealed by the stat 1 Will & Mary, c 10. This statute declares hearth money "not only a great oppression to the poorer sort, but a badge of slavery upon the whole people, exposing every man's house to be entered into and searched at pleasure by persons unknown to him, and therefore to erect a lasting monument of their majesties' goodness in every house in the kingdom the duty of hearth money was taken away and abolished"

But six years afterwards "the prospect of this monument of goodness was," to use Blackstone's words, "somewhat darkened," by the passing of an act (7 Will 3 c 18) laying a duty on all inhabited houses except cottages, and also on windows These duties were afterwards considerably increased they were, however, materially modified within the last few years, and neither the late window tax, nor the former house tax, could, previously to their repeal, be said to be oppressive But of the two the window tax was certainly the more objectionable, and if either was to be repealed it should have had the preference The house tax being, however the more unpopular was repealed in 1834 But the inexpediency of this measure having become obvious, the house tax was again revived in 1851, as a compensation for the loss of the window tax, which was then repealed The basis of the new tax is extremely narrow, for it affects only houses worth 20*l* a year and upwards It amounts to 3¾ per cent on the rent of all but farm houses and shops, being on the latter 2½ per cent

The house tax being assessed according to the rent, it frequently happened that private houses, shops, and taverns in towns were [illegible] larger sum than the finest houses of the nobility and gentry in the country There was not, however, any injustice in this, for, in point of fact, had any attempt been made to let the latter, they would rarely have found a tenant or brought any rent This apparent inequality afforded a convenient topic for declamation, and for raising an outcry against the tax, which might have been obviated by taking the cost as well as the rent of first-class houses into view [illegible]

With the exception of the duties on the postage of letters, which have been noticed elsewhere (*see* POST OFFICE), the observations now made will probably suffice to give the reader a general idea of the principles on which taxes should be imposed, and of the leading characteristics of the principal taxes now in force in this country

*Collection of Taxes*.—Taxes in Great Britain are almost [illegible] stamps, with the assessed taxes are each under the management of a particular department, having at its head a board of commissioners, with various classes of inferior officers The post office revenue is managed by a postmaster general and a principal secretary The heads of the different revenue departments correspond with and receive their instructions from the treasury, to which is committed the charge of supervising, controlling, and regulating all matters connected with the assessment and collection of taxes The number of commissioners in the different revenue boards was formerly much greater than at present, and it is contended by some very high authorities that their number might be advantageously reduced, and that the whole responsibility should rest with the head of each department Various reforms and retrenchments have been also introduced into the subordinate departments, and not a few abuses have been rectified in the assessment and collection of most duties Perhaps the only very material reforms that need now be looked for in this department, must arise rather from changes and modifications of duties than from any changes in the way in which they are charged and collected The reduction of the present exorbitant duties on tea and tobacco, by taking away an overwhelming temptation to their clandestine importation and adulteration, would be productive of great public advantage, at the same time that it would have other beneficial consequences In the excise there remains little to be amended

Those who wish for further information on the subjects treated of in this article may consult the article on Taxation in the new edition of the *Encyclopædia Britannica*, *Ricardo's Principles of Political Economy*, M'Culloch's *Treatise on Taxation*, &c.

# TAXATION.

**Account of the Public Income of the United Kingdom, specifying its different Sources, and the Amount derived from each, during 1848, 1849, and 1850**

| INCOME | 1848 | | 1849 | | 1850. | |
|---|---|---|---|---|---|---|
| **CUSTOMS AND EXCISE** | £. | £. | £ | £. | £. | £. |
| Spirits — Foreign | 1,235,438 | | 1,675,548 | | 1,430,298 | |
| Spirits — Rum | 1,154,156 | | 1,140,931 | | 1,099,950 | |
| Spirits — British | 5,455,475 | | 5,757,336 | | 5,909,381 | |
| Malt | 5,225,072 | | 4,964,067 | | 5,391,321 | |
| Hops | 892,381 | | 213,722 | | 819,458 | |
| Wine | 1,732,295 | | 1,767,516 | | 1,821,123 | |
| Sugar and Molasses | 4,741,272 | | 4,126,505 | | 4,114,134 | |
| Tea | 5,329,992 | | 5,471,422 | | 5,596,961 | |
| Coffee | 709,632 | | 612,520 | | 565,660 | |
| Tobacco and Snuff | 4,350,733 | | 4,408,018 | | 4,410,323 | |
| | | 30,324,446 | | 30,167,585 | | 30,658,409 |
| Butter | 140,105 | | 137,844 | | 158,081 | |
| Cheese | 106,089 | | 96,938 | | 84,497 | |
| Currants and Raisins | 476 662 | | 492,791 | | 490,682 | |
| Corn | 767,668 | | 461,181 | | 467,881 | |
| Silks | 274,506 | | 253 447 | | 218,718 | |
| Paper | 750,864 | | 815,375 | | 858,598 | |
| Soap | 991,923 | | 1,047 023 | | 1,066,472 | |
| Candles and Tallow | 99,330 | | 94,620 | | 77,261 | |
| Coals, sea borne | 4,193 | | 2,941 | | 976 | |
| Glass | 8,062 | | 8 732 | | 10,705 | |
| Bricks, Tiles and Slates | 455 816 | | 456,453 | | | |
| Timber | 737 235 | | 618,456 | | 665,910 | |
| Excise Licences | 1,103 436 | | 1,107,890 | | 1,130,175 | |
| Post horse Duties | 152,605 | | 150,993 | | 150,010 | |
| Hackney Carriages | 70,109 | | 73 235 | | 79,209 | |
| Stage Carriages | 196,871 | | 188,785 | | 193,580 | |
| Railways | 232,270 | | 235,175 | | 231,215 | |
| Miscellaneous of Customs and Excise | 743,060 | | 781,895 | | 716,047 | |
| | | 7 312,737 | | 7 104 377 | | 6 622 501 |
| TOTAL CUSTOMS AND EXCISE | | 37,637,183 | | 37,271,962 | | 37,280,424 |
| **STAMPS** | | | | | | |
| Deeds and other Instruments | 1,754 883 | | 1 738,435 | | 1,553,346 | |
| Probates and Legacies | 2,157,608 | | 2,368,621 | | 2,218,206 | |
| Insurance — Marine | 163,630 | | 158,563 | | 162,769 | |
| Insurance — Fire | 1,064,190 | | 1,080,972 | | 1,104,852 | |
| Bills of Exchange, Bankers Notes | 559,461 | | 560,739 | | 576,681 | |
| Newspapers and Advertisements | 363,353 | | 359,233 | | 362,224 | |
| Stage Coaches | | | | | | |
| Receipts | 185,281 | | 206,327 | | 169,570 | |
| Other Stamp Duties | 536,641 | | 540 373 | | 529,110 | |
| | | 6,785,050 | | 7,013,267 | | 6,706,761 |
| **ASSESSED AND LAND TAXES** | | | | | | |
| Land Taxes | 1,158,245 | | 1,159,323 | | 1,159,387 | |
| Windows | 1,659,676 | | 1,687,425 | | 1,708,025 | |
| Servants | 205,754 | | 206,634 | | 201,947 | |
| Horses | 304,380 | | 299,907 | | 292,944 | |
| Carriages | 416,491 | | 411,678 | | 402,622 | |
| Dogs | 147,749 | | 148,227 | | 150,075 | |
| Additional 10 per cent. | 289,041 | | 291,010 | | 302,490 | |
| Other Assessed Taxes | 327,125 | | 318,706 | | 315,220 | |
| | | 4,508,461 | | 4,522,910 | | 4,535,710 |
| PROPERTY and INCOME TAX | | 5,485,164 | | 5,564,833 | | 5,510,860 |
| POST OFFICE | | 2,143 680 | | 2,165,350 | | 2,461,262 |
| CROWN LANDS | | 362,501 | | 351,075 | | 365,809 |
| Other Ordinary Revenue, and other Resources | | 494,471 | | 757,995 | | 770,970 |
| Money from China, under Treaty of August, 1842 | | 539,305 | | | | |
| Excess of Expenditure over Income | | 1,034 919 | | | | |
| TOTAL INCOME | | 58,990,734 | | 57,647,392 | | 57,431,796 |

# TAXATION.

**Account of the Expenditure of the United Kingdom during 1848, 1849, and 1850; specifying the different Items, and the Amount of each**

| EXPENDITURE | 1848 | | 1849 | | 1850. | |
|---|---|---|---|---|---|---|
| | £ | £ | £ | £ | £ | £ |
| **REVENUE** — *Charges of Collection.* | | | | | | |
| Civil Departments { Customs | 677,112 | - - | 678,451 | - - | 666,525 | |
| Civil Departments { Excise | 705,793 | - - | 658,242 | - - | 645,444 | |
| | | 1,382 905 | | 1,336,693 | | 1,311,969 |
| Preventive Service, Land Guard, Revenue, Police Cruizers, and Harbour Vessels | - - | 564,810 | - - | 554,288 | - - | 521,980 |
| | - - | 1,947,715 | - - | 1,890,981 | | 1,833,949 |
| Stamps - - - - | - - | 144 930 | - - | 132,316 | - - | 134,639 |
| Assessed Taxes - - - | - - | 317,346 | - - | 317,371 | - - | 303,622 |
| Other Ordinary Revenues - | - - | 60,066 | - - | 62,288 | - - | 58,766 |
| Superannuation and other Allowances - | - - | 360 731 | - - | 379,069 | - - | 402,369 |
| TOTAL REVENUE - - | - - | 2,836,788 | - - | 2,782,025 | - - | 2,733,345 |
| **PUBLIC DEBT** | | | | | | |
| Interest on Permanent Debt - - | 23 908 679 | - - | 23,920,315 | - - | 23,878,803 | |
| Terminable Annuities - - | 3,79 › 076 | - - | 3,725 994 | - - | 3,737 325 | |
| Management - - | 69,134 | - | 71,597 | - | 71,756 | |
| | 27,773 189 | | 27,717,936 | | 27,687,884 | |
| Interest on Exchequer Bills - - | 790,328 | - - | 606 025 | - - | 403,706 | |
| Total Debt - - | | 28 563,517 | | 28,323,961 | | 28,091,590 |
| **CIVIL GOVERNMENT** — *Civil List — Privy Purse* | | | | | | |
| Salaries of the Household Tradesmen's Bills | 371 800 | - - | 371,800 | - - | 371,800 | |
| The Allowances to the several Branches of the Royal Family, and to his Royal Highness Leopold Prince of Coburg (now King of the Belgians) * | 284,286 | - - | 249,000 | - - | 173,273 | |
| The Lord Lieutenant of Ireland's Establishment - | 26,400 | - | 26,401 | - | 26,424 | |
| The Salaries and Expenses of the Houses of Parliament (including Printing) - | 103,376 | - - | 133,666 | - - | 170,646 | |
| Civil Departments, including Superannuation Allowances - | 553,067 | - - | 607,747 | - | 616,767 | |
| Other Annuities, Pensions, and Superannuation Allowances on the Consolidated Fund, and on the Gross Revenue - - | 215,770 | - | 235,980 | - - | 231 714 | |
| Pensions, Civil List - | 10,215 | - | 11,600 | - | 11,481 | |
| TOTAL CIVIL GOVERNMENT - | | 1,594,944 | | 1,636,197 | | 1,602,105 |
| **JUSTICE** | | | | | | |
| Courts of Justice - - | 931 709 | - - | 765,685 | - - | 677,793 | |
| Police and Criminal Prosecutions - - | 874,590 | - - | 893 927 | - - | 879,818 | |
| Correction - - | 521 342 | - - | 745,852 | - - | 841,574 | |
| TOTAL JUSTICE - | | 2,327,641 | | 2,405,464 | | 2,399,185 |
| **DIPLOMATIC** | | | | | | |
| Foreign Ministers Salaries and Extraordinaries | 166,192 | - - | 160,833 | - - | 159,285 | |
| Consuls Salaries and Superannuation Allowances - | 137,028 | - - | 129 413 | - - | 139 798 | |
| Messengers | 22,372 | | 30 666 | - | 30,509 | |
| TOTAL DIPLOMA - | | 325,852 | | 320,912 | | 329,592 |
| **FORCES** | | | | | | |
| Army — Effective — Number of Men | (113,064) | | (103 842) | - - | (99 042) | |
| Army — Effective — Charge | 4,317 021 | - - | 4 290 147 | - - | 4,146,609 | |
| Army — Non effective — Number of Men | (73,735) | - | (73 406) | - - | (72 133) | |
| Army — Non effective — Charge - - | 2 329 061 | - - | 2,2 8 962 | - - | 2,255,274 | |
| TOTAL ARMY - | 6 647 282 | - - | 6 519 109 | - - | 6 401 883 | |
| Navy — Effective - — Number of Men | (14 650) | - | (10,118) | - | (39,316) | |
| Navy — Effective - — Charge | 6 › 1 805 | - | ,518 969 | - | 5,071,608 | |
| Navy — Non effective — Number of Men | (19 138) | - | (18,824) | - | (18 734) | |
| Navy — Non effective — Charge | 1 367,182 | - - | 1,393 128 | - | 1,366,275 | |
| TOTAL NAVY - - | 7,922,287 | - - | 6 942,397 | - - | 6,437,883 | |
| Ordnance — Effective — Number of Men | (12,318) | - - | 13,282) | - - | (13,310) | |
| Ordnance — Effective — Charge | 2,910 201 | - | 2,168,762 | - | 2,387 616 | |
| Ordnance — Non-effective — Number of Men | (603) | | (575) | - - | (569) | |
| Ordnance — Non-effective — Charge - | 165 923 | - | 163 269 | - | 165,562 | |
| TOTAL ORDNANCE | 3,076,124 | | 2 332 031 | | 2,553,178 | |
| TOTAL FORCES - | | 17,645,695 | | 15,823,537 | | 15,392,944 |
| Kaffir War - - - - | | 1,100 000 | | | | |
| Bounties, &c. for promoting Fisheries - | | 12,013 | - - | 14,009 | - - | 16,149 |
| Public Works | | 706,243 | - - | 600,478 | - - | 601,364 |
| Payments out of the Revenue of Crown Lands, for Improvements - | | 152 084 | - - | 123 376 | - | 129,985 |
| Payments | | 1,392,944 | - - | 1,314,258 | - - | 1,447,058 |
| [illegible] | | 141 834 | - - | 135,766 | - - | 127,337 |
| [illegible] | | 2,186,679 | - - | 2,997 673 | - - | 2,070,880 |
| | | 58,990,734 | | 55,480,656 | | 54,938,554 |
| Surplus of Income over Expenditure - - | | - | - - | 2,166,736 | - - | 2,493,262 |
| TOTAL EXPENDITURE - - | | 58,990,734 | - | 57,647,392 | - - | 57,431,796 |
| Memorandum | | | | | | |
| [illegible] | | 3,742,742 | - - | 3,755,099 | - - | 3,808,862 |
| [illegible] | | 1,286,388 | - | 1,231,727 | - - | 1,199,815 |
| DIFFERENCE - - | | 2,456,354 | - - | 2,523,372 | - - | 2,609,047 |

* No part of this income is at present paid for the use of King Leopold. The trustees, after discharging certain annuities and pensions to the establishment of the late Princess Charlotte, repay the balance of the annuity to the Exchequer, the sum so repaid in the last year was 36,000*l*.

TA'XICORNS *Taxicornes* (Lat taxus, *a yew tree*, cornu, *a horn*) The name of a family of Coleopterous insects including those in which the antennæ gradually augment in size as they extend from the head, or terminate in an enlargement.

TA'XIDERMY (Gr ταξις *arrangement* and δερμα *skin*) The art of arranging and preserving the skins of animals The most popular treatise on taxidermy is Mr Swainson's volume in *Lardner's Cyclopædia*

TA'XIS In Surgery, the replacement of parts which have quitted their natural situation by the hand, and without instrument or operation, as in reducing hernia or rupture

TAXIS [illegible] ness of the parts to the end for wh[illegible]

TA'XUS (Lat) The botanical name of the yew tree, celebrated for the hardness and elasticity of its wood Its berries are harmless, but its leaves are poisonous, partaking of [illegible] oxglove It is the most simple form [illegible] alliance, and is usually taken as the [illegible] of the gymnospermous struct[illegible] its female flower is quite [illegible] What travellers in New [illegible] e species of *Dacrydium*.

TAYLOR'S THEOREM In Mathematics a very general and remarkable formula of most extensive application in analysis, discovered by Dr Brook Taylor, and given in his *Methodus Incrementorum*, published in 1715 The formula is this —Let $u$ be any function whatever of a variable $x$, and let $u'$ be what $u$ becomes when $x$ receives an increment $= h$, then

$$u' = u + \frac{du}{dx}\frac{h}{1} + \frac{d^2u}{dx^2}\frac{h^2}{1\ 2} + \frac{d^3u}{dx^3}\frac{h^3}{1\ 2\ 3} + \&c$$

Demonstrations of this important theorem are given in every treatise on the differential calculus, and it is made by Lagrange the [illegible] of the calculus itself (See Lagrange, *Théorie des Fonctions Analytiques*)

TEA The dried leaves of the tea tree of which there are two varieties 1 The *Thea nigra*, black or bohea tea. 2 *Thea viridis*, green tea The boheas include souchong, pekoe and congou, and singlo, and imperial or bloom tea lected and dried on iron plates by a gentle heat Tea taken in moderation, especially as we use the infusion, with sugar and milk, is strengthening and invigorating, [illegible] narcotic [illegible] tarly susceptible, and which renders it improper in hypochondriacal and hysterical patients We know little of the chemical properties of the varieties of tea, but the following table shows that, in regard to its more obvious constituents the different varieties are not widely dissimilar The column showing the weight of the precipitate by jelly may be taken as indicating the relative proportion of the astringent matter

| 100 Parts of Tea. | | | Soluble in Water | Soluble in Alcohol | Precipitate with Jelly | Inert Residue |
|---|---|---|---|---|---|---|
| Green | hyson | 14*s* per lb | 41 | 44 | 31 | 56 |
| | — | 12*s* — | 34 | 43 | 29 | 57 |
| | — | 10*s* — | 36 | 43 | 26 | 57 |
| | — | 8*s* — | 36 | 42 | 25 | 58 |
| | — | 7*s* — | 31 | 41 | 24 | 59 |
| Black | souchong, | 12*s* — | 32 | 36 | 28 | 64 |
| | — | 10*s* — | 34 | 37 | 28 | 63 |
| | — | 8*s* — | 37 | 35 | 28 | 63 |
| | — | 7*s* — | 36 | 35 | 24 | 64 |
| | — | 6*s* — | 35 | 31 | 23 | 65 |

Of the above precipitate by jelly, about 40 per cent may be regarded as *tannin*, and the difference between the second and the first column shows the quantity of resin contained in the above teas the resin has an agreeable flavour of the tea Water distilled off tea has an agreeable flavour, and is said to be narcotic it contains a trace of volatile oil Oudry's statement of the existence of a peculiar principle in tea (*thein*) requires confirmation

The late rise and present magnitude of the British tea trade are among the most extraordinary phenomena in the history of commerce Tea was wholly unknown to the Greeks and Romans, and even to our ancestors, previously to the end of the 16th or the beginning of the 17th century It seems to have been originally imported in small [illegible] by the Dutch; but was hardly known in this country [illegible] In 1660, however, it began to be used [illegible] sea, for, in an act passed in that year a duty of 8*d* is laid on every gallon of coffee, chocolate sherbet and tea, made and sold But it is abundantly evident that it was then only beginning to be introduced The following entry appears in the Diary of Mr Pepys secretary to the Admiralty —'September 26 1661 I sent for a cup of tea (a China drink) of which I had never drunk before' In 1661, the East India Company bought [illegible] as a present for his Majesty [illegible] import tea, directed to their agent at Bantam, to the effect that he should send home 100 lbs of the best tea he could get! (See the references in *Milburne's Orient Com* vol ii p 530, *Macpherson's Hist of Com with India*, pp 130—132) Since then the consumption seems to have gone on regularly, though slowly, increasing In 1689, instead of charging a duty on the decoction made from the leaves, an excise duty of 8*s* per lb was laid on the tea itself [illegible] to be ascribed to the reduction that was then effected in the duties Smuggling was then carried on to an enormous extent, and after every other means of checking it had been tried to no purpose, Mr Pitt proposed, in 1784, to reduce the duties from 119 to 12½ per cent This [illegible] ful Smuggling and the [illegible] immediately put an end to and the legal imports of tea were about trebled In 1795, however, the duty was raised to 25 per cent, and after successive augmentations in 1797, 1800 and 1803, it was raised in 1806, to 96 per cent *ad valorem* at which it continued till 1819, when it was raised to 100 per cent on all teas that brought above 2*s* per lb at the Company's sales

Down to the 22d of April, 1834, the duty on tea was an *ad valorem* one, being 96 per cent on all teas sold under 2*s* a pound, and 100 per cent on all that were sold at or above 2*s* Seeing that tea may now be considered almost as a necessary of life, this was certainly a high duty, though as a large amount of revenue must be raised we do not know that it could be fairly objected to on that ground But under the monopoly system the duty was, in fact, about 200 per cent *ad valorem!* For the price of the tea sold by the Company being forced up to nearly double what it would have been had the trade been free, it followed, inasmuch as the duty varied directly as the price, that it also was doubled when the latter was doubled But the monopoly having terminated in 1834, a new duty, charged as follows, was then imposed, viz —Bohea 1*s* 6*d* per lb, congou twankay, hyson skin, orange pekoe and campoi 2*s* 2*d* per lb, souchong, flowery pekoe, hyson young hyson, gunpowder, imperial, and other teas not enumerated 3*s* per lb

But it was soon found to be impracticable fairly to assess these duties and in 1836 they were repealed, and a new duty of 2*s* 1*d* per lb increased in 1840 to 2*s* 2½*d* per lb, imposed in their stead But while we admit that the necessity of the case or the impossibility of fairly assessing [illegible] have justified their repeal, we [illegible] justify the magnitude of the single duty by which they have been replaced It is beyond all question the most objectionable in our tariff

Taking the price of bohea and low congou in bond in London at 1*s* per lb (and it is usually less), the duty of 2*s* 2½*d* with which they are at present charged is equivalent to an *ad valorem* one of considerably more than *two hundred* per cent, whereas taking the price of the hyson and other superior teas consumed by the rich at from 3*s* to 4*s* per lb, the duty on them does not exceed from about 50 to 67 per cent *ad valorem* that is, it does not amount to more than from ¼ to ⅓ part of the duty laid on the teas consumed by the poor! Surely, however, this is neither an age nor a country in which an anomaly of this sort can be safely maintained The public necessities require that the tea sugar and other necessaries of the poor should be taxed, but the obvious principles of justice also require that the duties on them should be, if not lower, at all events no higher than those laid on the necessaries or luxuries of the rich The existing tea-duties contradict this plain principle and are at once unjust and exorbitant The duty on bohea and the lower congous should not, in fact, exceed 6*d* or 8*d* per lb

We subjoin an account of the quantities of tea entered for home consumption in the United Kingdom in 1849 and 1850, with the gross amount of duty received on the same —

| | Quantities lbs | Revenue £ |
|---|---|---|
| 1849 - | 50,021,576 - | 5,471,4-2 |
| 1850 - | 51,172,302 - | 5,596,961 |

TEAK WOOD, or INDIAN OAK The produce of the *Tectona grandis*, a large forest tree, that grows in dry and elevated districts in the south of India, the Burman empire, Pegu, Ava, Siam, Java, &c Teak timber is by far the best in the East, it works easily, and, though porous, is strong and durable, it is easily seasoned, and shrinks very little, it is of an oily nature, and therefore does not injure iron Mr Crawfurd says that, in comparing teak and oak together, the useful qualities of the former will be found to preponderate "It [illegible] are buoyant Its dura[illegible] and to insure

that durability it demands less care and preparation, for it may be put in use almost green from the forest, [illegible] wet rot [illegible] of climate [illegible] *Principles of Carpentry*, p 206, [illegible] *chip* vol i p 451)

The teak of Malabar, produced on the high table land of the south of India, is deemed the best of any It is the closest in its fibre, and contains the largest quantity of oil, being at once the heaviest and the most durable This species of teak is used for the keel, timbers, and such parts of a ship as are under water owing to its great weight, it is less suitable for the upper works, and is not at all fit for spars The teak of Java ranks next to that of Malabar, and is especially suitable for planking The Rangoon or Burman teak, and that of Siam, is not so close-grained or durable as the others, it is, however, the most buoyant, and is therefore best fitted for masts and spars Malabar teak is extensively used in the building yards of Bombay Ships built wholly of it are almost wholly indestructible by ordinary wear and tear, and instances are not rare of their having lasted from 80 to 100 years, they are said to sail indifferently, but this is probably owing as much to some defect in their construction as to the weight of the timber Calcutta ships are never wholly built of teak, the timbers and framework are always of native wood, and the planking and deck only of teak The teak of Burma, being conveyed with comparatively little difficulty to the ports of Rangoon and Martaban, is the cheapest and most abundant of any It is largely exported to Calcutta and Madras

A species of timber called African teak is pretty largely imported into England, from the west coast of Africa But, in point of fact, it is not teak and it is destitute of several of its most valuable properties It is, however, for some purposes a useful species of timber

TEANY, TAWNY or BRUSK In Heraldry a colour compounded of red and yellow, employed in blazonry, but rarely met with in English coats of arms, and reckoned one of the dishonourable colours In engraving, it is represented by diagonal and horizontal lines crossing each other

TEARS The fluid which lubricates the cornea of the eye, when secreted in excess forms *tears*, they are limpid, saline perfectly miscible with water, and have a slight alkaline reagency, owing to the presence of free soda their principal saline contents are common salt and a trace of phosphate of soda, and they contain traces of albumen, but the whole solid matter scarcely amounts to 1 *per cent* When the lachrymal duct by which the tears are conveyed into the nostrils is obliterated and they flow over the angle of the eye, they become concentrated by evaporation and leave an irritating muco saline crust The exact nature, however, of the animal matter contained in the tears has not been determined

TECHNOLOGY (Gr τεχνη *art* and λογος *a discourse*) A term invented to express a treatise on art or the arts

TECTIBRANCHIATA (Lat tego, *I cover*, and [illegible] In which the gills are covered by a process of the mantle containing a shell or enveloped in a reflected margin of the foot for this name that of *Monopleurobranchiata* has been substituted by M De Blainville

TECTORIUM OPUS (Lat tector, *a plasterer*) In Architecture the plasterers' work used on ceilings and interior walls it was a composition of lime and sand, and differed from stucco which was called albarium opus Great pains were taken to prevent its cracking, by crossing layers of reed upon it coated with argillaceous earth previous to coating it with paint

TECTRICES *Coverts* (Lat tego, *I cover*) The name of the feathers which cover the quill feathers and other parts of the wing See COVERTS

TE DEUM (From the first words of the original Latin, "Te Deum laudamus," *We praise thee O God*) The authorship of this sublime hymn has been ascribed by some to Ambrose and Augustine, by others to Ambrose alone, to Hilary, and other less distinguished persons It is, however, generally thought to have been composed in the Gallican church the most ancient mention of it being in the rule of Cæsarius, bishop of Arles in the fifth century The Te Deum, in the office of matins, is always sung after the reading of scripture, in the English morning service, between the two lessons (Palmer *Origines Liturgicæ*, ch i part i sec 2)

TEETH See DENTES

TEETH OF WHEELS, are generally the means by which the power of the first mover is conveyed to the working point of a machine, and it is obviously of great importance that they should be of such a form that as little as possible of the original power may be lost in transmission, and that the impulse should be conveyed through the train of wheels with a uniform force

In the formation of the teeth of wheels, the object aimed at is to give them such a curvature that the angular velocities of the two pieces working together shall maintain the same constant ratio in all positions of contact In order to preserve the constancy of the angular velocity ratio it is only necessary that the acting faces of the teeth shall have such a form that the normal common to the two surfaces in contact shall always divide the *line of centres* (that is, the line joining the centres of the wheel and pinion) in a fixed point Now the teeth of one wheel being assumed to have any form whatever, it is always *geometrically* possible to assign the form of those of another so that they shall fulfil this condition, and, consequently, work together correctly, but the forms which are found to answer in practice are limited to a comparatively small number We subjoin the following cases from Brewster's edition of *Ferguson's Mechanics* —

Case 1 — If the acting faces of the teeth of a wheel are epicycloids whose generating circle has the same radius as [illegible] pinion, and whose base has the same radius as the primitive radius of the wheel, and if these teeth drive the pinion by acting upon infinitely small pins in its circumference, — the motion of the wheel and pinion will be uniform

Case 2 — If the acting faces of the teeth of a wheel are epicycloids whose generating circle is of any magnitude whatever, and whose base is the convex circumference of the wheel, and if the acting faces of the leaves of the pinion are epicycloids described by the same generating circle and whose base is the concave circumference of the pinion, — the motion of the wheel and pinion will be uniform

Case 3 — If the acting faces of the teeth of a wheel are epicycloids whose generating circle has a radius equal to half the radius of the pinion, and a base of the same radius as the wheel, and if the acting faces of the leaves of the pinion are straight lines directed to the centre of the pinion, — the motion of the wheel and pinion will be uniform

Case 4 — If the teeth of a rack drive a pinion, then, when the acting faces of the teeth of the rack are cycloids whose generating circle has the same radius as the pinion, and when their teeth drive the pinion by acting upon infinitely small pins placed in its circumference, the motion of both will be uniform

Case 5 — If the acting faces of the teeth of the rack are cycloids whose generating circle has a radius equal to half the radius of the wheel, and if they drive the wheel by acting upon rectilinear teeth which are a continuation of the radii, — the motion of both will be uniform

Case 6 — When the teeth of a wheel driving a rack have their acting faces formed of the involutes of a circle having the same radius as the pinion, and drive the rack by acting upon infinitely small pins fixed in its rectilinear edge the motion will be uniform

For detailed information connected with this subject, the reader may be referred to the following works — Camus *On the Teeth of Wheels*, *Buchanan's Treatise on Mill Work*, by Rennie Airy, *On the Teeth of Wheels* (Cambridge *Phil Trans* vol ii), and particularly to *Willis's Principles of Mechanism* 1841 See WHEEL

TEGMENTA (Lat tego *I cover*) In Botany, the scales covering the leaf buds of the deciduous trees of cold climates

TEGUMENT or TEGMEN In Anatomy, the general covering of the body In Entomology, the term is applied to the coverings of the wings of the order *Orthoptera* or straight-winged insects

TEINDS In Scottish Law tithes By the course of various usurpations, the whole teinds of Scotland had become vested after the Reformation in the crown, or in private individuals, termed *titulars*, to whom they had been granted by the crown, or to the *feuars* or renters from the church By a succession of decrees and enactments these tithes were generally rendered redeemable at a fixed valuation and the clergy are provided for by stipends paid by the commissioners of tithes (when these are vested in the crown) or by the titular The minister can seek the increase of these stipends by process of augmentation and modification, and, if augmented, every heritor becomes liable in proportion to the amount of his teinds

TEINOSCOPE The name given by Sir David Brewster to an instrument otherwise called the *prism telescope*, formed by combining prisms in a particular manner, so that the chromatic aberration of the light is corrected, and the linear dimensions of objects seen through them increased or diminished

"If we take a prism, and hold its refracting edge downwards and horizontal so as to see through it one of the panes of glass in a window, there will be found a position, viz that in which the rays enter the prism and emerge from it at equal angles, when the square pane of glass is of the natural size If we turn the refracting edge towards the window, the pane will be extended or magnified in its length or vertical direction, while its breadth

remains the same If we now take the prism, and hold its refracting edge vertically we shall find, by the same process that the piece of glass is extended or magnified in breadth If two such prisms therefore are [illegible] in these positions so as to magnify the same [illegible] length and breadth, we have a telescope composed of two prisms, but unfortunately the objects are all highly fringed by the prismatic colours We may correct these colours in three ways —1st, We may make the prisms of a kind of glass which obstructs all the rays but those of [illegible] or we may use a piece of the same [illegible] ther rays when two common glass prisms are used 2d, We may use achromatic prisms in place of common prisms Or, 3d, what is best of all for common purposes, we may place other two prisms exactly similar in reverse positions" (*Brewster's Optics, Cabinet Cyc* p 363)

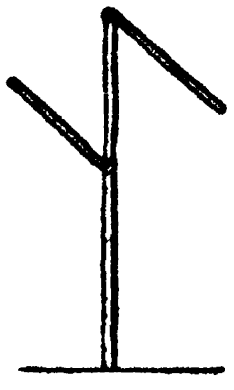
Professor Amici, of Modena, has recently constructed a combination of prisms of the same glass, in which the chromatic aberration is corrected, and a power of about three times obtained The plan is well suited for opera glasses Amici's telescope consists of four rectangular prisms having their refractive angles different and connected by pairs, the two pairs being similar those next the eye or the first pair are vertical, and the second pair horizontal, so that equal refraction is produced in every direction The distance between each pair is about an inch and a half (*Library of Useful Knowledge*, "Optical Instruments," p 55) Sir D Brewster (*Optics*, p 364) states that this instrument had been made by Dr Blair as well as by himself, before it was proposed or executed by Amici

TELAMO'NES (Gr τλαω, *I bear up*) In Architecture, figures of men used for supporting entablatures similar to Caryatides see that word

TE'LEGRAPH (Gr τηλε, *afar off*, and γραφω, *I write*) The name given to a mechanical contrivance for the rapid communication of intelligence by signals Of late years, the term *semaphore* (Gr σημα, *sign*, φερω *I bear*) has been introduced by the French, and frequently adopted by English writers

Although the art of conveying intelligence by signals was practised in the earliest ages and is known even to the rudest savages [illegible] only observed [illegible] established it has been [illegible] state of imperfection down almost to our times The first description of a telegraph universally applicable was given by Dr Hooke, in the *Philosophical Transactions* for 1684 The method which he proposed for it was not carried into practice consisted in preparing as many differently shaped figures, formed of deal —for example, squares, triangles circles, &c —as there are letters in the alphabet and exhibiting them successively, in the required order, from behind a screen, and he proposed that torches or other lights, combined in different arrangements, should supply their place by night About twenty years later, Amontons exhibited some experiments before the royal family of France and the members of the Academy of Sciences by which the practicability of the art was demonstrated But although both the proposal of Hooke and the experiments of Amontons were made public, telegraphic communication was not applied to any useful purpose until 1794 when the plan was adopted for conveying intelligence to the French armies The first telegraph actually used was the invention of Chappe It consisted of a beam which turned on a pivot in the top of an upright post, having a moveable arm at each of its extremities, and each different position in which the beam and its two arms could be placed at angles of 45° afforded a separate signal, which might represent a letter of the alphabet, or have any other signification that might be agreed upon In the following year 1795 several plans were submitted to the English admiralty, of which one, proposed by Lord George Murray was adopted, and continued to be made use of down to the year 1816 It consisted of six shutters, arranged in two frames which being opened and shut according to all the different combinations which can be formed, afforded the means of giving sixty-three separate and distinct signals In 1803, the French erected *semaphores* along their whole line of coast, formed of an upright post, carrying two, or sometimes three beams of wood each turning on its own pivot one above the other In 1807, Captain (now General) Pasley, of the Royal Engineers, published a *Plan for making Telegraphic Signals* by having beams turning on the same pivot, and, in order to obtain a sufficient number of different signals, he proposed to erect two or three posts at each station In 1816 Sir Home Popham considerably simplified this construction His telegraph, which was

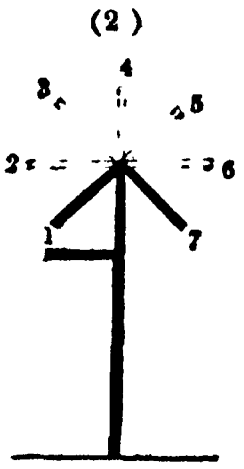
(1)



adopted in that year by the Admiralty instead of the shutter telegraph, and has continued in use ever since, consists of merely two arms, moveable on different pivots on the same mast, as represented in the annexed figure (1) It is capable of giving forty-eight [illegible] nals Lastly in 1822, General Pasley [illegible] plified the construction, by placing the two arms on the same axis As this form of the instrument appears to be the most perfect at present in use, we shall give a few details repecting its construction, and the mode of using it

For day signals, the telegraph consists of an upright post of sufficient height, with [illegible] same pivot on the top of it, and a [illegible] *indicator*, or one side, as in the annexed [illegible] (2) Each arm can [illegible] positions, 1, 2, 3, 4, 5, 6 7, besides the position called the *stop*, which points vertically downwards, and is hid by the post In order to show the number of signals that may be made with this machine, we may suppose the arm on the left hand [illegible] indicator reckoning in the order of the numbers as shown in the figure to denote tens, and the other arm [illegible] the signal represented in the figure would be 17, which may be taken to denote a letter of the alphabet If the arm on the left had the position indicated by 3 and that on the right the position indicated by 6 the signal would be 36 In this manner, the number of separate and independent signals, with their signification, will be as in the following table —

(2)




| No of Signal | Signification | No of Signal | Signification | No of Signal | Signification |
|---|---|---|---|---|---|
| 1 | A | 15 | L | 36 | V |
| 2 | B | 16 | M | 37 | W |
| 3 | C | 17 | N | 45 | X |
| 4 | D | 23 | O | 46 | Y |
| 5 | E | 24 | P | 47 | Z |
| 6 | F | 25 | Qu | 56 | |
| 7 | G | 26 | R | 57 | |
| 12 | H | 27 | S | 67 | |
| 13 | I | 34 | T | | |
| 14 | K | 35 | U | | |

There are thus, as already stated, 28 independent signals, which are more than sufficient for spelling any message, though not enough for indicating both the letters of the alphabet and also the numeral digits, and it may be remarked that No 4 is a bad signal, when used by itself, because it appears in the telescope as a prolongation of the post Advantage may, however, be taken of the indicator, if made moveable, to increase the number of combinations

The use of the indicator is to show the order or direction in which the signals are to be reckoned, that is, whether from right to left or from left to right This is indispensable at sea, or wherever it is required to convey intelligence in different directions at the same time

In order to adapt the telegraph to the purpose of making night signals a lantern called the central light, is fixed to the pivot on which the arms move, and one is also attached to the extremity of each arm A fourth lantern, used as an indicator is fixed in the same horizontal line with the central light, at a distance from it equal to twice the length of one arm, and as nearly as may be in the plane in which the lights revolve

The arms and the indicator are made of wood, framed and panelled for the sake of lightness The arms are fixed one on each side of the post, and counterpoised by [illegible] of light frames of iron work, which at a little [illegible] are invisible The precaution of counterpoising is necessary, as the arms would not otherwise remain in any given position unless held by the hand, or stopped by some mechanical contrivance, which would be attended with inconvenience Motion is communicated to the arms by means of an endless chain passing over two pulleys, one fixed to the arm itself, and turning on the same pivot, and the other on a pivot fixed to the lower part of the post, within the reach of the signalman The pulleys are of the same size, and worked with great care, so that the arms can be set with the greatest exactness, and the required positions are pointed out by a dial plate, the index of which is moved by a lever attached to the lower pulley

It is found from experience that the length of the arm should be about one foot for each mile of distance, and the width of the arm should be from one sixth to one eighth of its length The indicator should be of the same width, but only about four fifths of the length of the arm

Instead of employing the different telegraphic signals to represent the letters of the alphabet, each may have

a signification entirely arbitrary but settled by previous agreement, and thus a message may be communicated by a single sign When this plan is adopted, a much greater number of signals is required, but this is obtained by successively exhibiting two or more of the different single signs Thus, supposing the telegraph capable of exhibiting 20 independent signs, then by two successive changes 400 signals may be made, and [illegible] Every system of telegraphic [illegible] plan is of necessity accompanied with a telegraphic dictionary, containing the signification of the different combinations of signs Several works of this kind have been compiled One by Sir Home Popham, at present used in the English navy, contains about 13,000 words or sentences, which is probably more than is necessary for any practical purpose, though there are others much more extensive The Admiralty adheres to the safer, though somewhat less rapid practice, of spelling all the sentences

In the management of a fleet at sea, telegraphic communication is indispensable In the English navy, the signals are generally made by flags, though, from the difficulty of making out their figures and colours in calm weather, or when the wind blows in the direction in which the signal is to be communicated, the communication [illegible] be supposed would be made with greater certainty by means of the sun-glass

Various attempts have been made at different times particularly on the Continent, to supersede the optical telegraph, which is always useless in hazy weather, by applying the agency of electricity or galvanism to the [illegible] of intelligence An apparatus for accomplishing this purpose by means of galvanism has recently been contrived by Professor Wheatstone, of King's College, London, which, if experiments on a relatively small scale may be trusted to appears to be completely successful It has been adopted on some of the principal lines of railway in this country

TELLO'LOGY (Gr τελος, *an end*, and λογος *a discourse*) The doctrine of final causes is so called [illegible] existence of a Deity is deduced from the [illegible] apparent in the universe, which not only imply an intelligent Creator, but demonstrate at the same time his benevolence and other moral attributes When these are derived from material nature the argument is styled the *physico theological* The reader will find in *Whewell's Bridgewater Treatise* an explanation of Bacon's meaning in banishing final causes from the domain of physical science

TELEOSAUR, *Teleosaurus* (Gr τελειος *perfect*, [illegible] Saurian reptiles [illegible] Gr., [illegible] vertebræ [illegible] articulating surfaces [illegible] joints

TELESCOPE (Gr τηλε, *distant*, σκοπεω, *I look at*) An optical instrument for viewing distant objects

For several reasons a distant object is seen less distinctly than a similar near one The angle which an object subtends diminishes as the distance increases, the density of the light which renders it visible also diminishes with the distance, but in a much faster ratio, and a considerable portion of light is always lost in its passage through the atmosphere

It is found by experience that to be discernible at all in ordinary daylight, a detached object must subtend at the eye an angle of not less than 30″, and that the least angle under which [illegible] distinguished is about [illegible] By the aid of a telescope a magnified image of the object is formed, and within certain limits the object is not only enlarged, but rendered brighter than it appears to the unassisted eye

The invention of the telescope, to which practical astronomy is indebted for its most important discoveries, has been ascribed to various persons Sir David Brewster (*Encyc Brit*, art "Optics") says, "We have no doubt that this invaluable instrument was invented by Roger Bacon or Baptista Porta, in the form of an experiment, though it had not, perhaps, in their hands assumed the maturity of an instrument made for sale and applied to useful purposes, both terrestrial and celestial If a telescope is an instrument by means of which things at a distance can be seen better than by the naked eye, then Baptista Porta's concave lens was a real telescope, but if we give the name to a tube having a convex object-glass at one end, and a convex or concave lens at the other, placed at the distance of the sum or difference of their focal lengths, then we have no distinct evidence that such an instrument was used before the beginning of the 17th century Descartes ascribes the invention to James Metius [illegible] Alkmaer in Holland, Huygens to both [illegible] Zacharias Jansen, Borellus also to Jansen Professor Moll, who has discussed these rival claims, after examining the official papers preserved in the archives at the Hague, comes to the conclusion that Metius [illegible] was Jacob Adrianszy), on the 17th of October was in possession of the art of making telescopes, but that from some unexplained reason he concealed his invention, and thus gave up every claim to the honour he would have derived from it, that on the 21st of October in the same year 1608, John or Hans Lippersey a [illegible] maker of Middelburg was actually in possession of the [illegible] but there is little reason to believe that either Metius or Zacharias (or Jansen, father and son) were inventors of the telescope, though one of them invented a compound microscope about 1590 (*Journal of the Royal Institution*, vol i)

[illegible] its way into other countries In [illegible] the illustrious Galileo having heard [illegible] of the invention [illegible] the merchant who [illegible] and was soon in possession of a telescope which magnified three times In subsequent trials he succeeded in [illegible] countryman Harriot also, in 1609, began to use the telescope for examining the disc of the moon, and before he had heard of the discoveries of Galileo (*Priestly's History of Discoveries relating to Vision, Light, and Colours*)

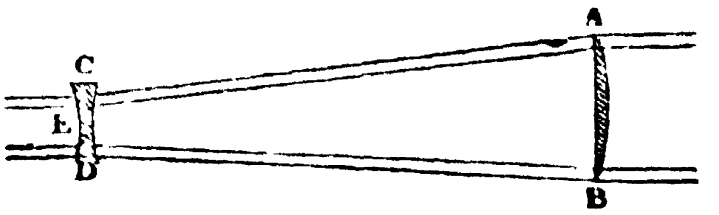
Telescopes are of two kinds, *refracting* and *reflecting* telescopes the former depending on the use of properly figured lenses, through which the rays of light pass, and the latter on the use of specula, or polished metallic mirrors, which reflect the rays, an inverted image of the object being formed in both cases in the focus of the lens or mirror

Refracting telescopes were those which were first constructed They were of the most simple character, consisting merely of an object glass of one lens, and an eye-glass of one lens, but of a shorter focus But in this construction the prismatic colours produced by the difference of refrangibility of the luminous rays tinged the images of all objects seen through the telescope, and the image was likewise distorted by the aberration of the extreme rays It was soon found that the latter defect could be sufficiently corrected by employing more lenses than one in the eye piece, but it was long before a remedy was found for the chromatic dispersion, and artists despairing of success generally turned their attention to the improvement of instruments of the reflecting class The difficulty, however, was at length overcome through the persevering efforts of John Dollond (*see* ACHROMATISM), and the *achromatic refracting telescope* may now be [illegible] instrument all but perfect

[illegible] on which telescopes depend having been explained under the terms REFLEXION and REFRACTION, and the properties and construction of their principal parts under ACHROMATISM LENS, MIRROR, we shall here describe some of the principal forms which the instrument has assumed It will be borne in mind that the general aim in the construction of a telescope is to form, by means of lenses or mirrors, as large, bright, and distinct an image of a distant object as possible, and then to view the image with a magnifying glass in any convenient manner We shall first describe those of the refracting class

*Galilean Telescope* — This is the most ancient form of the telescope and is that which was used by Galileo It consists of a convex converging object-glass A B (fig 1),

(1)



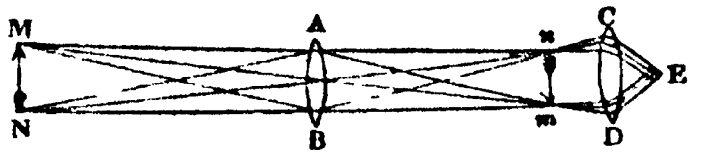

and a concave diverging eye glass C D On passing through the object-glass A B, the rays of light coming from the different points of a distant object in sensibly parallel pencils are rendered convergent, and proceed towards the principal focus where they would form an inverted image, but before they arrive at this point they fall upon the concave lens C D, by which they are again rendered parallel, or at least their convergence is corrected so as to give distinct vision of the object to the eye at E The lens C D is therefore placed between the object glass and the image and at a distance from the image equal to its principal focal distance The magnifying power is equal to the focal length of the object-glass divided by the focal length of the eye-glass. *See* LENS

In this telescope the object is seen erect and the length of the tube is only equal to the [illegible] between the [illegible] of the two lenses These properties render it preferable to any other telescope for many ordinary purposes, as, for example an *opera glass* When used for this purpose, the magnifying power is hardly ever greater than 4, and it is often as low as 2

*Astronomical Telescope* — This is composed of a convex object glass A B (fig 2), and of a converging eye glass C D Rays of light proceeding from any point

M of a distant object M N, and falling on the different points of the object-glass, are refracted into a point *m* in

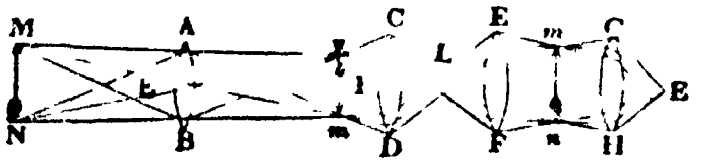
(2.)




the principal focus In like manner, those proceeding from the point N are refracted into the point *n*, and thus an inverted image *m n* is formed at the focus of the object-glass The eye-glass is placed so that its focus shall coincide with the place of the image, consequently rays diverging from any point of the image [illegible] lens C D, are refracted into a parallel direction [illegible] they enter the eye at E, and are thereby rendered fit to produce distinct vision The length of the telescope is equal to the sum of the focal distances of the two lenses, and the magnifying power is equal to the focal distance of the object-glass divided by the focal distance of the eye glass This telescope was first described by Kepler in his *Dioptrice* (1611), but it does not appear to have been executed until about twenty or thirty years later

*Terrestrial Telescope* — This differs from the astronomical telescope only in having two additional lenses F F, G H (fig 3), placed in the tube of the eye-glass for the purpose of restoring the inverted image to its erect position, and [illegible] trial object [illegible] are usually the same as [illegible] pencils of rays proceeding from the points M and N cross each other in the anterior focus of the second lens E F, and falling parallel on F F form in its principal focus an inverted image of *m n*, and consequently an erect image of the object M N This image *m' n'* is seen by the eye at F through the lens G H as the rays diverging from *m'* and *n'* in the focus of G H enter the eye in parallel pencils When the three first lenses are equal the magnifying power is the same as that of the astronomical telescope whose object and eye glasses are the same as A B and C D

(3)

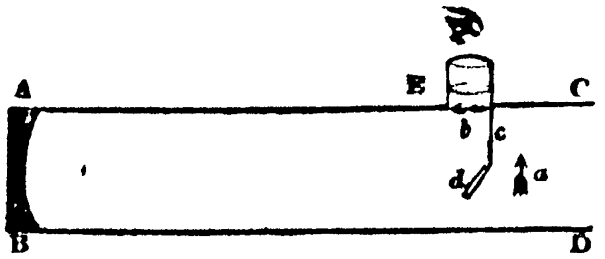



The performance of refracting telescopes depends most essentially on the goodness of the object glass, for if the first image is bright and distinct, and perfectly achromatic, there is little difficulty in constructing eye pieces to magnify it, without causing it to undergo any sensible alteration

*Reflecting Telescopes* — In reflecting telescopes the speculum, or mirror performs the same office that the object-glass does in those of the refracting kind and is therefore called the *object mirror* The instrument is constructed in various forms, but these differ from one another chiefly in reference to the contrivances which have been adopted for bringing the focal image into a convenient situation for being viewed by the eye piece The principal forms are the Newtonian, the Gregorian, the Cassegrainian, and the Herschelian

*Newtonian Telescope* —Let A B C D (fig 4) represent

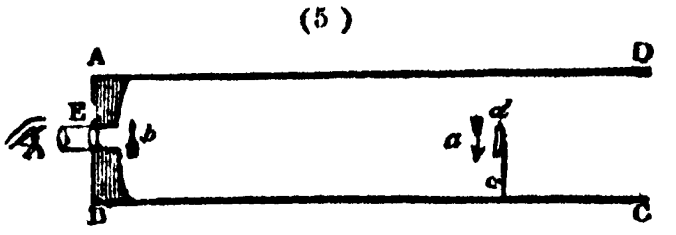
(4)




a section of the tube of the telescope A B a section of the object-mirror, which would form at its focus the image *a* of any distant object Now if a person attempted to view the image in its place at *a* by placing himself directly before the mirror, he would necessarily intercept the rays of light from [illegible] n the tube to the mirror, and [illegible] be no image to view Sir Isaac Newton overcame this difficulty by introducing a small diagonal plane speculum *d* between A B and *a*, which intercepting itself but a small portion of the light, reflects towards the side of the tube the rays converging from A B and causes the image which would have been formed at *a* to be formed at *b* where it can [illegible] viewed by the eye piece F attached to the [illegible] The [illegible] mirror is of an oval form, and is fixed on a slender arm *e* connected with a slide, by means of which it may be made to approach or recede from the large speculum A B, according as the [illegible] recede from it In this telescope [illegible] equal to the focal length of the object-mirror A B divided by that of the eye-glass

*Gregorian Telescope* — In this construction the object-mirror A B, fig 5, is perforated in the middle, and the

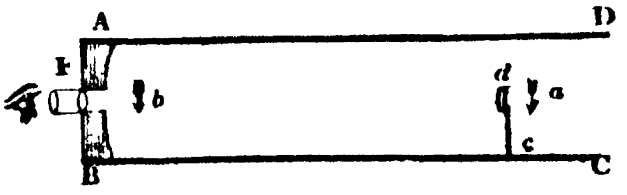
(5)




rays of light from a distant object being reflected from the surface of A B cross each other in the focus, where they form an inverted image *a*, and are then intercepted by a small convex mirror *d* which causes them again to converge to a focus at *b*, near the perforation of the object-mirror, where they form a reinverted or direct image, which is viewed by an eye piece E screwed into the tube behind A B The curvature of the small speculum should be elliptical, having the foci at *a* and *b*, but it [illegible] spherical In this case the great speculum should be slightly hyperbolic, to counteract the aberration of the small mirror

*Cassegrainian Telescope* — The great speculum of this instrument is perforated like the Gregorian, but the rays converging from the surface of the mirror A B (fig 6)

(6)

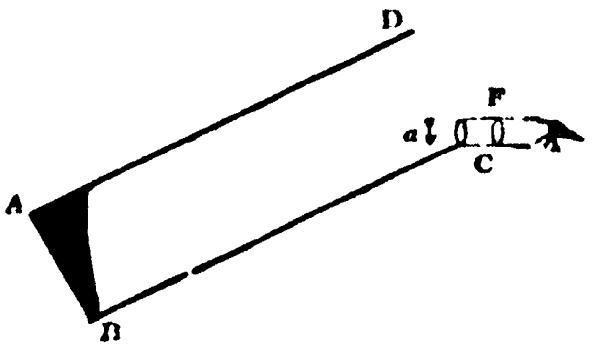



towards the focus *a* are intercepted before they reach that point by a small convex mirror *d*, not sufficiently convex to make the rays divergent, but of such a curvature as to prevent them from coming to a focus till they are thrown back to *b* near the aperture in A B, where they form an inverted image which is viewed by the eye piece F This construction has the advantage of requiring a shorter tube than the Gregorian, but the inversion of the image is not corrected and for this reason probably it has not been much used

In the two last constructions the small mirror *d* is adjusted by means of a rod turning on a shoulder near the eye end of the tube, and connected by a screw with the apparatus which carries the arm *c* to which the mirror is attached

*Herschelian Telescope* — This construction differs from the others in having no second mirror, and thus preventing loss of light by a second reflexion The large speculum A B (fig 7) is placed at the bottom of the

(7)




tube in an inclined position, so as to bring the focal image *a* near the edge of the tube, where it is viewed directly by the eye-piece F without interfering with the light entering the telescope from the object observed, but the image is a little injured by the oblique reflexion The magnifying power is the same as in the Newtonian

The reflecting telescope was invented by James Gregory, and is described by him in his *Optica Promota* (1663), but the first telescope of the kind was executed by Newton The celebrated instrument of Sir William Herschel, erected at Slough in 1789, was 40 feet in length. Its great speculum had a diameter of 49½ inches its thickness was about 3¼ inches, and its weight when cast was 2118 lbs Its focal length was 40 feet, and it admitted of a power of 6450 [illegible] it The essential advantage of large [illegible] kind con- [illegible] the [illegible] of light which they collect, [illegible] to perceive faint nebulæ and stars which are altogether invisible in ordinary instruments (For description of Lord Rosse's telescope, *see* SUPPLEMENT)

Reflecting telescopes are used only for observing *phenomena* In order to derive full benefit from them, they

must be used in the open air and must either be mounted equatorially (*see* EQUATORIAL) or else in such a manner as to be capable [illegible] th in a vertical and horizontal [illegible] this kind being generally used with a high magnifying power, and consequently having a small field of view, are always accompanied with a smaller telescope or *finder* fixed to the tube, so that the axes of the two instruments are exactly parallel

*Eye-pieces of Telescopes* — When the image formed by the object-glass or mirror is viewed with a single lens or eye-glass, whether concave or convex, it is only in the centre of the field that distinct vision is obtained, all towards the margin being hazy and distorted To remedy this defect, Boscovich and Huygens separately proposed the construction of an eye-piece formed of two lenses, placed at a distance from each other equal to half their focal length Boscovich recommended two similar lenses, Huygens that the focal length of the one should be twice that of the other and as this construction is found to answer best in practice, it is that which is most commonly used.

The two lenses are usually plano-convex, with the convex faces towards the object glass the larger lens, called the field glass, is innermost, or nearest the object-glass and a diaphragm cutting off the marginal rays is usually placed between them near the focus of the eye-lens, where the image is formed This eye piece is usually called the *negative* eye-piece, from its having the image seen by the eye behind the field-glass, and is that which is commonly supplied with telescopes intended only for the purpose of *seeing* objects, without reference to measurement

Another modification of the two lens eye-piece was proposed by Ramsden and is called the *positive* eye-piece, because the image observed is before both lenses The lenses are plano-convex, and nearly of the same focal length, but their distance from each other is less than the focal distance of the lens nearest the eye, two lenses thus placed acting as a compound simple lens This eye-piece is the most convenient when micrometer wires are placed in the focus, because it can be taken out without injuring the wires, and it has also this advantage, that the measure of an object given by one eye piece is not altered when it is changed for another of a different magnifying power

In both the eye pieces now described the image is seen inverted, and though this is of no importance in astronomical observations, it is inconvenient when the telescope is used for looking at terrestrial objects By placing an additional pair of lenses in the tube of the eye piece, the image is repeated and reinverted, and consequently seen erect By this means as explained above, the terrestrial telescope is obtained

The name of *diagonal eye piece* has been given to eye-pieces furnished with a diagonal reflecting mirror the object of which is to give a more convenient direction to the rays emerging from the eye piece when the telescope is pointed high

Telescopes are generally supplied with eye-pieces of different powers, which are all fitted to enter the same tube, and the focal adjustment is commonly effected by a rack and pinion motion acting on the tube which carries the eye piece

For full information respecting the construction of telescopes, and the best modes of mounting them, to secure steadiness and allow of the requisite motion, the reader is referred to *Pearson's Practical Astronomy*, vol ii (See also *Coddington's Optics*, and SUPPLEMENT for description of the largest refracting telescopes now in use)

TELLINA (Gr τελλίνη *a species of muscle*) A genus of cockles (Cardiaceous Bivalves in the Cuvierian system), characterized by the hinge of the shell having one tooth on the left and two teeth on the right valve, often bifid, in the right valve there is a plate which does not enter a cavity in the opposite valve There is a slight fold near the posterior extremity of both valves which renders them unequal at that part, where they gape a little The soft parts, or animal of the *Tellina*, called *peronæa* by Poli, has two long tubes for respiration and excretion, which can be withdrawn into the shell, and are concealed in a fold of the mantle

Cuvier separated from the Linnæan *Tellinæ* the genus *Loripes*, distinguished by the feebly developed cardinal teeth, and by a long cylindrical foot Other genera have since been detached from the Cuvierian *Tellinæ*, which now form a family *Tellinidæ*, in the system of Lamarck

TELL TALE The dial plate at the wheel, showing the position of the tiller

TELLURIUM (Lat tellus *the earth*) This rare metal has only been found in small quantities in the gold mines of Transylvania it occurs in the metallic state, combined with gold or silver It is white, brilliant, brittle, and easily fusible Its specific gravity is about 6 25 It is combustible, and often exhales a peculiar odour, like horse-radish, which Berzelius ascribes to the presence of minute portions of selenium It forms a protoxide and a peroxide, often called *tellurous* and *telluric acids* Its equivalent is either 32 or 64 In the former case, the protoxide consists of 1 atom of tellurium and 1 of oxygen (32 + 8), and the peroxide of 1 atom of tellurium and 1½ of oxygen (32 + 12), in the latter the numbers are doubled Tellurium forms a gaseous compound with hydrogen which has been called *hydrotelluric acid*

TEMPERAMENT (Lat temperare, *to moderate*) In Music, the adjustment of the imperfect concords, in musical instruments whose sounds are fixed, such as organs, piano-fortes, &c, so as to transfer to them part of the beauty of the perfect concords The defect to be remedied arises from the single short keys between the two larger ones serving for flats as well as sharps It is necessary to observe, that in the theory of harmonies the interval of a tone is not always the same, for instance, that lying between the fourth and fifth of the scale contains nine small parts, called commas, whereas that between the fifth and sixth of the major scale contains only eight commas Again, the diatonic semitone contains five commas, and the chromatic semitone three or four, according to the magnitude of the tone Hence it is that the different situation of these elements with regard to each other, causes intervals of the same names to consist of different degrees or elements To improve them, therefore, musicians *temper* them so as to reduce the whole more to mean distances from each other, necessarily producing a new division of the octave

TEMPERAMENT, in Physiology, has been defined as that peculiarity of organization which to a certain extent influences our thoughts and actions The ancient physicians enumerated four temperaments, namely, the bilious, the choleric, the phlegmatic he sanguine the melancholic To these some have added the nervous, and these terms are still in use among medical writers

TEMPERATE ZONES, in Geography, are two of the five zones into which the terrestrial globe is divided The *north temperate zone* is included between the tropic of Cancer and the arctic circle, and the *south temperate zone* between the tropic of Capricorn and the antarctic circle

TEMPERATURE A definite degree of sensible heat, as measured by the thermometer

TEMPLARS or KNIGHTS OF THE TEMPLE, A military order of religious persons It was founded by an association of knights, in the beginning of the 12th century, for the protection of pilgrims on the roads in Palestine afterwards it took for its chief object the protection of the Holy Sepulchre at Jerusalem against the Saracens Knights were fixed at Jerusalem by King Baldwin II [illegible] of the Temple [illegible] monks [illegible] poverty The classes of the [illegible] servitors, and chaplains, [illegible] was a girdle of linen thread The officers of the order were chosen by the chapter from among the knights they were, for military affairs, marshals and bannerets, for purposes of government, priors who superintended single priories or preceptories, abbots, commanders, and grand priors, who governed the possessions of the order within separate provinces, and the grand master, who, in some respects, assumed the dignity of a sovereign prince, being independent in secular matters, and depending solely on the pope in spiritual The chief part of the 9000 estates, lordships, &c which the society possessed in the 13th century was situated in France, and the grand master was usually of that nation The Templars were driven from Palestine by the Saracens, with the rest of the Christians and then fixed the chief seat of their order in Cyprus Their exorbitant power and wealth and the haughty manner in which they endeavoured to keep aloof from the control of European sovereigns, and act as a military republic independent of their authority, were probably the principal reasons which induced Pope Clement V and Philip the Fair of France to concert their overthrow The charges of heresy and idolatry, which were preferred against them, were at least unsupported by evidence In 1307, Jacques de Molay, the grand master having been enticed into France, was arrested by Philip, the Templars' estates were seized, many of them burnt alive after the mockery of a trial, and in 1312, the order was abolished by a bull of Clement V Its vast estates fell partly into the hands of the sovereigns of the countries in which they were situated partly into those of the Hospitallers and other military orders Detached bodies of the order, however, continued to subsist for some time in different countries See among numerous authorities, Raynouard's tragedy of *Les Templiers*, with the notes, *Turner's England in the Middle Ages*, vol ii, *Mem. de l'Ac des Inscr* vol xxxvii, *Addison's History of the Knights Templars and the Temple Church*, 1842 For a notice of the [illegible] doctrines attributed to them, see the [illegible] Baphomet

TEMPLE A building dedicated to the service o

some deity D ver [illegible] Gr τέμενος, [illegible] The term is [illegible] edinces, excepting in the [illegible] for the worship of God by Solomon at Jerusalem, which is emphatically denominated *the Temple* This edifice was similar in its plan to the Tabernacle, consisting of the holy of holies, the sanctuary, and a portico It is minutely described in 1 Kings vi

The Temple of Solomon was begun B C 1012, and destroyed by Nebuchadnezzar B C 586 It was rebuilt after the return of the Jews [illegible] period of nearly 500 years repaired and beautified by Herod the Great The restoration contemplated by this prince must have been extensive When the Jews said to Christ, "Forty years was this temple in building" they are generally supposed to allude to [illegible] repairs had been in progress, [illegible] were they brought to a completion when the temple itself, together with the entire city, were demolished by the army of Titus, A D 70

The structure to which this term is applied is of comparatively modern date for the earliest temples were an open spot with a rude altar of earth and stones, indeed, the Persian religion forbade the worship of the Deity except in the open air, and the earliest Greek temples give us some notion of the same sort of practice The oracle at Delphi, according to Pausanias, was merely an arbour of laurels, and from Herodotus we learn that the oracles at Dodona were delivered from an old oak The re- [illegible] lumns, the cell being always of diminutive size In Greece, at the period when they had advanced in art, every city exhibited structures of the most elaborate and splendid description dedicated to the service of their divinities, and the Romans long after emulated their masters in the care and riches bestowed upon these edifices Some of the most celebrated were those of the Parthenon (to Minerva) at Athens of Diana at Ephesus, of Apollo at Delphi, of Jupiter at Olympia, of Venus at Paphos and Cythera and that of the Capitoline Jupiter at Rome Asia Minor abounded with them, and in the other direction we find them as far west as Nismes Vitruvius has classed temples under seven heads, viz those *in antis*, the *prostyle*, the *amphiprostyle*, the *peripteral*, the *dipteral* the *pseudodipteral*, and the *hypæthral*, all of which are defined under these names in this work

TE'MPLET (Etym doubtful) In Architecture a short piece of timber laid under a girder or beam to distribute the weight Also a mould used by bricklayers for cutting or setting out work, and by millwrights for shaping the teeth of wheels

TE'MPO (It *time*) In Music, the Italian word constantly used to express time

TE'MPO D'IMBROGLIO (It *time of trouble*) In Music, a term applied to a composition written in one measure, but really performed in another

TE'MPORAL or TEMPLE BONES Two irregular bones one on each side of the head They are connected with the occipital, parietal, and sphenoid bones and are articulated with the lower jaw Comparative anatomy shows that the so called 'temporal bone,' in man, is essentially an assemblage of five bones, called squamous, zygomatic, tympanic, petrous, and mastoid, having distinct functions developed in different proportions and continuing permanently detached in the cold-blooded classes, but soon coalescing in the warm-blooded classes The tympanic element, however, continues perman [illegible] is

TENACITY OF THE METALS The power which metallic wires possess of sustaining, without breaking, the action of a suspended weight *See* COHESION, STRENGTH OF MATERIALS

TENA'CULUM A surgical instrument consisting of a fine sharp pointed hook [illegible] ing arteries are seized and drawn out, so that in operations they may be secured by ligaments

TENAILLON In Fortification, a kind of outwork made on each side of a small ravelin to increase its strength, and to cover the shoulders of the bastion Works of this kind are, however, so decidedly inferior to large ravelins that they are seldom adopted

TENANT, TENEMENT In Law These words are derived from the principles of the feudal system, according to which (as it prevailed in England) no land was without a lord, and every one who enjoyed land *held* it either of a mesne tenant, or of the crown The party holding the land is called *tenant*, the thing holden *tenement*, the mode of holding *tenure* Thus tenants are said to be in fee-simple, in tail, for life, for years, &c Tenement, in the largest sense of the word is every thing which may be holden, viz all corporeal hereditaments, and incorporeal hereditaments of a permanent nature issuing out of the same Thus lands, houses, rights of common, &c, franchises, offices, are all tenements in the larger sense In the more narrow acceptation in which the word is popularly applied, it describes a house with the homestall or immediate appurtenances

TENCH The name of a species of Cyprinoid fishes (*Tinca vulgaris*, Cuv) and the type of a subgenus of the family It is generally more or less abundant in ornamental waters and ponds, but is seldom found in rivers in this country It is common in most of the lakes of the European continent, whence it is supposed to have been imported into England The tench is remarkable for its tenacity of life, it spawns about the middle of June at which time the female is attended by two males Their food consists of the smaller soft-bodied aquatic animals, and vegetable matter In stocking a pond with tench, the large-sized fish should be selected, and two males to one female should be the proportion of the sexes See CYPRINIDÆ

TENDER In Law, the legal tender of a debt is by the actual production and offer of the sum due, unless [illegible] with it by a declaration that he will [illegible] The tender must be of money if beyond the sum of 40*s*, in gold, or in what has been rendered by act of parliament equivalent for that purpose, viz Bank of England notes, which are a legal tender for every sum above £5, except at the Bank [illegible] and its branches A tender of country bank notes, if not objected to on that ground, is sufficient The tender of a larger sum than that due is legal unless it be of a sum requiring change

TENDO ACHILLIS [illegible] from the muscles of [illegible] name has reference to the [illegible] in the Styx, his mother, [illegible] him by that part

TENDRIL, is any slender twining part by which one plant attaches itself to another It is often a transformation of a leaf which has no lamina, or which has the midrib elongated beyond it, retaining its usual tapering figure, and becoming long and twisted spirally In the vine it is an abortive bunch of flowers, in the passion flower, a metamorphosed branch, in some petals a thin extended point, as in *Strophanthus*

TENESMUS (Gr τείνω, *I stretch or constringe*) A straining and ineffectual inclination to void the contents of the bowels

TENNANTITE A mineral named in honour of the late Mr Tennant It is an arsenical sulphuret of copper and iron It occurs in the copper veins of some of the Cornish mines, both massive and crystallized

TENON (Lat teneo, *I hold*) In Architecture, the end of a piece of wood or timber, diminished usually by one third of its thickness, which is received into a hole [illegible] in size called a mortise by which exposed [illegible] are held jointed or fastened together

TENOR, or TENOR (It) In Music, the mean or middle part of a composition being the ordinary compass of the human voice when neither raised to a treble or lowered to a bass What is called counter-tenor is only [illegible]

TENREC The name of a small Insectivorous quadruped of Madagascar allied to the hedgehog it forms the type of the genus *Centetes*

TENSE (Lat tempus, *time*) In Grammar, that modification of the verb which defines the time at which the action is conceived as taking place *See* GRAMMAR

TENSOR MUSCLES, in Anatomy are those which tighten the part to which they are fixed, as the tensor vaginæ femoris tensor palati, &c

TENT, *Tinta* A Spanish red wine, chiefly from Malaga and Gallicia

TENT, in Surgery is a plug of lint used for dilating wounds a piece of sponge which has been imbued with [illegible] *tent*

TENTACLE (Lat tentaculum, *a holder*) This term is used by Savigny in a restricted sense to signify [illegible] whether jointed or not, which are used as instruments of exploration and prehension Thus the oral arms of the Polyps, the prehensile processes of Cirripeds and Annellides, the cephalic feet of the Cephalopods, the barbs of fishes, are termed tentacles

TENTH In Music, an interval containing nine degrees and five spaces

TENTHS The tenth part of the yearly value of all benefices, which was anciently paid, with the first fruits, to the pope *See* FIRST FRUITS

TENTORIUM The process of the *dura mater* which [illegible] the cerebrum from the cerebellum

TENUES (Lat *thin*, Gr ψιλαί) The three letters *k*, *p*, *t* in the Greek alphabet are so called, in relation to their respective middle letters *g*, *b*, and *d*, and [illegible]

TENUIROSTERS *Insessores* (Lat tenuis, *slender*, and rostrum, *a beak*) The name of a tribe of Insessorial birds, including those which have a long and slender bill

TENURE The feudal relation between lord and vassal in respect of lands Tenures in capite, or in chief,

were those by which land was held immediately of the crown, mesne tenures, of mesne or inferior lords English tenures under the feudal system are reduced by Blackstone to four knight-service, or chivalry, free socage, pure villenage, and villein-socage *See* FEUDAL SYSTEM, SOCAGE, VILLENAGE

TENURES, SCOTTISH, were five viz 1 Military, or *ward-holding*, abolished, with all its *casualties* or incidents, by 20 G 2 c 50 2 By *mortification*, or *mortmain*, which now only applies to manses and glebes, retained by the act of 1587 as mortified to the church 3 *Burgage holding*, by which the burgesses of royal burghs hold lands and houses within the burgh of the sovereign by service of watching and warding &c 4 *Blanch tenure* by which the grantee or vassal is bound to pay to the superior annually a species of quit rent or [illegible] 5 *Feu-holding* by grant, with reserva[illegible] services *See* FEU

TEPHROMANTIA (Gr τεφρα, *ashes* and μαντεια, *prophecy*) Divination [illegible] by redhot embers [illegible]

TERAPHIM A word used thirteen or fourteen times in the Old Testament, and commonly rendered by our translators "idols" Bryant explains them as "lunar amulets or types of the ark in the form of crescents supposed to have been invented by the patriarch Terah" (*Antiq* iii 321) In later times strange and horrible practices of witchcraft are described by Rabbinical writers in explaining this word The teraph, according to Rabbi Eliezer, was made by killing a first-born child, opening the head, putting a gold plate with the name of the impure spirit under the tongue, &c (See also the notes to *Southey's Thalaba*, book i)

TERATOLOGY (Gr τερας, *a monster*, and λογος, *a discourse*) That branch of physiological science which treats of the various malformations and monstrosities of the organic kingdoms of nature

TEREBELLUM (Lat terebro, *I bore*) The name of a genus of Buccinoid Pectinibranchiate Gastropods, having an oblong shell with a narrow aperture, destitute of folds and ridges and gradually enlarging to the extremity opposite to the spire

TEREBRANTIA (Lat terebro *I bore*) The name of a section of Hymenopterous insects, characterized by the possession of an anal instrument organized for the perforation of the bodies of animals or the substance of plants The borer (*terebra*) is peculiar to the female, and is composed of three long and slender pieces of which two serve as a sheath for the third, it is placed at the anal extremity of the abdomen and the oviduct is continued into it The females instinctively use this weapon to prepare a place for the deposition of their eggs, where the maggot may be incubated in safety, and upon its exclusion be surrounded by already organized matter adapted for its sustenance Some genera select vegetables for the parasitic support of their young as *Sirex* (Linn), which infests the pine tree, and *Cephus* (Latr) which perforates the stalks of corn for the purpose of oviposition Others as the ichneumons pierce the skins of insects and deposit their eggs in the subcutaneous fatty and nutrient material Some ichneumons are provided with long and extensible anal borers which they insinuate beneath the bark of trees, and into crevices and fissures, where their instinct and peculiar antennal organs of sensation teach them that the insect resides that may form a fitting nidus for the parasitic and carnivorous larvæ Other ichneumons with short terebra place their ova in the bodies of Lepidopterous larvæ or in those pupæ which are readily accessible to their attacks

The female ichneumons manifest a wonderful instinct at the season of oviposition in discovering the insects, as well mature as in their different stages of egg, maggot, caterpillar and chrysalis which are obnoxious to the wounds, with all the fatal consequences, of the instrument from which the present section of *Hymenoptera* takes its name

TEREBRATULA (Lat terebro, *I bore*) The name of a genus of Palliobranchiate Acephalous Bivalve Mollusks, in which one of the valves is perforated for the transmission of a peduncle the hole through which the peduncle passes is completed by a small detached calcareous piece

TEREDO (Lat teredo, *the ship-worm*) The name of a genus of Acephalous Mollusks which bore their habitations in submerged timber, and occasion destructive ravages in sunken piles, ships' bottoms, &c

TERGUM (Lat tergum, *the back*) in Entomology, [illegible] supine surface of the abdomen

TERM (Lat terminus *a boundary*), in Logic, is the expression in language of the notion obtained in an act of apprehension (*See* APPREHENSION) A term may consist of one word, or of several, but every word is not capable of being employed by itself as a term or, in logical language, *categorematic* Adverbs, prepositions, &c, and also nouns in any other case besides the nominative, are syncategorematic, i e can only form part of a term, while a verb is a mixed word, being resolvable into the copula (or auxiliary verb) and the term, to which the copula gives tense, mood, and position, but an infinitive mood is a term by itself Simple terms, or categorematics, are divided into *singular* and *common* A singular term stands for one individual as "Cæsar," "the king" [illegible] cannot be affirmed or denied [illegible] affirmatively or negatively) of any thing but themselves A common term stands for many individuals (which are called its significates), as "man," "king" These, it is evident, can be said (or predicated) of others, e g "Cæsar is a man," "[illegible] The subject of a proposition, therefore [illegible] may be either a singular or a common term, the predicate must be a common term Terms are said to be univocal, equivocal, analogous, &c, but these are rather distinctions of language than of logic They are also said to be "of the first intention" and "of the second intention," the [illegible] words used in a vague and general [illegible] words used in a limited and specific sense, which they bear in some particular art or science

TERMINALIA Annual festivals celebrated by the Romans in the month of February, in honour of Terminus, the god of boundaries On such occasions the peasants assembled at the different landmarks or *termini* that divided their property, and offered up libations of milk and wine *See* TERMINUS

The word *terminus* is now employed chiefly to designate the extreme points of a railroad

TERMINISTS In Ecclesiastical History, a name given to a class among the Calvinists, whose tenet it is (or was, for such opinions hardly exist at the present day), that there are persons to whom God has fixed, by a secret decree, a certain *term* before their death, after which he no longer wills their salvation, however long they may live They instanced the cases of Pharaoh, Saul and Judas among others

TERMINOLOGY (Lat terminus) In every science or art that preliminary knowledge which teaches us to define the words and phrases peculiarly employed in it (in other words, its technical terms) is called its terminology

TERMINTHUS A black pustule chiefly attacking the legs It is not, however clear what the disease was which the Greek writers describe under this name (*Med Dict*)

TERMINUS (Lat) In Ancient Architecture, a stone raised for the purpose of marking the boundary of a pro[illegible] or a [illegible] was the name of the god of boundaries among the Romans Terminus, in more recent times, is applied to the [illegible] to the first and last station of [illegible]

TERMITES (Lat termes, *the branch of a tree*) These insects constitute an extensive and important tribe of the Neuropterous order, confined to the warmer latitudes of the globe and performing a considerable share in the essential labour of completing the comminution and destruction of dead and decomposing organized matter The termites are all social, terrestrial, and are active carnivorous or omnivorous, in all the stages of their existence, save that of the ovum, after which they undergo only a semimetamorphosis The mandibles are always strong and hard but differ in relative size in dif[illegible] the same community [illegible] ides the genera *Mantispa*, *Raphidia Psocus*, *Perla*, and *Termes* proper (now the type also of a family, *Termitidæ*, as they are commonly called) [illegible] by four-jointed tarsi, but the wings are carried horizontally on the body, and very long the head rounded, and the prothorax short and square The body is depressed, with the antennæ short, the mouth very similar to that of the *Orthoptera*, with the four-cleft lower lip, three ocelli, one rather indistinct, the wings generally but slightly transparent, coloured, with the nervures not [illegible] and the legs short

The termites peculiar to the tropical and adjacent countries are known under the name of white ants, and commit most extraordinary ravages, especially in the larva state, in which they are called *workers*, these are like the perfect insect, but with the body softer, and without wings, and the head generally larger and destitute of eyes, or nearly so They are united into colonies of incalculable numbers, and live concealed in the interior of the earth, trees, and other wooden matters, such as furniture, shelves, &c, in which they form galleries, forming routes conducting to the centre of their nests, so that these objects, of which the outer surface is (with surprising instinct) left untouched, fall to pieces on the slightest touch The [illegible] of some species are external, but without any evident exit Sometimes they are elevated to a great height above the surface, like pyramids, occasionally surmounted by a solid roof, which,

[illegible] and number, appear at a distance like a [illegible] Sometimes these insects affix their nests to the branches of trees Another sort of individual, termed *neuters* or *soldiers*, and which Fabricius mistook for pupæ, defend the nest They have a head much larger and longer, and the mandibles are very long, and cross over each other They are far less numerous than the larvæ, and live near the outer surface of the nest, so that they make their appearance just when it is attacked they are also stated to compel the workers to labour The demi-nymphs have the rudiments of wings, and in other respects resemble the larvæ

When arrived at the perfect state the termites quit their habitation, fly abroad during the evening and night in great numbers they lose their wings before morning, which dry; [illegible] become the prey of birds, lizards, [illegible] collected by the larvæ, which inclose each of them in a large cell, but Latreille conjectures that the act of coupling takes place in the air, as in the ants, and that the females alone occupy the attention of the larvæ in order to the establishment of fresh colonies The abdomen of the female subsequently acquires an enormous size from the innumerable eggs which it contains The royal chamber occupies the centre of the habitation, and around it are distributed those which contain the eggs and provisions

Some larvæ of [illegible] to have habits somewhat approach our ants

Negroes and Hottentots are very fond of these insects

TERMS, in Law, are four sections of the year appropriated to the transaction of particular business in the superior courts of common law and equity They are now regulated by 11 G 4 and 1 W 4 c 70

*Hilary Term* begins the 11th, and ends the 31st of January

*Easter Term* begins 15th of April, and ends the 8th of May

*Trinity Term* begins 22d of May, and ends the 12th of June

*Michaelmas Term* begins the 2d, and ends the 25th of November

Whenever any one of these days falls on a Sunday the following Monday is substituted for it, and if the days from Thursday before to Wednesday after Easter Sunday inclusive, or any part of them fall within Easter term such days are regarded as holydays and the term is increased by an additional number of days at the end, and Trinity term proportionably postponed During term the three superior common law courts sit *in banc*, and all their business with the exception of the trial of issues in fact and such preliminary or other matters of minor importance as can be transacted before a judge at chambers, is performed The power of the courts has however been increased by a recent statute, enabling them to transact certain term business in vacation time The rest of the year is termed Vacation During the vacation one judge of each court sits at Nisi Prius for the trial of causes in London and Middlesex through the periods called Sittings, which are fixed by the same act to last not more than twenty-four days after Hilary Trinity and Michaelmas terms respectively nor more than six days after Easter term During the vacation also the circuits are held in which causes are tried and the gaols delivered in other parts of England and Wales

TERMS OF EQUATIONS, are the several parts of which they are composed connected by the signs of addition or subtraction Thus $2ax - bc$, has for its terms $2ax$ and $bc$ Generally all terms containing the same power of the unknown quantity are considered as one compound term, the coefficients, with their proper signs being connected with that power of the unknown quantity

TERPSICHORE (Gr τερπω, *I delight*, and χορος *a dance*) The muse who presided over dancing usually represented with a seven-stringed lyre or a plectrum in the hand and in the act of dancing

TERRACE (Fr terrasse) In Architecture a raised natural or artificial bank for the purpose of affording a promenade

TERRA COTTA, literally baked clay is the name given to statues architectural decorations figures vases &c, modelled or cast in a paste made of pipe or potter's clay and a fine-grained colourless sand from Ryegate with pulverized potsherds slowly dried in the air, and afterwards fi[illegible] hardness in a proper kiln

TERRÆ FILIUS In Classical Latinity a humorous designation of persons of low origin or obscure birth terræ filii, *sons of the earth* (See *Persius*, Satire 6) In the university of Oxford by an ancient custom, abolished [illegible] a Latin oration was read at the commencement annually by an undergraduate, who assumed the title of Terræ Filius and often indulged in considerable license in his treatment of the authorities of the place

TERRA JAPONICA The old pharmaceutical designation of the substance now called *catechu* It was formerly [illegible] earthy mineral

TERRA PONDEROSA The old mineralogic name of carbonate and sulphate of baryta

TERRA SIENNA A brown ochreous clay brought from Sienna, and sometimes used as a pigment

TERRE-PLEIN In Fortification, the horizontal surface of the rampart where the guns are placed and worked Its breadth may be from 24 to 40 feet, and it is bounded outside by the parapet and inside by the inner slope of the rampart *See* FORTIFICATION

TERRESTRIAL, *Terrestres* (Lat terra, *the earth*) The name of a section of the class *Aves*, comprehending the orders *Rasores* and *Cursores*, also of the family of Pulmonated Gastropods, and of a division of Isopodous Crustaceans

TERRE-VERTE Green earth A species of chlorite [illegible], found in Germany, France [illegible] According to Klaproth, it is a hydrated silicate of ox[illegible] little magnesia and alumina once used as a pigment

TERROR REIGN OF In the History of the French Revolution This term has been generally applied to the period during which the executions were most numerous and the country under the sway of the actual terror inspired by the ferocious measures of its governors, who had established it avowedly as the principle of their authority It seems to be most properly confined to the period between October, 1793 when the revolutionary tribunal although constituted at an earlier time, was first put in permanent action on the fall of the party of the Gironde, and the overthrow of Robespierre and his accomplices in Thermidor (July) 1794 The agents and partisans of the system have been termed Terrorists

TERTIALS, *Tertiariæ* (Lat tres *three*) These are the large feathers which take their rise from the proximal extremity of the bones of the wing, corresponding to those of the forearm near the elbow joint, forming a continuation of the secondaries They are so long in some birds of the snipe and lapwing kind, that when the bird is flying they give it the appearance of having four wings

TERTIAN FEVER An intermittent fever or ague the paroxysms of which return every other day *See* AGUE

TERTIARIES In Ecclesiastical History, a religious body a kind of associates of the Franciscans, who acknowledged the *third* rule of Saint Francis, and were connected with the Fraticelli and Beghardi of the 13th century (See *Mosheim* 13th cent part ii chap ii)

TERTIARY STRATA A series of sedimentary rocks which lie above the primary and secondary strata and are distinguished from them by their *organic remains* See GEOLOGY

TERTIUM QUID An obsolete chemical term formerly applied to neutral salts as being a third substance or *tertium quod*, resulting from the union of an acid and alkali

TERTULLIANISTS In Ecclesiastical History a branch of the African Montanists, so named from their father Tertullian, who embraced Montanist opinions (See *Burton's Lectures*, vol ii p 234)

TERUNCIUS A coin of ancient Rome, the same as the quadrans or triuncis being the 4th part of the *as* and consequently containing three ounces before the value was diminished

TERZA RIMA (*third or triple rhyme*) A peculiar and complicated system of versification borrowed by the early Italian poets from the Troubadours The verse are the ordinary Italian heroic lines of eleven syllables (interspersed very rarely with ten-syllable lines) The rhyme is thus arranged —At the commencement of a poem or portion of a poem verses 1 and 3 rhyme together, as do verses 2, 4 and 6, the third rhyme begins with verse 5 which rhymes to 7 and 9, the fourth is formed by 8, 10, and 12, and so on, and the poem or canto ends abruptly the last rhyme, like the first, being on a couplet instead of a triplet It is obvious that the rhyme is interlaced throughout and continually in suspense, so that no pause can be found until the end of the poem or canto, as at the end of every line, there must still be a rhyme incomplete This continuity gives a very peculiar character to the metre and renders it highly expressive of sustained narrative or passion, and the abruptness of the conclusion is often turned to good effect by masters of versification This metre has been rendered celebrated by Dante, who wrote in it his *Divina Commedia* It has been adopted by his imitators, of whom the latest, Vincenzo Monti, has used it to much advantage, and by Ariosto and other poets for their satires Byron has adopted it in English, with indifferent success, in his *Prophecy of Dante*, and it has been attempted by various translators

TERZETTO (It) In Music, a composition in three parts

TESSELATED PAVEMENT (Lat tessela, di-

min of tessera ) In ancient Architecture, a pavement [illegible] strata

TE'SSERA In Roman Antiquities, a die six-sided, like the modern dice, and thus to be distinguished from the talus, which had only three sides Tickets or tallies used for various purposes were called tesseræ Thus guards were set at night in their camps by means of a tessera with a particular inscription, given from one centurion to another through the army, and in this way the word tessera seems to have come to signify the watchword or password delivered to the guard (See *Mém de l'Acad des Inscr* vol xxxvii )

TESSERA In Architecture *See* TESSELATED PAVEMENT

TE'SSERACONTE'RIS (Gr τεσσερακοντα, *forty*, and ερετης, *I row* ) A galley with forty banks of oars, one of the largest of monstrous vessels mentioned by ancient writers Great doubts have been entertained as to the possibility of the construction of a vessel which, according to the received notions respecting classical shipbuilding, must have required about *four thousand* rowers, but it is seriously recorded that one was built for Ptolemy Philopater probably for purposes of show only *See* TRIREME GALLEY

TESSULAR A term applied in Crystallography to a system of crystals, including the cube, tetraedron, &c

TEST In Chemistry, any thing by which we distinguish the chemical nature of substances from each other thus infusion of galls is a *test* of the presence of iron, which it renders evident by the production of a black colour in water and other liquids containing that metal, in the same way sulphuretted hydrogen is a test of the presence of lead, and nitrate of baryta of sulphuric acid In Metallurgy and Assaying, the porous crucible which absorbs the liquid vitrifiable oxide of lead and other metals combined with it is sometimes called the *test*

TE'STA In Botany the integuments of a seed

TESTA'CEANS *Testacea* (Lat testa, *a shell* ) This term was employed by Linné to signify an order of the class *Vermes* It is applied by Cuvier to an order of his class *Acephala*, comprehending those which are provided with a calcareous shell

TESTACE'LLUS (Lat testa ) A [illegible] so called from their being furnished [illegible] shell, which forms a shield or protection to the heart Of this destructive genus the following species are British, and occasionally infest our gardens and nursery grounds — *Test scutellum*, Sowerby, *Test halyotideus*, *Test manget*

TESTAMENT, OLD AND NEW *See* BIBLE

TEST AND CORPORATION ACT The popular names of the statutes 13 Car 2 st 2 c 1 and 25 Car 2 ch 2 by the first of which it was provided that all magistrates in corporations should take the oaths of allegiance and supremacy, and another renouncing the doctrine that it is lawful to take arms against the king, and should have received the sacrament within a year before their election, according to the rites of the church of England The [illegible] these provisions to "all persons that shall bear any office or offices, civil or military," &c, and introduced a new declaration against transubstantiation These acts, long esteemed the great bulwarks of the Protestant church, were nevertheless evaded by means of acts of indemnity annually passed for the relief of those who had neglected to take the oaths They were finally repealed (9 G 4 c 17 ), as far as regarded the administration of the sacrament, and a declaration set forth in the act substituted Locke, as well as many other eminent men has strongly objected to the principle of making a religious solemnity a test of conformity it is defended by Dean Swift

TESTIMONY *See* EVIDENCE

TE'STING In Metallurgy, the operation of refining gold and silver by means of lead upon a vessel called a *test* or cupel *See* CUPELLATION

TESTUDINA'TA (Lat testa ) The name of a tribe of Cheloman reptiles of which the tortoise (*Testudo*) is the type It has been sometimes used as synonymous with *Chelonia*, and as a name for the whole order

TESTU'DO A military contrivance adopted by the Greeks and Romans principally in attacking walls and fortified places It was formed by a body of troops holding their shields above their heads so as to overlap one another and form a kind of penthouse, which threw off the missiles of the enemy while the assailants were up- [illegible] the name was borrowed

TE'TANUS (Gr τεινω, *I stretch* ) A spasm of the whole of the muscles It is frequently caused by lacerated [illegible] is termed *lockjaw* In hot [illegible] times produced by exposure to cold, or by suppressed perspiration, and it then often admits of relief and cure, but when it is the consequence of a wound it is usually fatal

TETHYDANS, *Tethydes* The name of a tribe of Tunicated Acephalous Mollusks, of which the genus *Ascidia* (Tethya of the ancients) is the type

TETHYS (Gr τηθυον *an ascidian* ) A name applied by [illegible] to a genus of Vermes [illegible] and by Cuvier to a [illegible] characterized by having two rows of branchiæ along the back in the form of tufts

TETHYS In Greek Mythology, the daughter of Uranus and Gaia, and wife of her brother Oceanus The symbol of the sea, and of the element of water, in which character she is sometimes confounded with Thetis, unless indeed the name of the latter goddess be only another form of hers

TETRA'CERAS (Gr τετταρες, *four*, and κερας, *a horn* ) The generic name proposed by Dr Leach for the four-horned antelope

TE'TRACHORD Gr [illegible] δη, *a string* ) In Music, a concord [illegible] degrees or intervals, and four terms or sounds, in modern music it is commonly called *a fourth* The word, in its strictly literal sense, signifies any instrument with four strings, and was applied to the lyre in its primitive state

TE'TRADITES A word used in several senses, all of them, however, bearing upon its original derivation from Gr τετταρες *four* 1 Among the ancients children were so called who were born in the fourth month, and such were believed to be unlucky 2 The Manichees and others, who believed the Godhead to consist of four instead of three persons, bore this name And 3 In Ecclesiastical History different sects of heretics were so called, in consequence of the respect with which they regarded the number four

TETRA'DORON (Gr ) [illegible] species of brick used by Greek [illegible] length

TETRADRACHM A common silver coin of the ancient Greeks of the value of four drachms

TETRADY'NAMOUS (Gr τετταρες, and δυναμις, *power* ) A flower having six stamens, of which two are short and separated by two [illegible]

TETRAE'DRON, or TETRAHE'DRON (Gr τετταρες, and εδρον, *side* ) In Geometry, one of the five Platonic bodies, or regular solids It is bounded by four equilateral and equal triangles, or it is a triangular pyramid having four equal and equilateral faces If we assume $a$ = the linear edge, $b$ = the whole superficies, $c$ = the solid content, $r$ = the radius of the inscribed sphere, R = the radius of the circumscribed sphere, then the following relations hold true —

$$a = 2\sqrt{6}\,r,\quad b = 24\,r^2\sqrt{3},\quad c = 8\,r^3\sqrt{3},\quad R = 3\,r$$

*See* PLATONIC BODIES

TETRAETE'RIS (Gr τετταρες, and ετος, *a year* ) In Grecian Chronology, a cycle of four years, invented by Solon to make the lunar year equal to the solar This he effected by intercalating a month of twenty-two days at the end of two years, and at the lapse of other two years another month of twenty three days making in all forty five days which will be found to be the difference between the lunar and solar year after an interval of four years

TE'TRAGON (Gr τετταρες, and γωνια, *angle* ) In Geometry a figure having four angles

TETRAGONIA (Gr τετταρες and γωνια), is a genus of herbaceous plants of the Portulaceous order, with four-cornered fruit, one species of which, native of New Zealand is cultivated as an esculent under the name of New Zealand spinach Although inferior to genuine spinach it is valuable on account of its resistance to drought and the great quantity of foliage that may be gathered from a single plant It is an annual of the easiest culture

TETRAGRA'MMATION Among several ancient nations, the name of the mystic number four, which was often symbolised to represent the Deity, whose name was expressed in several languages by four letters thus the Heb יהוה, the Assyrian Adad, the Egyptian Amon; the Persian Syre, the Greek Θεος, the Lat Deus By a curious coincidence, the same peculiarity prevails in many modern languages, as will be seen in the Germ *Gott*, the French *Dieu*, &c

TETRA'LOGY (Gr τετταρες, and λογος, *discourse* ) The name given to the collection of four dramatic compositions which was brought forward for exhibition at Athens by competitors for scenic honour It consisted of three tragedies and a "satyrus" (*see* SATIRE), of which the only example left is the *Cyclops* of Euripides

TETRAMETER (Gr τετταρες, and μετρον, *measure* ) A verse consisting of four measures, that is, according to the Greek prosody, of eight iambic, trochaic, or anapæstic [illegible] exceeding three times

TETRA'NDROUS (Gr τετταρες, *four*, and ανηρ, *a man* ) A flower having four stamens

TETRAO (Lat tetrao, *a bustard* ) A name selected

by Linnæus for an extensive genus of gallinaceous birds, characterised by a naked and generally red band, which occupies the place of the eyebrow This genus comprehended all the various species of grouse partridges, francolins quails, and tinamous and the necessity for subdividing it was consequently soon recognised Latham restricts the genus *Tetrao* to those species of which the feet are covered by feathers, and are without spurs, with naked toes, and a round or forked tail these are the true grouse The species in which the toes are feathered as well as the legs, called ptarmigan, form the genus *Lagopus* Brisson separated from the Linnæan *Tetraones* the partridges, francolins, and quails under the generic title *Perdix*, and the obvious characters indicated by the common names of these tribes, have been [illegible] grounds for so many distinct [illegible] New World to form the distinct genus *Ortyx*, The long-necked tinamous of America, constitute the last genus (*Tinamus*, Latham) of the family *Tetraonidæ*

TE'TRAPHA'RMACON An ointment composed of four remedies, namely, wax resin lard, and pitch

TE'TRAPLA (Gr τετραπλα) In Ecclesiastical History, the name of a Bible arranged by Origen in four columns, consisting of [illegible] versions, viz that of the Septuagint [illegible] of Symmachus, and that of Theodosian This work must not be confounded with the *Hexapla*, which see

TETRAPNEUMO'NIANS, *Tetrapneumones* (Gr τετρας, and πνευμων, *a lung*) The name of a section of spiders (*Aranidæ*), comprehending those which have four [illegible]

TETRAPTERANS, *Tetraptera* (Gr τετρας and πτερον, *a wing*) A name applied by some entomologists to the insects which have four wings, and which thus constitute an extensive primary division of the class

TE'TRARCH (Gr τετραρχης) The governor of a fourth part of a country This was a title granted by the Romans to some tributary princes, whom they did not dignify with the style of king It seems to have originated among the Galatians Such were the sons of Herod the Great amongst whom his dominions were divided after his death (See *Mém de l'Acad des Inscr* vol xxvii)

TETRASPASTON (Gr τετρας and σπαω *I pull*) In Mechanics, a machine in which four pulleys all act together

TE'TRA'STICH (Gr τετρας, and στιχος, *verse*) In Poetry a stanza of four verses

TE'TRASTYLE (Gr τετρας, and στυλος, *a column*) In Architecture a building that has four columns in front

TETTER An eruptive disease of the cuticle *See* Psoriasis

TETTI'GES (Gr *grasshoppers*) An appellation assumed by the ancient Athenians in allusion to the boast that they were produced from the soil which they inhabited In conformity with this belief they were often styled αυτοχθονες or earthborn, and wore golden grasshoppers in their hair

TETTIGO'NIANS *Tettigonia* [illegible] (Gr τεττιγονια *a kind of grasshopper*) A [illegible] insects, of which the genus *Tettigonia* is the type It is synonymous with Cicadarians *See* Cicada

TEUTA'TES In Mythology, a Celtic divinity to whom Roman writers have given some of the attributes of their Mercury (*Mem de l'Ac des Inscr* xxiv 349), enumerated by Lucan among the gods of the Gauls Quibus immitis placatur sanguine diro Teutates

TEUTHIDANS, *Teuthidæ* (Gr τευθος *a calamary*) The family of Dibranchiate Cephalods of which the calamary (*L* [illegible] he type

TEUTONIC [illegible] One of the principal military orders of religious persons It was founded in 1190, by Frederic duke of Swabia, and intended for Germans of noble rank only its rules were the same with those of the Templars Like the other orders (*see* Saint John Templars) its original object was the performance of service against the infidels in Palestine It was dedicated to the Virgin Mary After the conquest of Jerusalem by the Saracens, the grand master removed to Venice, and afterwards to Marburg By degrees it made extensive conquests from the various heathen nations on the southern shores of the Baltic The Prussians were subdued by it and forced to embrace Christianity, after a struggle of more than half a century In 1237 it was united with the order of the Brethren of the Sword in Livonia [illegible] it to the rank of a sovereign powe [illegible] rand master, during the epoch of its domination, had his seat at Marienburg, in Prussia Its territory extended from the Oder to the Gulf of Finland, and the population under its government is supposed to have amounted in the 15th century to two millions and a half of souls Its dominions, however, were gradually lost by revolt or foreign conquest West Prussia fell to Poland, East Prussia to the house of Brandenburg Afterwards the seat of the grand master was at Mergentheim in Swabia, and he became a spiritual prince of the empire By the peace of Presburg, in 1805 the rights and revenue of the grand mastership was obtained by the emperor of Austria, but the order was abolished by Napoleon in 1809; and its lands having passed to the sovereigns of the various districts in which they were situate, it now retains a titular existence only in A [illegible]

TEXTUARIES Among the Jews, the sect of Ca [illegible] has been so called (see that word), from [illegible] adhere to the text of the Jewish scriptures

THABORITES *See* Taborites

THALAMUS (Gr θαλαμος, *a bed*) In Anatomy, the part of the brain from which the optic nerves have part of their origin

Thalamus, in Botany, is the part on which the ovary is seated The succulent red centre of a strawberry, the core in the fruit of a raspberry are the thalami of these plants Some botanists call it the receptacle of the fruit

THALI'A (Gr θαλια, *the blooming one*) The muse who is generally regarded as the patroness of pastoral and comic poetry She is also supposed to preside over husbandry and planting She is represented leaning on a column with a mask in her right hand and a shepherd's crook in her left

THALI'DANS *Thalides* (Gr Θαλια, one of the Muses) The name of a tribe of Tunicaries, of which the genus *Salpa* or *Thalia* is the type *See* Salpa

THA'LLUS In Botany, a term given to the organs of vegetation of liverworts, lichens, and seaweed and to the bed of fibres from which many species of fungi arise It is regarded as a fusion or blending together of leaf and stem Hence [illegible] Thallophytes or [illegible] shows the appea [illegible]

THAMMUZ The tenth month of the Jewish civil year, answering to part of June and July, and including twenty nine days In Mythology, the name under which the Phœnicians worshipped Osiris or Adonis *See* Adonis

THANE (Sax thegn) In early English History, a title of honour among the Anglo-Saxons In its original meaning it [illegible] minister or servant and was applied to the [illegible] of kings and chieftains Thus the king's thanes were at an early period a distinct and elevated class In a later age of the Anglo-Saxon power the term had become more extensive in its signification and seems to have been appropriated to all landed proprietors who were below the rank of earl and above that of alderman, and had the privilege of assisting in framing the laws In Latin charters the word *miles* is the equivalent of thane There were superior and subordinate thanes, standing in the same relative situation as mesne lords and vassals under the feudal system of France and Normandy (See *Turner's Anglo-Saxons*, *Palgrave's Commonwealth*)

THATCHING Covering houses, stacks, or ricks with straw or reeds, in such a manner as to throw off the rain and exclude excessive heat or prevent its escape from within The straw generally used in thatching is that of the wheat as being the longest and thickest, and the most durable Next to wheat rye straw is preferred or, in default of that, the straw of oats, but the most durable of all thatch in cold countries is that formed of the reed (*Arundo donax*, Linn), or of the common heath or ling (*Calluna vulgaris*, Sal) A very durable covering of the thatch kind is also formed of the spray of birch of the bark of that tree, or of oak or pine and of the chips and shavings made by hurdle makers from the poles and shoots supplied by copse woods Thatched roofs were formerly almost universal in cottage architecture, but they are now being supplanted by roofs covered with tiles or slates, which are much more durable and not subject to catch fire, while the straw formerly used for roofs is much more profitably employed as litter for cattle, and thus turned into manure, and employed in reproduction,—a process which, in agriculture at least, ought not to be deprived of any material [illegible] to its aid as manure

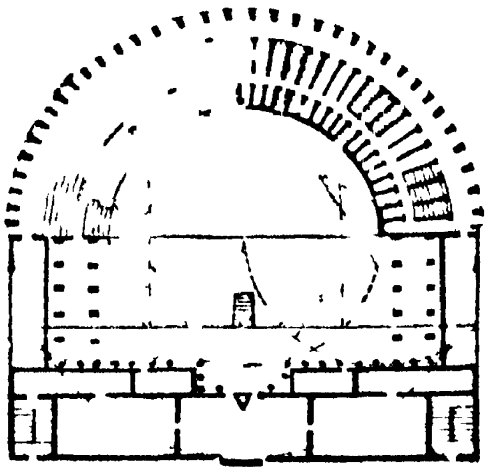
THAUMATROPE [illegible] (Gr θαυμα *a wonder*, τρεπω, *I turn*) The name given by Dr Paris to an optical toy, the principle of which depends on the *persistence* of vision A circle is cut out of a piece of card, to opposite edges of which two silk strings are fixed, by twisting which between the finger and thumb of each hand the disc is turned round with considerable velocity On one side of the disc is drawn any object, as a chariot; on the other side, the charioteer in the attitude of driving, so that when the card is twirled round, we see [illegible] sequence of [illegible] retina, we [illegible] of the card. (*Library of Useful Knowledge*, "Optics")

THEA (Chinese tcha), is the botanical name of the genus which includes the plants yielding tea They are found in China and the bordering countries in various situations, either in warm and damp valleys by the sides

of rivers as in Assam or on mountain sides, and on cool hills occurring in the latter situations as far northward as Chusan Some botanists assert that there is but one kind of tea tree, the difference in the samples of commerce depending upon the mode of preparation, others say that genuine black and green teas are the produce of distinct species, but that both kinds may be made artificially from the former sort The latter appears to be [illegible] cultivation of tea for commercial purposes has been attempted successfully in the Himalayas, Java, Brazil, and Madeira, but unprofitably in the two latter countries, on account of the high price of labour *See* TEA

THEATINES A religious order in the Roman Catholic church, the earliest in point of date of the communities of "regular clerks" it was founded in 1524 by St Cajetan of Thiene The members, besides the ordinary monastic vows, bound themselves to the duties of the cure of souls, preaching against heresies, tending the sick and convicts and to abstain from possessing property or asking for alms This order does not appear to have met with much success, except in Italy, where (it is said in the *Conv Lexicon*) the bishops are very generally chosen from it (See *Mosheim*, cent xvi)

THEATRE (Gr θεατρον, from θεαομαι, *I behold*) In Architecture, a building appropriated to the representation of dramatic spectacles The theatres of the Greeks and Romans display some of the most extraordinary specimens of their power in the arts Bacchus has the reputation of being the inventor of them, which, after their temples, appear to have been the most important public edifices of those people They seem to have been carried to perfection in the Grecian colonies at an earlier period than they were in the mother country The first theatre of *stone* at Athens called the theatre of Bacchus, was built in the time of Themistocles, and as there seems little doubt that the Athenians were the inventors of the drama as a regular scenic action, it is fair to presume that they were the first to regulate the form and proportions which necessity and pleasure dictated in their arrangement The subjoined [illegible] the general form of the Greek theatre, which [illegible] little from that of the Romans, and the instructions given by Vitruvius in the eighth chapter of his fifth book, as to the general outline of the plan, are as follows —"Whereas in the Latin theatre the points of four triangles touch the circumference, in the theatres of the Greeks the angles of three squares are substituted and the side of that square which is nearest to the place of the scene at the points where it touches the circumference of the circle is the boundary of the proscenium A line drawn parallel to this at the extremity of the circle, will give the front of the scene Three [illegible] to the proscenium, [illegible] ing the circumference on the right and left the one foot of the compasses being [illegible] with a radius equal to the distance [illegible] describe a circle on the right-hand side of the proscenium, and, placing the foot of the compasses on the left-hand point, with the distance of the right-hand interval describe [illegible] on the left side of the proscenium [illegible] three centres, the Greeks have a larger orchestra, and their scene is further recessed The pulpitum, which they call λογειον is less in width, wherefore among them [illegible] act upon the scene the [illegible] the orchestra" The ancient theatres were frequently used [illegible] the general assembly of the people [illegible] as we find from Tacitus and [illegible] as quarries freely used by the inhabitants of the cities in which they stood, there are still considerable ruins at Ephesus, Alabanda, Teos, Smyrna, Hierapolis, Cyzicus, Alinda, Magnesia Laodicea, Mylassa, Sardis, Miletus, Stratonicea Tralles, Iasus, and Patara, all in Asia Minor, in Sicily at Catana Taurominium, Syracuse, [illegible] Greece [illegible] Greece in its beauty and proportions, but in grandeur and magnificence the Roman theatres far surpassed those of the Greeks, nor is this surprising, considering the population the former had to accommodate compared with that of the latter For a very considerable period the theatres of Rome, like those of the Etruscans, were of wood and Pompey, on his return from the war against Mithridates was the first who constructed one of stone It must have been of large dimensions, inasmuch as it would contain 40,000 spectators The remains of it at some stables of a palace are still visible There were two other considerable theatres in Rome, the first built in the year 741 of the city, by Cornelius Balbus, and the second, which was begun by Julius Cæsar but not finished till the time of Augustus, who dedicated it to his friend Marcellus From the remains it appears that it was a specimen of great beauty and purity, as far as relates to the profiles of two of its orders there being no vestiges of the upper order The only other remains of Roman theatres are those at Fiesole and Orange, though the Romans usually erected theatres in their newly conquered cities, or at least embellished and improved those they found on the spot



The modern theatres of Rome are, perhaps, the worst in Europe Italy, however, boasts some beautiful examples, the principal whereof are those at Parma, now [illegible] Milan Verona, Turin, Naples, and Bergamo France has a very fine theatre at Bourdeaux, the theatre at Versailles, and some elegant theatres in Paris Till recently this country has been unsuccessful in the design of theatres, but a taste seems rising, which we doubt not, if opportunity occurred, would tend to raise its character in that respect in the eyes of foreigners We subjoin a short table of the width of the stage in a few European theatres —

| | |
|---|---|
| Milan | 40 feet |
| San Benedetto, Venice | 40 |
| Theatre Français, Paris | 40 |
| Parma | 40 |
| Bourdeaux | 39 |
| Turin | 39 |
| Covent Garden | 37 |
| Argentino at Rome | 36 |
| Theatre Italien, Paris | 33 |

THEBAID The name given to the heroic poem of Statius, which celebrates the civil war of Thebes waged between the two brothers Eteocles and Polynices It consists of twelve books The poet Gray has translated book ii

THEBAN YEAR In Chronology, the Egyptian year of 365 days 6 hours was so called (See Bryant, *Ancient Mythology*, iii 437)

THECA (Gr θηκη, *a case or receptacle*) This term is used in Botany in various senses It is applied to one of the lobes of an anther, to the case or urn containing the spores of mosses, to delicate tubes sunk in the shields of some lichens, and to certain simple kinds of fruit In all cases it expresses a hollow case It is now seldom used, except for the spore-vessel of a moss

THECAPHORI (Gr θηκη and φερω, *I bear*) In Botany, the long stalk upon which the ovarium of some plants is seated, as in *Clome* and the caper bush

THECODACTYLUS (Gr θηκη, and δακτυλος *a digit*) A subgenus of night-lizards or geckoes, distinguished by having the subdigital scales divided by a [illegible] to which the claw can be retracted

THECODONTS (Gr θηκη and οδους *a tooth*) A [illegible] The only remains of this tribe, from the magnesian conglomerate near Bristol has been called *Thecodontosaurus*

THECOSTOMES *Thecostoma* (Gr θηκη, and στομα, *a mouth*) The name given by Latreille to those insects which have a suctorious mouth enveloped in a sheath

THEFT In Jurisprudence, the general name for the most ordinary class of offences against property, for which English law uses the peculiar designation of larceny The difficulty of distinguishing between theft, those other species of fraudulent appropriation which are regarded by the laws of most countries as criminal offences, and, finally, that class which is only the subject of civil action, has given rise to a variety of definitions By the French Code, art 379, "Whoever has fraudulently abstracted a thing which does not belong to him is guilty of theft By that of Bavaria, art 209, "Whoever knowingly of his own accord takes possession of moveables not his, without consent of the person entitled thereto, but without violence to any one, with intent unlawfully to hold the same as his property, is a thief" The principal characteristics of English law on the subject are, that it requires an actual taking, and an actual [illegible] from the possession of another; [illegible] Criminal Law, [illegible] Whoever shall [illegible] without such consent as is hereinafter specified, [illegible] being the property of any other person, and, unless when it shall be otherwise provided, of some value, with intent to despoil the owner, and fraudulently appropriate the same, shall be guilty of theft."

THEISM *See* DEISM

THEME (Gr θεμα) A subject proposed for discussion, whether orally or in writing

THE'MIS (Gr Θεμις) In Grecian Mythology, the [illegible] She was one of the Titans, and bore to [illegible] er, Justice, the Fates, and Seasons

THEOCRACY (Gr Θεος, *God*, κρατεω, *I rule*) A term expressing the government of a state immediately by God The constitution of the Israelites previous to the appointment of kings, was emphatically a [illegible] considered in a secondary sense as a theocracy, from the general superintendence which Jehovah continued to exercise over it All polities may in this sense be called theocratic in which the final appeal in matters of moment is made to the will of God, as expressed in oracles, by [illegible] the mouth of the priesthood

THEODICY'SY (Gr Θεος, and κρασις, *mixture*) In ancient Philosophy, a term invented to signify the intimate union of the soul with God in contemplation, which was considered attainable by the newer Platonists Similar ideas are entertained by the philosophers of [illegible] *See* QUIETISM

THEODICE'A (Gr Θεος, δικαιος, *just*) A [illegible] Providence with man A work under this title was published by Leibnitz in the year 1710, in which he endeavours to prove that of all the possible schemes of government which God might have adopted, the one which actually exists in the world is the best This is commonly known under the name of Optimism

THEO'DOLITE (Gr Θεαομαι *I view*, and δολος, *stratagem*) A surveying instrument for measuring the angular distances between objects projected on the plane of the horizon

In accurate surveying, when the instrument used for observing the angles is a sextant or reflecting circle or such that its plane must be brought into the plane of the three objects which form the angular points of the triangle to be measured the altitudes of the two distant objects above the horizon of the observer must be determined, and a calculation is then necessary to reduce the observed angles to the plane of the horizon The object of the theodolite is to measure the horizontal angles at once and thereby render the previous calculation, and even the observation of the altitudes, unnecessary

It is easy to conceive, in a general way, how this object may be effected A telescope with cross wires in its focus must be mounted so as to be moveable both about a vertical and horizontal axis, in order that it may be brought to bear upon any object, whether in the horizon, or above or below it, and the proper means must be applied for measuring, with the utmost accuracy, the angle described about the vertical axis (which is the horizontal angle) in turning the telescope round from one object to another It is consequently necessary to fix a graduated circle to the vertical axis, with its plane exactly horizontal, and its centre coincident with the vertical axis, and about the same axis a radial bar, firmly connected with the telescope, must revolve parallel to the plane of the circle, for the purpose of indicating the divisions passed over on the limb of the circle when the telescope is turned from the first object to the second In order also to render the instrument subservient to the purpose of measuring altitudes, a graduated vertical arch is attached to the telescope, but as it seldom happens, in the practice of surveying that the objects observed are very much elevated above or depressed below the horizon, or that the vertical angles are required to be taken with the same degree of accuracy as the horizontal angles the vertical arch is generally only a portion of a circle of smaller radius and less minutely divided than the horizontal circle

The theodolite, as now generally constructed for the purposes of [illegible] is described as follows —The [illegible] two circular plates, which turn freely on each other The lower or graduated plate receives the divisions of the circle, and the upper [illegible] intricately opposite [illegible] conical parts, one working within the other The external part is attached to the graduated plate, and the internal to the vernier plate The diameter of the under plate is somewhat larger than that of the vernier plate, and its edge is sloped off to receive the graduations, and portions of the opposite edges of the vernier plate are sloped off in like manner to receive the vernier divisions The [illegible] to a degree, but sensibly [illegible] minutes, and in a well-made instrument quarter minutes may be estimated by the eye For the purpose of adjusting the plane of the circle to the horizon, the external axis is fitted into a ball, which works in a socket between two parallel plates held firmly together by the ball and socket, the under plate being connected with the staff head supporting the instrument But this adjustment may also be made (and in larger instruments is usually made) by [illegible] a foot screw at each extremity [illegible] a plate of metal supported by the staff Upon the [illegible] of the vernier plate are placed two spirit levels at right angles to each other, with their proper adjusting screws, by which the circle is brought accurately into the horizontal plane indicated by the levels In order that the circle is adjusted over the point which forms the centre of the station from which the observation is to be made by means of a plummet

Instead of the vernier plate described above, the index is sometimes formed by three radial bars connected with the internal vertical axis, each carrying a vernier at its extremity, and a fourth bar carries the clamp, by which the system is secured to the graduated limb

The horizontal axis of the vertical limb (which is usually a semicircle) is supported by a frame firmly imbedded in the vernier plate, and turning along with it about the vertical axis The telescope has two collars or rings of bell metal, ground truly cylindrical, on which it rests in supports permanently attached to the vertical limb, so that both move together in the vertical plane The divisions on this limb are read off to single minutes by means of a fixed vernier connected with the frame, and so adjusted that the index points to the zero of the graduated arc when the optical axis of the telescope is truly horizontal For effecting this adjustment, or determining its index error, a spirit level is attached to the telescope, at one end by a joint, and at the other by a screw whereby the end is raised or depressed until the air bubble stands at the middle of the glass tube The telescope is then reversed, and if the air bubble of the level still stands at zero, the adjustment is perfect, if not, the index error becomes known by bringing the level to the proper position, and may either be corrected or allowed for in the observations

In some theodolites the telescope is supported in the manner of a transit instrument, that is to say the telescope and the horizontal axis on which it turns form one piece and the vertical limb is a complete circle By this construction the instrument becomes better adapted for determining the altitudes of stars, and consequently for finding the direction of the meridian and the azimuths of objects, or for other astronomical purposes In fact, it becomes an altitude and azimuth instrument

In theodolites for common topographical purposes the horizontal circle is seldom more than five inches in diameter but as the double vertical axis gives the means of carrying round the telescope from the first object to the second without disturbing the graduated circle, and then, by clamping the vernier and graduated plates, of bringing it back, and the graduated circle along with it, to the first object, the measure of the angle may be repeated any number of times exactly as with the repeating circle, and a [illegible] of accuracy obtained even with a [illegible] (See REPEATING CIRCLE) But the principle of repetition is better carried into effect by means of a particular kind of stand or tripod, called a *repeating stand*, which turns round concentrically with the vertical axis of the theodolite, and this apparatus is usually had recourse to when the instrument is on a large scale

As the accuracy of the observation must depend on the horizontal circle remaining perfectly fixed while the telescope and verniers are turned round, a second telescope, called a watch telescope is sometimes attached to the horizontal circle beneath the limb, which [illegible] to a fixed object, serves to detect any disturbance of the circle clamp or accidental shifting of position while the upper telescope with the verniers is turned from the first object to the second But this can scarcely be applied to the repeating theodolite

The principal adjustments of the theodolite are, first, to rectify the line of collimation of the telescope, secondly, to make the axis of the horizontal limb truly vertical and thirdly to adjust the zero of altitude For the practical methods of making these adjustments in the case of the common [illegible] theodolite and instructions as to the mode of observing the reader may be referred to *Simms's Treatise on Mathematical Instruments*, 1834

In geodetical operations, where very great accuracy is indispensable, as, for example, in measuring an arc of the meridian, the instrument is constructed on a much larger scale The great theodolite by Ramsden, belonging to the Board of Ordnance, which has been used for measuring most of the principal angles of the British Trigonometrical [illegible] three feet in diameter, [illegible] inches focal length A similar one of equal dimensions had formerly been constructed by the same excellent artist for the Royal Society, and was used by General Roy in his operations for connecting the observations of Greenwich and Paris towards the end of the last century, and also by Colonel Colby and Captain Kater for the same purpose in 1821 A full description of this superb instrument is given in the *Phil Trans.* vol lxxx, and in the

first volume of the *Trigonometrical Survey of England and Wales* A theodolite of equal dimensions, by Cary, has been employed in the measurement of the great meridional arc of India by Colonel Lambton and Colonel Everest The French astronomers, in measuring their arc of meridian, used only the repeating circle, but in the more recent operations of the same kind in Germany and Russia, the geodetical angles were measured with the [illegible]

THEOGONY (Gr Θεος, *God*, γονος, *birth*) In the Religion and Literature of ancient Greece and Rome, the history of the descent and relationships of the various gods who were the objects of popular worship These genealogies were very variously related by different writers, and originated in some instances from national superstition, while in others they had an allegorical sense, and were invented by the learned men or poets of those countries

*Theogony* is also the title of a poem attributed to H[illegible] on the birth and parentage of m[illegible]

THEOLOGIUM [illegible] upper stage in the ancient theatre upon which the machinery of the gods was arranged

THEOLOGY (Gr Θεος, and λογος, *discourse*) The science which treats of the nature and attributes of God, of His relations to man, and of the manner in which they may be discovered Lord Bacon divides the science under the following heads —1 Inspired 2 Natural, which he calls the first part of philosophy 3 Appendices Theologiæ Inspiratæ sc Doctrina de legitimo usu rationis humanæ in civitate Dei, [illegible] logicam in prat[illegible] de angelis et spiritibus (*De Augm Scient* lib ch 1) [illegible] these subjects [illegible] res concerning them from data furnished by the constitution of nature alone It is only by the conclusions arrived at by this process that we are put in a proper condition to examine the evidence of *revealed religion*, the basis of which is the satisfaction it affords to the demands of the human reason and affections

A pure system of natural theology, looking no farther for the evidence of divinity than the marks of it displayed in the creation, is deism, — the belief in God as a superintending Providence, which seems to require as a corollary the idea of a future retribution Those who can discover no design in the constitution of the world, or no trace of God's hand therein, are atheists, or deniers of a Deity Again, the most common form of religion deduced by the heathens from their researches in natural theology is the [illegible] numerous gods, each manifesting himself [illegible] various functions and qualities of the animate and inanimate world, and sometimes, according to ancient legends and traditions, by direct communication in various ways Opposed to this is monotheism, which recognizes more distinctly than deism the unity of the godhead, and gathers up under one volition and agency the attributes which the polytheist dispersed in only a vast number of divinities Of monotheist religions the Jewish, Christian, and Mohammedan lay claim to express revelation by the word of God

THEOMANCY (Gr Θεος, and μαντικ *prophecy*) A name which has been given to that species of divination which was drawn from the responses of oracles among heathen nations, in which a god himself was supposed to answer the inquirer, or from the predictions of sibyls and others supposed to be immediately inspired by some divinity

THEOPA'SCHITES (Gr Θεος, and πασχω, *I suffer*) In Ecclesiastical History, a name given by the orthodox to certain heretics of the 5th century, followers of Peter the [illegible] Being strongly attac[illegible]s, his enemies charged him and his disciples with holding that all the three persons of the Godhead were crucified (*Mosheim*, 5th cent part ii ch 5 1)

THEOPHANY (Gr Θεος, and φαινομαι, *I appear*) A word invented to signify the manifestations of God to man by actual appearance These have formed a striking feature in most systems of religion (See on Pagan Theophanies the 4th Dissertation of M Foucher on the Religion of Boudha, *Mém de l'Acad des Inscr* vol xxxvi p 292)

THEOPHILA'NTHROPISTS (Gr Θεος, *God*, and φιλανθρωπος, *a lover of men*) A title assumed by a society formed at Paris during the first French revolution The object of its founders was to establish a new religion in the place of Christianity, which had been formally abolished in France by the Convention, and had lost its power over the minds of large classes of the people The Directory granted these philosophical sectarians the use of ten parish churches in Paris, where they held meetings for [illegible] st on the Decadi, or revolutionary Sunday afterwards on the Sunday Their system of belief was a pure deism; their service a simple liturgy, with some emblematic mummeries The attempt to found a new sect was, however, wholly unsuccessful In 1802 they were forbidden the use of the churches by the consuls, and then ceased to exist

THEO'RBO (It tiorba.) A lute of large dimensions, sometimes called the arch-lute, and formerly used for striking the chords of the thorough bass in accompaniments

THEOREM (Gr θεωρημα, from θεαομαι, *I observe*) In Geometry a truth proposed to be proved, in contradistinction to a *problem*, which proposes something to be done A theorem wants demonstration, a problem requires solution In algebra, the term is applied to various formulæ, as the *binomial theorem*, *Taylor's theorem*, and others, for which see the respective terms

THEO'RICON In ancient Attic History, the name given to that portion of the revenue of the state which was exclusively reserved for the purpose of theatrical representations (See *Boeckh's Public Economy of Athens*, i 289 299 &c)

THEORY (Gr θεωρια), in Science, properly expresses a connected arrangement of facts, according to their bearing on sc[illegible] law A *hypothesis* has been d[illegible] as an assumption which is conceived to allow [illegible] the discovered law Thus some have [illegible] at the [illegible] ted on the supposition of a [illegible] Here it is evident that the *facts*, and therefore the *theory* or connected survey of them, are unaffected by the *supposition* in question

THEORY The abstract principles of any science or art, considered without reference to practice

THEO'SOPHISTS (Gr θεος, *God*, and σοφια, *wisdom*) The name commonly g[illegible] who pretended to derive their knowledge of God and divine matters from direct inspiration One of the most distinguished of this class in modern times was Jacob Bohme

THERAPEU'TÆ (Gr *worshippers*) A Jewish sect of the first century after Christ, concerning whom some doubt is entertained whether or not they had embraced Christianity They are mentioned by Philo Judæus (See *Burton's Lecture on the Ecclesiastical History of the First Three Centuries*, vol i p 300)

THERAPEU'TICS (Gr θεραπευειν, *to heal*) A branch of pathology relating to the application of remedies, and the curative treatment of disease

THERAPHIM See TERAPHIM

THERIA'CA (Gr θηρ, *a venomous animal*) A name given in ancient Pharmacy to certain complex remedies supposed to be antidotes to poisons they were usually in the form of confections Some of the more celebrated have been transferred to comparatively modern pharmacopœia, such as the *Theriaca* of Andromachus, *Theriaca Veneta*, *Confectio Mithridati*, &c

THERMÆ (Lat) In Ancient Architecture *See* BATH

THE'RMIDOR In the French Calendar, the name of the 11th month of the year in the French Republic It commenced on the 19th of July, and ended on the 17th of August The name is derived from the Gr θερμος, *warm*, and was borrowed from the great heat which characterizes that period of the year It was the month [illegible] by which there and the be[illegible] [illegible] ly called the Revolution of Thermidor, and those who boasted of having participated [illegible] called themselves Thermidorians

THERMO-ELECTRICITY When one part of a metallic bar is heated and another cooled an electric current is generated in its substance which may be rendered evident and its direction ascertained by the galvanometer When two metals of different temperatures are brought into contact similar electric currents are generated, the quantity and direction of the electricity varying with the nature of the metals and their respective temperatures [illegible] ting these thermo-electric [illegible] bars of antimony and bismuth soldered together at their ends, so as to form a compound bar or parallelogram, the junctions of which may be alternately heated and cooled in this case the direction of the current is from the antimony to the bismuth, so that these metals bear the same relation to each other in the thermo-electric series, as the zinc and silver in the simple voltaic circuit The term *stereo-electric* has also been applied to these currents, implying their production in solid bodies independent of a fluid, ar[illegible] [illegible] hydro-electric or voltaic current See VOLTA'S BATTERY

THERMO'METER (Gr θερμος, *warm*, and μετρον, *measure*) An instrument for measuring variations of heat or temperature

The principle upon which thermometers are constructed is the change of volume which takes place in bodies when [illegible] an alteration Generally spe[illegible]en heated and contract when cooled, and in such a manner that, under

the same c[illegible] ...ngths of temperat[illegible] ...ber not [illegible] to the same d[illegible] ... becomes the exponent of the temperature which produces it But as it is necessary not merely that expansion and contraction take place, but that they be capable of being conveniently observed and measured, only a small number of bodies are adapted for thermometrical purposes Solid bodies, for example, undergo so small a change of volume with moderate variations [illegible] they are in general only used for [illegible] temperatures, as the heat of furnace [illegible] &c [illegible] (*See* [illegible] The gases on the other hand, are extremely susceptible of the impressions of heat and cold, and as their changes of volume are great even with moderate accessions of heat, they are only adapted for indicating very minute variations, or for forming *differential* thermometers (*See* DIFFERENTIAL THERMOMETER) Liquids hold an intermediate place, and, by reason of their moderate but sensible expansion through the ranges of temperature within which observations have to be made for by far the greater number of purposes, are commonly used for the construction of [illegible] Various liquids have been proposed, as [illegible] rits of wine, and mercury, but scarcely any other than the two last are now ever used, and mercury by far the most generally

The properties which render mercury preferable to all other liquids (unless for particular purposes) are these —1 It supports before it boils and is reduced to vapour more heat than any other fluid excepting certain oils and endures a greater cold than would congeal most other liquids excepting certain spirituous liquors 2 It takes the temperature of the medium in which it is placed more quickly than any other fluid Count Rumford found that mercury was heated from the freezing to the boiling point of water in 58 seconds, while water took 133 seconds, and air 617 seconds, the heat applied being the same in all the three cases 3 The variations of its volume within limits which include the temperatures most frequently required to be observed may be presumed to be regular, and proportional to the variations of temperature The spirit thermometer is now little used excepting for observations of very low temperatures, or as a self-registering instrument for meteorological observations

*Construction of the Mercurial Thermometer* —In order to render small [illegible] glass bulb, having a slender [illegible] s filled with mercury, so that expansion or contraction can only take place by the rise or fall of the liquid in the tube The diameter of the tube may be of any convenient size, but the smaller it is the larger will be the scale of the variations, and capillary tubes are usually employed It is essential that the diameter of the bore be of a uniform width throughout, a quality which is tested by drawing up into the tube a short column of mercury, and measuring its length at the different parts with a pair of compasses Not more than a sixth part of the tubes which come from the glass-house are found to be fit for the purpose

Having selected a tube, the workman begins by blowing a hollow ball A upon one extremity of it, by means of an air-bag of caoutchouc (in order to avoid the introduction of watery vapour by blowing from the mouth) The length which the thermometer is to have is then marked, and above this point the tube is expanded into a second bulb B, rather larger than the first When the tube has acquired its natural temperature one of the bulbs is warmed, in order to expel the air from it, and the open end of the tube is plunged into distilled and well-boiled mercury During the cooling the mercury rises into the second bulb B, which it is made to pass into A by placing this undermost, and expelling the air from it by heat, after which the mercury descends from the effect of cooling When the bulb A has been completely filled, and also a part of B, the tube is suspended horizontally over a charcoal fire, so as to be equally heated throughout, and the enclosed mercury boiled, in order to expel every remaining particle of air or humidity The open end is then touched with sealing-wax and the tube withdrawn from the fire, and placed in an upright position until it is cooled, when the bulb A and the portion of the tube under B will be filled with mercury A portion of mercury is then expelled by heat, so that the column may stand at the proper height in the tube The tube is then carefully softened with the blow-pipe, and hermetically sealed under the bulb B, which is thus cut off




*Graduation of the Scale* —The instrument prepared in the manner now described is admirably adapted for rendering evident the expansions and contractions of the enclosed fluid and it only remains to adapt a scale to it in order to have a complete thermometer The graduation of the scale is in some measure arbitrary, nevertheless, in order that different thermometers may be comparable with each other, it is necessary that two points at least be taken on the scale corresponding to fixed and determinate temperatures, the distance between which will determine the graduation The two points which are now universally chosen for this purpose are those which correspond to the temperatures of freezing and boiling water With respect to the first of these there is no difficulty, it is only necessary to surround the bulb with ice, and to mark on the stem the point at which the mercury stands when the ice begins to melt The boiling point is not so readily determined As the temperature at which water boils varies to a small extent with the barometric pressure it is necessary in order to have instruments comparable with each other, either that the boiling point on the scale be determined when the barometer stands at a certain height which is arbitrarily assumed for the standard, or else to apply a correction when the actual height of the barometer is above or below the assumed standard De Luc made a number of experiments on this subject, and gave a formula for the correction, which was adapted to Fahrenheit's scale and English inches by Horsley (*Phil Trans* vol lxiv) A committee of the Royal Society, who undertook to investigate the best method of [illegible] the fixed points and whose report is contained in [illegible] *Transactions*, laid down a set of rules which have been generally followed by English instrument makers They recommended the adoption of 29 8 inches for the standard barometric pressure, and gave a table of the corrections for all ordinary pressures above or below this standard. Their table is very nearly represented by the following simple rule, which will be quite sufficient for the guidance of the artist in all ordinary cases —

Supposing the thermometer placed in an atmosphere of steam immediately over the surface of boiling water, then for every tenth of an inch by which the barometer is above or below 29 8, the correction for the boiling point of the scale of the thermometer is one thousandth part of the interval between the freezing and boiling points The corrected must be placed lower than the observed boiling point by this quantity when the pressure exceeds 29 8 [illegible], and higher when the pressure is less than the standard

Several other minute circumstances must be attended to in the construction of delicate instruments As the temperature of boiling water is different at the top and near the bottom of the vessel in which it boils, the thermometer should not be plunged into the water itself, but into the vapour which rises above it, in a close vessel with an aperture for the escape of the steam The vessel should be of metal, because water boils at a different temperature in vessels of different substances, as metal and glass Distilled water, or clear soft water, should be used, if mixed [illegible] it boils w[illegible] ...ferent, and [illegible] ...ld inaccurate

The interval between the two fixed points on the stem may be divided into any number of degrees at pleasure, and the graduation continued above and below as far as may be thought requisite the numeration may also be begun at any point whatever on the scale, but there are only three methods of division so generally adopted as to require particular notice The first is Fahrenheit's, which is used in this country, in Holland, and North America, the second Reaumer's, which was formerly in general use in France, and is still followed in Spain and some parts of Germany, and the third that of Celsius, or the centigrade scale, now used in France, Germany, and Sweden

*Fahrenheit's Scale* —In this scale the interval between the freezing and boiling points of water is divided into 180 equal parts, or degrees, which number was chosen by Fahrenheit (or pro[illegible] ...retical considerations [illegible] the expansion of mercury, it being computed that the thermometer when plunged into melting snow contained 11,156 parts of mercury, which, at the temperature of boiling water, were expanded into 11,336 parts, being an increase of 180 parts. The zero point of the scale is placed at 32° below the freezing point of water It has been frequently stated that this point was [illegible] of a freezing mixt[illegible] from Boerhaave that it was adopted from a still more precarious supposition, namely, the greatest cold observed in Iceland, which was probably assumed to be the lowest natural temperature The freezing point is thus marked 32°, and consequently the boiling point at 32° + 180° = 212° [illegible] it possesses some [illegible] point and the smallness of the divisions, is not well adapted to philosophical purposes

*Reaumer's Scale* — Reaumer, in 1730, proposed to adopt the temperature of melting ice as the zero of the scale and to divide the distance between this and the boiling point of water into 80°, having observed that between those temperatures spirits of wine (which he used

for the thermometric fluid expanded from 1000 parts to [illegible] This division soon became general in France and other countries, and a great multitude of valuable observations have been recorded in terms of it, but it is now seldom used in works of science

*Centigrade Scale* — In 1742, Celsius, professor at Upsal in Sweden proposed to divide the space between the freezing and boiling points of water into 100 equal parts, [illegible] placed as in Reaumur's) at freezing [illegible] This is obviously in harmony with our decimal arithmetic, and has been adopted universally by writers since the Revolution, and is the best known in most parts of the world, notwithstanding [illegible]

It has been sometimes objected to this scale (and the [illegible] Reaumur's), that on account [illegible] point at which the zero is placed in each of these scales is determined by [illegible] the objection (if any) is a very trifling one, and is much more than compensated by the facilities for calculation which the scale affords

*Conversion of Degrees of one Scale into Degrees of another* — From the manner in which the three scales are graduated, it is easy to deduce formulæ expressing any temperature given according to one scale in terms of either of the others The interval which in Fahrenheit's scale is divided into 180 parts is divided into only 100 parts in the centigrade scale and into 80 in Reaumur's Hence one degree of Fahrenheit's is equal to 5 9ths of a degree of the centigrade, and to 4 9ths of a degree of Reaumur But some attention is required on account of the difference of the zero points For the sake of perspicuity, it is convenient to adapt the expressions to three distinct cases Let F denote degrees of Fahrenheit's scale, C degrees of the centigrade, and R degrees of Reaumur, then,

Case 1 For all temperatures above the freezing point

$$F - 32 = \tfrac{9}{5} C = \tfrac{9}{4} R.$$

Case 2 For all temperatures between the freezing point and the zero of Fahrenheit's scale,

$$32 - F = -\tfrac{9}{5} C = -\tfrac{9}{4} R$$

Case 3 For all temperatures below the zero of Fahrenheit,

$$-32 - F = -\tfrac{9}{5} C = -\tfrac{9}{4} R$$

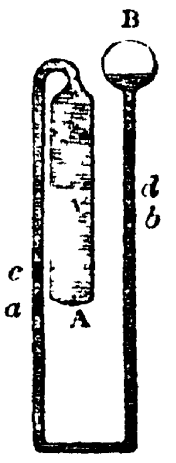
By substituting numbers in these formulæ for F C, or R as the case may require the corresponding values on the other scales is immediately obtained, but if many reductions are required to be made, it is more convenient to have comparative tables by which the correspondence of the scales is seen at a glance

*Theory of the Graduation* — It will be evident from what has now been said that, whatever scale be adopted, the division is founded on the assumed principle that equal increments of heat produce equal expansions. This assumption may be put to the test of experiment by the mixture of fluids at different temperatures For example if a pound of water at 122° F be mixed with another pound of water at 32°, and the requisite precautions be used, then the temperature of the mixture will be 122° which is the arithmetical mean between the two temperatures, and if the assumed principle be correct, a thermometer plunged into the mixture will stand at 122° This is found to be the case with the mercurial, but not with the spirit thermometer, and, in general, thermometers formed of other fluids when exposed to the same temperatures, do not give the same indications throughout the whole extent of the scale An important question hence arises what substance ought to be adopted as the standard to which, in comparing observations, all others should be reduced? It is, perhaps, not possible to determine this question with absolute certainty, but the experiments of the French chemists Dulong and Petit on the dilatation of various substances render it probable that air and the other permanent gases (which all expand equally) afford the most accurate indications of the true variations of temperature As compared with the air thermometer, the expansion of mercury is proportional to the increase of [illegible] to + 100° of the centigrade scale [illegible] point of mercury), mercury expands more rapidly than air, and consequently the mercurial thermometer stands higher than the air thermometer in the same circumstances When the former indicates 80 and 100 respectively, and it seems to be a [illegible] that all fluids with the same increase of heat expand more rapidly as the temperature approaches their boiling point The more rapid expansion of the mercury at high temperatures is, however, in some measure corrected by [illegible] of the bulb

*Change of the Zero Point* — There is a circumstance connected with the mercurial thermometer which requires to be attended to when very exact determinations of temperature are to be made Bellani in Italy, and Flaugergues in France, observed that when thermometers which have been constructed for several years are placed in melting ice, the mercury stands in general higher than the zero point of the scale, and this circumstance, which renders the scale inaccurate, has been usually ascribed to the slowness with which the glass of the bulb acquires its permanent arrangement after having been heated to a high degree [illegible] of the mercury Despretz (*Traité de Physique*) observes, that in very nice experiments it is always necessary to verify the zero point, for he found that when thermometers have been kept during a certain time in a low temperature, the zero point rises, but falls when they have been kept in a high temperature and the same applies equally to old thermometers and to those which have been recently constructed

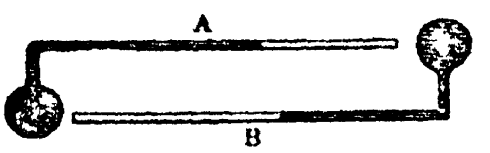
*Register Thermometers* — In meteorological observations, it is of great importance to ascertain the limits of the range of the thermometer in a given period of time, during a day or night, for example, while the observer is absent Numerous contrivances have accordingly been proposed for this purpose, but the two following are those most frequently used

*Six's Register Thermometer* — This instrument was invented by Mr Six of Colchester, and is described in the *Phil Trans* vol lxxii It is a spirit thermometer, having a long cylindrical bulb A, with a tube bent in the form of a siphon, and terminating in a small cavity B A part of the tube, from *a* to *b*, is filled with mercury, but the bulb A, and the remaining portion of the tube and a small part of the cavity B, with highly rectified alcohol The use of the mercury in the middle of the tube is to give motion to two indexes, *c* and *d* which consist each of a glass tube in which a small bit of iron wire is enclosed the ends being capped with enamel The indexes are of such a size that they move freely within the thermometric tube and allow the spirit to pass, but a slender spring is attached to each, which presses against the side of the tube, and is just strong enough to prevent the index from falling down when it has been raised to any point and the mercury recedes The action of the instrument will be readily [illegible] the figure An increase of heat expanding [illegible] in the bulb A, [illegible] mercury at *a* and consequently raises it [illegible] branch of the siphon at *b* The mercury while rising drives the index *d* before it, and when the temperature diminishes the mercury recedes from the index, which is retained in its place by the action of the spring, and consequently marks the highest point at which the mercury has stood In like manner, when the spirit in the bulb A is contracted by a diminution of heat, the mercury is pressed towards A by the elastic force of a portion of air purposely [illegible] with B and drives before it the index *c*, which [illegible] and consequently remains at the highest point at which the mercury has stood in that branch of the siphon When the observation has been made the indexes are brought back to the surface of the mercury by means of a magnet, which acts on the enclosed iron wire and overcomes the [illegible] A scale is applied to each limb of the [illegible] and by comparison with a standard thermometer




This instrument has all the defects which belong to the spirit thermometer, and the indications are besides in some degree deranged by the expansion and contraction of the enclosed column of mercury, probably, also, by the friction of the indexes Nevertheless, it is the best instrument we possess for determining the temperature of the [illegible]

*Rutherford's Thermometer* — A [illegible] register thermometer [illegible] Dr Rutherford [illegible] two thermometers, [illegible] A, and a spirit thermometer B attached horizontally to the same frame, and each provided with its own scale The index of A is a bit of steel, which is pushed before the mercury, but, in consequence of its horizontal position, remains in its place when the mercury recedes, and consequently indicates the highest degree of the scale to which the mercury has risen The index of B is of glass, with a small knob at each end This lies in the spirit, which freely passes it when the temperature rises, but when the spirit recedes, the cohesive attraction between the fluid and the glass overcomes the friction arising from the weight of the index, and the index is consequently carried back with the spirit towards the bulb As there is no force to move it in the opposite direction, it remains



curred By inclining the instrument, the indices are brought to the surfaces of their respective fluids, and prepared for a new observation

*History of the Thermometer* — The invention of the thermometer dates from about the beginning of the 17th century, but it is not certainly known when or by whom it was first brought into use By the Dutch authors it is ascribed to Cornelius Drebbel, a peasant of Alkmaar and by the Italians to Sanctorio Libri (*Annales de Chimie* Dec 1830) mainta s on the authority of Castelli and Viviani that the instrument was invented by Galileo prior to 1597 The thermometer of Drebbel and Sanctorio was a very imperfect instrument It consisted of a glass tube, having a ball blown on one of its extremities, and the other end left open A portion of air being expelled from the ball by heat, the open end was plunged into a cup containing any liquid, when, on the cooling of the ball the liquid would rise in the tube, and the variations of its height indicate the increase or diminution of the temperature of the bulb The instrument had no scale, and was therefore merely an indicator of changes of temperature, or a *thermoscope*, and it was defective even in this respect, inasmuch as it is affected not merely by heat and cold but by the varying pressure of the atmosphere The Florentine academicians first excluded the influence of atmospheric pressure by using a spirit instead of an air thermometer, and hermetically sealing the tube The next step in improvement was the adoption of a fixed point in the scale Boyle proposed the thawing oil of aniseeds, which he preferred to thawing ice, because it could be readily obtained at all times of the year Halley proposed the uniform temperature of a deep pit, which he probably considered would be the mean temperature of the earth, but he also suggested the point at which spirit boils as well as the boiling point of water Newton appears to have been the first who saw the advantage of having two fixed points in the scale, and in order that the instrument might be applicable to a wider r n e of te per t re used linseed oil as the thermometric fluid Th s l quor has not been found to answer on account of its sluggish motion and adhesion to the sides of the tube The knowledge of the fluctuation of the boiling p int of water, owing to atmospheric pressure is due to Fahrenheit about 1724 For improvements in graduation, &c see a very remarkable paper by Mr Sheepshanks in the *Monthly Notices of the Royal Ast Soc*, vol xi p 233 See also Deluc, *Recherches sur les Modifications de l'Atmosphere*, Genève, 1772, Biot, *Traite de Physique* tome I, *Nicholson's Chemistry*, *Library of Useful Knowledge*, "Thermometer and Pyrometer," Muncke in *Gehler's Physicalisches Worterbuch*, *Glaisher's Hygrometic Tables and Description of the Dry and Wet-Bulb Thermometers*, *Beddle's Manual of the Thermometer*

THERMOSCOPE (Gr θερμος, and σκοπεω *I view*) An instrument by which changes of temperature are indicated The modification of the air thermometer, called by Leslie a *differential thermometer* was claimed by Count Rumford as one of his own inventions, under the name of *thermoscope* See THERMOMETER

THERMOSTAT, or HEAT GOVERNOR (Gr θερμος and ιστημι, *I stand*) A self-acting physical apparatus for regulating temperature A thermostat the principle of which depends on the unequal expansion of metals by heat, was proposed by Dr Ure for regulating the safety valves of steam engines with more certainty than the common expedients. (See *Proceedings of the R* [illegible]

THESIS (Gr [illegible] general sense, [illegible] or negative, which is laid down or advanced to be supported by argument, but it is more particularly applied to those questions which are propounded in most of the Scotch and Continental universities to the students previously to their obtaining a degree

Thesis In Music, the depression of the hand in marking or beating time

THESMOPHORIA (Gr θεσμοφορια) A festival in honour of Ceres, surnamed *the lawgiver* (θεσμοφορος), because she first taught mankind the use of laws It was [illegible] with most observation and ceremony by the Athenians The worshippers were free-born women, whose husbands defrayed the expenses of the solemnity, assisted by a priest and band of virgins The women were clothed in white garments as emblematic of purity, and were strictly enjoined to preserve the strictest chastity some days previous to and during the whole of the festival, which lasted five days

THESMOTHETÆ The six inferior archons at Athens, who presided at the election of the lower magistrates, received criminal informations in various matters, decided civil causes on arbitration, took the votes [illegible] and performed a variety of other [illegible] (*Mem de l'Acad des Inscr* vol xxxix)

THESPIAN ART That of tragedy or tragic acting is so termed; from Thespis, an [illegible] who lived in the first half of the 6th century [illegible] and in[illegible] Drama

THETA (Gr θητα), [illegible] by the Greek [illegible] nation, from its being the first letter of θανατος, *death*. Hence the verse —

O multum ante alias infelix litera Theta.

THE'TES (Gr θητες) In ancient Attica, originally bondsmen, who were [illegible] magistracies of the state [illegible] they formed the lowest class of free citizens who contributed nothing to the support of the state, but in the course of the subsequent innovations which brought the state to a complete democracy all the restrictions on the thetes were removed They served generally as light-armed soldiers, but sometimes also as regular infantry upon an emergency (See Boeckh, *Public Economy of Athens* ii 258)

THE'TIS In Greek Mythology, one of the Nereids, daughter of Nereus and Doris was wedded under the auspices of the gods, among whom jealousy had arisen by reason of her beauty, to Peleus king of Thessaly By him she became the mother of Achilles According to the ancient cosmogonies, Thetis was an emblem of the element of water She is best known by the verses of Homer Her marriage with Peleus is the subject of some exquisite lines by Catullus

THEURGY (Gr θεος, *God*, and εργον, *work*) A [illegible] result of an intercourse with and influence over spiritual beings of the more exalted class, — gods dæmons, &c In the modern art magic it was that species of magic which operated by celestial means opposed to natural magic which was effected by knowledge of the occult powers of nature, and necromancy or magic effected by the aid of evil spirits (See *Mém de l'Acad des Inscr* vol xxvii)

THICKET Trees or shrubs crowded together in such a manner as to form a mass not easily penetrated by men or cattle

THINNING Reducing the number of plants or trees which have been sown or planted, with a view to those which remain attaining a more mature growth Natural woods are also thinned for the same purpose The operation ought to be commenced as soon as the extreme leaves or branches are [illegible] continue till the plants [illegible] full growth, or the required dimensions or age On no account should the branches of any one tree in a plantation be allowed to touch the branches of any other tree, because in that case the foliage is deprived of its due proportion of sun, air, and rain, and the tree is drawn up in height at the expense of its thickness and [illegible] while the timber or fruit produced [illegible] both in quantity and quality There is no department of planting less understood than the subject of sheltering young plantations and it may with truth be said that in by far the greater number of cases nothing is ultimately gained by drawing up trees in masses, and afterwards thinning them out The trees left being unprepared both by their bark and roots for the new atmospherical circumstances in which they are placed receive a greater check than if they had been originally planted so thin as at no period of their growth to touch one another

THIN OUT. Geologists say that strata *thin out* when they gradually diminish in thickness and disappear

THIRD In Music an imperfect concord, containing two degrees or intervals, and three terms or sounds

THIRD COAT In Architecture, the stucco when painting is to be used, or the setting for the reception of paper

THIRD ORDER In Ecclesiastical History, most of the chief religious orders (Premonstrants, Carmelites, Franciscans, Augustines &c) have or had bodies of secular associates, not bound by vows, but conforming to a certain extent to the general designs of the order, a custom thought to have originated about A D 1476, when Sixtus IV gave permission to the Carmelites to attach such persons to their body In course of time the third order contained a mixture of secular and religious persons

THIRST (Germ durst) The sensation of a desire to [illegible] of dryness and heat of the [illegible] stomach the posterior fauces [illegible] mucous secretion thick and viscid, as also the saliva A [illegible] disordered mind, and quick pulse ensue; and if not relieved, respiration becomes laborious, and the mouth is opened wide to admit the cool air Some people soon suffer from thirst, and are in the habit of [illegible] while others hardly ever [illegible]

m of febrile and other diseases, and is most effectively lieved in such cases by mild acid and mucilaginous inks, milk and emulsions are, however, sometimes ore efficient and agreeable Excessive exercise or per- iration are common causes of thirst, in which case the nsation seems merely to [illegible] of ater in the system [illegible] dulgence in drinking especially among labourers and ers who take excessive quantities of beer and which [illegible] carcely exist without unnecessary and preju- [illegible] use of that or similar beverages The first ired by excessive exercise in warm weather is in or- ary cases most effectually relieved by milk and water, warm tea In these cases indulgence in beer, cider, ne, or spirits and water [illegible] is re- ton and should the [illegible] be avoided

THIRTY YEARS WAR In History properly a ries of wars carried on between the Protestant and oman Catholic leagues in Germany, in the first half of e 17th century The house of Austria was throughout the head of the latter party The Protestant princes Germany were assisted by various foreign powers, in e earlier part of the war by Denmark and Sweden, d afterwards by France It is considered to have com- enced with the insurrection of the Bohemians in 1618, d ended with the peace of Westphalia in 1648 The lebra [illegible] war by Schiller, is her a spirited [illegible] accurate nar- ive

THISTLE or SAINT ANDREW A Scottish order knighthood, said to be of [illegible] vived James V in 1540, again by [illegible] VII Scotland, in 1687, and a third time in 1703 by Queen ne, who increased the number of knights to twelve, d placed the order on a permanent footing The istle as is well known is the national emblem of Scot- d, and the national motto is very appropriate being Nemo me impune lacesset," *nobody shall provoke me th impunity* This is also the motto of the order of thistle

THMEI The Egyptian goddess of justice or of truth figure is frequently represented in Egyptian sculp- es in the hands of the kings The Hebrew Thum- m (the well-known and mysterious Urim and Thum- m Exod xxxix 8 10) is the plural or dual of the same rd (*Wilkinson's Manners and Customs of the Ancient gyptians*, vol v p 58)

THO'LUS (Gr θόλος) In Architecture, a building a circular form, but used by Vitruvius for expressing roof of a circular building The term was also em- oyed to denote the laconicum of a bath, which was cir- lar in form

THOMÆANS, or THOMITES In Ecclesiastical tory A name given in Europe to the ancient church of rist's is established on the Malabar coast of India, and ought to have been originally founded by St Thomas, hough whether this was the apostle of that name is btful The language used by them in their sacred es when they were first discovered by Europeans, was Chaldee or Syriac The Portuguese have effected a rtial conversion of them to Romanism

THO'MISTS The followers of Thomas Aquinas Angelic Doctor, one of the most distinguished of the oolmen of the 13th century They differed from the al sect of Scotists chiefly in the milder form under ich they adopted the doctrines of realism The Scotists garded the universal as objectively and independently l, the Thomists sought rather to ground the objective a spiritual or rational principle, in some degree ap- oximating to the Platonic doctrine of ideas The omists continued as a sect to the commencement of 17th century, and numbered several eminent men in ir ranks, among whom may be mentioned Algidius of lonna and Francis Suarez

THOMSONITE (So called from the discoverer) variety of zeolite from Dumbarton it generally occurs radiated masses of small prismatic crystals

THOR In Scandinavian Mythology the son of Odin d Freya, and the divinity who presided over all mis- evous spirits that inhabited the elements His power epresented as irresistible Many of his deeds are pre- ved in the *Edda* (which see), but it is probable that worship of this divinity under the name of Donan, or l of thunder, spread also into Germany, where traces of n are still to be found in numerous local appellations, Donnersberg, Thorstein, &c As the worship of this l extended, nothing was more likely than that the rmans should confound him with the Jupiter of the mans, who were then invading their country, and ace in Germany the day sacred to Jupiter was deno- nated Donnerstag, while the [illegible] the same deity has been ret[illegible] English n [illegible]

THORACIC DUCT The great trunk which con- s the contents of the lacteals and absorbents into the od. In the human body it is about the diameter of a w-quill, and lies upon the dorsal vertebræ between the aorta and azygos vein, extending from the posterior opening of the diaphragm, in a somewhat serpentine course, to the angle formed by the union of the left sub clavian and jugular veins, into which it pours its con- tents See CHYLE and LYMPH

THORACICS, *Thoracici* [illegible] The name given by Linnæus to th[illegible] the ve[illegible] als

THORAX [illegible] The second segment of insects is so called by Latreille and Andouin, the term is restricted to the upper surface of the trunk by Linné and Fabricius In Arachnidans the thorax and head are confluent, and form but one segment, which is termed the cephalothorax As a cavity appropriated to the reception of the circulating and respiratory organs, the thorax is only distinct in Mammals

THORAX The chest, the part of the body between the neck and the abdomen It contains the heart and lungs, [illegible] the thymus gland, the thoracic duct part [illegible] and vena cava, the vena azygos, the eighth pair of nerves and a part of the great intercostal nerve

THORAX In Grecian Antiquities, a piece of defensive armour consisting of two parts, one defending the back, and the other the belly, called *lorica* by the Romans The more ancient were made of padded linen, but they were also made of leather brass, iron and other metals

THORINA (From Thor, the Scandinavian deity) An earthy substance discovered in 1828 by Berzelius in a rare Norwegian mineral called *thorite*, which is a hydrated silicate of thorina Like the other earths, thorina is the oxide of a heavy grey metal, which has been termed *thorium* and which is not acted upon by water, but when heated in the air it burns with great brilliancy into a white oxide Thorina obtained in this way is white, infusible, and very heavy its specific gravity being 9·4 It is insoluble in all acids except [illegible] and [illegible] with difficulty Its equivalent is [illegible] Thorina is distinguished from alumina and glucina by its insolubility in caustic potash, and from zirconia by being precipitated by ferrocyanuret of potassium

THORN APPLE See STRAMMONY AND DATURIA

THORNBACK The name of a species of ray (*Raia clavata* Linn) distinguished by the short and strong recurved spines, rising from a broad osseous tubercular base, which are scattered over the back and tail Two of these broad-based spines occupy the central ridge of the nose

THOROUGH BASS See BASS

THOTH, THOUTH TAAUT An Egyptian divinity, considered by the Greeks as identical with Mercury His hieroglyphic represents the beginning of the astronomical year He was regarded as the inventor of writing [illegible] philosophy, and is hence paralleled with Mercury [illegible] Cicero He is with the head of a lamb or [illegible], Plutarch *De Is et Osir*, Wilkinson, *Ancient Egyptians* vol v) Bryant says the same with Θεὸς (*Mythol* i 13)

THOUSAND AND ONE NIGHTS, more commonly called among ourselves the *Arabian Nights' Entertainments* from the title adopted in our first translation from Galland's version A well-known collection of oriental tales which has acquired in the west a popularity never attained by any other eastern composition The history of the work has been the subject of much investigation especially by De Sacy, Von Hammer and our last learned translator Mr Lane from whom we borrow most of this article It is the opinion of Mr Lane that the work in its present form is the composition of a single author living in Egypt, and that it was most probably "not commenced earlier than the last quarter of the 15th century of our era and completed before the termination of the first quarter [illegible] soon after the conquest of Egypt by [illegible] 1517" But the origin of the tales is a much [illegible] ject of inquiry It seems to be now [illegible] (on the discoveries of De Sacy and Von Hammer) that there was an ancient Persian [illegible] known by the name of the *Hezar* [illegible] Thousand Fanciful Tales") of unknown [illegible] earlier than the 9th century of our [illegible] that the framework of this collection was the same with that of the modern, namely, the story of the cruel king Shakryar and his ingenious queen Chehrazád, and that this was very early translated into Arabic by the name of the *Thousand Nights* But Mr Lane differs from these learned orientalists in still believing that the early work was only a model, that the greater proportion of the modern tales are really Arabian, especially all those founded on the supposed adventures of the Khalif Haroun [illegible] his queen Zobeyde, a few only being originally of Persian or Indian original, e g the *Magic Horse*, the *Damsel and the Seven Wezeers*. The difference seems to reduce itself to this, whether the present work is the last of several successive editions of the old *One Thousand Nights*, or has pretensions to be considered as a new construction on an old groundwork, the latter being Mr Lane's opinion (See De

edition of Galland's
o that of Trébutien,
Mr Lane's Preface, and "Review" at the conclusion of his third volume; the *Athenæum*, No 622)

But whatever the history of the work many of the main features of the stories are of primeval antiquity, and form, in fact, part of the popular literature of all countries The original Persian or Arab writers were connected by habits of travelling and merchandise through India with the far East, and through Greece with the extreme West, and the superstitions, anecdotes, and
halt, have contributed to enrich
The *Adventures of Sindbad* have been curiously illustrated with antiquarian learning by Mr Hole, and form one of the most singular examples of the ubiquity of good stories

It appears that the learned Arabs hold the *Thousand and One Nights* in small esteem, as an incorrect and unclassical composition, but it is a great mistake (a very natural one for distinguished orientalists, like Mr Lane, to fall into unconsciously) to imagine that their great charm to the people of the West consists in their faithful representation of Asiatic manners A far greater attraction lies in the fancy which dictated the narratives—a quality belonging to all times and places And hence it is that we are convinced Mr Lane is wrong in his low appreciation of Galland's version That it is very incorrect in point of costume is doubtless true, but the peculiar genius of Galland led him to detect the poetical fancy, the humour, the oddity the picturesqueness of the composition, under the cumbrous prolixity of Arab
in a manner by no means
so to give an oriental quaintness to his work, without the languor of the original
of Arab simplicity
We believe that while the versions of Mr Lane and other learned men will always be consulted with interest that of Galland will still be the cherished companion of all ages but especially of youth The numerous European imitations of the *Thousand and One Nights* are well known, and may for the most part be characterized as very unsuccessful perhaps the best is the French *Additional Arabian Nights*, containing the history of Mangraby the Magician &c

THRAVNIP The
arrangements of the
three classes of rowers in an Athenian trireme, the middle being called the zeugitæ, the lowest thalamitæ *See* GALLEY, TRIREME

THRA'SHING Separating grain or seeds from the straw or haum by means of a flail or thrashing machine, or by treading with cattle The latter was the mode employed in the ages of antiquity, and it is still practised in the south of Europe and in Persia and India The
with iron knots which they dragged over the corn, and which was spread on a circular floor, the driver standing in the centre, and guiding the oxen around him by means of reins It was customary to allow the oxen occasionally to breathe and take a bite of the corn, agreeably to the scripture precept A kind of flail or rod was also sometimes used by the Romans, and is doubtless the origin of
In colder and moister
where a floor sufficiently hard for threshing out corn could not be maintained in the open air, threshing appears to have been always performed under cover, and with the flail, till the latter end of the 18th century, when thrashing machines were introduced

THRA'SHING MACHINE A machine for separating corn or other seeds from the straw or haum, and either impelled by horse or cattle, wind water, or steam The modern thrashing machine was invented in Scotland about the year 1758 by a farmer in the parish of Dumblaine, Perthshire, and afterwards brought to nearly its present state of perfection by Mr Meikle, a millwright of Haddingtonshire about
machine consists of a cylinder
on its circumference, to which the corn being presented by rollers the ears are beat in pieces, and while the grain drops through a grating into a winnowing machine the straw is carried forward and delivered by itself ready to be made up into bundles Some thrashing machines
beat out the corn and separate it from the straw while others beat it out, winnow it, and sift it One of the most complete thrashing machines is that at Winstay,
which not only thrashes and winnows, but measures the corn and transports it to the granary in a fit state for being carried to market (See *Encyc of Agr* p 1311)

The employment of thrashing machines relieves the labourers from the severest drudgery incident to agriculture, they enable the work to be done at the time more readily and for corn and beans it be
straw, straw for particular wheat more
from the straw, they add both to the wealth of the farmer and the produce of the country; enabling the former to employ and the latter to feed, more labourers The latter is, indeed, a most important consideration It is calculated, by the best informed agriculturists, that 5 per cent, or one twentieth part, more produce is afforded by a crop thrashed by machinery than by the old method, and, estimating the total produce of the corn crops of Great Britain and Ireland at
we should, on this hypothesis have
supply of no less
machines universally
increase of produce in the hands of the farmers would obviously enable them to employ far more labourers than would be superseded by the use of the machine (*Brown on Rural Affairs*, vol i p 332)

As we remarked above, thrashing machines may be driven either by horse water, or steam power, but in all the great farms in the Lothians in Scotland, and in some parts of England, all other methods have merged in the last

THRE-COAT WORK In Architecture plastering which consists of pricking-up or roughing-in, floating, and a finishing coat

THRENODY (Gr θρῆνος *a dirge*, ᾠδή, *song*) A short species of occasional poem composed on the occasion of the funeral of some distinguished personage *See* EPICEDIUM

THRO'MBUS A small tumour, which sometimes ensues in consequence of the escape of blood into the cellular membrane in the operation of bleeding

THRONI (Gr θρόνος) In Architecture, a chair of state raised above the level of the floor whereon it stands, usually richly ornamented and covered with a canopy

THRUSH In Medicine This disease consists in small white ulcers upon the tongue palate, and gums and is common in infants who are ill fed or brought up by hand It is apt to extend through the whole course of the mucous membrane lining the alimentary canal exciting fetid eructations and flatulency with a troublesome diarrhœa and sometimes proves fatal The treatment consists in giving a gentle emetic of ipecacuanha and keeping the bowels clear and open with castor oil or
The strictest attention should be
to diet, which should consist of milk and light farinaceous food

THRUSH In Ornithology one of the largest and most melodious of our native song birds, the type of the genus *Turdus* Linnæus It is not
but is supposed to quit the more northern
for the southern provinces It makes its nest in March lays four or five blue eggs, spotted with black at the larger end It feeds on berries insects, and shell snails, and often selects a particular kind of stone against which it breaks the shell of the snail, and near which a great quantity
the shells may be found

THRUST (from the verb *to thrust*, or *to push*) In Architecture the horizontal force of an arch, by which it acts against the piers from which it springs Also a similar action of rafters or of a beam against the walls which bear them

THUG (From the Hindee verb thugna, *to deceive*) A member of a singular association of robbers and murderers, which has excited of late years much attention in India It appears that the existence of the system of *thuggee* as it is called, was hardly known before the year 1810, and that no combined measures were taken to put a stop to it until about 1830 Since that time it has been fully detected, and greatly checked chiefly through the admission of approvers from all the gangs Capt Meadows Taylor informs us that, between 1831 and 1837, 3266 Thugs were brought to justice, of
1059 transported, and 483 turned
by no means supposed to be extinct Its origin is unknown, and both Mohammedans and Hindoos belong to the society indifferently, although its tutelary goddess, Bhowanee, belongs to the latter faith The Thugs are peculiarly superstitious in their observances They are directed, in all their proceedings by auguries supposed to be vouchsafed by their goddess, and particular classes are altogether exempt from their attacks among whom are dancing girls, minstrels, sikhs, some religious mendicants, tailors, oilmen, blacksmiths, carpenters It is stated also that they seldom destroy women unless for their own safety, and they have very seldom ventured to attack Englishmen They usually move in large gangs, and attach themselves to travelling parties, they will journey with them for days, to find at last an opportunity to master them When all is ready one division of the murderers strangles the victim while another body prepares their graves, and by means of this division of labour the fearful work is accomplished with wonderful celerity It appears that numbers of Thugs resided together in villages, which they were prohibited by
by rajahs, to whom they paid tribute

nfessed to Col Lawson, who lost so many in m of exaggeration, that he had been concerned in the urder of 719 persons! The existence of so strange and strous a system can only be explained by the condition Ind a the extreme timidity and apathy of the ts, and their division into castes, the number of small tive governments, the habit of dwelling in villages, ided by extensive uninhabited tracts, the quantity of avelling that takes place in that commercial country, thout navigable rivers or secure conveyances, and the urderous spirit of Hindoo fanaticism (See *Col Sleeman's Ramaseana Vocabulary of the Thugs* and an ticle on it in the *Ed Rev* vol lxiv, and *Col Meadows aylor's Adventures of a Thug*, 2 vols London 1839, from which these details are chiefly taken)

THULE Name given by the ancients to the ost northern part of the habitable world, but it is the variety of opinions en- er any definite country was eant by this appellation Some have thought that orway, but most geographers are of opinion that Iceland, as the place alluded to But be this as it may it is ng since the prophecy of Seneca in the following lines s been fulfilled —

——— Venient annis

THULITE A rare mineral of a peach-blossom colour om Norway Its composition has not been ascertained

THUMERSTONE A variety of axinite from Thum, Saxony

THUMMIM *See* URIM

THU'NDER (Germ donner, Lat tonitru) The ise produced by an explosion of lightning, or by the ssage of lightning through the air from one cloud to nother, or from a cloud to the ground

The character of the sound of thunder varies with the ree and the distance of the explosion, the situation of e observer, the nature of the surrounding country, d it is probably influenced also by the relative situations the clouds

When lightning strikes an object near us on the earth, produces a noise resembling that of a violent crash ich is not repeated or prolonged by reflection When e explosion is more distant, [illegible] curring noise is heard, which [illegible] distance, like the prolonged echo of the sound of ordnce discharged in a mountainous district

Thunder frequently commences with an astounding ttle, which is probably occasioned by a series of explosns or discharges of electric matter in rapid succession om a highly charged thunder cloud

We have a familiar example of this *species* of noise in e cracking which accompanies the sparks discharged om the conductor of a well [illegible] electrical machine wards any adjacent [illegible] dy, the loudness of e snaps, as well as their frequency increasing with the ctric intensity And when we consider how trifling a ation of electric matter can be put in action by the st powerful means of artificial excitement compared with the quantity stored up in a full charged under cloud, the discrepancy between the appalling ash of the one and the insignificant snap of the other ll not appear surprising, though both originate in the me cause This cause is the vibration of the air proted by the passage of the electric discharge with a ater or less degree of intensity, and two explanations ay be given of the manner in which the vibration is oduced

The first explanation proceeds on the supposition that e electric fluid opens a passage to itself through air or her matter, in the manner of a projectile and that the und is caused by the rush of the air into the vacuum oduced by the instantaneous passage of the fluid But is objected that if this explanation holds good, the ssage of a cannon ball through the air ought to produce similar sound, whereas it only produces a sort of whistg noise, which even the most timid have never thought [illegible] thunder Another still stronger ob- [illegible] the experiments seem to indicate that e electric fluid is not transferred from point to point e a projectile of ponderable matter, but is conveyed ong by the vibration of an elastic medium, as sound conveyed through the atmosphere

[illegible] which appears more in harmony [illegible] founded on this vibratory progation of the electric fluid When the electric spark sses between two points, there is a [illegible] composition of electricity in all the [illegible] pears, and consequently a vibration more or less violent [illegible] which vibration gives rise to the sound n this supposition, the continued roll is the effect of the comparatively [illegible] through the air [illegible] lightning [illegible] instantaneously seen from one end to the other of this line At the same instant the flash is visible the vibration is communicated to [illegible] the whole extent of the line [illegible] placed in the direction of the line of the flash, and at the distance of 1125 feet from one end, then, since sound travels at the rate of about 1125 feet in a second (*see* SOUND), one second will elapse after the flash has been seen before any sound is heard When the sound begins, the vibration communicated to the nearest stratum of air has reached his ear, and since [illegible] line of disturbance to be 11250 in [illegible] of the more distant strata will continue to reach his ear in succession during the space of ten seconds Hence the [illegible] determines the duration of the sound, whilst the same flash will give rise to a sound of greater or less duration, according to the position of the observer with respect to its direction Thus, in the above instance, suppose a second observer to be placed under the line, and towards its middle he would only hear the sound during half the time it was heard by the first observer, and if we suppose the line to be circular, and the observer to be placed near its centre, the sound would arrive from every point at the same instant in a violent crash

Although the vibratory motion is communicated to all the strata of air along the whole length of the flash, they will not all receive the same impulsion, unless they are all at the same temperature and in the same hygrometric state, which can rarely happen Hence the first impression of the sound is not always the most intense, although it proceeds from the nearest point

During a thunder storm shelter should not be taken under trees or hedges, which are likely to act as conductors, but, at the same time, a person is safer when at the distance of about 30 or 40 feet from such objects than on an open plain Water should also be carefully avoided because it is a good conductor and the height of a man above it may determine the course of the lightning In a house, the safest position is near the middle of a room and the security may be increased by sitting on a feather bed or hair mattress, or thick woollen rug, all of which are bad conductors It is injudicious to take refuge in a cellar because the discharge is often from the earth to a cloud and buildings frequently sustain the greatest injury in the basement stories It is dangerous to be near the fireplace because the chimney is the part most likely to be struck, and the soot is a powerful conductor Gilt furniture, bell wires, and all large metallic surfaces are to be avoided for the same reason (See on this subject a highly interesting *Notice sur le Tonnerre*, by Arago in the *Annuaire*, for 1838, translated in the *Edinburgh Philosophical Journal*

THURLS Short communications between the adits in mines

THURSDAY The fifth day of the week, which derives its name from Thor the old Scandinavian god of thunder, equivalent to the Jupiter of the ancients, to whom this day was also consecrated

THUS (Gr θυω, *I sacrifice*, from its use in sacrifices) The resin of the spruce fir The term frankincense is also applied to it, and to *olibanum*, which is the gum resin of the *Juniperus lycia*

THWART In Naval Affairs, used for athwart or across also a bench for rowers

THYMELACEÆ (Thymelea one of the genera) A natural order of shrubby Exogens having a calyx only, and no corolla, although the flowers of many are coloured very gaily *Daphnes*, valued for their fragrance, *Mezereung* the various species of the Australian genus *Pimelea*, and the *Gnidias* and *Struthiolas* of the Cape of Good Hope, are favourite subjects of cultivation One feature of the order is the causticity of the bark, which acts upon the skin as a vesicatory, and causes excessive pain in the mouth if chewed The berries of *Daphne laureola* (the [illegible]) are poisonous to all animals except birds.

THYMUS GLAND A gland situated under the upper part of the sternum, in the anterior mediastinum. Its excretory duct has not been detected, nor is its use known It is of great comparative size in the fœtus

THYNNUS (Gr θυννος, *a tunny*) A genus of Scomberoid fishes, of which the highly valuable fish the tunny (*Thynnus vulgaris* Cuv) is the type The form of the body in this genus of fishes is like that of the mackerel but is less compressed, the first dorsal fin extends nearly to the second, the second dorsal and the anal fins are divided into numerous finlets, the sides of the tail are decidedly carinated, [illegible] rows of small pointed teeth in each jaw The [illegible] remarkable among fishes for its high temperature, its perfect respiratory organs, the quantity of nerves supplying the gills, and the general abundance of rich red blood throughout the body It is the object of [illegible] in the Mediterranean sea, and when salted and dried serves the inhabitants of most Catholic countries with the fast

days' meat The *bonito* (*Thynnus pelamys*) is a species of the present genus of fishes

THYRIS (Gr θυρις, *a window*) A genus of butterflies

THYROID (Gr θυρεος *a shield* and ειδος *form*) The thyroid or scutiform gland is placed peculiar to the cricoid cartilage of the larynx of which it is the upper and anterior part In men it is harder and more prominent than in women, it is sometimes called *Adam's apple* The thyroid gland is situated upon the thyroid and cricoid cartilages of the trachea, its duct has not been seen, and its use is unknown When enlarged it forms the bronchocele

THYRSUS (Gr θυρσος) A staff entwined with ivy, which formed part of the accoutrement of a Bacchanal, or performer in the orgies of Bacchus

THYRSUS In Botany, a form of inflorescence, consisting of a compact panicle the lower branches of which are shorter than those of the middle, in other words, it is composed of a primary axis developing secondary axes from its sides, which in their turn develop tertiary axes, the upper and lower branches being shorter than those of the middle as in the common lilac

THYSANURANS *Thysanura* (Gr θυσανος, *fringe*, ουρα, *a tail*) The name of an order of Ametabolian insects, comprehending those in which the abdomen is terminated by filaments, or by a forked tail adapted for leaping

TIARA The well-known ornament with which the ancient Persians adorned their heads It was in the form of a tower and adorned with peacocks feathers Xenophon says that it was sometimes encompassed with the diadem, at least in ceremonies and had frequently the figure of a half moon embroidered upon it This was the name also originally given to the mitre of the popes It was nothing more than a round high cap at first single instead of double like that of the other bishops Nicholas the First added the first gold circle, as the sign of the civil power The second was added by Boniface about 1300, the third by Urban V about 1365 (Bowden *Life of Gregory VII* i 60)

TIBIA (Lat) In Anatomy the largest of the two bones which form the second segment of the leg or sacral extremity In Entomology it is the fourth joint of the leg is very long and usually triquetrous Its name is said to have reference to its resemblance to the ancient pipe or flute

TIC DOULOUREUX A very painful affection of a nerve coming on in sudden and [illegible] it is perhaps most common in that [illegible] air which comes out of the infra-orbitary foramen Nothing is known of the cause of the douloureux except in one or two very rare cases where [illegible] bone has been found pressing on the nerves The treatment is equally uncertain, except where it assumes an intermittent form and then large doses of tonics, and especially carbonate of iron have proved useful

TICHORRHINE (Gr τειχος, *a wall*, ρις *a nose*) The name of a fossil species of rhinoceros (*Rhinoceros tichorrinus*), which is so called on account of the middle vertical bony septum or wall which supports the nose

TIDE MILLS are such as have the ebb and flow of the tide for their first movers As the tide rises, the water is admitted into a reservoir through a sluice over which the mill is built turning the water-wheel in its pas[illegible] thro[illegible] are shut till [illegible] they are opened, so as to allow the water to flow out again from the reservoir, and turn the wheel as it escapes through the sluice

In some tide mills the water-wheel turns one way as the tide rises, and the contrary as it falls, but in others an arrangement is adopted by which the wheel is made to turn always in the same direction In some the water-wheel rises and falls with the tide, and in others, the axis is fixed, so that it can neither rise nor fall In the latter case, the power is applied at an obvious disadvantage though rotatory motion to a certain extent may be given even when the wheel is wholly immersed in the water, from the *difference* of the velocity of the water at the top and bottom of the sluice (See *Gregory's Mechanics*, vol ii)

TIDES The alternate rise and fall of the waters of the ocean The moon is the principal agent in the production of the tides, but they are modified, both with respect to their height and the times at which they happen, by the action of the sun The effect of the planets is inappreciable

The attractive force of a body [illegible] inversely as the [illegible] the earth on the side next the moon will be attracted with a greater, and those on the opposite side with a smaller force, than those which are situated intermediately The gravitation towards the earth's [illegible] the particles nearest the moon will therefore be [illegible] and consequently will have a tendency to move along [illegible] will rise above the [illegible] level In like manner, the moon's attraction on the most distant [illegible] and the waters will consequently be heaped up on the side of the earth which is turned away from the moon Hence if the earth were at rest, the ocean would take the form of an oblong spheroid, with its longer axis passing through the attracting body, and it may be shown from theory that the spheroid would be in equilibrium under the influence of the moon's attraction, if the longer semi-axis exceeded the shorter by about 58 inches But in consequence of the rapid rotation of the earth about its axis, the spheroid of equilibrium is never fully formed; for before the waters can take their level, the vertex of the spheroid has shifted its position on the earth's surface, in consequence of which an immensely broad and very flat wave is formed, which follows the motions of the moon at some interval of time In the open sea the time of high water [illegible] the moon's [illegible] below the horizon The tidal wave, it is to be observed is entirely different from a current the particles of water merely rise and fall, but except when the wave passes over shallows or approaches the shore, there is little or no progressive motion

The waters of the ocean are affected in a similar manner by the action of the sun under the influence of which they have a tendency to assume at every instant the form of an elongated spheroid, but although the attractive force of the sun is immensely greater than that of the moon yet by reason of his greater distance the *difference* of the effect on particles situated on opposite sides of the earth (on which difference the phenomena depend) is very much less The solar tides are therefore comparatively small with respect to the lunar tides, and, in fact, are never perceived as distinct phenomena, but become sensible only from the modifications which they produce in the heights and times of those which primarily depend on the moon At the syzigies, when the sun and moon come to the meridian together, the tides are, *ceteris paribus*, the highest, at the quadratures or when the sun and moon are 90° distant the tides are least The former are called *spring tides* the latter *neap tides* Although we are not in possession of data to enable us to compute the exact height either of the spring or neap tides, yet their relative heights in the open ocean probably correspond very nearly to the ellipticities of the spheroids of equilibrium that would be formed under the action of the two bodies exerted separately Now the ellipticity of the aqueous spheroid formed by the moon's action is about five feet, and the ellipticity of that formed by the sun's action about two feet therefore, the spring and neap tides being the sum and difference of the separate effects the average spring tide will be to the average neap in the ratio of about 7 to 3, that is, of 5+2 5−2 *See* GRAVITATION

By reason of the excentricities of their orbits the distances of the sun and moon from the earth are continually changing, and the theory of attraction proves that the efficacy of either body in disturbing the waters of the ocean is inversely proportional to the cube of its distance Hence it is found that if the mean efficacy of the sun be represented by 20, the influence of the sun's action will vary between the extremes of 19 and 21, and that of the moon's between 13 and 29 [illegible] will therefore be to the lowest [illegible], that is, as 80 to 24, or as 10 to 3

Another effect of the solar action is observed in the times at which high water takes place from day to day In the spring and neap tides the time of high water is not altered by the sun's action, the solar and lunar tides being synchronous in the former case, and the time of actual low water being that of solar high water in the latter, but in the intermediate tides the time of actual high water is accelerated or retarded In the first and third quarters of the moon, the solar wave is to the westward of the lunar one, and consequently the observed tide, which is the result of the combination of the two waves will be to the westward of the place it would occupy if the moon acted alone, and the time of high water will therefore be accelerated In the second and fourth quarters, the general effect of the sun is to produce, for a like reason, a retardation in the time of high water This result of the combined action of the two attracting bodies is what is usually termed the *priming and lagging* of the tides and it is most [illegible] the times of new and full moon

It is to be observed, however, that the effect now described is modified to some extent by the inertia of the water The greatest and least tides do not happen exactly at the times of new and full moon; but at least two, and commonly three tides after, even at places directly exposed to the general tide of the ocean In consequence of the greater amount of impressed force, the acceleration of the lunar tide is greater than that of the solar, whence it may happen that when the lunar tide occurs two or three hours after the transit of the moon

the solar tide may be three or four hours after that of the sun, so as to be about an hour later at the times of conjunction and opposition The highest spring tides will thus occur when the moon passes the meridian about an hour after the sun while at the precise time of new and full moon the lunar tide will be retarded about a quarter of an hour by the solar tide But the time of high water does not follow the moon's transit at the same interval at every period of the lunation When the sun and moon are in conjunction the interval is called the *mean interval*, at other periods of the lunation the lunitidal interval is sometimes greater and sometimes less than the mean, and the difference is called the half-monthly or

ny port, in the
what is usually
Whewell calls

this the *vulgar* establishment, and the mean of all the intervals of tide and transit for a half lunation he terms the *corrected* establishment This corrected establishment is consequently the lunitidal interval corresponding to the day on which the moon passes the meridian exactly at noon or midnight

The two tides immediately following one another, or the tides of the day and night vary, both in height and time of high water, at any particular place with the distance of the sun and moon from the equator As the vertex of the tide wave always tends to place itself vertically under the luminary which produces it, it is evident that of two consecutive tides that which happens when the moon is nearest the zenith or nadir will be greater than the other and consequently when the moon's declination is of the same denomination as the latitude of the place, the tide which corresponds to the upper transit will be greater than the lower and *vice versa*, the differences being greatest when the sun and moon are in opposition and in opposite tropics This is called the *diurnal inequality* because its cycle is one day, but it varies greatly at different places and its laws which appear to be governed by local circumstances, are very imperfectly known

We have now described the principal phenomena that would take place were the earth a sphere and covered entirely with a fluid of uniform depth But the actual phenomena of the tides are infinitely more complicated From the interruption of the land and the irregular form and depth of the ocean, combined with many other disturbing circumstances, among which are the inertia of the waters, the friction on the bottom and sides, the narrowness and length of the channels the action of the wind, currents, difference of atmospheric pressure, &c &c, great variation takes place in the mean times and height of high water at places differently situated, and the inequalities above alluded to as depending on the parallax of the moon her position with respect to the sun, and the declination of the two bodies, are in many cases, altogether obliterated by the effects of the disturbing forces or can only be detected by the calculation of long series of observations

By reason of these disturbing causes it becomes a matter of great difficulty to trace the propagation of the tide wave and the connection of the tides in different parts of the world In the *Philosophical Transactions* for 1832, Sir John Lubbock published a map of the world, in which he inserted the times of high water at new and full moon at a great number of places on the globe, collected from various sources as works on navigation, voyages, sailing directions &c, and in order that the march of the tide wave might be traced more readily, the times were expressed in Greenwich time as well as the time of the place In the same *Transactions* for 1833, Mr Whewell prosecuted this subject at greater length, and availing himself of *a priori* considerations, as well as of a mass of information collected in the Hydrographer's office at the Admiralty inserted in the map a series of *cotidal lines*, or lines along which high water takes place at the same instant of time But these cotidal lines, as Sir J Lubbock remarks are entirely hypothetical, for we have few opportunities of determining the time of high water at a distance from the coast, though this is sometimes possible by means of a solitary island, as St Helena (*Lubbock's Elementary Treatise on the Tides*, 1839)

According to Mr Whewell's deductions from several

latitudes of 30 and 70 degrees, that a zone of water exists of sufficient extent to allow of the tide wave being fully formed Suppose, then, a line of contemporary tides, or *cotidal line*, to be formed in the Indian Ocean,
that is to say, in the direction of
certain distance to the eastward of the meridian in which the moon is As this tide wave passes the Cape of Good Hope it sends off a derivative undulation, which advances northward up the Atlantic Ocean, preserving always a certain proportion of its original magnitude and velocity In travelling along this ocean the wave assumes a curved form, the convex part keeping near the middle of the ocean, and ahead of the branches, which, owing to the
on the American and African
lines have always a tendency to make very small angles with the shore and in fact, run nearly parallel to it for great distances The main tide Mr Whewell observes, in reaching the Orkneys, will move forward in the sea bounded by the shores of Norway and Siberia on the one side, and those of Greenland and America on the other, will pass the pole of the earth, and finally end its course on the shores in the neighbourhood of Behring's Straits
the straits, and
But a branch tide is sent off from this main tide into the German Ocean, and this, entering between the Orkneys and the coast of Norway brings the tide to the east coast of England and to the coasts of Holland, Denmark, and Germany Continuing its course part of it at last passes through the strait of Dover, and meets in the British Channel the tide from the Atlantic, which arrives on the
but in passing along
is reflected from the
north coast of Germany and again meets the tide wave on the shores of Denmark Owing to this interference of different tide waves the tides are almost entirely obliterated on the coast of Jutland, where their place is supplied by continual high water

In the Pacific Ocean the tides are very small, but there are
the whole shore of Terra del Fuego from the western extremity of the Strait of Magalhaens to Staten Island, it is very remarkable that the tidal wave, instead of following the moon in its diurnal course, travels to the *eastward* This, however, is a partial phenomenon, and a little farther to the north of the last-named places the tides set to the north and west In the Mediterranean and Baltic seas the tides are inconsiderable, but exhibit irregularities for which it is difficult to account The Indian Ocean appears to have high water on all sides at once though not in the central parts at the same time

Since the tides on our coasts are derived from the oscillations produced under the direct agency of the sun and moon in the Southern Ocean and require a certain interval of time for their transfer it follows that, in general the tide is not due to the moon's transit immediately preceding, but is regulated by the position which the sun and moon had when they determined the primary tide The time elapsed between the original formation of the tide and its appearance at any place is called the *age* of the tide and sometimes after Bernoulli, the *retard* On the shores of Spain and North America the tide is a day and a half old, in the port of London, it appears to be two days and a half old when it arrives

*Velocity of the Tide Wave* — In the open ocean the crest of the tide travels with enormous velocity If the whole surface were uniformly covered with water the summit of the tide wave being mainly governed by the moon, would every where follow the moon's transit at the same interval of time and consequently travel round the earth in a little more than 24 hours But the circumference of the earth at the equator being about 25 000 miles the velocity of propagation would therefore be about 1000 miles per hour The actual velocity is perhaps nowhere equal to this and is very different at different places In latitude 60° south where there is no interruption from land (excepting the narrow promontory of Patagonia), the tide wave will complete a revolution in a lunar day, and consequently travel at the rate of 670 miles an hour On examining Mr Whewell's map of cotidal lines it will be seen that the great tide wave from the Southern Ocean travels from the Cape of Good Hope to the Azores in about 12 hours and from the Azores to the southernmost point of Ireland in 3 hours more In the Atlantic the hourly velocity in some cases appears to be 10° of latitude or near 700 miles, which is almost equal to the velocity of sound through the air From the south point of Ireland to the north point of Scotland the time is 8 hours and the velocity about 160 miles an hour along the shore On the eastern coast of Britain and in shallower water, the velocity is less From Buchanness to Sunderland it is about 60 miles an hour from Scarborough to Cromer 35 miles, from the North Foreland to London 30 miles, from London to Richmond 13 miles an hour in that part of the river (Whewell, *Phil Trans* 1833 and 1836) It is scarcely necessary to remind the reader that the above velocities refer to the transmission of the undulation, and are entirely different from the velocity of the current to which the tide wave gives rise in shallow water

*Range of the Tide* — The difference of level between high and low water is affected by various causes, but chiefly by the configuration of the land, and is very different In deep in bends of the shore,
the tide wave, and gradually contracting like a funnel, the convergence of the water causes

a [illegible] of the range Hence the very high ti[illegible] Channel, the Bay of St Malo, and the Bay of Fundy where the tide is said to rise sometimes to the height of 100 feet Promontories, under certain circumstances, exert an opposite influence, and diminish the magnitude of the tide The observed ranges are also very anomalous At certain places on the south-east coast of Ireland the range is not more than 3 feet, while at a little distance on each side it becomes 12 or 13 feet, and it is remarkable that these low tides occur directly opposite to the Bristol Channel where (at Chepstow) the difference between high and low water amounts to 60 feet In the middle of the Channel it amounts only to 2 or 3 feet At the London Docks the average range is about 22 feet at Liverpool 15 5 feet, at Portsmouth 12 5 feet, at Plymouth also 12 5 feet, at Bristol 33 feet

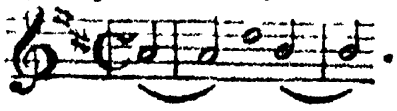
*Theory of the Tides* — The theory of the tides, considered as a consequence of solar and lunar attraction, was first sketched by Newton in the *Principia* In the 36th and 37th propositions of the third book, he determines the forces of the sun and moon to elevate the waters of the ocean, on the supposition that the sea is a fluid of the same density as the earth covering the whole terrestrial surface and which takes at every instant the figure of equilibrium He assumes, without demonstration, that this figure is an elongated spheroid One spheroid he supposes to be formed under the action of the sun, another under the action of the moon, and by reason of the smallness of their eccentricities they may be conceived as superposed the one on the other From these suppositions he deduced the general phenomena of the ebb and flow of the sea, and by comparing his theory with observations of the heights of the spring tides made at the mouth of the Avon near Bristol he determined the ratio of the attraction of the moon to that of the sun to be nearly 4 48 to 1, whence he deduced the mass of the earth to be to that of the moon as 39 788 to 1 the density of the sun to that of the earth as 1 to 4 and the density of the moon to that of the earth as 11 to 9 Newton's theory was defective in many points of view, but fifty years elapsed before it received any improvement In 1738, the subject of the tides was proposed as a prize question by the French Academy of Science which gave occasion to the celebrated treatises of Daniel Bernoulli Maclaurin, and Euler Maclaurin's Essay is remarkable [illegible] a demonstration of the theorem assumed by Newton that the elliptic spheroid affords an equilibrium under the action of the disturbing forces those of Bernoulli and Euler though they furnish no new principle of equal or similar importance in point of theory enter more into details and contain many useful illustrations That of Bernoulli indeed contains a table which has served as the model for all those (not purely empirical) which have since been formed The next important step in the theory of the tides was taken by Laplace, who first treated the subject as a general question of hydrodynamics and attempted to deduce the principal phenomena from the equations of the motions of fluids But in order to simplify the equations which are of a very complicated nature, he was forced to have recourse to the hypothesis of a fluid covering entirely a spheroid of a regular surface and consequently the results were far from representing the actual observations of the tides at any port The late Dr Thomas Young (*Ency Brit* art "Tides") extended Laplace's method to the more general case of an ocean covering a part only of the earth's surface and more or less irregular in its form, and attempted also to include in his calculation the effect of hydraulic friction on the times and magnitudes of the tides It is however, quite impossible to embrace in any calculation the whole of the accessory circumstances which influence the times and magnitudes of the tides the greater part of which are, in fact entirely unknown, and therefore, says Laplace all we can do is to analyze the general phenomena which should result from the joint action of the sun and moon and deduce from observations the data which are indispensable for completing the theory of the tides for each particular port

A great number of observations of the tides at the port of Brest during the last century, were discussed by Laplace in the *Mecanique Céleste*, but in order to determine the motion of the tide wave, and separate the general laws of the phenomena from local irregularities, it is necessary to have regular series of observations made at different parts of the ocean In 1829 Sir John Lubbock undertook the discussion of the tide observations which are made at the London Docks with the view of obtaining correct tables for predicting the time and height of the tides for the *British Almanac* The results which were published in the *Philosophical Transactions* for 1831, are deduced from a series of upwards of 13 000 observations, during a period of nineteen years, and are of great importance both as affording materials for the construction of tide tables and as pointing out the defects of the equilibrium theory with which they were accurately compared In some of the subsequent volumes of the *Transactions* the author has continued his investigations, and has also published, separately, an account of Bernoulli's *Traité sur le Flux et Reflux*, and an elementary treatise, which appeared in 1839 In the *Phil Trans* for 1833, Mr Whewell gave an *Essay towards a first Approximation to a Map of Cotidal Lines*, which has been followed by a series of interesting papers in the subsequent volumes to the year 1850 Mr Whewell's researches have been directed to the determination of the following points, [illegible] the tide wave at different parts of the ocean, [illegible] the observed laws at different [illegible] lastly, the laws of the diurnal inequality In 1834 the British Association procured an extensive series of observations to be made on the coasts of Britain and Ireland at 537 stations of the coast-guard These were repeated at the same places in June, 1835, and, at the request of our government, simultaneous observations were made by the other maritime powers of Europe and the United States The number of stations in America was 28, extending from the mouth of the Mississippi to Nova Scotia, and the number on the continent of Europe 101, between the straits of Gibraltar and the north Cape of Norway The results of these observations, reduced under Mr Whewell's superintendence, were published in the *Phil Trans* for 1836, and they are of great importance not only as affording a far more precise determination of the progress of the tide wave and the forms of the cotidal line on the coasts of Europe and North America than previously existed, but as furnishing more correct data for the construction of the tide tables (See *Phil Trans* for 1842, 1843 and 1845 for *Papers by Mr Airy on the Laws of the Tides at Ipswich and Southampton, in the River Thames, and on the Coasts of Ireland*)

*Influence of Atmospheric Pressure and Winds* — Besides the numerous causes of irregularity depending on the local circumstances the tides are also affected by the state of the atmosphere At Brest, the height of high water varies inversely as the height of the barometer and rises more than eight inches for a fall of about half an inch of the barometer At Liverpool, a fall of one tenth of an inch in the barometer corresponds to a rise in the river Mersey of about an inch, and at the London Docks a fall of one tenth of an inch corresponds to a rise in the Thames of about seven tenths of an inch With a low barometer the tides may therefore be expected to be high and *vice versa* The tide is also liable to be disturbed by winds Sir J Lubbock states that in the violent hurricane of Jan 8 1839 "there was no tide at Gainsborough which is twenty-five miles up the Trent — a circumstance unknown before At Saltmarsh only five miles up the Ouse, from the Humber, the tide went on ebbing and never flowed till the river was dry in some places, while at Ostend, towards which the wind was blowing, contrary effects were observed During strong north westerly gales the tide marks high water earlier in the Thames than otherwise and does not give so much water whilst the ebb tide runs out late, and marks lower, but upon the gales abating and the weather moderating the tides put in, and rise much higher whilst they also run longer before high water is marked, and with more velocity of current, nor do they run out so long or so low (*Elementary Treatise on the Tides* See also *Airy's Treatise on Tides and Waves* in the *Encycl Metropol*)

TIDE GAUGE A mechanical contrivance for registering the state of the tide continuously at every instant of time In the *Phil Trans* for 1838, there is a description of a very complete [illegible] machine for this purpose erected at Bris[illegible] M Bunt The principal parts are an eight day clock which turns a vertical cylinder revolving once in twenty four hours, a wheel to which an alternate motion is communicated by a float rising and falling with the tide, and connected with the wheel by a wire passing over a pulley and kept constantly strained by a counterpoise, and a small drum on the same axis with the wheel, which communicates one eighteenth of the motion of the float to a bar carrying a pencil which describes a curve on the cylinder and marks the fluctuations and the time and height of high water Various tide gauges, on [illegible] have been constructed by others, [illegible] Lloyd Mr Mitchell, Mr Palmer, Mr Bunt Mr Hewitson, and Mr Newman (See the *Nautical Magazine* for October, 1832, and *Phil Trans* for 1831 and 1838, and *Jury Report*, Class 10 *of the Great Exhibition of* 1851)

TIE In Architecture, a piece of timber or metal placed in any direction, whose office is to bind two bodies together which have a tendency to separate or diverge. *See* ROOF

TIE In Music, a character ‿ used in ancient music to connect syncopated notes, which were divided by a bar, thus  .

TIER A row or range of guns, casks, &c Also the place on the orlop deck on which the cables are stowed.

**TIERCE.** In Heraldry, a term used for the field when divided into three parts

**TIERS E'TAT** In the French [illegible] or commonalty, in the French estates [illegible] meaning of the word are illustrated by M Gautier (*Mém de l'Acad. des Inscr* vol xxxvii) The important part which the representation of the tiers état played at the commencement of the French revolution is known to all Previous [illegible] ition, the French were [illegible] the nobles, the clergy, [illegible] their united capacity the states general of the kingdom, and their deliberations were separately conducted by individual vote in different chambers, in [illegible] [illegible] Now as the number of the deputies was nearly equal in each order, the result of the votes taken collectively was always necessarily favourable to the privileged orders Hence it was loudly demanded that the number of the third or tiers estate should be doubled, and the definite resolutions decided by individual instead of collective votes It was owing to the refusal of [illegible] this demand, that [illegible] accelerated and to the consummation of this event a celebrated pamphlet of Sièyes, entitled *Qu'est ce que le Tiers Etat*, in a [illegible] See ASSEMBLY

**TIGER** A [illegible] as large as the lion, but with a rounder head and longer body, of a bright reddish fawn colour above a pure white below, irregularly crossed with black stripes It is clothed with short hairs, and has no mane The tiger is the most formidable and cruel of all quadrupeds, and the scourge of the less inhabited parts of India It is limited to the A[illegible] See FELIS

**TILIACEÆ** (*Tilia*, the linden or lime tree) form a natural order of Exogenous plants, very nearly allied to the M[illegible], from which they differ in the stam[illegible] In useful qualities they resemble that order the bark being tough their sap mucilaginous, and their timber light Russia mats are made from the tough inner bark of the common lime tree, and a species of Corchorus, called *olitorius* is employed in India as a potherb A few have gay flowers, but the majority are plants of little interest

**TILLAGE LANDS** Lands kept under the plough, that is, cropped with annual or biennial plants, which require a continual change of the surface soil by stirring and turning with the plough or other [illegible] plements, and by the addition of manure [illegible] plants of Britain and of analogous climates are chiefly the bread corn, leguminous or pea flowered plants such as the bean, pea tares, clover, &c, plants cultivated for their roots or tubers, such as the turnip carrot potato, &c, or plants cultivated for their seeds, such as mustard, rape, or for the entire plant, such as wood, flax, hemp, and a variety of others

**TILLER.** In Naval Language, the bar placed in the head of the rudder to turn it

**TILMUS** (Gr τιλλω, *I pluck*) Picking of the bedclothes, or floccitation; a symptom of the fatal termination of some disorders

**TIMBER** In Carpentry, a word used to denote those pieces of wood that admit of being squared, or are capable of being employed in house and ship-building

The trade in timber is one of great extent and importance In fact, if there be one article more than another [illegible] of the [illegible] importance that a great [illegible] like England should be [illegible] to the lowest possible terms, that article is timber But [illegible] years, this sound principle has been most materially interfered with, partly for the sake of revenue, and partly to foster a trade with our North American colonies This fostering system was carried to such an extent, that from 1820 down to 1842, a duty of 55*s* a load was laid on foreign timber, or timber from the N of Europe, while timber from British America was admitted at a duty of 10*s* a load making a discriminating or differential duty of no less than 45*s* a load in favour of the latter! Such a preference would, under any circumstances, have been most injurious, but it has been especially so from the fact of the timber of our North American possessions being unsuitable for various important purposes And though greatly modified this objectionable system is not yet wholly abandoned. In 1842 Sir Robert Peel reduced the duty on foreign timber to 25*s* a load which was a wise and a judicious measure But the duty of 10*s* on colonial timber was then, also, reduced to 1*s*, so that the differential duty continued to be such as to hinder any material change in the course of the trade, while, as there was little decline in the price of colonial timber, the heavy loss to the revenue was not fully compensated by the advantage to the consumer In 1846 the duty on foreign [illegible] was further reduced to 15*s* a load, and [illegible] was reduced to 7*s* 6*d* a load, which is as low as it should be, or lower Certainly, however, there was good reason why the duty of 7*s* 6*d* should not be extended to colonial timber It may, no doubt be said that the better plan would be to repeal the duty, but we should be inclined to dissent from such a proposal Except, perhaps, on ships the duty, supposing it to be extended to colonial timber, is now so limited that it can have no sensible, or, at all events, no prejudicial effect It must, however, be allowed that it is against all principle to admit foreign built ships duty free to the privileges of British ships, at the same time that a duty is laid on the timber employed in building the latter But this contradiction might be obviated without sacrificing the timber duties, by the easy expedient of allowing ships to be built in bond The importation and consumption of timber in the United Kingdom in the under-mentioned years has been as follows —

| Articles | Import ending 1st February | | | Consumption, ending 1st February | | |
|---|---|---|---|---|---|---|
| | Average of 1815—1849 | 1850 | 1851 | Average of 1815—1849 | 1850 | 1851 |
| *British America* | | | | | | |
| Pine, cubic feet | 6,313,514 | 6 392 026 | 5 652 213 | 6,172 114 | 5,689,026 | 6,375,213 |
| Oak [illegible] standard | 476 278 | 529 [illegible]8 | 528,213 | 490,089 | 481,212 | 479,914 |
| Staves, standard [illegible] | 226 | 377 | 225 | 239 | 316 | 286 |
| puncheon — | 706 | 1,010 | 1 129 | 794 | 718 | 1,034 |
| Pine &c planks, ft of 2 in | 18 441 [illegible]82 | 21,354 965 | 24,987 998 | 17,269,682 | 18,831,965 | 26,880,998 |
| Boards — | 492 [illegible]20 | 558 934 | 501 874 | 461,520 | 578 934 | 431,874 |
| Hardwood (Birch), cubic feet | 324,56[illegible] | 319,057 | 543,709 | 326 265 | 284,057 | 461,709 |
| Lathwood, fathoms | 1,351 | 828 | 950 | 1,417 | 894 | 1,037 |
| Sleepers, pieces | - | 209,036 | 22,246 | - - | 186,750 | 175,246 |
| *Baltic* | | | | | | |
| Timber Danzig, Memel, Riga, &c cubic feet | 956 133 | 301,090 | 399 255 | 900,533 | 497 090 | 434,255 |
| Deals, standard | 1,774 | 1,769 | 1 246 | 1,540 | 2,000 | 2,312 |
| Battens, standards | 504 | 644 | 266 | 417 | 697 | 493 |
| Wainscot logs whole | 540 | 151 | 739 | 414 | 701 | 463 |
| Wainscot logs half | 137 | - - | 363 | 125 | 47 | 341 |
| [illegible] | 2,085 | 367 | - - | 1,912 | 1,049 | 939 |
| [illegible] | 48 | 39 | 50 | 48 | 54 | 45 |
| [illegible] | 740 | 290 | 702 | 711 | 461 | 675 |
| Sleepers, pieces | - - | - - | - - | - | 286 | |
| Mahogany, logs | 20,388 | 23,761 | 27,478 | 19 636 | 23,905 | 27,847 |
| [illegible] | 1,77[illegible] | 5[illegible]0 | 492 | 1,880 | 462 | 504 |
| [illegible] | [illegible] | [illegible] | [illegible] | 2 [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

**TIME** A limited portion of duration, measured by certain conventional or natural periods, and often marked by [illegible] as the revolution of the celestial bodies, [illegible] of the sun, or the rotation of the earth on its axis

*Absolute Time* is time considered in itself without reference to that portion of duration to which it belongs, however noted or marked

*Relative Time* is time considered with reference to the termini of some specific interval of duration

*Apparent Time* is time deduced from observations of the sun, and is the same as that shown by a properly adjusted sun-dial.

*Mean Time* is that shown by a well-regulated clock, and would be the same as that shown by the sun, if the sun were always in the equator, and his apparent diurnal motion in the heavens were uniform

*Sidereal Time* is the portion of a sidereal day which has elapsed since the transit of the first point of Aries [illegible] of what-[illegible]

**TIME** In Music, that affection of sound whereby [illegible] is determinated as regards its con[illegible] same degree of time The signs or characters by which the time of notes is represented are given under the article Music

*Astronomical Time of Day* is the time past *mean noon* of that day, and is reckoned on to twenty-four hours in mea ı time

*Civil Time* is mean time adapted to the purposes of civil life The day commences at the midnight preceding the noon of the day a d is divided into parts of twelve hours each, the first twelve marked A M or *ante meridiem*, and the second P M or *post meridiem*

TIMOCRACY (Gr τιμοκρατια ) A term made use of by some Greek writers, especially Aristotle, to signify a peculiar form of constitution , but there are two different senses in which it is thus used, corresponding to the different meanings of the word τιμη, *a price* or *honour*, from which it is derived According to the first it represents a state in which the qualification for office is a certain amount of property , in the latter it is a kind of mean between aristocracy and oligarchy, when the ruling class, who are still the best and noblest citizens, struggle for pre eminence amongst themselves (See *Quart Rev* vol xlv )

TIN (Germ zinn ) This metal was known to the ancients, who procured it from Spain and Britain It appears to have been in use even in the time of Moses (Numbers xxxvi 22 ) It is rather a scarce metal, found in few parts of the world in any quantity Cornwall is its most productive source it also occurs in the mountains between Gallicia and Portugal and in those between Saxony and Bohemia Tin has also been brought from the peninsula of Malacca in India, and from Chili and Mexico There are only two ores of tin , the native peroxide, and the double sulphuret of tin and copper the latter sometimes called *bell-metal ore*, is extremely rare and it is exclusively from the former that the commercial demands are supplied In Cornwall, the native peroxide or *tin stone* (which is usually blended with oxides of iron and manganese), occurs in *veins* and in loose grains and nodules in alluvial soil the latter is called *stream tin* and from it the purest metal is obtained The ore is reduced by a very simple process , it is ground, washed and roasted in a reverberatory furnace it is then mixed with charcoal or Welsh culm and limestone, and strongly heated, so as to bring the whole into fusion, which is kept up for eight or ten hours the lime combines with the earthy matters of the ore into a fusible slag, whilst the coal reduces the oxide to the metallic state, and the fused metal is drawn out at the bottom of the furnace into a clay mould In this impure state it is exposed to a heat just sufficient to melt the pure tin, which runs off into a kettle while the less fusible impurities remain behind in the kettle the tin is kept in fusion, and agitated by plunging pieces of wet charcoal into it which causes a quantity of dross to rise to the surface, where it is skimmed off and the purified metal is then cast into blocks of about 3 cwt each

The stream tin is smelted by charcoal and the mass of grain tin obtained by such reduction is heated and let fall from a height, by which it splits into masses of a columnar fracture which characterizes the pure metal

Pure tin is a white brilliant metal It has a slight taste and smell when rubbed and its hardness is intermediate between that of gold and lead Its specific gravity is 7 2 It is very malleable , and one of its most useful forms is that of foil which is made by beating it s about a thousandth of an inch in thickness Its ductility and tenacity are inferior to most of the other malleable metals A tin wire 78 thousandths of an inch in diameter will not support more than 38 pounds without breaking It produces a peculiar crackling noise when beat Exposed to air it soon becomes superficially oxidized , and when melted successive films of a gray powder form upon its surface The temperature at which it melts is about 442° At a white heat it takes fire, and burns with a bright flame The equivalent of tin is 58 It forms two oxides The protoxide is thrown down by alkaline carbonates from an aqueous solution of protochloride of tin , and when dried and heated out of the contact of air its water is expelled, and it remains in the form of a dark substance, of the specific gravity 6 6 It burns like tinder and becomes converted into the peroxide It is soluble in sulphuric and hydrochloric, and in dilute nitric acid and in the pure fixed alkalies Its salts have a strong attraction for oxygen, and easily pass into persalts , so that it is a powerful deoxidizing agent, and is often used as such in some of the chemical arts When a solution of protochloride of tin is dropped into a solution of perchloride of gold, a purple precipitate, called from its inventor, *purple of Cassius*, is thrown down it appears to be a compound of peroxide of [illegible] with protoxide of gold [illegible] the deoxidizing powe[illegible] tin foil is put into nitric acid there is violent action, attended by the decomposition of the acid and the peroxidizement of the tin, which is thus converted into a white powder this when edulcorated and dried at a red heat acquires a yellow tint It does not easily form permanent compounds with the acids but it unites with the pure alkalies, and forms soluble compounds, which have sometimes [illegible] he peroxide itself *stannic aci*[illegible] are respectively composed of [illegible] tin and 8 oxygen and 58 tin and 16 oxygen their equivalents therefore are 66 and 74 Tin and chlorine also combine in two proportions the *protochloride of tin* is formed by passing hydrochloric acid gas over metallic tin gently heated in a glass tube, or by heating a mixture of equal weights of tin filings and calomel, when it remains, after driving off the mercury, in the form of a gray solid, fusible at a red heat, and volatile at higher temperatures Its aqueous solution is commonly termed *protomuriate of tin* When tin is heated in excess of gaseous chlorine, or when 1 part of tin filings is mixed with 3 of corrosive sublimate and heated, a volatile liquid distils over which is *perchloride of tin*, and its aqueous solution forms the *permuriate* Exposed to air it is decomposed by the aqueous vapour of the atmosphere, and exhales dense white fumes hence it has been called, after its discoverer, *fuming liquor of Libavius* Both the protomuriate and permuriate of tin are used by dyers and calico-printers The former is prepared by heating granulated tin in strong hydrochloric acid as long as hydrogen continues to be evolved , the latter, by gradually dissolving granulated tin in a mixture of two parts by measure of hydrochloric acid, one of nitric acid and one of water These chlorides of tin are respectively composed of 58 tin and 36 chlorine and 58 tin and 72 chlorine and are therefore represented by the equivalents 94 and 130

When melted tin and sulphur are brought together, a black *protosulphuret of tin* is formed The *bisulphuret of tin* is a yellow glistening substance, sometimes called *Mosaic gold* (*aurum musivum*), and used in ornamental japan work It is prepared by heating in a glass retort 2 parts of peroxide of tin, 2 of sulphur and 1 of sal ammoniac and [illegible] a low red heat till sulphurous acid ceases to be evolved The sulphuret and bisulphuret of tin are constituted of 58 tin and 16 sulphur and 58 tin and 32 sulphur , and have, therefore the equivalents 74 and 80 The total produce of the tin mines and works of Cornwall may at present (1842) be estimated at about 4000 tons a year, worth from 65*l* to 80*l* a ton

TINCA (Lat tinca *a tench* ) A subgenus of Cyprinoid fishes characterized by having short anal and dorsal fins , very short barbules or tentacles about the mouth no bony serrated ray at the commencement of either the dorsal or anal fins , small scales Like the rest of the Linnæan *Cyprini* the *Tincæ* or tenches have no teeth except in the pharynx whence the name of "leather mouthed fishes " applied to this family of *Pisces Abdominales*

TINCAL The commercial name of rough borax as imported from India

TINCTURE A pharmaceutical preparation generally consisting of active remedies dissolved in rectified or proof spirit Tinctures are generally made by digesting bruised or pulverized vegetable substances in the spirit, either at common temperatures or aided by heat The term *tincture* is sometimes applied to alcoholic solutions of resins of which tincture of myrrh of assafœtida &c furnish instances Tinctures, from the quantity of alcohol which they contain are necessarily exhibited in small doses the most important of them are those which contain highly active ingredients, such as tincture of opium &c

TINCTURES in Heraldry are of three descriptions metals colours and furs The former are or, argent , the second gules azure sable vert purpure, sanguine, and tenny The chief furs are ermine and vair , but there are several varieties of both distinguished by different names Each metal and colour in blazonry (except the two last and least honourable sanguine and tenny) is represented by a distinct precious stone and heavenly body , and when the arms of sovereign princes or high dignities are described by old heralds, the tinctures are frequently denoted by the names of these jewels or celestial bodies See OR, ARGENT &c

TINEA The scald head See RINGWORM

TIN PLATE White iron The art of tinning iron originated in Saxony and was first made known here by Mr Andrew Yarranton, about the year 1665 , but it was not till nearly a century afterwards that works were established for its production upon a large scale at Pontypool It is made by immersing for about one hour and a half very carefully cleaned plates of rolled iron in melted tin, by which they acquire a bright surface, and are applicable to a number of purposes for which iron plate, in consequence of the [illegible] which it rusts, could not be used [illegible] ture of the surface of thes[illegible] by washing it over with a [illegible] it with an alkaline ley and varnishing with a transparent varnish Thus modified, it forms an ornamental article called *moirée métallique* (On the manufacture of tin plate, see *Parkes's Chemical Essays* )

TIRONIAN NOTES The short-hand of Roman

a [illegible] Accord ng to the received story they were [illegible] Romulus Piro the [illegible] favour to [illegible] he is supposed to have imported [illegible] Greek MSS, which these, and [illegible] called the Tironian notes, are not infrequently of the date of the 7th century and downwards, and never are [illegible] in marginal notes Kopp (*Tachygraphia veterum Exposita*, p 1817) thinks that they are called from the word *tiro*, a learner His second volume contains a dictionary of these notes, which he appears to have succeeded in deciphering Some have thought that valuable lost classics may be recovered through this key, but as yet these hopes have been nugatory (See *Ed Rev* vol xlviii p 357 &c)

TI'SRI The first Hebrew month of the civil year, and the seventh of the ecclesiastical year It corresponds to part of September and October

TI'SSUE, in Plants the thin membranous organization of which every part is composed microscopical in size, and often appearing to the naked eye homogeneous, although it consists of a great variety of forms closely compacted Vegetable anatomists regard its primitive form as spiral and that the tubes and spiral vessels are mere extensions of that form Tissue appears to be in all plants of the same nature originally, but it soon becomes altered by the deposition of various secretions upon its sides

TI'TAN In Grecian Mythology, according to the more modern account, the eldest son of Uranus and Gaia, who relinquished the sovereignty of gods and men to his younger brother Saturn [illegible] His children [illegible] those of Titan He afterwards recovered the sovereignty from Saturn, but Jupiter the son of the latter vanquished him, and restored it to his father This however, is a tale altogether unknown to the original mythologists According to them, the Titans were many in number, children of Uranus and Gaia Hesiod makes them six The children of the Titans Atlas for example retained the same appellation The war of these Titans with Jupiter was the subject of many different and contradictory legends Its scene was laid in Thessaly, by Homer on the mountains Olympus Pelion and Ossa By some writers Titan is identified with Hyperion, but this point is involved in great obscurity

TITANITE Native oxide of titanium

TITA'NIUM A rare metal discovered by Gregor in a mineral from Cornwall called *menachanite* Its characters were first ascertained by Klaproth who gave it the above name In the year 1822 Dr Wollaston ascertained that the minute copper-coloured crystals occasionally found in the slag of the iron smelting furnaces at Merthyr and elsewhere were pure titanium and it is to him that we are indebted for a precise account of its properties [illegible] colour is extremely infusible, [illegible] 58, it is so hard as to scratch not only glass but crystal It resists the action of air and acids but is oxidized by the action of nitre at a red heat [illegible] of two degrees of oxidizement [illegible] blue or purple [illegible] called *anatase* [illegible] pure in *titanite* or *rutilite*, and is combined with the oxides of iron and manganese in *menachanite* The equivalent of titanium has not been very satisfactorily ascertained, but it is probably about 24 upon the hydrogen scale

TI'THES In Ecclesiastical Law, the tenth part of the produce of the land, which in this and other Christian countries, was anciently set apart for the endowment of the church By the Mosaical law, the Levites by whom the public worship of the Jewish state was performed, were supported, not as the other tribes, by the allotment of a certain district of Canaan but by the appointment of divers cities in various parts of the country for their abode, and the payment of tithes from the whole community This ordinance has frequently been appealed to under the Christian dispensation as establishing the divine right of the clergy to the receipt of tithes for ever, but this ground of claim has been generally abandoned in modern times, nor does the practice of the early church, at its first establishment in connection with the state, give any reason to suppose that such an idea was then entertained Nor, in this country do the people conversion, to have felt [illegible] of any strict payment of tithes It was [illegible] siastical [illegible] discovered in the laws of Offa, king [illegible] In France, a similar law was enforced [illegible] 778, and from that time the payment has been continued without interruption to modern times

Of tithes there are three kinds —1 *Predial*, of the vegetable productions of the land, as corn, hay, &c, 2d, *Mixed*, as of wool, pigs, &c, which, though natural products [illegible] 3d *Personal*, as of the profits [illegible] like And the third division [illegible] small



or parsonage and vicarage tithes of these the former are chiefly corn, hay and wood the latter are predial tithes of other kinds together with mixed and personal tithes The great tithes belong to the rector whereas only the small tithes are due to the vicar By the original law, all the land of [illegible] excepting the property of the [illegible] church itself But when at the Reformation the monasteries were dissolved, and their estates granted for the most part to laymen, these lands would have become tithable again, but for a particular statute which was enacted for the advantage of the new possessors It was also allowable, up to the 13 Eliz, to effect compositions between the clergy and owners of the land, by which the parish was discharged of these payments for ever, in consideration of lands made over to the parson in exchange This practice was, however, restrained by the statute above referred to, which limited all such compositions to a period of three lives or twenty-one years From these causes, however, it is that we find a great deal of land in the hands of lay proprietors not subject to this charge The monasteries, however held one third of the benefices of the kingdom, from all of which they received tithes, and appointed members of their own body, as their vicars or curates, to discharge the ordinary functions of ministers in them To these they either gave fixed stipends, or allotted the small tithes taking, as their own share the greater or rectorial This is called *appropriation* of tithes, but when these benefices fell into the hands of laymen the same practice was continued, and is distinguished by the title of *impropriation*

Tithes are either due *de jure* or by custom to the latter class belong all personal tithes

The subtraction of tithes from a parson, whether a clergyman or lay impropriator (*see* IMPROPRIATION), or from a vicar, is cognizable in the ecclesiastical courts But these courts cannot try the right to tithes except between spiritual persons, consequently if the defendant pleads any matter involving the question of right it must be tried by [illegible] suits are generally carried in the Court of Exchequer By the 53 G 3 c 127 justices of the peace have jurisdiction for the recovery of small tithes to the amount of 10*l*

Lands and their occupiers may be discharged from the payment of tithes either in part or totally, by a real composition or by custom or prescription The first is where an agreement is made between the owner and the parson or vicar, with consent of the ordinary and patron, that some land or other real recompence, be given in satisfaction of tithes By 13 Eliz c 10 as we have seen, no real composition made since that statute is good for any longer time than three lives or twenty one years Compositions between a tithe-owner and parishioner cease on the death of the incumbent with whom they were made

A discharge by custom or prescription is either, 1 *De modo decimandi* where a *modus*, or particular manner of tithing is shown to exist by custom, which must have existed immemorially [illegible] is not good if evidence be shown of its non existence at any time since the reign of Richard I Or 2 *De non decimando*, where a total exemption from tithes is shown

Such is a general view of the law of tithe previous to the great changes introduced by the Tithe Commutation Act 6 & 7 W 4 c 71 the object of which was to convert a tax, imposed on the gross produce of the soil, and varying annually in amount as well as money value along with it, into a [illegible] charge perpetual as to the amount, but varying according to the money value

By this act the money value of the tithes in each parish was to be calculated according to the average of the seven years ending at Christmas, 1835 *minus* the expences of collecting &c, but without deduction on account of parochial or county rates, &c The commissioners appointed for that purpose under the act were then to award that sum (subject to some unimportant allowances) as the amount of the rent charge to be paid in respect of the tithes This rent-charge was to be [illegible] among the lands of the parish, having [illegible] to their average tithable produce and productive [illegible] rent-charge, being thus valued in money, was to be taken as the price of such a quantity of wheat, barley, and oats as it would have purchased (each grain in equal quantities), according to the average price at the period of the confirmation of the apportionment That quantity of grain was therefore to remain for ever as the annual charge upon the parish In order to regulate the money amount of the tithes, the money payment each year was to be equal to the price of that quantity at the average of the seven years immediately preceding, to be ascertained by an advertisement of the comptroller of corn returns published in the month of January every year The rent-charge to be paid by the occupiers of the land on which it is respectively apportioned

It will be apparent from this brief outline of the provisions of the act that a very great benefit was conferred by it, for all immediate purposes, upon the tithe owner,

and for many upon both parties The strifes and heart-burnings between the occupiers of the soil and the clergyman which were occasioned by the old mode of collecting the impost, have been removed The latter has been relieved alike from the consequences of indulgence towards his debtors, and the imputation of rapacity In point of fact, the result of the valuation has been a considerable improvement in the incomes of the clergy who comparatively seldom received their full due The tenant and landowner gain by the removal of a most injurious tax on improvement, for the tithe, while it increased along with the produce of the land, acted as a great discouragement to increasing that produce

But looking to the future, its advantages are far more questionable The tithe owner will gain, no doubt, by any increase which may take place in the money price of corn But he will be a loser by any fall in the price of corn, while any increase in the quantity of commodities produced in the country, the price of corn remaining the same, will leave his condition stationary, while other classes advance It is thought that, in the last century, the agricultural produce of England has trebled The tithe has nearly trebled along with it If the same progression should continue for a century more, the produce of the country will again have trebled, rents and other incomes will have increased in proportion population will have followed the same law of advance —tithe will remain stationary, the income of the church will be no greater than what is now deemed sufficient for her support, while the exertions required of her will have greatly augmented

And a permanent rise in the money price of corn, which might compensate this relative loss is probably the last thing to be anticipated Indeed should that price fall materially from the introduction of foreign grain it will, probably, be necessary to commute anew if the income of the tithe-owners is to be maintained at all

To those who consider the sufficient temporal maintenance of the church a matter of high national interest, this prospect is a serious one, but even those who think otherwise cannot possibly regard it with indifference Tithes are the property of the nation, and it cannot be for the advantage of any country that state property should not partake in the advance of individual wealth — that it should, relatively speaking, continually decrease.

The Tithe Commissioners report (1851), that they have received notices that voluntary commutations have been commenced in 9 634 tithe districts, have received 7 070 agreements and confirmed 6 778 5,029 drafts of compulsory awards (such as they are empowered to cause to be made on the non-agreement of the parties), and confirmed 5,260 Thus, in 12,038 tithe districts the rent charges to be hereafter paid have been finally established by confirmed agreements or confirmed awards The report concludes with various suggestions for bringing the office of the commissioners to a satisfactory close According to the returns under the property tax (1810) it appeared that about 8,000 000 acres in England and Wales were tithe-free, and 21 000 000 tithe able Mr *M'Culloch's Statistics of the British Empire* contains the following analysis of appropriations, &c of tithes —

| | |
|---|---|
| Belonging to the crown - - - | 38 |
| Archbishops and bishops - - - | 385 |
| Ecclesiastical corporations aggregate - - | 702 |
| Dignitaries and other eccl corporations sole - | 488 |
| Universities colleges, and hospitals - - | 281 |
| Private owners - - - - | 2502 |
| Municipal corporations (since sold) - - | 43 |
| Vicarages partly endowed - - - | 121 |
| Ditto wholly endowed - - - | 132 |

**TITHING** A territorial division, of which the origin is pretty generally attributed to Alfred It was a district supposed to contain ten freeborn men of whom each was pledge for the others (*see* FRANKPLEDGE) One of these was annually appointed *tithingman*, *borsholder*, or *headborough* (from borg, *a pledge*) Ten tithings constituted (as is supposed) a hundred

**TITULAR** Chiefly in Ecclesiastical usage, a person invested with the title to a benefice, generally used for one who has the title only, without possession or enjoyment

**TMESIS** (Gr τμησις, *I cut*) In Grammar, a figure by which a compound word is separated into two parts by the intervention of one or more words, as in the following line of Terence, "Quæ meo cunque animo lubitum est facere," for [illegible] This figure is a licence frequent in Terence and Lucretius rare in later writers, in the Greek it is more common, but of all Western languages, the German lends itself most readily to the division of compound words In English the figure is unused

**TOADSTONE** A provincial term applied to certain igneous or basaltic rocks associated with the limestone formations of Derbyshire *See* GEOLOGY

**TOBACCO** The dried leaves of the *Nicotiana tabacum*, a plant indigenous to America but which succeeds very well and is extensively cultivated, in most parts of the Old World The recent leaves possess very little odour or taste, but when dried, their odour is strong, narcotic and somewhat fœtid their taste bitter and extremely acrid When well cured they are of a yellowish green colour When distilled they yield an essential oil, on which their virtue depends, and which is said to be a virulent poison The leaves are used in various ways, being smoked and ground and manufactured into snuff It is in the last mentioned form that tobacco is principally used in Great Britain, and, though the contrary has often been asserted, its use does not seem to have been productive of any perceptible bad consequence

The term *tobacco* is probably derived from Tabaco, a province of Yucatan, where it was first found by the Spaniards To Sir Francis Drake and Sir Walter Raleigh has been ascribed the honour of having introduced it into England, nearly three centuries ago For full particulars as to the history and statistics of this important article of commerce, see the *Com Dict*

**TOCSIN** An old French word, of which the derivation seems not to be ascertained (Gregory of Tours uses the word "seing" for the sound of a bell (see *Encycl Méthodique*), signifying an alarum-bell (Germ sturmglocke) The use of the terrible tocsin, during the troubles of the Revolution, to assemble the multitude, has rendered the word almost proverbial

**TOD** A weight used in weighing wool It contains 28 lbs avoirdupois

**TOFT**, in old English appears to signify the ground or enclosed space on which a messuage has formerly stood

**TOGA** The gown or mantle peculiar to the Roman people whence it was sometimes designated as the *gens togata* or toga-clad nation The toga was a loose flowing woollen garment covering the whole body round, and close below but open at the top down to the girdle The end was drawn up and thrown over the left shoulder, leaving the right arm at liberty as it had no sleeves The ordinary colour of the toga was white, but this was changed for a dark colour in mourning The chief dignitaries of the state were distinguished by a purple band affixed to the edge of the toga which was then called *prætexta* An embroidered toga was worn by generals when they triumphed (See *Rich's Companion to the Latin Dictionary* for the different species of toga) It was the national characteristic of the Romans in the republican age, and when Augustus thought he perceived its disuse commencing among the crowds assembled at the theatre, and the substitution of the ordinary "lacerna," he repeated with emphasis the line of Virgil—

Romanos rerum dominos gentemque togatam

Among women, the toga was only worn by the disreputable the dress of the matron was the stola

**TOISE** A French measure of length containing six French feet or 1 949040 metres The French toise is equivalent to 6 3915925 English feet

**TOKAY** A wine made at Tokay in Hungary, it is luscious and yet has an agreeable quickness of flavour It is usually more or less turbid and is the only wine which is preferred in that state, and consequently agitated before it is poured into the glass

**TOLERATION** (Lat tolero, *I bear*) is used in a general sense to express impunity and safety in the state for all dissenters from the established church, who do not maintain any doctrines inconsistent with the peace and welfare of the state Hence toleration implies a right of enjoying the benefit of the laws and of all social privileges without any regard to difference of religion The first toleration act in England passed in 1689, but it was not till 1829, when the Catholic Emancipation Bill was passed that dissenters could be said to be on equality with churchmen in every respect The Jews are now the only sect in England precluded from the full enjoyment of civil rights in consequence of their religion

**TOLL** (Germ zoll) The name usually given to the duties imposed on travellers and goods passing along public roads bridges, &c It is also used to indicate the payment to the corporation of a town or to the lord or owner of a market or fair, upon sale of things tollable The right, whether to take toll, or to be exempt from its payment rests upon prescription or grant from the king Toll is sometimes taken by a man for every beast driven across his ground, and is then called *toll-traverse*, also by a town for beasts going through it, or over a bridge or ferry maintained at its cost, and is then called *toll-thorough* *See* FAILLE

**TOLMEN, or DOLMEN** In Antiquities Borlase, in his *History of Cornwall*, gives this name to large stones with passages apparently hollowed through them, which are commonly believed to be Druidical remains There are many such in Britanny See also *Archæologia*, vol ii and vol viii p 210, where there is a description and representation of a celebrated one at Primham Rocks, in

Yorkshire It has [illegible] contrivances, by [illegible] oracular answers

TOLU BALSAM The concrete balsam of *Myroxylon peruiferum*, a tree growing in the warmest parts of South America This substance is pale brown, brittle in cold, but tenacious in hot weather, fragrant when heated, and entirely soluble in alcohol It appears to contain that modification of the benzoic acid which has [illegible]

TOMB (Gr [illegible] tumulus) Is used to express both the grave or sepulchre in which the body of a deceased person is interred, and a monument erected in his memory In many countries it was customary to burn the bodies of the dead, and to collect the ashes into an urn (*see* URN) which was deposited in a tomb The tombs of the Jews were generally hollow places hewn out of a rock The Greeks constructed their tombs outside the walls of their cities, with the exception of those raised to distinguished personages The same distinction was observed by the Romans, their sepulchres were in the country near the high roads, and none but emperors, vestals, and great personages had the privilege of burial within the walls In Etruria, several tombs of the ancient inhabitants have been discovered containing beautiful vases, for full particulars respecting which, the reader may consult Mrs H Gray's interesting *Tour to the Sepulchres of Etruria* See for the tombs of the Egyptians Sir G Wilkinson's *Manners of the Ancient Egyptians* vol iii p 183

TOMBAC An alloy of copper and zinc, or a species of brass with excess of zinc When arsenic is added, it forms *white tombac*

TOMENTOSE (Lat tomentum, *sheared wool*) Covered with short inconspicuous interwoven hairs

TON A denomination of weight equal to 20 cwt, or 2240 lbs avoirdupois *Ton* is also the name of an English measure of capacity containing 252 gallons, but when used in the latter sense, the word is usually written *tun*

TONDINO (Ital) In Architecture, the same as *astragal* which see

TONE (Gr τονος) In Music a property of sound which brings it under the relation of grave or acute or the gravity or acuteness it may have from the number of vibrations of the sonorous body producing it It is more particularly used for expressing that degree or interval of time by which sounds may be raised or lowered from one extreme of concord to another, so as still to produce melody

TONES, ECCLESIASTICAL In Music the eight modes, now generally called the Gregorian Chant in which the service of the Catholic church is performed four whereof are authentic and four of them plagal Pope Gregory has been considered the inventor of them They are the foundation of all music, and will ever be considered stupendous monuments of composition

TONGUE In Architecture *See* GROOVE

TONGUE In Anatomy the organ of taste, a soft fleshy viscus moveable in all directions composed of muscular fibres covered by a nervous membrane, upon which, especially at the tip and sides, are numerous nervous papillæ The tongue is largely supplied by blood vessels, its arteries being branches of the ranine and labial, and its veins emptying into the great linguals which proceed to the external jugular, the nerves come from the fifth, and eighth and ninth pairs The tongue performs important functions, not only in tasting, but in articulating, and in eating or chewing or swallowing food, and in re[illegible]

TONIC From *Tone*) In Music the principal note of the key It is the chief sound upon which all regular melodies depend, and in which they all terminate Its octaves, both above and below are equally called by the same name It is however to be understood that the termination here alluded to has relation only to the chief melody, or to its bass, inasmuch as the inner or mean parts of the harmony conclude on the third or mediant, and the fifth or dominant

TONICS (Gr τονοω, *I strengthen*) Medicines which strengthen and increase muscular action To this class belong vegetable bitters, stimulants, astringents, &c

TONNAGE, implied originally the number of tons weight a vessel might safely carry Prior to January, 1836, the rule established by act of parliament for the measurement of the tonnage of ships was founded on erroneous principles, and led to the most mischievous consequences

[illegible] nearly the same, th[illegible]adth, and hence increasing the breadth of a vessel increased her *nominal* tonnage for the payment of dues more than it increased her real capacity Under this pernicious system vessels came to be built narrow and deep, and thus not only [illegible] In 1823 a committee, of which the [illegible] Dr Young was chairman, proposed to measure the internal capacity by taking the breadth and depth at each quarter of the length, but for some reason no step was taken. In 1832 another committee was appointed to consider the subject, and they concluded their labours in 1834 by recommending [illegible] method of Mr Riddle of the Royal Hospital, Greenwich Mr Riddle observed that since a great number of direct measures for capacity would afford a result very near the truth, an approximation might be obtained by means of a smaller number of measures provided additional weight was given in the calculation to those dimensions which extend through a greater part of the hull He obtained the multipliers of these dimensions, the midship breadth and depth, by trial, from the vessels measured for the guidance of the committee, and the method is therefore founded on an arithmetical fact The rule, briefly expressed, is as follows —

Divide the upper deck, between the after part of the stem and the fore part of the sternpost, into six equal parts At the foremost, middle, and aftermost points of division, measure, in feet and decimals, the depths from the under side of the upper deck to the ceiling at the limber strake Divide each depth into five equal parts, and measure the inside breadths at 1-5th and 4 5ths (from the upper deck) [illegible] 2-5ths and 4-5ths of the [illegible] length, as above, at half the midship depth To twice the midship depth add the extreme depths, for the sum of the depths To the upper and lower breadths at the foremost division add three times the upper and lower breadths at the midship division, and the upper and twice the lower breadth at the aftermost division, for the sum of the breadths Multiply the sum of the depths by the sum of the breadths, and the product by the length, and divide this product by 3500, the result is the tonnage for register

In vessels with a poop or a break in the upper deck, measure the mean length, breadth and height multiply these together, and divide by 92 4, and add the result to the former quantity In open vessels, the depth is measured [illegible] In steam vessels [illegible] the [illegible] of the engine room (the depth being considered as the midship depth, and the breadth that at 2 5ths of this depth), divided by 92 4, is to be deducted

The relative capacities of ships are determined very nearly by this method, that is, within little more than 4 or 5 per cent generally, though, in extreme cases, the difference may amount to 10 or 12 per cent even this, however is insignificant, as compared with the usual errors of the former method The divisor by which cubic content is reduced to nominal tonnage was adopted, merely that while the reputed tonnage of most kinds of vessels would be corrected by the new rule, the total registered tonnage of the kingdom might remain unaltered By the new method the dues paid on tonnage are proportioned to the capacities of the vessels, and as no advantage is gained in these respects by defective forms, a marked improvement in merchant vessels has followed the passing of the bill in 1835

TONSILITIS Inflammation of the tonsils *See* QUINSEY

TONSILS (Lat tonsilla) An oblong subovate gland on each side of the fauces, and opening into the cavity of the mouth by several large ducts

TONTINE Is derived from the name of the inventor Lorenzo Tonti proposing a loan raised on life annuities with the benefit of survivorships *See* ANNUITIES

TOOTHING In Architecture, bricks alternately projecting at the end of a wall, in order that they may be bonded into a continuation of it when the remainder is carried up

TOP In Naval Language, a small light platform near the lower mast-head

TOPARCHY (Gr τοπος, *a place*, and αρχη, *government*) In Antiquity signified a small state or lordship consisting only of a few cities or towns, or a petty country under the sway of a toparch Thus Judæa was anciently divided into ten toparchies

TOPAZ (Gr τοπαζιον) A crystallized mineral harder than quartz of a yellow or wine colour, composed of 60 alumina, 35 silica, 5 fluoric acid When heated the Brazilian topaz becomes rose red, and is sometimes in this state passed off as a ruby, the Saxon topaz loses its colour by heat When without flaws and of a good colour, it is much employed in jewellery The Saxon is usually paler than the Brazilian which often has a pinkish hue, the Siberian topaz is usually colourless, and the Scotch has a blue tinge

TOPAZOLITE (Gr τοπαζιον and λιθος, *a stone*) A subvariety of garnet of a pale yellow colour, found in Piedmont It is a silicate of alumina, lime, and iron, with traces of glucina and manganese

TOPCHAINS Chains used in action, by which the lower [illegible]

TOPE [illegible]

TOPHET A polluted unclean place near Jerusalem, into which the Jews used to throw the carcasses of beasts, or the bodies of men to whom they refused burial; and

where a fire was perpetually kept up to consume all that was brought Hence Tophet is sometimes used metaphorically for hell This place had also been defiled by human sacrifices which had been offered to Moloch Hence Milton says of this hideous deity, that he

made his grove
[illegible] Tophet thence
[illegible] stupid Idols

The name is derived by some from Heb toph, *a drum*, on account of the beating of drums and other instruments by which the cries of the children sacrificed to Moloch were stifled

TO'PHUS A soft tumour upon a bone In Mineralogy, the term *tophus* has been applied to porous deposits of calcareous matter from water

TO'PICS (Gr *τοποι, a place*) In Rhetoric By abstracting from a proposition which conveys a truth in the concrete (*i e* respecting certain circumstances expressed in the terms of the proposition) a portion of those circumstances denominated accidental, we arrive at the same truth in the abstract, or (in stricter language) more widely [illegible] to many different sets of [illegible] Thus, for example, in jurisprudence, from an investigation of the truth in various insulated cases in which a too strict application of legal principles has been attended with evil effects, we deduce the general truth that such application is so attended or in the proverbial phrase "summum jus summa injuria" Among the helps employed by the ancients in their favourite study of rhetoric was the collection and arrangement of a great variety of such general truths according to the several sciences or subjects to which they belonged These they termed *topoi*, or places, from which the modern term *topic* is derived They considered it useful for the student in rhetoric to have at hand by means of his memory those compendious expressions of universal sentiment and the general reasonings or declamations applicable to each of them, in order to employ them for particular use by performing the converse of that operation by which they were arrived at, viz clothing them with the particular circumstances of the case Thus the *topos* just cited might be useful to the forensic orator it affords a subject for reasoning and declamation applicable to a great number of individual instances Many of these topics answer to what in modern phrase we should term axioms, and indeed some of the axioms of pure mathematics are enumerated by Aristotle among the topics which are proper to every species of oratory

TOPOGRAPHY (Gr *τοπος a place* and *γραφω, I describe*) Strictly the description of a place or the science of describing places (distinguished from *chorography* or the description of a district, and from *geography* the description of the earth)

TOPPING LIFT A rope for raising the end of any yard or boom

TOP, SPINNING A well-known toy The steady motion which a well-spun top soon acquires suggested to Mr Sisson, about eighty years ago the employment of a mirror placed upon it at right angles to its axis as an artificial horizon which might probably be used at sea and on sending out the first of the late polar expeditions, the attention of Mr Troughton was turned to the subject But though useful observations might have been made on land with the instrument which he constructed it was not found at sea to give results of any practical value, and we are not aware that any further attempts have been made to improve [illegible] which is attended with considerable [illegible]

TOPOGRAPHY (Gr *τοπος sculpture*, and *γραφω, I describe*), signifies either the science or art of sculpture, or a description of ancient and modern [illegible] in relief

TORNATILE (Gr *τορνευτος polished*) In Sculpture [illegible] to such objects as are executed with high finish, delicacy and polish [illegible] properly to all figures in hard wood ivory &c

TORMENTIL ROOT The root of the *Potentilla tormentilla* It is occasionally used in medicine as an astringent

TORNA'DO (Spanish) A violent hurricane or gust of wind, which, arising suddenly from the shore, veers round to all points of the compass, and indeed has been described as blowing from all points at once Tornadoes are usually accompanied with thunder storms and are generally of short duration They are frequent in the Chinese seas and the West Indies *See* STORMS

TORNATELLA A genus of oval marine Univalves belonging to the *Pleuroceæ*, found in the oolite and superjacent strata Recent tornatellæ are found in shallow water creeping upon and furrowing the sand

TORPE'DO (Lat torpedo, *numbness*) A genus of Cartilaginous fishes, separated from the *Raiæ* of Linnæus on account of the circular form of the body, and more especially from the presence of the electrical organs on which that form of the body mainly depends Violent shocks are experienced on touching the living and active torpedo It is probable that it exerts its electric powers in order to secure [illegible] prey; [illegible] same power is employed in defending itself against assailants, to whose assaults it would be otherwise more exposed than are the ordinary rays, for the torpedo has a smooth skin, and is not defended by the spiny tubercles or barbed and pointed body weapons, with which the non electric rays are provided

TORQUES In Antiquities a chain or collar formed of a number of small ringlets interlaced with each other, framed of metal, and worn round the neck No ornament perhaps was of more early or general use It is mentioned in Genesis, xli 42, as one of the ornaments conferred by Pharaoh on Joseph It was in use among the Greeks and Romans [illegible] nations The legends respecting [illegible] who invaded Rome are well known It was from his victory over a Gaul that [illegible] derived his surname (*Livy*, lib vii ch 10) And no relic is more commonly found in this country by antiquarian explorers Boadicea wore a large golden torques (*Dio Cass* lxii) See the *Archæologia*, vol xiv p 97 and *passim*, for descriptions of particular specimens

TORREFACTION (Lat) The operation of roasting ores to deprive them of sulphur, arsenic, or other volatile ingredients When ores are [illegible] only dried or partially toasted or roasted, they are also said to be torrefied

TORRICE'LLIAN VACUUM In Physics, the vacuum produced by inverting a tube of sufficient length, filled with mercury or any other fluid, in a vessel containing a portion of the same fluid and allowing the fluid in the tube to descend until its weight is counterbalanced by that of the atmosphere In this manner the first barometers were formed by Torricelli, and thence called *Torricellian tubes* See BAROMETER

TORRID ZONE In Geography the zone of the earth included between the tropics of Cancer and Capricorn It extends from the equator, on both sides, to the parallel corresponding to the sun's greatest declination about 23½ degrees See ECLIPTIC, ZONE

TORSION (Lat torsio, *from torqueo I twist*), in Mechanics is the twisting or wrenching of a body by the exertion of a lateral force If a slender rod of metal suspended vertically, and having its upper end fixed be twisted through a certain angle by a force acting in a plane perpendicular to its axis it will on the removal of the force untwist itself or return in the opposite direction with a greater or less velocity and after a series of oscillations will come to rest in its original position The limits of torsion within which the body will return to its original state depend upon its elasticity A fine wire of a few feet in length may be twisted through several revolutions without impairing its elasticity and within those limits the force evolved is found to be perfectly regular and directly proportional to the angular displacement from the position of rest If the angular displacement exceeds a certain limit the particles of the body will be wrenched asunder, or if the elasticity is not perfect (as in a wire of lead for example) before disruption takes place, the particles will assume a new arrangement or *take a set* and will not return to their original position on the withdrawal of the disturbing force

The resistance which cylinders or prisms formed of different substances oppose to torsion furnishes one of the usual methods of determining the elasticity and strength of materials, and the property which a metallic wire or thread stretched by a small weight possesses of becoming twisted and untwisted in a series of isochronous and perfectly regular oscillations has been ingeniously applied in the torsion balance to the measurement of very minute forces and thereby to the establishment of the fundamental laws of electricity and magnetism, and to the determination of the mean density of the earth *See* BALANCE OF TORSION

The laws of torsion have been experimentally investigated by Coulomb in a variety of substances The method which he employed consisted in attaching a body of given form and dimensions to the extremity of the wire, and, after twisting it through a certain angle, to abandon it to the action of the force evolved and observe the time of the oscillations The following general laws were found to hold good —

1 On loading a wire or thread with different weights, it will settle in different positions of stable equilibrium, that is to say, an index attached to the weight will point in different directions If the weight be varied, and the angular deviation may amount even to a whole circumference

2 The oscillations are isochronous

3 The time of oscillation is proportional to the square root of the weight which stretches the wire

4 The time of oscillation is as the square root of the length of the wire.

5 The time of oscillation is inversely as the square of the diameter of the wire

From the second of these laws it follows that when the wire is twisted round from the position of rest, the force with which it tends to return to that position is proportional to the angle to be described in order to attain it For it is a general result of mechanics, that all motions produced by forces acting according to this law have the property of isochronism, that is to say, the oscillations are performed in equal times, whatever be the length of the arc This fundamental property is usually enunciated by saying that the force of torsion is proportional to the angle of torsion

Let F denote the force of torsion, measured by the weight which it would be necessary to apply by means of a pulley to a point $p$, situated at the unit of distance (one inch) from the axis of the wire, and invariably connected with it, to cause the point $p$ to describe an arc of a circle equal in length to the unit of distance, then, by the property enunciated, the force which must be applied at $p$ in order that the point may describe any arc $\varphi$ is expressed by $F \times \varphi$ If the arc of torsion is expressed in degrees instead of parts of the radius, we have $\varphi = \pi \varphi^\circ - 180^\circ$ ($\pi$ being the semicircumference to radius 1, or = 3 14159), whence the expression of the force becomes $F \times \pi \varphi^\circ - 180^\circ$

On this principle of the proportionality of the impelling force to the angle of deviation the problem of determining the time of an oscillation is solved Suppose a body of any form attached to the extremity of a slender wire, whose weight in comparison of that of the body may be neglected, and let $d m$ be an element of the mass, $r$ the distance of $d m$ from the axis of the wire and T the time of an oscillation, the solution of the problem gives

$$T = \pi \sqrt{\left(\frac{\int r^2 \, d m}{F}\right)}, \text{ or } T^2 = \pi^2 \frac{\int r^2 \, d m}{F},$$

where the integral $\int r^2 \, d m$ is the *moment of inertia* of the attached body If the body be a cylinder whose axis coincides with that of the wire and if $a$ denote its radius and M its mass then $\int r^2 \, d m = \frac{1}{2} M a^2$, or, expressing the mass in terms of the weight and observing that if the weight be denoted by P and the accelerating force of gravity by $g$ (= 32 1908 feet or 386 2894 inches in a second), we have $P = M g$, $\int r^2 \, d m = \frac{P a^2}{2 g}$ Hence the expression for the time becomes $T = \pi a \sqrt{\frac{P}{2 g F}}$

If the attached body were a slender cylindrical needle suspended horizontally by its middle to the wire, we should, on denoting its length by $2 l$, have $\int r^2 \, d m = \frac{1}{3} M l^2$, whence $T = \pi l \sqrt{\frac{P}{3 g F}}$

The following results are deduced from the formula — 1 The force of torsion is independent of the weight which stretches the wire or F remains constant while P is varied For suppose P to become P′ and let T′ be the corresponding time of oscillation, and T′ the corresponding force, we have then

$$T^2 = \frac{\pi^2 a^2 P}{2 g F}, \quad T'^2 = \frac{\pi^2 a^2 P'}{2 g F'},$$

whence $T^2 : T'^2 :: P F' : P' F$ But by the third experimental law, $T^2 : T'^2 :: P : P'$, therefore $F' = F$

2 The force is inversely as the length of the wire For, supposing P to remain constant we have $T^2 : T'^2 :: F' : F$ But, by the fourth experimental law, $T^2 : T'^2 :: l : l'$, whence $F' : F :: l : l'$

3 The force is proportional to the fourth power of the diameter of the wire Let there be two wires of the same substance, but of different diameters, D and D′, and stretched by the same weight P, and let T and T′ be the corresponding times By the fifth experimental law, we have $T : T' :: D'^2 : D^2$ But it has been shown that $T^2 : T'^2 :: F' : F$, therefore $T : T' :: D^4 : D'^4$

To show the method of applying the formulæ, we shall compute one of the experiments of Coulomb An iron wire was stretched by a vertical cylinder of 0·5 of an inch radius, and weighing 2 lbs, and it was observed to make 20 oscillations in 242 seconds, or one in 12 1 seconds It is proposed to determine the force F From the formula for the time of an oscillation we have, by transposition, $F = \frac{\pi^2 a^2 P}{2 g T^2}$ Substituting numbers in this formula, we have $\pi^2 = 9\,8696$, $a^2 = 64$, $P = 2$, $g = 386\,2894$, $T^2 = (12{\cdot}1)^2 = 146\,41$, consequently $F = \frac{12\,633}{113113} = 0001117$ of a pound, or about 78 of a grain Hence the weight applied at the distance of one inch from the axis of the wire that would be required to twist the [illegible] complete revolution, or 360°, is 6 283 times [illegible] nearly five grains

For the demonstration of the fundamental formula, namely, $T^2 F = \pi^2 \int r^2 \, d m$, see Coulomb, *Théorie des Machines Simples*; or Biot, *Traité de Physique*, tom i

TORSO (It ` I Sculpture a statue of which nothing but the trunk or the principal figure remains

TORT (Fr wrong) In Law signifies injustice or injury

TORTOISE This name is usually applied to species of that division of the Linnæan genus *Testudo* including the terrestrial Chelonians, to which the generic name is now limited *See* TESTUDO

TORTOISE SHELL The name given to the horny scutes or plates of the sea turtles, and in particular to those of the hawk's bill turtle, *Chelone imbricata*

TORTRICES (Lat torqueo, *I wreath*) The name of a tribe of nocturnal Lepidopterous insects, comprising those the larvæ of which live concealed in leaves, which they roll around them for the purpose

TORTURE (Lat torqueo, *I twist* or *torment*) In a legal sense, the infliction of pain on an accused person in order to extort an avowal of guilt, or revelation of accomplices Such a practice is sufficiently common among all half-civilized nations, but the Greeks and Romans were perhaps the first who introduced it as a part of their regular proceedings in criminal cases Both at Athens and Rome torture was, however, considered as applicable only to extort evidence from slaves towards them it was used profusely, and it was, in fact, a usual occurrence to order a whole family of slaves to the torture, in order to extract revelations where an atrocious crime had been committed, as for instance, the murder of the master Cicero in several passages, condemns the use of torture, and Ulpian (Lex I *De Quæstionibus*) says, 'Res est fragilis et periculosa et quæ veritatem fallit nam plerique patientia sive duritiâ tormentorem ita et tormenta contemnunt, ut exprimi eis veritas nullo modo possit, alii tanta sunt impatientiâ ut quid vis mentiri quam pati tormenta malint' (As to the torture at Rome see *Gibbon*, vol ii p 59 4to ed) Notwithstanding these recorded opinions of the highest luminaries of ancient jurisprudence, torture was adopted along with the rest of the process of the civil law in most European countries (For its use in France see QUESTION) The general principle of the civilians was, that it could not be used unless *vehement suspicion* [illegible] But no very definite meaning was [illegible] to these words, especially in Germany, where the abuse seems to have been carried to the greatest extent by the [illegible] in her smaller states When Howard visited the prisons of that country (about 1770), it was still in general use (See his *Account of Prisons*) The writings of various philosophical authors of the 18th century, especially Voltaire Thomasius, and Beccaria (whose short treatise, *Dei Delitti e delle Pene*, obtained such singular notoriety), effected much towards bringing its employment into disrepute, but its general abolition can only be attributed to the superior regard for the rights of man introduced every where by the agitation of the French Revolution In England, judicial torture was not recognized by the common law (for the peine forte et dure hardly falls within the same definition), and that it was also nearly unknown in practice in the 14th century at least, may be inferred from the reluctance of Edward II to submit the Templars to torture, which was overcome by the instances of Pope Clement V, and from a curious paper of questions addressed on that occasion by the archbishop of York to some divines from which it appears that *no torturer could at that time be found in England* (See Raynouard *Memoires sur les Templiers*; *Hallam's Constitutional History*) The rack is said to have been introduced as an engine of state by the Duke of Exeter in the reign of Henry VI However this may be during the whole of the 16th century we find that the Privy council assumed and exercised the right to direct torture-warrants to the lieutenant of the Tower and other officers, commanding them to submit to the torture persons accused not only of state offences, but of ordinary municipal crimes when strong suspicion but no sufficient evidence, existed Torture-warrants were also issued, not by the council, but under the sign manual only During this period the council seems, in fact to have acted as a supplementary tribunal in aid of the regular courts, for the purpose of extorting discoveries of criminal offences The instances of torture of seminary priests, &c, in Elizabeth's reign, have been often cited, but it is not so generally known that the practice was not confined to accusations of treason and sedition, but extended to other cases (See *Jardine's Reading on the Use of Torture in England*, 1837) Under James I and Charles I torture seems to have become less frequent, and to have been only employed in state offences and this perhaps, [illegible] the well known [illegible] of the judges to Charles's [illegible] on the prisoner of the Duke of Buckingham, that he ought not to be tortured, "for no such punishment is known to our law." The last recorded case is that of William Archer, 1640, and as in that year the act for the abolition of the Star Chamber

granted a habeas corpus to all persons detained on warrants from the privy council, torture must then have been virtually abolished. In Scotland it was so in the 7th year of Anne.

TO'RUS (Lat. [illegible] moulding used in the [illegible] is semicircular. This term is also used in botany for the central part of the flower on which the carpels are placed.

TORY. A well-known party name in English history. (*See* WHIG.) The Irish [illegible] bers and half insurgents, who [illegible] Irish at the [illegible] the [illegible] which [illegible] were the first to whom this [illegible] appeared. It is said to have been transplanted into England about the time of the Popish Plot, when the public mind was agitated by chimerical fears respecting the apprehended employment of Irish Catholics to further that imaginary design, whence it was commonly applied by way of reproach to the court party, against which the popular hostility was then directed, as favouring and countenancing the supposed abettors of the plot. From the period of its introduction into England down to the present times the term Tory has been constantly employed to designate a large political party in this country. Down to the period when Hume wrote his *Essay on the Parties of Great Britain*, the conduct of the two great parties in the state (the Whigs and Tories) had been so vague and undetermined as to have led him to declare his utter inability to tell their nature, pretensions, and principles. Since that period however, the conduct of the Tories has been more uniform, and it might now be easier to define the principles by [illegible] century. [illegible] the last two or three years the word Tory has [illegible] placed by *Conservative*, which seems [illegible] permanent designation of the Tory party. This term was originally assumed in contradistinction to *Destructives*, a name by which the more violent reformers came to be designated by their enemies; and it is now understood as referring to the whole Tory party, but more especially to what may be called the more liberal portion of that party.

TOTIPA'LMATES, *Totipalmati* (Lat. *totus*, *entire*, and *palma*, *a palm*.) The name of a tribe of *Palmipedes* or swimming birds, including those in which the hinder toe is enveloped in the same web with the three anterior toes.

TOUCH. In Medicine. The belief in the possibility of curing various maladies by the touch has produced a variety of singular superstitions. Plutarch attributes singular virtues to the touch of King Pyrrhus of Epirus. According to Suetonius, Adrian and Vespasian had the power of curing various diseases in the same manner. In what period the opinion respecting the virtue of the touch of the kings of France and Engla[illegible] lepsy, scrophulas, &c. had its origin [illegible] certain. André Dulaurent, chief physician of Henry IV. of [illegible]. The ceremo[illegible] was practised at the four great feasts of the year, sometimes as many as 1500 were touched at a time. By an odd etiquette the Spaniards had the first rank, then other foreigners, and the French last of all. The formula used at each imposition of the royal hand was, "Le roi te touche, et Dieu te guerit." Polydore Virgil attributes this virtue to Edward IV. and all our kings down to the end of the Stuart dynasty touched for the king's evil. Much efficacy has been attributed in different diseases, particularly tumours, &c., to the touch of the hand of a dead body, especially, according to Pliny and various modern authorities, of one who had died violently. We do not know whether the superstition is yet extinct under the influence of which scrophulous persons used to have themselves touched by the hands of criminals after execution. Boyle endeavours to explain away part of the miracle by attributing some virtue to the coldness of the application.

TOUCH. One of the five senses, residents [illegible] papillæ of the skin, it is also the [illegible] the whole body. It is much more exquisite in some parts than others.

TOUCH. In Naval language, the sails are said to *touch* when the wind comes edgeways upon them.

TOUCH NEEDLES. Small bars, consisting of gold and silver alloyed with various definite proportions of copper, are thus termed by assayers, who use them to judge by comparing their colour and streak upon a piece of hard black stone, such as basalt, with that of alloys of the precious metals, of the relative quantity of gold or silver in the latter. Hence also the term *touchstone*.

TOURMALINE. The more perfect forms of *schorl* go under this name. It is the *lyncurium* of the ancients. Its chief constituents are silica and alumina, with about 10 *per cent.* of soda, and a little oxide of manganese and of iron. The transparent coloured varieties are sometimes cut into ring-stones, and some of them are much [illegible] light [illegible]. It anciently made thrice every year by the sheriff, for the purpose of holding in each hundred the great court leet of the county. The jurisdiction exercised by the sheriff on his tourn extended by the common law to the cognizance of all offences not capital, but sheriffs are prohibited by Magna Charta from holding any pleas of the crown in which they [illegible] interest in procuring a conviction, [illegible], and was at the same time supplied by the establishment of annual circuits. The tourn though never disallowed by law, has, with the curtailment of its jurisdiction, and the abandonment of the leet as a registry of pledges, long fallen into disuse, and the right of the jury or suitors at the tourn to present nuisances, or convict of minor offences, has, with other functions of courts leet, been transferred to the quarter sessions.

TOURNAMENT (in modern Latin torneamentum), or TOURNEY, originally derived from the Fr. tourner, modern Latin tornare, *to turn*. A well-known military sport of the middle ages, which without doubt arose from the exercises of military training. A joust or just is pro[illegible] purpose of exhibiting such justs, or the encounter of several knights on a side. The earlier tournaments were highly dangerous and sanguinary sports. They were performed with the ordinary weapons of warfare, the lance and the sword, and the combatants had only the strength of their armour to rely on for their defence. It was a recognized custom, according to Meyrick (*Hist. of Ancient Armour*), that whoever slew or disabled an adversary in the tournament was indemnified against all consequences. The account of the tournament given by the Count of Chablais in Savoy to Edward I. on his return from Palestine to England as given by Thomas de Walsingham represents a sort of violent melee, in which knights, squires, and archers were engaged on both sides endeavouring to unhorse the riders and overthrow the footmen by every possible means. But in the course of time this chivalric amusement became the subject of minute regulations, which in some degree diminished the danger and insured the fairness of the sport. The English *Statuta Armorum de Torneamentis* are assigned by Dr. Meyrick to the year 1295. (*See* SAINTE-PALAYE.)

Impartial taste, says Gibbon, must prefer a Gothic tournament to the Olympic games of classic antiquity." (*Decl. and Fall*, ch. 50.)

In tournaments when under the strict regulation of knightly usage two sorts of arms were employed, those expressly made for the purpose, viz. lances with blunt heads of iron, and the ordinary arms of warfare, termed 'armes a outrance,' which were only employed by such champions as were desirous to signalize themselves in a more than ordinary degree, and frequently were not permitted by the judges of the tournament. Every knight attending was required to show his noble birth and rank, as a title to admission. These were at first proclaimed by the heralds with sound of trumpet, and hence the word blazonry, which signifies the correct deciphering of the heraldic symbols on a coat of arms, is derived by some from the German blasen, *to blow*. Afterwards when armorial bearings became general the shield of the knight gave token of his rank and family. The attendance of ladies at the tournaments, their distribution of prizes to those who had borne themselves best, arming and unarming the knights, &c., are various romantic circumstances well known to the reader of chivalric legends; but they must not be supposed to have been the necessary, or even usual accompaniments of these knightly sports at least until a later age, when the taste for [illegible] tacle, [illegible] more than gorgeous pageants. When we arrive at the reigns of Edward III. and Henry V., we find the justs usually held in honour of ladies, and every knight bound to possess in reality or in show a dame of his affections, for whose sake all his deeds of chivalry were performed. Dr. Meyrick quotes from a manuscript of the reign of Elizabeth the ordinances of justes, made by John Earl of Worcester, constable of England, in the sixth year of Edward IV., from which it appears that the law of justs had become by that time the subject of very minute regulation. The prize belonged to him who broke most spears "as they ought to be broken," [illegible] on the head or body of the antagonist. From Stow we find that the lists erected in Smithfield in 1467, when the Bastard of Burgundy challenged Lord Scales, were 380 feet in length by 260 in breadth; these champions rode at each other two days with spears, and on the third encountered on foot with [illegible] axes. In the reign of Henry VIII. when the real spirit of chivalry was far advanced [illegible] its decline the tournament was [illegible] almost wholly with the character of a court pageant, but celebrated with a degree of splendour and costliness scarcely equalled in

former times The famous volumes of woodcuts of the same period, styled the *Triumphs of Maximilian*, show that it was as favourite and almost as magnificent a spectacle at the court of Germany The tragical death of Henry II of France, in consequence of a blow received in a tournament, is well known, and was the cause of the final, although only gradual abolition, of this knightly amusement, which was revived at intervals in court solemnities in the seventeenth century, but rather as a memorial of past times than as a subsisting and popular custom

T [illegible] recently attempted [illegible] of Eglinton, but [illegible] of that attempt was [illegible], or was such as to induce any party to renew it At the court of Wurtemburg tournaments are not unfrequently exhibited at this day

See Sainte-Palaye, *Memoires sur la Chevalerie*, *Turner's History* (*Middle Ages*), vol i p 472, *Hist de l'Ac des Inscr* vol xix, and Walter Scott's admirable delineation in *Ivanhoe*, which gives a more vivid idea of the tournament, with all its variety of martial exercises, than any serious work extant

TOURNIQUET (Fr) A bandage which may be tightened to any extent by means of a screw, so as to exert pressure upon a cushion and compress the arterial trunks to which it is applied it is chiefly used to prevent haemorrhage in the operations of amputation

TOW To draw a vessel along by a rope As the vessel towed affects the motions of the other, much attention is required on her part to second the intentions of the towing vessel

TOWER (Lat turris) In Architecture, a lofty building square, polygonal or circular on the plan, and often consisting of several stories The tower of a church is that part which contains the bells, and from which the steeple rises

TOWERS ROUND In Ireland, remarkable edifices of extreme antiquity, of which the origin has perplexed antiquaries to an unexampled degree They are tall narrow edifices, varying in height from 80 to 120 feet That at Kildare, we believe, is the highest, cylindrical in shape, with a door 8 or 10 feet from the ground and narrow apertures at the top There are sixty-two of these curious relics ascertained to exist in Ireland, and two in Scotland at Abernethy and Brechin They cannot have been watch-towers, their position being generally low, nor belfries their shape and construction rendering such a supposition impossible, although some appear to have been used in that way in later times, and the notion that they were places of confinement for penitents or hermits seems extravagant Common belief however, attaches to them an ecclesiastical origin and use, and the well-known passage of Giraldus Cambrensis, a writer of the 12th century (who says that the fishermen of Lough Neagh reported that in clear weather remains of buildings and among others round towers of the country fashion, were seen at the bottom), necessarily implies a greater antiquity Irish antiquaries, however as may be supposed have luxuriated in hypotheses connecting them with ancient forms of pagan worship, such as the pyrolatry of the Persians, the Phallic rites, &c (See *Moore's History of Ireland*, vol i ch 2, for a variety of these opinions, and their authors See also Mr Petrie's able work)

TOXICOLOGY (Gr τοξικον *poison* and λογος, *a discourse*) Poisons have been divided by Orfila and Christison into irritants narcotics and narcotico-acrids the first class including those whose sole or predominating symptoms are those of irritation or inflammation, the second those which produce stupor, delirium, and other affections of the brain and nervous system, and the third, those which are of a mixed character

The chief effects of *irritants* are upon the alimentary canal, exciting inflammation, and sometimes ulceration of the tongue, fauces, and œsophagus difficult deglutition, nausea, vomiting, and heat and pain of the stomach, with more or less tension of the abdomen, and pain on pressure The sickness is generally accompanied by extreme anxiety and anguish and the matters vomited consist, in the first instance, of any food that may have been in the stomach with portions of the poison itself, and afterwards of viscid mucus, often streaked with blood and tinged with bile, the pain afterwards extends throughout the intestines, and mucous, bilious, and often bloody diarrhœa succeeds The skin is [illegible] the pulse quick and feeble the breathi[illegible], and the countenance expressive of extreme anxiety

*Narcotic poisons* induce a train of symptoms of a very distinct character: headach, vertigo, confused vision, stupor, convulsions, paralysis, and coma, are their leading effects; but each particular poison is usually attended by certain peculiarities in the succession, violence, or generic character of the symptoms, which assist the experienced practitioner not only in determining the nature of the poison, but in discriminating between its effects and those of disease

The symptoms of the *narcotico-acrid poisons* usually consist of those of the two former classes blended, and are often of a very complicated character, for the most part, however, their narcotic and irritant effects appear to be incompatible In large doses, narcoticism predominates, in smaller, irritation it is rarely that both are coexistent

In the following tabular view of the principal poisons of the above classes, they are enumerated in the order in which they are described by Dr Christison, to whose *Treatise on Poisons* the reader is referred for details which would [illegible] can be allotte[illegible] heads, however, of many of the individual substances mentioned in the following list we have elsewhere given particulars respecting their composition and properties, and sometimes referred to their toxicological history

I Irritant Poisons

| | |
|---|---|
| Mineral acids | Arsenic and its compounds |
| Phosphorus | Mercurial compounds |
| Acetic acid | Salts of copper |
| Oxalic acid | Antimonial poisons |
| Fixed alkalies | Salts of tin |
| Nitre | Salts of gold |
| Alkaline and earthy chlorides | Salts of silver |
| | Salts of bismuth |
| Lime | Salts of chromium |
| Ammonia and its salts | Salts of zinc |
| Alkaline sulphurets | Lead poisons |
| Barytes | Diseased and decayed animal matter |
| Vegetable acrids | |
| Cantharides | Mechanical irritants |
| Venomous serpents | |

II Narcotic Poisons

| | |
|---|---|
| Opium | Hydrocyanic acid |
| Hyoscyamus | Carbazotic acid |
| Lactuca | Poisonous gases |
| Solanum | |

III Narcotico-acrid Poisons

| | |
|---|---|
| Nightshade | Strychnia |
| Thornapple | Cocculus Indicus |
| Tobacco | Upas |
| Hemlock | Poisonous fungi |
| Monkshood | Poisonous grain |
| Hellebore | Alcohol |
| Squill | Ether |
| Meadow saffron | Empyreumatic oils |

The treatment of cases of poisoning must, of course, vary with the nature of the poison, the quantity taken, and the peculiarities of the individual In almost all cases, copious vomiting should be excited as soon as possible by tickling the throat, and by emetics, such especially as sulphate of zinc or ipecacuanha with emetic tartar, the former however, if [illegible] dissolved in a little warm water and re[illegible] observation of [illegible] minutes till it freely operates, [illegible] The use of the stomach-pump should also be resorted to The vomiting should be kept up, and the stomach washed out with bland albuminous or mucilaginous fluids, such as milk barley-water flour and water, or thin paste, &c, sometimes sugar and water

The following is a short summary of the antidotes which may be resorted to in reference to particular poisons They should of course, be administered as speedily as possible

1 For *Mineral Acids*, or *Acetic and Oxalic Acid* Chalk, or whiting and water magnesia and water, soap and water, followed by albuminous diluents, such as milk and white of egg mixed with water

2 *Alkalies Soda Potash*, *Ammonia* &c Vinegar, or any mild acid and water or even very dilute mineral acids, such as water acidulated by them, olive oil, almond oil

3 *Arsenic* Emetics, and then milk, gruel, thick barley-water, and other similar diluents, in large quantities

4 *Corrosive Sublimate* White of egg and water, milk and cream, decoction of cinchona, infusion of galls

5 *Sulphate of Copper* and other *Cupreous Poisons* Sugar and water, white of egg and water

6 *Antimonial Poisons* Warm milk, gruel, or barley-water, infusion of galls; decoction of cinchona

7 *Nitrate of Silver* Copious draughts of warm salt and water

8 *Sulphate of Zinc* Solution of carbonate of soda in water, with milk, and mucilaginous or farinaceous liquids

9 *Acetate of Lead* Emetics; solution of sulphate of soda in water, milk, white of egg and water

10 *Opium and its Preparations* Emetics, strong

coffee, dashing cold water upon the face and breast; preventing improperly forced exercise

11 *Prussic acid* Ammoniacal stimulants cautiously applied to the nose as ammonia, or sal volatile, in repeated small doses small doses of solution of chlorine in water, small doses of chloride of lime in water

12 *Strychnia and Vegetable Alkaloids* Infusion of gall nut decoction of cinchona, etc etc

TOXODON (Gr τοξον, *a bow* and οδους *a tooth*) An extinct genus of quadruped of the order Pachydermal with the Rodent order and distinguished by the curved form of all its teeth The only known species, *Toxodon platensis* Owen was as large as a hippopotamus, and appears to have been restricted to the warmer parts of South America

TOXOTE (Gr. τοξον, *a bow*) In Greek Military History, bowmen In the Plays of Aristophanes the toxotæ mentioned like the French "archers," are a kind of police, employed to keep order in the assemblies of the people and on other public occasions

TRABEA In Roman Antiquities, the robe used at first by the kings, but afterwards by consuls and augurs The purple *trabea* was used only on the occasion of great sacrifices The second sort of purple and white was commonly worn by consuls on state occasions A third, of purple and scarlet, was the dress of the augurs

TRABEATION (Lat trabes *a beam*) In Architecture the same as *entablature*, which see

TRACHEA (Gr τραχια from τραχυς *rough*) The windpipe A cartilaginous and membranous tube through which the air passes into and out of the lungs Its upper extremity is called the *larynx* and consists of five cartilages The upper one forms a kind of valve at the mouth of the larynx called the *epiglottis* it closes the passage in the act of swallowing The sides of the larynx are formed by the *arytenoid* cartilages and the anterior part of the *thyroid* and *cricoid* or annular cartilages these may be felt under the skin in the front of the neck These cartilages are united by elastic ligaments and are acted upon by appropriate muscles so as to modify the dimensions and form of the aperture in the act of speaking they are moistened by a mucous secretion The canal from the larynx downwards is called *trachea*, till it divides into two *bronchiæ* opposite the fourth or fifth dorsal vertebra They are kept open for the free passage of the air by their elastic cartilaginous texture, which consists of rings with intervening membrane and muscular fibres

TRACHEÆ in Botany are what are now called spiral vessels, which received that name in consequence of their being considered the respiratory tubes of plants *Trachenchyma* is a tissue composed of tracheæ

TRACHEARIES, *Trachearia* (Gr τραχια *the windpipe*) The name of an order of the class *Arachnida* including those which breathe by means of tracheæ

TRACHELIDANS *Trachelidæ* (Gr τραχηλος *a neck*) The name of a family of Coleopterous insects comprising those which have the head supported on a kind of pedicle or neck

TRACHELIPODS, *Trachelipoda* (Gr τραχηλος and πους *a foot*) The name given by Lamarck to an order of Mollusks comprehending all those which have a free and flattened foot attached to the under side of the part of the body which he considers as analogous to a neck The order corresponds nearly with the Pectinibranchiata of Cuvier

TRACHELOCELE (Gr τραχια and κηλη, *a tumour*) A tumour upon the trachea, an enlargement of the thyroid gland *See* BRONCHOCELE

TRACHELOTOMY (Gr τραχια and τεμνω *I cut*) The operation of making an opening into the trachea in cases of threatened suffocation

TRACHINUS (Gr τραχυς, *rough*) A genus of spiny-finned fishes, characterized by their compressed body and approximated eyes two dorsal fins, the first short, and with spinous rays, the second long and with flexible rays The anal fin is very long the operculum is armed with a long spine directed backwards By the wounds which the species of *Trachinus* usually called "weevers," inflict with their opercular spine they have become formidable to fishermen of all nations and it is said that the French have a police regulation, by which the fishermen are directed to cut off the spines before they expose the fish for sale

TRACHITIS Inflammation of the trachea.

TRACHYTE (Gr τραχυς, *rough*) A variety of lava which is often porphyritic, and when containing hornblende and augite passes into the varieties of trap called basalt greenstone dolerite &c

TRACT, TRACTATE In Literature, both originally from the same Latin word tractatus; the latter through the French It would be difficult to assign any reason for the difference in signification between two words identical in origin and etymological meaning; but the first is now commonly used to describe short compositions, in which some particular subject is "treated," generally in the form of a pamphlet; the latter more extensive works

TRACTION (Lat traho, *I draw*) The act of drawing, or state of being drawn In Mechanics, the *angle of traction* is the angle which the direction of the power makes with a given plane

TRACTORS, METALLIC Small bars of metal which were supposed to possess certain magnetic powers, and to cure pain affections and tumors by being drawn over the part They bore the name of their inventor, Perkins, and were in considerable vogue about thirty years ago A number of wonderful cures, however, having been attested, which were performed by means of spurious imitations the imaginary virtues of the magnetic or metallic tractors were exploded, and sunk into oblivion

TRACTORY, or TRACTRIX (Lat traho, *I draw*), in the geometry of curve lines, is the curve characterized by this property that the tangent is always equal to a given line It was called the tractory by Huygens, because it may be considered as described mechanically by a small weight attached to one extremity of a thread, while the other extremity is drawn along a given straight line But in order that the curve may be described in this manner, it is necessary to suppose the friction of the plane of traction to be infinite, or at least to destroy at every instant the momentum which is generated by the motion of the small weight, otherwise the direction of the motion of the describing point would not be a tangent to the curve The tractory has much analogy with the logarithmic whose *subtangent* is constant The evolute of the curve is the common catenary (D Alembert, *Ency Methodique*, *Peacock's Examples* p 174)

TRADE *See* COMMERCE

TRADE WINDS are winds which in the torrid zone, and often a little beyond it blow generally from the same quarter, varying according to circumstances, from NE to SE

The cause of this wind is to be ascribed principally to the high comparative temperature of the torrid zone, combined with the rotation of the earth from W to E The heated air at the surface ascending into the higher regions of the atmosphere, its place is supplied by the colder air rushing from the poles, which also becoming rarified ascends in its turn, and is carried in the upper regions towards the poles to supply the stream of the under current these under polar currents moving in progress towards the equator from the zones where the earth's motion is slower to others where it is more rapid acquire an apparent relative motion in a westerly direction The currents from the two hemispheres meeting near the equator their meridional motions are there destroyed and they therefore advance together with the remaining motion from the eastward round the globe The regularity of the trade winds is disturbed in some places by local causes and chiefly by the superior rarefaction of the air over land heated by the sun's rays They extend farther to the northward or southward according as the sun's declination is north or south, and in some places they become periodical, blowing one half of the year in one direction and the other half in the opposite one (*See* MONSOON) In the great Pacific ocean, however the trade wind blows with a uniform and gentle breeze all the year round The name of *trade winds* was given them from their important influence in commerce, expressing as they do the "*wind blowing* trade"

TRADITION (Lat trado *I deliver*) A truth of doctrine or fact, delivered or handed down to one from another and received on the faith that the first to whom it was so delivered received it from an authentic source In common language the word is used to signify records of facts preserved in the memory of successive persons or [illegible] and not committed to writing In [illegible] means, generally that body of doctrine [illegible] supposed to have been put forth by our Saviour or his inspired Apostles and not committed to writing and thus [illegible] from Scripture [illegible] tradition of doctrine [illegible] which is commonly said to be directly affirmed by tradition and proved by Scripture, and tradition of rites and ceremonies called by Hooker "traditions ecclesiastical" or "ordinances made in the prime of Christian religion, established with that authority which Christ has left to his church in matters indifferent and, on that consider[illegible] like authority give just [illegible] *Pol* v 65)

It is of course impossible to deny that Revelation may have been communicated to man in this manner as well as in the form of Scripture Therefore when a Protestant asserts that Scripture is the *only* rule of faith he must mean this only that the evidence on which Scripture rests is solid while no particular tradition has sufficient evidence to support it for if any tradition had evidence to support it there can be no *à priori* reason assigned why it should not be as binding as any Scripture. "I

make no scruple to grant," says the high church writer Hammond, "that apostolical traditions, such as are truly so, as well as apostolical writings, are equally the matter of that Christian belief which is equally secured by the [illegible] tolical [illegible] tradition" one of those unmeaning phrases which are of such common occurrence in this widely spread controversy, for the [illegible] may be "equally [illegible]" in the case of [illegible] of scripture and [illegible] judge of [illegible] [illegible] real difference, on this [illegible] Protestant The former holds tradition of equal authority with Scripture, but then he also holds that the church, that is, the pope, with or without a council, is the authoritative declarer of tradition

It is curious to observe that at the Council of Trent this fundamental difficulty namely who is to say what is tradition and what is not, struck the minds of the divines who were [illegible] the doctrine of the Catholic church [illegible] hardly agreed as to the form, rather than the substance, of its solution "All agreed," says Paolo Sarpi, "that Christian faith is contained partly in Scripture and partly in tradition Yea, some said more [illegible] ation of the Catholic doctrine, for [illegible] not believed but by tradition" But Vicenzo Lanello a Franciscan friar, thought "that they ought first to treat of the church, which is a more principal foundation," since "Scripture itself is founded upon it," according to Saint Augustin's saying, and "that no use can be made of traditions except by grounding them upon the same authority" But his opinion had no followers 'Some objected that the synagogues of the heretics [illegible] authority of a church' Others [illegible] of the church was sufficiently declared already (Book 2) Perhaps some confusion would have been avoided if the father's suggestion had prevailed but there is no doubt that the Romanist by tradition, means tradition declared to be such by the church

Protestants, on the other hand, without laying it down as a doctrine that tradition is equal to Scripture have in general, assented to the proposition that an authentic tradition of doctrine is binding but on the question, what is the authority competent to pronounce a tradition authentic, they have wandered strangely indeed from a reluctance to admit to its full extent that very right of private judgment on which they founded their dissent from Rome And this is peculiarly the case with those reformed divines who dislike parting with the title 'Catholic"

When the early Reformers, especially those of the Lutheran and Anglican schools attacked a doctrine or practice of Rome their first endeavour was generally to show that it was not scriptural, their second that it was not *ancient*, i e did not rest on tradition For this purpose, they opposed to the authority of the church, as it existed in their day, the authority of early fathers and councils as [illegible] belief of an earlier age Thus they *recog* [illegible] of private judgment to try the authority of the existing church by comparing it with authorities of earlier times, they permitted each individual to apply for himself the historical test But at the same time they denied, more or less directly the right of private judgment to go further, and criticise the ancient authority itself, to examine, for instance whether a doctrine acquiesced in, in the fourth century, might not have been altogether unknown to the first, whether corruption in the church may not have commenced at so very early a period as to invalidate greatly the testimony even of the oldest father, and, lastly, whether traditions resting on high historical authority, are or are not consistent with Scripture And even to the present day, the high church school of Anglican divinity does practically [illegible] these as points without the [illegible] of [illegible]

Now this we cannot but think an untenable position Either the church has and always had authority to declare to us what is tradition, or it has not If it had, then the Reformation was an unlawful thing *ab initio*, and no church commencing in schism can be said to have a pure and real existence If it had not, then each man, in the last resort, must judge for himself of the authenticity of what is propounded to him as tradition He will be bound to judge with humility respect and submission, but the decision belongs ultimately to the *forum* of his proper conscience

He will, therefore, feel it necessary to examine the value of the evidence for the doctrines or rules of discipline presented to him as traditional, by the same principles of criticism which he would apply to other testimony, not receiving all in the mass, on the faith of [illegible] [illegible] the Apostles, several hundred bishops, convened from all parts of Christendom, at the Council of Nice, declared that the doctrine of the Trinity, as embodied in the creed of that council, had been "handed down" in their respective [illegible] from [illegible] He accepts this as evide [illegible] that there was an [illegible] the Apostles and their [illegible] form in Scripture But when he is required to receive the doctrines, for instance, of the Apostolical succession as commonly understood, or of the sanctity of celibacy, or the use of language widely deviating from that of [illegible] Sacraments, on the ground that [illegible] he holds himself at liberty to inquire, first, whether the language of fathers and councils respecting them is distinct and consistent, when freed from rhetorical exaggeration, next, whether it is not least strong in the age nearest the Apostles, and increases in force as we proceed lower, and, lastly, whether on all these subjects their testimony was not likely to be warped by the ordinary causes of error which throw discredit on witnesses and from which we have no right whatever to imagine the Christian writers of the fourth, third, or second centuries exempt, such as the ambition of the clergy, the tendency to admit gnostic and heathen influences, and the deficiency in solid judgment and reasoning power which characterized the educated men of those ages Again he will not be influenced by the common Romish argument already alluded to, and frequently in use among high Anglican writers also that 'Scripture itself is found to be such by tradition" Because we receive the testimony of early Christian writers that such and such books were *canonical*, i e received in the church in their time, it by no means follows that we must receive their deductions from Scripture as having the form of tradition, not even when they style these the deductions of the church Such reasoning would not pass for current in any but theological controversy We receive the testimony of Xenophon and Plato as to the actions and sayings of Socrates, we do not therefore admit as authoritative their exposition of his philosophy, not even as an authoritative representation of what was regarded as his philosophy at Athens and yet they were his contemporaries Irenæus the earliest father on whom we depend for any thing like extensive testimony to tradition, lived a hundred years after the Apostles and a hundred years of much corruption and dissention

Lastly he will know that if an overweening contempt of the authority of early uninspired writers, and of old ecclesiastical traditions, is most unbecoming a Christian inquirer an exaggerated and superstitious veneration for them if a more amiable error, is scarcely a less serious one There could be no traditions more venerable more sanctioned by the apparent authority of the church, than those of the Jews at the time of our Saviour, yet our Saviour does not on that account in any degree mitigate his condemnation of them, or speak of them as entitled even to respect, when he denounces those who teach for doctrines the commandments of men

(It would be impossible to refer to particular works on this subject of controversy The extreme Protestant view of tradition is no where so fully argued as by Chillingworth, *passim* For a concise and fair view, on high church principles of the estimate of tradition by the English Reformers see *Palmer's Church of Christ*, vol i p 493 504)

TRAGACANTH A variety of gum it is the produce of the *Astragalus Tragacantha* native of Africa, and imported in small [illegible] pieces, white or yellowish and translucent or nearly opaque When put into water they swell up, and gradually form a gelatinous or pasty mass, not dissolving into a clear solution, as is the case with gum arabic An analogous kind of gum is found in other plants and the generic name of *tragacanthin* is sometimes applied to it

TRAGEDY (Gr τραγος, *a goat*, and ᾠδη, *a song*) A species of drama in which the diction is elevated and the catastrophe melancholy The name is usually derived from the ancient Greek custom of leading about a goat in procession at the festivals of Bacchus, in whose honour those choral odes were sung which were the groundwork of the Attic tragedy Some recent writers however, have given a new explanation of the word τραγος considering it an ancient Greek adjective, and translating it melancholy' or lamentable" *See* DRAMA

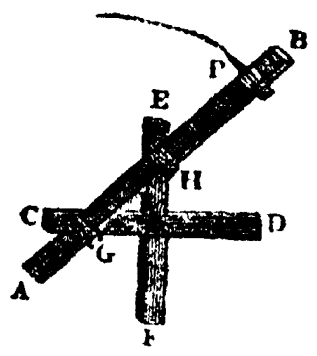
TRAGI-COMEDY In literature a compound name, invented to express a class of the drama which should partake both of tragedy and comedy If the mixture of [illegible] in the piece alone entitles [illegible] all the Plays of Shakespeare (with the [illegible] exception of the *Merry Wives of Windsor* to [illegible] *Twelfth Night* and perhaps [illegible] [illegible] and [illegible] almost all the works [illegible] But *Troilus and Cressida* alone, of the Plays of Shakespeare, bears this title in old

editions on what account we do not know French critics define the distinction to be, that the *event* of the tragi-comedy is not unhappy or bloody Dacier condemns them as [illegible] Guarini the Italian poet, wrote an essay [illegible]

TRAGUS [illegible] the term applied to the small cartilage [illegible] the entrance of the external ear in the adult it is beset with small hairs

TRAJECTORY (Lat trajectus) The curve which a body describes in space, as a planet or a comet in its orbit, or a stone thrown obliquely upwards in the air The form of the trajectory depends on the initial velocity with which the body is projected, the law and direction of the forces which act upon it, and the resistance of the medium in which it moves The planetary orbits would be strictly elliptical, were it not for the disturbing forces which they exert on each other, and but for the resistance of the air, a body projected obliquely from the earth would describe a portion of a parabolic curve

TRAMMEL (Old French trunel) An instrument for drawing ovals much in use among joiners and other artificers It consists of a cross C D E I, in which are cut two grooves at right angles to each other, and a beam A B carrying two pins G H (which are clamped to A B, and slide in their grooves) as well as a pencil P these parts are called the cross and the beam By turning A B round the pins G H slide along the grooves and the pencil P describes an elliptic curve A demonstration of the properties of this instrument may be seen at p 700 vol xiv of *Hutton's Abridgment of the Philosophical Transactions*




TRAMONTANE See ULTRAMONTANE

TRANSCENDENTAL In Algebra a term applied to any quantity which cannot be represented by an algebraic equation of a finite number of terms with determinate indices Such quantities include all exponential and logarithmic expressions and trigonometrical lines in terms of the arc Thus $a^x$ $x^x$ $\log x$ $\tan x$ &c are transcendental expressions and any equation into which such expressions enter is called a *transcendental equation* and any curve defined by such an equation is called a *transcendental curve*

But by *transcendental equations* are sometimes meant such differential equations as can only be integrated by means of curves logarithms or series

TRANSCENDENTAL A word used by German philosophers to express that which *transcends* or *goes beyond* the limits of actual experience This general meaning is somewhat restricted by Kant who draws a distinction between the *transcendental* and the *transcendent* The transcendental he defines to be that which though it could never be derived from experience yet is necessarily connected with experience and which may be shortly expressed as the intellectual *form* the *matter* of which is supplied by sense "I call" says he "all knowledge transcendental which has regard in general not so much to *objects* as to our mode of knowing or apprehending objects (that is to say to formal knowledge) so far as this is conceived to be possible *a priori* A system of such conceptions would be named transcendental philosophy as the system of all the principles of pure reason" The *transcendent* on the contrary is that which regards those principles as objectively real to which Kant assigns only a subjective or formal reality and consequently is by him regarded as beyond the limits of the human reason altogether

TRANSEPT (Lat trans and septum) In Architecture, the cross part of a cathedral which extends on the north and south sides of the area between the nave and the choir and forming as it were the short arms of the cross upon which the plan is laid out

TRANSFIGURATION The supernatural change which is described to have taken place in the appearance of Christ, when, as is recorded in Matth xvii, Mark ix, Luk ix, he took Peter, James, and John up into a high mountain with him, and was transfigured before them his face shining as the sun, and his raiment showing white as light There appeared in conversation with him Moses and Elias, and the apostles erected three tabernacles or tents to them An ancient tradition assigns Mount Tabor as the scene of this event upon which three contiguous grottoes have been fashioned to represent the three tabernacles

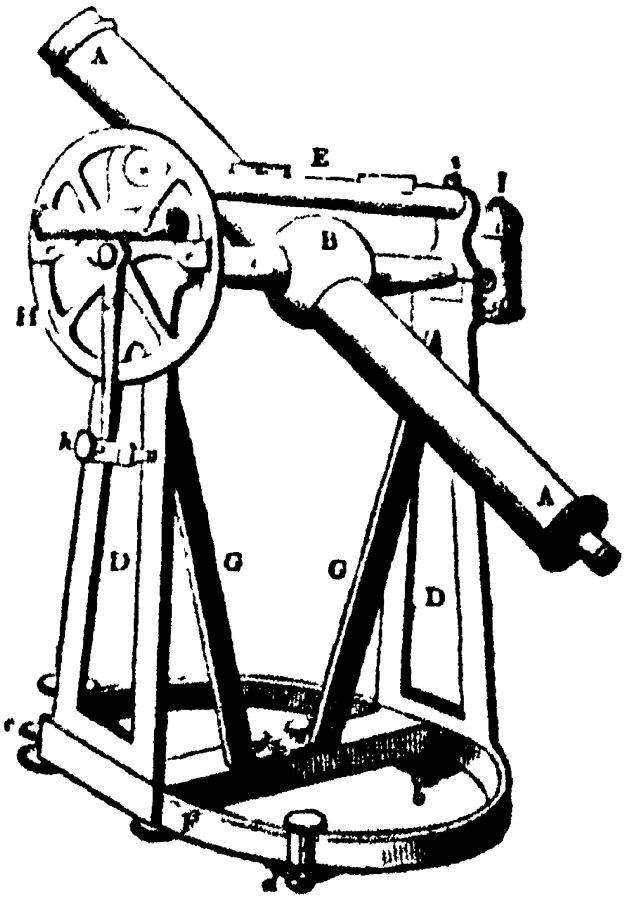
TRANSFUSION The injection of blood from one living animal into another It was at one time supposed that this operation might be resorted to, to sustain life in cases of great loss of blood from accidental hæmorrhages and other causes, and that in certain cases of mental and bodily disease a cure might be effected by abstracting a large quantity of blood, and supplying its place by transfusion from another animal, such as a calf or sheep Some of these experiments appeared at first to be attended with success, but bad consequences followed, and in two or three cases in which it was tried upon the human subject it proved fatal

TRANSIT (Lat transitus, *passage*), in Astronomy, is the culmination or passage of a celestial object across the meridian of any place The determination of the exact times of such transits is one of the most important operations of practical astronomy as it is by this means that the differences of right ascensions, and consequently the relative situations of the fixed stars, and the motions of the planets and comets in respect of the celestial meridians become known, and it is most easily and accurately effected by the aid of the *transit instrument* the nature and method of using which will be explained under that term

*Transit* is also used to signify the passage of an inferior planet across the sun's disk See MERCURY and VENUS

TRANSIT INSTRUMENT This important instrument called by the French *instrument des passages*, *lunette méridienne*, consists essentially of a telescope firmly attached to a transverse horizontal axis the ends of which are directed to the east and west points of the horizon The extremities of the axis are formed into cylindrical pivots of exactly equal diameters, which rest in notches (technically called Y's from their resemblance to that letter) formed in metallic supports susceptible of nice adjustment both horizontally and vertically so that the axis can be placed perfectly horizontal and at right angles to the plane of the meridian in which the telescope moves In the focus of the eye piece is placed a system of three five, or sometimes seven vertical and equidistant wires or spider lines generally crossed by two horizontal ones between which it is convenient that the passage of objects over the vertical wires should be observed By means of adjusting screws the diaphragm or plate to which the wires are attached is brought into such a position that the middle vertical wire intersects the optical axis of the telescope in which position it is permanently fixed

When the system of wires is brought into this position, the middle one will be a visible representation of that part of the meridian to which the telescope is directed, and when a star is seen to pass this wire, it is in the act of culminating or *transiting* the celestial meridian The instant of the transit is noted on a clock or chronometer, which is an indispensable accompaniment of the instrument and in order to render the observation more certain the instant at which the star passes each of the vertical wires is noted when practicable and the mean taken as the true instant of passing the vertical wire The sidereal times at which certain principal stars pass the meridian of Greenwich (and consequently the meridian of any other place whose longitude from Greenwich is known) being given in the *Nautical Almanac* the comparison of the time indicated by the clock and the time in the almanac gives the *clock error*, and by observing the same stars from day to day the *clock rate* is determined In this manner we are enabled to assign the exact interval of sidereal time between the transits of the different stars, and consequently the difference of their right ascensions For determining the absolute place of a celestial body it is necessary to know also its polar distance, which is given by the mural circle, so that the



transit instrument and mural circle are the two essential [illegible] omical observatory [illegible] represents the *portable* transit [illegible] or two feet in focal length The telescope tube A A is in two parts, connected together by a sphere B, which also receives the larger ends of the two cones C C placed at right angles to the telescope and forming the horizontal axis The axis terminates in two cylindrical pivots, which rest in [illegible] D D One of the [illegible] means of [illegible] of the [illegible] stride across the telescope and rest on the two pivots, serves to show when the axis is horizontal The standards D D are fixed by screws upon a brass circle F, which rests on three screws, *b*, *c*, *d*, forming the feet of the instrument and by which the levelling is performed G G are two oblique braces for the purpose of steadying the supports On the extremity of one of the pivots, which extends beyond its Y, is fixed a divided circle H, which turns with the axis, while a double vernier remains stationary in a horizontal position and shows the altitude to which the telescope is elevated The verniers are set horizontal by means of a spirit level *f* and are fixed in their position by a brass arm *g h* clamped to the supports The whole of this apparatus is moveable with the telescope and when the axis is reversed can be attached in the same manner to the opposite standard For the purpose of illuminating the wires when observations are made at night, one of the pivots is pierced, and admits the light of a lamp I which is thrown upon the wires by a reflector placed diagonally in the sphere B (*Simms's Treatise on Mathematical Instruments*)

*Adjustments* — In practice the transit instrument is subject to three principal errors 1st The optical axis of the telescope may not be quite perpendicular to the axis of the instrument which is called the error of collimation 2d The axis may not be perfectly horizontal, which is called the error of level And 3d The axis may not be exactly east and west or the optical axis may not be exactly in the meridian which is called the error of azimuth The error of collimation is detected by pointing the telescope to a distant well defined terrestrial object and bisecting it by the middle vertical wire, the telescope is then lifted out of its supports and reversed (that is, the end of the axis which was turned to the west is now turned to the east) and brought again to bear on the same object If the middle wire is found to be still bisected, the adjustment is perfect, if not the diaphragm is moved a little to the right or left by means of the adjusting screws until the middle wire bisects the object in both positions of the axis To place the axis exactly horizontal, the level I is suspended in the proper manner from the pivots and the air bubble brought to the middle by means of the foot screws The level is then reversed that is, the end which was turned to the west is now turned to the east, and if the air bubble still stands at the middle the axis is horizontal if not the foot screws are adjusted until it stands at the middle in both positions of the level To place the instrument exactly in the meridian some knowledge of practical astronomy is required It is easy to place it *nearly* in the meridian by the transit of the sun at apparent noon or of any star whose right ascension is known, and when in this approximate position to the meridian the deviation may be discovered and corrected in various ways One of the simplest is to observe two successive transits of Polaris (or any circumpolar star) above and below the pole If the interval between the two transits is exactly twelve sidereal hours the telescope is exactly in the meridian, and the difference of the interval from twelve hours shows both the amount and the direction of the azimuthal error Thus suppose the *east* pivot to be too far *north* by $n''$ and let $\Delta$ be the N P D of Polaris and $c$ the colat of the place Then, at the upper transit, Polaris will pass the meridian too *late* by $n^s \times \frac{\sin\ (c-\Delta)}{15 \sin\ \Delta}$, and at the transit below the pole it will pass too *early* by $n^s \times \frac{\sin\ (c+\Delta)}{15 \sin\ \Delta}$ Hence, if $t$ and $t'$ be the observed times of upper and lower transit (the latter corrected for clock-rate and change of R A in 12 hours),

$$t' + n^s \times \frac{\sin\ (c+\Delta)}{15 \sin\ \Delta} - t + n^s \times \frac{\sin\ (c-\Delta)}{15 \sin.\ \Delta} = 12^h$$

Hence $n^s \times \frac{2}{15} \sin\ c \cot\ \Delta = 12^h - (t'-t)$, which will determine the value of $n$. A similar process may be used with a high star and a low star for showing whether the instrument deviates much in azimuth, by comparing the difference of their times of transit with the difference of their right ascensions In the case of fixed instruments, a meridian mark is usually made on some distant object, and permanently established for the convenience of ready reference





The transit instrument appears to have been invented by the Danish astronomer Roemer, by whom it was first described in 1700, in the *Miscellanea Berolinensia*, tome iii Dr Halley placed a transit instrument in the Greenwich observatory in 1721, the telescope of which was [illegible] was little used until 1742, when Bradley [illegible] ar series of meridional [illegible] ment till lately in use in the Royal Observatory is the workmanship of Troughton and was set up in 1816 It has recently been superseded by the gigantic *transit circle* now in use, for which *see* SUPPLEMENT It is sufficient to state here that its telescope is of 12 feet focal length, and the diameter of its object-glass 8 inches, and that it is furnished with the usual apparatus of wires in its eye-piece

For full details respecting the construction and adjustments of this important instrument, see *Pearson's Practical Astronomy*, *Memoirs R Astr Society*, vol i, and the article in the *Penny Cyclopedia*

TRANSITION ROCKS A Geological term, formerly applied to the older secondary series, under the idea that they were formed during the transition of the globe from the uninhabited to the inhabited state *See* GEOLOGY

TRANSITORY ACTIONS In English Law, actions in which the *venue*, [illegible] declared in the declaration is immaterial, and consequently the trial may be had in any county, opposed to local actions, in which the trial can only be had in the county where the alleged injury was committed To the former class belong actions of contract and quasi contract (assumpsit, debt &c) *See* ACTION VENUE

TRANSLATION In Literature, the rendering of a literary work from the original language into another The peculiar merits and peculiar difficulties of successful translation have often been pointed out by critics but their judicious directions have been seldom realized by authors In truth, those difficulties require a talent of so high an order to surmount them, that few writers are fit to undertake the office of translators (we mean of works of any high literary merit), except those whose genius has more congenial occupation in original composition, for notwithstanding Dryden's sarcastic remark that imitation of an author is the most advantageous way for a translator to show himself, but it is the greatest wrong which can be done to the memory and reputation of the dead" we are inclined to doubt whether in reality imitation be not the more advantageous method of the two Every author," says an able critic (*Edin Review* vol xxxvi), "is a mannerist This manner constitutes as it were, the identity of each author, it is what the translator ought to catch, and is nevertheless the very thing which is apt to evaporate in translation Or, to borrow again the language of Dryden the office of the translator is especially to render the particular turn of thoughts and expression which are the characters that distinguish, and as it were, individuate him from all writers But nothing is so arduous as the attempt to catch this spirit or manner when the writer is also bound by the duty of rendering faithfully the sense The imitator freed from the necessity of exactly copying the sense is far more at liberty to devote himself to seizing the evanescent qualities of the manner This truth might as it appears to us be exemplified by many instances Terence and Horace seem to have aimed at familiarizing Roman ears with the best poetry of Greece not by translation but by imitation Indeed much as the Romans borrowed from the Greeks, actual translation seems to have been uncommon the only two examples which we at this moment recollect are Cicero's version of Aratus and that by Catullus of a poem of Callimachus Among modern authors which of the English translators of Horace has approached half so near him as Pope in his *Satires*? Where among all the translations of the Greek drama shall we find anything so thoroughly imbued with the spirit of that noble order of poetry as the *Samson Agonistes* of Milton, and the *Bride of Messina* of Schiller? What translator of Lucan is nearly so Lucanic as Corneille? We do not mean to disparage the utility of translations, or the merits of some few among those which have passed into popularity, but as, with scarcely an exception, they are in relation to the original to use the well-known phrase of Cervantes, only the "wrong side of the tapestry turned outwards," so, in themselves, considered as literary works they generally leave an impression of that peculiar stiffness which belongs to all copies.

[illegible] greater force to poetic [illegible] among the latter, more [illegible] works of taste and fancy than to scientific or historic treatises In the latter, an easy style, clearness, and fidelity appear of greater importance in translation, than the more difficult feat of catching the manner and spirit of the author In literary, and especially poetical translation, much controversy has been carried on between the advocates of literal and loose adherence to the sense of the author Each has its advantages and merits, but

the last, approaching most nearly to the character of *imitation*, appears to us on the whole the better extreme of the two *Three* distinct styles of translation are not ill characterized by a lively writer in the *Quarterly Re-* [illegible] p 482 [illegible] the forms of language according to the intention with which they are employed he will therefore, in his translation, make use of the phrases in his own language to which use and custom have assigned a similar conventional import, taking care, however, to avoid those which from their form, or any other circumstances, are connected with associations exclusively belonging to modern manners He will likewise, if he is capable of executing his work upon a philosophic principle, endeavour to render the personal and local allusions into the *genera* of which the local or personal variety employed by the original author is merely the accidental type and to reproduce them in one of those permanent forms which are connected with the universal and immutable habits of mankind The *faithful translator* will not venture to take liberties of this sort, he renders into English all the conversational [illegible] their grammatical and logical form, [illegible] to the current usage which has [illegible] them to particular and definite [illegible] The *free translator*, on the contrary, employs the corresponding modern phrases, but he is apt to imagine that a peculiar liveliness and vivacity may be imparted to his performance by the employment of such phrases as are particularly connected with modern manners, and if at any time he feels more than usually anxious to avoid the appearance of pedantry he thinks he cannot escape from it in any way more effectually than [illegible] the slang and jargon of the day The [illegible] ancient times he endeavours to represent by substituting in their place the peculiarities of his own time and nation"

He proceeds to exemplify these distinctions by an instance from Aristophanes —

λοιδορεισθαι δ ου πρεπει
ἀνδρας ποιητας ωσπερ αρτοπωλιδας

This says he, the faithful translator will render literally 'scold each other like bakers' wives' The spirited translator will adopt the modern popular phrase most nearly analogous, — 'like oyster wenches' The translator *par excellence* will choose a phrase rendering the particular and obsolete expression of the ancient by a general equivalent which must be equally appropriate in the idiom of all times and countries, — like market-women," or "hucksters.' Without cavilling at this ingenious piece of criticism, we must be permitted to doubt whether a translation of a highly idiomatic author conducted on this last principle would not preserve his general meaning with the serious sacrifice of his spirit

In most modern languages there are some few translations which have attained celebrity In English, Fairfax's *Tasso*, one of the earliest, has great beauty but is rather enervate The versions of Dryden are distinguished by their poetical power, though we agree with Mr Hallam (*Introduction to the Literature of Europe*, iv 536), that he did not give the example as well as precept of rendering the "particular turn of thought and expression" of his authors The utter want of individuality in his respective translations is plainly perceptible, for instance, in that from the fourth book of Lucretius (It may be observed, in passing, that the remarks of Dryden on the art of translation, of which so much has been said, are chiefly to be found in his prefaces to *Ovid's Epistles*, and to his *Second Miscellany*) Pope's *Homer* is a bad and careless version (critically speaking) of the Latin translation of the Greek poet but it has one essential characteristic of the original, namely his [illegible] which renders it, even now more pop[illegible] though not unfrequently dignified and elegant work of Cowper Some portions of Cumberland's versions from *Aristophanes* deserve mention although on the whole he is prosaic and has not dared to follow the bold flight or imitate the metrical variety of his original Mitchell's *Aristophanes* has been much admired, but it is wearisome from the continual striving after effect Some of Elton's translations are very pleasing, especially of parts of *Hesiod* Shelley has left two of the most beautiful essays in this line of composition which are to be found in our language the *Hymn to Mercury* of Homer, and the *Walpurgis Night Scene* from Goethe's *Faust* In the latter, indeed, he laboured under the disadvantage of an inadequate knowledge of the language, but none of Goethe's more critical translators (not even Dr Anster) has so powerfully seized his "turn of thought and expression" The same cannot be said of Byron's performance, — the first book of the *Morgante Maggiore*, which is, however, a remarkable feat of dexterity, from its extreme literalness a feat in [illegible] and Frere's recent version of the *Di[illegible]* of Boiardo Mickle's *Lusiad*, though now little read, is one of the most poetical of English translations Coleridge's *Wallenstein* is a truly wonderful work So carelessly written that the poet has omitted whatever he found difficult, or thought unessential it is so exact and so spirited, that the reader is constantly impressed with the idea of Schiller himself rewriting his own drama in English, with here and there a variation as perfectly Schiller-like as the German original Among prose translations Philemon Holland's numerous ones, particularly that of *Pliny* are occasionally referred to by literary men, more for their quaintness rather than their merit Melmoth's *Epistles of Cicero and Pliny*, once much admired, are polished but cold Gordon's *Tacitus* is a creditable attempt at rendering an extremely difficult author Among our numerous translators from the German in the present times, none bears so high a reputation as Mrs Austin Mr C Lewis's translation of Boeckh's *Public Economy of Athens* is a work of great merit. French is a language affording so many advantages to the prose translator, from its condensation, its exactness, its rhetorical force, that it is, perhaps, rather to be wondered at that higher distinction has not been attained by individual French writers in that line But few French translators are much remembered, except Amyot, and he chiefly for his vernacular language possessed of great sweetness as well as quaintness, which formed a mode of style in the 16th century The Chevalier Townley's translation of *Hudibras* is worth mentioning as a phenomenon, from its singular felicity and spirit Italian, on the other hand seems to be an unfit language for the purposes of translation, from extreme diffuseness, yet it boasts of one translator of *Tacitus* (Davanzati) [illegible] that affectedly [illegible] in Latin. But of all modern languages, at least of those generally known in the literary world German has by far the greatest capabilities for this purpose This must be conceded *à priori*, by those who are familiar with its peculiar powers and flexibility, and not less by those who are acquainted with this portion of its literature Among the most highly esteemed poetical works of this description in Germany are Voss's *Homer* and *Virgil*, Streckfuss's *Dante*, Schlegel and Gries's *Calderon*, Schlegel's *Shakspeare* In prose, the complicated syntax of the Germans, perhaps we may add the as yet unformed character of their prose style, detract from the natural powers of the language, still they have some excellent specimens of, [illegible] *Humboldt* [illegible] *Ranke*)

TRANSLUCENCY (Lat *translucco*, *I shine through*) Semitransparency The term is chiefly used in descriptive mineralogy as applied to minerals which admit of a passage of the rays of light, but through which objects cannot be definitely distinguished

TRANSMIGRATION OF SOULS *See* METEMPSYCHOSIS PYTHAGOREAN PHILOSOPHY

TRANSMUTATION In Alchemy, the operation of changing the imperfect metals (as they were termed) into the two precious, — gold and silver This was the great object of that pretended science *See* ALCHEMY

TRANSMUTATION, in Geometry, the change of one figure or body into another of equal area or solidity, as a [illegible]

TRANSOM [illegible] (*a traverse*) In Architecture, the horizontal piece framed across a double-light window when a window has no transom it is called a *clere story* window

TRANSPARENCY is that quality in certain bodies by which they give passage to the rays of light, and is generally supposed to be a consequence of the homogeneity of the matter of which they are composed

TRANSPLANTING The art of removing a plant or tree from one situation to another in such a manner as not to interrupt its growth This operation is commonly performed in the winter season or in autumn and spring, when vegetables are generally in a dormant state, and the great object of the transplanter is to lift as many of the roots as possible without injuring them, and to replace them in a new situation to which the tree is transplanted in such a manner as to facilitate their growth With herbaceous plants and young trees this is comparatively a simple operation, but with large trees it is an operation of skill, care, and labour The tree to be transplanted should be considerably under the normal age of the species, and to prepare it for the change which it is to undergo other trees, or objects of its own height, with which it is immediately surrounded, should be taken away a year or two previous to removal, in order to accustom the tree to the direct action of the light and air on every part of it which is above ground The next part of the operation is to dig a trench round the tree, equidistant from the trunk, at the distance of three, six, nine, or twelve feet, according to its height, and to such a depth as to cut through all the horizontal roots The tree may then be removed to its new situation, with or without the earth attached to that part of the roots which remain; or, which is a more certain mode, the trench may be left open during a year, in order that the sections

of the amputated roots may heal over, and be prepared to emit new fibrous roots after the tree is transplanted, or, and which is the more general mode, the trench may be filled [illegible] rage the [illegible] year, or of two years if the tree is very large, it may be removed to its final situation Hitherto we have said nothing of the trunk and branches of the tree to be removed In a moist climate, such as that of Ireland or the west of Scotland, all the branches may be retained, but in dry climates, such as that of England the branches require to be thinned out in proportion to the roots cut off, and in dry and warm climates, such as that of central France, the greater number of the branches require to be removed The proper season for transplanting all ligneous plants, whether small or large, is in autumn, after the leaves of deciduous trees have dropt and when the sap of evergreen trees, in consequence of the decline of temperature, is comparatively in a dormant state

TRA'NSPORT A vessel hired by government to [illegible] In Law, a species of punishment It is not known to the common law of England, and was originally a commutation of punishment, pardon being granted to various descriptions of offenders on condition of undergoing transportation generally for seven or fourteen years, or for life It is now a statutable punishment for a great variety of offences It is said to have been first inflicted as a punishment by 39 Eliz c 4, enacting that such rogues as were dangerous to the inferior people should be banished At that time the English plantations in North America were the receptacles of transported convicts Virginia, the Jerseys, Delaware, Maryland, &c are the districts which received the greatest accession to their population from this cause At the very commencement of the practice, the same arguments were employed against it by Lord Bacon which are urged at this day by many law reformers 'It is,' he says, 'a shameful and unblessed thing to take the scum of people, and wicked condemned men, to be those with whom you plant' It was not however, brought into general use as a punishment until 1718, by 4 Geo I which act gave the courts a discretionary power to banish [illegible] American plantations After [illegible] of our American colonies several years elapsed before the government fixed on any place by way of substitute At length, in 1787, Botany Bay, on the coast of New South Wales, was fixed upon 760 convicts were despatched that year But when the expedition arrived, it was discovered that Botany Bay (discovered by Cook in 1770) afforded no practicable site for the colony, which was consequently landed at Port Jackson, where the town of Sydney was founded From that period to the present great numbers of convicts have been transported to Port Jackson, and to the later founded colony of Van Diemen's Land—our only two penal settlements Much has been done of late years towards regulating the condition of the convicts in the colony and subjecting the worse part of them to severe privations, in particular by transporting some of them to particular depots, where they are liable to close inspection and hard labour Among the writers who have lately contended against the policy of continuing the punishment of transportation, we may particularly mention Archbishop Whately (See his *Tracts on Secondary Punishments and Transportation*)

Returning from transportation before the legal expiration of sentence was an offence formerly punishable with death, but by 4 & 5 W 4 c 67 those who commit the offence, or aid others in its commission are punishable with transportation for life A great mass of evidence on the effect of transportation as a punishment for crime in Great Britain, and its effect on the moral condition of the Australian colonies will be found in the volumes published by the two committees of 1838 and 1839 It requires however, to be read with much caution, on account of the evident bias of the committees themselves, for every one knows how effectually the inclinations of a committee give a colour to the evidence taken before it, from the mode in which the operation is performed The views of that committee resembling those of Archbishop Whately of the inutility of the punishment here and its mischievous effects in the colonies, have had some effect on the proceedings of government, so far, at least, as to produce the abolition of the practice of the immediate assignment of convicts as labourers on their arrival and [illegible] ble numbers in the hulks in [illegible] their sentence

Many of the vices ascribed to the system are undeniable, but it must never be forgotten that the truly philosophical or sensible mode of looking at it is by comparison with other secondary punishments Take *any* mode of punishment in the abstract, and the eyes of the inquirer will soon detect so much of mischief caused to the sufferers, and so little visible good produced on the community, as to tempt him to regard it as detestable In the first place, transportation must be considered without the bad practice of immediate and indiscriminate assignment, which was a mere abuse Thus corrected, let it be compared with the best regulated system of imprisonment—1 In respect of its effects on the [illegible] and it may be doubted whether the Pentonville whether on the silent or separate system, the mind of the majority of sufferers goes through a more wholesome process than in the penal settlements, notwithstanding all we have heard even of the frightful condition of Norfolk Island, which is not an ordinary sample 2 In respect of its effects on the ill disposed population at home, and here, defective as transportation is commonly supposed to be, the experience of any one conversant with courts of justice will decide which sentence appears to produce the greatest impression when announced,—imprisonment, or banishment And it must not be forgotten that it is not the [illegible] gination, which c [illegible] of the gaol are thought little of by any one except the sufferer, while the evils of expatriation are greater in idea than in reality 3 In respect of the ultimate reform of the offender, and here transportation possesses an incalculable advantage over every other secondary punishment The convict who has undergone it begins life afresh he remains, indeed, under some disabilities, sufficient to mark the sense entertained by society of the difference between him and the man unstained by crime, but there is nothing to prevent his rising by regular and honest conduct, if he chooses, into a station of comfort, and even of respectability The man who leaves a gaol is utterly ru [illegible] no means of [illegible] ing him back [illegible] His character is gone for ever, and if it could be really ascertained how many among relapsed offenders are actually driven into the recommission of crime by the hopelessness and infamy of their condition, if not by the actual want which results from it we suspect that many who are now ready to give their suffrage for the abolition of transportation would be induced at least to pause until they can [illegible] this difficulty

TRANSPOSITION In Algebra is the transposing of a term from one side of an equation to the other, and is in effect the adding of equal quantities to or subtracting equal quantities from each side of the equation the *signs* of the quantity being changed from + to — or from — to + For example, if $a + x = c - d$, by transposing $a$ we have $x = c - d - a$, or if $a + b = c - x$, by transposing $x$ and $a + b$ we get $x = c - a - b$ The object of transposition generally is to bring all the unknown terms to one side of the equation for more conveniently finding their value with respect to the known terms

TRANSPOSITION In Music, the change which takes place by [illegible] pitch wh [illegible] nature as the pitch of the new key note may require

TRANSUBSTANTIATION The doctrine held by the church of Rome, that in the Eucharist the bread and wine are annihilated and replaced by the body and blood of Christ In one of its liturgical offices it says, 'This *is not bread* but God and Man, my Saviour' It is maintained by Protestants that this dogma, which was made the principal test of a true faith by the Papists at the Reformation is not found in Scripture, which in the most literal acceptation only asserts of the elements that *they are Christ's body and blood*, i e that the substances coexist in some mysterious manner Nor can they discover it in the writings of the fathers or in the canons of the early church They affirm that the first theologian who asserted even the consubstantiation, or union of substances, was Paschasius, in the ninth century, and that he was accused of making too gross an explanation of the mystery It was in the course of these disputes and in consequence of the formal and definite statement of their opinions to which controversialists were forced, that this idea of transubstantiation came into fashion among theologians, nor was it ever propounded as an article of faith by the authority of a council till the beginning of the 13th century in the papacy of Innocent III

TRANSUDA'TION (Lat. trans and sudo, *I transpire*) The oozing of fluids through membranes, or through porous bodies

TRANSVERSAL In Geometry, the name applied to a line (whether straight or curved) which *traverses* or intersects any system of other lines, as when a straight line intersects the three sides of a triangle The properties of [illegible] transversals are discussed by Carnot in his *Géométrie de Position* and *Essai sur la Théorie des Transversales*

TRANSVERSE AXIS, in Conic Sections, is the diameter which passes through both foci It is the longest diameter in the ellipse the shortest in the hyperbola, and in the parabola it is infinite, as in that curve all diameters are *See* CONIC SECTIONS

TRAPE'ZIUM (Gr τραπεζα, *table*), in Geometry, is the general name [illegible] straight lines When [illegible] are parallel, it

cal'ed a trapezoid, when both pairs of opposite sides are parallel, it is called a paral'elogram

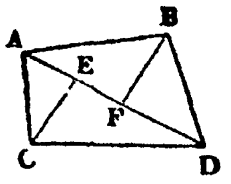
The following are a few of the most remarkable elementary properties of this figure

1 The sum of any three sides is greater than the fourth side

2 The sum of the squares of the diagonals is equal to the sum of the squares of the sides, together with four times the square of the line joining the middle points of [illegible]

3 The [illegible] of the sides form a parallelogram

4 If the figure can be inscribed in a circle, the sum of each pair of opposite angles is two right angles, and the sum of the rectangles of sides is equal [illegible] diagonals




To find the area of a trapezium, let A D be a diagonal, and C E, F B perpendiculars upon it, then A D × ½(C E + B F), is the area

**TRAPEZIUS** In Anatomy, a muscle situated immediately below the integuments of the posterior part of the neck and back Its principal action is upon the scapula, and it also acts upon the neck and head, drawing the latter backwards and turning it on its axis

**TRAPEZO'ID** A trapezium which has one pair of opposite sides parallel The area of a trapezoid is equal to half the sum of the parallel sides multiplied by the perpendicular distance between them

In Anatomy the *trapezoides* is the second bone of the second row of the carpus

**TRA'PPISTS** The name of a religious order which still exists in Normandy It was founded in 1140 by a Count de Perche in a deep valley called La Trappe whence the name of the order, and has survived all the changes and revolutions of France The rules of this order are of the strictest kind It was however far less celebrated under its original foundation, than from the reform it underwent under the celebrated Abbe de Rance in the reign of Louis XIV The history of this celebrated man is well known he was a gallant and daring profligate whose conversion was owing to the sudden death of a mistress His character and reform were a favourite subject of discussion in the court of that king in its last and devout period, and he was himself the fashion and much consulted and thought of by the fashionable devotees of the time Perhaps the best appreciation of him will be found in the notices scattered through the *Memoirs* of Saint Simon, who reverenced him, but was too clear-sighted to idolize any one His rule was of the austerest description, comprising among other severities absolute silence on the part of those admitted for a considerable period At the Revolution the community of La Trappe was dispersed many members escaped to England and were received by Mr Weld, the proprietor of Lulworth in Dorsetshire There are now several congregations of Trappists The famous Baron Geramb so long the lion of the fashionable circles in London ended his career by entering one of them (See the *Encyl Methodique* 'Theologie') There is an account of the present state of the original convent in the *Revue de Paris* vol xxix It is a melancholy picture Many of the stories told of the austerities of La Trappe—*e g* that each of the monks is employed in digging every day a portion of his grave &c —are fables But the main features of the discipline the enforced silence, the complete seclusion from the world (insomuch that the superior alone receives news of the decease of a relation of any monk and it is only announced to the community by a direction to pray for the soul of the kinsman of *one* of the brethren, without naming him), [illegible] ported

**[illegible]** (From the Swedish trappa *a flight of steps*, because these rocks frequently occur in large tabular masses rising one above another like the successive steps of a staircase) They are apparently of igneous [illegible] minerals give rise to many varieties See GEOLOGY

**TRAUMATIC** (Gr τραυμα *a wound*) Relating to wounds, hence the traumatic balsams and ointments of old pharmacy

**TRAVELLER** In Naval affairs, a ring or hoop which slides [illegible] or spar

**TRAVERSE** In Law, a name given to a plea containing [illegible] matter of fact alleged on the other [illegible] refer the matter to the decision of a jury

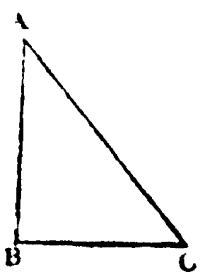
In cases of misdemeanour where the defendant postpones the trial of the indictment until the next sessions or assizes, he is said to traverse the indictment The delays which this form formerly occasioned have been materially abridged by the act 60 G 3 and 1 G 4 c 4, under which persons in custody or held to bail twenty days before the sessions are bound to plead, unless a certiorari has been delivered before jury sworn

**TRAVERSE SAILING**, in Navigation, is sailing on different courses in succession, and the method of reducing such compound courses and distances into an equivalent single course and distance is called *resolving a traverse* The reduction may be effected either by geometrical projection or trigonometrical computation, but it is generally performed by inspection, with the aid of [illegible]

**TRAVERSE TABLE**, in Navigation, is the tabulated form in which the northing southing easting and westing are made on each [illegible] course and distance in a traverse, for the purpose of finding results of difference of latitude and departure made upon the whole, the difference between the sums of the northings and southings being the *diff lat*, and between the sums of the eastings and westings the *departure*

The northing, southing, easting, and westing are generally taken by inspection from a table which contains the parts of a right-angled plane triangle corresponding to a given acute angle, and a hypothenusal line of every unit in length from 1 to 300 and sometimes to 500, an extent sufficient for the wants of the practical navigator This table itself is also called a *traverse table*, from the facility which it affords in resolving a traverse, but it may be applied advantageously to many other purposes

In the annexed figure A B C is a plane triangle right-angled at B, and if A B represent a portion of the meridian (considered a straight line) passing through A and A C the distance from A to C, then the angle A is called the course, A B the difference of latitude and B C the departure, and to given values of A the corresponding values of A B and B C, being computed and entered in a table, form a portion of a traverse table




The table is thus constructed to A C and angle A as *arguments*, the angle being taken to every degree and every quarter point of the compass and the hypothenuse to every integer from unity to as high a number as may be thought requisite But the table being formed any two elements which geometrically determine the triangle may be assumed as the given one and the other found by inspection from the table But the use of the table is not limited to the solution of right angled triangles only, for every case of oblique triangles may be solved by means of it

**TRAVERTIN** (Ital travertino) A limestone deposited from water holding carbonate of lime in solution The word is a corruption of *tiburtinus*, this kind of stone being abundantly formed by the river Anio at Tibur near Rome The species about Alba is usually called *peperino* They are both of good quality and were much used by the ancient Romans Its Latin name was *lapis tiburtinus*

**TRAVESTIE** (Fr travestir *to disguise*) In Literature a word used in the same signification as parody See PARODY

**TREACLE** The viscid brown syrup which drains from the sugar in the refining moulds Its specific gravity is generally 1 4 and it contains on the average 75 per cent of solid matter (*Ure's Dictionary*)

**TREAD** (Sax tredan *to set the feet on*) In Architecture, the horizontal part of a step on which the foot is placed

**TREAD MILL** A recent invention for giving useful employment to persons imprisoned for crime

Its usual form is that of a cylindrical wheel of about 5 feet diameter and 16 feet long, and several of such wheels are sometimes coupled together The circumference is furnished with twenty four equidistant steps, on which the prisoners are made to work on the mill Each individual treads in a separate compartment, boarded off so that no intercourse can take place between the parties at work at the same time

All mounting the first step together, their weight sets the wheel in motion, bringing down the step trod upon, when they step up to the next one, which descends in the same manner, and so on, producing a continuous rotatory motion in the wheel, which may be applied as the moving force to a mill for grinding corn, or in turning any other machinery

The prisoners at work on the wheel are assisted and supported by a hand-rail before them The wheel makes about two rounds per minute, which is equivalent to a vertical ascent of about 32 f [illegible] this is about the maximum of labour [illegible] on the wheel These machines, which have now been introduced into all the great prisons in England and Wales, have been most efficacious in counteracting that feeling which disposes the worthless to balance the pleasures of idleness against the discomforts of confinement The application of it to prisoners *before trial* was much denounced as an abuse (See *Ed Rev* vol xxxix for a paper by the Rev Sydney Smith on this subject) The Court of King's Bench, however, refused a mandamus to compel the justices of Yorkshire to allow food, except bread and water, to prisoners committed for trial who refused to work.

TREASON, or HIGH TREASON By the statute 25 E 3 c 2 the limits of this great offence were first accurately defined, and although subsequent enactments at different periods widely enlarged the range of actions which might be drawn within its penal character, yet most of these have been regarded as encroachments upon the principles of our jurisprudence To compass the death of the king, queen, or king's eldest son and heir, to violate the king's wife or daughter, or the wife of the heir apparent, to levy war against the king in the realm, to assist the king's enemies in the realm or elsewhere, to counterfeit the king's privy seal, to clip or counterfeit the king's money, to slay the chancellor or other high judicial magistrates, — these are the seven species of treason constituted by this act The many fresh species devised during the troubled periods which followed that reign, and by the arbitrary genius of Henry VIII, were repealed in the first year of the reign of Queen Mary Of new treasons since created by analogy to those which were previously so considered, the principal are defined by 36 G 3 c 7 such as conspiring to excite foreigners to invade the realm, levying war in order to compel the king to change his measures or counsels, or to overawe either house of parliament, and the expressions or declarations of such opinions by printing, writing, or any other overt act Counterfeiting the king's money or filing and clipping the king's coin, are still treasons, as well as having coining tools in possession, and [illegible] from abroad Most other offences [illegible] of a lower description In high treason all parties concerned are principals no accessaries being recognised in this offence (See the *Sixth Report of the Commissioners of Criminal Law*)

TREASURER, LORD HIGH Formerly the third great officer of the crown in England The office is now executed by five persons styled the lords commissioners of the treasury, one of whom holds also the office of chancellor of the exchequer See TREASURY

TREASURE TROVE During the middle ages *treasure trove*, or money dug from the ground formed an important branch of the revenue of this and of most other European states The security of property which we have enjoyed since the Revolution has however, put long [illegible] practice of burying treasure [illegible] known to a late period the practice was common in Ireland and is, perhaps, not yet altogether abandoned in that country, and it is also common in some of the Continental states Neckar mentions that in France, under the *ancien regime* the vassals of many of the nobles afraid of subjecting themselves to the violence of their masters buried all the money they could scrape [illegible] during the anarchy and brigandage of [illegible] vast sums were thrown into the earth The well informed Russian economist, M Storch mentions that the practice of burying treasure is still extremely prevalent in Germany, Italy, and Russia, and at must necessarily be more or less prevalent in every country exposed to the ravages of war, and where the rights of property are imperfectly protected But it is chiefly in the despotical states of Asia, and in Turkey in Europe, that the burying of money is carried to the greatest extent *There* every rich individual estimates his wealth not by the stock or capital he has lent to others, or has employed in the great work of production but principally by the amount of the treasure he has been able to conceal, and every poor man deposits in the earth whatever he can contrive to withdraw from the grasp of his avaricious masters 'The rajahs,' says Mr Luke Scrafton, in his valuable tract on Hindostan 'never let their subjects rise above mediocrity, and the Mohammedan governors look on the growing riches of a subject as a boy does on a bird's nest he eyes their progress with impatience, then comes with a spoiler's hand and ravishes the fruit of their labour To counteract this the Hindoos bury their money under ground, often with such secrecy as not to trust even their own children with the knowledge of it, and it is amazing what they will suffer rather than betray it When their tyrants have tried all manner of corporeal punishments on them they threaten to defile them but even that often fails, for resentment prevailing over the love of life, they frequently rip up their bowels or poison themselves, and carry the secret to the grave" Mr Scrafton considers that the universality of this practice, and the quantity of the precious metals which must in consequence have been lost, has been a principal cause of the long-continued drain of specie to the East From the discovery of the American mines down to a very late period, the greatest portion of their produce has been directly or indirectly exported to Turkey, Hindostan, and other eastern countries, and yet it is said that the precious metals do not seem to have become more abundant in those countries, or the prices of commodities to be materially increased But, without attempting to investigate the precise degree of credit that ought to be attached to this statement, it is abundantly certain that the want of security which has caused this locking up of so large a quantity of capital must be one of the main causes of the poverty and wretchedness in which the people of India, Persia, Turkey, &c are involved

TREASURY, BOARD OF In England, the board to which is entrusted the management of all matters relating to the sovereign's civil list or other revenues. This office was formerly committed to the lord high treasurer, the third great officer of the crown, but in modern times a lord high treasurer has not been appointed the [illegible] by [illegible] commissioners The chief of these or first lord of the treasury, is generally the prime minister for the time being, and, when a commoner, also chancellor of exchequer, though Sir Robert Peel has recently deviated from this practice The salary of the first lord of the treasury is 5000*l* per annum, that of the others 1200*l* each The other officers of the board are, two joint secretaries, a number of clerks (chief, senior, junior, minute, copying &c), a receiver of fees, a keeper of the papers, a solicitor, a chamber keeper, messengers, housekeepers, extra clerks and extra messengers

TREATY In Law, an agreement between two or more independent states Grotius (*De Jure Belli et Pacis*, l ii ch 15 s 5) divides treaties into two classes those which turn on things to which the contracting parties are already bound by the law of nature, such as mutual amity commerce, &c, and those which contain stipulations for something more, such as treaties regulating boundaries, conceding particular powers, &c The municipal constitution, in every state, determines in whom resides the authority to make and to ratify treaties In most monarchies it is vested in the sovereign, in republics, in the chief magistrate senate or executive council, in federal states, sometimes exclusively in the federal authority, as in the United States, while in the Germanic federation the particular states retain the right of making treaties of alliance and commerce not inconsistent with the fundamental laws of the confederation In order to enable a public minister or other diplomatic agent to conclude and sign a treaty, he must be furnished with a full power and when so concluded the treaty is binding on the state in the same manner as an agent is bound by the act of his principal But the question how far, and in what cases ratification is necessary has been the subject of much debate among writers on international law It is usual to reserve a power to ratify in the treaty itself It is necessary also, in most constitutional governments for the sanction of the legislative body to be subsequently given to treaties of commerce taxes on the people entered into by the [illegible] Thus the government of Great Britain when making treaties granting subsidies, &c usually stipulates that the king will recommend to parliament to make the grant necessary for the purpose, but under the constitution of the United States it has been thought that congress is bound to sanction treaties in general made by the president with the advice and consent of the senate Treaties have been divided into real and personal the former of which are said to bind the contracting parties independently of any change of sovereignty or in the rulers of the state, the latter are made with express reference to the person of the actual ruler But treaties properly so called, as of friendship and alliances commerce and navigation, even if perpetual in terms are said to expire — 1 In case either of the [illegible] parties cease to be an independent state 2 When the internal constitution of government is so changed as to render the treaty no longer applicable In this they differ from what are called transitory conventions which pass from one government to another, such as treaties of cession, boundary &c (See *Wicquefort* book ii, *Vattel* book ii, Schoell, *Hist. des Traités de Paix* 4 vols Brussels 1817)

TREBLE (Said to be the same as 'threefold," sed quære?) In Music the highest part in a concerted piece Thus we say a treble violin a treble hautboy &c In vocal music this part is committed to boys or females The treble is divided into first or highest treble, and second or low treble Half treble or, as it is sometimes called *mezzo soprano* is a high counter tenor

TREKSCHUYT (Dutch, *track ship or boat*) The covered boats drawn by horses or cattle, and used for the conveyance of goods and passengers on the Dutch and Flemish canals, are so called For an admirable description of the accommodations and management of the 'trekschuyt" now so rapidly falling into disuse from the introduction of railways, see *Murray's Handbook for Northern Germany*

TREENAILS In Naval Language, wooden bolts by which the planks of a ship's bottom are secured to the timbers

TREFOIL (Lat tres, *three*, and folia, *leaves*) In [illegible] to three cusps in a circle, resembling a [illegible] clover

TREFOIL A name given in English to different kinds

of three-leaved plants White trefoil is *Trifolium repens*, yellow trefoil is *Trifolium minus*, black trefoil is *Medicago lupulina*, bird's foot trefoil, *Lotus corniculatus* All such plants are used for the food of cattle The French word *trèfle* has a similar application

TREMA'NDO *Tremol* (It *trembling*) In Music, a direction for one of the graces of harmony, which consists in a reiteration of one note of the chord: this, however, applies more directly to the word *tremolo*, whilst the *tremando* is a general shake of the whole chord

TREMATODES, *Trematoda* (Gr τρημα, *a hole*) The name of an order of Sterelminthans, or Parenchymatous Entozoa comprising those which have organs of locomotion and adhesion in the form of suckers

TREME'LLA (Lat tremo, *I tremble*) A jelly-like plant of the lowest organization, found in damp walks and similar situations It is composed of a thallus containing microscopical spores, and is closely allied to the [illegible]

TREMOLITE A mineral, often of a fibrous texture, generally containing silica magnesia, and carbonate of lime, originally found in the valley of Tremola on St Gothard

TRE'NCHES (Fr tranché), in Fortification, are places cut out by besiegers to approach the place attacked in greater security They are generally from 8 to 10 feet wide and in depth something more than the height of a man being commonly about 7 feet

TRENT, COUNCIL OF, in Ecclesiastical History, was assembled by Paul III in 1545, and continued in twenty-five sessions until 1563, under Julius III and Pius IV This celebrated council was convoked at a period when the Christian world was agitated by the early efforts of the reformers, and its most important decrees have therefore reference to the points on which the controversies of the Reformation chiefly turned *e g* transubstantiation, image-worship, the authority of the pope There is a certain degree of ambiguity in the expression of some of its decrees owing to the uncertainty which the doctrines of the reformers caused in the minds of supporters of the Romish faith But on the whole, it cannot be denied that they express the general belief of Western Christians at the period when they were drawn up, and that they condemn although with little decision and [illegible] many of the more gross abuses of the church The authority of these decrees (except so far as the more strictly doctrinal part of them is embodied in the creed of Pope Pius IV) has been much debated among Romish ecclesiastics In Germany Poland and Italy they appear to have been adopted from the beginning without restriction in Spain only with a reservation of the rights of the monarch in France they have never been solemnly received But as regards the more important portions of them which contain the rule of faith they probably accurately express the belief of the Roman Catholic church at the present day The famous history of Father Paul (*Paolo Sarpi*) is in many respects a noble model but does not always contain a fair estimate of the subject That of Cardinal Pallavicino represents the more Romanist view (See *Mosheim* vol iii, *Robertson's Charles V*, *Hallam's Intr to the Literature of Europe*, vol ii)

TREPA'N (Gr τρυπαω *I perforate*) A circular saw for perforating the skull The term *trephine* is also applied to a similar but improved form of the instrument (See the article "Trephine," in *Cooper's Surgical Dictionary*)

TRE'SPASS, in Law, strictly is any transgression of the law less than felony or misprision of felony, but is generally used to signify any wrong or damage which is done by one private person to another *Trespass vi et armis* is where an act is done which is in itself an immediate injury to another's person or property, such as assault and battery, or breaking and entering a house or close *Special trespass*, or *trespass on the case*, where an act is [illegible] but only by consequence and [illegible] is a personal action of tort, and lies for injuries of a very miscellaneous character Trespass on the case, as a form of action arose originally out of a power given to the Court of Chancery to frame new writs for injuries which could not be redressed under the common forms of trespass or covenant *Trover* and *assumpsit* are, in their origin, different forms of trespass [illegible]

TRESSURE In Heraldry, a border running parallel with the sides of the escutcheon, which should contain about one quarter of the bordure It is generally either double or triple, and has usually fleur-de-lis, arranged in opposite directions alternately, perpendicular to the length of the tressure it is then called *flory counter-flory* The tressure forms part of the royal arms of Scotland and of those of many noble Scottish houses

TRESSURE TRIER See Visor

TRET In Commerce, an allowance of 4 lbs for every 104 lbs for the waste which certain kinds of goods are liable to from dust, &c

TRIAD (Gr τριας *three*) As to the mysterious triad of deities of [illegible] have been the basis of the [illegible] according to a passage in Proclus on the *Timæus* of Plato (see *Bryant's Ancient Mythology*, vol iii p 167), "they could," he says, in accordance with his singular theory, "be no other than the three sons of Noah, who were the Baalim of the Scriptures, and the Δαιμονες and Αρεα [illegible] of Greece" Others have imagined that the [illegible] his [illegible] with the [illegible] W [illegible] by Cymric antiquaries *of the Welsh Bards* are poetical histories, in which the facts recorded are thrown into a kind of triplets Thus, to take the commencement of the first Triad as an example,—"Three names have been given to the Isles of Britain since the beginning Clas Merddin, Tir Inys, and Inys Pridain" The Triads are supposed to be of no greater antiquity than the reign of Edward I, although they probably contain fragments of old history (See *Turner's Anglo-Saxons*, vol i "Britannia after the Romans")

TRIAD In Music, a compound of three sounds, which, from the extraordinary property it has of being naturally divisible into two thirds, one major and the other minor, constituting a fifth in the whole, has received the name of the *harmonic triad* Its name is founded on its being formed of a third and a fifth, which, with the bass or fundamental sound, make three different terms

TRIAL, in Common Law, is the examination and disposal of an issue of fact, either in criminal or civil proceedings Trials are by *certificate* by *inspection* by the *record*, and *per pais*, or by a jury The three first are of a peculiar character Trial by certificate is where the evidence of the person certifying is the only proper test of the issue, as the customs of the city of London are to be tried by the *certificate* of the mayor and aldermen &c Trial by inspection is said to be where the judges personally examine and decide the question in dispute, a practice long obsolete Trial by the record is where the point at issue being whether or not a certain record exists, or certain averments in it, it is decided by the production of the record itself But the ordinary trial of all facts with these very rare exceptions is by a jury summoned to try the issue raised by the pleadings Trials at bar of civil actions are those which take place before all the [illegible] of which the record is, the original [illegible] mode of trial, from which all others are variations although it is now very rare in practice In ordinary cases, it has been long superseded by trial at Nisi Prius (since 13 Ed I) (See NISI PRIUS) A trial at bar is now only granted on special grounds Trials before the sheriff are when the demands do not exceed *20l* by virtue of the stat 3 & 4 W 4 c 42 s 17 These are the only modes of disposing of issues raised on records in the superior courts, and trials of actions in courts of limited jurisdiction are governed by the same general rules Criminal trials are had in like manner when an issue of fact is tried, whether guilty or not guilty, is raised by the [illegible] *Venires* in civil cases, are granted where the court of which the record is, sees reason to be dissatisfied with a verdict, either on the ground that evidence was improperly received or rejected, or that the judge misdirected the jury as to the law applicable to the facts, or that the verdict was against the weight of evidence, or that a party was unfairly surprised, or, lastly, that fresh evidence has since been discovered

TRIA'NGLE (Lat triangulum) A three-sided figure which consequently has also three angles

Triangles are rectilineal spherical, or curvilineal Rectilineal or plane triangles are bounded by straight lines, spherical triangles are formed on the surface of a sphere by the intersection of the planes of three great circles, curvilineal triangles are those which are bounded by [illegible]

[illegible] from the relation of their sides and angles Plane triangles are denominated *equilateral* when their three sides are all equal, *isosceles* when two only are equal, and *scalene* when all three are unequal They are called *right-angled* when [illegible] is a right angle, *oblique-angled* when [illegible] is greater than a right angle, and *acute-angled* when each of the angles is less than a right angle, lastly, triangles are said to be *similar* when their angles are respectively equal each to each

The following are some of the principal properties of plane triangles

1 The greater side is opposite the greater angle, and *vice versa*

2 The sum of any two sides is greater, and the difference of any two less than the third side

3 The sum of the three angles is equal to two right angles and if one of the sides be produced, the exterior angle is equal to both the interior and opposite ones.

4 The sum of the squares of the sides of a right-angled triangle is equal [illegible] This is the 47th Pro[illegible], and is usually called the Pythagorean Proposition, from the circumstance of its discovery being ascribed to Pythagoras

5 Lines which bisect the angles of a plane triangle w[illegible] pass th[illegible] the centre of the inscribed circle, per[illegible] the middle of the sides pass through the centre of the circumscribing circle, and lines drawn from the angles to the middle of the opposite sides pass through the centre of gravity

6 Triangles are to each other in the compound ratio of their bases and altitudes, since the area of a triangle is the half of the product of the base and the perpendicular let fall upon it

The area of a plane triangle is found by multiplying the length of one of the sides into that of the perpendicular let fall upon it from the opposite angle, but there are various other expressions for the area, for which see TRIGONOMETRY

TRIANGLE In Astronomy, one of the forty-eight constellations of Hipparchus, situated in the northern hemisphere The same name is also given to one of the twelve southern constellations formed by Bayer There is also the *Little Triangle*, added by Hevelius, near the first named *See* CONSTELLATION

TRIANGLE In Music, a small steel triangular musical instrument of percussion, open at one of its angles It is set in vibration by being struck with a short bar of the same metal as that whereof the instrument is composed

TRIANGLE, ARITHMETICAL The [illegible] by Pascal to a table of certain numbers [illegible] form of a triangle The first vertical column of the table contains units only, the second contains the series of natural numbers, the third the series of triangular numbers, the fourth the series of pyramidal numbers, and so on (*See* FIGURATE NUMBERS) Thus -

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 1 | 1 | | | | | |
| 1 | 2 | 1 | | | | |
| 1 | 3 | 3 | 1 | | | |
| 1 | 4 | 6 | 4 | 1 | | |
| 1 | 5 | 10 | 10 | 5 | 1 | |
| 1 | 6 | 15 | 20 | 15 | 6 | 1 |
| &c | &c | &c | &c | &c | &c | &c |

Any number in the table is obtained by adding the number next above it in the same column, to the number in the same line in the next preceding column, and it will be observed that the oblique diagonal rows, beginning at the left and descending towards the right are the same as the vertical columns One of the properties of the table is, that numbers taken on the horizontal lines are the coefficients of the different powers of a binomial For the description and uses of the table, see the Introduction to *Hutton's Mathematical Tables*

TRIANGULAR COMPASSES Compasses having three legs, two opening in the usual manner and the third turning round an extension of the central pin of the other two, besides having a motion on the central joint of its own The instrument is useful in the construction of maps and charts, as three points may be taken off at once

TRIANGULAR NUMBERS The series of numbers formed by the successive sums of the terms of an arithmetical progression, of which the common difference is 1 Thus,

| | |
|---|---|
| Arithmetical progression, | 1, 2 3, 4, 5, 6, &c |
| Triangular numbers, | 1, 3, 6, 10, 15, 21, &c |

The general term of the series is $\frac{1}{2} n (n + 1)$ *See* FIGURATE NUMBERS

TRIARII The third last, or veteran rank of infantry in the Roman legion (*See* LEGION) There is an essay on this particular rank, *Mem de l'Ac des Inscr* vol xxix

TRIBE (Lat tribus) A principal subdivision of the Roman people The word signifies a division into three, which was the number of the patrician tribes, which were distinguished by the names Ramnes, Titienses, and Luceres The first of these consisted of the original body of patricians, the next two were added at different times under the kings from the free citizens, who grew up round the first The plebeian tribes, which finally included the whole people, were quite distinct from the above They were instituted by Servius Tullius, who divided the city into four regions, and the rest of the Roman territory into twenty-six, most probably making in all thirty tribes, to correspond to the number of patrician *curiæ* Ten of these are supposed to have been swept away by the cession of the territory on the Etruscan bank of the Tiber to Porsenna, as we hear of only twenty-one immediately after that event, the one having been most probably added In later times, the number of tribes was increased to thirty-five, and they then included all the free citizens In the mean time the patrician tribes became quite extinct, when all the difference of privileges enjoyed by [illegible] were abolished (See *Niebuhr's* [illegible] p 417)

TRIBOMETER (Gr τριβω, *I rub*, and μετρον, *measure*) In Mechanics, the name given by Muschenbroek and Coulomb to a sort of sledge, or apparatus for measuring the force of friction *See* FRICTION

TRIBUNAL A raised seat in the forum of Rome, [illegible] of a half moon, hence any judgment seat also a raised place in a camp whence the general addressed his soldiers and issued orders

TRIBUNE Properly is the name denoting the chief magistrate of a *tribe* [illegible] officers in the Roman [illegible] plebeian tribunes, who were first created after the secession of the commonalty to the Mons Sacer (*See* A U), as one of the conditions of its return to the city They were especially the magistrates and protectors of the commonalty, and no patrician could be elected to the office At their first appointment the power of the tribunes was very small but it increased to the assembling the plebeians, [illegible] aggression, but their persons were sacred and inviolable, and this privilege consolidated their other powers, which, in the later ages of the republic, grew to an enormous height and were finally incorporated with the functions of the other chief magistracies in the person of the emperor The number of the tribunes varied from two to ten, and each of these might annul the proceedings of the rest by putting in his veto (See *Niebuhr's Hist of Rome*, 2d edit i 624, Labletterie, *Mém de l'Ac des Inscr* vol xxxvii) 2 Military tribunes were first elected in the year 310 A U in the place of the [illegible] consequence of the demands of the commonalty to [illegible] a share of the supreme power This measure was not, however, a complete concession of their demands, but, in fact, evaded them in a great degree, for the tribunate was not vested with the full powers or honours of the consulate, not being a *curule* magistracy, and though it was open to all the people, patricians were almost invariably chosen The number of the military tribunes was sometimes six, and sometimes three For above seventy years sometimes consuls were elected and sometimes military tribunes, at last the old order was permanently restored but the plebeians were admitted to a share of it (See *Mem de l Ac des Inscr* vol xxxvii) 3 Legionary tribunes or tribunes of the soldiers, were the chief officers of a legion, six in number, who commanded under the consul, each in his turn, usually about a month in battle each led a cohort

TRIBUNE In Ancient Architecture, a raised seat or stand whence speeches were delivered to the people, the term is still used in this sense in the French chambers

TRIBUTE (Lat tribuo, *I give*) A sum of money paid by inferior sovereign or state to a superior potentate to secure the friendship or protection of the latter The *black mail* formerly levied by the Scottish borderers on their less powerful neighbours, for protecting their property from the depredations of caterans, was a species of tribute

TRICA In Botany, one of the names of the shield or [illegible] of a lichen

TRICHECHUS (Gr θριξ, *hair*, and ιχθυς, *fish*) A name invented by Artedi to designate the manatee, as being the only species of fish, or whale fish, that was hairy "quia solus inter pisces fere hirsutus sit" Linnæus, in his *System of Nature*, adopted the term *trichechus* as the generic appellation for the manatee (*Trichechus manatus*), but he added the walrus as a second species of the genus Subsequent zoologists, in separating these very different animals, and placing them in distinct genera, have [illegible] too many other cases, invented [illegible] the animal so well designated by its original epithet, and have restricted the application of the term *trichechus* to the walrus, for which it was not originally designed

TRICHIASIS (Gr θριξ, *a hair*) A disease of the eyelids in which the eyelashes grow inwards and irritate the bulb of the eye

TRICHIDIUM (Gr θριξ) A netted filament- [illegible] etted purse, in which the spores [illegible] included

TRICHINA (Gr diminutive of θριξ) The name of [illegible] of microscopic entozoa, which infest the muscular tissue of the human subject

TRICHIURUS (Gr θριξ and ουρα, *a tail*) The name of a genus of spinous finned fishes, literally rendered in their popular English name of "hair-tails," significative of their most striking generic character, which is taken from the single elongated hair-like filament that terminates the rayless tail The *Trichiuri* have no anal fin, and have neither ventral fins nor supplemental scales But one species, viz the silvery hair-tail (*Trichiurus lepturus*, Linn), has been admitted into the catalogue of British fishes

**TRICHOCE'PHALUS** (Gr θριξ, and κεφαλη, *a head.*) The name of a genus of Hematoid Entozoons, one species of which (*Trichocephalus dispar*, Rudolphi) i[illegible] intestinum cæcum

[illegible] TRANS, *Trichoptera* (Gr θριξ, and πτερον, *a wing*) The name of an order of insects founded by Kirby for the case-worm flies, which are charac[illegible]erized by [illegible] the [illegible] those of the Lepidopterous, the mandibles [illegible]

**TRICLI'NIUM** (Gr τρεις *three* [illegible] In Ancient Architecture, a room furnished on three sides with couches the fourth side being left open for facilitating the attendance of the servants, in which company was received and the repasts served The winter triclinia were placed to the west, and those for summer to the east

**TRI'COLO'R** The national French banner of three colours, blue white, and red, adopted on the occasion of the first revolution The immediate occasion for adopting them is said to have been that they were the colours worn by the servants of the Duke of Orleans, and they were first assumed by the people when the minister Necker was dismissed in 1789 But these colours, in combination appear to have formed a national emblem in France from a very early period It is also said to have been formed by uniting the three colours successively used in the French standards at different periods, viz the blue of the banner of St Martin, the red of the oriflamme (*see* ORIFLAMME) and the white of the white cross supposed to have been assumed under Philip of Valois The three colours were given by Henry IV to the Dutch on their desiring him to confer on them the national colours of his country and they have since been borne successively by the Dutch republic and the kingdom of the Netherlands The domestic livery of Louis XIV was tricoloured, as were also the liveries of the Bourbon kings in Spain At the revolution, when the three colours were assumed on the national flag, they were borne in the same order as the Dutch, but in a different position, viz the division of colours parallel to the flag staff, whereas in the Dutch flag it is at [illegible] being the favourite banner [illegible] flags have been adopted in Belgium, &c and they are often employed as emblematical of liberty in other states

**TRICU'SPID VALVE** The valve of the right ventricle of the heart

**TRIDENT** (Lat tres *three* and dens *a tooth*) The sceptre which the poets and painters of antiquity placed in the hand of Neptune is so called by way of eminence It is in the form of a spear or fork with three prongs or teeth hence the name *See* NEPTUNE

**TRIENS** A small Roman copper coin, worth one third of the *as* (which see) as the derivation of the word implies This was the piece of money usually placed in the hands of the deceased poor to pay Charon for their passage over the Styx

**TRIERA'RCHIA** (Gr τριηραρχια) An Athenian institution which imposed on a certain body of citizens the duty of fitting out triremes for the use of the state About 1200 citizens were usually chosen for this purpose from the richest individuals, and these were subdivided into clubs of 12 or 16 to each ship Demosthenes introduced a new regulation by which the burden to be borne by each individual was made to bear a given proportion to his property (See Boeckh, *Public Economy of Athens* ii 319 360)

**TRIE'TERIS** (Gr τρεις *three*, and ετος *a year*) In Grecian Chronology a cycle invented by Thales to connect his year, which consisted of 12 months of 30 days each, amounting to 360 days, this falling short of the true solar year, he inserted a month of 30 days at the end of every three years by which means he made it exceed the true year by 13 days

**TRIFO'RIUM** (Lat) In Gothic Architecture an arched story between the lower arches and the clerestory in the aisles, choir, and transepts of a church An example may be seen in Westminster Abbey, where the triforium affords a communicating gallery entirely round the church

**TRIGAMOUS** (Gr τρεις, *three* and γαμος, *marriage* is a name applied by some botanists to plants containing three sorts of flowers in the same flower-head, the [illegible] females, and hermaphrodites

**TRIGE'MINI** Lat tres, *three*, and geminus, *double* [illegible] of nerves they arise from the crura of the cerebellum, and are divided within the cranium into three branches [illegible] superior and [illegible] is divided into the frontal, lachrymal, and nasal nerves, the superior maxillary into the spheno-palatine, posterior alveolar, and infra-orbital nerves, and the inferior maxillary into two branches, the internal lingual, and one more appropriately termed the infra-maxillary

**TRIGLYPH** (Gr τρεις, *three*, and γλυφω, *I carve*) In Architecture, an ornament in the Doric frieze, consisting of two whole and two half channels, separated by flat spaces called *femora*

**TRI'GONALS**, *Trigona* (Gr τρεις, *three*, γωνια, *an angle*) The name of a family of Decapodous Crustaceans, the carapace of which is nearly triangular *Trigonia* is also the name of a genus of Bivalves of a triangular form, and of which most of the species are fossil

**TRIGO'NIA** (Gr τριγωνος, *having three corners*) A name applied by Lamarck to a genus of Ostracean Bivalves, most of the species of which are found fossil, but which has a beautiful recent representative in the seas of the southern hemisphere, remarkable for the iridescent lining of the valves, *La Trigone nacrée* of Lamarck It is also the name of a genus of South American plants

**TRIGONOCE'PHALUS** (Gr τριγωνος and κεφαλη, *a head*) A genus of poisonous serpents, characterized by having the tail terminated by a horny conical process or spur No species is known to inhabit Europe or Africa, in which cont[illegible] the *Trigonocephali* are replaced by the vipers [illegible] of the island of Martinique, called by the French settlers "fer de lance," is a species of the present genus (*Trigonocephalus lanceolatus*)

**TRIGONO'METRY** (Gr τριγωνος *triangle* μετρεω, *measure*) This term as its derivation implies originally signified the measurement of triangles or the branch of mathematics which treats of the relations between the sides and angles of triangles but in its modern acceptance it includes all formula relative to angles or circular arcs and the lines connected with them, these lines being expressed by numbers or ratios In relation to its practical utility it may be regarded as the most important of all the applications of mathematics

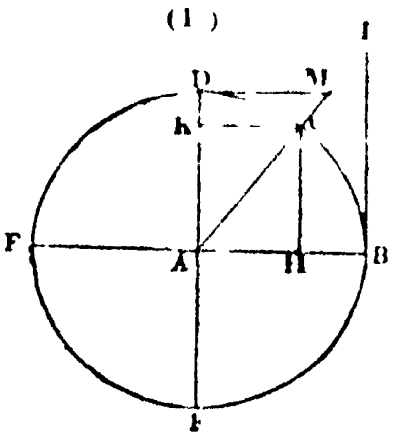
The magnitude of an angle is usually measured by the circular arc which has its centre at the angular point, and is intercepted by the straight lines forming the angle, but there is no necessary connection between an angle and the arc which subtends it and in some modern works the fundamental properties of trigonometry are explained without any reference to the circle This method of proceeding is undoubtedly more direct than the other, nevertheless as the language of trigonometry has taken its form from considerations respecting the circle there is some advantage on the score of perspicuity in the ancient method for which reason we shall adhere to it in the present sketch

The primary unit by which angles and their corresponding arcs are numerically expressed is the *degree*, or the ninetieth part of a right angle or of a quadrant This division of the quadrant into ninety parts is entirely arbitrary It was adopted by the ancient Greeks and has been all but universally followed down to the present time for although the French mathematicians attempted to introduce the decimal system by dividing the quadrant into a hundred parts their example has not been imitated, as the first effect of the alteration would be to derange and render useless the whole of the existing trigonometrical tables

The degree is divided into 60 minutes and the minute into 60 seconds Anciently the seconds were subdivided into thirds, but the practice of writing down the parts of seconds as decimals is now universally followed The expression 20° 16′ 43 57″ is read 20 degrees 16 minutes, 43 seconds, 5 tenths and 7 hundredths of a second

Let B A C (fig 1) be an angle contained by the two straight lines A B A C with A as a centre and radius A B describe a circle, let B A be produced to meet the circumference in I, and draw the diameter D I perpendicular to B E From C draw C H and C K respectively perpendicular to B I and D I, and let B I and D M be also perpendicular to B L and D F, meeting A C produced in I and M Now, since the angles at the centre of a circle are proportional to the arcs on which they stand, the arc B C may be taken as the geometrical measure of the angle B A C, and both will be expressed without distinction by the same number of degrees, minutes, &c The following definitions are used

(1)




The arc D C, which is the defect of B C from the quadrant, is called the *complement* of B C, and C E, which is its defect from the semicircle is called its *supplement* C H is the *sine* of the arc B C, and C K or A H is the sine of its complement or the *cosine* of B C, B L is the *tangent* of the arc B C, and D M is the tangent of its complement or the *cotangent* of B C; A L is the *secant* of B C, and A M the secant of its complement, or its *cosecant*; B H is the *versed sine* of B C, and D K its

*co-versed sine* These appellations are abbreviated as follows — The arc B C being taken as the measure of the angle B A C, its sine is expressed by *sin* A, its cosine by *cos* A, its tangent by *tan* A, its cotangent by *cot* A, its secant by *sec* A, its cosecant by *cosec* A, its versed sine by *ver sin* A, and its co-versed sine by *co-ver sin* A

Since the arc B C is assumed as the measure of the angle B A C, the above lines may be regarded respectively as the sine, cosine, tangent, &c of the angle, and since all quantities used in trigonometry are to be expressed by numbers, we may take, instead of those lines, any numbers which are proportional to them, and thence we may assume the ratio of the arc B C to the radius A B, that is, B C ÷ A B, as the measure of the angle B A C. In like manner the sine of the angle B A C may be represented by C H ÷ A B, its cosine by A H ÷ A B, its tangent by B L ÷ A B, its secant by A L ÷ A B, its cotangent by D M ÷ A D, and its cosecant by A M ÷ A D. Adopting these definitions, the values of the trigonometrical functions of the angle B A C will evidently remain the same when the angle remains constant, whatever be the magnitude of the circle to which they are referred. It is usual to regard the radius A B as a unit, in which case the sines, cosines, tangents, &c will be expressed in terms of that unit by the decimal notation. This is the way in which they are expressed in the trigonometrical tables.

From the right-angled triangles in the above diagram we have $AH^2 + HC^2 = AC^2$, $AB^2 + BL^2 = AL^2$, $AD^2 + DM^2 = AM^2$; and because the three triangles A H C, A B L, A D M are similar, we have also

$$\begin{array}{llll} AH & HC & AB & BL \\ HC & CA & BL & LA \\ CA & AH & LA & AB \end{array} \qquad \begin{array}{llll} DM & DA, \\ DA & AM, \\ AM & DM \end{array}$$

Making the radius A B = A C = A D = 1, and denoting the angle B A C by A, these proportions give

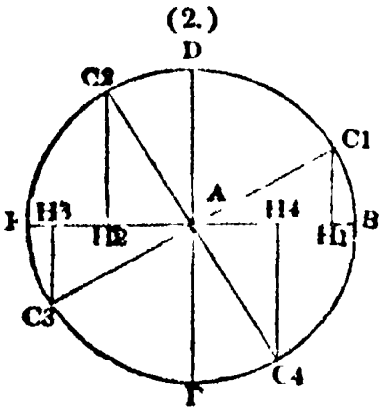
$$\begin{array}{llllll} \cos A & \sin A & 1 & \tan A & \cot A & 1, \\ \sin A & 1 & \tan A & \sec A & 1 & \operatorname{cosec} A, \\ 1 & \cos A & \sec A & 1 & \operatorname{cosec} A & \cot A, \end{array}$$

from which, and the above equations, we obtain the following table of formulæ exhibiting the relations among the trigonometrical lines —

$$\begin{aligned} &\cos^2 A + \sin^2 A = 1 \\ &\sec^2 A - \tan^2 A = 1 \\ &\operatorname{cosec}^2 A - \cot^2 A = 1 \\ &\cos A \sec A = 1 \\ &\sin A \operatorname{cosec} A = 1 \\ &\tan A \cot A = 1 \\ &\tan A \cos A = \sin A \\ &\cot A \sin A = \cos A \\ &\sin A \sec A = \tan A \\ &\cos A \operatorname{cosec} A = \cot A \\ &\tan A \operatorname{cosec} A = \sec A \\ &\cot A \sec A = \operatorname{cosec} A \end{aligned}$$

*Of the Signs of the Trigonometrical Lines* — In the above definitions and formulæ the angle A was assumed to be less than a right angle, or less than 90°, and the sine, cosine, tangent, &c were all regarded as positive. We have now to inquire what the expressions severally become as the arc increases through all its values from 0 to 360°. As before, let B L and D F (*fig* 2) be two diameters of the circle at right angles to each other, suppose the arc to begin at B, let B $C_1$ be less than a quadrant, and let the arc B $C_1$ or angle B A $C_1$ be denoted by A. Draw A $C_2$ at right angles to A $C_1$; then since $C_1 C_2$ is 90°, the arc B $C_2$ = 90° + A. Let $C_1$ A be produced to meet the circumference in $C_3$, then (reckoning always in the same direction) B $C_3$ = 180° + A. Lastly, let $C_2$ A be produced to meet the circumference in $C_4$, and we have B $C_4$ (or B D F $C_4$) = 270° + A. Draw $C_1 H_1$, $C_2 H_2$ &c perpendicular to E B. Now, according to the usual convention of analytical geometry, if the point A be regarded as the origin of [illegible] distances measured in the direction A B be considered as positive, those measured in the direction A E will be negative, and of the lines perpendicular to E B, if those above F B be positive, those below it will be negative. Hence the sines and cosines of arcs in the different quadrants will be as follows —

(2.)




In the first quadrant the arc B $C_1$ (= A) is less than 90°, and $C_1 H_1$ and A $H_1$ are both positive, that is, sin A and cos A are positive. In the second quadrant we have B $C_2$ = 90° + A, its sine is $C_2 H_2$ which is positive, and its cosine is A $H_2$, which is negative. But from similar triangles we have $C_2 H_2$ = A $H_1$, and A $H_2$ = $C_1 H_1$; therefore, sin (90° + A) = cos A and cos (90° + A) = − sin A. In the third quadrant, we have A $C_3$ = 180° + A; the sine is $C_3 H_3$ negative, and the cosine is A $H_3$ negative, but $C_3 H_3$ = $C_1 H_1$ and A $H_3$ = − A $H_1$, therefore sin (180° + A) = − sin A, and cos (180° + A) = − cos A. In the fourth quadrant we have A $C_4$ = 270° + A, the sine is $C_4 H_4$ = negative, and the cosine is A $H_4$ positive. But $C_4 H_4$ = A $H_1$, and A $H_4$ = $C_1 H_1$, therefore sin (270° + A) = − cos A, and cos (270° + A) = sin A.

Having found the directions and values of the sine and cosine of an arc in each of the different quadrants, those of the tangent, cotangent, secant, and cosecant are also determined, for the above formulæ give

$$\tan A = \frac{\sin A}{\cos A}, \quad \cot A = \frac{\cos A}{\sin A}, \quad \sec A = \frac{1}{\cos A}, \quad \operatorname{cosec} A = \frac{1}{\sin A}$$

Whence it appears that the tangent and cotangent will be positive when these quadrants have both the same sign, and negative when they have opposite signs, that is in the second and fourth quadrants. It follows also that the secant has always the same sign as the cosine, and the cosecant the same as the sine.

On these principles the following table is constructed, which will very frequently be found useful in calculation, as it shows not only the sign to be prefixed to the several trigonometrical lines when the arcs to which they belong exceed 90°, but also how to find those lines in tables which contain them only for the first quadrant.

| 1st Quadrant. | 2d Quadrant. |
|---|---|
| + sin A | sin (90° + A) = + cos A |
| + cosec A | cosec (90° + A) = + sec A |
| + cos A | cos (90° + A) = − sin A |
| + sec A | sec (90° + A) = − cosec A |
| + tan A | tan (90° + A) = − cot A |
| + cot A | cot (90° + A) = − tan A |
| **3d Quadrant** | **4th Quadrant.** |
| sin (180° + A) = − sin A | sin (270° + A) = − cos A |
| cosec (180° + A) = − cosec A | cosec (270° + A) = − sec A |
| cos (180° + A) = − cos A | cos (270° + A) = + sin A |
| sec (180° + A) = − sec A | sec (270° + A) = + cosec A |
| tan (180° + A) = + tan A | tan (270° + A) = − cot A |
| cot (180° + A) = + cot A | cot (270° + A) = − tan A |

*Of the Trigonometrical Tables* — We now proceed to show how the different trigonometrical lines may be computed. The ordinary tables contain the logarithms of the sines, cosines, tangents, and cotangents for every ten seconds, and some of the better tables as Taylor's, Bagay's, &c, for every second of the quadrant, but it is evident from the formulæ given above that if the values of any one of the four be computed for the different angles between 0 and 90°, the values of all the others will be obtained at the same time. Thus, since cos A = sin (90° − A), a table of the values of the sine is also a table of the values of the cosine, and since tan A = sin A ÷ cos A, the logarithm of the tangent of any angle is obtained by subtracting the logarithm of the cosine from the logarithm of the sine, and the logarithm of the cotangent by subtracting the logarithm of the sine from that of the cosine. The whole difficulty, therefore, or nearly the whole (for some peculiar artifices must be employed when the angles differ very little from 0° or from 90°) is reduced to the computation of the sine, and as this is expressed indefinitely in terms of the arc, it is necessary, first of all, to determine the length of the whole circumference in terms of the radius, from which the arc corresponding to any given number of degrees, minutes, and seconds is found by proportion.

It is usual to designate the semicircumference of a circle whose radius is 1 by $\pi$. A great number of formulæ have been given for computing the value of $\pi$ by means of infinite series. That which was discovered by Mechin, is the most rapidly convergent, and therefore the best adapted for computation —

$$\pi = 16\left(\frac{1}{5} - \frac{1}{3\,5^3} + \frac{1}{5\,5^5} - \frac{1}{7\,5^7} + \frac{1}{9\,5^9} - \&c\right) - 4\left(\frac{1}{239} - \frac{1}{3\,239^3} + \frac{1}{5\,239^5} - \frac{1}{7\,239^7} + \&c\right).$$

By computing a few of the terms of this series, the value of $\pi$ is readily obtained. The following is its value correct to 20 decimals —

$$\pi = 3.14159265358979323846, \&c$$

The series which give the trigonometrical lines in terms of the arc are as follows — Let $x$ be any arc less than 90°, then

$$\sin x = x - \frac{x^3}{1\,2\,3} + \frac{x^5}{1\,2\,3\,4\,5} - \frac{x^7}{1\,2\,3\,4\,5\,6\,7} + \&c.$$

$$\cos x = 1 - \frac{x^2}{1\,2} + \frac{x^4}{1\,2\,3\,4} - \frac{x^6}{1\,2\,3\,4\,5\,6} + \&c.$$

$$\tan x = x + \frac{x^3}{3} + \frac{2x^5}{3\,5} + \frac{17x^7}{3^2\,5\,7} + \frac{62x^9}{3^3\,5\,7\,9} + \&c.$$

$$\cot x = \frac{1}{x} - \frac{x}{3} - \frac{x^3}{3^2\,5} - \frac{2x^5}{3^3\,5\,7} - \frac{x^7}{3^3\,5^2\,7} - \&c$$

$$\sec x = 1 + \frac{x^2}{1\,2} + \frac{5x^4}{1\,2\,3\,4} + \frac{61a^6}{1\,2\,3\,4\,5\,6} + \&c$$

$$\operatorname{cosec} x = \frac{1}{x} + \frac{x}{1\,2\,3} + \frac{7x^3}{3\,4\,5\,6} + \frac{31x^5}{3\,4\,5\,6^2\,7} + \&c.$$

For other and more expeditious methods of computing the trigonometrical lines, or deriving them from one another, the reader is referred to the Preface to the *Tables Trigonometriques Decimales*, by Delambre, or to *Callet's* or *Hutton's Tables*

The following expressions for the sine and cosine of an angle found in John Bernoulli are of frequent use in analytical trigonometry —Let $e = 2.7182818$ (the base of the Napierian logarithms) then

$$\sin x = \frac{e^{x\sqrt{-1}} - e^{-x\sqrt{-1}}}{2\sqrt{-1}},$$

$$\cos x = \frac{e^{x\sqrt{-1}} + e^{-x\sqrt{-1}}}{2}$$

To these we may add the following formula for a multiple angle, discovered by Demoivre, which is readily deduced from them ($m$ is any number whatever) —

$$\left(\cos x + \sin x\sqrt{-1}\right)^m = \cos mx + \sin mx\sqrt{-1}$$

*Formulæ relative to Two Arcs* — In trigonometrical calculations, it is very frequently necessary to express the sines, cosines, &c of the sum or difference of two angles in terms of the sines, cosines, &c of the single angles The following table contains a synopsis of the most useful formulæ, the first four are easily demonstrated by means of a simple geometrical construction, and all the others are deduced from these four by the ordinary algebraic transformations —

$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$
$$\cos(A - B) = \cos A \cos B + \sin A \sin B$$
$$\sin(A + B) = \sin A \cos B + \cos A \sin B$$
$$\sin(A - B) = \sin A \cos B - \cos A \sin B$$
$$\cos B + \cos A = 2\cos\tfrac{1}{2}(A + B)\cos\tfrac{1}{2}(A - B)$$
$$\cos B - \cos A = 2\sin\tfrac{1}{2}(A + B)\sin\tfrac{1}{2}(A - B)$$
$$\sin A + \sin B = 2\sin\tfrac{1}{2}(A + B)\cos\tfrac{1}{2}(A - B)$$
$$\sin A - \sin B = 2\cos\tfrac{1}{2}(A + B)\sin\tfrac{1}{2}(A - B)$$

$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

$$\tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

$$\cot(A + B) = \frac{1 - \tan A \tan B}{\tan A + \tan B}$$

$$\cot(A - B) = \frac{1 + \tan A \tan B}{\tan A - \tan B}$$

$$\tan A + \tan B = \frac{\sin(A + B)}{\cos A \cos B}$$

$$\tan A - \tan B = \frac{\sin(A - B)}{\cos A \cos B}$$

$$\cot A + \cot B = \frac{\sin(A + B)}{\sin A \sin B}$$

$$\cot B - \cot A = \frac{\sin(A - B)}{\sin A \sin B}$$

$$\tan A + \cot B = \frac{\cos(A - B)}{\cos A \sin B}$$

$$\cot A - \tan B = \frac{\cos(A + B)}{\sin A \cos B}$$

$$\cos 2A = 1 - 2\sin^2 A, \quad \sin 2A = 2\sin A \cos A$$

$$\tan 2A = \frac{2}{\cot A - \tan A}, \quad \cot 2A = \tfrac{1}{2}(\cot A - \tan A)$$

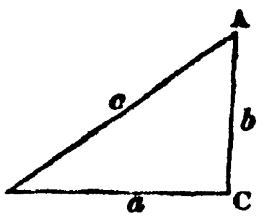
$$\cos\tfrac{1}{2}A = \sqrt{[\tfrac{1}{2}(1 + \cos A)]}, \quad \sin\tfrac{1}{2}A = \sqrt{[\tfrac{1}{2}(1 - \cos A)]}$$

$$\tan\tfrac{1}{2}A = \frac{\sin A}{1 + \cos A}, \quad \cot\tfrac{1}{2}A = \frac{\sin A}{1 - \cos A}$$

*Solution of Plane Triangles* — Having explained the nature of the trigonometrical quantities, and exhibited some of their most useful relations, we come next to apply them to the solution of triangles which forms the proper object of trigonometry Of the six parts of which a triangle consists, namely, the three sides and the three angles, it is known from geometry that when any three (excepting the three angles) are given all the rest are determined, accordingly, we have to find expressions for each part in terms of three others, and so arranged that they can be immediately calculated from a table which contains the logarithms of the sines [illegible] and cotangents to every minute or smaller division of the quadrant The solution of triangles may therefore be regarded as the art of applying such a table to each particular case It is convenient to consider the cases of the right-angled triangle separately

*Right-angled Plane Triangles* — In all the solutions which follow, the sides of the triangle will be denoted by $a, b, c$, and the angles respectively opposite by A, B, C In the right-angled [illegible] let C be [illegible] the hypothenuse There are four distinct cases, and in each case the solution follows immediately from the definition of the sine, cosine, tangent, and cotangent

(3)




Case 1 Given the two sides $a$ and $b$ to find the angles A and B, and the hypothenuse $c$ Here we have from the definition

$$\tan A = \frac{a}{b}, \quad \tan B = \frac{b}{a}; \quad \cos A = \frac{b}{c}, \quad \text{whence } c = \frac{b}{\cos A},$$

or in like manner $c = a - \cos B$

Case 2 Given the hypothenuse $c$ and a side $a$, to find the angles A and B and the side $b$ Here

$$\sin A = \cos B = \frac{a}{c}, \quad \sin B = \frac{b}{c}, \quad b = c\sin B = c\cos A$$

The side $b$ may be found independently of the angles, for since $b^2 = c^2 - a^2$, we have $b = \sqrt{[(c + a)(c - a)]}$

Case 3 Given a side $a$ and one of the acute angles A, to find the other side $b$, the hypothenuse $c$, and the angle B

Here $\cot A = \frac{b}{a}$, $\sin A = \frac{a}{c}$, $b = a\cot A$, $c = \frac{a}{\sin A}$

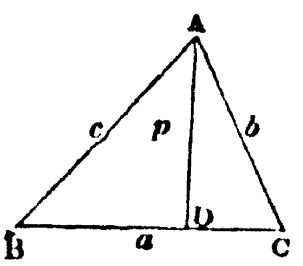
For the angle we have $B = 90^\circ - A$

Case 4 Given the hypothenuse $c$ and an angle A, to find the sides $a$ and $b$ and the other angle B Here $a = c\sin A$, $b = c\cos A$, $B = 90 - A$

*Oblique-angled Plane Triangles* — The solutions of the different cases are all derived from the three following propositions First the sum of the three interior angles of any triangle is equal to two right angles, that is,

$$A + B + C = 180^\circ \qquad (1)$$

(4)




Secondly, in any triangle, the sides are to each other as the sines of the opposite angles For, draw AD (fig 4) perpendicular to BC, and let $AD = p$, we then have $\sin B = \frac{p}{c}$, $\sin C = \frac{p}{b}$, whence $\frac{\sin B}{\sin C} = \frac{b}{c}$ The same property must evidently hold true of sides $a$ and $c$, and $a$ and $b$, whence

$$\frac{\sin A}{\sin B} = \frac{a}{b}, \quad \frac{\sin B}{\sin C} = \frac{b}{c}, \quad \frac{\sin C}{\sin A} = \frac{c}{a} \qquad (2)$$

The third general property may be derived from the second but is more readily found as follows —In the last figure let $BD = m$ $DC = n$, we have then $m = a - n$, whence $m^2 = a^2 + n^2 - 2an$ Adding $p^2$ to both sides, and observing that $m^2 + p^2 = c^2$, $n^2 + p^2 = b^2$, and $n = b\cos C$, we have $c^2 = a^2 + b^2 - 2ab\cos C$, and consequently

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab} \qquad (3)$$

We now proceed to give the solutions of the different cases of which there are four

Case 1 Given the three sides, $a, b, c$, to find the three angles A, B, C

$$\text{Put } s = \tfrac{1}{2}(a + b + c), \quad M = \sqrt{\left\{\frac{(s-a)(s-b)(s-c)}{s}\right\}},$$

$$\text{then } \tan\tfrac{1}{2}A = \frac{M}{s-a}, \quad \tan\tfrac{1}{2}B = \frac{M}{s-b}, \quad \tan\tfrac{1}{2}C = \frac{M}{s-c}$$

Case 2 Given two sides, $a, b$, and the included angle C, to find the other side $c$, and the other angles A B

Find first the sum and difference of A and B from these two formulæ, $A + B = 180^\circ - C$, $\tan\frac{1}{2}(A - B) = \frac{a-b}{a+b} \times \tan\frac{1}{2}(A + B)$, then

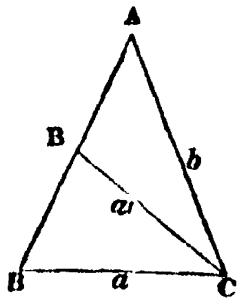
$$A = \tfrac{1}{2}(A + B) + \tfrac{1}{2}(A - B)$$
$$B = \tfrac{1}{2}(A + B) - \tfrac{1}{2}(A - B)$$
$$c = a\frac{\sin C}{\sin A} = b\frac{\sin C}{\sin B}$$

Case 3 Given two sides $a, b$ and the angle opposite one of them, A, to find the third side $c$, and the other angles B, C

Here we have $\sin B = \frac{b}{a}\sin A$; $C = 180^\circ - (A + B)$;

$c = a \frac{\sin C}{\sin A} = b \frac{\sin C}{\sin B}$ In this case, however, it is necessary to remark, that if the side which is adjacent to the given angle be greater than the side opposite to it (that is, if $b$ be greater than $a$) then there are two triangles which have the same data, and consequently the solution is ambiguous. For with C (fig. 5) as a centre, and radius equal to C B, describe an arc of a circle intersecting A B in B′, and join C B′; it is obvious that the data $a$, $b$, A belong to both triangles A C B and A C B′, and the solution gives alike $c$ = A B, and $c$ = A B′. The solution is therefore said to be ambiguous.

(5)




Case 4. Given two angles, A, B, and the side between them $c$.

In this case the third angle is likewise given by reason of C = 180° − (A + B), and consequently the sides are found from the formulæ

$$a = c \frac{\sin A}{\sin C}, \quad b = c \frac{\sin B}{\sin C}$$

*Area of a Plane Triangle.*—Euclid has shown that the area of any plane triangle is equal to the rectangle contained under half the base and the perpendicular let fall on it from the opposite angle, that is, area = $\frac{1}{2} a p$ (fig. 4). But for $p$ we may substitute $b \sin C$ (or $c \sin B$), and we have area = $\frac{1}{2} a b \sin C$. If from this expression we eliminate $b$ by the first of the equations (2), we shall have the area in terms of a side and the three angles, or, if we eliminate sin C by means of the formula (3) and the equation $\cos^2 C = 1 - \sin^2 C$, we shall have an expression for the area in terms of the three sides. Assume $s = \frac{1}{2}(a + b + c)$, then the area is expressed by any of the following formulæ —

$$\text{area} = \frac{a b \sin C}{2} = \frac{a^2 \sin B \sin C}{2 \sin A} = \sqrt{[s (s - a) (s - b) (s - c)]}$$

*Spherical Trigonometry.*—This branch of trigonometry considers the relations between the sides and angles of triangles formed on a sphere. Before giving the formulæ for the solutions of the different cases it will be useful to state a few elementary properties of spherical triangles, deduced from principles purely geometrical.

For these definitions must be premised.—1. The common section of the spherical surface and any plane passing through the sphere is called a *great circle*. 2. The *pole* of a great circle is a point on the surface of the sphere from which all straight lines drawn to that great circle are equal. 3. A *spherical angle* is the angle on the surface of the sphere made by two great circles at their intersection. It is identical with the angle made by the planes of the circles, and is measured by an arc of the great circle whose pole is at the angular point. 4. A *spherical triangle* is a figure on the surface of the sphere bounded by three arcs of great circles, each of which is less than a semicircle. 5. Any arc of a great circle is the measure of the plane angle formed at the centre of the sphere by the two radii passing through the extremities of the arc.

From these definitions the following properties are easily derived —

1. The distance of a great circle from its pole is a quadrant.

2. If two great circles cut one another at right angles, each passes through the pole of the other, and, consequently, if two great circles cut a third at right angles, they will meet in its pole.

3. A spherical triangle which has two equal sides has the angles opposite those sides equal, and the greater side is opposite to the greater angle.

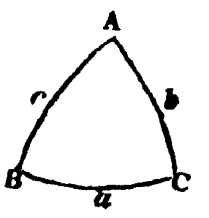
4. The sum of any two sides is greater than the third, the difference of any two less than the third, and the sum of all the three sides is less than the circumference of a great circle.

5. If about the angular points of a spherical triangle as poles there be described three great circles on the sphere, these, by their intersections, will form a triangle which is said to be *supplemental* to the former, and the two triangles are such that the sides of the one are the supplements of the arcs which measure the angles of the other.

6. The sum of the three angles of any spherical triangle is greater than two right angles, but less than six right angles.

*Solution of Spherical Triangles.*—The solutions of all [illegible] are deduced from the following [illegible] which all the different [illegible] each set express all the same property, and are formed by merely interchanging the letters. Those of the first set are readily demonstrated from the properties of the triangular pyramid, or *tetraedron*, and the others may be all deduced analytically from the first, so that, in fact, the whole of spherical trigonometry is comprehended in the first of the underwritten equations. The radius of the sphere is supposed to be unity, the three sides or arcs are respectively denoted by $a$, $b$, $c$ (fig. 6), and the measures of the angles respectively opposite by A, B, C. It is to be observed that the sides $a$, $b$, $c$ (as well as the angles A, B, C), are expressed in degrees, minutes, &c., and not, as in plane trigonometry in absolute measures, as feet, yards, &c.

(6)




I

$$\cos a = \cos b \cos c + \sin b \sin c \cos A$$
$$\cos b = \cos a \cos c + \sin a \sin c \cos B$$
$$\cos c = \cos a \cos b + \sin a \sin b \cos C$$

II

$$\frac{\sin b}{\sin a} = \frac{\sin B}{\sin A}, \quad \frac{\sin c}{\sin a} = \frac{\sin C}{\sin A}, \quad \frac{\sin b}{\sin c} = \frac{\sin B}{\sin C}$$

III

$$\cot a \sin b = \cot A \sin C + \cos b \cos C$$
$$\cot a \sin c = \cot A \sin B + \cos c \cos B$$
$$\cot b \sin a = \cot B \sin C + \cos a \cos C$$
$$\cot b \sin c = \cot B \sin A + \cos c \cos A$$
$$\cot c \sin a = \cot C \sin B + \cos a \cos B$$
$$\cot c \sin b = \cot C \sin A + \cos b \cos A$$

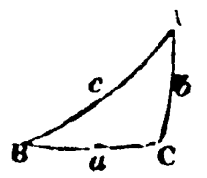
IV

$$\cos A = -\cos B \cos C + \sin B \sin C \cos a$$
$$\cos B = -\cos A \cos C + \sin A \sin C \cos b$$
$$\cos C = -\cos A \cos B + \sin A \sin B \cos c$$

The above general formulæ apply to every case of spherical triangles, but when one of the angles is a right angle, they become considerably more simple, and, in the case of oblique-angled triangles, they admit of transformations by which they are rendered more convenient for logarithmic calculation.

*Right-angled Spherical Triangles.*—As before, let C be the right angle and $c$ the hypothenuse.

(7)




Case 1. Given the two sides $a$, $b$, to find the hypothenuse $c$, and the two oblique angles A, B. Here

$$\cos c = \cos a \cos b, \quad \tan A = \frac{\tan a}{\sin b}, \quad \tan B = \frac{\tan b}{\sin a}$$

Case 2. Given the hypothenuse $c$ and a side $b$, to find the other side $a$ and the two oblique angles.

$$\cos a = \frac{\cos c}{\cos b}, \quad \cos A = \frac{\tan b}{\tan c}, \quad \sin B = \frac{\sin b}{\sin c}$$

Case 3. Given a side $a$ and the opposite angle A, to find the other side $b$, the hypothenuse $c$, and the angle B.

$$\sin b = \frac{\tan a}{\tan A}, \quad \sin c = \frac{\sin a}{\sin A}, \quad \sin B = \frac{\cos A}{\cos a}$$

In this case it is necessary to observe, that as a sine belongs [illegible] to the angle [illegible], and consequently the solution is ambiguous, as two distinct triangles may be formed of the same data.

Case 4. Given a side $a$, and the adjacent angle B, to find $b$, $c$, and A.

$$\tan b = \sin a \tan B, \quad \cot c = \cot a \cos B, \quad \cos A = \cos a \sin B$$

Case 5. Given the hypothenuse $c$, and an angle A, to find the sides $a$, $b$, and the angle B.

$$\sin a = \sin c \sin A, \quad \tan b = \tan c \cos A, \quad \cot B = \cos c \tan A$$

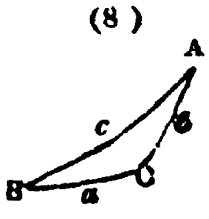
Case 6. Given the two oblique angles A, B, to find the two sides $a$, $b$, and the hypothenuse $c$.

$$\cos a = \frac{\cos A}{\sin B}, \quad \cos b = \frac{\cos B}{\sin A}, \quad \cos c = \cot A \cot B$$

All the six cases of right-angled spherical triangles, it is proper to remark, were reduced by Lord Napier, the inventor of the [illegible] to two rules, which are known by the name of *Napier's Rules of the Circular Parts*. See CIRCULAR PARTS.

*Oblique-angled Spherical Triangles.*

(8)




Case 1. Given the three sides $a$, $b$, $c$, to find the three angles A, B, C.

Find $s = \frac{1}{2}(a + b + c)$, and put M =

$$\sqrt{\left\{\frac{\sin (s - a) \sin (s - b) \sin (s - c)}{\sin s}\right\}},$$

then $\tan \frac{1}{2} A = \frac{M}{\sin (s-a)}$, $\tan \frac{1}{2} B = \frac{M}{\sin (s-b)}$, $\tan \frac{1}{2} C = \frac{M}{\sin (s-c)}$.

Case 2 Given two sides $a$, $b$, and the included angle C, to find $c$, A, and B

$$\tan \tfrac{1}{2}(A+B) = \frac{\cos \frac{1}{2}(a-b)}{\cos \frac{1}{2}(a+b)} \cot \tfrac{1}{2} C,$$

$$\tan \tfrac{1}{2}(A-B) = \frac{\sin \frac{1}{2}(a-b)}{\sin \frac{1}{2}(a+b)} \cot \tfrac{1}{2} C,$$

$A = \frac{1}{2}(A+B) + \frac{1}{2}(A-B)$, $B = \frac{1}{2}(A+B) - \frac{1}{2}(A-B)$,

$$\sin c = \sin a \frac{\sin C}{\sin A} = \sin b \frac{\sin C}{\sin B}$$

The side $c$ may be otherwise found without finding the angles A and B Thus find a subsidiary angle $\varphi$ such that $\cot \varphi = \tan a \cos C$, then

$$\cos c = \frac{\cos a \sin (b+\varphi)}{\sin \varphi}$$

Case 3 Given two sides $a$, $b$, and the angle opposite one of them A, to find the third side $c$, and the angles B, C

Find two subsidiary angles $\varphi$ and $\psi$, such that $\cot \varphi = \tan b \cos A$, $\tan \psi = \cos b \tan A$, then

$$\sin (c+\varphi) = \frac{\cos a \sin \varphi}{\cos b}, \quad \sin B = \sin A \frac{\sin b}{\sin a},$$

$$\sin (C+\psi) = \cot a \tan b \sin \psi$$

This case is ambiguous for the same reason as the corresponding case in plane trigonometry

Case 4 Given two sides $a$, $b$, and the side between them $c$, to find the other sides $a$, $b$, and the remaining angle C

Find two angles $\varphi$ and $\psi$, such that $\tan \varphi = \cos c \tan A$, $\tan \psi = \cos c \tan B$, then

$$\tan a = \frac{\tan c \sin \varphi}{\sin (B+\varphi)}, \quad \tan b = \frac{\tan c \sin \psi}{\sin (A+\psi)},$$

$$\cos C = \frac{\cos A \cos (B+\varphi)}{\cos \varphi} = \frac{\cos B \cos (A+\psi)}{\cos \psi}$$

Case 5 Given two angles A, B, and the side opposite one of them $a$, to find the other sides $b$, $c$, and the remaining angle C

Find two angles $\varphi$ and $\psi$, such that $\tan \varphi = \tan a \cos B$, $\cot \psi = \cos a \tan B$, then

$$\sin b = \sin a \frac{\sin B}{\sin A}, \quad \sin (c-\varphi) = \cot A \tan B \sin \varphi,$$

$$\sin (C-\psi) = \frac{\cos A \sin \psi}{\cos B}$$

This case is also ambiguous

Case 6 Given the three angles A, B, C, to find the sides $a$, $b$, $c$

Find $S = \frac{1}{2}(A+B+C)$, and assume

$$N = \sqrt{\left(\frac{-\cos S}{\cos (S-A)\cos (S-B)\cos (S-C)}\right)}, \text{ then}$$

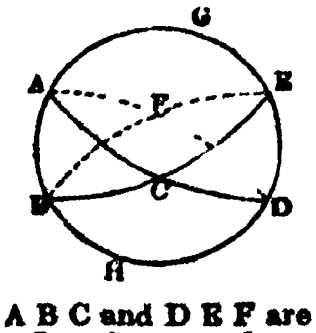
$$\tan \tfrac{1}{2} a = N \cos (S-A),$$
$$\tan \tfrac{1}{2} b = N \cos (S-B),$$
$$\tan \tfrac{1}{2} c = N \cos (S-C)$$

When the sides of a spherical triangle are very small in comparison of the radius of the sphere, as is the case in all triangles measured on the surface of the earth, the sides may be computed from the observed angles with all the accuracy which the observations will admit of by approximate formulæ, which greatly abridge the calculations *See* SURVEYING

*Area of a Spherical Triangle* — It is known from the integral calculus that the area or surface of a sphere is equal to four times that of one of its great circles or $= 4 \pi r^2$, where $r$ is the radius of the sphere, and $\pi = 3.14159$ Hence surface of hemisphere $= 2 \pi r^2$

Now it is manifest that the portion of the spherical surface included between two great circles, which is called a *lune*, will have the same proportion to the surface of the hemisphere as the angle of the lune has to 180°, therefore if the angle of the lune be A°, its surface will be $2 \pi r^2 \times (A - 180)$

(9)




Let A B C (fig 9) be a triangle upon the hemisphere A B H E, and let the sides B C and A C be produced till they meet again in F on the opposite hemisphere, then, since C D F and C E F are semicircles, they are equal to A C D and B C E, whence A C = D F and B C = F E, and the two triangles A B C and D E F are every way equal

Let S = surface of the triangle A B C, then S = surface of hemisphere − B H D C − A G E C − D C E = $2 \pi r^2$ − (lune A H D − S) − (lune B G E − S) − (lune C D F E − S) = $2 \pi r^2 \left(1 - \frac{A}{180} - \frac{B}{180} - \frac{C}{180}\right)$ + 3 S, therefore $S = \frac{A+B+C-180}{180} \pi r^2 = \frac{E}{180} \pi r^2$, where $E = A + B + C - 180°$

From this it follows that the area of a spherical triangle is proportional to the excess of the sum of its three angles above 180°, and hence this quantity, which is called the *spherical excess*, is sometimes taken as the measure of the area of the triangle The spherical excess and the area are mutually deducible from each other *See* SPHERICAL EXCESS

In the above formulæ the area is given in terms of the three angles The following elegant formula, which gives the spherical excess in terms of the three sides, is due to L'Huillier — Let $s = \frac{1}{2}(a+b+c)$, then

$$\tan \tfrac{1}{2} E = \sqrt{[\tan \tfrac{1}{2} s \tan \tfrac{1}{2}(s-a) \tan \tfrac{1}{2}(s-b) \tan \tfrac{1}{2}(s-c)]}$$

Trigonometry owes its origin to the Greek astronomers of Alexandria The solutions of the most useful cases of spherical triangles have been known from the time of Hipparchus, and the fundamental formulæ appear in the *Analemma* of Ptolemy The Greeks, however, instead of the *sines*, employed the *chords* of the double arcs The sines were introduced by the Arabians, to whom the science is indebted for some other improvements Regiomontanus introduced the *tangents*, which have greatly simplified the calculations But the present elegant and compact form in which the solutions now appear is the result of improvements in modern analysis The treatises on trigonometry are extremely numerous For the history the reader may be referred to Montucla *Histoire des Mathématiques*, Delambre, *Histoire de l'Astronomie*, and the Introduction to *Dr Hutton's Mathematical Tables*

TRIANGULAR (Lat tres, *three*, and latus, *side*) Three sided, a term applied to all triangular figures

TRILLION In Arithmetic, a million of billions, or a million of million of millions The term is said by Dr Johnson to have been invented by Locke

TRILLO (It) In Music, a term by which it is intimated that the performer is to beat quickly on two notes in conjoint degrees alternately one after another, beginning with the highest and ending with the lowest It is marked with a single T as well in a vocal as in an instrumental part

TRILOBITES (Lat tres, *three*, and lobus, *a lobe*) The name given by Cuvier to an order of Crustaceans, [illegible] remarkable fossil species in which the body is divided into three lobes by two fissures which run parallel to its axis

TRILOGY (Gr τρεις *three* and λογος, *a discourse*) The word applied to a series of three dramas, which, although each of them is in one sense complete, yet bear a mutual relation, and form but parts of one historical and poetical picture All the plays of Æschylus, and the *Henry VI* of Shakspeare are examples of a *trilogy*

TRIM The position of the keel of a ship with respect to a horizontal line Also the disposition of the weights or stowage, as favourable or otherwise for sailing, which are expressed by *in trim*, and *out of trim*

TRIMERA, *Trimera* (Gr τρεις, *three*, and μερος, *a part*) The name of a section of Coleopterous insects, including those which have each tarsus composed of three articulations

TRIMMER In Architecture, a piece of timber framed at right angles to the joists opposite chimneys or the well holes of stairs which receives the ends of the joists intercepted [illegible]

TRIMMING JOIST In Architecture, a joist into which a trimmer is framed

TRIMYARIES *Trimyaria* (Gr τρεις, *three*, and μυων, *a muscle*) The name by which those Bivalves are distinguished which present three muscular impressions on each valve

TRINAL (Lat trinus *threefold*) Of threefold dimensions,—length, breadth, and thickness In Astrology, the trine is one of the five aspects of the influential bodies, the angle subtended by the two planets as seen from the earth being 120°, or the third of the zodiac The trine was supposed to be a benign aspect *See* ASTROLOGY

TRINGA (Lat *a wading bird*) A genus of wading birds (*Grallæ*), characterized by a compressed bill of moderate length, enlarged at the point, and a hind toe, too short to reach the ground It is by the latter character that the species *Tringæ* are distinguished from the plovers (*Charadrii*) in which the hind toe is wanting

TRINITARIANS A religious order, founded in 1198 under the pontificate of Innocent III Its members devoted themselves to the [illegible] of ransoming [illegible]

order of the same name, and dedicated to the same objects

TRI'NITY The three persons comprised in the G[illegible] listinguished as the Father, the Son, and [illegible] The term is not found in the Scriptures and its introduction is referred at the earliest to the 2d century All [illegible] Christians that believe in the Trinity [illegible] comprised under the general name [illegible] several theories have been framed as to the existence of supposed doctrines of a Trinity in Pagan systems (See, as to the Orphic, Platonic, Jewish, and Greek and Latin Magian, and Indian Trinities *Dissertation* vol iv)

TRINITY SUNDAY The Sunday next after Whit Sunday, so called on account of a feast which was anciently and still continues to be held on that day, in the Romish church, in honour of the Holy Trinity This feast does not appear to have been fully established in the Western Church until the year 1334, under Pope John XXIII

TRINO'MIAL (Lat tres *three* and nomen, *name*) In Algebra, a quantity consisting of three terms connected by the signs + or −, as $a + bc^2 - d^3$

TRI'O (It) In Music, a composition consisting of three parts Besides the [illegible] which forbid that two [illegible] either to the bass or any other part in trios, the third must be heard in every time of the bar either with the bass or between the other two upper parts, or in other words, one of the parts must make a third with the bass, and the other a fifth or octave

TRIOLET A stanza of eight lines, in which the first line is thrice repeated

TRIO'NES In [illegible] cipal stars in the constellation Charles's Wain, four of the stars being fancied to represent a wain or waggon, and the three others the horses by which it is drawn

TRIPHA'NE A synonym of the mineral called also *spodumene*

TRI'PHTHONG (Gr τρεις *three*, and φθογγη *sound*) In Grammar, a composite sound of three vowels as a diphthong is of two, such as the German "aeu" There is no such sound in English nor strictly speaking in French, unless the combinations "ieu" in that language be so considered

TRI'PLE (Gr τριπλους *threefold*) In Music, one of the kinds or measures of time of which there are many different subdivisions There are however, only four principal ones, whereof the others are varieties See art Music

TRIPLE SALTS A term by which in Chemistry certain salts are sometimes designated in which two bases are combined with one acid Thus emetic tartar which is composed of oxide of antimony and of potassa with tartaric acid and Rochelle salts in which soda and potassa are combined with the same acid are *triple tartrates* These salts, however are more properly regarded as *double salts*, that is as consisting of tartrate of antimony and of tartrate of potassa or of single equivalents of tartrate of potassa and tartrate of soda

TRI'PLET In Poetry, three verses rhyming together Thus, in the famous lines of Pope

"[illegible] In Dryden's [illegible]
[illegible] vary [illegible]
The long majestic march and energy divine"

In Music, notes grouped together by threes, thus,



In common time, where three of the quavers are intended to be equal in duration to a crotchet, a 3 is sometimes placed over them, but they [illegible] together and thus [illegible] whole measure

TRIPLICATE RATIO In Arithmetic and Geometry, the ratio of the cubes is the cube of the simple ratio Thus the triplicate ratio of 2 to 3 is the same as that of 8 to 27 Similar solids are to each other as the triplicate ratio of their like dimensions

TRI'POD (Gr τρεις, *three*, and πους, *a foot*) In Architecture a vessel, table, seat, or instrument having three feet It was from such a seat that the Pythian goddess rendered oracular answers at Delphi

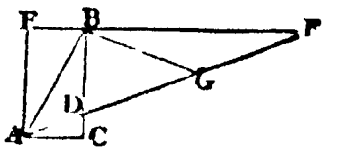
TRI'POLI A mineral used for polishing, originally from Tripoli in Barbary It occurs in friable earthy masses of a dull clay colour Its essential components are silica, alumina, and oxide of iron, but the varieties of tripoli appear to vary extremely in composition Ehrenberg has found the different tripolis to be aggregates of silicified animalcules

TRI'REME (Lat tres, and remus, *oar*, Gr τριηρης *a galley with three rows of oars*) The usual war vessel of the Greeks at the time of the Persian and Peloponnesian wars, and [illegible] down to the period of the first Punic, when we find quinqueremes pretty generally substituted With respect to the construction, and the difficulties attending its explanation, see GALLEY. Some light has been thrown on Athenian naval matters by the recent discovery of nine inscriptions at the Piraeus, which have been commented on by Boeckh (See *Foreign Quart Rev* Jan 1841 See also his *Public Economy of Athens* transl i 372 &c)

TRISAGION (Gr τρις, *thrice*, and αγιος, *holy*) In the Greek Church, the threefold invocation of the Deity as "Holy" (Lat tersanctus) This invocation takes its origin from Isaiah, vi 3, [illegible] The ordinary form is that in Isaiah [illegible] Lord God of Hosts all the earth is [illegible] A different form of the trisagion is repeated daily in the service of the Greek church, and is attributed to Saint Proclus Concerning the war which was raised A D 508-518 by the addition of the words "who was crucified for us" see *Gibbon*, chap xlvii

TRISECTION (Lat trisectio) The dividing of any thing into three equal parts

TRISECTION OF AN ANGLE In Geometry, a problem of great [illegible] Greek mathematicians [illegible] angle cannot be effected by plane geometry, that is to say, by means of the straight line and circle, inasmuch as the analytical equation o[illegible] to the third degree, but it may [illegible] of the conic sections and some other curves as the quadratrix The geometrical conditions on which the solution of the problem depends may be explained as follows —




Let B A C be the angle and suppose D A C to be its third part Through any point B in A B draw B C perpendicular to A C, and B E parallel to A C, produce A D to meet B E in E, and complete the rectangle A F B C Now since D A C is the third of B A C therefore B A D is equal to twice D A C or twice B E A Draw B G, making the angle F B G equal to B E G, then B G A, being equal to G B E and G F B together, is equal to twice B E A and consequently equal to B A G Hence the two triangles F G B and G B A are isosceles, or G F = G B = B A Again the angle G B D is the difference between a right angle and F B G, and G D B or its equal A D C is the difference between a right angle and D A C which is equal to F B G, therefore G B D is equal to G D B whence G D is equal to G B or A B It thus appears that D G and G F are each equal to A B, or that D F is equal to twice A B which is a given line If therefore in a rectangle A F B C a straight line A D could be drawn from the angular point A so that on producing it to meet the opposite side F B the produced part should be equal to a given straight line, the problem would be solved This is the condition to which the trisection of the angle is reduced by Pappus of Alexandria, in the 4th book of his *Mathematical Collections*, where he shows how it may be constructed by means of an hyperbola When however the rectangle A F B C becomes a square that is when the given angle B A C is half a right angle, the construction is easily effected by elementary geometry (See *Leslie's Geometrical Analysis*)

TRISMUS (Gr τριζω *I gnash*) Lockjaw, tetanus affecting the jaw There are two species of this malady the one caused by wounds, or, under certain circumstances by exposure to cold, the other attacking infants during the two first weeks from their birth

TRI'SPAST or TRISPASTON (Gr τρις *three*, and σπαω *I draw*) A machine with three pulleys acting in connection w[illegible] to raise weights

TRI'THEISM (Gr τρεις *three* and θεος *God*) In Controversial [illegible] both before divines appear to have [illegible] their zeal to support the honour due to each of the three persons of the Trinity Sherlock in his controversy with South, whose views seemed to tend to confound the separate natures of the Father Son and Spirit and were generally characterized as Sabellian, is accused of having been betrayed into the opposite dogma of Tritheism

TRI'TICUM See WHEAT

TRI'TON In Mythology a marine deity, son of Neptune Tritons are sometimes mentioned in the plural number They were represented as half fish in form In Zoology, the name *Tritonia* has been given to a genus of marine, naked gastropodous Mollusks, or sea-slugs

TRI'TONE, or TRITONUS (Gr τρεις, *three*, and τονος, *tone*) In Music, an interval, now generally called a sharp fourth, consisting of four degrees, and containing three tones between the extremes on which account the ancients gave it its name It is moreover divisible into six semitones, three diatonic and three chromatic In dividing the octave, we find on one side the tritone and on the [illegible] false fifth

TRITOXIDE In Chemistry, such oxides as contain [illegible] three atoms of oxygen

TRIUMPH (Lat triumphus) The highest military

honour that could be obtained by a Roman general It was a solemn procession, with which the victorious leader and his army advanced through the city to the capitol, accompanied by the captives taken in war, and vehicles bearing the spoils, and all the furniture that could add magnificence to the spectacle On arriving at the capitol the general offered up a prayer of thanksgiving to Jupiter and the other gods, and sacrificed white bulls A triumph was decreed by the senate, and sometimes by the people against the will of the senate to the general who had put a great war with foreigners and civil ones battle, had slain above [illegible] of the state, and enlarged the limits of the empire *See* OVATION

TRIUMPHAL ARCH In Architecture, an arch erected to perpetuate the memory of a conqueror or of some remarkable victory or important event At first it consisted of a single arch, decorated merely with a statue and spoils of the victorious commander, but arches were afterwards erected with two, and then with three passages Those on the Via Triumphalis in Rome were the most magnificent, and in cases where they served as gates, they were usually constructed with two openings, so that one was appropriated for carriages passing into, and the other for carriages passing out of the city The following is a list of some of the principal triumphal arches of antiquity — The arch at Rimini erected in honour of Augustus on the completion of the repairs of the Flaminian Way from Rome to that city It was one of the noblest as well as most ancient of the arches of the ancients, having a single passage about thirty-three feet wide, and was contrary to the usual practice, crowned with a pediment The lesser arch of Septimus Severus at Rome, commonly called the *Arch of the Goldsmiths*, is a curious example being of a single opening, and crowned with a flat lintel An extremely elegant [illegible] the Italian side of Mont Cenis [illegible] of Aosta The arches of Aurelian and Janus, which possess more singularity than beauty The arch of Pola, in Istria which is curious from the use of coupled columns which it exhibits, and was erected by Salvia Posthuma, in honour of Sergius Lepidus and his two brothers The arch of Trajan at Ancona, which, though it has been [illegible] retains the beauty of its [illegible] still in tolerable preservation It stands at the entrance of the mole of the port and has four Corinthian columns on pedestals The arch of Titus at Rome, in which the order used is Composite, and was probably erected after the emperor's death An arch at Benevento, in honour of Trajan somewhat resembling that of Titus at Rome, also of the Composite order An arch of Gavius at Verona, called *del Castel Vecchio*, but no longer in existence The arch of Septimus Severus at Rome, at the foot of the capitol, and that of Constantine in the same city All these are each with three openings For the latter the arch of Trajan was despoiled of its ornaments, as the greater part of the bassi-relievi upon it represent the victories of that emperor It is in better preservation than any of the other arches that we have mentioned, and was indebted for its state to the care of Pope Clement XII

TRIUMVIRATE In Ancient History, this term was applied to two great coalitions of the three most powerful individuals in the Roman empire for the time being The first of these was effected in the year 60 B C between Julius Cæsar, Pompey and Crassus who pledged themselves to support each other with all their influence This coalition was broken by the fall of Crassus at Carrhæ in Mesopotamia, soon after which the civil war broke out, which ended in the death of Pompey and establishment of Julius Cæsar as perpetual dictator After his murder, 44 B C, the civil war again broke out between Antony, who wished to avenge the death and succeed to the fortunes of Cæsar, and the republic, on whose side were ranged Octavius and Brutus Lepidus with a large army remained in suspense which side to take But after the battle of Mutina, in which both consuls fell, 43 B C, Antony, Octavius, and Lepidus coalesced, thus forming the second triumvirate each party confirming the bond of union by the sacrifice of some of his own friends to the hatred of the others, — in which case was Cicero, who was delivered up by Octavius to the vengeance of Antony Against this confederation Brutus still held out, with the rest of the conspirators against Cæsar, till their destruction at the battle of Philippi The triumvirates divided the provinces of the empire, Octavius taking the west, Lepidus Italy, and Antony the east, but the iniquitous union was soon broken by the passion of Antony for Cleopatra which induced him to repudiate Octavia, the sister of Octavius War ensued, which was terminated by the defeat and death of Antony at Actium, in 32 B C, after which every thing fell into the hands of Octavius, Lepidus offering no obstacle

TRI'VIUM (Lat *three ways*) The name given in the schools of the middle ages to the three first liberal arts (grammar, rhetoric, and logic) which were studied together The other four (arithmetic, music, geometry, and astronomy) formed what was termed the quadrivium; and the two following mnemonic lines comprehend the whole: —

Gram loquitur; Dia verba docet, Rhe verba ministrat;
Mus. canit, Ar numerat, Ge ponderat; As colit astra.

TROCAR An instrument used in tapping [illegible] the dropsy The name is said to be corrupted from the French *trois quarts* [illegible] of resemblance

TROCHANTER (Gr τρεχω, *I run*, because the muscles inserted into it are those chiefly concerned in the act of running) A name given to two processes (greater and less trochanter) at the upper end of the thigh bone

TROCHE (Lat trochus, or trochescus, dim of *wheel*) A small round lozenge or cake generally composed of sugar and mucilage, united with small portions of more active remedies, intended to be allowed gradually to [illegible] the mouth

TROCHEE (Gr τροχαιος, *A rhythmical measure* [illegible] thus, — ⏑

TRO'CHILUS (Gr τροχιλος *a small bird*) This term was applied by Linnæus to the genus of small and brilliantly coloured birds which, from the energy and rapidity of the vibrations of their wings during flight are called humming-birds They include the smallest of the feathered tribe, and are the most diminutive of vertebrated animals some humming birds scarcely exceed a humble-bee in size, they are unable to escape from the strong webs of the large spiders of the American tropics, and thus sometimes become their prey

The humming-birds are characterized by a long and slender bill inclosing an extensile bifid tongue by which they extract the nectar and the small insects which may lurk in the recesses of flowers They have very small feet, long and narrow wings a broad and entire sternum with an unusually deep keel and a short and strong [illegible] apparatus for rapid [illegible] Humming birds live in pairs they have the character of being very quarrelsome, the males fighting desperately with each other both sexes combine to defend their nests with courage

TROCHLEA (Gr τροχαλια, Lat trochlea) In Mechanics the same as pulley or tackle *See* PULLEY

[illegible]

accompanied by the *trochlearis nerve*

TROCHOID (Gr τροχος *a wheel* and ειδος *form*) The curve described by any point in a wheel rolling straight forward on a level It is the same as the cycloid, and for an account of its principal properties, see CYCLOID The same name is also given to another curve, sometimes called the companion of the cycloid, or *curve of arcs*

TRO'CHUS (Gr τροχος) The name given by Linnæus to a genus of the *Vermes Testacea*, characterized by a subconical spiral shell, with the margin entire without a fissure or canal for the siphon of the mantle, the animal not possessing any respiratory tube The mouth of the shell is closed by an operculum, or some analogous part The species to which the characters of the Linnæan genus are applicable constitute a family of Pectunibranchiate Gastropods in the system of Cuvier, called *Trochoida*, which includes the following genera — *Pelasia* Montfort, *Calcar*, Montf, *Rotella*, Lam, *Cantharis* Montf, *Infundibulum*, Montf, *Telescopium* Montf, *Solarium* Montf, *Euomphalus*, Sowerby The Gastropod called *Turbo pica* by Linnæus, having been ascertained to have an operculum, is now referred to *Trochus*

TROGLODYTES (Gr τρωγλη, *cave* and δυνω, *I enter*) Tribes of men who have their dwellings in subterraneous caverns Several such tribes are mentioned by ancient authors, and the remains of their dwellings still attest their existence, especially along the banks of the Nile in Upper Egypt and Nubia and in parts of Syria and Arabia (See *Bryant's Mythology*, iv 381)

The chimpanzee has been called by Blumenbach *Si-*[illegible]

TROMBONE (It) A brass musical wind instrument serving as the bass to the trumpet, to which in general form it is similar, but of much larger dimensions

TRO'NA A native sesquicarbonate of soda found on [illegible] lakes of Sukena in Africa

TROY WEIGHT The most ancient of the weights used in Scotland, and though its use is now prohibited by law it is still occasionally employed in some of the rural districts in weighing wool, cheese, butter, &c The troy pound was not a well-defined weight, but varied from 21 to 28 ounces avoirdupois

TROOP A body of [illegible] soldiers, equivalent to *company* in foot regiments The term *troops* is not limited to cavalry, but extends to all kinds of soldiers, whether mounted or not

TROPHÆUM (Lat trophæum *a trophy*, the leaves

resembling a buckler, and the flowers an empty helmet) A genus of handsome trailing plants, some of whose species have pungent fruits which have rendered them useful as condiments Indian cress, the name given to *Tropæolum majus* expresses their quality They form a small group nearly allied to the Geraniaceous order, if not [illegible]

TROPE (Gr τροπος *I turn*) In Rhetoric, literally any expression *turned* from its primary signification, and employed in a sense derived in some manner from that primary signification In this sense, the general term trope comprises the various figures termed metaphor, allegory, metonymy, synecdoche (which see), and perhaps several others By the natural progress of language, words or phrases at first employed as tropes become impressed so strongly with their new or derivative signification, that it finally supersedes the original, its *tropical* or *figurative* being lost in its *simply indicative* character

TROPHI (Gr τροφω, *I nourish*) A name given by Kirby to the different instruments of, or organs contained in the mouth, or closing it, and employed in manducation or deglutition They include the *labrum, labium, mandibulæ, maxillæ, lingua* and *pharynx*

TROPHONIUS [illegible] Greek [illegible] son of Erginus, king of Orchomenos, [illegible] his brother Agamedes, built the temple of Apollo at Delphi, and having prayed for a reward from the god, it was promised him on the seventh day, on which he and his brother were both found dead The story is told in other ways He had a temple at Lebadea as Jupiter Trophonius In this temple was the celebrated cave into which those who descended spoke oracularly on their return, and in this way responses were made But the impressions produced by the descent were thought so to work upon the spirit of a visitor, that he remained a victim to melancholy the remainder of his life Hence arose the proverb [illegible] ous man —that he looked as if he [illegible] Trophonius Some thought that the priests had secret access to the cavern and that those whose minds did not give way under the terror of the scene which they encountered were murdered by them (See Bryant *Anc Myth* vol ii p 361)

TROPHOSPERM (Gr τροφω *I nourish* and σπερμα *a seed*) A name given by some French botanists to the placenta of a plant

TROPHY (Gr τροπαιον, from τροπω *I turn*) A monument consisting of some of the arms of slain enemies hung upon the trunk of a tree, or a stone pillar, by a victorious army in token of its victory and the flight of the enemy, whence its name Trophies were always dedicated to some deity and especially to Jupiter, whence it was deemed sacrilegious for any one to injure or demolish them, while at the same time it was esteemed an equal crime to repair them when decayed This custom was common to all the Greeks except the Macedonians who were forbidden to raise trophies by a law of one of their ancient kings Perhaps the most celebrated trophies of ancient times were those of Marius at Rome which were of marble, and were restored by Cæsar after their destruction by Sylla, contrary to all the usages of the times (See as to Roman trophies, *Mem de l'Ac des Inscr* xxix 32)

TROPICAL HIEROGLYPHICS *See* HIEROGLYPHICS

TROPICAL YEAR (Gr τροπη *return*) The time between the sun's leaving a tropic and returning to it popularly it means the time from the longest day in one year till the longest in the next *See* YEAR.

TROPICS, in Astronomy, are the parallels of declination between which the sun's annual path in the heavens is contained, the distance of each from the [illegible] equal to the sun's greatest declination [illegible] tropic is called the tropic of Cancer, and the southern one that of Capricorn, from their touching the ecliptic in the first points of those signs

The distance of the tropics from each other is equal to the difference between the greatest and least meridian [illegible] whose latitude [illegible] *See* ECLIPTIC

TROPICS, in Geography, are the two parallels of latitude on the earth, over which the sun is vertical when his declination is greatest, or when it is the longest day in the hemisphere in which the tropical circle is situated over which the sun is, and the shortest in the other hemisphere

TROPIDONOTUS (Gr τροπις, *a keel*, and νωτος *the back*) A genus of non-venomous serpents, nearly allied to the true Colubers, but with bodies thicker in proportion to their length, the back more keel-shaped, and the abdomen more expanded and convex, the head is large and conical, with a slender and short muzzle The species seldom exceed three or four feet in length, they live near fresh-water streams and are good swimmers they are confined to the old world continents, and are replaced in South America by the genus *Homalopsis* The *Coluber scaber*, Linn, a serpent of the Cape of Good Hope, remarkable for the presence of teeth in the œsophagus, and their absence from the mouth, is referred to the genus [illegible] Schlegel

TROUVERS [illegible] Inventors (Ital trovare; Fr trouver, *to find*) A school of poets who flourished from the 11th to the latter end of the 13th century, principally in the south of France, but also in Catalonia, Arragon and the north of Italy They wrote in varieties of the Provençal or Romance language, also called in the middle ages langue d'oc They flourished under the lines of the Counts of Toulouse Barcelona and Provence, and their minstrelsy and peculiar spirit declined from the time of the crusade against the Albigenses, when the former of these noble houses was vanquished and humiliated and their land overrun by the steiner adventurers of the north The most renowned among the Troubadours were knights, who cultivated poetry as an honourable accomplishment, but their art declined in its later days, when it was chiefly cultivated by minstrels of a lower class The names and some of the productions of more than 200 Troubadours have been preserved, and [illegible] able characteristics of the Provençal poetry were its almost entire devotion to the subject of romantic gallantry and the very complicated character in general, of its metre and rhymes The principal species of composition cultivated by the Troubadours were *tenzones*, or poetical contests between two minstrels, sometimes breathing satire or defiance, sometimes rivalling each other in the praise of their ladies, sometimes aiming at mere exertions of verbal ingenuity, *sirventes*, pieces devoted to martial and other serious subjects, short songs, or *chanros*, and a variety of other lyrical strains, *soutas, lais, pastourelles, arbades, serenades retronage*, and *redondes* The earliest Italian poets framed their style of thought and versification closely after the model afforded them by the troubadours (See Sismondi *Literature du Midi de l'Europe* vol i, the works of M Raynouard, *Mr Lewis's Researches into the Romance Language*, Schlegel *Obs sur la Langue et la Provençale*)

TROUGH OF THE SEA The ship is said to be in the trough, when she lies parallel to the hollows between the waves

TROUT (Lat trutta) This name is restricted properly and specifically to the *Salmo fario* of Linnæus, but is applied in a generic sense to other native species of *Salmo* the *S erox* of Linnæus which is the *S salar* of Rondeletius, being called the bull trout and grey trout, the *Salmo ferox*, the great grey trout, or lake-trout, the *S trutta* the salmon trout, &c The common trout inhabits most of our lakes and rivers and is subject to many varieties of colour, proportions, and even of internal structure as in the stomach of the gillaroo-trout, according to the variations of soil and food The season of spawning with the trout is generally in the month of October at which period the gravid fish make their way up the stream to the shallows Trouts are in finest condition from the end of May to September

TROVER In Law, is an action of tort. It is a species of action on the case (*see* ACTION), which is employed to try a disputed question of property in goods and chattels The declaration in trover assumes (by a fiction) that the plaintiff lost and the defendant found and converted to his own use, the goods in question

TROWELLED STUCCO In Architecture, stucco left ready for the reception of paint

TROY WEIGHT An English weight chiefly used in weighing gold, silver, diamonds, and other articles of jewellery The pound troy contains 12 ounces or 5760 grains, the pound avoirdupoise containing 7000 of such grains The name is supposed to have reference to the monkish name given to London, of Troy Novant *See* WEIGHTS

TRUCE (Mod Lat treuga, from the Teutonic treue, *truth*) An agreement between states or those representing them for the suspension of hostilities Such an agreement when made by officers of the state in the general exercise of their [illegible] for the purpose expressly, or by necessary implication ranks among that class of conventions which jurists term sponsions, and which are binding only if ratified (See SPONSION) A [illegible] which is limited to particular places, as between two armies, or between a besieged fortress and the besieging army The [illegible] in general requires ratification power to include the latter is held to be implied in the general authority of military and naval officers (See *Vattel*, book iii ch 16, *Wheaton on International Law*, vol ii)

TRUCE OF GOD, *Treuga Dei* A suspension of arms, which occasionally took place in the middle ages, putting a stop to private hostilities The right to engage in such hostilities was [illegible] maintained by the inferior feudatories of the several monarchies of Europe But it was restrained by the repeated promulgation of these truces, under the authority of the church Thus, in the

county of Roussillon, A D 1027, it was determined in a synod of the clergy that no man should attack his enemy from the hour of nones on Saturday to the hour of prime on Monday In 1041 a general truce of God was accepted by the barons of Aquitain, and then of all France, to last from the Wednesday evening of every week to the Monday morning following This regulation was soon after established in England, in 1042, with some additions of great festivals and other days It was confirmed by many councils especially the Lateran council of 1179 The observation of it was sworn by knights, burgesses, and peasants, of the age of fourteen and upwards, and the penalty of its infringement was excommunication, which, however, was quite insufficient to maintain it Philippe Auguste introduced a new species of truce, termed the quarantine by one of his ordinances. It restrained the family of an injured or murdered person from the commencement of hostilities until forty days after the act done, under penalty of high treason

TRUCK The small wooden cap at the extremity of a flag staff, or at the mast head Also a small circular piece of wood with a hole bored through it for a rope to run through

TRUCK SYSTEM A name given to a practice that has prevailed particularly in the mining and manufacturing districts, of paying the wages of workmen in goods instead of money The plan has been for the masters to establish warehouses or shops, and the workmen in their employment have either got their wages accounted for to them by supplies of goods from such *depôts* without receiving any money, or they have got the money, with a tacit or express understanding that they were to resort to the warehouses or shops of their masters for such articles as they were furnished with (For the advantages and disadvantages of this system see *Com Dict*)

TRUFFLE A subterranean fungus of a roundish oblong form and a blackish brown colour much employed in cookery It is found by dogs and pigs trained for the purpose in soil beneath trees especially beeches and oaks, it is however very local It is propagated by spores included in sinuous chambers in the interior but has never yet been cultivated with success, notwithstanding many attempts that have been made Botanists recognise several kinds of truffles, the commonest being the *Tuber cibarium*

TRUMPET In Acoustics, an instrument used for the purpose either of conveying articulate sounds to a great distance, or for applying to the ear in order to collect the sonorous rays and render sounds more distinct In the former case the instrument is a *speaking-trumpet*, in the latter a *hearing-trumpet*

*Speaking-trumpet* — The object of the speaking-trumpet is to increase the intensity of speech and transmit it to considerable distances in a particular direction In order to obtain this effect, it is necessary that the aerial undulations which would disperse themselves in all directions be confined by the sides of the trumpet and reflected so as to take as nearly as possible a direction parallel to the axis This is accomplished by giving the trumpet such a form that its diameter becomes greater towards the extremity furthest from the mouth A cylindrical or prismatic tube, of equal diameter throughout assists powerfully in conveying sound from one extremity to the other but contributes in no degree to give a direction to sound, or transmit it through free air

The theoretical explanation of the effects of the speaking-trumpet is attended with considerable difficulty Assuming that the reflexion of sound takes place according to the laws of catoptrics, Lambert (*Berlin Memoirs for* 1763) shows the best form of the instrument is a truncated cone, for the rays successively reflected from the interior surface of this figure make smaller angles with the axis after each successive reflexion Cassegrain (*Journal des Savans*, tom iii) recommends the surface formed by the revolution of a hyperbola about its asymptote, and Kircher had previously proposed a truncated parabolic conoid, the mouth-piece occupying the focus Some authors suppose that the trumpet should be formed of a very elastic material, in order to strengthen the sound by its vibrations Others are of opinion that it should be without elasticity to avoid the confusion that might be caused by the vibrations of the tube Hassenfratz (*Journal de Physique*, tom lvi, who made a number of experiments on the power of the trumpet by fixing a small watch in the mouth piece and observing the distance at which the beats ceased to be audible, found that the effects were precisely the same with a trumpet of tinned iron, whether used in its naked form, or tightly bound round with linen to prevent vibration, or when lined with woollen cloth, whereby reflexion was entirely prevented It would appear therefore, that neither the shape of the instrument nor the material of which it is formed, is of much consequence. Leslie (*Experimental Inquiry into the Nature and Propagation of Heat*) supposes the effect of the trumpet to be owing to the more condensed and vigorous impulsion given to the air from its lateral flow being checked "The tube" he observes, "by its length [illegible] detains the efflux of air and thus the [illegible] of the [illegible] created [illegible] ticulation strike with [illegible] so [illegible] are from the reflected form of [illegible] abled to escape, and to spread themselves along the atmosphere" p 225

The invention of the speaking-trumpet is commonly ascribed to Sir Samuel Moreland, who, about the year 1670, proposed the first form of the speaking trumpet as a [illegible] the Royal Society, and exhibited some instruments, constructed according to his own views These were, in general, large conical tubes spreading suddenly at the extremity to a greater width They were tried in St James's Park, and it is stated that their effects were such that the king (Charles II), speaking in his ordinary colloquial pitch of voice, through a trumpet of only five feet and a half long was distinctly heard at the distance of 1000 yards Another person was perfectly understood at the distance of four miles and a half Kircher claims the credit of having made such experiments previously, but his remarks apply rather to hearing than to speaking trumpets

*Hearing-trumpet* — The hearing-trumpet, or ear-trumpet, may be considered as a reversed speaking-trumpet, with which it generally corresponds in form, though, for the sake of portability it is often made curved or spiral Lambert recommends the parabolic figure as the most advantageous, but in order to give the greatest effect, the apex of the paraboloid must be cut off, and the mouth of a small tube inserted in the focus to convey the sound concentrated at that point to the auditory organ [illegible] adopted in practice, and of late [illegible] rubber tubes have been brought into use having a conical mouth-piece of ivory or silver at one extremity, and a small tube of like material to be applied to the ear A trumpet of this kind may be used advantageously not only for remedying the defects of the organ of hearing, but [illegible] to collect feeble and distant sou[illegible] *Memoir on the [illegible] Invent* 1671, Chladni, *Traité des Sons*, Gel *Physikal Worterbuch* art "Horrohr")

TRUMPET A musical wind instrument usually made of brass but sometimes of silver This instrument formerly possessed but few notes, but in later times it has, by means of slides and keys been vastly extended in its inflexions Its compass will be seen by referring to the synoptical view of the different instruments at the end of the article Music

TRUNDLE In Mechanics a portion having its teeth formed of thick cylinders or spindles, otherwise called a *lantern wheel* or *wallower*

TRUNK (Lat truncus) In Architecture, the same as *shaft* In the application of this word to a pedestal, it signifies the die dado, or body of the pedestal

TRUNK in Entomology, signifies the intermediate section of the body which lies between the head and the abdomen

TRUNNIONS The pivots or short cylinders projecting from the sides of a piece of ordnance, by which it rests on the cheeks of the carriage The *trunnion ring* is the ring on a cannon next before the trunnions

TRUSS (Fr trousser) In Architecture a framed assemblage of pieces of timber for the purpose of tying up or suspending a principal beam or piece *See* Roof

TRUSS A rope confining the middle of a lower yard to the mast

TRUSS, in Surgery, is an apparatus by which in cases of rupture the intestine is retained in the abdominal cavity This is usually effected by the aid of a steel spring resting upon a small pad or cushion, which is kept in its place by a proper bandage

TRUSSED ROOF In Architecture, one so constructed as to sup[illegible] [illegible] tie beam at certain points [illegible] likely to occur *See* Roof

TRUST In Law, is a term commonly used to designate any equitable right or interest, as distinguished from a legal one properly, that class of equitable rights supposed to be founded in the confidence placed by one party in another, the name *trustee* denoting the person in whom confidence is placed, *cestuy que trust*, the person who trusts, — in other w[illegible] [illegible] a beneficial interest in the o[illegible] [illegible] has the legal property

The origin of conveyances in trust may be traced to the *fidei commissum* of the Romans, which was a gift by will to a person capable of taking in trust for another incapable by the Roman law [illegible] such benefit whose claim under such gifts was [illegible] precarious, and merely fiduciary, but came at length to be recognized and enforced by law With us in the same manner, the original motive for the introduction of the fiduciary right, which was certainly borrowed from the Romans

was the wish to escape from the disabilities affecting certain persons, or bodies, or the liabilities attached to property in its direct and simple shape. Such was, in particular, the disability of corporations to purchase land at common law; and on this account, as it is commonly said, the ecclesiastics, who were chiefly interested in this matter, introduced this new species of property, which was [illegible] then usually ecclesiastics [illegible] adopt the principles of the civil law. The clergy were, however, soon themselves deprived of the benefit of [illegible] invention, the disability of corporations [illegible] extended by statute to the new right so created. But there still remained many liabilities arising from feudal tenure, incident to property at common law, such as, for instance, dower, escheat, wardship, restraint upon alienation by will, which it was [illegible] and possible either to evade by this mode of conveyance in trust, or to transfer to a quarter less likely to be affected by them; and there were also many modifications of property for the benefit of families, which could only be given to it in this manner. It must be admitted, further, that there were less honest purposes, such as the [illegible] bona fide purchasers by secret alienation, sought to be attained by the same means. For these, among other reasons, conveyances in trust were still resorted to, and the Court of Chancery, which had once, for whatever reason, originally recognized, continued to enforce them.

There were also two other means of creating a trust, or rather raising a use, not by actual conveyance; the one by agreement for money, the other by covenant under seal in consideration of near *relationship*.

The right so created was called indifferently a *trust* or *an use*, more commonly the latter, from the actual enjoyment of the rents and profits annexed to it in equity. Indeed the benefit of the use or trust was in the first instance confined to this, but the cestuis que use, or parties beneficially interested, soon acquired the right of directing a conveyance by the holders of the legal estate, legally termed the feoffees to uses, and also of calling upon them to use the legal title in their defence in a court of common law.

Several statutes were passed at different times, giving to the owner of the use or trust partial legal rights, and partially also subjecting interests of that sort to legal liabilities, before the celebrated statute, commonly called the Statute of Uses, which was passed in the 27th year of Henry VIII. The general object of this statute, as stated in the preamble, was to prevent those secret and fraudulent transfers occasioned by the separation of the real from the apparent ownership, and to restore those rights of the feudal lord, and of the crown, which had been in a great measure evaded, by keeping the legal title to which alone they attached in a course of succession, where it was likely to be forfeited by treason, and where it was less frequently subject by descent to an infant heir to the burden of wardship and relief. The general effect of the statute, as stated in the title, was the transferring or changing the use into possession, that is, annexing to the use the legal right of possession, whereby the real owner would be made manifest to all, and the real ownership would become subject to all the liabilities incident to the legal title. In short, the distinction between equitable and legal rights would be abolished, and the adjudication on all questions of property, except in particular cases of fraud or accident, would be restored to the courts of common law.

The statute, however, was so worded as not to apply either to copyholds or leaseholds, nor indeed to personal property of any description, which at that time was little thought [illegible] and personalty [illegible] they arose again, very shortly afterwards, in every species of real property, it being held by the courts of common law that such uses or trusts only were executed and transferred into possession by the statute as were raised or declared upon what was *before* the statute the legal seisin or estate, so that where a new legal estate taking effect as such by virtue of the statute was created or conveyed in trust, such trust right not being within the purview of the statute, and not being recognized by the courts of common law, was adopted and enforced in equity, for reasons altogether similar in kind to those which originally led to the introduction of uses. Hence a new system of equitable rights grew up under the name of trusts, commensurate with the new system of legal rights or uses (for the use henceforth denoted the legal estate) created by the statute, and though some of the peculiar advantages of the old trust were, by the effect of the statute, transferred to the new legal ownership, such as the capability of modification for the benefit of different parties upon different events, and though the right of disposition by will was shortly afterwards extended to it by special statute, and though whatever advantages were still possessed by the *trust*, as a means of evading the burdens of tenure or other liabilities now attached to the use, were gradually removed either by [illegible] those burdens or the extension of those [illegible] ts still continued and continue to be habitually resorted to for various purposes. These are, generally, either to protect the interests of married women and children, by placing in the hands of trustees for them the legal rights which they would be incapable of exercising, or to secure the rights of those in remainder, by severing from the usufruct of property for a life the power of disposing of the whole, or, lastly, the convenience of management, where many parties are interested in the same subject. These observations can apply [illegible] to express trusts. An [illegible] trust supposes a legal transfer of the property actually completed, and a declaration in the same instrument, or having reference to the same instrument [illegible] power thereby created) of the [illegible] operty so transferred is to be held. Such trusts may be declared in or by a reference to any instrument, either deed or will, that is sufficient to pass property at law; the ground upon which they rest is the express confidence that is placed in the trustee, by the person who transfers the property to him, no consideration of money or blood between the trustee and those for whom he holds [illegible] an inducement for the interference o[illegible] most commonly raised by marriage-settlements, or by will. The usual trusts in the former case, as to real estate, are upon legal estates in terms of years, to arise upon certain events, to be held in trust, in the first place, for securing to the wife payment of her pin-money during marriage, and of her jointure after the husband's death, then for the raising, [illegible] provisions f[illegible] for their maintenance during minority. The ultimate trust of such terms, whether expressed or not, is for the person entitled to the corpus of the estate, subject to those charges which the terms are created to secure. Similar trusts, also, are commonly raised in wills, for the maintenance or advancement and portioning of younger children. In all such cases, the legal rights vested in the trustees most commonly remain in their hands as a means only of compelling the person actually in possession to discharge those claims subject to which he holds his estate. But there are other trusts of frequent occurrence, both in marriage settlements and in wills, which require a more active interference on the part of the trustees, and which, therefore, carry with them a greater degree of responsibility. These are trusts for the sale of land and investment of the proceeds upon security, or in the purchase of other land, or trusts for the investment of what was originally personalty, in which cases, it is important for the trustees to consider, in the first place, how far the trust for sale or conversion is imperative and immediate, lest by delay they become liable for any loss that may ensue from the alteration in the value or price of land securities; in the next place, what are the securities in which they are directed to invest, as they will be answerable for the failure of any security a resort to which has not been authorized by the terms of the trust. Where these securities are private, or where a purchase of land is made with trust moneys, they are further bound to see that the usual professional inquiries are in either case instituted into the validity of the title. It is obviously their duty, also, to look to the due appropriation or distribution of the proceeds. Where there is a conversion absolute, or, as it is called, *out and out*, of realty into personalty, or of personalty into realty, either agreed to or directed by deed or will, land is in equity considered as money, and money as land, for all the purposes of succession or transmission; but it rarely happens that a conversion by will is in terms sufficiently absolute to exclude the right of the heirs, or, where it is personalty, the rights of the personal representative, to such part of the real or personal estate, whether actually converted or not, as shall not be required to fulfil the purposes for which the conversion was directed.

The system of trusts is still more generally prevalent in limitations of copyhold and personal property, particularly personal chattels, as money or stock in the funds, to neither of which classes of property the Statute of Uses applied, and in which, therefore, the legal interest remained, at least for a time, subject to the narrow rules of [illegible], and copyhold property is therefore, for [illegible] for other reasons, more commonly settled upon trust than is property of freehold tenure. Personal property, though once held incapable at common law of partial or shifting limitations, has long, by a somewhat forced though ingenious rule of construction, been released from that restriction; and therefore in the settlement of chattels real, of which the title is distinct from the possession, the creation of a distinct equitable title is not more often resorted to than in the settlement of real property of freehold tenure. But it is in regard to that sort of personal property, the title to which, or rather the power of conferring a title to which, is annexed to the possession, either from the nature of the thing itself, as in the case of money, or for reasons of

public convenience, as in the case of bills of exchange, and in regard also to stock in the funds (a class of property over which the holder, whether it be in trust or not has by the regulations of the bank absolute power of alienation) that the utility of trusts is more particularly conspicuous Whenever it is sought to create in any such property shifting or partial interests nothing in such cases can secure future or contingent rights from the dishonesty of the tenant for life or partial owner but the intervention of trustees, in whose hands the whole legal interest, that is to say the whole power of alienation, resides, and though a similar danger is sometimes to be apprehended even at their hands, yet their number itself, and the discretion that may be exercised in their appointment, afford a greater security than is to be found in the integrity of a single individual

*Duties of Trustees* —It is only in cases of express trusts, whether such in the origin, or become such by the acceptance and acknowledgment of the legal owner under whom he acts as trustee that the rules respecting the duties, liabilities and rights of trustees are applicable As to their liabilities, they are liable not only for such sums as they actually have received but for such also as they might but for their wilful neglect or default have received Where there are several trustees each is generally liable for his own acts and receipts only but where all concur in empowering either one of themselves or a third party to do or receive that which he could not do or receive but by virtue of such authorization all are responsible for his acts and receipts under such joint authority It is the duty of trustees besides being faithful accountants, to apply and distribute rightly the property they are entrusted with according to the various rights of the parties entitled to it, and they are liable for any misapplication arising either from ignorance of facts which they ought to have known or might by common diligence have known, or from ignorance of the law in any case It is their business then, as to the first, to inquire diligently into all the circumstances of the trust and as to the second, where upon consulting professional advisers there appears to be any reasonable doubt to refer it to the opinion of the court by instituting a suit for the fulfilment of the trust The rights of trustees are confined to the reimbursement of their proper expenses out of the trust property An express trust will not fail for the want of trustees, where none are nominated the court will take upon itself the appointment To the same class of trusts proper that is to say equitable rights arising from confidence reposed may be assigned implied or resulting trusts in which the confidence is not expressed, but implied by courts of equity from the want of consideration or motive apparent in such cases to give away the whole or as it may be, any part of the beneficial interest Such trusts arise in the first place upon the conveyance or transfer by deed or will of property real or personal upon some trust expressly declared which does not exhaust the whole beneficial interest, or expressly upon trust though no trust be declared, in the first of which cases the surplus of the beneficial ownership, after satisfaction of the express purpose or trust and in the second case the whole of the ownership, results to the party making such conveyance or transfer To the former class of partial resulting trusts belongs the equity of redemption upon a mortgage, which is an equitable right resulting to the mortgagor after all right of redemption is forfeited at law, to recover back the thing mortgaged upon payment of the capital and interest of the money borrowed upon the security of such pledge This equity of redemption subsists in favour of the real or personal representatives of the mortgagor against the real or personal representative mortgagee, till it is destroyed either by twenty years of the adverse possession *i e* possession without any acknowledgment whatever of any rights in the mortgagor, or, which is the most common case, by decree of foreclosure in equity, by which a peremptory day is fixed

Trusts of a similar nature frequently arise upon devises of real property for payment of debts, in which cases a trust results in the surplus, either for the heir, or the residuary devisee, where there is one, but it should be observed, that where any specific purpose for which a trust is created by devise in the produce of land fails of taking effect, such as a legacy charged upon land by predecease of the legatee, or a similar legacy void under the Statute of Mortmain, the benefit of the lapse results to the heir, and not to the residuary devisee, who takes by such devise not that which ultimately is not applicable to the purposes of the will, but that only which the testator expresses no intention of otherwise disposing of But where a legacy, payable out of the personalty fails of taking effect, the lapse shall enure for the benefit of the residuary legatee, where there is one, in preference to the next of kin, the reason of the difference being that previous to the late Wills Act a devise of land spoke from the time of the will, a bequest of personalty from the death of the testator

A trust is implied in the *whole* beneficial ownership upon the conveyance or transfer by deed of the legal interest in real or personal property, *i e.* where it is either [illegible] of the property [illegible] whom no motive or consideration moves, and in whose favour no declaration of trust is contained in such deed or instrument, in which case a trust is implied, either for the party making [illegible] for the person from who [illegible] e consideration for such conveyance or transfer, as, for instance, the money with which the purchase was made, actually moved The implication of resulting trusts has, perhaps, arisen through an unwise departure from the Statute of Frauds, as it is a reliance upon parol evidence in opposition to the legal title It should, however, be observed, that the parol evidence upon which such trusts may be *raised* must be evidence not of declarations or intention, but parol evidence of facts as, for instance of the payment of money by a person not the nominal purchaser, but to repel a presumption of a trust parol evidence of a declaration of intention is admissible because such evidence is corroborative of the legal import of the deed

TRUTH In the Fine Arts, a faithful adherence in representation to the models of nature or the prototypes on which the principles of art are founded

TRY'ING, or A-TRY In Naval language, a word somewhat obsolete for *heaving* or *hove to*

TRY'SAIL A small gaff sail of strong or storm canvass, set in bad weather

TUBE (Lat tubus) A pipe or long hollow body [illegible]

TUBER In Botany a kind of fleshy stem, formed underground and filled with starch It is commonly looked upon as a root as in the potato Also the systematical name of the truffle

TU'BERCLE In Morbid Anatomy, this term is applied to certain diseased structures, as *tubercles* of the lungs small hard superficial tumours of the skin are also called tubercles

TUBERCLE OF LOWER An eminence in the right auricle of the heart where the two venæ cavæ meet, it was first described by Richard Lower in 1665

TUBER'CULA QUADRIGEMINA Four white oval tubercles in the brain two of which are situated on each side over the orifice of the third ventricle and the aqueduct of Silvius The old anatomists called them *nates* and *testes*

TU'BICOLES *Tubicola* (Lat tubus *a tube* colo *I inhabit*) The name of an order of Ancillidians, comprehending those which live in tubes, and which are Cephalobranchiate also the name of a family of Lamellibranchiate Acephalous Mollusks, including those which have a tubular calcareous sheath in addition to the two shelly valves

TU'BICORNS *Tubicornia* (Lat tubus cornu *a horn*) The name of a family of the order of Ruminants comprehending those in which the horns are composed of a horny axis covered with a horny sheath

TUBIFERS *Tubifera* (Lat tubus fero, *I carry*) The name given by Lamarck to an order of the class *Polypi*, comprising those which are united upon a common substance fixed at its base and whose surface is wholly or partially covered with retractile hollow tubes

TUBIPORIS *Tubipora* (Lat tubus, porus, *a pore*) The name of a family of Zoophytes comprehending those in which the animals are isolated and contained in elongated cylindrical calcareous cells, attached by their base, and [illegible]ed by cross bars at definite distances

TUBULARIA The name of a genus of Corallines, with simple or branched horny tubes, from the extremities of which the polypes are protruded, these have two rows of tentacles, of which the external is expanded in a radiated manner the internal one raised into a tuft

TUBULIBRA'NCHIANS, *Tubulibranchiata* (Lat tubus branchiæ gula) The name of an order of Heteropodous Gasteropodes Mollusks comprehending those which have the shell in the form of a more or less irregular tube in which the branchia are lodged

TUBULICOLES, *Tubulicola*, *Polypes à Tuyaux* (Lat tubus, colo, *I inhabit*) A name applied by Cuvier to a family of Polypes, including those which inhabit tubes of which the axis is traversed by the gelatinous flesh, and which are open at the summits or sides to give passage to the digestive sacs and prehensile mouths of the polypes

TU'ESDAY In the Calendar, the third day of the week, named after Tuisco, the Saxon god of war, whence the astronomical symbol is the same as that for the planet Mars As to the god Tuisco, or Tuisto, see *Mem de l'Ac des Inscr* vol xxiv

TU'FA (Italian) A volcanic rock, composed of an [illegible]

TUFO [illegible] cies of porous, light, sandy, calcareous stone, suited to the construction of vaults The *travertino*, with which the cupola of St. Peter's is constructed, is of this species

TU'GENDBUND (Germ *union of virtue*) A patriotic [illegible] established in Prussia after the treaty of Tilsit in [illegible] Its object was to prepare the people of that country by moral instruction and discipline for better times It was abolished at the instigation of the French, [illegible] and it had great effect in producing [illegible] against Napoleon in 1813

TULIPA (Turk tolliban) A gay flower inhabiting the warmer parts of Europe and Asia Minor It is well known for the gaudiness of its colours, which have made it a favourite with gardeners, who have converted its cultivation into a system of gambling, which the Dutch have been obliged to [illegible] laws It is a genus of the Hexandria order

TUMBLE HOME The [illegible] describing the [illegible] of the upper timbers of the ship's side

TUMBREL (Old Fr *tumerel*) A low carriage with two wheels, occasionally used for the most ordinary purposes by farmers, but it is chiefly used for carrying the [illegible] to trains of artillery

TUMULUS See BARROW

TUN A measure of capacity The English tun contains 252 gallons, or 4 hogsheads *See* TON

TUNE (Gr *τονος*) In Music, the relation of notes to each other and the distances between them, whereby arises melody In other words, it is a certain succession of different single sounds arranged according to art

TUNGSTATES Compounds of the *tungstic acid* *See* TUNGSTEN

TU'NGSTEN (Swedish tung sten *heavy stone*) The ores of this metal are the native tungstate of lime and the tungstate of iron and manganese, the latter mineral is known under the name of *Wolfram* Tungsten is a white hard and brittle metal, very difficult of fusion, and having the high specific gravity of 17 4 Heated to redness in the open air, it burns into the *peroxide* or tungstic acid The equivalent of tungsten is probably about 100, and the tungstic acid consists of 1 atom of metal and 3 atoms of oxygen ($8 \times 3 = 24$), and is represented by the equivalent 124 This metal was discovered by Messrs Delhuyart It is sometimes called *Wolframium*, and also *Scheelium*, in honour of Scheele, who first examined the nature of tungstate of lime

TUNIC (Lat *tunica*) A garment worn by the ancient Romans of both sexes, under the *toga* (which see) and next to the skin It was generally of wool of a white colour and it reached below the knee The senators wore their tunics with a broad stripe of purple sewed on the breast the equites had narrow stripes, hence the epithets *latiClavii* and *angustiClavii*, applied respectively to these orders

TU'NICARIES *Tunicata* (Lat tunica *a tunic*) The name of an order of Acephalous Mollusks comprehending those in which the exterior covering is uncalcified, soft, and elastic It is equivalent to the *Ascidiæ* of Savigny and the *Acephales sans Coquilles* of Cuvier

TUNKERS or DUNKERS A religious sect, a subdivision of the Baptists chiefly found in Pennsylvania Their name is said to be derived from tunken Germ *to dip*, because in baptism they plunge the person head foremost into the water They differ little in doctrine from other Baptists but every brother is allowed to speak in their churches This society was originally founded by one Conrad Beissel, in 1720, who founded a colony called 'Ephrata,' sixty miles from Philadelphia They wear long beards

TU'NNEL (Sax *tunel*) In Engineering, a subterranean passage cut through a hill or under a river, for the purpose of carrying a canal road railway, &c

In the construction of railways and canals it is sometimes absolutely necessary, and very frequently expedient, to have recourse to tunnelling either to preserve the requisite level, or shorten the distance or to lessen the expense of open cutting The circumstances on which the question of expediency depends are often of a very complicated nature, but generally speaking it must be decided by considerations of economy for in the present state of engineering, a tunnel may be made of almost any length and through materials of any description, from a granite rock to a quicksand The nature of the ground can hardly be said to interpose any farther obstacle than what may be occasioned by the expense

On account of the peculiar nature of the difficulties to be overcome, the tunnel which has recently been carried under the bed of the Thames, from Rotherhithe to Wapping, may perhaps be regarded as the most remarkable work of the kind which has ever been executed A short account of this operation will probably be the best mode of conveying a notion of the extent and difficulty of such works generally

Some previous attempts had been made to carry a tunnel under the river below London bridge In 1799 one was projected at Gravesend, but the project was soon abandoned In 1804, another was attempted from Rotherhithe to Limehouse A shaft of 11 feet in diameter was sunk to the depth of 42 feet and continued at a reduced diameter of 8 feet to the depth of 76 feet, whence a drift was carried 923 feet under the river, and to within [illegible] where difficulties of so formidable a [illegible] and the engineer reported farther progress to be impossible The scheme, however, continued to be agitated, and in 1823, Mr Brunel proposed a plan which has at length been carried successfully [illegible]

The act of [illegible] the operation was obtained in June, 1824, and shortly after the work was commenced at Rotherhithe The shaft at this place is 150 feet from the river It was formed by building a cylinder of brickwork 50 feet in diameter, 42 feet in height, and 3 feet in thickness on the top of which a steam engine [illegible] the water and earth The cylinder [illegible] the ground, forcing its way through a bed of gravel and sand 26 feet deep, and full of land water The shaft was sunk to the depth of [illegible] 25 feet in [illegible] a smaller shaft to form a well or reservoir for the [illegible] of water The excavation for the body of the tunnel was commenced at a depth of 63 feet and was carried on at a declivity of 2 feet and 3 inches per 100 feet, in order to have sufficient thickness of ground to pass safely under the river The excavation is 38 feet in breadth, and 22½ feet in height, presenting a sectional area of 850 feet, and the base, at the deepest part of the river, is 76 feet below high-water mark The body of the tunnel is of brickwork in Roman cement

The means by which this extensive excavation was effected, consisted of a powerful apparatus of iron, which has been called a shield It was formed of twelve great frames lying close to each other, and severally provided with the mechanism necessary to move them forward, and to secure them, when stationary against the brickwork The frames were 22 feet in height, and about 3 feet in breadth, and each divided into three stages or stories, the whole thus presenting thirty six compartments or cells for the workmen These compartments were open at the back, but in front small boards which could be [illegible] against the ground to be excavated by screws Each workman in his cell operated upon the surface opposed to him taking out one of the small boards at a time, cutting the ground away to the depth of a few inches, and then replacing the board before he proceeded to the next, and when from 3 to 6 inches were thus removed over the whole surface of the shield, the frame was moved forward, and the work secured by immediately adding so much more of brickwork to the body of the tunnel By this means the excavation and the structure were carried forward simultaneously

The tunnel consists of a double and capacious archway one side being appropriated to carriages passing in one direction and the other to those passing in the contrary with paths for foot passengers by the sides of the carriage roads The middle wall between the two archways was first built solid for greater strength but openings were afterwards cut at short distances, so that each has a ready communication with the other The two shafts at the extremities will contain easy flights of steps for foot passengers, and the access for carriages is intended to be by circular roadways 200 feet in diameter, the declivity of which will not exceed 4 feet in 100 The entire length of the tunnel is 1300 feet and the expense is said to have been about 1200*l* per yard

In the course of the work, two irruptions of the river took place, the first on the 18th of May, 1827, after the excavation had been advanced to the distance of about 400 feet, and the second in January, 1828 These accidents were repaired by filling the chasms in the river with bags of clay, and on clearing the tunnel of water, the structure was found on both occasions, to be in a perfectly sound state, and to have sustained, in fact, little or no injury After the second irruption, however, the works, from want of funds, remained suspended for seven years, but assistance having at length been obtained from government they were [illegible] and proceeded without further interruption [illegible] tunnel reached the termination on the Wapping side of the river, early in 1842 This extraordinary work, which during its progress and since its completion has been visited by multitudes of persons from all parts of the world, is, doubtless destined to remain for ages a proud monument of the genius and perseverance of the engineer by whom [illegible] successfully executed

The [illegible] in this country has given rise to some stupendous undertakings in the way of tunnelling One of the most remarkable, perhaps the most remarkable of all, is the Box Tunnel, on the Great Western Railway an account of which is given in the *Companion to the British Almanac* for 1842, and the *Railway Times* for July 10, 1841 This tunnel pierces through Box Hill between Chippenham and Bath, part of which is 400 feet above the level of the railway "It [illegible] and 35 wide to the outside [illegible] for making

and ventilating it are thirteen in number, and vary in depth from 80 to 306 feet. The excavation amounted to 414,000 cubic yards, and the brickwork and masonry to more than 54,000 cubic yards The number of bricks used was 30,000,000, a ton of gunpowder and a ton of candles were consumed every week for two years and a half, and 1100 men and 250 horses were kept constantly employed" For a considerable distance, the tunnel passes through freestone rock, from the fissures of which there was at times an immense influx of water, whereby on one occasion the works were interrupted for a period of nine months On a subsequent occasion, after an irruption, water was for some tim discharged by the engine at the rate of 32,000 hogsheads a day This tunnel occurs on an inclined plane of 1 in 100

The extent of brickwork or other structure which may be necessary to secure the excavation in works of the class now mentioned will depend of course, on the nature of the materials through which the tunnel is driven, and in deciding this question, it is important to attend to the geological formation of the locality In the unstratified rocks an excavation may be made with perfect safety and will require no support, while in those whose strata are nearly vertical, danger may be apprehended from slipping In the chalk oolite, marl lias, and similar formations, the tunnel requires to be lined with brickwork throughout as the materials cohere so imperfectly, that even the vibration arising from the passage of the carriages will cause the fall of parts of the roof

The following table of the dimensions of a few railway tunnels will enable the reader to form an accurate notion of the gigantic scale on which such operations are conducted —

| | Length in Yards | Height in Feet | Width in Feet |
|---|---|---|---|
| Box Tunnel, Great Western | 3,247 | 39 | 35 |
| Wapping to Edge Hill, — Liverpool and Manchester | 2,400 | 16 | 22 |
| [illegible] Street | 1,760 | 19 | 25 |
| Kilsby — London and Birmingham | 2,120 | 27 | 23½ |
| [illegible] | 1,280 | 25 | 22 |
| [illegible] | 880 | 12 | 12 |
| Leicester and Swannington | 1,760 | 13½ | 10½ |

TU'NNY *See* THYNNUS

TU'RBAN The usual head-dress of the Turks Persians, and most other eastern nations It varies in form in different nations, and in different classes of the same nation It consists of two parts a quilted cap, without brim, fitted to the head, and a sash scarf or shawl, usually of cotton or linen, artfully wound about the cap and sometimes hanging down the neck The Grand Signior's turban contains three heron's feathers, and is ornamented with diamonds

TU'RBO (Lat turbo, *a whirling*) The name of a Linnæan genus of the *Vermes Testacea* characterized by [illegible] with an entire [illegible] d together by this specific character form a family of Pectinibranchiate Gastropods in the system of Cuvier which is subdivided into the genera *Turbo* proper, Cuv, *Delphinula*, Lam, *Pleurotoma*, Defrance, *Scissurella*, D'Orb, *Fornatella*, Lam, *Scalaria*, Lam, *Cyclostoma*, Lam, *Valvata*, Müll *Littorina* Ferussac &c

TU'RBOT The best, and, excepting the halibut, largest of our flat fishes, it is the type of the subgenus *Rhombus* of Cuvier It is taken either by the troll net, or, in deep water by the many hooked line baited with the common smelt or small gar-fish A preference is given in the London markets to the turbots caught by the Dutch, who are estimated to have drawn for this supply not less than 80,000*l* a year

TURF The surface of grass lands, of a smooth and uniform texture, covered with pasture grass The term is also sometimes applied to peat cut out of bog *See* PEAT

TU'RKEY RED A fine and durable red dyed upon calico and woollen cloth, the colouring matter used in its production is madder, but the process for producing it in perfection is tedious and complicated (See *Bancroft on Permanent Colours*)

TU'RLUPINS (A word of which no satisfactory derivation has been found See *Du Cange's Glossary*) In French Ecclesiastical History, one of the numerous popular by-names by which the sectaries of the 14th century the precursors of the Reformation, were distinguished called elsewhere Beghards, Picards, Beguins, Lollards, &c

TU'RMA In the Roman Legion, a company of horse, of which ten formed the whole complement of the legion According to Varro, it consisted of thirty horsemen, ten answering to each of the three original equestrian tribes the Tatienses, Ramnenses and Luceres But in addition to the ten, there seem to have been two file leaders, and as the word turma was sometimes indiscriminately used for the subdivision or third part of the full turma, the following lines of *Virgil's Æneid* seem to describe the arrangement —

Tres equitum numero turmas, ternique vagantur
Ductores pueri bisseni quemque secuti.

(See M Le Beau's 8th Dissertation on the Roman Legion, *Mem de l'Ac des Inscr* vol xxxii)

TU'RMERIC The root of the *Curcuma longa* This root yields a fine yellow powder which is occasionally used as a dye stuff in medicine, it also forms one of the ingredients of *curry powder* Paper stained with turmeric is often used in the chemical laboratory as a test of the presence of free alkalies and their carbonates, by which its yellow colour is converted to brown

TURN In Music, a grace thus marked ∾, indicating that the note above it, one degree higher, must be struck before it shortly, then passed quickly through the note itself and *turned* from the note a degree below into the note itself, over which the mark is placed

TU'RNIP-FLY As different insects prey, in the larva state, upon the leaves of the growing turnip, the most destructive, and consequently the most important and interesting of these, will be noticed under the present head They are the turnip flea, as it may be called from its power of agile leaping (*Haltica nemorum*), and the turnip fly (*Athalia centifolia*) The turnip-flea belongs to a genus (*Haltica*) of minute Coleopterous insects, of the section *Tetramera*, and family *Galerucidæ*, in which genus the species are all remarkable for the large size of the femora or thighs of the hindmost pair of legs The species in question does not exceed the twelfth of an inch in length, it is of an oval form, with the elytra of a greenish tinge each ornamented with a broad longitudinal stripe of a pale brimstone colour, but there are other species of the same genus perhaps equally destructive, and not characterized by the longitudinal elytral bands The perfect insect shelters itself in the rough uncultivated margins of fields feeding upon the hedge-weeds, and appears to be ready at any time, provided the weather be warm, to commence the work of destruction on the young turnip shoots Late sowing of the turnip seed does not therefore obviate the attacks of the *Haltica* The first precaution obviously is to clear away all the weeds in the neighbourhood of the turnip grounds that may afford food or shelter to the little enemy When the turnip flea has made its appearance in the crop the ground should be dusted with quicklime and this repeated as often as rain or wind beats it off, and the flea reappears The other enemy to the turnip (*Athalia centifolia*) belongs to the order *Hymenoptera*, and family *Tenthredinidæ* or saw flies

TU'RNSOL *See* LITMUS

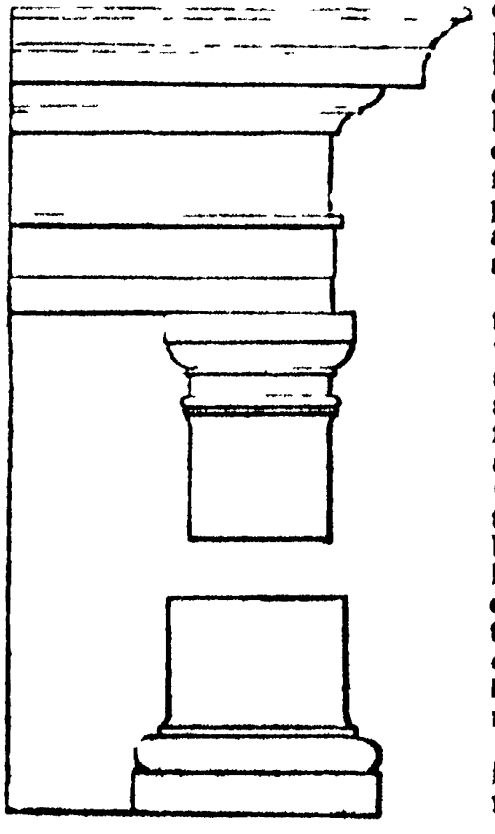
TU'RPENTINE A viscid exudation from certain trees either spontaneously formed upon the bark, or obtained by incision Common turpentine is the produce of certain species of *Pinus* or fir trees When distilled with water it yields a limpid volatile oil (oil of turpentine) and yellow resin remains in the still

TURPETH MINERAL (From its yellow colour, which resembles the powdered root of the *Convolvulus turpethum*) The yellow *subpersulphate of mercury*

TU'RQUOISE A blue mineral found in great quantities in the Nishapoor mines in Persia It appears to derive its colour from oxide of copper and of iron, and consists chiefly of hydrated alumina it is admired in jewellery

TU'RTLE This word is used to signify a species of dove (*Columba turtur*), and also a genus of Chelonian reptiles (*Chelone* Brongn)

TU'SCAN ORDER In Architecture, one of the five orders, and the simplest of them all It is not found in any ancient example Palladio has given two examples of this order, from one of which the profile here given is adopted, though by some that composed by Vignola has been preferred The base, as will be seen on inspection, consists of a simple torus with its fillet, [illegible] a plinth [illegible] Chambers assigns to the column, with its base and capital, a height equal to seven of its diameters Vitruvius speaks of this order with little praise, but Palla[illegible] it for its [illegible] It does not allow the introduction of ornament; and it is to be



observed, that its columns are never fluted By some architects it has been varied on the shaft with rustic cinctures, but such taste is perhaps very questionable Though not suitable to every application of the order, the most perfect profile in this country to which we can refer is that of the portico of St Paul's, Covent Garden, by Inigo Jones

TUTENAG An alloy of copper, zinc, and nickel, made in China, the term is also sometimes applied to a pale brass, and to bell-metal (*See* PACKFONG) In India, zinc also sometimes goes under this name

TUTORS *See* UNIVERSITIES

TU'TTI (It *all*) In Music, a notice to the performer that, from the place to which it is affixed all the parts are to play together This word is generally used to contradict the words *soli* or *solo*, which see

TUTTY An impure oxide of zinc collected from the chimneys of smelting furnaces

TWELFTH BIRDS In the old Sussex Commonwealth, the ghosts of [illegible] They were [illegible] special privileges

TWELFTH-DAY The festival of the Epiphany, or Manifestation of Christ to the Gentiles, being the twelfth day, exclusive, from Christmas (*See* EPIPHANY) For the customs peculiar to this day in England, see *Brande's Popular Antiquities*)

TWELVE TABLES, LAWS OF THE The celebrated laws of the Roman republic, framed by the decemvirs appointed A U C 303, on the return of three commissioners who had been sent to Greece to examine into foreign laws and institutions The tables, as set up by the decemvirs, were originally ten in number, two were added in the second year of the decemvirate, and bore a more aristocratic stamp than the original ten (according to Cicero, the prohibition of marriages between patricians and plebeians was among the number) The text of the Twelve Tables were preserved down to the latest age of Roman literature, and formed the basis of the greater part of the Roman jurisprudence they are called by Livy, "fons omnis publici, privatique juris" The authentic remains of them are given by Haubold (*Institutionum juris Romani privati Lineamenta*, Leipsig 1826) There is a valuable chapter on the early Roman law, as founded on the Twelve Tables, in *Dr Arnold's History of Rome* vol i

TWILIGHT (Germ zwielicht) In Astronomy the faint light which is perceived for some time after sunset and before sunrise

The twilight is produced by the reflexion of light from the atmosphere When the sun descends below the horizon the rays of light no longer reach the earth directly, but as they pass [illegible] of them are reflected [illegible] to its surface At first the light, falling on the lowest and densest strata, is reflected in great abundance, but as the sun descends to a greater distance below the horizon, his rays fall on strata at a greater height and consequently less dense A smaller number of them, therefore, suffer reflexion, and as this number is constantly diminishing the strength of the twilight diminishes in the same proportion, till at length the solar rays fall on strata so rare as to be incapable of reflecting light, and the twilight [illegible] In the morning the change from [illegible] place by the same gradations

From this theory it is evident that twilight must begin and end when the sun's depression below the horizon attains a certain limit The limit however cannot be fixed with any precision It is [illegible] ing to the time which elapses fr[illegible] l stars which are seen by the naked eye become visible But this mode of estimating the duration of twilight is uncertain and arbitrary, and it will be reckoned greater or less according to the goodness of sight of the observer, and the temperature and pressure of the atmosphere Accordingly the sun's depression at the beginning and end of twilight has been fixed at various limits by different observers, by Alhazen, at 19°, by Tycho, at 17°, by Rothman, at 24°, by Stevinus at 18°, by Cassini, at 15°, and by others at different quantities, but the limit usually assigned is 18° Assuming this limit, the duration of twilight in different latitudes, and at the different seasons of the year, is computed as follows —




In the spherical triangle Z P S, let P S = 90° − *d* be the distance of the sun from the pole, Z P = 90 − *p* the distance of the pole from the zenith of the observer or the co-latitude, and Z S = 90° + 18°, S being the place of the sun when he reaches the circle parallel to and 18° below the horizon Now as *d*, the sun's declination, is known, and also *p*, the latitude of the [illegible] [illegible] triangle are given when [illegible] Z P S [illegible] (*see* TRIGONOMETRY) by the formula,

$$\cos Z P S = \frac{-\sin 18° - \sin p \sin d}{\cos p \cos d}$$

If, therefore, we make A = the semidiurnal arc of the sun or the angle at the pole w[illegible] zon, and consequently [illegible] have from the same formula

$$\cos A = -\tan p \tan d,$$

whence the angles Z P S and A are known, and their difference expressed in time gives the duration of the twilight

For places at the equator sin *p*=0, cos *p*=1, and A=90° We have, therefore, cos Z P S = $\frac{-\sin 18°}{\cos d}$ 1st, Suppose the sun to be in the equator in this case we have also *d*=0, and Z P S becomes equal to Z S=90° + 18°, whence the duration of twilight is equal to the time in which an arc of 18° on the equator passes over the meridian, or equal to 1 hour and 12 minutes 2d, Suppose the sun to be at the tropic of Cancer, in this case *d* = 23½°, and the duration of twilight is found by computing from the formula to be 1 h 19 m

By computing from the above formula, the duration of twilight, at the time of the equinox, is found to be 1 h 55 m at the latitude of 50°, and 2 h 32 m at the latitude of 60° At the shortest day, its duration at different latitudes is as follows —

1 h 26 m at latitude 25°,
2 h 6 m at latitude 50°,
2 h 57 m at latitude 60°,

and at 70°, when the sun no longer rises above the horizon, it continues about 5 h 12 m after the sun has passed the meridian of the place

When the angle Z P S = 180°, we have cos Z P S = −1 But in order that the hour angle may have this value, the sun must be on the lower semicircle of the meridian, and consequently, as his depression below the horizon is [illegible] 18°, the twilight will not entirely disappear [illegible] continue through the whole night The formula in this case becomes

$$\cos p \cos d = \sin 18° + \sin p \sin d,$$

or cos (*p* + *d*) = sin 18° whence *p* + *d* = 72° When, therefore the sun's declination *d* = 72° − *p*, the twilight will continue through the whole night at the place whose latitude is *p* Hence, by giving different values to *p*, we find the declination, and consequently the day of the year on which twilight begins to continue through the whole night Suppose *p*=50°, then *d*=22°, which corresponds to the 1st of June In the latitude of London (52°) perpetual twilight begins about the 20th of May At 60° latitude it begins about the 22d of April, at 70° about the 26th of March, at 80° about the last of February, and at the pole itself about the 29th of January It is scarcely necessary to remark, that as no account has been taken of the refraction, these expressions are only approximative

One of the problems most frequently proposed respecting the twilight, is to find the day of the year when its duration is the least possible at a given latitude This problem, which is the same as to determine the sun's declination when his zenith distance increases from 90° to 108° in the least time possible, was first solved by John Bernoulli (*Opera* t i p 64) Solutions of it are given in most works on Practical Astronomy (See Delambre *Astronomie* t i)

TWO-COAT WORK In Architecture, plasterer's work that is either laid and set, or rendered and set

TYMPANI'TIS, or TYMPANY An elastic distension of the abdomen arising from a morbid collection of gas in the intestines The disease is sometimes termed *drum belly*, and arises occasionally from air secreted into the abdominal cavity in which case it is usually fatal

TY'MPANUM (Lat *a drum*) The drum of the ear, the cavity behind the membrane of the tympanum, surrounded by the petrous portion [illegible] temporal bone, and terminating at the cochlea of [illegible], it contains the four small auditory bones, and the Eustachian tube opens into it

TYMPANUM, in Architecture, the space in a pediment enclosed by the cornice of the inclined sides and the horizontal fillet of the corona

TYMPANUM, in Botany, is a membrane stretched across the mouth of the theca of a moss

TYPE (Gr τυπος) In the Fine Arts, the model or pattern in nature of an object used Thus, in architecture the types of columns are said to be trees, &c &c

TYPE Properly, the figure stamped upon a coin, hence a figure, sign, or symbol, especially those by which Christ was prefigured to the Jews, as the Brazen Serpent, the Lamb of the Passover, the Sacrifice of Isaac, or persons whose character and history are considered as embodying an anticipatory representation of the Saviour, as Moses, David, the prophet Jonah &c

Many types are referred to as such by the writers of the New Testament and hence we learn to look for such intentional meaning in what we might otherwise,

in particular instances, pass over as mere coincidences and analogies It is the great sum of such analogies, and the fulness with which they pervade the whole of Scripture, which seem most strikingly to evince the unity of design

TYPE METAL The alloy of lead and antimony used in casting printers' types One part of antimony to three of lead are the usual proportions This alloy takes a sharp impression from the mould or matrix, and is hard enough to stand the work of the press, without being brittle or liable to fracture

TYPES By this term is understood the letters, from the smallest size to the largest, with which books and other articles are printed A single type consists of the shank, the beard, and the face The shank is the body of the letter, the beard is that part between the shoulder of the shank and the face, the face is the shape of the letter, from which the impression is taken

The following are the English names of the different sizes in their regular order, with the addition of the Dutch, French, German, and Italian names —

1. Diamond, the smallest
2. Pearl (*Fr* La Parisienne ou Sedanoise, *Ger* Perl, *Ital* Occhio di Mosca)
3. Ruby
4. Nonpareil (*Dutch* Nonpareil, *Fr* La Nompareille, *Ger* Nonpareille, *Ital* Nomparigha)
5. Emerald
6. Minion (*Fr* La Mignione, *Ger* Colonell, *Ital* Minione)
7. Brevier (*Dutch*, Brevier, *Fr* Le Petit Texte, *Ger* Petit or Jungfer, *Ital* Piccolo Testo)
8. Bourgeois (*Dutch* Bourgeois, *Fr* La Gaillarde, *Ger* Burgeois *Ital* Gighardi)
9. Long Primer (*Dutch* Garmond *Fr* Le Petit Romain, *Ger* Corpus or Garmond, *Ital* Garamone)
10. Small Pica (*Dutch* Dessendiaan *Fr* La Philosophie, *Ger* Brevier, or Rheinlænder, *Ital* Filosofia)
11. Pica (*Dutch* Mediaan, *Fr* Le Cicero, *Ger* Cicero, *Ital* Lettura)
12. English (*Dutch*, Augustyn, *Fr* Le Saint Augustin, *Ger* Mittel, *Ital* Silvio)
13. Great Primer (*Dutch* Text, *Fr* Le Gros Romain *Ger* Tertia *Ital* Testo)
14. Paragon (*Dutch* Paragon *Fr* Le Petit Paragon, *Ger* Paragon, *Ital* Paragone)
15. Double Pica (*Dutch*, Dubbelde Dessendiaan *Fr* Le Gros Parangon, *Ger* Text, or Secunda, *Ital* Due Linee Filosona)
16. Two Line Pica (*Dutch* Dubbelde Mediaan, *Fr* Les Deux Points de Cicero, *Ger* Doppelcicero)
17. Two Line English (*Dutch* Dubbelde Augustyn *Fr* Palestine *Ger* Doppelmittel, *Ital* Canonemo)
18. Two Line Great Primer (*Dutch* Kanon *Fr* Petit Canon, *Ger* Kleine Canon *Ital* Grosso Testo)
19. Two Line Double Pica (*Dutch* Groote Kanon, *Fr* Trismegiste, *Ger* Grobe Canon)
20. Trafalgar
21. Canon (*Dutch* Parys Romeyn *Fr* Le Gros Canon, *Ger* Kleine Missal, *Ital* Canone)

Canon is the largest size with a specific name Pica then becomes the standard to distinguish them and the next size to Canon is Four Line Pica then Five Line Pica and so on to the largest size used in posting bills

1 To enable the reader to form an opinion of the comparative sizes of
2 types, and the proportions they bear to each other there is given
3. in this paragraph a line of each size, from Diamond, the
4 smallest type in general use in England, up to Great
5 Primer, inclusive, numbered to correspond with
3 the preceding list, in order to distinguish
7. them by their names There is a smaller
3 type than Diamond lately introduced,
9. but it is as yet little used. The
0. French have one so small that
1. it cannot be read by the
2. naked eye, even by
13. young persons.

TYPHŒUS One of the Titans, said to have been overthrown in the war against Jupiter, and imprisoned under the weight of Ætna, a circumstance in mythological romance well known from the descriptions of Virgil, Pindar, and Æschylus And see *Bryant's Ancient Mythol* iv 318

TYPHON The Evil Genius of Egyptian Mythology according to Sir G Wilkinson, *Ancient Egyptians*, vol iv p 417 &c), they seem to have acknowledged two deities, who answered to the description given by the Greeks (especially Plutarch, *De Is et Os*) of Typho "One who was the brother of Neptys, and opposed to his brother Osiris, as the bad to the good principle; the other bearing the name of Typho and answering to that part of his character which represents him as the opponent of Horus" the true evil genius Ombte, whom the Greeks seem to confound with Typho "He is figured under the human form, having the head of a quadruped, with square-topped ears, which some might have supposed to represent an ass with clipped ears, if the entire animal did not too frequently occur to prevent this erroneous conclusion" In his Egyptian names is "Ombte," in which Sir G Wilkinson thinks he traces a connection with Antæus, the son of Earth. There appears to have been a general propensity to erase his figure and titles from the monuments at some remote epoch See also Bryant *Ane Myth* vols ii and iii)

TYPHOON The name given to a violent tornado or hurricane in the Chinese seas *See* STORMS

TYPHUS This term (implying to burn with a concealed and smothered flame) is applied to certain continued fevers, attended by great debility and a tendency to putrefaction It is contagious or infectious and often epidemic, and is most prone to attack debilitated persons especially where aided by want of cleanliness, good food and fresh air, so that it often spreads in hospitals [illegible] such causes [illegible] fever liable to several modifications commonly termed low fever putrid fever, nervous fever jail fever, &c Its attack is generally characterized by inordinate muscular and nervous debility and by great depression of spirits weariness flying pains sighing, and a frequent small hard and fluttering pulse the tongue is foul and brown and the taste impaired and not unfrequently nausea and bilious vomiting prevail [illegible] hat variety of typhus which is sometimes [illegible] is fever As the disease advances the debility increases, the mouth becomes very foul and the breath fetid the urine deposits a brown sediment and, together with the motions is fetid and rapidly putrefies all these symptoms increase in intensity the speech becomes inarticulate muttering and delirious, there is a tendency to bleeding from the nose mouth and bowels petechiæ or livid spots appear upon the surface the pulse sinks and intermits, the mind wanders hiccup comes on the hands and feet become cold and under these horrible symptoms the patient dies Such is an outline of the progress of a typhus fever to a fatal termination In this climate it may endure for three weeks or a month but in hot countries the symptoms follow each other more rapidly and violently and it is not of more than eight or ten days duration When it does not terminate fatally the symptoms begin to assume a more favourable aspect about the twelfth or fourteenth day, the pulse improves the patient gets some tranquil sleep perhaps perspires, the urine deposits a red sediment, bilious stools are passed he becomes more tranquil in mind and body and his symptoms gradually disappear till health is restored but it is a disease the event of which must be anticipated with the utmost caution for attacks apparently mild sometimes terminate fatally, and in other cases the constitution has rallied under the most alarming and malignant features At the very commencement an emetic and a mild aperient are proper followed up by aromatic opiates, with camphor and ether It is possible that some particular symptom indicative of local congestion may call for bleeding or blistering the former, except in some very rare cases, should be local only, and very limited as to quantity Serpentaria Peruvian bark cascarilla and colombo are the tonics which are most relied on, and, with these camphor, aromatic confection, opiate confection and ether or if agreeable to the stomach and bowels sulphuric and muriatic acids in small doses, and acidulous drinks Wine and brandy and in some cases, bottled ale and porter are requisite to keep up the general powers of the system, but care must be taken lest their use should be followed by over excitement, and the quantity in some measure regulated by the previous habits of the patient Broths jellies and the varieties of farinaceous food, may constitute the diet, [illegible] attention must be paid to ext[illegible] change of linen ventilation and the due use of chlorine fumi[illegible]tion On the first attack of typhus the effusion of cold water performed two or three times a day, often affords much relief, and afterwards when the shock of such a remedy would be too great sponging the head and body with cold or with slightly tepid water is productive of [illegible]

TYPOGRAPHY The art of printing *See* PRINTING

TYRANNY (Gr τυραννος *a tyrant*) In the original sense of the word a citizen who acquired sovereignty by violence or other usurpation is called, in the language of Greek political writers, a tyrant; and where the power thus acquired became hereditary, the title of

[illegible] his descendants in the generations [illegible] A tyrant in this sense is opposed to basileus, a rightful king with power either limited by the laws or sanctioned by ancient usage (See, as to the Greek tyrannies, Wachsmuth, *Historical Antiquities*, vol i ch 6, and the explanation of the difference between [illegible] and modern sense of the word given by Mitford *Hist of Greece*, i 250 ed 1829)

TYTHING A tything was a subdivision, *i e* a tenth part, as its name indicates, of the hundred, with which it was probably coeval in institution, as it was certainly identical in object, as far at least as regards the prevention of offences by the condition of liability for the production of offenders, or in default thereof reparation of the mischief, in the case of offences committed within the district For this purpose, all free persons above the age of twelve years were required by the Saxon law to belong to some tything No jurisdiction seems to have belonged to the tything, and the office of tythingman, or constable, seems always to have been confined, as it is now, to the preservation of the peace, and the apprehension of offenders The limits of a tything were in most cases coextensive with those of a parish with which it is now commonly, for practical purposes, identical.

## U. and V.

U and V were long considered the same letter, and were used indiscriminately the one for the other, but at the beginning of the 16th century their peculiarities came to be marked, and *u* has since been used as a vowel and [illegible] *every where*) In Ecclesiastical History, a school of Lutheran divines, so called from their tenet that the body of Christ was present in the Eucharist in virtue of his divine omnipresence Luther is said to have maintained this argument, as a mode of reconciling the doctrine of transubstantiation with reason, for two years Brentius, one of his disciples passes for its principal supporter Melanchthon opposed it, but it seems to have obtained great credit among the Lutherans of the sixteenth and seventeenth centuries

UCKLWALLISTS In Ecclesiastical History a sect of rigid Anabaptists, so called from one Uke Wallis a native of Friesland They appear to subsist still, independent of other Anabaptists and Mennonites, in Friesland and Groningen (See *Mosheim*, vol v)

UKASE An ordinance of the emperor of Russia having the force of law in his dominions

ULCER (Lat ulcus) A solution of continuity in any of the soft parts of the body, attended by a purulent or other discharge The several kinds of ulcers are divided by surgeons into *local* and *constitutional* but these often run into each other They have been termed *simple* and *specific* sores or ulcers, the former resulting from accidental injuries, the latter from specific poisons or particular habits of body (See *Cooper's Surgical Dictionary*)

ULEMA (Turk *learned men*) The college or corporation consisting of the Turkish hierarchy the [illegible] or doctors of law [illegible] tice This organization (Dohsson, *Tableau de l'Empire Ottoman*) was first framed by the caliphs, and adopted along with the other principles of their government, by the Ottoman sultans Candidates for admission into the Ulema are educated at the different colleges (medressés) of the empire The *Sheikh ul Islam* or mufti of Constantinople is the president of the whole body (See *Ed Rev* vol 50)

ULLAGE In Gauging, what a cask wants of being full is so called

ULMACEÆ (Ulmus, the principal genus), are woody plants, usually timber trees, inhabiting temperate climates They are apetalous Exogens, nearly allied to the Urticaceous order, from which they principally differ in having a two celled fruit The various kinds of elm trees are the best known species, but the thin papery fruit of these plants is by no means characteristic of the order, it is merely a character of the genus *Ulmus*

ULMIN (Lat ulmus, *the elm tree*) A black or dark brown substance which exudes from the bark of the elm and several other trees, and which appears to be contained in most barks It may be obtained by digesting elm-bark in boiling alcohol, and afterwards in cold water, by which various more soluble substances are removed, the residue is then digested in an aqueous solution of carbonate of potash it acquires a brown colour, and yields a precipitate when neutralized by muriatic acid, which, after having been washed and dried, is *ulmin* It is very sparingly soluble in water, but readily soluble in solutions of the alkaline carbonates According to Boullay (*Annales de Chim et Phys* xlii 273), it is a compound of 567 carbon and 433 hydrogen and oxygen in the ratio to form water He terms it *ulmic acid*, and considers it identical with the brown matter of vegetable mould and turf, and as contributing materially to the nutriment of growing plants

ULNA The larger of the two bones of the forearm, It forms the point of the elbow, and is articulated by a species of hinge-joint to the humerus, and to the radius, and below to the radius, and [illegible] the wrist

ULTIMATE ANALYSIS [illegible] in Chemistry to the resolution of substances into their absolute elements, and is opposed to the *proximate analysis*, by which they are merely resolved into secondary compounds The ultimate analysis of crystallized blue vitriol, for instance, teaches us that its true elements are sulphur, copper, oxygen, and hydrogen, its proximate elements are sulphuric acid, oxide of copper, and water, the ultimate elements of sulphuric acid are sulphur and oxygen, of oxide of copper, copper and oxygen, and of water, hydrogen and oxygen The terms *ultimate analysis* and *ultimate elements* are, however, most generally used in reference to organic products. gum resin, starch, and other [illegible] found associated in a vegetable, and [illegible] its *proximate* principles and they are separated by proximate analysis, but all these are resolvable into carbon, hydrogen, and oxygen These three elementary substances, therefore, are their *ultimate* components The accurate determination of their relative proportions in the various products of vegetables is almost always a difficult chemical problem

ULTIMATE RATIO The ratio of evanescent quantities *See* PRIME and ULTIMATE RATIO

ULTIMATUM (Lat) In Diplomacy, the final conditions offered by a government for the settlement of its dispute with another

ULTRA In Modern Politics, those who carry to their farthest point the opinions of the party to which they belong are so termed The name was applied in 1793 to the more violent revolutionists, it has since been bestowed on the extreme section of all parties in turn

ULTRAMARINE (Lat ultra, *beyond*, and marinus, *belonging to the sea*) The [illegible] of the lapis lazuli This substance [illegible] by painters, on account of the beauty and permanence of its colour, both for oil and water painting In its preparation the finest lapis lazuli is selected, heated to a dull red heat, and quenched in water, it is thus rendered friable, and is ground down into an impalpable powder This is then mixed with a tenacious paste made of linseed oil, wax resin, turpentine, and mastic, and the mixture being kneaded in warm water gives out the blue particles, which are afterwards collected by subsidence Chemists have long in vain endeavoured to imitate this colour, but till lately its nature even had not been determined It appears from the experiments of Gmelin that sulphuret of sodium is the principle to which the blue colour is owing and he has succeeded in preparing an artificial ultramarine by heating sulphuret of sodium with a mixture of silex and alumina (See the *Annales de Chimie et Physique* vol xxxvii p 409)

ULTRAMONTANE, or TRAMONTANE A name applied by Italian writers to theologians and jurists of other countries beyond the Alps especially France In ecclesiastical law, ultramontane tenets are those least favourable to the supremacy of the popes As to ultramontane jurists, see Savigny, *Hist of Roman Law*, vol vi

UMBEL In Botany a form of inflorescence in which all the pedicels proceed from a single point, as in *Astrantia* If there is no subdivision, the umbel is called simple, but if the pedicels produce other umbels, as in parsley, the umbel is compound

UMBELLIFEROUS PLANTS (Umbel), are a race of great frequency in all cool or temperate climates, and even occur in hot ones though much more rarely They are known in general by their flowers being disposed in an umbel They have a herbaceous stem, leaves usually much divided, often inflated when they join the stem; and they have universally a dry fruit, which divides into two seed like pieces Some of them are poisonous, as hemlock and water dropwort, others are esculents, as celery carrots and parsnips, many yield aromatic fruits, as caraway coriander and anise, a few secrete a fœtid gum resin, of which assafœtida ammoniacum, and galbanum are examples The species are extremely numerous, and difficult to recognize with accuracy, and, unfortunately, no general rule has yet been discovered for distinguishing those poisonous from the harmless kinds

UMBER Two distinct substances are used as pigments under this name one is a variety of peat or brown coal large beds of which are worked near Cologne, it is said to be largely used in the adulteration of snuff the other, called *Turkish umber*, is a variety of ochraceous iron ore [illegible] according to the analysis of Klaproth of 48 per cent of iron [illegible] peroxide of manganese, 13 silica, 5 alumina, 14 water. The term umber

is said to be derived from Ombria, or Spoleto, in Italy, where it was first obtained

UMBI'LICAL CORD, in Botany is an elongation of the placenta in the form of a little cord, as in the hazel nut.

UMBI'LICATE. (Lat umbilicus, *a navel*) In Zoology, when a pit, tubercle, or granule has a depression in its centre

UMBILI'CUS (Lat) Properly the navel; whence it was metaphorically applied to the two ends of the roller on which the manuscripts of the ancients were rolled, and which were usually adorned with ornamental knobs, while the ends of the parchment were filed with pumice-stone, in order that the folds might lie smooth and neat

UMBILICUS In Conchology, the aperture or depression [illegible] around which the shell is convoluted

UMBILICUS In Botany, the scar by which a seed is attached to the placenta, frequently of a different colour from the rest of the seed, and not uncommonly very dark-coloured It is more commonly called *hilum*

UMBILICUS In Geometry, used by the older geometers synonymously with *focus*

UMBO (Lat) A protuberance or boss In Conchology it is that point of a bivalve shell immediately above the hinge

UMBRA A shadow In Astronomy, this term is applied to the dark cone projected from a planet or satellite on the side opposite to the sun *See* Eclipse

UMPIRE The word appears to be properly derived from the Fr *impair*, *unequal in number*, an umpire being a third party to whom a dispute is referred An umpire is properly a person whom two referees each chosen by his client, being unable to agree, jointly [illegible] them

UNBEND In Seamanship to take the cable from the anchor, a sail from its yard, &c, to untie one rope from another

UNCIÆ The name given by the old writers on algebra to the coefficients of the letters in the expansion of any power of a binomial Thus the expansion of $(a+b)^4$ gives $a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4$ in which the numbers 1, 4 6 4 1 are the *unciæ* or coefficients

UNCIA'LES LITERÆ (Lat) Uncial letters or writing In Diplomatics, a species of character compounded between the capital and the minuscule or small characters, some of the letters resembling the former others the latter It is supposed to have been employed in Latin MSS as early as the third or fourth century, but was seldom used after the tenth

UNCIFORM BONE (Lat uncus *a hook*) The last bone of the second row of the wrist bones, so called from its hook-like process, which projects towards the palm of the hand, and gives origin to the great ligament which binds down the tendons of the wrist

UNCOMMON CHORD In Music another term for the chord of the sixth, not so called however because it is unusual or improper but to distinguish it from the *common chord*, wherein the lowest note is the root or fundamental bass *See* Music

UNCONFORMABLE STRATA A term applied by geologists to strata not lying parallel with the subjacent ones, or having a different line of direction or inclination.

UNCTION, EXTREME *See* Extreme Unction

UNDE'CAGON (Lat undecim *eleven* and Gr γωνια *angle*) In Geometry, a plane figure of eleven sides or angles The area of a regular undecagon is found by multiplying its side into $\frac{7}{11}$ of the square of $73\frac{7}{11}$ degrees, hence if the side be 1 the area is 9·3656

UNDERFLOW A current below different from that at the surface

UNDERWOOD The low woody growths produced among timber trees sometimes called coppice wood, though the term *coppice* [illegible] especially applied to woods in which the growths of [illegible] the stools of trees are more abundant than timber trees *See* Coppice Wood and Shoot

UNDINES, or ONDINES (Lat unda, *water*) The name given by the Cabalists to one class of their spirits of the elements, namely those residing in the waters The ancient Greeks believed springs and lakes to be haunted by a peculiar race of supernatural nymphs (*see* Naiads) and this belief passed down unimpaired to the middle ages The ancient Saxons adored the female deities of the Elbe, and the belief in undines is still scarcely eradicated in that region The Saxon peasants report that an undine is often met in the market-place of Magdeburg, dressed as a girl of their own class, but always to be known by having one corner of her apron wet Near Toulouse many objects of value were once discovered on draining a large artificial lake, which are supposed to have been thrown in as offerings to the spirits of the water The *nixe* of the northern countries is of the same family, and the Scottish *kelpies* are creatures of a similar superstition.

UNDULATION (Lat unda, *a wave*) A waving motion, applied, in physics, to the vibratory motion of an elastic fluid, as the atmosphere.

UNDULATORY THEORY, in Optics, is the hypothesis according to which the impression of light is conveyed to the eye by the undulations of an elastic medium. This theory supposes the universe to be filled with an ether or medium of great elasticity, but so extremely rare as to offer no resistance to the motions of the planets For an explanation of the phenomena of light and colours according to this theory, see Light

UNEVEN NUMBER In Arithmetic, the same with *odd number* [illegible] of the form 2

UNFORMED STARS, in Astronomy, are such as [illegible] of the constellations

UNGUICULATA, or CLAWED *Unguiculata* (Lat unguis, *a claw*) The name of a primary division of the class Mammalia, including those which have the digits armed with claws, but free for the exercise of touch upon their under surface *See* Mammalia

UNGUIS, or CLAW The narrow part of the base of a petal, taking up the place of the footstalk of a leaf, of which it is a modification The term is also used as a term of measure equal to a nail, or half an inch, or the length of the nail of the little finger

UNGULA (Lat *a hoof*) In Geometry a solid formed by cutting off a part from a cylinder [illegible] of revolution, by a plane passing obliquely through the base The ungula is consequently, bounded by the plane of the base, the intersecting plane, and the portion of the surface of the cylinder, &c included between them The name is derived from its resemblance to the hoof (ungula) of a horse

UNGULATA *Ungulata* (Lat ungula, *a hoof*) The name of a primary division of the class Mammalia, including those species which have the digits inclosed in hoofs the under surface not being left free for the exercise of touch *See* Mammalia

UNICORN (Lat unus, *one*, cornu *horn*) The beast called unicorn, in our version of scripture (Heb reem) is now commonly understood to be the rhinoceros But the fabulous unicorn, which has passed into heraldry, is represented with the figure of a horse, and a single horn issuing from its forehead The unicorn of Pliny, however, has the head of a hart the feet of an elephant, the tail of a boar, and the rest of the body resembling a horse Aristotle Ælian and all the classical writers on animals, mention the unicorn The traveller Ludovicus Romanus asserts that he saw *two* unicorns, kept alive in the temple of Mecca Altogether there is perhaps no fabulous beast for whose existence there is so much appearance of evidence, and some seem to imagine that it may yet be discovered in the interior of Thibet Many strange virtues were attributed of old to the horn of the unicorn, particularly against poison, but the horns preserved in collections, and to which that name was given, were either of the rhinoceros, or of the narwal or sea-unicorn

UNIFORMITY (Fr uniforme) In the Fine Arts, resemblance in shape between the correspondent parts of a subject

UNIFORMITY ACT OF In English History, the first act of uniformity is the 1 Eliz c 2, that at present [illegible] 13 & 14 Car 2 c 4 It regulates the form of public prayers administration of the sacraments, and other rites of the Church of England

UNIGE'NITUS The celebrated constitution in the form of a bull, issued by Pope Clement XI in 1713, in condemnation of Père Quesnel's *Reflexions Morales sur le N Testament* It is so called from its beginning, "Unigenitus Dei Filius" Father Quesnel was a friend of the celebrated Jansenist leader Arnauld, and became chief of that religious party after the death of the latter He died in exile at Amsterdam in 1679 The bull was procured by [illegible] Father le Tellier, it condemned [illegible] Quesnel's work Its [illegible] in France Most of the bishops accepted it, but with explanations which they gave to the public Cardinal de Noailles and others refused to accept it all As soon as the Duke of Orleans became regent, Father le Tellier was banished, and the party opposed to the bull came into power, but [illegible] from [illegible] by the Duke of Orleans himself etc, Cardinal de Noailles [illegible] the bull After that event the Jansenist party only survived in small fragments, especially among the communauty of Port [illegible] *See* Jansenists

UNILOCULAR (Lat unus, *one*, loculus, *partition*) In Conchology, shells which are not divided into chambers In Botany, seed vessels not separated into cells

UNION. In British History The union of the crowns of England and Scotland took place on the accession of James I to the [illegible] the uniting the kingdoms was afterwards several times taken up, and commissioners were appointed to consider it in the reigns of Charles II and James II But it was finally carried

into execution in 1706, the statute passed on that occasion being the 5 Anne, c 8 By this enactment laws relating to trade, customs, and excise were to be the same in both countries, other laws to remain in force in each respectively The parliament of the United Kingdom, called Great Britain, was to have 16 Scottish peers, and 45 members of the House of Commons The mode of election of peers was subsequently regulated (*See* PARLIAMENT) Since the union, acts of parliament, in general language, are held to extend to Scotland a proviso being inserted where it is to be excepted The union of Great Britain and Ireland took place in 1800 by the statute 39 & 40 G 3 c 67 of the British and 40 G 3 c 38 of the Irish statutes It admitted 4 Irish lords spiritual, 28 temporal, and 100 commoners to the united legislature, the lords temporal elected for life, the lords spiritual sitting by a certain rotation By article 5 the churches were united For the changes which have since taken place in the number of Scottish and Irish members of the House of Commons, see PARLIAMENT

UNIPELTATES *Unipeltata* (Lat unus, *one*, and pelta, *a buckler*) The name of a family of Stomapodous Crustaceans in which the carapace [illegible] plate

UNISON (Lat unus, *one*, and sonus, *sound*) In Music, a consonance of two sounds equal in gravity or acuteness produced by two bodies of the same matter, length, thickness, tension, &c equally struck at the same time, so that they yield the same tune or sound

UNIT, UNITY In Arithmetic, the number one, an individual of discrete quantity Euclid defines number to be a multitude or collection of units

UNITARIANS Those who confine the Godhead to a single person, in which general sense the term may be taken to represent the Arians and Socinians, as well as the sect which is more strictly denominated Unitarian These last are the descendants of the religious communities which adopted, in the 16th century the opinions of Socinus, but in the course of years they have gone considerably further towards reducing Revelation to a mere ethical system They have been supplied with an abundant stream of converts from the Presbyterians and Independents in this country many congregations of whom became first Arian, and latterly Unitarian in sentiment The principal Unitarian authorities are Drs Priestley, Belsham, and Channing, who have either entirely rejected or neutralized the doctrine of the atonement, and represent the language of the apostles upon this and other mysterious points as either intentionally accommodated to the ideas current among their hearers, or derived from erroneous conceptions of their own The revelation of the New Testament is thus reduced to the assertion of a mere historical fact—that of the existence of the man Jesus as a moral teacher [illegible] latitude of interpretation [illegible] it appears that in their view the exposition of the first disciples is not to be implicitly relied on nor do they allow infallibility to the Author of the religion himself The Unitarians were subjected to severe penalties as deniers of the Trinity, long after other dissenters had been relieved by the Act of Toleration the laws against them were not repealed by statute till the year 1813

In this country they do not constitute a numerous body the number of their congregations has been stated at something more than 200, but they are principally composed of persons of the educated classes In Geneva the pulpits of the established church are mostly occupied by professors of these opinions, and in the northern states of America they form one of the most influential of Christian denominations

UNITED BRETHREN In Ecclesiastical History, a body of reformers in Bohemia who separated themselves from the Catholics and Calixtines (according to some writers) about 1467 It is also said that they received episcopal ordination from the Vaudois According to others (Bossuet, *Variations des Eglises Protestantes*, chap ii), they were an offshoot from the Taborites or Thaborites (see that article) At all events, it appears certain that there already existed a considerable body of persons professing the tenets of the Reformation in Bohemia at the period of Luther

UNITIES in the Drama [illegible] of time, place, and action The latter only is referred to in the dramatic compositions of classical antiquity, but what is termed by moderns the *classical* drama (in opposition to the *romantic*) requires all three *See* DRAMA

UNIT JAR A small insulated Leyden jar placed between the electrical machine and a larger jar or battery, so as to ann [illegible] discharges, which may be counted, [illegible] which have passed into the larger jar This is among the many valuable additions [illegible] apparatus by Mr Snow Harris

UNIVALVE (Lat unus, *one*, valva, *a valve*) This term is applied to those Mollusks, the shell of which is composed of one piece, and which is generally

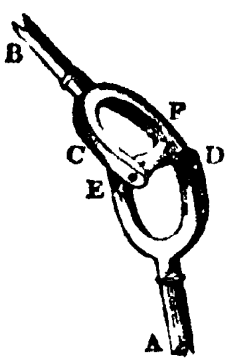


[illegible] Latreille also thus denominates a [illegible] odous Crustaceans

UNIVERSAL In Logic A universal proposition is that which has the subject distributed so that the predicate is declared [illegible] in it; *e g* [illegible] universal negative propositions the predicate is distributed also, *e g* "No men are immortal"

UNIVERSALISTS A name by which the Arminians are sometimes characterized, expressing the universality which they attribute to the operation of grace, conceiving it to be given to all men without favour or reserve On the other hand, the Calvinists, or those who hold the particular election of individuals, are designated Particularists

UNIVERSAL JOINT, or HOOKE'S JOINT In Machinery an ingenious contrivance of Dr Hooke for the purpose of communicating motion obliquely It is single or double In the single universal joint, the two shafts or axles, A and B, between which the motion is to be communicated, terminate in semicircles, the diameters of which are fixed in the form of a cross, their extremities moving freely in bushes placed at the extremities of the semicircles Thus, while the central cross remains unmoved, the shaft A and its semicircular end may revolve round C D as an axis, and in the same manner B, with its semicircular end, will revolve round E F If the shaft A be made to revolve without changing its direction, the points C D will move in a circle whose centre is at the middle of the cross The motion thus given to the cross will cause the points E F to move in another circle round the same centre, and hence the shaft B will be made to revolve (*Mechanics, Cabinet Cycl* p 253)




When the shafts are inclined to each other under an angle of 40° it is necessary to employ a double universal joint, as represented in the annexed figure In this manner the motion may be transmitted from one shaft to another at right angles Instead of employing a cross in the manner now described, the joints may be constructed with four pins, fastened at right angles upon the circumference of a hoop or ball Universal joints are of great use in cotton mills, where the tumbling shafts are continued to a great distance from the moving power, for, by applying a universal joint, the shafts may be cut into convenient lengths and so be enabled to overcome a greater resistance (See *Gregory's Mechanics*, vol ii p 9, *Willis's Principles of Mechanism*, p 272)



UNIVERSITY In the middle ages, the Latin term universitas signified the whole body of students or of teachers and students, assembled in a place of education, with corporate rights, and under by-laws of their own, in later times, also, the name was held to imply that all branches of study were taught in a university In the modern sense of the term, a university signifies an establishment for the purposes of instruction in all or some of the most important divisions of science and literature, and having the power of conferring certain honorary dignities, termed degrees It is generally understood that the authorization of the sovereign power in the state is necessary to enable such an establishment to confer degrees, and, in most European countries, there are various offices and professional situations for which a person is qualified by having taken a certain degree at one of these establishments Hence universities, although in many instances they are composed of private foundations, are justly regarded as national institutions The University of Paris, the most celebrated of those of the middle ages, and which served in some degree as a model to the rest, was formed about 1200 by the union of the various schools of rhetoric, [illegible] ich that city abounded, [illegible] That university was divided into four nations,—French Picard Norman, and English the first comprehended students from Italy and Spain, the last from the north [illegible] rope generally The subjects taught were arranged under faculties, viz theology, law, medicine, and that of the seven liberal arts,—rhetoric, logic, grammar, geometry arithmetic, astronomy, music (See TRIVIUM, QUADRIVIUM) These faculties were corporate, and elected each a dean, and these last, with the procuratores of the nations, represented the university The lowest degree was that of bachelor, the next licentiate, the third magister (this degree at Paris corresponded with that of doctor at Bologna) The colleges were royal or private foundations for the benefit of poor students, whose board was,

in some instances, found for them, and who received [illegible] The faculty of theology [illegible] the name of the Sorbonne (*q v*) This slight sketch of the constitution of the famous University of Paris may serve for similar establishments in other Continental countries during the middle ages, and down to a comparatively late period In England, the two national universities have been established, from a period of considerable antiquity, at Oxford and Cambridge The original constitution of these universities much resembled that of the Parisian, with the exception of the division into four nations, which was wanting But their subsequent history was much modified by the growth [illegible] or individual foundations, into a much higher degree of consequence These were originally destined by their founders merely to entertain a certain number of junior students (generally termed scholars), and a higher body (named in most cases Fellows) to furnish them with assistance in their [illegible] while the great body of independent students lodged in the numerous halls, and attended only on the public university lectures But by degrees the colleges likewise became receptacles for independent students, under the tuition of the fellows, the halls were for the most part abandoned and such as remained partook of the collegiate character, and, in the modern system (which has subsisted for more than two centuries) no student is admitted to take a university degree unless he has completed his studies in a college or collegiate hall, under the superintendence of its tutors But the original division into independent and foundation students still subsists, although the fellowships in many instances, instead of being filled up from the junior foundation members in each college are left open as prizes for the competition of the whole university The degrees, in Oxford and Cambridge, are differently named, or arrived at in different succession in the several faculties, but degrees in theology and medicine can only be obtained after the acquisition of certain degrees in arts In Spain the universities are arranged on a system somewhat resembling that which prevails in England the students being entered of their respective colleges In Germany as in England the [illegible] universities (Prague, founded in 1348 and Vienna, in 1365) were framed on the model of that of Paris Germany has now a far more numerous list of universities than any other country From the Bursæ (charitable establishments resembling our collegiate foundations for the benefit of poor students) was derived the term *Burschc* by which the students of these universities are so generally known But the collegiate system never prevailed in that country as among ourselves On their present arrangement (which is pretty similar in all Catholic as well as Protestant) the four faculties are retained Professors in the various branches are appointed by government These form the senate at the head of which is the prorector, who is chosen annually or biennially Besides these there are extraordinary professors, who receive small salaries, and an inferior class of licensed teachers, or licentiates who receive none The professors are obliged to give public lectures in the branch of study to which they are appointed, but they, as well as the other two classes, may give also private lectures on whatever subject they please, and from the fees of attendance at these their principal income is derived The student is for the most part left at liberty to attend what lectures he pleases but licences to practise various professions, benefices in the various churches, &c, are only given especially in Prussia, to those who have studied a certain number of years by attending lectures in the requisite branch of study The constitution of the Scotch Universities has a great resemblance to those of Germany, and the same observation is applicable to the two universities established in the metropolis within the last few years — London University and King's College In France the old university system may be said to have been entirely done away with by the Revolution As to the [illegible] see Savigny, *Hist of Roman Law*, [illegible] elaborate defence of the English system, see *Quart Rev* vols xlix lx The history of the great change effected in it by the substitution of collegiate for professorial instruction has been traced in a series of recent papers in the *Edin Rev*

UNIVOCALS, or SYNONYMS In the Aristotelian Logic (as used by the schoolmen), generic words, i e words of which both the genus and the difference are predicable of many different species e g the genus animal" is "univocum univocans with respect to "man" and "brute," both of which are comprehended under any definition which can be given of the word "animal," and are called with reference to it "univoca univocata" *Universal terms are also such as have only one signification* opposed to equivocal

UNMOOR To take up one of the two anchors by which the ship is moored

UPAS TREE (Upas, the Javanese name), is a plant common in the forests of Java and some of the neighbouring islands to which extraordinary stories, for the most part fabulous, have been attached Upon the authority of Dutch writers, it has been asserted that it is a most deadly poison, employed in the execution of criminals, who are, however, pardoned if they succeed [illegible] Birds [illegible] and the whole country round it was asserted to be desolated by its pestilent effluvia The truth is, that the Upas tree is merely a tree with poisonous secretions, and nothing more, there is nothing deleterious in its atmosphere It is an Urticaceous plant, called *Antiaris toxicaria*, and is very nearly related to the fig, some of whose species are also deadly poisons

UPHERS In Architecture, fir poles chiefly used in scaffolding they are from twenty to forty feet in length, and from four to seven inches in diameter

UPLANDS Lands on hills or steep declivities, which in general require a different kind of management from lands in plains or comparatively flat surfaces Uplands are generally kept in pasture or underwood.

UPUPA (Lat upupa *a hoopoe*) A genus of Tenuirostral Passerine birds, distinguished by an ornamental head-crest formed of a double range of feathers, which can be erected at will The common hoopoe (*Upupa epops*) is an occasional but rare visitant of England

URACHUS The ligamentous chord which arises from the base of the urinary bladder, and terminates in the umbilical cord

URANIA In Mythology the muse of Astronomy She is generally represented with a crown of stars, in a garment spotted with stars, and holding in her left hand a celestial globe or a lyre

URANIUM A metal discovered by Klaproth in 1789, who named it after the planet Uranus discovered about that time It occurs only in two native combinations, — the *pechblende* of Saxony and the *uranite*, of the latter fine specimens have been found in Cornwall Little is known of the properties of metallic uranium it appears to be a brittle gray metal, of the specific gravity about 9 From the experiments of Berzelius and Arfwedson we deduce the number 217 for its equivalent, that of its protoxide being 225 and of its peroxide (sesquioxide) 229 The salts of the oxides of uranium are of a fine grass green or yellow colour the persalts have been most examined Ferrocyanate of potassa produces in them a very characteristic rich brown precipitate not unlike that formed by the persalts of copper They are also precipitated brown by infusion of galls

URANOSCOPUS (Gr *ουρανος, heaven*, *σκοπεω, I explore*) A genus of fishes was so called by Linnæus because both eyes were placed on the superior surface of the head which presents a nearly cubical form The mouth is cleft vertically at the anterior part of the head and like the eyes is directed upwards The species of of this genus commonly called "star gazers" belong to the *Percoid* family of Acanthopterygian fishes in the [illegible] of Cuvier

URANUS (Gr *ουρανος, heaven*) In Mythology a divinity, the first king of the Atlantic nation, and the father of Saturn

URANUS In Astronomy the remotest known planet belonging to our solar system The mean distance of Uranus from the sun is 19 18·39, that of the earth being considered as unity whence its real distance is upwards of 1800 millions of miles Its sidereal revolution is performed in about 84 Julian years The orbit is inclined to the ecliptic in an angle of only 46′ 28″ 4, and the eccentricity of the orbit is 0 046679 half the major axis being taken as unity The apparent diameter of Uranus (which, on account of the great magnitude of its orbit in comparison of that of the earth undergoes very little variation) is about 4″, whence the real diameter of the planet must be about 35 000 miles, or nearly four and a half times that of the earth, and its bulk about eighty times that [illegible] of a small [illegible] rings belts, or discernible spots From analogy we infer that it revolves about its axis, but of this there is no direct proof the great distance of the planet, indeed, precludes our obtaining much knowledge of its physical state Four satellites at least are known to attend Uranus. Sir William Herschel thought he could discern six, but the existence of more than four has not been clearly made out Two of these were discovered in 1847 by the independent observations of Mr Lassell and M Otto Struve The satellites which are in some degree known have this remarkable peculiarity that, instead of advancing from west to east round the centre of the primary, the planes of their orbits are nearly perpendicular to the ecliptic, and their motion is retrograde

Uranus was discovered by Sir William Herschel, at Bath, on the 13th of March 1781 It had been previously observed by Flamstead Bradley Mayer, and Lemonnier in their ordinary star-observations, but, owing to the inferiority of their telescopes, not one of these astrono-

mers suspected it to be a planet Sir W Herschel called it the *Georgium Sidus*, in honour of George III Foreigners for some time called it *Herschel*, and it is now, in some English works, called the *Georgian* See PLANET and NEPTUNE in Supp

URE'A A peculiar crystallizable substance held in solution in the urine When dried in vacuo it consists, according to Dr Prout, of

| | Atoms | Equiv | Theory | Experiment |
|---|---|---|---|---|
| Nitrogen - | 2 | 28 | 46 67 | 46 65 |
| Carbon - | 2 | 12 | 20 00 | 20 07 |
| Hydrogen - | 1 | 4 | 6 67 | 6 65 |
| Oxygen - | 4 | 16 | 26 66 | 26 63 |
| | 1 | 60 | 100 00 | 100·00 |

Urea is readily soluble in water, tasteless, inodorous, and when mixed with the other contents of the urine very prone to putrefaction, the principal result of which is carbonate of ammonia Urea has been artificially obtained by the action of ammonia on cyanate of lead, oxide of lead is precipitated, and colourless crystals of urea [illegible] by carefully evaporating the solution

URE'DO (Lat uro, *I burn*) A genus of microscopical Fungi, whose presence is known by the burnt appearance of the part they infest They consist of extremely minute brown spores, which multiply with great rapidity, and appear to injure plants by absorbing their juices Smut and brand diseases too well known to the farmer, are caused by their ravages Steeping corn in lime water is the best means of repelling their attacks

URETER The membranous tube which conveys the urine from the kidney to the urinary bladder

URE'THRA The membranous tube or canal by which the urine is voided

U'RIA A genus of web footed birds, belonging to the short winged family *Brachypteres* of Cuvier, and, like the rest of that family, admirable divers The species of *Uria* are all marine, and generally known by the name of "Guillemots" They resort in vast numbers to breed among the rocks of the Orkney and Shetland Isles, and are a source of profit to the adventurous inhabitants

URIC ACID An acid peculiar to the urine of certain animals, it is always present in human urine and in the excrements of many birds of prey and of serpents especially of the *Boa constrictor*, which is voided in white nodules, consisting of little else than urate of ammonia Uric acid also forms one of the commonest varieties of urinary calculi, and of the red gravel or sand which is voided in certain morbid states of the urine Pure uric acid is obtained in the state of a very insoluble white powder by digesting powdered uric calculus or the excrement of the boa, in potash, and dropping the solution into weak muriatic acid the precipitate which falls is to be well washed, and dried at 212° Its most distinctive chemical character, by which it is at once easily recognized, is, that when moistened with nitric acid and heated it dissolves and upon evaporation to dryness leaves a red compound, which upon the addition of a drop or two of a solution of caustic ammonia becomes of a fine crimson (*purpurate of ammonia*) The following is the composition of uric acid —

| | Atoms. | Equiv | Theory | Experiment |
|---|---|---|---|---|
| Nitrogen - | 2 | 28 | 31 11 | 31 125 |
| Carbon - | 6 | 36 | 40·00 | 39 875 |
| Hydrogen | 2 | 2 | 2 22 | 2 225 |
| Oxygen - | 3 | 24 | 26 67 | 26 775 |
| | 1 | 90 | 100·00 | 100 000 |

U'RIM A word connected in its [illegible] word *thummim*, being the plural [illegible] *light, a luminary*, whence it has come to signify fire *Thummim*, which is the plural of thom or tam, means *fulness* or *perfection* See *Wilkinson's Ancient Egyptians* as to the connection of this word with the title of the Egyptian god Thauth, or Thoth

The two words [illegible] *manifestation and truth* The urim and thummim were the precious stones on the high priest's breastplate, which made known the will of God by casting an extraordinary lustre and thereby *manifested* the success of events to those who consulted them

The high priest alone could officiate at this solemn ceremony, and the urim was to be consulted only at the instance of public persons such as the king, the president of the sanhedrim and the general of the Israelitish army, and only on such public matters as related to the common interest of the twelve tribes

The manner in which the high priest consulted the urim was as follows: — Having entered into the sanctuary or holy place being [illegible] his robes and breastplate, and with [illegible] wards the ark of the covenant, upon [illegible] presence [illegible] opened the breastplate the matter to be consulted, the person [illegible] behind him, and [illegible] and eyes await the answer The high priest then fixed his eyes on the pectoral, and those letters which formed the answer shone with more than ordinary lustre, [illegible] were significantly raised out of their places So when David inquired of God, by means of the urim, whether he should go up to one of the cities of Judah, three letters came out of their places as it were, and gave the answer

While the Hebrews were under a theocracy, or immediately governed by Jehovah, it was necessary there should always be means at hand to consult him, but when this theocracy ceased, and the kingdom became hereditary in the person and family of Solomon, and Israel became divided into two monarchies, under Rehoboam and Jeroboam, the consulting of the urim and thummim [illegible]

URINE (Gr ουρεω *I urine out*) The fluid secreted [illegible] passes by the ureters into the bladder The variable appearance of the urine announces, even to the casual observer, corresponding fluctuations in its composition, these have long been studied by physicians and medical chemists, as furnishing useful prognostics in disease The chemical analysis, however, of the urine is attended by many difficulties, chiefly arising out of the great number of different substances which are found in it the variations in quantity and quality to which they are liable, and the facility with which they are modified by the analytical reagents which it is necessary to employ The substances always found in healthy urine are water, carbonic acid, phosphoric acid, or superphosphate of lime, uric acid, or superurate of ammonia, phosphates of lime, soda, magnesia, and ammonia, sulphate of soda, chloride of sodium (common salt), urea, albumen, and mucus, colouring and odorous matter [illegible] benzoic and lactic [illegible] ammonia, sulphate of potassa, fluoride of calcium, muriate of ammonia, sulphur, silica In certain diseases other products make their appearance, which are not discoverable in healthy urine, such as oxalic acid, or oxalate of lime, nitric acid, sugar, carbonate of lime, cystic oxide, and occasionally some anomalous organic compounds the nature of which has not been very satisfactorily ascertained

It is almost impossible, in consequence of the circumstances above mentioned to give a correct notion of the relative proportions of the component parts of healthy urine, but the following statement, from Berzelius will serve to give an idea of the average composition of this complicated fluid

| | |
|---|---|
| Water - - - - - - | 933 00 |
| Urea - - - - - - | 30 10 |
| Sulphates of potash and soda - - | 6 87 |
| Phosphate of soda and of ammonia - - | 4 59 |
| Chloride of sodium - - - - | 4 45 |
| Muriate of ammonia - - - - | 1 50 |
| Free lactic acid (acetic?) } Lactate of ammonia } Animal matter } - - - | 17 14 |
| Earthy phosphate and a trace of fluoride of calcium - - - - - | 1 00 |
| Uric acid - - - - - | 1 00 |
| Mucus and albumen - - - - | 0·32 |
| Silica - - - - - - | 0 03 |
| | 1000 00 |

When the urine is in a healthy state, there are many circumstances of mind and body which materially influence its appearance and quantity It is often little else than water, as after very copious draughts of diluting and diuretic liquids, at other times it is saturated with its solid contents, and even deposits part of them as it cools If turbid at the time it is voided it may always be considered as in a morbid state Sometimes it contains foreign matters which have been taken as medicine or food The peculiar odour imparted to it by asparagus, the colour by spinach, rhubarb, &c, and the passage of certain saline substances by the kidneys are familiar cases of these modifications to which the urine is subject The daily average voided under ordinary circumstances, by healthy individuals, is not less than 30 nor more than 40 ounces, and its specific gravity should not exceed [illegible] diabetes, and [illegible] the kidneys (as in cases of albuminous urine described by Dr Bright) it rises to 1040 The usual average is 1020 It always reddens the vegetable blues which indicate free acid. In cases of suppressed perspiration its quantity is usually increased, and in hot weather and when the perspiration is copious, it is diminished, for it is one of the great outlets of mere water from the system We may also observe, that a large quantity of nitrogen is thrown off by the same channel, for that element constitutes 20 *per cent.* of urea.

*Urinary Calculi* — When the uric acid of the urine, which we have already stated to be one of its most insoluble contents, is secreted in any extraordinary proportion, it is passed in a solid state, generally in minute red crystals, or *red sand*, and these not unfrequently agglutinate, so as to form small *calculi* from the size of a pin's head upwards These, passing with more or less pain from the kidney along the ureter into the bladder, produce what is termed a *fit of gravel*; and if one or more of them remain in the bladder, it then increases in size, and becoming too large to be passed with the urine gives rise to symptoms of *stone in the bladder* The increase of this nucleus will be more or less rapid, ac[illegible] e, but if the inordinate [illegible] that substance will frequently be deposited upon it in successive layers, and it will sometimes thus attain a considerable size and consist almost entirely of uric acid But if the uric attack [illegible] the kidney is transient, the small uric calculus in the bladder usually becomes encrusted with a white deposit, composed of *ammonio-magnesian phosphate* perhaps with more or less *phosphate of lime* this mixture forming what has been termed the fusible calculus, and this gives rise to a second and frequent species of urinary calculus namely, that in which a uric nucleus is enveloped in the phosphates The natural tendency of the urine is to deposit the above-mentioned difficultly soluble phosphates upon any extraneous matter or nucleus which may chance to be in the bladder, but the rapidity with which it is deposited is very different in different individuals, and accordingly the increase in size of such a calculus is sometimes very slow, and sometimes extremely rapid, and as the violence of the symptoms generally depends (but not always) upon the size of the concretion, they will be subject to great consequent irregularity It [illegible] ppen that calculi are formed in the [illegible] of any morbid state of the urine itself, or of any uric nucleus sent down from the kidneys, but these cases are rare, and appear to depend upon the accumulation of sand and mucus in certain disordered states of the bladder which is gradually indurated into a nucleus, and which then goes on to increase in the phosphates, so that, on cutting such a calculus through the centre, we do not, as in the majority of cases observe a uric nucleus, but the whole concretion is white and more or less crystalline, and usually consists of little else than ammonio-magnesian phosphate This outline of the formation of calculi includes by far the greater number of cases, but it occasionally happens that not only the nucleus but the bulk of the stone, is made up of *oxalate of lime* a substance which we [illegible] urine [illegible] often [illegible] seed, or, when more carefully examined are found to be a congeries of little rounded particles, but when they have increased in the bladder, they are then generally rough and dark brown on the exterior, whence they have acquired the name of *mulberry calculi* Another, and more rare substance, which forms gravel and calculi is the *cystic oxide*, and in some very rare cases small concretions of *carbonate of lime* have been voided, most probably originating in the prostate gland [illegible] of *silica* are said to have been detected in the [illegible] this substance has also been found in calculi, but it is rare, and in small quantity In concluding this sketch of the history of the urine and urinary calculi, we cannot too strongly insist upon the importance of attending to the early symptoms of the disease, and to its first announcement, which *generally* consists in habitual turbidness and deposits in the urine All persons are subject to occasional appearances of this kind, but when they are *constant*, they ought to be considered as alarming indications of further mischief [illegible] are almost always curable, either by diet [illegible] both, but when once a stone has formed in the kidney or bladder, all hope of its removal, except by an operation (and even that not admissible in the case of kidney calculi), is vain, nothing having been yet discovered to which the term *solvent* is properly applicable The removal of the stone from the bladder is effected by operation in two ways either by an incision into the bladder and the removal of the stone by a forceps, — this constitutes *lithotomy*; or by *lithotrity*, in which certain instruments are introduced by the urethra, so as to grasp the stone and enable the operator to reduce it to fragments sufficiently small to allow of being voided by the usual passage

URN, in Mosses, is the hollow urn in which the spores or false seeds are lodged.

URN, CINERARY or SEPULCHRAL. (Lat uro, *I burn.*) A species of vase used among the ancients to receive and preserve the ashes of the dead The form of the urn was derived by the Romans from Greece, but the Greeks did not employ their urns for sepulchral purposes Among the Romans these vessels were especially consecrated to retaining the ashes of the dead Similar vessels were used by the ancient Teutonic and Slavonic tribes who likewise burnt their dead. Sir T Brown's celebrated work, *Hydriotaphia, or Urn Burial*, contains a strange collection of learned fragments and philosophical reflections on this subject Numerous descriptions of cinerary urns, both Roman and British, discovered at different periods in this country, will be found in the *Archæologia*

UROCE'RATA [illegible] The name of a tribe [illegible] nopterous insects, in which the *terebra* or borer of the females is sometimes very long and prominent and composed of three filamentary processes sometimes capillary [illegible] interior of the abdomen

[illegible] Gr οὐρα and δηλος, *manifest*. [illegible] Caducibranchiate Batrachian reptiles which preserve the tail through all the stages of their existence

URO'PTERANS, *Uroptera* (Gr οὐρα, and πτερον, *a wing*) The name of a family of Amphipodous Crustaceans, including those in which the tail is terminated by enlarged appendages in the shape of fins

UROPY'GIUM (Gr οὐρα, *a tail* and πυγη, *behind*) The base of the tail in mammals and birds

URO'SCOPY The judgment of diseases founded upon an inspection of the urine

U'RSA MAJOR The Great Bear, one of the forty-eight constellations of Ptolemy, in the northern hemisphere and near the pole It is often alluded to in the most ancient histories, sacred and profane, under the various denominations of Arctos, Bootes, Helix, Callisto, Megisto the Waggon, the Plough It contains seven very conspicuous stars, called *septemtriones*, whence *septemtrio*, the north

URSA MINOR The Lesser Bear, also one of the forty-eight constellations of Ptolemy It was called by the Greeks *Cynosura*, that is, the *Dog's Tail* The pole star [illegible]

U'RSULINES [illegible] History, an order of nuns of which the origin is ascribed to Angela di Brescia, about 1537, but which derived its name from St. Ursula (a lady of the family of Benincasa at Naples) The Ursulines were bound to perform charitable offices to the sick, poor, and penitent They were erected into an order by Gregory XIII, in 1577, at the solicitation of St Charles Borromeo They take in addition to the three ordinary vows, a fourth — to devote themselves to education (See Waddington, *History of the Church*, p 401)

U'RSUS (Lat ursus, *a bear*) A genus of Plantigrade Carnivora in the system of Cuvier, restricted to those species which have three large tuberculate molars on each side of both jaws, the anterior lower and the posterior upper one being the largest They are preceded by a tooth a little more trenchant representing the carnassial tooth and by a variable number of small premolars In accordance with this dentition, the bears are omnivorous or frugivorous They are heavy, stout-bodied animals with thick limbs, and a very short tail the cartilage of the nose is moveable, and sometimes very long, as in the labiated bear commonly called the ursine sloth The bears of the northern regions pass the winter in a state of somnolency in dens or other hiding places, and it is in these retreats that the female brings forth her young The species best known are the common brown bear (*Ursus arctos*), the black bear (*Ursus Americanus*), the grisly bear (*Ursus* [illegible]) the polar bear (*Ursus maritimus*) the *Ursus labiatus Ursus Thibetanus*, *Ursus* [illegible] *Ursus Syriacus*

URTICACEÆ (Lat urtica, *the nettle*), form a very large and natural order of plants, with apetalous flowers, a lenticular simple fruit, and a seed whose embryo always directs its radicle towards the top of the cavity The stinging properties of the common nettle are participated in by many others whose acridity is intense Others are provided with a poisonous juice, which in its most concentrated form gives the upas tree of Java its formidable qualities A narcotic principle is highly developed in hemp, and the toughness of the fibre of that plant occurs in many others of the order Nevertheless the fig, the bread-fruit, the mulberry, and hops, in which nothing deleterious is remarked, are the produce of some species, and even the milk tree of the Caraccas, whose bland juice feeds the natives of the country, is an Urticaceous plant [illegible] which, in *Ficus elastica*, is of the finest quality

URTICARIA [illegible] NETTLE RASH

USANCE [illegible] Law A foreign bill is often drawn at one, two, or more "usances," meaning thereby certain periods of time which it is the usage of the countries between which the bills are drawn to allow for payment thereof Thus the usance between London and Paris is one calendar month, a bill drawn here at one usance," on the 2d January, is payable there on the 5th February, allowing three days of grace.

USE, in its original sense, signified the equitable right one had to take the rents and profits of land whereof the

legal ownership was in another It was very nearly the same as the trust of the present day [illegible] following manner — The owner of land conveyed [illegible] feoffment to some friend, on the understanding that the feoffee should hold it for the sole use and benefit of the feoffor, or such persons as he might nominate In this way the seisin or legal property of the land became vested in the feoffee to uses as trustee, while the feoffor, or other person nominated by him, who was called the cestui que use, had the substantial use and enjoyment of it The simplicity of the common law, however, recognised but one person in connection with the soil, namely, its real owner, and repudiated the idea of any use as separated from the seisin; so that if the trustee, abusing the confidence placed in him, refused to let cestui que use take the rents and profits, there was no redress for the grievance But the Court of Chancery, as a court of equity, considered the agreement entered into by the trustee as binding [illegible] and after calling on him by writ of subpœna [illegible] oath of the par[illegible] trust, compelled him to perform it

The system of uses was transplanted from the civil law, and introduced into this country about the time of Edward III. by the ecclesiastics, who procured conveyances to be made, not directly to themselves, but to lay persons as trustees for them in order to evade the statutes of mortmain Once known, it was generally adopted, and though crushed in its infancy, so far as regarded religious houses, continued to flourish without disturbance in other respects, and was found admirably adapted to the wants and convenience of the people at large in softening the rigours of feudal tenure and facilitating the alienation and settlement of property The laws and policy of feudal tenure required the vassal to render certain fruits and services to his lord, and if these were not duly rendered, or any act were done in derogation of the lord's title, the estate was forfeited The tenancy of the freehold could not be interrupted or suspended for an instant, and to every transfer of it actual and public delivery of possession, in the presence of witnesses, and accompanied by much solemn ceremonial, was absolutely indispensable, so that the lord might always have some person to perform the services due to him, and always know with certainty who that person was The lord was entitled to sell [illegible] the land during [illegible] ation of the land heavy fines were payable to him The tenant had no power of directing the destination of the land by will, such a mode of disposition would at once have been wanting in notoriety, and have deprived the lord of his fruits upon a descent

When, however the equitable interest in land, as distinguished from the legal property in it became recog[illegible] land to B to A's own use, the terms upon which B took the land were said, in equity, to affect his conscience, and to impose upon him a moral obligation to fulfil them honestly But it was in equity only that A had any claim there he might call upon B to allow him to take the profits of the land, and to make such conveyances of it as he might from time to time direct At law A had no control over or connection with the land any longer remaining to him His use, therefore altogether evaded the grasp of tenure, which rested entirely upon the common law It was held of no one, it was the creature of his own declaration, operating upon the conscience of the person in whom he confided It might be transferred at any time without any public solemnities by a secret declaration At law A could not carve out for himself a portion of the whole fee, and limit the residue of it to others, without first of all going through all the formalities of a conveyance to B, and then taking back a reconveyance, with the same formalities, of that portion of the fee which he might wish to retain to himself Husband and wife being one person in law, he could not carve out a portion for her without conveying to B, in order that B [illegible] afterwards convey to her He could not convey [illegible] of it, to B, so that it should, on the happening of any named event, or the expiration of any named period, shift either wholly or in part from him to any other person He could not even convey to B at all without giving him immediate possession a conveyance to him in futuro, as from Christmas next, would have been altogether void He might, however, resorting to equity, and making a declaration of the uses to which he wished his property to be applied, effect all these and innumerable other arrangements by a single stroke of the pen or a mere breath The use [illegible] law, had such a suppleness [illegible] whims He might dispose [illegible] to his heirs in the course of the common law; but no fine was payable upon its descent It was not liable either to dower or to curtesy, it was not extendible for debts, nor forfeited for treason

Lord Bacon accordingly complains, that it "deceived many of their just and reasonable rights A man that had cause to sue for land knew not against whom to bring his action, or who was the owner of it The wife was defrauded of her thirds, the husband of his curtesy, the lord of his wardship relief, heriot, and escheat, the creditor of his extent for debt, and the poor tenant of his lease" To remedy these and other [illegible] the statute 27 Henry [illegible] 10 was passed [illegible] the Statute of Uses, which enacts, that when any person shall be seised of lands to the use, confidence, or trust of any person [illegible] be seised and possessed of the land of and in the like estate as he had in the use, trust, or confidence

The statute thus executed the use, as it is called, by transferring it into possession, and doing away with the distinction between the beneficial interest and legal property in land Whoever had the use had now also the legal estate Thus the use was not abolished, according to the probable intention of the legislature, but merely annexed to and incorporated with the legal estate, to which, therefore, it now superadded all the convenient ductility of its own nature It had no longer a merely precarious existence in equity, but a firm locus standi in courts of law It was shorn, indeed, of many of its old privileges, such as exemption from dower, curtesy, and forfeiture, but for this loss there was soon contrived a remedy The judges in their narrow construction of the statute, decided that its provisions did not extend to a use limited upon a use, as their phrase was Accordingly, on a feoffment to A and his heirs, to the use of B and his heirs to the use of (or in trust for) C and his heirs, they held that the statute clothed the first use with the legal ownership, and that the second was a nullity But as it was quite clear that C, and not B, was the person intended to enjoy the estate, this verbal pedantry of the common law judges drove C into the Court of Chancery for relief, where he was immediately received as the substantial cestui que use, and the *use* which the statute had been in law held not to execute was considered a valid *trust* in equity Thus by limiting two uses successively instead of one only as before the statute,—by making, in fact, the conveyance only three words longer than had been customary the equitable interest and the legal estate were again disunited, and the use under its new name of trust was as popular and available as ever In this manner the destructive qualities of the statute are virtually repealed, while its creative qualities are to this day in full operation, and the legislature, instead of paralyzing the use has only given new form and flexibility to the legal estate

Uses are of various kinds

An *executed use* is one to which the statute applies by annexing to it the legal ownership That to which the statute does not apply is called, as has been already mentioned, a *trust*

*Secondary* or *shifting use* is one which takes effect in derogation of a use previously [illegible] to A to the use of B, and if C [illegible] return from Rome or pay B a certain sum of money, then to the use of C

*Springing use* is one limited to arise on a future event, where no preceding use is limited

*Future* or *contingent use* is one limited to a person not ascertained, or upon an uncertain event, but without derogation of an use previously limited, as to A for life, and afterwards to his unborn son

*Resulting use* When the use limited expires or cannot vest, it is said, either after such expiration or during such impossibility [illegible] on a conveyance by A [illegible] life, then to her eldest [illegible] riage, the use results back to A, or results to him in fee in the event of his [illegible]

USHER (P[illegible]) An officer who has the care of the door of a court or hall, &c In the court of England, he is an officer of considerable rank, whose business it is to introduce foreign ambassadors or other high strangers to the sovereign

USQUEBAUGH A [illegible] liquor made in greatest perfection at Drogheda [illegible] Brandy or other spirits raisins cinnamon cloves, and various other spices are its ingredients

USTRINUM or USTRINA (Lat. uro, *I burn*) In Roman Antiquities, a public burning-place, enclosed by walls, in which bodies, mostly of the poorer sort of people, were consumed An ustrinum, according to Montfaucon, was square, and in compass about 300 feet In the *Archæologia* (vol xxvi) will be found a detailed account of the site of one recently discovered in Cambridgeshire, which appears to have been of rather large dimensions

USTULATION (Lat) A term of old Pharmacy, implying the gradual desiccation and torrefaction of substances

USUCA'PTION In Civil Law, the acquisition of property in any thing by possession and enjoyment for a certain term of years, commonly considered as synony-

mous with prescription, although some have restrained [illegible] fined to be the right of enjoying indefinitely something belonging to another without diminishing its substance *Usufruct* differs from *use*, because he who has the use of a thing can only enjoy it personally, whereas the right of him who has the usufruct is alienable, and may be granted, sold, or hired to another Usufruct may be constituted in four ways by contract, by will, by judgment of a court (as where the judge, in effecting a division of common property, may under certain circumstances, instead of dividing the [illegible], allot the usufruct to one, and the thing to another), and by operation of law Usufruct is, properly speaking, confined to things real, and to incorporeal rights (whether they would be termed real or [illegible] to the division of our law), such as [illegible] of usufruct (quasi usufruct) may exist [illegible] be consumed by use The division between the fruit (which belongs to the usufructuary), and the thing itself (which belongs to the proprietor) affords room for a great variety of legal distinctions Usufruct may be extinguished in several ways by the death, natural or civil of the usufructuary, by loss, by prescription, the right being extinguished if disused for a certain period, by forfeiture, where the usufructuary abuses his right, by expiration of time, if the usufruct have been granted for a term, and by the union of the usufruct with the property in the same hands

U'SURY The taking of interest for money from the Latin word usura The Jews were forbidden by the law of Moses to exact interest from one another By the old Roman law of the twelve tables, the rate of interest allowed as legitimate was the usura centesima which was strictly one per cent a month, and has been supposed by some to have amounted to twelve, by others to ten per cent in the year Interest was also computed in the following manner — Usura uncuaria being the lowest term, one per cent, or one twelfth of the usura centesima, usura semis, or semis, half the centesima (six per cent), bes quadrans quincunx, &c, two third parts a quarter, a fifth of the centesima (eight three, two per cent) The Roman laws against excessive usury were frequently renewed, and constantly evaded, but the same principle, additionally sanctioned by mistaken religious opinions, pervaded the laws of all countries in which the civil jurisprudence prevailed The amount of legal interest has been fixed by various statutes in England In the reign of Henry VIII ten per cent was allowed, by 21 J 1, 8 per cent, by 12 C 2 6 per cent, by 12 Ann. 5 per cent All contracts made for the payment of any principal to be lent on usury above this rate were utterly void The question of usury, *i e* whether a contract is *bona fide*, or a colour for a usurious loan was determined by the verdict of a jury But the usury laws have been relaxed by several recent statutes By the last 2 & 3 Vict. c 37, bills of exchange not having more than 12 months to run, and contracts for loans or forbearance of money above 10*l*, are no longer affected by those laws But 5 per cent remains the legal interest recoverable on all contracts, unless otherwise specified

UT In Music, the name of the first of the musical syllables The Italians, for the sake of softening the sound, use the syllable Do instead of Ut in the modern solfeggi

U'TERINE (Lat uterus, *belly*) In the Civil Law, an uterine brother or sister is one issued from the same mother

UTILITA'RIANS A name which has been given to a particular sect of modern politicians, those, namely, who profess to try the excellence of modes of government and usages simply by their utility The celebrated Jeremy Bentham, regarded as the founder of this sect, introduced into the critical department of politics a closer logic than had been [illegible] and aimed at applying his fame[illegible] atest happiness of the greatest number," as an immediate test by which to affirm or deny the value of institutions It is evident that all political sects, both of writers and statesmen, profess ultimately the same object The real characteristic of the Utilitarians consists in the peculiar sense in which they understand it They contend for the most part the proposed [illegible] so as to restrict it to that which is useful for the material and economical well-being of the multitude Their tenets have been attacked in two celebrated articles in the *Edin Review* (vols 49 and 50) *Mill's Essay on Government*, and *Austin on Jurisprudence*, may be referred to as containing the most [illegible] them

UTI[illegible] olitics, a treaty which leaves belligerent parties mutually in possession of what they have acquired by their arms during the war is said to be based on the principle of *uti possidetis* — "as you possess"

UTO'PIA A term invented by Sir T More (from *ou* not, *τοπος* *a place*) and applied in his celebrated work called *Utopia* to an imaginary island, which he represents to have been discovered by a companion of Amerigo Vespucci, and as enjoying the utmost perfection in laws politics &c in contradistinction to the defects of those which then existed The work was first printed in 1516 but Froben's edition of 1518, is more correct The word *Utopia* has now passed into all the languages of Europe, to signify a state of ideal perfection, and *Utopian* is used synonymously with *fanciful* or *chimerical*

UTRICULUS (Lat dim of *uter*, *a bladder*) A term in Botany applied to one called one or few-seeded, superior membranous fruit frequently dehiscing by a transverse suture, as in (*Chenopodium* It is also used to denote a fruit with a thin skin and a single seed Sometimes this word is employed to express [illegible] of the cellular tissue of a plant, which [illegible] bladder

UVA URSI The *Arbutus uva ursi*, *bear's berry*, or *whortleberry* The leaves of this small shrub have a highly astringent and sweetish taste, their decoction or infusion is occasionally used in medicine, especially in certain disorders of the kidney and bladder

U'VULA (Lat dim of uva, *a grape*) A small fleshy protuberance attached to the soft palate, and hanging over the tongue It consists of the common integuments of the mouth and a small vermicular muscle by the contraction of which the uvula is elevated In some cases of enlarged or relaxed uvula which will not yield to local or other remedies, it becomes necessary to amputate a part of it, in consequence of the impediment to deglutition which then ensues, and the tickling cough and retching which it induces

VACCINA'CEÆ (Vaccinium one of the genera) A natural order of shrubby Exogens chiefly inhabiting North America Formerly combined with the Ericaceous order from which they differ in their inferior ovary and succulent fruit The berries of many are eaten, under the names of cranberry, bilberry whortleberry, &c, and some of the species are cultivated as objects of ornament

VACCINATION *See* Cow Pox

VACU'NA or VACI'NA The ancient Italian goddess of leisure, to whom the husbandmen sacrificed at the close of harvest, or 'harvest home,' to which rustic festival Horace alludes in the words "fanum putre vacunæ" (See also *Ov Fasti* vi)

VA'CUUM (Lat vacuus, *empty*) in Physics is a portion of space void of matter The possibility of the existence of a perfect vacuum has been a favourite subject of dispute with the schoolmen and metaphysicians Its existence was maintained by the Pythagoreans Epicureans, and Atomists, and denied by the Peripatetics, who ascribed the rise of water in a sucking-pump, and some other phenomena of the same kind produced by atmospheric pressure, to nature's abhorrence of a vacuum Descartes made the essence of matter to consist in extension and therefore denied the possibility of a vacuum, for if extension be the essence of matter, wherever extension is there matter must be Those again, who suppose all material bodies to be formed of the agglomeration of elementary particles, are compelled by the phenomena of motion to admit at least the existence of what was called by the schoolmen a *vacuum interspersum*, or of intervals devoid of all matter among the interstices or pores of bodies, for if there were no interstices, all space would be full of matter, in which case no body could be moved out of its place inasmuch as there would be no unoccupied place into which it could move For the arguments on this subject, see *Newton's Optics*

The most perfect vacuum that can be produced artificially is the *torricellian vacuum*, or the space above the mercury in the barometric tube But in this sense vacuum merely signifies the exclusion of atmospheric air, for this space in the barometer may be filled with the vapour of mercury, or with some other medium infinitely more rare than air, and inappreciable to our senses It is obvious, from the nature of the pneumatic machine that the vacuum produced by an air-pump, or the Boylean vacuum as it has been called, can never be perfect as some air must always remain in the receiver, however [illegible] process may be continued

The question of the existence of a vacuum is not worth discussing, but there is another question of great interest with reference to physical astronomy connected with the subject, — namely, whether the spaces in which the planets move are so far void of matter as to offer [illegible] or are occupied by a medium [illegible] impede their motions in the long run in a sensible degree Recent observations appear to give some countenance to the supposition that this is actually the case It has been observed that after the most careful allowance has been made for the attractions of the [illegible] causes of disturbance, [illegible] the same returns of that body to [illegible] periods which are constantly [illegible] *See* Comet Now this is precisely the effect that would be produced if the body moved in a medium which offered a small resistance to its motion;

and as this is the only obvious mode of explaining the phenomenon, it has been generally adopted Nevertheless it is extremely difficult to reconcile the supposition of an existing medium with the astronomical fact, that during the last two thousand years of observation, it has produced no perceptible effect on the motions of the large planets capable of being accurately observed by the most delicate instruments This fact, however, in spite of the extreme feebleness of the resistance, does not furnish an absolute proof that such a medium may not exist, and that its effects may not ultimately become sensible even on the densest planets If it does exist, the consequence seems inevitable that all the planets and satellites, as well as the comets, must be ultimately precipitated into the sun

Another argument against the existence of a vacuum is furnished by the undulatory theory of light If this hypothesis be true, and it is rendered probable by numerous phenomena, a medium of great elasticity must pervade all the parts of space through which light penetrates There could in this case be no vacuum, unless, indeed, the term be understood to denote merely the absence of ponderable matter *See* LIGHT

VA'DE IN PACE (Lat *go in peace*) In monastic communities offences were sometimes punished by the dreadful infliction of starving to death in prison, and bones have occasionally been found among the ruins of convents of victims who appear to have perished in this manner. The punishment took this name from the words in which the sentence was pronounced The use which Walter Scott has made of this custom in his poem of *Marmion* is well known But it is no romantic fiction (See Fleury, *Hist Eccles* vol xx p 102, where however, the *vade in pace* is described as perpetual solitary imprisonment *Dict de Trévoux*)

VAGA'NTES (Lat *vago, I wander*) The name of a tribe of spiders (*Aranidæ*) comprehending those which watch their prey concealed in a web, but also frequently run with agility and chase and seize their prey

VAGI'NA (Latin term for *sheath*) is applied by botanists to the leafstalk of those plants in which it becomes thin and rolls round the stem to which it then forms a sheath this is the case in grasses

VAGI'NATES *Vaginati* (Lat vagina *a sheath*) Sheathed Polypes The name of an order of Polypes, comprehending those which are constantly surrounded by and attached to a calcareous or horny polypiary

VA'GRANCY (Lat vagro *I wander*) In Law a very miscellaneous class of offences against public police and order is comprehended under this title in English Law Vagrants under the present act of parliament in force on the subject (5 G 4 c 83) are of three descriptions —1 Idle and disorderly persons, including persons neglecting to maintain their families, paupers returning without certificate to parishes whence they have been legally removed beggars, common prostitutes, pedlars without licence &c all of whom may be summarily convicted and committed to gaol for a month by any single justice, subject to an appeal to the sessions 2 Rogues and vagabonds including persons guilty of the former offences who have been once already convicted of being idle and disorderly, fortune tellers and other impostors persons guilty of indecent exhibitions, procurers of charitable contributions under false pretences playing at games of chance in public places, having in their possession housebreakers' implements or offensive weapons with intent to use them, reputed thieves frequenting public places to commit felony, and others, all of whom may be committed for three months 3 Incorrigible rogues, viz persons guilty of the last class of offences, having been already convicted, persons breaking out of legal confinement, &c, who may be committed to the next sessions, and there sentenced to a years imprisonment Under this act justices possess very extensive powers, such as to issue warrants to bring before them persons suspected of vagrancy, to search lodging houses reasonably suspected of harbouring vagrants, &c

VAIR In Heraldry one of the furs employed in blazonry It is supposed to represent the skin of a small squirrel It is always white and blue, unless otherwise specified in the blazon, as vair of *or* and azure, vair of ermine and gules, &c Vair appears to be derived from varius *Vairy* is the pattern of vair with more than two colours.

VA'LENTINE Feb 14 is the day sacred to St Valentine a presbyter who according to the legend, was beheaded at Rome under Claudius Mr Brand (*Popular Antiquities*, vol i p 47) says that he cannot find in the life of the saint any circumstances likely to have given origin to the peculiar ceremonies of the day It appears to have been a very old notion, [illegible] to by Chaucer, as well as by Shakspeare (in *The Gentlemen of Verona*), that on this day birds begin to couple And the custom of "choosing Valentines" is of great antiquity in this country as well as in France, where, however it has been long disused Lydgate mentions it (1476), Grose explains Valentine to mean "the first woman seen by a man, or man by a woman," on that day, but it does not appear where [illegible] this explanation There is also a curious [illegible] tine, composed by the poet Gower, in *Warton's History of English Poetry* (Additions to vol ii p 31). Herrick mentions the notion and the custom —

[illegible]
[illegible]

It appears that the Reformers attacked this as well as other legendary customs of their time, and that the Romanists themselves were so scandalized at it that devices were invented for turning the day to profitable use St Francis de Sales introduced the practice of drawing lots for patron saints on it, by way of substitute According to others this latter practice was of much older date and substituted for a pagan custom by which boys and girls drew each other's names on the 15th February (day of Februata Juno) However this may be, it is certainly one of the few saints' days in the calendar popularly remembered in England, as the returns of the [illegible] ably testify

VALENTI'NIANS In Ecclesiastical History, a sect of the second century, so called from Valentinus, their founder They were a branch of the Gnostics *See* GNOSTICS

VALE'RIAN The root of this plant, the *Valeriana officinalis* is used in the form of infusion, decoction, or tincture as a nervous [illegible]

VALERIANA'CEÆ [illegible] A natural order of herbaceous Exogens inhabiting temperate climates They are distinguished from the Dipsaceous order by their flowers not being in heads, by the want of albumen, and the absence of an involucel The roots of *Valeriana officinalis* are aromatic and antispasmodic and the young leaves of the species of *Valerianella* are eaten as salad, under the French name of mâche, or the English one of lambs lettuce and corn salad

VALE'SIANS An ancient sect of heretics mentioned by Epiphanius and supposed to have become known about A D 240, said to have adopted the practice of eunuchism

VA'LET VARLET Originally the sons of knights and afterwards those of the nobility before they had attained the age of chivalry The name is sometimes written *vasletus* and seems to be derived from the same root with vassal [illegible] the Celtic was (*See* VASSAL) Valet in French [illegible] degenerated in later times into the signification of servant

VALHA'LLA, or WALHALLA The palace of immortality in the Scandinavian mythology, inhabited by the souls of heroes slain in battle

VALKY'RIUR or DISAS The Fates of the Scandinavian mythology the 'choosers of the slain' who conduct heroes killed in battle to Valhalla

VALLEY (Lat vallis) In Architecture the internal angle formed by two inclined sides of a roof It is supported by a rafter called the *valley rafter*, or *valley piece*, on which lies a board for the reception of the lead gutter called the *valley board*

VA'LLUM (Lat) The rampart with which Roman armies enclosed their camps and which was crowned with a breastwork of stakes

VALVA'TA (Lat valvæ *folding doors*) A genus of fresh water snails or Gastropods, so called from the valve like form of the operculum or lid which covers the aperture of the depressed spiral shell Of this genus several species are British, as *Valvata obtusa* common in the ditches at Battersea, *Valv spirorbis*, *Valv planorbis* *Valv minuta* &c

VALVE In Mechanics a close lid affixed to a tube, or hollow piston or opening in a vessel, by means of a hinge or other sort of moveable joint, in such a manner that it can be opened only in one direction A spherical ball of metal laid on the end of a tube properly formed and retained in its place by its weight alone, is sometimes [illegible] instead of a valve, as in the *hydrostatic* [illegible] *safety valve* of the steam engine is a valve attached to the boiler to obviate the danger of its bursting in case the steam should become too strong The valve is so loaded that its weight, added to that of the atmosphere exceeds the pressure of the steam, when of a sufficient force When the expansive force increases so far that its pressure preponderates over the pressure of the atmosphere and the weight of the safety valve, the valve opens and the steam escapes from the boiler till its elastic force is sufficiently diminished, and the valve shuts by its own weight By opening the safety valve the engine may be stopped at pleasure, for which purpose a particular apparatus is attached to the valve As any accidental derangement of the safety valve might be attended with the most disastrous consequences it has been proposed to make the valve of a metal which melts at a [illegible] means the elastic force [illegible] which corresponds to the temperature at which the valve would melt [illegible] in France

**VALVES** In Botany, the pieces into which the fruit of a plant naturally separates when it bursts The name is also applied to similar parts in any other organ, as the anther

**VA'MBRACE** (Fr avant-bras) In Plate Armour, the piece which served as a protection to the arm below the elbow

**VA'MPIRE** A blood-sucking spectre, the object of superstitious dread among various nations of Europe The belief in vampires, *i e* in persons returning to the earth after death and burial not as ghosts, but in actual corporeal substance, and sucking the blood of living men appears to have prevailed in classical times The Empusæ, Lamiæ, and Lemures were species of vampires One of the most detailed stories of vampires is the tale of *Machates and Philinnion* which Goethe has made the foundation of his poem of the *Bride of Corinth* in which the dead bride of a young man visits him at night, and withers him by her embrace But in modern Europe, the populations among which vampire superstitions have prevailed appear to be of Sclavonic descent The word vampire is said by Adelung to be of Servian origin, and although the modern Greeks have also their vampires, yet the barbaric names by which they call them (Vroucolachas, Vuroulachas, Vardoulachas) seem rather to indicate the Sclavonic, or perhaps Albanian source, from which they derived both the tradition and the word In Crete they are called Katakhanàs and firmly believed in (See *Pashley's Travels*) About a century ago there prevailed in several districts of Hungary an epidemic dread of vampires, which lasted some years and gave birth to many extraordinary stories It was believed that in several places those among the dead who belonged to the class of vampires arose nightly from their graves and sucked the blood of the living who fell into consumptions and perished, that those who had died in this manner became infected with vampirism, and that the only way of exterminating the plague was by disinterring all the suspected vampires and if it were discovered that they exhibited the tokens of their hideous character, burning them to ashes or driving a stake through their middle The attestations which these grotesquely fearful tales received are among the most singular instances of human credulity recorded in all the annals of superstition They are in many instances related on the authority of the pastors and other most credible persons of villages and towns who depose to having been themselves witnesses of the scenes beheld on opening the vampires' graves Some indeed had actually seen the spectres themselves on their nightly excursions, but more generally the subscriptions are by persons present at the inspection of the dead bodies, when, if the subject was a true vampire, he was generally found of a florid and hale complexion, his hair beard and nails had grown, his mouth hands &c were stained with fresh blood, his eyes open and brilliant Sometimes, when the stake was driven through him, he was heard to utter cries like those of a living person It was believed that the consumption produced by the sucking of the vampire could be cured by eating earth from his grave The popular name of the vampire-bat (*Vesperilio spectrum*), a small animal of South America which sucks the blood of persons asleep, is derived from these imaginary monsters

**VAN** In Naval language the foremost division of the line of battle, which is also the weather division when the fleet is on a wind

**VANADIUM** (Lat Vanadis, *a Scandinavian deity*) A metal discovered in 1830, by Professor Sefstrom of Fahlun in iron prepared from the iron ore of Taberg in Sweden Vanadium has also been found in a lead ore from Wanlockhead in Scotland and in a mineral from Zimapan in Mexico When [illegible] it is a brittle metal, very difficult of reduction, not oxidized by air or water, and insoluble in sulphuric, muriatic, and hydrofluoric acids, but soluble in nitric and nitromuriatic acids, with which it yields solutions of a fine dark blue colour It is not acted upon by boiling caustic potash nor by the carbonated alkalies at a red heat The peroxide of vanadium is of an orange colour and very slightly soluble in water, it unites with the salifiable bases, with the alkalis its salts are soluble, with the other bases sparingly soluble These salts are orange or yellow coloured, in these and other respects there is a close resemblance between vanadium and chromium Peroxide of vanadium, or vanadic acid, is distinguished from chromic acid by the action of deoxidizing substances, which give a blue solution with vanadium, but a green one with chromium When heated with borax in the reducing flame of the blowpipe, both of the acids yield a green glass, but in the oxidising flame the bead becomes *yellow* if vanadium is present, but the green colour is permanent if produced by chromium According to the experiments of Berzelius, the equivalent of vanadium is about 68; and the protoxide, the deutoxide, and the vanadic acid, are composed respectively of 1 atom of vanadium, and 1, 2, and 3 of oxygen



**VANE.** A contrivance for showing the direction of the wind It consists usually of a thin slip of wood or metal, attached to a [illegible] axis, round which it moves freely, and is [illegible] it presents always the same extremity to the point of the horizon from which the wind blows

**VANI'LLUS** (Lat *a lapwing*) A name applied by Bechstein to a subgenus of the Linnæan *Tringæ* including the true lapwings which are distinguished from the *Squatarolæ* of Cuvier by their more distinct though small, hinder toe, and their partially scutellated tarsi

**VANE'SSA** (Or better *Phanessa*, from *φανης* one of the names of Venus or Love in the Greek as well as [illegible]) The term is applied to a genus of [illegible]

**VANG** A rope for steadying the extremity or peak of a gaff &c, the slip sside

**VANGUARD** That part of an army which precedes the main body on the march, as a security against surprise

**VANI'LLA** (Span baynilla, *a small pod*), is the succulent fruit of a plant of the Orchidaceous order, climbing over trees in the tropical parts of America after the manner of ivy Its fragrance is owing to the presence of benzoic acid crystals of which form upon the pod if allowed to be undisturbed It is an aromatic, employed in confectionary and the preparation of liqueurs, and in flavouring some kinds of

**VA'POUR** (Lat vap[illegible]

solids are heated they become converted into elastic fluids or *vapours*, which differ from *gases* in this respect, that they are not under common circumstances permanently elastic, but resume the liquid or solid form when cooled down to ordinary temperatures The term *vapour* is frequently limited to water in the state in which it exists in our atmosphere and in other humid aeriform bodies, that is, in a perfectly invisible state When very moist air is duly cooled, the vapour, previously to assuming the liquid state becomes visible, as seen in mist and fog, it is observed in the same state when steam issues rapidly from the spout of a tea kettle, or when it escapes into the air from the surface of hot water In this case it [illegible] from its action [illegible] in the form of minute vesicles Different substances yield vapours with very different degrees of facility or, in other words, are more or less volatile, a circumstance dependent, probably, upon the less or greater cohesion with which their particles adhere Hence fluids are generally more volatile than solids and hence solids generally pass into the liquid state before they assume the form of vapour To both these statements there are however, many exceptions, [illegible] vaporiz[illegible]

concentrated sulphuric acid is also a very fixed liquid, requiring a high temperature for its vaporization, and camphor and some other solids evaporate at common temperatures and arsenic and sal ammoniac at high temperatures, without previously assuming the liquid state The space which vapours occupy always exceeds that of the substances from which they arise Thus, at the temperature of 212°, and under a pressure of 30 inches of mercury, a cubic foot of water produces 1696 cubic feet of vapour, of alcohol 660, and of ether 443 Hence it is obvious that different vapours differ very considerably in density, and that this property is not directly as that of the liquids which furnish them Thus, if we assume the density of air as 1000, that of aqueous vapour or steam is only 625, the density of aqueous vapour to that of atmospheric air being as 1000 to 1694 Again, assuming the density of air as = 1000, that of alcohol vapour is 1613 and of ether no less than 2586; though alcohol and ether are both, in the liquid state, lighter than water As water boils at a higher temperature than alcohol and alcohol at a higher temperature than ether it was supposed that the density of vapours was probably directly as the volatility of their respective liquids but this law has exceptions, for bisulphuret of carbon yields a heavier [illegible] All, [illegible] heated above [illegible] for every [illegible] of Fahrenheit's thermometer they increase by $\frac{1}{180}$th of the volume which they occupied at 32°

**VAPOUR**, in Physics, denotes the condition of a body, when by the accession of heat its particles acquire a repulsive force, and it is reduced to the state of an elastic fluid Every liquid possesses the property of boiling at a certain determinate temperature, under the mean pressure of the atmosphere Water, for example, boils at the temperature of 212° of Fahrenheit's scale, when the pressure of the atmosphere is equal to a column of mercury 30 inches in height; but under a diminished pressure it boils at a lower temperature; and by increasing the pressure the temperature of the boiling point is increased In the course of ebullition an elastic fluid, or vapour, is generated; and it is only when the [illegible] vapour [illegible] equal to the pressure at the [illegible] of boiling [illegible] ebullition, and the

consequent rapid formation of vapour only take place at a given temperature under a given pressure, vapour will rise from the surfaces of all liquids in free contact with the atmosphere at much lower temperatures Water, for example, exposed in an open vessel, undergoes a gradual diminution of bulk, and is dissipated at temperatures far below the boiling point, and ice itself soon wastes away in the same insensible manner This dissipation has been shown by Dalton to be occasioned by the formation of vapour of the same temperature as that of the water from which it proceeds, and having an elastic force equal to that of the vapour of water boiling at that temperature under a diminished pressure Some liquids, ether for instance, require to be carefully secluded from the atmosphere to prevent their rapid evaporation

*Tension of Vapour at different Temperatures* —Dr Dalton of Manchester was the first who ascertained by accurate experiments the elastic force of vapours at dif- [illegible] he employed consisted in introducing a portion of liquid into the vacuum of a barometer, where it floats on the surface of the mercury, and part of it is immediately converted into vapour The tension of the vapour causes the mercury to descend, and the force of the tension is measured by the space through which the mercury falls, or by the difference of the height of the mercury in the tube in which the experiment is performed and its height in the common barometer Dr Dalton employed two barometric tubes plunged in the same cistern of mercury, into one of these the liquid furnishing the vapour was introduced, the other serving the purpose of comparison, and in order that the experiment might be made at any determinate temperature, the two tubes were surrounded by another wider tube, into which water was poured of the temperature required When the liquid on which the experiment was made was water and the water surrounding the two barometric tubes was at the temperature of ebullition, the vapour formed in the tube caused the mercury to descend to the level of that in the cistern whence it was inferred that at the temperature of ebullition the elastic force of aqueous vapour is precisely equal to the atmospheric pressure A similar result was obtained when the experiment was performed with other liquids

If the tube containing the portion of liquid be of considerable length, and the basin in which it is inverted of considerable depth, the pressure on the vapour above the mercury may be varied by raising or lowering the inverted tube When the pressure is diminished in this way, it is found that so long as any liquid remains new vapour of the same degree of tension will be generated and the altitude of the mercury in the tube remain constant On the other hand, an increase of pressure causes the condensation of a part of the vapour, and the mercury in the tube stands at the same height above that in the cistern If the quantity of liquid in the barometric tube be so small that the whole is converted into vapour it will be found that on raising the tube and increasing the space in which the vapour is contained, the elastic force [illegible] space is increased The law of Mariotte [illegible] vapours as well as to the permanent gases (*see* PNEUMATICS), but with this distinction, that the vapours of all liquids, at a certain determinate temperature, have a maximum of density and tension which cannot be exceeded, and on attaining which they are condensed into the liquid form by any attempt to compress them further It follows, therefore, that at a given temperature no more than a limited quantity of vapour can exist in a given space This forms the criterion which distinguishes vapours from the permanent gases

The results obtained by Dalton, in his experiments on the tension of aqueous vapour, are exhibited in the following table (*Manchester Memoirs*, 1802) —

Table showing the Maximum [illegible] at Temperatures below 212° [illegible] the Column of Mercury they are capable of supporting

| Temperature | Tension in Inches of Mercury | Temperature | Tension in Inches of Mercury | Temperature | Tension in Inches of Mercury |
|---|---|---|---|---|---|
| 2° | 0·068 | 77° | 0 91 | 152° | 7 81 |
| 7 | 0·082 | 82 | 1 07 | 157 | 8 81 |
| 12 | 0 096 | 87 | 1 24 | 162 | 9·91 |
| 17 | 0 116 | 92 | 1 44 | 167 | 11 25 |
| 22 | 0 139 | 97 | 1 68 | 172 | 12 72 |
| 27 | 0 168 | 102 | 1·98 | 177 | 14 22 |
| 32 | 0·200 | 107 | 2 32 | 182 | 15 86 |
| 37 | 0 237 | 112 | 2 68 | 187 | 17 80 |
| 42 | 0 283 | 117 | 3·08 | 192 | 19 86 |
| 47 | 0 339 | 122 | 3 50 | 197 | 22 13 |
| 52 | 0 401 | 127 | 4 00 | 202 | 24 61 |
| 57 | 0 474 | 132 | 4 60 | 207 | 27 20 |
| 62 | 0 560 | 137 | 5 29 | 212 | 30 00 |
| 67 | 0·655 | 142 | 6 05 | | |
| 72 | 0·770 | 147 | 6 87 | | |

From this table the following formula for the elastic force or tension (which is measured by the pressure $p$), in terms of the degrees of temperature $t$, reckoned from 32°, has been deduced, which nearly represents the table, namely,

$$p = 1718\,(1 + 006\,t)^7.$$

In order to determine the tension of vapour at a temperature above the boiling point, it is necessary to have recourse to a different method of experimenting By far the most satisfactory experiments hitherto made on this subject are those of Dulong and Arago, which were undertaken at the instance of the French government, for the purpose of ascertaining the exact temperatures at which aqueous vapour acquires a given tension, with a view to establish such legislative regulations as might appear necessary to prevent accidents from the bursting of steam boilers As an account of these experiments, and a table of the results, have already been given under the term STEAM, (p 1157) it is here only necessary to remark, that the pressures or tensions were ascertained by direct experiment at different temperatures from 212° to 436° of Fahrenheit, between which they were found to vary from 1 to 24 atmospheres, and that the relation between the pressure and temperature (at least for all pressures exceeding four atmospheres) was found to be represented very nearly by the following empirical formula, viz

$$p = (1 + 0\,003974\,t)^5,$$

in which $p$ denotes the tension or elasticity expressed in atmospheres, and $t$ the degrees of temperature of Fahrenheit, counting from 212°

It is evident from this empirical formula, as well as the numbers in the table, that the tension of aqueous vapour increases in a much faster ratio than the temperature This is [illegible] to be general and applicable to the elastic [illegible] vapours of all liquids, at least so far as may be judged from the imperfect experiments which have hitherto been made on the vapours of mercury alcohol, and ether Dalton thought that he had discovered a law which would establish a very simple relation among the tensions of the vapours of different liquids It consists in this, that at an equal number of degrees above or below the point of ebullition corresponding to each liquid the elastic force of their vapours is equal Thus, water boils at 212° alcohol at 175° and ether at 100°, the tension of the vapour at the boiling point being in all cases the same and equal to the pressure of the atmosphere Now, from the experiments of Dulong it appears that the tension of aqueous vapour is doubled when heated under pressure to 251°, that is by an increase of temperature of 39° above the boiling point Hence, by the law of Dalton, the tension of the vapour of alcohol is equal to two atmospheres when its temperature is 175° + 39° = 214°, and that of ether equal to two atmospheres when the temperature is 100° + 39° = 139° Dalton himself afterwards discovered that this law fails when the distances from the point of ebullition are considerable

*Density of Vapour* —The density of vapour may be determined by introducing a known weight of the liquid which yields it into a receiver containing mercury and inverting the receiver in a vessel also containing mercury, and tall enough to contain above the mercury, a sufficient depth of water to cover the receiver The whole apparatus is then heated, and when the whole of the liquid in the inverted receiver has been evaporated, the space the vapour occupies and its temperature are noted We have then a given bulk of vapour, the weight of which is the same as that of the liquid from which it has been produced, and consequently known The temperature is also known, and the pressure given in terms of the column of mercury in the receiver and the height of the surrounding fluid compared with the indication of barometer In this manner the density is found, and when the density of a vapour at a given temperature and under a given pressure has been found, its density under any other pressure, and at its corresponding temperature, may be calculated in the following manner — Let $a$ = the constant coefficient of dilation = ·00208 (it being found by experiment that vapour out of contact with liquid expands or contracts at the same rate as permanently elastic fluids by variations of temperature, that is to say by 1-480th part of its volume for each degree of Fahrenheit's scale), $t$ = the number of degrees of Fahrenheit's thermometer above 32°, $v$ = the volume, $p$ = the pressure, and $d$ = the density of a vapour at the temperature of 32°, and let $v'$, $p'$, and $d'$ be respectively [illegible] at the temperature, [illegible] When the pressure is constant, the density is inversely as its volume, and, by the law of Mariotte, the density of a gas or vapour is directly as the pressure, whence $\frac{d'}{d} = \frac{p'}{p} \times \frac{v}{v'}$, and consequently $\frac{d'}{d} = \frac{p'}{p\,(1 + a\,t)}$, or $d' = \frac{d\,p'}{p\,(1 + a\,t)}$.

If we compare the density of aqueous vapour at any temperature with its density at the boiling point of water, which is 180° above the freezing point, and put $d''$ = the density, and $p''$ = the pressure at the boiling point, the formula becomes $d' = \frac{d'' p' (1 + 180\, a)}{p'' (1 + a\, t)}$ The following table, computed from this formula, with Dalton's values of the pressures, shows the density and volume of aqueous vapour, at its maximum tension, for every [illegible] degree of temperature from the freezing to [illegible] The unit of density is water at the temperature of 32°, and the unit of volume the volume of an equal weight of water also at 32° As the density is inversely proportional to the volume, the numbers in the two last columns are the reciprocals of each other They differ slightly from the numbers given by Gay Lussac

| Temperature. | Density | Volume |
|---|---|---|
| 32° | 0000053 | 188600 |
| 41 | 0000073 | 137000 |
| 50 | 0000097 | 103000 |
| 59 | 0000131 | 76330 |
| 68 | 0000173 | 57800 |
| 77 | 0000227 | 44050 |
| 86 | 0000297 | 33670 |
| 95 | 0000390 | 25640 |
| 104 | 0000199 | 20030 |
| 113 | 0000637 | 15690 |
| 122 | 0000810 | 12350 |
| 131 | 0001028 | 9784 |
| 140 | 0001261 | 7930 |
| 149 | 0001592 | 6281 |
| 158 | 0001964 | 5091 |
| 167 | 0002388 | 4187 |
| 176 | 0002936 | 3406 |
| 185 | 0003557 | 2811 |
| 194 | 0004261 | 2346 |
| 203 | 0005074 | 1971 |
| 212 | 0005896 | 1696 |

By means of this table the weight of water may be calculated that would be contained in the form of vapour of the maxium tension in any given volume — a calculation which is frequently required in meteorological inquiries

The phenomena of vapour have been studied with reference to two objects, the condition of the atmosphere as to moisture, and the properties of steam as a moving power in machinery On the subject of vapour in connection with the first of these objects see *Daniell's Meteorological Essays*, *Davy's Elements of Agricultural Chemistry* also the terms DEW, EVAPORATION HYGROMETRY See also *Greenwich Meteor Obs* For experiments on the elasticity and density of aqueous vapour, see, in addition to the Memoirs of Dalton and of Arago and Dulong, already cited, *Robinson's Mechanical Philosophy*, Ure, in the *Phil Trans* for 1818, Pouillet, *Traite de Physique*, Despretz *Traité de Physique*, *Gehler's Physikalisches Worterbuch*, art "Dampf," by Prof Muncke See also STEAM

VARIABLE QUANTITY, in Analysis is a quantity conceived to be in a state of increase or diminution or or to have different values in the same equation Thus, the abscissa and ordinates of a curve are variable quantities because they have different values for every different point in the curve, and in passing from one point to another their values increase or diminish according to the law of the curve In the equation of the circle $y = \sqrt{(2\,a\,x - x^2)}$, $x$ and $y$ are variables, for $x$ may have any value whatever between 0 and $2\,a$ and there will be a corresponding value of $y$, which satisfies the equation The quantity $a$ is a *constant* quantity, and remains the same, whatever be the values of $x$ and $y$ It represents, in fact, the radius of the circle In mechanics a *variable motion* is that which is produced by the action of a force which varies in intensity, or which continues to act after motion has been communicated

VARIANCE In Law, a difference of statement between two material documents in a cause; as where the plaintiff's declaration differed (formerly) from the writ, or where it differs from a deed on which it is grounded And, in ordinary language, a departure in the oral evidence from the statement in the pleadings is termed a variance This variance may be either immaterial or material, and in the latter case [illegible] or not according to a great variety of distinctions The powers of amendment given to courts and judges are greatly extended by 3 & 4 W 4 c 42 s 23, 24

VARIATION (Lat varius, *changing*) In Music, a difference in performing the same air or melody, either by subdivision of its notes into several others of less duration, or by adding graces, but, nevertheless, in such a manner that the original melody is not lost in the decorations or alterations which it is thus made to undergo

VARIATION OF CURVATURE, in Analytical Geometry, is the change which takes place in the curvature in passing from one point of a curve to another The circle is the only curve in which the curvature is uniform at every point. The curvature of a curve line at any point is the same as that of the osculating circle at that point But the curvature of a circle is inversely as its radius hence the curvature of any curve is inversely proportional to the radius of curvature, and, consequently the differential of the curvature is proportional directly to the differential of the radius, and inversely to the square of the radius of curvature In the conic sections, the variation of curvature at any point is [illegible] point

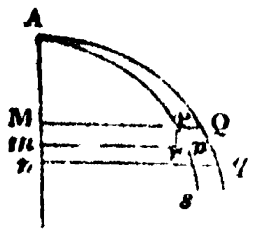
VARIATION OF THE COMPASS The angle which the magnetic needle makes with the plane of the true meridian It is otherwise called *declination* (*See* DECLINATION OF THE MAGNETIC NEEDLE) For tables showing the variation of a great number of places, and [illegible] journal changes, see *Brewster's* [illegible] 1837, reprinted from the *Greenwich Magnet Obs*

VARIATION In Astronomy, an [illegible] the angular [illegible] from that part of the sun's disturbing force which is at right angles to the radius vector, and which accelerates the motion of the moon from the quadratures to the syzygies, and retards it from the syzygies to the quadratures It is proportional to the sine of twice the angular distance between the sun and moon, and its maximum value, or the coefficient of its arguments, is 35′ 41″ 9 Hence it is represented by the formula (35′ 41″ 9) sin 2 A A being the angular distance of the moon from the sun The variation was discovered by Tycho Brahe It had escaped the observation of Hipparchus and the ancient astronomers though of sufficient magnitude to have been sensible to them, probably because they chiefly observed the moon in the syzygies and quadratures, and at these points of the orbit its value is nothing

VARIATIONS, CALCULUS OF An important branch of the modern mathematics, invented by Lagrange the principal object of which is to resolve in a general manner certain classes of questions respecting *maxima* and *minima* the solution of which cannot be obtained by the ordinary processes of the differential calculus In solving problems of maxima and minima by the differential calculus it is necessary to find the determinate values of the different variables which enter into a proposed finite function of those variables, in order that the proposed function may have the greatest or least value possible Many problems of this nature are met with in the writings of the ancient geometers particularly in the Conics of Apollonius and the application of algebra to geometry gave rise about the end of the 17th century, to numerous others, proposed and solved chiefly by Fermat, Slusius, Hudde &c As no general method of solving such questions was known previously to the invention of the differential calculus their solution was accomplished by particular artifices and was frequently attained with very considerable difficulty This difficulty was removed in respect of the class of questions now mentioned by the invention of the calculus but as the instrument of investigation was improved new views were opened, and a more difficult class of questions was proposed, to which the known methods seemed inapplicable It was proposed to find among all curves subjected to a given law, that [illegible] magnitude and position encloses the greatest space, to find the curve along which a heavy body must descend in order to pass from one given point to another given point in the least time possible &c In such questions the relations between the variables is not given, as in the ordinary cases of maxima and minima, the object proposed is to find that relation, or to find the equation which must subsist between the variables in order that the condition of maximum or minimum may be fulfilled

The first problem of this kind which was solved appears to have been that of the solid of least resistance In the first edition of the *Principia*, published in 1687, Newton gave the equation of the curve by the rotation of which about its axis the solid is formed which, when moved through a fluid in the direction of the axis, is less resisted than any other body of the same specific gravity and [illegible] but when the [illegible] by which he had been guided About ten years later the famous question of the *brachystocrone*, or curve of quickest descent was agitated between the two brothers James and John Bernoulli in which Leibnitz and some of the other most illustrious mathematicians of the day took a part The more general problem of *isoperimeters* was solved by James Bernoulli in 1701, and it was in the analysis which he gave on this occasion that the principle on which the solution of similar questions depends was first distinctly unfolded Euler treated the whole subject in his peculiarly luminous manner in a treatise published in 1744, under the title *Methodus Inveniendi Lineas Curvas Maximi Minimive Proprietate* [illegible] And, lastly, the method was reduced to its [illegible]

plicity by Lagrange, who supplied the algorithm and gave it the form under which it is now exhibited as the calculus of variations




In order to give an idea of the nature and objects of this calculus, let us suppose a parabola A P referred to its rectangular co-ordinates A M = $x$, M P = $y$, and of which the parameter is $a$ The equation of this parabola is $y^2 = a x$ Now if $m p$ be drawn infinitely near M P, and P $r$ parallel to the axis, the line M $m$ or P $r$ will represent $d x$, the differential of the axis $x$, and $r p$ will represent $d y$, the differential of the ordinate $y$, also the relation between those differentials is found by differentiating the equation $y^2 = a x$, which gives $2 y\, d y = a\, d x$, whence $d y = \frac{a\, d x}{2 y}$, or $d y = \frac{a\, d x}{2 \sqrt{a x}}$

Let us now suppose the parameter of the parabola also to vary and to become $a + \delta a$ (the Greek letter $\delta$ being used to indicate the variation of a quantity in the same manner as $d$ is used to denote the ordinary differential) On constructing another parabola A Q, the parameter of which is $a + \delta a$ the variations which the co-ordinates undergo in consequence of this variation of the parameter will be represented as follows — Supposing the abscissa A M to be the same in both parabolas, the ordinate M Q of the new parabola A Q will be equal to the ordinate M P augmented by the small quantity P Q, which, therefore, is the variation of $y$, and according to the notation of the calculus denoted by $\delta y$ In order to find the value of this variation, we must substitute $y + \delta y$ for $y$ and $a + \delta a$ for $a$ in the equation $y = a x$ This gives $(y + \delta y)^2 = (a + \delta a) x$, from which subtracting the original equation $y^2 = a x$ and neglecting quantities of the second order, as in the differential calculus, we get $2 y\, \delta y = x\, \delta a$, whence $\delta y = \frac{x\, \delta a}{2 y} = \frac{x\, \delta a}{2 \sqrt{a x}}$

2 Suppose the abscissa also to vary and to become A $n$ We have then M $n = \delta x$, and $s\, q = \delta y$ By substituting $x + \delta x$ for $x$ $y + \delta y$ for $y$ and $a + \delta a$ for $a$ in the original equation, it becomes $(y + \delta y)^2 = (a + \delta a)(x + \delta x)$, whence, by performing the multiplications indicated, subtracting the equation $y = a x$ and neglecting quantities of the second order, we get $2 y\, \delta y = a\, \delta x + x\, \delta a$, and consequently $\delta y = \frac{a\, \delta x + x\, \delta a}{2 y} = \frac{a\, \delta x + x\, \delta a}{2 \sqrt{a x}}$, for the value of the variation of $y$

From this example we may see clearly the distinction between differentials and variations The changes of the co-ordinates relative to the same curve are made by differentials, those which take place in passing from one curve to another of the same kind are made by variations Each of the small quantities $\delta x$ $\delta y$ $\delta a$ is arbitrary, and we may make $\delta x = d x$, but this equality being established we are no longer at liberty to suppose $\delta y = d y$ or $\delta a = d a$ It is also obvious that the variations of [illegible] exactly in the same manner as the differentials of [illegible] quantities, in fact, it is only necessary to substitute the characteristic $\delta$ for $d$ and to follow the rules of the differential calculus This remark extends to variations of all orders, and to circular and exponential quantities

The rules being entirely the same in both methods, it is evident that the variation of $d x$ is $\delta d x$, and reciprocally that the differential of $\delta x$ is $d \delta x$ These two quantities are also identical, for if we suppose $x$ and $x'$ to be two consecutive values of $x$, we have by the principles of the differential calculus, $d x = x' - x$ whence $\delta d x = \delta x' - \delta x$ But in the same manner as $x$ and $x'$ are two consecutive quantities in the series of values of the variable $x$ so $\delta x$ and $\delta x'$ may be regarded as two consecutive values of the variable $\delta x$, whence $d \delta x = \delta x' - \delta x$, and consequently $\delta d x = d \delta x$

Another principle of equal importance is, that the variation of the integral of any differential quantity is equal to the integral of the variation, that is to say in any function P of different variables, as $x$, $y$, $z$, &c and their differentials, we have $\delta \int P = \int \delta P$ To prove this let $\int P = U$ We have then $P = d U$ by taking the differentials, whence $\delta P = \delta d U$, and therefore, by what has been shown, $\delta P = d \delta U$ Integrating this last equation, we get $\int \delta P = \delta U$, whence, by restoring the value of U, $\int \delta P = \delta \int P$

By means of these two principles we are enabled to find the variation of an indefinite integral expression $\int V d x$, which, in fact, is the principal object of the method of variations If this integral is a maximum or minimum its variation must be made equal to nothing, and in this manner an equation is obtained which gives the required relations between the variable co-ordinates

Lagrange, in his *Mecanique Analytique*, has founded a complete system of rational mechanics on the method of variations The object of this important application may be understood from considering that the co-ordinates of [illegible] bodies may be used either to fix the [illegible] situation of two different points at the same instant, or of two consecutive positions of the same point In the former case, the only relation between the co-ordinates is that which results from the form [illegible] in the latter the change of [illegible] by the conditions of the motion, and a new variable is introduced which is the measure of the time The co-ordinates, therefore, vary in two totally distinct modes, which it is necessary to indicate by different symbols One of these modes becomes, in reference to the other, the calculus of variations, which, according to this view of the subject, may be described as a method of [illegible] a particular [illegible] differentiated on the supposition that they vary in a different manner See Lagrange, *Mecanique Analytique*, Id *Leçons du Calcul*, Lacroix, *Traité du Calcul Diff et Intégral*, tome II, Bossut, *Traité du Cal Diff et Integ*, *Woodhouse on Isoperimetrical Problems*, *Airy's Mathematical Tracts*

VARICE'LLA *See* CHICKEN POX

VARICOCE'LE (Lat varix, *a distended vein*, and κηλη, *a tumour*) A swelling of the veins of the spermatic cord

VARI'ETY (Lat varietas) In Zoology this term is applied to individuals of the same species which from the operation of different causes, as age climate, food, locality domestication, &c, present deviations from the specific type in size, colour, form, and relative proportion of parts of the body, but have the capacity of reverting to the original typical form in successive generations, on the cessation of the influences under which the variety originated

VARIOLA *See* SMALL POX

VA'RIOLITE A porphyritic rock consisting of an imperfectly crystallized aggregate of felspar and quartz

VARI'OLOUS (Lat variola *small pox*) In Zoology, when a part is beset with many shallow impressions like marks of the small pox

VARIO'RUM EDITIONS In bibliography, certain editions of the classic authors of antiquity, published chiefly in Holland, in the 17th and 18th centuries, and containing the notes of numerous commentators, are so called These editions are chiefly valued by collectors

VA'RIX (Lat) A dilatation or swelling of a vein

VA'RNISH (Fr vernis) A fluid which when spread thin upon the surface becomes dry and forms a coating impervious to air [illegible] There are two kinds of varnish namely *spirit* and *oil varnishes* rectified alcohol is used for the former, and for the latter fixed and volatile oils or mixtures of the two The solid substances dissolved in the above menstrua and which constitute what is termed the body of the varnish are almost exclusively resinous and are chiefly the following — 1 *Turpentine*, all the varieties of which are employed by the varnisher they form an excellent body, and give strength and glossiness at a small expense, but they do not dry without other additions. 2 *Copal* a peculiar resin, very difficult to dissolve, but forming a hard and durable ingredient It is generally melted over a gentle fire previous to use 3 *Lac*, which gives great toughness and hardness, but is often inadmissible, on account of its reddish brown colour 4 *Mastic*, which yields a tough, hard, brilliant, and colourless varnish 5 *Elemi* a resin of a pale yellow green tint, and a valuable ingredient, on account of its toughness and durability 6 *Sandarach*, a resin which imparts splendour but which alone is not durable. [illegible] on account of its hardness [illegible] difficulty of [illegible] great solution, and hence chiefly used in opaque varnishes 8 *Benzoin*, added on account of its fragrancy 9 *Anime*, which gives brilliancy and some scent 10 *Gamboge*, for yellow varnishes 11 *Dragon's blood*, for red varnish These, together with turmeric, saffron, and annotta, are chiefly used on account of their colour, and to cover brass and copper under the name of *lacquers* 12 *Caoutchouc* This extraordinary vegetable product has of late been much employed in a variety of preparations used as varnishes It is invaluable where materials are to be rendered air tight as balloons for example, and where at the same time flexibility and even elasticity are required, but its principal application in this way is in the manufacture of various *water proof* articles 13 *Asphaltum*, the varieties of which are indispensable in black oil varnishes In making spirit varnishes, the strongest alcohol of commerce should be used (of a specific gravity not exceeding 820), and its solvent power over some of the more intractable resins is sometimes improved by the addition of a little camphor, in order to prevent the agglutination of the resin, it is often requisite to mix it

If we compare the density of aqueous vapour at any temperature with its density at the boiling point of water, which is 180° above the freezing point, and put $d''$ = the density, and $p''$ = the pressure at the boiling point, the formula becomes $d' = \frac{d'' p' (1 + 180\, a)}{p'' (1 + a t)}$ The following table, computed from this formula, with Dalton's values of the pressures, shows the density and volume of aqueous vapour, at its maximum tension, for every ninth degree of temperature from the freezing to the boiling point The unit of density is water at the temperature of 32°, and the unit of volume the volume of an equal weight of water also at 32° As the density is inversely proportional to the volume, the numbers in the two last columns are the reciprocals of each other They differ slightly from the numbers given by Gay Lussac.

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VARIABLE QUANTITY, in Analysis, is a quantity conceived to be in a state of increase or diminution or to have different values in the same equation Thus the abscissa and ordinates of a curve are variable quantities because they have different values for every different point in the curve and in passing from one point to another their values increase or diminish, according to the law of the curve In the equation of the circle $y = \sqrt{(2 a x - x^2)}$ $x$ and $y$ are variables, for $x$ may have any value whatever between 0 and $2a$ and there will be a corresponding value of $y$, which satisfies the equation The quantity $a$ is a *constant* quantity and remains the same whatever be the values of $x$ and $y$ It represents, in fact, the radius of the circle In mechanics a *variable motion* is that which is produced by the action of a force which varies in intensity, or which continues to act after motion has been communicated

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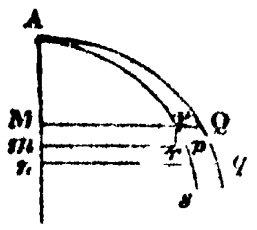
VARIATION OF THE COMPASS The angle which the magnetic needle makes with the plane of the true meridian It is otherwise called *declination* (*See* DECLINATION OF THE MAGNETIC NEEDLE) For tables showing the variation of a great number of places and [illegible] and diurnal changes, see *Brewster's Treatise on Magnetism* 1837, reprinted from the [illegible] *Greenwich Magnet Obs*

VARIATION OF THE MOON In Astronomy, an inequality of the moon's motion, depending on the angular distance of the moon from the sun It arises from that part of the sun's disturbing force which is at right angles to the radius vector, and which accelerates the motion of the moon from the quadratures to the syzygies, and retards it from the syzygies to the quadratures It is proportional to the sine of twice the angular distance between the sun and moon, and its maximum value, or the coefficient of its arguments is 35′ 41″ 9 Hence it is represented by the formula (35′ 41″ 9) sin 2 A A being the angular distance of the moon from the sun The variation was discovered by Tycho Brahé It had escaped the observation of Hipparchus and the ancient astronomers though of sufficient magnitude to have been sensible to them, probably because they chiefly observed the moon in the syzygies and quadratures, and at these points of the orbit its value is nothing

VARIATIONS CALCULUS OF An important branch of the modern mathematics invented by Lagrange the principal object of which is to resolve in a general manner certain classes of questions respecting *maxima* and *minima* the solution of which cannot be obtained by the ordinary processes of the differential calculus In solving problems of maxima and minima by the differential calculus, it is necessary to find the determinate values of the different variables which enter into a proposed finite function of those variables, in order that the proposed function may have the greatest or least value possible Many problems of this nature are met with in the writings of the ancient geometers particularly in the Conics of Apollonius and the application of algebra to geometry gave rise about the middle of the 17th century to numerous others proposed and solved chiefly by Fermat, Slusius, Hudde &c As no general method of solving such questions was known previously to the invention of the differential calculus their solution was accomplished by particular artifices and was frequently attained with very considerable difficulty This difficulty was removed in respect of the class of questions now mentioned by the invention of the calculus, but as the instrument of investigation was improved new views were opened, and a more difficult class of questions was proposed to which the known methods seemed inapplicable It was proposed to find among all curves subjected to a given law, that which [illegible] for example, that curve which [illegible] of equal altitude and position, encloses the greatest space, to find the curve along which a heavy body must descend in order to pass from one given point to another given point in the least time possible &c In such questions the relations between the variables is not given as in the ordinary cases of maxima and minima, the object proposed is to find that relation or to find the equation which must subsist between the variables in order that the condition of maximum or minimum may be fulfilled

The first problem of this kind which was solved appears to have been that of the solid of least resistance In the first edition of the *Principia* published in 1687, Newton gave the equation of the curve by the rotation of which about its axis the solid is formed which, when moved through a fluid in the direction of the axis is less resisted than any other body of the same specific gravity and bulk, but without demonstration or indication of the views by which he had been guided About ten years later the famous question of the *brachystocrone*, or curve of quickest descent was agitated between the two brothers James and John Bernoulli, in which Leibnitz and some of the other most illustrious mathematicians of the day took a part The more general problem of *isoperimeters* was solved by James Bernoulli in 1701, and it was in the analysis which he gave on this occasion that the principle on which the solution of similar questions depends was first distinctly unfolded. Euler treated the whole subject in his peculiarly luminous manner in a treatise published in 1744, under the title *Methodus Inveniendi Lineas Curvas Maximi Minimive Proprietate Gaudentes* And, lastly, the method was reduced to its utmost sim-

plicity by Lagrange, who supplied the algorithm and gave it the form under which it is now exhibited as the calculus of variations




In order to give an idea of the nature and objects of this calculus, let us suppose a parabola A P referred to its rectangular co-ordinates A M = $x$ M P = $y$, and of which the parameter is $a$ The equation of this parabola is $y^2 = a x$ Now if $m p$ be drawn infinitely near M P, and P $r$ parallel to the axis, the line M $m$ or P $r$ will represent $d x$, the differential of the axis $x$, and $r p$ will represent $d y$, the differential of the ordinate $y$, also the relation between those differentials is found by differentiating the equation $y^2 = a x$, which gives $2 y d y = a d x$, whence $d y = \frac{a d x}{2 y}$, or $d y = \frac{a d x}{2 \sqrt{a x}}$

Let us now suppose the parameter of the parabola also to vary and to become $a + \delta a$ (the Greek letter $\delta$ being used to indicate the variation of a quantity in the same manner as $d$ is used to denote the ordinary differential) On constructing another parabola A Q, the parameter of which is $a + \delta a$ the variations which the co-ordinates undergo in consequence of this variation of the parameter will be represented as follows —1 Suppose the abscissa A M to be the same in both parabolas The ordinate M Q of the new parabola A Q will be equal to the ordinate M P augmented by the small quantity P Q, which, therefore is the variation of $y$ and according to the notation of the calculus denoted by $\delta y$ In order to find the value of this variation, we must substitute $y + \delta y$ for $y$ and $a + \delta a$ for $a$ in the equation $y = a x$ This gives $(y + \delta y)^2 = (a + \delta a) x$, from which subtracting the original equation $y^2 = a x$ and neglecting quantities of the second order, as in the differential calculus, we get $2 y \delta y = x \delta a$, whence $\delta y = \frac{x \delta a}{2 y} = \frac{x \delta a}{2 \sqrt{a x}}$

2 Suppose the absciss also to vary and to become A $n$ We have then M $n = \delta x$ and $s q = \delta y$ By substituting $x + \delta x$ for $x$ $y + \delta y$ for $y$, and $a + \delta a$ for $a$, in the original equation, it becomes $(y + \delta y)^2 = (a + \delta a)(x + \delta x)$, whence by performing the multiplications indicated subtracting the equation $y^2 = a x$ and neglecting quantities of the second order, we get $2 y \delta y = a \delta x + x \delta a$, and consequently $\delta y = \frac{a \delta x + x \delta a}{2 y} = \frac{a \delta x + x \delta a}{2 \sqrt{a x}}$, for the value of the variation of $y$

From this example we may see clearly the distinction between differentials and variations The changes of the co-ordinates relative to the same curve are made by differentials, those which take place in passing from one curve to another of the same kind are made by variations Each of the small quantities $\delta x$ $\delta y$ $\delta a$ is arbitrary, and we may make $\delta x = d x$, but this equality being established, we are no longer at liberty to suppose $\delta y = d y$ or $\delta a = d a$ It is also obvious that the variations of algebraic quantities are found exactly in the same manner as the differentials of those quantities, in fact it is only necessary to substitute the characteristic $\delta$ for $d$ and to follow the rules of the differential calculus This remark extends to variations of all orders, and to circular and exponential quantities

The rules being entirely the same in both methods, it is evident that the variation of $d x$ is $\delta d x$, and reciprocally that the differential of $\delta x$ is $d \delta x$ These two quantities are also identical, for if we suppose $x$ and $x'$ to be two consecutive values of $x$, we have by the principles of the differential calculus, $d x = x' - x$, whence $\delta d x = \delta x' - \delta x$ But in the same manner as $x$ and $x'$ are two consecutive quantities in the series of values of the variable $x$, so $\delta x$ and $\delta x'$ may be regarded as two consecutive values of the variable $\delta x$, whence $d \delta x = \delta x' - \delta x$, and consequently $\delta d x = d \delta x$

Another principle of equal importance is, that the variation of the integral of any differential quantity is equal to the integral of the variation that is to say, in any function P of different variables, as $x$ $y$, $z$, &c , and their differentials, we have $\delta \int P = \int \delta P$ To prove this let $\int P = U$ We have then $P = d U$ by taking the differentials, whence $\delta P = \delta d U$, and therefore, by what has been shown, $\delta P = d \delta U$ Integrating this last equation, we get $\int \delta P = \delta U$, whence, by restoring the value of U, $\int \delta P = \delta \int P$

By means of these two principles we are enabled to find the variation of an indefinite integral expression $\int V d x$, which, in fact, is the principal object of the method of variations If this integral is a maximum or minimum, its variation must be made equal to nothing, and in this manner an equation is obtained which gives the required relations between the variable co-ordinates.

Lagrange, in his *Mecanique Analytique* has founded a complete system of rational mechanics on the method of variations The object of this important application may be understood from considering that the co-ordinates of the different points of a moving body may be used either for the purpose of comparing the positions of two different points at the same instant or of two consecutive positions of the same point In the former case, the only relation between the co-ordinates is that which results from the form of the surface of the body, [illegible] of the co-ordinates is determined by [illegible] motion and a new variable is introduced which is the measure of the time The co-ordinates, therefore, vary in two totally distinct modes, which it is necessary to indicate by different symbols One of these modes becomes, in reference to the other, the calculus of variations, which, according to this view of the subject, may be described as a method of [illegible] a particular [illegible] having [illegible] the [illegible] which vary in a different manner See Lagrange *Mecanique Analytique*, Id *Leçons sur le Calcul des Fonctions*, Lacroix *Traité du Calcul Diff et Intégral*, tome iii , Bossut, *Traité du Cal Diff et Integ* , *Woodhouse on Isoperimetrical Problems*, *Airy's Mathematical Tracts*

VARICELLA *See* CHICKEN POX

VARICOCE'LE (Lat varix, *a distended vein*, and κηλη, *a tumour*) A swelling of the veins of the spermatic cord

VARIE'TY (Lat varietas) In Zoology, this term is applied to individuals of the same species, which, from the operation of different causes, as age climate, food, locality domestication, &c , present deviations from the specific type in size colour, form and relative proportion of parts of the body, but have the capacity of reverting to the original typical form in successive generations, on the cessation of the influences under which the variety [illegible]

VARIOLA *See* SMALL POX

VA'RIOLITE A porphyritic rock consisting of an imperfectly crystallized aggregate of felspar and quartz

VARIO'LOUS (Lat variola, *small pox*) In Zoology when a part is beset with many shallow impressions like marks of the small pox

VARIO'RUM EDITIONS In bibliography, certain editions of the classic authors of antiquity, published chiefly in Holland, in the 17th and 18th centuries, and containing the notes of numerous commentators, are so called These editions are chiefly valued by collectors

VA'RIX (Lat ) A dilatation or swelling of a vein

VA'RNISH (Fr vernis) A fluid which when spread thin upon a solid surface becomes dry and forms a coating impervious to air and moisture There are two kinds of varnish namely *spirit* and *oil varnishes* rectified alcohol is used for the former, and for the latter fixed and volatile oils or mixtures of the two The solid substances dissolved in the above menstrua and which constitute what is termed the body of the varnish, are almost exclusively resinous, and are chiefly the following —1 *Turpentine*, all the varieties of which are employed by the varnisher they form an excellent body and give strength and glossiness at a small expense, but they do not dry without other additions. 2 *Copal*, a peculiar resin, very difficult to dissolve but forming a hard and durable ingredient It is generally melted over a gentle fire previous to use 3 *Lac* which gives great toughness and hardness, but is often inadmissible, on account of its reddish brown colour 4 *Mastic*, which yields a tough, hard, brilliant, and colourless varnish 5 *Elemi* a resin of a pale yellow green tint, and a valuable ingredient, on account of its toughness and durability 6 *Sandarach*, a resin which imparts splendour, but which alone is not durable. 7 *Amber* a valuable ingredient, on account of its hardness and durability, but difficult of transparent solution, and hence chiefly used in opaque varnishes 8 *Benzoin*, added on account of its fragrancy 9 *Anime*, which gives brilliancy and some scent 10 *Gamboge*, for yellow varnishes 11 *Dragon's blood*, for red varnish These, together with turmeric, saffron, and annotta, are chiefly used on account of their colour, and to cover brass and copper under the name of *lacquers* 12 *Caoutchouc* This extraordinary vegetable product has of late been much employed in a variety of preparations used as varnishes It is invaluable where materials are to be rendered air-tight as balloons, for example, and where at [illegible] the manufacture of various *water proof* articles 13 *Asphaltum*, the varieties of which are indispensable in black oil varnishes [illegible] of common [illegible] exceeding [illegible] more intractable resins is sometimes improved by the addition of a little camphor, in order to prevent the agglutination of the resin, it is often requisite to mix it

with sand or pounded glass, by which the surface is much increased, and the solvent energy of the spirit facilitated The proportions in which the several ingredients are used, and the selections for particular purposes, are infinitely various The following are a few good varnishes, in illustration of their varieties —1 *Spirit varnish* Sandarach 4 oz , seed lac 2 oz , elemi 1 oz , digest the whole in a quart of moderately warm alcohol, and when dissolved add Venice turpentine 2 ozs 2 *Lac varnish* Seed lac 8 oz , digest for four days in a warm place with a quart of alcohol, and then strain through flannel 3 *Turpentine varnish* Mastic 12 oz , mixed with 5 oz of pounded glass, and digested in a quart of oil of turpentine, adding at intervals about half an ounce of camphor in small pieces When the mastic is dissolved add to the warm fluid an ounce and a half of previously liquefied Venice turpentine, and stir the whole together 4 *Copal varnish* Copal which has been previously melted by a gentle heat 3 oz oil of turpentine 20 oz (measure) put the oil into a flask placed in boiling water, and add the powdered copal in small portions at a time so that it may be gradually dissolved , let it stand a few days to clear, and then pour it off, and if too thick for use add to it a little warm oil of turpentine This varnish dries slowly but is very durable 5 *Linseed varnish* Melt 16 oz of copal in an iron pot with as gentle a fire as possible, and when fused pour in 3 oz of hot linseed oil , stir the mixture, remove it from the fire, and while yet warm gradually add a pint of warm oil of turpentine when the whole is incorporated, strain it through a piece of linen into phials This is a hard and durable but also a coloured varnish 6 *Amber varnish* Melt 16 oz of amber in an iron pot, then add 2 oz of melted lac and 10 oz of hot drying linseed oil , incorporate the whole by stirring , remove it from the fire, and before it cools add a pint of warm oil of turpentine 7 *Black varnish* Melt 16 oz of amber in an iron pot, and add half a pint of hot drying linseed oil, 3 oz of powdered rosin, and 3 oz of powdered asphaltum , stir all together and when removed from the fire and sufficiently cool add a pint of warm oil of turpentine 8 *Lacquer* Digest 3 oz of seed lac 1 oz of turmeric, and 2 drs of dragon's blood for six days in a pint of alcohol frequently shaking the bottle which should be kept in a warm place , strain the lacquer through linen The above are samples of each of the principal varnishes but every maker varies the proportions, and often the nature of the ingredients In the preparation of varnishes in consequence of the highly combustible nature of all the materials, the utmost care is requisite to avoid accidents by fire

VA'RVICITE An ore of manganese found at Hartshill in Warwickshire It appears to be a compound of 2 equivalents of peroxide and 1 of sesquioxide of manganese with 1 of water

VA'SCULAR SYSTEM, in Botany, is that portion of the tissue of plants which is destined for the conveyance of air Vascular plants are those in which the vascular system occurs, or forms a principal feature The air vessels are the *tracheæ* or spirals

VASE (Lat vas ) In Sculpture a vessel usually ornamented with sculpture of fruits flowers bassi rilievi &c

VA'SES, ETRUSCAN In Antiquities These well-known and beautiful objects of ancient art have been discovered [illegible] chiefly in the sepulchres of ancient Italian cities Its material is terra cotta and they are painted with figures and scenes The most beautiful, and indeed the most numerous, were formerly obtained from Campania and Magna Græcia and it was much controverted among antiquarians whether the workmanship was not originally Greek which is maintained by Sir W Gell (*Topography of Rome* vol i ) Of late years, the great sources have been the sepulchres of Etruria Proper Five thousand have been taken in twenty five years from the ruins of Tarquinia alone and it seems to be now generally admitted that the manufacture is rightly called Etruscan, that it is of extreme antiquity , that in its origin it is connected, in some way not easily explicable, with early Egyptian art , that in its progress Greek taste and style were introduced , that the art had fallen into disuse in the flourishing period of the Roman empire, which is evinced by this fact among others, that none have been found in Pompeii or Herculaneum "The most ancient vases are those called of the Egyptian style They are particoloured, of red and black upon a pale yellow ground *Black* vases, with friezes of animals and ornaments in bassi-rilievo, are also of very high antiquity [illegible] a *red* ground come next in order, while those [illegible] modern are *black* with *red* figures such of them, at least, as depart from the old stiff Etruscan style, and have the more natural shapes of Greek art , for example those of Magna Græcia in general, and Nola in particular " (Mrs H Gray *Sepulchres of Etruria* p 40 )

VA'SSAL (Derived according to Sir F Palgrave *on the English Commonwealth* from the Welsh gwas *a young man or page* , gwassaeth, *the state of pagehood*, being rendered in Latin vassaticum ) The holder of a fief, by fealty and service of a feudal superior or lord (*See* FEUDAL SYSTEM ) From the Celtic origin of this word, it has been inferred that some portion of the feudal usages were derived from those of the tribes which possessed Gaul and Britain before their annexation to the Roman empire In the ancient documents of the Carlovingian kings the vassal is termed vassus or homo fidelis the lord generally "senior " The term vassal was also more generally used, in common language, to signify all who were dependent on a superior lord from those who held fiefs of him down to his serfs or villeins (See Guizot, *Civilization en France*, vol iv )

VASTUS A term applied by anatomists to two muscles of the thigh, the *external* and *internal vasti*

VA'TICAN, the ancient palace of the popes, and the most magnificent in the world, stands at Rome on the right bank of the Tiber, and on the hill anciently called by the same name, derived, according to Aulus Gellius, from Vaticinium, or rather from an ancient oracular deity of the Latins, called by the Romans Jupiter Vaticanus, who was worshipped there Some say that Pope Symmachus began the construction of the palace It was inhabited by Charlemagne in 800, and the present irregular edifice has been raised by the gradual additions of a long series of pontiffs Its extent is enormous, the number of rooms, at the lowest computation, amounting to 4422 , and its riches in marbles, bronzes, and frescoes, in ancient statues and gems and in paintings, are unequalled in the world , not to mention its library, the richest in Europe in manuscripts The length of the museum of statues alone is computed to be a mile here are the Sistine Chapel , the Cameræ of Raphael, painted by himself and his pupils , the museum of Pius VI peculiarly rich in objects of ancient Italian workmanship , and other deposits of art and antiquity, each of which by itself would suffice to render a city illustrious

VAUDEVILLE In French Poetry a species of light song frequently of a satirical turn, consisting of several couplets and a refrain or burden, introduced into theatrical pieces The origin of the word is disputed , some derive it from Vau-de-Vire a village in Normandy Short comic pieces interspersed with such songs are also termed Vaudevilles

VAUDOIS (Lat Waldenses ) The inhabitants of some valleys in the Alps between Italy and Provence from whence they derive their name, and who must be distinguished from the Waldenses or followers of Peter Waldo who acquired celebrity in the 12th century, and from whom some writers have deduced both their religious tenets and their appellation also The Vaudois are celebrated for having maintained the purity of their doctrine for many ages before the Reformation , and it has been asserted by some theologians that the true spirit of the primitive Christianity was kept alive among them throughout the whole period of Romish corruption This position however, does not seem susceptible of proof Another claim that they possess to a place in ecclesiastical history is derived from the numerous persecutions to which they have been exposed on account of the witness they have so long borne against the erroneous doctrines of the nations by whom they are surrounded Their extreme antiquity is certain at all events , and the numerous attempts which have been made by Romanist writers to fix on them the stigma of Manicheism seem unsupported by the evidence For the last three centuries they have been viewed with displeasure by the dukes of Savoy and kings of Sardinia their masters and repeatedly visited with military execution or more legal forms of violence One great persecution, in the 17th century is known to us by Milton's noble sonnet Not long after it they were altogether expelled and retreated into Switzerland, whence they returned by a celebrated march, and recovered their valleys by force , an event commemorated in the work of Arnaud, one of their pastors, *La Glorieuse Rentrée des Vaudois dans leurs Vallées* At present they are by no means free from occasional vexations Their number is about 30 000 (See *Faber on the Waldenses and Albigenses* as to their tenets )

VAULT (Fr voute , It volta ) In Architecture, an arched roof, so contrived that the stones, bricks, or other materials whereof it is constructed, sustain and keep each other in their places Vaults are circular and elliptical When their section rises higher than a semicircle, they are said to be *surmounted* , when less, *surbased*

VA'VASSOR A word of uncertain derivation, although probably derived from the same root with vassal (gwâs *a youth or page*, in some Celtic dialects) The vassals who held immediately of the higher nobility, under the feudal system in France, were frequently comprehended under this general name , the châtelains being such vavassors as possessed castles or fortified houses (See Hallam, *Middle Ages*, vol i p 149 ) The word, however seems to have been of very loose application [illegible] are termed vavassors in old French romances In England the title was not usual, although it

is mentioned in Bracton in contradistinction to baron, and sometimes appears to have designated persons who held land by military tenure of others than the king (See *Archæologia*, vol ii )

VE'CTIS (Lat *the lever* ) In Mechanics, the same with *lever* *See* LEVER

VE'CTOR (Lat vehere, *to carry*), or RADIUS VECTOR In Astronomy, a straight line conceived to be drawn from the centre of a planet to the centre of the sun, by which the planet appears to be *carried* round the sun in its orbit In geometry, the radius vector of a conic section is a straight line drawn from one of the foci to any point in the curve

VE'DA The name by which the Hindoos designate the collective body of their scriptures, sometimes called Vedam Bedam &c , according to various provincial pronunciations by European writers The four Vedas (Rig Yajust, Saman, and Atharvan) are believed, according to the orthodox creed, to have been revealed by Brahma But these sublime visions are confined to a few sacred works Upavedas Angas Upangas &c some of which are considered by Mr Colebrooke to constitute according to received opinion a fifth Veda The arrangement is ascribed to one Vyasa, a sage of whom nothing positive can be ascertained The Vedas chiefly consist of prayers, precepts or maxims, and stories, called respectively by different titles Thus a portion of the mythological histories are called Puranas, but these are not to be confounded with the poems of romantic mythology called by the same name (*See* PURANAS ) The genuineness and antiquity of the Vedas have been matter of much dispute among western antiquaries The chief chronological data are that they were compiled before the supposed incarnation of Vishnu, as Rama and Krishna, under which titles he is now [illegible] among the Hindoos, and also [illegible] Buddha Sir William Jones [illegible] gave them a conjectural antiquity of about 3000 years, and Mr Colebrooke (Ib vol viii ) arrives at about the same conclusion

VEDA'NTA A sect among the Hindoos whose theory of philosophy is professedly founded on the revelations contained in the Vedas Its fundamental tenets appear to have a near connection with the opinions of Epicharmus, Plato Pyrrho, and what is termed the Berkeleian philosophy among ourselves, namely, that matter has no existence independent of mental perception, with the ordinary consequences of that doctrine of which those practically most important are the maxims of Quietism See on the philosophy of the Vedas *Ritter's History of Ancient Philosophy* (translation), vol i p 66, &c

VEER In Naval Language to give the ship more scope of cable Also to let any thing drop astern by a rope Also the old term for *to wear*

VEGETABLE EARTH Soil in which decayed vegetable matter is in a much larger proportion than the primitive earths In Horticulture, vegetable earth is called mould, and in Agriculture the term is applied to the surface soil of hollows which contain alluvial soil beneath and vegetable matter, generally of a black colour, on the surface

VEGETA'TION *See* BOTANY

VEGETATION, CHEMISTRY OF From the moment a seed begins to grow a series of chemical changes are induced essential to the development of its germ The process has been chiefly studied in regard to bicotyledonous plants and a general outline of it is given under the word GERMINATION

VE'HMIC COURTS (Germ vehm, or femgerichte ) Criminal courts of justice established in Germany during the middle ages These courts are commonly said to have originated in those held by the Missi Dominici or imperial legates, sent by Charlemagne into the provinces of his empire, but many circumstances denote their descent from the more ancient tribunals of the German tribes held in the open air in the primitive periods of their history (See a curious account of the free field courts of the Germans in Sir F Palgrave's work on the *English Commonwealth*, *Wigand's Femgericht Westphalens* ) But the character under which these institutions became formidable and important, about the beginning of the 13th century, arose from the disordered state of northern Germany after the dissolution of the duchy of Saxony The Vehmic, or, as they were called, free courts, were then modelled on a secret system of organization The president was usually a prince or count of the empire, his assistants (styled Freischoffen) were persons affiliated to the society by secret initiation, to the number, it is said, at one time of 100,000 All these were bound to attend the secret meetings of the courts when summoned and to execute their decrees, if necessary by taking the life of persons accused Westphalia, styled, in the language of the free courts, the Red Land, was the district in which their central authority was seated These courts exercised a great power, which was occasionally serviceable in repressing the lawless violence of the nobles of that period, but which was also liable to be perverted to the gratification of private malice and tyranny Various leagues were formed in the 15th century, by the nobles of the empire, for the purpose of destroying their influence, which was at last effected, chiefly by the introduction of a better system of public judicature and police in the several states See also the publication of the Library of Entertaining Knowledge Society, *Secret Societies of the Middle Ages* The romantic use of this history made by Goethe in his *Goetz von Berlichingen* is well known

VEIL A term used in describing fungi to denote the horizontal membrane connecting the margin of the pileus with the stipes

VEINS (Lat vena ) In Anatomy, elastic tubes which convey the blood from the arteries back to the heart *See* HEART

VEINS, MINERAL Cracks or fissures in rocks filled up with substances differing from the rock itself When these are of a metallic nature, they form the chief repositories [illegible] veins [illegible] most beautiful mineral products Some veins are several yards wide, and they often branch off into smaller ramifications, which are gradually lost in the surrounding rock *See* GEOLOGY

VELI'FERA (Diminutive of velum, *a sail* ) The name of a genus of Acalephes, characterized by a vertical crest or sail, by means of which they are wafted along the surface of the ocean

VE'LITES The light- [illegible] to a Roman legion were so ca [illegible] *des Inscr* vol xxix ) They were equipped with bows, slings and javelins, a light wooden buckler covered with leather, and a head piece

VI'TULUM (Lat velamen or vitulinum ) A fine kind of parchment made of calfskin The skins are limed, shaved, washed, and stretched in proper frames, where they are scraped with the currier's fleshing tool, and ultimately rubbed down to a proper thickness with pumice stone

VELO'CE (It *swift* ) In Music a term which, prefixed to a movement, indicates that it is to be performed in a rapid manner

VELO'CIPEDE (Lat velox, *swift* and pes *foot* ) A vehicle invented at Mannheim in 1817, by M Drais, consisting of a piece of wood about five feet long and half a foot wide resting on two wheels, one behind the other On this an individual sits as on horseback his feet touching the ground, and thus propelling the machine The front wheel may be turned at pleasure, so that the rider may give any direction to the machine This species of vehicle never came into general use, but it was improved by Knight in this country, and a patent received for it

VELO'CITY (Lat velox, *swift*), is measured by the space which a moving body passes through in a given time The velocity of a body is uniform when it passes through equal spaces in equal times, and variable when the spaces passed through in equal times are unequal It is accelerated when the force by which a body is put into a state of motion continues to act after the motion has commenced, and retarded when the moving body encounters obstacles which tend to destroy the motion. Velocity is merely a relative term, for there is nothing, as Biot remarks ( *Traité de Physique* I iii p 148 ), which in itself is either swift or slow, any more than great or small The velocity of a cannon ball appears very great, as it can scarcely be followed by the eye yet it is slow in comparison of the motion of a point on the earth's equator carried round by the diurnal motion, and this, in its turn, is far inferior to the velocity of the earth in its orbit, which again is greatly exceeded by the velocity of light (For the velocity of falling bodies, see ACCELERATION, for the velocity of a body moving in curve about a centre of force, see CENTRAL FORCES *See also* GUNNERY, VIRTUAL VELOCITY, &c

VELVET A rich kind of stuff, extensively used for ladies' dresses and a variety of other purposes Of velvet there are properly only two kinds, that with a plain, and that with a twilled [illegible] is also called a Genoa ground or back When the material is silk, it is called velvet, when cotton, velveteen The latter is a species of *fustian*, which, under a variety of names, is largely used for men's wearing apparel

VENA CAVA *See* HEART

VENEER In Architecture, a thin piece of material of a more valuable kind laid on another of a more common sort, by which the whole substance appears to be of the more valuable sort Veneering is more usually applied to furniture than to strictly architectural purposes

VENETIAN SCHOOL In Painting The distinguishing character of this school is colouring, and a consummate intellectual knowledge of chiaro scuro, in both which all is grace, spirit and faithful adherence to nature so seductive as to lead the spectator away from any consideration of its defects. It is an exquisite bouquet of

[illegible] other wanting the still higher accomplishments, for the head of it was Marco Vecelli, and in its ranks are to be found Tintoretto Paul Veronese, Giorgione, and many other illustrious masters *See* PAINTING

VENIAL SIN (Lat *venia forgiveness*) In Theology is defined, by Roman Catholic theologians, a sin which weakens sanctifying grace but does not take it away It is not necessary although commendable, to mention such sin in confession Reformed theologians altogether reject the formal distinction between venial and mortal sin

VENIRE FACIAS In Law a judicial writ, directed to the sheriff to cause a jury to *come* or appear in the neighbourhood where a cause is brought to issue, to try the same (*See* JURY) A *venire facias de novo* being a writ directing the sheriff to cause a jury to come and try a cause a second time, is granted where there has been a mis trial, on the ground of irregularity, as, for instance, in summoning the jury, on the ground of misconduct by the jury, and also in certain cases where the verdict given is imperfect by reason of some ambiguity and uncertainty The great rule of difference between a venire de novo in the latter case and a new trial is, that the former is only granted on matter appearing on the record

VENI, SANCTE SPIRITUS (Lat *Come, Holy Ghost*) The name given to a mass in the Roman Catholic church to invoke the assistance of the Holy Spirit

VENTAYLE, or AVENTAYLE The visor of a helmet *See* HELMET

VENTER (Lat) In Entomology, signifies the lower part of the abdomen

VENTILATION (Lat ventus *wind*) literally signifies fanning or blowing In Domestic Economy, it is the art of conveying currents of fresh air through close apartments or confined places, so as to maintain the atmosphere in a state of purity

Atmospheric air consists of two ingredients oxygen and azote blended together in the proportion of one part by measure of the former to four of the latter When these proportions are altered air becomes unfit for respiration, and when the oxygen is withdrawn or consumed it is rendered altogether incapable of supporting animal life or combustion But there are operations both of nature and art continually going forward in which the oxygen of the atmosphere is consumed and gaseous products evolved which are destructive of life Thus in the act of respiration a certain portion of the oxygen contained in the air inhaled into the lungs is converted into carbonic acid, a substance which acts as a narcotic poison, and hence in a confined apartment air is soon rendered, by breathing alone not merely incapable of maintaining life but highly destructive of it in consequence of the evolution of a deleterious gas In like manner oxygen is consumed, and carbonic acid evolved in the process of combustion, and the burning of a pan of charcoal in a close room is known to be a certain means of extinguishing life

Although a decomposition and deterioration of air is thus continually going forward nature has by various means provided so effectually for the restoration of the two constituent gases that in whatever part of the world and at whatever height in the atmosphere air is taken it is found when chemically examined to contain azote and oxygen in exactly the same proportions *See* AIR

*Quantity of air required for Ventilation* — If the question were solely how to command a sufficient supply of fresh air it would be easily solved, but as in our climates the temperature of the external atmosphere is in winter generally very much lower than is necessary for comfort we have at the same time to provide for the maintenance of an artificial temperature in our apartments, by allowing the air to enter no faster than it can be warmed One of the first points, therefore to be considered, is the amount of the supply of fresh air which an individual requires for comfort and health This however, is a point on which by reason of the variety of circumstances concerned, it is difficult to arrive at any satisfactory conclusion

Dr Henry estimates that an adult person makes, on the average, 20 inspirations per minute, and draws into his lungs at each inspiration 20 cubic inches of air Peclet allows 40 cubic inches for each inspiration. Taking the mean of the two estimates, we have 600 cubic inches expired per minute But, according to Dr Arnott, air expelled from the lungs is found to vitiate, so as to render [illegible] respiration twelve times as much pure air, [illegible] quantity of unexpired air remained in the lungs [illegible] cubic inches Dr Arnott however supposes the waste to be only half of this quantity But there are several other causes of deterioration besides the production of carbonic acid from the lungs the effluvia and vapour of animal matter exuded from the whole surface of the body is not less injurious than carbonic acid, and, according to M Seguin, in a temperature of 60°, about 3½ cubic feet of air per minute is charged with animal vapour transmitted through the skin of an adult, and rendered unfit for respiration When artificial lights are used, a further allowance must be made for the waste by combustion Besides, air is required for various other purposes than those which have now been mentioned It acts as a cooling power and hence the supply requisite for comfort depends on its temperature It likewise serves to carry off moisture from the skin, and therefore its state as to dryness or humidity must be considered Dr D B Reid found from observations on a number of persons assembled in an experimental room, that not less than 10 cubic feet per minute should be allowed to each individual on the [illegible] able temperature, but that, to maintain [illegible] in all its purity, a much larger supply would at times be desirable On the whole, therefore, we may conclude that 10 cubic feet of fresh air per minute, for each individual, is the smallest allowance that should be made in order to ensure healthful ventilation

*Source of Aerial Movement* —One of the most efficient means of ventilation is afforded by the action of heat At ordinary temperatures air suffers an expansion of about 1-500th part for each degree of Fahrenheit's thermometer by which the temperature is raised, and being rendered specifically lighter in the same proportion the pressure of the surrounding atmosphere predominates, and the heated air is forced upwards This principle is exemplified in the action of the ordinary chimney which may be regarded as a tube open at both ends, and placed in any position except the horizontal The air in the lower end of the tube being heated by the fire rises and passes out at the upper end while its place is supplied by the pressure of the fluid surrounding the lower opening and the circumstances of motion are the same as if another tube filled with air of the original temperature, were adapted to the lower end of the chimney which is filled with heated air so that the current is established in the same manner as in an inverted siphon in which two columns of air of different densities but equal altitudes, press against each other At the lower opening of the chimney the draught or velocity of the current is expressed by this formula,

$$v = \sqrt{[2 g h a (t' - t)]},$$

where $v$ denotes the velocity in feet per second, $g$ the accelerating force of gravity (= 32·2 feet per second) $a$ the rate of expansion for one degree of increased temperature $t$ the temperature of the heated air as it enters the chimney and $t'$ that of the external air It appears from this that the velocity of draught is as the square root of the height of the chimney and the square root of the excess of temperature at the lower opening But as the same quantity of air must be supposed to pass through every different section of the chimney in the same time it follows that the velocity at every part must be inversely as the density and, therefore, decreases from the bottom to the summit

As the draught of a chimney depends on the difference of the temperature of the air at its lower and upper ends it will afford a considerable power of ventilation even when there is no fire if the room be heated by any means (as by an assemblage of persons) above the temperature of the external atmosphere In warm weather this may, however be insufficient, but in this case a large shaft, [illegible] with the apartment at some distance, [illegible], by means of a good fire, an exhausting power to any extent This is the method by which the Houses of Parliament are at present ventilated and the principle has been frequently applied in mines and manufactories The impulsion of air into a chamber by mechanical means is often had recourse to in particular circumstances In the printing office of the Bank of England there is a ventilating apparatus consisting of a square box for a pump body, with a loose piston and furnished with large valved openings, by means of which 1100 cubic feet of air per minute are driven through the apartments For ventilating the holds of ships, cellars &c, the windsail is usually applied though sometimes a fanner is introduced for the same purpose

The subject of ventilating is intimately connected with that of warming apartments, and the great difficulty to be overcome is, to provide for both objects at the same time The open fire place, so generally used for private buildings in this country, affords beyond question, the purest and wholesomest source of heat but it is attended with many serious defects By far the greater part of the heat produced by the combustion passes through the chimney without contributing to warm the apartment, [illegible] a great waste of fuel, while the air admitted into the room to supply the place of that which sustains the combustion is allowed to find its way through the imperfect fittings of the doors and windows, wherever accident leaves an aperture, under no regulation, and accordingly passes through the apartment to the fire-place, in offensive and injurious currents Nor,

after all, is the ventilation by any means complete, for while currents of cold air are passing along a few inches or feet above the floor, they seldom rise above the level of the chimney piece and the air in the upper part of the room may exist in a greatly vitiated state by the products of respiration and the combustion of the lamps or candles The eyes is right, indeed be of late to a considerable extent, and the currents in the room much diminished, by bringing an independent supply of air through tubes [illegible] from the outer air to the fire-place, and providing with valves to regulate the quantity Count Rumford recommended that the air should be conducted from the roof of the building through a pipe or canal [illegible] was, that the air, in its passage through it into the room, should be warmed by the contrary current of air from the fire place, thus economising the heat which in the ordinary arrangement is entirely lost This suggestion has been improved upon in a great variety of ways, and the principle applied to close as well as to open stoves

When apartments are warmed by other means than open fires, as close stoves, the circulation of hot water in tubes, heated air, &c, means should be applied to obtain ventilation entirely independent of the heating, and controlled by valves If stoves are used, the chimney to carry off the products of combustion and the tubes which supply the air necessary to maintain it should have no communication with the chamber in which the stove is placed Stoves of low combustion, like Arnott's stove, or the porcelain stoves used in the north of Europe, are the best Iron, heated to a high temperature, causes an offensive smell, and decomposes the air, besides the air which comes in contact with it, in consequence of the temperature it acquires, rushes rapidly to the highest part of the room and renders regulated ventilation impossible The mild hot-water apparatus when the pipes are suitably disposed affords an agreeable warmth, and has this advantage — that the sources of heat not being confined to a particular part of the room, equable ventilation is rendered more easy In rooms for public assemblies where the air requires to be changed rapidly, greater difficulty is encountered the best method undoubtedly is, to admit the pure air from a chamber in which it is previously heated (or cooled, as the case may require) to the suitable temperature and to carry off the respired and vitiated air by the shaft of a furnace

Of late years the subject of ventilation, as connected with the public health has engaged much attention, and a mass of useful information respecting it will be found in the recent *Parliamentary Reports*, particularly on the ventilating and acoustic arrangements of the present House of Commons on education and manufactures, and the means of improving the health of large towns (See *Tredgold's Principles of Warming and Ventilating Public Buildings &c*, *Arnott on Warming and Ventilation*, *the Monthly Chronicle*, vol i p 220 *Dr Reid's Chemistry of the Atmosphere*, *Encyc Brit* art "Ventilation," Peclet *Traité de la Chaleur*)

VENTILATOR Any machine or contrivance for promoting or regulating ventilation The common ventilator placed in windows which revolves in the same manner as a smoke-jack in consequence of the impulsion of a current of air serves only to retard in some degree the entrance of the current to disperse it in different directions, and to prevent any sudden increase in the intensity of the draught It has no power of acting so as to create a current, or keep up its intensity when it has been established

VE'NTRICLE (Lat venter, *the belly*) A term in Anatomy applied to cavities of the brain and of the heart

VE'NTRICOSE In Zoology a part is so termed when it bellies out as if filled with air

VENTRI'LOQUISM (Lat venter *the belly*, loquor, *I speak*) One whose voice appears to come from his belly Ventriloquists are generally supposed to have the power of making the voice appear to come from distant objects or quarters, but this is a deception, arising out of the manner in which the ventriloquist manages his voice The art appears to consist in filling the lungs with air, and employing during expiration such organs of voice as can be used without the aid of the lips, or at least with as little movement of the lips, mouth, or cheeks, as is compatible with the pronunciation of certain words By practice many individuals have acquired considerable dexterity in this art, and when certain words can be distinctly pronounced in different tones, in the way described, the imagination of the hearers easily leads them to suppose that they come from a person in a box, or up the chimney, or from inanimate objects, especially if adventitious means be resorted to to aid the illusion as [illegible] in such exhibitions

VE'NUE [illegible], Lat vicinetum *neighbourhood*) [illegible] by the original institution of trial by jury, jurors were summoned from the immediate neighbourhood where a fact happened, to try it by their own knowledge Hence, long after the institution had been altered in character, jurors were still summoned in point of form from the parish, village, &c, until by 4 Ann c 16 they became summonable, as they still are, from the body of the county The venue, therefore, was the neighbourhood named in the venire facias, or writ summoning the ju[illegible] the old practice, in criminal [illegible] hed by 5 G 4 c 50 (*See* JURY) The venue, therefore, is the county in which the action is to be tried which is specified in all material allegations in the pleadings, and it need not be the county in which the fact took place except in [illegible] *See* PLEADING

VENUS (Ven'us) is one of the principal planets, the second in the order of distance from the sun, and the most brilliant of all the planetary bodies From her alternate appearance in the morning and evening, Venus was called by the Greeks *Hesperus* and *Phosphorus*, the *evening* and *morning star*, sometimes also she is called the shepherd's star

The distance of Venus from the sun is 7233316, that of the earth being unity, whence her true distance is about 68 millions of miles Her sidereal revolution is performed in 224 7007869 mean solar days, and her synodical period, or the interval between her successive conjunctions with the sun, is 583 920 mean solar days The inclination of the orbit to the ecliptic was 3° 23′ 28 6″ at the commencement of the present century and is subject to a decrease of about 0 0455″ in a year The eccentricity of the orbit is 00686074, half the major axis being unity, and the longitude of the ascending node at the commencement of the present century was 74° 54′ 12 9″, having a motion westward when referred to the fixed stars, amounting to 17 6″ in a year

The mean apparent diameter of Venus, or her apparent diameter when at her mean distance is 16′ 9, but it is subject to great variations, being only 9″ 6 at the time of her superior conjunction, and at the time of the inferior conjunction sometimes so much as 61″ 2 Comparing this with her mean distance, her true diameter is 975, that of the earth being unity, and is consequently about 7700 English miles Her volume is therefore 927 of that of the earth Her mass, as compared with that of the sun, is 0000024638

Venus being an inferior planet, is never seen in opposition to the sun Her greatest elongation, or angular distance from the sun, varies from 45° to 47° 12′ According to her various positions relatively to the sun and earth, she changes her phases like the moon appearing when she first emerges from the sun's rays and becomes visible in the morning as a fine luminous crescent, the horns of which are turned away from the sun As the planet recedes from the sun, the breadth of the crescent increases at the greatest elongation it becomes a semicircle after this the breadth of the disk goes on increasing till the planet arrives at its superior conjunction where it appears as a full orb, the illuminated side being turned towards the earth These appearances, on account of the irradiation, are not appreciable by the naked eye, but they become visible in an ordinary telescope

Venus is supposed to revolve about an axis, and the time of rotation is stated, from observations made by Schroeter to be 23 h 21 m 7 2 sec, the axis of rotation being inclined to the ecliptic in an angle of about 75° There is however considerable doubt as to the accuracy of these conclusions On this subject Sir John Herschel remarks that Venus "although it attains occasionally the considerable apparent diameter of 61″, which is larger than that of any other planet, is yet the most difficult of them all to define with telescopes The intense lustre of its illuminated part dazzles the sight, and exaggerates every imperfection of the telescope, yet we see clearly that its surface is not mottled over with permanent spots like the moon we perceive in it neither mountains nor shadows but a uniform brightness, in which we may, indeed fancy obscurer portions, but can seldom or never rest fully satisfied of the fact It is from some observations of this kind that both Venus and Mercury have been concluded to revolve on their axes in about the same time as the earth The most natural conclusion, from the very [illegible] appearance and want of permanence in the spots, is [illegible], as in the moon the real surface of these planets, but only their atmospheres, much loaded with clouds and which may [illegible] the glare of their sunshine (*Outlines of Astronomy* p 311)

Venus is sometimes seen to pass over the disc of the sun, presenting a phenomenon analogous to that of a solar eclipse by the moon This phenomenon, which is called a *transit of Venus*, can only happen when the planet is at its inferior conjunction, and, at the same time, very near one of its nodes It is therefore a rare occurrence but a very important one, inasmuch as it affords the best means astronomers possess of determining the sun's parallax, and consequently the dimensions of the planetary system (*See* PLANET) Delambre

has given a list of all the transits occurring in a period of 4000 years The following contains all that have happened since 1631, and that will happen before the end of the 21st century :—

| | |
|---|---|
| 1631, Dec. 6 | 1874, Dec 8. |
| 1639, Dec 4 | 1882, Dec 6. |
| 1761, June 5 | 2004, June 7 |
| 1769, June 3 | 2012, June 5 |

(See *Baily's Astronomical Tables and Formulæ* )

The first transit ever seen was that of 1639 which was observed in this country by Horrox and Crabtree The importance of the phenomenon for determining the sun's parallax was first pointed out by James Gregory in his *Optica Promota*, 1663

VE'NUS In Zoology, a name applied by Linnæus to a genus of *Vermes Testacea* including those which have a bivalve shell with the frontal margin flattened with incumbent lips; the hinge with three teeth, all of them approximate, and the lateral ones divergent at the top

The Bivalves thus characterized enter into the Cardiacean family of the Testaceous Acephala of Cuvier, and are subdivided into the genera *Venus* proper, Lam , *Astarte*, Sowerby; *Cytherea*, Lam ; *Capsa*, Brug , *Petricola*, Lam

VENUS The Latin name of the Grecian Aphrodite (Ἀφροδίτη) This goddess is generally supposed to have been of eastern origin and to have been the same as the Phœnician Astarte By [illegible] the daughter of Jupiter and [illegible] accounts, arose from the [illegible] shipped as the goddess of beauty and love, her principal seats being the islands of Cyprus and Cythera The Romans regarded her as the progenitress of their nation, which was fabled to have sprung from Æneas the offspring of her union with the Trojan Anchises She was married to Vulcan, but was not remarkable for fidelity to her husband. Her amour with Adonis is particularly celebrated in ancient poetry (See, as to her worship, *Mém de l'Ac des Inscr* vol xvi , *Bryant's Mythology*, i 392 iii 157 )

VENUS URANIA, or HEAVENLY, was distinguished from Pandemos, or Popular, rather by philosophers than the multitude The most celebrated ancient statues of Venus now existing are the Anadyomene and Medicean, both at Florence

VERA'TRIA An alkaline principle found in the root of the *Veratrum album*, or white hellebore, in the seeds of the *Veratrum sabadilla*, and in the bulb and seed of the [illegible] ow saffron It is acrid and [illegible] in water readily soluble in alcohol, and less so in ether It excites violent sneezing, and is probably the principle upon which the efficacy of colchicum in the cure of gout depends

VERB (Lat verbum, *a word* ) In Grammar, a part of speech which consists of an affirmation and a property or attribute affirmed Verbs are distinguished into transitive, intransitive, and passive Besides these there is the verb substantive, which expresses simple affirmation abstracted from any particular property affirmed *See* GRAMMAR

VERBAL In Grammar, a noun derived from a verb In English verbals are commonly known by the termin- [illegible] are derived from the Latin

VERD ANTIQUE A beautiful mottled green marble [illegible] of marble and serpentine

VERDICT [illegible], the answer of a jury given to the court concerning the matter of fact in any cause committed to their trial A special verdict is a verdict not [illegible] behalf of either plaintiff or defendant [illegible] referring the law arising up [illegible] court *See* JURY

VERDIGRIS [illegible] prepared in the south of France by covering copper plates with the refuse of the grape after the expression of the juice for wine It appears to be a mixture of the sub acetates of copper, and is now largely manufactured in this country by alternating copper plates and pieces of coarse woollen cloth previously soaked in crude pyroligneous acid

VERDITER A blue pigment [illegible] decomposing solution of nitrate of copper by the addition of chalk It is a hydrated [illegible]

VERDURER or VERDEROR An officer [illegible] royal forests, whose peculiar charge was the care [illegible] vert [illegible] in forest language the trees and underwood of the forest, all vegetation sufficient to cover a deer being included in the term, which was divided, in old language, into *over vert* and *nether vert* The verderor is sworn to keep the assizes of the forest, to view, receive and enroll attachments and presentments &c

VERGE OF THE COURT The compass of the king's court, within which is bounded the jurisdiction of the lord steward of the household It is said to be so called from the verge, or rod of office, borne by the marshal *See* STEWARD

VE'RJUICE The expressed juice of unripe or green grapes The term is applied also to a kind of vinegar made of the juice of unripe apples

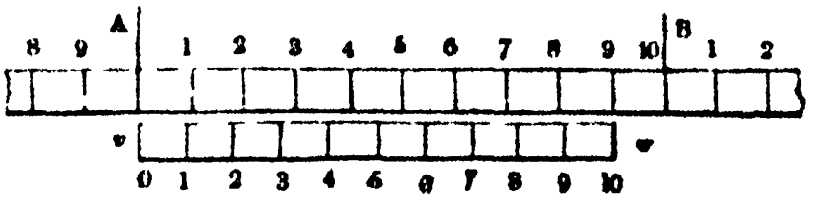
VERMIFUGES (Lat vermis *a worm*, and fugo, *I put to flight* ) Medicines used in effecting the expulsion of intestinal worms these are sometimes merely purgatives, such as calomel, scammony, gamboge, jalap, &c Some substances are supposed to have a specific action on the worm, such as male fern root; others act as mechanical irritants, such as the spicules of cowhage The most effective vermifuge is a large dose of oil of turpentine (*See* ANTHELMINTICS )

VERMILION Red sulphuret of mercury *See* CINNABAR and MERCURY

VE'RMIN Quadrupeds, reptiles, worms, or insects, which are injurious to the cultivator The number of these is great in [illegible] and calls into continual requisition the skill [illegible] of man to subdue them In British agriculture the sheep and poultry are attacked by foxes, weasels, and other quadrupeds, the corn and other seeds and roots by rats and mice, and all plants, as well as seeds, by the weevil, the gnat, the [illegible] cockchafer, the wire- [illegible] In gardening almost all plants are liable to the attacks of insects, seeds to those of rats and mice, and fruits to be eaten by birds In general, the most efficient mode to subdue insects which attack plants is to invigorate their growth as much as possible by culture, because it is found that insects thrive best on plants which are in a state of incipient disease, and the next best mode to this is the encouragement of such natural enemies to vermin as are not themselves more injurious than the creatures they prey upon Thus birds of every kind from the crow to the sparrow, are the natural enemies of insects, the crows seeking out and devouring the larva of the cockchafer, the beetle and the wireworm, found at the roots of grasses, [illegible] slugs, and [illegible] snakes, and the singing birds and sparrow destroying not only the larva of insects, but their eggs, and the insect in a winged state while flying through the atmosphere Hedgehogs and weasels while kept in outhouses and gardens prey upon rats, mice frogs, lizards worms, snails slugs and beetles There are some insects such as the turnip fly, the wheat or Hessian-fly, and the aphides or green fly, which propagate themselves very extensively in consequence of the extensive propagation of the plants on which they feed, and these are the insects which are most injurious to the cultivator, because he cannot multiply their natural enemies in the same proportion as he multiplies the insects by cultivating on a large scale the plants on which they grow The aphides he may destroy by the application of tobacco-water and other means, but he has little or no control over the turnip fly or the wheat-fly Happily for man the seasons are not always alike propitious to these and other enemies to vegetation, and thus chance providence or the nature of things enables him to maintain his struggle against his natural enemies

VERNATION The manner in which the nascent leaves are arranged with a leaf-bud

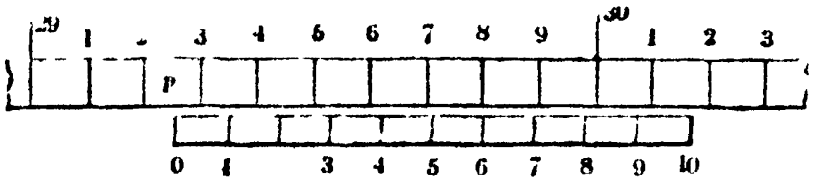
VERNIER A contrivance for measuring intervals between the divisions of graduated scales or circular instruments The name is given from that of the inventor, Peter Vernier, who published an account of the contrivance in a work printed at Brussels in 1631 It consists of a small moveable scale, sliding along the graduated scale or arc, the divisions on the one scale being to those on the other in the proportion of two numbers which differ from each other by unity The theory of the instrument, and the manner in which it is used, may be explained as follows — Let A B = $a$ be a distance




on the scale containing $n$ of its divisions Let $v\,v$ be another scale equal in length to $n-1$ of the divisions on A B, and let $v\,v$ be divided into $n$ equal parts Since the distance A B = $a$, and contains $n$ equal parts, each division on the scale = $\frac{a}{n}$ Hence the length of the vernier $v\,v = a - \frac{a}{n}$; and, as it is divided into $n$ equal parts, each division on the vernier = $\frac{1}{n}\left(a - \frac{a}{n}\right) = \frac{a}{n} - \frac{a}{n^2}$; and therefore the difference between a division on the scale and one on the vernier = $\frac{a}{n^2}$ Suppose the zero of the vernier to coincide with the division marked A

on the scale; then the first division on the vernier will not coincide with the first after A on the scale, but fall behind it by a quantity equal to their difference, or equal to $\frac{a}{n^2}$ In like manner, the next line on the vernier will fall behind the next on the scale by a quantity equal to twice the difference of the divisions, or equal to $\frac{2a}{n^2}$ The third on the vernier will fall behind the third on the scale by $\frac{3a}{n^2}$, and so on to the $n$th division on the vernier, which will fall behind the $n$th on the scale by $\frac{na}{n^2} = \frac{a}{n}$, that is by a whole division; and the vernier coincides with the $n$th on the scale (Conceive the scale to be a scale of inches, and suppose it divided into tenths, then $a = 1$ inch, $n = 10$, $\frac{a}{n} = \frac{1}{10}$th of an inch, and $\frac{a}{n^2}$ (the difference between a division on the scale and on the vernier) $= \frac{1}{100}$th of an inch, so that the $\frac{1}{100}$th of an inch is exhibited on the scale, though its divisions are only to tenths

The vernier is connected with the scale in such a way that it can be moved along it by means of a rack and pinion, or a tangent screw, or some similar contrivance, and its zero be brought to coincide with any point on the scale If, when the vernier is so placed, its zero coincides exactly with a division on the scale, the measure is read off at once, but if (as must generally happen) the zero falls between two of the divisions on the scale, then some one of the lines on the vernier will coincide, or very nearly coincide with one of the divisions on the scale, and the distance of the zero beyond the last division on the scale behind it is expressed in hundredths by the number of the division on the vernier which is coincident with a division on the scale Suppose, for example, the position of the vernier with respect to the scale to be as represented in the annexed figure, where the zero of the vernier is brought




to coincide with a certain point $p$ on the scale The point $p$ is read on the scale 29 inches 2-10ths, and a fraction which is to be measured by the vernier Here the division 5 on the vernier coincides with that which is marked 7 on the scale, therefore the distance of the zero of the vernier from the last division (2) behind it on the scale is 5-100ths of an inch, for as 5 on the vernier coincides with 7 on the scale, the distance of 4 from 6 is 1 100th, of 3 from 5, 2-100ths, of 2 from 4 3-100ths, of 1 from 3, 4-100ths, and of 0 from 2 5-100ths In like manner, if the vernier were placed so that its 10 or 8 coincided with 30 inches on the scale, the reading of the zero point would be 29 inches 2-10ths and 8-100ths If, when the zero is brought to coincide with $p$, none of the divisons on the vernier coincide exactly with a division on the scale —for example if the 5 on the vernier should be a little past the 7 on the scale and the 6 not up to the 8,— the reading would be between 5 100ths and 6 100ths, but its precise amount could only be stated by estimation If the line 5 appeared nearer 7 than 6 to 8, the distance measured would be greater than 5-100ths, or 10-200ths but less than 11-200ths, and if the line 6 appeared nearer to 8 than 5 to 7, the distance would be greater than 11-200ths but less than 12-200ths or 6-100ths Thus in any case the limits of the uncertainty must be confined within a distance = 1-200th of an inch In order that the coincidences may be observed with greater certainty the divisions are cut with a bevel

The vernier is usually applicable to circular scales, such as astronomical circles; it is then circular also, and must move concentric with the limb of the circle Suppose the limb divided into intervals of 10′, and let $n = 10$ We have then 10 divisions on the limb $= 100' = a$, and the length of the vernier $\left(= a - \frac{a}{n}\right) = 100' - 10' = 90'$, which, divided into 10 equal parts, gives 9′ for the length of a division on the vernier, and consequently the difference of the length of a division on the scale and on the vernier = 1′ The arc, therefore, can be read to minutes But the reading may be carried to much more minute quantities by increasing the length and the number of divisions on the vernier Instead of embracing 9 of 10′ on the scale, let the vernier embrace 59 intervals, and be divided into 60 equal parts. We have then $a = 10' \times 60 = 600'$, $n = 60$, $n^2 = 3600$; therefore, $\frac{a}{n^2} = \frac{600'}{3600} = \frac{1'}{6} = 10''$, that is to say, the arc may be read to 10″



In barometers, where a considerable degree of accuracy is required the inch is divided into 20 equal parts, the vernier is made equal in length to 24 of these, and divided into 25 equal parts In this case we have $a = \frac{25}{20} = 1\cdot25$ inch, $n = 25$, therefore $\frac{a}{n^2} = \frac{1\cdot25}{625} = 0\cdot002$, so that the vernier gives the reading to 1-500th of an inch

Instead of making the vernier equal to $n - 1$ divisions of the scale, it is sometimes made equal to $n + 1$ divisions, and the object will still be accomplished in precisely the same manner For in this case the length of a division on the scale being as before, $\frac{a}{n}$, and that of a division on the vernier $\frac{1}{n}\left(a + \frac{a}{n}\right) = \frac{a}{n} + \frac{a}{n^2}$, the difference is still $\frac{a}{n^2}$ The principle is the same in both cases.

The vernier is often called a *nonius*, but improperly, the Nonius or Nunnez being on a different principle *See* NONIUS

VERRUCOSE (Lat verruca, *a wart*) In Zoology, when a surface presents several wart-like prominences

VERSED SINE OF AN ARC, in Trigonometry, is the difference between the radius and the cosine

VERT (Old Fr vert, *green*) In Heraldry, one of the colours or tinctures employed in blazonry It is equivalent to emerald among precious stones, to Venus among planets In engraving it is represented by diagonal lines from the dexter to the sinister sides of the escutcheon

VERTEBRÆ The bones of the spine They are divided into *true* and *false*, the former constituting the upper, and the latter the lower portion of the spinal column The true vertebræ are further divided into those of the neck, back, and loins, or the *cervical*, *dorsal*, and *lumbar* vertebræ There are seven cervical vertebræ, the first of which is called the *atlas*, the second the *axis*, and has the process forming a kind of pivot upon which the head rotates The dorsal vertebræ are twelve in number, and the lumbar vertebræ five In the neck the spine projects forwards, it is then curved backwards in the thorax, and in the loins again projects forwards There is an elastic substance between the vertebræ, admitting of a certain degree of motion, small between the individual bones, but considerable as affects the whole column The vertebræ, and their projections or processes, afford attachments for a number of muscles and ligaments, and the spinal marrow is lodged in the bony canal which their several perforations form

VERTEBRATA, *Vertebrata* (Lat vertebra *a bone of the spine*) The name of a primary division of the animal kingdom, including those which have a cerebro-spinal nervous axis, protected by a bony cylinder composed of a succession of vertebræ, which are expanded into a cranium where they inclose the enlarged anterior or upper portion of the nervous axis, called the brain *See* ZOOLOGY

VERTEX (Lat *the top*), in Astronomy, is the point of the heavens directly overhead more frequently called the zenith In Geometry, of an angle or a cone is the angular point or that in which the sides of the angle or of the cone intersect The vertex of a curve is the point in which the diameter meets the curve

VERTICAL Relating to vertex *Vertical angles*, in Geometry, are the opposite angles formed by two straight lines which intersect each other Euclid demonstrates that vertical or opposite angles are equal

*Vertical Circle*, in Astronomy, a great circle of the sphere passing through the zenith and nadir The meridian, and all azimuth circles, are vertical circles The *prime vertical* is that particular vertical or azimuthal circle which is perpendicular to the meridian, or which passes through the eastern and western points of the horizon

*Vertical Line* in Drawing is a line perpendicular to the horizon, in the Conic Sections it signifies any line on a vertical plane which passes through the vertex of the cone.

*Vertical Plane*, in Conics, denotes a plane passing through the vertex, and parallel to the plane of the section

VERTICE'LLUS, is a ring for organs of any kind placed round a stem upon the same plane It the arrangement is not precisely so, and cannot be described by a line drawn horizontally round a stem but consists of parts either above the line or below it the verticillus is said to be broken It is in English called a *whorl*

VERTI'GO (Lat verto, *I turn*) Giddiness This affection is a common symptom of fulness of the vessels of the head, and of nervous and general debility. In some it is produced by an overloaded stomach, and in others by emptiness of that organ It is frequently symptomatic of fevers, inflammations, and other disorders, and requires peculiar treatment accordingly

VERTIGO In Zoology a genus of marsh or land snails,

so named from the abrupt twist of the volutions of the shell Several species of this genus are British, as *Vertigo secale turtm* &c

VERTUMNUS An Italian deity of rather obscure character Some make him preside over merchandise, others over spring or the seasons in general

VESA'NIÆ (Lat vesanus, *insane*) A class of diseases in which the judgment is impaired without stupor or [illegible] forms of insanity

VESICANTS (Lat vesica, *a bladder*) Substances which [illegible]

VESICLE [illegible] or bladder-like tumour, formed by an elevation of the cuticle, and containing a serous fluid

VESICULO'SANS, *Vesiculosa* The name of a tribe of Tanystome Dipterous insects comprehending those which have the abdomen [illegible] form of a bladder

VESPER, or HESPERUS The evening star A name given to the planet Venus when it is to the east of the sun and consequently appears after sunset

VESPERTILIONIDÆ (Lat vespertilio, *a bat*) The name of a family of Cheiropterous Mammals of which the genus *Vespertilio* is the type It includes the insectivorous and bloodsucking species of the order

VESPI'DÆ (Lat vespa, *a wasp*) A family of aculeated hymenopterous insects characterized by their geniculate antennæ, composed in the males of thirteen joints, and sometimes, in this sex, hooked at the extremity Mandibles strong and dentated elypeus large, ligula [illegible] bifid The sting of the females and neuters long powerful and highly venomous The larvæ of the wasp tribe are vermiform and without feet those of the solitary species are inclosed separately in a cell in which the mother deposits with singular apparent foresight at the same time with the egg the bodies of insects killed for the purpose, and upon which the larva feeds The true wasps form large societies, composed of males females and neuters A colony is commenced by a solitary female, which lays eggs that produce neuters or labourers These proceed to enlarge the nest by detaching particles of old wood or bark mastering and reducing them into a pulpaceous mass resembling that of pasteboard and constructing of this material a conical or subspherical comb, usually suspended by a stalk and having on the under side ranges of vertical hexagonal cells These are appropriated exclusively to the use of the larvæ, a cell to each, which the neuters enlarge in proportion to the growth of the occupant The nest is generally surrounded by an envelope pierced with a common central opening The larvæ are nourished with the juices or pulp of fruit provided for them by the neuters, they are shut up, and spin for themselves a cocoon, when about to become nymphs

**VESTA.** One of the ultra-zodiacal planets which circulate between the orbits of Mars and Jupiter Vesta was discovered by Dr Olbers of Bremen, on the 29th of March, 1807 Its mean distance from the sun is 2 36108, the mean distance of the sun from the earth being unity, and its sidereal revolution is performed in 1325 7147 mean solar days The orbit is inclined to the ecliptic in an angle of 7° 8' 2" and the eccentricity of its orbit is 0 0907 Vesta is supposed to be the smallest of all the celestial bodies with which we are acquainted, its volume being estimated to be only about a fifteenth thousandth part of that of the earth and its surface not to exceed that of the kingdom of Spain On account of its smallness it is however, difficult to determine its apparent diameter with any degree of certainty It is distinguished from the other small planets by the vivacity of its light

VESTA, the Hestia (Ἑστία) of the Greeks in Classical Mythology was a goddess about whom hangs considerable obscurity She is called the daughter of Saturn and Rhea, and was worshipped as the patroness of the domestic and public hearth At Rome she was attended by six virgins, called vestals, whose duty it was to preserve the sacred fire in her temple unextinguished, as the safety of the city was held to be connected with its preservation (See *Mém de l'Ac des Inscr* vol xxvii xxix) According to Ovid (*Fast* vi),

> Vesta eadem est quæ Terra subest vigil ignis utrique
> Stat vi Terra sua vi stando Vesta vocatur

(See Bryant, *Anc Myth* i 77 281) The beautiful building popularly called the Temple of Vesta, at Rome, is not known to have been such

VESTAL VIRGINS This name was given to the six virgin priestesses of the goddess Vesta, who had charge of her temple at Rome, and the superintendence of the sacred fire, which was never to be suffered to go out They had several privileges granted them, but the loss of their virginity was punished by burying the offender alive. Their institution is ascribed to Numa Their abolition was one of the last victories of Christianity (See Beugnot, *Destruction du Paganisme en Occident* i 164)

VESTIBULE (Lat vestibulum) In Architecture, an area before the entrance of the Roman houses, said by some to have been so called because an altar to Vesta was placed therein It was surrounded by a wall, and was the place in which the master of the house received his clients It is used in modern architecture to signify an ante-hall lobby or porch

VESTIBULE OF THE EAR A small bony cavity of the internal ear, the opening of which into the cavity of the tympanum is closed by the small bone called the *stapes* It is also connected with the cochlea and semicircular canals

VE'STMENTS or VESTURES, ECCLESIASTICAL Articles of dress or ornament worn by ministers in the celebration of divine service The following were and are the principal known to the Western church, and many of them to the Eastern also —1 The vestment appropriately called a chasuble called in the Western churches *casula*, *planeta*, *pænula*, *amphibolum* &c and in the Eastern φαινόλιον, *phenolium*, was a garment extending from the neck nearly to the feet closed all the way round, with only one aperture, through which the head passed When the offices were performed, it was lifted up at the sides, while the front and back remained pendent The Greeks retain this primitive form, the Latins have divided it at the sides It admitted of various materials and colours It is of very great antiquity, mentioned by Gregory of Tours and appearing in a mosaic of A D 1540 2 The cope (cappa pallium pluviale, &c) similar in form to the vestment, but longer, and with a short division in the lower part of the front, and a cowl, which in modern times has given place to a sort of triangular ornament of the same shape hanging over the shoulders It is also of the highest antiquity in the Western church 3 The tunicle, or dalmatica (in the East stichárion used by deacons) received the addition of wide sleeves as early as the 4th century 4 The alb (camisia alba linea in the East podéris from reaching the feet) a garment made of white linen 5 The scarf or stole is worn by bishops with the rochet and generally by dignitaries and prebendaries in cathedrals and by chaplains Its origin is obscure It is called oradium by the Greeks The pall (pallium, which see) generally worn by Western metropolitans appears to have been a kind of stole called ὠμοφόριον in the East 6 The rochet a linen garment worn by bishops, much resembling the surplice but in modern times and in our church, with very wide sleeves 7 The chimere zimarra, cimar (probably from χιμαιρα, *kid*) a sort of cape worn under the rochet by bishops in modern England of black silk 8 The pastoral staff (baculus pastoralis) was spoken of in the 4th council of Toledo in the 7th century as used by bishops The form of the shepherd's crook is rather later 9 The surplice (see that article) which only differs from the alb in having wider sleeves 10 The hood was generally fastened to the back of the cape, called an amice, [illegible] linutium when lined with fur or wool The square cap is thought to have been originally part of the amice

Most of these vestments are noticed in the Act of Uniformity passed in the 2d year of Ed VI which regulates the habits of the English church But many of the directions are alternative, *e g* that a vestment or a cope, an alb or a surplice may be used in particular instances (See *Palmer's Origines Liturgicæ* vol ii Appendix, from which this article is chiefly taken, and *Archæologia*, vol xi)

The extreme hostility conceived by the Calvinist and Zuinglian reformers and the Puritan party in England, to vestments and especially the surplice is well known The argument against them, as stated by Beza (*Tract Theol* iii 29) refers chiefly to the danger of wounding weak consciences by retaining apparent relics of popery, &c The defence by Hooker is in book v ch 29

VESTRY (Lat vestiarium) The robing room attached to a church, and from hence applied to designate a meeting of parishioners for parochial purposes, the bishop and priests having in former times used these rooms when they met to consult together on similar affairs

A *general vestry* is one to which every parishioner or outdweller assessed to or paying the church rates, or scot and lot, is admissible of common right The minister whether rector, vicar, or perpetual curate is ex officio chairman of the meeting The powers of the vestry extend to investigate and restrain the expenditure of parish funds, to determine on repairs, enlargements, ornaments, &c of the church; and to elect certain parish officers

*Select vestries* existed by custom in many large and populous parishes, especially in and round the metropolis Originally these consisted of a number of householders annually elected by the rate-payers But by usage of long standing, these bodies were in many instances self-elected, *i e* the members of the vestry filled up by their own choice any vacancy occasioned by death or resignation

Power has been given to parishes in which select vestries did not exist by custom to appoint such vestries

by the stat 59 G 3 c 12 , and in many parishes the election of vestrymen, &c has been regulated by local acts

But in the first and second years of the last reign, an act was passed (1 & 2 W 4 c 60 ) "for the better regulation of vestries, and for the appointment of auditors of accounts, in certain parishes in England and Wales" Every parish not already under a local act is empowered to decide, by a majority of the votes of its rate payers, whether it will adopt the provisions of this statute If adopted, a certain number of vestrymen, limited by the act according to the amount of the population, and five auditors, are to be annually elected by the rate-payers , the rector, district rectors, vicar, perpetual curate, churchwardens being always vestrymen ex officio Vestrymen duly elected under this act must, in in any parish out of London and the metropolitan police district, be rated to the poor on a rental of 10*l* a year within that district or city , if the resident householders amount to more than 3000, on a rental of not less than 40*l* per annum This act does not extend to parishes in which there are not more than 800 rate payers, except in cities or towns

VESUVIAN The volcanic garnet The idocrase of Haüy

VETCH (Lat vicia ) The name given to leguminous plants with herbaceous stems, often supporting themselves on surrounding objects by means of the tendrils with which their leaves are terminated The common vetch or tare is extensively cultivated in Europe and is considered a very valuable agricultural plant, being an excellent fodder for milch cows and working stock, &c

VETERAN (Lat vetus, *old* ) Among the Romans, a soldier who had passed the legal age of military service, which extended from seventeen to forty-six, was termed veteranus , or, in the later times of the republic, one who had served a requisite number of campaigns, generally twenty-five

VETO (Lat *I forbid* ) In Politics the power enjoyed by a branch of the legislature, which cannot of itself originate or modify a law to reject the propositions of the other branch or branches In the Polish diet every noble who was an independent member could prevent any resolution from passing by his simple dissent (expressed in the words ' Nie pozwalam ' *I do not permit*) The privilege of thus arresting the deliberations of the diet was termed the "liberum veto,' and proved the fertile source of the disorders and anarchy of that country In most constitutional monarchies the king has an absolute veto (as in France and England), in some it is only suspensive Thus in Norway, if three successive storthings (assemblies) repeat the same resolution, it becomes law against the will of the king The president of the United States may return a bill, with his reasons for dissenting from it to the house in which it originated but if both houses pass it afterwards by a majority of two thirds in each, it is not in his power again to reject it

VETO An act passed by the General Assembly of the Church of Scotland known by the name of the Veto Act Lay patronage, or the presentation by a lay-patron of a minister to a living in the church has never been cordially recognised on the part of the people of Scotland On the final establishment of Presbytery as the national church, in 1690 patronage was vested in the elders and heritors (landowners) of a parish In 1711 (10 Anne, c 12 s 4 ) that law was annulled and patronage was transferred as a civil right to individuals as an accessory of land or as a separate estate , and those patronages which had of old belonged to the pope or to monasteries, or to archbishops bishops and chapters were vested in the crown The act of Queen Anne was never universally acceptable in Scotland Two dissenting denominations (the United Associate Synod and the Relief) owed their origin to the indiscreet exercise of lay-patronage and though patrons were generally disposed, particularly within the last twenty years, to show due deference to the feelings of the people, yet hostility to this mode of nominating clergymen having gained greater force, the general assembly, in 1834, passed the Veto Act, whereby, if a majority of the male heads of families, in full communion with the church appear before the presbytery and dissent, or lodge dissents at the meeting for moderating in a call," the presentee was to be rejected No specific objections were required to be made by the act the dissentients being only required to declare if asked that they were actuated by no factious or malicious motive but solely by a conscientious regard for the spiritual interests of themselves and the congregation and if such declaration was made, their dissent was sustained, if not, it was rejected Those entitled to dissent are ascertained from a roll annually made up The Veto Act was first passed as an interim act, but, being referred to presbyteries, and having received the sanction of a majority of presbyteries, it was enacted [illegible] of the church by the General Assembly (Cook's *Practice of the Judicatories of the Church*, p 83 )

Against the provisions of this act, the minority of the assembly entered, and had recorded, both in 1834 and 1835, their solemn protest, on the ground that these provisions were not merely wrong in themselves, but also *ultra vires* on the part of the assembly, in violation of the statutes conferring on the church the privileges of an establishment and calculated, therefore, on the first occasion on which a patron or presentee should determine to enforce his rights, to lead to a collision between the ecclesiastical and civil courts Nor was this apprehension without foundation Immediately after the rising of the assembly of 1835, the Earl of Kinnoull, as patron of the church and parish of Auchterarder, and the Rev Robert Young, whom his lordship had presented to that living, and whom the presbytery of Auchterarder had rejected in terms of the Veto Act, raised an action in the court of session to have it found and declared that the said presbytery had acted illegally, and to the hurt and prejudice of the pursuers in having rejected Mr Young, there being no other ground of such rejection as admitted in the record of presbytery than that a majority of the male heads of families communicants, in the parish of Auchterarder, had dissented, without any reason assigned, from his admission as minister In giving judgment in this action, the court of session (8th March, 1838) repelled the objections started against the jurisdiction of the civil court in the matter and to the competency of the action, and found that the presbytery had acted illegally and to the hurt and prejudice of the pursuers, and in violation of their duty and in particular contrary to the provisions of the statute of 10 Anne

This decision of the court of session was appealed from by the defenders to the House of Lords, and this supreme court affirmed the judgment in question (3d May, 1839) without the alteration of a single word Subsequently to this affirmation, when the case had been remitted to the court of session to apply the sentence, the latter tribunal pronounced in regard to it a further judgment, to the effect that the presbytery and the individual members thereof are bound and astricted to make trial of the qualifications of the pursuer the said Rev Robert Young, as presentee to the church and parish of Auchterarder, and if in their judgment, after trial and examination in common form he is found qualified, to receive and admit him minister of the said church and parish, according to law '

The dominant party of the church had, meanwhile, come to the resolution not to obey or recognise the judgment of the court of session though confirmed by the highest judicatory in the empire, to which themselves had made the appeal but to declare the ecclesiastical law as supreme Accordingly, the assembly of 1839 resolved by a majority of forty nine to adhere to the Veto Act notwithstanding the decision of the House of Lords They maintained that the ecclesiastical and civil courts were endowed with co ordinate powers, that their provinces were sufficiently distinct, each being supreme in its own department , and that the church courts were the sole and only judges of what was spiritual and what was civil In short they refused to induct Mr Young as minister of the church and parish of Auchterarder They regarded the parish as still vacant, and nominated a clergyman of their own sentiments to the parochial charge *quoad spiritualia*, leaving the temporalities untouched Thus the case still stands but Mr Young has raised an action of damages against the members of the presbytery of Auchterarder both as a body and as individuals for illegally and contumaciously depriving him of both his ecclesiastical and civil rights and privileges

But the case of the parish of Marnoch in the presbytery of Strathbogie, affords a still more striking illustration of the fruits of the collision that has taken place between the civil and ecclesiastical courts The Rev Mr Edwards having been legally presented to that parish, and having been rejected by means of the Veto act a majority of the members of the said presbytery (seven in number) were disposed, in consequence of the decision in the Auchterarder case and
been declared by the highest civil judi
as *ultra vires* of the church, to show due respect to the civil law, and to proceed with the settlement of Mr Edwards, as if such a statute as the Veto had never existed The majority, however, feeling the delicacy of the circumstances in which, both as clergymen and as loyal subjects bound to obey the civil law they were placed, did not proceed hastily to take steps towards the induction of Mr Edwards They remained inactive till a special decree, on the application of the presentee, had been obtained from the court of session, finding that they were bound to take him on trial, in common form, and that, if they found him qualified, to receive and admit him according to law On their adopting the preliminary steps for the purpose, the commission of the General Assembly, 1839, suspended the seven ministers from the function of their sacred office, both judicial and ministerial Against this proceeding the seven ministers applied to the court of session for protection, which

court granted an interdict prohibiting the sentence of suspension from being carried into execution and prohibiting any clergyman of the established church from occupying the pulpits of the deposed ministers, or performing any sacerdotal functions in their respective parishes This interdict was disregarded by the dominant party in the church, who treated the seven parishes as if their ministers had been finally suspended from their functions

Matters remained in this anomalous state till the meeting of the General Assembly of 1840, which court besides continuing the suspension, imperatively demanded of the suspended ministers that they should unconditionally acknowledge the supreme authority of the church in all things which it might define to be spiritual and in all such matters yield implicit obedience to the decrees of the ecclesiastical courts, notwithstanding any order or injunction to the contrary, of even the highest civil tribunal of the land This requisition, too, was made under the penalty that, if after a limited period had elapsed, it should not have been complied with, the parties refusing to comply should be served with a libel or indictment for contumacy The ministers of Strathbogie refused to submit to the conditions sought to be imposed on them though in regard to the settlement of Marnoch they did not take any farther steps till the presentee had raised another action against them, both collectively and individually calling on them to receive and admit him as minister of that parish Mr Edwards was thus ordained minister of Marnoch on the 21st of January, 1841 Meanwhile the suspended ministers had been served with a libel for contumacy, and were in consequence deposed by the ensuing assembly (May, 1841) from the office of the ministry An interdict from the court of session was forthwith obtained setting aside the ecclesiastical sentence of deposition, and reinstating the seven deposed ministers in their temporal and spiritual privileges as parochial clergymen This interdict was, like the former and others to which in this article we cannot particularly allude *, disregarded by the dominant section of the church Not only have they treated the parishes as vacant and introduced preachers of their own party into them but have taken steps against such of the minority of the church as regard the deposed gentleman as still ministers of the establishment and as such have in consequence [illegible] officiating in their pulpits or assisting them [illegible] occasions And such has been the forbearing conduct of the deposed ministers, that they have hitherto restrained from adopting means to have their brethren punished for violating these interdicts and for encroaching on their official rights and privileges

The same assembly which deposed the seven ministers of Strathbogie, deprived Mr Edwards whom they would not recognise as an ordinary clergyman of his licence as a probationer, and ordered the minority of the said presbytery (four in number) to proceed with the settlement of another minister in the parish of Marnoch as if it had been vacant This was accordingly done

A similar case afterwards occurred in the presbytery of Garioch, and under exactly similar circumstances The presentee (Mr Middleton) to the parish of Culsalmond having been served with a veto, was notwithstanding inducted by the majority of the presbytery and is now minister of that parish The ecclesiastical courts promptly interfered, interdicts however, against their authority were obtained and the case having been appealed to the House of Lords, a decision was given in favour of the presentee thus declaring that the General Assembly had no power to pass the VETO ACT, and that all proceedings under it were null and void This decision was not, however, submitted to by the majority of the Assembly by whom it was regarded as a usurpation upon their rights, and no legislative measure having been proposed calculated to allay the public irritation, or to mitigate the extreme exercise of the right of patronage, the leaders of the dominant party in the Assembly determined to secede from the Church accordingly on the first day (18 May) of the meeting of the General Assembly of 1843 the ministers and elders, members of that body, opposed to the right of patronage and in favour of the *veto*, gave in a Protest stating, among other things, that "The courts of the Church as now established, and members thereof, are liable to be coerced by the civil courts in the exercise of their spiritual functions, and in particular in their admission to the office of the holy ministry and the constitution of the pastoral relation, and that they are subject to be compelled to intrude ministers on reclaiming congregations in opposition to the fundamental principles of the church and their views of the Word of God, and to the liberties of Christ's people " And this protest having been read, the protesters withdrew to a separate place of meeting, and constituted themselves, and such as might afterwards adhere to them, into a body to be denominated the FREE CHURCH OF SCOTLAND The Protest was signed by 125 ministers and 77 elders. But within a few weeks no fewer than 470 clergymen seceded from the establishment, and joined the Free Church Of these, 273 were parish clergymen being nearly a third part of the total number of those belonging to the establishment The rest were *quoad sacra* ministers And whatever may be thought of its wisdom this proceeding sets in a striking light the sincerity and zeal by which the seceders were animated The voluntary abandonment by so many individuals of their homes and incomes, rather than hold them by compromising what they believed to be a fundamental principle, reflects the highest credit on the Scottish church and character For an account of the most recent events in reference to the consequences of the Veto, see FREE CHURCH, in SUPPLEMENT

* A presentee to the parish of Lethendy, presbytery of Dunkeld, having been rejected by the Veto Act, the majority of the members of that presbytery inducted another minister in defiance of an interdict of the court of sessions, for which contempt they were summoned before their lordships, the censure of the court was pronounced against them; and they were found liable in expenses.

VEXILLA'RII Veteran troops in the Roman army who had served out their time, but, under the emperors, were retained in service, and fought distinct from the legions under a particular standard of their own (vexillum)

VEXIL'LUM, or STANDARD (Lat ) In Botany, a term given to the upper petal of a Papilionaceous corolla, which is erect, and more expanded than the other four petals

VIADUCT See RAILROADS, BRIDGE

VIA'LACTEA In Astronomy, the *galaxy* or *milky way* See MILKY-WAY

VIA'LES In Roman Antiquities, a name given to those gods who had charge of the roads and highways (viæ) Jupiter and Mercury were among the number

VIA'TICUM (Lat *a supply of something requisite for a journey* ) In Ecclesiastical usage the sacrament given to a dying person In ancient times both the sacraments appear frequently to have been given to the dying, namely baptism to catechumeni (hence termed *ἐφόδιον*, or *viaticum* by some Greek fathers) or unbaptized converts the eucharist to those who were in communion with the church

VIA'TOR (Lat *traveller* ) The title of inferior officers among the Romans sent by the senate or people to convey decrees, mandates, &c, and also by governors of provinces and other high functionaries

VIBRA'TION (Lat vibrare *to shake* ) In Music, that regular reciprocal motion of a body, which, suspended or stretched between two fixed points swings or shakes to and fro The vibrations of chords are the source of the different tones they emit If two strings or chords of a musical instrument merely differ in length, their tones, that is, the number of vibrations they make in equal times, are in the inverse ratio of their lengths If they differ in their diameters only their sounds will be in the inverse ratio of their diameters To measure the tension of strings, let us conceive them stretched by weights attached to their ends, then their sounds will be in the direct ratio of the square roots of the weights stretching them, that is the pitch of a string stretched by a weight equal to 4 will be an octave above the pitch of a string stretched by a weight 1

VIBRATION In Mechanics, the reciprocating motion of a body as of a pendulum, a musical chord, or elastic plate The term *oscillation* is, however, more frequently used to denote a slow reciprocating motion, as that of the pendulum, which is produced by the action of gravity on the whole mass of the body, while *vibration* is generally confined to a motion with quick reciprocations as that of a sonorous body, and which proceeds from the reciprocal action of the molecules of the body on each other when their state of equilibrium has been disturbed

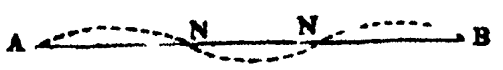
*Vibrations of Musical Chords* —The laws of the motion of vibrating chords were first investigated by Dr Brook Taylor, in his *Methodus Incrementorum*, published in 1715, and afterwards by John Bernoulli, Daniel Bernoulli, D Alembert, and Euler, but the complete solution of the problem, which is one of great difficulty, requiring the integration of an equation of partial differences of the second order, was reserved for the illustrious Lagrange Let a homogeneous metallic wire, or musical chord, stretched between two fixed points by a given force, be made to vibrate then as has been shown in the article SOUND, (p 1134 ) the number of vibrations in a second (the vibration being understood to signify the excursion of any point from its greatest distance from the position of rest on one side to its greatest distance on the other, and not the going and coming) is expressed by either of the two formulæ

$$n = \sqrt{\left(\frac{g t}{l w}\right)}, \text{ or } n = \frac{1}{r l}\sqrt{\left(\frac{t}{\pi \delta}\right)},$$

where $n$ is the number of vibrations in a second, $g$ = the accelerating force of gravity (= 386 29 inches in a second); $t$ = the tension of the chord or weight by which it is stretched $w$ = its weight $l$ = its length in inches, $r$ = its radius, $\delta$ = its specific density, and $\pi$ = 3 14159.

The consequences which follow from these formulæ are important in the theo[illegible] much as they furnish the means of [illegible] sounds numerically

A curious circumstance, indicated by the calculus, and confirmed by experiment is, that a vibrating chord may spontaneously divide itself into any number of parts each of which, being an aliquot part of the whole will vibrate separately, in the same manner as if it were fixed at its two extremities and formed a separate chord, and which, consequently performs its vibrations as much more rapidly as it is a smaller aliquot part Thus the chord




A B may divide itself into 2, 3, 4, or any number of equal parts in the points N N' &c , each of which will vibrate 2, 3, 4, &c times more rapidly than the whole chord and in such a manner that the motion of any two contiguous parts will be in opposite directions at the same instant of time, while the points of division N, N' remain fixed But the most remarkable circumstance is, that these different states of vibration may coexist, superposed as it were one on another, so that a musical chord will emit not only the fundamental sound corresponding to the number of vibrations given by the formula, but also, at the same time, a series of other sounds corresponding to the number of vibrations of chords of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c of the length

The preceding remarks apply only to transversal vibrations, or those in which the motion of any material point of the chord is at right angles to the straight line which joins its extremities, but the molecules of a stretched chord may also be put into a state of longitudinal vibration, in which case the motion is parallel to the axis of the chord, and is subject to a different law Poisson (*Mem de l'Acad de l Institut* tom viii ) found, from the mathematical analysis of the problem, the following simple relation to exist between the transversal and longitudinal vibrations of the same chord —Let $n$ be the number of transversal vibrations, $n'$ the number of [illegible] (in the preceding [illegible] direction), $l$ = the length of the chord, and $k$ = its elongation, or the increase of its length under the weight by which it is stretched, then

$$n \sqrt{l} = n' \sqrt{k}$$

This equation is verified by experiment, and as $k$ is always a very small fraction of the length $l$, it follows that the number of longitudinal vibrations $n'$ is always very much greater than the number of transversal vibrations $n$, which explains the extreme acuteness of the sounds which are produced by the longitudinal vibrations The quantity $k$ depends upon the elasticity of the chord and is therefore different in respect of chords of different substances

*Vibrations of Elastic Rods* —The laws of the vibrations of elastic rods are different from those of the vibrations of chords, for in the case of the latter the tension acts only in the direction of the length of the chord whereas in the case of elastic rods and plates, and rigid elastic [illegible] specific gravity of the rod, is expressed, as in the case of a vibrating chord, by a very simple formula Let

$n$ = the number of vibrations in a second,
$l$ = the length of a vibratory rod or plate,
$h$ = its thickness,
$e$ = the elasticity of the matter of the rod,
$d$ = its specific density,

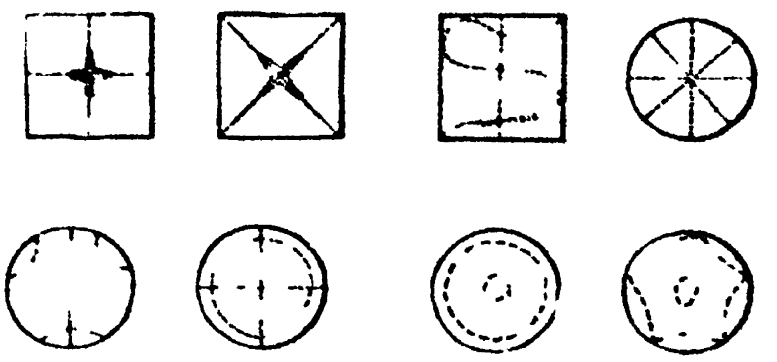
then the following equation is deduced from the principles of dynamics,

$$n = \frac{a^2 h}{l^2} \sqrt{\left(\frac{g\,e}{d}\right)},$$

in which $a$ denotes a constant number depending on the mode and initial circumstances of vibration (*i e* the mode in which the rod is supported whether fixed at one end or at both ends, or in the middle, &c ) This formula will apply, in general, to any elastic rods or plates of the same form, and of which the mode of vibration is similar It shows that in rods of the same matter the number of vibrations is directly as the thickness, and inversely as the square of the length of the vibrating part If the lengths of two rods are equal, the number of vibrations is proportional to the thickness, a result which might be anticipated [illegible] since the thicker the rod the greater will be the force or spring with which it tends to redress itself when drawn aside from the position of rest, and therefore the quicker the vibration When the figures of the rods are similar, the numbers $h$ and $l$ are proportional, and consequently the number of vibrations is inversely as the homologous dimensions, or as the cube root of the weight [illegible] which was first given by Riccati in [illegible] *Italian Society*, has also been verified by experiment [illegible] like [illegible] solves spontaneously into several parts, which vibrate in unison, and are separated by *nodes*, or parts which remain at rest The extreme parts are shorter than the others, which are all of equal length but [illegible] of all the parts are synchronous This sonorous [illegible] may be induced in a slip or tube of glass by holding between the fingers in the middle, and rubbing it longitudinally with a piece of moist cloth when it will emit a very acute sound Poisson found from theory the ratio of the number of transversal vibrations ($n$) to the number of longitudinal vibrations ($n'$) of a cylindrical rod to be as follows $\frac{n}{n'} = 3\,5608\,\frac{r}{l}$, $r$ being the radius, and $l$ the length of the rod. This formula has been verified by Savart from direct experiments (*Annales de Physique et de Chimie*, tome xxxvi )

*Vibrations of Elastic Plates* —All elastic solid bodies, when put into a state of vibration, may be conceived, in reference to the internal motions of their molecules, as spontaneously separating themselves into parts, each of which vibrates independently of the others, and in such a manner that the molecules of one part are at every instant moving in a direction opposite to that of the molecules of the adjacent part. It follows that the points of separation between two parts participate neither in the motion of the one nor of the other, and consequently remain at rest In the case of thin elastic plates, the continuity of these points forms lines of repose, or *nodal lines* the forms and positions of which are detected by placing the vibrating plate in a horizontal position, and strewing a small quantity of fine sand over its upper surface This ingenious mode of determining the nodal lines was pointed out by Galileo in his *Dialogues*, and was practised by Chladni (*Traité d'Acoustique*), and more recently by Savart in his numerous experiments on this subject

These lines assume a great variety of forms, depending on the figure of the plate the position of the point or points at which it is fixed, and the rapidity and direction of the motion by which the vibration is communicated to it Circular plates afford numerous different systems of nodal lines When the plate is fixed at its centre between two knobs or points held fast by a vice, two nodal lines are in general produced crossing each other at the centre By applying the finger to the plate at a suitable point, so as to interrupt the vibration three of those lines may be formed Disks of metal furnish a number of nodal lines dividing the circle into numerous sectors In certain circumstances these straight nodal lines are intersected by a greater or smaller number of concentric circular lines, the circular lines may also exist by themselves, and sometimes the nodal lines assume the form of the branches of a hyperbola Some of these forms are represented as under



The investigation of the laws of vibration of a homogeneous solid body of a given form when the circumstances in which it is placed and the forces by which it is thrown into vibration are perfectly defined is a problem of pure analysis, but though the differential equations of motion to which it leads have been integrated in a number of particular cases, their integration in general presents difficulties which, in the present state of the calculus, cannot be entirely overcome (See Poisson, *Traité de Méc* [illegible] Herschel, *Encyc Metrop*, art Sound Mémoires *Savants étrangers de l'Analyse*, p 415 , Riccati, *Mem di Mat e di Fis della Soc Ital* t I , Lagrange, *Melanges de la Soc de Turin*, t i ii and iii For the experimental researches, see Chladni, *Théorie d'Acoustique* Savart *Annales de Phys et de Chimie*, Biot *Traité d Physique* &c )

VIBRIONIDÆ The name of a tribe of Animalcules, commonly known as microscopic eels of which the genus *Vibrio* is the type One of the species of this genus of Animalcules is parasitic upon wheat they form a cottony mass in the interior of the grain, which, when the latter is ground, will not pass through the cloth, but remain behind in the bran When full grown, the *Vibrio tritici*, as this species is termed, attains a quarter of an inch in

length; but the young are of such microscopic minuteness that Mr Bauer the naturalist, by whom it was parasite has been successfully investigated, has calculated that [illegible] of wheat [illegible] armed ear- [illegible] as the most obvious remedy for these creatures

VIBRI'SSA (Lat vibrissa, *a whisker*), in Mammalogy, are the stiff long pointed bristles which grow from the upper lip and other parts of the head In Ornithology, the term is also applied to hairs which stand forward, like feelers, or which in some birds, as the fly-catcher, point [illegible] wards from both the upper an [illegible] or which spread out on each [illegible] pper sides of the [illegible] he goatsucker, when they are termed [illegible]

VICA'R [illegible] vicarius) An ecclesiastical personage who has the care of a parish in the place of (vice) a lay or collegiate rector See TITHES

VICARS OF THE EMPIRE In the German constitution, princes who had the right of representing the emperor in case of absence or interregnum The king of the Romans, whenever there was one, was perpetual vicar If there were none, the office was divided into two the elector of Saxony exercised the vicariate in the two Saxon circles, the electors palatine, and of Bavaria, alternately in the remainder of the empire They administered revenues, presented to benefices, received [illegible]

[illegible] An officer of the king's household immediately under the lord chamberlain

VICEGE'RENT (Lat vicem gerens, *holding the place of any one*) Any officer acting as deputy or lieutenant of another In France the bishops appointed formerly vicegerents to the official in every ecclesiastical officiality

VI'CEROY, or VICE-KING A title often applied in common usage to any officer representing the supreme authority in a dependency, *e g* the lord lieutenant of Ireland But it has seldom been officially given, except to the governors of certain dependencies of the old Spanish monarchy, such as Naples Peru, and Mexico each of whom bore the pompous title of 'Alter Ego" of the sovereign

VICTIM (Lat victima, of uncertain etymology, said to be from vinco, *I bind*) The creature immolated at a sacrifice was so called among the Romans (See SACRIFICE) The well-known ceremonies of leading the victim, unbound to the [illegible] ing [illegible] sc on its forehead, the ceremonies of kil [illegible] it — are all amply described in the writers In general object of sacrifice, in all ancient religions was expiation but to this must be added another peculiar to the Romans,—that of deducing from the appearance of the entrails of the victim Victims of different kinds had many designations *bidentes*, according to some, all kinds of sheep, according to others lambs only *eximiæ*, animals chosen beforehand out of a flock or herd for their beauty or other fitness to serve for sacrifice *prodigiæ*, according to Festus, those which were entirely consumed, instead of leaving, as in the ordinary case various parts which were consumed or sold by the priests *succidaneæ* those immolated in a sacred sacrifice to repair some error committed in a former one *probatæ*, after they had been examined by the priest to ascertain their fitness Various auguries were deduced from the demeanour of the victim its resistance its unusual cries, above all its flight, were unlucky Artificial victims, made of flour, spices &c, were sometimes sacrificed Pythagoras seems to have introduced the [illegible] ion [illegible] his disciples

VICTORY In Classical Mythology, a goddess, called by Varro the daughter of Heaven and Earth Her altar was preserved in the curia or senate house of Rome, and its destruction was the subject of one of the latest contests between Christians and Pagans (See Beugnot, *Destr du Paganisme en Occident*, i 410 430, *Mém de l'Ac des Inscr* vol xviii 21)

VIDA'ME In French Feudal Jurisprudence, originally an officer who represented the bishop, as the viscount did the count (vice-dominus) In process of time these dignitaries erected their offices into fiefs, and became feudal nobles, such as the vidame of Chartres, Rheims &c, continuing to take their titles from the seat of the bishop whom they represented, although the lands held by virtue of their fiefs might be situated elsewhere

VIDELICET (More properly *scilicet*) In Law In pleading it is usual to state any allegation which forms part of the facts set out, but which it is not intended to prove with precision, with the word "scilicet" (in English, "to wit") preceding it Thus, numbers and dates, for instance, are frequently laid under a videlicet as where any thing is alleged to have taken place heretofore, "to wit," on [illegible] r where, in trespass, the plaintiff charges [illegible] with carrying away or injuring divers, "to wit," [illegible] general rule on this subject is [illegible]

is in itself immaterial so that the issue or [illegible] established [illegible] the pleading a fact [illegible] not dispense with the proof but where a fact is itself immaterial there [illegible] or I but not always) the omission of a videlicet [illegible] render it material, and make it necessary for the party so alleging it to prove it as stated But the [illegible] on this subject run, as may be supposed, into extreme minuteness

VI'GIL (Lat vigilium, *watch*) An ecclesiastical usage, the evening before a feast day, is so termed The observation of vigils is said by some to be nearly the oldest of Christian ceremonies According to Lactantius, Jerome, and other ancient authorities, the second advent of our Saviour was expected to take place on the vigil of Easter They were originally celebrated by meeting together at night (as they are still on some occasions in the Eastern [illegible] and are said thus to preserve the memory [illegible] of primeval assemblies of Christians in times of persecution

VIGNI'TTE (Fr) A small ornamental engraving used in printing for the illustration or decoration of a page of any work

VIGOROSO (It *vigorous*) In Music, a term which, prefixed to a movement, denotes that it is to be performed with strength and firmness

VI'LLA In Roman Antiquities, originally any country dwelling, farm-house, &c, but in architectural language the country residences of individuals of the wealthier classes were so called Many descriptions of ancient villas are here and there scattered in the pages of classical writers, but the two most complete, undoubtedly (besides those contained in the work of Vitruvius) are the accounts given by Pliny the younger of his Laurentine and Tuscan residences (Epist ii 17 and v 6) the first being the complete picture of a marine, and the second of an inland villa The remains of the first are thought to have been discovered not far from Ostia in the beginning of the last century To these may be added the pleasing, though over ornamented poetical delineation of Statius, *Silvæ* lib 3 entitled 'Surrentinum Tolli describing a magnificent residence overlooking the Bay of Naples The most important parts of an ordinary villa were the porticoes one or more along the front or sides of the mansion, the triclinium or dining room the wings forming suites of living apartments, commonly called in the time of Pliny, diæta, the baths, with their appurtenances the hypocausta or vaulted heating rooms, apodyteria or [illegible] rooms for exercise (sphæristeria) &c [illegible] main portico was generally the xystus (which see) There is a work by A Castell on the villas of the ancients, with ill [illegible] (fol 1728) The remains of several [illegible] in England (See *Archæol* vol 8, *Pictorial History of England* i 561)

VI'LLAGE or VILL (Lat villa, properly a *country house*) In English Legal phraseology, a subdivision of a parish, sometimes a whole, at first and sometimes a part Most commonly it means the out part of a parish consisting of a few houses separate from the rest (See *Bacon*, i 6, and 1 *Inst*) In countries where there are peasants attached to the glebe, or possessing distinct rights and obligations from other subjects a village is properly a place inhabited by peasants only From the Latin villa was derived the French ville, *city* originally signifying any residence, and thence a collection of houses which gradually grew around a principal residence Thus especially in Normandy, ville is a common termination to the names of places, like *ton* or *by* in England, and consequently, also, of family names The English "town" furnishes a parallel instance of the alteration of the meaning of a word produced by an increase of population, our principal towns having been single residences or hamlets, and in Scotland, at this day a house with its appurtenances in rural districts is sometimes called "the town"

VILLEIN, *Villenage* In Anglo-Norman Feudal Jurisprudence, the villeins are thought to have been those who, under the Saxons, had held by the tenure known to the Saxons as "folk-land" Villeins were either "regardant," *i e* annexed to the manor, or "in gross," transferable from one owner to another On the Continent, the rank of "villeins," "villins," seems to have been from the beginning superior to that of serfs (See Guizot, *Civilisation en France, Archæologia*, vol ii, The word villein is derived from the Latin villa, whence villani *country people* Besides the actual servile population of the Roman empire, there appears to have been a class of cultivators of the soil, who probably became greatly multiplied in the later period of the western division of that [illegible] who were wholly [illegible] attached to the soil and liable to certain fixed services to the proprietors of it, but not destitute of property or civil rights Out of this class, augmented in process of time by the addition of numbers whom the vicissitudes of [illegible] revolutions of the dark ages, subject [illegible] with or without consent, to the protection and control of masters, arose

the villein population of Europe in the middle ages Among the causes which increased their numbers, Mr Hallam also enumerates the fines and compositions so generally imposed in the barbarian codes of law, by default in payment of which many were reduced into this state, and the prevalent superstition which induced men to surrender their persons as well as [illegible] to the control of churches and monasteries [illegible] are designated in these early codes under the general name of *lidi leudes*, &c. (leute, *people*), a name which, however, is also applied to the free vassals, or liegemen some, who were attached to the soil of royal or church demesnes, are termed *fiscalini*, or *coloni*, and the condition of various classes appears to have been extremely different [illegible] Meyer *Institutes Judiciaires*, liv i c 7) The general obligation common to all villeins was that of remaining on the lord's estate, and passing along with it by subinfeudation and alienation The lord had also every where jurisdiction over the persons of his villeins But in other respects there were several degrees of servitude In England, at least from the reign of Henry II, only the inferior sort of villeins, or absolute serfs, seem to have existed They were not only bound to the soil (*villeins regardant*), but they might also be severed from the soil and conveyed apart from it by the lord, and then became in legal phraseology, *villeins in gross* They were incapable of acquiring a full right to property, their *peculium* (as the Romans termed the possessions of a slave) being liable to be seized at any moment by the lord Their tenure bound them to what were termed villein or ignoble services, indeterminate in degree It must, however be observed, that these villein tenures were rather attributes of the land than of the individual holding it, insomuch that lands held in villenage were frequently in the occupation of freemen, and thus, in process of time, our English copyhold tenures have been derived from those which prevailed in these lands of a villein equality In France and Germany, where serfs of this description likewise existed, there were at the same time other classes whose servitude was of a less severe character, being bound only to fixed duties and payments in respect of their lands

The abolition of villenage, in the greater part of Western Europe was brought about by various causes Among others, 1 Manumissions, which during some centuries were extremely common from religious principles, being strongly inculcated by the church, although that body is accused of not having added the force of example to its precepts, the villeins on church lands having [illegible] last parts, among the last emancipated Becoming [illegible] villein himself was also a common mode of [illegible] freedom 2 The influence of the towns, within which, when enfranchised, serfs by a certain period of residence frequently obtained their freedom But, perhaps more generally, the process was gradual, the severest attributes of personal servitude being the first to disappear, while predial servitude or a liability to servile duties and payments in respect of land, existed down to a comparatively late period in most countries of Western Europe, and still exists though much modified in parts of Germany In the 15th century there were, according to Machiavel, no villeins left in Italy Predial servitude, in some rare instances, existed in England, it is believed as late as the reign of Charles I In France it was not wholly abolished until the Revolution In the greater part of the Prussian territories, the condition of the peasantry was still in some respects marked with the attributes of villenage until the reforms of Stein in the present reign In those eastern parts of Europe in which the feudal system never prevailed (Russia and Poland), the condition of the great mass of the people is still servile, and, in some respects, lower perhaps than that of most feudal villeins The Russian peasants are divided into those belonging to the crown, and those belonging to individuals, the former being rather more than half as many as the latter throughout the empire The late emperor Alexander introduced some ameliorations in the condition of the crown peasants, with a view to their ultimate enfranchisement He also planned measures for the prevention of the sale of serfs apart from the estates on which they reside Under his superintendence, the nobility in the German provinces of Courland and Livonia abolished villenage altogether, but hitherto without much advantage in improving the state of the peasantry

VILLOSE (Lat villus, *wool*) In Zoology, when a part is covered with soft flexible hairs thickly set

VILLOUS In Anatomy, this term is applied to vascular surfaces which, when minutely examined, look like the pile of velvet, as in the *villous* or internal coat of the intestinal canal

VINALIA According to Varro and Ovid (from vinum, *wine*), a festival in ancient Rome There were two Vinalia the first in April, sacred to Venus, the second in August, to Jupiter. The latter was considered as the beginning of the vintage season, before which new wine was not permitted to be conveyed into Rome (See Ovid *Fast* l iv)

VINCULUM (Lat *a bond or tie*) In Algebra, a mark or character which connects several letters or quantities and indicates that they are to be treated as a single quantity Formerly used the bar or line over the quantities for a vinculum, thus, $a \times \overline{b + c}$, meaning that the quantity $a$ is to be multiplied by the sum of the quantities $b$ and $c$ This manner of connecting quantities was generally used by the early English writers on algebra, but it is now more common to make use of the parenthesis, which is a much more convenient mode of notation, especially when the expression is somewhat long Thus, instead of writing $a \times \overline{b + c}$, or $\sqrt{x^2 + 2xy + y^2}$, it is more usual to write $a(b + c)$ $\sqrt{(x^2 + 2xy + y^2)}$ The parenthesis, which has generally been used by the foreign mathematicians, is said by Hutton to have been first used as a vinculum by Albert Girard

VINE, in Horticulture, (*Vitis vinifera*, L) the grape vine, is a ligneous climber, found wild in Syria and in various parts of Asia and in Greece, the fruit of which is in universal demand for the desert, either fresh, or dried as raisins and its fermented juice forms wine, the noblest liquor that ever gladdened the heart of man The best grapes for the table are grown under glass, but grapes are also grown of very good quality against walls and on cottages south of London, and on walls heated artificially as far north as Glasgow Formerly the grape vine was grown [illegible] for the purpose of wine [illegible], and Mr Hort published an interesting work on the *Cultivation of the Vine* in which he shewed with proper care this might be done in some districts even in the present day *See* VINEYARD

VINE is often employed in a general sense to designate any stem which trails along the ground without rooting, or entangles itself with other plants, to which it adheres by means of its tendrils or by twining, as the cucumber and the hop

VINEGAR This term is applied to various modifications of the acetic acid The simplest mode of obtaining vinegar is to excite a second or acetous fermentation in wine in this case oxygen is absorbed, a variable proportion of carbonic acid is generally evolved and the alcohol of the wine passes into acetic acid Very good vinegar is also made from strong beer, or from a wort or infusion of malt prepared for the purpose, or from a decoction of common raisins or from a mixture of about 1 part of brandy with 8 of water and some sugar and yeast

When vinegar is distilled, various impurities which it contains remain in the still, and the liquid which passes over is the acetic acid, nearly pure but largely diluted with water In this state it is usually called *distilled vinegar*, and is used chiefly in pharmacy But though a considerable quantity of vinegar is made in wine countries by the first mentioned process and here and elsewhere by the second, in which malt is employed, yet for all the purposes of the arts and manufactures, as well as for domestic consumption the [illegible] from another source, which is [illegible] of wood It has long been known that when certain kinds of dry wood especially beech and such woods as are not resinous, instead of being burned in the open air, are converted into charcoal in close vessels, so as in fact to be submitted to distillation, that the vapours which pass off yield, [illegible] large quantity of tar, and of very acid [illegible] in fact, an impure vinegar, that is, it owes its acidity to acetic acid, which is formed during the process out of the carbon, hydrogen, and oxygen of the wood, which elements are also those of acetic acid, and, what is remarkable, not in very different proportions When this impure acetic acid is freed from the tar and empyreumatic oils with which it is mixed, it is called *crude pyroligneous acid* To convert it into pure acetic acid, that is, to separate from it the empyreumatic products with which it is intimately combined, is a somewhat [illegible] which the following is an outline [illegible] distilled, by which *pyroxilic spirit* and *oil of tar* first pass over and these are followed by a quantity of impure or rough acetic acid This rough acid, which is used by dyers and calico-printers, and by makers of sugar of lead, is saturated with powdered slaked lime, and [illegible] yields a solution [illegible], which [illegible] porated to dryne [illegible] with dilute sulphuric acid, yields a purer acetic acid than the former, but which still has a burned and disagreeable flavour, it [illegible] gum saturated by lime and this liquid [illegible] is mixed with a solution of sulphate of soda, which acting by double decomposition, yields a precipitate of [illegible], and acetate of soda remains in solution The latter salt is [illegible] and purified by torrefaction and [illegible] vinegar makers, who purchase it, decompose it in retorts or proper stills, by means of sulphuric acid by which a very pure and strong acetic acid passes over, sulphate of

soda remaining in the retort The acetic acid thus obtained, which is in its most concentrated state, is extremely acrid, sour, and pungent, and is often called *radical vinegar* or when perfumed *aromatic vinegar*, it is also occasionally [illegible] from its property of congealing [illegible], and remaining frozen at temperatures below 50° In this state it is a compound of 1 atom of real acetic acid = 51, and 1 of water = 9, the real or anhydrous acid, as it exists in the dry acetates, being composed of—

| | Atoms | Equiv | Per Cent |
|---|---|---|---|
| Carbon - - | 4 | 24 | 47 06 |
| Hydrogen - | 3 | 3 | 5 88 |
| Oxygen - - | 3 | 24 | 47 06 |
| | 1 | 51 | 100 00 |

proportions which are equivalent to 4 atoms of carbon and 3 of water When this strong acid is diluted with water and slightly coloured, it forms a very pure and excellent substitute for common vinegar, and is cheaper than acid of the same strength prepared in any other way

The combinations of acetic acid with various bases are called *acetates*, and of these salts some are importantly useful in the arts such especially are the acetates of lead copper, iron, and alumina, which are chiefly employed in dyeing and calico printing, the acetates of ammonia and of potash, which, as well as acetate of lead, are used in medicine, and the acetates of lime and of soda, which have been mentioned as steps in the preparation of strong acetic acid The acetates are recognized by their solubility in water, and by the fumes of acetic acid which they evolve when acted upon by sulphuric acid The specific gravity of the strongest liquid acetic acid is 10629, that of good malt vinegar is 10200, and that of distilled vinegar about 10023 The strength or value of vinegar, and of acetic acid, can only be learned by its saturating power

A duty of 2*d* per gallon is imposed upon vinegar, and the manufacture is consequently placed under the control of the excise Previously to 1826 the duty was 4*d* per gallon. The manufacture is chiefly confined to England, the quantity produced in Scotland and Ireland being [illegible] on the annual average to more than [illegible] The quantity of vinegar manufactured in England is nearly 2 700,000 gallons annually

VINEYARD A plantation of grape vines cultivated for the purpose of making wine Though vineyards at present are chiefly confined to the warmer parts of the Continent, yet it appears that formerly they were occasionally to be met with in Britain, more particularly in the neighbourhood of religious establishments Among the last vineyards which we have any account of are one at Hatfield, near Ledbury, which belonged to the celebrated Jacob Tonson, one in the Isle of Wight, another at Pain's Hill in Surrey The ground chosen in all these cases was a sloping surface of dry gravelly soil, with a southern aspect, and the vines were planted in rows at four feet apart every way and trained to short stakes about four feet high Every year the shoots were cut down to within a foot of the ground and not more than three shoots were allowed to be matured by each plant Each shoot produced two or three bunches of grapes, and the shoots were shortened in the course of the summer so as never to reach higher than the stakes, to which they were tied with rushes previously cut and dried for the purpose, or [illegible] The kinds of grapes grown were [illegible] or large black cluster, and the small black cluster or miller grape, so called from the white mealy appearance of the leaves In fine seasons a tolerably good wine was produced On the Continent, the vineyards which produce the best wine are invariably found on dry soils, more or less calcareous, and the most celebrated are on the dry sunny sides of granite or calcareous hills with the surface formed into terraces, like the steps of stairs on a large scale each step or terrace being supported on the lower side by a stone wall, to which the vines planted at the base of the wall are sometimes attached, not by nails, as wall trees are in Britain, but by hooked sticks driven into the interstices between the stones, such walls being for the most part built without mortar In France and the south of Germany, vines are seldom allowed to grow higher than four feet and [illegible] after the crop has been gathered [illegible] to within one or two feet of the ground In the neighbourhood of Stuttgard and between that city and Heidelberg where the sides of the hills are covered with vineyards the shoots are not cut down before winter; but those of each stool or plant are bent down to the ground, where they are tied together with a straw band and retained in that position by laying a stone on the bundle This is for the purpose of preserving the vines from the extreme cold of winter, the shoots, when so laid prostrate, being soon covered with snow In spring the shoots are raised up again, pruned, and tied to stakes In the north of Italy, and chiefly in the plains of Lombardy, the vineyards are managed much in the same manner as they are in France; but in Tuscany, the Papal States, and Naples, the vineyards are interspersed with mulberry trees which are kept pollarded and to these the vines are attached partly by ties of willow and partly by their tendrils, and they produce bunches of grapes to the height of six or eight feet from the ground Sometimes the shoots are trained to elms, mulberry trees, or poplars, in which case they pro- [illegible] The only plantation [illegible] which we know of in England at present, is a small one at White Knights, near Reading, where, however, the plants for several years past have been in a state of utter neglect, the leaves and young shoots being injured or totally destroyed by rabbits The ground which was occupied by the vineyard at Pain's Hill is now covered with a plantation of pine trees, among which some of the vines still continue to spring up [illegible] since been laid [illegible] century there [illegible] bourhood of Lo [illegible] still bears the name of the Vineyard, and is now occupied as a nursery But the most celebrated of the London vineyards appears to have been one cultivated by Richard Warner at Rotherhithe, who is supposed to have introduced the Hamburg grape There was a vineyard in the neighbourhood of Gloucester cathedral, one at St Alban's; and one at Canterbury [illegible] y which is no [illegible] that city

[illegible] Naval language, a purchase used occasionally in weighing the anchor

VIOLA (It) In Music, a musical instrument of the same form and with the same numb [illegible] violin and like it, played with a bow [illegible] it the tenor violin

VIOLACEÆ (*Viola*) are Polypetalous Exogens well represented by the sweet violet of our woods, and distinguished by having five membranous anthers adhering to each other round a superior ovary, with parietal placentæ The heartsease or pansy is a kind of violet and there is a large number of other species in different parts of the world An emetic property resides in their roots, and renders some of them useful medicinal agents as substi- [illegible]

VIOLIN [illegible] In Music, a musical instrument, vulgarly called a fiddle, mounted with four strings, and played with a bow It consists of three parts — the neck the table, and the sounding board, at the side are two apertures in the shape of S s On it is a bridge, which bears the strings up from the belly over which they pass from one extremity called the tail-piece, to the other near the head, where they are received by turning pins, wh [illegible] n them at pleasure

VIOLINCELLO (It) In Music, a bass violin with four strings, whose principles of construction are the same as those of that instrument

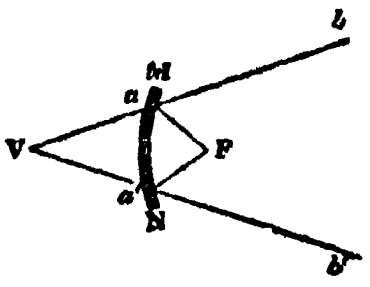
VIOLONE (It) In Music, a large bass violin, commonly called a *double bass*, seldom played with more than three strings, which lie an octave below the violoncello

VIPER (Lat a contraction of Vivipar, from vivus *alive*, and paro, *I bring forth*) The common name of a genus of venomous serpents which produce living young, and have a head broader than the neck, and no pits behind the nostrils The true vipers (*Vipera*) are distinguished by the head being covered with scales, like those on the back, and by the nostrils being very large The horned viper of North Africa and the puff adder of South Africa belong to this group The adders (*Berus*) have the head covered with granular scales with larger ones intermixed in some species, and have the nostrils of moderate size The black adder and the common adder (*Berus chersea*), which are the only indigenous venomous reptiles of Great Britain, are examples of this group

VIRGILIAN HUSBANDRY That kind of agriculture which was practised by the Romans, and which is described in the *Georgics* of Virgil, or, in other words, the old mode of managing arable land throughout Europe By this system two or three corn crops were taken in succession, and the land afterwards allowed to lie fallow for several years, when it was broken up again, being sometimes prepared by paring and burning The Virgilian and Roman practice is fully described in *Dickson's Agriculture of the Ancients* The first departure from this kind of husbandry in Britain was made by Jethro Tull in the middle of the last century whose plan it was to keep arable land continually under crops cultivated in rows, and alternately growing corn and pulse, or plants cultivated for their leaves or roots

VIRGO (the Virgin) In Astronomy, one of the twelve zodiacal constellations or signs being the sixth in order, beginning with Aries Virgo is usually represented with an ear of corn in her hand, and is hence called *Signum Cereris* The sun enters this sign about the 23d of August The constellation Virgo contains one bright star of the first magnitude, called *Spica Virginis*

**VIRTUAL FOCUS**, in Optics, is the point from which rays that have been reflected diverge after incidence on or refraction through a surface Thus in the reflexion of a metallic speculum from a radiating point F, the rays falling on the speculum at *a* and *a'* are reflected to the points *b* and *b'*, and the straight lines *a b* and *a' b'*, if produced, concourse of the straight lines *a b* and *a' b'*, is called the *virtual focus* of the reflected rays *See* REFLEXION

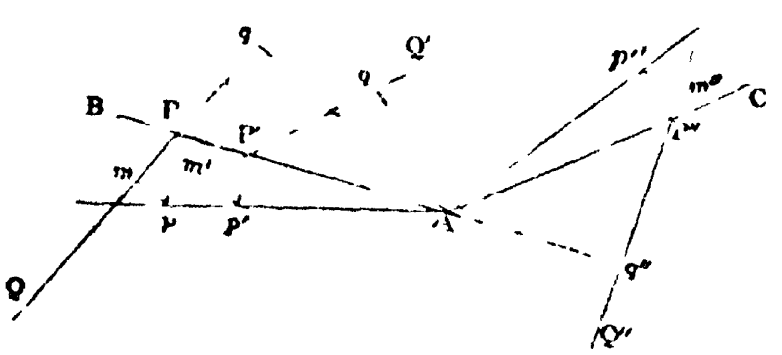



VIRTUAL VELOCITY, in Mechanics, is the velocity which any point of a body in equilibrium would actually acquire during the first instant of its motion in case of the equilibrium being disturbed

The general principles on which the laws of equilibrium in machines are established may be reduced to three, namely, the principle of the *lever*, the principle of the *composition of forces*, and the principle of *virtual elocities* The last consists in this, that forces are in equilibrium when they are in the inverse ratio of the virtual velocities of the points to which they are applied, estimated in the direction in which they respectively act Thus, let F and F′ be two forces applied to the points *p* and *p′* of a body which is in equilibrium by means of their joint action, and let *s* and *s′* be the spaces which the points *p* and *p′* would describe in the first instant of time, in case of the equilibrium being disturbed, then F F′ *s′ s*, or F *s* = F′ *s′* The principle is thus enunciated generally by Lagrange (*Mec Analytique*, p 22) —

"If any system of bodies or material points, urged each by any forces whatever be in equilibrium, and there be given to the system any small motion, by virtue of which each point describes an indefinitely small space, which space will represent the virtual velocity of the point, then the sum of the forces multiplied each by the space which the point to which it is applied describes in the direction of that force, will be always equal to zero or nothing regarding as positive the small spaces described in the direction of the forces, and as negative those described in the opposite direction"

In order to illustrate this principle, we may take as an example the case of the bent lever Let P, P′, P″ be




the points of application of the three forces F, F′, F″, acting on the lever B A C, in the directions P Q, P′ Q′, P″ Q″, which are all supposed to be comprised in the same plane Suppose the lever to describe an indefinitely small angle about the fulcrum A, so that the points P, P′, P″ come into the positions *p*, *p′*, *p″* According to the definition given above, the indefinitely small arcs P *p*, P′ *p′*, P″ *p″*, which may be considered as straight lines, will be the virtual velocities of the points of application P, P′, P″, of the three forces F, F′, F″ From the points *p*, *p′*, *p″*, let there be drawn *p m*, *p′ m′*, *p″ m″* respectively perpendicular to the lines P Q, P′ Q′, P″ Q″, then P *m* will be the virtual velocity of the point P resolved in the direction P Q of the force F, and P′ *m′*, P″ *m″* will in like manner represent the virtual velocities of the points P′ and P″ resolved in the directions in which the forces F′ and F″ respectively act Let P *m* = *s*, P′ *m′* = *s′*, and P″ *m″* = *s″*, and as the force F acting in the direction P Q tends to turn the lever in the direction in which the motion has been supposed to take place, while F′ and F″ tend to turn it in the contrary direction, the space *s* must be regarded as positive, and *s′* and *s″* as negative

Now, according to the principle of virtual velocities, the sum of the forces multiplied by the velocity of its point of application reduced to the direction of that force, is zero in the case of equilibrium, and, reciprocally, when this sum is zero in equilibrium, hence the equation of the lever is

$$F s + F' s' + F'' s'' = 0$$

It is easy to verify this equation by showing that it may be derived from the equation of equilibrium deduced from the principle of the lever. From A let A *q*, A *q′*, A *q″*, be drawn respectively perpendicular to the directions P Q, P′ Q′, P″ Q″, and let the angle P A *p* = θ, then, since the angle A P *p* may be regarded as a right angle, *m* P *p* = P A *q*, whence the two triangles *m* P *p*, *q* A P are similar, and *m* P : A *q* :: P *p* : P A :: tan θ : 1; therefore *m* P = A *q* tan θ that is, *s* = A *q* tan θ In like manner we have *s′* = A *q′* tan θ *s″* = A *q″* tan θ; whence by substituting in the above equation, and leaving out the common multiplier tan θ, we find

$$F\ A q + F'\ A q' + F''\ A q'' = 0,$$

which is the well-known equation of equilibrium *See* STATICS

The equation F *s* + F′ *s′* + F″ *s″* = 0 may be extended to a solid body of any form, or to any machine whatever Let *d m* be an element of the body, F an accelerating force applied to *d m*, *v* the velocity of that element, *z* the angle comprised between the direction of the force F and that in which the element *d m* moves, then the moving force of the element will be F *d m*, and *v* cos *z* its velocity estimated in the direction of this force, and consequently, by the principle of virtual velocities, the equation of equilibrium will be $\int F v \cos z\, dm = 0$

The principle of virtual velocities is easily verified by experiment, with respect to all the simple machines; namely the lever, the pulley, the wheel and axle, the inclined plane, and the screw Its importance as a fundamental principle in rational mechanics was first recognized by John Bernoulli (see the *Nouvelle Mecanique* of Varignon, tom II), and Lagrange has derived from it the whole theories of statics and dynamics in his celebrated work, the *Mécanique Analytique* Fourier (*Journal de l'Ecole Polytechnique*, cahier V) has demonstrated the principle from the property of the lever

**VIRTUE**, in Moral Philosophy, is employed both in an abstract and comprehensive sense to signify the law or laws in which right conduct consists, and also concretely for that quality of actions and persons which arises from their agreement with the rules of morality By theories of virtue are understood the different explanations which have been given both of that which distinguishes right from wrong, and of the nature of the feelings with which virtue and vice are contemplated by mankind The distinction of these two questions, so frequently confounded by ethical writers, is due to Adam Smith, but has since been strongly insisted upon by Mackintosh and Hampden The former question Mackintosh entitles 'The Inquiry into the Criterion of Morality in Action' and the latter, "The Theory of Moral Sentiments," which was [illegible] of Virtue and the former as "the Inquiry into the Nature of Virtue" and apply the term *criterion of virtue* to the principle of approbation In the use of the phrase "Theory of Moral Sentiments," the last two writers again are at issue Smith understands by it moral philosophy in general, while Hampden limits it to a division only of ethical inquiry According to the latter, it comprises the two investigations already specified that into the nature, and that into the criterion, of virtue It constitutes the *subjective* branch of ethics, and arises from a consideration of man in himself as the *subject* of moral action, while the objective branch results from a regard to the end or object to which the moral nature of man has reference This speculation into the final cause of man's capacity for virtue and happiness, Hampden considers to be the complement of ethics, and entitles it *the theory of natural religion* Lastly he defines ethics thus understood to be the science of *but ought to be* subtracted from the science of *what is*, or of moral facts as they are exhibited in life or as they may be classed in the philosophy of history, and the study of the intellectual arts, which are based upon an appeal to the actual moral nature of man These two together make up the whole domain of moral philosophy (*Hampden's Lectures on Moral Philosophy*)

The several theories of virtue are conveniently divided into ancient and modern The distinction, however, is not founded on any essential difference of theory, but rather on the opposite points of view from which they respectively viewed the moral facts While modern theories are permanently subjective the object of question is the character to be aimed at in all contingencies The leading speculation of the former is what is the origin and nature of moral obligation? The first problem of the latter was to determine the object or end to which the moral constitution of man has reference, and this ultimate end of human activity they usually denominated the end or sovereign good (τέλος, *finis bonorum*, *summum bonum*) And although the consideration of this question might tend in a few as in Socrates and Plato, to carry the mind forward to some higher system, in which should be realised [illegible] which man aspires, still, as these promptings of natural religion were but vague and unauthoritative, the ethical writers of antiquity confined their views to this life alone, and the sovereign good which they proposed as the final cause of moral action was limited to the greatest good attainable in the present state of existence.

With Socrates, the first object of speculation was to

acquire a knowledge of man's true and proper nature; but this self-knowledge he held to be impossible so long as man continues ignorant of the universal principle. Now the nature of God can only be learned from his works, and these bespeak him to be good and intelligent. Moreover the consciousness of man attests his participation in the divine essence; consequently the ultimate destination of man is reason and goodness, and his moral end is the cognition and practice of good. Virtue, therefore, is the intelligent performance of duties, whose notions man may arrive at by a study both of his own nature and of the laws of an all-wise Creator discoverable in the system of the universe. In this pursuit happiness is inseparable from virtue. But if Socrates thus founded morality on a disinterested principle, he reconciled it with interest rightly understood; and on the other hand raised political science above the mere calculation of utility, by identifying it with justice as founded not on convention (δογμα πολεως), but on natural right, or the invention of what is (του οντος εξευρεσις).

Socrates having thus referred the laws of morality to the Deity as their author and upholder, Plato proceeded by a definition of the divine nature to guard against the objection of their arbitrary position by the will of God. He made the Deity to be the perfection of intelligence as resulting from an union of the good, the beautiful, and the true, which are in their nature eternal, necessary, and immutable. This perfection is also the term to which man spontaneously tends. For reason is the true principle of his nature, although in the present existence there is mingled with it a foreign element — *matter*, which, by obstructing its development, becomes the cause of his falling short of perfection. All then that is now possible for man is to [illegible] to the divine excellence. This is virtue, and is effected by the harmony of the *rational*, *irascible*, and *concupiscible* parts of the soul. Although the two latter belong to the foreign element in man's nature, they are yet indispensable to the moral act; for the third affords a motive to action, inasmuch as beauty, being identical with the good and true, gives rise to desire or love (ερως) and thereby impels to virtuous action; while the second, disapproving what is base, and ugly, and false, furnishes the fortitude requisite for attaining to what [illegible] every difficulty and every hindrance. To each of the three parts of the soul Plato assigns a special virtue, in a lower sense, and names them, respectively, *prudence*, *fortitude*, and *temperance* (φρονησις, ανδρεια, σωφροσυνη), while in a proper sense he declares virtue to be eminently one and the same with justice (δικαιοσυνη). These four are the so-called cardinal virtues. From the notion of justice he draws the connection of ethics and politics; the latter is but an application of the former to society. At the close of the republic he teaches that as an individual cannot be at peace with himself except by the harmonious adjustment of all his faculties, wherein each is allowed its due weight, so in the whole world happiness is proportionate to justice, and each individual derives the greater benefit from the community the more complete the harmony is in which he lives with all his fellow citizens.

Essentially agreeing, the ethical systems of Plato and Aristotle are chiefly distinguished by the relative value which they respectively ascribe to happiness; the former considering it as the natural fruit of virtue, while the latter rather viewed virtue as the means of attaining to happiness. Plato taught, that although the just man regulates his conduct by no reference to his own enjoyment, yet pleasure invariably attends him, since justice is good not only in itself, but also in its effects, and renders all things fitting and friendly to man. In Aristotle's opinion, the end of morality is to render individuals as useful as possible to society; the objects of whose institution is to procure in its members the highest moral perfection as necessary to the attainment of the greatest possible felicity by the whole. Man he teaches is a free intelligent agent, and therefore acts spontaneously and [illegible] invariably proposing to himself some end [illegible] to action. All human arts and pursuits, then, have their appropriate ends; but among these there is a certain subordination, which implies a supreme end towards which they all converge, [illegible] sake, but the cause for which [illegible] supreme good is perfection; virtue is the approximation thereto, and consists in the habit of mediocrity according to right reason; in other words, it is self-control, which triumphs alike over the impetuosity of the passions and the weakness of the will, and thereby accomplishes a just mean. Every special virtue in like manner lies in a kind of middle between the two opposite vices of too much and too little. [illegible] between cowardice and [illegible] offends by an excessive, the latter by a defective, regard to the proper objects of fear.

According to the Stoics the supreme good which is the final cause of every special good is to act conformably to nature, *i. e.* in obedience to the immutable laws which reason discovers in the universe. This eternal and universal order, which they called *fate*, is an infinite enchainment of causes and effects, in virtue of which whatever happens is what ought to be. It embraces all living things, and man therefore has a principle within him which obliges him to seek that state of his nature which is the best and most perfect that it is capable of. This is reason. Wisdom, therefore, is man's chief good, and the pursuit of it is philosophy. Perfect wisdom, however, as modelled in the sage of the Stoics, they did not believe to be conceded to mortals, to whom nothing more is granted than to be in *the way to* perfection. Now, as they made reason to be the supreme arbiter in moral determinations, they naturally held vice to be but an error; yet this error, they taught, is the only evil; and, on the other hand, nothing is good but what is such at all times and all circumstances; all else is morally indifferent. But even indifferent things are, in a lower sense, agreeable to nature and objects more or less of choice or aversion. That perfect rectitude of conduct, therefore, which constitutes the essence of virtue, consists in a just and accurate dis[illegible] its due [illegible] natural scale of things. Lastly, although their first object was to emancipate the moral man from all dependence on external conditions and from the slavery of his passion, — and although, therefore, they removed all sensuous pleasures and pains from the catalogue of good and evil, — nevertheless the apathy which they taught was not, as commonly understood, an absolute insensibility, but rather the undisturbed supremacy of reason over the passions.

All the preceding theories agree in making reason the end of human activity, and are thereby distinguished from the Epicurean, which gives the first place to the sensuous element of [illegible] and reduces reason to the rank of a mean. According to Epicurus, pleasure alone is sought for its own sake, and philosophy and all else is but the pursuit of it. If, sometimes, it seems to be foregone, it is only with a view to some higher gratification, as pain also may occasionally be endured in the acquisition of a pleasure whose intensity will fully compensate for the intermediate suffering. The pleasures and pains that are primarily the objects of desire and aversion are corporeal, and from these the pleasures of the mind are ultimately derived, and consist merely in the anticipation of future and in the recollection of past states. This, however, constitutes the superiority of the secondary pleasures of the mind over their corporeal originals, for the latter do not extend beyond the present sensation. *Virtue*, therefore, is an enlightened pursuit of pleasure, which, although it is selfish in its principle, still allows free[illegible] affections as [illegible] a pa[illegible] source of gratification beyond the calculations of personal interest. For though they may expose a man to the chance of pain, as in the case of the death of a friend, still this is a less evil than apathy, and the deprivation of a natural enjoyment. Justice, lastly, has no other object than the general good; and right, properly understood, is but the sign of utility.

Modern ethics having taken their rise from a system greatly resembling the Epicurean, the inquiry into the nature of virtue became the first question that was proposed for solution. Accordingly this fact furnishes a general classification of the later theories of morals into selfish or disinterested, according as they found virtue on a selfish or on a benevolent principle.

The selfish theory has found its ablest advocates in Hobbes, Helvetius, Paley, and Bentham. Of these the first and last deserve a particular notice: Hobbes as the originator of the controversy into the nature of morality; Bentham as furnishing the most complete and elaborate exposition of the utilitarian scheme. According to Hobbes (born 1588, died 1679), the only motive that can induce men to any act is the pleasure which will follow from its execution. A preconception of pleasure is the necessary condition of every moral determination. Good and evil are simple tendencies to pleasure and pain, without which every object is indifferent. Self-love is the exclusive passion of man's nature. Other passions differ from it outwardly only, *i. e.* in the objects which excite them; pity, for example, is but the imagination of misfortunes which may happen to ourselves, suggested by the contemplation of another's sufferings; love, the conception of advantages to be derived from its object; and benevolence, nothing more than the consciousness of power sufficient to secure not only one's own happiness, but that of others also. The first law of nature is self-preservation; whatever tends, therefore, to this end is lawful and good, and all men have a natural right to appropriate by every means in their power whatever is conducive to their personal happiness. As this is the imprescriptible right of all, there are as many forms of natural right as there are separate and independent wills; and actions [illegible] virtuous and legitimate. [illegible] right to all things, and as there is no reason why one

should yield to another the objects which both may desire, the state of nature must be one of war, but as, in such a condition of things, the safety of every one is constantly endangered by the conflicting interests of all others, peace, at any price, becomes preferable to it Peace, however, is the result of society alone [illegible] as defined by Hobbes, of the existence within a community of a sufficient force to control all individual wills and forces But this is only practicable in two ways either all are seized with a desire to terminate the state of hostility, and enter into a mutual compact, by which they engage to do no violence, nor to suffer it to be done to each other, or a single person succeeds by stratagem or force in establishing his own authority over the rest [illegible] and indeed as the only [illegible] of warfare among its members, and as the more unlimited the power is the better calculated it must be to effect this object, an absolute monarchy is the very best polity that can be devised Against the government in such a society, it is evident that subjects cannot consistently possess any rights, for these would impede its effectiveness they have but one duty and that is —implicit obedience (*On Human Nature, Leviathan, &c*)

Bentham (born 1748, died 1832), sets out from Hobbes' principle, that every object would be perfectly indifferent but for its fitness to produce pleasure or pain, which, he declares, are the sole motives of human determinations This proposition he does not attempt to prove but, asserting that it is one of those primary and self-evident truths which are the foundation of all reasoning he proceeds to draw from it certain practical conclusions in the form of definitions Thus he defines utility to be the fitness of actions and things to augment the happiness, or to diminish the misery, of individuals and communities, [illegible] intelligible int[illegible] [illegible] ice and morality of an action [illegible] next defined to be that which exclusively derives the quality of actions from their twofold property of augmenting the happiness or misery of one or many This he asserts is the only valid principle of moral appreciation, and he reduces all opposing theories to two classes, which he designates by the principle of asceticism, and the principle of sympathy and antipathy Under the latter head, Bentham comprises every theory of morals which draws the distinction of good and evil from any other principle than a consideration of consequences, whereas he explains the ascetical principle as agreeing with the utilitarian in drawing its qualification of objects from their tendency to produce pleasure or pain, but as differing from it in that it proceeds in an inverse manner, and calls pain good, but pleasure an evil To forego the least pleasure, simply as pleasure, is to act on a principle of asceticism, but the true disciple of utility holds every pleasure to be in itself good Even the abominable pleasure which the wretched criminal enjoys in gloating over his crime is good so far as it is a pleasure, it is only evil so far forth as it entails the ill consequences of fear and punishment, which far transcend [illegible] [illegible] ision, therefore, [illegible] only really good when it will give rise to more of pleasure than of pain, and evil, when its painful exceed its pleasurable consequences It becomes, consequently of the first importance to possess an accurate standard by which the amount of pleasure and pain likely to result from certain actions, and the relative value of the two quantities may be measured This desideratum Bentham has attempted [illegible] constitutes the most original [illegible] his theory and system The first item of this moral arithmetic is what is intended for an exhaustive enumeration of all the pleasures and pains of which human nature is susceptible In the next, he proceeds to furnish a method of determining their comparative value For this purpose it is necessary to take into the account the following considerations —I What are the intrinsic circumstances of the pleasure itself which can augment or diminish its value and these are, 1 intensity, 2 duration, 3 certainty 4 [illegible] ts or remoteness, 5 fecundity, or the p[illegible] [illegible] immediate pleasures engendering others more remote, 6 purity, or whether its pleasures are mixed or not with more or less of pain II What circumstances are likely to affect the sensibility of the agents, and so to modify indirectly the result These are of two kinds, individual and general to the former belong temperament, constitution, habits, intellectual development and other traits of personal character those of the latter order are little more than generalisations of the first, and are—sex, age, education, profession, climate national character government, and religion III What are the consequences which, going beyond the immediate objects of the action, remotely affect others more or less numerous, and even the whole of society By allowing their due weight to all these particulars,



Bentham pretends that any ordinary capacity may form a correct estimate of the real tendency of actions and thereby arrive at that general utility which is the proper end of morality to secure (*Treatise on Morals and Legislation*)

The recognition of a principle of action independent of self love will afford a general characteristic of the remaining theories Some of these, however, place the origin of the disinterested determination in a perception of moral good and evil by the intellect or reason, while others explain the distinction by certain facts which take place within the sensibility or emotive part of man, so that the disinterested determinations which result proceed from an instinct or sentiment These two classes may be conveniently designated the rational and the sentimental or instinctive Of instinctive theories, however, while some are content with referring the moral principle to an original and admitted tendency of human nature such as sympathy or benevolence, others have derived it from a new and peculiar faculty

To begin with the former class According to Smith (born 1723, died 1790), when we are in the company of another who is sensibly affected with any sentiment or passion, our nature spontaneously, and without the intervention of reason or will, tends to reproduce in ourselves the same sentiment or passion and not only have we this disposition to sympathy, but we even feel a pleasure in finding ourselves to be brought thereby into harmony with those around us Indeed so strong and so instinctive is the desire for such union between our own minds and those of others, that when we are under any strong emotions in the presence of another who is unable to conceive any thing that approaches to the same degree of violence with our own, in such a case we involuntarily and unconsciously lower our passion to that pitch in which the spectator can go along with it The spectator, on the other hand, seeing what we suffer, endeavours to enter into our sentiments, and rises by an instinctive complaisance to the level of them In regard to those objects which have no peculiar relation either to ourselves or others this sympathy is simple In whatever degree, for instance, the love of truth may be felt, it will not directly affect the happiness of any one, it cannot excite any [illegible] [illegible] [illegible] with It may, there [illegible] [illegible] [illegible] because there is no reason either of instinct or of reason to suppress it There are however certain internal dispositions which excite a twofold or even a triple sympathy, which are all of the same kind, thus, when we see a man animated with sentiments of charity and love, pity and benevolence, towards his fellow men, we are affected by a twofold sympathy, *directly* with the benevolent disposition, and *indirectly* with the gratitude which is due from its objects As, then, the two mutually strengthen each other, the benevolent dispositions evidently awaken the highest degrees of sympathy and consequently they contribute most of all to effect that perfect harmony of sentiments and affections to which all men instinctively aspire But, on the other hand, there is a divided sympathy Suppose the case of merited anger, on the one hand we sympathise with the passion of anger, and on the other with the object of it, and with the sufferings which it may bring upon him These are the elements of moral approbation and disapprobation We approve those sentiments of others in which we ourselves are able to participate, and when this sympathy is pure our approbation is unqualified, but mixed with disapprobation when our sympathy is divided. But further, when we witness, for instance, an act of benevolence, we sympathise not only with the feelings of the actor, but also with the emotion of the party benefited Now this emotion is gratitude, but what else is gratitude but an instinctive desire to do good to the benefactor? [illegible] as we participate in the feelings of the [illegible] we wish to do good to the author of [illegible], we feel that he *merits* it in reward for the good which he has done As to the judgment which we pass on our own sentiments and actions, Smith asserts that if it were possible for a human creature to grow up to manhood in some solitary place without communication with his species he could no more think of his own character, of the propriety or demerit of his own actions, of the beauty or deformity of his own mind, than of the beauty or deformity of his own face Since society is essential [illegible] [illegible] which is the rule of [illegible] of all our [illegible] [illegible] to a consciousness of that rule, and by it appreciate the morality or immorality of his acts Our moral criticisms are first exercised upon the character and conduct of others, but we soon learn that others are exercising their judgment upon our own we become anxious to know how far we deserve their censure and applause, and, in order to examine in this respect our own passions and conduct, we have the faculty of supposing ourselves spectators of our own dispositions and behaviour, and so experience in some degree the same sensations as would be excited in our minds by the sight of similar actions

and feelings in another By virtue of this faculty we feel as it were a sympathy with ourselves when we have acted well, and are led to suppose that all other spectators would be similarly affected This consciousness of unison between our own conduct and the sentiments of our fellows constitutes the pleasure of rectitude And further, by aid of the same principle by which we judge of the actions of others, we feel that we have a right to pronounce our own also to be good This is a source of inward tranquillity and satisfaction, while the least suspicion of the contrary gives rise to the pains of remorse In manhood, indeed, when experience has drawn a system of general rules from the occasional judgments of sympathy, [illegible] a new source of pleasure arises We have [illegible] intellectual perception also of the conformity of the act with the law of morality; and, independently of the instinctive approbation the reason also awards to it its sanction This rational perception is wanting in the infantine and uncultivated mind, but it is invariably found wherever education or experience has stored the mind with the general maxims of morality which are primarily founded on the instinctive emotions The act of reason in approbation is simply a perception of the agreeableness of the act with the moral laws, and therefore implies them Lastly, the act itself appears by its very nature to be part of a system of conduct framed to establish a perfect agreement of sentiments among mankind, and this universal harmony being eminently beautiful in itself, we judge in virtue of this perception, the act in question to be not only good but even beautiful This is the principle of moral beauty, which is the origin of every other species of the beautiful (*Theory of Moral Sentiments*)

The doctrine of a moral sense owes its origin to Lord Shaftesbury (born 1671, died 1713) According to this writer, the human dispositions are of two kinds,—the social or benevolent, and the personal or selfish The former lead us to desire the welfare of others simply for its own sake and without regard to our own interests In the developments of these affections the soul takes part, and some are naturally agreeable and others disagreeable to it, of the former it approves and disapproves the latter As these dispositions are a source of pleasure to the soul, there must be in it some faculty distinct from the dispositions themselves by virtue of which they become agreeable or otherwise and which performs the same office in their case as they do with respect to their immediate objects This faculty Shaftesbury calls a sense which he characterises from its mode of operation as *reflex*, and from its object-matter as *moral* The dispositions which this reflex sense approves or disapproves are morally good or evil [illegible] to the former, but resisting the latter Between goodness and virtue there is agreement, but not identity, the former being merely a constitutional predominance of the benevolent affections in the character and conduct the latter being the same state produced by the operation of the conscience or moral sense, which, when the personal affections are of equal force with the social ones, interposes its authority, and inclines the balance in favour of the latter

Butler (born 1692, died 1752), in the same manner divides the principles of action into those which lead directly to private good, and those which promote immediately the good of the community, but of both he shows with great originality that they are alike disinterested The objects of both classes of passions are outward things, which are sought as ends in themselves and without any regard to their tendency to promote happiness, which is the proper end of self-love This, again, is distinguished by Butler from selfishness, which consists in the weakness of the public affections and the undue strength of personal desires Self-love, or an [illegible], is not a vice, [illegible] with the happiness of him who harbours it, since without the gratification of the benevolent feelings it is impossible to attain to the greatest satisfaction of our nature, of which they are a part But, besides these personal and social instincts and self-love, Butler discovers in man another faculty, which by its very nature is supreme over all others, and authoritatively approves or disapproves both the affections of our minds and the actions of our lives This principle is conscience Its perceptions are immediate, and its very idea implies that supremacy and authority are essential to it (*Sermons at the Rolls Chapel*)

The first object of Hutcheson (born 1694, died 1747,) is to show that the very frame of our nature which determines us to pursue happiness for ourselves, also determines us both to esteem and to benevolence on their proper occasions But besides these original desires, he shows that there arise, in consequence of them, *secondary* desires of every thing useful to gratify the primary ones But there is also in man an idea of moral good which can be explained by neither of the former By a careful analysis, Hutcheson shows that by moral good we understand neither what gives pleasure by satisfying our benevolence nor what is simply good to others, nor is it what is useful to others or agreeable to the spectator nor, lastly, is it a conformity to the will of God or to law, or truth, or order It is simply what the word itself expresses, which [illegible] by any other From its simple and special character of the term, Hutcheson argues that it must be perceived by a sense, because the senses alone are percipient of simple qualities, and by a special sense specifically apprehended by it differs from all other objects of sensation Further he observes that this perception is attended with pleasure, which is the property of all sensations perceptions, and that as moral [illegible] and rule of action, it must be apprehended by a sense, since the understanding can neither propose the ends of human activity nor exercise any influence on the will Again, the pleasure which accompanies the perception of moral being a consequence of [illegible] presupposes it, therefore it is impossible to resolve moral good, or the approbation which we award to it, into that pleasure, this would be to resolve the cause into the effect and the consequence into the principle As the qualities which it is the province of the moral sense to discover belong to the internal affections and emotions, it is internal and not external, although, like the outward senses, it is capable of improvement by education and habit This sense is designed to govern all the others, and we have an immediate consciousness of its authority Reason is the servant of this sense, its only office being to discover and to combine the means necessary to the attainment of the objects which the moral sense approves of [illegible] benevolence alone every [illegible] which has in view our own advantage is, simply on that account, morally wrong, it may be innocent—it cannot be virtuous. (*Inquiry into Beauty and Virtue*)

According to Hume, (born 1711, died 1776,) all the mental qualities and actions which are generally approved of by mankind agree in the [illegible] being useful to society The fact that [illegible] of moral approbation correspond to the degrees of utility, affords an explanation of the greater merit ascribed to the benevolent passions for these tend to the happiness of many, and indeed of all, whereas the personal affections tend to that of the agent alone Yet even the latter are in a degree meritorious, inasmuch as they are useful to one, and they are only to be blamed when they are entertained at the sacrifice of the social feelings The pursuit of self interest is in the latter case culpable, although in itself it is not only innocent, but praiseworthy for we admire in any character certain qualities such as prudence, for instance merely because they appear fitted to promote his personal welfare In short, whatever is useful is morally good, and is only to be disapproved when it is preferred to what is more useful That which judges of utility and the contrary is reason, but if we approve of one and disapprove of the other, and call the former good, [illegible] evil, this is in virtue of a primary sentiment of our nature, which leads us to prefer the useful to the hurtful, as we prefer what is sweet to what is bitter This instinct, however, is distinct from and frequently opposed to self-love, for this would lead us to love what is useful to ourselves and not what is useful in itself absolutely and independently of any reference to our own advantage This instinct is commonly called conscience, or the moral faculty, but more frequently designated by Hume as benevolence or [illegible] as its object is the good of mankind [illegible] idea [illegible] is simply a conception of the [illegible] What is honoured by this name is, he says, nothing more than the undoubtedly correct view, that there is more happiness in obeying the impulses of the moral sense than in following the dictates of self love The reason is incapable of exercising any influence on the will What determines us when we resolve to act rightly is merely the charm which utility exercises on the mind, and the force of certain dispositions which propel us to seek the good of ourselves and others, and are invariably seconding the promptings of conscience (*Inquiry concerning the Principles of Morals*)

Mackintosh (born 1765, died 1832,) agrees with all the writers of the instinctive school in denying conscience to be either a state or act of the understanding, but differs from one form of the sentimental theory by denying that man has any special organization for moral perception, while he equally dissents from the other view, which would refer these perceptions to some one of the original and admitted sentiments of our nature Butler and Stewart had shown that self-love is a secondary principle, and Hartley had exhibited the important part which association plays in the formation of our passions and affections, and even of our sentiments of [illegible] and duty This view was further developed by Mackintosh who declared conscience itself to be a similar derivative

In the same manner he says that in the formation of self-love the desire which originally attaches to external objects is transferred to the pleasure which results from [illegible] certain actions is transferred to the volitions which determine conduct, so that the latter become at last the immediate objects of love and repugnance In this manner there is formed by association a number of secondary desires and aversions, whose proper object is volition, and which collectively form that interior principle called conscience, which judges, without regard to consequences, unerringly and authoritatively As to the action of conscience on the will, this is composed both of the [illegible] of the primary dispositions, which it [illegible] and of the pleasures naturally attached to them, as well as those which are produced by the gratification of the secondary affections Accordingly, Mackintosh strongly insists upon the distinction between perception and emotion and declares that the phrase *association* of ideas, as overlooking this distinction, conveys but a partial and incomplete view of the truth He therefore proposes to substitute for it association of thoughts with emotions and with each other, but at the same time declares that the term "association" very inadequately indicates that perfect combination and fusion which occurs in these operations of the mind For the moral faculty is properly and intelligibly spoken of as one Now it is as common in mind as in matter for a compound to have properties not to be found in any of its constituent parts the originally separate feelings are so completely blended together that they can no longer be disjoined from each other Thus the sentiment of moral approbation, formed by association out of antecedent affections may become so perfectly independent of them that we are no longer conscious of the process by which they were formed It is in this mature and sound state of nature that our emotions at sight of right and wrong are ascribed to conscience And although this supreme arbiter and judge of human conduct does not supersede the ordinary motives of virtuous feelings and habits which are the ordinary motives to good actions, it yet exercises a lawful authority over them Whatsoever actions and dispositions are approved by conscience acquire the names of virtues and duties, they are thereby pronounced to deserve commendation, and we are justly considered as under a moral *obligation* to practise the actions and cultivate the dispositions The peculiar character of the moral sentiments is their exclusive reference to *states of the will* and this is a character both of the private desires and social affections, and indeed, among the many dissimilar elements that enter into the formation of conscience this is the only common property that the mind can discover Hence, however, the facility with which general terms, at first limited to relations between ourselves and others, are gradually applied to any voluntary acts and dispositions it is thus that prudence and temperance, for instance, become objects of moral approbation On the other hand, as the will is the sole means of gratifying any passion, the power of conscience is coextensive with the whole man It is a universal principle because will is the universal means And as, when the mind is in a healthy state, nothing is interposed between it and the will, the dictate of conscience is immediately followed by a determination of will, conscience is thus at once universal, independent, and commanding Lastly, as Mackintosh held that utility as tending to promote the greatest happiness of the species, is the criterium of morality he naturally felt himself called upon to explain the fact that, while the moral approbation involves no perception of a beneficent tendency there is nevertheless a striking coincidence between that principle and the moral sentiments He replies that it is true that conscience itself rarely contemplates so distant an object as the welfare of all sentient beings, but that all its elements are invariably tending to this end The social affections promote happiness so far as their foresight and power extend, the rules of justice are conducive, if not necessary to the well-being of society, even the angry passions, so far as they are ministers of morality, are employed in removing hindrances to the welfare of ourselves and others, and if the private passions terminate in the happiness of the individual this is yet a part of the general happiness [illegible] this beneficent tendency [illegible] conscience, because our voluntary acts are not felt to affect it, yet little is left to reason to perform, which is, to discover merely the truth, that the acts of those who labour to promote separate portions of happiness must increase the amount of the whole (*Dissertation on the Progress of* [illegible])

[illegible] the rational theory of morality is, that it considers the idea of good to be an *à priori* conception of reason, in which the idea of obligation is necessarily and essentially implied As to the nature of the idea itself, two opinions have been held. While some moralists of this school pronounce it to be simple and immediate others resolve it into some higher notion of the intellect, from which it derives at once its explanation and authority

The most distinguished representatives of the latter opinion are Clarke and Wollaston, while the former has fo[illegible] C[illegible]worth Price and Stewart [illegible] died 1729), the universe is an assemblage of objects held together by certain mutual relations which result from their respective natures, but as the nature or essence of things is immutable and real, and the essence is the principle of the relations, the latter must be equally real and immutable, and as they must have been always present to the Eternal Mind they are also eternal Now, as soon as reason conceives these relations as constituting the laws of individual things, and the order of the universe, they immediately appear to command the respect of every free and rational agent Hence the obligation on every creature capable of thought to act conformably to those relations, and every act agreeable to them is judged to be good, and evil if opposed to them Now, moral good being the conformity to the relations of objects, these, while they constitute, serve also to explain, all duties Thus, the true nature of God and man, and their reciprocal relations, being known, the duties of man towards God are at once discoverable In the same way the duties of man to his fellows similarly suggest themselves from a consideration of their relations as equally free and independent beings, and as the latter relation is one of equality, whereas that between God and man is one of inequality, the difference between the two classes of duties which those relations respectively engender is at once conceivable In confirmation of this view of the moral principle, Clarke appeals to the historical fact of the gradual development of moral ideas among mankind for the knowledge of the nature of things, and their consequent relations, is neither natural nor immediate to the mind, but is gradually unfolded by observation and science, which are more or less complete according to the degrees of its culture The evolution of moral science, although subsequent to that of nature, nevertheless being once awakened, is promoted by its progress and keeps pace with the advancement of civilization (*Being and Attributes of God, Evidence of Natural and Revealed Religion*)

Wollaston (born 1659, died 1724) makes morality to be conformity to t[illegible] of this view he asserts that actions, [illegible] are but signs, and that consequently every true proposition, *i e* one which expresses things as they are, may be contradicted by deeds as well as by words To violate a compact, for instance, is simply to deny by that act that there is any such compact subsisting He then asserts that no act, whether word or deed, of any free and rational agent to whom moral good and evil are imputable, which interferes with any true proposition or denies anything to be as it is can be right 1 or, 1, if a false proposition be wrong, the act which implies, or is founded on it cannot be right 2 Whatever interferes with a true proposition, which expresses the relation between the subject and attribute as it is in nature must therefore, interfere with nature, and is consequently unnatural, or wrong in nature 3 An act which contradicts a true proposition contradicts what is and is, therefore, a revolt against God, the author of whatever is 4 To deny things to be as they are, is a transgression of the great law of our nature — the law of reason What is said of acts inconsistent with truth may be said of omissions to act, since by these, also, true propositions may be denied to be true For instance, whoever having [illegible] nevertheless voluntarily [illegible] as if there had been no suc[illegible] Having thus established his theory, he [illegible] to show that it is agreeable to facts and [illegible] that of the progressive development of morality For morality being simply the truth expressed in action, it implies the knowledge of truth, and consequently the improvement of the moral perceptions must be proportional to the progress of science It also affords an explanation of erroneous views in morality, and of the difference so universally drawn by the common sense of mankind between error and vice If it is possible to err in morals, this is because the mind is liable to err in science, and not to see things as they actually are To err in morals is but to affirm practically a false position hence the act may be evil, but the [illegible]able, since his error is involunta[illegible] maintains that his [illegible] acknowledged [illegible] affords the only just [illegible] of them [illegible] is immutable, because it expresses the unchangeable nature of things, and therefore the ideas of moral good are immutable Hence, too, the same eternal distinction between moral good and evil as between truth and falsehood Whatever, in short, may be predicated of truth, is applicable to the moral principle, and its foundations are as valid and

imperishable as those of science itself. (*The Religion of Nature*.)

T[illegible] which explains the [illegible] conception of the intuitive reason, intelligible in itself, and incapable of definition, now remains for elucidation. According to Cudworth (born 1617, died 1688), certain universal and absolute ideas exist from all eternity in the Divine mind, from which the human intellect [illegible] re- fore, by its nature possesses these [illegible] to experience. They remain dormant, it is true, until outward objects call them forth; but when once awakened, they immediately apply themselves to things, and give them a significant character, which in themselves they do not possess. Cudworth's chief object in advancing this theory of intellection, was to exempt the ideas of right and wrong from [illegible] relative character with which the [illegible] of Hobbes had invested them. [illegible] he shows that no relation of human will or pleasure can constitute these ideas. Positive laws, he urges, do not oblige by their mere enactment, but by virtue of the natural ideas of jus[illegible] which they imply. Neither is this [illegible] man's reason, for this does but conceive it, and, by applying its unchangeable standard to actions and characters, appreciates and judges them. [illegible] combined with that of obligation. [illegible] assumes the character of a duty, and is as unalterable as good itself. (*Eternal and Immutable Morality*.)

Price (born 1723, died 1791,) ascribes all simple ideas to two faculties—sense and understanding. The latter sees things as they are; the former perceives the effects only that they produce on the sensuous organization. The ideas of the understanding consequently express realities which are independent of man, whereas those of the latter are sensations which would be different if man's sensuous organs were changed. Now the question of the objective reality and immutability of the ideas of right and wrong reduces itself to the inquiry into their origin. According to Price they belong to the understanding as a faculty of intuition or immediate power of perception distinct from the understanding as a reasoning or deductive faculty. The doctrine which would assign them to sensation as their origin has its source in the fact that the moral perceptions are invariably attended with agreeable or disagreeable emotions, and the exclusive consideration of this circumstance. But when men declare gratitude to be a virtue, and ingratitude a vice, they intend to signify not merely that they produce emotions in their own minds but that they are naturally virtuous and vicious in themselves. If by virtue and vice nothing more be meant than certain mental affections, then, in that case our moral judgments would be infallible, and the same act might with equal truth be the subject of the most conflicting estimates, and all things would be indifferent in their own nature since the understanding, which alone apprehends things as they are, could see in them neither good nor evil. Moreover, in this case, they would be without authority for [illegible] to do what is pleasing, or to [illegible] But these ideas are both immutable and imperative; they are immutable, since they are real qualities of actions, and every real quality is a part of the nature of things, which is immutable. God may destroy the things themselves but he cannot cause them to be what they are not. After establishing the rational origin and immutable character of the moral perceptions Price proceeds to explain the manner in which they are apprehended by the intuitive reason. As the sight of an event suggests the idea that it must have taken place in time, and thereby we arrive at the idea of duration, in the same way certain actions of free and rational agents are immediately apprehended to be good or evil, and the ideas of right and wrong arise in the consciousness. As to the notions of moral beauty and deformity, these we ascribe to good and evil actions in virtue of the pleasure and pain which accompany, but yet are distinct from the perception of right and wrong. In contemplating the actions and affections of moral agents, we have both a *perception of the understanding* and a *feeling of the heart*, the latter are the effects of the former, and partly depend on the positive constitution of our nature and [illegible] object and faculty. [illegible] and the [illegible] we [illegible] give [illegible] have, so God has [illegible] some objects and ideas which have a natural fitness and unfitness to please our mind, and such is the nature of certain actions that when perceived by a [illegible] there must result in him certain emotions and affections. These are at first of a purely intellectual kind, but, as such, they are too weak to govern and actuate mankind, and they are therefore combined with a stronger excitement, and we are endowed with certain special instincts which impel us to goodness, and by means of these we are effectually moved towards their proper objects. As to duty or obligation: this idea is so intimately allied to that of good, that one cannot appear without the other. Obligation to action and rightness to action are plainly coincident and identical. It is not plainer that figure implies something figured, than that rightness implies oughtness. Rewards and punishments suppose in their very idea moral obligation, and are founded upon it. They do not make it [illegible] motives to comply with it. They are the *sanctions* of virtue, but not its *efficients*. The ideas of good and ill desert are equally immediate, for they are really nothing less than a species of the ideas of right and wrong; although there is this difference in them, that while the latter are properly ascribed to actions, merit and demerit are applicable to agents or persons only. We have an immediate approbation of making the virtuous happy, and discouraging the vicious apart from all consequences. The conception of virtue is totally distinct from the fact that virtue is a source of pleasure; for it is one thing to find by experience that the tendency of virtue is to the happiness of the world, and vice to its misery; and another to conceive that virtue is by a necessary truth deserving of happiness. Neither does it result from the view that virtue is of public utility; for, even though this consideration may incline us to wish good to the virtuous, yet are we antecedently moved to the same wish by the more immediate and more simple consideration that he is virtuous and as such, without any other consideration, we pronounce him deserving of honour. Lastly, Price makes liberty and intelligence to be essentially necessary to the morality of the agent, and rightly distinguishes absolute virtue, which is to act voluntarily and consciously in conformity with the moral laws from practical virtue, or acting on a belief of good in supposed conformity to good. (*View of Principal Questions and Difficulties in Morals*.)

Stewart (born 1753, died 1828,) distinguishes two questions in the fundamental problem of ethics—that of the nature of good, and that of the faculty which discerns and judges of it. With respect to the first, he teaches that upon observation of certain actions the idea of good arises in the mind. This idea represents a certain quality of the actions themselves, and inherent in them, like the primary qualities of bodies, and therefore independent of the sensuous percipient, and not, like the secondary qualities, mere relations between us and the actions. As to the nature of these qualities they are, like the ideas which we have of them, perfectly original, simple and irreducible, and consequently indefinable. He further shows after Price, that it is impossible to explain the terms good and evil except by synonyms, or by substituting for the ideas which they represent some of the circumstances which accompany the perception of them. As to the second question Stewart argues that good being a simple and real quality in actions, it is impossible to refer the idea of it to any faculty which is not a source of original ideas, and which does not apprehend the real and inherent qualities of objects. It is therefore, impossible to refer it to a sense,—such as that of taste or smell which do not reveal the real nature of objects but only the effect which they produce in the perceiving subject; nor to reason—if by this term we understand nothing more than the faculty which seizes the relations and deductions of ideas previously established, because the idea of good is simple and original, and not one of relation and consequence; but if by sense we understand a faculty analogous to that which perceives the primary qualities of bodies and their existence,—or if by reason we mean the intuitive understanding which furnishes the simple primary, and original ideas of time, space, and causation,—then the ideas of good and evil may be referred to either. If Stewart inclines, nevertheless, to favour the claims of reason he yet declares the question to be unimportant when once it has been admitted that good and evil are simple and indefinable. (*Philosophy of the Active and Moral Powers*.)

In this exposition, the first object has been to give a correct and impartial view of the several theories which have been proposed of the nature of virtue and of the moral perceptions. Their comparative merits have been left to the reader's judgment, unbiassed and undisturbed by any critical estimate by the writer himself, except so far as [illegible] implies [illegible] (*[illegible] History [illegible] Philosophy*, [illegible] *Dissertation on Ethical Philosophy*, [illegible] *Nature*, [illegible] *Philosophy* [illegible], and the articles ETHICS and SCHELLING in this work.)

**VIS** (Lat. *force* or *power*), in Mechanics, is synonymous with *force*. The term is chiefly used by the older writers, and is applied by them to divers kinds of forces or powers. Thus *vis acceleratrix*, accelerating force; *vis inertiæ*, resistance; *vis motrix*, moving force, &c. *Vis mortua*, and *vis viva*, are terms which were used by Leibnitz and his followers, the former signifying a pressure, and the latter the force of a body in motion estimated by the distance the body goes to.

About the beginning of the last century, a keen dispute [illegible] manner [illegible] to be estimated It began with a prize essay by John Bernoulli on the Investigation of the Laws of the Communication of Motion," and was carried on for many years with great asperity The question was, whether the force of a moving body [illegible] to the square of the velocity, or to the [illegible] only of the velocity No controversy, [illegible] was ever carried on by more illustrious disputants Maclaurin, Stirling, Desaguliers Jurin, Clarke, Mairan, were all engaged on the one side, and on the opposite were Bernoulli Herman Poleni, S'Gravesande, Muschenbroek The dispute was taken up as a point of national honour Germany, Holland, and Italy declared for the *vis viva*, England stood firm for the old doctrine, and France was divided between the two opinions (*Dissertation on the Progress of Math and Phys Science, Ency Brit*) The difference in this case, as in most other disputes of a similar kind, arose from the parties not understanding each other When the effect of a body in motion is measured by the distance to which it goes, the effect is proportional to the square of the velocity If measured by the time that elapses before the motion is destroyed by a resistance of uniform intensity, it is as the velocity simply Both measures may be considered as correct, and they are not inconsistent when rightly understood (*Playfair's Nat Phil* vol i p 56) The *vis viva*, considered as a power residing in a moving body, is otherwise [illegible] *See* FORCE

VISCOUNT A title of honour, in its original signification, the delegate of a count (vice-comes) and applied to governors of towns and districts under the authority of that officer In England the appellation of vice-comes or viscounte, in Norman French, was long used to designate the sheriff of a county (the vicegerent of the earl) before it became a title of peerage It is the most modern of English honours in the latter sense, and was first conferred by letters patent on John Lord Beaumont, and the heirs male of his body, by Henry VI in 1440 For the rank of the viscount, see PRECEDENCY

VISHNU One of the three principal deities of the Hindoo mythology, the other two being Brahma and Siva He is commonly called the Preserver the other two being respectively the Creator and the Destroyer The great objects of his providence are brought about by his successive incarnations or avatars, in which he appears and acts on earth Nine of these have taken place The last is said to have been the appearance of Buddha, which is supposed by some learned critics [illegible] to have taken place about A D 1014, and hence the Buddhists reject the Vedas, which were compiled before that event (*See* VEDAS) The tenth avatar of Vishnu is yet to take place, when he will appear on a white [illegible] the everlasting punishment [illegible] incarnations of Vishnu is the celebrated Juggernaut, whose temple and worship hold such a prominent place in Indian superstition On the great annual festival in his honour, all distinctions of castes and classes are forgotten, and even on that occasion the Brahminical Hindoos and the followers of Buddha cease their [illegible] hostilities The word Juggernaut signifies literally *Lord of the Universe*, and it is said that on the day he expired Buddha assumed this appellation exclaiming, "*O Universe, I am thy Lord*"

VISIBLE Capable of being seen Objects are visible or otherwise, according as they emit or reflect a sufficient quantity of light to make a sensible impression on the retina of the eye According to Newton, colour is the proper object of sight, the visibility of an object must therefore depend on its transmitting to the eye rays of a different colour from those which proceed from [illegible]

VISION [illegible]s, the faculty of seeing Philosophers have disputed much respecting the means of vision, and its seat in the eye The Platonists and Stoics held vision to be effected by the emission of rays out of the eyes The Epicureans supposed vision to be performed by the emanation of images or corporeal species from objects to the eye, and the Peripatetics differed in opinion from the Epicureans by [illegible] species received by the eye to be incorporated [illegible] philosophers agree in referring the cause of vision to the impressions of light on the eye, but whether this impression is made by material [illegible] or a self-luminous body, and reflected [illegible] or by the medium of a fluid of great elasticity exciting the eye by the vibrations communicated to it by the luminous body, is a question which is still undetermined (*See* LIGHT) In what [illegible] the eye or the particular part of it affected [illegible] conveys to the brain the impressions it receives from the luminous rays, is a question which philosophy has not yet solved, and will probably [illegible]

*Seat of Vision* — The retina of the eye, on which an inverted image of external objects is formed, has usually been regarded as the seat of vision, but this opinion was [illegible] brought into doubt by the accidental discovery of Mariotte, that the base of the optic nerve is insensible to the rays of [illegible] incapable of conveying to the [illegible] vision But the retina, being only the extension or contraction of the optic nerve, Mariotte inferred that if the former were the true seat of vision, that part of it at the entrance of the nerve, and where it exists in the greatest quantity, and where precisely vision is wanted, ought to be at least as sensible to the rays of [illegible] parts. Mariotte, therefore, concluded [illegible] d coat which lies immediately below the retina, and lines the whole bottom of the eye excepting the place at which the optic nerve is inserted is the real seat and cause of vision (*Priestley on Vision, Light, and Colours*, p 722, or *Hutton's Dictionary*) The opacity of the choroid coat, and the transparency of the retina, which render it an unfit ground for the reception of images, furnish arguments in support of this view, and an interesting fact was observed by Sir D Brewster which points to the same conclusion He observed that in young persons the choroid coat which is generally supposed to be black, and to grow fainter by age, reflects a brilliant crimson colour, like that of dogs and other animals Hence, if the retina is affected by rays which pass through it, this crimson light, which must necessarily be transmitted by it ought to excite the sensation of crimson, which he found not to be the case ("Optics," *Cab Cycl* p 291)

M Lehot, a French writer, has recently attempted to prove that the seat of vision is in the vitreous humour, and that instead of seeing a flat picture of objects, we actually see an image of three dimensions To produce this effect he supposes that the retina sends out a number of small nervous filaments, which extend into the vitreous humour, and convey to the brain the impressions of all parts of the image (Id p 292 For further information on this subject, see *Jurin's Essay on Distinct and Indistinct Vision*, in *Smith's Optics*, *Robins' Tracts*, vol ii, a paper *On Vision* by Dr T Young *Phil Trans* 1793, *Horn on the Seat of Vision*, 8vo 1813) *See* OPTICS

VISION, BEATIFIC In Theology The doctors of the church distinguish three manners of seeing or knowing God which they call, 1 *Abstractive vision*, i e through the consideration of his attributes 2 *Beatific* or *intuitive vision*, that which the faithful enjoy in heaven (1 Cor xiii 12) The belief termed Catholic by the Romanists is that this vision is accorded to the just, who die with it leaving a sin unexpiated, immediately on their departure The Greek church holds that they do not enjoy it before the general resurrection This is one of the points decided by the Council of Florence in 1439, and its decision is confirmed by that of Trent 3 The third kind of vision, or *comprehension*, is that which belongs to God, who alone can know Himself as He is Prophetic vision is only the knowledge of future or distant events given by inspiration

VISITATION In Ecclesiastical Law, the inspection by the bishop of the several parishes in his diocese, or by an archbishop of the dioceses in his province By the ancient canon law visitations were to be held once a year, and by the personal repairing of the ordinary to each parish, but the modern practice, which appears to have come gradually into use, owing to the extent of dioceses, is to summon the clergy from several parts to one convenient place The times of episcopal visitations are now usually fixed in this country about Easter and Michaelmas By Can 60 of the English Church, such visitations for the purpose of confirmation must be triennial at least The [illegible] of the ancient practice has by degrees devolved [illegible] archdeacon [illegible] bound to see that the offices of the church are duly administered, to keep account of the ornaments, vestments, &c appertaining to the churches, to examine into the state of repair of parsonages, churchyards, &c; and to receive presentments of excesses committed by ecclesiastical persons Ecclesiastical corporations, such as conventual bodies, had usually their special visitors appointed by the founder, as is the case at present with colleges in our universities, hospitals, &c

VISITATION A festival of the Western Church, in honour of the visit of the Virgin Mary to Elizabeth; said to have been first instituted among the Franciscans by Saint Bonaventure, general of that order It is celebrated on the 2d July A female religious order was founded in Savoy in 1610 by St Francis de Salis, in honour of the visitation

VISUAL ANGLE, in Optics, is the angle under which an object is seen, or the angle formed at the eye by the rays of light coming from the extremities of the object *Visual rays* are the lines of light coming from an object to the eye

VITAL VESSELS A name given by Schultz to certain vessels ramifying in all directions in plants, especially near the surface, and conveying latex, which that

physiologist calls a vital fluid The milk-vessels of [illegible] are vital vessels

VITELLUS In Botany, a name given to the fleshy sac that is sometimes present in seeds, interposed between the [illegible] enveloping the latter [illegible]

VITILIGO (Lat vitulus, *a calf*) A disease of the skin, giving it a white appearance somewhat resembling that of calves

VITIS (Celt. gwid, *a tree*), the grape vine, is doubtless a native of Asia Minor, although its universal cultivation renders it no longer possible to distinguish the wild from the domesticated kinds It is the type of the Vitaceous order, which consists of plants climbing by tendrils and producing astringent berries succeeded by succulent fruit Some of the species are however to be compared with the true grape *Vitis vinifera* for quality, the best of the American species being disagreeable to the taste and some of the order even acrid The reputed varieties of grape are innumerable if we are to believe the writers on the subject, 1400 being cultivated in the garden of the Luxembourg alone There is no doubt however that many of these are repetitions of each other When the pulp is fleshy and sweet, and the skin thick, raisins are prepared from the fruit, and when it is watery and less sweet, with a thin skin grapes are best suited for wine The currants of the grocers are the dried berries of a small variety of the grape cultivated at Zante

VITREOUS HUMOUR so called from its glassy appearance is the third or interior humour of the eye, filling a large portion of the eyeball and greatly exceeding in quantity the aqueous and crystalline humours together According to Sir D Brewster, the refractive power of the vitreous humour is 1 3394 See OPTICS

VITRIFIED WALLS or FORTIFICATIONS Ancient remains discovered in Scotland, constructed of stones piled rudely upon one another and firmly cemented together by some matter which has been vitrified by means of fire They generally surround the top of some steep conical hill They have been discovered chiefly in the Highlands, but also in Galloway The vitrification is mostly external the interior of the walls being a mere heap of loose stones Daines Barrington considered the vitrification to be accidental, but his explanation of how it took place is not very intelligible (*Archæologia*, vol vi) It seems more reasonable to suppose that the art was derived from observation of the ease with which some kinds of earth containing much iron ore are vitrified by fire and that the process was rendered easy by the quantities of wood which in early days covered the Highlands

VITRINA (Lat vitrea *glass*) A genus of fresh-water Gastropods, so called from the extreme thinness and fragility of the shell, and its watery green appearance *Vitrina pellucida* and *Vitr elongata* are natives of Great Britain

VITRIOL (Lat vitrum *glass*, from the glassy character of its crystals) This term is applied by the old writers to crystallized sulphate of iron, or *green vitriol* sulphate of copper and sulphate of zinc were afterwards called *blue vitriol* and *white vitriol* See IRON, COPPER, ZINC

VITRIOL, OIL OF The old name of sulphuric acid, which was originally obtained by distilling green vitriol See SULPHUR

VIVACE (It *lively*) In Music, a term which, affixed to a movement, denotes that it is to be executed by the performer in a lively manner It is a mean between *allegro* and *largo*, but, if any thing, rather nearer the former than the latter

VIVERRIDÆ (Lat viverra, *a ferret*) Civet tribe The name of a tribe of Carnivorous Mammals of which the genus *Viverra* is the type The characters are three premolars above and four below, two tolerably large tuberculate molars above, one tuberculate and one sectorial molar below, the tongue beset with firm papillæ, claws more or less retracted, a large anal scent-gland and pouch

VIVIPAROUS (*Viviparus*) (Lat vivus, *alive*, and pario, *I bring forth*) Those animals are so called which bring forth their young developed and alive, and commonly extricated from the egg coverings, as all the Mammalia, which were hence called Zootoka by Aristotle, many reptiles, as the viper or "viviper," some fishes, and numerous invertebrate animals In its restricted sense, the term signifies that mode of generation in which the chorion, or external tunic of the ovum, contracts a vascular adhesion with the uterus, and hence only the Placental Mammalia are truly viviparous, the rest being termed ovi-viviparous

VIZIR (In Arabic *a porter*, and, by a singular metaphor, the title in various oriental countries of a minister and councillor of state) The grand khalifs had their vizirs, who attained to the highest rank and consideration in their states, and were often more powerful than their masters, but after the creation of the new dignity of Emir-ul-omrah (commander of commanders), by Khalif Radh [illegible] consideration In [illegible] in the divan, generally eight in number, are styled vizirs, and the chief among them vizir azem, rendered by us by grand vizir, which is the highest temporal dignity in the empire

VOCATION (Lat voco, *I call*) In Divinity, the grace vouchsafed by God to any man in calling him from death unto life putting him into the way of salvation It is also used for the call of the Holy Spirit, by which persons are supposed to be initiated into the [illegible]

[illegible] produced by the vibration of air emitted from the lungs of animals which vibration is caused by an organ developed in the wind pipe, called the "larynx" Mammals, birds, and reptiles, are the only animals, which, according to the above definition, possess a voice, but many species of other classes produce peculiar sounds by which the individuals are attracted to each other or express their wants and feelings A true organ of voice includes the lungs, bronchi, trachea, larynx and mouth The most essential parts are two vibratile chords bounding a slit shaped aperture called the "glottis," and this may be situated at different parts of the air-tube in different animals, the portion of the tube between the glottis and the oral outlet being the true sonorous instrument In mammals and reptiles the glottis is situated at the end of the wind-pipe which communicates with the bronchial tubes and consequently the whole trachea becomes, in this class, part of the vocal instrument The organ of voice in reptiles consists of a simple larynx, without an epiglottis and in which the glottis is merely membranous, not provided with fibrous vocal chords Since neither fleshy moveable lips nor soft palate exist in this class, the voice cannot undergo any farther modification after its formation by the simple larynx It consequently rarely rises beyond a hiss, and in the frog tribe, where the bones or gristles of the larynx are largest and most complicated and the vibratile membrane of the glottis is best developed, the voice is only a more or less noisy croak

In mammals the air driven by the muscles of expiration from the lungs through the trachea strikes against the two vibratile vocal chords which bound the sides of the glottis, and a voice is produced varying in different animals according [illegible] of tensions of the [illegible] shape, and various [illegible] of the pharynx, of the tongue, and of the mouth and lips

The superior organization and mobility of the tongue and lips enables man to modify his vocal sounds so as to render them articulate and adapted to express the ideas which it is his peculiar privilege to form Although some quadrupeds possess the imitative faculty, and can be taught to do certain tricks it would seem that the physical condition of their vocal organs is an insuperable impediment to their imitation of the human speech

The sacculi or membranous pouches which communicate with the larynx in the chimpanzee, orang and most other quadrumanous animals, together with their thicker and more confined tongues and less flexible lips, are assumed to constitute the impediments to speech in them, but it may be doubted whether they have the imitative faculty for sounds possessed by the parrot or starling, and in respect of their voluntary application of their vocal organs to speech the absence of any such [illegible] is accounted for by presuming that they [illegible] to say

In birds, which possess the most diversified and complicated organ of voice, combined in some species with a [illegible] instances are not uncommon, [illegible] and crow tribe, of an acquired power of forming articulate sounds superadded to the [illegible]

VOIR DIRE (Norm Fr a corruption of vrai dire, *to speak the truth*) In Law, according to ancient practice, an objection to the competency of a witness, in a trial at common law, could only be taken on a preliminary examination, in which the witness was sworn *to speak the truth*, and then examined touching his interest in the subject matter The same practice is still followed occasionally, although the objection may now be taken when it arises on the examination in chief.

VOLATILE ALKALI See AMMONIA.

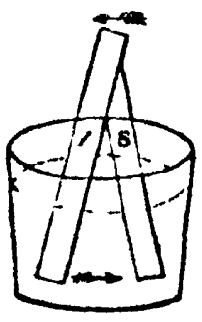
VOLCANO See GEOLOGY

VOLTA-ELECTRIC INDUCTION The term *induction*, as applied to common electricity (of tension), has been explained under the word ELECTRICITY By volta-electric induction, we mean that is [illegible] was discovered by Mr Faraday (*Philos Trans*), and were briefly as follows — A long copper wire was wound in the form of a spiral round a cylinder of wood a similar but perfectly separate spiral, was then wound upon the same rod, the coils of each

being interposed and close to each other, but nowhere in contact; the extremes of one of the wires were then connected with the galvanometer and those of the other with a voltaic battery At the moment of making the contact with the battery, as well as of breaking it, the deflection of the galvanometer indicated a current of induced electricity in the proximate spiral, but in the interval, that is, while the current of electricity was continuing quietly to traverse, no deflection took place the induced current was found to be in one direction upon making the contact, and in an opposite direction upon breaking it

VOLTAIC ELECTRICITY The phenomena resulting from the evolution of electricity by chemical action, as manifested by that important instrument of electro-chemical research called the *Voltaic Battery*, are usually included under the above term Whenever substances act chemically upon each other their electrical states are disturbed, but the electricity thus evolved is, in ordinary cases, so lost and dissipated as to escape observation It may, however, be rendered manifest by the following simple arrangements —When a plate of pure zinc (or of common zinc rubbed over or amalgamated with mercury) is dipped into a glass of very dilute sulphuric acid, little or no action is observed, nor does any thing happen when a similar plate of silver is placed in the same cup of acid provided the metals be kept apart from each other But if as in the annexed figure, the zinc and silver be brought into contact, at their extremities out of the liquid, the water is decomposed, its oxygen combines with the zinc to form oxide of zinc, which is dissolved by the acid, and its hydrogen passes over to the surface of the silver, where it collects, and ultimately escapes in gaseous globules These phenomena are further connected with the production of a continuous current of electricity passing *from* the zinc across the water *to* the silver, and again from the silver by metallic contact, to the zinc, in the direction represented by the darts It is not necessary that the metals should be connected exactly as represented in the above diagram, but it *is* necessary to the establishment of the continuous electric current that they should be somewhere in contact, or at least connected by what is usually termed a perfect conductor By modifying (as represented in the margin by fig 2) the preceding arrangement, so that the metallic contact between the plates be made *out* of the vessel, namely at the point A the electric current takes the same direction travelling through the liquid *from* the zinc or generating plate *Z to* the conducting plate S, and through the wires B and C back again to Z, as shown by the darts Here again Z is oxidized and dissolved, and hydrogen is liberated upon S, but the moment that the circuit is broken, by parting the wires at A these actions cease, because the electric current ceases to flow It is evident that various substances may be interposed between the wires at A, or they may be immersed into different liquids, and provided these are capable of transmitting electricity the current will still pass, and its phenomena under a variety of circumstances may be studied In this arrangement the end of the wire B is the *emitting*, and of C the *receiving* point or pole, hence these have been termed, in reference to the common electrical machine, the *positive* and *negative poles* Mr Faraday with a view of avoiding certain misapprehensions to which these terms give rise calls them the *electrodes*, the positive electrode he further terms the *anelectrode*, and the negative the *cat-electrode* *See* ANODE

(1)

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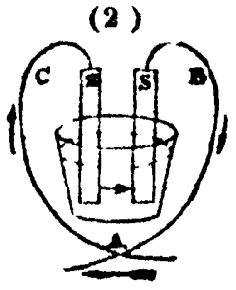


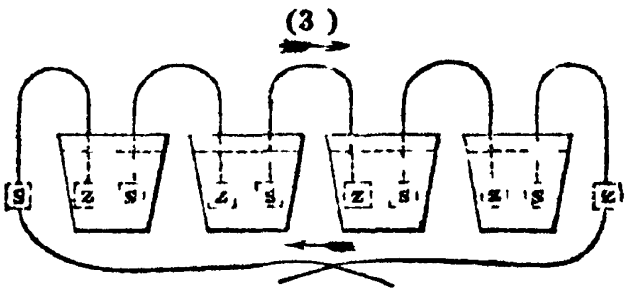

In the preceding paragraph it has been assumed that the generating metal is *zinc*, the conducting or conveying metal *silver*, and that the intermediate liquid is *dilute sulphuric acid* A number of other metals may be substituted for the above; namely, for the zinc, cadmium for instance, or iron, and for the silver, platinum, gold, or copper Many liquids may also be substituted for the dilute sulphuric acid, the requisite condition being that one of the metals shall be chemically acted on whilst the other is indifferent, or at least not acted on by the liquid to the same extent And the current is always in the direction above represented, that is to say, passes *from* the metal most attacked *to* that least attacked, whenever the communication is perfect or the circle closed In the above cases also certain forms of charcoal, which are excellent conductors of electricity, may be substituted for the conveying metal or passive element of the arrangement Another requisite condition [illegible] *Voltaic* is, that the [illegible] further, that it shall be capable of that form of decomposition which Faraday has designated *electrolysis*, that is, resolvable into its elements by the electric current *See* ELECTROLYTE

Such, then are the conditions requisite for this evolution of electricity The existence of the electric current, and its direction may be rendered manifest in various ways the most striking is perhaps afforded by its magnetic effects, as exhibited by the galvanometer *See* GALVANOMETER and ELECTRO-MAGNETISM

The *quantity* of electricity generated in the above instances depends chiefly upon the superficial extent of the metals concerned, and upon the activity of the liquid acting upon the generating metal, and that it is considerable, even where small surfaces and weak acids are used is manifest by the violence with which the magnetic needle of the galvanometer is deflected But in the above described arrangements, the *intensity* of the electricity is very feeble, and in order to attain this, and to give the current that apparent impetus which it requires to traverse bad conductors, and easily to effect electrochemical decompositions, it becomes necessary to repeat the fundamental alternations, or, in other words, to employ a properly arranged succession of [illegible] conducting, and electrolytic substances This was the great discovery of Volta, namely, the [illegible] *Voltaic Pile* or *Battery*

In this arrangement, which, like the simple circles, admits of infinite varieties, the metals generally used are zinc on the one hand, and copper or silver or platinum on the other The alternations originally adopted by Volta, and which are quite effectual, were zinc, silver, and flannel or pasteboard soaked in acid, and these were repeated according to the effects that were to be obtained The inconvenience of arrangement led him, however, to various modifications of it, and, among them, to that represented in the following diagram (fig 3), which he called the *crown of cups* (couronne

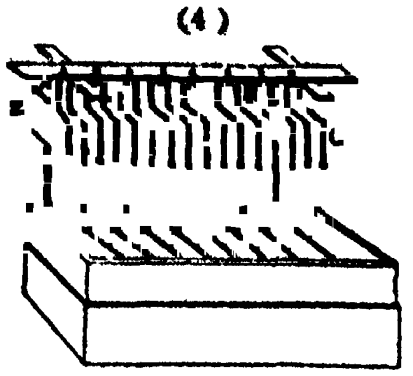
(3)




des tasses), and which, slightly modified, has since been very generally adopted The flannel is rejected, and in its place a cup of dilute acid, or other proper electrolyte, is substituted, so that each silver and zinc plate are in [illegible] the vessels the [illegible] Z and [illegible] acid, silver Ag Here [illegible] the course of current is the same as in the simple circle, namely, from the zinc through the liquid to the silver, but in this form of the apparatus, for the mere convenience of carrying on the series, the conducting wire connected with the first zinc plate has a supernumerary silver one attached to it, and that with the last silver plate a supernumerary zinc plate, so that much confusion has arisen in regard to the direction of the current in these cases, in consequence of calling what is here the silver extreme the *negative pole*, and the zinc extreme the *positive pole*, whereas it is in fact the reverse, and the circulation of the current goes on through the electrodes precisely as in the simple circle But though the *direction* of the current is the same, and the absolute *quantity* of travelling or circulating electricity not increased, the case as regards *intensity* is very different, and with numerous series arranged as above we obtain, on removing the electrodes (which in this experiment ought to consist of pointed pieces of well-burned boxwood charcoal) a little from each other, a most brilliant and continuous current of fire, luminous, so that the eye can scarcely endure it, and capable of overcoming obstacles and traversing conductors and electrolytes in a way essentially different from that of the simple circuit Yet even with all these energetic phenomena, and with a quantity of circulating electricity far beyond any thing which the most powerful frictional machines can afford, the intensity is still insufficient to penetrate a thin layer of card or paper, or to make its way through non-conducting obstacles, as it does in the case of the discharge of the Leyden jar or battery And now, if the hands be well moistened with salt and water, so as to overcome the non-conducting tendency of the cuticle, and the body be made part of the circuit, an extraordinary and unendurable sensation is perceived, which is in fact a *continuous shock* By the same means wires may be ignited, metals burned, combustibles exploded, magnets made and galvanometers affected, at any distance from the pile, provided the conducting communication is perfect Thus it is that this power has been used to blast rocks, to explode gunpowder under water, and to communicate telegraphic signs, as in the arrangement of Professor Wheatstone

The modification of Volta's couronne des tasses, and the form of voltaic apparatus in most general use, is the annexed (fig 4), in which the plates are attached, in proper order and connection, to a piece of dry wood, so that they may at once be plunged into the cells of the porcelain trough over which they are suspended Sometimes also plates of zinc and copper soldered together are cemented into a wooden trough with intervening cells, which when required for action are filled with proper acid or saline solutions as shown in fig 5

(4)



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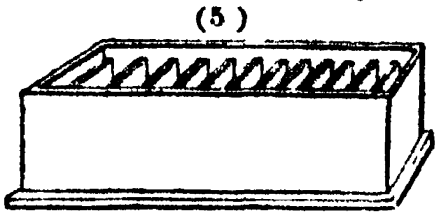
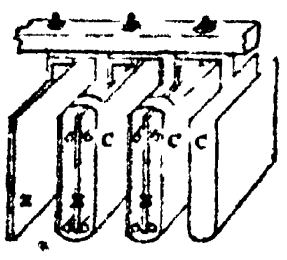


An important modification, as regards the arrangement of the plates of fig 4, introduced by Dr Wollaston, is represented in fig 6, in which the copper plate, instead of being single, is doubled over the zinc plate actual contact being prevented by wooden cylinders placed between them In this way much of the electricity lost in the preceding arrangements is brought into circulation

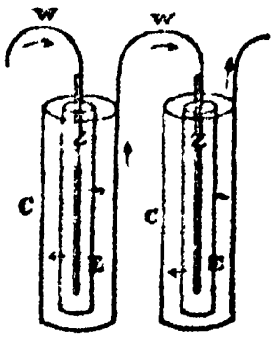
(6)




But the most important modification of this instrument is that suggested by Mr Daniell, and which he terms a constant battery In all the preceding arrangements the electrical power is liable to fluctuation, and after a time various causes induce such a falling off of its evolution as to render them inconvenient, or even useless where continuous or regular action is required In Wollaston's battery, for instance, which is the best of them, several circumstances combine to render it inconstant in its action the adhesion of hydrogen to the copper plate and the precipitation of zinc upon it, the saturation of the acid by oxide of zinc, and the local action which common zinc induces are perhaps the principal sources of the above mentioned irregularity and inconstancy In Mr Daniell's arrangement those inconveniences are to a great extent obviated, and although it is more complicated than the preceding, its constant and regular action, when it is properly constructed, amply repays the additional trouble and expense there are, [illegible] can scarcely be carried [illegible]

The annexed diagram fig 7, which is intended to represent two cells of the constant battery, may perhaps serve to illustrate

(7)




C [illegible] vessels of copper, [illegible] cylinders or tubes of porous earthenware, Z Z are rods of amalgamated zinc which are connected by the wires W W with the next copper cylinder, and so on in succession The porous tubes are filled with dilute sulphuric acid (about 1 part of acid to 8 of water), and the copper vessels are filled with a strong solution of sulphate of copper, also acidulated by sulphuric acid so that the acid in the generating cells is separated from [illegible] of a [illegible], but the porosity of the [illegible] so far imbued with the [illegible], ssage of electricity, the current being in the direction of the darts At the same time the sulphate of zinc is prevented mixing with the sulphate of copper [illegible] upon the copper prevents [illegible] hydrogen evolved [illegible] s to reduce the oxide of [illegible] and to form [illegible] which [illegible] of metallic copper [illegible] become lined In proportion as the sulphate of copper is decomposed fresh portions of that salt are added, and the acid in the generating cells requires occasional renewal for the former purpose the [illegible] receptacle or colander in the upper [illegible] which is kept filled with crystals [illegible] (See *Daniell's Introduction to Chemical Philosophy*, p 438)

It has already been stated that, in all the ordinary forms of the voltaic battery, two metals and an acid dissolved in water are the essential elements. But it is by no means necessary that two metals should be employed to [illegible] for if only one metal be used [illegible] are differently acted on by an acid or other fluid, electricity will be evolved, according to the same law, a particle of the metal most acted on becoming [illegible] rent is established [illegible] oxidized or corroded zinc are used, or even when one of the plates is of cast and the other of rolled zinc So also when a stick of copper, clean at one end and corroded at the other, is immersed in dilute nitric acid, an electric current is produced In all these cases the surface most open to chemical action corresponds to the zinc, and that least so to the silver of the above described simple circles

An electric current is also manifested when a single plate of metal of uniform surface is acted on by two fluids exerting distinct chemical actions upon it If, for instance, a vessel be half filled with a strong solution of sulphate of copper and then carefully filled up with dilute sulphuric acid, so that the latter may lie upon but not mix with it, a plate of iron immersed will be so acted on as to produce an electric current, the upper part becoming the equivalent of the zinc, and the lower that of the copper in the simple circle A plate of copper immersed in the same way will produce a similar effect, and metallic copper will be deposited upon its lower end (See *Faraday's Researches*, *Philosophical Transactions*, 1840)

The chemical powers of the electric currents produced by and circulating under the circumstances above detailed [illegible] recently noticed, [illegible] the phenomena [illegible] by interposing different substances between the electrodes in proper vessels, so that the changes which they suffer in the axis of the electric current may be more conveniently and distinctly observed. Under these circumstances we find that all electrolytes must, to a certain extent, be conductors, and that the same body in different states may either be or not be an electrolyte, according as it has or has not a power of conduction Thus *water* is a conductor and an electrolyte, but *ice* is a non-conductor, and therefore unsusceptible of electrolysis So also nitre, chloride, iodide, and bromide of silver and many other salts, require to be *fused* in order to become susceptible of electrolytic action It would moreover appear probable, from Faraday's researches, that all bodies susceptible of true or primary electrolytic action (electric decomposition) must be compounds of single atoms, or equivalents of their components (*proto-compounds*) thus protochloride and protoiodide of tin are decomposed but the bichloride and biniodide are not Of this phenomenon the ultimate cause requires further investigation The principal apparent exceptions to it have been ranked by Faraday among cases of *secondary decomposition* Thus when common sulphuric acid, or oil of vitriol (which is a compound of 1 atom of sulphur, 3 of oxygen, and 1 of water, or the ultimate elements of which are 1 atom of sulphur, 1 of hydrogen, and 4 of oxygen), is subjected to the electric current, sulphur and hydrogen appear at the cathode (or negative electrode), and oxygen at the anode (or positive electrode) But in this case the sulphur is the result of the action of the hydrogen upon the acid, for in all cases of true or primary electrical decomposition of the sulphurets, the sulphur is evolved at the anode

[illegible] laws, but *proximate* elements are also similarly separated Thus when sulphate of soda, nitrate of potassa, and other neutral salts, are subjected in aqueous solution to the action of the current the respective acids travel with the oxygen [illegible] and the bases oxides or bases, with their [illegible] to the cathode Faraday terms substances susceptible of these transferences *ions*, and those which go to the anode *anions*, those to the cathode *cations* thus doing away with the less definite terms of *electro-negative* and *electro-positive* bodies And he has drawn up the following table of simple and compound anions

*Anions.*

| | |
|---|---|
| Oxygen | Sulphuric acid |
| Chlorine | Phosphoric acid. |
| Iodine | Carbonic acid |
| Bromine | Nitric acid |
| Fluorine | Selenic acid |
| Sulphur | Chloric acid |
| Selenium | Boracic acid |
| Cyanogen | Acetic acid. |
| Sulpho cyanogen | Tartaric acid |
| | Citric acid |
| | Oxalic acid. |

*Cations.*

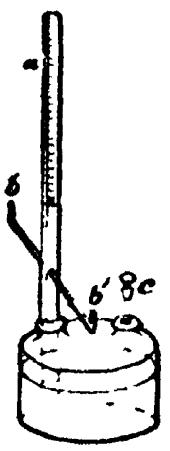
| | |
|---|---|
| Hydrogen. | Nickel |
| Potassium. | Antimony. |
| Sodium | Bismuth. |

| | |
|---|---|
| Lithium. | Mercury |
| Barium | Silver |
| Strontium | Platinum. |
| Calcium. | Gold |
| Magnesium | Ammonia. |
| Manganese | Potassa. |
| Zinc. | Soda |
| Tin | Lithia. |
| Lead | Baryta |
| Iron | Strontia |
| Copper | Magnesia |
| Cadmium | Alumina |
| Cerium | Protoxides generally |
| Cobalt | Vegeto-alkalies generally |

Analogy leads us to assume that all elementary bodies are *ions*, but this has not been experimentally proved in regard to carbon, phosphorus, nitrogen, silicon, boron, and aluminium

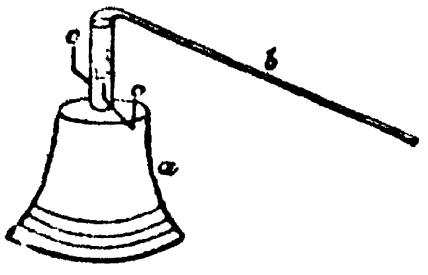
VOLTA'METER (Ital volta, and Gr μετρον, *a measure*) An instrument contrived by Mr Faraday for measuring the voltaic electricity passing through it, and which, being interposed in the course of the current used in any particular experiment, serves as a *comparative standard* of effect, or as a *positive measurer* of the electricity

The indicating body used in this instrument is water acidulated by sulphuric acid The electrodes are plates of platinum, and the quantity of electricity which has passed is indicated by the quantity of the mixed gases (oxygen and hydrogen, resulting from the decomposition of the water) evolved, or, in other words, by the weight of water decomposed When the quantity of evolved gases is small, the voltameter represented in the margin




two platinum electrodes, connected with the external wires *b b* This tube is fitted by grinding into one mouth of the double-necked bottle acidulated water, and is , so that when an electric current is passed through it the gases evolved collect in the upper part of the tube and displace the dilute acid, the stopper *c* being left open When the graduated part of the tube is filled with the mixed gases the electric current may be broken by removing the wires connected with *b b*, the stopper *c* replaced and the meter-tube refilled by inclining the instrument, a second measure of the gases is then collected on re establishing the circuit, and so on

When large quantities of the mixed gases are to be measured as in cases where the current is left continuous for several hours or days, a voltameter in the form of a small retort may be used set up in the block or foot *a*, and the evolved gases will then pass by the tube *b* into the common pneumatic trough, where they may be received into a graduated jar and measured *c c* are the projecting wires by which communication is made with the platinum electrodes




In using these and similar forms of apparatus for the electro-chemical decomposition of water great care must be taken that the electrodes are kept clean and covered by the water, and that their ends are never exposed to the mixed gases in the tube, for in that case they would be apt to become heated and even incandescent, in consequence of the peculiar action of clean platinum on a mixture of hydrogen and oxygen, and in such a case an explosion might take place In these voltameters the contact of the electrodes must be prevented by inserting between them a small piece of glass tube

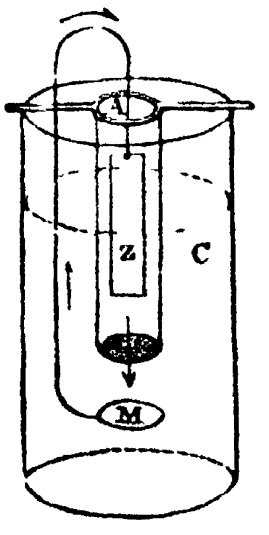
VOLTATYPE or ELECTROTYPE It has been stated under the article on Voltaic Electricity, that , are in certain cases decomposed, so that the metal in its pure state is deposited upon the cathode or upon what is usually termed the negative electrode In these cases the metallic deposition is usually a secondary effect, arising out of the action of the hydrogen evolved at the cathode upon the oxide of the metal A good illustrative experiment of this metallic precipitation consists in plunging two pieces of clean platinum into a solution of sulphate of copper nothing happens But if the electric current be transmitted through the solution, so that these platinum plates may form the electrodes, copper is immediately precipitated upon the catelectrode or negative surface, the positive surface or anelectrode remaining clean. If the current be now reversed, the copper will be removed from the platinum plate upon which it had just been deposited, and will be transmitted to the clean plate, and thus by reversing the direction of the electric current, the copper may be sent backwards and forwards, it always being deposited upon the negative pole, or, in other words, upon that surface by which the electric current leaves the electrolyte A solution of sulphate of copper suitable to this experiment, , acidulated by sulphuric acid , and the copper in a clean metallic state, and by a continuance of the electric current, and keeping up the strength of the solution by the occasional addition of fresh portions of the salt of copper, the metallic film upon the cathode may be obtained of any required thickness, and may afterwards be peeled off the platinum surface The texture of the deposited copper varies with the power employed and with the temperature and strength of the solution, so that it may be obtained hard, brittle, and crystalline, or malleable and tough, or even pulverulent, according to the management of the operator A low electric power, or rather a current of low intensity, a moderately strong acidulated solution of sulphate of copper, and a temperature not below 60° or 70°, are the circumstances under which the best deposit of copper is usually obtained for the purposes to which this process is commonly applied

When the negative pole or cathode, instead of being, as above represented a plane surface of platinum, is irregular, or worked into a pattern, or a medal or coin for instance, an exact impression of the irregularities of surface, or of the device upon the medal or coin, may be taken off on , and to copies or plates of this kind by proper management, be substituted or copper a variety of voltatypes may be obtained or if the precipitated metal be left upon the surface on which it is thrown down gilding silvering and applications may be extensively and beautifully effected This whole new art of *plating* has arisen also out of these electro-chemical actions

We shall now proceed briefly to point out the manipulation in a few of the principal applications of this new art, and to describe the apparatus commonly employed, illustrating the subject in the first instance, by one of the simplest cases, in which we will suppose that an impression in copper is to be obtained from a copper medal, which, being in relief, will of course yield an impression in indent the original being a cameo, the copy will be an intaglio

The medal is first slung in a loop of annealed copper wire so that it may be conveniently suspended and made electro-negative in the metallic solution, the following simple voltaic arrangements may then be used

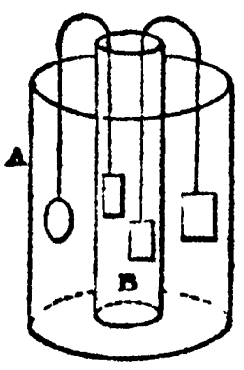
A is a glass cylinder (a common lamp-glass answers the purpose), closed at bottom with a piece of bladder, or with a plug of plaster of Paris, and filled with dilute sulphuric acid (1 of acid to 8 of water by measure), Z is a piece of zinc immersed in , connected by copper wire with the medal M, C is a jar nearly filled with a strong solution of sulphate of copper, acidulated by the addition of about a tenth part of sulphuric acid In this arrangement the acid in the generating cell is prevented mixing with the solution in the jar by the diaphragm of bladder or plaster, which, however when thoroughly wetted, suffers the electric current to pass from the zinc to the medal (or negative pole) and so through the wire, in the direction of the darts, back to the zinc In this way a film of metallic copper is gradually thrown down upon M, which goes on increasing, and which, when it is sufficiently thick (perhaps in 24 or 30 hours), the wire with Z and M at its ends is lifted out, and by the point of a knife carefully a , if necessary, by a file, the deposited of M, of which it presents a faithful and minute copy or impression To prevent the deposition of copper upon the edges, and upon the reverse of the medal, those parts should be covered with a varnish not acted upon by the solution, and the connecting wire should also be similarly varnished, to prevent its receiving an unnecessary incrustation of copper In this way, by careful management, any number of impressions may be taken from either side of a medal without materially injuring the original, and for the medal a metallic plate may be substituted, provided its dimensions and weight be not such as to render it inconvenient or inconvenient in this form of apparatus




But it often happens that the article to be *voltatyped*,

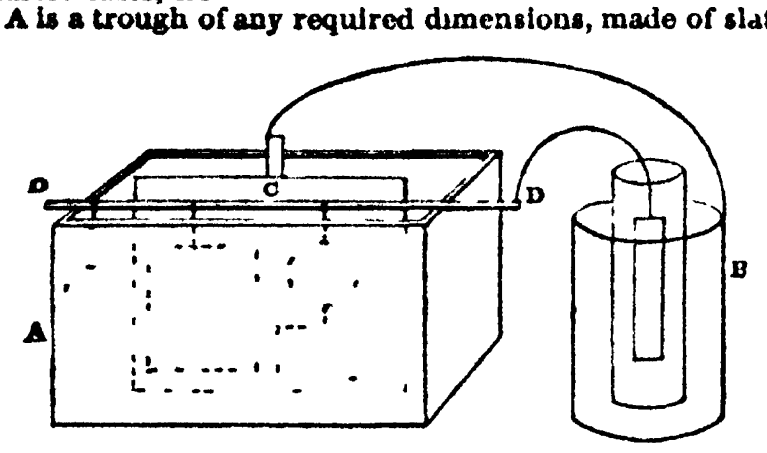
as this process is now called, is not a conductor of electricity, as, for instance, a seal, or sulphur or wax impression, or a plaster cast of a medal or coin In these cases the surface is carefully covered by a film of the purest plumbago, or black lead, which is applied by a soft brush, and which, being a good conductor of electricity renders the surface equivalent to that of a metal care being at the same time taken that the conducting wire is in good contact with the plumbago, so that the electrical current may be nowhere intercepted by a non-conductor Where the material of the cast is porous, or permeable to water, it must be imbued with melted wax or oil, or some kind of fatty matter, where plaster casts are used, melted [illegible] the surface to be voltatyped is [illegible] ded and the process carried on as above The use of black lead so extremely convenient in these and a number of similar cases was first suggested by Mr Robert Murray and communicated by him to the Society of Arts, who awarded a medal for the invention

In the case of seals, coins, and other small articles, a number of them may be put in process at once by the following modification of the above described apparatus A is a jar filled with a saturated and slightly acidulated solution of sulphate of copper, B is a porous earthenware cylinder, similar to those used in Daniell's constant battery, filled with dilute sulphuric acid The articles to be coated with copper are prepared as above described and attached to copper wires having a small piece of zinc at their other end, several of these may then so be suspended round the porous tube as that the zinc being in the acid, and the coin or seal in the cupreous solution the process goes on until the voltatype is perfect




When a number of articles of different sizes are to be voltatyped, the following is the preferable arrangement, and is that which is generally used where the process is employed upon a large scale, as in preparing voltatypes from wood-cuts, copper-plates, plaster casts, &c

A is a trough of any required dimensions, made of slate




or wood, and filled with a proper solution of sulphate of copper, C is a copper-plate immersed in the trough and forming the positive electrode of the constant battery B (of which one cell only is here represented but of which two or more may be employed as required), D D is a copper rod forming the negative electrode, to which the articles to be coated with copper are suspended by copper wires These several articles, previously properly prepared by the means above described, are retained in the circuit till adequately coated by copper In this form of a, para[illegible] it is not necessary to [illegible] the impoverishment of the cupreous solution [illegible] portion to the quantity of copper deposited upon the moulds is that which is taken up from the plate C, and when this plate is so far dissolved as no longer to form an effective electrode it must be replaced by another

Where other metals are to be employed, proper solutions must be selected for the purpose, and the electric power modified accordingly the weakest power, consistent with the precipitation of the metal and the non-evolution of hydrogen at the negative electrode, is that which is generally to be preferred For gilding copper or silver, the solution which is generally employed is a double cyanide of gold and potassium it is made by dissolving about 60 grains of sulphuret or of oxide of gold in a pint of a solution of cyanide of potassium containing 1 part of the cyanide to 10 of water The sulphuret of gold is prepared by precipitating a solution of perchloride of gold by sulphuret of potassium, and washing the precipitate with hot water the oxide of gold may be similarly prepared by precipitating the solution of the chloride of gold by potassa at a boiling heat With this solution silver and copper may be effectively gilded, and the thickness of the coat of gold may be carried to any required extent If it be desired to gild the inside of a silver vessel, the vessel may be filled with the gilding solution, and connected by its outside with the negative electrode, a plate of gold immersed into the centre of the solution in the vessel constituting the positive electrode

For covering or plating articles with silver, a solution of 60 grains of chloride or of oxide of silver in a pint of the solution of cyanide of potassium of the strength above stated is to be used In this case the article which is to receive the deposit is made the negative electrode, and a plate of silver may be used as the positive electrode Here, as in the case of gold, the plating may be carried to any extent, and articles from which the silver has been abraded by wear may easily be replated

In all cases where silver or gold is to be thus voltaically deposited so as to give a durable adhesive coating, the receiving surfaces must be perfectly clean, hence the necessity of dipping them in the first instance into warm aquafortis (or nitric acid diluted with three or four parts of water), and then washing them in a large quantity of pure water, previously to putting them into the solution it is also generally right to make the connection with the battery, and immerse the positive pole, previous to putting the article into the depositing liquid Messrs Elkington of Birmingham, who have patented these operations, have produced a number of beautiful specimens both of gilding and silvering, and have largely applied them in numerous processes of the arts

Mr Palmer of London has made the most important applications of these precipitations to the purposes of the fine arts, in voltatyping the plates of engravings executed by the first artists In these cases much care and dexterity are required in the manipulations, but the results are then beautifully perfect The first impression of the etched or engraved plate is of course in relief, and serves as a *matrix* from which any number of impressions in indent (or fac similes of the original plate) may be obtained Mr Palmer has also invented various modifications of the process, full descriptions of which would be inconsistent with our present object, but which promise to render it much more extensively subservient to the purposes of the fine and useful arts Messrs De la Rue have also carried these processes to great perfection and have extensively multiplied their applications to various purposes of ornamental printing See the article VOLTAIC ELECTRICITY in this Dictionary Also Mr Smee's *Elements of Electro Metallurgy*, whose platinized silver battery is well adapted to most of the preceding operations)

VOLTA (It *turn*) In Music, a term directing that the leaf is to be turned over

VOLUME (Lat volumen, from volvo, *I roll*) A book Thus a library is said to consist of so many thousand volumes, and a long work is divided for convenience into several volumes Every single roll of paper or parchment, in an ancient library, was of course equivalent to a single book in one of our own, hence the name is derived It should seem that the *books* (in the sense of divisions of the subject) of ancient works were originally [illegible] that the *History* of Herodotus [illegible] of as many volumes, in ordinary writing, as books The French word *tome* (signifying, properly, a single volume of a work containing more than one) is derived from the Greek τεμνω, *to cut* or *divide*

VOLUTA (Lat voluta, *a wreath*) A name applied by Linnæus to a genus of the *Vermes Testacea*, including those which have a univalve spiral shell, with an aperture without a beak, [illegible] and a columella twisted or plaited [illegible] lips or perforation The Mollusca thus characterized form a family in the Buccinoid tribe of the Gastropods of Cuvier's system, and the [illegible] genera *Oliva* Brug [illegible] *Voluta* proper, *Cymbium* Mont *Marginella* Lam, *Columbella*, Lam, *Mitra*, Lam *Cancellaria* Lam

VOLUTE (Lat. volvo, *I* [illegible] the spiral scroll appended on each side to the capital of the Ionic order The Corinthian and Composite capitals are also decorated with volutes, but their character is different, their size smaller, and they are always diagonally placed In the Corinthian order they are more numerous, and in the Composite they are larger than in the Corinthian

VOLVA, or WRAPPER A term used in describing fungi to denote the involucrum-like base of the stipes of *Agaricus* It was originally the bag enveloping the whole plant, but was left at the foot of the stipes when [illegible] burst through it [illegible] volvere, *to roll up*, because it was supposed to arise from twisting of the intestines) See ILIAC PASSION

VOMICA (Lat vomo, *I spit up*) An abscess of the lungs

VOMITORIA (Lat vomo) In Architecture, the openings, gates, or doors, in the ancient theatres and amphitheatres, which gave ingress and egress to the public.

VO'RTEX. (Lat ) An eddy or whirlpool; a body of water running rapidly round and forming a cavity in the middle into which floating bodies are drawn The term is also applied to whirlwind In the Cartesian philosophy vortex signifies a collection of material particles forming a fluid or ether, endowed with a rapid rotatory motion about a axis By means of this hypothesis and the received doctrine of centrifugal forces, a plausible explanation may be given of the motion of the planets, which move nearly in the same plane, but the motions of the comets which traverse the heavens in all directions are inexplicable, and in fact are inconsistent with the hypothesis Descartes, nevertheless, had the merit of attempting to show how the universe might have assumed its present form and be preserved on mechanical principles For an explanation of the system of vortices, see *Maclaurin's Account of Newton's Philosophical Discoveries*

VO'RTICEL *Vorticella* (Lat vortex *a whirlpool*) The generic name of certain pedicellate Wheel Animalcules, which are provided with vibratile organs at their anterior extremity, whose apparently rotatory actions produce little whirlpools in their vicinity, and thus attract the particles of food

VO'TIVE (Lat votum *vow*) In Numismatics, votive medals are such as were struck in grateful commemoration of any auspicious event, such as the recovery from sickness of a prince, &c, especially those of the Roman emperors struck every five ten or twenty years, on which the public vows on their behalf are recorded. The custom is said to have originated in the repeated continuance of Augustus in his [illegible] of the [illegible] of the people A votive tablet, picture &c [illegible] dedicated in consequence of the vow of a worshipper, in classical Europe to some deity, in modern Roman Catholic countries to saints

VOU'SSOIRS, in Bridges, are the stones which immediately form the arch, being of the shape of a truncated wedge Their under sides form the intrados or soffitt The length of the middle voussoir, or keystone, ought to be about 1 10th or 1-16th of the span, and the rest should increase all the way down to the imposts Their joints should be cut perpendicular to the curve of the intrados, consequently the angle of the sides is determined by the curvature (*Hutton's Tracts* vol 1)

VOW (Lat voveo, *I vow*) A promise made to God of a thing which we believe to be agreeable to him, and which we are not on other grounds obliged to render to him This is what the Theologians understand by it when they say "vow is 'promissio de meliore bono'" To promise God to do what he commands, or to avoid what he forbids, is not a vow, because we are under an obligation so to act (*Dict de Theologie* Toulouse [illegible] The use of vows is found in most religions The Roman Catholics adduce numerous passages from the Old Testament to prove that vows are acceptable to God, the Protestants on the other hand reject the theory of [illegible]

VOWEL, [illegible] a letter which can be pronounced alone, thus distinguished from consonants, which require to be sounded with the aid of a vowel They are divided in ancient prosody into long short and common [illegible] either long or short at pleasure A [illegible] two vowels, of which the sounds run (or are supposed to run) into one another

VU'LCAN In Mythology the Latin name for the divinity called by the Greeks Hephæstus,—the god who presided over the working of metals He was also called Mulciber He was the son of Jupiter who, incensed at his interference on the part of his mother Juno cast him out of heaven he fell in the isle of Lemnos and broke his leg in the fall His feats as the patron of armourers and workers in metal, his marriage with Venus, and her infidelities, form the subjects of many of the best known classical stories (See Bryant, *Anc Myth* vi 115) There is about the character of Vulcan much of the usual confusion belonging to Greek mythology Cicero mentions three Vulcans, besides the son of Jupiter: one, the child of Uranus, another, of Nilus, who reigned in Egypt [illegible] third of Mænalius A peculiarity attending the worship of Vulcan was, that the vic- [illegible] in reference to his character he is represented as bearded, with a hammer and pincers, and a pointed cap He does not appear lame, as represented by the poets Cicero, however, praises the sculptor Alcamenes for making his lameness observable without amounting to deformity The description of his cavern in the Isle of Vulcan, or Hiera, in the 8th Book of the *Æneid* is among the best known passages in classical poetry

VU'LPES (Lat *a fox*) This has been made a subgeneric term by those naturalists who so distinguish the foxes from the dogs, jackals, and wolves, to which they consequently restrict the term *Canis* The grounds for the proposed distinction are chiefly the form of the pupil of the eye, which is vertical in the foxes, circular in the dogs; the lobes of the upper incisor teeth are less distinctly marked than in the dog, the tail of the fox is longer and more bushy, its head broader, and terminated by a narrower and more pointed muzzle, its gait and attitude crouching

VU'LPINITE, so called from Vulpino, near Bergamo in Italy, where it is found An anhydrous sulphate of lime, containing a little silica It is sometimes employed by the Italian artists for small statues and other ornamental work, under the name of *marmo bardiglio*

VU'LTUR (Lat *a vulture*) The name of a Linnæan genus of diurnal Accipitrine birds, characterized by a elongated beak curved only at the extremity and by having a greater or less proportion of the head, and sometimes of the neck, denuded of feathers To the brief Linnæan phrase descriptive of this genus it may be added, that the power of the claws does not correspond with the bulk of the body The wings are so long that they are carried in the half-extended state when the vulture walks on the ground In general the birds of this group are of a [illegible] on dead carcasses and offal, their gullet dilates into a considerable crop, which, when distended with garbage, projects above the furcular bone When gorged with food a fœtid humour is discharged from the nostrils, and the bird is reduced to a state of stupidity The vultures of Linnæus are divided into the subgenera *Vultur*, Cuv, *Cathartes*, Cuv, *Sarcoramphus*, Cuv, *Percnopterus*, Cuv, *Gypaetus*, Storr

# W.

W A letter found only in the alphabets of modern languages In form, it resembles two Vs, and its English name is derived from the fact of the letter *v* being identical with *u* in the Latin, and in the more early form of the English language In German, *w* is pronounced like the English *v*, the latter having the sound of *f* When *w* commences a syllable, it is a consonant but in all other positions a vowel

WACKE (German) A modification of basalt

WAD or WADDING [illegible] or paper, tow, old rope- [illegible] the powder to keep [illegible] experiments of Dr Hutton it does not appear that the wadding has any effect in increasing the force of the charge

WADD A name occasionally given to plumbago, and also to an ore of manganese found in Derbyshire, which when mixed with linseed oil for the purpose of a paint is apt to take fire

WA'DERS, WADING BIRDS *Grallatores* An order of birds including those which have long legs naked from above the distal or lower extremity of the tibia downwards *See* GRALLATORES

WA'DSETT In Scotch Law, a right by which goods are pledged for the recovery of a debt, answering to the English mortgage

WAGER OF BATTLE The use of decid[illegible]g a civil suit by battle was common to the jurisprudence of many of the Teutonic tribes which established themselves in the provinces of the Roman empire It was especially favoured among the Lombards, and there is a celebrated passage in the laws of their king Luitprand, in which while he recognizes the impiety of the custom, he professes his inability to abolish it in consequence of the prejudices of his subjects In England, battle trial is not mentioned in any Anglo-Saxon laws now extant, and its introduction is therefore attributed to William the Conqueror, although bearing in his laws the Saxon name of "orneste" probably *earnest* (See *Sir F Palgrave on the British Common Law* ch vii, who believes that the Conqueror did no more than confirm a usage already known to the inhabitants of England He supposes that [illegible] civil [illegible] was regularly joined in the Anglo-Saxon county courts) Trial by battle, by the English common law, was used in civil cases only, where issue was joined upon a writ of right, in which the tenant pleaded the general issue, viz that he had more right to hold than the demandant to recover, which he offered to prove by the body of his champion, for in civil actions the combat was not between the parties themselves The champions were armed with batons and targets, and the combat took place before the judges and serjeants of the Court of Common Pleas The combatants were bound to fight until the stars appeared in the evening, and if the champion of the tenant could either hold out so long, or obtain the victory, the tenant prevailed in his cause Victory was obtained either by the death of the champion, or by his pronouncing the horrible word "craven," which caused his principal the loss of his land and legal infamy to himself The trial by battle was the only mode of deciding a writ of right, until Henry II introduced the grand appeal or trial by inquest, and gave the tenant his choice between [illegible] The last trial by battle in the Court of Common Pleas was in the 13th Elizabeth, 1571, but in the Court of the County Palatine of Durham

there was one in 1639 Trial by battle in criminal cases is explicitly noticed in the laws of the Conqueror It took place on an *appeal*, when the appellee of felony pleaded not guilty, and declared he would defend the same with his body as in *approvement*, when a party arraigned of treason or felony having become a approver by appealing or accusing his accomplices, the latter [illegible] same manner demand trial by battle, in which case the combat was between the parties themselves [illegible] battle awarded in this country was abolished [illegible] and Mary st 7th of Charles I , but the king, after having appointed a constable to preside, revoked the commission In 1818, William Ashford having brought an appeal against [illegible] Thornton for the murder of his sister the appellee waged his battle Judgment was stayed in consequence of a legal difficulty which arose in the case, and in the following year an act was passed, by which appeals of treason, felony, and other offences, and trial by battle on writs of right, were abolished

WAGER. In Law, wagers are valid, and may be made subjects of action, unless they are on illegal matters Illegal wagers are of two kinds such as are rendered expressly void by [illegible] as have an illegal or immoral tendency [illegible] ess belong wagers on the event of prohibited games, wagers on horse races if the sum betted by either party be above 10*l*, or on any horse race not a bonâ fide race on the turf, of the latter class many instances might be given Anything that incites to a breach of the peace or to immorality, or that has a tendency to annoy the feelings of another or cast ridicule on him, is not a legal subject of wagers Wagers on merely speculative subjects, not arising out of circumstances in which the parties have an interest (for instance, on a point of law, or on the amount of a branch of the public revenue), are of too trivial characters to be [illegible] proceedings When a wager is illegal, [illegible] recover back their deposits [illegible]

[illegible] *See* COMPURGATION

WA'GES, in Political Economy are the return made or compensation paid to those employed to perform any kind of labour or service by their employers

In ordinary language, the term wages is usually employed to designate the sums paid to artizans or labourers employed in manufactures, in household services, and in agriculture, mines, and other manual occupations Substantially and in fact, however, it has a much more extensive application the salaries of public functionaries of all sorts, and the fees of lawyers, physicians, and other professional men are as really wages as the sums paid by them to the menials in their service, and depend on the same laws and principles "Every man," says Dr Paley "has his work The kind of work varies and that is all the difference there is A great deal of labour exists besides that of the hands, many species of industry besides bodily operation equally necessary, requiring equal assiduity more attention, more anxiety It is not true, therefore, that men of elevated stations are exempted from work, it is only true that there is assigned to them work of a different kind, whether more easy or more pleasant may be questioned, but certainly not less wanted, nor less essential to the common good." (*Assize Sermon*, July 29 1795)

*Rates of Wages in different Employments* — The wages paid to the labourers engaged in different employments differ so very widely that at first sight it may seem to be impossible to lay down any principles that should be generally applicable to them all Such however, is not the case The differences in question are apparent rather than real, and when the various favourable and unfavourable circumstances connected with different employments are taken into account, it will be found that the wages or earnings of those engaged in them are very nearly the same

If all employments were equally agreeable and healthy, if the labour to be performed in each was of the same intensity, and if each required the same degree of dexterity and skill on the part of those employed, it is evident, supposing industry to be quite free, that there could be no permanent or considerable difference in the wages of labour, for if those employed in a particular business were to earn either *more* or *less* than their neighbours, labourers would, in the former case, leave other businesses to engage in it, and in the latter, they would leave it to engage in others until the increase or diminution of their numbers had lowered or elevated wages to the common level. In point of fact, however, the intensity of the labour to be performed in different employments, the degree of skill required to carry them on, their healthiness, and the estimation in which they are held, differ exceedingly, and these varying circumstances necessarily occasion proportional differences in the wages of the workmen engaged in them Wages are the price paid to the labourer [illegible] the exertion of his physical powers, skill and [illegible] [illegible] are therefore, necessarily vary according to the several [illegible] of the labour and the degree of skill and ingenuity required. A jeweller or engraver, for example, must be paid a higher rate of wages [illegible] scavenger, for a [illegible] to instruct a man in the business of jewelling and engraving, were he not indemnified for the cost of this [illegible] rate of wages he would [illegible] [illegible] before [illegible] [illegible] the rate of wages [illegible] creasing or diminishing it only so far as may be necessary fully to counteract the unfavourable or favourable peculiarities attending any [illegible]

The following [illegible] are the principal circumstances which occasion the rate of wages, in some employments, to fall below or rise above the *general average* rate of wages —

1st The agreeableness and disagreeableness of the employments

2d The laziness or cheapness, or the difficulty and expense of learning them

3d The constancy or inconstancy of the employments

4th The small or great trust that must be reposed in those who carry them on

5th The probability or improbability of succeeding in them

It would be useless even if our limits permitted to enter into any lengthened details with respect to the variations in the rates of wages arising out of the particular circumstances now enumerated They have been fully illustrated by Smith in the 10th chapter of his first book Every one must see that, *cæteris paribus*, those engaged in a disagreeable or [illegible] employment [illegible] have great [illegible] [illegible] employed in such as [illegible] respectable Wherever a comparative disadvantage attaches to any branch of industry, it must be compensated to those engaged by higher wages or profits, or both, otherwise they would withdraw wholly from it And on this principle it is plain that those engaged in a business or profession which it costs a great deal to learn must be more amply remunerated than those engaged in a business that may be learned with comparatively little trouble and expense Inconstancy of employment must also it is obvious be indemnified by a higher rate of wages during the period of employment, and greater trust by requiring higher character must also be remunerated by higher wages The probability or improbability of success in different employments applies mostly in the higher departments of industry The instances are rare in which a person who is bound apprentice to a tailor shoemaker, or other [illegible] in an ordinary business, fails of acquiring [illegible] proficiency to enable him to live by it But it is far otherwise in the higher departments, and supposing an individual is bound apprentice to a lawyer, physician, painter, sculptor player, &c , the chances are more than twenty to one that he will not attain to distinction in his profession, and perhaps five to one that he will not be able to live by it But, in professions where so many fail for one who succeeds, that fortunate one should gain not only what will indemnify him for the expenses of his education, but also all that has been laid out on the education of his unfortunate competitors Hence the comparatively large earnings of successful lawyers physicians, players and so forth, though it be, after all, abundantly certain that they hardly compensate for the losses of the unsuccessful candidates for wealth and honours

It will be found, [illegible] into account, that [illegible] ments approach pretty near an equality, and that the higher rate in some, and lower rate in others, is uniformly occasioned by certain contingent circumstances

But without insisting farther on the causes of variation from the common standard, we shall now proceed shortly to inquire into the circumstances which determine this common standard, that is, into the circumstances which determine the rate of wages paid to labourers engaged in the common and ordinary departments of manufacturing and agricultural labour, or in such as require no peculiar skill or other superior quality, and have nothing particularly disagreeable about them

To facilitate the acquisition of clear and correct views with respect to the circumstances which [illegible] the price of ordinary labour, wages may be considered in a double point of view viz either (I ) as the sum which the labourers receive at any given period in return for their services, or (II ) as the sum which the habits of society render necessary to enable them to subsist and continue their race Wages, considered in the first point of view, may be called market or actual wages, and considered in the second, they may be called natural or necessary wages

[illegible] Dr Smith has said, *Wealth of Nations*, p 30, M'Culloch's edit , that the common or market rate of wages depends every where upon the terms of the contract

between the workmen and their employers But we must not thence infer that these terms are adjusted on any arbitrary or capricious principle In businesses of small extent, and placed under peculiar circumstances, this may occasionally be the case But in the vast majority of cases, it is not possible for any combination, whether of the masters or the workmen, materially to affect the rate of wages That must always depend on the amount of capital devoted to the payment of wages as compared with the number of labourers

That portion of the capital, or wealth of a country, which the employers of labour lay out in the purchase of labour may be much larger at one time than at another, but whatever may be its absolute magnitude, it obviously forms the only source from which any portion of the wages of labour can be derived No other fund is in existence from which the labourers, as such, can draw a single shilling And hence it follows that the average rate of wages, or the share of the national capital appropriated to the employment of labour falling, at an average, to each labourer, must entirely depend on its amount as compared with the number of those amongst whom it has to be divided

An increase of capital, or of the means of supporting and employing labourers, is not therefore, as is so generally supposed, always productive of an increased rate of wages It has this effect when the number of labourers remains stationary or when it increases in a less proportion than capital, but not otherwise Were capital and population to increase or diminish in the same proportion, the rate of wages, or the quantity of necessaries and conveniences falling to the share of the labourer, would undergo no change, but if the mass of capital be, on the one hand, augmented with
augmentation taking place in the
share of such capital will fall to e
rate of wages will be increased And if on the other hand, populat [illegible] capital, a *less* share will be [illegible] or the rate of wages will be reduced The well being and comfort of the labouring classes are thus especially dependent on the proportion which their increase bears to the increase of capital There are, in fact, no means whatever by which their command over the necessaries of life can be increased that do not at bottom, resolve themselves into an increase of capital as compared with population and every scheme for improving the condition of the labouring class not bottomed on this principle, can hardly fail to prove nugatory and ineffectual

It is needless to enter into any disquisition with respect to the circumstances which tend to increase capital Suffice it to observe that its increase is always of the greatest importance to the bulk of the population It may not, indeed occasion a corresponding increase in the demand for labour, but it is notwithstanding sure to increase it considerably and consequently to improve the condition of the labourers Their condition may also be improved by a greater prevalence of moral restraint or of foresight in the formation of matrimonial connections for, by lessening the rate at which population was previously increasing such increased restraint would tend to reduce the number of labourers as compared with the demand, and would contribute to improve their condition in the same way as an increase of capital On this ground, it is believed that the establishment of a proper system of education might be made to contribute by enlightening the public as to the governing causes of the rate of wages to increase their amount It were right certainly that education should be made to embrace such subjects The causes of national poverty should be explained to every one, that all may be made aware of their existence and enabled in some measure to provide against them It should be impressed on the labouring classes that the means of increased comfort are, to a very great degree, in their own hands, that what others can do for them is but trivial compared with what they can do for themselves, that the best institutions, and the most tolerant and liberal system of government, cannot shield them from poverty and degradation, should their numbers become too great as compared with the means of subsistence, and that to obviate this and to advance their individual and collective interests, they should exercise a reasonable degree of foresight in the formation of matrimonial engagements, and should if possible, endeavour to make some previous provision against unfavourable contingencies We have already seen (art POPULATION in this work), that the native sagacity of the bulk of the people, and their laudable desire to preserve their present position or to rise to a higher are powerful enough to make the progress of population subordinate to the increase in the means of subsistence And it seems reasonable to conclude, without overrating the power of education, that the prudential virtues would acquire greater strength were their importance and the influence they exercise over the condition of society explained to and enforced on the attention of every one

The laws with respect to corporations apprenticeships combinations, &c, the effect of which on the [illegible] of wages has been ably pointed out by Dr Smith have of late years undergone very great modifications The statute of the 5th of Elizabeth, regulating the duration of apprenticeships in most common trades in England and Wales, was repealed in 1814, the laws preventing voluntary combinations amongst workmen were repealed in 1824 [illegible] and the privileges of the different corporations so far as they [illegible] made [illegible] swept off all the vexatious enactments with respect to apprenticeships and corporations that formerly restricted the freedom of industry in France, and they have also disappeared in Prussia, the Netherlands, &c The compulsory provision for [illegible] is the only institution [illegible] seems to have any very considerable influence over the rate of wages *See* POOR

II But whatever fluctuations may take place in the rate of wages, there is in all countries a limit below which it is generally difficult to reduce wages for any considerable period, and below which they can never be permanently reduced, without a change taking place in the habits of the population This limit forms what has been denominated the natural or necessary rate of wages, and consists of the various necessaries and accommodations, or the money sufficient for their purchase, required to enable the labourers to exist and continue their race according to the habits and customs prevailing in the countries to which they belong

It is obvious from what has now been stated, that the natural or necessary rate of wages is susceptible of much variation It varies in different countries according to the varying wants and necessities of the labourers, and it varies in the same country according to the perpetually occurring changes in their diet dress lodgings and other accommodations

The varieties in the climate of different countries occasion considerable variations in the necessary rate of wages Humboldt states that there is a difference of about a third part between the wages of labour in the hot and temperate districts of Mexico Nor is it difficult to see why this is the case According as the severity of the climate increases warmer and for that reason, speaking generally more expensive clothing, more substantially built houses, and a larger supply of fuel become necessary The influence of these circumstances may, it is true be either partially or wholly counteracted by others, such as the superior progress made by countries with a less genial climate in the arts of civilized life the possession of unusually productive coal mines, &c But abstracting from these circumstances it is plain as a general proposition that the rate of necessary wages must vary with variations of climate, and that other things being equal, it will be highest in countries where the most expensive clothes and houses and the largest supplies of fuel are required

The share of the wages of labour appropriated to the purchase of food necessarily differs in different countries In all however [illegible] and even in Great Britain where the labourers [illegible] and neat cottages a [illegible] it is commonly supposed that at an average from *two* to *three-fifths* of their earnings are laid out on food It is obvious, therefore, that the necessary and by consequence also the market rate of wages, must be especially dependent on the sort of food consumed by the inhabitants, and the cost at which it may be raised Taking, for example, the present average rate of wages in agricultural employments in England at 25*l* a year and supposing three-fifths of this sum or 15*l* to be expended on food it is obvious that, if either by a reduction in the price of corn or by substituting potatoes in its place or any other means, the cost of food were reduced a half, the necessary rate of wages might be reduced in the same proportion or from 25*l* to 17*l* 10*s* Such a reduction in the price of corn or such a change in the species of food as has been supposed, would lead to an increase in the means of subsistence, an additional stimulus would in consequence be given to population and though the market rate of wages would not sink in the same degree that necessary wages are supposed to have sunk it would sink to some extent, and were necessary wages to sink still more, market wages would also sustain a certain decline, which would be greater or less according to the habits and foresight of the people

The state of the labouring classes in every country furnishes abundant proofs of what has now been stated In Bengal, for example, where clothing, lodging, and fuel are of comparatively inferior importance the necessary wages of labour are almost entirely determined by the cost of the food consumed by the labourer And this food being the simplest and cheapest imaginable, [illegible] of boiled rice with split pulse, and salt [illegible] pidity, a labourer is able to subsist on

the merest trifle; and in consequence the customary rate of wages in common employments is so low as 2½d a day (Colebrooke *On the Husbandry of Bengal* pp 20 131 )

But it is [illegible] distant countries or remote periods for an example of this principle The contrast between the wages and the condition of the labouring classes in Great Britain, and the wages and condition of the same classes in Ireland, illustrates it in the most striking manner In Great Britain the necessary rate of wages is principally determined by the cost of wheat and butcher's meat, and in a less degree by the rent of a comfortable cottage, the price of clothes, beer, tea, &c In Ireland, on the contrary, the peasantry rarely taste butcher's meat, they do not even consider bread as necessary to their subsistence, they are generally without either beer or tea, and their hats, clothes, &c, are all of the most miserable description The rate of necessary wages is there almost entirely determined by the price of potatoes, and as a quantity of these sufficient for the support of a family may be bought for a third part of the price of the bread and other articles required for that purpose, the necessary rate of wages is proportionally low The market rate of wages too, owing to the weakness in Ireland of moral restraint, and the nearly total non existence of the prudent fore[illegible] and decent pride which distinguishes the [illegible] in Great Britain does not differ [illegible] from the necessary rate The principle of increase has filled up the population to the level of mere subsistence, so that while the wages of common labour may be taken on a rough average at 20*d* a day in England, they are not supposed to exceed 6*d* or at most 7*d* a day in Ireland

If we except the influence that would be exerted on the progress of population and consequently also on the rate of wages, by the prevalence of a greater degree of moral restraint, an increased demand for labour and a fall in the price of the articles consumed by the labourer, seem to be the only modes in which wages can be raised From whatever causes an increased demand for labour may proceed, it must obviously raise the rate of wages and it is hardly less obvious, that a fall in the cost of producing any article consumed by the labourer or suitable for his consumption must in so far improve his condition The demand for labour is in most cases immediately increased, and it is never generally or permanently reduced by a reduction in the cost of producing commodities But supposing that the demand for labour continues the same after commodities fall in price, then, as the number of labourers in the market, and consequently the money wages paid them, must also be the same as before the fall it is plain they will obtain a greater quantity of produce, and that their condition will be in so far improved It is, no doubt, true, that were population to increase, as is sometimes alleged, proportionally to the increased demand for labour, or to the fall in the price of produce, the improvement in the condition of the labourer would only be temporary But it is not improbable merely but next to impossible that population should increase in the same proportion A period of about twenty years necessarily elapses before the stimulus which an increased demand for labour gives to population can occasion any increase in the number of labourers, and the labourers being accustomed during this long interval, to an improved manner of living, the standard of natural or necessary wages [illegible] and the majority will be [illegible] that might tend to sink themselves and their children below the new level to which they have attained

The effects produced by a decreasing demand for labour, or by a rise in the price of the articles usually consumed by the labourer, are directly the reverse of those now stated The number of labourers continuing for a while at least the same, the rate of wages is necessarily diminished when the demand for labour declines, and it necessarily continues at its old level when prices rise, so that in both cases the condition of the labourers is changed for the worse In consequence, they are obliged to economise and should the pressure continue for a considerable period, there is a risk lest their habits be degraded, or that they should learn to be satisfied with an inferior species of food, or a lower standard of comfort Should this change unfortunately take place, the population would accommodate itself to the new state of things, and it would be difficult for the labourers to attain at any subsequent period, to the elevation from which they had been cast down

When the labourers are already subsisting, as in Ireland on the lowest species of food, it is of course impossible for them to go to a lower in a period of scarcity, and should their wages, or the means of subsistence falling to their share, sustain any serious decline, an increase would necessarily take place in the rate of mortality But in a country like England, where the inhabitants have been long accustomed to superior comforts, and enjoy various privileges, it is probable that they might pass through a pretty long period of privation, and that it would rather give new efficacy to the principle of moral restraint, and lessen the proportion of marriages and births, than induce them to submit to a lower scale of living or to relinquish comforts they have long possessed, and been taught to regard as indispensable As the well-being of the labouring classes is essential to the tranquillity and happiness of the state, it is of the highest importance that this principle should be strengthened by every possible means It is easy from this to see that a principal advantage of a compulsory provision for the support of the poor consists in the assistance it gives them in periods of adversity, and in its thereby contributing to prevent their tastes and habits or their standard of comfort from being lowered by the privations to which they might otherwise be compelled to submit

**WAHA'BEES** or **WAHA'BYS** A Mussulman sect, of which the founder was a learned Arabian, named Abd el Wahâb, who became persuaded of the corruption, both of doctrine and practice, prevalent among the professors of Islam, especially the Turks His daughter married Mohammed Ibn Saoûd, the principal person of the town of Derayeh, who became his first convert and leader of the sect about 1760 Like the original prophet of their faith, Saoûd and his followers propagated their doctrines at once by persuasion and arms Abd el Aziz and Ibn Saoûd, the son and grandson of the first Saoûd, carried their arms to the utmost extremities of Arabia, and conformably with the old Mohammedan principle, established a spiritual and temporal leadership united in their persons The Bedouins or wandering tribes, formed the bulk of their converts They acknowledged the Koran and the Sunne, or orthodox tradition, and they professed adherence to the liberal tenets of both, but they accused the other Mohammedans of an idolatrous veneration for the prophet and other saints, and denied the intercession of saints altogether Like the early Protestants of Europe their favourite taste was the destruction of the cupolas and tombs of saints To this the mob of Wahabys added a strong aversion to the rich dress of the Turks, and to the practice of smoking tobacco, which had been prohibited by Abd el Wahâb much on the same bold principle which had induced Mohammed himself to condemn the use of wine The province of Nedjd became the chief seat of the Wahaby power Under the last Saoud (a very handsome man, whom the Arabs called Abou Showareb or [illegible]) [illegible] reached its greatest extent [illegible] ministered justice in person to great part of Arabia The Wahabys, in the first twenty years of this century, extended their plundering expeditions to Syria, Irak, and Mesopotamia In 1803 they took Mekka and soon conquered the Hidjah In 1809 Mehemet Ali began hostilities in Arabia, and in 1812 the Hidjah was restored, and the caravans of pilgrims once more arrived with their usual pomp at Mekka, but for some years afterwards the Wahabys maintained their superiority in the rest of Arabia Saoûd died in 1814, and was succeeded in his political and religious authority by his son Abdallah, under whom the Wahabys were finally subdued by Mehemet Ali, but we possess no authentic account of their conquest, or their present condition (See *Burkhardt's Travels in Arabia*, his *Notes for a History of the Bedouins and Wahabys*, 1830, and the *Travels of Ali Bey*, *Ed Rev*, vols xxvii xxxiv )

**WAIF** (From the Saxon wafian, *to abandon* ) In Law, goods stolen and abandoned by the felon were so termed and were forfeited to the king, or lord of the manor having the franchise of waif, but if the owner made fresh pursuit after the felon, and sued an appeal of robbery, or gave evidence whereby he was concluded, within a year and a day, he was entitled to restitution

**WAINSCOT** In Architecture, the framed lining in panels wherewith a wall is faced The wood originally used for this purpose being a species of foreign oak that wood has acquired the name from the purpose to which it [illegible]

**WAIST** [illegible] part of the gun-deck between the fore and main masts

**WAITS**, the popular name for the music played in our streets on the nights of the Christmas holidays, is thought to be only a corruption of "wake," the common name for a nocturnal solemnity (See *Archæol* vol ii p 66 )

**WAI'VER** In Law, a term used to signify a party's declining or refusing to accept to avail himself of something, as waiver of an estate, which may be made by infant or his heirs of an estate conveyed to him in his minority, waiver of tort, in some cases where action of [illegible] of contract [illegible] aggrieved party [illegible] the former and [illegible] remedy

**WAKE** [illegible] Antiquities and popular usage, the word is of the same meaning as vigil; and the custom originated in the processions which took place early in the morning of feast days to the church, and were not uncommonly followed by revelling and drunkenness At present most fast days are popularly called wakes by the English peasantry, but the peculiar "wake" or "revel"

of county parishes was, originally, the day of the week on which the church had been dedicated, afterwards, the day of the year In 1536, an act of convocation appointed that the wake should be held in every parish on the same day, namely, the first Sunday in October, but it was [illegible] Wakes are expressly mentioned in Charles I's *Book of Sports*, among the feasts which it was his majesty's pleasure should be observed The wake appears to have been also held on the Sunday after the day of dedication, or more usually, the day of the saint to whom the church was [illegible] In Ireland, it is called the Pattern Day (See *Archæologia* )

WAKE The track of a ship which she leaves in the water A vessel directly astern of another is said to be in her wake

WALDENSES In Ecclesiastical History, a religious sect said to have derived their name from [illegible], a merchant of Lyons, who preached what he regarded as the pure doctrine of the Scriptures about 1180 Historians have confounded them, on the one hand, with the Vaudois (see that article), who appear, although their history is involved in much obscurity, to be an older and separate people, and on the other (especially those of the Catholic party), with the Albigenses, and thus it has been endeavoured to throw on them the discredit of the Manichean tracts, which are commonly (but on very doubtful testimony) imputed to the latter It seems clear, however, that the Waldenses were distinct from these, and probably from the Vaudois also Their distinguishing character, it has been said, 'seems to have consisted in a strict adherence to what they considered to be the doctrine originally delivered by Christ to his apostles" And out of their extremely literal interpretation of the Gospel appears to have arisen most of their peculiarities, whether good or evil They seem to have rejected an established succession of the priesthood, and the distinguishing characteristics of the priestly office, the High Catholic doctrine of the sacraments, besides the common ecclesiastical abuses of their day, and are said in addition to have protested against oaths, warfare, lawsuits, and the accumulation of wealth Their later history is obscure, and it may be said of them as well as of other sects of the day, that they had little of the elements of permanence, the same opinions being continually promulgated afresh by new reformers, and then receiving new denominations (*See* ALBIGENSES, PETROBRUSIANS, VALDOIS ) The reader may consult *Milner's Ecclesiastical History* for the most favourable view of these and similar sectaries, and, among many other authorities, Faber, *On the Churches of the Waldenses and Albigenses Mosheim*, cent 12 vol iii There is a curious notice of an establishment of Waldenses in Kent in the *Archæologia*, vol ix

WALL In Architecture, a body of stone, bricks, or other materials, serving to inclose a space, or carry superincumbent [illegible] for these purposes

WALL [illegible] structure for the purpose of improving the climate of plants by shelter, by supplying heat, and by exposing them to the influence of the sun Garden walls are formed either of brick wood, or other materials, and are either solid, flued, or cellular, upright or sloping, straight or angular, according to the purpose intended by their erection (See *Loudon's Encyc of Gardening*, p 575, &c )

WALLEYE An opacity of the cornea of the eye *See* GLAUCOMA

WAITOWER In Machinery [illegible] synonymously with lantern or trundle See LANTERN WHEEL

WALL PLATE In Architecture a piece of timber lying on a wall, on which girders, joists, and other timbers rest

WALPURGIS NIGHT The night of the 1st of May, a festival of St Philip and St James Saint Walpurga was an English lady sister of Boniface, the apostle of the Germans her festival falls on the same day with that of the above [illegible] and is a common day in Germany like Lady-day in England for the commencement of leases, &c It is also known as the day on the eve of which, according to popular superstition, the great witch festival is held on the summit of the Brocken, in the Hartz mountains This superstition is supposed to have originated in the rites performed by the pagan remnants of the Saxons to their gods when their nation was [illegible] converted to Christianity, which, being [illegible] in remote places, were supposed by the vulgar to be supernatural orgies

WALTZ (German walzer) The name of the German national dance, and also of the species of music by which it is accompanied Bohemia is said to be the original home [illegible] and within the last few years it has become naturalised in England

WAPENTAKE A territorial division in use among the Danish inhabitants of England its name [illegible] Yorkshire is subdivided into wapentakes instead of hundreds

WAR, in International Law, is said to be "public," when it is a contest, by force, between independent sovereign states A civil war is regarded by Grotius as "mixed" in its nature, being, according to him, public on the side of the established government, and private on that of the portion of the people resisting its authority Public war is said to be perfect when one whole nation is at war with another, and all the members of each are authorized to commit hostilities mutually, subject only to the general laws of war An imperfect war is limited as to persons places and things to which class may be referred the hostilities of the United States against France in 1798 the hostilities between England, France, Russia, and Turkey, in 1827, and perhaps the recent proceedings against the Pacha of Egypt

Formal declarations of war are now out of use the latest example is said to be that by France against Spain, at Brussels, in 1635, which was announced by heralds War is now usually preceded by the publication of what is termed a manifesto (see that word), and the permission of "reprisals" (which see) is usually the last step short of actual hostilities, and preceding them The immediate effect of the commencement of hostilities would appear to be, on principle, the liability of all property belonging to subjects of one of the belligerent parties within the dominions of the other to seizure and confiscation, but many exceptions have been introduced by the practice of civilized states (See Grotius, *De Jure B & P* lib iii, *Vattel*, lib ii, &c) In recent times, it has been the regular practice in Great Britain to seize and condemn, as droits of admiralty, property of the enemy found in our ports at the commencement of hostilities Trade, and every species of contract between subjects of belligerent states, is in general unlawful, although often authorized for particular times and purposes Subjects of hostile states *domiciled* in the enemy's country, are held liable to reprisals, but not, it is said, mere travellers or temporary sojourners

The "rights of war" are such as arise in times of hostilities,—1 Between enemies, 2 Between neutrals As between enemies, it is a general law that subjects of a hostile state who are not in arms, or who have submitted, may not be slain The killing of prisoners is only justifiable in very extreme cases The usage of exchanging prisoners is now general, but was only firmly established in the 17th century, and it is not now considered obligatory As to property, that belonging to the government of the vanquished nation belongs to the victorious state, wherever it is found, but private rights are unaffected by conquest, with the remarkable exception of private property when at sea, which is by general usage held lawful prize Acts of hostility are only lawful, according to the modern usage, when committed by those authorized by the express or implied command of the state, such as the regularly commissioned military and naval forces of the nation, and all others called out by the government in its defence, as well as persons spontaneously defending themselves in case of necessity Irregular bands of marauders are therefore denied the rights of war, and liable to be treated as banditti, and this distinction is generally only observed so far as suits the belligerent's purpose Even private citizens taking up [illegible] nations, are considered [illegible], as by the French in the Peninsular war, and in numerous other cases As to suspensions of hostilities, &c, see TRUCE, TREATY As to the rights of war as to neutrals, see NEUTRALITY

WARD In Feudal Law, the heir of the king's tenant *in capite* during his nonage was so called, and in general language, all infants under the power of guardians (See GUARDIAN) The court of wards and liveries, for cognisance of various matters relating to the king's prerogative, was established by Henry VIII, and abolished at the Restoration (See *Archæologia*, vol ii )

WARD MOTE A court in each ward of the city of London, which has power to present defaults in matters relating to the watch, police, &c

WARDEN, LORD, OF THE CINQUE PORTS (*See* CINQUE PORTS ) The constable of Dover Castle was created warden of the Cinque Ports, and [illegible] the adjacent coast, by William the Conqueror [illegible] resembling that of the *comes littoris saxonici* in the decline of the Roman empire The lord warden has the authority of admiral in the Cinque Ports and their dependencies, with power to hold a court of admiralty, and courts of law and equity he is returning officer of all the ports The salary is 3000*l* a year There is also a lord warden of the stannaries *See* STANNARIES

WARMTH In Painting, a tone of colour arising from the use of colours expressive of heat

WARP In Weaving the *longitudinal* threads of a woven fabric, they are crossed by the *transverse* threads, or *woof Warp*, in Naval affairs, signifies a rope laid out for the purpose of moving the ship *To warp* is to move a ship from one position to another by means of warps.

WARPING (Fr guerpier ) A mode of increasing the

fert l v of t age lands on the banks of rivers liable to be overflowed by [illegible] which empty themselves into the estuary of the Humber The water of these rivers, from passing through a great extent of alluvial country, are, after heavy rains, muddy to an excess, and they are in that state conducted over the adjoining surface in portions enclosed by banks, and there suffered to deposit their mud, which is technically called *warp*, and which being of the depth of an inch or [illegible] the soil, and ultimately [illegible] existed on the banks of the Po, and other rivers in the north of Italy, from time immemorial

WARPING In Architecture *See* CASTING

WA'RRANT In Law, a precept under seal directed to a proper officer to arrest offender

WA'RRANT OF ATTORNEY, in Law, is a power given by a client to his attorney to appear and plead for him, or to suffer judgment to pass against him by confession It authorizes a creditor to enter up judgment and levy execution either instantly, or within a certain time specified in the instrument

WARRANT OFFICERS, in the Navy, are the gunner boatswain and carpenter

WA'RRANTY in Law as applied to lands is a promise or covenant real annexed to lands or hereditaments whereby the bargainor and his heirs are bound to warrant the same to the bargainee and his heirs against all men But the ancient law of warranty of real property has been long obsolete in practice

With regard to warranty of things personal it is the general rule, that a purchaser of goods and chattels may have a satisfaction from the seller if he sells them as his own and the title proves deficient without any express warranty for that purpose, but that with regard to the goodness of the things so purchased the vendor is not bound to answer unless he has expressly warranted them to be good, or unless he has in any way misrepresented them

WA'RREN (Fr garenne, from the Teutonic wahren *to protect or defend*) In Law a franchise or place privileged for the keeping of beasts and fowls of warren which are said by some to be only hares and rabbits partridges and pheasants, others add quails woodcocks waterfowl, &c The franchise is from the crown by grant, or prescription which implies grant It is often called *free warren* In common language a warren is a surface of poor dry sandy soil on which rabbits are kept In general, warrens may be described as the natural habitations of wild rabbits appropriated by man and preserved for the breed of these animals but they are occasionally formed in suitable situations The rabbits are allowed to burrow in the soil at pleasure and to crop the natural herbage which grows on the surface, but to render warrens profitable the rabbits require to be supplied with clover, hay, corn or other food in the winter season

WASH The fermented liquor from which spirit is distilled

WA'SHER A circular piece of leather or pasteboard placed at the base of a screw, so as to prevent the metal surfaces from being injured when it is screwed home, it is also used to render screw and other junctions air-tight

WASHER In Architecture, a flat piece of iron pierced with a hole for the passage of a screw, between whose nut and the timber it is placed to prevent compression on a small surface of the timber

WA'SSAIL (From the Ang Sax waes hael *be in health*) A common salutation used in drinking, whence the "wassel-bowl," which was anciently carried round on New Years' Eve "A carol for a wakel bowl" will be found in *Ritson's Ancient Songs*, 1790 p 304 (See *Brand's Popular Antiquities*, vol i p 1)

WASTE in Law is the destruction or material alteration of things forming an essential part of the inheritance, as houses, timber, &c Neglect of repairs is termed *permissive* waste, active injury, *voluntary* waste The action of waste, at common law, can only be brought by a person who has an estate of inheritance in immediate expectancy upon the devastator's estate

WASTE LAND Any tract of surface not in a state of [illegible] little or no useful herbage, or wood In this sense the kind of land in Britain was estimated, about the end of the last century at upwards of six millions of acres, four millions of which were considered capable of being brought under the plough, and the greater part of the remainder of growing wood

WATCH A well-known portable machine moved by a spring, for measuring time When executed in the most perfect manner, it is called a *chronometer*, and used in navigation for determining differences of longitude *See* LONGITUDE CHRONOMETER

Watches are said to have been made at Nuremberg so early as 1477; but it is uncertain how far the watches then constructed resembled those which now go by that name Some of the early ones were very small, in the shape of a pear, and sometimes sunk or fitted into the top of a walking-stick As time keepers watches could have very little value before the application of the spiral spring as a regulator to the balance The merit of this excellent invention has been claimed by Hooke and Huygens, but it seems established by unquestionable evidence that the priority belonged to Hooke by at least fifteen years The date of the invention is about the year 1658 Hooke's first balance spring was straight, and acted on the balance in a very imperfect manner, but he soon perceived its defects, and attempted to obviate them by adopting first the cylindrical, and afterwards the flat spiral The latter appears to have been applied to watches before the publication of Huygens' [illegible] (*Encyc Brit* art "Clock and Watch Work") *See* HOROLOGY

WATCH The portion of the ship's crew on duty at a time This is usually half, and the watches are called the *starboard* and *larboard* watches Large crews are put in three watches The period of the time called a watch is four hours, the reckoning beginning at noon or midnight Between 4 o'clock and 8 P M, the time is divided into two short or *dog* watches, in order to break the constant recurrence of three watches at the same hours

WA'TER (Germ wasser) The old chemists considered water as an element and supposed it convertible into earth, and into various organic products This opinion was first questioned, and afterwards disproved, by the experiments of Watt and of Cavendish in the years 1780 and 1787 (*Phil Trans*) And it has since been satisfactorily demonstrated that hydrogen and oxygen are the elements of water, and that they are contained in it in the relative proportions by weight of 1 and 8, or by volume 2 and 1, the specific gravity of hydrogen being to that of oxygen as 1 to 16

The electro chemical decomposition of water is that which affords the most satisfactory evidence of its nature When made part of the voltaic electric circuit it is resolved into 2 measures of hydrogen and 1 [illegible] the former evolved at the negative and the positive surface, and if the gases thus obtained be mixed, and fired by the electric spark they again combine, and produce their weight of water The analytic and synthetic evidence therefore, of the composition of water is thus rendered complete

But although perfectly pure water such, for instance, as has been boiled and very cautiously distilled is in fact an *oxide of hydrogen* and composed as above stated all common water is more or less contaminated by foreign matters which, if not in excess or of an uncommon or injurious nature render it generally speaking more fit for most of the ordinary uses to which it is applied Of all water, *rain water* carefully and cleanly collected is most pure But it absorbs air and with it traces of carbonic acid, minute portions of certain ammoniacal salts are also found in it, and very near the sea it is seldom free from a trace of salt During thunder storms the rain which falls sometimes exhibits indications of nitric acid, formed no doubt by the passage of the lightning through the humid atmosphere Next to rain water *river water* is generally speaking most free from foreign matter The water of the Thames, especially where it is not contaminated by drainage and manufactures, only contains about 2 grains of saline or soluble matter in each pint, and this is chiefly carbonate of lime with a little sulphate of lime chloride of sodium (common salt), and chloride of magnesium and traces of organic matter The saline contents of a gallon of Thames water in its most impure state do not exceed 24 grains, and when in its purest state, fall short of 16 grains This statement refers only to matters *dissolved* in the water, for it is often loaded with substances *mechanically suspended* to a much greater extent as is obvious from the muddy state in which it is often supplied to the houses of London and its vicinity by the water companies These last impurities are separated either by subsidence or by filtration; hence the [illegible] for the water to clarify itself in reservoirs [illegible] for use or of filtering it through fine sand, which imparts nothing to the water, and renders it clean and transparent When water contaminated by animal or vegetable matter is kept for some time it undergoes a spontaneous depuration losing its odour and colour, and depositing more or less sediment By this process, however, it becomes *hard*, in consequence of retaining certain indestructible saline matters in solution The water for the supply of ships is well known to undergo this process of fermentation and purification, and the larger the quantity of destructible matter the more complete and rapid is the depuration hence the preference given to Thames water for sea store, the purer river waters fermenting less rapidly, and remaining more or less foul and putrid for a much longer time It is obvious however, that for all ordinary purposes the purer the water the better, and it is quite clear that London ought to be supplied with Thames water from above Richmond, and out of the reach of the

tides, instead of from the heart of the metropolis, where it is loaded with the contents of the sewers, the offal of manufactures, and the mud stirred up by the steamers

*Spring water*, as afforded by our common wells, may be considered as rain water modified by filtration through the superficial strata of the earth, and consequently containing more or less of the soluble substances which it meets with in its course In and about London the purity of the water is very various at different depths from the surface In the more superficial wells it is usually very hard, and abounds in sulphate of lime, in the deep wells, and especially the *artesian* and overflowing wells, the water is softer, and contains less foreign matter These different states of purity may be judged of with a degree of accuracy sufficient for all common purposes by dropping into the water a solution of soap in spirit of wine with pure water such as rain or distilled water, it remains clear, but with river or spring water it becomes more or less turbid or milky, in proportion to the impurity Water which is thus rendered decidedly opaque or milky is not fit for washing, but that which is only slightly troubled or becomes merely opalescent, is usually called *soft water* This simple experiment shows the cause of softness and hardness in water, for pure water perfectly dissolves soap, whereas in common spring water the salts are of such a nature as to form insoluble compounds with it, and these adhere to whatever is washed in it, and give that unpleasant sensation called *hardness* when we wash our hands The application of a few other simple tests may be resorted to to indicate more exactly

of a white cloud upon adding a few drops of a solution of *chloride of barium* (which shows the sulphuric acid), and of *oxalate of ammonia* (which detects lime) Such water generally leaves a white crust in the decanter in which it is kept and incrusts boilers and kettles with a troublesome sediment, so that unless frequently cleansed they are soon destroyed by the action of the fire in consequence of the sulphate of lime which coats their interior, and which prevents the transmission of heat This impurity chiefly belongs to what are called *land springs* and is derived from the blue clay upon which London is built and which abounds in sulphate of lime The deeper springs especially those from the sandy deposits nearer to or upon the chalk or those from the chalk itself, are more pure especially where the land springs are excluded, and though they exhibit traces of sulphate of lime common salt carbonate of lime and carbonate of soda, are yet pure enough for washing brewing, &c Traces of ammoniacal salts and of nitrates are also not uncommon in the waters from the deep wells of London and its vicinity

Carbonate of lime, or chalk is sometimes held in solution in spring water by excess of carbonic acid in this case the water becomes turbid upon the addition of oxalic acid and slightly effervesces with muriatic acid when boiled, the excess of carbonic acid which holds the carbonate in solution is expelled and the water becomes more or less turbid It is sometimes contained in such quantity as to be deposited upon substances thrown into the water and upon the

the *petrifying* springs of

where, and the beautiful *stalactites* which line the caverns in limestone rocks are produced in the same way Spring water which (*after having been boiled and filtered*) becomes turbid upon the addition of a few drops of nitrate of silver generally contains common salt and the proportion may be judged of by the degree of milkiness thus occasioned If water after it has been evaporated to a small bulk be tested by turmeric or violet paper it often shows an alkaline reaction and upon closer examination is found to contain carbonate of soda, and it occasionally evolves during its evaporation traces of carbonate of ammonia, and affords to delicate tests indications of organic matter This is especially observed in the pump water from churchyards in which most improper situation wells for the supply of the neighbourhood are often sunk

*Mineral springs* or *waters* are of such a nature as to be unfit for common purposes, and often derive important medical efficacy from the substances which they hold dissolved Those which

and which become red

or by exposure, are usually called *chalybeate waters*, and contain carbonate or sulphate of iron when examined as they flow from the spring, they blacken with a few drops of tincture of galls or of strong green tea. *Tunbridge water* is an instance of a chalybeate containing carbonate of iron, and the *Brighton chalybeate* contains sulphate of iron There are some mineral waters which derive their efficacy from certain salts, and are called *saline waters*, such as *Cheltenham water*, *Leamington water*, &c The salts which they contain are chiefly sulphate of soda and sulphate of magnesia, they

are more or less aperient

by evaporation and set aside for a few hours in a cool place, the salts generally crystallize What are termed *sulphurous waters* are usually saline, and also contain *sulphuretted hydrogen* which is presently recognized by its fetid smell and by becoming black when a solution of sugar of lead is dropped into it and turbid on the addition of a little muriatic acid, or by mere exposure to air, from the deposition of sulphur *Harrogate* and *Aix-la-Chapelle* waters are instances There are some waters which are occasionally resorted to medicinally, but which are only remarkable for extreme purity such as *Malvern water*, and there are others which, exclusive of their chalybeate or saline qualities, are *effervescent* or sparkling, from the presence of carbonic acid, which gives them an agreeable and slightly pungent flavour these qualities are entirely

they lose the power of reddening vegetable blues after they have been exposed to heat In respect to *medical virtues*, the chalybeate springs are more or less tonic and

small relative proportions, they are perhaps on that very account more likely to be absorbed into the system, and to effect cures where larger doses of the same remedies fail There are also some mineral waters which contain *iodine* and *bromine*, and which, though in very minute quantities are powerful medicines, in others, baryta and strontia have been discovered But a course of mineral water is often useful upon other principles it generally is accompanied by strict attention to diet, by moderate bodily exercise, by mental relaxation and by regular hours, all of which are powerfully curative resources, and with these aids the mere diluent effect of pure water (such as that of Malvern) may, in many instances, prove of eminent service this is certainly often the case in the early stages of calculous complaints

*Sea Water* — The chemical history of sea water is extremely important, as involving that of sea salt (*see* SODIUM and CHLORINE), of *magnesia* and its most important combinations and of those

known to chemists under the

It appears from the best authorities that the composition of sea water when not influenced by adventitious or accidental causes is nearly uniform in the vast extent of the ocean, which covers about two thirds of the globe, and probably has a mean depth of not less than half a mile (2640 feet) Its specific gravity varies from 10269 to 10285, and it contains rather more than three *per cent* of solid matter composed chiefly of common salt muriate of magnesia sulphate of magnesia, and sulphate of lime These are the principal ingredients of sea water, besides which it contains traces of chloride of potassium, of muriate of ammonia of carbonate of lime, of hydrobromate of magnesia and often of hydriodate of magnesia There is some difference of opinion as to the state of combination in which the acids and bases exist in sea water The following tables show their proportions in a pint of sea water of the Frith of Forth taken up near Leith, as obtained by evaporation and as presumed to exist after and previous to evaporation —

| After Evaporation | | Before Evaporation | |
|---|---|---|---|
| Common salt - - | 180 5 | Common salt - - | 180 5 |
| Muriate of magnesia | 23 0 | Muriate of magnesia | 18 3 |
| | 15 5 | Muriate of lime - | 5 7 |
| Sulphate of lime - | 7 1 | Sulphate of magnesia | 21 6 |
| | 226 1 | | 226 1 |

The other substances exist in such small quantities that they are omitted in this general statement *See* OCEAN

WATER BAILIFF An officer in port towns whose duties in general are with respect to the searching of ships in London he has also the supervision of the fish market gathering of tolls &c

WATER CLOCK A contrivance for measuring time by the flow of water *See* CLEPSYDRA

WATER COLOUR PAINTING A species of painting in which the medium of representation is colour levigated with water and gum, and which in our days has been carried to such extraordinary as to rival oil painting in every thing

WATER DEVIL A name given by some micrographers to the larva of a British species of *Hydrophilus*

WATERLANDIANS In Ecclesiastical History a division of the Dutch Anabaptists, also called "Gross" (Grob), or "Moderate," in contradistinction to the "Fine," or "Rigid" They were so called from a district in North Holland denominated Waterland and originated in the 16th century John de Ries, in 1580, composed a confession of faith, which seems to have been pretty generally used among them They still constitute (we believe) a portion of the general body of Mennonites (See *Mosheim* cent 16, sec 3, part ii)

WATER LINE The boundary of any horizontal section of the bottom of a ship The uppermost one is called the load water line; the lowest the light water line.

**WATER-LOGGED** A Nautical term, denoting the state of a ship when a quantity of water having been received into the hold by leaking &c she has in a great measure lost her buoyancy, and yields to the effect of every wave passing over the deck

**WATER MEADOWS** Meadows on low flat grounds, capable of being [illegible] flown with water [illegible]

The principal season at which this operation is performed is during winter when the water is allowed to remain stagnant on the surface for some weeks, but meadows which [illegible] especially [illegible] neficial has never been satisfactorily explained By some it is attributed to the warmth retained in, or communicated to the soil, by the water during winter, by others to its effect in destroying insects, worms, &c, and by some to the particles of manure deposited on the surface of the soil During summer the effect is more readily accounted for a supply of moisture being advantageous to all plants at that dry season *See* IRRIGATION

**WATER OF CRYSTALLIZATION** Some crystallized salts contain more or less water, which, as it bears a definite proportion to the other components of the salt, may be considered as one of its essential constituents Crystallized sulphate of lime, for instance, is a compound of 68 of dry sulphate and 18 water, or of one equivalent of anhydrous salt and two equivalents of water, one equivalent of crystallized sulphate of magnesia = 123 contains 7 of water = 63 and an equivalent of crystallized sulphate of soda = 162, contains 10 of water, = 90, the equivalent of water being 9 But it does not necessarily follow that a salt in crystals contains water, there being many crystals which are *anhydrous* such as nitre sulphate of potash, &c

**WATERSPOUT** A very remarkable meteorological phenomenon, observed for the most part at sea but sometimes also on shore, though generally in the neighbourhood of water Its general appearance may be described as follows —from a dense cloud, a conical pillar which appears to consist of condensed vapour is seen to descend, with the apex downwards When over the sea, there are usually two cones, one projecting from the cloud, and the other from the water below it These sometimes unite and the junction has been observed to be accompanied with a flash of lightning, but more frequently they disperse before the junction is effected In calm weather the column maintains its vertical position while carried along the surface, but when acted on by the wind it becomes oblique to the horizon The causes of this meteor are very imperfectly known By some it is supposed to be formed by a whirlwind of extreme intensity, while others ascribe to it an electric origin Dr Young (*Nat Phil* vol i) thinks that some of the circumstances may be explained by considering the spout as a whirlwind, carrying up drops of water which it has separated from the waves, and that the remainder may perhaps be deduced from the co-operation of electricity already existing in a neighbouring cloud (See also Pouillet, *Elémens de Physique*, tome ii)

**WATER TABLE** In Architecture, a projection or horizontal set-off in a wall, so placed as to throw off the water from the building

**WATER WAYS** Strong pieces of wood extending round the ship at the junction of the decks with the sides to carry off the water

**WATER WHEEL** In Hydraulics, an engine for raising water in large quantities (*See* PERSIAN WHEEL) Also a wheel turned by the force of running water Of these there are two kinds the *undershot wheel*, and the *overshot wheel* In the case of the undershot wheel the water strikes the float boards below the axle, and acts by the impulse due to its velocity, in the case of the overshot wheel, the water is brought over the top of the wheel, received in buckets, and acts solely by its weight

**WAVE** The alternate elevation and depression of parts of the surface of a liquid above and below the natural level

When the surface of a liquid is unequally pressed, the [illegible] being communicated to the contiguous columns, these will be lengthened and rise above that level But as the elevation is not sustained by a hydraulic pressure, the lengthened columns again fall, and acquiring in the fall a velocity due to the height, they descend below the original level, and communicate in their turn a pressure to those which are adjacent to them In this manner a reciprocating motion is produced the particles to which the primitive impulse was communicated being alternately the lowest and the highest, and a series of ridges and hollows is formed, which are called *waves* or *undulations*

In passing from the columns which are shortened to those which are lengthened, and back again to those to which new ones succeed the particles of the fluid [illegible] unimpeded, no progressive motion takes place, each column being kept in its place by the pressure of the surrounding columns If, however, free oscillation be prevented (by the shelving of the shore, or the interposition of a rock, for example), the columns in the deep water are not balanced by those in the shallower, and in consequence acquire a progressive motion towards the latter, or form *breakers* Hence the reason why waves always break against the shore, whatever be the direction of the wind

When waves are produced by the agitation of a small portion of the fluid, as for example by throwing a stone into stagnant water, they appear to advance from the [illegible] centre, but that there is no transference of any part of the mass from one place to another, is manifest from the motions of any light body floating on the surface The appearance of progression is in the [illegible] produced by the form of the wave [illegible] lation On attending closely to the phenomena it will be seen that the fore part is always in the act of rising, and the hinder part in the act of falling, and thus the whole system appears to roll onwards, while each particle of water in succession merely oscillates with a vertical ascent and descent

If a second series of concentric waves take its origin from a different point at some distance from the first, the two sets will cross each other without the slightest interruption Where a wave of the first series meets one of the second, and the two elevations correspond, the resulting elevation will be equal to the sum of the two, and the same is the case with the depressions Where the elevation in the one series corresponds with a depression in the other, the surface will maintain its original level, at least if the waves of the two series have the same height Thus, although different series of waves do not interfere with each others' propagation, they may nevertheless increase or neutralize each others' effects The one series is in fact superposed on the other

A series of waves meeting a vertical obstacle, as a wall or bank is reflected, and the reflected waves are propagated in the same manner as those arising from the original impulse but in an opposite direction Waves proceeding in concentric circles are reflected in concentric circles, and in such a manner as to appear to diverge from a centre as far behind the obstacle as the original centre is in front of it and in [illegible] be subjected to all those laws which are usually stated to belong to reflected light

If the obstacle against which the waves strike have an opening in it of small horizontal breadth relatively to the breadth of the [illegible] it will act as a [illegible] and a series of waves will diverge from the aperture as from a new centre, but when the aperture is considerably wider than the wave, the wave confines its motion in a great measure to its original direction, though with some small divergence or the oscillation is continued principally in the direction of a sector, whose centre is at the point from which the original wave proceeded

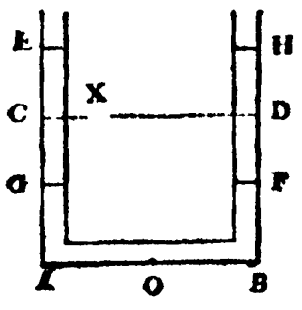
Waves which have been raised by the wind in the open sea proceed in parallel and nearly straight lines; and the original impulse being increased by the continued action of the wind, they will increase in height until the weight of the elevated column, together with the friction, becomes equal to the inciting cause It has been inferred that the greatest height to which a single series of waves raised by the wind blowing constantly in one direction will attain does not exceed six feet The force of the wind also tends to give a progressive motion to the mass of water raised above the general level, and likewise to alter the shape of the wave by diminishing the acclivity of the side against which it strikes In a strong gale this effect may be increased so far as to cause the top of the wave to project over the base in which case it breaks and rolls over on the preceding wave Hence as is well known to sailors, a very strong wind will blow the sea down

If the wind, after having given rise to a series of waves, suddenly veers about so as to strike the waves on the opposite side, it will produce a greater effect from its more direct impact; and hence the greatest waves are [illegible] wind, or by the wind [illegible] to that in which the [illegible] manner the elevation of the waves may be greatly increased above the height to which they would be raised by winds of equal force blowing constantly in the same direction, and hence the ocean is comparatively smooth in regions where the winds are constant And as it is by the friction of the wind on the water that the waves are raised and kept up, whatever diminishes the friction will tend to lessen the elevation. Hence the comparative tranquillity produced by

pouring oil on agitated water. The influence of the wind, which is exerted entirely at the surface, does not extend to a great depth, probably not more than 30 or 40 feet, below which the water suffers no agitation excepting that which arises from the motion of the tide wave

*Mathematical Theory of Waves* — In order to determine the time of an undulation and the velocity of the propagation of waves from the theory of hydrodynamics, Newton compares the undulatory motion of waves on the surface of water with the oscillations of the fluid in a siphon, with which they have a considerable, though not perfect analogy Let the tube C A B D (fig 1 ), open and turned up at both ends, be filled with any liquid up to the level C D Suppose the equilibrium to be disturbed, and that the liquid rises in consequence in the branch A C from C to E The tube being supposed equally wide throughout it is evident that the liquid will fall as much in the branch B D as it rises in A C, thus making D F = C E, from D to I Let C G = D F, then the effect of the hydrostatic pressure [illegible] and according to the principle of D'Alembert the accelerating force which acts on the fluid is the difference of the masses in the two columns divided by their sum, that is proportional to E G divided by E A B I , or, bisecting A B in O, proportional to E C — C A O Now, C A O is constant, therefore the accelerating force is proportional to I C, or to the distance from the position of rest Hence it may be inferred that when the fluid has been disturbed so as to rise from C to I , it will acquire, in falling to its level, a velocity which will carry it to an equal height H in the other branch, and that the oscillations, whether large or small, will be isochronous, or performed in equal times

(1 )




To prove this, and also to determine the time of the oscillation, let X be any point in C F, and make I X = $x$, F C = $a$, and C A O = $l$ Also let $v$ = the velocity, and $\phi$ = the accelerating force when the liquid is at the point X, and $g$ = the accelerating force of gravity We have then, by what has been shown, $\phi = \frac{a-x}{l} g$ But from the theory of accelerating forces $\phi = \frac{dv}{dt}$, and $v = \frac{dx}{dt}$, (*see* FORCE), the substitution of which in the former equation gives

$$v\,dv = \frac{a-x}{l} g\,dx,$$

whence, by integrating and extracting the square root,

$$v = \frac{dx}{dt} = \sqrt{\left\{\frac{g}{l}(2ax - x^2)\right\}},$$

and consequently

$$dt = \sqrt{\frac{l}{g}} \frac{dx}{\sqrt{(2ax - x^2)}}$$

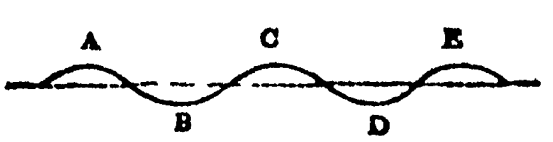
The general integral of the variable part of this expression is an arc whose cosine is equal to $(1 - \frac{x}{a})$, therefore between the limits $x = 0$ and $x = 2a$, the integral is

$$t = \pi \sqrt{\left(\frac{l}{g}\right)},$$

($\pi$) [illegible] whose radius = [illegible] es during the passage of any particle of the water from the highest to the lowest point , and it is also the time in which a pendulum whose length is $l$, vibrating in an infinitely small arc, makes a single oscillation (*see* PENDULUM) Hence the time of passing from the highest to the highest again or of a complete undulation is the double of this, or equal to $2\pi\sqrt{(l-g)}$ or to $\pi\sqrt{(4l-g)}$, the time in which a pendulum whose length is $4l$ makes one oscillation

To apply this solution to the undulatory motion of a fluid mass of indefinite extent, let A B C D E, &c (fig 2 ) represent a superficies of stagnant water ascending and descending in successive waves , and let A C E, &c , which are at one instant the highest, become in their turn the lowest, and the moving power is the weight of the elevated water the alternate rise and fall will be analogous to the reciprocating motion of water in a siphon, and will observe the same laws as to time , therefore if the distance between a summit A and the adjacent lowest point B be equal to $2l$, the highest points A C E, &c will become the lowest in the time in which a pendulum whose length is equal to $l$ makes one [illegible] and become the highest in the time of [illegible] Hence the interval of time from the wave being the highest at any point to its being the highest at that point again will be equal to two oscillations, and the wave will describe its *breadth* (that is, the space between two successive summits or cavities, as from A to C or from B to D, which space is equal to $4l$) while the pendulum oscillates twice , or in the time [illegible] equadruple the length that is equal to $l$ or equal to the breadth of the wave, without date once (*Principia*, lib ii prop 46 )

(2 )




It must be admitted that the supposition on which this theory is founded, namely, that the vertical oscillations of waves are similar to that of water in a bent siphon, is a very precarious one , in fact, the theory itself is altogether insufficient for the explanation of the phenomena, as it gives no account whatever of the *form* of the wave The subject however one of great difficulty and delicacy has been treated by the best mathematicians [illegible] Newton's incomplete theory and considerations in the *Mécanique Analytique*, has given a [illegible] to the true general theory of waves for real [illegible] successive and limited [illegible] elevations and depressions of stagnant water in a canal of small depth Poisson (in the *Annales de Mathematique*, and *Mémoires de l Acad* tome i ) and Cauchy (*Mem de l'Acad* ) have treated the subject more generally , and Professor Kelland (*Edin Phil Trans* vols xiv and xv ) has endeavoured to obtain the equations of motion of a regular set of waves, without imposing any restriction whatever on the conditions M Kelland deduces from his analysis the following results which apply to the motion of a wave in a canal whose depth is continually but slowly [illegible] 1 That the length [illegible] 2 That the velocity of transmission at any point varies as the square root of the depth 3 That the elevation of the crest of the wave varies reciprocally as the total depth of the fluid M Kelland states that his endeavours to deduce a relation between the depth of the fluid and the length of the wave have been unavailing

*Experimental Researches on Waves* — In the *Reports of the British Association* for 1838, there is an account by Mr Scott Russel of a series of observations on waves in the river Dee in Cheshire, and the Frith of the Clyde, and also in the open sea which are interesting, as they establish the existence of waves of different kinds, following totally different laws The most important results of these observations are the following —

1 The progressive wave sent forward by a floating body in rapid motion (or generated in any other manner) differs entirely in its character and phenomena from the oscillatory waves of the sea, or those which ripple the surface of a lake, or are caused by the sudden elevation or depression of a small portion of the fluid It is not necessarily followed either by a depression or elevation, but is a single elevation of [illegible] ferred with a uniform ve [illegible] ed by Mr Russel the *great primary wave of translation* It is analogous to the tide wave of the ocean

2 The velocity of the primary wave in channels of uniform depth is independent of the breadth of the fluid, and equal to the velocity acquired by a heavy body in falling freely through a height equal to half the depth of the fluid, reckoned from the top of the wave to the bottom of the channel The velocity of the wave is accordingly proportional to the square root of the depth of the water, as the theory indicates, and it is not affected by the velocity of the impulse or the form of the body by which it is generated

3 If waves be propagated in a channel whose depth diminishes uniformly they will break when their height above the surface of the level fluid becomes equal to the depth below the surface When waves of the sea approach the shore, or come into shallow water, they become waves of translation and, in conformity with this law, always break when the depth of the water is not greater than the height of the wave above the level

4 The great primary waves are reflected from surfaces at right angles to the direction of their motion, without suffering any other change but that of direction , and they cross each other without change of any kind, as the small oscillations on the surface of a pool

5 In the primary wave of translation the displacement of [illegible] [illegible] of the greatest depth whereas in [illegible] atory kind the displacement of the particles of the fluid is greatest at the surfaces, and diminishes rapidly, and extends only to an inconsiderable depth

6 The phenomenon called a *tidal bore* is produced in

two ways First, if the water is so shallow that the first waves of the flood tide move with a velocity so much less than the succeeding ones that they are overtaken by them, and secondly, where the tide rises so rapidly, and the water on the shore or in the river is so shallow, that the height of the first wave is greater than the depth of the water

The law by which the velocity of the primary wave varies according to the square root of the depth of the water gives rise to several other phenomena Thus any change in the depth of rivers produces a corresponding change in the interval between the moon's transit and the hour of high water A wave of high water of a spring tide travels faster than a wave of high water of a neap tide, &c

The character and phenomena of the primary wave of transmission, and its importance as an element in the amount of the resistance of fluids on bodies moving through them, were first detected and examined by Mr Russel in 1834 (*Transactions of the Royal Society of Edinburgh*, vol xiv part I) Its existence and laws are of great importance in reference to the construction and improvement of tidal rivers

WA'VELLITE A mineral named after Dr Wavell of Barnstaple, in which neighbourhood it was first found It is a hydrated phosphate of alumina it has also been called *hydargillite*

WAX (Germ wachs) This is a common vegetable product, forming the varnish which coats the leaves of certain plants and trees It is also found upon some berries, as of the *Myrica cerifera*, and it is an ingredient in bees , but Huber found that though excluded from all food except sugar they still formed wax, and accordingly it has been found that the elementary composition of bees' wax and vegetable wax is slightly different Bees wax is prepared by draining and washing the honeycomb which is then melted in boiling water, strained and cast into cakes English and foreign wax are found in the market, the latter being chiefly imported from the Baltic the Levant and the coast of Barbary Fresh wax has a peculiar honey-like odour its specific gravity is 96 At about 150° it fuses and at a high temperature volatilizes and burns with a bright white flame It is bleached by being exposed in thin slices or ribands to light air and moisture, or more rapidly by the action of chlorine, but in the latter case it does not answer for the manufacture of candles, which is one of its principal applications Wax candles are made by suspending the wicks upon a hoop over the cauldron of melted wax, which is successively poured over them from a ladle till they have acquired the proper size, so that the candle consists of a series of layers of wax cut off After in moulds, but when thus made they burn irregularly Bleached or white wax is generally adulterated with more or less spermaceti and sold at different prices accordingly, in this case it has not the peculiar lustre of pure wax, and is softer and more fusible It is also largely adulterated with stearine or stearic acid, which is detected by the odour of fat or tallow which it evolves when highly heated, and by its crumbly texture, it may also be separated to a certain extent by ether or alcohol Wax is insoluble in water, and scarcely acted upon by the acids so that it forms a good lute or cement boiling alcohol and ether act partially upon it and deposit the portion which they had dissolved on cooling Some varieties of vegetable wax appear to contain two distinct principles, which Dr John has termed *cerin* and *myrin*, the former soluble, and the latter insoluble, in alcohol Heated with the fixed alkalies, wax forms a difficultly soluble soap

WAY The Sea term for progress A ship in progress is said to have *way* upon her, when stationary, to have no *way*

WEALDEN FORMATION and STRATA *See* GEOLOGY

WEAR To put the ship on the other tack by turning her round, with her stern to the wind

WEA'THER (Germ wetter) The state or condition of the atmosphere with respect to heat, cold, dryness, moisture, wind, rain, snow, fogs, &c The appreciation of the various causes which determine the state of the atmosphere, and produce those changes of *Meteorology* and *Climate* (See those terms, also ATMOSPHERE, BAROMETER, CLOUD, DEW, HAIL, HYGROMETRY, RAIN, WIND, &c)

In all ages of the world, mankind have attempted to explain and the changes of the weather; but such of the subject, and the vast multitude of circumstances to be taken account of, that no theory can furnish rules for determining the order in which they succeed each other, or for predicting the state of the weather of the atmosphere are the necessary results of principles, not only fixed and unalterable in their nature, but (many of them at least) well known in their separate and individual operation The difficulty of tracing the results of their combined influences arises chiefly from their complexity and endless concatenation

The principal cause of all the variations which take place in the state of the atmosphere is the heating action of the sun's rays, but in order to appreciate correctly its effect, it is necessary to know not only the extent of the atmosphere, but the properties of all the substances of which it is composed Modern science has discovered that the atmosphere is composed of three different gaseous fluids, every where combined in the same proportions, and penetrated by an ever-varying quantity of elastic vapour These two distinct envelopes of air and vapour mechanically mixed have different relations to heat, and therefore, in consequence of the unequal temperature of the surface of the earth, with which they are in contact when at rest in equilibrium at rest in the latitude of, and in rotation, the different parts of the atmosphere are constantly receiving different quantities of heat, as the solar rays penetrate more or less obliquely This inequality of temperature produces wind which, if the surface of the earth were perfectly even and homogeneous, would always blow in but, the surface of the earth being composed of materials of various kinds, and distribution of heat over it is extreme The winds sweeping along the surface, acquire its temperature and hence the atmosphere also becomes irregularly heated This produces an accumulation of air at one place and a deficiency at another, and hence a subsequent rush to restore the equilibrium As the air is cooled it becomes also incapable of holding the same quantity of aqueous vapour, a portion of which is therefore set free, and gives rise to clouds mist rain, dew snow &c Besides all this, there is to be taken into account the development of electricity the influences of light and galvanism, the agitation of the atmosphere produced by the rise and fall of the tides, and probably a variety of other circumstances with which we are entirely unacquainted This very imperfect enumeration may serve to give an idea of the difficulties to be overcome in forming a theory of the weather *See* CLIMATE

It has always been a favourite prejudice that the weather is influenced in some mysterious manner by the moon The moon can be supposed to act on the earth only in one of three ways, namely, by the solar rays which it reflects by its attraction, or by an emanation of some unknown kind Now, the light of the moon does not amount to the 100 000th part of that of the sun and the heat which it excites is so small as to be altogether inappreciable by the most delicate instruments or the best devised experiments With regard to the attraction of the moon we see its influence on the tides of the ocean, and might therefore be disposed to allow it a similar influence on the atmosphere, but when we take into account the small specific gravity of atmospheric air in comparison with water, and the consequent smallness of the mass of matter to be acted upon, it will readily be perceived that this influence also must be extremely feeble In fact it has been demonstrated by Laplace that the joint action of the solar and lunar attraction is incapable of producing more than an atmospheric tide flowing westward at the rate of about four miles a day, and this is scarcely if at all, appreciable As to the remaining supposition that the moon may act on the atmosphere by some obscure emanation it is sufficient to remark that no meteorological observations that have yet been made afford the slightest traces of any such connexion between the earth and its satellite The registers which are now kept in various observatories and other places also prove, contrary to the popular belief, that the changes of weather are in no way whatever dependent on the lunar phases (See the *Annuaire du Bureau des Longitudes* for 1833 Kamptz, *Lehrbuch der Meteorologie, and Walker's Translation*, Schubler, *Einfluss des Mondes auf die Veranderung unserer Atmosphare*, Leipzig, 1820, *Greenwich Meteor Obs*)

WEATHER The Sea term for that side on which the wind blows *To weather*, to pass to windward of an object

WEATHER BOARDING In Architecture, feather-edged boarding nailed upright, whose boards lap over each other, so as to prevent the rain, &c from penetrating them

WEATHER GAGE A ship to windward of another is said to have the weather gage

WEATHER GLASS A name sometimes given to the barometer, but sometimes applied to other instruments for ascertaining the state of the atmosphere, or measuring atmospheric changes It is thus applied to the *thermometer* the *hygrometer*, &c

WEAVERS, *Textores* The name of a tribe of spiders

including those which fabricate webs in order to entrap their prey

WEAVING, the art of forming cloth in a loom by the union or intertexture of threads The art of weaving is of great antiquity it has been practised in all ages and in all countries, but it would be impossible within our limits to give even a sketch of its history, progress, and successive improvements down to its present perfect state We had intended to present the reader with a notice of the various improvements that have been made in the loom from its simplest construction, down to the elaborate invention of Jacquard, but it was found that this could not be effected without the introduction of numerous diagrams and details, which would have been foreign to the purpose of the work, and we must, therefore, content ourselves by referring to *Ure's Dictionary of Arts, &c* for full particulars

WEDGE In Geometry, a solid having five sides or faces, three of which are rectangles, and the remaining two [illegible] parallel to each other, [illegible] figure, is a prism with a triangular base Its content is therefore equal to the area of the triangular base multiplied into the distance between the parallel planes

WEDGE, in Mechanics, is one of the five simple engines or mechanical powers and is used sometimes for raising bodies, but more frequently for dividing or splitting them In the [illegible] wedge to be urged by [illegible] is precisely the same as that of the inclined plane, for it is evidently the same, in point of mechanical advantage whether the wedge be pushed under the load, or the load be drawn over the plane The power is therefore to the force to be overcome is the tangent of the angle of the penetrating sides to the radius, leaving the friction out of consideration hence the thinner the wedge the greater is its effect But when the wedge as is generally the case, is driven forward by percussion its power cannot be estimated with any degree of accuracy The percussive tremor excited by the blow destroys for an instant the friction at the sides and augments prodigiously the [illegible] effect Besides, when the wedge is used in [illegible] or other substances the parts of the block are generally separated to a considerable distance before the edge of the wedge as in the annexed figure, in which case it acts besides as a lever the power being applied at the end of the block or acting part [illegible] being at the [illegible] to separate



All the various kinds of cutting and piercing tools as axes, knives, scissars, chisels, &c nails pins, awls, &c, are modifications of the wedge The angle in these cases is more or less [illegible] to the purpose to which it is applied The mechanical advantage is increased by diminishing the length of the wedge, but the strength of the tool is thereby also diminished In tools for cutting wood the angle is generally about 30°, for iron it is from 50° to 60°, and for brass from 80° to 90° In general the softer the substance to be divided is, the more acute may the

WEDNESDAY [illegible] day, Lat dies Mercurii) The fourth day of the week consecrated by our Scandinavian ancestors to Woden the deity whose functions corresponded to those of Mercury in the Greek and Roman mythology

WEEK A period of seven days, of uncertain origin, but which has been used from time immemorial in eastern countries The week did not enter into the calendar of the Greeks, who divided the civil month into three periods of ten days each, and it was not introduced at Rome till after the reign of Theodosius By some writers the use of weeks is supposed to be a remnant of the tradition of the creation, by others that it was suggested by the phases of the moon, while a third class, with more probability, refer its origin to the seven planets known in ancient times This opinion explains the circumstance that the days of the week have been universally named [illegible] to a particular order In the [illegible] order of the [illegible], beginning with the [illegible] Saturn, Jupiter, Mars the Sun, Venus Mercury Moon The Greeks divided into 24 hours, and each successive hour consecrated to a particular planet in the order now stated, so that one hour being consecrated to Saturn, the next fell to Jupiter, the third to Mars, and so on, and each day was named after the planet to which its first hour was consecrated Now, suppose the first hour of a particular day to have been consecrated to Saturn it is evident that Saturn would also have the 8th, the 15th and the 22d hours The 23d hour would therefore fall to Jupiter, the 24th to Mars; and the 25th, or the first hour of the following day, would belong to the Sun from which it would take its name By proceeding in the same manner, it is found that the first hour of the third day would fall to the Moon, the first of the fourth day to Mars, of the fifth to Mercury, of the sixth to Jupiter, and of the seventh to Venus The cycle being completed the first hour of the eighth day would return to Saturn and all the others constantly succeed in the same order According to Dio Cassius, the Egyptian week began with Saturday The Jews, on their flight from Egypt, made Saturday the last day of the week The Saxons seem to have borrowed the week from some eastern nation [illegible] the names of their own divinities for the [illegible] of Greece In England, the Latin names of the days are still retained in legislative and judiciary acts (See *Ency. Brit*, "Calendar")

WEEPING CROSSES In Ecclesiastical Antiquities, stone crosses, at which penances were commonly finished with weeping and signs of contrition, were so called There was one close to the town of Stafford (See Mr Astle's "Observations on Stone Crosses," *Archæol.* vol xiii)

WEIGH To take the anchor out of the ground

WEIGHT In Physics, that property of bodies in virtue of which they tend towards the centre of the earth. In this sense, weight is synonymous with gravity *See* GRAVITY

WEIGHT, in Mechanics denotes the resistance to be overcome by a machine, whether in raising, or sustaining, or moving a heavy body The force applied to the machine for this purpose is called the moving power, and where the equilibrium subsists, the difference between the weight and the moving power is the purchase of the machine In all cases of equilibrium by the intervention of machinery if the machine be put in motion by a small additional force, the space passed over by the moving power will be greater than that passed over by the weight in proportion as the weight is greater than the moving power, or the product of the weight by its velocity will be equal to the product of the moving power by its velocity *See* MOMENTUM, VIRTUAL VELOCITY

WEIGHT, in Experimental Philosophy and Commerce, is the measure of the force by which any body, or a given portion of any substance, gravitates to the earth The process by which this measure is obtained is called *weighing*, and when required, as in many philosophical experiments, to be performed with great accuracy, is a tedious and delicate operation *See* BALANCE

The measurement of weight, like that of extension, consists in the comparison of the thing to be measured with some conventional standard But it is impossible to fix such a standard by written law or oral description, for it is impossible to communicate by words, and without reference to a sensible object, any adequate idea of a pound-weight or foot rule Standards of linear measure, not accurately defined indeed, but having an average value sufficiently well known for the rude purposes of mankind in the early stages of society, were furnished by the different parts of the human body, hence the measures *foot, cubit, span pace*, &c (*See* MEASURES) But the method of comparing the weights of bodies does not suggest itself so obviously to the mind as the comparison of linear dimension and is not so easily accomplished A balance is necessary the construction of which requires some degree of mechanical knowledge Hence the art of weighing though of great antiquity (see Goguet, *Origine des Lois* &c) was probably practised at a later period, and in a still less accurate manner, than that of measuring There has also been a much greater variety of standards of weight still less definite than those of measure, as will be readily conceived by considering the origin and import of such terms as *stone, load last*, &c The term *pound* (pondus) implies only weight indefinitely The *grain*, as a standard of small weight, being taken from the grains or corns of wheat, was perhaps the only denomination of weight that would universally convey any thing like a precise idea

As there is a constant ratio between the volumes and weights of the same substances when placed in the same physical circumstances, it is obvious that standards of weight may be derived from those of measure For example, a cubic foot or a cubic inch of distilled water, at the same temperature, and under the same atmospheric pressure, will always have the same weight Advantage has been taken of this property of bodies to connect weights with measures in the metrical systems that have been adopted in this and other countries

[illegible] laws were decreed by the Great Charter that the weights [illegible] England but no one measure [illegible] was established, for the diversity [illegible] from being [illegible] not only to produce confusion and inconvenience, but to render the system of weights adopted in one part of the country scarcely intelligible in another The old English pound, which is said to have been the legal standard of weight from the time of William the Conqueror to that of Henry VII, was derived from the weight of grains of wheat. 32 grains

gathered from the middle of the ear and well dried made a pennyweight, 20 pennyweights an ounce, and 12 ounces a pound Henry VII altered this weight, and introduced the *troy* pound instead, which was 1-16th [illegible] Saxon pound, into ounces pennyweights and grains, but the pennyweight contained only 21 grains and consequently a grain troy became a much heavier weight than the grain of wheat [illegible] troy contains 5 760 grains, while the [illegible] was divided into 7,680 grains, contained only 5,400 troy grains Another weight, the *avoirdupois* pound, was introduced by a statute of 24 Henry VIII , and though its first object was that of weighing butchers' meat in the market, it has gradually come to be used for all kinds of coarse goods or merchandize Two legal measures of weight were thus established, and have continued to be used in the country ever since, the avoirdupois weight being used for common purposes, and the troy for the precious metals, and, with a different division by apothecaries in compounding their drugs The standard of these measures was originally fixed by the act of parliament passed on the 17th June, 1824, cap 74 George IV , entitled "An act for ascertaining and establishing Weights and Measures," which was repealed by clause (A) of an act to prolong the time of the commencement of that act to January 1826 The following are the terms in which the standard is defined by the act —"That from and after the 1st day of May, 1825, the standard brass weight of 1 pound troy weight made in the year 1758, now in the custody of the clerk of the House of Commons, shall be and the same is hereby declared to be the original and only standard measure of weight, and that the said weight shall be, and is hereby denominated, the Imperial standard troy pound , and shall be, and the same is hereby declared to be, the unit or only standard measure of weight, from which all other weights shall be derived, computed, and ascertained, and that 1 12th part of the said troy pound shall be an ounce and that 1-20th part of such ounce shall be a pennyweight, and 1-24th part of such pennyweight shall be a grain so that 5 760 such grains shall be a troy pound , and that 7,000 such grains shall be and they are hereby declared to be a pound avoirdupois and that 1-16th part of the said pound avoirdupois shall be an ounce avoirdupois, and that 1-16th part of such ounce shall be a dram "

It follows from this that the weight of the pound troy to that of the pound avoirdupois, or common pound is in the proportion of 5 760 to 7,000, or of 144 to 175 The retention of two different systems of weights was in compliance with the common usages of the country, and the motives which influenced the commissioners of weights and measures in recommending the system which has been adopted were thus explained by Mr Davies Gilbert —"The troy pound appeared to us to be the ancient weight of this kingdom, having, as we have reason to suppose, existed in the same state in the time of Edward the Confessor, and there are reasons, moreover, to believe that the word *troy* has no reference to any town in [illegible] to the notion given to London [illegible] founded on the legend of Brute Troy weight, therefore, according to this etymology, is, in fact, London weight We were induced, moreover, to preserve the troy weight, because all the coinage has uniformly been regulated by it, and all medical prescriptions and formulæ now are, and always have been, estimated by troy weight, under a peculiar subdivision which the College of Physicians have expressed themselves most anxious to preserve "

In the sixth clause of the act it is enacted, that if the standard troy pound should be lost or destroyed, it is to be restored by a reference to a cubic inch of distilled water, which has been found and is declared to be 2 52 458 troy grains, at the temperature of 62° of Fahrenheit, the barometer being at 30 inches Hence the weight of a pennyweight troy is to that of a cubic inch of distilled water, in such circumstances, in the proportion of 24 to 252 458, or of 24 000 to 252 458 so that the weight of the cubic inch of distilled water must be conceived to be divided into 252,458 equal parts, and 24 000 of such parts will be the standard pennyweight, or 100 of such parts will be the standard pound The restoration of the standard, however, in the manner prescribed by the act, is wholly impracticable

Though the commissioners on this occasion probably acted wisely in accommodating their regulations to existing usages, it cannot be disputed that the circumstance of having different weights expressed by the same names, as the pound and ounce troy and avoirdupois is a source of great inconvenience and confusion Few persons, in fact, recollect the different standards and divisions well enough to have any clear or accurate ideas on the subject The comparison of the weights is always a matter requiring care and calculation The avoirdupois pound is greater than the troy pound, as has been already stated, in the ratio of 175 to 144 , but in consequence of the different division the ounce avoirdupois is *smaller* than the ounce troy the former being equal to 437½ grains while the latter contains 480 grains The dram in apothecaries' weight is 60 grains, while the dram avoirdupois is equal to only 27 11/32 grains

For philosophical purposes and in delicate weighing troy weight only is used, and the weight is usually reckoned in grains By this means fractional numbers are avoided and no ambiguity can arise, as there are no other grains than troy grains Dr Kelly, in his *Universal Cambist*, an elaborate and useful work, states that the dram avoirdupois like the drachm of apothecaries has sometimes been subdivided into scruples and grains but as no such weight as an avoirdupois grain ever existed, the use of the expression is an instance of the confusion inseparable from having different systems of weights in which the same names are applied to things totally distinct

The irregular divisions which have been adopted and retained are also liable to much objection, on account of the great number of weights to be employed in practice The most convenient system would probably be the decimal division, which requires weights of the following values —1, 2, 3, 4, &c (grains for instance) , 10, 20, 30, 40, &c , 100, 200, 300, &c , 1000, 2000 3000, &c up to 9000 , and 1, 2, 3, &c , 01, 02, 03, &c , 001, 002, 003, &c By this means arithmetical calculations would be facilitated, and the number of weights in the scale would equal the digits in the number by which the grains or units of weight are expressed Thus a load of 735 4 grains, would be counterpoised by weights of 700 grains, 30 grains 5 grains, and 4 10ths of a grain The composition according to the geometrical series, 1, 2 4, 8, 16 &c offers this advantage, that a smaller number of weights would be necessary than when any other system is adopted

In consequence of the destruction of the parliamentary standards of weights and measures by the burning of the two houses of parliament in 1834 a commission (at the head of which was the Astronomer Royal) was appointed in 1838 to consider and report upon the steps to be taken for their restoration The report of the commissioners, which is dated the 21st of December 1841, enters very fully into the subject, and recommends the adoption of considerable changes in the present system of weights and measures and coinage, chiefly with the view of introducing at least partially, a decimal system But as these recommendations may not be adopted by the legislature, or at all events will probably be considerably modified, it is unnecessary, in the present state of affairs, to state them in detail With respect to weights in particular, the plan of the commissioners is briefly this – that the troy pound be abolished and that the use of the troy ounce and pennyweight be confined to gold silver, and precious stones, that apothecaries' [illegible] to be used for the combination of [illegible] other purposes the only legal weights shall be derived from a pound, equal [illegible] distinctive term a [illegible] is to be divided into 16 ounces and 7 000 grains and no denomination is to be recognised lower than pound except the ounce and the grain and the decimal parts of the pound They also recommend that the weight of 14 pounds, or stone in common use and its multiples 28 pounds 56 pounds, 112 pounds, be abolished , and that the only legal weights above one pound be weights of multiples of 1 pound and not exceeding 10 pounds, and weights of 10 pounds and its multiples not exceeding 100 pounds According to this plan there would only be decimal multiples of the standard , while, with respect to the submultiples there would not only be a decimal system, but also a denomination of weight equal to a 10th and another equal to a 7-thousandth part of the standard It is not easy to see what stronger reason there can be for retaining the ounce than the stone or the hundred-weight, which are so extensively used particularly for purposes connected with agriculture The quantity of iron weights of 14 lb and its multiples in use in the country is estimated to be not less than 30 000 tons, and the expense of changing them to weights of a decimal system would be between 100,000l and 120,000l Without, however, altering the standard unit the commissioners recommend that a platinum weight of 7,000 grains be constructed and declared to be the parliamentary standard of weight , but that it be not defined with reference to any natural standard or to measures of length or capacity, as a cubic inch of distilled water

*Tables of British Weights*

1 *Imperial Troy* [illegible] One cubic inch of distilled water, at [illegible] thermometer, the barometer being 30 inches, weighs 252 458 troy grains.

| grs. | dwts | oz | lb |
|---|---|---|---|
| 24 = | 1 | | |
| 480 = | 20 = | 1 | |
| 5760 = | 240 = | 12 = | 1 |

Troy weight is used in weighing gold, silver, jewels, &c, and in philosophical experiments

2 *Apothecaries' Weight* — Standard The same as in troy weight, with the ounce divided into 8 drachms and 24 scruples

| grs | scrs (℈) | | | |
|---|---|---|---|---|
| 20 = | 1 | drs. (℥) | | |
| 60 = | 3 = | 1 | oz (℥) | |
| 480 = | 24 = | 8 = | 1 | lb (℔) |
| 5760 = | 288 = | 96 = | 12 = | 1 |

Medicines are compounded by this weight, but drugs are usually bought and sold by avoirdupois weight

3 *Imperial Avoirdupois Weight* — Standard: The same as in troy weight; and one avoirdupois pound = 7000 troy grains

| drs | oz | | | | |
|---|---|---|---|---|---|
| 16 = | 1 | lbs | | | |
| 256 = | 16 = | 1 | qrs | | |
| 7168 = | 448 = | 28 = | 1 | cwts | |
| 28672 = | 1792 = | 112 = | 4 = | 1 | ton |
| 573440 = | 35840 = | 2240 = | 80 = | 20 = | 1 |

This weight is used for the general purposes of commerce

The preceding are the British statute weights, but numerous other discordant denominations of weight, generally multiples of the avoirdupois pound, are still used in different parts of the country for weighing particular kinds of merchandise One of the most common of these is the *stone*, which has a great variety of different significations In London, however, only two stones are generally understood, viz the stone of 8 pounds for butchers' meat, and the stone of 14 pounds for other commodities (For values of different local weights see *Buchanan's Tables of Weights and Measures*, *General Paisley's work on the Measures, Weights and Money used in this Country*, *M'Culloch's Commercial Dictionary*, *Kelly's Universal Cambist* &c)

A particular denomination of weight, a *carat*, is used for weighing diamonds An ounce troy is equivalent to 151½ carats, whence 1 carat is = 3·17 grains In expressing the fineness of gold by *carats*, the term rather denotes a proportion than a weight Thus gold 22 carats fine signifies an alloy such that the proportion of the weight of pure gold to that of the whole weight is as 22 to 24, or such that it contains 22 parts by weight of pure gold and 2 parts of some inferior metal

*French System of Weights* — The French denominations of weight occur so frequently in works connected with the physical sciences, that it is convenient to be acquainted with their values The unit of weight is the *gramme*, which is the weight of the 100th part of a cubic metre of distilled water at the temperature of melting ice A gramme is equal to 15·434 troy grains, whence the following comparative table of French with troy weight —

| | grammes | | Troy grains. |
|---|---|---|---|
| Milligramme = | ·001 = | | ·01543 |
| Centigramme = | ·01 = | | ·15434 |
| Decigramme = | 1 = | | 1·5434 |
| Gramme = | 1 = | | 15·434 |
| Decagramme = | 10 = | | 154·34 |
| Hectogramme = | 100 = | | 1543·4 |
| Kilogramme = | 1000 = | | 15434 |
| Myriagramme = | 10000 = | | 154340 |

The kilogramme is equal to 2 lb 3 oz 4·428 drams avoirdupois weight In the *Système Usuel* the standards are the same as the above, but the denominations are those which were anciently in use It was found impossible to introduce the new terms The divisions are binary Half the kilogramme forms the *livre usuel* which is divided into halves, quarters, eighths, &c, down to the *gros*, which is the eighth of the *once*, or the 1-128th of the *livre* (For a comparative table of the weights and measures used in different countries of the world, see the *Encyc Britannica*, art "Weights")

WELD [illegible] (*Reseda Luteola*) A plant cultivated for the use of [illegible] When the seeds are ripe the plant is cut and dried it yields a brownish yellow decoction, the colour of which is rendered paler by acids, and richer and deeper by alkalies Alum throws down a yellow precipitate, and leaves the clear liquor of a fine lemon yellow, tartar also brightens its colour, and solutions of tin give it a dilute green tint When a mixture of whiting and alum is added to a hot decoction of weld, a yellow precipitate is obtained, which, when collected, washed, and dried, is of a fine delicate colour, and much employed by paper-stainers

WELDING There are a very few of the metals which are susceptible of being united by pressure or hammering, or of being *welded* together Two pieces of potassium may be [illegible] (at 60° to 80°), but [illegible] junction of two pieces [illegible] and steel Platinum, also, although infusible, may be welded at a white heat; and it is in this way that that valuable metal, when in the granular or pulverulent state, is worked into bars

WELL In Architecture, a deep pit sunk by digging, for the purpose of collecting and retaining the water of a spring or of a reservoir, by which it may be supplied *See* WATER and ARTESIAN FOUNTAINS

Before proceeding to dig a well, it ought first to be determined on, whether a mere reservoir for the water which oozes out of the surface soil is desired or obtainable, or a perpetual spring If the former is the object [illegible] supply, unless a watery vein or spring is hit on if the latter, the depth may be various there being instances of 300 and 400 feet having been gone through before a permanent supply of water was found

The art of well-digging is generally carried on by persons who devote themselves exclusively to that department The site being fixed on, the ground-plan is a circle, generally of not more than six or eight feet in diameter the digger then works down by means of a small short handled spade, and a small implement of the pick-axe kind, the earthy materials being drawn up in buckets by the hand or a windlass fixed over the opening for the purpose Where persons conversant with this sort of business are employed, they usually manage the whole of the work, bricking round the sides with great facility and readiness, but in other cases it will be necessary to have a bricklayer to execute this part of the business

There are two methods of building the stone or brick within the well, which is called the steining In one of these a circular ring is formed, of the same diameter as the intended well, and the timber of which it is composed is of the size of the brick-courses with which the well is to be lined The lower edge of this circle is made sharp, and shod with iron, so that it has a tendency to cut into the ground, this circular kirb is placed flat upon the ground, and the bricks are built upon it to a considerable height like a circular wall The well-digger gets within this circle, and digs away the earth at the bottom, the weight of the wall then forces the kirb and the brickwork with which it is loaded to descend into the earth, and as fast as the earth is removed it sinks deeper, the circular brick wall being increased or raised at top as fast as it sinks down, but when it gets very deep, it will sink no longer, particularly if it passes through soft strata in this case a second kirb of a smaller size is sometimes begun within the first When a kirb will not sink from the softness of the strata, or when it is required to stop out water, the bricks or stones must be laid one by one at the bottom of the work, taking care that the work is not left unsupported in such a manner as to let the bricks fall as they are laid this is called underpinning

Well-diggers experience sometimes great difficulty from a noxious air which fills the well, and suffocates them if they breathe it The usual mode of clearing wells of noxious air, is by means of a large pair of bellows, and a long leathern pipe which is hung down into the well to the bottom and fresh air forced down by working the bellows

The use of the auger is common in well-digging, both in ascertaining, before commencement, the nature of the strata to be dug into, and also in course of digging for the same purpose, and because, by boring in the bottom of a well to a considerable depth, the spring is sometimes hit upon, and digging rendered no longer necessary

The use of the borer alone may procure an adequate supply of water in particular situations This mode appears to have been long resorted to in this and other countries From what we have already stated as to the disposition of strata, the conditions requisite for its success will be readily conceived, viz watery strata connected with others on a higher level the pressure of the water contained in the higher parts of such strata on that in the lower will readily force up the latter through any orifice, however small All that is necessary, therefore, is to bore down to the stratum containing the water, and, having completed the bore, to insert a pipe, which may either be left to overflow into a cistern, or it may terminate in a pump In many cases, water may be found in this way, and yet not in sufficient quantity and force to rise to the surface, in such cases a well may be sunk to a certain depth, and the auger-hole made, and the pipe inserted in it in the bottom of the well From the bottom it may be pumped up to the surface by any of the usual modes

As an example of well-digging combined with boring, we give that of a well dug at a brewery at Chelsea, Middlesex, in 1764 The situation was within 20 or 30 feet of the edge of the Thames, and the depth 394 feet, mostly through a blue clay or marl At the depth of nearly fifty feet a quantity of loose coal, twelve inches in thickness, was discovered and a little sand and gravel was found about the same depth The well-digger usually bored about ten, fifteen, or twenty feet at a time lower than his

work as he went on, and on the last boring when the rod was about fifteen feet below the bottom of the well, the man felt as the first signal of water, a rolling motion something like the gentle motion of a coach passing over pavement upon his commencing to bore, the water presently pushed its way by the side of the auger with great force scarcely allowing him time to withdraw the borer, put that and his other tools into the bucket, and be drawn up to the top of the well The water soon rose to the height of 200 feet

In a case which occurred in digging a well at Dr Darwin's, near Derby, the water rose so much higher than the surface of the ground, that by confining it in a tube, he raised it to the upper part of the house (*Rees's Cyclopædia*, art "Well," and *Derbyshire Rep*)

The process of boring the earth for spring-water has of late been practised with [illegible] parts of England, chiefly by Mr [illegible] In the neighbourhood of London, many fountains of pure spring-water have lately been obtained by these means We may particularly mention those at Tottenham, Middlesex and Muswell Hill, both of which afford a constant stream or perennial flow of water, at one time equal to about eight gallons per minute, but now reduced to a much smaller quantity, in consequence of the great number of holes that have been bored into the supplying strata

WELL A small enclosed space near the mainmast, extending from the bottom of the ship to the principal gun deck containing the pumps

WE'REGILD Among the Anglo-Saxons, the compensation paid by a delinquent to the party injured, or his relations, for offences against the person This custom was common to all the Teutonic tribes, and to many Celtic It is mentioned by Tacitus in his account of the ancient Germans The great distinction between Saxon freemen was that between the 'eorls' or nobility and 'ceorls' or commonalty, and the *were* of the former was usually rated at six times the amount of that of the latter

WE'RNERITE A mineral named after Werner It is a silicate of alumina, lime, and oxide of iron, of a green or grey colour and for [illegible] crystals It has been found in [illegible] also in Switzerland

WE'SLEYANS The chief denomination of the Methodists so called from John Wesley, their founder See METHODISTS

WE'STERN EMPIRE The name given by historians to the western division of the Roman empire when divided, by the will of Theodosius the Great between his sons Honorius and Arcadius, A D 395 After the deposition of the emperor Augustulus by Odoacer A D 476 the Western empire was definitively at an end But when Charlemagne in the year 800, assumed the imperial crown it was with the view of reassuming the ancient dignity of the Cæsars in Western Europe, and after him the German emperors were considered by the jurists of their own country and of their party in Italy, as representing the majesty of ancient Rome the Italian states being looked on as feudatories of the empire

WHALE *See* BALENA

WHEAT (*Triticum*, L, *Triandria Digynia* L, *Gramineæ*, Juss Inflorescence spiked Glume two-valved, many-flowered shorter than the spikelet, the valves nearly equal, beardless or with one beard enclosing the florets Palæ two one of them bearded from the end Seed enclosed in the palæ rarely otherwise)

Wheat is by far the most important and most extensively cultivated species of bread-corn raised in England It is sown after fallow turnips, cabbages potatoes beans, &c In light soils it follows clover and the cultivated grasses but it never at least in the best farmed districts, follows any other white crop Wheat may be raised on all sorts of soils, but those of a clayey nature are the most suitable So peculiarly, indeed is wheat adapted to heavy stiff lands, that they are usually termed "wheat soils" The lighter the soil, the less is it suited to this species of grain, and it is an error in practice to force the cultivation of wheat on soils, and under circumstances, better suited to the production of other grain In this country it does not admit of being raised at a great elevation As it is a crop on which the farmer mainly depends, the preparation for it, in whatever rotation it comes, should be an object of great care and attention If it be intended to sow wheat after fallow, the land is repeatedly ploughed, harrowed, and well manured, if after clover, only one ploughing is given, and seldom more after beans, where tares have been previously sown, they are got off the land in sufficient time to plough it more than once, when wheat follows turnips or cabbages, it must, unless they be stored or eaten, be sown in the spring months

The kinds of wheat grown in England seem mostly all to be varieties of two species – the *Triticum hybernum*, or winter wheat, and the *Triticum turgidum* or turgid wheat. The culture of the latter is mostly confined to clays; the cone or bearded wheat, being the most esteemed of its varieties it enjoys this pre-eminence, not because it yields the finest flour, but because it is comparatively productive, and not subject to disease on wet soils

The varieties of wheat are perpetually changing, in consequence of variations of culture, climate, and soil Those most in use are distinguished by different local terms They may, however, be divided into the two [illegible] preferred to those that are woolly and thick-chaffed Wheat sown in the spring is called *spring wheat*, but the species is quite the same as that sown before winter, though, by being sown in the spring, its period of ripening is changed It is always sown before winter when the ground can be got ready, but when it follows turnips, cabbages and such like crops, it has frequently to be deferred to the spring (*Low on Agriculture*, pp 222—228)

Winter wheat is seldom sown in any part of England before the beginning or middle of September, or later than the end of November Spring wheat is generally sown between the middle of March and the middle of April The seed is invariably pickled or steeped, a process intended to prevent *smut* The quantity of seed allowed to an acre, when sown broad-cast, usually varies from 2½ to 3, and even 4 Winchester bushels

The drill husbandry as applied to wheat, is practised to a considerable extent in many parts of England, and in some places it is not unfrequently planted with the dibble but by far the greater portion is sown broad-cast While growing but little attention or labour is bestowed upon it When drilled, it is generally hoed, and when sown broad cast, it is sometimes hand weeded, and occasionally, though rarely harrowed and rolled in the spring But these operations are generally, perhaps, prosecuted as much in the view of covering the clover and grass seeds that are then frequently sown in the wheat fields as of improving the wheat crop

Wheat harvest generally commences in the south of England, about the 20th of July or the beginning of August in the midland counties it is about ten days and in the northern counties from a fortnight to three weeks later There is [illegible] field operations, with [illegible] kinds of grain, between the north and south of England, in the former, during harvest, the corn-field exhibits a large number of reapers, perhaps 50 60, or even 100 all working together and presenting an interesting and animating spectacle In the south of England on the other hand and over the greater part of the midland counties wheat is reaped by small sets of individuals, who contract to cut a field or a certain number of acres, so that in general the field merely exhibits one or two men with, perhaps their wives working in different parts of it Wheat is seldom or never cut down with the scythe, but is either reaped with the common sickle, or as is the practice in some of the counties near the metropolis, as well as in some of the south western counties it is *bagged*, that is struck down near the ground with a large and heavy hook It is universally bound in sheaves, which are set up in *shocks* or *stooks*, each containing twelve or fourteen sheaves Perhaps no circumstance marks the difference of climate in the south and north of England more strongly than the difference in point of time during which it is necessary to keep wheat and other grain in the field before it is carried home In the southern counties it is generally ready in a week or ten days, whereas in the north it is necessary to let it stand out for two or three weeks In the southern eastern, and midland counties it is frequently put into barns in the north, it is almost universally stacked

As this grain is so extensively cultivated, frequently on very inferior soils, and after very imperfect preparation, the produce per acre varies materially in different counties and districts, it is also very liable to injury from a bad seed time, a wet winter, or a blight during the period of its flowering (which last is the most common cause of the failure or deficiency of our wheat crops), so that its produce varies as much in different seasons on the same farms, and under the same management, as it does during the same season on different farms The lowest quantity of produce, except where an absolute deficiency from blight occurs, may, perhaps be rated at from 10 to 12 bushels an acre, and the highest at from 48 to 56 or 64 bushels Occasionally, indeed, even more than this has been reaped on the deep loams near Chichester, in Sussex on the calcareous loams near Epsom, and in some of the more favoured and highly cultivated parts of Kent, Essex, Lincoln, Somerset, &c

The wheat counties are [illegible] Hertford, Berks, Hants, [illegible] are the counties most distinguished for the quality as well as the quantity of their wheat In the north, this

grain is sometimes raised of a very fine quality, but generally it is inferior, being colder to the feel, darker coloured thicker skinned, and yielding less flour In the best wheat counties, and in good years, the weight of a Winchester bushel of wheat varies from 60 to 62 lbs In the Isle of Sheppey, in Kent (where, perhaps, the best samples are produced) it sometimes weighs, in fine seasons, 64 lbs a bushel Where the climate is colder, wetter, and more backward, or in bad seasons, the weight of the bushel does not exceed 56 or 57 lbs It is calculated that, at an average, a bushel of good English wheat weighs 58½ lbs, and that the average yield of the kingdom is 1½ lbs of flour to 14 lbs of grain The weight of the straw is supposed to be about double that of the grain, so that an acre yielding 30 bushels of wheat, at 58½ lbs per Winchester bushel, would yield 3,510 lbs of straw (*Statistics of British Empire*, i 464)

The increase of population, and the extraordinary extension and improvement of cultivation during the ten years ending with 1850, coupled with the inquiries we have made, have satisfied us that in average seasons the quantity of wheat raised in the United Kingdom for food cannot at present (1851) be less than 15 000 000 quarters, and this ⅛th part for seed, the total produce will be 17,000,000 quarters, worth at the low average price of 52*s* a quarter, 45 500 000*l* But notwithstanding its magnitude, the supply is, speaking generally, inadequate to meet the demand and whenever the crops are below an average there is a large importation

We incline to think that of the total produce of wheat in the United Kingdom, at least 15 000,000 quarters are furnished by England The climate of Scotland and Ireland especially of the latter, is speaking generally, too cold and moist for the profitable culture of wheat Along the east coast of Scotland, indeed in Berwickshire, East Lothian, Fife Perth, and Forfar, there are extensive tracts where the soil and climate are comparatively good and the culture excellent and where very good wheat is raised But with these exceptions the rest of Scotland and the whole of Ireland, is more suitable for the growth of oats and barley than for that of wheat Indeed its culture in Ireland has recently been declining

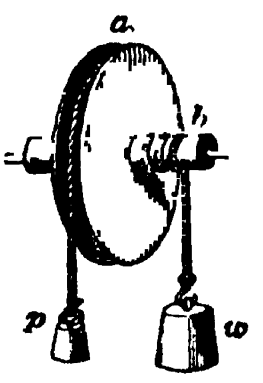
ACCOUNT of the Quantities of Foreign and Colonial Wheat imported into re exported from, and retained for Consumption in the United K[illegible] h Year since 1807 inclusive, with the [illegible] Prices of Wheat per Imperial Quarter

| Years | Imported | Re-exported | Retained for Consumption | Annual Average Prices of Wheat per Imperial Quarter |
|---|---|---|---|---|
| | *Qrs* | *Qrs* | *Qrs* | *s d* |
| 1807 | 36 523 | 5 [illegible] | | 73 4 |
| 1808 | 41 910 | 1 013 | | 81 4 |
| 1809 | 331 011 | 2 737 | - | 97 4 |
| 1810 | 1 433 977 | 62 951 | - | 106 5 |
| 1811 | 188 786 | 71 313 | - | 93 3 |
| 1812 | 171,615 | 18 201 | - | 126 6 |
| 1813 | 310,181 | Records destroyed | - | 109 9 |
| 1814 | 623,760 | 23 103 | 623 086 | 71 4 |
| 1815 | 191 632 | 56 761 | 116 582 | 63 7 |
| 1816 | 204 [illegible] | 19 172 | 82 263 | 78 6 |
| 1817 | 1 064 031 | 41 080 | 1 023 912 | 96 11 |
| 1818 | 1, 93 820 | 17 693 | 1,600 280 | 86 3 |
| 1819 | 472,203 | 22 [illegible] | 121 858 | 71 6 |
| 1820 | 58 [illegible] | 87 826 | 34,476 | 67 10 |
| 1821 | 129 612 | 193 210 | 9 | 56 1 |
| 1822 | 43 113 | 118 [illegible] | 2 | 44 7 |
| 1823 | 1[illegible] 746 | 111 733 | 12 188 | 53 4 |
| 1824 | 82,667 | [illegible] 051 | 16 [illegible] 32 | 63 11 |
| 1825 | 381 003 | 33 031 | 2, 007 | 68 6 |
| 1826 | [illegible] 888 | 11 [illegible] | 511 38 | 58 8 |
| 1827 | 304 203 | 48,986 | [illegible] 707 | 56 8 |
| 1828 | 741 114 | 71 174 | 841 947 | 60 5 |
| 1829 | 1 6[illegible] 341 | 72,377 | 1 761,340 | 66 3 |
| 1830 | 1,661 847 | 31,[illegible] 38 | 1,702 137 | 61 3 |
| 1831 | 2,303 975 | 63 [illegible] 3 | 1 493 2 6 | 66 4 |
| 1832 | 417,102 | 288 190 | 3[illegible] 789 | 58 8 |
| 1833 | 297 563 | 93 767 | 83 [illegible] 14 | 52 11 |
| 1834 | 176,322 | 1[illegible] 499 | 64 [illegible] 2 | 46 2 |
| 1835 | 66,905 | 132 223 | 27 [illegible] 27 | 39 1 |
| 1836 | 2[illegible] 1,742 | 2[illegible] 037 | 70 096 | 48 6 |
| 1837 | 559,912 | 308 102 | 244 086 | 55 10 |
| 1838 | 1,371 [illegible] 98 | 156 10[illegible] | 1 834,453 | 64 7 |
| 1839 | 2 875 427 | 38,890 | 2 681,390 | 70 8 |
| 1840 | 2,432,766 | 83,547 | 2 389 731 | 66 4 |
| 1841 | 2,770 617 | 27 [illegible] 52 | 2, 19 702 | 64 4 |
| 1842 | 3,040 469 | 66 261 | 2 9[illegible] 7 302 | 57 3 |
| 1843 | 1 061 918 | 69 560 | 982 287 | 50 1 |
| 1844 | 1,379, 62 | 76 699 | 1 021 681 | 51 [illegible] |
| 1845 | 1,141,9[illegible] 7 | 67 [illegible] 62 | 313 24[illegible] | 50 10 |
| 1846 | 2,344,142 | 13[illegible],111 | 2,013 926 | 54 8 |
| 1847 | 4,464,737 | 18[illegible],272 | 4 612,111 | 69 9 |
| 1848 | 3,078,351 | 10,967 | 2 180,876 | 50, 6 |
| 1849 | [illegible] | [illegible] | 1 [illegible] 696 | 44 [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

**WHEEL AND AXLE** In Mechanics, one of the simple mechanical powers or machines, consisting of a



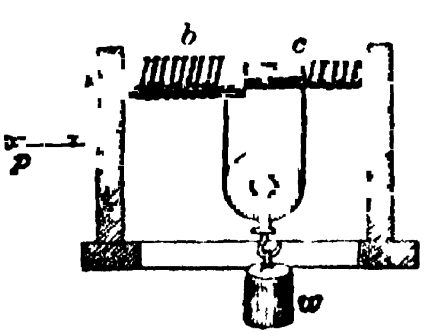
wheel having a cylindrical axle passing through its centre, resting on pivots at its extremities, or carried in [illegible] of revolving The power is applied [illegible] of the wheel, and the weight or force to be overcome to the circumference of the axle, and equilibrium takes place when the power and [illegible]




*w* the weight The power is applied by a rope passing round the wheel, and the weight attached to another rope coiled round the axle in a contrary direction. As the wheel and axle turn together, the wheel takes up or throws off as much more rope than the axle as its circumference is greater than that of the axle, or the space through which *p* descends is as much greater than that through which *w* is lifted up as the circumference or radius of the wheel is greater than the circumference or radius of the axle Hence if *a* denote the radius of the wheel and *b* that of the axle we have, by the principle of virtual velocities, *p* *w* *b* *a*, or $p\,a = w\,b$

The wheel and axle is a perpetual lever, so contrived as to have a continued motion about a fulcrum When the thickness of the rope is taken into consideration, the force must be conceived as acting at the centre of the rope, and therefore the thickness of the rope which supports the weight must be added to the diameter of the axle, and the thickness of that which supports the power to the diameter of the wheel But the modes in which the power is applied are very various, and frequently otherwise than by means of a rope If the power acts not at the circumference of the wheel, but at the extremity of a handspike or of projecting pins inserted in the wheel the distance of that extremity from the centre of the axis is to be accounted the radius of the wheel The common winch with which a grindstone is turned or a crane worked, the capstan the windlass, the crank, and other contrivances of a similar kind, are only different modifications of the wheel and axle

A form of the wheel and axle is represented in the subjoined figure, by which a great mechanical advantage is obtained The axle consists of two parts having different thicknesses, and the rope after being coiled round one of the parts is carried round a pulley attached to the weight, and coiled round the other in the opposite direction The power *p* is applied at the handle of the winch, which here takes the place of the wheel In order to compute the advantage gained by this machine let *a* denote the circumference described by the handle of the winch *b* the circumference of the thicker part of the axle and *c* that of the thinner part, then,




while the winch makes one revolution in the direction which raises the weight the part of the rope which passes from the one part of the axle to the other round the pulley will be shortened by the quantity $b-c$, and consequently the weight *w* will be raised through the height $\frac{1}{2}(b-c)$ But the space described in the same time by the power *p* is equal to that through which the handle of the winch passes, or equal to *a*, therefore, by the principle of virtual velocities *p* *w* $\frac{1}{2}(b-c)$ *a* or $p\,a = \frac{1}{2}w\,(b-c)$ As the circumferences of circles are to their radii in a constant ratio it is evident that the formula will equally apply if the letters *a*, *b*, *c* be taken to represent the respective radii

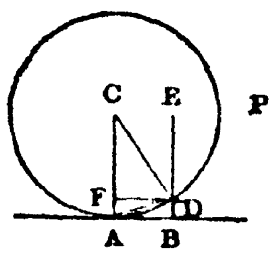
WHEEL In a Ship, the wheel and axle by which the tiller is moved

**WHEEL ANIMAL, or WHEEL ANIMALCULE.** *See* ROTIFERS

**WHEEL BREAKING ON THE** A mode of capital punishment, said to have been first employed in Germany, according to some writers, on the murderers of Leopold, duke of Austria, in the 14th century According to the German method of this savage execution, the criminal was laid on a cart-wheel with his arms and legs extended and his limbs in that posture fractured with an iron bar But in France (where it was restricted to cases of assassination or other murders of an atrocious description, highway robbery, parricide, and rape), the criminal was laid on a frame of wood in the form of a St. Andrew's cross with [illegible] cut transversely in it above and below the knees and elbows, and the executioner struck eight blows with an iron bar, so as to break the limbs in those places sometimes finishing the criminal by two or three blows on the chest or stomach the use

called *coups de grace* He was then unbound and laid on a small carriage wheel, with his face upwards, and his arms and [illegible] by which the executioner was directed to strangle the criminal, either before the first or after one two, or three blows This punishment was abolished in France at the Revolution, but it is still resorted to in Germany as the punishment for parricide, the last instance of which took place in 1827 near Gottingen The assassin of the bishop of Ermeland in Prussia, in 1841, was sentenced to the wheel

**WHEELS OF CARRIAGES** Wheels applied to carriages serve a twofold purpose In the first place, they greatly diminish the friction on the ground by transferring it from the circumference to the nave and axle, and in the second place, they serve to raise the carriage more easily over obstacles and asperities met with on the roads The friction is diminished in the proportion of the circumference of the axle to that of the wheel, and hence the larger the wheel, and the smaller the axle, the less is the friction. The mechanical advantage of the wheel in surmounting an obstacle may be computed from the principle of the lever Let the wheel touch the horizontal line of traction in the point A, and meet a protuberance B D Suppose the line of draft C P to be parallel to A B join C D, and draw the perpendiculars D E and D F We may suppose the power to be applied at E, and the weight at F, and the action is then the same as the bent lever E D F turning round the fulcrum at D Hence P W F D D F But F D D E tan F C D 1, and tan F C D = tan 2 (D A B), therefore P = W tan 2 (D A B) Now, it is obvious that the angle D A B increases as the radius of the circle diminishes, and therefore the weight W being constant, the power required to overcome an obstacle of a given height is diminished when the diameter is increased Large wheels are therefore best adapted for surmounting inequalities of the road There are however, circumstances which prescribe limits to the height of the wheels of carriages If the radius A C exceeds the height of that part of the horse to which the traces are attached, the line of traction C P will be inclined to the horizon and part of the power will be exerted in pressing the wheel against the ground The best average size of wheels is considered to be about 6 feet in diameter The fore wheels of carriages and waggons in this country are usually much too small

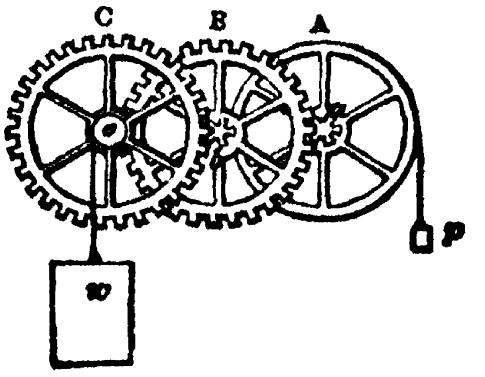



Cylindrical wheels are best adapted for level roads, and the breadth of the rim should be considerable (not less than three inches), to prevent their sinking into the ground For hilly and uneven roads a slight inclination of the spokes, called *dishing*, tends to give strength to the wheel, but this is very frequently carried to excess

**WHEEL WORK**, in Machinery consists of a combination of wheels communicating motion to one another Such combinations may be formed in various ways, but they are generally reducible to the principle of the wheel and axle, though the wheel which turns the other is not usually on the same axis with it The motion in such cases is communicated from the one wheel to the other, either by belts or straps passing over the circumferences of both, or by teeth cut in those circumferences, and working in one another In either of these ways the velocities of points in their circumferences are equal, and consequently their angular velocities or the number of revolutions which they make in the same time, are inversely as their radii When one wheel drives another by teeth, they necessarily turn in opposite directions if united by a cord or belt, they will turn in the same direction, if the belt does not cross itself between the two wheels, but if the belt crosses itself, they will turn in opposite directions The chief advantage of transmitting motion by cords or belts is, that the wheels may be placed at any convenient distance from each other, and be made to turn either in the same or in opposite directions

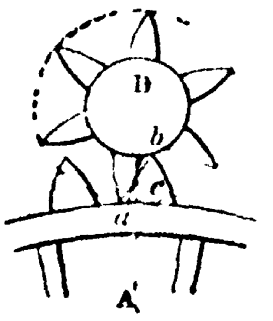
Wheels may act on one another so as to communicate motion in various ways When the resistance of the work is not great, the object may be accomplished by the mere friction of their circumferences In order to increase the friction the surfaces of the rims are faced with buff leather (caoutchouc might answer the purpose better), or wood cut against the grain and pressed together with a certain degree of force This method is sometimes used in spinning machinery, and has even been applied [illegible] accompanied with little noise

When motion is to be transmitted through a train of wheel work, toothed wheels are generally employed It is usual to call a small wheel acted on by a large one a *pinion*, and its teeth the *leaves* of the pinion Wheels and pinions are combined in the manner represented in the annexed figure On the axle of the wheel A, which bears the power, is [illegible] The axle of this wheel carries a pinion *b*, which drives the wheel C In the figure, the axle *c* of this wheel carries the weight, but the combination may be continued at pleasure When motion is communicated in this manner, the angular velocity of the first wheel is to that of the last pinion as the product formed by multiplying together the radii of all the wheels to the product formed by multiplying together the radii of all the pinions Consequently if R R', R'', &c denote respectively the radii of the wheels and *r*, *r'*, *r''*, &c the radii of the pinions, we shall have, by the principle of virtual velocities, *p* (R × R' × R'', &c) = *w* (*r* × *r'* × *r''*, &c) As the size of the teeth of any wheel and the opinion into which it works must be equal we may substitute for the radii the number of teeth in the wheels and pinions respectively




Toothed wheels, as distinguished by the position of the teeth relatively to the axis are of three kinds *spur wheels*, *crown wheels* and *bevelled wheels* When the teeth are raised upon the edge of the wheel, or are perpendicular to the axis (as in the above figure), the wheel is a spur wheel, when they are raised parallel to the axis or perpendicular to the plane of the wheel it is a crown wheel, and when they are raised on a surface inclined to the plane of the wheel, it is called a bevelled wheel The combination of a crown wheel with a spur wheel as pinion is used when it is required to communicate motion round one axis to another at right angles to it Two bevelled wheels are employed to transmit motion from one axis to another inclined to it at any proposed angle Wheels have also different names, according to their mode of action, as *heart wheel*, *sun-and-planet wheel*

*Form of the Teeth of Wheels* — In the construction of machinery, it is of the utmost importance that the several parts act on one another with a uniform force, and with the smallest possible amount of friction When wheels act by teeth working into each other, every point of the side *a b* of the tooth which is in action comes successively into contact with the tooth of the pinion as the wheel turns round and the force is necessarily exerted at the points *c*, which are in contact Hence the lengths and positions of A *c* (A being supposed the centre of the wheel) and B *c* the levers by which they act, are constantly changing, and in order therefore, that the force of the one tooth upon the other may be constant, it is necessary that the line drawn perpendicular to the surfaces of both teeth, at the point of contact *c*, always intersect the line A B of the centres in the same point There are many different curves according to which the teeth might be formed so as to answer this condition, but that which has been most generally adopted, and which appears the most convenient, is the epicycloid generated by the revolution of a circle whose radius is equal to half the radius of the pinion on the circumference of a circle equal to the wheel This was first proposed by Roemer, the celebrated Danish astronomer The evolute of the circle was proposed, with other curves, by Euler *See* TEETH OF WHEELS




When the teeth are constructed according to the theoretical rules, the action is not only uniform, but there is little friction, for the teeth roll on one another, and neither slide nor rub But as it is impossible to attain perfect accuracy in practice, the surfaces of the teeth will always present some inequalities, and there will consequently be some friction In order, therefore, to equalize the wear, it [illegible] pinion should work in [illegible] the wheel, and not always [illegible] and hence the number of teeth in a wheel and in a pinion which work into each other should be prime to one another This precaution is more especially necessary in mill work, and where considerable force is used (*Willis's Principles of Mechanism*; *Buchanan on Mill Work*, by Rennie, *Gardner's Mechanics Cab Cyclop*, *Gregory's Mechanics*, &c)

**WHELPS** Short upright pieces placed round the barrel of the capstan, to afford resting points for the messenger or hawsers

**WHE'TSTONE** A talcy slate containing silica, used for hones *See* NOVACULITE.

**WHEY** The limpid part of milk which remains after the separation of the curd and butter it consists chiefly of water holding between 3 and 4 per cent of sugar of milk in solution *See* MILK

**WHIGS** The well-known designation of a political party in English history It was first used in the reign of Charles II The term, which is of Scottish origin (*vide infrà*), was first assumed as a party name by that body of politicians who were most active in placing William III on the throne of England Since that time it has been borne by successive generations of those who by hereditary [illegible] party [illegible] popular, and their measures when in power, tending to increase the democratic influence in the constitution It may not be out of place to subjoin a few of the various accounts of the origin of the term *Whig*, now incorporated indelibly in the political vocabulary of this country It was introduced immediately after the failure of Hamilton's expedition into England, in the year 1648, for the rescue of Charles I from the hands of the English levellers and fanatics After Hamilton's defeat at Preston the Westland Whigs raised an insurrection, which is thus alluded to —

'The party appellation of *Whigamores* or briefly *Whigs* had its origin at this period, and the insurrection referred to was called the 'Whigamores' raid,' or incursion, that term being the common one for the predatory expeditions of the Borderers This nickname being still preserved in the vocabulary of party, although there is truly none now existing that can be in any degree assimilated to the original faction, it seems proper to explain how the distinction originated Mr Laing, in his History (vol i p 381 2d ed 1804), informs us that 'the expedition was termed the Whigamores' inroad from a word employed by these western peasants in driving horses, and the name transferred, in the succeeding reign, to the opponents of the court, is still preserved and cherished by the Whigs as the genuine descendants of the Covenanting Scots' And in a footnote he adds 'According to others from whig or whey, the customary food of those peasants'"

Sir Walter Scott, in his *Tales of a Grandfather Prose Works* vol xxiv ), says, 'This insurrection was called the Whigamores raid, from the words *whig, whig*, — that is, get on get on — which is used by the western peasants in driving their horses, a name destined to become the distinction of a powerful party in British history"

In Daniel Defoe's *Memoirs of the Church of Scotland*, printed 1717, p 173, speaking of the Covenanters he says, "This is the first time that the name of a Whigg was used in the world —I mean as applied to a man or to a party of men, and these were the original primitive Whiggs, the name for many years being given to no other people The word is said to be taken from a mixed drink the poor men drank in their wanderings, composed of water and sour milk"

And Bishop Burnet, who lived nearer to the time in which the nickname was invented gives the following explanation of it in the *History of his Own Times* (p 26 imperial ed 1837) — "The south-west counties of Scotland have seldom corn enough to serve them round the year, and the northern parts producing more than they need, those in the west come in the summer to buy at Leith the stores that come from the north, and from a word *whiggam*, used in driving their horses, all that drove were called Whiggamores and shorter, the Whiggs Now, in that year, after the news came down of Duke Hamilton's defeat, the ministers animated their people to rise and march to Edinburgh, and they came up marching on the head of their parishes with an unheard-of fury praying and preaching all the way as they came The Marquis of Argyle and his party came and headed them, they being about six thousand This was called the Whiggamores' inroad, and ever after that all that opposed the court came, in contempt, to be called Whiggs, and from Scotland the word was brought into England, where it is now one of our unhappy terms of distinction"

**WHINSTONE** A species of basalt *See* GEOLOGY

**WHIP** In sea language, a rope passed through a single block or pulley

**WHIRLING TABLE** A machine contrived for representing several phenomena of centrifugal force, by giving bodies a rapid rotation Mr Robins invented a whirling machine for the purpose of determining the resistance of the air, which is described in the 1st vol of his *Tracts*, and also in *Hutton's Tracts* vol iii, where the results of a series of experiments with it are detailed.

**WHIRLPOOL** A vortex, eddy, or gulf, where the water has a circular motion Whirlpools are produced by the meeting of currents which run in different directions Their danger to navigation is well known, but is perhaps not equal to the dread which sailors entertain of them Some of the most celebrated are the Euripus near the coast of Negropont the Charybdis in the straits of Sicily and the Maelstrom on the northern coast of Norway (*Murray's Geography*, Introd )

**WHIRLWIND** A revolving column or mass of air, supposed with most probability to be produced by the meeting of two currents of air blowing in opposite directions, but ascribed by some to electricity It is analogous to the *whirlpool* When the opposite currents have the same velocity, the circulation will be maintained at the same spot, but if the motion of one of them is more rapid than that of the other, it will transport the whirling motion with its excess of celerity, and a progressive and rotatory motion are thus maintained at the same time Whirlwinds generally occur in summer, and are most violent in tropical countries, where they frequently produce most destructive effects The diminution of atmospheric pressure arising from the centrifugal force of the revolving portion is found, to a sufficient degree of approximation, by the formula —

$$\frac{5\,r}{4\,t^2}$$

where $r$ is the radius described by the whirlwind, and $t$ the time of circumvolution in seconds, the [illegible] pressure of the column at the verge, which [illegible] corresponding to the fraction $\frac{5\,r}{4\,t^2}$ The amount of this diminution over the whole base would be reduced to three fourths, and consequently, $h$ expressing the height of the revolving column of air, $\frac{15\,r\,h}{16\,t^2}$ would represent the mean effect of centrifugal action Suppose the whirlwind to have an elevation of 200 feet, and a radius of 50, and to circulate in 3 seconds, the diminished pressure would be equal to the weight of a column of $\frac{15 \times 50 \times 200}{16 \times 9} = 1040$ feet This example, assuming a celerity of sixty-five miles an hour, might be reckoned an extreme case, but it would occasion the mercury to sink in [illegible] than an inch, or 1 12 ' (*Ency Brit* [illegible] *See* STORM, WINDS

**WHISKEY** (A corruption of the Gaelic word *usquebaugh*) A species of corn spirit *See* DISTILLATION

**WHISPERING DOMES, or GALLERIES**, are places in which whispers or feeble sounds are communicated to a greater distance than under any ordinary circumstances In order to produce this effect, the form of the roof or walls of the building must be such that sound proceeding from one part is transmitted by reflection or repeated reflections to another The dome of St Paul's church in London furnishes an instance *See* SOUND

**WHITE** In Painting, a negative colour (if such definition may be allowed), whose opposite or antagonist is *black*, which may best serve as its explanation, because black is void of all colour, properly so called

**WHITE** The colour produced by the combination of all the prismatic colours mixed in the same proportions as they exist in the solar rays This is proved both by decomposing white light by means of a prism, and by recompounding the primitive colours in due proportions *See* COLOUR, LIGHT, REFRACTION

**WHITE ARSENIC** Oxide of arsenic, or arsenious acid *See* ARSENIC

**WHITE BAIT** The name of a small and peculiar species of *Clupea*, confounded, until studied by Mr Yarrel with the young of the [illegible] (*Clupea alosa*. The young fish of the white bait (*Clupea alba*, Yarrell) begin to ascend the Thames at the beginning of April and continue in that part of the river where there is a mixture of salt with fresh water until September, when young fish of the year four or five inches long are not uncommon though accompanied by others of smaller size, but the parent fish are believed not to ascend beyond the estuary [illegible] not two inches and a half [illegible] white bait season is over, [illegible] by a spotted appearance behind the edge of the upper part of the operculum, which the white bait never exhibits Mr Yarrel suggests that if a net sufficiently small in the mesh were used the white bait might be taken in other rivers besides the Thames, but he states that the Hamble, which runs into the Southampton Water, is the only other river from which he has received this justly estimated fish.

**WHITE COPPER** An alloy used by the Chinese and called by them Packfong or Pakfong it is composed, according to the analysis of Dr Fyfe, of 40 4 parts of copper, 25 4 of zinc, 31 6 of nickel, and 2 6 of iron *German silver* is a modification of this alloy

**WHITE EAGLE, ORDER OF THE** An order of knighthood in Poland, instituted by Uladislaus V in 1325, revived by Frederic Augustus I in 1705

**WHITE LEAD** Carbonate of lead *See* LEAD. This

important compound, of which from 16,000 to 17,000 tons are annually manufactured in England, is chiefly used as the basis of white oil paint, it is also employed to a small extent in the manufacture of cements It is chiefly made in two ways either by precipitation, as when carbonic acid or a carbonate is used to decompose a soluble salt, or a subsalt of lead or by exposing plates of cast lead to the joint action of the vapour of acetic acid air and carbonic acid it is by the latter process only that the resulting carbonate of lead is obtained of that degree of density and opacity, and perfect freedom from crystalline texture, which fits it for paint This last, commonly called the *Dutch process*, was introduced into England about the year 1780 It is described together with the other processes in *Brande's Manual of Chemistry* fifth ed p 814 White lead is often largely adulterated with sulphate of baryta, which is detected by insolubility in dilute nitric acid, whereas pure white lead is entirely dissolved by it

WHITE LEG A disease which generally occurs in women soon after delivery, and which has been erroneously supposed to arise from redundancy of milk It commences with stiffness and pain of the limb, which afterwards becomes tumid and tense from the effusion of serum, and in some instances goes on to suppuration Leeches, fomentations friction, and gently stimulating liniments with the internal use of mild aperients and remedies calculated to allay the febrile symptoms that attend it are the principal points of treatment Those women who during pregnancy have suffered very much from swellings of the lower extremities are generally most liable to its attacks

WHITE PRECIPITATE The white powder which falls on adding ammonia to a solution of corrosive sublimate it is a compound of peroxide and bichloride of mercury with ammonia it is virulently poisonous, and is chiefly used in ointments and for killing vermin

WHITE STONE A granite abounding in white felspar

WHITE SWELLING A term vulgarly applied to indolent tumours in scrophulous habits

WHITE VITRIOL The old name of sulphate of zinc *See* ZINC

WHITEWASH A mixture of whiting, size, and water for whitening [illegible]

WHITFIELDIAN METHODISTS The name given to the most numerous body of the Methodists after the Wesleyans so called from Whitfield whose early connection with the Methodists will be found noticed under that term Soon after the return of Mr Whitfield from America in 1741, he withdrew connection with Wesley on account of religious tenets, the former holding the high doctrine of Calvinism, and differing from the latter chiefly on the subjects of election and general redemption But [illegible] differed in sentiments these good men [illegible] in heart Whitfield devoted his life to itinerant preaching and was, if possible, more popular as an extemporaneous and eloquent pulpit orator than his former colleague He did not confine his labours to Great Britain and Ireland, but visited North America no fewer than seven different times and died there at Boston, in 1770, in the fifty-sixth year of his age But he can scarcely be said to be the founder of a sect his chief object was itinerating At several places indeed he erected chapels or *tabernacles* as he called them, but these he invariably left to the care of any orthodox clergyman whether in the establishment or among the dissenters who was prepared to occupy them Since his death the members of these congregations have been nominally, but only nominally classed together as a distinct body under the title of the *Tabernacle Connection* They are not governed by a general conference, nor is their cause supported by a common stock, but each congregation is virtually independent in itself, and provides for its own expenses The lay-preachers are few, most of their ministers being ordained among themselves, but, like the Wesleyans they have a periodical change of pastors (*Dr Gillies's Life of Whitfield*)

Among the most zealous of Whitfield's followers was [illegible] Huntingdon in whose family he had [illegible] as chaplain She devoted her ample funds to the erection of chapels in different parts of England, and invited clergymen of the established [illegible] the education of pious young men for the ministry She thus became the foundress of a distinct sect, under the name of *Lady Huntingdon's Connection* The college has, since her death, which took place in 1791, been transferred to Cheshunt, in Hertfordshire In her chapels about sixty in number, the service is performed according to the ritual of the church [illegible] (*D'Aubigné's Hist of the Church*, vol [illegible] *Evangelical Magazine*, vol iii 146 56)

A [illegible] whose name is frequently found in connection with that of Whitfield, are the Welsh Calvinistic Methodists This body, which, though not founded by Whitfield, received much countenance and support from him in its earlier stages had its origin so early as 1735, but was not formally organized till 1785 Its founder was Mr Howell Harris of Trevecca The field of the operations of this sect is chiefly Wales, and there is scarcely a village in the principality in which one of their chapels is not to be found

WHITING The name of a species of the Cod tribe (Merlangus vulgaris Cuv), and the type of a subgenus, [illegible] the true cod by the absence of the [illegible] It is esteemed for the delicacy of its flavour and [illegible] of digestion

WHITING (Chalk) carefully cleared of all stony matter, ground, levigated, and made up into small oblong cakes As it is often [illegible] it should be very carefully freed from [illegible] or sand

WHITLOW (Sax) A painful inflammation, tending to suppuration at [illegible]

WHITSUNDAY [illegible] seventh Sunday, or 49th day [illegible] corresponds with *Pentecost* This Sunday was called in the ancient church *Dominica Alba*, White Sunday, or *Dominica in Albis*, the Sunday in which *white garments were worn* it having been formerly a custom with those who were baptized on this day to dress in white for the occasion The term however, has been differently derived from the Saxon "utas" octave, the eighth from Easter (*Hamon l'Estrange* See *Riddle's Christian Antiquities*)

WICKLIFFITES In Ecclesiastical History, the followers of the reformer Wickliff who are better known by their popular name of Lollards (which see) The memory and opinions of Wickliff were solemnly condemned by the council of Constance in 1415 His bones were dug up and publicly burned in 1428, an event finely commemorated in one of the sonnets of Wordsworth

WILL or TESTAMENT is, in Law, the legal declaration of a man's intentions as to what he wills to be performed after his death In strictness of language, the term *will* is limited to land, *testament*, to personal estate

Wills, according to the law up to a recent period were either nuncupative or written A nuncupative will could not revoke one that is written, it must be proved by the oaths of three witnesses present at the making of it, must have been made in the last sickness of the testator, and at his house, and was subject to various other restrictions A written will to dispose of personal property was good if sufficient proof could be obtained of the writing of the testator even without his signature or the attestation of any witnesses A will of real property must, by 29 C 2 c 3 be in writing, signed by the testator, or by some other person in his presence, and by his express direction, and witnessed or subscribed in the presence of the testator by three or four credible witnesses This state of the law gave rise to considerable inconvenience Much litigation was occasioned by the uncertainty as to what was or was not, a paper sufficient to convey personal property as a will much fraud was supposed to have been caused by the facility with which such testaments might be forged, or surreptitiously obtained while on the other hand, the rules respecting the publicity of wills of real property were thought more stringent than the case required These considerations induced the legislature to pass the statute 7 W 4 & 1 Vict c 26 (in 1837) by which the making of wills is now regulated All wills (except those of seamen and soldiers on service), whether of real or personal property, must be in writing, and signed at the foot by the testator or some other person in his presence and by his direction, and such signature must be made and acknowledged by the testator in the presence of two or more witnesses present at the same time, and such witnesses must attest and subscribe the will in the presence of the testator, but no form of attestation is necessary All appointments by will, whatever formalities may have been required by the creator of the power, must now be made according to the provisions of this statute and require no further form

The same statute enacts that no will of a minor shall be valid All devises and gifts by will to an attesting witness are void To put an end [illegible] which had arisen respecting the [illegible] provided that they shall be revoked only by the marriage of the party, or by another will duly executed, or some writing declaring an intention to revoke and executed with such formalities, or by burning, tearing or otherwise destroying with intention to revoke All wills now speak from the death of the testator unless they show on the face a contrary intention, that is, they act upon the property which he possesses at his death And various important alterations are introduced in the effect of the ordinary language used in devises and bequests

A married woman cannot make a will of lands or tenements, nor, without the consent of her husband, of personalty

A disposition by will of real property is termed a *devise;* of personal property, a *bequest* or *legacy*. *See* DEVISE, EXECUTOR

WILLOW *See* SALIX

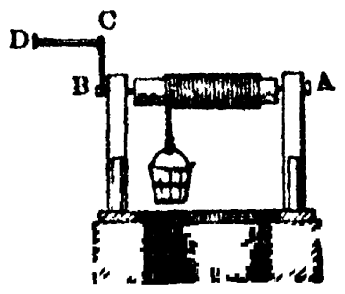
WINCH In Mechanics, a bent handle or rectangular lever, for turning a wheel grindstone &c The term *winch* is also popularly applied to the *windlass*. *See* WINDLASS

WIND *See* WINDS

WINDAGE OF A GUN The difference between the [illegible] very considerable with large [illegible] bore, but it has been [illegible] truer, and that a smaller quantity of powder is required, when the above allowance is considerably diminished (*Hutton's Tracts*, vols ii iii) *See* GUNNERY

WIND GAGE An instrument for measuring the force or velocity of the wind *See* ANEMOMETER

WINDLASS A machine used for various purposes It consists of a cylinder or axle to which the power is applied by means of a rectangular lever or *winch* The arm B C of the winch represents the radius of the wheel, and the power is applied to C D at right angles to B C The windlass is frequently used in merchant ships or small trading vessels instead of a *capstan* for heaving the anchors, &c In this case it consists of a large cylindrical piece of timber laid in a horizontal position and supported at its two ends by two pieces of wood called *knight heads* placed on opposite sides of the deck near the foremast The axle is pierced with holes directed towards the centre, in which long levers are inserted, called handspikes It is furnished with strong *pauls* to prevent it from turning backwards when the pressure on the handspikes is intermitted




WINDMILL In Mechanics, a mill which receives its motion from the impulse of the wind The general appearance of the windmill is familiar to everyone The building containing the machinery is usually circular To the extremity of the principal axis, or wind-shaft are attached rectangular frames (generally five) on which cloth is usually stretched to form the sails The surfaces of the sails are not perpendicular to the axis, but inclined [illegible] form is in some degree twisted, and different from a plane surface Suppose the axis to be placed in the direction of the wind, the wind will then strike the sails obliquely, and the force may therefore be resolved into two parts, one of which, acting in the direction perpendicular to the axis, gives a motion of rotation to the sails, and consequently to the wind shaft, from which it is communicated to the machinery The wind-shaft is inclined to the horizon in an angle of from 8° to 15°, principally with a view to allow room for the action of the wind at the lower part, where it would be weakened if the sails came too nearly in contact with the building

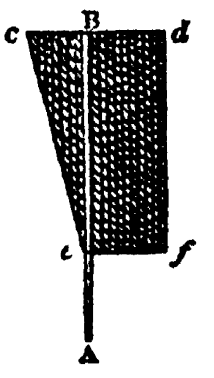
As the direction of the wind is constantly changing, some apparatus is required for bringing the axle and sails into their proper position This is sometimes effected by supporting the machinery on a strong vertical axis, the pivot of which moves in a socket firmly fixed in the ground, so that the whole [illegible] by a lever But it is now usual to construct the building with a movable roof, which rests upon friction rollers, and the shaft being fixed in the roof is brought round along with it The roof is brought into the required position by means of a small vane wheel furnished with wind sails, which turns round when the wind strikes on either side of it, and drives a pinion which works into the teeth of a large crown wheel connected with and [illegible] through the moveable roof

*Of the Form and Position of the Sails* — From the investigations of Parent and Belidor it appears that the greatest impulse effect of the wind on the sails is produced when their inclination to the axis of rotation is about 54½ degrees, or when the *angle of weather*, that is to say, the angle formed by the plane of the sail and the plane of its revolution, is 35½ degrees But this result, being obtained from considering the effect of the wind on the sails when at rest, does not agree with that which is found by experiment In fact, as the velocity of the sail tends to withdraw it from the action of the wind it is necessary to counteract the diminution of force by diminishing the angle of weather, or to bring the sail into such a position that the wind strikes its surface more directly, and since the velocity of the different parts of the sail is in proportion to their distance from the axis, it follows that in order to produce the greatest effect every elementary portion of it ought to have a different angle of weather diminishing from the centre to the extremity of the sail. Euler has given a theorem which determines the law of variation Let $a$ be the velocity of the wind, and $b$ the velocity of any given part of the sail, then the action of the wind upon that part of the sail will be a maximum when the tangent of its inclination to the axis, or the cotangent of the angle of weather, $=$

$$\sqrt{2+\left(\frac{3b}{2a}\right)^2}+\frac{3b}{2a}$$

Suppose that at a given part of the sail the velocity of the sail is equal to the velocity of the wind, we have then $a = b$, and the formula becomes $\sqrt{2+\frac{9}{4}}+\frac{3}{2}=3\,561$ = tangent of 74° 19′, which gives 15° 41′ for the angle of weather

This subject was investigated experimentally by Smeaton (*Philosophical Trans* vol lxii) who found that the common practice of inclining the sails from 2 to 7½ to the axis is much more efficacious than the angle assigned by Parent, the effect being as 45 to 31 When the sails were weathered in the Dutch manner, or with their surface concave to the wind, and the angle of inclination greater towards the extremities, the effect was greater than when weathered either in the common way or according to Euler's theorem But the effect was greatest of all when they were enlarged at their extremities, and had the form *c d f e*, represented in the annexed figure, so that *c d* was one third of the radius A B, and *c* B to B *d* as 5 to 3 If the sails be farther enlarged, the effect is not increased in proportion to the surface, and besides, when the quantity of cloth is great the machine is much exposed to injury from sudden squalls In Smeaton's experiments the angle of weather varied with the distance from the axis, and it appeared from several trials that the most effectious angles at the different parts of the sail were those in the following table —




| Parts of A B which divided into six equal parts. | Angle with the Axis | Angle of Weather |
|---|---|---|
| 1 | 72° | 18° |
| 2 | 71 | 19 |
| 3 | 72 | 18 |
| 4 | 74 | 16 |
| 5 | 77½ | 12½ |
| 6 | 83 | 7 |

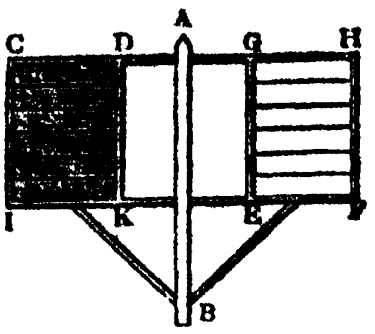
If the radius A B of the sail be 30 feet, then the sail will commence at 1 6th of A B, or 5 feet from the axis, where the angle of inclination will be 72° At 10 feet from the axis, the angle will be 71°, and so on, as in the table

*Theory of Windmill Sails* — The following maxims [illegible] the sails were deduced by Smeaton from his experiments —

1 The velocity of windmill sails, whether loaded or unloaded, so as to produce a maximum effect is nearly as the velocity of the wind, their shape and position being the same 2 The load at the maximum is nearly, but somewhat less, as the square of the velocity of the wind, the shape and position of the sails being the same 3 The effects of the same sails at a maximum are nearly, but somewhat less, as the cubes of the velocity of the wind 4 The load of the same sails at the maximum is nearly as the squares, and their effects as the cubes of their number of turns in a given time 5 When the sails are loaded so as to produce a maximum effect at a given velocity, and the velocity [illegible] the load continuing the same, then [illegible] effect, when the increase of the velocity of the wind is small, will be nearly as the square of those velocities, when the velocity of the wind is doubled, the effect is nearly as 10 to 27½ When the velocities compared are more than double of that where the given load produces a maximum, the effects compared increase nearly in the simple ratio of the velocity of the wind 6 In sails where the positions and figures are similar and the velocity of the wind the same, the number of turns in a given time will be reciprocally as the radius or length of the sail 7 The load at a maximum that sails of a similar figure and position will overcome at a given distance from the centre of motion will be as the cube of the radius 8 The effects of sails of similar figure and position are as the square of the radius 9 The velocity of the extremities of Dutch sails, as well as of the enlarged sails in all their usual positions, when unloaded, or even loaded to a maximum, is considerably quicker than the velocity of the wind

*Horizontal Windmills* — A [illegible] constructed in such a manner that the planes of the sails intersect each other in the wind-shaft, in which case they are [illegible] wind-shaft, however, might be placed with equal advan-

tage in the horizontal position In this construction




A B is the wind-shaft or arbor, which moves upon pivots Cross bars are fixed in this arbor, which carry the frames C D E F and G H I K The sails C E and G I are stretched on these frames, and are [illegible] toothed wheel fixed upon the arbor gives motion to the machinery Two sails only are represented in this figure, but there are always other two at right angles to these When the wind impels the two sails C E and G I equally, it is obvious that no motion can ensue In order then, that motion may be communicated to the machine, the impulse of the wind on the returning sail must be removed by screening it from the wind or at least diminished by making it present a less surface when returning against the wind The first of these methods is said to be practised in Tartary, and some provinces in Spain, it is the simplest, and probably the best The other method requires the sail to be formed of several flaps moveable on hinges, and so adjusted that on one side of the axis they present their surfaces to the wind, and when returning on the other only their edges Other contrivances have been proposed, but horizontal windmills are greatly inferior in point of effect, to those which have vertical sails, and are accordingly seldom met with

On account of the irregularity of the moving force, and the interruption from calm weather, machines impelled by the wind can only be used advantageously for purposes which are not urgent and where regularity is not indispensable The chief purposes to which they are applied are grinding corn expressing oil from seeds, bruising oak bark for tanning sawing wood raising water, &c Windmills were brought into Europe from the East about the time of the Crusades (*Phil Trans* vol ii, *Smeaton's Miscellaneous Papers*, *Ferguson's Lectures* by Brewster, *Gregory's Mechanics*)

WINDOW (Quasi wind door) In Architecture, an aperture in a wall for the admission of light and air to the interior In distributing windows so that there be had a sufficiency of light it is usual to make the piers or intervals between them never less than the width of the window, and never more than two widths of the same Where it is required to ascertain the total area of light necessary for a room, the following empirical rule is frequently used — Multiply together the length, breadth, and height, and extract the square root of the product, which will be the area of light required

WINDS Currents in the atmosphere, conveying the air, with more or less velocity from one part to another Notwithstanding all that has been written on the subject of the winds their theory is still involved in considerable obscurity The subject is exceedingly complicated, and no attempt that has yet been made to derive a general law from the observations has been attended with much success Nevertheless we can discern, clearly enough, certain prevailing causes of the disturbances which are constantly taking place in the equilibrium of the elastic fluid which envelopes the earth though the [illegible] is modified and sometimes altogether counteracted, by disturbing causes, the effects of which we have no means of adequately appreciating

The principal cause of wind may be ascribed to the unequal and variable distribution of heat through the atmosphere, the temperature of which is mainly determined by that of the surface of the earth The distribution of heat at the surface is determined by the manner in which it is received from the sun, and radiated from the earth to the celestial spaces If we consider the whole earth, or the state of any given portion of it through a long space of time, the quantity of heat received from the sun and the quantity lost by radiation exactly balance each other, and the mean temperature remains invariable But, on considering any particular portion of the earth it is easy to see that though a balance is effected in the long run between the heat received and parted with, the two quantities are never precisely equal at the same time, or only so for very short intervals, the one alternately exceeding and falling short of the other The radiation goes on continually, though not uniformly; but the supply of heat from the sun, on a given surface, is interrupted entirely while the sun is below the horizon, and during the day varies with the sun's altitude It varies also at the different seasons of the year, in consequence of the unequal lengths of the days and nights and the greater or less obliquity with which the rays strike against the surface

But the effect of the solar rays depends not only on the obliquity with which they fall upon the surface, but also in a great degree on the nature of the surface. The diurnal illumination of the sun warms the land to a very [illegible] depth, [illegible] inch The [illegible] the temperature of which is rapidly increased when the heat received exceeds that which is radiated away, and as rapidly cooled in the reverse circumstance. In water, however, the calorific rays penetrate to a depth not less than twenty or thirty feet If we suppose a tenth part of the incident solar rays to be intercepted by a stratum of water one foot in thickness, while they are totally intercepted by 1 2 inch of dry land, it would follow that the sun communicates every day a hundred times less heat to the surface of a body of water than to an equal expanse of level ground Now in general the effect of the two surfaces in heating the superincumbent atmosphere will be in proportion to the respective temperatures, but in the [illegible] is modified by two circumstances In the first place, a portion of the solar rays, perhaps a fiftieth of the whole, are intercepted in their passage through the atmosphere, and communicate heat, and it is obvious that the increase of temperature caused by this portion is independent of the nature of the surface In the second place, a small portion of the rays which fall upon water are reflected from the surface into the atmosphere, and communicate heat On the whole, it may be concluded that the change of temperature in the air caused by the succession of day and night is about thirty times less over water than over land Hence, if the whole surface of the globe had been covered by the ocean the effect of the alternation of day and night in producing atmospheric currents would have been scarcely sensible. Hence, also over a great part of the surface of the ocean, the winds are reducible to fixed and determinate laws, while on continents, and also on the ocean in high latitudes the order and periods of their recurrence are irregular and anomalous

Besides the effects arising from the disturbance of the equilibrium of temperature we have also to consider the mechanical effect of the earth's rotation about its axis If the earth were a sphere of uniform temperature, and at rest in space, the atmosphere would also be at rest, its height would be constant over every point of the earth's surface, and its density and elasticity at equal altitudes every where the same But if the temperature of the motionless sphere instead of being equal at every point, were greatest at the equator, and decreased towards the poles, then, though the pressure on every point of the surface would still continue the same, the altitude of the atmospheric column would become greatest at the equator, and consequently its specific gravity less there than at the poles The heavier fluid at the poles would then, by virtue of its greater weight, pass beneath and displace the lighter, and a current be established in the lower part of the atmosphere from the poles towards the equator In the higher regions of the atmosphere the effect would be reversed The lower stratum of air in the equatorial regions being heated by its contact with the earth, becomes rarified and ascends, and thus produces an accumulation and causes a counter current in the higher regions from [illegible] the poles The height at which this [illegible] rection of the motion takes place under certain circumstances may be computed Professor Daniel (*Meteorological Essays*) computes that the lower current, from the poles to the equator extends to the height of 2¼ miles, diminishing in velocity from the surface upwards

If we now suppose the sphere to revolve about its polar axis, an apparent modification will take place in the directions of the currents The lower current, coming from a zone where the velocity of rotation is less than that of the parallel at which it arrives, will appear to be affected with a motion contrary to that of the diurnal rotation; while the upper current, flowing from the equator to the poles, would be apparently affected in an opposite manner On this theory it is usual to explain the *trade winds*, which prevail within and to a considerable distance beyond the tropics in both hemispheres These easterly currents, however, receive important modifications, both as to their direction and the [illegible] from the variation of the [illegible] configuration of the land They prevail in the [illegible] ocean in the Atlantic and Pacific, between the [illegible] of N and 27 S On entering this zone from either side the deviation arising from the rotation of the earth towards the east is greatest, and this deviation becomes less and less as the equatorial zone is approached In the immediate vicinity of the zone the wind is nearly due N on the northern side of the equator and nearly due S on the southern side See Trade Winds

In the Indian Ocean the trade winds receive a curious modification from the position of the [illegible] and the effect of the solar heat on it [illegible] of the year from November to April the winds blow in the ordinary direction of the trades, that is to say, from the north east, but from April to November they blow

in the directly opposite direction These periodical winds are called the *Monsoons* (*See* Monsoons) Between the equator and 10° south latitude, north-west winds prevail from October to April, and south-west the rest of the year In other parts of the tropics, the regular trade w[illegible] of the land [illegible] constantly blows from the south-west, in the opposite direction to the trades Near the Cape Verd Islands calms and variable winds are usually experienced

Between the parallels of 30° and 40°, in both the North and South Pacific Oceans, westerly winds blow almost constantly, excepting only for a short time after each equinox In the North Atlantic Ocean the prevalence of westerly winds between those parallels is less consi[illegible] e narrowness of th[illegible] of the opposite continents, they are still, however, the prevailing winds, except in the months of April and October, when a north-east wind is more frequent In consequence of these winds, the voyage from Europe to America is much more tedious than the [illegible]

Upon the continents the diurnal changes of temperature are much more rapid and extensive than over the ocean, hence there is little constancy in the direction or intensity of the winds, even in equatorial countries In high latitudes the inequalities are still greater, and extend even to the open seas Beyond the latitude of 40°, the winds do not seem to be reducible to any fixed laws

The different manner in which land and water are affected by radiation and the direct heat of the sun gives rise to the *land* and *sea breezes* which prevail on the coasts, particularly in tropical countries, though they are not confined to any particular latitude, and are perceptible sometimes as far north as Norway During the day the surface of the land becomes more heated than that of the adjacent ocean, and the air over the land, in consequence of [illegible] the denser air rushi[illegible] *sea breeze* b[illegible] at some hour in the morning and [illegible] is near setting, will flow from the water towards the land At night the water remains warm, while the surface of the land cools rapidly, and hence the current sets from the land towards the water, and forms the *land breeze* Winds of this sort are more frequent about islands and small peninsulas than in other situations

A variety of *local winds* are observed, the circumstances occasioning which are either too complicated or too imperfectly known to admit of their being satisfactorily explained The *Etesian* is a northerly or north-easterly wind, which prevails very much in summer all over Europe The *Sirocco* is a hot moist, and relaxing wind, which visits Naples and the south of Italy from the opposite shores of the Mediterranean The *Samiel* or *Simoom* of Arabia is a hot arid, pestilential blast generally coming from the south The *Kamsin* of Egypt is of the same kind The *Harmattan* is a dry east wind, also of an unwholesome description, occurring in Guinea and some other countries

In the preceding remarks the winds have been considered as produced by the unequal distribution of temperature in the atmosphere, combined with the earth's diurnal rotation Other causes, however, depending on the physical constitution of the atmosphere, must be assigned for those sudden and irregular blasts which occasionally spring up, and rage for some time with tremendous fury Among those causes, one of the most powerful is, doubtless, the rapid condensation of vapours in the bosom of the atmosphere An inch of rain has sometimes been observed to fall within the space of an hour over a great extent of country, particularly in the equinoctial regions [illegible] which rain has fallen [illegible] 100 square leagues, if the vapour necessary to produce this quantity of rain existed in the atmosphere at the temperature of 50° of Fahrenheit, it would occupy a space 100,000 times greater than in the liquid state, that is to say, it would occupy a space equal to a column of which the base is 100 square leagues, and the altitude 100,000 inches, or nearly 9,000 feet, and such would be the dimensions of the vacuum created by the condensation Some abatement must be made from this estimate, inasmuch as the vapour existing in the atmosphere is in the vesicular, and not the elastic state, but in any case its condensation into drops and precipitation must create an immense void the filling up of which must necessarily occasion violent atmospherical concussions On this principle may be explained a fact, the observation of which is often of great importance at sea, that an unusual fall of the barometer is generally followed by a gale of wind *See* Storms.

The velocity of wind varies from nothing to upwards of a hundred miles an hour; but the maximum is variously stated by different experimenters By means of Whewell's anemometer the velocity has been constantly measured at Greenwich since 1841, and advantage has been taken of violent storms to compare the maximum indications of velocity with those of pressure obtained from Osler's anemometer In vol II of the *Philosophical Transactions* a table is given of the different forces and velocities of winds, drawn up by Smeaton from a considerable number of facts and experiments, by the assumption that the pressure varies as the square of the velocity [illegible] extract from it

| Velocity of the Wind | Perp Force on 1 Sq Foot, in lb Avoirdupois | Co[illegible] of W[illegible] |
|---|---|---|
| Miles in an Hour | | |
| 1 | 005 | Hardly perceptible |
| 4 - | 079 | Gentle pleasant wind |
| 5 - | 123 | |
| 10 | 492 | |
| 15 | 1 107 | Pleasant brisk gale |
| 20 - | 1 968 | |
| 25 | 3 075 | Very brisk |
| 30 - | 4 429 | |
| 35 | 6 027 | High wind |
| 40 - | 7 873 | Very high |
| 60 - | 12 300 | A storm |
| 60 - | 17 715 | A great storm |
| 80 - | 31 490 | A hurricane |
| 100 | 49 200 | A violent hurricane |

Of late years the theory of winds (in common with other meteorological phenomena) has received much attention, and through the recommendation of the British Association, self-registering anemometers have been erected at the principal observatories and other places, with a view to obtain systematic series of observations The principal points to be determined are the mean duration of the different winds the law of their succession, and their connexion with the state of the barometer, thermometer, and [illegible] see *Prof Forbes' Reports on Meteorolog*, [illegible] Association for 1831 and 1840, Experiments by Col Beaufoy in the *Annals of Philosophy*, vol viii p 94, *Daniell's Meteorological Essays*, *Murray's* [illegible] Introd, Pouillet, *Elemens de Physique*, [illegible] *Meteor Obs*)

WIND SAIL A tube or funnel of canvass, employed to convey a stream of fresh air down into the lower part of a ship

WINE (Germ wein) All spirituous products of fermentation are occasionally denominated *wines* The term however, is more generally limited to fermented grape juice or *must*, and the theory of the process has been noticed under the word FERMENTATION There are many circumstances which influence the general characters or quality of wine among which are principally climate, soil and aspect, the nature and maturity of the grape, and the mode of fermentation In regard to climate for instance it may be observed that that which is best suited to the culture of the vine extends from the 35th to the 50th degrees north latitude, in more northerly situations the grape seldom ripens perfectly, and the wines that it yields [illegible] those produced in [illegible] climates, on the other hand, the juice becomes too rich and saccharine It often happens, however, that a very luscious grape transplanted to a colder climate yields a good wine, and that vines carried from a cold to a warmer climate, within the latitudes mentioned, afford excellent liquors, it is said, indeed, that we are indebted for some of our most choice wines to such judicious transplantations Chaptal has stated that the *must* obtained from grapes grown in the south of France was richer than that from the northern departments With respect to soil, it may be observed that no fruit is more remarkably influenced by its qualities than the grape Light and porous soils are best suited to it, and although the plant will grow vigorously in rich and moist ground, the fruit is by no means excellent in proportion to its luxuriance Dr Henderson states (*History of Wines*), that strong argillaceous soil not only checks the extension of the roots, but keeps them too moist, and often imparts to the wines a peculiar earthy taste, such as we perceive in Cape wi[illegible] A stony or gravelly soil is preferable to all others, it allows of the free growth of the roots, and is sufficiently retentive of moisture Volcanic soils are also favourable to the growth of the vine, as shown in the Island of Madeira, Italy, Sicily, and the south of France The quality of the grape is also greatly influenced by differences in the exposure and inclination of the ground Hills are preferable to plains, especially where the aspect is such as to be duly exposed to the sun and sheltered from cold winds, hence the advantage of a south-eastern aspect The influence of season, so important in regard to the ripening and perfection of all fruits, is especially so with respect to that of the vine, its consequences going beyond the mere temporary perfection of the grape as fitting it for the table, and extending in a very striking manner to the qualities of the wine, hence the notoriety and high character of the vintages of particular seasons, as, for instance, that of the comet in 1811 In a cold year the wine is weak and

acescent "When the season is rainy," observes Dr Henderson, "the produce will be increased, but it will be poor and insipid, and generally found to contain a large portion of malic acid, which gives to it a peculiar flavour, always most perceptible in those wines which are most devoid of spirit A moderate degree of humidity, however, is essential to the welfare of the vine In those climates, accordingly, where great droughts prevail, as in Persia, and in the neighbourhood of Malaga, the earth is formed into a dish around the plant in order to collect and retain the rain which falls during the spring High winds and fogs are always very injurious to the vine" Manures are generally regarded as prejudicial in warm climates, but in colder aspects, as upon the Rhine they are often not only useful, but necessary Different methods of planting and training the vine are adopted in different countries, but it is generally found advantageous to keep the plant as low as possible, for the same vine yields fruit of very different qualities depending upon the mode in which it is trained and trimmed But there are no circumstances by which the quality of the wine is more affected than those dependent upon the state of maturity of the grape When grapes are fully ripe they generally yield the most perfect wine as to strength and flavour If suffered to shrivel to a greater or less extent the wine will be more saccharine, and if they are not fully mature, it will be brisk, and often tart "In general, dry and clear weather ought to be chosen for the vintage, but when a slow and imperfect fermentation is required, as in the case of the brisk champagne wines, the grapes that are collected during a fog, or before the dew that has settled on the vines is dispersed, are found to answer best, and to yield the largest quantity of *must*" The few facts which have now been stated will show how many minute circumstances must be attended to in the selection and cultivation of the vine, and it is astonishing how much the character and excellence of the produce depend upon causes which often appear so trifling as to be beneath notice But the ultimate production of good wine involves a variety of other considerations connected with the process of fermentation, in the due management of which much practical skill is often requisite, and the utmost cleanliness always indispensable The component parts of *must* and the changes which they undergo in the fermenting vats, have already been noticed (*see* FERMENTATION), so that it only remains here to add a few remarks upon the general characters and composition of the principal varieties of wine The colour of the wine almost always depends upon the husks of the grape, for the pulp, even of the blackest fruit, is, with very few exceptions, equally colourless with that of the green grape The seeds of the grape, and more especially the stalks, containing tan and extractive matter, also modify the taste of the wine, hence they are added to Port wine, but generally excluded from the delicate wines of Bourdeaux and of the Rhine The peculiar aroma or perfume is sometimes dependent upon very recondite causes, as in the fine wines of Burgundy In some cases it is acquired by age, and appears to depend upon some chemical change, perhaps connected with the formation of something like a variety of ether, but it also depends upon the quality of the grape, as in the Muscadine and Frontignac wines The leading character, however, of wine must be referred to the *alcohol* which it contains, and upon which its intoxicating powers principally depend not exclusively however, for some of the lighter wines, if brisk and effervescent, seem to derive from the admixture of carbonic acid a peculiar character not directly proportional to their alcoholic strength And again, we find other wines, among which certain Burgundies stand foremost, which produce a lasting though not very strong [illegible] (as the quantity of alcohol (of the specific gravity mentioned), by measure, contained in 100 parts by measure of the respective wines Some other vinous and spirituous liquors have been added, for the purpose of showing the relation which they bear to wine in the proportion of alcohol which they contain.

| | | Proportion of Spirit per Cent by Measure | Average |
|---|---|---|---|
| 1 | Lisse | 26 47 | |
| | Ditto | 24 35 | |
| | Ditto | 15 90 | |
| | | | 25 41 |
| 2. | Raisin wine | 26 40 | |
| | Ditto | 25 77 | |
| | Ditto | 23·20 | |
| | | | 25 12 |
| 3 | Marsala | 26 03 | |
| | Ditto | 25·05 | |
| | Ditto | 18 40 | |
| | | | 25 09 |
| 4 | Port | 25 83 | |
| | Ditto | 24 99 | |
| | Ditto | 23 71 | |
| | Ditto | 23 59 | |
| | Ditto | 22 30 | |
| | Ditto | 21 40 | |
| | Ditto | 19 00 | |
| | | | 22 96 |
| 5 | Madeira | 21 42 | |
| | Ditto | 23 93 | |
| | Ditto (Sercial) | 21 40 | |
| | Ditto | 19 24 | |
| | | | 22 27 |
| 6 | Currant wine | 20 55 | |
| 7 | Sherry | 19 81 | |
| | Ditto | 19 83 | |
| | Ditto | 18 79 | |
| | Ditto | 18 25 | |
| | Ditto (very old) | 23 80 | |
| | | | 19 17 |
| 8 | Teneriffe | 19 79 | |
| 9 | Colares | 19 75 | |
| 10 | Lachryma Christi | 19 70 | |
| 11 | Constantia (white) | 19 75 | |
| | Ditto | 14 50 | |
| 12 | Ditto (red) | 18 92 | |
| 13 | Lisbon | 18 94 | |
| 14 | Malaga (1666) | 18 94 | |
| 15 | Bucellas | 18 49 | |
| 16 | Red Madeira | 22 30 | |
| | Ditto | 18 40 | |
| 17 | Cape Muschat | 18 25 | |
| 18 | Cape Madeira | 22 94 | |
| | Ditto | 20 50 | |
| | Ditto | 18 11 | |
| 19 | Stein wine | 10 60 | |
| 20 | Grape wine | 18 11 | |
| 21 | Calcavella | 19 20 | |
| | Ditto | 18 10 | |
| 22 | Vidonia | 19 25 | |
| 23 | Alba Flora | 17 26 | |
| 24 | Malaga | 17 26 | |
| 25 | White Hermitage | 17 43 | |
| 26 | Roussillon | 19 00 | |
| | Ditto | 17 26 | |
| 27 | Alicatico | 16 20 | |
| 28 | Ætna | 30 00 | |
| 29 | Claret | 17 11 | |
| | Ditto | 16 32 | |
| | Ditto | 14 08 | |
| | Ditto | 12 91 | |
| | | | 15 20 |
| 30 | Malmsey Madeira | 16 40 | |
| 31 | Lunel | 15 52 | |
| 32 | Sheraaz (red) | 15 52 | |
| | Ditto (white) | 19 80 | |
| 33 | Syracuse | 15 28 | |
| 34 | Sauterne | 14 22 | |
| 35 | Grenache | 21 24 | |
| 36 | Burgundy | 16 60 | |
| | Ditto | 15 22 | |
| | Ditto | 14 53 | |
| | Ditto | 11 95 | |
| | Ditto (20 years in bottle) | 12 16 | |
| | | | 17 84 |
| 37 | Hock | 14 37 | |
| | Ditto | 13 00 | |
| | Ditto (old in cask) | 8 85 | |
| | | | 12 05 |
| 38 | [illegible] | 8 71 | |
| 39 | [illegible] | 10·72 | |
| 40 | [illegible] | 7 36 | |
| 41 | Nice | 11 36 | |
| 42 | Barsac | 13 86 | |
| 43 | Tent | 13 30 | |
| 44 | Champagne (still) | 13 80 | |
| | Ditto sparkling | 12 80 | |
| | Ditto [illegible] | 12 56 | |
| | Ditto ditto | 11 30 | |
| | | | 12 01 |
| 45 | Red Hermitage | 12 32 | |
| 46 | Vin de Grave | 13 94 | |
| | Ditto | 12 80 | |
| 47 | Frontignac | 12 79 | |
| 48 | [illegible] | 12 32 | |
| 49 | Gooseberry wine | 11 84 | |
| 50 | Orange wine (average of six samples made by a London manufacturer) | 11 26 | |
| 51 | Tokay | 9 88 | |
| 52 | Elder wine | 8 79 | |
| 53. | Cyder (highest average) | 9 87 | |
| | Ditto (lowest ditto) | 5 21 | |
| 54 | Perry (average of four samples) | 7 26 | |
| 55 | Mead | 7 32 | |
| 56 | Ale (Burton) | 8 88 | |
| | Ditto (Edinburgh) | 6·20 | |
| | Ditto (Dorchester) | 5 56 | |
| 57 | Brown stout | 6 80 | |
| 58 | London porter (average) | 4 20 | |
| 59 | Ditto small beer (ditto) | 1 28 | |
| 60 | Brandy | 53 39 | |
| 61 | Rum | 53 68 | |
| 62 | Gin | 51 60 | |
| 63 | Scotch whiskey | 54 32 | |
| 64 | Irish ditto | 53 90 | |

It is necessary, however, to observe that the proportion of alcohol in the same wine varies materially according to the age of the wine and other circumstances, and that wines having the same quantities of alcohol in each, may, notwithstanding, differ essentially in every other respect Practically wines are distinguished by their colour hardness or softness on the palate, their aroma, and their being still or effervescing In many cases, too, the same variety of wine may be distinguished into a number of sub varieties differing more or less in one or more of these particulars Thus, in [illegible] varieties are red, and others [illegible], some are dry and others sweet, the aroma of one variety differs from that of another, and, while some are still, others have every different degree of effervescing power

The same variety exists in the case of clarets, and, indeed of almost every description of wine

The differences in the quality of wines depend partly on differences in the vines, but more on the differences of the soils in which they are planted in the exposure of the vineyards and in the treatment of the grapes, and the mode of manufacturing the wine Though the vine grows in every sort of soil, a rising ground, or gently-sloping hill facing the south, with a loose, gravelly, or rather volcanic soil, is by far the best situation for a vineyard —

"——— apertos
Bacchus amat colles"

It is in such situations that all the finest wines are produced

It would be useless in a work of this kind to attempt characterizing the different sorts of wine used in Great [illegible] and sherry have long enjoyed a decided [illegible] and it must be admitted [illegible] But they are often harsh, and have the disadvantage of being strong and heating, so that they cannot be taken, to anything like excess, by most persons with impunity They are well enough for a glass or two, but they are not wines for conversation or society It is not probable, indeed, had it not been for the high differential duties with which French wines were so long burdened, that the use of port and sherry would ever have been so general in England, and since the abolition of the differential duty in 1831, French wines have begun gradually, though slowly, to make their way from the highest, to which they have hitherto been mostly confined, amongst the middle classes They are, indeed, superior, in almost all respects, to every other variety The best growths of claret, champagne, and Burgundy, seem to unite all the qualities required to constitute perfect wines Had they been known in antiquity we apprehend they would have engrossed most part of the praise so profusely lavished on the Falernian, Cecuban, Falernian, and other renowned wines of Greece and Rome We subjoin

An Account of the Quantities of the different Sorts of Wine imported into and exported from the United Kingdom the Quantities entered and retained for Home Consumption, &c, for the Year ending Jan 5 1851

| Wine | Quantities imported | Quantities upon which Duty has been paid | Quantities exported | Quantities retained for Consumption, deducting Export after Payment of Duty |
|---|---|---|---|---|
| | *Gallons* | *Gallons* | *Gallons* | *Gallons* |
| Cape | 234 774 | 216 408 | 2 643 | 216 132 |
| French | 680 243 | 365 183 | 173 808 | 340 [illegible] |
| Portugal - | 3 363 012 | 2,893 847 | 329,681 | 2,811,473 |
| Spanish - | 3,826 783 | 2,587 116 | 786 172 | 2 461,038 |
| Madeira | 198 311 | 82 754 | 152 029 | 70,760 |
| Rhenish | 66 813 | 56,332 | 13 220 | 54,668 |
| Canary | 149,154 | 16 181 | 130,854 | 18,916 |
| Teneriffe | 52 | 215 | 509 | 445 |
| Sicilian and other sort | 686,123 | 437,932 | 91 035 | 425,056 |
| Mixed, in bond | | - | 87 217 | |
| Total | 9,304 312 | 6 684 668 | 1 754 718 | 6 437,722 |

WINGS In Naval matters Passages along the sides of the ship between the fore and after cockpit

WINGS in Plants are membranous expansions of different parts The two lateral oblong petals of a Papilionaceous corolla, the two lateral sepals of a Polygam, the expansion from the back of the fruit of the ash tree, from the sides of the seed of a Bignonia, and from the surface of many Umbelliferous fruits, are all called *wings*

WINGS In Architecture *See* ALAR

WINTER One of the four seasons of the year Winter is usually understood to begin with the shortest day and to end when the sun returns to the vernal equinox

WIPERS, in some kinds of machinery, as oil-mills, powder mills, fulling-mills, are pieces projecting generally from horizontal axles, for the purpose of raising stampers, [illegible] pistons, in vertical directions, and [illegible] to fall by their own weight The principal object to be attended to in the construction of wipers is to give them such a form that the weight shall be raised with a uniform force and velocity (*Gregory's Mechanics, Appendix to Ferguson's Lectures*, by Brewster *Willis's Principles of Mechanism*)

WIRE DRAWING The art of extending the ductile metals into wire The operation is performed by casting or hammering the metal into a bar, which is then successively drawn through holes in a steel plate, each being smaller than the other, until the requisite fineness is attained The holes through which extremely fine wires of platinum, gold, or silver are occasionally drawn, [illegible] ruby *See* GOLD, &c

WIT [illegible] briefly to be the unexpected combination of distant resemblances The term *wit* has in the course of two centuries passed through more significations than most others in the English language Without going further back than the reign of James I, wit is used by Sir J Davies as the most general name for the intellectual faculties of which reason, judgment, wisdom, &c are subdivisions In the time of Cowley and Hobbes, it came to denote a superior degree of understanding, and more particularly a quick and brilliant reason By Dryden it is used as very nearly synonymous with talent or ability; but after his time, and more particularly by Addison in his papers on Wit, we find a gradual approximation to the modern signification of the term

The forms of wit are so various that it would be impossible to include them all within the circle of a precise definition but the [illegible] enumeration of the forms by the [illegible] may be interesting to the reader "Sometimes it lieth in pat allusion to a known story, or in seasonable application of a trivial saying, or in forging an apposite tale, sometimes it playeth in words and phrases, taking advantage from the ambiguity of their sense, or the affinity of their sound, sometimes it is [illegible] of humorous expression, sometimes [illegible] an odd similitude, sometimes it is lodged in a sly question, in a smart answer, in a quirkish reason, in a shrewd intimation, in cunningly diverting or cleverly [illegible] objection, sometimes it is couched in [illegible] speech, in a tart [illegible] in a [illegible] nonsense, sometimes a scenical representation of persons or things accompanied with a mimical look or gesture, passeth for it, sometimes an affected simplicity, sometimes a presumptuous bluntness giveth it being, sometimes it riseth only from a lucky hitting upon what is strange, sometimes from a crafty wresting obvious matter to the purpose Often it consisteth in one knows not what, and springeth up one can hardly tell how Its ways are unaccountable and inexplicable, being answerable to the numberless rovings of fancy and windings of language" (See as to the difference of meaning between *wit* and *bulls*, *Edin Rev* vol iii p 399)

WITCH, WITCHCRAFT It has been a subject of much controversy whether the verse, "Thou shalt not suffer a witch to live," in the 22d chapter of Exodus, is correctly rendered in modern versions The Septuagint render it by *φαρμακος, a poisoner* It is, however, generally held, that the latter interpretation is not the true one, and that the practice here condemned was that of pretended divination by means of supernatural agency This was, by the Jewish law, an act of rebellion against the Almighty Ruler of the Jewish nation, and punished as such (See also Deuteronomy, xviii 10, 11) The only detailed and particular narrative of witchcraft in the Old Testament is that of the evocation of Samuel by the witch of Endor (See on this subject *Sir W Scott's Second Letter on Demonology and Witchcraft*)

Among the Greeks, a general belief prevailed in magical practices and incantations, especially by women, and Thessaly was the region most celebrated for the pursuit of these arts by its inhabitants The same superstition was equally prevalent among the Romans. But in the sense in which the word is used in modern times, a witch is supposed to derive her power from a peculiar compact with [illegible] and this species of witchcraft is of course [illegible] the rise of Christianity although the belief in demoniacal possession was common from the first ages of the Christian church, and a particular class of the clergy was early set apart for the purpose of conjuring devils with the name of exorcists The first traces of the modern superstition respecting witchcraft are perhaps to be found in Augustine who speaks of magicians as living in society with devils, and having a compact with them The ancient witchcraft of the classical times became easily connected in vulgar belief with the superstitions arising out of Christian theology As early as the Council of Ancyra (308), the belief in transformations by magical art (of which we find so remarkable an instance in the romance of Apuleius) is condemned as heretical. The gods of the ancient mythology by the zealous preachers of the Christian clergy, acquired in popular imagination the attributes of demons, and there is little doubt that many of the supposed assemblies of witches and devil-worshippers, which terrified the imaginations of the chroniclers and historians of saints in the early part of the dark ages, originated in the secret meetings of the proscribed worshippers of Pagan deities, who endeavoured to secure their privacy by terrifying their orthodox neighbours (See a poem of Goethe's on this subject) From all these causes combined, the belief in witchcraft grew, as has been observed, side by side with the prevailing worship of saints and relics About the time of Charlemagne

and his successors, we find one species of imaginary witchcraft peculiarly prevalent Storms and tempests were attributed to certain magicians (defensores), who were believed, as in the classical mythology, to have acquired a power of controlling the elements, but this belief was condemned by the church as superstitious The very general superstition (which also is mentioned by Augustine) of assemblies of females riding through the air with the demon Diana, Minerva, or Herodias (from which, in later days the notions of the witch festival on the Brocken in Germany, the French sabbat, &c, were all derived), is also reprobated by the divines of this period It has been supposed by some that the sudden spread of intelligence, [illegible] more liberal sentiment which [illegible] the time of the Crusades checked for a time, at least among the higher orders, the spread of debasing superstitions, but if this was really the case, the effect was but temporary Up to this time we have found the church generally condemning most of the popular fancies respecting demoniac agency as superstitious, but from the end of the 12th century we find them gradually gaining ground, so as to become articles of religious credence At the coronation of Richard I, Cœur de Lion, Jews and women were forbidden to attend the latter because so many of them were suspected of witchcraft The works of Gervase of Tilbury (at the beginning of the 13th century) give perhaps the best picture of the extent to which similar opinions prevailed about that epoch In the same century, witches and heretics were first connected in the eye of the church the commissioners who tried the various sectaries of the time were equally directed to inquire into and punish magical practices In the 14th century the persecution of witches assumed a more regular and severe character The well-known accusations against the T[illegible] which all the common charges of compacts w[illegible] witch-assemblies &c were mingled with those of atheism and heresy were but the prelude to a long series of similar proceedings About this time the south of France, north of Italy and some parts of Germany seem to have been most infected with demoniacal agency The female sex seems from the earliest times to have been most implicated in the public horror of witchcraft, and from the commencement of the 15th century we find this common notion become a confirmed doctrine almost all the decrees of councils, &c, which speak of witchcraft, and the prosecutions which are carried on, henceforward are directed against women only From this time therefore, we may date (as far as accuracy is practicable on such subjects) the separation in popular belief of the higher magic practised by learned and distinguished men, from the petty witchcraft of which the great performers were poor old and ignorant women Many of the great magicians were believed to operate their wonders by the control which they had acquired over inferior spiritual agents, without any express compact with the devil, and although such practices were often condemned by the church, always liable to suspicion and sometimes brought those who indulged in them (together with alchemists and astrologers) under the cognizance of criminal tribunals yet they were always considered as of a different order altogether from the feats of common witches In 1484 appeared the famous bull of Innocent VIII, "Summis desiderantes affectibus" In this remarkable instrument all the absurdities of the popular superstition are formally recapitulated, and a commission directed to three individuals (Institor, Sprenger and Gremper) to examine and punish witches in the German empire Although immediately relating to Germany only, this bull is rightly considered by Herzog (the author of the article on witchcraft in *Ersch and Gruber's Encyclopædia*, from whom we have borrowed largely on the present subject) as forming a period in the history of this superstition Although much cruelty had been committed before in the pursuit of this imaginary crime it is from this solemn confirmation of the vulgar superstition that we must date the continuous course of legal persecution which lasted for two centuries over the greater part of Europe

The details of these legal proceedings bear a striking similarity in all the countries in which this baleful superstition so long prevailed. It has been seen that by the bull of Innocent VIII witchcraft was rendered a crime peculiarly cognizable by ecclesiastical authorities so it remained for the most part in Catholic countries, especially where the Inquisition was established, and this constituted the chief difference between the procedure in those regions and that which prevailed in Protestant districts, where the civil magistrate took cognizance of the offence Thus the various forms of religious observance which were interwoven with the judicial proceeding in the former exorcisms and so forth, were for the most part disused by Protestants In other respects, the mode of investigation and punishment was much the same Every where they exhibited a singular mixture of legal refinement with popular violence Thus the various ordeals by which suspected witches purged themselves (one of the most vulgar superstitions connected with witchcraft) were conducted with gravity and regularity under the eye of the law The best known in England was that of water if the accused swam when thrown in, it was held as a proof of guilt On the Continent a favourite mode, among many others, was by weighing In the scales set apart for this purpose a true witch was always found to weigh more than her previously ascertained weight There was in the 17th century a weighing beam at Budewater in Holland, of such celebrity that persons accused of witchcraft in many neighbouring provinces used to appeal to it When, however, the suspected person was in the hands of the tribunal, there was in general one only mode of proce[illegible] This was carried to the most hor[illegible] excesses; and as it was generally recognized that witchcraft was a crime entirely out of ordinary rules, the various provisions of the civil or municipal laws by which that dreadful practice was mitigated were wholly neglected, and the accused abandoned to all the cruelty with which fear or fanaticism might inspire the judges In England, which forms in this respect a solitary exception, torture was not judicially practised, but the various severities to which the unfortunate prisoners were subject had probably nearly equal effect And thus every where the witch persecutions produced the same result—confessions, namely, of all the strange and monstrous crimes with which the accused lay charg[illegible] have grown more voluminous and [illegible] in every generation, and this may be naturally accounted for for when a witch had made up her mind to confess, it cost her nothing to promulgate the most extravagant inventions, and these being regarded as undoubted truths, formed the basis of interrogatories to be administered to other unhappy beings who might be brought under the same accusation The punishment was uniformly death, usually at the stake

Much has been said concerning the connection between religious fanaticism and the superstition of witchcraft. It has already been seen that the cruelties and absurdities of witch persecution had reached a great height even before the Reformation, but it can scarcely be denied that the strong religious excitement which produced and accompanied that event was in some way connected with the rapid spread and development of that atrocious system The more intense the belief in the overruling providence of God, and his immediate interference in the course of ordinary events (which especially characterized the revival of religion), the more does the parallel belief in the agency of evil spirits, and their dealings with man appear to take root in the imagination Sir W Scott observes that, among Protestant sects, the Calvinists (whose views of religion were at once the most gloomy and the most engrossing) seem to have afforded the most terrible examples of this prevailing mania There seems also to have been a constantly [illegible] to treat witchcraft and heresy as allied offences It appears upon the whole, that the persecu[illegible] and 17th centuries were most violent in those countries which were the scene of much strife between the two religions, or in which the Calvinist opinions were pushed to an extreme,—France, the Netherlands Northern and Western Germany Switzerland Scotland, England under the Commonwealth, and at a still later period New England A singular example of the contagion of fanaticism suddenly spreading with extraordinary violence and subsiding again after one terrible outbreak, is to be found in the history of the witch persecutions in Sweden, in the end of the 17th century In Italy, with the exception of one or two northern districts, the superstition was generally less prevalent, or at least less distressing in its effects, and the same may be said of Spain, after the first period of the history of the Inquisition

Among many and voluminous authors who wrote disquisitions on witchcraft with a full conviction of its reality, we may cite, as some of the most remarkable, [illegible] three inquisitors whose [illegible] *Malleus Maleficarum* [illegible] contains a complete code of precedents for inquisitors, which was adopted, varied, and extended through succeeding generations; Delrio the Jesuit, the author of *Magical Disquisitions*, Bodinus, and Remigius a judge in the duchy of Lorraine, who put to death eight hundred witches in sixteen years, and was at last himself burnt as a conjuror In England, King James I [illegible] by his literary [illegible] Even from the earliest times there were not [illegible] bold and enlightened individuals, [illegible] to publish their sentiments against the [illegible] Molitor a distinguished divine at the period of the Council of Constance, avowed his doubts of the very existence of the crime of witchcraft. In 1558 appeared the book of Wier (a native of Brabant), [illegible] in which he exp[illegible]

and absurdity of the judicial proceedings; but either from caution, or from his own imperfect enlightenment, he ascribes the confessions of the witches to their own melancholy, or the delusion of the devil so working on them as to make them believe they had seen and done what they avowed In England, Reginald Scot, in the reign of Elizabeth, was still more advanced beyond his age Even at the end of the 17th century, Balthazar Bekker, a Dutch Jesuit, for having ventured to assail the prevalent superstition in his *Monde Enchante* was persecuted, and died in want The writings of Thomasius, about 1700, had much effect in Germany, and prepared the way for the abolition of witch persecutions in all her Protestant states But the public mind was at that period rapidly changing Louis XIV had already put an end to them by edict in France The last execution on account of witchcraft in England was probably in 1682, although the statute against it was not repealed until the 9th of Geo 2 In Scotland, a woman was executed in Sutherlandshire in 1722 But the practice lingered on later in some Continental districts, as in Catholic Germany, Spain, and Switzerland The sub prioress of a convent was burnt at Wurtzberg in 1749 And the last probably of all the victims of this superstition, was burnt at Glarus in Switzerland in 1783 It now exists only as a vulgar delusion, which it will probably require some centuries more wholly to extirpate It is prevalent to a degree little suspected among the English peasantry in remote districts The writer of this article has seen a horse-shoe suspended inside over the door of a gaol in a Cornish borough, as a protection against the "ill wishes" to which the guardians of such an establishment naturally considered themselves exposed The most pains-taking collection of learning on this strange subject will be found in *Horst's Zauber-Bibliothek* An amusing essay on it is contained in the *Quarterly Review*, vol xlviii See also *Grimm's Deutsche Mythologie*, passim

WITENA GEMO'TE, or MEETING OF THE WISE MEN The great national council of the Anglo-Saxon kings, also termed the "Mycel gethoht" or Great Thought Who composed the Witen cannot now be ascertained bishops, abbots, earls, aldermen, thanes of the Danish burghs, &c attended It seems that in East Anglia the possession of forty hides of land was necessary to entitle a person to rank among those termed in the Latin of the age 'proceres" who appear to have been members of the great council The powers and character of the witena gemote passed to the great council of the early Norman kings, which are called by the same name by Saxon writers The subject has been abundantly discussed by older and more recent antiquarians, the reader may consult an article in the *Ed Rev* vol xxxiv

WITHERITE In Mineralogy a name applied to carbonate of baryta, in honour of Dr Withering, who first discovered it at Anglesark in Lancashire

WITNESS In Law one who gives evidence in a judicial proceeding In civil cases witnesses are compelled to attend by the process called *subpœna ad testificandum* (which see) and punishable if they neglect to do so by attachment or action In criminal cases by subpœna or by recognizance taken by the magistrate before whom the information is given

By the law as it at present stands, witnesses are disqualified or rendered "incompetent" by reason, 1 of want of reason or understanding 2 Want of religious principle, that is, their want of belief in a God and a future state of rewards and punishments, 3 Infamy that is, conviction of an infamous crime, and judgment thereupon, the crimes which fall within this class being treason, felony, and other offences which involve the charge of falsehood The suffering of the punishment, if so provided by statute, restores the witness to competency, as does also pardon, the only exception being the case of convictions for perjury or subornation of perjury, which disqualify for ever unless reversed, 4 Interest, on which grounds the heads of exclusion are numerous, and the distinctions very refined, the general principle being, in civil causes in courts of common law, that every one interested in the event and in [illegible] matter of much debate, and perhaps the only practical reason which can really be given for this is that the time of courts of justice being limited, it is advisable to exclude at once from consideration all those classes of evidence which, from their peculiar deficiency, must be of less weight than the [illegible] interested It is clear that [illegible] has ought not for the purpose of incompetency by reason of infamy or interest, except in the case of parties to the suit, and one or two other special exceptions

WIZARD (Seems to be from the old verb witan *to know*, and of the same derivation with *wise* and *witch* Glanville, *Saddusismus Triumphatus*) The popular name in England for a sorcerer *See* SORCERY, WITCHCRAFT

WO'DEN, or WUOTAN An Anglo-Saxon divinity, considered to correspond with the Mercury of the ancient Greeks and Romans from whom Wednesday derives its name (see *Mem de l'Acad des Inscr* vol xxxv) He is sometimes also though erroneously considered as identical with Odin See ODIN

WOLF-FISH The name of a species of fish (*Anarrhichas lupus*, Linn), which subsists on whelks and other shell-fish, which it seizes by means of strong conical slightly curved anterior teeth, set in the jaws like grappling hooks, and bruises by the action of very powerful posterior molar teeth The flavour of this forbidding-looking fish is much superior to what might be supposed from the general low estimation in which it is held

WO'LFRAM A native tungstate of iron and manganese

WOLLASTONITE A name applied by some mineralogists to a species of prismatic augite, in honour of Dr Wollaston

WOOD, in Plants, physiologically considered, is the support of all the deciduous organs of respiration, digestion and impregnation, the deposit of the secretions peculiar to the individual species, and also the reservoir from which the newly forming parts derive their sustenance until they can establish a communication with the soil It consists organically of woody tissue, and various kinds of vessels surrounded by cellular matter, and more or less carefully arranged In the youngest state it is succulent and brittle, and is of nearly the same quality in all plants, but as it gains age the sides of the woody tissue become hardened and thickened by the deposit within them of matter of solidification, and wood then [illegible] and appearance peculiar to different species In the young state it is called *sapwood* or *alburnum*, when hardened and coloured it becomes *duramen* or *heartwood* It abounds in nitrogen, which may be removed by simple washing, and it is supposed that the perishable quality of wood is owing to the presence of this element It is believed that the preserving power of certain agents employed to render wood durable depends upon their rendering the azotized matter insoluble

WOOD, or TIMBER The trunks or main stems of ligneous plants which attain such dimensions as to be fit for use in architectural construction In general, every country has its appropriate timber which is produced by its indigenous trees, but there are some kinds of timber, such as that of the oak and that of the pine, which, in consequence of their durability and of commercial intercourse, are used in all countries The most useful timbers of Europe are the oak, the ash, the Scotch pine, the larch, and the spruce fir, those of North America are the hiccory, the different species of pine, and some species of oak, those of tropical countries are the teak tree, the different species of bamboo, and the palm The oak, the teak, and the larch are throughout the whole world found the most suitable timbers for shipbuilding, and the pine, and fir, and the bamboo those most conveniently adapted for civil architecture

WOOD COAL A synonym of brown coal.

WOOD-ENGRAVING *See* ENGRAVING.

WOOD-OPAL An opalized quartz occurring in various vegetable forms

WOODSTONE Petrified wood

WOOD-TIN An opaque fibrous and nodular variety of oxide of tin of a brown colour, hitherto only found in Cornwall

WOODY FIBRE Very slender transparent membranous tubes tapering acutely to each end, lying in bundles in the tissue of plants having no direct communication with each other They are of extreme tenuity and form the substances called hemp and flax.

WOOL (Germ wolle) A term used very indefinitely, being applied both to the fine hair of animals, as sheep, rabbits, some species of goats, &c, and to fine vegetable fibres as cotton (called in German baumwolle, or *tree-wool*), but when used without restriction it is generally confined to the wool of sheep—a substance which, from the remotest period of history, has been of primary importance to mankind In reference to textile fabrics, sheep's wool is of two different sorts, the short and the long stapled, each of which requires different modes of manufacture in the preparation and spinning processes as also in the treatment of the cloth after it is woven to fit it for the market Each of these is, moreover, distinguished in commerce by the names of fleece wools and dead wools according as they have been shorn at the usual annual period from the living animal, or are cut from its skin after death The [illegible] are comparatively weak, and incapable [illegible] giving [illegible] more especially if the [illegible] same [illegible] disorder The annular pores, leading into the tubular cavities of the filaments, seem, in this case, to have shrunk and become obstructed The time of year for sheep-shearing most favourable to the quality of

the wool, and the comfort of the animal, is towards the end of June and beginning of July—the period when Lord Leicester holds his celebrated rural fête for that interesting purpose

The wool of the sheep has been surprisingly improved by its domestic culture The *moufflon* (*Ovis ammon*), the parent stock from which our sheep is undoubtedly derived, and which is still found in a wild state upon the mountains of Sardinia, Corsica, Barbary, Greece, and Asia Minor, has a very short and coarse fleece more like hair than wool When this animal is brought under the fostering care of man, the rank fibres gradually disappear, while the soft wool round their roots, little conspicuous in the wild animal, becomes singularly developed The male most speedily undergoes this change, and continues ever afterwards to possess far more power in modifying the fleece of the offspring, than the female parent The produce of a breed from a coarse-woolled ewe and a fine-woolled ram, is not of a mean quality between the two, but half-way nearer that of the sire By coupling the female thus generated, with such a male as the former another improvement of one-half will be obtained affording a staple three-fourths finer than that of the grandam By proceeding inversely, the wool would be as rapidly deteriorated It is, therefore, a matter of the first consequence in wool husbandry, to exclude from the flock all coarse-fleeced rams

Long wool is the produce of a peculiar variety of sheep, and varies in the length of its fibres from 3 to 8 inches Such wool is not carded like cotton, but combed like flax, either by hand or appropriate machinery Short wool is seldom longer than 3 or 4 inches, it is susceptible of carding and felting, by which processes the filaments become [illegible] used principally for hosiery, though of late years the finer kinds have been extensively worked up into merino and mousseline-de-laine fabrics The longer wools of the Leicestershire breed are manufactured into hard yarns, for worsted pieces, such as waistcoats, carpets, bombasines, poplins, crapes, &c

The wool of which good broad cloth is made should be not only shorter, but generally speaking, finer and softer than the worsted wools, in order to fit them for the fulling process Some wool-sorters and wool-staplers acquire by practice great nicety of discernment in judging of wools by the touch and traction of the fingers Two years ago I made a series of observations upon different wools, and published the results The filaments of the finer qualities varied in thickness from $\frac{1}{1500}$ to $\frac{1}{2000}$ of an inch, their structure is very curious exhibiting in a good achromatic microscope, at intervals of about $\frac{1}{300}$ of an inch, a series of serrated rings, imbricated towards each other, like the joints of *Equisetum* or rather like the scaly zones of a serpent's skin (See *Philosophy of Manufactures*, *figs* 11, 12, p 91 2d ed)

There are four distinct qualities of wool upon every sheep, the finest being upon the spine from the neck to within six inches of the tail, including one-third of the breadth of the back, the second covers the flanks between the thighs and the shoulders, the third clothes the neck and the rump, and the fourth extends upon the lower part of the neck and breast down to the feet, as also upon a part of the shoulders and the thighs to the bottom of the hind quarter These should be torn asunder, and sorted, immediately after the shearing

The harshness of wools is dependent not solely upon the breed of the animal, or the climate, but is owing to certain peculiarities in the pasture, derived from the soil It is known that in sheep fed upon chalky districts, wool is apt to get coarse, but in those upon a rich loamy soil, it becomes soft and silky The ardent sun of Spain renders the fleece of the Merino breed harsher than it is in the milder climate of Saxony Smearing sheep with a mixture of tar and butter, is deemed favourable to the softness of their wool

All wool, in its natural state, contains a quantity of a peculiar potash soap, secreted by the animal, called in this country the *yolk*, which may be washed out by water alone, with which it forms a sort of lather It constitutes from 25 to 50 per cent of the wool being most abundant in the Merino breed of sheep, and however favourable to the growth of the wool on the living animal should be taken out soon after it is shorn lest it injure the fibres by fermentation, and cause them to become hard and brittle After being washed in water, somewhat more than lukewarm, the wool should be well pressed, and carefully dried. England grows annually about 1,000,000 packs of wool and imports 100,000 bags. (*Ure's Dict of Arts*)

The woollen manufacture was the early staple of England The first impulse towards the improvement of the woollen manufacture was given in the 14th century, by Edward III, who invited a number of Flemish manufacturers to settle in England But the manufacture laboured, down almost to our own day, under a number of vexatious and oppressive restrictions; and it did not begin to make any very rapid progress, or to participate in the wonderful improvements made in the cotton trade, till the introduction of the gig-machine, &c, in 1802, and the repeal of the prohibitory acts of Edward VI and Mary, in 1807 The total value of woollen goods exported in 1850 was upwards of £[illegible], of which the exports to the United States were nearly one-fourth The woollen factories of England and Wales employed in 1850 [illegible] males and [illegible] females

WOOLSACK The seat of the Lord Chancellor of England, in the House of Lords is so called, from its being a large square bag of wool without back or arms, covered with red cloth

WOOTZ A species of steel imported from Bengal, peculiarly excellent for some cutting instruments It appears to contain minute portions of silicium and aluminum

WORMING An operation performed on puppies, consisting in the removal of a vermiform ligament from under the tongue, it is sometimes supposed to prevent madness, but, in fact, merely breaks them of their habit of gnawing

WOULFE'S APPARATUS A series of two or three-necked bottles, connected by intermediate tubes, used in the chemical laboratory for impregnating water and other liquids with [illegible]

WRANGLER [illegible] who have the highest honours in [illegible] for the degree of bachelor of arts are so called At the close of the last day of examination, those who have most distinguished themselves (to the number of thirty at least) are arranged in order of merit by the examiners, [illegible] wranglers, senior optimes, [illegible] first or senior wrangler is the most distinguished mathematician of his year The name is probably derived from the public disputations in which candidates for degrees were formerly required to exhibit their powers, of which the "exercises" still held [illegible] the form

WRECK Goods cast up by the sea after a shipwreck, and left on land within the limits of some county The goods so brought to land belong at common law to the king, or to the lord of the manor enjoying the franchise of wreck It was ordained by Henry I and II that such forfeiture should not take place if any man or beast escaped alive from the wreck, and we find in Bracton (Henry III) that in his time if the goods could be known by marks to appertain to any owner, it was no wreck, even if no living creature escaped The limitation of claims by the owner, by stat Westm 1 (3 E 1), was within a year and a day By 7 & 8 G 4 plundering wrecked vessels or goods stranded is felony Goods cast overboard at sea, and not stranded, are divided into *jetsam* i e things sunk to the bottom, *flotsam* things found floating, and *ligsam*, things sunk, but fastened to a buoy or cork in order to be found again These are all the king's, if no owner appears to claim them, and they do not pass by the ordinary grant of wreck

WRIT In Law, a precept in writing under seal, in the name of the king judge, or other person having jurisdiction in the particular subject matter, and directed to some public officer or private person, requiring him to do something in relation to a suit or action Writs, though still very multifarious have been within the last few years much reduced in number The original writ issuing out of Chancery for the commencement of actions in the three courts of common law is now superseded by three judicial writs which issue in the name of the chief justices of the respective courts, namely, the writ of *summons*, the writ of *capias ad respondendum*, and the writ of *detainer* The first of these is the one in ordinary use, the second is only used when it is intended to arrest the defendant, and the last when he is already in prison for some other cause

WRITERS TO THE SIGNET A numerous society of lawyers in Scotland, equivalent to the highest class of attorneys in England They possess several privileges *See* SIGNET

WROUGHT In Architecture, a term applied to any [illegible] brought to a fair surface.

WYTHAM *See* WITHAM

## X.

X A letter borrowed from the Greek and used chiefly in words derived from that language Numerically it [illegible] as an abbreviation it is used for Christ. [illegible] stmas, &c

XANTHIC (Gr ξανθος, *yellow*) Tending towards a yellow colour, or some colour not green of which yellow forms a part, as orange, which is a mixture of yellow and red, scarlet, which is another mixture of the same colours &c

XA'NTHIC ACID (Gr ξανθος, *yellow*, and γινομαι,

*I generate*) An acid composed of sulphur, carbon, hydrogen, and oxygen, obtained in combination with potassa by agitating sulphuret of carbon mixed with solution of pure potassa in strong alcohol Its compounds are mostly of a yellow colour, whence its name The relative proportions of its component parts have not as yet been satisfactorily obtained

XANTHIC OXIDE (Gr ξανθος, *yellow*) A yellow substance found by Dr Marcet, composing a urinary calculus, its solution in nitric acid, when evaporated to dryness, left a bright lemon-coloured residue.

XEBEC, a small three-masted vessel, constructed for [illegible] is chiefly found in [illegible] of Spain and Portugal

XENELA'SIA (Gr *the expulsion of strangers*) A Spartan institution which prohibited strangers from dwelling in Sparta beyond a certain time, and also from entering the city except on stated days The object of this institution was to preserve the simplicity of manners of the nation, and prevent foreigners from prying into their measures, but it acquired for Lacedæmon the reputation of great inhospitality

XE'NIA (Gr ξενος) In Classical Antiquities, the presents given by friends connected by the rites of hospitality as pledges of that singular relation In the *Iliad*, the mutual gifts which pass between Glaucus and Diomede are so called

XEROPHA'GIA (Gr ξηρος, *dry*, φαγω, *I eat*) In Ecclesiastical Antiquities, a name given to the rigorous practice of certain fasts, during which nothing was consumed but bread with salt, and water It was particularly observed in Holy Week

XIPHIRHY'NCHS, *Xiphirkynchi* (Gr ξιφος, *a sword*, ρυγχος, *a beak*) The name given by Latreille to a family of Acanthopterygious fishes, of which the sword-fis [illegible]

[illegible] *Xiphosura* (Gr ξιφος, and ουρα, *a tail*) A name of a tribe of Crustaceans, comprehending those in which the body terminates posteriorly in a long, [illegible]

[illegible], ξυλον, *wood*, and γραφω, *I draw*) The same as wood engraving *See* ENGRAVING

XYLOPHAGANS *Xylophaga* (Gr ξυλον, and φαγω, *I eat*) The name of a tribe of Coleopterous insects comprehending those of which the larvæ devour the wood of trees in which they are developed, also applied to a family of Dipterous insects, the larvæ of which have similarly destructive habits

XYLOPHILANS, *Xilophili* (Gr ξυλον, and φιλεω, *I love*) The name of a tribe of beetles, consisting of those which live on decayed wood

XYLOTROGUS *Xylotrogi* (Gr ξυλον and τρωγω *I gnaw*) The name of a tribe of Serricorn beetles, comprehending those which perforate timber

XYNOECIA In Classical Antiquities an Athenian festival in commemoration of the union by Theseus of the little townships of Attica into one commonwealth whence the name, derived from ξυνος, *common*, and οικεω *I inhabit*

XYST, or XYSTOS (Gr ξυστος, from ξυω, *I polish*) In ancient Architecture, an open or sometimes covered court of great length in proportion to its width, with porticoes on three sides, for the performances of the athletic exercises of wrestling, running, &c

# Y.

Y A letter borrowed from the Greek υ, is considered a consonant at the beginning, and a vowel in every other place in English words As a vowel, it has exactly the sound of i being short or long, according to its position

YACHT A vessel of state or pleasure

YA'GERS, or JAGERS (Germ *hunters*) Light in[illegible] from the mountain districts In Germany the term *jager* is applied to a peculiar species of higher servant attached to the families of the aristocracy

YA'NKEE, the popular name for the New Englanders in America, and among English people pretty indiscriminately applied to all inhabitants of the United States, a word for which many ridiculous etymologies have been assigned, is, according to *Dr Webster's Dictionary* a corruption of the word English by the [illegible] America

YANOLITE A mineralogical synonym of AXINITE, which see

YARD The British standard measure of length. *See* MEASURES

YARD A beam or rod suspended by a rope called the halliards, for the purpose of extending a sail, signals, &c. A yard is called a *square yard* when hung horizontally by the middle such a yard is turned round by braces

YARD-ARM In naval language, the extremity of the yard *Yard-arm and yard-arm* is a term descriptive of [illegible] other as close as possible [illegible] temporary deviation from a direct course

YAWL A particular kind of carvel-built boat, rather narrow and [illegible] carrying mainly oars

YAWS A disease in which eruptions form upon the skin, somewhat resembling a raspberry *See* FRAMBOESIA

YEAR A period of time determined by the revolution of the earth in its orbit, and embracing the four seasons. The year is either *astronomical* or *civil*

The astronomical year is determined by astronomical observations, and is of different kinds, according to the celestial body or the point of the heavens to which the earth's revolution is referred When the earth's motion in its orbit is referred to an immoveable point in the heavens, to a fixed star, for example, the time of revolution is that which elapses from the instant at which the star, the sun, and the earth are in a certain relative position, till the earth returns again into the same position with regard to the sun and the star This interval is called the *sidereal year* But when the earth's motion is referred to a point of the ecliptic, as one of the equinoctial points or the tropics, the time of revolution is that in which the earth returns to that point, and is called the *equinoctial*, or *tropical* or *solar year* On account of the precession of the equinoxes (*see* PRECESSION) the equinoctial and solstitial points, in reference to the fixed stars, have a retrograde motion on the ecliptic, in consequence of which the earth returns to one of these points in a shorter time than it returns to the same fixed star

The length of the *sidereal year* is 365 2563612 mean solar days, or 365 d 6 h 9 m 9 6 sec

The length of the *equinoctial* or *tropical* year is 365 2422414 mean solar days, or 365 d 5 h 48 m. 49 7 sec (*Bailey's Tables*, p 16)

The difference is 20 minutes, 19 9 seconds of mean solar time, being the time in which the earth describes in its orbit an arc of 50″ 1, the annual precession of the equinoxes *See* EARTH

The earth's motion may also be reckoned by the time in which a revolution is completed with respect to the line of the *apsides* or the line of the *nodes* In these cases the times of revolution may be called respectively the *anomalistic year* and the *nodical year* the former term is sometimes met with

The *civil year* is the year of the calendar As it is always supposed to begin with the beginning of a day, the civil year contains a whole number of days, and hence, in order that the seasons may always correspond with the same parts of the year, it is necessary from time to time to vary the length of the year, or to intercalate a day when the fractional parts neglected have accumulated to a whole day The ancient Egyptian year consisted invariably of 365 days, and hence was called a *vague* or *erratic* year because the first day of the year in the course of 1460 years *wandered* as it were over all the seasons

The *Julian year*, which is frequently employed in chronological reckoning consists of 365¼ days Julius Cæsar, advised by the astronomer Sosygenes ordered that the civil year should consist of 365 days for three successive years, and that the fourth year should contain 366 days This practice of intercalating a day every fourth year has been adopted in all European countries, with the modification introduced by the Gregorian calendar The mean Julian year is longer than the true tropical year by [illegible] which amounts to a whole day [illegible] years [illegible] common years, those which [illegible] years *See* LEAP YEAR

According to the regulations of the Gregorian calendar the intercalations are omitted on years in which centuries end excepting when the number of the year is divisible by 4 after leaving out the two zeros. Thus the years 1700 1800, 1900 which would be leap years in the Julian calendar, are common years in the Gregorian, but 1600 and 2000 are leap years in both calendars (*See* CALENDAR) The mean length of the Gregorian year is 365 d 5 h 49 m 12 sec, exceeding the true tropical year by 22 38 sec, which amounts to a whole day only in [illegible] years

The civil or legal year, in England formerly commenced on the 25th of March the day of the Annunciation, though the historical year began on the 1st of January, the day of the Circumcision Between these two epochs it was usual to date the year both ways, as 1745 6, or 174⅚. By the act of parliament for the alteration of the style in 1751, the beginning of the year was transferred to the 1st of January It is frequently necessary to keep this circumstance in mind in referring to old dates.

The fraction by which the tropical years exceed 365

days is ·2422414; and the series of approximating vulgar fractions alternately greater and less than this quantity is,

$$\frac{1}{4},\ \frac{7}{29},\ \frac{8}{33},\ \frac{39}{161},\ \frac{281}{1160},\ \text{&c.}$$

The fractions in this series indicate the intercalations by which the coincidence between the civil and solar year may be restored to any degree of exactness The third, $\frac{8}{33}$ offers a very convenient mode of intercalation which would preserve the coincidence with great accuracy It requires eight intercalations to be made in thirty-three years, that is to say one at the end of four years seven times in succession and the eighth at the end of the fifth year The mean length of the civil year would be [illegible] correct differ in excess from the solar year only by 1·38 seconds, while the Gregorian year is too long by 22·38 seconds In a period of thirty-three years, it therefore produces a nearer coincidence between the civil and solar years than the Gregorian method does in 400 years, and by reason of its shortness it also confines the evagations of the mean equinox from the astronomical within much narrower limits The modern Persians are said, but not on very good authority, to intercalate in this manner (Delambre, *Astronomie Moderne*, tom i) *See* CALENDAR.

*Lunar Year* —Though the return of the seasons obviously depends on the motion of the sun, or rather of the earth in its orbit, some nations have chosen to regulate their civil year by the motions of the moon, and many others have formed luni-solar years, by combining periods determined by the revolutions of both bodies The proper lunar year consists of twelve lunar months or lunations, and consequently contains only 354 days its commencement, therefore, anticipates that of the solar year by upwards of eleven days, and passes through the whole circle of the seasons in about 33 lunar years The inconvenience attending this circumstance has been so universally perceived that excepting the modern Jews and Mohammedans almost all nations which have regulated their months by the moon have employed some method of intercalation for the purpose of retaining the beginning of the year at nearly the same place in the seasons These methods are founded on certain luni-solar periods or cycles which were established in the most ancient times, and which, with other relics of a barbarous age, are still preserved in our ecclesiastical calendars *See* CHRONOLOGY, CALENDAR, CYCLE

YEAST The substance produced during the vinous fermentation of vegetable juices and decoctions, rising partly to the surface in the form of a frothy flocculent, and somewhat viscid matter, insoluble in water and alcohol and gradually putrefying in a warm atmosphere It excites fermentation, and accelerates the process when added to saccharine and mucilaginous liquors It appears closely allied to *gluten* and like that vegetable principle, it contains nitrogen as one of its ultimate elements

YE'LLOW In Painting a colour of golden hue and of many varieties It is one of the seven primary colours *See* COLOUR LIGHT

YE'LLOW FEVER A bilious remittent fever *See* FEVER

YE'NITE A ferruginous silicate of lime from Elba, named by Lelièvre, its discoverer, in honour of the battle of Jena

YEO'MAN (From the Anglo-Saxon gemen, Germ gemein, *common*) Camden ranks yeomen as the next class to the gentlemen, and calls them "ingenuos" The name seems to have been generally appropriated in the middle ages to small freeholders In the king's household the yeomen of the different departments have a middle place between the sergeant and the groom

YEOMAN A seaman appointed to certain duties, as to attend to the storerooms

YEO'MANRY CAVALRY A denomination given to those troops of horse, which were embodied during the Revolutionary wars of France and afterwards among the gentlemen and yeomen of this country They were called out [illegible] trained for three weeks, and as they consisted entirely of volunteers, and were not called upon to leave their homes, or to quit their ordinary employments, except for the short period they were in quarters, the duty was not found to entail any serious privation Several troops of yeomanry are still kept up, though most of them have been disbanded The infantry troops that voluntarily enrolled themselves for similar purposes to the yeomanry were called *volunteers* These were all disbanded at the peace

YEOMEN OF THE GUARD *See* GUARD, YEOMANRY OF THE.

YOKE A piece of wood or light frame of two arms, placed over the head of a boat's rudder instead of a tiller, and having two lines (*yoke lines*), by pulling on which the boat is steered

YTTRIUM The metallic base of an earth, discovered in 1794 by Professor Gadolin in a mineral found at *Ytterby* in Sweden, whence it was called *Yttria*. The metal was first obtained by Wöhler in 1828: it is of a [illegible] brittle The salts of Yttria have [illegible] some of them a pale purple colour. Yttria is distinguished from glucina by the amethystine colour of its salts [illegible] by its pure potassa, and by yielding a precipitate with crystallized sulphate of potassa According to Berzelius the equivalent of Yttrium is about 32 and that of Yttria when considered a protoxide 40

YTTROTANTALITE A mineral from Ytterby in Sweden containing Yttria and oxide of columbium

YU (Chinese, *Yuh*) A precious stone or jade which see

YULE The common Scottish name for Christmas It appears to be a very ancient word In Welsh, wyl or gwyl signifies a holyday; whence also the old phrase 'Gule of August,' the first day of August, or feast of St Peter and Vincula, for which various absurd etymologies have been found Perhaps the old French word "Noel," for Christmas (used also generally as a popular cry of rejoicing), has the same original (See *Archæol* vol ii) Count de Gebelin, however, derives yule from a supposed primitive word, connected with the idea of revolution or "wheel." (See *Brand's Popular Antiq* vol i p 364)

# Z.

Z The last letter in the alphabets of all the modern languages, usually regarded as a double consonant, from its having the sound in some languages of *ts* or *ds* Like the letter *x*, it begins no word originally English, and Dr Johnson has remarked, that although it is found in the Saxon alphabet [illegible] grammarians, it is read [illegible]

ZAFFRE A impure oxide of *cobalt*, obtained by exposing the native arseniuret of cobalt broken into small pieces to the action of heat and air in a reverberating furnace, by which its elements are oxidized, and the greater part of the arsenic driven off

ZA'MIA Fossil zamia

ZA'NTHOPI'CRIN A bitter principle, obtained from the bark of the *Zanthoxylon caribæum* It forms yellow acicular crystals insoluble in ether, but readily soluble in alcohol and sparingly in water

ZAX A [illegible] tecture, a tool for cutting slates

ZE'CHSTEIN (Germ) A magnesian limestone, lying under the red sandstone

ZE'IN A substance of a tough elastic nature, resembling gluten, but said to [illegible] contained in Indian wheat, [illegible]

ZEMINDA'R (From the Persian zemin, *land*) A title introduced into India by its Mohammedan conquerors conferred in Bengal, and generally throughout the Mogul empire, on the agent [illegible] share of the produce of the soil [illegible] zemindars were the great landholders of the empire, but the nature of their tenure has given rise to much dispute Whether they were hereditary absolute owners of the soil, or only tenants of the sovereign at a fixed rent by way of land-tax for which they were personally responsible, was a question much agitated by writers on Indian subjects at the period of the "Permanent Settlement" in 1793 By that settlement the rent was to be fixed in the first instance by custom, and the zemindar was then to give the ryot a lease restricted to himself and his assignees on performance of its conditions his own share being fixed as before at 10 per cent of the assessment, and his hereditary right secured A zemindary, i e the district of a zemindar, is liable to be sold by government for arrears of revenue, and existing leases with the ryots to be set aside At present the land-tax of India is levied in three methods, which prevail in different districts —the "zemindar settlement," by which the zemindar is responsible to government, the "mouzawar" or village settlement, by which the collector contracts with the head man of the village, and the "ryotwar" or cultivator settlement, by which the tax is collected immediately from the peasantry (See, as to the effects of the zemindary settlement, *Mill's History of British India*, vol v, M'Culloch's Edition of *Smith's Wealth of Nations*, note 19, *Edin Rev* vols xxxi lxxi) *See* RYOTS

ZE'ND-AVE'STA (Pers *Living Word*) The sacred books of the Parsees in India, and Guebers in Persia, who profess the religion of the ancient Persians According to the popular belief among them, these books are attributed to the famous Zoroaster Their real history is much disputed, but it is generally supposed that they are not of great antiquity, and that the belief of the modern Guebers is for the most part a compound of legendary notions drawn from various religions (*See* MAGIANS.) Sir William Jones thought the *Zendavesta* a forgery of the learned adventurer Anquetil du Perron. (See *Mém de l'Ac des Inscr* vol xxxi.; *Milman's Hist. of Christianity*, vol i. p 68, for the arguments for and against its authenticity; and the *Cons. Lex.*, article "Per-

dian Religion" See also *Bryant's Mythology*, vol ii p 390 401 ) It is certain, at all events, that the Zend language, in which it is written, is of great antiquity, and radically allied to the Sanscrit. *See* SANSCRIT, PARSEES

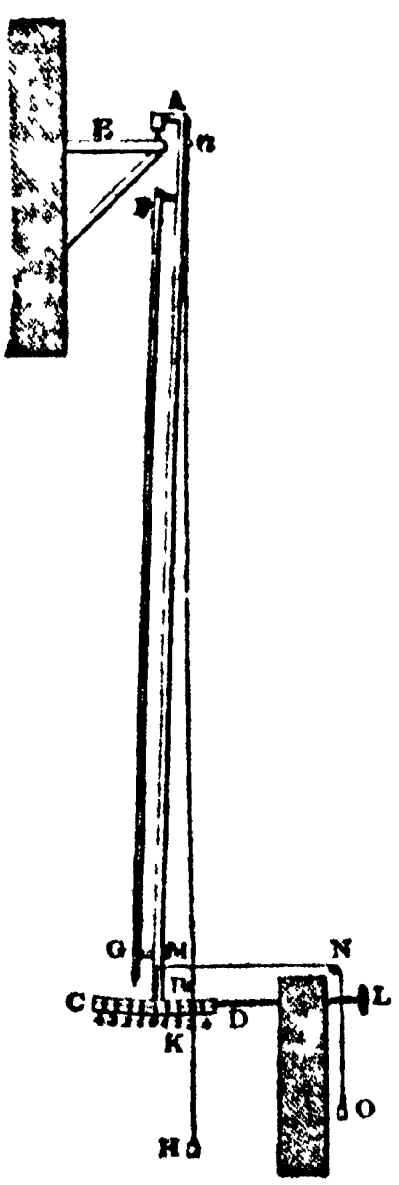
ZE'NDIK In Arabic, a name given to those who are charged with atheism, or, rather, disbelief of any [illegible] The sect [illegible] the progress of Mohammedanism Arabia with great [illegible] appears to have had many features in common with [illegible] among the Jews

ZE'NITH. (From the Arabic ) In Astronomy, the top of [illegible] the point directly overhead [illegible] of the celestial sphere which would be intersected by the plumb line, supposed to be indefinitely extended It may also be defined as the pole of the horizon, from which it is 90° distant All vertical circles or azimuths necessarily pass through the zenith

ZE'NITH DISTANCE The angular distance of any celestial object from the zenith; or the complement of the altitude of the object above the horizon

ZE'NITH SECTOR. An astronomical instrument, contrived for the purpose of measuring with great accuracy the zenith distances of stars which pass near the zenith It was by means of a zenith sector that Bradley discovered the existence [illegible] important astronomical elements [illegible] ght, and the nutation of the earth axis The instrument has also been generally used (in this country at least) in [illegible] for determining the difference of [illegible] a purpose for which it is very convenient, for the difference of the zenith distances of the same star, observed at its meridional passages at two places, gives the difference of the astronomical latitudes of the places without any regard to the star's declination The general description of the zenith sector has been given by the present Astronomer Royal as follows (*Ency Metr*, art "Figure of the Earth") —

"In the annexed figure A B is a bar of iron with a cross piece C D, the whole in one piece The top A is formed in such a way that the instrument can be turned half round in azimuth when suspended at the top, and that the bottom can be moved freely in the directions D C or C D The bracket or other support F, on which it rests is attached to some firm part of the building To the bar A B is firmly attached a telescope E G At a point *a*, near A, is attached a plumb line *a* H, sometimes it is fastened at a point of attachment which is moveable in order that by moving the point of suspension the plumb line may be made to pass over a fine dot at *a* The limb C D is graduated, sometimes on a circular arc of which *a* is the centre, [illegible] through a block strongly connected with the floor, and acting with its point against the end D of the piece C D, and M N O are a string and weight pressing the sector against the point of the screw"




The method of observing with the zenith sector is this — A clock being regulated by transits of stars, the direction of the meridian is found, and guides fixed to compel the sector to move in the meridian When a star is to be observed the screw L D is turned till the plumb line falls exactly on some point K of the graduated arc, such that the telescope is very nearly directed to the point through which the star will pass when it comes to the meridian When the star enters the field of view, the screw is again turned till it appears to glide exactly along the horizontal wire fixed in the focus of the eye-glass, and the position of the screw be thus ascertained, and the value of the division known the apparent zenith distance of the star is found But it is evident that this is not the true zenith distance unless the zero point of the divisions on the scale be quite accurate; that is to say, so placed that when the plumb line falls on it the optical axis of the telescope is exactly vertical It is impossible to insure this accuracy; but it is easy to see that if the instrument be turned half round in azimuth, and the same observation made, the apparent zenith distance will be just as much greater than the true as in the former determination it was less The mean of the two will therefore be the true zenith distance of the star

The advantages of the zenith sector are these — The stars observed being very near the zenith, the tremor and [illegible] generally affects apparent positions [illegible] [illegible] about the effects of refraction, the telescope and the whole instrument are not subject to flexure, and the variation of temperature [illegible]

[illegible] zenith sector used in the measurement of the English arcs of the meridian, see the second volume of the *Trigonometrical Survey of England and Wales*, or *Phil* [illegible] This superb instrument was unfortunately burnt in the great fire which took place in the Tower of London in October, 1841 Another sector, on a different plan from that above described (the zenith point being determined by levels), has been constructed for the use of the survey by Troughton and Simms, under the directions of the Astronomer Royal A description and drawing of the new instrument is given in the *Monthly Notices of the Royal Astronomical Society* for May, 1842 For Reflex Zenith Tube at Greenwich *see* SUPPLEMENT )

ZEOLITE (Gr ζεω, *I boil*, and λιθος, *stone* ) A name given to a family of mineralogical species which, heated before the blowpipe, melt with considerable bubbling They mostly consist of silica, alumina, lime, and water

*Natrolite* A species of zeolite containing soda from *natron*, or soda

ZE'PHYRUS (Gr ζεφυρος ) The west wind, a [illegible] child of Astræus and Aurora, ac- [illegible] whom Anchises sacrifices a ram. [illegible] wind with the Latin Favonius; but [illegible] between the two

ZERYNTHIA (Gr *Ζερυνθια*, one of the names of the goddess of love ) The name of a subgenus of butterflies in Treitschke's system, where it is erroneously written *Zerynthia*

ZE'RO (Ital ?) A term generally used in reference to the thermometer, implying the point at which the graduation commences The zero of Reaumur's and of the centigrade thermometer is the freezing point of water The zero of Fahrenheit's scale is 32° below the point at which water congeals, being about the temperature of a mixture of salt and snow *See* THERMOMETER.

ZETHES In Classical Mythology, Zethes and Calais were the sons of Boreas, king of Thrace, and Orithyia They accompanied the Argonauts, and were afterwards slain by Hercules

ZEUGMA (Gr ζευγμα, *yoke* ) A figure in grammar by which an adjective or verb which agrees with a nearer word is referred also, by way of supplement, to one more remote

ZI'MOME (Gr ζυμωμα, *a ferment* ) That part of the gluten of wheat which is insoluble in alcohol When rubbed in a mortar with powdered guaiacum, it produces a fine blue colour

ZINC A metal, first mentioned by Paracelsus, but its ores were known at a much earlier period In commerce it is often called *spelter*, and is obtained either from the native carbonate of zinc, called *calamine*, or from the native sulphuret or *blende* of mineralogists. These ores are roasted and mixed with charcoal or carbonaceous flux the mixture is put into a kind of crucible closed at top and perforated at bottom by an iron tube, which passes through the grate of the furnace into water, the vapour of the zinc distils downwards through this tube and is condensed in the water The first portions are impure containing arsenic, and often cadmium, in which case the vapour burns with what the workmen call a *brown blaze*, when the *blue blaze* appears the zinc is collected The zinc of commerce (which is not quite pure) has a peculiar blueish colour and lustre, a lamellar and crystalline texture, and its specific gravity is about 7 At common temperatures it is tough and intractable under the hammer; and when heated to above 500° it becomes brittle, and fuses at about 770°. But at temperatures between 220° and 320° it becomes malleable and ductile so that it may be beaten out under the hammer, and rolled into sheets and leaves, and drawn into wire, in a manner extremely remarkable when its highly crystalline texture is considered Being a cheap and light metal and one which, after having been superficially oxidized, long resists the further action of air and water, it has lately been much employed as a substitute for lead in lining water cisterns and covering buildings, it has also been lately employed in the curious operation of transferring printing (under the name of zincography) It is a very infusible metal burning in the flame of a spirit lamp, with a brilliant white light, but the oxide which forms interferes with its continuous combustion,

which can only be carried on at a high red heat, when the vap[illegible] flame, [illegible] oxide, [illegible] formerly called *philosopher's wool*, *pompholix* and *nihil album* The equivalent of zinc is 32, and that of its oxide 40. Though zinc is apparently without action upon wate[illegible] lubility of [illegible] when a film is once formed upon it, it resists further change, but when a little acid is present in the water, and the zinc not quite pure, it is rapidly acted upon, and oxidized at the expense of the water, which evolves abundance of hydrogen (when dilute sulphuric acid is used) and the oxide of zinc is removed and dissolved by the acid It is this action which renders zinc so powerful a generator of electricity in the voltaic pile The salts of zinc are mostly soluble and have a nauseous, astringent, and metallic taste The *sulphate of zinc*, or *white vitriol*, is employed in medicine as an emetic and tonic, and the oxide and carbonate are externally used in the form of ointment The *chloride of zinc* is a colourless compound, fusible at a heat a little above 212°, and known to the older chemists under the name of *butter* [illegible] and copper

ZINGIBERACEÆ [illegible] one of the genera), or [illegible] er of Herbaceous Monandrous Endogens inhabiting the tropics It is distinguished from the Musaceous order in the latter having five or six stamens, with a calyx and corolla of the same texture, and from *Iridaceæ*, by two of the stamens being either deformed or abortive, and from *Marantaceæ* by the single stamen [illegible] or anther [illegible] proceeding from the base of the posterior outer division Cardamoms are the seeds of several plants of this order, which are, however, principally valued for the aromatic stimulating properties of the root or rhizoma, such are found in ginger (*Zingiber officinale*), galangale (*Alpinia* [illegible] and zedoary (*Curcuma zedoaria* and [illegible] meric a substance half dye and half condiment, is the powder of the rhizoma of *Curcuma longa*

ZIRCON A mineral chiefly composed of zirconia and silica found in the sand of the rivers of Ceylon, and occasionally imbedded in primitive rocks It is of various colours, and when transparent is sometimes used in jewellery

ZIRCONIUM The metallic base of *zirconia*, an earth discovered in 1789 by Klaproth in the jargon or zircon of Ceylon Zirconium has only been obtained in the form of a black powder which when heated in the air burns into the oxide The salts of zirconia are distinguished from those of [illegible] glucina by being precipitated by all the pure alkalies, and by being insoluble when they are added in excess

ZOA'NTHUS (Gr ζωον, *an animal*, and ανθος *a flower*) The name of a genus of Polypes, comprehending those which possess the complex structure of the *Actiniæ*, but consist of different individuals adhering to a common fleshy basis

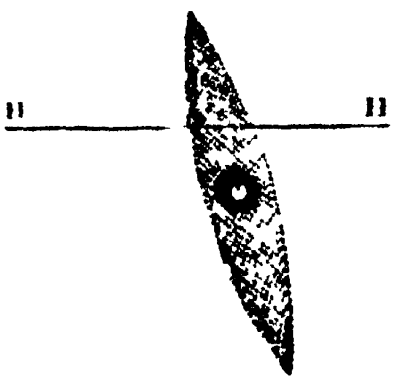
ZO'CLE, or ZOCCOLO (It zoccolo, *a wooden shoe*) In Architecture, the same as *socle*, which see

ZO'DIAC (Gr ζωδιον, dim of ζωον, *animal*, because the constellations of the ecliptic are for the most part represented in celestial charts by the figures of animals) An imaginary zone or belt in the heavens, extending to about 8° or 9° on each side of the ecliptic, which divides it in the middle No use is made of the zodiac in astronomy, the name only indicates that region of the heavens within which the apparent motions of the sun, moon, and all the greater planets are confined Three of the new planets, Juno, Ceres, and Pallas, have inclinations which exceed the limits of the ancient zodiac, and are therefore sometimes called *extra-zodiacal* planets, but Vesta is also sometimes included in the same description *See* PLANET

The zodiac is divided into twelve equal parts, called *signs*, which are designated by the names of the constellations with the places of which the signs anciently corresponded They are Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, and Pisces The signs are counted from the vernal equinox, one of the points in which the equator intersects the ecliptic, whence, in consequence of the regression of the equinoctial points, their position with respect to the constellations or fixed stars is greatly different from what it was in remote ages Some time prior to Hipparchus, the first points of the constellations Aries and Libra corresponded to the vernal and autumnal equinoxes; those of Cancer and Capricorn to the summer and winter solstices: at present, the difference is about 30°. The vernal equinox now happens in the constellation Pisces, the summer solstice in Gemini, the autumnal equinox in Virgo, and the winter solstice in Sagittarius, but the vernal equinox always corresponds to the first point of the sign Aries, the summer solstice to the first of Cancer, and so on. On this account it is necessary to distinguish between the *signs* of the zodiac, which follow the motions of the equinoctial points, and the *constellations* of the zodiac, which are immoveable in the celestial sphere

It has been supposed that the constellations of the zodiac were invented in Egypt in a very remote age and that they had a reference to the divisions of the seasons and the agriculture of that country at the time of their invention If we go back to a period about 2500 before Christ, the constellations Aquarius and Pisces, at the season of the overflow of the Nile, would be diametrically opposite to the sun and would consequently rise at sunset Virgo, usually represented as a woman with an ear of corn in her hand, would be the constellation rising at sunset in the time of the harvest in Egypt Such conjectures, however, it is easy to conceive, are at best extremely uncertain Representations of the zodiac have been found in several Egyptian temples, and also in other eastern countries, which have given rise to much discussion (See Dupuis, *Mémoire sur l'Origine du Zodiaque*, Biot *Recherches sur l'Astronomie Egyptienne*, Montucla, *Histoire des Math* tom i, Bailly, *Histoire de l'Astr Ancienne*)

ZODIACAL LIGHT In Astronomy, a faint nebulous aurora which accompanies the sun This curious phenomenon was observed by Kepler, who supposed it to be the solar atmosphere, but it was first accurately described by Dominic Cassini, who gave it the name by which it is now known It is visible immediately before sunrise or after sunset, in the place where the sun is about to appear or has just quitted in the horizon It has a flat lenticular form, as represented in the annexed figure, extending from the horizon H H obliquely upwards, and following the course of the ecliptic, or rather of the sun's equator For this reason it is scarcely visible in our latitudes, excepting in those seasons when the plane of the sun's equator is most nearly perpendicular to the horizon The most favourable times for observing it are in the months of April or May, in the evening or at the opposite season of the year before sunrise At other times the plane of the solar equator being more oblique, and the luminous pyramid inclined in the same degree it rises so little above the horizon that its light is absorbed by the atmosphere of the earth The apparent angular distance of its vertex from the sun varies according to circumstances from 40° to 90° or 100°, and the breadth of its base perpendicular to its axis from 8° to 30° It is extremely faint and ill-defined, at least in this climate, though it is better seen in tropical countries




Numerous opinions have been entertained respecting the nature and cause of this singular phenomenon Cassini thought it might proceed from the blended light of an innumerable multitude of little planets circulating about the sun, as the milky way owes its appearance to the light of [illegible] and myriads of stars Euler endeavoured to [illegible] it proceeds from the same causes as the tails of comets Kepler had ascribed its appearance to the solar atmosphere, and the same hypothesis was adopted by Mairan and others, till it was shown by Laplace to be untenable for the following reasons — In the first place, the solar atmosphere cannot extend beyond the distance at which the centrifugal force would be balanced by the attraction, but this point lies far within the orbit of Mercury, the greatest elongation of which is 28°, whereas the zodiacal light has been observed to extend to 100° from the sun In the second place in order that the spheroid of the solar atmosphere may be in equilibrium, the ratio of the equatorial to the polar axis cannot exceed that of 3 to 2, whence its form would not correspond with the lenticular [illegible] of the zodiacal light Sir John Herschel [illegible] "it may be conjectured to be no other than the denser part of that medium, which, as we have reason to believe, resists the motion of comets; [illegible] the actual materials of the tails of [illegible] of which they have been stripped in their successive perihelion passages An *atmosphere* of the sun it cannot be" — *Outlines of Astronomy*, p 616 (Biot, *Astronomie Physique*; Mairan, *Traité Physique et Historique de l'Aurore Boreale*; Euler, *Mém de Berlin*, 1746, Lalande, *Astronomie*, tom i; Hooke *Opera Posth*)

ZOHAR (Heb *splendour*) A Jewish book, highly esteemed [illegible] to be of great, the [illegible] It consists of cabalistical commentaries on Scripture, especially the

books of Moses It has been translated into Latin (ed 1680)

ZOISITE A variety of epidote, named after its discoverer Baron von Zois

ZONE (Gr ζωνη, *a girdle* or *belt*), in Astronomy, denotes a portion of the celestial sphere included between two parallel circles [illegible] are the five broad spaces or belts [illegible] of the earth is divided by the two tropics and the two polar circles The space included between the tropics is called the *torrid zone*, its breadth is equal to 47° or twice the sun's greatest declination and it is divided into two equal parts by the equator That included between the tropic of Cancer and the arctic circle is called the *north temperate zone*, and that between the tropic of Capricorn and the antarctic circle the *south temperate zone* The breadth of each of these is 43° The space between the arctic circle and the north pole is the *north frigid zone*, and that between [illegible] pole is the *south frigid zone* See Geography, Earth

ZOOGRAPHY (Gr ζωον, and γραφω, *I write*) The description of animals

ZOOLATRY (Gr ζωον, *an animal*, and λατρευω, *I worship*) The worship of animals, which was the characteristic of the ancient Egyptian religion most remarked upon by foreigners

ZOOLOGY (Gr ζωον, *an animal*, λογος, *a discourse*) The science of animals It teaches their nature and properties, their classification, and their order of succession upon and their distribution over the earth

A knowledge of the nature of animals, as it implies that of their organization, and of the functions and interdependencies of their component parts, constitutes the two great branches of zoology, called *Zootomy*, or comparative anatomy, and *Physiology* The doctrine of the succession of species of animals upon the earth, as it relates principally to such as no longer exist, is included in a third branch of the science of animals, called *Palæontology*, with which is closely connected that which treats of the geographical distribution of existing species The term *Zoology* is practically restricted to the science of the outward characters, habits, properties, and classification of animals

As the forms of living animals, the parts they play in the theatre of nature, their good and evil relations to man cannot be profitably treated of in the space assigned to this article, it will be limited to the exposition of the principles of the classification of animals and of the characters and relative value of those groups which have not been already treated of in the present work

A classification is essentially based on the ideas of likeness unlikeness, and proportion in its subjects When it is purposed to define, in a classification of animals, their different degrees of resemblance, a natural system is aimed at When a classification is restricted to the enunciation of a few likenesses which may be most readily detected and most easily retained in the memory, it becomes an artificial system A likeness extends as far as a character is common, and the more extended or common the property or structure on which such character is founded the more important and essential it becomes as an element of the classification

Zoologists having ascertained as many of the characters common to all animals as served to form their complex idea of an animal, have, in the next place, endeavoured to discover the difference, which, added to the idea or definition of the animal would form the most extended species of that genus, logically speaking

Such a difference or character is not to be detected by a superficial examination Aristotle thought he had found [illegible] only the red-coloured [illegible] as in the arteries and veins of man His primary division of animals was therefore into [illegible] the *Enaima* and the *Anaima* The Enaima were the beasts, birds, reptiles, and fishes, and the Anaima, or bloodless animals, included all the lower species

Nothing, perhaps, can show more forcibly the nature and amount of observation required to frame a good classification, and the value of the information concentrated in its expression, than the great [illegible] branch of zoology, and the minute and extended researches required for the elimination of its erroneous element First, it was found that many of the Exsanguineous animals of Aristotle did actually possess blood, differing only in colour from that of the so called Sanguineous species This discovery however, led only to a non-[illegible] primary division of animals; [illegible] and the Anaima "white-blooded" animals. It was reserved for Cuvier, in the course of his minute dissections of the lower animals, to discover that an extensive class of worms had red blood circulating in a closed system of arteries and veins; and this discovery first materially affected the value of the character adopted by Aristotle for the primary groups of the animal kingdom.

Now, if scientific classification were really based on the idea of likeness alone, and the grouping together of individuals into kinds in forming a natural system were regulated by a consideration of their resemblances only, then the modification of the Aristotelian system involved in Cuvier's discovery would be merely an extension of the group Enaima at the expense of the group Anaima; and the Anellides, or red-blooded worms, must have been united with birds, fishes, and other Sanguineous animals But the zoologist, in the formation of a natural system, has to be governed at every step by the idea of difference as well as by that of likeness Coincident with the discovery above mentioned was the perception that if the Anellides resembled beasts in the colour of their blood, they differed from them in most other essential points, and thus the circulating fluid was rejected as a ground for the primary groups of the animal kingdom, and other characters were eagerly sought for

Lamarck conceived that he had discovered the best substitute for the Aristotelian primary character in the vertebral column, this structure being present in all the Enaima of Aristotle, and absent in all the Anaima He proposed, therefore, the name of *Vertebrata* for the one class, and *Invertebrata* for the other The defect of this primary division of the animal kingdom was soon perceived to arise from the neglect of a third fundamental idea in a classificatory science, viz that of proportion, or relative value, in the primary groups and in the attempt to remedy this defect the important discovery was made, that the vertebral column was a modification of structure subordinately related to a particular condition of an organic system of much higher importance in the animal body than the skeleton, viz the nervous system A knowledge of the anatomy of this system hence became essential to the zoologist, and the result of a long series of minute and elaborate dissections was the detection of at least three modifications of the nervous system of equal importance with that in regard to which a skull and vertebral column are dependent and subordinate Hence arose the proposition by Cuvier to divide the animal kingdom primarily into four provinces or subkingdoms viz *Vertebrata*, *Mollusca*, *Articulata*, and *Radiata*, or, as they have been termed, in accordance with the modifications of the nervous system respectively characterizing them, *Myelencephala*, *Heteroganglıata* *Homoganglıata*, and *Acrita*

All previous primary divisions of the animal kingdom*, having been proposed in ignorance of the true characters by which such groups exist in nature, are now abandoned by the common consent of naturalists, and nothing would be gained by quoting them in this place. Herein the Linnæan method is inferior to the Aristotelian system the class *Vermes* of the *Systema Naturæ*, as it included the *Ostracoderma* and *Malakia* of Aristotle, afterwards the *Mollusca* of Cuvier, with the true *Vermes*, was a retrograde step in this branch of zoological science

The subkingdom *Vertebrata*, or *Myelencephala*, is subdivided into classes according to the modifications of the respiratory and circulating organs These modifications are essentially four in number, which may be thus expressed —

1 Lungs suspended freely in a thoracic cavity, subdivided into minute air-cells Heart divided into four cavities [illegible] distinct

2 Lungs [illegible] cavity, communicating with large air-cells in other cavities of the body Heart with four cavities, pulmonic and systemic circulations distinct

3 Lungs suspended freely in or attached to the parietes of [illegible] not divided into minute air-cells Heart with four or three cavities, pulmonic and systemic blood mixed in the general circulation

4 Gills for respiration, with or without lungs Heart with two cavities, transmitting all the blood to the breathing organs

The first condition of the respiratory and circulating organs coexists with a viviparous generation, and lacteal organs for the nourishment of the new-born young, whence the class was termed *Zootoca* † by Aristotle, and *Mammalia* by Linnæus, and the latter term is retained, because it expresses a character which is truly peculiar to the class The total or partial clothing of hair, and the other organic coexistences which proclaim the natural [illegible] group in question, are mentioned under the term MAMMALIA

The [illegible] of the respiratory and circulating organs characterizes the class of Birds It is associated in this class with an oviparous generation, a covering of feathers, and those other modifications of the vertebrate type of structure which are detailed under the

* If we except some of the schemes of classification of the animal kingdom by John Hunter, found among his manuscripts after his death (See Preface to Palmer's edition of his *Animal Economy*.)

† The term *Zootoca* has been degraded by a modern naturalist to designate a subgenus of lizards, distinguished by their viviparous generation.

head of Aves. This is the most natural and circumscribed of all the groups of animals of [illegible] value. Both mammals and birds differ [illegible] classes of animals in being warm blooded, whence they have been combined to form a group called *Hematherma*.

The condition of the circulating and breathing organs [illegible] vertebrate animals, [illegible] old blood, and a covering of scales, bony plates, or a naked skin. The generation is oviparous or ovoviviparous; the other characters are given under the head Reptilia.

Fishes, besides breathing by gills, and having a heart composed of a single auricle and ventricle, have the skin defended by scales, or by bony plates, or are naked. They are likewise oviparous, or ovoviviparous, and, with a few exceptions, as the tunny, the temperature of their blood corresponds with that of the surrounding medium. They are exclusively aquatic, and their general characters and classification are given under the heads Pisces and Ichthyology.

The subkingdom *Mollusca* or *Heteroganglıata* is characterized by a ring of nervous matter surrounding the gullet, whence the nerves radiate, often unsymmetrically, to different parts of the body. There is a ganglion or little brain below the gullet, and sometimes also above that tube, the [illegible] with one or more [illegible]. The [illegible] body corresponds with [illegible] system, and is often unsymmetrical; it is generally soft, covered with a mucous skin, and destitute of jointed limbs. In one class (*Cephalopoda*), in which the supra-œsophageal nervous mass is large, it is protected by a cartilaginous cranium, but this is absent in other Mollusca, and a vertebral column exists in none. Many species have for their skeleton a calcareous plate or plates, called *shells*, secreted by the skin. (*See* Conchology.) The animal functions are feebly enjoyed in the *Heteroganglıata* subkingdom. Distinct organs of hearing and smell have as yet been found only in the highest class (*Cephalopoda*), the eyes are reduced to mere rudiments in the group next in subordination (*Gasteropoda*), and the head is altogether wanting in the three lower classes, thence collectively called *Acephala*. The machinery of the organic functions, on the other hand, is largely and completely developed. Every mollusk has a heart, and a closed system of arteries and veins; in the higher Cephalopods the [illegible] system is physiologically as perfect as in the highest Vertebrates, and the heart is anatomically more complicated. An organ of respiration is never wanting, but it presents this character, that whereas in the *Vertebrata* it communicates with the mouth, in the *Mollusca* it is connected with the opposite termination of the alimentary canal. The *Mollusca* are either Dioecious or Hermaphrodite.

The primary division of *Mollusca* is according to the presence or absence of a head, into the *Encephala* and *Acephala*.

The Encephalous Mollusks are divided according to their locomotive organs, into the classes *Cephalopoda*, *Gasteropoda*, and *Pteropoda*, the Acephalous Mollusks, according to their respiratory organs, into *Lamellibranchiata*, *Palliobranchiata*, and *Heterobranchiata*; the two latter classes are more commonly called *Brachiopoda* and *Tunicata*. See those names of classes, and Malacology.

The third primary division of the animal kingdom, viz. the *Articulata*, is as well characterized, Cuvier states as that of the *Vertebrata*. "The skeleton is not internal, as in the latter, neither is it annihilated as in the *Mollusca*. The articulated rings which encircle the body, and frequently the limbs supply the place of it, and as they are usually hard they furnish to the powers of motion all requisite points of support, so that we have here as many kinds of locomotion as among the *Vertebrata*. This external position of the hard parts and internal one of the muscles, reduce each articulation to the form of a sheath, and allow it but two kinds of motion, unless the limbs be united by flexible membranes, or fit into one another, and then their motions are more various, but have not the same force.

"The system of organs in which the *Articulata* resemble each other the most is that of the nerves. Their brain, which is placed above the œsophagus, and furnishes nerves to the parts adhering to the head, is very small. Two cords, which embrace the œsophagus, are extended along the abdomen, and united at certain distances by double knots or ganglia, whence arise the nerves of the body and limbs. Each of these ganglia seems to fulfil the functions of a brain to the surrounding parts, and to preserve their sensibility for a certain length of time when the animal has been divided. If to this we add that the jaws of these animals, when they have any, are always lateral, and move from without inwardly, and not from above downwards, and that no distinct organ of smell has hitherto been discovered in them, we shall have expressed all that can be said of them in general."

The existence, however, of the organs of hearing, the presence, number, and form of those of sight, the kind of respiration, the condition of the organs of circulation, and the colour of the blood, present great differences, which characterize the subdivisions or classes of the Articulate or Homogangliate subkingdom.

These classes are, *Crustacea*, *Arachnida*, *Insecta*, *Anellata* and *Cirripedia*. See those words.

The first three are combined by Latreille into a large group called (*Ondgitopoda* in reference to their possessing articulated members, but these are likewise possessed by the *Cirripedia* which, although placed by Cuvier in the Mollusceous subkingdom are proved by their nervous system and metamorphoses to be essentially *Articulata*, nearly allied to the Crustaceans.

The Radiated, or fourth primary division of animals in the system of Cuvier, is so called because the low-organized animals composing it agree, Cuvier says, in having their parts arranged [illegible] several radii, or on one or [illegible] the *Entozoa* have [illegible], or [illegible] nervous trunks proceeding from a collar round the [illegible] four suckers situated round a proboscidiform elevation. The nervous system, when [illegible] have been visible, is also arranged in [illegible]; however, be affirmed with propriety of the nerves of the *Entozoa* or *Rotifera*, but these classes agree with all the other *Radiata* (*Holothuria* excepted) in [illegible] tory organs. It has been [illegible] animals, or Zoophytes of Cuvier, into two subkingdoms the *Nematoneura*, presenting conspicuous nervous filaments, and the *Acrita*, in which such filaments are rarely distinguishable. The *Nematoneura* are more definitely and readily characterized by having the alimentary canal in the form of a distinct tube, with proper parietes, floating in an abdominal cavity, and provided with a separate inlet and outlet, while in the *Acrita* the digestive cavity is excavated in the parenchyma of the body, is devoid of distinct parietes, and has no anal outlet. The *Nematoneura* never propagate by germination or spontaneous fission, but these modes of reproduction are common in the *Acrita*. The latter division has been termed *Oozoa*, from their analogy to the ova or germs of the higher classes, but I have elsewhere observed* that as the changes of the embryo succeed each other with a rapidity proportionate to its proximity with the commencement of its development, so also, in each class of *Acrita*, there are genera which closely [illegible] merge into some one or other of the [illegible] neurous classes and their characters are consequently less definite and fixed. If, therefore, guided by their natural affinities we arrange the *Radiata* into their primary groups, it will be found that one part of each of these groups presents the characters of the *Nematoneura*, and another those of the *Acrita*. This will be exemplified in the disposition of the Radiated classes in the following table of the primary groups and classes of the animal kingdom.

Kingdom Animalia

[illegible] *ata*.

[illegible] Mammalia
Aves
Reptilia
Pisces

| Subkingdom *Articulata* | Subkingdom *Mollusca*. |
|---|---|
| Class Crustacea | Class Cephalopoda |
| Arachnida | Gasteropoda |
| Insecta | Pteropoda |
| Anellata | Lamellibranchiata. |
| Cirripedia | Brachiopoda |
| | Tunicata. |

Subkingdom Radiata

| *Nematoneura* | *Acrita*. |
|---|---|
| Class Radiaria, Lamarck | |
| Echinoderma, Cuv | Acalepha, Cuv |
| Class Entozoa, Rudolphi | |
| Cœlelmintha, Owen | Sterelmintha, Owen |
| Class Polypi, Cuvier | |
| Ciliobrachiata, Farre. | Nudibrachiata†, Farre. |
| Class Infusoria, Cuvier | |
| Rotifera, Ehrenb | Polygastria, Ehrenb |

ZOO'NOMY (Gr ζωον, and νομος.) The branch of science treating of the laws of animal life.

ZOO'PHAGANS. (Gr ζωον, and φαγω, *I devour*.) The term applied to the order of Unguiculate Mammals.

* *Cycl. of Anat. and Physiol.* art. "Acrita."

† This [illegible] again subdivided into the Tethyana and *Nudibra* [illegible], which lead to the doubtful class of *Spongia*.

which live on animal food, and corresponding to the French term *Carnassiers*; also the corresponding group of the Marsupial Quadrupeds.

ZOO'PHORUS (Gr ζωον, *an animal*, and φερω, *I bear*) In Architecture the same as frieze, which see

ZO'OPHYTES, *Zoophyta* (Gr ζωον, and φυτον, *a plant*) The name given by Cuvier to his fourth and last primary division or subkingdom of animals By Linné it was applied in a more restricted sense to an order of *Vermes* comprehending those [illegible] which he supposed to participate of the [illegible] animal and plant Mr Hatchett's dissertation [illegible] in the *Philosophical Transactions* [illegible] nearly all the chemical information which we have respecting them [illegible] they may be arranged into [illegible] classes [illegible] which consist almost entirely of carbonate of lime and gelatine They are perfectly soluble, with effervescence in muriatic acid, and the solution yields slight traces only of animal matter: when heated red hot they evolve but little smoke or odour, and leave quicklime Common white coral (*Madrepora virginea*) is an instance of this variety 2 Those which like the former, have carbonate as their [illegible] but which when steeped in muriatic [illegible] acted on, and leave membranous or cartilaginous films, and which, when heated, exhale smoke and the odour of burned bone, these therefore, consist of carbonate of [illegible] Such are the *Madrepora zamea* [illegible] *iscicularis* The *Isis hippuris* is a curious variety of this class, in which separate portions of var 1 are united by cartilaginous joints 3 This class includes the *Gorgonia nobilis*, or red coral the *Tubipora musica*, and some other varieties, the earthy part of which is not merely carbonate of lime, but contains a portion of phosphate of lime, whilst the animal part resembles class 2 4 This class includes the various sponges Some of these consist almost exclusively of what may be called animal matter, that is of a peculiarly organized albumen, with a trace of gelatine, others are hardened by abundant siliceous or calcareous spiculæ Mr Hatchett has pointed out the resemblance which exists among the three first classes to porcellaneous shell, mother-of-pearl shell, and [illegible] the crab and lobsters

ZOO'TOMY (Gr ζωον and τεμνω *I dissect*) The branch of anatomical science which relates to the structure of the lower animals. *See* ANATOMY, COMPARATIVE

ZOTHE'CA (Gr) In ancient Architecture, a small apartment or alcove, capable of being separated from or added to a larger one by means of curtains

ZU'MIC ACID (Gr ζυμη, *leaven*) A compound [illegible] which [illegible]

ZUMO[illegible] (Gr [illegible] *course*) [illegible]

ZUMO'METER or ZUMOSE'METER (Gr ζυμη, and μετρον, *a measure*) An instrument intended to show the degree to which fermentation has proceeded in different fermenting liquors *See* SACCHAROMETER

ZU'RLITE A name given to a recently discovered Vesuvian mineral

ZYGODA'CTYLES (Gr ζυγον *a yoke*, δακτυλος, *a finger*) The name given by M Temminck to an order of Climbing Birds, including those which have the toes arranged in pairs, two before and two behind, corresponding to the *Scansores* of Cuvier

ZYGŒ'NA (Gr Ζυγαινα the name of a fish in Aristotle) A genus of Cartilaginous fishes of the Squaloid or Shark tribe, remarkably characterized by the extreme breadth and flatness of the head, the sides of which extend outwards at right angles with and far beyond the body, just as the head of a hammer is placed on the handle the eyes are placed at the lateral margins of the head The term *Zygœna* has also been applied by [illegible] of *Lepidoptera*

ZYGO'MA (Gr [illegible] *a yoke*, because it transmits the tendon of the temporal muscle like a yoke) The cavity under the *zygomatic* process of the temporal bone Hence also the term *zygomatic muscles*

ZYGOPHYLLA'CEÆ (Zygophyllum one of the genera) A natural order of arborescent, shrubby or herbaceous Exogens, inhabiting the hotter parts of the world Are nearly allied to *Oxalidaceæ*, from which they differ in many characters, with *Simarubaceæ* they accord in the stamens [illegible] on the back of an hypogynous scale, and [illegible] from *Rutaceæ* in the leaves being constantly opposite, with lateral or intermediate stipules and in being generally compound, and always destitute of pellucid dots The ligneous plants of this order are remarkable for their hardness Guaiacum or *Lignum Vitæ*, is one of them

# SUPPLEMENT.

## ABSINTHINE.

ABSI'NTHINE (Gr α, *priv*, ψινθος, *sweetness*) A peculiar bitter principle extracted from wormwood (*Artemisia Absinthium*)

ACE'TAL (Lat acetum, *vinegar*.) A colourless inflammable liquid, obtained by the action of spongy platinum upon the vapour of alcohol it is convertible by slow combustion into *acetic acid*

ACETO'METER (Lat acetum and Gr μετρον *measure*) An instrument in the form of an hydrometer, for determining the strength of vinegar and other forms of acetic acid It was invented by Messrs J and P Taylor, and is described in the *Quarterly Journal of Science and the Arts* vol vi.

ACE'TONE (Lat acetum) When acetate of lime, baryta, or lead, is subjected to dry distillation a limpid colourless liquid is obtained, to which the above name has been given it has a penetrating aromatic odour and is [illegible] its ultimate components are 3 atoms of carbon and 1 of oxygen

A'CETYLE The hypothetical radical of the acetic compounds it is composed of 4 atoms of carbon and 3 of hydrogen Its symbol therefore is $C_4 H_3$, and that of the acetic acid $C_4 H_3 O_3$

ACHILLEI'NE A peculiar bitter principle procured from the *Achillea millefolia*

ACHMITE (Gr αχμη *the point of a sword* Named from the pointed form of its crystals) A mineral found near Kongsberg in Norway It is a double silicate of soda and iron

ACIDI'METER. (Lat acidus, *acid*, Gr μετρον, *measure*) An instrument for determining the strength of an acid by its saturating power it usually consists of a glass tube graduated into 100 equal parts and containing an alkaline liquor of known strength the proportion of which requisite to saturate a given quantity of any acid is the equivalent of that acid *See* ALKALIMETER

A'CINI (Gr ακινος, *a grape*) A number of vesicles [illegible] usually round the ends or by the sides of the branches of the ducts of aggregated glands Each acinus seems to be formed by the fusion of the walls of several vesicles which combine to form one cavity lined or filled with secreting cells The various modes of grouping of the *acini* afford characters for the different aggregated or conglomerate glands

ACRO'LEINE (Gr ακρος, *extreme*, ελαιον, *oil*) An [illegible] destructive distillation of the [illegible] arise from the decomposition of glycerine inasmuch as it is not obtained [illegible]

ACTINOGRA'PHY (Gr ακτινη, γραφω, *I write*) An instrument for the purpose of registering the variations of chemical influence in the solar rays the intensity of which has been found to bear no direct relation to the quantity of light, but to vary at different periods of the day and year The instrument, as contrived by Mr Hunt, and described to the British Association, "consists of a fixed cylinder, on which is placed a prepared photographic paper This is covered by another metal cylinder which revolves once in twenty-four hours [illegible] there is a triangular opening [illegible] which the paper is exposed to the sunshine. As [illegible] which the smallest part of the opening [illegible] to be exposed is one hundred times less than the time during which it is exposed by the largest opening, different effects are produced on the paper, and consequently a register for

## ACTINOMETER

every hour of the day may be numerically kept of the actinic radiation associated with light" — *British Association Reports* for 1845 and 1846

ACTINOMETER (Gr ακτινη, a sunbeam and μετρον *measure*) [illegible] for measuring the force of solar radiation It consists of a hollow cylinder of glass soldered at one end to a thermometer tube terminating at the upper end in a hollow ball drawn out to a point, and broken off so as to leave the end open The other end of the cylinder is closed by a silver, or silver-plated cap cemented on it, through which a screw, working in a collar of leather, passes into the interior of the cylinder and gives the means of increasing or diminishing the hollow capacity of the cylinder to a small extent at pleasure The cylinder is filled with a deep-blue fluid (the ammonio sulphate of copper), a graduated scale is applied to the stem, or thermometer tube, and the instrument is defended from currents of air by being enclosed in a case having the interiors of three of its sides blackened, and the fourth, or face, composed of a thick plate of glass

Before using the instrument for observation any air-bubbles in the cylinder must be carefully expelled This is easily effected by means of the screw and the ball at the top of the stem, which serves as a reservoir and contains a small portion of superfluous liquid When the ball and stem are both filled and no air bubble is left, the fluid is brought down to the zero of the scale by turning the screw

The general object is to determine the expansion of the liquid produced by the exposure of a given area of the cylinder to the direct rays of the sun during a given interval of time But as the expansion of the liquid depends, not only on the heating power of the sun, but also on the rapidity with which the heat received is radiated away and [illegible] exerting a thermometrical influence it is [illegible] to eliminate those influences For this purpose the observations are made with the instrument alternately exposed to and screened from the solar rays for intervals of one minute

On exposure to the sun, the liquid in the stem rises rapidly, and the difference of the readings of the scale at the beginning and end of the interval of exposure shows the combined effect of all the heating and cooling influences The instrument is then placed in the shade during an equal interval If during this second interval the liquid remains stationary, then it may be inferred that the rise in the first interval was due to the solar action alone If the liquid *falls* during the shade observation then it [illegible] opposed or counteracted [illegible] the number of division through which it [illegible] must be *added* to the number through which it rose in the interval of exposure, in order to have the measure of the solar action But if the liquid continues to rise during the shade observation, then it is plain that the action of the solar rays is assisted by other heating influences, and the number of divisions through which the liquid rises in the second interval must be *subtracted* from the number through which it rose during the first.

The observations are made in triplets that is to say, the instrument is held in the sun's rays one minute, then one minute in the shade, and again one minute in the sun, an interval of 20 or [illegible] seconds being interposed at each change for the purpose of noting the readings The difference of the readings at the beginning and end

of each minute interval is taken, and the difference in respect of the second interval is added to or subtracted from the mean of the two differences in respect of the first and third A complete actinometer observation, however, cannot consist of less than three sun observations and two shade observations intermediate, but the more there are taken the better

It will be readily seen that the results obtained, as above described, are only relative, some positive determination must therefore be had recourse to before the indications given by any two instruments are comparable This is a matter of much difficulty No doubt it is possible to determine for every instrument both the area of the section of the sunbeam which falls on the bulb and is effective in raising the temperature, a [illegible] capillary [illegible] or, which comes to the same thing, to determine the value of the parts of the scale in water [illegible] measure, but even this [illegible] so delicate an experiment, the slightest difference in the thickness or composition of the glass would produce discrepancies, and no two plates of glass are ever found to be precisely the same in respect of the proportion of calorific rays they stop or absorb Hence the only means of discovering the relation between the results given by two instruments is to make a series of experiments with both together, and under precisely the same circumstances Sir John Herschel proposes to adopt as the *actine*, or unit, that intensity of solar radiation which, at a vertical incidence, and supposing it to be wholly absorbed, would suffice to melt one-millionth part of a *metre* in thickness from the surface of a sheet of ice horizontally exposed to its action in one minute of mean solar time

In the Philosophical Transactions for 1842 Professor Forbes, of Edinburgh, has given an account of some interesting experiments with the Actinometer made by him on the Faulhorn (in Switzerland), for the purpose of ascertaining the difference of solar radiation at the bottom and top of the mountain, and thence the proportional quantity of calorific rays absorbed in passing through a stratum of the atmosphere of a given thickness This is one of the most useful purposes to which the instrument can be applied It may also be used for measuring the defalcation of heat in an eclipse of the sun

The Actinometer was first described in the *Edinburgh Journal of Science*, vol i for [illegible] For a full description of the instrument, and of the method of using it, see the *Report of the President and Council of the Royal Society on the Objects of scientific Inquiry in Physics and Meteorology* 1840)

AD'JUTAGE, or AJUTAGE (French) In Hydraulics the name given to a short tube or pipe applied to a vessel containing a liquid for the purpose of facilitating the discharge *See* HYDRAULICS in DICT

ADRIANO'PLE RED A [illegible] the red obtained from madder [illegible] *Turkey red*

AE'RIAL IMAGES In Optics, the name given to images of objects produced by reflection or refraction when they appear suspended in the air For example, a spectator standing before a concave mirror, at a somewhat greater distance from it than its radius of curvature, sees an inverted image of himself, hanging as it were between himself and the mirror For examples of aerial images produced by refraction, see FATA MORGANA, MIRAGE, in DICT

ÆS'CULINE A peculiar substance contained in the bark of the horse chestnut tree (*Æsculus hippocastanum*) it appears in the form of a white crystalline powder, and when dissolved in very minute quantities in water communicates a blue opalescence to it

Æ THIOGEN (Gr *αιθων brilliant* γιγνομαι, *I become*) A compound of nitrogen with boron, remarkable for the intense luminosity which it exhibits in the flame of the blowpipe

AETITES (Gr *αετος, an eagle*) A mineralogical term applied to globular masses of clay iron-stone The name is derived from its being supposed to form one of the component parts of an eagle's nest.

AFFERENT The term, in Anatomy, applied to those lymphatic vessels which enter the lymphatic glands, subdivide and form tortuous plexuses therein, whence other vessels proceed, converge, and unite into two or more efferent vessels which are larger than the afferent ones, and proceed towards the main trunk called "thoracic duct" The term *afferent* has also been applied to those nerves which convey impressions to the central axis, and which Hartley called "sensory" nerves, in contradistinction to the efferent or "motory" nerves

AG'GREGATED GLANDS Those secreting organs in which a number of compound vesicles or *acini* are arranged in groups, forming lobules (*See* CONGLOMERATE) Such are the so called mucous glands of the mouth trachea and vagina, the tonsils salivary, pancreatic and mammary glands, the lachrymal and Brunnian glands, Cowper's glands and prostate

AGMINATED GLANDS (Lat *agmen*) The glands of Peyer, in the small intestines, where they are aggregated in groups, are so called these groups are of various sizes, and [illegible]

ALCOHOL [illegible] table of the specific gravities of mixtures of alcohol and water

| Sp. Gr at 60° | Per centage of real Alcohol. | Sp Gr at 60° | Per centage of real Alcohol | Sp Gr at 60° | Per cent age of real Alcohol |
|---|---|---|---|---|---|
| 9991 | 0 5 | 9511 | 34 | 8769 | 68 |
| 9981 | 1 | 9490 | 35 | 8745 | 69 |
| 9965 | 2 | 9470 | 36 | 8721 | 70 |
| 9947 | 3 | 9452 | 37 | 8696 | 71 |
| 9930 | 4 | 9434 | 38 | 8672 | 72 |
| 9914 | 5 | 9416 | 39 | 8649 | 73 |
| 9898 | 6 | 9396 | 40 | 8625 | 74 |
| 9884 | 7 | 9376 | 41 | 8603 | 75 |
| 9869 | 8 | 9356 | 42 | 8581 | 76 |
| 9855 | 9 | 9338 | 43 | 8557 | 77 |
| 9841 | 10 | 9314 | 44 | 8533 | 78 |
| 9828 | 11 | 9292 | 45 | 8508 | 79 |
| 9815 | 12 | 9270 | 46 | 8483 | 80 |
| 9802 | 13 | 9249 | 47 | 8459 | 81 |
| 9789 | 14 | 9228 | 48 | 8434 | 82 |
| 9778 | 15 | 9206 | 49 | 8408 | 83 |
| 9766 | 16 | 9184 | 50 | 8382 | 84 |
| 9755 | 17 | 9160 | 51 | 8357 | 85 |
| 9741 | 18 | 9135 | 52 | 8331 | 86 |
| 9728 | 19 | 9113 | 53 | 8305 | 87 |
| 9716 | 20 | 9090 | 54 | 8279 | 88 |
| 9704 | 21 | 9069 | 55 | 8254 | 89 |
| 9691 | 22 | 9047 | 56 | 8228 | 90 |
| 9678 | 23 | 9025 | 57 | 8199 | 91 |
| 9665 | 24 | 9001 | 58 | 8172 | 92 |
| 9652 | 25 | 8979 | 59 | 8145 | 93 |
| 9638 | 26 | 8956 | 60 | 8118 | 94 |
| 9625 | 27 | 8932 | 61 | 8089 | 95 |
| 9609 | 28 | 8908 | 62 | 8061 | 96 |
| 9593 | 29 | 8886 | 63 | 8031 | 97 |
| 9578 | 30 | 8863 | 64 | 8001 | 98 |
| 9560 | 31 | 8840 | 65 | 7969 | 99 |
| 9544 | 32 | 8816 | 66 | 7938 | 100 |
| 9528 | 33 | 8793 | 67 | | |

ALCOHO'LMETER An instrument by which the quantity of alcohol contained in wines and other spirituous liquors is determined by reference to their respective [illegible] at given pressures

ALCORNINE A crystallisable substance contained in the alcornoque bark of America

ALDEHYDE From *Al*(*cohol*) *dehydr*(*ogenatus*) A chemical term applied to a peculiar [illegible] obtained by distilling alcohol with oxide of manganese and sulphuric acid Alcohol is a compound of 4 atoms of carbon, 6 of hydrogen, and 2 of oxygen, whereas aldehyde consists of 4 of carbon, 4 of hydrogen, and 2 of oxygen

ALKARSINE A compound of carbon, hydrogen, oxygen, and arsenic, it was formerly called *Cadet's fuming liquor of arsenic* it is the *oxide of kakodyle* of modern chemistry *See* KAKODYLE

ALLANTOINE The substance originally termed *Allantoic acid* It has been produced artificially by the action of peroxide of lead on uric acid its formula is $C_4 H_6 O_3 N_2$

ALLO'PATHY (Gr *αλλος, different*, and *παθος, disease*) A term recently invented to describe the ordinary system of medical practice in opposition to *Homœopathy* which see

ALLOPHANIC ACID (Gr *αλλος, different*, and *φαινομαι, I appear*) An acid body discovered by Wohler and Liebig, and formed [illegible] acid into alcohol its chemical formula is $C_4 H_4 O_4 N_2$

ALLO'TROPY (Gr *αλλοτροπος (αλλος, different, τροπος manner*) A term used by Berzelius to designate the property belonging to certain substances of exhibiting variable characters at different temperatures especially as relates to *colour*, *texture*, *solubility*, &c thus sulphur is usually yellow and brittle, but if fused at a high temperature, and poured into water, it becomes brown and viscid. The characters of phosphorus may also be remarkably changed by temperature, though its nature, as well as that of sulphur, remains the same

ALLO'XAN One of the products of the action of nitric acid on uric acid it is a colourless crystalline substance, the aqueous solution of which tinges the cuticle purple its chemical formula is $C_8 H_4 O_{10} N_2$

AL'LYLE (Lat *allium, garlic*) A hydro-carbon ($C_6 H_5$) supposed to constitute the basis of the volatile oil of garlic

ALTE'RNATE GENERATION In Physiology, that modification of generation in which the young do not resemble the parent but the grand-parent; so that the successive series of individuals seem to represent two species alternately reproduced The *salpa* a floating gelatinous mollusc or animal is an example It may be found as a solitary individual, pregnant with numer-

ous minute salpæ, of a more simple structure, which continue after birth to be united together in the form of a long chain floating upon the sea In each individual of this chain there is generally developed an egg, from which is hatched a solitary salpa, of the form and organisation of the parent of [illegible] thus the species is represented by alternations of simple and aggregate salpæ *See* PARTHENOGENESIS

AMANI'TA MUSCA'RIA (*Fly Mushroom*) One of the most poisonous of the fungi of this country it renders water in which it is boiled so poisonous that animals are killed by it, whilst the boiled fungus itself is nearly harmless The liquid procured from it is used as a *fly-poison*, whence the name of the mushroom is derived It is known by its rich orange-red colour

AMI'DOGEN (The generator of *amides*) A compound of 1 atom of nitrogen and 2 atoms of hydrogen this compound has not been isolated, but may be traced in combination with other substances, constituting compounds called *amides* thus *potassiamide* is a compound of the metal potassium with amidogen, and, in reference to the same view, ammonia (which see) is an amide of hydrogen Amidogen is thus represented by the symbol NH [illegible] NH$_2$ + H, or NH$_3$

AMPHIO'XUS (Gr *αμφι*, *both*, and *οξυς sharp*) The name of a genus of fishes, so called because the animal is sharp at both ends It has not, in fact, any proper head brain, or heart, and is recognised as a vertebrate animal only by its gelatinous dorsal chord, which supports a medullary spinal chord or nervous axis and gives attachment to segmental partitions

AMPU'LLA (Lat) In Anatomy, that end of each of the three semicircular canals of the internal organ of hearing which is dilated than the other

AMY'GDALINE (Gr *αμυγδαλον an almond*) A crystalline principle contained in the bitter almond, which, under the influence of *emulsine* and water yields hydrocyanic acid, and the volatile oil of bitter almonds By the action of certain bases amygdaline yields ammonia [illegible] The composition of amygdaline is C$_{40}$ H$_{27}$ O$_{22}$

AMY'LE or AMYLENE (Gr *αμυλον starch*) This term implies in chemistry the hydrocarbon which is the basis of the so called *Amylic alcohol* or hydrated oxide of amyle Amyle contains 10 atoms of carbon [illegible] and is represented therefore, by [illegible] The volatile oil of potatoes or [illegible] Germans, includes this compound

ANACA'RDIC ACID An acrid fatty substance, found in the fruit of the *Anacardium occidentale*, or Cashew nut

A'NALOGUE (Gr *ανα* and *λογος method*) In Comparative Anatomy an organ which resembles another in its functional relations, as the wing of a bird is analogous to the wing of the flying lizard (*Draco volans*) and to the wing of an insect though it be not in its structure [illegible] organ of the body

ANAMO'RPHOSIS (Gr [illegible] In Natural History, expresses the change of form which may be traced throughout the species or higher members of a natural group of animals or plants either in the actual series, or as they have succeeded each other in the course of time on this planet, which change is usually ascensive, or indicative of a progression towards a higher series of species It has been conjectured that the succeeding or supplanting species may be actually the species supplanted but changed, [illegible] otherwise and commonly more highly developed, but of this there is no proof, and the term "anamorphosis" must be understood as expressive of an *ideal* change in contradistinction to the real or bodily change observed in the development of the individual, and which is called "metamorphosis"

ANAPO'PHYSIS (Gr *ανα backward*, *αποφυσις a process*) That process of a vertebra which, arising in the dorsal region from above the diapophysis or transverse process, recedes to the side of the centrum, as the vertebræ approach the sacrum, and projects more or less backwards It usually supports and strengthens the joint of the anterior zygapophysis of the succeeding vertebra. It is well developed in the hare and most rodents

A'NATASE (Gr *αναταση*, *extension*) A mineralogical name of the *oxide of titanium*

ANCHU'SINE The colouring principle of alkanet root (*Anchusa tinctoria*)

ANEMO'METER Dr Lind's Anemometer, described in the DICTIONARY OF SCIENCE, gives the means of determining at any particular instant the force of the wind by its pressure against a column of water directly opposed to it For meterological purposes it is, however, very important that instruments should be *self-registering*, because the changes proposed to be measured often take place very suddenly, and may therefore escape notice altogether when observations are taken at intervals The anemometer now generally introduced into the principal observatories was contrived by Mr Osler of Birmingham, and registers the direction as well as the force of the wind at every successive instant It is described as follows in the *Report of the President and Council of the Royal Society on the Objects of Scientific Inquiry in Physics and Meteorology*, 1840

"In this instrument the direction of the wind is obtained by means of the vane attached to the rod, or rather tube, that carries it, and consequently causes the latter to move with itself At the lower extremity of this tube is a small pinion working in a rack, which slides backwards and forwards as the wind moves the vane, and to this rack a pencil is attached, which marks the direction of the wind on a paper ruled with the cardinal points, and so adjusted as to progress at the rate of one inch per hour by means of a clock, the force is at the same time ascertained by a plate one foot square, placed at right angles to the vane, supported by two light bars running on friction rollers, and communicating with three spiral springs in such a way that the plate cannot be affected by the wind's pressure without instantly acting on the springs, and communicating the quantum of its action by a wire passing down the centre of the tube, to another pencil below, which thus registers its degree of force"

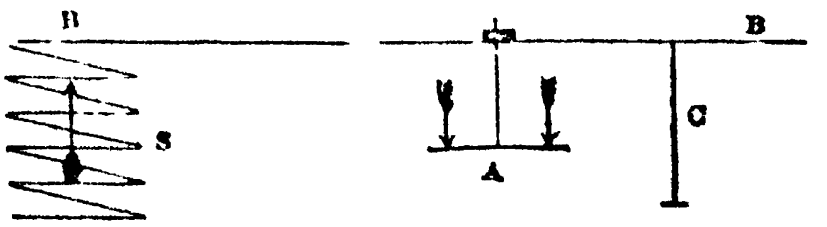
Another self-registering anemometer, proposed by the Rev Dr Whewell, is described in the same Report "In it a small set of windmill vanes, something like the ventilators of windows, are presented to the wind by a common vane, in whatever direction it may blow The current, as it passes, sets these vanes in rapid motion, and a train of wheels and pinions reduces the motion, which is thence communicated to a pencil traversing vertically, and pressing against an upright cylinder, which forms the support of the instrument 1000 revolutions of the fly only cause the pencil to descend 1-20th of an inch The surface of the cylinder is covered with white paper and the pencil, as the vane wavers, keeps tracing a thick irregular line like the shadings on the coast of a map The middle of the line may be easily [illegible] while [illegible] of the wind, and the length of time during which it blows in each direction" This instrument consequently records both the direction and integral effect of the wind Being more complex in its construction than Osler's it is practically more liable to derangement It is, however, very useful in this respect that it gives indications of very light breezes when Osler's totally fails (See *Phillips's Report on Anemometry, British Association Reports for* 1846)

ANEMO'METRY The process of measuring and registering certain effects of the pressure of the wind *See* ANEMOMETER

ANEROID BAROMETER An instrument for indicating the variations of atmospheric pressure, recently [illegible] into use and said to be the invention of M Vidi of Paris for whom a patent was taken out in this country by M Fontainemoreau in 1844

In the ordinary barometer the pressure of the atmosphere is measured by the height of the column of mercury which it supports, in the aneroid the differences of pressure are measured by the effect produced on a metallic spring, no fluid being employed Hence the composition of the terms from the Greek *α*, *without*, *νηρος*, *watery* and *ειδος*, *form*

The instrument may be described as consisting of three essential parts first an air-tight box or vase formed of thin metallic plates so that the sides yield to the pressure and collapse when the air is withdrawn from the interior, secondly, a spiral spring resisting the compression of the sides of the box, and thirdly, a system of levers connected with the box and spring and giving motion to an index by which the amount of pressure is exhibited on a scale The arrangement is represented in the annexed diagram, in which A represents the vacuum-vase, B B the main lever C the fulcrum or support, and S the spring; the direction of the forces being indicated by the arrows If, at a certain pressure, the lever has the direction indicated in the figure, then, supposing an increase of pressure to take place, the upper side of the box will be pressed downwards, carrying the lever, with which it is shown to be in connexion, along with it, and consequently compressing the spring against which it acts The lever, it will be observed is of the second order and, as usually constructed [illegible] is to that of [illegible] six to one.



The box is cf a cyl ... form, about 2¼ inches in diameter, and ... inch deep, partially exhausted of air and hermetically sealed It is composed of thin corrugated copper plates The spring is formed of steel wire, about 1-20th of an inch in thickness, and the helix or coil is about an inch in height, and 5-8ths of an inch in diameter A system of levers is employed to multiply the movement of the main lever, and to the ultimate lever is attached a piece of fine watch-chain pressing round a small roller, on the axis of which the index is placed, which exhibits the variations of pressure on a graduated dial The index is kept in its place and the chain in a state of tension, by means of a delicate spiral spring attached to the same axis The whole is placed within a cylindrical box, about five inches in diameter, and the general form of the instrument resembles that of a watch

The principal difficulty to be overcome, in the construction of the aneroid, is to eliminate the influence of changes of temperature, and the manner in which this is done, or, perhaps it should be said, *attempted* to be done is sufficiently ingenious It has been stated above that the air tight box is only partially exhausted of air, indeed, it would scarcely be possible to effect a perfect vacuum A small portion, however, is purposely allowed to remain, and elastic fluids as is well known, expand about 1-480th part of their volume by an increase of temperature ... to a degree of Fahrenheit's thermome ... range of temperature in our climate may be considered to be about 50 degrees, and consequently the expansion of unconfined air will vary to more than one-tenth of its volume But as the capacity of the vase remains sensibly the same (for the small increase arising from expansion of the metal of which the box is formed may be disregarded) the portion of air confined within it cannot vary in volume, its elastic force is therefore increased with the increase of temperature, and the action of this force being in opposition to the external pressure on the sides of the box, the effect on the lever is the same as would be produced by an increase of the elastic force of the spring But the effect of an increase of temperature on the spring itself is to diminish its elastic force Hence it is easy to see that, in order to effect a perfect compensation, the parts of the instrument must be so adjusted to each other that, upon an increase of temperature taking place the loss of elastic force sustained by the spring shall be just equal (allowing for the leverage) to that which is gained by the air confined within the vase, and the lever consequently remain in equilibrio It is manifest that a perfect adjustment must be attended with great practical difficulty if indeed it be possible

From comparisons that have been made, it appears that within a certain range of barometric pressure (and a variation corresponding to two or three inches of mercury is all that is necessary to provide against), the indications of the aneroid agree sufficiently well (for ordinary purposes) with those of the mercurial barometer, the greatest differences of reading through the ordinary range of the barometer and thermometer having been found, in the case of certain instruments, not to exceed six or seven hundredths of an inch It possesses great advantages in its small bulk, its portability and also its extreme sensibility which is such that the variation of pressure corresponding to ... or descent of a few feet is distinctly ... On the other hand it is liable to move by jerks, the spring can hardly be expected to preserve the same elasticity for any considerable time, and it has been found that the zero point has been altered by a journey For philosophical purposes it can never supersede the mercurial barometer, but there are cases in which it may be used with great advantage for example, by sailors employed in the coast trade, or the fisheries, as it may be carried even in an open boat

Though the aneroid has been brought forward as a new invention, Mr Weld, in a communication to the Athenæum (December 30, 1848), has shown that the principle was developed so long ago as 1798 by M Conte, who describes an instrument similarly constructed, and resembling a watch in appearance, in the *Bulletin des Sciences Naturelles*, tom i No xiii p 106 (See *Dent on the Aneroid Barometer*, *Frodsham's Few Remarks upon the Construction and Principles of the Aneroid, &c.*, *Belville's Manual of the Barometer*, *Mechanics' Magazine* No 1307 )

ANGLEMETER This name has been specially given to an instrument used by geologists for measuring the dip of strata, the angles of joint planes, &c (*British Association Reports* 1847 )

ANHARMONIC RATIO In Geometry, if four points A, B C, D, be taken in a straight line in any order, the ratio which is compounded of the ratio of A B to B C and of C D to D A, or (A B B C)× (C D D A) has been styled by Chasles *anharmonic ratio* In the particular case in which this compounded ratio is one of equality, or 1 1, we have A B B C= A D : C D ; and when this property holds the line A D is said to be *harmonically* divided in B and C The term *harmonical* applied in this sense, first occurs, we believe, in Lahire's Conic Sections The characteristic property of the anharmonic ratio is the following — If from any point out of the given straight line four straight lines *a*, *b*, *c*, *d*, be drawn through the four points respectively, and if sin (*a b*) denote the sine of the angle included between *a* and *b* (and so with the others), then the double or anharmonic ratio is equal to [sin (*a b*) sin (*b c*)]×(A B B C)×(C D D A)× [sin (*c d*) sin (*d a*)] These angles being entirely independent of the position of the straight line in which the four points A, B, C, D are taken, it follows that if any ... whatever be drawn to intersect the four straight lines *a*, *b*, *c*, *d* respectively in the points A′, B′, C′, D′, then the anharmonic ratio (A′ B′ B′ C′) ×(C′ D′ D′ A′) will be the same as (A B B C)× (C D D A) From this general property some very remarkable relations of geometrical figures have been deduced (Steiner, *Systematische Entwickelung der Abhangigkeit geometrischer Gestalten von einander*, Berlin, 1832 ( ... *Aperçu Historique des Méthodes en Géométrie* Mem ... de Bruxelles 1837 )

A′NILINE (... plant ) A colourless oil-like liquid ... and hot aromatic flavour, remarkable for its tendency to form crystallisable compounds with the acids, so that it was originally termed *crystalline*, it is a product of the distillation of certain organic substances and among others it has been derived from *indigo* It is a compound of carbon, hydrogen, and nitrogen $= C_{12} H_7 N$

ANORTHOSCOPE (Gr ανορθος, and σκοπεω, *I view* ) The name given by M Plateau, of Brussels, to an instrument invented by him, and intended to produce a peculiar kind of anamorphoses by means of two discs rotating rapidly one before the other, the hind one of which is transparent, and bears distorted figures while the front one is opaque, and pierced with a small number of narrow slits As in other toys of a similar kind, the *Phenakistoscope*, for example the effect depends on the persistence of impressions on the retina The instrument is described at length in the *London, Edinburgh, and Dublin Philosophical Magazine*, Third Series No 245 —June, 1850

ANTAGONISTICS In Anatomy, those muscles are so termed which are opposed to others in their action, as the extensors to the flexors, the pronators to the supinators, the abductors to the adductors, &c

ANTH′ELIA (Gr αντι *opposite*, ηλιος, *the sun* ) Luminous coloured rings or glories observed under certain conditions round the shadow of the spectator's own head The conditions of the phenomenon are two, first, that the sun be near the horizon, and secondly, that the shadow be projected on a surface covered with dew drops as a field of grass or stubble or on a dense cloud or fog-bank, distant about 50 or 60 yards Generally the luminous appearance is very faint, and only one or two rings can be traced, but sometimes, in favourable circumstances, it is strikingly vivid and two or three small concentric circles appear, surrounded by a much larger one, of whitish light, the head of the observer's shadow being at the common centre Such brilliant Anthelia were observed by Bouguer and his companions on the clouds of the Andes (*Figure de la Terre*, p 43 ), and by Scoresby on the fog banks in the Arctic seas Scoresby gives the following dimensions of the rings as measured by him on one occasion radius of the first or innermost ring 2°, of the second 4° 45′, of the third 6° 30′, and of the outermost 38° 50′ The cause of interior rings is thus explained by Fraunhofer Light falling directly from the sun on the anterior side of an aqueous globule undergoes a refraction, and a portion of this refracted and consequently coloured light on falling on the interior surface of the opposite side of the g... reflected back to the eye of the spectator The ... is supposed to be formed by a double reflection, as in the case of the ordinary rainbow See HALO in DICT

ANTIARINE The poisonous principle contained in the milky juice of the *Antiaris Toxicaria*, a large forest tree growing in Java. This poison acts upon the ... , and paralyses the heart

ANT... A siphon, so inserted into casks or carboys as to admit air over the liquor contained in them, and to allow of its being poured out without agitation

A′NTIPERISTA′LTIC (Gr αντι and περιστελλω, *I wrap up* ) That movement of the intestinal tube which is retrograde or contrary to the proper course impressed upon the contents by the ordinary vermicular or peristaltic action

APIINE A gelatinous substance (distinguished by affording a blood-red colour with solution of sulphate of iron), obtained from parsley (*Apium petroselinum*)

APLANA′TIC LENS (Gr α, *without*; πλανη, *de-*

*ration*) In Optics a lens such that rays parallel to its axis, or rays diverging from a point in its axis, after passing through it and suffering refraction at its surfaces, converge to a single point, or the true focus In order, therefore, to be aplanatic, the lens must not only have the true geometrical figure necessary to destroy aberration, but must also be constructed of different media, so as correct the effects of the unequal refrangibility of the different rays, that is to say, it must be achromatic Neither of these conditions can be accurately fulfilled in practice, the object aimed at is [illegible] that with a given [illegible] shall be the least possible *See* ABERRATION ACHROMATISM, in DICT

APOPHY'LLITE (Gr απο and φυλλον, leaf from [illegible] In Mineralogy, a lamellar zeolite

APOTHEMI (Gr αποτιθημι, I deposit) A term applied by the old chemists to some of the varieties of *extractive matter*

A'QUA VITÆ (in Fr *Eau de vie*) The name [illegible]

AQUÆDUCTUS [illegible] to certain canals leading from the labyrinth or internal ear to the outside of its bony capsule or os petrosum one of these, which extends from the hinder part of the [illegible] the petrosal, is called [illegible] d canal leading from the cochlea to the jugular fossa of the petrosal is called "aquæductus cochleæ" the function of the "aqueducts" is unknown

A'QUEOUS HUMOUR A thin watery fluid holding in solution a small quantity of chloride of sodium and extractive matter, situated in a space behind the cornea of the eye ball, which is divided into an anterior and posterior chamber by a musculo-membranous partition called 'iris,' perforated by the aperture called "pupil" the chief use of the aqueous humour is to maintain the convexity of the cornea and support and [illegible] the movements of the iris

ARCH In Anatomy, a structure commonly composed of bone or other hard material disposed in a bow-like form, and constituting the chief part of the primary segment of the skeleton that which rests upon the body of the vertebra (projects backward in man), and spans across the neural axis or trunk of the nervous system, is called the "neural arch," that which is suspended in an inverted position (extends forward in man), and incloses [illegible] is called the [illegible] composing the head are called with their surrounding soft parts in the embryo "visceral arches" Curved portions of the great arterial and intestinal tubes are called 'arches,' as the 'arch of the aorta,' the arch of the colon"

A'RCHETYPE (Gr αρχη *beginning*, and τυπος, *a type*) In Anatomy, is that ideal original or fundamental pattern on which a natural group of animals or system of organs has been constructed, and to modifications of which the various forms of such animals or organs may be referred The archetypal figure has been most clearly recognised in the study of the modifications of the skeleton of the vertebrate animals

A'RCOGRAPH (Lat arcus *a bow*, γραφω, *I write*) A drawing instrument for describing arcs of circles, or other curves, without centres

ARDENT SPIRIT *See* ALCOHOL

A'REA (Lat.) In Embryology, certain definite spaces which successively arise in the germinal membrane are so called thus the opaque spot produced by an accumulation of cells and cell nuclei is called 'area germinativa,' or germinal area, the clear space which subsequently appears in its centre is called 'area pellucida,' and the outer part of this space where the blood-vessels are first formed, is called 'area vasculosa"

A'REOLAR TISSUE In Anatomy, a term synonymous with CELLULAR TISSUE which see

ARGAND LAMP The application of a circular wick to oil lamps so contrived as to allow of a current of air both inside and outside, was originally patented by a person of the name of Argand the contrivance constitutes an important epoch in the history of the improvement of lamps, by it the amount of light derivable from a given quantity of oil was enormously increased The same principle is also applied to gas burners *See* LAMP

A'RMATURE A piece of soft iron applied to a load- [illegible] poles of a horse-shoe magnet

ARNICINE A bitter principle contained in the flowers of the *Arnica montana*

A'RRAGONITE A peculiar variety of carbonate of lime originally found in Arragon in Spain it is harder than the common variety, and is prismatic instead of rhomboidal Some specimens contain about 3 per cent. [illegible]

ARTESIAN Numerous works of this kind have been executed of late years One of the most remarkable of them is that of Grenelle, a suburb at the south-west of Paris, where there was formerly a great scarcity of water The strata which were penetrated were, 1 the tertiary strata above the chalk, 2. chalk, 3 green sand and clay, 4 oolite or Jura limestone The sheet of water flows in a stratum of gravel under the limestone On account of th [illegible] the boring the work was attended with [illegible] and retarded by various accidents At length, in February, 1841, after eight years of exertion, the engineer (M Mulot) had the satisfaction of seeing the water he was in search of burst forth from a depth of about 600 English yards, and the jet yielded no less than 4,000,000 litres, or in round numbers 880,000 imperial gallons in the 24 hours The temperature is 81° of Fahrenheit, corresponding to an increase of 1° for each 20 4 yards of descent The bore is protected by a metal tube divided into four unequal lengths, and successively decreasing in diameter The dimensions are as follows — From the surface of the ground to the commencement of the first tube, 2 5 yards, length of first tube, 162 yards, of second tube, 227 yards, of third, 75 yards, of fourth, 124 yards, from extremity of last tube to bottom of bore, 7 5 yards, total, 598 yards The diameter of the first or highest tube is about a foot, and of the lowest about six inches, English The expense was about 12,000*l* sterling For a description of the boring apparatus and methods of [illegible] as usually followed in this country, see [illegible] *Dictionary of Arts, Manufactures, and Mines*, and for details respecting some Artesian wells in England, the *Reports of the British Association*

ASAFŒTIDA *See* ASSAFŒTIDA

A'SBOLINE (Gr ασβολη, *soot*) A resinous pitchy matter obtained from wood-soot

ASSOCIATION In Physiology, a name given to that combination of motions which arises from the voluntary impulse to one motion exciting other motions contrary to or independently of the will, as, for example, whenever the eye is voluntarily turned inwards the iris contracts these are termed associate or consensual movements

ASTATIC NEEDLE A term applied to the magnetic needle when it is [illegible] the action of the earth's magnetism, and has no longer the *statical* position in which it is in equilibrio with the influence of this force A needle is rendered astatic by placing the axis about which it is moveable in the direction in which terrestrial magnetism acts, because it cannot then receive any motion from this force, and will rest in any position The same effect will be accomplished by neutralising the action of the earth by means of an [illegible] (*Brewster's Treatise on Optics*)

ASTIGMATISM (Gr α without, στιγμα, *a mark*) In Optics the name given to a peculiar defect in the eye, which consists in its refracting the rays of light differently in different planes The defect may be detected by looking at a small pin-hole in a card, h [illegible] ky or any bright object, and moved [illegible] from the eye In the case of ordinary eyes the image of the hole remains circular at all distances, but to an eye having the peculiar defect in question the image of the hole, as the card is moved away from the eye, becomes elongated in a particular direction and at a certain distance passes into a straight line O [illegible] arther from the eye it becomes [illegible] perpendicular to the former and again at a certain distance (the second limit of distinct vision) it passes into a straight line This imperfection may be corrected by means of a cylindrical or spherico-cylindrical, lens, the distances of the card from the eye when the two focal lines are formed, giving the means of calculating the required curvature of the cylindrical surface (See *Transactions of the Cambridge Philosophical Society for* 1829, *Reports of the British Association for* 1849)

ASTRÆA One of the recently discovered small planets circulating between the orbits of Mars and Jupiter Astræa was discovered on the 8th of December, 1845, by Hencke of Driessen, in Prussia, who had for several years previously been engaged in astronomical observations directed to the discovery of such a body The announcement of his success excited great interest among astronomers, no other addition having been made to the planetary system since the discovery of Vesta by Olbers in 1807, but nine others belonging to the same group have since been added to the number Astræa appears as a small star of the ninth magnitude Its mean distance from the sun is 2 577 times that of the earth, and it completes its revolution in 1511 095 mean solar days Unlike the four others previously discovered in the same region, the inclination of its orbit was found to be only 5° 19′ 22 7″ which is less than the inclination of Mercury, and consequently the term *ultra-zodiacal* is no longer applicable to the whole group This distinction also belongs to three of the others since detected, viz Flora Iris, and Metis. Hebe, also

discovered by Heucke, has an inclination of nearly 15° *See* PLANET

ASTRO'METER (Gr *αστηρ*, *a star*; *μετρον*, *measure*), the name given by Sir John Herschel to an instrument invented and employed by him for comparing the intensities of light of the stars one with another by the intervention of the moon, or the planet Jupiter, or some other *natural* standard no invariable standard of artificial light having yet been discovered It is necessary that the intermediate standard of comparison be brighter than any of the stars to be compared, so as to allow [illegible] with them by a reduction of its light [illegible] and at the same time either invariable, or at least variable in such a manner that its changes can be calculated and reduced to numerical estimation Jupiter being brighter than any of the stars subject to no phases and variable in its light only by the variation of its distance from the sun, may be considered as best fulfilling all the conditions "The process" says Sir John, "consists in deflecting the light of the moon by total internal reflexion at the base of a prism, so as to emerge in a direction exactly coincident with that of the undeflected light of one of the stars to be compared It is then received upon a lens of short focus by which the image of the moon is formed, which viewed at a considerable distance by an observer placed in or near the axis of the lens will appear to him as a star This artificial star is then to be approached to or removed from the eye until its light is judged to be exactly equal to that of the real star which lying in nearly the same direction from the observer, will be seen side by side with the artificial one by the same eye, or with both eyes at once without the aid of a telescope in the ordinary mode of natural vision The distance of the eye from the focus of the lens being then measured the prism and lens are to be placed so as to form another similar artificial star in a direction nearly coincident with that of the other star under comparison, and another equalisation being made and distance measured it is obvious that the intensities of the lights of the two stars or at least their effects on the retina under the circumstances of comparison will be to each other in the inverse ratio of the distances so measured respectively" (*Results of Astronomical Observations*, &c, p 353, also *Outlines of Astronomy*, Art 783)

Sir John remarks that the use of a prism to deflect the light of a standard luminary by total reflexion at its base, is common to the astrometer described by him and an instrument which had been previously described by Steinheil in a paper printed in the Memoirs of the Gottingen Academy in 1836, though he had no knowledge of the existence of Steinheil's memoir until his return to Europe from the Cape (where he had used the astrometer) in 1838

It may be noticed that the name *Astrometer* was given by Bouguer to the Heliometer or object-glass micrometer It was also given by Jeaurat to an instrument for finding the rising and setting of the stars and their position, which he has described in the *Memoirs* of the Academy of Sciences of Paris An improved instrument for the same purpose is described in the *Edinburgh Encyclopædia* art SCIENCE

ASTRONOMY During the few years that have elapsed since the publication of the DICTIONARY, the progress of this science has been very remarkable A brief outline of the principal discoveries and improvements which have been made in it in the decade 1840—1850 is, therefore, necessary, in order to bring down its history to the present date

Among the recent discoveries in astronomy, the most prominent, and in certain respects the most remarkable ever made in the science, is that of the new planet, to which the name of Neptune has been given, beyond the orbit of Uranus In all previous instances of the discovery of a new planet, the discovery was accidental, in so far as the existence of the body was not foreknown, or even suspected, until its true nature became revealed by the observation of its relative motion In the present case, not only [illegible] et been made known through [illegible] but the precise spot which it occupied in the heavens had been indicated by the results of a profound theoretical investigation and the planet was immediately recognised in directing a telescope upon the spot so indicated The [illegible] able result were directed [illegible]

For several years it had been remarked that the motions of the planet Uranus were not in accordance with theory On comparing the observations with the tables of Bouvard, it appeared that the true longitudes of Uranus began to be in advance of the computed longitudes from about the year 1795, and more notably from 1821 the difference continuing gradually to increase till about 1832 when the excess attained its maximum After that year the difference began to diminish rapidly, and in 1830 the tabular and true longitudes agreed But the planet still continued to fall behind, as if hindered [illegible] irregularities; and in searching for a cause, the idea of disturbance from a more remote planet did not fail to present itself, and in fact afforded the only probable explanation of the phenomena It was no easy matter, however, to test this hypothesis, for unless the place of the supposed planet could be assigned within moderate limits, so as to direct the observations any attempt to find it must be undertaken at random, and insufficient to prove its non-existence as a visible object The problem, therefore, which presented itself for solution (and it had never before occurred in physical astronomy) was this Given the disturbances to find the orbit and the place in that orbit of the disturbing planet. By a singular coincidence, though not without example in the history of discovery, the problem was undertaken about the same time by two distinguished mathematicians, Mr Adams in England and M Leverrier in France, neither having the slightest knowledge of the other's attempt, and both arrived at a correct conclusion Mr Adams's results however, though communicated to two or three astronomers, were not published or generally known until some time after the actual discovery of the planet and as it [illegible] contribute in any way to that discovery Those of M Leverrier were given to the Academy of Sciences at Paris, and published in the *Comptes Rendus*, and by their means the planet was found by Dr Galle, of Berlin, on the very day on which his attention was directed to them, within less than a degree of its predicted place This memorable discovery took place on the 23rd of September, 1846, and was hailed by every astronomer of Europe as the most signal triumph of theory which had ever been achieved

Soon after the planet had been found and regularly observed, it was perceived that, notwithstanding the agreement between its actual and predicted position, the elements of its orbit differed very considerably from those which had been assigned by the two mathematicians In order to render the computations possible, it had been necessary to assume a certain mean distance of the hypothetical planet from the sun, and both M Leverrier and Mr Adams had assumed as a first approximation the law of Bode (*see* PLANET), which, though purely empirical, had a great probability in its favour, in consequence of its being observed to hold good in the case of the other planets According to this law, the mean distance of the planet from the sun should be double that of Uranus or 38 34 radii of the earth's orbit, in which case the periodic time would be 237 4 years M Leverrier had concluded the distance to be 36 15, and Mr Adams 37 25, radii of the terrestrial orbit, the former corresponding to a period of 217 4 years and the latter to one of 227 3 years On computing the real orbit from the observed motions of the planet, the mean distance was found to be only 30 036 radii, and the period 164 6 years, differing widely from both predictions, and still more from the law of Bode, which fails entirely in this single instance On considering all the circumstances of the case, the disagreement between the elements of the real and theoretical planet will not appear in any way remarkable, the latter, in fact, representing the perturbations which were to be accounted for with all the accuracy that could possibly be expected in such a research

Neptune is attended by at least one satellite, probably two, and is suspected to resemble Saturn, in having also a ring Its position in the ecliptic, since the date of its discovery, has been unfavourable to its being distinctly seen

The next most remarkable feature in the recent progress of astronomy is the discovery of six new planets belonging to the group which circulate between the orbits of Mars and Jupiter It has been stated, under the term PLANET, that the first of these small bodies, or asteroids, as they have been called was discovered by Piazzi, at Naples, on the first day of the present century; and the discovery was regarded with great interest by the astronomers of that time, more especially as it had been surmised that a planet probably existed whose orbit, lying between those of Mars [illegible] to [illegible] preserve the continuity of Bode's law [illegible], and the orbit of the new planet was found to be in conformity with that law The discovery of a second, in the following year, was entirely unexpected, but it led to a more careful observation of the small stars in and near the zodiac than had previously been attempted, in the hope of detecting others The result was the discovery of a third, in 1804, and of a fourth in 1807, but for nearly forty years the number was not increased About the end of 1845, however, a fifth, belonging to the same group, was discovered by M Hencke, of Driessen, in Prussia, and since that time ten more have been found, so that at the present time (January, 1852) no fewer than fifteen small bodies are known, all circulating at nearly the same mean distance from the sun and consequently

in nearly the same period of time. Their names, with those of their discoverers, and the dates of their respective discoveries, are as under —

| | | |
|---|---|---|
| Ceres, | discovered by Piazzi - | 1801, Jan. 1 |
| Pallas - - | Olbers - | 1802, March 28 |
| Juno - - | Harding - | 1804, Sept 2. |
| Vesta - - | Olbers - | 1807 March 29 |
| Astræa - - | Hencke - | 1845, Dec 8 |
| Hebe - - | Hencke - | 1847, July 1 |
| Iris - - | Hind - | 1847, August 13 |
| Flora - - | Hind - | 1847, Oct 18 |
| Metis - - | Graham - | 1848, April 25 |
| Hygeia - - | De Gasparis | 1849, April 12 |
| Parthenope - | De Gasparis | 1850, May 11 |
| Victoria - - | Hind - | 1850, Sept 13. |
| Egeria - - | De Gasparis | 1850, Nov 2. |
| Irene - - | Hind - | 1851, May 19 |
| Eunomia - - | De Gasparis | 1851, July 29. |

In reference to the eleven recently discovered planets it is proper to remark, that although none of them was previously known to exist, their discovery was in every instance the result of a "careful and minute examination and mapping down of the smaller stars in and near the zodiac, undertaken with that express object" The singular circumstance of so many planets moving in orbits of nearly the same dimensions, and all so insignificant (in comparison of the other planets) in size, gives considerable probability to the hypothesis proposed by Olbers on the discovery of Pallas, that a large planet originally occupied that region of space, and was shattered into fragments by an internal convulsion But the hypothesis of Laplace, that they have their origin in a ring or zone of nebulous matter, thrown off from the sun's atmosphere in the gradual process of cooling, and broken up into small masses, no one being of sufficient magnitude to attract the others to its centre (as has happened in the case of all the other planets), will equally account for the phenomena. But whatever hypothesis may be formed respecting their origin the number of them already known makes it extremely probable that many more exist, though by reason of their excessive smallness they may long, or for ever, elude observation Those already known appear in the telescope as stars of the ninth or tenth magnitude, but such is their minuteness that it is impossible with [illegible] observation to measure their [illegible] thence to deduce their real dimensions with any degree of accuracy

Another recent discovery, affording evidence at the same time both of the excellence of the instrumental means now applied to astronomy and of the attention bestowed on the careful and accurate examination of the heavens, is that of an eighth satellite of Saturn, and it is not a little remarkable that the discovery was made both in England and America at the same time — even on the same day In England the body was first observed by Mr Lassell, of Liverpool with a two foot reflecting telescope, on the 18th of September, 1848, and taken for a faint star On the 19th it seemed to have changed its place, [illegible] of Saturn, and was accordingly suspected [illegible], and on the 21st when it was next observed its true nature was satisfactorily made out The same object was observed in America by Mr G P Bond at the Cambridge Observatory Massachusetts, on the 16th of September and then supposed to be a small star On the 18th it was again noticed, but still without suspicion of its nature On the 19th it was suspected to be in motion, and its position was therefore accurately determined On the 20th it could not be seen, but on the 21st it was proved by its relative motion to be an attendant of Saturn The new satellite is very faint and can only be seen in a powerful telescope Reckoning from the outermost satellite inwards towards the planet, it is the second in the order of distance

Cometary Astronomy has also been cultivated of late years with great assiduity, and in a manner which promises to lead to important results Formerly the computation of an orbit was a task which not many observers were competent to undertake At present the methods of performing such computations are far more generally known, and, indeed, no sooner does a comet make its appearance than elements of its orbit proceed from many quarters with a sort of rivalry The first approximate calculations are carefully corrected by means of subsequent observations till the path of the body is determined with great accuracy and in this manner the means are prepared of identifying it if it should make its appearance at any future time Only a small number have yet been satisfactorily proved to move in elliptic orbits, and consequently to return at definite intervals, by far the greater numbers move in orbits which cannot be distinguished from parabolas, and after passing their perihelia shoot off to indefinite distances and may possibly enter within the sphere of attraction of other systems. Their physical constitution still remains a profound mystery One of the most remarkable on record appeared in 1843 It was visible within four degrees of the sun and in full day No other comet has been known to approach so near to the sun At its perihelion its distance from the luminous surface of the sun was computed to be less than a seventh part of the sun's radius, and the whole segment of its orbit cut off by the plane of the ecliptic was passed through in the short space of two hours its actual velocity being then no less than 366 miles per second It has been supposed to be identical with a comet which appeared in 1668

[illegible] accession to our knowledge [illegible] through the publication of the results of Sir John F W Herschel's observations at the Cape of Good Hope This distinguished astronomer, after devoting some years to the examination and description of the nebulæ and double stars in the northern hemisphere, with the view of completing the work begun by his father Sir William Herschel (who may be regarded as the founder of this interesting branch of astronomy) conceived the idea of extending his survey to the southern hemisphere, in order to place on record a description of the principal nebulæ and double stars over the whole heavens as observed with the same telescope and by the same observer, whereby the astronomers of future time would be enabled to detect changes in their physical appearances or relative positions, should any such take place For this purpose he removed his Observatory to the Cape of Good Hope, where he passed four years (1834-1838) assiduously employed in carrying out the objects of his great undertaking, and after completing the still more laborious task of reducing his observations, the results were given to the world in 1847 Though the main purpose of his [illegible] of double stars, [illegible] accompanied with minute description and interesting remarks, the work also embraces a great variety of observations and disquisitions on other matters connected with astronomy, — the constitution of the galaxy, the Magellanic clouds, Halley's comet, the satellites of Saturn, the solar spots &c It is right to add, that this noble enterprise, which has conferred so much honour on his country, and been productive of so much benefit to astronomy, was undertaken and carried through by Sir John Herschel at his own private charges He held no public appointment, and received no public assistance, and for the means of rendering his labours available to astronomers by the publication of the results, he professes his obligations to the Duke of Northumberland

Among the circumstances which have most contributed to the general advance of astronomy in late years, one is the increased dimensions now given to telescopes, in consequence of which the objects of observation are not only greatly multiplied but the observations are made with far greater distinctness and precision Refracting object-glasses, of a foot or upwards in diameter, can now scarcely be considered as rare But greatly exceeding these in optical power is the reflecting telescope made and erected by the Earl of Rosse, at his lordship's seat, in Ireland The mirror of this gigantic instrument is six feet in diameter, and weighs about four tons For a short account of the ingenious contrivances and apparatus made use of for the casting, grinding polishing and placing in its position this enormous mass of metal, we must refer to article *Telescope*, in this Supplement, they are all due to Lord Rosse himself, and could only have been produced by the combined exercise of extraordinary ingenuity, patience, and mechanical skill Nor has the performance of the instrument disappointed the expectations which were formed of it Nebulæ which, in other telescopes, gave no indication of resolvability, are by this instrument resolved into stars, and in fact it already seems probable that it will be the means of upsetting the whole nebular theory The appearance of some of the nebulæ or clusters in this telescope is extremely remarkable Some are observed of a spiral form, perfectly regular, others exhibit streaks, sometimes straight, and sometimes curved and generally they give evidence of systematic arrangement Telescopes on the same principle have also been brought to great perfection by Mr Lassell and though of far inferior [illegible] to that of Lord Rosse, have already rendered good service in connexion with the discovery of a satellite of Neptune, of the eighth satellite of Saturn, and of Hyperion

Concurrently with the increase of optical powers, the art of observing, and the science of reducing the observations, have undergone corresponding improvements The probable errors are consequently now confined within much narrower limits, and the consequence is, that astronomers are enabled to recognise and measure minute changes in the places of stars which formerly eluded observation It is to this extreme practical accuracy that we are indebted for the present perfection of [illegible] astronomers look for the solution of many problems still beyond their reach, such

as the parallaxes and proper motions of the stars, and their systematic connexion with one another and with our own sun Already the point in the heavens towards which the sun, with all his planets, appears to be moving, has been indicated with considerable probability; and a German astronomer (Madler) has ventured to assign a star in the Pleiades as the centre about which not only the sun, but the whole stratum of stars among which it is placed, is revolving

The measurement of two additional arcs of the terrestrial meridian in India by Colonel Everest under the auspices of the East India Company is a work of the highest importance in an astronomical point of view to deserve notice in this rapid retrospect Under the term *Degree of Latitude*, in the *Dictionary*, a short reference has been made to the principal geodetical operations for determining the magnitude and form of our globe,—an element of great importance in physical astronomy, and by which the magnitudes of all the planets are estimated,—and among these operations some which had been effected in India occupied a prominent place With instruments of a much superior kind to any which had previously been used in that country, and with all the appliances of modern science, Colonel Everest has added two arcs of meridian to the former measurements, one of 6° 3′ 56″, and the other of 5° 23′ 37″, which, taken in connexion with Lambton's operations, gives a continuous meridianal arc of 21° 21′ 13 extending from Cape Comorin to the foot of the Himalayas The details of the measurement were published in 1847 It may also be noticed, that the trigonometrical measurement of the Brit[illegible] 7′ 55″, from Dunnose, in the Isle of Wight, to Burra in Shetland, is understood to be completed [illegible] as may be hoped, the details will shortly be given to the public For the purpose of verification, a new base was measured in 1849, on Salisbury Plain, with the same apparatus as was used in measuring the Irish base, and it may be presumed, that all the distances will be given in terms of this new measurement, the results being much more trustworthy than those which were obtained by the older methods. Another interesting operation of the same kind, extending to about 4½°, and including a repetition of Lacaille's arc, has been completed at the Cape of Good Hope, but the results are not yet published

Physical astronomy has now been carried to a state of such perfection that the disturbing forces resulting from the reciprocal attractions of the different planets on each other so completely represented by mathematical formulæ, that the improvements which remain to be made must consist chiefly in giving greater accuracy to the numerical coefficients, which depend on data furnished by observation For this purpose the most important work which has been executed in recent times is the reduction of the planetary and lunar observations made at Greenwich, from 1750 to 1830, under the superintendence of the Astronomer Royal, a work of immense labour and utility which puts the theoretical astronomer in possession of the results, in their most available shape for perfecting the elements of the solar system by means of the longest, and probably the most accurate series of continuous observations which the world can furnish

ATA'CAMITE The native muriate of copper of the desert of Atacama in South America

ATHAMA'NTINE A crystallisable substance contained in the root of the *Athamanta oreoselinum*

ATHA'NOR A term applied by the alchemists to a furnace so constructed as to supply itself with fuel

ATHERMANOUS (Gr *a priv* and θερμος *heat*) Transparent or translucent substances which resist the passage of radiant heat

ATMOSPHE'RIC TIDES Diurnal oscillations of the atmosphere produced by the attractions of the sun and moon, analogous to the tides of the ocean The attractions of the sun and moon tend continually to cause a variation in the figure of the atmosphere relatively to the meridian of any place and consequently to produce a change in the amount of barometric pressure, but the change is so small in comparison to those produced by many of the other causes which disturb the equilibrium of the atmosphere, that a long series of accurate observations is necessary to render it sensible, even within the tropics where the influence of solar and lunar attraction is greatest, and the other causes of atmospheric disturbance act with least effect In the *Philosophical Transactions* for 1847, Colonel Sabine gives an account of a series of observations of the barometer made at St Helena, *hourly*, during a period of three years, for the purpose of determining the moon's influence The result of the first year's observations, which were reduced at St Helena, showed an average excess of barometric pressure of [illegible] parts of an inch at the hour when the moon is on the meridian (above or below the pole), and an average defect of 00115 when six hours distant from the meridian, making together an average difference of 00255 in when the moon is on the meridian, and when 90° from it The observations of the other two years were reduced at Woolwich, under the superintendence of Colonel Sabine and the result was still more decided the average difference exceeding [illegible] in, or nearly four thousandths of an inch These differences are, no doubt exceedingly minute, but as the observations were made with great care, and on being broken up into periods of six months were still found to give consistent results, it may be reasonably presumed that they represent with considerable accuracy the amount of the lunar influence on the atmosphere The effect of the sun's attraction being not only much smaller than that of the moon, but also masked in the diurnal barometric oscillation by the much greater and variable influence of the solar heat, probably cannot be satisfactorily determined

ATOLL, or LAGOON ISLAND In Physical Geography the name given to a particular kind of coral [illegible] consists of a chaplet or ring of coral, [illegible] portion of the ocean in its centre [illegible] the part of the ring which rises above the surface of the sea is nearly a quarter of a mile, and it seldom rises higher than from six to ten or twelve feet above the surface On the outer side the ring gradually shelves down to the distance of 100 or 200 yards from its edge [illegible] to about 25 fathoms, beyond which [illegible] almost perpendicularly into the unfathomable depths of the ocean On the lagoon side where the water is calm the bounding ring or reef shelves into it by a succession of ledges, also of living coral, but of a different species from those which build the exterior wall and the foundation of the whole ring The size varies from two to ninety miles in diameter The lagoon islands are widely spread, but chiefly in the Pacific Ocean Most frequently they occur in elongated archipelagos extending in groups over a large surface, the Caroline Islands, for example, extend to 1000 miles Sometimes the lagoons have islands within them Otaheite, the largest of the Society group, is a remarkable instance of this formation The bay on which encompasses it is thirty fathoms deep, and hemmed in from the ocean by a coral band of the usual kind at a distance varying from half a mile to three miles (*Somerville's Physical Geography*)

AUGITE (Gr αυγη *splendor*) A crystalline mineral common in volcanic and basaltic rocks It is the *pyroxene* of Hauy

AURIC ACID (Lat aurum, *gold*) A term now frequently applied by chemists to the *peroxide of gold*

AURIPIGMENTUM (Lat) Yellow sulphuret of arsenic

AUROCYA'NIDES Compounds of the cyanide of gold with basic oxides The aurocyanide of potassium is used in the art of electro-gilding

AUTOMALITE (Gr αυτομαλος, *a deserter*) Named from the presence of zinc in a mineral not resembling a metallic ore) A crystalline mineral consisting chiefly of oxide of zinc and alumina It is the zinc-spinelle of some crystals

AUTOMATIC In Physiology, applied to those muscular actions which are not dependent on the will or other act of the mind such are the successive contractions of the hollow viscera of organic life, e g the heart, the intestines the ureters, urinary bladder, the uterus, the involuntary movements of respiration, the motions of the muscles of the eye during sleep, the persistent contraction of the sphincters

AVANTURINE (Deriv unknown) A beautifully iridescent variety of rock crystal

AXIS-CYLINDER In Anatomy, the name applied to the central substance of the primitive nerve-fibre

AZOLITMINE A dark red substance forming a great part of the colouring material of litmus Its chemical [illegible] is according to Kane, $C_{18}H_{10}O_8N$

AZOTISED PRINCIPLES (Gr α *without* and ζωη, *life*) In Anatomy the two chief classes of substances of animal bodies — viz the gelatinous and albuminous. In Chemistry, the term is chiefly applied to substances containing nitrogen, and used as aliments many of them are common to animals and vegetables

## B.

BA'BLAH An astringent dye-stuff imported from the East Indies and from Senegal it has been used for dyeing drabs, as a substitute for more expensive materials It is the shell of the fruit of the *Mimosa cineraria*

BACK A reservoir or cistern The *liquor back* in a brewery is the water reservoir

BAGA'SSE (Fr) The sugar-cane in its dry crushed state, as used for fuel in the colonial sugar-houses

BALEI'N (Fr baleine) The term in common use among whale fishers for whalebone

BALSA (Spanish) A species of float or raft, chiefly used on the coasts of South America, for landing goods

through a heavy surf. The balsa is formed of two seal skins sewed up so as to form two large bags, which are covered with pitch to render them perfectly air-tight, and secured by ligatures. The bags or bladders thus prepared are inflated with air passed through a flexible tube, which is left of sufficient length to reach the mouth of the conductor, who is thus enabled to replenish them with air, should any have escaped. The two bags are fastened together at one end, which forms the prow of the vessel, the opposite ends being kept about four feet apart by means of cross bars, and the raft is completed by a platform of canes, over with matting, having thus the shape of a wedge or triangle. It is propelled by a double-bladed paddle, and the conductor, standing on the shore, contrives to keep the bows of the balsa to the highest wave that it is thrown on the beach to the greatest extent the surf reaches, where it is immediately secured. The balsa will carry three passengers besides the person who conducts it, and by this means cargoes are landed from merchant vessels where the violence of the surf prevents ordinary boats from passing through it without great danger. Floats of a still ruder kind, usually formed of the hides of bullocks simply stretched on a frame, are used for crossing rivers in South America, and go by the name of balsa. (*Penny Magazine*, vol. iii. p. 150.)

BANDA'NNA. A style of calico-printing in which white spots are produced upon a red ground. The term is of Indian origin, and the art has been extensively adopted and improved upon in this country. (See a detailed account of Messrs. Monteith's manufactory at Glasgow, in Brande's *Quarterly Journal of Science and the Arts*, June, 1823, and in the *London Journal of Arts*, &c.)

BARBADOES NUTS. The fruit of the *Jatropha Curcas*, a native of South America and Asia. They are sometimes called *physic nuts*, and are virulently purgative.

BARBA'DOES TAR. Petroleum. A bituminous liquid of the consistence of tar; it oozes from the soil along with water, from which it is skimmed off and preserved in earthen jars. By distillation it yields *naphtha*. It is used in medicine as an internal remedy in certain chronic pulmonary affections, in obstinate diseases of the skin, and against tape-worm. As an external agent it is sometimes employed in ill-conditioned ulcers and to chilblains. These bituminous oils have been recommended in cholera; the dose is from 30 drops upwards.

BARM. The yeast which collects upon the surface of fermenting beer. The term is of Welsh origin.

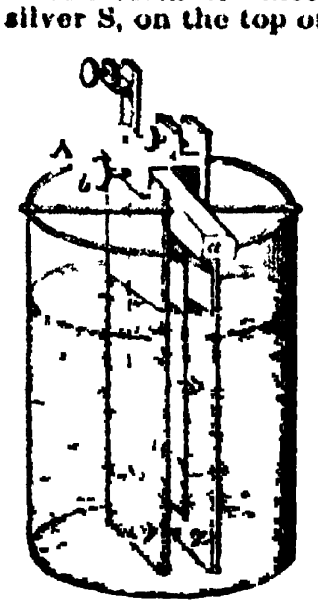
BAROSELENITE. A mineralogical name applied to *sulphate of baryta*, or heavy spar.

BASTARD SUGAR. *Bastards* is a term applied by the sugar refiners to an impure sugar chiefly produced by the action of heat and various substances used in the refining, and which cannot be remuneratively purified. They are also called *pieces*.

BATTERY, ELECTRICAL. A series of Leyden jars so arranged that they may all be discharged at once. *See* ELECTRICITY in DICT.

BATTERY, GALVANIC. Several forms of this apparatus have already been described (*see* VOLTAIC ELECTRICITY), many others have lately been invented, two of which, namely, SMEE'S BATTERY, and GROVE'S BATTERY, deserve particular notice. In Smee's battery, of which a detailed description will be found in his *Elements of Electro-metallurgy*, the positive or generating plates are composed of amalgamated zinc, and the negative plates of platinised silver, which, on account of its rough surface favours the escape of the hydrogen gas evolved upon it, the adhesion of which to platinum or silver in their ordinary state is a serious impediment to the action of the battery.

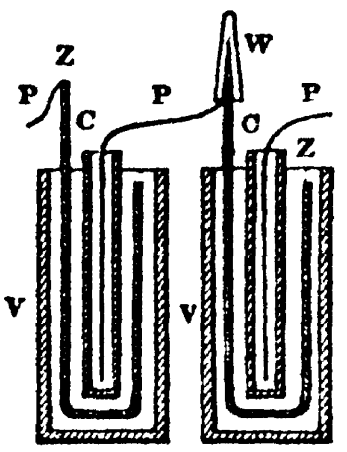
One form of Smee's battery "consists of a piece of silver S, on the top of which is fixed a beam of wood *w* to prevent contact with the silver. A binding screw is soldered on to the silver to connect it to any required object. A strip of zinc *Z*, varying, at the fancy of the operator, from one half to the entire width of the silver is placed on each side of the wood, and both are held in their place by a binding-screw *b*, sufficiently wide to embrace the zincs and wood. These batteries vary from the size of a tumbler to a ten or twelve gallon vessel."



1353

A single cell of this battery is represented in the annexed cut. A is an earthenware or glass vessel containing dilute sulphuric acid (composed of 1 part of oil of vitriol to 6 or 7 of water). *w* is a bar of wood to which the platinum, or platinised silver plate is attached. Z Z are two plates of amalgamated zinc, connected and secured to the bar by a binding screw; and a separate binding screw is soldered to the platinised plate, these are for the convenience of making connections by wires. When a series of these cells are required they are connected together in the usual way.

Grove's battery, called also *the nitric acid battery*, is an extremely valuable instrument both to the lecturer and experimentalist; it combines great power both of quantity and intensity, it is free from the inconveniences of local action, so far, a *constant battery*, it occupies little space, and is on the whole more economical than any other form of battery possessing the same [illegible] properties. The annexed sections of two cells of this battery are represented in the annexed cut.




The outer vessel V is a flat cell of glazed [illegible] within it is another shaped, but smaller and thinner cell C, of *porous* earthenware. A flat plate of amalgamated zinc Z is bent so as to receive the porous cell, a plate of thick platinum foil P being contained within the latter cell, and long enough to extend to the projecting end of the zinc plate of the [illegible]. The porous cell is charged with strong nitric acid, the outer porcelain cell is filled with a mixture of 1 part of oil of vitriol and 6 of water. The zinc being amalgamated, there is in this apparatus, as in Daniell's, no chemical action till the electrical current passes, and then the evolved hydrogen is suppressed by the nitric acid, which it converts by deoxydizement into nitrous acid. Twenty of these cells form a very powerful combination. Many years ago Mr. Cooper proposed to substitute coke for platinum in these batteries, and a similar plan has been more recently adopted by Bunsen, but so much inconvenience has attended the use of this material that it has not been generally adopted.

BE'BEARINE. A bitter basic principle contained in the bebeeru plant or *Greenheart* of British Guiana.

BEESTINGS, or *Colostrum*. The first milk yielded by the cow immediately upon the birth of the calf.

BELU'GA. The species of whale (*Delphinus leucas*, Pallas) which, from its colour, is commonly called by the whalers "white-fish." It is confined to northern latitudes.

BENGAL STRIPES. Cotton cloth woven with coloured stripes. Ginghams.

BENJAMIN. *See* BENZOIN, in DICT.

BENZO'LE. A compound of carbon and hydrogen, originally discovered by Faraday amongst the products of the destructive distillation of whale oil. The same compound was produced by Mitscherlich from *Benzoic acid*. It consists of 12 atoms of carbon, combined with 6 of hydrogen, its formula being $C_{12}H_6$. It has a peculiar aromatic odour; it boils at 176°, and concretes into a crystalline solid at 32°, a property which enables it to be separated from other hydrocarbons, which remain liquid at low temperatures. Benzole has lately acquired much interest from having been discovered by Mansfield (*Journal of the Chemical Society of London*) amongst the products of the distillation of coal tar; it promises to form a valuable article for the manufacture of varnishes, and as a source of light.

BERLIN BLUE. *See* PRUSSIAN BLUE.

BERM (Fr.) in Fortification, a narrow level space, two or three feet wide along the exterior slope of a parapet to prevent the mass of earth and other materials of which it is composed from falling into the ditch.

BERRIES OF AVIGNON (*Graines d'Avignon*). The fruit of the *Rhamnus infectorius*, generally known under the name of *Persian Berries*. They are grown in Provence, Languedoc, and Dauphiné, and another variety comes from Persia. They contain a peculiar principle which has been termed *Rhamnine*, and which acquires a [illegible]

BEZOA'R MINERAL. Peroxide of antimony. It [illegible]

[illegible] *pond*.) In Anatomy, when a part has two cusps, or pointed portions, as the bicuspid valve between the left auricle and ventricle.

BIO'LOGY (Gr. βιος, *life*, λογος, *discourse*.) A branch of statistics having for its object the determination of the average duration of human life from the comparison of recorded observations. The term MORTALITY, or *doctrine of* MORTALITY, is more generally applied to the same inquiry.

**BITTER APPLE.** The fruit of the *Cucumis colocynthis*

**BLACK ASH** Impure carbonate of soda.

**BLACK DROP** A preparation of opium, known also under the name of *Lancaster*, or *Quakers' black drops* It is said to be a solution of opium in verjuice

**BLAS** A term applied by Van Helmont to certain supposed emanations of the heavenly bodies

**BLISTERED STEEL** *See* STEEL

**BLOCK MACHINERY** A system or assemblage of machines for manufacturing the shells and sheaves of blocks required for ship tackle The term is specially applied to the ingenious machinery designed by M I Brunel and set up in the dockyard at Portsmouth between 1802 and 1808, and also at Chatham about 1807, for the supply of the royal navy By these machines every operation connected with the construction of blocks, from the cutting up of the timber to the polishing of the iron pinion which the sheave turns, is performed with astonishing celerity and precision, and when it is known that a single ship of war of 74 guns requires about 1430 blocks for her equipment, the advantage and even the necessity of abridging the labour of construction [illegible] be understood Although [illegible] without entering into [illegible] workings to give an idea of [illegible] the principal operations may be easily indicated In the first place the rough timber (which is generally elm) is squared by an upright saw, it is then cross cut into pieces of the proper length by a circular saw These pieces are then brought under the *boring machine*, when one centre bit bores a hole for the centre pin of the sheave, and another bores another hole at right angles to the former at one extremity of the mortise (or two or more such holes are bored when the block is to hold two or more sheaves) to admit the first stroke of the chisel The next operation is performed by the *mortising machine*, which consists of a set of [illegible] to a moveable frame, and makes [illegible] dicular strokes in a minute, the block being placed on a carriage which at every ascent of the chisels advances forward a little until the proper length has been mortised out The block is then removed from the mortising machine and the four corners are taken off by a circular saw, after which it is placed under the *shaping machine* when by tens at a time the proper curvature is given by means of a tool moving in a direction curved towards the line of the axis In the *scoring machine* scoops out a groove round the larger end of the block to receive the hempen or iron strap which goes round the block and by which it is suspended when in use and the *shell* is thus completed The *sheaves* of the block are made of lignum vitæ a log of which wood is first cut into plates of the proper thickness by a circular saw The plates are then carried to the *crown saw* which at once bores the centre hole through which the pin is to pass, and gives an exact circular form They are next brought to the *coaking machine* for the purpose of having grooves cut in them on both sides for the insertion of the *coak* or bush which is of gun metal and of a peculiar shape (to prevent them from turning in the sheaves) the section being bounded by three semicircles, the diameters of which form the sides of an equilateral triangle This part of the machinery is exceedingly curious, and so accurately is the operation performed that the coaks are fixed in the sheaves by the tap of a hammer The two coaks (one on each side of the sheave) are secured by copper rivets passing through them and the sheave—an operation also performed by the machine The sheave is then completed by turning a groove round its periphery for the rope to run in, and by smoothing its sides, both operations being performed on the same lathe The iron pin only now remains, and this is also turned and polished by engines for the purpose The whole of the machinery is put in motion by straps passing over drumheads, and is driven by a single steam engine It is found that by means of this machinery ten men can with ease finish in one year from 130 000 to 140,000 blocks of different sizes

**BLOWING MACHINES** Instruments for producing a current or blast of air, chiefly for the purpose of exciting the combustion of fuel, and producing a great heat. The common bellows is an instrument of this kind but for certain processes of metallurgy as in smelting and refining ores, the intermittent blast produced by the single bellows is prejudicial and even in the double form of the machine, as used generally by blacksmiths, the defect is not altogether remedied Various contrivances have been had recourse to for the purpose of producing a continuous and equable blast, though depending generally on the principle of forcing air into large cylinders or air-chests, by means of a force air-pump, and allowing it to escape by eduction pipes under a regulated pressure For the regulation of the pressure the air may be forced into a vessel inverted in a reservoir of water, but as the air is chilled by its contact with the water, the water regulator is found to be objectionable for large blast furnaces, and a weight is employed Machines on this principle, frequently on a large scale, are in use at every foundry and great engine manufactory; and they have this advantage, that a number of forges may be supplied from the same air-chest (See Ure's *Dictionary of Arts, Manufactures, and Mines* Art *Metallurgy*)

**BLUE PILL** The *pilula hydrargyri* of the Pharmacopœia It consists of mercury triturated with conserve of roses and the powder of liquorice root till the globules disappear, and a homogeneous bluish grey pill-mass is obtained it contains one-third of its weight of mercury

**BLUE STONE** *Blue vitriol* Sulphate of copper

**BOCCIUS LIGHT** A form of gas-burner invented by Boccius, in which two concentric metal cylinders are so placed over the flame as to modify the combustion and increase the proportion of light

**BOLOGNA PHIALS** Small flasks or phials of unannealed glass which fly into pieces when their surface is scratched by a hard body as by dropping into them a fragment of flint, whereas a bullet may be dropped into them without injury

**BONE BLACK** The black carbonaceous substance obtained by heating bones to redness in a retort or other close vessel When deprived by the action of hydrochloric acid of the phosphate of lime with which it is blended, it yields one of the most valuable forms of *animal charcoal* and is highly prized by chemists as a decolorising and decolorising material

**BORNEO CAMPHOR** The camphor of the *Dryobalanops aromatica*, or camphor tree of Sumatra

**BOUGIE** (French) A slender flexible tube, intended for introduction into the urethra, œsophagus, or rectum when those passages are obstructed by stricture or other disease

**BOULDERS** In geology, detached masses or fragments of rocks detached from their native locality, and scattered about upon the actual surface of the earth. They are also called erratics and greyheads"

**BOXINGS** A term applied by millers to an inferior or second flour

**BOYLE'S FUMING LIQUOR** This term was applied to the *hydrosulphuret of ammonia*, originally obtained by distilling a mixture of sulphur sal ammoniac, and quick lime When recently prepared it exhales dense fumes on exposure to air

**BOYLE'S REFLUX** A piece of chemical apparatus contrived by Boyle, resembling a flattened flask with a very long neck It was principally used for the preparation of oxide of mercury (*precipitatum per se*)

**BRAZING** The soldering of metals with an alloy of brass and zinc, to which small portions of tin are occasionally added

**BREAST-WHEEL** In hydraulics the name given to a water-wheel so placed as to be struck by the stream of water nearly on a level with the axle, the lower quadrant of the circumference on the side opposed to the stream being placed in a *race* or channel concentric with the wheel, through which the water is conducted in its descent from the higher to the lower level, and in falling on the float boards within the channel acts both by its momentum and weight

**BRIGHT'S DISEASE** A morbid condition of the kidney, occasioning the secretion of urine loaded with albumen the disease has hence been termed *Albuminuria* it was originally described by Dr Richard Bright

**BRITANNIA METAL** An alloy of tin with a little copper and antimony, used for tea pots and similar purposes

**BRONZE POWDER** Copper or brass reduced to the state of a fine powder

**BRONZING LIQUID** A solution containing chloride of antimony and sulphate of copper, used for bronzing iron gun-barrels Brass is sometimes bronzed by washing it over with a solution of chloride of platinum

**BRUNNER'S GLANDS** These glands, so called after their discoverer, are minutely lobulated bodies, situated beneath the mucous membrane in the submucous tissue of the duodenum they are provided with permanent gland-ducts, which pass through the mucous membrane and open on the internal surface of that intestine They resemble the pancreas in intimate structure

**BRYOZOA** (Gr βρυον, *moss*, ζωον, *animal*) An order of compound polypes, including the *Flustra* or sea mat which [illegible] bodies like moss The organisation [illegible] polypes resembles that of the Ascidia[illegible]

**BUDE LIGHT** This term has been applied to various forms of oil and gas burners contrived by Mr Gurney, of Bude in Cornwall The original proposal was to maintain the combustion by means of a supply of

oxygen gas to the burner, by which, with oil, or naphthalised gas, an intense [illegible] an inconvenience and [illegible] with its economical adoption Large gas burners with variously formed reflectors and refractors have since been erected in different parts of London under the name of *Bude Lights*, but they have nothing in common with the original proposal

BUFF LEATHER A leather prepared by imbuing the prepared skin with an aluminous compound, and afterwards some oily matter such as yolk of egg

BUFFERS Elastic cushions attached to railway carriages for the purpose of breaking the shock when one carriage is pushed against another They are usually formed of horsehair covered with leather, but may consist of strong iron springs or of vulcanised caoutchouc

BUFFY-COAT When the coagulation of blood is retarded so as to allow the red particles to sink, and the [illegible] towards the surface, the [illegible] coagulates without the red [illegible] e ones, and forms a light-[illegible] white corpuscles resting upon the main body of the coagulum which has included the red corpuscles, and constitutes what is called the "buffy-coat" It is indicative of inflammatory disease, during which the coagulation of the blood is retarded beyond the ordinary time

BULBUS ARTERIOSUS In Embryology, the third cavity developed upon the primitive arterial trunk, the first being the auricle the second the ventricle The trunks of the aorta and pulmonary artery are developed out of the bulbus arteriosus in the warm-blooded vertebrata In Comparative Anatomy the muscular basis of the branchial artery in fishes is so called which may be regarded as a retention of the embryonic structure by arrested development

BULBULO A glass flask or mattrass of flattened ovoid shape, in which camphor is sublimed

BURSÆ MUCOSÆ In Anatomy, synovial serous sacs, either subcutaneous or situated beneath tendons that glide over bones

BUTY'RIC ACID One of the fatty acids contained in butter it is also formed in certain cases in which sugar undergoes fermentation in contact with curd, and hence termed *butyric fermentation* This acid is a volatile, colourless and very mobile liquid of a pungent sour odour, resembling that of a mixture of acetic acid and rancid butter, its taste is first pungent and sour then sweetish and ethereal The chemical formula of this acid is $C_8 H_7 O_3 + HO$, that is the anhydrous butyric acid consists of 8 atoms of carbon, 7 of hydrogen, and 3 of oxygen, which in the ordinary acid are combined with an atom of water in the *butyrates* this atom of water is replaced by an atom of base

## C.

CA'CODYLE *See* KAKODYLE

CACO'THELINE A substance formed by the action of nitric acid upon brucia

CALO'RIFA'CIENT (Lat calor, *heat*, facio, *I make*) [illegible] to those non azotised [illegible] of fat starch, sugar gum, which are believed to be employed in the production of heat

CA'LOTYPE, or KALOTYPE (Gr καλος, and τυπος) A term applied [illegible] tained by the action of [illegible] *See* PHOTOGRAPHY

CA'LYX In Anatomy is applied to that branch of the pelvis of the kidney which receives the apex of the cone or bundle of the uriniferous tubules in man there are several "calyces" in the kidney

CAM or CAMB In Machinery a contrivance for converting a uniform rotatory motion into a varied [illegible] The end of a rod which is free to [illegible] of its length is held in contact, by the action of a spring, or weight, with the edge of an irregularly shaped mass which revolves uniformly upon an axis A varied motion is thus communicated to the rod, which carries with it the machinery by which the motion is to be applied This contrivance is much used in the machinery for lace-making *See* ROSE ENGINE in DICT

CAM WOOD The wood of *Baphia nitida* the tree which yields it grows in Sierra Leone and the interior of Africa It is used in dyeing instead of Brasil wood, and gives a finer and more durable red

CANNA STARCH The fecula of the *Canna coccinea* and [illegible] of *Tous les mois* It is imported from St Kitts, and is a good substitute for arrow-root Its granules are comparatively large, and [illegible] object

CA'PRIC ACID One of the volatile acids of butter obtained by saponifying it with soda, adding excess of sulphuric acid, and distilling it passes over mixed with butyric acid and with two other acids namely, the *caproic* and the *caprylic* acid Capric acid has a mixed odour of acetic acid and the smell of a goat The odour of caproic acid is less goaty and that of caprylic acid strongly resembles perspiration. A curious relation exists between the formulæ of these several acids, the carbon and hydrogen successively increasing by the addition of 4 equivalents, as shown in the following table —

| | |
|---|---|
| Butyric acid - - | $C_8 H_7 O_3, HO$ |
| Caproic - - - | $C_{12} H_{11} O_3, HO$ |
| Caprylic - - - | $C_{16} H_{15} O_3, HO$ |
| Capric - - - | $C_{20} H_{19} O_3, HO$ |

CA'PSICINE An acrid soft resin found in the fruit or seed pods of the *Capsicum annuum*, it appears to be the acrid principle of Cayenne pepper

CAPSULAR LIGAMENTS Those ligaments which surround moveable articulations, and retain the synovia as in a bag

CAPSULE (Dimin. of *Capsa*, a box or case) In Anatomy, a membranous sac investing an organ, as the capsule of the liver, the spleen, &c those flask-shaped sacculi from which the uriniferous tubes commence are called "capsules of Malpighi" they surround the capillary glomerules or plexuses, called "corpuscles of Malpighi"

CARAGHE'EN MOSS The *Chondrus crispus*, called also Irish moss It is very common on rocks and stones on the sea coast it appears to contain a peculiar mucilage, which has been called *Carageenine* It is a popular remedy for pulmonary complaints, and is sometimes used in soups and jellies

CA'RAITES A sect among the Jews who adhere closely to the text and letter of the Scriptures, rejecting the rabbinical interpretations and the Cabbala

CA'RAMEL *See* CARAMEL

CA'RAPACE The upper shield or plate of the armour or shell of the tortoise and crab

CA'RBAMIDE A compound of carbonic oxide and amidogen, contained according to Regnault, in chlorocarbonate of ammonia its chemical formula is $CO\ NH_2$

CARBO'LIC ACID A substance obtained by the distillation of coal tar it crystallises in prismatic needles which fuse at 95° and boil at 270° it has a penetrating odour and burning taste, and in many respects resembles kreasote its specific gravity is 1 06 It appears to be identical with the substance called [illegible] Its formula is $C_{12} H_5 O, HO$

CARINTHINE In Mineralogy, a sub-species of *Augite* from Carinthia

CARMI'NIC ACID This, according to De la Rue, is the [illegible] of *cochineal* Its formula is [illegible] W[illegible] in powder it is of a brilliant crimson It [illegible] the substance described by Pelletier and [illegible] under the names *Coccinelline* and *Carmeine*

CAROLI'TIC COLUMNS Architecture Columns with foliated shafts

CA'ROTINE A deep red crystallisable substance contained in carrots

CARPO'LOGY (Gr καρπος *fruit*, and λογος, *discourse*) That branch of botany which treats of the structure of fruits

CARPUS In Anatomy the segment of the skeleton of the upper or fore [illegible] to the wrist it [illegible] bones in the human subject

CARTHAMINE The colouring matter of the *safflower*

CA'RYOPHY'LLINE (Gr καρυα, *a walnut tree*, and φυλλον, *a leaf*) A crystalline substance (called also *Clove camphor*) deposited by a strong alcoholic tincture of *Cloves* In composition it resembles common camphor $C_{10} H_8 O$

CA'SCALHO The name given to the alluvial deposit in which the diamond is found in Brazil

CASE HARDENING The superficial conversion of iron into steel

CA'SEINE *See* CASEUM

CASKET A small rope used to fasten the sail to the rope in furling

CASSEL YELLOW A compound of oxide and chloride of lead it is also known in commerce under the name of *patent yellow* and *Turner's yellow*

CA'STOR OIL The expressed oil of the seed of the *Ricinus communis*, or *Palma Christi* It is a mild aperient

CATALYSIS (Gr κατα, and λυω, *I dissolve*) That process in which a substance excites by its mere presence (and without itself undergoing change) some che[illegible]

CATECHU'IC ACID [illegible] of [illegible] which [illegible] Plain cutz contained in *Catechu*. Its formula is [illegible] It has also been termed *Catechine* and *Tanningenic acid*.

CAT SILVER A species of mica.

CAUDA EQUINA (Lat ) In Anatomy, the roots of the terminal spinal nerves which are contained in the neural canal of the vertebræ, and surround the "filum terminale" of the myelon

CAU'DATE (Lat cauda, *a tail* ) In *Anatomy*, when the apex of a pyramidal part or [illegible] a long slender point certain [illegible] in ganglia are termed especially "caudate" nerve-corpuscles. In *Zoology*, an animal provided with a tail

CAUK or CAWK The term applied by miners to massive sulphate of baryta or heavy spar

CAUSALITY A miner's term for the light parts of ore [illegible] by washing

CAUZ'ANITE A crystallised mineral found at Cauzeran in the Pyrenees, of a black or dark blue colour It is a silicate of lime and alumina, with potassa and soda

CAVA VENA *See* VENA CAVA

CA'VENDISH EXPERIMENT An important mechanical experiment for the purpose of ascertaining the mean density of the earth, the method employed being a comparison of the force of terrestrial attraction with that of the attraction of leaden masses of known magnitude and density, determined by means of the balance of torsion

The idea of rendering sensible and measuring the attractive force of a dense body upon another body in its immediate vicinity by means of the torsion balance, appears to have been suggested by the Rev John Michell, but the experiment was first actually made by the celebrated Henry Cavendish, whose report is published in the *Philosophical Transactions* for 1798 It was subsequently repeated by Reich, Professor of Physics at Freiberg in Saxony, who published his results in 1838, and again by the late Francis Baily with far greater precision, and by a far more varied and extensive series of observations, the details of which are given in a paper of great value published in the *Memoirs of the Royal Astronomical Society*, vol xiv 1843

In the mode of proceeding adopted by Cavendish, and followed by Baily, the data for determining the earth's mean density were obtained [illegible] — A slender deal rod of six feet in length, having a leaden ball of about two inches in diameter attached to each of its ends, is suspended horizontally from a beam by a fine metallic wire, about 40 inches in length This forms the torsion balance Immediately under the balance is placed a strong horizontal plank about 8 feet in length supported by and turning upon an axle the central line of which is in the same vertical with the suspension wire On this plank, near its extremities are placed two equal spheres of lead (12 inches in diameter, and each weighing about 3801bs ), cast with great care, in order that the density may be uniform throughout the mass, and accurately turned The apparatus is so arranged that the centres of the two balls at the extremities of the arm of the torsion balance, and the centres of the two leaden spheres, or *masses*, are in the same horizontal plane, and equally distant from the vertical axis of motion Suppose now the torsion balance to be at rest in a certain direction, and the plank which supports the masses to be at right angles to the direction of the balance, in this position the attraction of the two masses will have no tendency to give motion to the balance But let the beam be turned round till the two masses approach near to the balls, then the attraction of each mass, acting most powerfully on the nearest ball, tends to bring the masses and balls still closer together A motion is thus given to the arm of the torsion balance, and in consequence of the elasticity of the suspension wire the balance performs a series of isochronous oscillations, and ultimately comes to rest in a position in which the attraction of the two masses on the balls is exactly counterbalanced by the torsion of the wire

The force developed by the leaden masses being exceedingly minute, not more than a 50-millionth part of their weight, a very small disturbing force will prevent the success of the experiment, and accordingly many precautions are requisite In Baily's experiments the torsion rod was enclosed in a mahogany case, gilt in the inside, wrapt round with thick flannel, and covered over with gilt paper, to prevent the radiation of heat, and consequent derangement from the currents of air thereby produced The balls were also gilt and burnished and the whole apparatus was surrounded by a close wooden frame or case, having glazed openings, through which the motions of the torsion rod were observed by means of a telescope from a distant part of the room

In order to deduce the mean density of the earth from the data furnished by the experiments, it is necessary to find expressions for the torsion developed in the wire, and for the attractive force of the masses on the balls, in that position of the arm of the balance at which it comes to rest under the action of the two forces, which then counterbalance each other The theory is as follows

Let F denote the force (measured by the weight in grains) which, being [illegible] as the arm to pass through a unit of angular space, or describe an arc equal to the radius Also, let F′ denote the torsion actually developed by the attraction of the masses, $a$, the distance of the suspension wire from the centre of the ball, and $\theta$ the angle of deviation of the arm from its first position By the nature of the lever, the force required to produce a given effect is inversely as the distance of its point of application from the fulcrum, which is here the suspension wire, and according to the law determined by Coulomb, the force of torsion is directly proportional to the angle of torsion, therefore

$$F' = F\frac{\theta}{a}$$

The measure of this force F′ is deduced from the time in which the oscillations of the balance are performed The general formula (see TORSION, in *Dict* ) for the torsion force is,

$$F = \frac{\pi^2}{n^2} \times \text{moment of inertia},$$

where $\pi = 3\ 14159$, and $n$ is the number of seconds in the time of an oscillation In the present case the whole of the matter in each ball may be regarded as accumulated at its centre, and the matter in the rod may be neglected, hence in respect of each ball the moment of inertia is expressed by the mass ($m$) multiplied into the square of the distance of its centre ($a$) from the suspension wire, that is by $a^2 m$ consequently the inertia in respect of both balls is $2a^2m$, and the above formula becomes

$$F = \frac{2\pi^2}{n^2} a^2 m$$

Let $w$ denote the weight in grains of each ball, $g$ the accelerating force of gravity and $l$ the length of the seconds' pendulum, then $w = gm$, and $g = \pi^2 l$, whence by substitution $F = \frac{2a^2 w}{ln^2}$, and consequently, since $F' = F\frac{\theta}{a}$,

$$F' = \frac{2a w \theta}{ln^2}$$

Having obtained an expression for the torsion force, we have next to find the force of the attraction of the leaden masses In respect of each mass let $g'$ denote the force of attraction, $r$ the radius, $v$ the volume, and $d$ the density, and in respect of the earth (assumed to be a sphere) let the same elements be respectively denoted by $g$, R, V, and D, also, let $k$ denote the distance of the centre of the mass from the centre of the ball at the middle of the oscillation and assume $f$ to be the coefficient of gravity Now because the attraction of a sphere on a point without it is directly as its mass, that is, as its volume multiplied into its density, and inversely as the square of the distance of the attracted point from its centre, we have $g' = \frac{fvd}{k^2}$, and $g = \frac{f\mathrm{VD}}{\mathrm{R}^2}$, whence $\frac{g'}{g} = \frac{vd\mathrm{R}^2}{\mathrm{V}Dk^2}$ But $\frac{v}{\mathrm{V}} = \frac{r^3}{\mathrm{R}^3}$, therefore $\frac{g'}{g} = \frac{r^3 d}{\mathrm{R}Dk^2}$, consequently since the attraction of the earth upon the ball is the same thing as the weight of the ball, or $g = w$, we have $g' = \frac{r^3 dw}{\mathrm{R}Dk^2}$, and therefore

$$\text{attraction of both masses} = \frac{2r^3 dw}{\mathrm{R}Dk^2}$$

By the conditions of the problem this attraction is equal to, or balances the torsion force F′, therefore, putting the two expressions equal to each other, we have $\frac{a\theta}{ln^2} = \frac{r^3 d}{\mathrm{R}Dk^2}$, whence, finally,

$$\mathrm{D} = \frac{r^3 ld}{a\mathrm{R}k^2} \frac{n^2}{\theta}$$

In this expression for D, the mean density of the earth, all the quantities are supposed known excepting $n$ and $\theta$, and the object of the experiment is to determine their values The angle $\theta$ is determined by observing the number of divisions, on a known scale, passed over by an index or pointer attached to the extremity of the arm of the balance, so that if $\beta$ denote the value of one division of the scale in parts of an inch, $\lambda$ the distance in inches between the suspension wire and the extremity of the index, and $h$ the number of divisions passed over by the index when the arm of the balance moves from its position of rest *before* the mass is approximated to the ball, to its position of rest *after* the approximation, then $\theta = \frac{h\beta}{\lambda}$

Cavendish gives the numerical values of the constants which enter into the expression for D as follows $r = 6$, $l = 39\ 14$, $a = 36\ 65$, $k = 8\ 85$, R = 250800000, all in inches;

and $d$ (the density of the leaden mass as compared with water)=10·64. He also had $\beta=\frac{1}{20}$, $\lambda=38\ 8$, whence $\theta=1\div766$, and the substitution of these numbers in the formula gives $D=\frac{n^2}{10683\delta}$ There are, however, several corrections to be made, on account of the attraction of the matter in the plank and mahogany case, and other parts of the apparatus as also for the inertia of the arm of the balance and for the variation of the masses on the balls according to the position of the arm, for the details of which we must refer to the memoir of Baily already cited It may be noticed that the motion of the arm is very slow, the average time of a complete vibration in Cavendish's experiments having been from six to seven minutes

The result obtained by Cavendish gave the mean density of the earth, as deduced from 17 sets of experiments, equal to 5 45, that of [illegible] Reich, from 57 experiments, found [illegible] Baily's experiments were far more numerous and varied than those of his two predecessors The torsion rod was suspended in different ways by a single copper wire, as had been practised by Cavendish and Reich, and by double lines, as proposed by Gauss, and in the latter case the substances used were silk fibres, brass wire and iron wire In order to ascertain whether the results would be affected in any way by varying the substance of the attracted body, the experiment was made not only with leaden balls attached to the ends of the torsion balance, but also with balls of platina, zinc glass, ivory, and hollow brass, and with a torsion rod of brass without balls The actual number of experiments recorded in the memoir is no fewer than 2153, and nearly as many more, which had been made before the anomalies of the balance had been entirely got rid of, were rejected The mean result from all the recorded experiments, without exception, gave the mean density of the earth equal to 5 675 with a probable error of 0038

CE'LANDINE, the poisonous irritant principle of the *Chelidonium majus*

CE'LESTINE (Lat cœlum) The blue variety of sulphate of strontia

CELL In Anatomy a primary microscopic vesicle, of larger average size than the nucleus, composed of membranous cell-walls, with usually liquid contents, round or oval, and sometimes flattened like a scale With a few exceptions —*e g* the mammalian blood discs and old cells of the epidermal or adipose systems — the primary cell contains a nucleus

CENTRAL SUN In sidereal astronomy, the name given to the body about which the sun, and all the stars in the great cluster or nebula to which the sun belongs, is assumed to be revolving M Madler of Dorpat has recently published a paper under this title in which he attempts to assign the real motions of the stars and consequently the position of the central point, in reference to a dynamical theory He thinks there is no reason for supposing that there exists anywhere a star of such magnitude as to dominate the motions of others as the sun does the motions of the planets, but if we suppose the stars of our stellar cluster to be pretty uniformly distributed, and the form of the limit of the cluster to be nearly spherical, or a surface compressed between two planes as is supposed to be the case of the milky way, then, whatever the law of attraction may be the stars near the centre will move with much smaller linear velocity than the distant one, and this difference of real velocity will give rise to apparent motions by comparison of which the relative distances from the centre may be assigned Applying the considerations to the apparent motions actually observed, and assuming the direction of the sun's motion in the heavens to be that which has been determined by Argelander and others Madler shows that a point somewhere in the group of the Pleiades and probably not far from the star $\eta$ *Tauri*, possesses the characteristics of the central point Having thus obtained, approximately, the position of the central body, Madler proceeds to discuss its probable distance from our sun, and the velocity of the sun's orbital motion about the centre Assuming the star 61 *Cygni* to be at the same distance from the central body as the sun is, and the distance of 61 *Cygni* from the sun to be known from the parallax found by Bessel, he finds from these assumptions, and from the observed proper motions of 61 *Cygni* and $\eta$ *Tauri*, that the parallax of $\eta$ *Tauri* is 0″·0061, or that its distance is thirty four millions of times as great as the distance of the earth from the sun The proper motion of $\eta$ *Tauri* gives for the periodic time of our sun round the centre is 2[illegible] years, and the velocity of our sun in its orbit round the central sun is about thirty English miles in a second of time (*Monthly Notices of the Royal Astronomical Society*, vol vii No 12. February, 1847)

CERAUNIA (Gr κεραυνος, *lightning*) Thunderstones of the old mineralogists.

CEREBRIC ACID (Lat cerebrum, *the brain*) A fatty acid, containing nitrogen and phosphorus, forming one of the compounds of brain

CERINE (Lat cera, *wax*) A name given by some chemists to that portion of bees' wax which is soluble in boiling alcohol the insoluble portion has been termed Myricine

CEROSINE (Lat. cera, *wax*) A waxy substance which exudes from the sugar-cane

CERVID[illegible] See DEER, in DICT

CHALCOLITE (Gr χαλκος, *copper*, and λιθος, *a stone*) A green crystalline mineral found in several of the Cornish mines, and supposed to contain copper, till it was shown by R Phillips to be a *hydrated phosphate of uranium*

CHAILLITE A mineral found in the Donegore mountains in the county of Antrim It is a hydrated silicate of alumina, lime, and oxide of iron its name is derived from its *flint* appearance—χαλιξ *a flint*

CHAMOISITE A mineral from Chamoison in the Valais, it is of a dark greenish grey colour, and appears to be a hydrated silicate of protoxide of iron

CHARTISTS the name assumed by a certain political party in England, composed chiefly of the working classes, who have embodied their principles in a document called the "People's Charter," the leading points of which are universal suffrage vote by ballot annual parliaments [illegible] abolition of property payment of members of parliament

CHARYBDIS See SCYLLA, in DICT

CHA'SCHISCH The term applied by the Indians to the inspissated juice of the Cannabis sativa, or Indian hemp it has been used as a substitute for opium It is also known under the name of *Churrus* It is a powerful narcotic poison

CHE'LMSFORDITE A crystallised greyish white mineral composed of silicate of alumina and silicate of lime It appears to have the same composition as Meionite and Scapolite

CHEILOGNATHA (Gr χειλος, *a lip*, γναθος, *a jaw*) An order of myriapods or centipedes, of which the lower lip is formed by the tongue and two mandibles

CHEILOPODA (Gr χειλος, and πους, *a foot*) A family of myriapods, in which a pair of feet form the lower lip

CHLOROPHYLLA The poisonous principle of the *Chærophyllum silvestre*, or Wild chervil

CHIASTOLITE Hollow-spar A mineral found imbedded in clay-slate it occurs in the slate of Cumberland, and of Antrim in Ireland in rhomboidal prisms, exteriorly greyish-white, and interiorly black. Some of the sections of the crystals have the form of an X, hence the term from χιαζω to mark with that letter

CHINA INK A finely divided carbon, probably lamp-black of some kind, mixed with gelatine, and formed into cakes or sticks It is sometimes stated to be the desiccated ink of the cuttle-fish

CHINOLEINE, or CHINOLINE An oily liquid obtained by distilling quinine with caustic potassa

CHINONE A substance obtained by distilling certain salts containing kinic (cinchonic) acid, as for instance the kinate of lime, with oxide of manganese and sulphuric acid Chinone sublimes in the form of golden-coloured crystals, soluble in water, very volatile, and of a very peculiar and distinctive odour Their formula is said to be $C_{25}\ H_8\ O_8$

CHITINE [illegible] The hard insoluble [illegible] tra of insects

CHLORACETIC [illegible] e acid obtained by the action of the solar rays upon a mixture of chlorine with the vapour of acetic acid Its formula is $C_4\ Cl_3\ O_3$, $H\ O$, in it, therefore, the hydrogen of the acetic acid is replaced by chlorine

CHLORHYDRIC ACID *See* HYDROCHLORIC

CHLO'RIC ACID A compound of 1 atom of chlorine with 5 of oxygen, represented therefore by the formula $Cl\ O_5$ Its most important salt is the chlorate of potassa, formerly called oxymuriate of potash

CHLOROFORM (Gr χλωρος, *pale*, and Lat. formica, *an ant*) A compound represented by the formula $C_2\ H\ Cl_3$, and obtained by distilling a mixture of chloride of lime with diluted alcohol It is a heavy liquid, its sp gr being 1 48, it boils at 140° Its name has reference to the constitution of *formic acid*, which is represented by $C_2\ H\ O_3$, and is therefore the teroxide [illegible] $C_2\ H$ [illegible] which the term *formyle* [illegible] reference to this view of [illegible] has also been denominated [illegible] When the vapour of pure chloroform is respired it soon induces insensibility, in the same way as other vapour, and hence has been similarly used, in [illegible] and in child-birth [illegible] quisite in its administration

CHLOROPAL A mineral of a greenish yellow colour, associated with the opal of Hungary. It is a hydrated silicate of iron

**CHLO'ROUS POLE.** The voltaic pole or electrode at which chlorine is evolved in cases of the electrolysis of chloric compounds

**CHOLE'IC and CHOLIC ACID** Choleic acid is a fatty acid, which, in combination with soda, constitutes a principal ingredient in *bile* By the protracted action of caustic potass it evolves ammonia, and is converted into *Cholic acid* The elements of choleic acid are carbon, hydrogen oxygen nitrogen and sulphur, the following being its formula ($C_{52}H_{40}O_9NS$

**CHON'DRINE** (Gr. *χονδρος, cartilage*) That form of gelatine which is obtained from cartilage, and which differs from ordinary gelatine in being precipitable by acetic and the mineral acids and by sulphate of alumina and potash persulphate of iron and acetate of lead

**CHONDRODITE** (Gr *χονδρος a grain*) A mineral found in Finland and also in N America It is yellow, and of a vitreous fracture [illegible]

**CHO'RDA DORSALIS** See NOTOCHORD

**CHO'RDA TYMPANI** (Lat) A branch of the facial nerve or portio dura, which crosses the tympanum, and supplies the lingualis and some other muscular fibres of the tongue

**CHOR'DÆ VOCA'LES** (Lat) In Anatomy are the ligaments which extend from the thyroid to the arytenoid cartilages, and bound the glottis. They contain much elastic tissue, and can be made to vibrate under various degrees of tension by the action of the muscles upon the cartilaginous parts of the larynx to which they are attached [illegible] voice

**CHR[illegible]** (Gr. *χρονος, time, γραφω, I describe*) The name given by the late Professor Wallace, of Edinburgh, to an instrument contrived by him for the mechanical solution of this geodetical problem, viz "Having given the position of a station, having given the angles made by lines drawn from it to three other stations in the same plane, whose positions are known" The problem, which is important by reason of its frequent application in maritime surveying, was reduced by Professor Wallace to another very simple one, viz "To construct two similar triangles on two given straight lines, having given their angles" The triangles may be constructed by any of the ordinary methods, but inasmuch as they are similar, the construction is much facilitated in practice by means of the *chorograph*, a particular kind of protractor, having two moveable indices or arms "The circle from which the two arms project is of brass, and is divided into 180 equal parts each serving as the measure of an angle of two degrees at the centre, or one at the circumference Each of the equal parts is subdivided into half degrees

[By means of a vernier the degrees are subdivided into single minutes] The graduations on the scale are numbered quite round from 0 to 180° both ways One of the three arms has a fixed position on the circle, and is placed against zero and 180°, the others turn on a common centre There is a steel pin terminating in a point at the extremity of each arm, at equal distances from its centre and perpendicular to its plane By the graduated circle the moveable arms may be placed in such positions that lines joining the steel points at the extremities of the arms may form a triangle similar to any given triangle" (*Geometrical Theorems and Analytical Formulæ, &c* By W Wallace, L L D Edinburgh 1870)

**CHROMA'TIC THERMOMETER** When the edge of a rectangular plate of glass is applied to a piece of heated metal, or other substance having a temperature different from that of the glass, and exposed to a beam of polarized light coloured fringes are developed, and as the particular tints depend on the difference between the temperature of the glass (which is supposed to be [illegible] and that of the substance to which it is applied, the colour of the central fringe affords a means of inferring the temperature of the substance Hence the term *Chromatic Thermometer* The phenomena in question were discovered and first studied by Sir David Brewster

**CHROME-ALUM** The potassa-sulphate of chromium, a salt isomorphous with alum, in which alumina is replaced by oxide of chromium

**CHROME YELLOW** The [illegible] colour

**CHROMULE** (Gr *χρωμα* [illegible] colour and *ειδος* form) [illegible] more commonly and [illegible]

**CHRYSAMMIC ACID** (Gr *χρυσος, gold, αμμος, sand*) A substance in the form of a brilliant golden-coloured powder, obtained by the action of nitric acid on aloes

**CHRY'SENE** (Gr *χρυσος, gold*) One of the numerous products of the destructive distillation of woods

**CHRYSOLE'PIC ACID** (Gr *χρυσος* and *λεπις, a scale*) A peculiar acid formed along with chrysammic acid by digesting aloes in nitric acid

**CHUCK** In Mechanics the name given to that part of the turning-machine by which the *work* is connected with the lathe. There are various kinds of chucks, as the *screw*-chuck, the hollow-chuck, the drill-chuck, &c, for ordinary turning; the excentric chuck, the geometric chuck [illegible]

**CHYLE-CORPUSCLES** [illegible] of a subspherical form, greyish-white colour, about $\frac{1}{2500}$ of an inch in diameter: often tuberculated on their surfaces When found in the blood they are called "[illegible]"

[illegible] *See* CHEMISTRY Those who derive the word from *χυω, I melt* or *dissolve*, adopt the former mode of spelling

**CINCHONIC ACID, or *Kinic Acid*** An acid found in combination with the alkaloids in the varieties of Peruvian Bark, or *Cinchona* it is crystallisable, and represented by the formula $C_{14}H_{11}O_{11}, HO$

**CINNAMIC ACID** When the essential oil of cinnamon is exposed to air, it gradually absorbs oxygen and deposits crystals of cinnamic acid $= C_{18}H_7O_3 HO$ It much resembles *benzoic acid*, into which it is converted when mixed with bichromate of potassa and sulphuric acid This acid is found, together with benzoic acid, in Peruvian and in Tolu balsam, from the latter of which it is readily obtained

**CINNAMYLE** The supposed *radical* of oil of cinnamon and of cinnamic acid, and of which oil of cinnamon is the *hydruret* The formula of Cinnamyle is $C_{18}H_7O_2$, and that of oil of cinnamon, $C_{18}H_7O_2 + H$

**CIRCINNUS** The Compasses — a constellation of four stars near the South Pole

**CIRCULATION OF THE BLOOD** *See* BLOOD.

**CIRROCU'MULUS** The *sonder cloud* (Lat cirrus, *a curled lock of hair*, and cumulus, *a heap*) A cloud intermediate between the Cirrus and Cumulus *See* CLOUD

**CIRRO'STRATUS** (Lat cirrus and stratus, *a bed* or *covering*) The *wane cloud*, intermediate between the Cirrus and Stratus The *mackereled sky* of a summer evening, which [illegible] is a modification of this [illegible]

**CIRRUS** The *curl cloud* or *mare's-tail*

**CITRACO'NIC ACID** One of the acids resulting from the action of heat on citric and on itaconic acid

**CITRI'BIC ACID, CITRICIC ACID CITRIDIC ACID** Acids derived from the *Citric acid* and identical with the *Citraconic, Itaconic*, and *Aconitic* acids

**CI'TRINE OINTMENT** An ointment containing nitrate of mercury, it has a lemon yellow colour The [illegible] *citratis* of the Pharmacopœia

**CLEAVAGE** In Mineralogy the direction in which the structure of a crystal enables it to be split the resulting [illegible] *cleavage planes*

**CLEVELANDITE** A variety of soda-spar it has also been called *Albite*

**CLEDGE** A miner's term, applied to thin strata of clay or fuller's earth

**CLEPSAMMIA** (Gr *κλεπτω, I hide*, and *αμμος, sand*) An antient instrument for measuring time by the running of sand like the modern hour glass

**CLEW LINES CLEW GARNETS** Tackle by which the sails of a ship are trussed up to the yard

**CLICHY WHITE** A pure carbonate of lead, or white-lead, manufactured at Clichy in France

**CLOT** [illegible] coagulum of blood

**CLUTCHES or GLANDS** In machinery couplings which have no coupling boxes are denominated *clutches*, or *glands* A coupling of this kind consists of two crosses, one fixed to the end of each of the shafts to be connected One of the crosses, having its end bent forward lays hold of, or *clutches* the other, and by doing so turns round the other shaft Instead of cross pieces two round cast-iron plates are sometimes used, each having a part cut out, and a corresponding projection. The projection of the one plate is inserted in the opening of the other, and thus serves to engage the shafts (*Buchanan on Mill Work*)

**COAGULUM** (Lat) The part of the blood which changes from the fluid to the solid state, when drawn from the body and left at rest, or subjected to heat or certain chemical reagents It consists of the fibrine with the blood discs

**COAGULABLE LYMPH** A term given in some surgical works to the fibrine of the blood, which is the only part that has the power of spontaneously coagulating.

**COCHLEA** (Lat. *shell*) In Anatomy a portion of the internal ear, which in mammals is shaped like the common snail-shell, with its base resting on the bottom of the internal meatus, and perforated to receive some [illegible] nerve It [illegible] called modiolus [illegible] canal" makes two turns and a half It [illegible] divided into two ramps or "scalæ" by a partition of bone called the "lamina spiralis" At the base of the cochlea one scala communicates with the vestibule, the other with the tympanum, they communicate with each other at the apex of the cochlea.

COCI'NIC ACID When the solid fatty matter of cocoa-nut oil is saponified, the crystalline fatty acid into which it is converted has been called *cocinic* or *cocostearic* acid

COCOA The fruit of the *Theobroma Cacao*, which is about the size of a kidney-bean, and inclosed in a thin shell

COD LIVER OIL This oil expressed from the liver of the cod-fish, has lately acquired much reputation for its remedial powers It has been used in the dose of a table-spoonful three or four times a day in pulmonary phthisis, in various scrofulous affections, rheumatism, and in some obstinate [illegible] supposed to contain iodine or bromine, to which its efficacy has been ascribed but, on the other hand, it is asserted that it cures those forms of scrofula and other diseases which do not yield to the usual forms of iodine

COGS In mill work the term *cogs* is given to the teeth of wheels when they are not of the same piece with the body of the wheel, but are each of a particular piece

COIN WEIGHING MACHINE A machine for this purpose was constructed by Mr Napier for the Bank of England in 1844 and has since been more extensively applied at the Mint

It consists of a square brass box, on the top of which is placed a hopper to hold the sovereigns to be weighed, and in front of it are two small apertures fitted with receivers, one for the sovereigns of full weight, and the other for light sovereigns The balance for weighing the sovereigns is placed inside the box near the upper plate vibrating upon a knife edge, and receiving the [illegible] beam [illegible] by means of a small pendulum on which, at about an inch below the platform, there is an oblong perforation, about half an inch in length, technically called a *slot*, in which a small ivory rod works freely up and down, without touching the sides

Between the slot and the platform a pair of forceps is placed From a knife-edge at the other end of the beam a small round polished plate is suspended, to which a pendulum is fixed, and at its lower part the scale is placed to receive the weight Above the small round plate, under the top of the box, is fixed an agate with a blunt point When the machine is in motion the small ivory rod is depressed, this, on touching the bottom of the slot, or opening in the pendulum in which it works, brings down the beam on that side, and raises it of course on the other, the weight side, until the small round plate on that side touches the agate point The beam is then in a horizontal position As soon as this is effected the forceps catch hold of the pendulum between the platform and the slot, and hold it firmly The balance is then in a condition to receive the sovereign, which is shifted from the bottom of the pile in the hopper, and brought by means of a slide along a channel, just large enough for a sovereign of the proper standard gold to pass, but not large enough to admit a counterfeit, and deposited upon the platform The forceps then let go their hold, the ivory rod is gently raised and, if the sovereign happens to be light that end of the beam rises, and the other end leaves the agate point, but if the sovereign be of full weight, the beam remains stationary, and the small plate on the weight end is in contact with the agate point

When the sovereign is weig[illegible] removal is very ingenious, and [illegible] are placed at right angles to each other, and on each side of the platform or scale there is a part cut away to admit of the bolts striking so far into the area of the platform as to remove anything that would nearly fill it These bolts are made to strike at different elevations the lower one striking (as to time) a little before the other If the sovereign be of full weight the scale rises down and the lower bolt knocks [illegible] light box If the sovereign [illegible] and the first bolt strikes [illegible] higher bolt then strikes and knocks it off into the light box [illegible] in one [illegible] adjusted to within the ten-thousandth part of a grain

COLCHI'CIA An alkaloid obtained from, and probably constituting the active principle of the *Colchicum autumnale* [illegible]

COLD BLOODED [illegible] so called which have a temperature [illegible] above the freezing point [illegible] which follow the [illegible] through their [illegible] vertebrata animals and fishes and reptiles, amongst vertebrates, are "cold-blooded" in this sense

COLISEUM *See* AMPHITHEATRE.

COLLA'TERAL CIRCULATION In Physiology, the passage of the blood from one part to another of the same system of vessels by collateral communicating channels: it is much more frequent in the veins than in the arteries

COLLO'DION (Gr κολλα, *glue*) A term applied, in consequence of its adhesive properties, to a solution [illegible]

[illegible] Gr κολοβοω, *I contract*) The adhesion of the eyelids Congenital fissures of the upper eyelid

COLOGNE EARTH A deep brown pigment, or species of umber It is supposed to be of vegetable origin

COLUMN In Anatomy, the term is applied to longitudinal portions or tracts of the myelon, of which there are three in each lateral moiety, called from their situation in the upright posture of man, "anterior," "middle," and "posterior," columns.

COLU'MNÆ CARNEÆ (Lat) In Anatomy, the fleshy prominences from the inner surface of the ventricles of the heart Some are conical, with free apices giving attachment to the threads "chordæ tendineæ" attached to the valves, others extend from one part of the walls of the ventricle to another, and are sometimes called "trabeculæ"

COMBU'STION-HEAT A term given by Liebig to the animal heat generated by the union of the oxygen absorbed into the blood from the atmosphere with the carbon and hydrogen it takes [illegible] as food

COMBUSTION, SPONTANEOUS [illegible] in DICT

COME'NIC ACID When a solution of *meconic* acid in water, or in dilute sulphuric acid, is long boiled, or when dry meconic acid is heated to 400°, it is converted into a modified bibasic acid, water and carbonic acid being at the same time evolved The formula of comenic acid is $C_{12}\ H_2\ O_8 + 2\ H\ O$

COMMUNISM *See* RIGHT OF PROPERTY and SAINT SIMONIANS in DICT

COMPASS OF THE VOICE In Physiology is the number of notes of [illegible] in the voice of a singer [illegible] three octaves

COMPENSATION PENDULUM *See* PENDULUM

COMPOST [illegible] called COMPO *See* CEMENT

COMPLEMENTARY COLOURS In Optics, two colours are said to be complementary to each other which are such that the blending together of the two [illegible] the prism into rays of seven primary colours if, therefore, the rays of one colour be intercepted, the composition of the remainder will give the complementary colour Or adopting the simpler supposition of Mayer, that all colours are produced by the mixture of three [illegible] — in certain proportions [illegible] rays in a beam of white light, the remaining yellow and blue rays will give the colour arising from the mixture of yellow and blue, namely green, so that red and green are complementary colours In like manner as a mixture of red and yellow gives orange, and a mixture of red and blue gives violet, orange is the colour complementary to blue, and violet to yellow *See* CHROMATICS in DICT

CONDUCTION OF IMPRESSIONS In Physiology, is the propagation of that state or action of a nerve fibre, which is produced by the application of a stimulus, through the whole length of the fibre, it takes place with immeasurable rapidity in the same way as electricity [illegible] a wire

CONSE[illegible] In Physiology, when one motion gives rise to the production of other motions contrary to or independent of the will, they are so called as e g the contraction of the iris when the eye is voluntarily directed inwards

CONTRACTILITY In Physiology, is the power which certain tissues have, during life of shortening themselves in a peculiar manner it is usually observed in muscular and some kinds of fibro cellular tissue, but is also exercised by series of cells, as in the *Hydra* polype

CONVOLUTIONS (Lat) In Anatomy, the winding [illegible] superficial layer of the brain, and also [illegible] of the intestinal tube

COPYRIGHT, INTERNATIONAL A literary treaty of vital importance to the interests of authors, translators [illegible] engravers, was agreed [illegible] and in 1851 The French enactment contains fourteen separate articles, and by the fourteenth it is stipulated that, after its legislative sanction by the British parliament, a day shall be fixed on which the following important privileges shall be granted to all works published subsequent to its date The authors of literature or of art of either nation are to exercise the same rights with respect [illegible] the country in which they were [illegible] as are granted to authors of similar works when first produced in that country Authors of either nation will be entitled in both coun-

tries to the protection of the laws which are or may hereafter be in force in England or France for the suppression of piracy Translators, under certain conditions, are to enjoy the same privileges as original authors Nevertheless it is only in the case in which an author chooses to reserve to himself the exclusive right of translating his own original work that the law prohibits independent translations of the same work To reserve to himself this exclusive right of translation for five years in either country, the author must have registered and deposited his original work within three months from the day of its publication in the other country; he must have declared in the title-page his intention of reserving this right; the translation must appear in part at least within three years from the date of the deposit, and when eventually published in either country must be legally registered.

These stipulations apply also to all species of original dramatic works and musical compositions Nevertheless, the prohibitions against translations are not intended to apply to imitations or adaptations of works suitable to the theatres of either country All pirated works, whether printed in France, England, or elsewhere, are to be considered as contraband, to be seized and destroyed, and the persons introducing or selling them to be liable to prosecution The question of piracy is in all cases to be determined by the legal courts of the country in which the act has been committed The treaty, which is only to be applicable to works which shall be published after the day upon which it shall come into operation is to remain in force for ten years from that day, and to continue to exist until a year's notice of cessation shall have been given

CO'RIUM (Lat ) In Anatomy, is the basis of the skin, or "true skin," and consists of a vascular and fibro-cellular tissue, of interlaced dense, but elastic, filaments It rests on the subcutaneous cellular tissue, and is covered by [illegible]

CORPUS [illegible] In Anatomy, the great commissure, or band of transverse fibres, connecting the hemispheres of the cerebrum

CORPUS LUTEUM (Lat ) In Anatomy, a yellowish mass which is formed in a Graafian vesicle subsequent to the escape of an ovum It is largest, most conspicuous and [illegible] ovum in the human subject

COU'PLING In Machinery, this term is applied to any contrivance for connecting or disconnecting the different parts of a machine, and particularly for effecting the [illegible] *Hook's Joint* (Dict of Science, [illegible] contrivances of this kind (See Buchanan's *Essays on Mill Work, &c., with Additions*, by Tredgold and Rennie )

COU'NTERPOISE In Mechanics a mass of metal connected with an instrument for the purpose of giving [illegible] on some particular point, as, for example, the pressure of the pivots of a transit-instrument on its supports

CRAB A machine for raising weights, consisting of a horizontal barrel, usually turned by a winch handle, and having a rope wound round it, which, when the weight is to be raised to a greater height than the machine, passes over a pulley fixed on the scaffolding *See* Windlass

CRE'ATINE *See* Kreatine

CRE'NIC ACID, or KRENIC ACID. (Gr κρηνη *a fountain* ) A term applied by Berzelius to a species of extractive matter occurring in spring-water

CRISPITE [illegible] name of the *titanite*

CROCO'NIC A[illegible] (Gr κροκος *saffron* ) A yellow substance resulting from the action of potassium on carbonic oxide It is [illegible] astringent taste Its composition is $C_4O_3$

CRO'NSTEDITE A [illegible] Pritzbram in Bohemia It was originally [illegible] as a species of tourmaline

CROSS COURSES A [illegible] of Cornwall to veins of stony matter running North and South

CROWN GLASS. The glass usually employed for windows it differs from *flint glass* in containing no oxide of lead

CRUOR (Lat ) In Anatomy, the substance contained in the red discs or corpuscles of the blood

CRURA (Lat *crus* the leg ) In Anatomy, are the bundles of nervous fibres which expand into the hemispheres of the cerebrum (crura cerebri), or of the cerebellum (crura cerebelli)

CUBE ORE A hydrated arseniate of iron, crystallising in [illegible]

CUBE SPAR A synonym of the *anhydrite* or anhydrous sulphate of lime

CUBIZITE, A mineralogical synonym of the *cubic zeolite* or *analcime*

CURVOGRAPH *See* Arcograph.



CYCADEOI'DEA A name given by Buckland to a genus of fossil dicotyledonous plants: the genus *Mantellia* of Brongniart

CYCADITES. A genus of dicotyledonous fossil plants

CYCLOGRAPH. *See* Arcograph.

CY'PRINE A variety of the green garnet, or *grossularia*

CYSTINE. A term applied by some chemists to the *cystic oxide*, a constituent of certain urinary calculi.

CY'TISINE A purgative bitter principle, extracted from [illegible] *alpinus*

CYTOBLAST (Gr κυτος, *a hollow vessel*, βλαστος, *a sprout or germ* ) In Physiology, the nucleus cellule, or centre of assimilative force, from which the organic cell is developed

CY'TOBLASTE'MA. (See above ) The structureless substance in which the elementary nuclei, cellules, or cytoblasts, are imbedded.

## D.

DA'NAIDE. In *Hydronamics*, a machine put in motion by the power obtained from a fall of water applied in a particular manner A cylindrical trough of tin-plate is fixed to a vertical axis of iron, which passes through the middle of a hole in the bottom of the cylinder, the diameter of the hole being somewhat greater than that of the axis, so as to allow the water to escape A drum of tin-plate, close above and below, is also fixed upon the axis, and placed within the trough, its diameter being so much less than that of the trough that a clear cylindrical space of about an inch and a half in thickness is left between the outer circumference of the drum and the inner circumference of the trough, and the bottom of the drum is also about an inch and a half from the bottom of the trough This space between the two bottoms is divided into compartments, by diaphragms radiating from the axis to the circumference of the drum Into the space between the two cylinders water is made to fall from a reservoir above, through one or more pipes, the ends of which are bent into a horizontal direction so that the water escapes in the direction of a tangent to a horizontal section of the cylinders, and, impinging on the interior surface of the [illegible] the water between the cylinders thus acquires a centrifugal force, in consequence of which it presses against the interior surface of the trough and the diaphragms on the bottom, while, on the other hand, the action of gravity constantly tends to make it run out at the hole in the bottom [illegible] power is measured by the weight of water escaping from the supply pipes multiplied into the height of the reservoir, and the useful effect by the same product diminished by half the force which the water retains when it issues from the hole in the bottom of the cylinder (*Encyc Brit* art *Hydrodynamics* )

DA'TISCINE A name given by Braconnot to a substance having the appearance of grape sugar, which he extracted from the *Datisca Cannabina*

DAUBRE'E A variety of Tourmalin

DA'VIDSONITE A mineral discovered by Dr Davidson in the granite quarry of Rubislaw, near Aberdeen it is a *Silicate of Alumina*

DECIDUA (Lat ) In Anatomy, a product or an alteration of the mucous membrane of the uterus, preparatory to the reception of the impregnated ovum, which is discharged at parturition. When the ovum enters the womb it becomes imbedded in the decidua, which yields and is protruded inwards, and becoming more and more inverted as the ovum grows, it is called the "decidua reflexa," while the other part of the membrane [illegible] "decidua vera"

DECLINOMETER An apparatus for measuring the declination of the magnetic needle, or the force of terrestrial magnetism in the plane of the horizon *See* Magnetometer

DEGREES OF LATITUDE AND LONGITUDE The most important operation executed of late years in connexion with the measurement of terrestrial degrees, of which the results have been published is the prolongation of the great meridional arc of India described by Colonel Everest in his Account of the Measurement of two Sections of the Meridional Arc of India bounded by the parallels 18° 3′ 15″, 24° 7′ 11″, and 29° 30′ 48″, published in 1847 Of these two sections the southern one, extending from Damargida to Kalianpur, had been previously measured, and the results referred to under the article Dronke (Dict of Science), but [illegible] the state of the instruments the result was [illegible] as altogether satisfactory; a [illegible] new [illegible] apparatus and [illegible] scription had been provided for the purpose of extend-

ing the arc to the northward, the Directors of the East India Company sanctioned the repetition of the whole operation The northern section, from Kalianpur to Kaliana, embraces an arc of rather more than 5° 23′ Adding both sections to the arcs formerly measured by Colonel Lambton, the result is the "Great Meridional Arc of India" extending from Punnæ, near Cape Comorin (lat 8° 9′ 31″) to Kaliana, near the base of the Himalayas (lat 29° 30′ [illegible] 31″·7 of the meridian—the [illegible] been measured on the surface of the earth

Colonel Everest's measurement was executed with extraordinary care, and with instruments sufficient to ensure the utmost attainable accuracy Three base lines, each exceeding seven miles in length, were measured with a compensating apparatus similar to that invented and used by General Colby for the measurement of the base of the trigonometrical survey of Ireland The terrestrial angles were observed with theodolites of three feet in diameter, and the two celestial arcs were determined by observations of stars made simultaneously at both extremities of each arc with altitude and azimuth circles, having vertical circles also of three feet in diameter The final results were as follows the amplitude of the arc corresponding to the northern [illegible] Kalianpur was found by the mean of all the observations to be 5° 23′ 37″·051, and that of the southern, Kalianpur to Damargida, 6° 3′ 59″·973 The terrestrial distances on the meridian, computed from the mean of the two bases (near the extremities of each section) and reduced to the level of the sea, were 1961157·117 feet, and 2202926·196 feet respectively Hence the length of the meridional degree, as found from the northern section, is 363606 feet, or 68·865 miles, at the middle latitude 26° 49′ and as found from the southern section is 363187 feet or 68·785 miles at the mean latitude 21° 5′ The comparison of the two arcs, without reference to other measures gives an ellipticity to the terrestrial spheroid of 1—192 considerably greater than the ellipticity deduced from the results (properly combined) of all the principal operations of the same kind executed in different countries namely 1—300, and consequently indicating some irregularity either in the curvature of the earth at that locality or in the density of the superficial strata, giving rise to local attraction at the terminal stations

The long-protracted operations connected with the trigonometrical survey of the British Islands are now it is understood, approaching completion, and one of the results will be the prolongation of the arc of meridian which was measured about the beginning of the century between Dunnose in the Isle of Wight and Burleigh Moor in Yorkshire, to Balta in Shetland, the amplitude or difference of latitude of the extreme stations being 10° 7′ 55″·28 The astronomical observations made at the extreme and several intermediate stations were published in 1842, and as the principal triangles of the southern sections have been observed anew, and the distances have been computed from the base measured in Ireland the result will be entirely independent of the previous work A base of verification was measured on Salisbury Plain in the summer of 1849, and it is understood that the calculations are now completed and ready for publication

Degrees of the meridian have now been measured under so many latitudes in the northern hemisphere that it is not probable the general elements of the terrestrial spheroid as already determined, will be much disturbed by any future operations The distance between the parallels of Kaliana Col Everest's northern station, and Formentera, the southern extremity of the French arc, is only about nine degrees, and with the exception of this interval and another of about five and a half degrees between the parallels of the northern extremity of the Russian arc and the southern extremity of the Swedish, the whole distance (though in different meridians) has been measured between the parallels of Punnæ (lat 8° 9′ 31″) and Pahtavara (lat 67° 8′ 49″) being nearly two-thirds of the distance from the Equator to the Pole In the southern hemisphere an arc of about four degrees has been recently measured by Mr Maclear, near the Cape of Good Hope, the details of which have not yet been published, but the operation is of peculiar interest on account of the anomalous result obtained by Lacaille in the same locality about the middle of the last century, which led to the inference that the two hemispheres are dissimilar Mr Maclear has, however, made it known that the anomaly in Lacaille's result was caused by local attraction, and that the extended measure proves the length of the meridional degree at the Cape to be the same as in the northern hemisphere under the corresponding latitude

[illegible] two [illegible] of [illegible] by means of pocket chronometers carried forwards and backwards repeatedly between the two places (or rather between Greenwich and Kingston and Valentia, the operations being subdivided into distinct parts), under the superintendence of the Astronomer Royal The number of chronometers employed was [illegible] The difference of apparent time was ascertained probably with greater certainty than could be done by the method of fire signals hitherto chiefly relied on for this purpose, but scarcely available for so long an arc The geodetical distance on the parallel of latitude being computed from data furnished by the trigonometrical survey and assumed elements of the earth's figure, and the result converted into time, it was found that the difference between the computed arc and the chronometrical arc amounted only to a small fraction of a second The inference from this agreement is, that the assumed elements of the spheroid represent the curvature of the earth at this locality so accurately as to require no correction As a definite result they give the length of 1″ in the arc perpendicular to the meridian in latitude 51° 40′ equal to 101·6499 feet

The conveyance of local time from one place to another, by means of chronometers, has also been adopted for determining the differences of longitude between Greenwich and some of the principal observatories on the continent A still better means is now becoming available, in the use of the electric telegraph, which has already been applied to this purpose in America, and by which instantaneous signals may be transmitted to any distance, however remote The preparations are nearly completed for connecting Greenwich immediately with all the great continental observatories, by means of wires communicating with the terminus of the Dover railway

The following elements of the spheroid of rotation, deduced by Bessel from the principal measures of meridional arcs, may be considered as representing, with the most probable accuracy, the present state of our knowledge on this subject —

Equatorial radius 20923600·00 feet,
Half the polar axis 20853657·16 feet,
Ratio of equatorial to polar axis 299·1528 : 298·1528,
Ellipticity = 1—299·1528 = ·00334273

Let $l$ denote the latitude, $m$ the length in feet of a degree of the meridian between two parallels whose latitudes are respectively $l-\frac{1}{2}$ and $l+\frac{1}{2}$ and $p$ the length of a degree of the parallel circle at latitude $l$, then

$$m = 364575·6 - 1831·0 \cos 2l + 3·9 \cos 4l - \&c$$
$$p = 365491·2 \cos l - 305·8 \cos 3l + 0·4 \cos 5l - \&c$$

from which formula the degrees of the meridian and parallel at any latitude are readily computed

DELPHI'NIC ACID A fat-acid obtained by saponification from the oil of the *Delphinus* or porpoise it has also been termed *phocenic* acid It exists in the [illegible] in the berries of *Viburnum Opulus*

DELPHINITE A variety of *Epidote* from Dauphiny

DE LUC'S COLUMN An alternation of different substances, such as silver, zinc, and thin paper, which produce an electric arrangement It is sometimes called the *dry pile*

DENTINAL TUBES (Lat dens, *a tooth*) The subparallel branching tubes which radiate from the pulp-cavity of a tooth at or nearly at right angles with the periphery of the dentine they have a diameter of $\frac{1}{10000}$th of an inch, at their origin, in the human teeth, and consequently admit only the plasma, or colourless liquor of the blood

DENTINE (Lat dens, *a tooth*) The fundamental and most constant substance or tissue of which a tooth is composed It consists of an organised animal basis disposed in the form of extremely minute tubes and cells, and of earthy particles which have a two-fold arrangement, being either blended with the animal matter of the interspaces and parietes of the tubes and cells, or contained in a minutely granular state in their cavities

DEODORIZERS A term applied to a class of disinfectants especially characterised by their power of destroying fetid effluvia chlorine and several of its compounds come under this class chloride of zinc and nitrate of lead, which are active in decomposing sulphuretted hydrogen, are also *deodorizers* Some kinds of charcoal, and especially that obtained from peat, when mixed with manure or excrement not only destroys the odour but forms an excellent compost for agricultural purposes

DEOXYDIZEMENT, or DEOXYDATION The chemical process of the abstraction of oxygen these terms are synonymous with *reduction* A compound of a metal with oxygen may for instance in many cases be reduced or deoxydized by heating it with carbon, or in a stream of hydrogen gas in which case it is subjected to the process of *deoxydation*, and the metal set free

DESMINE (Gr δεσμη, *a bundle*) A variety of foliated *Zeolite*

**DESMO'LOGY** (Gr. *δεσμος, a chain*, and *λογος, escription*) That part of anatomy which relates to ligaments and ligaments

**DEVI'TOPMI N** In Physiology, is the process y which each tissue and organ of the body is formed, nd subsequently transmuted, so as to be adapted to he actions of the most perfect state of the individual

**DEVO'NIAN SYSTEM** In geology, comprises the *Old Red Sandstone*. *See* GEOLOGY, in DICT

**DI'VONIT** A mineralogical synonym of the [illegible] Devonshire

**DIVI[illegible]** d having the [illegible] the action of alphuretted hydrogen on a boiling solution of alloxan

**DIAMAGNE'TIC** A term applied to bodies which ppear to be *repelled* by either pole of a magnet, as opposed to the term *magnetic* bodies, the particles of which are *attracted* by either pole

**DIAPHORE'TIC ANTIMONY** In old pharmacy his term has been applied to the peroxide of antimony, nd also to the antimoniate of potassa obtained by deflagrating [illegible]

**DIAPOPHYSIS** (*διὰ through, ἀπο from, φυσις*) n Anatomy, the upper of the two transverse processes which project from the sides of the cervical and anterior dorsal vertebræ of the crocodile, and which is usually nchylosed with a rudimental rib in the cervical vertebræ f birds and mammals, in these it forms the sole "transerse process" of the succeeding vertebræ, and is usually eveloped from the neural arch

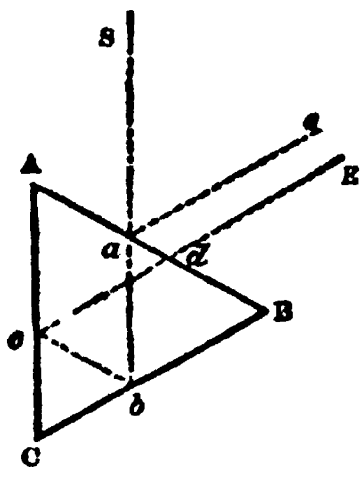
**DIATO'NIC SCALE** *of Colours* Newton found, r supposed, that the spaces occupied by the seven primary colours in the solar spectrum are exactly proporional to the lengths of chords that sound the seven notes in the diatonic scale of music On this assumpion the spaces occupied by the different colours are as he intervals of the numbers 1, $\frac{8}{9}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{3}{5}$, $\frac{9}{16}$, $\frac{1}{2}$, which orm the diatonic scale It is now known however, hat the relative lengths of the spaces occupied by the lifferent colours in the spectrum depend on the nature of the substance of which the refracting prism is formed ee CHROMATICS in DICT

**DICTIOPHY'LLUM** A name given by Lindley nd Hutton to a fossil leaf first described by Phillips rom the upper sandstone, shale, and coal of the Yorkhire oolite The term *Dictiophyllum* is employed to lesignate all fossil leaves of a common reticulated structure, while the term *phyllite* is applied to leaves whose [illegible] the base and apex

**DI[illegible] DIHEDRAL** In *Geometry* a dieral angle is the angle or corner formed by the intersection of two planes

**DIPLEI'DOSCOPE** (Lat duplex *double*, Gr *σκεπτω, I view*) An optical instrument for indicating the passage of the sun, or a star, over the meridian, by the coincidence of two images formed by a single and double eflexion

The instrument is constructed as follows A B, A C, and B C are three reflecting planes, one of which, A B is transparent, and the other two of silvered glass, the three [illegible]




placed exactly in the plane of the meridian, and a pencil of light proceeding from the sun, S, to fall upon the transparent plane A B at *a*, in the direction S *a* parallel to A C A portion of this light will be reflected from *a* in the direction *a e*, which is such that the angle *e a* B is equal to S *a* A Another portion of it will pass through the transparent plane A B and, proceeding in the same direction will fall on the silvered mirror at *b* where it will suffer a total reflexion in the direction *b c* and, falling on the second silvered mirror at *c*, will [illegible] direction *c d*, and will pass [illegible] plane A B, and continue its course in the same direction *d* E Now, the angles of incidence and reflexion being equal, when S *a* is parallel to A C, then *b c* is parallel to A B, and *c d* to C B, and the direction *d* E to *a e* so that an eye at E or *e* will see only a single image of the sun S But if S *a* be not parallel to A C, then *d* E will not be parallel to *a e*, and a double image will appear Suppose, for instance, the sun's course to be in the direction from A towards B, then, before the sun comes to the meridian, the pencil of light S *a* will make with A B an angle S *a* A less than 60° Consequently, the reflected ray *a e* will make the angle *e a* B less than 60° But in this case the angle F *e* B will be greater than 60°, and therefore two images will be seen by the eye at E, one in the direction *e a*, and the other in the direction E *d* The first of these will appear to move with the sun in the direction A B, and the second in the opposite direction B A, they will approach each other until S *a* becomes exactly parallel to A C, when they will coincide, after this, as the angle S *a* A becomes greater than 60°, they will separate, and gradually pass off the field, one at B, and the other at A Hence it is evident that if A C be in the plane of the meridian, the instant of the coincidence of the two images will be that of apparent noon

When used as a meridian instrument, the dipleidoscope must be fixed so that one of the reflecting planes, A C, is exactly vertical, and also in the meridian The latter adjustment may be made by any of the means which suffice for fixing a sun-dial, or for drawing a meridian line, the former, by suspending a fine plumb-line a few feet be[illegible] and turning the instrument slowly about the edge A C till the two images of the line become exactly parallel These are the only essential adjustments, but it is convenient also to fix the instrument so that the lines of intersection of the three planes may be parallel to the axis of the earth's rotation, in order that the sun's greatest altitude above the plane of the instrument at midsummer may be equal to his greatest depression below it at midwinter On account of the intense light of the sun, the eye must be protected by a coloured glass, and the field of view may be magnified by a small telescope Three observations should be made, the first, of the instant at which the two images come into contact, the second of the instant at which they exactly coincide, and the third, of the instant at which they separate The instrument, if accurately made and fixed, is capable of giving true time within a fraction of a second

The dipleidoscope is a patent instrument, the property of Mr Dent, chronometer maker, of the Strand, who has published a popular description of it in a small pamphlet, in which he states that the idea was first suggested by Mr Bloxam but that the original form has been much improved and simplified From its small size, and the facility of the observation, it may be conveniently employed for the regulation of time keepers in circumstances under which recourse cannot be had to a transit instrument

**DI'STHENE** One of the varieties of *Cyanite*

**DITHIO'NIC ACID** (Gr *δις, twice* and *θειον, sulphur*) Berzelius applies this term to the *hyposulphuric acid*, and he calls the hyposulphurous acid, *dithionous* The term implies the existence of *two* atoms of sulphur in each of these acids

**DOBEREINER'S LAMP** A small instrument for obtaining instantaneous light, in which a jet of hydrogen gas is inflamed by coming into contact with spongy platinum

**DO'MITE** A white mineral found in the Puy de Dome in Auvergne

**DRUMMOND'S LIGHT** The name given to the [illegible] of lime by directing against it a jet of [illegible] and the flame of alcohol, or some still more quick [illegible] The light produced by burning lime in this manner is of extreme intensity, and Mr Drummond of the Engineers while engaged in the trigonometrical survey of Ireland suggested its use as a signal for the observation of distant stations For this purpose the ball of lime, about a quarter of an inch in diameter, was placed in the focus of a parabolic mirror, the axis of which was directed to the point from which the observation was to be made, and such was the brilliancy of the light that it was sometimes distinctly seen, even in hazy weather, at a distance of upwards of sixty miles, when argand burners and other modes of illumination previously used were altogether ineffectual But the use of this signal is found to be attended with some inconveniences, and the heliostat is now generally preferred in geodetical operations (See Lieut Drummond's paper in the *Philosophical Transactions* for 1826)

**DU'MASINE** An oily liquid [illegible] among other products, by distilling acetate of [illegible] its formula is $C_{10} H_8 O$ It is named in compliment to the celebrated French chemist Dumas

**DYNACTINO'METER** (Gr *δυναμις, power, ακτις, a sunbeam, μετρον measure*) An instrument for measuring the intensity of the photogenic (light-producing) rays, and computing the power of object glasses It is described by Mr Claudet in the *Philosophical Magazine* for June 1851

**DYNAM, or DYNAMICAL UNIT** For the purpose of measuring or comparing the moving power of machines, or the useful effect procured by the exertion of animal force applied in different ways, it is necessary to adopt some standard, or unit of force, and for convenience of explanation it is desirable the unit should be designated by an appropriate name When the steam-engine came into use, the work accomplished by it in a given time was naturally compared with that of the

moving power which it most frequently superseded; hence the term *Horse-power*, which was originally used by Watt to denote, in a rough way, the force developed by a horse of average strength drawing a load during twenty four hours without intermission Watt subsequently gave a definite signification to the term, by defining it to be the force which suffices to raise a weight of 32,000 [illegible] of one foot in one second [illegible] *Géometrie des Arts et Métiers et des Beaux-Arts*, proposed the term *Dyname* to denote the unit of moving force, represented by one cubic metre of distilled water at its maximum density raised to the height of one metre in an astronomical day Dr Whewell, in his *Mechanics of Engineering*, recommended the adoption of the English synonyme, *Dynam*, to represent the effect equivalent to a weight of one pound raised to the height of one foot in a second The terms *efficiency*, and *duty*, are frequently applied in a similar sense

DYNA'METER In Optics, an instrument for measuring the magnifying power of a telescope The [illegible] ratio of the solar focal distance of the object glass to the focal distance of the eye-piece considered as a single lens, and this ratio being the same as the ratio of the diameter of the aperture of the telescope to the diameter of its image or disc formed at the solar focus, and seen through the eye-piece, the object of the instrument is to measure the exact diameter of this image, which, not being projected on any solid body, can only be measured by optical means Ramsden proposed for this purpose the double image micrometer (MICROMETER, in DICT ), an instrument formed by dividing the eye lens of a positive eye-piece into two equal parts, and mounting them so that the divided edges are made, by means of a fine screw-apparatus, to slide along each other Each semi-lens thus gives a separate image, and the distance of the two centres, measured by the revolutions of the screw, when the borders of the two images are brought exactly into contact, gives the distance of the centres of the images, or the diameter of one of them The construction of this dynameter has been improved by Dollond. (Pearson's *Practical Astronomy*, vol ii )

## E.

EAR TRUMPET, or HEARING TRUMPET An instrument for aiding defective hearing The ordinary ear trumpet consists of a metal tube, usually of a conical shape, the wide end being turned towards the speaker to collect the waves of sound, and the narrow end terminating in a small tube, and bent sideways so as to enter the ear of the deaf person Various other instruments besides the *trumpet* are used for the same purpose The *Auricle* is a small scroll-shaped instrument which is worn in the ear, the expanded mouth only being visible *Ear-cornets* are applied outside the ear, and held in their place by a slender steel spring, a bent tube entering the ear in this case, as in that of the common trumpet Flexible tubes, made of India rubber covered with silk, and kept open by a spiral spring of wire, terminating at one end in a tube, which enters the ear, and in a cup or hollow hemisphere at the other, into which the speaker speaks, are found to be of great efficiency *Sonifers* are large bell-shaped instruments of metal which are placed on a table, and turned towards the part of the room whence the sound proceeds, and the sound being collected at the bottom of the instrument is conveyed to the ear by a flexible tube With respect to acoustic instruments in general, it does not appear that mathematical accuracy of figure is of much importance Whatever prevents the dispersion of the undulating air, and directs it upon the tympanum, will partially assist hearing, though of course, it is advantageous that as much as possible of the sound which enters the instrument should be reflected forward to the ear

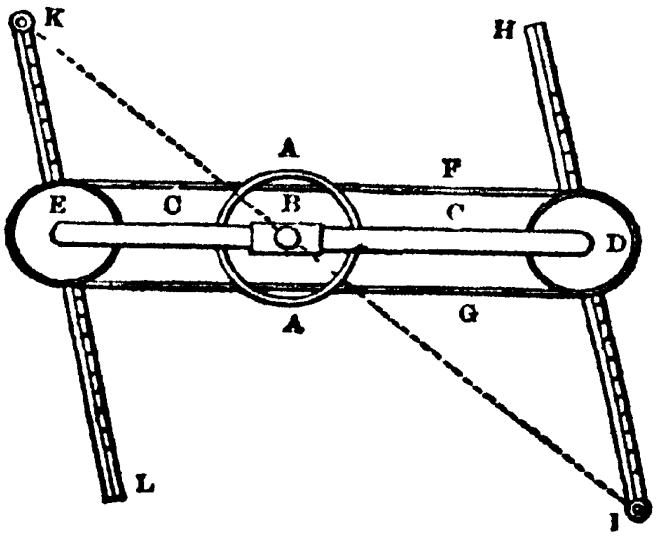
ECDY'SIS (Gr *ἔκδυσις* ) The act of stripping The moulting of the skin

EGERIA One of the small planets between Mars and Jupiter It was [illegible] at Naples on the 2nd of November, 1850, by [illegible] (who had previously discovered Hygeia and Parthenope), and is the 13th of the group in the order of discovery *See* PLANET

EI'DOGRAPH (Gr *εἶδος, form*, *γράφω, I describe* ) A copying instrument invented by Professor Wallace, of Edinburgh, by which copies of drawings are made, reduced, or enlarged in any proportion within certain limits It answers the same purposes as the ordinary pentagraph, but is more convenient and accurate

The geometrical theory of this ingenious instrument is contained in the following proposition "If two lines which contain a given angle turn in a plane about a fixed point at their intersection and have to each other a constant ratio, and the moving extremity of one of them trace a line of any kind, the extremity of the other will trace a similar corresponding line, and these two lines will have to each other the constant ratio of their distances from the centre of angular motion" To apply this property mechanically it was necessary to connect two material points moving on a plane (the tracer and the pencil) in such a way that straight lines drawn from them to a fixed centre should contain a given angle, and have to each other a given ratio It is convenient to take the given angle equal to 180°, in which case the two moving points are in the same straight line with the centre, and on opposite sides of it

The instrument is represented in the annexed figure.




A beam, C C, about 30 inches in length (formed of a hollow rectangular prism of brass, in order to combine strength with lightness), passes horizontally through a socket B B, attached to the top of a strong steel conical axis, which turns in a tube rising perpendicularly from the centre of a mass of metal, A A, forming the base of the instrument, and heavy enough to afford a steady support The beam thus turns freely about the steel axis, and may be clamped at any point Two wheels D, E, of exactly the same size, are attached to the beam at its extremities, by means of steel axes screwed to the wheels and entering upright sockets fixed to the beam The wheels are connected by a metallic band F G, part of which (as much as is applied on the wheels in making about half a revolution) is formed of thin and narrow watch spring, and they are crossed by two arms, H I and L K, about 27 inches in length, which slide through sockets placed under the centres of the wheels and must be placed truly parallel Both the beam and the arms have a scale of equal parts engraved on them for the purpose of adjustment

Suppose the beam and the two arms respectively clamped in their sockets in such wise that the beam is divided at the axis *b* in any given ratio and D I is equal to D *b*, and E K to E *b*, then on turning the beam about its axis, the two arms will manifestly retain their parallelism, and the three points I, *b*, K will be always in the same straight line, consequently, in virtue of the geometrical theorem above enunciated the two points I and K, will have similar corresponding motions, and the lines traced by them will always be in the ratio of D I to E K It only remains, therefore, to attach a tracing point at I and a copying point (a pencil) at K, in order to complete the construction These are placed in vertical tubes, and carefully adjusted to the centres of the tubes The tracer is guided by the right hand over the contour of the figure to be copied, and the pencil accurately follows its motions, describing a similar but reversed figure on a sheet of paper placed under it The pencil is pressed down by a small weight, and is raised from the paper, when required, by means of a rectangular lever, one end of which is connected with the pencil-carrier and the other moved by a string which passes over a pulley, and is held by the operator in his left hand In order to facilitate this motion the pencil is kept steadily in its place, and at the same time prevented from pressing against the tube, by small friction-wheels fixed in the tube The motion is extremely free, and with a little practice the outlines of even the most complicated figures, anatomical drawings for example, are copied with great facility and perfect precision

By combining two instruments adjusted to make reduced copies the reduction may be carried by a single operation to a much greater extent than could be done by one instrument For obvious reasons, the power of enlarging a figure is more limited Professor Wallace, likewise, proposed a form of the instrument, by which a copy of any subject is produced so reversed as to have the appearance of the [illegible] reflected from a plane mi[illegible]

invented about 1821, and was first described in the *Transactions of the Royal Society of Edinburgh*, vol xiii , it is also described in Wallace's *Geometrical Theorems and Analytical Formulæ*, 1839

ELAIOMETER (Gr ελαιον, *oil*, and μετρον, *measure*) An instrument for detecting the adulteration of olive oil

ELAOPTENE (Gr ελαιον, *oil*, and πτηνι, *I fly*) The *liquid* portion of the volatile oils, when separated from the concrete, or crystallisable portion, which had been called *Stearoptene*

ELECTRIC COLUMN An electric instrument invented by Deluc consisting of numerous alternating discs of silver leaf, zinc leaf, and paper *See* ELECTRICITY in DICT

ELECTRO MAGNETIC CLOCK The discovery of the mutual relations of electricity and magnetism by Oersted in 1819 necessarily led to the construction of the *electro-magnet*, and amongst its numerous applications that to *timekeepers* was perhaps one of the most obvious By referring to the description which we have elsewhere given of the electro magnet it will be seen that a bar of iron of any required form may have any amount of magnetism conferred upon it by proper adjustments of an electric current, and inasmuch as the magnetic power ceases the moment that the electric current is discontinued so we are enabled to render an iron bar, or horse shoe, a strong magnet, and at the next to withdraw all [illegible] further obvious that these magnets may be made and unmade at any distance, by an adequate extent of metal wire, so that at one and the same moment a magnet may be made and unmade at London and at Liverpool [illegible] if we please with the vibrations of the [illegible] which announce the signals of the electric telegraph And, of course, the magnet may be made alternately to lift and drop a weight, or to bend and release a spring or to raise and depress a lever Bearing these matters in mind the *principle* of electric clocks will be intelligible without entering into minute details respecting their varied mechanism

There are several ways in which electro-magnetism has been applied to these purposes, one of the first consisted in fixing upon the arbor or axis of the seconds wheel of a clock a wheel or disc of metal the circumference or edge of which was divided into sixty alternating divisions of metal and of ivory or wood the metal being a conductor and the ivory or wood a nonconductor of electricity A small platinum peg or point, was kept in contact with this divided edge, so as by the revolution of the wheel to be alternately in contact with the conducting and nonconducting surfaces, and so connected with a voltaic series as alternately to admit and resist the passage of an electric current In this way supposing the clock in question to be keeping accurate time one or more electro-magnets placed anywhere in the circuit of the conducting wire would be made and unmade at each succeeding second Now it is easy so to connect an electro magnet with a lever as to give motion to a wheel and axle and to cause it to revolve so as to indicate seconds and when in communication with a proper train of wheels to move the minute and hour hands of a clock, and this secondary, or *electro-magnetic clock*, would of course be regulated in its movements by the alternating electric current derived in the way we have mentioned, from the original time-keeper Every clock therefore, upon the circuit would show the same time as that shown by the regulator, and in this way, one good regulator may be made to preside as it were over any number of electro-magnetic movements, each of which will indicate the same time

Another form of the electro magnetic clock is that in which the pendulum is itself kept in action by electro-magnetism, and through it the other movements of the clock are sustained, and this is effected either *directly* as in Bain's clock, or *indirectly*, as in Shepherd's clock In Bain's clock the pendulum, at each vibration, moves a light slide by which the electric current is alternately completed and broken, and by which magnetism is alternately conferred upon, and abstracted from a coil enclosed in a heavy hollow brass case or tube, which constitutes as it were the bob of the pendulum, and on either side of which are the poles of two common, or permanent bar magnets, which alternately attract and repel the coil of the bob, as it is magnetised and demagnetised by the alternate presence and absence of the electric current These clocks have been kept in motion by electric currents derived from a zinc plate buried in damp earth, and so far, therefore, independent of the usual forms of voltaic battery, in which the electricity is derived from the action of dilute sulphuric acid upon zinc

The most recent form of electric clock is that invented and patented by Mr Shepherd, the large clock at the Great Exhibition of 1851, in Hyde Park, was of this description, and it appears to possess several advantages In this clock, electro-magnetism is the sole moving power, its force being employed, not only to give impulse to the pendulum and to propel the ordinary movement of the clock, but also to perform the striking of the hour, no auxiliary weights or springs being employed The pendulum is so arranged as to make and break the electric circuit, and make and unmake a horseshoe magnet at each vibration Each time that the magnet is made, it attracts its armature, which lifts certain levers, one of these is concerned in raising a weighted lever, and causing it to be held up by a latch or detent, the magnet is then unmade in consequence of the pendulum breaking the circuit, and its armature is released, when the pendulum lifts the latch and allows the weighted lever to fall, which, in falling strikes the pendulum so as to give it a certain adequate impulse, then the circuit is again completed the armature attracted, the levers moved, the weight raised and held by the detent, another vibration breaks the circuit and then releases the armature, the pendulum then raises the detent the weight falls, and in falling its arm strikes the pendulum and gives it its impulse, and so on

But the pendulum at each vibration not only makes and breaks the electric circuit which maintains its own action but also and simultaneously, that of another battery, of which the duty is to make and unmake the electro-magnets belonging exclusively to the clock or clocks which are upon this circuit These electro-magnets act upon the extremes of one or more horizontal bar magnets so as alternately to attract and repel their opposed poles and which carry upon their axes the pallets by the alternating motion of which to the right and left, the ratchet wheel is propelled onwards at the rate of a tooth each second, and the axis of this ratchet wheel carries the pinion which moves the other wheels of the clock

The circuit of the battery connected with the *striking* part of the clock, is only completed once in each hour, and is connected with an electro-magnet so arranged as by means of a proper lever to pull the ratchet wheel attached to the notched striking-wheel one tooth forward every two seconds and each tooth is accompanied by a blow on an electro magnetic bell The number of blows depends upon the notched wheel, the spaces in the circumference of which are adapted to the number to be struck and when this is complete a lever falls into the notch and in so doing cuts off the electric current which is not re established through the striking electro magnet till the completion of the next hour when a peg upon the hour-wheel pushes the striking lever forward so as to cause it to be depressed by a similar peg on the minute wheel

Electro magnetic clocks are peculiarly fitted for all large establishments where many dials each indicating the same time are required the pendulum by which the whole series is controlled is placed in some safe and quiet place and the only requisite precaution for maintaining them in order consists in careful attention to the conditions and functions of the voltaic apparatus or source of the electric current Smee's batteries as they are called consisting of amalgamated plates of zinc in proper connexion with plates of platinum, or platinised silver, and immersed in dilute sulphuric acid, or in sand moistened with that acid, are generally used the number and dimensions of the plates or cells depending upon the extent of wire which the electrical current is required to traverse and care being taken that the chemical action of the acid upon the plates is as small and feeble as is consistent with the object in view These clocks also promise to become importantly useful upon lines of railway, and for a variety of other purposes, more especially when some few difficulties attending their first expense and maintenance are overcome

ELECTRIC TELEGRAPH *See* TELEGRAPH, ELECTRIC

ELECTRICAL EEL *See* GYMNOTUS, in DICT

ELECTROLYSIS, or ELECTROCHEMICAL DECOMPOSITION (Gr ηλεκτρον and λυω, *I dissolve*) The separation of the elements of a compound by the transmission of electricity

ELECTRO-BIOLOGY (Gr ηλεκτρον, *Bios life*, and λογος *description*) A term that has recently been applied to certain mental phenomena produced by various applications of Mesmerism to the human body

ELECTROMETALLURGY The electro-chemical precipitation of the metals, as applied to various purposes in the arts

ELECTROMOTOR, or ELECTROMOTIVE FORCE Terms applied to the development of electri[illegible] Those substances which in electro chemical decompositions make their appearance at the *anode* or electropositive pole The term has reference to the mutual attraction of bodies dissimilarly electrical, and hence those which appeared to be attracted by the positive pole in the Voltaic circuit were presumed to have an inherent *Electronegative* state.

**ELE'CTROPO'SITIVES** Bodies appearing in electrochemical decompositions at the *cathode* or electronegative pole

**ELECTROTYPE** An impression of a medal, or bas-relief obtained by electric precipitation *See* VOLTAIC in Dict

**ELECTROVITAL CURRENTS** Two electric currents are supposed by some physiologists to move in the nerves of animals the one external and cutaneous, moving from the extremities to the *cerebro-spinal* axis, the other centrifugal, proceeding from that axis

**ELLIPTIC FUNCTIONS** In the higher mathematics the term *Elliptic Function* is used to designate any integral comprised in the formula $\int \frac{P\,dx}{R}$, in which P is a rational function of $x$, and R is a radical of the form $\sqrt{(\alpha+\beta x+\gamma x^2+\delta x^3+\varepsilon x^4)}$, $\alpha$ $\beta$, $\gamma$ $\delta$ $\varepsilon$, being constant quantities Such integrals are called elliptic functions because they either contain, or are closely connected with expressions for the arc of an ellipse The principal works on the subject are the following *Exercises de Calcul Integral* 3 vols 4to 1811, and *Théorie des Fonctions Elliptiques*, 3 vols 4to 1825—1828, by Legendre, *Œuvres de* N H Abel, 2 vols 4to 1839, and Jacobi's *Fundamenta Nova Theoriæ Functionum Ellipticarum*, 4to 1829

**ELLIPTIC POLARIZATION** *See* POLARIZATION OF LIGHT

**ELVAN COURSES** In Mining, the term *Elvan* is applied by the Cornish miners to the porphyritic and other veins and masses which occasionally traverse granite and clayslate, deranging the direction of the metallic veins

**ENCKE'S COMET** *See* COMET, in Dict

**ENDE'LLIONITE** The triple sulphuret of antimony, lead and copper found in the mine Huel Boys, in the parish of Endellion, Cornwall

**ENDLESS SCREW** A piece of mechanism formed by combining the screw with a cog-wheel, or by making a screw act on the threads of a female screw sunk in the edge of the wheel The axis of the screw may be either in the plane of the wheel or at right angles to it, in the latter case it is called the American endless screw In its mechanical principle the endless screw is a combination of the inclined plane and the lever

**ENDOSMOMETER** (Gr ἐνδοσμος, and μετρον *measure*) In Physics, an instrument invented by M Dutrochet, to measure the endosmose with which one or other of two mixing fluids of different densities, will pass into each other and by which the less dense fluids are shown to pass with greater rapidity into the more dense fluids than *vice versâ*, in other words that "endosmosis" is more rapid than "exosmosis" A simple form of the instrument is a graduated tube expanded into a bell at one end over which a portion of membrane may be tied If the bell be filled with a fluid of much density such as a strong solution of salt and be immersed in one of less density, as water, the water will endosmose, or pass into the solution more rapidly than the solution will exosmose or pass out But if the water were put into the bell and the saline solution outside the directions of the currents would be reversed In both cases, however the currents would continue until the two fluids were equally mixed on both sides of the membrane

**ENTERIMENTA** *See* INTESTINALIA, in Dict

**ENTOMOLINE** (Gr ἐντομα *insects* and λινον *thread*) A chemical principle called also *chitine*, found in the shells of insects

**ENTROCHITE** (Gr ἐν *in*, τροχος, *a wheel*) A genus of fossils constituted of the petrified arms of the sea starfish

**EPENCEPHALIC ARCH** (Gr ἐπι *upon* or *near*, ἐγκεφαλον, *the brain*) The bony arch which encompasses and protects the epencephalon it is composed of the basioccipital, exoccipitals and superoccipitals and, in general anatomy, forms the neural arch of the occipital vertebra

**EPENCEPHALON** (See above) In Anatomy, the hindmost of the four primary divisions or segments of the brain including the medulla oblongata pons varolii cerebellum, and fourth ventricle

**EPIDIDYMIS** (Gr ἐπι *upon*, διδυμοι *twins*, or *the testicles*) In Anatomy, a body formed by convolutions of the commencement of the sperm-duct or *vas deferens*, lying upon the testicle and more or less closely attached to that gland In anthropotomy the epididymis is divided into *caput minor*, *corpus* and *caput majus*

**EPIMERON** (Gr ἐπι, *upon*, μηρος, *a limb*) In Zoology the part of the segment of an articulate animal which is above the joint of the limb

**EPITHE'LIUM** (Gr ἐπι *upon*, θηλη, *a teat*) In Anatomy, a thin and delicate kind of cuticle, like that which covers the nipple The term is now confined to the innermost layer of the internal cavities and canals of the body, which corresponds to the cuticle of the outer surface The epithelia of mucous membranes consist of the secreting cells of those surfaces, and are either "tesselated," "cylindroid," or "ciliated" The tesselated, or "*pavement epithelium*," is composed of flat, roundish, or polygonal cells, arranged in one or more layers, and is spread over the mouth, pharynx, and œsophagus, the conjunctiva, and the vagina, it is the kind of epithelium which most nearly resembles the external cuticle A tesselated epithelium also lines most of the vascular system, the ducts of many glands The *cylindroid* epithelium is composed of closeset cells of a conical or cylindrical form, and extends from the cardiac end of the stomach along the intestinal tract to the anus and lines the principal gland-ducts which open upon this surface It lines the ureters and urinary bladder,

The cells of this epithelium support at their free ends appendages called cilia, which are in constant and rapid vibration this kind of epithelium lines the whole respiratory tract, the interior of the cerebral ventricles, the uterus and oviducts, and the Malpighian capsules of the kidneys of the Batrachia

**EPIZOO'TIC DISEASES** (Gr ἐπι, *upon*, and ζωον, *an animal*) When diseases prevail among inferior animals, they are said to be *Epizootic*, corresponding to *Endemics* among men

**EQUA'TION, PERSONAL** The term *Personal Equation* has of late been introduced into Astronomy to denote the interval of time by which an observer, on the average of a number of observations, notes a phenomenon before or after the instant assumed to be that of its actual occurrence If it were possible to determine the true instant of the occurrence of any phenomenon with absolute certainty, the personal equation of an observer would be the amount of error he is in the habit of making or the probable error of a single observation made by him, but as the true instant of the occurrence can only be assumed by taking the mean of a number of observations the term has only a relative signification For instance, if, on comparing a number of observations of the same phenomenon by A and B, it be found that A notes the phenomenon, on the average, half a second sooner than B, then half a second is the *difference* of their personal equations, but this does not enable us to form any judgment with respect to the amount of error due to either, and it is only by a further comparison of observations made by A and B with those of other observers, that we are enabled to assume that the true instant at which the event occurred lies between the times noted by them respectively or before or after both If, however, it be assumed that either A or B observes correctly, then the personal equation of the other is half a second

Generally speaking the personal equation of an observer is a minute quantity seldom exceeding a few tenths of a second, but it is sometimes found even in the case of experienced observers to amount to, or even exceed, a whole second It is found to vary with the age of the observer and may possibly at all times depend in some measure on the state of his health The subject is treated at length in a *Memoir on the Difference of Longitude of Greenwich and Brussels*, by Prof Quetelet and Mr Sheepshanks, *Memoires de l Academie Royale de Bruxelles* tom xvi See also Introductions to the volumes of the Greenwich Observations

**ERYTHRINE** (Gr ἐρυθρος, *red*) One of a series of substances obtained from the *Roccella tinctoria*, a lichen which furnishes the blue dye stuff called *litmus*

**ERYTHROPHYLLINE** (Gr ἐρυθρος, *red*, and φυλλον, *a leaf*) The *red* colouring matter formed in certain leaves, when they change into their autumnal tints

**ESMARKITE** A species of Datholite or Borosilicate of lime discovered by Esmark at Arendal

**ESOCIDE** (Lat esox *the pike*) The *Pike tribe*, a family of *Malacopterygious*, or soft-rayed fishes having the ventral fins placed under the abdomen and including most of the voracious fresh-water fishes, as well as several marine species

**ESSONITE** A variety of the *Cinnamon Stone* of Ceylon consisting of lime, alumina, and oxide of iron

**ETHIONIC ACID** (Gr αἰθηρ and θειον, *sulphur*) An acid formed by the action of the vapour of anhydrous sulphuric acid on alcohol

**EUCHRONIC ACID** (Gr εὐχροος *of a fine colour*) An acid formed by the action of heat on the mellitate of

**EUCHYSIDERITE** (Gr εὐχυσις, *to melt easily*, σιδηρος, *iron*) A silicate of lime, magnesia, and protoxide of iron A species of *pyroxene*

**EUDE'MONISM** (Gr εὐδαιμονια, *happiness*) A term applied by some German philosophers to a system of moral philosophy which makes morality to depend on the production of happiness

**EUDIALITE** (Gr εὐ, *easily*, and διαλυω, *I dissolve*,

from the facility with which it is gelatinised by the action of hydrochloric acid.) A mineral from Greenland, of a red colour, and in dodecaedral crystals it contains silica, zirconia, lime, soda, and the oxides of iron and manganese

EUGE'NIA A genus of plants named by Michel in honour of Prince Eugene of Savoy, and the type of the order of Botany It embraces the large tree which yields the Clove Tree, and the Jambos, or Malabar plum, the ripe fruit of which has the odour of the rose

EUGE'NIN A crystalline substance extracted by alcohol from cloves

EUKAIRITE (Gr *ευκαιρος, seasonable*) A native seleniuret of silver and copper from Sweden

EU'LYTINE (Gr *ευ, easily*, and *λυω, I dissolve*) A mineral found at Freiberg, composed of silica, oxide of bismuth, and lime

EUNOMIA One of the small planets belonging to the group between Mars and Jupiter It was discovered by M De Gasparis at Naples on the 29th of July, 1851, and is the fifteenth in order of discovery At its discovery it appeared like a star of the ninth magnitude Four sets of elements have been computed, but they exhibit considerable discordance as usual, the extreme values of the semi-axis major being 955" and [illegible] vol xi No 9) *See* PLANET

EUPATORIUM (Eupator being the discoverer of its virtues) The herb *Agrimony*, in common use in Hospitals

EUPEPSIA (Gr *ευ*, well, and *πεπτω, to concoct*) Good digestion

EUPHOTIDE (Gr *ευ* and *φως light*) A rock consisting of saussurite and diallage It is the *gabbro* of the Italian mineralogists

EUPHRASIA (Corrupted from *Euphrosyne* from *ευφραω, merry*, because it exhilarates) The name of a genus of plants It includes the *E officinalis* or *Eyebright*, much esteemed as a popular remedy for diseases of the eyes it is also an ingredient in British herb tobacco

EUPYRION (Gr *ευ, easily*, and *πυρ, fire*) A term applied to several contrivances for obtaining instantaneous light, such as the fire-matches &c

EURITE or WHITE STONE (Gr *ευρυς, broad*) A fine grained granite in which the spar predominates

EUXANTHINE (Gr *ευ*, and *ξανθος, yellow*) A substance obtained from India under the name of *Purree*, or *Indian yellow* It is supposed to be derived from the bile of the camel, or of the elephant it forms small pale yellow crystals

EUXENITE (Gr *ευξενος, welcome*) A mineral containing columbium, yttria, and uranium, found at Arendal in Norway

EVERLASTING FLOWERS Certain flowers, whose hard tissue and deficient moisture renders them little liable to change, and enables them to retain their colour and appearance after having been gathered

EVIDENCE LAW OF An important enactment was passed in the 14 and 15 Vict chap 99, by virtue of which parties to suits, actions, or other proceedings in any court of justice are admitted witnesses It provides that on the trial of any issue joined, or of any matter or question, or on any inquiry arising in any suit, action, or other proceeding in any court of justice, or before any person having by law, or the consent of parties, authority to hear, receive, and examine evidence, the parties thereto, and the persons in whose behalf any such suit, action, or other proceeding may be brought or defended shall be competent and compellable to give evidence either *viva voce* or by deposition, according to the practice of the court, on behalf of either or any of the parties to the suit, action, or other proceeding By this clause, in addition to the parties offering themselves to give evidence in their own behalf, their opponents can compel them to give evidence in the cause Nothing in the act is to compel persons charged with criminal offences to give evidence nor is the act to apply to proceedings consequence of adultery Further, the new law authorises the common law courts to compel an inspection of documents whenever equity would grant a discovery Foreign and colonial acts, judgments &c, are to be received in evidence, without proof of the seal or signature, as also are apothecaries certificates Documents are to be admitted in England or Ireland from each other's place, and the courts, without proof of seal Persons forging the [illegible] be guilty of felony, and punished [illegible] act, which extends to all parts of the [illegible] except Scotland, came into force on the 1st of November, 1851

EXA'NGIA (Gr *εξ*, and *αγγειον, a vessel*) A term applied by some medical writers to diseases in which large blood vessels are broken or perforated, or enlarged, without any external opening it includes *aneurism varix*, and *cyanea*

EXA'NTHALOSE. (Gr *εξανθεω, to effloresce*) A name given by Beudant to native *sulphate of soda*, occurring as an *efflorescence* on certain lavas, and elsewhere

EXANTHEMATA (Gr *εξανθεω, to effloresce*) An efflorescence or eruption on the skin

EXCENTRIC Is applied to a wheel in which the axis is removed from the centre of the figure, or of which the periphery is not circular Excentrics are used for converting circular motion into alternating, rectilinear, or intermitting motion, and are usually driven [illegible]

EXCITANTS Medicines which excite the actions of the system they are either *general* such as alcoholic liquors, &c, or *local*, such as diuretics, diaphoretics

EXCITO-MOTORY ACTS In Physiology, the term has recently been applied to the first class of nervous actions defined by Hartley as "those sensory vibrations which are excited in the external organs and ascend towards the brain, when they arrive in their ascent, at the origins of motory nerves, as they arise also from the same common trunk, plexus, or ganglion, with the sensory ones affected detach a part of themselves at each of those origins down the motory nerves, which part by agitating the small particles of the muscular fibres excites them to contraction" (*On Man*, i p 92) "The actions of [illegible] coughing, hiccoughing [illegible] faeces and urine, with others of a like nature, are to be deduced from the first and fourth classes of motory vibrations, i e either from those vibrations which first ascend up the sensory nerves, and then are detached down the motory nerves, which communicate by some common trunk, plexus or ganglion, or else from those vibrations that run along the surfaces of uniform membranes, and so affect all the muscles which lie contiguous to any part of the membranes" (*Ib* p 97) "The yawnings and stretchings of persons disposed to sleep, the convulsive respiration of those that are just fallen asleep, and the convulsive motions which attend the extinction of the senses in epileptic fits, and the near approach of death, may be derived, perhaps, in part, from this source" (*Ib* p 93).

EXCRE'TORIES The ducts which convey the secretions [illegible] glands

EXCURSORES (Lat excurro, *I rush hastily*) An order of birds intermediate between the flying and walking tribes and belonging to the *Insessores*

EXINE A membrane situated between the extine and intine in the pollen of yew, juniper, cypress, &c

EXOCHNA'TA (Gr *εξοχος, prominent*) A designation of the long-tailed *Crustacea*, as the lobster and shrimp

EXPECTORATION (Lat) The act of ejecting matters from the chest The term is sometimes applied to the matter ejected, which is, however, more properly termed *sputum*

EXPERIME'NTUM CRU'CIS. (Lat) Bacon's *Crucial*, or *decisive* experiment, so called from the *crosses*, or finger-posts on roads as at once determining between two or more possible conclusions

EXPIRATION (Lat) In Physiology, the movements by which the air that has been changed by the respiratory process, is expelled from the lungs they are chiefly due to the elastic contraction of the lungs and the walls of the chest, after they have been dilated in the act of inspiration

EXSE'RTED (Lat exsertus, *thrust out*) A term applied to such stamens of plants as are longer than the corolla.

EXTENSOR MUSCLES As opposed to *flexor muscles*, are those which extend any limb or part, the muscle in the fore-arm which extends the joints of the fingers called the *extensor digitorum*, is an instance

EXTINE The external membrane of the pollen-grain of plants

EXTROVERSION (Lat) A term applied by surgical writers to those malformations of the body in which a part is, as it were, turned wrong side outwards Such [illegible] thus cases are on record of *extroversion* [illegible] in which there is a congenital defect of its anterior part, and of the corresponding portion of the parietes of the abdomen so that the internal surface of the bladder projects and forms a tumour

EYEBRIGHT *See* EUPHRASIA

EYE-PIECE (SOLID) The *solid eye-piece* is an invention of the Rev J B Reade, of Stowe, near Aylesbury It consists of three lenses, the anterior and posterior of which are double convex of crown glass, and the intermediate one a concave lens of flint The contact surfaces are cemented together, and consequently the action of the rays of light is similar to that of a single lens The advantages of this construction are, that it gives a large and flat field of view, and that the defects of spherical and chromatic aberration are got rid of These advantages arise from the great thickness

of the flat lens, which is a perfectly new feature in the construction of eye pieces

EYE PIECE (PERSONAL BINOCULAR) An eye-piece recently invented by Mr Thomas Jones, a well-known optician of London, for enabling two persons to observe the image of the same star with the same telescope It consists of two 3-glass eye-pieces having the first lens common to both This first lens is contained in a tube adapted in the usual way to the telescope, and, branching off at angles of 120° from it, are two other tubes, each containing other two lenses, fixed in smaller tubes sliding in them At the junction of the tubes is an equilateral prism, by which the pencil of rays passing perpendicularly through its first surface, is divided into equal parts at the opposite angle, and is reflected in two equal parts into the two branch tubes All the light received on one half of the object-glass is reflected into one tube, and that received on the other half into the other tube, and thus two distinct images of the star, as well as of the wires in the focus of the object-glass, are formed

By the use of this eye-piece, two persons may, under precisely the same circumstances, observe transits of stars, and thus obtain, much more certainly than it has been effected by other means, their *personal equation*, that is, the difference of average estimation of the time of a star's transit across the wires of a transit instrument In this respect the invention of Mr Jones is likely to be of inestimable service to astronomy, since the uncertainty attending the observation of time, and the different estimations of this element by different observers, have been the greatest obstacles to a perfect system of observation since the construction of large instruments and the great improvements introduced during the present century into the systems of the great observatories of Europe

## F

FA'CET (Fr façette) In Anatomy, a small but well-defined surface of a bone or other part, as, e g the hexagonal divisions of the surface of the cornea of the compound eye of the insect and crustacean

FACTORIALS In Analysis, the name given by Arbogast to certain symbolical expressions representing the continued product of a series of factors such that each is greater or less than the preceding one in the series by a constant quantity For example, the expression $x^{n+a}$ denotes the continued product

$$x\,(x+a)\,(x+2a)\,(x+3a)\quad\ldots\quad(x+\overline{n-1}\,a)$$

FÆ'CES (Lat) The excrements, usually confined, in Physiology to the solid matter evacuated from the alimentary canal According to the analysis of Berzelius, human fæces of consistence sufficient to form a coherent mass are composed of

| | | | |
|---|---|---|---|
| Water | | | 75 3 |
| Matters soluble in water | Bile | 0 9 | 5 7 |
| | Albumen | 0 9 | |
| | Peculiar extractive | 2 7 | |
| | Salts | 1 2 | |
| Insoluble residue of the food | | | 7 0 |
| Insoluble matters which are added in the intestinal canal,—mucus, biliary resin, fat, and a peculiar animal matter | | | 14 0 |
| | | | 102 0 |

This term is also applied to sediments, especially in vegetable infusions, tinctures and fermented liquors

FAUJASITE A hydrated silicate of alumina lime, and soda, from Baden, named after Faujas St Fond

FAVO'SE (Lat favus, *a honeycomb*) In Botany, honey-combed cellular

FAYALITE A native silicate of iron from the island of Fayal

FE'BRIFUGE (Lat febris, *fever*, and fugo, *I drive away*) A remedy which cures or relieves fever the term is commonly applied to medicines used in the treatment of agues

FELLIC and FELLI'NIC ACID (Lat fel, *gall*) Products obtained from bile

FENESTRA (Lat *a window*) In Anatomy, the term is applied to certain holes in the osseous or petrous capsule of the internal organ of hearing, one on the outer wall of the labyrinth, which is filled by the base of the "stapes," is called the "fenestra ovalis," a second, at the base of the cochlea, is called the "fenestra rotunda," and is separated by a membrane from the cavity of the tympanum

FERRIC ACID. A compound of 1 atom of iron with 3 atoms of oxygen, $Fe\,O_3$ It is very unstable, and has [illegible]

FERRIDCYANOGEN A compound of 2 atoms of iron and 6 of cyanogen and which, in combination with 3 atoms of potassium, forms the *Ferridcyanide of potassium* or [illegible] *of potash*

FERROCYANOGEN A compound of 1 atom of iron and 3 atoms of cyanogen, or 1 of iron, 6 of carbon, and 3 of nitrogen, and which, in combination with 2 atoms of potassium, constitutes *anhydrous ferrocyanide of potassium*, the crystals of which include 3 atoms of water This crystallized ferrocyanide of potassium is generally known under the name of *yellow prussiate of potash*

FI'CHTELITE A white crystalline substance found in a peat moss in Bavaria it is a hydrocarbon

FI'MBRIÆ (Lat fimbria, *a fringe*) In Anatomy, the jagged processes of the abdominal opening of the oviduct or "Fallopian tube," are so called

FIRE SHIP A vessel filled with combustible materials for the purpose of being sent in a burning state among the ships of an enemy, in order to set them on fire, and thereby effect their destruction As the destruction of the vessel itself is a necessary consequence, it must be abandoned by the men, and therefore cannot be steered Hence fire-ships are formidable only to vessels which cannot be manœuvred, either by reason of their having been disabled, or on account of their occupying a confined space, as a harbour, where there is not room for escape

FISCHERITE [illegible] phates of [illegible]

FLABE'LLIFORM (Lat flabellum *a fan*) Fan-shaped—as the plaited leaves of some palms

FLAGELLIFORM (Lat flagellum *a whip*) Whip-shaped A [illegible] whip's lash

FLEAM An instrument used by farriers to bleed horses and cattle it includes a small pointed blade, which is projected from a sheath by means of a spring

FLE'XOR MU'SCLES Muscles, the office of which is to *bend* the joints

FLOOD-GATE A sluice, or gate, for drawing off the superfluous water from a canal or reservoir liable to be flooded by falls of rain

FLORA One of the recently discovered small planets belonging to the group between Mars and Jupiter Flora was discovered at Mr Bishop's Observatory in the Regent's Park, on the 18th of October, 1847, by Mr Hind while comparing the fourth hour of the map of Professor Knorre with the Heavens It had then the appearance of a star of the ninth magnitude, but shortly after the discovery the brightness [illegible] equal to that of a star of the eighth [illegible] At Mr Bishop's request, Sir John Herschel named the planet *Flora*, with a rose for the symbol It is the eighth of the group The period of revolution of this planet appears to be somewhat shorter than that of any other of the group being 1193 25 days (*Monthly Notices of the Royal* [illegible] *See* PLANET

FLUOCERINE, FLUOCERINE The native fluoride of cerium, occurring near Fahlun, in Sweden

FLUELLITE Native fluoride of aluminum, occurring at Stenmagwyn, in Cornwall.

FOG-RINGS Banks of fog arranged in a circular or ring form, a meteorological phenomenon not unusual on the coast of Newfoundland (See *British Association Report for* 1846)

FOLLICLE (Lat) In anatomy this term is applied to a simple gland, consisting merely of a hollow vascular membrane, and an excretory duct hence the term *mucous* and *sebaceous follicles*

FOMES In medical language this term is applied to porous substances capable of absorbing and retaining contagious effluvia Wool and woollen clothes are said to be active *fomites*

FONT *of Type* *See* FOUNT, in DICT

FORENSIC MEDICINE (Lat forum, *the bar*) The application of medical science to the elucidation or solution of judicial questions

FOREST MARBLE A portion of the series of the lower oolite formation consisting of a coarse laminated shelly oolite, interposed between beds of clay and grit See GEOLOGY

FORESTS, SUBMARINE The inroads of the sea have in many places submerged forests of considerable extent A submarine forest on the coast of Lincolnshire was described in 1799 by Correa de Serra (*Phil Trans*) Another was discovered in 1832 in Cardigan Bay it is said to have been submerged in the year 520 The remains of the trees are covered by peat. A similar fir wood, beneath the mean level of the sea, exists at Bournemouth, in Hampshire These forests are sometimes also found in inland situations, of which there is a [illegible] four miles west of Newcastle-on-[illegible] consisting of an immense number of trees lying a few feet beneath the surface At the bottom of the moss of Kincardine, under a bed of peat

from 8 to 12 feet thick, are a number of trees which have been cut down, and hatchets are occasionally found in the moss It is supposed that these are the relics of the Caledonian forest cut down by Agricola (Lyell's *Geology*, &c Thomson's *Geology*, &c )

FORMULA (Lat ) In Chemistry, a concise mode of exhibiting by symbols the results of chemical changes, and dependent upon the theory of atomic equivalents These formulæ are employed either to represent the actual results of experiment, or to indicate the different theoretical or hypothetical views which may be taken in reference to the composition of certain products Formulæ, therefore, are either empyrical or rational As an instance of the first-mentioned application of formulæ we may give those of water, of sugar, of carbonic acid, of alcohol, and of ether Water is a compound of an atom of hydrogen=1, and an atom of oxygen=8, the formula, therefore, of *water* is H O The formula of grape-sugar is $C_{12} H_{12} O_{12}$, that is, it consists of 12 atoms of carbon, 12 of hydrogen, and 12 of oxygen Carbonic acid consists of 1 atom of carbon =6 and 2 atoms of oxygen=16, its formula, therefore, is $C O_2$ Alcohol is a compound of 4 atoms of carbon, 6 of hydrogen, and 2 of oxygen, its formula being $C_4 H_6 O_2$, and lastly, ether is a compound of 4 atoms of carbon, 5 of hydrogen, and 1 of oxygen, and is represented by the formula $C_4 H_5 O$ All these are *empyrical formulæ*, that is simple statements of the composition of the several bodies

In the act of fermentation sugar is resolved into alcohol and carbonic acid, and this change may be concisely represented by the following arrangement of formulæ

$$C_{12} H_{12} O_{12} = 4 (C O_2) + 2 (C_4 H_6 O_2)$$

that is, 1 atom, or *equivalent* (for we use these terms synonymously) of grape-sugar, is equal to 4 atoms of carbonic acid and 2 atoms of alcohol

Now, in reference to the use of *rational* formulæ it may be remarked, that sugar may be hypothetically represented as a compound of 12 atoms of carbon, and 12 of *water*, and in that case its formula would be $C_{12} + 12 (H O)$

Again, alcohol is resolvable into ether and water, for $C_4 H_6 O_2$ is $= C_4 H_5 O + H O$ and lastly, ether may be regarded as an oxide of a hydrocarbon composed of 4 atoms of carbon and 5 of hydrogen, and which has been termed *Ethyle*, in which case its formula might be written $C_4 H_5 + O$, or ether may contain a hydrocarbon composed of 4 atoms of carbon and 1 of hydrogen in combination with an atom of water, in which case its rational formula would be $C_4 H_4 + H O$

FORMYLE The basic hydrocarbon of the formic acid $= C_2 H$

FORSTERITE A crystalline mineral accompanying the products of Vesuvius

FOUSEL OIL or FUSEL OIL (Gr φυω, *I produce*) [illegible] spirit and potato-spirit, and which [illegible] a disagreeable taste and smell When purified it constitutes the *amylic alcohol*, or hydrate of oxide of amyle, of modern chemists Its formula is $C_{10} H_{11} O + H O$

FOWLERITE A silicate of manganese and iron, from New Jersey

FOWLER'S MINERAL SOLUTION A solution of *arsenite of potassa* introduced into medicine by Dr Fowler of Stafford, as a substitute for a similar preparation, sold as a quack medicine, under the name of *Tasteless Ague Drops* The *Liquor Arsenicalis* of the Pharmacopœia is for the same purpose

FRAGARIA (Lat fragro *I smell sweet*) A genus of plants including the *Strawberry*

FRAGMENTARY ROCKS A geological term [illegible] posed of the agglutinated [illegible] *ceæ* and *Conglomerates* are of this class

FRANKLINITE A ferriferous oxide of zinc occurring in New Jersey, N America, so called in honour of Dr Franklin

FRAXINUS (Lat.) The ash A genus of plants, in which the common ash, *Fraxinus excelsior*, and the manna tree *Fraxinus ornus*, are included

FREE CHURCH OF SCOTLAND The name assumed by the [illegible] Presbyterians in Scotland that separated from the Established Church in 1843 Under the head Voluntaryism we have detailed at some length the causes that led to this important movement, and their results; and it remains for us here only to say [illegible] expected, the Free Church embraces a [illegible] adherents In 1851, no fewer than 570 [illegible] built for the accommodation of its members, 70 more were, at the same time, in the course of being built, and others were projected It had then, also, 613 ordained clergymen, and 197 congregations without ministers Very conflicting estimates have been formed of the total numbers of those within the pale of the Free Church; these being exaggerated by its friends, and underrated by its opponents On the whole, however, they may perhaps be safely estimated at about 600,000

Nothing, perhaps, has been so extraordinary, in connexion with the history of this secession, as the zeal and liberality displayed by the public in subscribing funds for the building of churches and the support of the clergy These amounted, in May, 1845, to no less than 776 453*l*, of which not 10 per cent was unpaid Large additional subscriptions have since been received During the year ended 30th March, 1850, the sum of 306 622*l* was received by the Free Church for its various objects A handsome college in connexion with the Free Church has been opened in Edinburgh, and houses (manses) for the accommodation of the clergymen have been built in most parts of the country

FRENCH CHALK Talc, or silicate of magnesia

FRENCH POLISH A solution of shell-lac in spirit of wine is the basis of this compound, a small quantity of linseed oil is added to it at the time of its application, and it is laid on by a ball of cotton-wool and rapidly rubbed in the direction of the fibres of the wood, when dry it is finished off by friction with tripoli and oil

FRENCH WHITE Finely pulverised talc

FRIABILITY (Lat frio, *to crumble*) The property by which substances admit of being crumbled into powder by gentle friction

FRIARS BALSAM The *compound tincture of Benzoin* of the London Pharmacopœia It is an alcoholic solution of benzoin styrax, tolu balsam, and aloes, it is used as a stimulating application to wounds and ulcers

FRIESLAND GREEN *Brunswick Green* An oxichloride or an ammonio chloride of copper

FRITILLARIA In Botany a genus of *liliaceous* plants including the *F Imperialis* or *Crown Imperial*

FRONTAL SINUS A cavity in the frontal bone, placed over the orbit, on each side

FRUGORDITE A silicate of alumina, lime, and magnesia from Finnland

FULGURITE The fused or vitrified tube which is produced by the passage of lightning through a sandy soil

FUMARIC ACID An acid existing in the *fumaria officinalis*, or common fumitory it may be produced by the action of heat on malic acid

FUMING LIQUORS Certain chemical compounds which exhale visible fumes or in common language *smoke*, when exposed to air *Boyle's fuming liquor* is sulphuret of ammonium *Cadet's fuming liquor* is an arsenical compound now termed *oxide of kakodyle* the *fuming liquor of Libavius* is the anhydrous bichloride of tin

FUNDUS (Lat fundus, *a basis*) In Anatomy, the base of any cone shaped organ the term is usually restricted to that part of the womb, the urinary bladder and the gall bladder

FUNGUS HÆMATODES *Spongoid inflammation, Soft cancer* A species of malignant tumor, called also *medullary sarcoma*

FUSCIN (Lat fuscus *tawny*) A brown colouring matter obtained from empyreumatic oils

FUSCITE (Lat fuscus *tawny*) A yellowish variety of compact scapolite from Norway It has also been termed gabronite

FUSEL OIL See FOUSEL OIL

FUSIBLE CALCULUS That species of urinary calculus which consists of a mixture of ammonio magnesian phosphate, and phosphate of lime, and which is characterised by the facility with which it enters into fusion before the blow pipe

FUSIFORM (Lat fusus *a spindle*) Spindle-shaped, thickest at the middle and tapering towards the ends

FUSINÆ, in Conchology, a term used for spindle shells

## G

GABIAN OIL A petroleum or mineral naphtha exuding from the strata at Gabian, a village in Languedoc

GABRONITE (Gabbro, the Italian name of a rock composed of diallage and felspar) A mineral found in a vein of titaniferous iron near Arendal, in Norway It is a silicate of alumina, soda, and potassa It has also been termed *Fuscite* and *compact scapolite*

GADUS In Ichthyology, the name of a Linnæan genus of fishes, including the haddock, cod, whiting, and [illegible]

GAHNITE [illegible] of zinc, called also *automalite* Named from Gahn, who first described it

GALACTIC CIRCLE (Gr γαλα, *milk*) A term first used by Sir John Herschel to denote that great circle of the heavens to which the course of the Milky

Way, as traced by the unaided eye, most nearly conforms It is inclined, at an angle of about 63°, to the equator, and cuts that circle in two points, whose right ascensions are respectively about 0 h 47 m and 12 h 47 m, so that its northern and southern poles respectively are situated in R A 12h 47 m, N P D 63°, and R A 0 h 47 m, N P D 117° This circle, Sir John Herschel observes, is to sidereal what the invariable ecliptic is to planetary astronomy — a plane of ultimate reference, the ground-plane of the sidereal system (*Outlines of Astronomy*) *See* GALAXY

GALA'CTIC POLES (Gr γαλα, *milk*) The two opposite points of the heavens, situated at 90° from the Galactic Circle

GA'LACTINE (Gr γαλα, *milk*) An ingredient in the sap of the *Galactodendron utile*, or Cow tree of S America

GALACTODEN'DRON (Gr γαλα, *milk*, δενδρον, *a tree*) The *Palo di Vaca*, or *cow tree* of S America when tapped it yields a white, palatable, and nutritious liquid, much resembling milk

GA'LAXY (Gr γαλαξια, from γαλα, *milk*) The *Via Lactea* or Milky Way This luminous zone, so remarkable in a clear night, must have attracted the notice of the first observers of the heavens, and its true nature seems to have been surmised at an early period Manilius, in his Astronomicon, after alluding to the well known mythological fable of its origin, asks

> Anne magis densâ stellarum turba coronâ
> Contexit flammas, et crasso lumine candet,
> Et fulgore nitet collato clarior orbis?

The explanation of the phenomenon here suggested, namely, the condensed light of countless multitudes of small stars so crowded together as to be individually undistinguishable, is ascribed to Democritus, and its truth was confirmed or at least rendered greatly more probable, immediately on the discovery of the telescope, Galileo himself enumerating among the advantages resulting from his instrument, that of putting an end to the disputes about the nature of the milky way About the middle of the last century, Wright of Durham, and Kant and Lambert in Germany, speculated on the connexion of the phenomenon with the general arrangement of the stars in space, but the first who undertook a systematic examination of the galaxy with telescopes of adequate power was Sir William Herschel and it is to the indefatigable labours of this great astronomer and to those of Sir John F W Herschel who, during his memorable residence at the Cape, with the same telescope as had been used by his father, and by a similar process of examination, explored the regions of the sky which are invisible in our latitudes that astronomers are mainly indebted for the facts upon which any sound speculation respecting the constitution of the heavens can as yet be founded

The Milky Way, as seen by the naked eye presents the appearance of a succession of luminous patches of varying intensity Its breadth is very unequal in some parts hardly exceeding 5 degrees in others extending to 16 degrees, and there is a part between Serpentarius and Antinous where the two branches into which it is there divided occupy together a breadth of 22 degrees Its course through the heavens is nearly that of a great circle inclined at an angle of about 63 degrees to the equator, and cutting that circle in two points whose right ascensions are, respectively, 0 h 47 m and 12 h 47 m Struve remarks that the most condensed stratum does not lie exactly in one plane but appears rather to be contained in two different planes inclined at an angle of 10 degrees, and intersecting in the plane of the celestial equator, the sun being at a little distance from the line of intersection This slight deviation from a great circle had been remarked at an earlier period, and Lambert supposed it might be occasioned by the place of the sun being not exactly in the middle of the zone, but a little on one side It is convenient however, in speaking generally of the system of the galaxy, to refer it to a great circle of the sphere, and the great circle to which it most nearly conforms has been named by Sir John Herschel the *Galactic Circle*

At several parts of its course the Milky Way throws off streams or branches In Perseus a branch is sent off which is traceable to a considerable distance Another proceeds from a point near the star *m Puppis* nearly on the southern tropic In Argus it opens out into a wide fan-like shaped expanse, nearly 20° in breadth, which terminates abruptly, and at this part its continuity is interrupted by a wide gap At *α Centauri* it again subdivides At *γ Sagittarii* it suddenly collects into a vivid oval mass, about 6° in length and 4° in breadth, so exceedingly rich in stars that a moderate calculation gives upwards of 100,000 On the other hand, spaces occur in the very middle of its course, [illegible] eye, entirely devoid of stars, [illegible] most remarkable of these is situated in the Southern Cross, where the Milky Way approaches the nearest to the south pole, and so striking is its appearance that the early navigators described it by the name of the *coal sack* This space is of an irregular pear shaped form; it is about 8° in length and 5° in breadth, and was described and figured by the Abbé Feuillee in 1710 Lacaille correctly attributed its striking blackness to the effect of contrast with the vivacity of the Milky Way which surrounds it on all sides, and which in this region is remarkably brilliant.

At first view it might seem a hopeless attempt to determine the form or boundaries of the agglomeration of stars forming the galaxy, insomuch as we see only its projection on the surface of the celestial sphere, and that, too, from a position within it If however, the two following hypotheses be admitted 1st, that the stars are so distributed through space as to be, on the average, at nearly equal distances from each other, and 2d, that the telescope penetrates so far as to reach the extreme limits of the agglomerated mass, — then the relative distances of the remotest stars in every direction, and consequently the shape of the mass, may be estimated [illegible] number of stars in the field of view of one [illegible] same telescope in a great number of different directions, for, granting the above hypothesis, it is obvious that the distances of the remotest stars will be proportional to the cube root of the whole number visible in the field This was the process followed by Sir William Herschel, in his celebrated *gauges of the heavens* The telescope he made use of was a reflector of 20 ft. focal length, having an aperture of 18 inches in diameter, and the magnifying power was 180 With this instrument he made upwards of 3400 gauges, and thereby ascertained the number of stars visible in the field of the telescope in so many different directions

[illegible] was [illegible] field of view on increasing the angle between the direction of the telescope and the plane of [illegible] From a careful analysis of the gauges of Sir William Herschel Struve deduced a formula which expresses the number of stars in a field of view of 15 minutes in diameter in terms of the angular distance from the galactic equator At the distances of,

| 0° | 15° | 30° | 45° | 60° | 75° | 90° |
|---|---|---|---|---|---|---|

the numbers (representing the average of the gauges) are, respectively,

| | | | | | | |
|---|---|---|---|---|---|---|
| 122 00 | 30 30 | 17 68 | 10 36 | 6 52 | 4 68 | 4 15 |

whence it appears that the average density of the stars in the plane of the galactic circle is nearly thirty times greater than in the direction of its poles The researches of Sir John Herschel have established the fact that a similar law of diminution is observed in the southern galactic hemisphere, the average number of stars in a field in both hemispheres being very nearly the same at equal angular distances from the galactic equator

It is to be remarked that the great increase in the number of stars which is observed in the neighbourhood of the galaxy is occasioned chiefly by the greater abundance of telescopic stars that is to say, of those beyond the 6th order of magnitude Stars of the first magnitude are distributed over the sphere with tolerable uniformity Taking however, the whole number visible to the naked eye, a rapid increase is perceptible as we approach the limits of the galaxy, but with respect to those of the smaller magnitudes, and particularly beyond the 11th, the accumulation along that circle and its branches almost exceeds imagination The vast predominance of the small stars must be held to indicate the immense distances at which they are situated

From the relatively greater abundance of stars in the plane of the galactic circle, than in the regions on either side of it, and from the indication of some preponderance on the southern side, Sir W Herschel drew the conclusion that the galaxy is composed of a stratum of stars of which the thickness is inconsiderable in comparison of its length and breadth, and that the sun is placed not far from the middle of the stratum, but somewhat nearer to its northern than to its southern side He was also enabled to draw a further conclusion Assuming the real magnitudes of stars to be the same on the average, through the whole sidereal system, he determined by a series of photometrical experiments that stars of the 6th magnitude (the least visible to the naked eye) are 12 times more remote than those of the first (Sirius, for example), and that the penetrating power of his 20-foot telescope (with the front view) was 75 times greater than that of the naked eye so that the smallest stars visible in the telescope are at a distance equal to 900 times the distance of Sirius Now the average apparent breadth of the Milky Way is about five degrees, consequently its linear breadth at that great distance must be 900 × sin 5° or equal to 78 times the distance of Sirius or more than six times the distance of the stars of [illegible] Therefore the Milky Way even in [illegible] its poles, extends to three

times the distance of the smallest stars visible to the unaided eye, the sun being supposed at the centre of the stratum Hence it follows that not only our solar system, but all the stars in the firmament visible to the naked eye, are plunged to a great depth in the stratum of stars forming the galaxy, and form an integral part of it

It must be kept in mind that the above conclusions are based on two hypotheses which are, at best, very precarious, and in fact both of them appear to have been abandoned by Sir W Herschel himself in his later years. With respect to the first, namely, the distribution of the stars in space at nearly equal distances from each other, he remarks in a paper published in 1817, that although a greater number of stars in the field of view may be taken in general as an indication of their extension to a greater distance, yet the gauges have in reality more direct reference to the condensation than to the distance, and hence a greater number in the field of view may be explained as well by a greater condensation of the nebula as by a greater extension of its figure in the direction in which the stars appear most numerous The other hypothesis, namely, that the telescope penetrates to the extreme boundaries of the galaxy is subject to much doubt, and cannot be easily established or disproved Sir W Herschel, speaking in 1818 of his 40-foot telescope, the penetrating power of which he estimated to reach to 2300 times the distance of Sirius, states, as his opinion, that even at this enormous distance the limit of the stratum was not attained, inasmuch as the telescope failed to resolve the nebulous appearance into stars and he therefore concluded the stratum to be fathomless Sir John Herschel thinks the limit has been attained only in certain directions, "Throughout by far the largest portion of the extent of the Milky Way in both hemispheres the general blackness of the ground of the heavens on which its stars are projected, and the absence of that innumerable multitude and excessive crowding of the smallest visible magnitudes, and of the glare produced by the aggregate of multitudes too small to affect the eye singly, which the contrary supposition would appear to necessitate, must, we think, be considered unequivocal indications that its dimensions, *in directions where these conditions obtain* are not only not infinite, but that the space penetrating power of our telescopes suffice fairly to pierce through it and beyond it" But, on the other hand, there are parts where not the slightest indication of a limit is discernible "Such is, in effect, the spectacle afforded by a very large portion of the Milky Way in that interesting region near the point of its bifurcation in Scorpio where through the hollows and deep recesses of its complicated structure, we behold what has all the appearance of a wide and indefinitely prolonged area, strewed over with discontinuous masses and clouds of stars, which the telescope at last refuses to analyse" (*Outlines of Astronomy*, 1849)

It thus appears that the amount of knowledge which has yet been obtained respecting the constitution of the galaxy, is extremely [illegible] conclusions, in fact, which can be safely drawn are the following —

1 That the whole light of the Milky Way is nothing but the light of innumerable stars of all magnitudes down to the faintest point perceptible in the best telescopes

2 That the phenomena, on the whole, agree with the supposition that the stars of our firmament, instead of being scattered through space indifferently in all directions, form a stratum of which the thickness is small in comparison of its length and breadth, and that the sun occupies a place near the middle of the thickness, and near the point where the stratum is subdivided into two principal laminæ

3 That if all the fixed stars in the firmament be regarded as forming one great system — that of the galaxy — we are still in complete ignorance of its extent, and without the least idea of its external form

GALE'GA (Gr *γαλα*, *milk*, because it is supposed to increase the milk of [illegible] The name of a genus of [illegible] or *goat's rue*, a plant of little taste, and eaten in Italy in salads

GA'LIPOT A white resin derived from the *Pinus maritima*

GALLI'ZENITE A mineralogical synonym of *Titanite*

GALT A provincial term applied to certain beds of chalk-marl, found in the east of England, between the upper and lower greensand

GANGUE The mineral substances which accompany metallic ores in the veins of rocks

GARANCINE One of the colouring matters derived from *madder*

GARCINIA (From Dr Garcin) A genus of plants including the celebrated *Mangasteen tree*, the fruit of which, about the size of an orange, is said to excel in flavour and salubrity

GASHO'LDER. A hollow cylindrical vessel open at bottom and closed at top, suspended by counterpoises in a tank of water, so that it may be filled with gas introduced by a central pipe, and the gas afterwards distributed by proper pressure through the mains which convey it for service Some of these gasholders of coal-gas are of enormous size, holding half a million cubic feet and upwards

GASOMETER This term is often applied to the gasholders of coal-gas works, but it should rather be limited to a smaller instrument constructed upon more delicate principles, and capable of accurately measuring the quantity of gas of any kind which passes into and out of it These instruments are sometimes constructed upon a much smaller scale in glass and iron, for the purpose of containing mercury, so as to be used for gases which are absorbable by water

GASTRO'TOMY (Gr *γαστηρ*, and *τεμνω*, *I cut*) The [illegible] cutting into the abdomen

GAY LUSSITE A mineral named after Gay Lussac, found at Lagunilla, near Merida, it is composed of nearly equal weights of carbonate of soda, carbonate of lime, and water

GAZOLYTES *See* AEROLITES, in DICT

GEAR, or GEER A term applied in Mill work to wheels, or wheels and pinions, acting into each other *Spur gear* signifies wheels acting together in the same plane, with their axes parallel, for example, the wheel and trundle *Bevel gear* is applied to wheels acting together whose axes are inclined to each other

GEINE (Gr *γη the earth*) The soluble brown matter which may be extracted from soils by the action of water *See* HUMIC ACID

GELO'SCOPY (Gr *γελαω*, *I laugh*, and *σκοπεω*, *I view*) A divination founded upon laughter, whence the qualities and characters of persons might, it was presumed be deduced

GEMITRICES (Lat *gemo*, *to moan* or *coo*) In Ornithology, an order of birds comprising the *Columbinæ* or pigeons

GENETTE (Fr) A small variety of horse Also an animal of the weasel kind (*Viverridæ*), having a musky odour

GENIOGLO'SSI (Gr *γενειον*, *the chin*, and *γλωσσα*, *the tongue*) In Anatomy, a pair of muscles by which the tongue is protruded

GENISTA (Lat *genu*, *a knee*, so named from the inflection and angularity of the twigs) A genus of plants including the *G tinctoria* or *Dyer's Broom*, &c

GEORAMA (Gr *γη the earth*, and *οραω*, *I see*) The name given to a large concave globe, or spherical chamber, having the features of the earth delineated on the concave surface A spectator in the interior of such a globe sees a much larger portion of the surface at once than if he occupied an exterior position, and it has accordingly been suggested as a theatre for geographical lectures (*Address to the Anniversary Meeting of the Royal Geographical Society*, 1850, by the President Captain W H Smyth R N)

GEOTHERMO'METER (Gr *γη*, *the earth*, and thermometer) An instrument for measuring the earth's heat at different places, as in wells and mines, and for determining its rate of increase with the depth The temperature rises about one degree of Fahrenheit's scale for every 70 or 80 feet of descent, hence the inference that at the depth of a few miles the earth must be incandescent

GERMAN SILVER A silver-like alloy generally composed of nickel, copper, and zinc, various proportions are given, amongst which the following are said to be the best 1 nickel, 1 zinc, 2 copper, and 8 nickel, 3½ zinc, 8 copper It resembles the tutenag of the Chinese

GERM-CELL In Physiology, the cell which results from the union of the spermatozoon, or spermatic matter conveyed by it with the germinal vesicle, or its nucleus The germ-cell assimilates the surrounding yolk and propagates its kind by spontaneous fission, whence the first or parent-cell has been termed the "primary germ-cell," and its progeny the "derivative germ cells"

GERMINAL AREA In Physiology, the circular or oval space formed by liquefaction and metamorphosis of a peripheral portion of the germ mass preparatory to the appearance of the first trace of the proper embryo It is divided into a central clear part called "area pellucida," and a peripheral part called "area opaca," the portion of the latter, in which blood and blood-vessels are developed is called the "area vasaclosa"

GERMINAL MEMBRANE In Physiology, the strata of cells and nuclei of cells originally forming, and afterwards extending from, the germinal area: the external stratum is the "vertebral" layer, also called the "serous" and "animal" layer, the internal stratum is the "visceral" layer, also called the "mucous" and "vegetal" layer

GERMINAL SPOT In Physiology, the nucleus of

the germinal vesicle. it consists of a finely granulated substance, strongly refracting the rays of light

GE'RMINAL VESICLE In Physiology, a clear nucleated cell, which is the first formed and most essential part of the ovum it is surrounded by the yolk, and passes to the periphery of that part prior to impregnation, after which the germinal vesicle becomes opake, or disappears It was formerly called, after its discoverer, the Purkinjian vesicle

GERM MASS In Physiology the materials prepared for the future formation of the embryo, consisting of the derivative germ-cells and the yolk which they have assimilated

GERM YOLK In Physiology, that portion of the primary yolk of the egg which is to be assimilated by the derivative germ-cells in the formation of the germ-mass In some animals the whole yolk is so assimilated, in others, as e. g the bird, only a very small portion, that, viz which is included in the germ-mass of cells [illegible]

GIANT'S CAUSEWAY *See* GEOLOGY, in DICT

GIB'BSITE The native hydrated alumina of Massachusetts, named after Col Gibbs

GI'LBERITE A white talcy mineral composed chiefly of silica, alumina, and lime, from St Austle, in Cornwall, named by Dr Thomson, from Mr Davis Gilbert, late President of the Royal Society

GILL A measure of capacity equal to the fourth part of a pint Most people, however, to all Physiologists other than ichthyologists and other aquatic animals

GI'MBERNAT'S LIGAMENT The tendinous expansion of the lower portion of the oblique muscle of the abdomen, by some defined as the third insertion of *Poupart's Ligament*

GI'NGLYMUS GINGLYMOID (Gr *γιγγλυμος, a hinge, ειδος, like*) Hinge-like An anatomical term applied to joints formed for motion in one plane

GIROUETTE (Fr *a weathercock*) Public characters who turn with every political breeze The French published a *Dictionnaire des Girouettes*, containing the names of the most celebrated revolutionary characters, with a number of weathercocks against each, corresponding to the number of his political [illegible]

GISMONDINE A native silicate of lime, first noticed by Gismondi at Capo di Bove, near Rome It occurs in octohedral crystals

GIZZARD The proper stomach of birds, its texture differs remarkably in granivorous and carnivorous birds, being thick and fleshy in the one and thin in the other

GLACIES MARIA (Lat) One of the old mineralogical names applied to the large foliated *mica*.

GLANDERS A disease in horses characterised by mucous discharge from the nostrils

GLASS-GALL The saline scum which rises to the surface of fused glass in the glass pots, it is also called *sandiver*

GLASS SOAP A term sometimes applied in the glasshouse to certain substances which take away colour from glass, thus oxide of manganese destroys the green tint derived from iron

GLASS FOR TELESCOPES Till lately, English artists had failed in producing large disks of glass for the formation of object glasses for telescopes, all the large object-glasses in the public and private observatories being of foreign manufacture Since the duty has been taken off [illegible] in England [illegible] and Messrs [illegible] of pure glass 29 inches in [illegible] is 2½ inches, and weight [illegible] iced at the Great Exhibition of 1851, and was subjected to a very severe examination for the purpose of detecting defects arising from striæ, tension arising from imperfect annealing, bubbles, &c The only serious defect which was detected after a very lengthened examination was the existence of a group of striæ occupying a space of about 6⅛ inches in length, and 2⅛ inches in breadth, beginning at about 1⅛ inches from the edge, and having its longer dimension directed towards the centre It was found that if it were ultimately thought necessary to sacrifice the defective portion, a disk of absolutely pure glass of at least 22 inches, or probably even of 25 inches in diameter, would still be left, being almost double the diameter of the largest object-glasses mounted in any observatory at present

GLAUBERITE A double sulphate of lime and soda, occasionally associated with rock salt.

GLAUBER'S SECRET SAL-AMMONIAC Sulphate [illegible]

GLAUCOLITE (Gr *γλαυκος, azure, and λιθος, a stone*) A blue-green mineral from near Lake Baikal in [illegible] and potassa.

GLAUCONITE (Gr *γλαυκος, azure*) A constituent of the *green-sand* formation, it is also sometimes found in the cavities of certain trap-rocks. Under the name of *green-earth* it is used as a pigment It is [illegible] iron alumina and magnesia

GLAZING [illegible], it often contains oxide of lead [illegible]

GLECHO'MA A genus of plants including the *G. Hederacea* or *Ground Ivy*, a favourite popular remedy for the cure of obstinate coughs

GLE'NOID (Gr *γλενη, a cavity, ειδος, like*) A term applied in anatomy to certain articular surfaces of bones thus the surface of the scapula which articulates with the head of the humerus is called the *glenoid cavity* of the scapula or blade-bone

GLI'ADINE (Gr *γλια, glue*) A chemical term applied to one of the constituents of the gluten of wheat

GLO'CHIS (Gr *γλωχις a projecting point*) A form of hair occurring in plants forked at the apex a *barb*

GLO'SSOPETRÆ (Gr *γλωσσα, tongue*, and *πετρα, rock*) The fossil teeth of certain fishes

GLO'TTALITE (From *Glotta*, the river Clyde) A white mineral from the vicinity of Glasgow It is a hydrated silicate of lime and magnesia

GLUCO'SE (Gr *γλυκυς, sweet*) A distinctive chemical term applied to the sugar of grapes, and to starch sugar, &c See GRAPE SUGAR

GLUME In Botany, the *husk*, or peculiar calyx of grasses

GLUTE'AL (Gr *γλουτος, the buttock*) Of or belonging to the buttocks as gluteal *muscles, arteries, &c.*

GLYPHO'GRAPHY (Gr *γλυφω, I engrave, γραφειν, to draw*) An art by which an engraving is produced by the simple mode of drawing in other words, an art by which the operations of drawing and engraving, which were formerly distinct, are here combined in one Various admirable specimens of this art were displayed at the Great Exhibition The process is as follows — a drawing having been made through the ordinary etching ground, the plate is then etched, and rolled up with a mixture of various substances, a copper-plate be [illegible] over the whole

GMELINITE A hydrated silicate of alumina, potassa, and peroxide of iron, named after Gmelin, the mineralogist It has also been called *hydrolite*, from the quantity of water which it includes

GNAPHA'LIUM (Gr *γναφαλον, the wool of the teasel*) The name of a genus of plants including the *G dioicum* or *Cotton Weed*

GODBOLD'S VEGETABLE BALSAM A quack remedy composed chiefly of honey and vinegar

GO'DFREY'S CORDIAL A quack medicine made by infusing 9 ounces of sassafras shavings, and of bruised caraway, coriander, and anise seeds each 1 ounce, in 6 pints of water [illegible] reduced to 4 pints, then add [illegible] and treacle boiling for a few minutes straining, and adding lastly 3 ounces of tincture of opium

GOLD The auriferous deposits in California were discovered so late as 1848, and the accounts of their extraordinary productiveness occasioned an unparalleled influx into the country of adventurers from the U. States and all parts of the world For a while the accounts in question were pretty generally regarded by the less sanguine portion of the public as being in the highest degree exaggerated But the result has shown that such had not been the case, and the produce obtained from the washings and the mines has exceeded even the most extravagant *à priori* estimates of its magnitude It is believed on good grounds, to have amounted in 1849, 1850, and 1851, to from 8,000,000*l* to 10,000,000*l* a year, and it is increasing with every increase in the numbers and skill of the diggers and miners Whether it will continue at this rate for any considerable time it is impossible to say But if it does, it cannot fail to exercise a powerful influence over the value of gold

But it is not alone from California that new supplies of gold are beginning to be thrown upon the market An auriferous region has very recently been discovered in Australia, about 160 m W Sydney And though it be, at present, impossible to form any estimate of its probable productiveness its appearances are most flattering Some very large masses of native gold have been discovered, and the locality in which it is found bears, it is said, a striking resemblance to that of the most productive of the auriferous regions of California

GOLDBEATER'S SKIN The membrane used by goldbeaters, and interposed between the leaves of gold when they have attained considerable tenuity the intestinal membrane of the rectum of the ox is generally used

GOLDEN SULPHURET OF ANTIMONY A preparation of [illegible] consisting of a mixture of the sulphuret and oxide of the metal

GOLD LEAF *See* GOLD, in DICT

GO'LHITE One of the mineralogical synonyms of

the *hydrated peroxide of iron*, or brown fibrous hematite of ores

GOMPHOLITE (Gr *γομφος* a nail, *λιθος* a stone) A term applied by Brongniart to certain rocks of the tertiary series of the Isle of Wight

GORDIUS (Lat) The hair worm, or *seta equina*, found in stagnant water in Lapland and elsewhere

GORGONIA NOBILIS (Lat) An old synonym of *Corallium rubrum* or red coral

GOSSYPIUM (Lat) Cotton The systematic name of the cotton plant is *Gossypium herbaceum*

GRAIN The integer of our system of weights *See* WEIGHTS, in DICT The troy pound contains 7000 grains, and the avoirdupois pound 5760 grains The French decigramme is about 1 5 English grains, the gramme being 15 434 English grains

GRAIN TIN The purest kind of tin The term was formerly applied to the metal obtained from the rounded pebbles of tin stone, called *stream tin* The peculiar columnar fracture which pure tin exhibits when broken, is given by heating the ingot till it becomes brittle, and then letting it fall from a height upon a hard pavement

GRAINS OF PARADISE The seeds of a species of *amomum* they are acrid, and said to be the *malaguetta pepper* of Africa

GRAMMATITE The name originally given by Hauy to the mineral usually called *Actinolite* or *Amphibole*

GRAMME The French integer of weight = 15 434 English grains *See* WEIGHTS, in DICT

GRAMMITE A mineralogical synonym of the variety of bisilicate of lime, commonly called *Tablespar*

GRAPE SUGAR or GLUCOSE The peculiar form of sugar existing in grapes and in fruits generally it differs from cane sugar in having much less sweetening power and in being very imperfectly crystallisable its chemical formula in its crystallised state is $C_{12} H_{14} O_{14}$, that of crystallised cane sugar being $C_{12} H_{11} O_{11}$

GRASS-OIL Some of the *grasses* yield odorous volatile oils as the *Anthoxanthum odoratum*, the *Andropogon* of *Ivanguza*, and from the *Andropogon calamus aromaticus* or *nardoides*

GREEK FIRE A highly inflammable compound supposed to have been invented by the Greeks, and to have consisted of bitumen, or asphaltum, nitre, and sulphur

GREEN EARTH *See* GLAUCONITE

GREENLANDITE A [illegible]

GREEN LEAD ORE [illegible]

GREGORITE The *menachanite* of Cornwall discovered by Mr Gregor, whose name it bears An ore of titanium

GRIFFITHS' MIXTURE The Mistura Ferri Composita of the London Pharmacopœia, it is a useful ferruginous tonic, deriving its efficacy from the protocarbonate of iron

GROUND GRU Ice formed under peculiar circumstances at the bottom of running water *Grue* is the name given by the people of Lincolnshire to snow swimming in or mixed with water, and the ground ice, a phenomenon of not unfrequent occurrence in that part of the country having a considerable resemblance to this goes by the same name

[illegible] of the formation of ground ice is attended with some difficulty Dr Farquharson, who has carefully investigated the facts, and given the results of his observations on the ground grue of the rivers Don and Leschal in Lincolnshire, in two papers printed in the *Philosophical Transactions* for 1835 and 1841, is of opinion, that the ice is formed when the water has gone down to the temperature of the freezing-point in consequence of the bottom being cooled to a still lower temperature through the effect of radiation, in the same manner as dry land, under a clear sky is cooled below the temperature of the air and in corroboration of this opinion he states, that the formation never occurs excepting under a clear sky, and does not take place where the stream is shaded by bridges or high banks It has been objected to this theory, that ground ice has been observed in the Neva under a thickness of three feet of surface ice, and an additional covering of three feet of [illegible] ch radiation could not take [illegible] rightly remarks, that this fact can form no valid objection to his explanation, unless it were ascertained that the ground ice was formed *after* the surface ice and fall of snow, and not before M Arago, in the *Annuaire du Bureau des Longitudes* for 1833, after stating the observations which had then been collected on the subject, attributes the formation to three circumstances 1 In a body of water in motion, the temperature of which is below 39° of Fahrenheit (under which water becomes specifically lighter by a further diminution of temperature), the eddies of the current throw down the coldest parts which, in still water, would remain at the surface, so that the whole stream from the surface to the bottom acquires the same temperature through this mechanical action 2 The aptitude to the formation of crystals on the stones and asperities at the bottom 3 Less impediment to the formation of crystals at the bottom, in consequence of the comparatively greater stillness of the water Probably all these circumstances may concur, but as it frequently happens that they are all present when surface ice only is formed, some other conditions appear to be necessary, and Dr Farquharson's theory, or radiation, seems the most probable which has been yet suggested On this subject see, in addition to the works above referred to, Colonel Jackson's paper on the Congelation of the Neva, in the *Journal of the Royal Geographical Society*, Mr Eisdale's, in the *Edinburgh New Philosophical Journal*, vol xvii , and Mr Weitz's, on the Ground Gru of the Siberian rivers, in the *London Geographical Journal*

GROUND SWELL An undulation of the ocean caused by the continuance of a heavy gale of wind Ground swells are rapidly transmitted through the water, sometimes to great distances, and even in direct opposition to the wind, until they break against a shore, or gradually subside in consequence of the friction of the water They indicate, by the direction of their movement, the quarter in which a storm has raged, and occasionally they are observed to come from various points of the compass at the same time

GUN COTTON *Pyroxyline* A highly inflammable and explosive substance, discovered by Schonbein obtained by steeping clean cotton wool for a few minutes in a mixture of the strongest sulphuric and nitric acids in equal proportions, it is then thoroughly washed, and cautiously dried at a temperature of 212° The original appearance of the cotton is little changed, but it has now become explosively inflammable, and when kindled by a spark it very suddenly flashes off with greater rapidity and energy than gunpowder, for which it has been proposed as a substitute, but the sad accidents which have occurred in the attempts to manufacture it upon a large scale have hitherto prevented its employment. When used in a gun it is much more energetic, weight for weight, than gunpowder, but, like fulminating mercury, it is apt, from the extreme suddenness of its explosion to burst the gun It appears to be pre-eminently fitted for blasting rocks

The composition of gun cotton has not been very satisfactorily determined, by some it has been considered as a *nitrate of lignine*, that is, as a direct atomic combination of lignine and nitric acid, represented by the formula $C_{24} H_{16} O_{16} + 5 NO_5$ Porret thinks that the cotton acquires oxygen from the nitric acid and forms a new basic compound which he calls *lignea* and he regards gun cotton as a *hyponitrite of lignea*

Gun cotton is soluble in ether, and furnishes a glutinous liquor which has been used as an adhesive application in surgery, and even as a substitute for common sticking plaster or goldbeater's skin This solution has been called *Collodion* When spread upon a surface the ether evaporates and leaves the gun cotton in the form of a transparent film, still very inflammable and explosive, and like the gun cotton itself, becoming highly electric on friction

GURHOFITE A compact magnesian carbonate of lime from Gurhoff in Lower Austria

GUTTA PERCHA This important article, the uses of which in arts and manufactures are on the rapid increase is the produce of a large forest tree (*Isonandra Gutta* Nat Ord *Sapotaceæ*) growing in the mountains of Singapore and in the forests of Johore at the extremity of the Malayan Peninsula, and in Borneo, it is plentiful at Sarawak where it is called *Nato*, it is also supposed to abound on the clusters of islands to the south of Singapore The gutta percha appears to separate from the juice or sap of the tree in the same way as India rubber, and its general properties in regard to solvents and to the products of destructive distillation resemble those of caoutchouc At common temperature gutta percha is somewhat hard and very tough and unyielding, but when immersed in boiling water it softens so as to admit of being beaten into a mass and moulded into any requisite shape, and on cooling it resumes its hardness In very thin films it has a pale yellow or pinkish tinge, but generally occurs in brown or blackish lumps or masses, of a somewhat mottled appearance upon the cut surface, and translucent at the edges When softened it may be stretched into slips which do not recover their former shape when the force is withdrawn, but retain a kind of leathery pliability on cooling When heated to about 350° gutta percha undergoes a kind of fusion, and remains viscid when cold It burns with a strong yellow smoky flame It is said to be obtainable in very large quantities, but that from the destructive mode hitherto pursued by the natives in obtaining it, there is a risk of its scarcity It was first

made known in England in 1843 by a communication from Dr Montgomery to the Society of Arts

Gutta percha has been applied to the manufacture of ornaments architectural and other ornaments book-bindings water pipes engine-hose picture frames [illegible], and in hinges, and of the soles of boots and shoes, &c &c , and when blended with caoutchouc it is used for driving machinery, for saddles, cushions, walking sticks &c

GYNÆCONOMI Athenian magistrates superintending the conduct of women, and having the power of inflicting punishment in cases of misdemeanour They differed, therefore, from the *Gynæcosmi*, who were inspectors of dress

GYRASOL *See* GIRASOL in DICT

GYRATION, CIRCLE OF If a body revolve round an axis, a point can be found in it at a certain distance from the axis at which, if the whole body were compressed, the moment of inertia would remain the same This point is called the *centre of gyration*, and the radius of the *circle of gyration* is its distance from the axis Thus, if M be the mass of a body and $k$ the radius of gyration then $k^2 \times M$ = the moment of inertia, and if $r$ be the distance of any particle $m$ of the body from the axis, we have the equation $k^2 M = \Sigma (r^2 m)$ where the quantity on the right-hand side of the equation will be found by integration for the particular body under consideration

GYRINUS (Lat ) The water flea

GYROSCOPE (Lat gyrus *a circle*, Gr σκοπεω, *I view* ) An instrument for exhibiting the effects of revolution or rotation, or both together

## H

HABERGEON (Fr ) A coat of mail composed of chain-work for the defence of the neck and breast

HÆMACHROME (Gr αιμα *blood*, and χρωμα, *colour* ) The colouring matter of the blood called [illegible]

HÆMAL ARCH (Gr αιμα *the blood* ) That part of the vertebra or primary segment of the skeleton which encompasses the main axis, or its prolongations, of the vascular system It is situated opposite the neural arch, and, except in man, is inverted and beneath the centrum

HÆMAPOPHYSIS (Gr αιμα and αποφυσις *process* ) The autogenous vertebral elements which close or form the hæmal arch In the human thorax they lose the arch, as "cartilages of the ribs, with the aid of a hæmal spine or 'sternal bone,' in the Saurian and they form with the spine, the entire hæmal arch

HÆMATINE (Gr αιμα, *blood* ) The colouring principle of logwood

HÆMATOLOGY (Gr αιμα *the blood*, and λογος, *description* ) The doctrine of the blood

HAIDINGERITE [illegible] of antimony and iron, named after Haidinger

HAIR PENCILS A term applied by artists to the small brushes used in painting and often termed *camel's hair* pencils they are composed of fine hairs especially of the marten, badger, minever, polecat, &c , and are mounted, when small, in quills, but when larger, in [illegible]

HAUSMANNITE [illegible] of magnesia

HAIR'S BREADTH The forty-eighth part of an inch is sometimes so called

HALISPONGIA (Gr ἁλς, *the sea*, and Lat [illegible] The generic type of a group of sponges distinguished by the presence of *siliceous* spiculæ

HALITUS (Lat *vapour* ) In Physiology, the term is applied to the watery vapour which rises from newly-drawn blood the peculiar odour of blood is conveyed by this exhalation

HALLITE The subsulphate of alumina found at Halle

HALLOYSITE A mineral named after M Halloy It is a hydrated silicate of alumina

HALOSCOPE An instrument for the exhibition of all the phenomena of the parhelion &c Originated by Bravais who published a description of it in the Journal de l'Ecole Polytechnique of London in 1851 The instrument consists mainly of the following parts, all connected with and revolving on a vertical axis by means of a clock-movement — Two triangular glass prisms and one quadrangular, the first of which is hollow for the reception of water, a small mirror carried by a short arm, two opaque plates of glass for the purpose of observing one or two sides of the prisms, as may be found necessary, and, finally, a plate of glass.

To produce a representation of the parhelion, it is necessary to place a candle in a darkened chamber, on a level with and from 10 to 12 ft distant from the glass-prism on its axis of rotation the prism having two sides covered On looking [illegible] parhelion circle becomes visible By observing one side of the prism, only three horizontal lines are seen, two being found by external and one by internal reflexion

To produce an imitation of the white parhelion, the candle is placed in the same position, and two sides of the prism darkened, when, on looking at the [illegible] at a distance of 120° from the candle, [illegible] be perceived

Coloured parhelia may be exhibited by means of the prism of water, viewed at an angle of 20° or 25° One side of the prism being obscured [illegible] parhelion, red on the side next the [illegible] white train prolonged to 15° or 20°, will be seen

To imitate coloured parhelia, formed at a distance of 98° from the sun, the arrangements are the same By observing the prism and looking at the distance of 98° from the candle, a coloured spot will be observed, red to the side opposite to the candle, and less bright than the parhelion

The circumzenithal tangent of the arc may be imitated by means of the prism of water, the candle being lowered from its original position, and two sides of the prism darkened, on placing the eye in a proper position, the image will then be reflected upon the ceiling Several changes may be produced by simply turning the prism The circumzenithal arc may be produced by the above arrangement, the position of the eye only being altered

To imitate the anthelion it is necessary to make use of the quadrangular prism, its large transparent surface is turned towards the observer and the candle placed a little above the prism at the distance of six or eight feet from it A small circular mirror is then so placed that its centre is on a level with the top of the prism The eye being situated behind the prism will perceive a luminous circle described beneath its edge If a little slip of paper be placed beneath, it will be perceived more distinctly without moving By moving the position of the eye several distinct phenomena will become visible There are means of adjusting the apparatus to render the image for a time permanently fixed. Other phenomena besides those detailed can be shown by this instrument, and great merit is due to M Bravais, the inventor

HAND A measure of four inches, by which the height of a horse is computed also the parts of a horse — as *forehand*, for the head neck, and fore quarters, and *hindhand*, which includes the rest It also designates the hand of the rider, the *spur-hand* being the right hand, and the *bridle hand* the left

HARMALINE A crystallisable alkaloid contained in the seeds of the *Peganum Harmala*

HARMATTAN The dry parching wind prevailing on the coast of Africa, between Cape Verd and Cape Lopez, in the months of December, January, and February

HARMONIC RATIO In Geometry a straight line is said to be divided harmonically, or in harmonic ratio, when it consists of three segments such that the whole line is to one extreme as the other extreme is to the middle part *See* ANHARMONIC RATIO

HARRIER A small hound trained for hunting the hare remarkable for the acuteness of the sense of smell

HARRINGTONITE A mineral compound of silica, alumina, lime, soda, and water, from the North of Ireland

HARUSPICES *See* ARUSPICES in DICT

HAUSMANNITE [illegible] of manganese, so called from Prof Hausmann

HAVERSACK A strong coarse linen bag for carrying provisions on a march

HAYTORITE A variety of calcedony

HEADSTOCK In machinery, the framing used for supporting the gudgeons of a wheel

HEBE One of the recently discovered small planets belonging to the group whose orbits lie between Mars and Jupiter Hebe was discovered on the 1st of July 1847, by Hencke, of Driessen the discoverer of Astræa, while examining the stars in Bremiker's chart It had then the appearance of a star of the ninth magnitude, but soon after became fainter, and appeared as one of the tenth The new planet was named *Hebe*, with a cup for its symbol, by Professor Gauss Its periodic time is about 1380 days (*Monthly Notices of the Royal Astronomical Society*, vol viii ) *See* PLANET

HECATESIA In Grecian antiquity an entertainment [illegible] moon in honour of Hecate.

HECTOGRAMME A French measure of weight =100 grammes or 1543 4 English grains,

HECTOLITRE A French measure of volume =100 litres, or 6102 8 English cubic inches

HECTOMETRE A French measure of length =100 metres or 3937 English inches

HEDENBERGITE A silicate of lime and iron, first described and analysed by Hedenberg, in Sweden

**HE'DYPHAN.** An arsenio-phosphate of lead and lime from Sweden

**HE'LENINE** *Flecampane Camphor* A crystalline camphor-like substance, found in the root of *Inula Helenium*, or Elecampane Its vapour has a peculiar odour somewhat resembling that of *patchouli* Its chemical [illegible] the analyses of Dumas and Gerhardt [illegible]

**HELIOGRAPHY** (Gr ἡλιος, *the sun*, and γραφω, *I describe*) A general name given to the art of fixing images of objects by means of *Photography*, which see

**HE'LVINE** A mineral occurring in small crystals at Schwartzenberg, in Saxony, it is composed of the silicates of manganese, glucina, and iron

**HEMERALOPIA** (Gr ἡμερα, *the day*, and ωψ, *the eye*) A peculiarity in the sight, in which persons see in broad day light but not in the evening it is said to be endemic in some parts of Europe, and of the West Indies The pupil is generally more dilated and less sensible than in healthy eyes

**HEMIPINIC ACID** Semi-opianic acid An acid obtained by the oxidizement of the *opianic acid*

**HEMIPLEGIA.** (Gr ἡμισυς, *half*, and πλησσω, *I strike*) Paralysis of one side of the body

**HE'MISPHERES** In Anatomy, the two moieties of which the cerebrum is chiefly composed In man and mammalia they approach the hemispheric form, but in most of the lower vertebrata where the cranial cavity affords more room for the small brain, both moieties are spherical

**HEMITROPE** (Gr ἡμισυς, and τρεπω, *I turn*) A term applied by some crystallographers to what are usually called *twin crystals*, from their being generally conceived to result from the cutting, as it were, a crystal in half, and then turning one of the halves half round upon the other The plane common to the two portions of the crystal is called the *twinning plane* These crystals are often distinguished by the presence of notches or *re entering angles*

**HEPATIC AIR** (Gr ἡπαρ *the liver*) Sulphuretted hydrogen of modern chemistry

**HEPATITE** (Gr ἡπαρ *the liver*) A mineralogical name of some of the varieties of sulphate of baryta which have a liver colour

**HEROS FOUNTAIN** *See* FOUNTAIN, in DICT

**HE'RSCHELITE** A prismatic mineral from Catania, in [illegible] alumina, and potassa, so called [illegible] Herschel

**HESPERIDINE** An insipid white crystalline substance obtained from the soft spongy part of orange and lemon rind It has also been called Aurantine

**HE'TERO** (Gr ἑτερος, *the other, one of two*) As a prefix, or in composition, this term usually indicates *difference*, in opposition to the prefix *homo*, which indicates resemblance

**HETOPYLITE** (Derivation unknown) A native phosphate of iron and manganese

**HEULANDITE** A mineral formerly classed with the zeolites found in the basalt of the Giants' Causeway and [illegible] cate of alumina and lime

**HIBERNATION** [illegible] HYBERNATION, in DICT

**HIPPOCRENE FOUNTAIN** *See* FOUNTAIN, in DICT

**HILUM** The point by which a seed is attached to the seed vessel

**HI'PPOCRAS** Spiced wine The following is one of the most approved recipes for its preparation 2 ounces of cinnamon, half an ounce of canella alba, and of cloves, mace, nutmeg, ginger, cardamoms, each 1 drachm these are to be finely bruised and digested for three or four days, in a warm place, in a mixture of 12 quarts of canary and Lisbon wines the liquor is then to be filtered and 3 pounds of refined sugar added

**HIPPOCRATES SLEEVE** *Manica Hippocratis* An old pharmaceutical term [illegible] strainer made of flannel or linen, [illegible] bag

**HIPPUS** (Lat) A spasmodic affection of the iris, occasioning repeated dilatations and contractions of the pupil of the eye

**HI'SINGERITE** A hydrated silicate of peroxide of iron, found in Sweden and Germany, occurring in [illegible]

**HISTOLOGY** (Gr [illegible] λογος, *a discourse*) [illegible]

**HOCK** [illegible] al formerly observed in England on the second Tuesday after Easter, in commemoration of the destruction of the Danes in the time of Ethelred

**HOCAULITE** A [illegible] of *natr lite* from [illegible]

**HOLMITE** A species of carbonate of lime, named after [illegible]

**HOMBERG'S PHOSPHORUS** Fused chloride of calcium

**HOMBERG'S PYROPHORUS** *See* PYROPHORUS, in DICT

**HOMBERG'S SEDATIVE SALT.** Boracic acid, to which Homberg erroneously assigned sedative powers.

**HO'MO.** (Gr ὁμος, *one and the same*) A prefix used in composition to denote *resemblance*, and thus [illegible] ch indicates *difference*

**HOMŒOPATHY** (Gr ὁμοιος, *similar*, παθος, *affection*) A medical hypothesis promulgated at the commencement of the present century by the late Dr. Hahnemann, of Leipsig, according to which every medicine has a specific power of inducing a certain diseased state of the system, and if such medicine be given to a person suffering under the disease which it has a tendency to induce, such disease disappears because two similar diseased actions cannot simultaneously subsist in the same organ Medicines, therefore, are administered in doses sufficient to induce an action somewhat superior to that of the disease, and the doses which answer this purpose are *infinitesimal*, as it is called a millionth of a grain is often an excessive quantity "With respect to the homœopathic theory of the operation of medicines," observes a good recent authority, "all that can be said is, that it is a mere whim, unsupported either by reason or by facts With respect to the practice, it evidently amounts to doing nothing but regulating the diet and habits of the patient" Now, all judicious practitioners have long been agreed that there are many cases which are best treated in the manner just mentioned, and in which physic does more harm than good, in which, in short, a sensible physician endeavours to amuse the patient, while nature cures the disorder so that the frequent success of homœopathic treatment may be explained, without admitting the principles upon which it is presumed to be founded

**HOMOLOGY** (Gr ὁμος, *the same*, and λογος, *description*) In Anatomy, that department of the science which teaches the essential correspondence or answerableness of the parts, either in different animals, or in different segments of the same animal, or in the same segment, also the correspondence of the parts of an animal with the ideal archetype which has governed the plan of its organisation Thus firstly the wing of a bird is, homologically the same limb as the arm of a man or the fore-foot of a horse and the "os quadratum" of a bird is shown to be the same bone as the "os tympanicum" of the tortoise, and as the "auditory process of the temporal bone" of a man They are said to be 'homologous" parts, and the propositions are examples of what has been called "special homology' Secondly the wing of a bird is the same or correlative part in its segment of the body, as the leg is in a more posterior segment just as the frontal bone is the correlative element in its segment, with the superoccipital bone in its segment The wing of the right side is also the answerable part of the wing of the left side, in the same way that the right neurapophysis of any given segment answers to the left neurapophysis in the same segment Propositions of this kind are examples of what is termed 'serial homology," and the parts so corresponding are said to be 'homotypal" thus the arm is the homotype of the leg, the humerus of the femur, the radius of the tibia, the ulna of the fibula, &c Thirdly, in relation to the archetype of the verte[illegible] age" [illegible] ral spine," the exoccipital bone or "condyloid part of the occipital bone" in 'Anthropotomy" is the "neur[illegible] segment these propositions are instances of what is termed "serial homology," as being expressive of the [illegible] in that philosophical department of anatomical science — See Owen *On the Archetype and Homologies of the Vertebrate Skeleton*

**HOMONYMOUS** (Gr ὁμος, *the same*, and ονυμα, *a name*) In Anatomy, syn of Homotypal "If those of the right side arise from the left part of the brain, and *vice versâ*, which seems to be the opinion of the best anatomists, then one would imagine that the homonymous nerves of the right and left side must, in crossing over, lie somewhere contiguous to each other [illegible] other *Hartley*

**HOMOTYPAL** [illegible] d τυπος) In Anatomy, the correlative in one segment with any given part in another segment, or in the same segment, of one and the same animal Thus the frontal bone is the homotype of the superoccipital bone, the humerus is the homotype of the femur, the parts on the right side are homotypes of those which are repeated on the left side It is the object of "serial homology" to determine "homotypal" parts *See* HOMOLOGY

**HONEY DEW** A sweetish substance ejected upon the leaves of plants by certain *aphides*

**HOPPITE** A mineral named after Dr Hope, late Professor of Chemistry at Edinburgh, it is said to be a hydrous phosphate of zinc and cadmium

**HOOPOO** The vernacular name of the *Upupa Epops*, in Ornithology.

**HORSE POWER** A dynamical unit employed for [illegible] a steam engine [illegible] s improved steam engine [illegible], many of which had previously been [illegible] by horses, it became desirable to possess some measure of power whereby the size of engine proper for the supercession of any given number of horses might be approximately determined Mr Watt consequently made several experiments to ascertain the amount of power exerted by a horse in a given time, and he found that a strong dray horses would on an average raise a weight of 32 lbs through one foot in the minute, by the intervention of appropriate mechanism This dynamic effort, therefore, he designated a *horse power*, and when he had to introduce an engine which should be capable of performing the work of any given number of horses, he had only to take care that it would be able to raise 33,000 lbs one foot high in the minute for every horse power that it was intended to supersede The dimensions of engine which should be capable of raising any multiple of 33,000 lbs one foot high in the minute were at the same time determined, and that multiple expressed the number of horses power the engine was able to exert Thus [illegible] dimensions as to be able to [illegible] foot high in the minute, it would be 5 horses power, if it were able to raise 10 times 33,000 lbs one foot high in a minute, it would be of 10 horses power, and so of any other number The effective pressure on the piston of these engines, or the pressure considered available for imparting motion to any body, after deducting the power consumed by the engine itself, was reckoned to be about 7 lbs on the square inch The area of the piston, therefore, in square inches multiplied by 7 represented the effective moving pressure, and the space travelled through by the piston in the minute gave the distance through which the pressure or weight operated The total effective weight or pressure upon the piston, therefore multiplied by the space through which it passed and divided by 33,000, would indicate the number of horses power that the engine was capable of exerting, and as the effective pressure upon the piston was limited to about 7 lbs on the square inch, and as the speed of the piston was limited to about 220 feet in the minute, a certain dimension of engine was necessary to realise any prescribed power, and came to be considered as tantamount to that power In this way, therefore, engines of certain dimensions came to be considered as of a certain power, and engines were bought and sold by the horse power in the same way that cloth is bought or sold by the yard measure, and the engine would in all cases exert just about the power at which it was nominally rated

In process of time, however, a different state of things supervened When Watt's patent expired, numerous other manufacturers of engines sprang into existence By degrees the pressure upon the piston came to be increased the velocity of its motion was also increased, and a dimension of engine answerable to a horse power [illegible] than 33,000 lbs one [illegible] ontinued, however, to be bought and sold by the horse power, just as if there had been no increase in their efficiency, and the same dimension of engine was reckoned equal to a horse power that was accepted before There came, consequently to be two kinds of horse power,—the one a *dynamical unit*, which measures the number of times 33,000 lbs can be lifted one foot high per minute by the engine, and the other a *commercial unit*, which measures the dimension of the engine The dynamical horse power is what is termed *actual horse power*, the commercial or conventional unit is what is termed *nominal horse power* In [illegible] have been calculated from the [illegible] difference between actual and nominal power

The actual power of any engine cannot be determined except approximately before the engine is made, but it is ascertained when the engine is at work, by means of an instrument called the indicator An engine sometimes exerts more actual power than at other times, although its nominal power remains unaltered. For example, when a steam vessel in entering a harbour lowers her speed, the steam is partially excluded from the cylinder, and there is consequently less pressure upon the piston than before A similar result will follow if the coals be bad, or there be an inadequate proportion of boiler, and the efficiency with which an engine works is in all cases ascertained by determining by means of the indicator the actual power (see INDICATOR, in the SUPPLEMENT) In modern engines the actual power is from 2 to 4 times greater than the nominal power In other words, an engine purchased or popularly spoken of as 1000 horses power, will be able to lift from 2000 to 4000 times 33,000 lbs one foot high in the minute Such an engine, therefore, though nominally of 1000 horses power, will exert actually from 2000 to 4000 horses power; the exact amount of power exerted being determinable only by the application of the indicator to the engine For the mode of determining the actual power of an engine see the article INDICATOR The nominal power may be determined by the following rule — Multiply the square of the diameter of the cylinder in inches by the cube root of the stroke in feet and divide by 47 The result is the nominal power of the engine in horses The reader will find in the *Artizan Club's Treatise on the Steam Engine*, p 96, a table of the nominal horse power of low pressure or con[illegible]

**HUMORAL PATHOLOGY** The doctrine which refers disease to a morbid condition of the humours or fluids of the body, as opposed to *nervous pathology*, which refers them to the nervous energy resident in the solids

**HUMBOLDILITE** So called in honour of Humboldt A crystalline mineral found in the lava of Vesuvius [illegible] magnesia

**HUMIC ACID HUMIN** (Lat humus, *the ground*) The peculiar brown matter which may be obtained from bog-earth, peat, and turf, and which may also be extracted from most soils, where it is derived from the slow decay of plants, it is also contained in brown decayed wood, and in the brown exudations of the bark of certain trees, more especially in that of the elm, or *ulmine* By the action of several chemical agents on different organic bodies, the same substance is frequently produced It is a substance which contributes to the fertility of soil, chiefly, perhaps, in consequence of its absorptive power in regard to ammonia.

**HUMMOCK** A level sheet of *ice* A circular mound appearing at a distance is also so called

**HUNGER** (Germ) The sensation in the region of [illegible] which was considered [illegible] sometimes attended by pain and windy rumblings in the epigastrium When severe, hunger is [illegible] by slow respiration and circulation, a diminution of the heat of the body and of the secretions The return of hunger is accelerated by exercise and fatigue, and by a low temperature In debilitated constitutions excessive hunger should be carefully avoided, and in any case, the effects of fasting may prove prejudicial to the functions of [illegible]

**HUREAULITE** A phosphate of iron and manganese [illegible] in the Haute Vienne

**HURONITE** A mineral from the vicinity of Lake Huron, it is imbedded in a species of hornblende it is a hydrated silicate of alumina, and contains also lime, magnesia, and oxide of iron

**HYALOSIDERITE** (Gr *υαλος, glass, σιδηρος, iron*) A mineral consisting essentially of the silicates of magnesia and iron, from Sasbach, in Brisgau It is of [illegible]

**HYDROLITE** (Gr *υδωρ, water, λιθος, a stone*) A silicate of alumina, iron, and potassa, containing nearly 30 per cent of water it has principally been found in the amygdaloidan rocks of Antrim in Ireland.

**HYDROPATHY** (Gr *υδωρ* and *παθος disease*) This term is applied to a treatment of disease generally called the *cold water cure*, it was suggested in 1828, by Vincent Priessnitz of Graefenberg in Silesia, and consists in the internal and external administration of cold water, accompanied by air and exercise, early hours, and strict attention to diet, there are, therefore, many cases in which such a plan rationally pursued must be obviously useful, more especially to overphysicked individuals, residing in populous towns, eating and drinking too much, and keeping bad hours At the same time, some parts of the treatment "are of so outrageous a character, as frequently to aggravate the [illegible] which they were [illegible] and occasionally [illegible] temper or even destroy the life of the patient" (The term *hydropathy* is considered to be a corruption [illegible]

**HYDROSULPHURIC ACID** (Gr *υδωρ* and *θειον, sulphur*) Hydrosulphuric [illegible] of hydrogen

**HYDRURET, or HYDROGURET** A term applied in chemistry to some of the compounds of hydrogen more especially with the metals

**HYGEIA** One of the [illegible] planets between Mars and Jupiter Hygeia was discovered by Dr Annibal De Gasparis, of the Observatory at Naples, while comparing Steinheil's map with the heavens, on the 12th of April, 1849 It had then the brightness of a star between the ninth and tenth magnitudes De Gasparis referred the naming of the planet to Capocci, who called it *Hygeia*, and selected for its symbol a serpent crowned with a star It was the tenth in the order of discovery *See* PLANET.

**HYGROMA** (Gr *υγρος, moist*) A tumour contain[illegible]

**HYGROMETRY** (Gr *υγρος, moist*, and *μετρεω, measure*) Of the various methods which have been proposed for ascertaining the hygrometric condition of the atmosphere that which consists in deducing

the tension of the aqueous vapour contained in it from the temperatures indicated by two contiguous thermometers, one having its bulb kept wet, while that of the other is dry, is, perhaps, the most generally convenient, and is accordingly that which is usually adopted in [illegible] The apparatus has been called [illegible] and is described under that [illegible] the DICTIONARY OF SCIENCE, though the term, from its etymology, might be applied with equal propriety to any other hygrometer or instrument for measuring the quantity of vapour existing in air On account of the importance of this instrument in meteorology, we propose, here, to state the theory upon which its application depends

It may be proper to premise that the relation between the tension, or the elastic force of aqueous vapour and the temperature (a relation which is the subject of experiment) is supposed to be known for all temperatures under consideration, and exhibited in a table Hence to determine the elastic force of the vapour existing in the atmosphere at a given temperature, is the same problem as to determine the degree of temperature to which if the air were cooled down, it would be saturated with the same quantity of vapour as it actually contains, and begin to deposit moisture, and, reciprocally, if this temperature, which is that of the *dew point*, be determined, the tension of the vapour existing in the air becomes known from the previously ascertained relation between the tension and the temperature of aqueous vapour Tables of the numerical expression of this relation were constructed by Dalton, and are given in most works which treat of the subject *See* VAPOUR, in DICT

*Theory of the Psychrometer* —When water or any wetted surface is exposed to air not saturated with moisture, vapour is formed, and in the formation of vapour, heat is absorbed or becomes latent The heat thus absorbed being taken from the body from whose surface the evaporation takes place the body becomes colder, and the thin shell or stratum of air in immediate contact with it is cooled down to the same temperature Now, the theory of the psychrometer is founded on this hypothesis, namely, that the quantity of heat abandoned by the thin shells of air which successively come into contact with the wetted bulb of the thermometer is precisely equal to the heat absorbed in the formation of the vapour

From this hypothesis an equation is obtained which gives the tension corresponding to the temperature of the dew point in terms of the tension corresponding to the temperature of the wet bulb (that of evaporation) the difference of the readings of the wet bulb and dry bulb thermometers, and the height of the barometer, in the following manner Let $t$ denote the temperature, in Fahrenheit degrees, indicated by the dry bulb thermometer, and $t'$ the temperature indicated by the wet bulb thermometer The thin shell of air in immediate contact at any instant with the wet bulb, which previous to the contact had the temperature $t$ is cooled down to $t'$, and consequently abandons a certain quantity of heat But the shell is composed partly of dry air, and partly of aqueous vapour If, therefore, we assume

A=the heat abandoned by the dry air in the shell,
B=the heat abandoned by the vapour originally existing in the portion of air forming the shell,
C=the heat absorbed by the vapour formed and taken up by the shell,

then by the hypothesis

$$A+B=C \qquad (1)$$

To express these portions of heat universally, we have
A=weight of dry air in shell × specific heat of dry air × $(t-t')$,
B=weight of vapour in shell × specific heat of vapour × $(t-t')$,
C=weight of vapour formed × latent heat of vapour at temperatures between $t$ and $t'$

Now let
[illegible] air, at 32°, under a pressure [illegible] mercury,
$\alpha$=coefficient of expansion of air for 1° Fahrenheit =1-480th,
$\delta$=ratio of density of vapour to density of dry air,
$h$=height of the barometer in inches,
$f'$=elastic force of aqueous vapour, in saturated air, at temperature $t'$, measured in inches of mercury,
$x$=elastic force of the vapour actually existing in the air at temperature $t$, or the tension of vapour at the dew point,

then, in respect of the thin shell of air surrounding the wet bulb, we have the following expressions for the several weights, viz

Weight of dry air in shell $= w \frac{1}{1+\alpha t'} \cdot \frac{h-f'}{30}$,

Weight of vapour in shell previously to contact with wet bulb $= w\delta \frac{1}{1+\alpha t'} \cdot \frac{x}{30}$,

Weight of vapour formed $= w\delta \frac{1}{1+\alpha t'} \cdot \frac{f'-x}{30}$

Now putting

$\gamma$=specific heat of dry air,
$k$=specific heat of vapour,
$\lambda$=latent heat of vapour between $t$ and $t'$,

and substituting these and the above expressions for the weights in A, B, and C, the equation (1) becomes

$$\gamma(h-f')(t-t')+k\delta x(t-t')=\lambda\delta(f'-x),$$

from which we obtain

$$x=\frac{\lambda f'-\frac{\gamma}{\delta}(t-t')(h-f')}{\lambda+k(t-t')} \qquad (2)$$

Of the quantities which enter into this equation $t$, $t'$, and $h$ are given by direct observation, and $f'$ is given when $t'$ is known from the table of tensions above referred to The remaining quantities are supposed to have been determined experimentally, and their values are as follows —

1 From the experiments of Laroche and Berard the specific heat of dry air, $\gamma$, was found to be 0 2669, that of water being unity

2 The specific heat of aqueous vapour, $k$, is less certainly determined August assumes it to be equal to that of dry air Laroche and Berard found it to be 3 130 times that of dry air In the present case its accurate value is not important, for the term which it multiplies is so small in comparison of $\lambda$ that it may be rejected without sensible error

3 The density of aqueous vapour, $\delta$, referred to that of dry air at the same temperature, was found by Gay Lussac to be 0 6235, or nearly 5-8ths Regnault assumes $\delta$= 0 622

4 With respect to the latent heat of vapour, $\lambda$, its value at any temperature is deduced from its known or assumed value at 212° by means of the hypothesis (confirmed by experiment) that the sum of the latent and sensible heat is constant for all temperatures At 212° the latent heat of vapour is usually assumed according to the determination of Lavoisier to be 1000, that is to say as much heat is absorbed in the formation of a certain weight of vapour as would raise the temperature of 1000 times the same weight of water one degree of Fahrenheit's scale Hence at 32° it is 1180 Regnault ascertained by direct experiment that the formula for the psychrometer would be more accurate by taking $\lambda$ equal to 610° on the centigrade scale at the temperature of freezing, this corresponds to 1098° of Fahrenheit, and consequently, at 0° Fahrenheit the latent heat is 1130° For any other temperature, $t'$, we have, therefore, $\lambda=1130-t'$

Substituting these values of $\gamma$ $k$ $\delta$, and $\lambda$, in the formula (2), and rejecting $k(t-t')$ in the denominator, it becomes

$$x=f'-\frac{0\,429(t-t')(h-f')}{1130-t'} \qquad (3)$$

For $t'$=50°, this gives $x=f'-0\,0\,397(t-t')(h-f')$

If the temperature of the wet bulb fall below the freezing point the water surrounding the bulb is frozen, so that it is ice which is evaporated And as 140° of heat are expended in converting ice into water the formula becomes, for this case,

$$x=f'-\frac{0\,429(t-t')(h-f')}{1270} \qquad (4)$$

The value of $x$ being computed from this formula, the corresponding temperature in the table is that of the dew point

Objections of various kinds, theoretical and practical, have been raised to the results obtained by this method The fundamental principle adopted by August is that the whole of the [illegible] heat to the wet bulb falls to the [illegible] becomes completely saturated with moisture But it seems more probable that the air coming into contact with the bulb does not quite take the temperature of the bulb, and that the saturation is not complete [illegible] that the ratio of the quantity of [illegible] from the bulb by the vaporisation of the water to the quantity which it loses in being cooled is probably not constant, but so much the greater as the air is drier, because dry air absorbs moisture with greater avidity than when it is nearly saturated Another objection is that the heat which is absorbed in converting the water on the wet bulb into vapour is not supplied exclusively by the surrounding air, but in some measure by the radiation from objects around (for example, the frame to which the thermometers are attached, or the dry [illegible] which it is perhaps [illegible] Other objections [illegible] certainty as to the numerical values of some of the elements which enter

into the formula and especially with a view to the amount absorbed by water when vaporised [illegible] the object of the present paper is to describe the method of [illegible] Of several of accomplishing this is to compare the results of a large number of observations with the temperatures of the dew point ascertained directly by simultaneous observations with a Daniell's hygrometer, but as this instrument itself cannot be relied on with certainty, the only sure method would seem to be that of separating the moisture from the air and determining their proportions by actually weighing them.

It is important to determine the influence of the wind on the results obtained by this instrument According to theory, when the difference of the temperatures indicated by the two thermometers has become stationary, the agitation of the air should have no effect on them, for as the degree of cold ultimately produced depends on the *intensity*, and not on the *velocity*, of evaporation, the effect of wind on the wet bulb might be expected to be only that of depressing its temperature more speedily, but not to a lower point Regnault made numerous experiments on this subject, and arrived at the conclusion that wind certainly does influence the observation, but when the instrument is exposed to free air the influence is not perceptible so long as the velocity of the wind does not exceed five or six *metres* per second (16 or 20 English feet, or from 11 to 14 miles per hour) When the wind blows strongly, another disturbance may arise from the circumstance that the masses of air successively brought into contact with the wet bulb may have very different degrees of humidity On the other hand, when the air is perfectly calm it is not improbable that an atmosphere of saturated air may be formed and remain about the wet bulb, extending to some sensible distance, for it is known that vapour diffuses itself through air in this state slowly and with difficulty It is scarcely necessary to add, that when the air is nearly saturated with vapour, and there is consequently little difference between the temperatures indicated by the two thermometers, the results obtained must be liable to considerable uncertainty

The formula for computing the temperature of the dew point, from observations of a dry and wet bulb thermometer, was first investigated by Professor August, of Berlin, and is given in his work *Ueber die Fortschritte der Hygrometrie* (Berlin, 1830), the same in form as the above, but with slightly different constants There is also an investigation on the same principle, and leading to the same results by Dr Apjohn, in the Dublin *Transactions* for 1834 and 1835, and tables have been constructed by Col Boileau for facilitating the computation of the formula But the fullest and best information on the subject is contained in a paper by Regnault, published in the *Annales de Chimie et de Physique* (3me series, tome xv, Paris, 1845) In this paper Regnault describes a new [illegible] method by him, for determining the dew [illegible] ation, the cold being produced as in Daniell's hygrometer, by the evaporation of ether, but in Regnault's instrument the ether, instead of being poured over the wet bulb, and much consequently wasted, is confined within a glass tube, or cylinder, of about an inch in diameter, and agitated by blowing a stream of air into it through a flexible tube A rapid evaporation consequently takes place within the cylinder, and the cold thereby produced causes a deposition of dew on the outside A delicate thermometer placed inside the cylinder, immediately over the ether, indicates the temperature, which must be noted at the instant the deposition commences, and should be again noted at the instant it disappears A portion of the cylinder over the ether is blackened for the purpose of intercepting the passage of light, whereby the deposition is rendered more easily visible. Of the various hygrometers which have been proposed [illegible] vapour [illegible] of Daniell, this appears to be the most satisfactory

HYOID'S (From the Greek letter *υ*, and *ειδος*, *like*) A bone situated [illegible] of the tongue and the larynx is called [illegible] or hyoid bone, from its [illegible]

In Anatomy, the usually exogenous process which descends from the lower part of the centrum or vertebral body, it is sometimes single, as in the cervical vertebræ of the lizard; sometimes perforated, as in certain cervical vertebræ of birds, sometimes double in a transverse pair, as in the caudal vertebræ of certain mammals, where they support the hæmal arch

HY'PER. (Gr *υπερ*, *over*, *above*) In chemical nomenclature this [illegible] containing more oxygen than those to which the term *per* is prefixed

HYPERÆ'MIA (Gr *υπερ*, and *αιμα*, *blood*.) Congestion of blood in any part

HYPERCATHA'RSIS (Gr *υπερ*, and *καθαιρω*, *I purify*.) Excessive purging

HYPERI'CUM (Gr *υπερ*, and *εικων*, *an image* so called from a supposed power of expelling evil spirits) The *Hypericum perforatum*, or St John's Wort, was much esteemed by the ancients as an anodyne.

HYPO (*υπο*, *under*) In chemical nomenclature this prefix indicates the presence of a smaller quantity of oxygen than that contained in the acid or compound to which it is prefixed, thus the *hyposulphurous acid* [illegible] the sulphurous and the *hypo-* [illegible] than the sulphuric, and the *hyponitrous* acid less oxygen than the nitrous, etc

HYPOCYSI A pharmaceutical name of the inspissated juice of the *Cytisus hypocistis*, a parasitical plant on the roots of several species of *cystus* in the S of Europe

HYPOGÆ'UM (Gr *υπο*, and *γη*, *the earth*) A term applied by ancient architects to the cellars and other underground parts of a building

HYPOGASTRIUM (Gr *υπο*, and *γαστηρ*, *the stomach*) The middle part of the lower region of the belly

HYPOGLOSSAL NERVES (Gr *υπο*, and *γλωσσα*, *the tongue*) The [illegible] nerves

HYPOPHYSIS (Gr *υπο* and [illegible], *nature* or *origin*) In Anatomy, the gland-like body and sac which originate from the under surface of the third ventricle of the brain and are lodged in the "sella turcica" *See* PITUITARY GLAND

HYPSOMETRY (Gr *υψος*, *height*, and *μετρεω*, *measure*) The art of measuring heights either relative or absolute, by trigonometry or the barometer

HYSON A commercial name of one of the varieties of *green tea* *See* TEA, in DICT

HYSSOP The name of a genus of plants including the common hyssop (*Hyssopus officinalis*), formerly used in medicine as a stimulant and expectorant

HYSTEROTOMY (Gr *υστερα*, *the womb*, *τεμνειν*, *to cut*) The extraction of the fœtus from the uterus The *Cæsarean operation*

# I

IA'TRALEI'PTES (Gr *ιατρος*, *a physician*; *αλειφω*, *I anoint*) A physician who cured diseases by external remedies only, as by friction, inunction, &c There was among the Greeks a sect of Ιατρολειπται founded by Prodicus, a disciple of Esculapius

IA'TROMATHEMATICI (Gr *ιατρος*, and *μανθανω*, *I learn*) Physicians who explain the functions of the body, and the action of remedies on mechanical principles These doctrines seem to have originated with Asclepiades, and in modern times were promulgated by Borelli as founded on the atomic philosophy of Descartes.

ICE (Ger eis) Frozen water At the temperature of 32° water, in its ordinary condition, crystallises into ice which if slowly produced forms prisms crossing each other at angles of 60° and 120°, the primitive figure has not been ascertained, though it is probably rhomboidal The arrangement of the acicular prisms in flakes of snow is very various, but in the same snow storm the same forms of arrangement generally prevail The specific gravity of ice in its densest form is about 950 It is a nonconductor of electricity, and becomes electric by friction The expansion of water in the act of freezing, takes place with irresistible force, and the frequent rupture of thick iron and leaden pipes from this cause is a familiar instance of this Exposed to air ice loses considerably by evaporation In the act of freezing water parts with all soluble matter, so that coloured water becomes colourless ice, saline solutions become pure water, and spirituous liquors part with their alcohol To effect this purification perfectly, the ice must be formed under circumstances which prevent the accumulation of blebs and air bubbles, and the entanglement in the ice of any of the unfrozen or ejected liquor, for the foreign matters held previously in solution in the water, are, in the act of freezing, transferred to the portion which remains unfrozen, when the whole of the water becomes a mass of porous ice the impurities are retained in the pores, but those brilliant and perfectly transparent and dense masses of ice which we find in the American and Norway ice as imported into this country, yield, when thawed, water equal in purity to that which has been distilled, and nearly free from air

ICHTHYO'PHAGIST (Gr *ιχθυς*, and *φαγω*, *I eat*) A fish eater some savage tribes who live almost entirely on fish were called by the ancients *Ichthyophagi*

I'GLOITE A mineralogical synonym of one of the varieties of carbonate of lime, or *Arragonite*

ILLU'DERITE. A mineralogical synonym of *Epidote*

I'LMENITE The titaniferous iron ore from Ilmensea near Minst

I'LVAITE A mineral from *Elba*, in black prismatic crystals it is a silicate of iron and lime

IMBIBI TION (Lat in, and bibo, *I drink*) The absorption of a liquid into the pores of a solid much importance has been attributed to this property as belonging to the organic tissues and as affecting their functions

IMPE'RIAL A beverage formed by dissolving one drachm or one drachm and a half of cream of tartar in a pint of boiling water and flavouring with lemon peel and sugar When cold, it may be taken *ad libitum*

INCLINO'METER, an instrument for determining the vertical element The difficulty of determining method is considerable, on account the apparatus which is requisite Various indirect methods have been proposed Dr Lloyd, in the *Account of the Magnetical Observatory at Dublin*, describes an Inductive Inclinometer, 'the principle of which is the measurement of the intensity induced on a vertical bar of soft iron by the deviation it is capable of causing in a horizontal bar suspended near it." Weber, of Gottingen, proposed a method, in which "the deflexion of the horizontal magnet is produced by the earth's magnetism, induced not on a vertical bar of soft iron at rest, but on a ring, sphere, or plate of copper made to revolve about a vertical axis" Dr Lamont, of Munich proposed a third and less simple method "As in Dr Lloyd's process, a bar of soft iron is used as a temporary magnet The bar so temporarily magnetised is made to act unequally on the two bars of an astatic magnetic couple, thereby tending to draw them aside from a given position in which they would otherwise be held by a fixed magnet of a given power This tendency is however, destroyed by another magnet placed in a given position at a given distance A series of reversals and changes of distance in the soft iron bar and the neutralising bar is then operated, which furnishes equations by means of which every quantity excepting the intensity sought and known quantities can be eliminated '—(*British Association Report*, 1842) *See* Magnetism

INDIAN RUBBER *See* CAOUTCHOUC, in DICT A compound material discovered by Mr Hancock under the name of *Vulcanised India rubber*, and is, in fact, caoutchouc combined with a very small proportion of sulphur the several modes of effecting this are fully described in the specification of his patent Vulcanised India rubber does not, like the ordinary article become hard and rigid by cold and it bears a very high temperature without change of properties It is much more perfectly elastic than the common rubber, so that when stretched it does not acquire a set, but returns, when released, to its former dimensions This discovery has rendered caoutchouc applicable to an infinity of purposes for which, in its ordinary state, it is either unfit or objectionable Among the most remarkable properties of Vulcanised caoutchouc, is the resistance which it affords to naphtha, oil of turpentine, ether, oils, and a variety of other substances which are comparatively without action upon it, whereas they either soften, or dissolve it

INDIAN YELLOW *See* EUXANTHINE

INDICATOR (Lat indico, *I point out*) An instrument for determining the power exerted by a steam engine This instrument consists of a small cylinder and piston, which is placed in connexion with the cylinder of the engine by means of a pipe and stop-cock fitted into the cylinder cover The cylinder of the indicator is open at the top, so as to permit the access of the atmosphere, and its piston is kept at about the middle of its stroke by means of a spring, when the instrument is out of connexion with the engine, but when the stop-cock is opened so that the space beneath the piston of the indicator is put in connexion with the cylinder of the engine, the piston of the indicator is pressed up and down every stroke by the alternate steam pressure and vacuum existing within the cylinder of the engine The extent to which it is pressed up and down indicates the amount of pressure urging the piston of the engine, and a scale is attached to the side of the indicator, graduated with connexion of pounds pressure above the atmosphere that is exerted by the steam, and also the number of pounds pressure below the atmosphere that is exerted by the vacuum

INDIGOGENE *Indigo white* *See* INDIGO, in DICT

INDIGOTINE The sublimate obtained by heating indigo *See* Indigo in Dict

INFUNDIBULIFORM An anatomical term, signifying *funnel shaped* Infundibulum

the brain is a canal proceeding from the lower and anterior part of the third ventricle of the brain to the pituitary gland

INGUINAL (Lat. inguen, *the groin*) Appertaining to or situated in or near the groin as *inguinal artery*, *inguinal hernia*, etc

INHALATION (Lat) The drawing of air, gases, or vapours into the lungs Many substances are medicinally applied in this form, by means of an *inhaler*, an instrument so contrived as to admit of the inhalation of air or vapours from or through various substances, hence the inhalation of vapour of tar, of ether, of chloroform, of iodine, chlorine, &c are often thus administered

INJE'CTION A liquid thrown into cavities of the body by means of a bladder, syringe, or bottle Injections thrown into the rectum are called *enemata*, or *clysters* (from κλυζω, *I wash*)

I'NOLITE (Gr ινος, *I cleanse*, and λιθος, *a stone*) A variety of carbonate of lime

INOSI'NIC ACID (Gr ινος, *I absorb*) An acid said by Liebig to exist in the juices of the flesh of animals

INTERCO'STAL (Lat inter, and costa *a rib*) In anatomy, a designation of certain bloodvessels, nerves, and muscles situated between the ribs

INVERMINATION (Lat in and vermis, *a worm*) The morbid state of the alimentary canal occasioned by the presence of entozoary animals *See* INTESTINALIA, and ENTOZOA in DICT

I'ODATES Salts of the iodic acid

IRE'NE One of the small planets belonging to the group whose orbits lie between those of Mars and Jupiter and the fourteenth in the order of discovery Irene was discovered by Mr Hind, at Mr Bishop's observatory in the Regent's Park, on the 19th of May, 1851 When first observed, its brightness rather exceeded that of a star of the ninth magnitude, its light is very blue, and it appears to be surrounded with a faint nebulous envelope, not perceptible about the stars in its vicinity Its period is about 1519 days (*Monthly Notices of the Royal Astronomical Society*, vol xi) *See* PLANET

IRIDESCENT FILMS Iridescent films are produced by dropping a little oil or spirit of varnish upon the surface of water contained in a vessel When the water becomes tranquil, the varnish spreads in all directions, becoming exceedingly attenuated and reflects the most vivid colours of the spectrum If any objects that require ornamenting, such as insects, shells, birds, bronzes paper hangings, &c are previously immersed in the water and slowly raised to the surface after the film has been formed, the latter will adhere to their surfaces, and when they are completely dried, it will be found firmly attached to them and perfectly iridescent, having brilliancy of colouring This is a the production of colours on a thin transparent surface, by the agency of light such as is commonly seen in an ordinary soap bubble

IRIS (Lat *the rainbow*) One of the newly discovered planets of the group between Mars and Jupiter Iris was discovered by Mr Hind, at Mr Bishop's Observatory, on the evening of August 13 1847, while engaged in systematic comparison of the Berlin charts with the heavens, which soon after rewarded him with the discovery of a second planet *Flora* Iris, when discovered had the appearance of a star between the eighth and ninth magnitudes The symbol adopted for its designation is a semicircle, to represent the rainbow, with an interior star and a bare line, for the horizon Its period is about 1342 days Iris is the seventh of the group in the order of discovery (*Monthly Notices of the Royal Astronomical Society*, vol vii) *See* PLANET

IRISCOPE (Lat iris *the rainbow*, and Gr σκεπτω, *I view*) An instrument proposed by Dr Joseph Reade for exhibiting the prismatic colours, thus described by Sir David Brewster, in the *Philosophical Transactions* for 1841 —"This instrument consists mainly of a plate of highly polished black glass, having its surface smeared with a solution of fine soap, and subsequently dried by rubbing it clean with a piece of chamois leather If we breathe upon the glass surface, thus prepared, through a glass tube, the vapour is deposited in brilliant coloured rings, the outermost of which is black, while the innermost has various colours, or no colour at all, in proportion to the quantity of vapour deposited The colours in these rings, when seen by common light, correspond with Newton's *reflected* rings, or those which have *black centres* the only the plate of vapour, which is the rings in the Iriscope have black circumferences

IRISH MOSS The *Chondrus Crispus* *See* CARRAGEEN Moss

ISCHIOCELE (Gr ισχιον, *the hip*, and κηλη, *tumour*) A hernial tumour at the foramen of the ischium

I'SERINE. *Titanfate of iron*, from the Iser in Bohemia

I'SINGLASS The term I[illegible] to be derived from *ice* and [illegible] transparent and viscous appearance of the concrete jelly which may be obtained from it, but the word is more evidently a corruption of the German *hausenblase* [illegible]

ISOCHROMATIC (Gr *ισος, equal, and, χρωμα, colour*) A term in Optics applied to two or more bodies of which the colours are identical or undistinguishable

ISOGONIC LINES (Gr *ισος equal, γωνια angle*) In Terrestrial Magnetism, are those lines passing through all places on the earth's surface in which the horizontal magnetic needle makes the same angle with the meridian, or at which the *declination* is the same *See* MAGNETISM TERRESTRIAL

ISOPYRE (Gr *ισος, equal, πυρ, fire*, because the effect produced upon it by the blowpipe is the same as that produced on several other minerals!) A silicate of alumina, iron, and lime, found imbedded in granite from Cornwall

ITACO'NIC ACID An acid formed by the action of heat on *aconitic acid*

ITA'LIAN JUICE The extract of liquorice prepared in *Calabria* That grown on the estates of the Marchioness of Solazzi, and known in commerce under the name of *Solazzi juice*, being so stamped, is the most esteemed The *Spanish juice* is prepared in *Catalonia*

## J

JA'LAPINE The purgative principle of jalap root it is a basic resin

JAMES'S POWDER (*Pulvis Jacobi*) A mixture of bone-earth, or phosphate of lime, and oxide of antimony it is often called *fever powder*, and acts as a diaphoretic, and also on the bowels, and sometimes nauseates or vomits, according to the dose in which it is exhibited It is an uncertain remedy, and may be properly replaced by emetic tartar mixed with a little chalk or magnesia The *pulvis antimonialis*, or *antimonial powder* of the London Pharmacopœia is intended as a substitute for James's preparation, but it also is open to the objection of uncertain activity, dependent upon the state of oxidizement of the antimony, the protoxide of that metal being virulently active, while the peroxide is nearly inert The usual dose of James's powder is from one to five grains

JE'RVIA (from *Jerva*, the Spanish name of a poison obtained from white hellebore) A basic crystalline substance, contained, together with *veratria*, in the [illegible] white hellebore

[illegible] *compound tincture of benzoin* of the Pharmacopœia called also *Friar's balsam*

JE'SUITS' POWDER Powdered Cinchona bark

JEWS' PITCH *Asphaltum*

JU'NKERITE A native crystalline proto carbonate of iron from Pullouen

JU'RINITE A mineral from Dauphiny, containing *titanium*

## K

KA'KODYLE (Gr *κακος, bad*, and *ωζειν, smell*) A compound hydrocarbon and arsenic, having the formula $C_4 H_6 As$ It is a clear liquid which takes fire when dropped through the air, burning with a blue flame, and forming water, carbonic acid, and arsenious acid, the latter rises as a white smoke *Cadet's fuming liquor* called also *Alkarsine*, is an oxide of Kakodyle $C_4 H_6 As O$

KA'RSTENITE Anhydrous sulphate of lime *Anhydrite*

KE'RATOPHYLLITE (Gr *κερας, a horn*, and *φυλλον, a leaf*) A mineralogical synonym of Amphibole or Actinolite

KEY'SER'S PILLS A once celebrated mercurial preparation, the active ingredient in which is the *acetate of mercury*

KIKI KUNE MAO a resin, much resembling copal brought from America, where it is said to be used medicinally It forms excellent varnishes

KILKENNY COAL *Anthracite*

KI'MMERIDGE CLAY The clay formation of Kimmeridge, on the coast of the Isle of Purbeck, it contains beds of bituminous shale, used as fuel, and called *Kimmeridge coal* In the neighbourhood are found the pieces called *coal money*, they are about 3 inches diameter, flat on one side, and convex on the other, and on the flat side are two or four small holes They are supposed to have been either money or amulets In the same neighbourhood there has been found a shallow bowl of Kimmeridge coal containing coal money.

KINEMA'TICS, or KINE'TICS (Gr *κινεω, I move*) A term used by some writers to denote the doctrine which treats of the effects of motion without reference to its causes, and in contradistinction to dynamics Curves produced by combined movements, or by machinery, are called kinematic curves of which many beautiful specimens are given in Mr Henry Perigal's work on the subject The term is used chiefly by German writers, and applies to the same subjects as are usually treated [illegible]

KI'RWANITE A [illegible] from the basalt of the North East coast of Ireland, named after Kirwan the mineralogist

KISH A substance occasionally produced in iron smelting furnaces in appearance it resembles plumbago, but is said to consist chiefly of carbon and manganese

KNE'BELITE A silicate of iron and manganese

KOME'NIC ACID A substance resulting from the action of heat on *meconic acid*, and formed when a solution of the latter acid is boiled It has also been ca[illegible]

KO[illegible] alogical synonym of the Chinese *figure stone*, called also *Agalmatolite*

KREATINE (Gr *κρεας, flesh*) A crystallisable organic substance contained in the juice of the muscular fibre of animals

KREMNITZ WHITE A pure variety of *White Lead*.

KROKI'DOLITE (Gr *κροκις, woof*) A mineral of a fibrous asbestiform texture, it is a hydrated silicate of iron and soda there is also a compact variety, it is occurs near the Cape of Good Hope

## L

LAGGING OF THE TIDES In Terrestrial Physics, a phenomenon of the tides, consisting in the irregularity of the lengths of the successive tide-days or intervals of the occurrence of high water at any particular place, and caused by the combined action of the sun and moon on the ocean If the tides were caused by the moon's attraction only, the intervals between two successive arrivals at the same place of the same vertex of the tide-wave would be the lunar day, that is, the interval between two successive arrivals of the moon at the same meridian In like manner if the tides were caused by the sun's attraction only, the tide-day would be of the same length as the solar day In consequence of the moon's revolution about the earth in the same direction as the diurnal rotation, the lunar day is longer than the solar, and the actual or lunisolar tide being the result of the superposition of the two tides caused by the sun and moon respectively, it follows, that from the time of a coincidence of these two tides the actual tide-day (reckoned in mean solar time) will become longer and longer, until the moon has completed a quarter of a revolution, after which the lunar wave will fall back on the next following solar wave, and the tide-day will become shorter and shorter during the next quarter of the moon's revolution, and the coincidence will again take place when a semi-revolution is completed This alternate acceleration and retardation of the tidal intervals is called the *priming and lagging of the tides*, and is most remarkable about the time of new and full moon *See* TIDES, in DICT

LAGOPHTHA'LMIA (Gr *λαγως, a hare*, and *οφθαλμος, eye*) A disease in which the eye cannot be closed sometimes it is a paralytic affection, and sometimes [illegible] tion enlargement of the eye, it is also occasionally [illegible] nate The term has reference to the notion that hares sleep with their eyes open.

LA'PIS DIVINUS (Lat) A compound of nitre, alum, and verdigris, melted together, camphor is sometimes added, and white vitriol substituted for verdigris A portion of this fused compound dissolved in water formed a celebrated eye lotion, it was hence also called *Lapis Ophthalmicus*

LA'PIS LY'DIUS (La[illegible] A siliceous slate, used as a *touchstone* [illegible] the quality of gold [illegible] colour of the streak

LAPIS SPECULA'RIS (Lat) Selenite or spathose gypsum formerly used as a remedy for fits

LA'RDITE A mineralogical synonym of the Chinese *figure-stone*, or Agalmatolite

LA'SIONITE A mineralogical synonym of Wav-

ellite or hydrargyllite the hydrated phosphate of alumina

LECA'NORINE *Lecanoric Acid* A crystallisable substance obtained from several species of *Lecanora*, and some other *lichens*

LECCA GUM The gum of the olive tree, which is [illegible] Lecca in Calabria

LEHI'NITE A compact *zeolite* found in Antrim by Captain Lehunt

LE'MANITE A synonym of felspar, so called from Lake Leman where it is found

LEPIDOKROKITE (Gr λεπις, *a rind*, and κροκος *saffron*) Fibrous brown hematite

LEVANT NUT One of the commercial names of the berries of *Cocculus Indicus*

LIBETHE'NITE A native phosphate of copper fr[illegible]

LICHANO'S [illegible] χω, *I lick*) The fore finger, us[illegible] tity of anything

LICHTENBERGIAN FIGURES When the knob of a charged Leyden phial is drawn over a flat surface of lac or resin, as, for instance, the plate of an electrophorus it leaves a charge in its track, positive or negative, as we choose, and if, after this, a mixture of certain powders be sifted upon the plate, as, for instance, of powdered sulphur and red lead the sulphur will adhere to the one, and the red lead to the other electrified surface, and with a little management groups of figures resembling flowers may be thus brought out, as Lichtenberg first observed

LIEBERKU'HNIAN GLANDS In Anatomy, are simple secerning cavities, having the form of blind tubular depressions of the intestinal mucous membrane, thickly distributed over the whole surface of the large and small intestines They are so called after their discoverer Lieberkuhn, who observed them in the small intestines where they are visible only with the aid of a lens, their orifices appearing as minute dots scattered between the villi They are larger in the large intestine

LIENTERY (Gr λειος, *the spleen* soft or smooth) A medical term formerly applied to a form of diarrhœa in which the food passes rapidly through the bowels in an apparently undigested state Lubricity of the intestines

LIEVRITE A crystallised mineral discovered by Le Lièvre It is a silicate of iron and lime, it has also been called *Jenite*, in commemoration of the battle of Jena in 1806, and specimens from Elba have been termed *Praite*

LIFT TENTER The name given in some parts of England to a sort of regulator or governor applied to wind mills to counteract the irregular action of the wind In a wind mill for grinding corn the distance between the upper and lower millstones is regulated according to the velocity, and if, when the mill is at work, the velocity should receive any considerable increase, the corn is forced rapidly through the mill without being sufficiently ground To prevent this is the object of the lift-tenter Like the governor of a steam-engine it acts by the centrifugal force of one or more balls which fly out when the velocity is augmented, and as they rise in the arc of a circle allow the end of a lever to rise with them, while the other end descends with the upper millstone, and brings it a little nearer to the under one

LIGATURE (Lat ligo, *I bind*) In surgery, a waxed thread of silk used in tying arteries or veins

LIGHTHOUSE The Light Tower recently erected on the small island or rock of Skerryvore, on the west coast of Scotland, is one of the most remarkable works of this class both by reason of its magnitude and the difficulties encountered in its construction The following particulars are extracted from the very able and [illegible] account of it drawn up by the engineer, Mr [illegible] and published under the authority of the Commissioners of the Northern Lighthouses

Skerryvore is the largest of a group of rocks lying in the channel between the western isles of Scotland and the north coast of Ireland, and in the track of the larger vessels [illegible] the north of Ireland from the Clyde [illegible] It is of inconsiderable extent, the surface of the solid rock being only about forty square yards, and consequently the stones had to be quarried, and the greater part of the works carried on in the island of Tyree, the nearest land, situated about eleven nautical miles to the north east Much of the difficulty attending the operation arose from the distance of this latter island from the site of the works, from its being destitute of any shelter for shipping, and from the exposed and stormy situation, which frequently rendered communication impossible

The dimensions of the [illegible] reference to the situation [illegible] great dist[illegible] ks, some of them not less than [illegible] of the rock, made it desirable [illegible] mand an extensive range, and consequently that the tower should be of conside[illegible] on the [illegible] up the [illegible] accomm[illegible] and the stowage of stores It was accordingly determined that the light should be elevated 150 ft above the level of high-water at spring tides, so as to illuminate a visible horizon of not less than eighteen miles radius, and that the void space within the pillar should be about 13,000 cubic feet.

In determining the form of the tower the object is to obtain the greatest strength with the smallest consumption of materials, having regard to the necessary conditions of height and internal accommodation The shaft of the Skerryvore pillar is a solid generated by the revolution of a rectangular hyperbola about its asymptote as a vertical axis Its exact height is 120·25 feet, its diameter at the base 42 feet, and at the top 16 feet The first 26 feet of [illegible] containing about 27,110 cubic feet [illegible] this level the walls are 9 58 feet in thickness, whence [illegible] decrease through the whole height of [illegible], at the top, they are reduced to two feet in thickness Above the shaft is a cylindrical belt 18 inches deep, which is surmounted by a cavetto 6 feet high and having 3 feet of projection The cavetto supports an abacus 3 feet deep, the upper surface of which forms the balcony of the tower, and above it rest the parapet wall and lantern The whole masonry of the tower contains 58,580 cubic feet, weighing about 4308 tons

The general arrangement in the interior of the tower is as follows "The ascent to the outside door is by a ladder or trap of gun metal 26 feet high The first apartment on the level of the entrance door is chiefly appropriated to the reception of iron water tanks, capable of holding a supply of 1251 gallons The next story is set aside for coals, which are stored in large iron boxes The third apartment is a workshop, the fourth is a provision store and the fifth is the kitchen Above are two stories, each divided into two sleeping apartments for the four light keepers Over them is the room for the visiting officers, then follows the oil store and lastly comes the light room, making in all 12 apartments"

In its general a[illegible] is identical with [illegible] Dict of Science) It consists of [illegible] the first order in the system of A[illegible] inches focal distance, revolving round a lamp with four concentric wicks, and producing a bright blaze as each lens passes before the lamp Above these principal lenses there are placed eight pyramidal lenses of 19·68 inches focal distance inclined at an angle of 50° with the horizon, and combined with eight plane mirrors inclined in the opposite direction under the same angle of 50° by means of which the rays which would pass upwards are turned into the horizontal direction. The light appears in its brightest state at intervals of one minute and is well seen as far as the curvature of the earth permits

The works were begun in 1838, and the tower was finished in 1842 but considerable time was required for completing the internal fittings, and the light was not exhibited as a sea light till February 1844 The expense of the lighthouse, including the opening of quarries and forming wharfs for shipping the stone both in Mull and Tyree amounted to 90 268*l* 12*s* 1*d* (*Account of the Skerryvore* [illegible] *of Lighthous*[illegible] *to the Northern Lighthouse Board*, 4to *Edinburgh*, 1848)

LIGHTHOUSES A plan of the arrangement of the reflectors for lighthouses was produced by Messrs Chance at the Great Exhibition of 1851, which combines the principles of Fresnel's fixed and revolving lights with an improved method of reflexion, and does away with the use of metal reflectors

The system of reflectors and refractors may be divided into three compartments, the upper and lower of which are composed respectively of thirteen and six catadioptric zones, which produce a vertical strip of light extending the whole length of the apparatus, similar to Fresnel's fixed dioptric light The central compartment consists of eight lenses of three feet focal length, each of which is the centre of a series of eleven concentric prismatic rings designed to produce the same effect as a solid lens of equal size These compound lenses are mounted upon a revolving frame, and transmit horizontal flashes of light as they rotate Motion is communicated by clock-work, and one revolution is performed in the spa[illegible] a flash of light is [illegible] horizon by each of the lenses in succession The apparatus is lighted by an Argand lamp, with four concentric wicks; it is provided with four burners, the

largest of which is 3¼ inches and the smallest $1\frac{6}{10}$ inches in diameter

LIGNONI (Lat lignum, *wood*) A liquid which may be separated by distillation from commercial wood spirit It [illegible]

LIGNOSULPHURIC ACID A peculiar acid resulting from the action of sulphuric acid upon lignine It is more properly termed *Sulpholignic acid*

LIGNUM VITÆ (Lat) The wood of the guaiacum tree

LILACINE A bitter crystallisable principle contained in the leaves of the *Syringa vulgaris* It has also been termed *Syringine*

LIMBILITE A granular mineral found in the volcanic formation of Limbourg

LIMONITE (Gr λειμων, *a meadow*) In Mineralogy, brown iron ore

LIMOSIS (Gr λιμος, *hunger*) A genus of diseases distinguished by excessive or defective appetite

LINARITE In Mineralogy, the cupreous sulphate of lead from Linares, in Spain It also occurs in Cumberland, and at Leadhills in Scotland

LINCTUS (Lat lingo, *I lick*) A medicinal preparation of the consistence of thick syrup, or honey, which requires to be licked off the spoon

LINDEN TREE The Lime tree, *Tilia Europæa*

LININ A bitter principle obtained from the *Linum catharticum* or purging flax

LINNITE In Mineralogy, native sulphuret of cobalt, first noticed in Sweden by the celebrated Linnæus

LINNÆAN SYSTEM *See* BOTANY, in DICT

LINSENERZ In Mineralogy, octohedral arseniate of copper

LINT A soft woolly material made by scraping old linen by hand It is also made by machinery It is used in surgery for dressing wounds and ulcers, either alone or spread with some ointment

LIPAROCELE (Gr λιπαρος, *fat*, κηλη, *a tumour*) A fatty tumour

LIPIC ACID (Gr λιπος, *fat*) An acid formed by acting upon stearic and oleic acid, by means of nitric acid

LIPOMA (Gr λιπος, *fat*) An encysted fatty tumour

LIQUATION *See* ELIQUATION, in DICT

LIQUIDAMBER A balsam procured in Mexico and Louisiana from the stem of *Liquidamber styraciflua* It is, probably, identical with the so called *White Balsam of Peru*

LIQUORICE The extract of the root of the *Glycyrrhiza glabra* or officinal liquorice it is often called Spanish liquorice or Spanish juice, of which that stamped with the name Solazzi, and imported in sticks or bars six or eight inches long is considered the best It is in common use as an emollient in catarrh and cough The so called *refined liquorice*, rolled into pipes or quills, is often much adulterated

LIQUOR SANGUINIS *See* PLASMA

LIRIODENDRINE (Gr λιριον, *a lily* and δενδρον, *a tree*) A bitter crystallisable principle obtained from the bark of the root of the *Liriodendron tulipifera*

LITHAGOGUE (Gr λιθος, *a stone*, and αγω, *I drive away*) Medicines supposed to have the power of expelling [illegible] matter from the kidney or bladder

LITHOCHROMATICS (Gr λιθος, *a stone*, and χρωμα, *colour*) A term applied to a recent invention, which consists in printing [illegible] upon stone, and taking impressions upon canvass

LITHOCOLLA (Gr λιθος, *a stone*, and κολλα, *glue*) A cement for stone-work

LITHOFELLIC ACID (Gr λιθος, *a stone*, and Lat. fel, *gall*) A substance obtained by Gobel from a Bezoar stone In 1844, Taylor made the curious discovery of the identity of the substance constituting the so called *Oriental Bezoars*, which are probably the intestinal concretions of a species of antelope with the acid called *Ellagic acid*, contained, along with tannic and gallic acids in the gall nut

LITHOPHAGI (Gr λιθος, and φαγω, *I eat*) *See* LITHODOMES, in DICT Molluscous animals which bore into stones

LITHOPHYTES (Gr λιθος, and φυτον, *a plant*) Polypes which have a stony axis, as distinguished from the Keratophytes or horny polypes

LIVER ORE OF MERCURY *Hepatic ore* A bituminous cinnabar, or sulphuret of mercury, from Idria

LOBELINE A peculiar acrid oil contained, along with *Lobelic acid*, in the leaves of the *Lobelia inflata*

LOBOITE In Mineralogy, a magnesian idocrase from Norway

LONDON CLAY A very extensive tertiary geological deposit of a bluish clay, superficially brown, and abounding in Middlesex, Essex, Suffolk, and part of Norfolk *See* GEOLOGY, in DICT.

LOPEZ *Radix Lopeziana* The name of the root of an unknown tree, supposed to grow at Goa It is said to be [illegible] effective in checking diarrhœa

LORIMER A name formerly given to the makers of bits, spurs, and other articles of iron used for horses

LOVE APPLE The Tomata The fruit of *Solanum lycopersicum* An excellent ingredient in soups and sauces, in especial use in Spain and Portugal

LUPIA (Gr λυπεω, *I molest*) An encysted tumour

LUSTRE Several varieties of *Lustre* are referred to in descriptive mineralogy such as splendent, glistening, glimmering shining, dull &c

LUTEOLINE and LUTEOLE'INE Peculiar colouring principles, said by Preisser to be obtained from *weld*

LUZ The name of a bone in the human body, celebrated in Rabbinical writings, and supposed to be indestructible according to some it was a vertebra, others regard it as having been the sesamoid bone of the great toe, and others one of the triangular bones near the lambdoidal suture of the cranium

## M.

M In medical prescriptions M stands for *misce*, or mix also for *manipulus* a handful

MACER The bark of the root of a tree growing in Malabar It is astringent, and celebrated for the cure of diarrhœa

MACQUERS SALT A pharmaceutical designation of the bisarseniate of potassa

MACROCOSM (Gr μακρος, *large*, κοσμος *world*) A term applied to the world at large, or *universe*, as opposed to *microcosm*, having reference to man

MADAROSIS (Gr μαδαρος, *bald*) A falling off of hair, especially of the eyelashes

MAGDEBURGH EXPERIMENT or HEMISPHERES A hollow sphere composed of two hemispheres which fit air-tight intended to show the amount of the air's pressure, by the amount of force with which they are so held together after the interior air has been removed by the air-pump This apparatus was first suggested by Otto Guericke of Magdeburgh, the inventor of the air pump

MAGELLANIC CLOUDS These singular objects were carefully examined by Sir John Herschel during his residence at the Cape of Good Hope, from 1834 to 1838, and are minutely described in his "Results of Astronomical Observations" &c The greater nebula, or *Nubecula major*, is situated between the meridians of 4 h 40 m and 6 h 0 m, and the parallels of 156° and 162° of North Polar Distance occupying an area of about 42 square degrees The lesser is situated between the meridians 0 h 28 m and 1 h 15 m and the parallels of 162° and 166° N P D and covers about ten square degrees, their general shape is round, or somewhat oval, and the larger, which deviates most from the circular form, exhibits the appearance of an axis of light very ill defined and by no means strongly distinguished from the general mass which seems to open out at its extremities into somewhat oval sweeps "When examined through powerful telescopes" Sir John observes, "the constitution of the nubeculæ and especially of the Nubecula major, is found to be of astonishing complexity The general ground of both consists of large tracts and patches of nebulosity in every stage of resolution, from light irresolvable with 18 inches of reflecting aperture, up to perfectly separated stars, like the Milky Way, and clustering groups sufficiently insulated and condensed to come under the designation of irregular and in some cases pretty rich clusters But besides those there are also nebulæ in abundance, both regular and irregular, globular clusters in every state of condensation, and objects of a nebulous character quite peculiar and which have no analogue in any other region of the heavens Such is the concentration of the objects, that in the area occupied by the Nubecula major not fewer than 278 nebulæ and clusters have been enumerated, besides 50 or 60 outliers, which (considering [illegible] such objects in the immediate [illegible] certainly to be reckoned as its appendages, being about six and a half per square degree which very far exceeds the average of any other, even the most crowded parts of the nebulous heavens. In the Nubecula minor the concentration of such objects is less, though still very striking, 37 having been observed within its area and 6 adjacent but outlying The nubeculæ, then, combine each within its own area, characters which, in the rest of the heavens, are no less strikingly separated, — viz those of the galactic and the nebular system Globular clusters (except in one region of small extent) and nebulæ of regular elliptic forms are comparatively rare in the Milky Way, and are found congregated in the greatest abundance in a part of the

heavens the most remote possible from that circle, whereas, in the nubeculæ, they are indiscriminately mixed with the general starry ground, and with irregular [illegible] (*Outlines of Astronomy*, p 613)

MAGNETISM TERRESTRIAL During the last quarter of a century immense efforts have been made to determine both the [illegible] of terrestrial magnetism The first great impulse to the improvement of science is mainly due to the celebrated Humboldt, who, in 1828, formed an association at Berlin for the purpose of verifying an inference which had been drawn from the comparison of corresponding observations made at London and Upsala by Graham and Celsius in the last century, and recently at Paris and Kazan by Arago and Kupffer, namely that the irregular movements of the needle take place simultaneously at places very distant from each other At first the operations were on a very limited scale, being confined to hourly observations on some particular days previously agreed on at Berlin and Freyberg, but in the following year the plan received an immense extension in consequence of the establishment by the Russian government of magnetical observatories at St Petersburg Kazan, Nicolaieff, and Sitka (on the north-west coast of America), that is to say, across the whole continent of Europe and Asia A second association was soon after formed at Gottingen by Professor Gauss through which very important improvements were effected both in the instruments of observation and the methods of observing, which have been since generally adopted In 1836 the indefatigable Humboldt addressed a letter to the late Duke of Sussex, then President of the Royal Society, on the best means of perfecting the knowledge of terrestrial magnetism, and, his suggestions being approved by the Council of the Society, the government was induced, through the representations of that body to sanction the establishment, in several of the British colonies, of observatories, equipped with appropriate instruments, and superintended by military or naval officers, with sufficient assistance at their disposal for making continuous *hourly* or *two hourly* observations of the different magnetic elements The places selected were Toronto, St Helena the Cape of Good Hope, and Hobarton, in Van Diemen's Island, and, as it was considered important to obtain observations in high southern latitudes the expedition to the Antarctic seas, under the command of Sir James Clarke Ross, was projected and ordered at the same time The East India Company likewise promised its co-operation by providing for the establishment of [illegible] observatories at Bombay Madras Lucknow, Singapore and Simla At home a magnetical and meteorological department was added to the Royal Observatory at Greenwich, and another is kept on foot at Dublin It was originally proposed that the colonial observatories at the four stations above named should be continued for three years only, but the grant of the requisite funds has been renewed from time to time, and they are still (1852) in operation The observations have been made systematically according to rules drawn up by a Committee of the Royal Society, and are reduced under the superintendence of Colonel Sabine, at an establishment also maintained by the government, at Woolwich Several volumes of observations have been published containing a regular series, since 1841, made at Toronto, Hobarton, and St Helena, and including those made in 1841 and 1842 by the officers of the Antarctic expedition In addition to these official volumes, Colonel Sabine has also contributed a series of interesting papers to the *Philosophical Transactions*, and the *Reports of the British Association* containing the results deduced from a comparison of the observations at the different places The observations made at Greenwich are re- [illegible] the whole were for some [illegible] nually, at present only a portion of those made continuously by a photographic process are published in an Appendix to the volumes containing the astronomical observations By all these means a very large collection of well observed facts has been accumulated but it cannot be said that the theory has yet made corresponding advances

A magnetical observation is complete when three elements are determined, — the *declination* of the magnetic needle, its *inclination*, and the intensity of the force The two latter however, are not usually observed directly, but in lieu of them the horizontal and vertical components of the intensity are observed, and, from the variations of the two components, those [illegible] and of the force itself, are computed The declination and inclination indicate the direction in reference to the horizontal and vertical planes which a freely suspended needle would assume, so that, in fact, the direction of the magnetic force and its intensity are the two elements sought to be determined The instruments employed are called by the general name of *Magnetometers* (*See* the term)



In order to obtain a knowledge of the laws of terrestrial magnetism, it is necessary that the mean values of the three elements, and the variations of those elements, should be determined at a great number of points taken all over the earth's surface For the purpose of comparison, the points or stations at which the observations have been made are projected on maps, and lines being drawn through those points at which the mean values are the same in respect of each element, a series of curved lines is obtained, which indicate the values of the elements at the intermediate points with more or less accuracy, according to the proximity of the stations at which observations are made The curves thus traced through the points of equal declination are called *Isogonal*, those through the points of equal inclination, *Isoclinal*, and those connecting the points of equal force, *Isodynamic*

*Declination*, or *Variation* Although the general direction of the horizontal needle is nearly north and south, there are few places at which it points exactly in the direction of the meridian At London and over the greater part of Europe, the north end of the needle declines to the west, while in Siberia and some parts of the North American continent it declines to the east. In the northern hemisphere the isogonal lines, though extremely irregular, appear to converge towards two separate points or poles whence it has been inferred that there are four magnetic poles, two in each hemisphere Supposing this to be the case, the declination of the needle will be east or [illegible] of observation is to the we [illegible] passing through the nearest or most powerful pole, and there will be in each hemisphere two isogonal lines of no declination, or in which the direction of the needle coincides with the meridian These lines, accompanied by others passing through the series of points at which the declination is respectively 5°, 10°, 15°, &c were first laid down by Halley, in 1700, in a *Sea Chart* or *Variation Chart*, and since that time similar charts have been published by various persons, — Hansteen, Barlow, Erman, and others Halley supposed they would be useful as a means of finding the longitude at sea, but, on account of the changes which the declination is undergoing at almost every place where correct observations have been made they are not only useless for this purpose, but do not long continue to represent the actual declinations

The changes which take place in the declination are of three kinds, — secular annual, and diurnal The laws and period of the secular change are very imperfectly known At London in 1580 the declination was 11° 17′ E about 1660 it was 0° Soon after that year the needle began to deviate to the west, and the westerly declination continued to increase till 1815, when it seems to have attained its maximum of 24° 27′ 18″, inasmuch as it has gradually decreased since that time The mean declination deduced from the observations at the Greenwich Observatory in 1846 was 22° 49′ 35″ At Paris, the observations give a similar increase up to the same period But this agreement is by no means general in Jamaica, for example the declination seems to have remained nearly constant The explanation of these phenomena forms one of the greatest difficulties in the theory of terrestrial magnetism

The annual variation of the declination was first remarked at Paris by Cassini From a comparison of observations made at Paris from 1784 to 1788, and at London from 1793 to 1805, Arago found a minimum of declination towards the vernal equinox, and a maximum towards the summer solstice But it may be doubted whether these ancient observations were sufficiently accurate to determine this question, more especially as the result is not confirmed by the recent observations in the colonial observatories At St Helena and Toronto no variation of the rate of the secular change in the different seasons is perceptible At Hobarton the east declination appears to be, on the average, somewhat greater in the summer months than in the winter months but the differences are extremely small

*Diurnal Variation* The declination is also subject to a diurnal change which was first remarked by Graham at London, in 1722 The remark was confirmed by the observations of Celsius, and by Hiorter in Sweden [illegible] by those of Wargentin, [illegible] declined towards the west from the hours of 8 or 9 before noon till 1 or 2 after noon, and then towards the east till 8 or 9 in the evening The same observers also remarked that the needle was affected by Aurora or polar light and that in the presence of this phenomenon the change in its mean direction was sometimes as much as 5° in the course of a day In the *Philosophical Transactions* for 1759 there is a paper by Canton, giving the results of observations on the daily variation during 663 days On 574 of those days the deviations were regular, and nearly the same as those found by Celsius; on the remaining days they were irregular, and on those days there were displays

of Aurora Canton ascribed the diurnal change to the effect of the sun's rays in heating the earth, and thereby dim' nishing the magnetic fo ce ... in the morning, when the earth is heated on the eas ... side of the meridian, the magnetic force on that side is weakened, and the needle consequently declines to the west, and in the afternoon, as the earth becomes heated on the western side of the meridian, the needle begins to move in the opposite direction and declines to the eastward of its mean place The amount of the diurnal change is different at different places, and at different seasons of the year At London, for the years 1817—1819, it was found by Col Beaufoy to be from 4′ to 5′ in December and January, and above 11′ in June and August At the Royal Observatory the mean diurnal range for the year 1846 was in summer, 15′ 14″, in winter, 11′ 53″, and the mean for the whole year 13′ 34″ At Toronto and Hobarton the diurnal range is also greatest in the summer months and least in the winter months, and the changes take place at nearly the same hours of local time

*Inclination*, or *Dip* The inclination has a general dependence on the latitude, but it varies considerably at different places under the same latitude A line drawn through all those places where the dipping needle becomes horizontal (usually, though perhaps improperly, called the magnetic equator) appears to intersect the equator of the earth in four points In the Atlantic Ocean, between Africa and America it lies wholly [illegible] south [illegible] steen the nodes or points intersective with the equator of the earth are on the meridians 22° E 187° E, 120° W, and 108° W, but these determinations must be taken as subject to considerable uncertainty the observations being by no means accordant The other isoclinal lines follow, with more or less irregularity, the direction of the magnetic equator until a high latitude is attained In Boothia Felix, in latitude 70° 5′ 17″ N, and longitude 96° 45′ 48″ W, Sir James Clarke Ross found the dip to be 89° 59′, within a minute of the vertical, and the needle had there altogether lost its directive power In the southern hemisphere, on board the Erebus in 1841, Sir J C Ross observed an inclination of 88° 36′ in latitude 75° 22′ S, and longitude 161° 48′ E (Sabine, *Phil Trans* 1843) The places at which the dipping needle becomes exactly vertical and to which the above most nearly approach are usually styled the *magnetic poles*, but as will be seen presently, they not only do not coincide with, but are at a great distance from, the places at which the intensity of the magnetic force is a maximum —a circumstance which it is necessary to keep in mind, as the term *pole* is also frequently applied to the points of greatest force Like the declination, the dip is subject to secular, annual, and diurnal changes At London it was observed by Graham, in 1720, to be 74° 42′, and by Captain Kater, in 1830, to be 69° 38′ The mean of the Greenwich observations for 1846 is 68° 58′ 1, whence it appears that the dip at London is diminishing The annual variation is scarcely perceptible At Toronto and Hobarton the range of the diurnal variation of the dip is about 1′ 25, at Greenwich for 1846, the difference of the means of the daily observations at 9 A M and 3 P M was 1′

*Intensity* The absolute intensity of the magnetic force, like the declination and dip, varies at different places, and probably at different times It is compared at different stations by observing the number of oscillations made in a given time by a magnetic bar suspended horizontally by a fine wire or silk fibre If F denote the force, D the inclination of the dipping needle, and N the number of oscillations made by the suspended bar in a given time at any station and F′, D, N′, denote the same things at a second station, then the following proportion holds, which gives the relative value of the two forces, *viz*

$$F : F' :: N^2 \cos^2 D : N'^2 \cos^2 D'$$

From the large table of results given by Hansteen, it appears that if the intensity at the magnetic equator in Peru (where it was supposed by Humboldt to be a minimum be ... then the intensity at Naples is 1 275 at Marseilles 1 2[illegible] at Madrid 1 [illegible]4, at Paris 1 348, at London 1 370 at Christiania 1 420, in Baffin's Bay (lat 76° 45′ N, long 58° 20′ W) 1 705 The maximum intensity hitherto observed is 2 052, and the minimum 0·706 Both observations were made at places in the southern hemisphere, the former by Sir James Clarke Ross, in lat 73° 47′ S, long 171° 50′ E (of London), where the dip was observed to be 87° 4′; and the latter by Erman, in lat 19° 59′ S, and long 35° 4′ W, off the eastern coast of Brazil, where the dip is 7° 55′ the two extreme intensities are therefore in the ratio of 1 : 2 906 In both hemispheres there are two points, or rather regions, of maximum intensity, which may be regarded as centres of separate magnetic action The position of the principal or strongest northern maximum intensity was ascertained by Captain Lefroy, in 1842 and 1843, to be in lat 52° 19′ N, long 2[illegible] (Sabine, *Phil Trans* 1846), that of the minor maximum was determined in 1828 and 1829 by Hansteen, and Erman, in the Russian expedition, to be in the meridian of 111° 27′ E The interval between the two meridians is consequently 270°—111°=159°, so that they are not directly opposite Both points appear to have undergone progressive changes from west to east, though not at the same rate In the southern hemisphere the two centres of maximum force are still nearer each other in respect of geographical longitude, and the intensity is greater than in the northern hemisphere (Sabine, *Phil Trans* 1850) The isodynamic lines are in general nearly parallel to each other, and also to the isoclinal lines, though at some particular places the two sets of lines are nearly at right angles The intensity does not appear to be affected by elevation above the surface

*Simultaneous Perturbations* In the volume of Hobarton Observations, 1841 to 1848, Col Sabine gives an interesting comparison of the simultaneous affections of the three elements at Hobarton and Toronto, on one of Gauss's term days, April 21, 1842, these two stations being specially selected for comparison as being geographically situated at nearly opposite points of the globe The result showed that the amount of disturbance on this day was nearly the same at both stations, and that the instants of extreme disturbance are not unfrequently as nearly identical at both as the nature of the observations enables us to determine The inference is that many of the perturbations or particular disturbances observed, must be regarded as general affections of the whole globe, manifesting themselves at stations the most remote from each other

*Theory* On considering all the phenomena, and particularly those of the diurnal and annual variations (which obviously depend on solar heat), as well as the disturbances accompanying displays of polar light it must appear extremely improbable that the magnetic force on which these phenomena depend is deeply seated in the earth If it belongs to the earth it must be supposed to be near to or at the surface, in order to account for the correspondence of the phenomena with the diurnal variations of temperature Accordingly it has been suggested that the cause must be looked for in the atmosphere Sir D Brewster (*Treatise on Magnetism*, 1837) adopts this view, and considers it to be proved, by certain experiments of Fusinieri, that iron is diffused through the atmosphere in a state of vapour But a new light has very recently been thrown on this subject by Faraday, who has demonstrated that the oxygen of the atmosphere is magnetic, and that the intensity of its magnetism like that of iron is diminished by an increase of temperature This fact renders the hypothesis of a diffusion of ferruginous vapour through the atmosphere unnecessary, and as the constituent gases of the atmosphere are every where in the same proportion the phenomena depending on the magnetic properties of its oxygen must be precisely the same as if the whole atmosphere were magnetic In a paper published in the *Philosophical Transactions* (Part I 1851), Professor [illegible] applied [illegible] magnetic force The earth he remarks, is a great magnet its power, according to Gauss, being equal to that which would be conferred if every cubic yard of it contained six one-pound magnets The disposition of this magnetic force is not regular, nor are there any points on the surface which can properly be called *poles*, still the regions of polarity are in high north and south latitudes These regions are connected by lines of magnetic force, which, generally speaking, rise out of the earth in one (magnetic) hemisphere, and, passing in varied directions over the equatorial regions into the other hemisphere, then enter into the earth to complete the known circuit of power A free needle shows the presence and directions of these lines, which invest the globe with a system of forces like that about an ordinary magnet, and wherever they pass through the atmosphere the forces are subject to the changing action of the magnetic oxygen There is every reason to suppose that these lines are *held* in the earth, just as the lines which originate in a magnet are held by it, and that any disturbance from above will cause a greater change in their place and direction in the atmosphere than in the earth When space, traversed by uniform lines of magnetic force, is occupied by a uniform body, as air, the disposition of the lines is not altered, but if a better conducting substance is introduced, the lines are concentrated or drawn closer together in it, and if a worse conducting substance is introduced they are opened out, and stand at greater distances from each other Now, supposing the whole atmosphere to have a mean temperature, the lines of force would have the direction determined by the arrangement of the power within the earth Then the [illegible]

would be opened out, and as the sun came up to and passed the meridian similar changes in the directions of the lines of force would there take place, so that in the morning a needle would be deflected towards the west, and in the afternoon towards the east As the night came on, and with it a lower temperature than the mean, the lines of force would be concentrated, and a reverse variation of the needle would take place The magnetic properties of oxygen and its daily variations of temperature, manifestly produce effects similar to those which actually take place, but whether they cause the whole of the observed variations, or are competent to do so, is a question that can only be decided after a very careful inquiry Professor Faraday states that the hypothesis has been compared with the mean daily variation for all the months in the year at north and south stations, as Toronto and Hobarton, and at many others near to and far from the equator, and the agreement is very remarkable Thus, according to the hypothesis, the paths described by the upper ends of free needles in the north and south hemispheres should be closed curves with the motion in opposite and certain directions, and so they are,—the curves should be larger in summer and smaller in winter, and so they are,—the northern hemisphere ought to have a certain preponderance over the southern, because of its superior temperature, and that is so,—the disposition of land and water ought to have [illegible] and the observations indicate one in the [illegible] What still remains to be done, to verify this ingenious theory is to ascertain the amount of change in the conducting power of the air for given changes of temperature, in order that it may be seen whether the effect on the magnetic instruments thereby produced corresponds with that which actually takes place

MAGNETITE In Mineralogy, magnetic ore of iron

MAGNETOMETER An instrument or apparatus for determining the elements of terrestrial magnetism, in direction and force When adapted to the purpose of determining the declination of the needle it is called a *Declinometer*, for the inclination and vertical force, it becomes an *Inclinometer* (see the terms) From the experience obtained in the British colonial observatories, it appears that these instruments, at least in the form recommended in the *Instructions* drawn up by the Committee of the Royal Society [illegible] of irregularity, one [illegible] magnetised bar to lose a portion of its magnetism, and others on causes not perfectly understood (Sabine, *Phil Trans* 1850) The instruments used at the Greenwich Observatory, and the modes of using them, are described in detail in the Introductions to *Greenwich Magnetical Observations*, which were published annually from 1841 to 1847

MALABATHRUM The leaf of the Cassia laurel, from Malabar

MALACOSTEON (Gr μαλακος, *soft* and οστεον, *a bone*) A diseased softening of the bones *mollities ossium*

MAL DE LA ROSA A disease endemic in the Asturias, attended by redness of the skin.

MALPIGHIAN In Anatomy, this term is applied to certain parts especially of the kidney, in allusion to the anatomist Malpighi by whom they were discovered or first definitely described Thus the numerous secreting tubes (*tubuli uriniferi*), where they are collected into conical bundles, form the "Malpighian" cones or pyramids, the more tortuous parts of the tubes which pass towards the surface of the kidney, terminate in or bear on small pedicles appended to their walls flask-shaped sacculi, named "Malpighian capsules" The arteries of the kidney, before dividing into capillaries, form, by tortuous convolutions, little balls, called "Malpighian corpuscles or [illegible]

MALTHAZITE A [illegible] mineral from Lobau

MANDELIC ACID (Germ mandeln, *almonds*) A white crystalline acid obtained by the action of hydrochloric acid on bitter-almond oil Its chemical formula is $C_{16} H_7 O_5 + H O$ It has also been called *Isomobenzoilic acid*, inasmuch as it contains the elements of formic acid and hydruret of benzoyle

MANDRIL The part of a turning lathe which carries the chuck upon which the *work* (that is, the material to be turned) is fixed It consists of a pulley, fixed upon an axle which is supported in the headstock, and receives its motion from the foot wheel (or the treadle, in the case of the pole-lathe), by means of a catgut band passing over the mandril pulley, into which grooves are cut for receiving the band Mandril, also, is the name given to the iron rod upon which a gun barrel is welded. In Zoology, a species of baboon is so called

MANGANITE In Mineralogy, grey ore of manganese.

MANNACROUP A granular preparation of wheat deprived of bran, used as an article of food for children and invalids

MARASCHINO A liquor prepared from a peculiar cherry growing in Dalmatia, it is bruised fermented, and then distilled and afterwards sweetened with sugar. [illegible] root

MARCASITE. In Mineralogy, white iron pyrites. A sulphuret of iron

MARIOTTE'S LAW This important relation between the elastic force and the density of gaseous matter, [illegible] is due to the first discoverer to be called *Boyle's Law* In a tract published at Oxford in 1668, [illegible] of air is [illegible] is equivalent to saying, that the elastic force is directly as the density or inversely as the volume, under the same temperature Boyle's experiments were made on atmospheric air confined in the closed end of a U-shaped glass tube, and compressed by the weight of a column of mercury It does not appear that he took the precaution to expel the moisture from the air, and the greatest pressure he applied was only equal to four atmospheres, so that it may, perhaps, be said that his experiments were neither sufficiently accurate nor extensive to establish the general law, even in respect of atmospheric air, without mentioning the other gases Mariotte's experiments were described in the Memoirs of the Paris Academy of Sciences, published about eleven years later, namely in 1679, without any reference to Boyle's announcement, which was possibly unknown to him, and as it was through this channel that the law became known to the continental philosophers who were the first to perceive its importance, they naturally distinguished it by the name of the person whom they supposed to be its discoverer

The relation in question has recently been investigated by M Regnault of Paris, in a series of experiments, conducted with the utmost attention to every circumstance affecting their accuracy, and the results are interesting If $v$ denote the volume of a gas under the pressure $p$ and $v'$ its volume under pressure $p'$, then the law gives $vp = v'p'$, whatever the pressures may be, if the temperature remains unaltered But, on comparing the results of his experiments, M Regnault has found that the above equation is not strictly true for any gas, and that, assuming $vp = v'p'(1+q)$ (where $q$ is a small correction) the value of $q$ increases with the pressure In respect of atmospheric air, the elastic force, under a pressure of twenty-five atmospheres, is less by a quantity somewhat exceeding the seventh part of an atmosphere than it would be if the law were strictly true With respect to carbonic acid the deviation is considerably greater In the case of hydrogen the correction $q$ becomes negative, so that while air and the other gases expermented upon were more compressed than they would be if the law were exactly followed hydrogen was less compressed, and its compressibility was found to diminish as the pressure increased But temperature has a considerable influence on these results, and as it was found that the deviation from the law diminishes as the temperature is increased, M Regnault concludes that the law is only rigorously true when the gases are infinitely dilated and that it becomes less and less exact in proportion as they are in a state of greater condensation (*Memoires de l'Institut*, tome xxi)

MARTIAL FLOWERS An old pharmaceutical name of black oxide of iron

MARTIAL REGULUS Metallic antimony obtained by decomposing sulphuret of antimony by means of iron

MASTICIN That part of mastic which is insoluble in alcohol it has some of the characters of caoutchouc The part of mastic soluble in alcohol, has been termed *Mastic acid*

MATERIA HERMAPHRODITA A term applied by Boerhaave to a peculiar substance soluble both in alcohol and water, and contained in vegetable extracts. Scheele called it *Materia saponacea* It is the *extractive* [illegible] leaves of a Peruvian plant, said to be a species of pepper, have been brought under this name to England, and much extolled for their medical virtues

MAULSTICK (Germ *Mahlstock*) A painter's stick on which he rests his hand whilst painting

MECCA BALSAM The produce of the *Balsamodendron Gileadense*, growing at Gilead, in Judwa It is also called *Opobalsamum*

MEDULLA OBLONGATA (Lat *the oblong pith*) In Anatomy, is the name given to the mass of grey and

white neurine contained in the occipital segment of the cranium, and forming the medium of connection between the spinal nerves and the encephalon It sometimes extends beyond the foramen magnum, but properly constitutes the myelon; but it has distinct and higher functions, and constitutes the chief part of the encephalic cavities

MEDULLA SPINALIS (Lat *the spinal pith*) In Anatomy the part of the nervous axis which is contained in the vertebræ of the trunk See MYELON

MELAMPYRINE (Gr μελας, *black* and πυρ *fire*) A crystallisable substance, soluble in water and nearly insipid, contained in the *Melampyrum nemorosum*

MELANOCHROITE (Gr μελας, *black*, and χροα, *colour*) A mineralogical variety of chromate of lead

MELANOGALLIC ACID A synonym of *Metagallic acid*

MELANTANNIC ACID (Gr μελας, *black*) The black substance formed by the action of excess of potash upon tannic or gallic acid

MELASSES See Molasses in Dict

MENDIPITE A native oxychloride of lead from the Mendip Hills Somersetshire

MENINGITIS (Gr μηνιγξ, *a membrane of the brain*) Inflammation of the membranes of the brain

MENSIS PHILOSOPHICUS (Lat) A chemical or philosophical month, its duration is variously stated, it is generally considered as including three days and nights

MENTHENE A liquid hydrocarbon obtained by distilling the crystallisable portion of peppermint oil, or *peppermint camphor* with anhydrous phosphoric acid Its formula is $C_{20} H_{18}$

MESENCEPHALON (Gr μεσος, and εγκεφαλον, *brain*) The natural primary division of the brain, which is usually encompassed by the parietal segment of the cranium and consists of the lobe of the third ventricle, the optic lobes, with the appendages called the "conarium," "hypophysis," and in fishes the "hypoaria" Chaussier gave the term "mesocephale" to an artificial combination of the pons varolii with the optic lobes dissociating the one from the medulla oblongata and cerebellum, and the other from the lobe of the third ventricle By some Anthropotomists the term "mesocephalon" is used synonymously with that of "pons varolii"

MESITE (Gr μεσος, *middle*) A liquid existing in pyroligneous spirit, the formula of which appears to be $C_6 H_6 O_2$ it is therefore, the hydrocarbon mesytilene $(C_6 H_4)+2 H O$

MESOXALIC ACID An acid obtained by boiling a saturated solution of alloxanate of baryta, which is thus resolved into *mesoxalate of baryta* and other products. This acid is crystallisable and very sour and soluble Its formula is $C_3 O_4+2 H O$

MESLIN (Fr mesler) A mixture of various kinds of grain

METACETONE (Gr μετα indicating *change* and acetone) A product formed during the distillation of a mixture of 1 part of starch with 8 of quick lime it is a colourless liquid, insoluble in water, but soluble in alcohol and ether, and of an agreeable odour Its formula is $C_6 H_5 O$ It [illegible] into *Metacetonic (metac[illegible]*

METAGENESIS (Gr μετα indicating *change*, γινομαι *I produce*) The changes of form which the representative of a species undergoes in passing by a series of successively generated individuals from the egg to the [illegible] It is contradistinguished from [illegible] which those changes are undergone by the same individuals. The following is an example of Metagenesis — The egg of the Medusa is developed into a polype, which assuming a form called *Strobila*, separates into numerous individual young Medusa The larval polype propagates other similar polypes by gemmation, each of which becomes a *Strobila*, and is resolved into numerous Medusæ Thus there is a successive production of procreating individuals from a single impregnated ovum of a Medusa, according to the law of Parthenogenesis

METALLIC TRACTORS Towards the end of the last century Dr Elisha Perkins, of Norwich, in Connecticut, introduced a method of treating diseases by drawing over the affected part two small metallic rods made of different metals, which he called *metallic tractors*, and the operation was called *tractoration*. The use of tractors has been called *Perkinism*, as that of animal magnetism has been called *Mesmerism* It is almost needless to say that in many instances they operate on the fancy of the patient (Hooper's *Medical Dictionary*)

METALLOCHROMES (Gr μεταλλον, *metal*, and χρωμα *colour*) When very thin films of peroxide of lead are deposited by electrolytic action upon polished steel plates they exhibit those beautiful prismatic tints which Nobili first described under the above name For the method of their production, see *Brande's Manual of Chemistry* p. 1518

METAMERIC (Gr μετα, indicating *change*, and μερος, *part*) A term applied in Chemistry to bodies having one and the same composition, and atomic weight, but yet differing remarkably in certain of their properties, probably in consequence of dissimilar molecular constitution This [illegible] of oxide of [illegible] and ether of oxide of [illegible] $C_6 H_6 O$, but [illegible] are metameric [illegible] larly grouped, as represented in the following formulæ:

Formiate of oxide of ethyle $C_4 H_5 O+$ / $C_2 H O_3$ — — — } $=C_6 H_6 O_4$
Acetate of oxide of methyle $C_2 H_3 O+$ / $C_4 H_3 O_3$ — — — }

METAPOPHYSIS (Gr μετα, *between*, αποφυσις, *a process*) In Anatomy, the exogenous process commonly situated between the diapophysis and anterior zygapophyses in the human skeleton it is best developed in the last dorsal and first lumbar vertebræ, the metapophyses are developed more, and from more numerous vertebræ, in most of the interior mammalia, arriving at their maximum of length in the armadillos, in which they equal the neural spines in length in the posterior dorsal and the lumbar vertebræ, they relate in these singular quadrupeds with [illegible] the neural spines [illegible] the [illegible] and the metapophyses [illegible] beam, [illegible] arch [illegible] of a roof

METEOROLITE See Aerolite in Dict

METHIONIC ACID (Gr μεθυω [illegible] *change*, and θειον *sulphur*) An acid obtained by the action of anhydrous sulphuric acid on ether, althionic acid is at the same time formed

METHODIC MEDICINE Medicine as practised by the methodic sect of physicians of which Themison was the head They endeavoured to reduce medicine to exact rules, and assumed that all diseases arose from constricted fibre

METHYLENE See Methylene in Dict

METIS One of the small planets belonging to the group between Mars and Jupiter Metis was discovered by Mr A Graham, at Mr Cooper's observatory, Markree Castle on the 25th of April, 1848, and is the ninth of the group in the order of discovery Its brightness was equal to that of a star between the 9th and 10th magnitudes The symbol chosen to designate it is an eye and star Its period of revolution appears to be about 1346 days nearly the same with that of Iris See PLANET

METOPION (Gr) An ancient ointment containing galbanum, which was formerly called *Metopium*

METRE The French standard measure of length See Measure, in Dict The metre is = 39 371 or nearly 39⅜ English inches

MICROCOSMIC SALT (Gr μικρος, *small*, and κοσμος, *the world*) The ammonio phosphate of soda, it is obtained among the products of the evaporation of urine and was formerly used as a blowpipe flux

MIDDLETONITE A fatty substance found in the coal strata at Middleton, near Leeds

MILLIPEDES Several insects formerly used in medicine were included under this name amongst them the *Armadillo vulgaris*, or *pill millipede*, the *Porcello scaber*, or *Sclater* of the Scotch the *Oniscus asellus* or common *Woodlouse*

MIMOTANNIC ACID The astringent acid of *catechu*, called also *tanningenic* acid

MIRAGE From observations of this phenomenon made by Mr J Hopkins on the sea coast of Lancashire, it appears that mirage is produced by vapour when the atmosphere is loaded nearly to saturation, at which time there is consequently little or no evaporation as indicated by the difference of temperature of a dry and wet bulb thermometer He found, that when the sky was cloudy and apparently threatening rain evaporation in the air near the surface of the earth was very active, and there was no mirage, but at other times, when the sun was shining brightly evaporation was checked, and at such times mirage might be seen Mr Hopkins supposes that in strong sunshine the direct rays raise the temperature of the ground considerably, when energetic evaporation from the wet sand takes place, and sends much vapour into the adjacent strata of the atmosphere, the presence of which checks the evaporation from the wet bulb It is not improbable that some of the vapour thus formed is condensed by the comparatively cool air at a small distance from the surface of the sand, and a stratum of cloud formed, from the surface of which light is reflected and the phenomenon of mirage produced. But, however this may be, the presence of vapour in sufficient quantity to saturate, or nearly saturate, the air at the place where the mirage appeared, always accompanied its appearance (*Reports of the British Association*, 1849)

MOHSITE. In Mineralogy, crystallised titaniate of

iron from Dauphiny; so named, in honour of Mohs, the crystallographer

MOLE Different productions of and excretions from the uterus are so called by medical writers. Small soft excrescences of the cuticle are also termed moles

MONGOLFIER BALLOON A balloon filled with atmospheric air considerably dilated by heat, so called from [illegible] A fire-balloon

MONILIFORM (Lat monile, *a necklace*) A botanical term it is applied to the pod of the *Hedysarum monilifrum* from its necklace-like appearance

MONOPHYODONTS (Gr *μονος one*, *φυω, I generate*, *οδους, tooth*) In Zoology, those mammals which generate one set of teeth, as, e g the Sloths, Armadillos, Cape ant eater, Ornithorhynchus and the true Cetacea all other mammals that have teeth generate two sets, called 'deciduous' and 'permanent' *See* DIPHYODONTS

MORINE The colouring principle of the wood of *Morus tinctoria* or *fustic*

MORMONS The name assumed by a religious sect in the United States of North America, which derives its origin from a person called Joseph Smith, whose account of his own mission is as follows —He all at once found himself labouring in a state of great darkness and wretchedness of mind—in the first stage, in fact of what is ordinarily known among Methodists as "receiving a call He was bewildered among the conflicting doctrines of the Christian world, and could find no comfort or mental rest In this state he resorted to earnest and vocal prayer, kneeling in the woods and fields, and after long perseverance in this course, his prayers were answered by the appearance of a bright light in heaven, which gradually descended until it enveloped the worshipper who found himself standing face to face with two supernatural beings Of these he inquired which was the right and true religion of the world? The reply was that all religions were equally erroneous, but that the true doctrine and the crowning dispensation of Christianity should at a future period be miraculously revealed to himself Several similar visitations ensued, and at length he was informed that the North American Indians were a remnant of Israel that when they first entered America they were a great enlightened, and favoured people that their priests and rulers kept the records of their history and their doctrines, but that, having fallen off from the true faith and worship the great body of the nation were supernaturally destroyed—not, however until after a priest and prophet named Mormon had, by celestial direction, drawn up an abstract of their national record and religious opinions This abstract, Joseph Smith was told still existed, buried in the earth, and he it was whom God had selected for the instrument of its recovery and its manifestation to all nations The record, he was told contained many prophecies as to "these latter days" and would give instructions for the gathering of the saints" into a temporal and spiritual kingdom preparatory to the second coming of the Messiah, which was at hand After several of these preliminary visions, the spot in which the book lay buried was at length indicated Joseph Smith went there and after digging, discovered a sort of box formed of upright and horizontal flags, within which lay a number of plates "resembling gold and about the thickness of common tin These plates were bound together by a wire and were engraved with 'Egyptian characters' Beside them lay two transparent stones, "called by the ancients Urim and Thummim," which were evidently divining crystals, and the angels informed Joseph Smith that by using them he would be enabled to decipher the characters on the plates What ultimately became of the plates in question—if such things existed at all—does not appear They were said to have been seen and handled by eleven witnesses But, it should be noticed, that with the exception of three persons, these witnesses were either members of Smith's family, or of a neighbouring family of the name of Whitmer Professor Anthon described a document submitted to him as having been a sort of *pot pourri* of ancient marks and alphabets "It had evidently been prepared by some person who had before him a book containing various alphabets, Greek and Hebrew letters, crosses and flourishes, Roman letters, inverted or placed sideways were arranged in perpendicular columns, and the whole ended in a rude delineation of a circle, divided into various compartments decked with various strange marks, and evidently copied after the Mexican Calendar given by Humboldt, but copied in such a way as not to betray the source whence it was derived"

The result of these facts is startling In spite of two bitter persecutions accompanied by murder, robbery, and arson, and two expulsions from flourishing settlements, in the course of twenty years the number of firm adherents to this faith has increased to upwards of 300,000 persons, of which a large number are now settled as an independent state, having a regular charter and organised local government, on a territory of which they possess not only the sovereignty but the *fee simple*—a beautiful and exceedingly fertile tract as large as England, and situated upon the best "trail" from Eastern America to California and the Pacific. This state is called Deseret, or Utah, and will probably soon be added to the group of the American Union Its capital [illegible] town, which [illegible] Such being their head-quarters, the Latter-day Saints have agencies and missions in every capital in Europe, and in every large town in the United Kingdom The great object of these undertakings is to make converts and to 'gather the saints to Deseret From Great Britain, since 1840 upwards of 14,000 persons have inclined to the doctrines of Mormon, and have gone forth to join the settlement The Mormon emigration, in 1849, passing through Liverpool, amounted to 2,500 persons, all of the better class of emigrants, and it is calculated that 30 000 Latter day Saints then remained behind In June, 1850, there were in England and Scotland 27 863 Mormonites, of whom London contributed 2 529, Manchester, 2 787, Liverpool, 1,018, Glasgow, 1,846, Sheffield, 1 920, Edinburgh, 1 331, Birmingham 1,900, and Wales—South Wales principally—4,312 And the Mormonite census was taken in last January, giving the entire number in the British Isles as 30,747 "Saints" During the last fourteen years more than 50,000 had been baptised in England, of which nearly 17 000 had emigrated from her shores "to Zion" (The above details are borrowed from an interesting little work called "The Mormons or Latter Day Saints" published by the proprietors of the "Illustrated London News")

MOTORY or MOTORIAL (Lat moveo, *I move*) In Physiology, this term was applied by Hartley in 1749, to the nerves conveying the stimulus to the muscles, in contradistinction to the nerves conveying the impressions to the neural axis which he called "sensory," but he distinguished those actions which result from the conveyance of impressions to the brain producing sensation and exciting volition, from those actions that are now called "reflex," as where he states that, 'the actions of sneezing swallowing coughing, hiccoughing, vomiting and expelling the fæces and urine, with others of a like nature, are to be deduced from those vibrations which first ascend up the 'sensory' nerves, and then are detached down the 'motory' nerves, which communicate with these by some common trunk, plexus, or ganglion

MOUNTAIN BLUE and GREEN The blue and green carbonates of copper

MOUNTAIN CORK MOUNTAIN LEATHER In Mineralogy, varieties of asbestos

MULE A machine for spinning cotton This very ingenious piece of mechanism was invented, about the year 1777, by Samuel Crompton, formerly of Hall in the Wood Lancashire For many years the machine was worked by hand only, the variety of its movements rendering it difficult to accomplish the moving of it by the power of water or of steam so simply as to be of common use One form of the mule was in use in Manchester in the year 1797 (Buchanan's *Essays on Mill-Work*, 1841)

MUM A malt liquor made chiefly at Brunswick of the malt of wheat, with the addition of a little oat and bean meal

MUMIA MINERALIS (Lat) A bituminous substance resembling brown asphalt

MUNJEET Indian madder

MUREXAN The *Purpuric acid* of Dr Prout Its formula is $C_5 H_3 O_5 N_3$

MUREXIDE (Lat *Murex* a molluscous animal giving a purple dye) The *Purpurate of ammonia* of Dr Prout It is best obtained by adding 4 grains of alloxan, and 7 of alloxantine dissolved in half an ounce of boiling water, to one-sixth of an ounce of a saturated solution of carbonate of ammonia The liquor acquires a magnificent purple colour, and deposits small crystals of murexide, which are green, and iridescent by reflected light, but deep red by transmitted light they form a beautiful microscopic object The chemical formula of [illegible]

MUSCADINE MUSKATEL A rich sweet wine [illegible] in the South of France

MUSCOVY GLASS Mica It is used in Siberia as a substitute for [illegible]

MUSK, ARTIFICIAL A substance obtained by the action of nitric acid upon oil of amber, and having an odour which some have thought to resemble that of musk

MYELON (Gr *μυελος, marrow*) The single-worded equivalent of "spinal marrow" and "spinal cord"

MYKOMELINIC ACID An acid resulting from the mutual action of alloxan and ammonia It forms a yellow powder $= C_8 H_5 O_5 N_4$

MYRIORAMA (Gr *μυριας a myriad* and *οραω I view*) A picture made up of many different scenes, as in landscapes, &c, so as to admit of an infinity of combinations

MYRISTIC ACID (Gr *μυρον, an odorous oil*) One of the fatty acids contained in the expressed oil of nutmeg

MYRO'NIC ACID (Gr. *μυρον, an odorous oil*) A [illegible] black mustard seed

MYROXYLIC ACID (Gr *μυρον, an odorous oil*, and *ξυλον, sharp*) A substance obtained from the Peruvian balsam the produce of the *Myroxylon Peruiferum*

MYRRHIC ACID A substance obtained by heating the resin of myrrh

## N

NARCOGENI'NE (Gr *ναρκη, stupor*, and *γιγνομαι, I produce*) A basic substance resulting from the oxidation of narcotina

NATURAL SCIENCE The term has been applied, arbitrarily, to signify the science of organic bodies, in contradistinction to *Physical Science*, by which is meant the science of inorganic matter

NAVI'CULAR (Lat navicula, *a little boat*) Boat-shaped The *navicular* bone is one of the bones of the tarsus The termed is also used in botany

NE'BULA In the *Philosophical Transactions* for 1850 (Part II), the Earl of Rosse has given a description of several remarkable nebulæ as seen in the great reflecting telescope erected at his Lordship's seat in Ireland. This noble instrument has a mirror of six feet in clear aperture, with a focal length of 53 feet, and by reason of the great extent of reflecting surface it gives a better means of observing faint objects of this class than any other which has ever been applied to the heavens

Among the new features which Lord Rosse's telescope has brought out, the most remarkable, perhaps, is the spiral arrangement of the nebulous matter, or what appears to be so, observed in various cases The most strongly developed instance is the 51st nebula of Messier's catalogue, one of the first known, and which has been often described Messier describes it as a double nebula without stars, Sir W Herschel as a bright round nebula with a halo or [illegible] surrounding it and attended by a companion, and Sir John Herschel observed the subdivision of the ring, through about two-fifths of its circumference as if into two lamina, one of which has the appearance of being turned up towards the eye out of the plane of the other portion Viewed through Lord Rosse's telescope, this upturned portion of the ring assumes the aspect of a nebulous coil tending in a spiral form towards the centre, and a general tendency to a spiroid arrangement of the streaks of nebulæ becomes apparent The companion is also seen to be connected with the general nebula The number of nebulæ in which the spiral arrangement had been observed to prevail was fourteen at the time the paper was communicated to the Royal Society, but some have been detected since They are in general difficult to be seen and the full powers of the instrument are required to bring out the details

When the catalogue of Sir John Herschel was published only two *annular nebulæ* were known to exist in the northern hemisphere Now there are seven, five of the planetary nebula having been found to be annular One of them has two perforations, but it is remarked, in reference to this class of objects, that in no instance is the central opening entirely dark Lenticular or long elliptic nebulæ are very numerous

With respect to the structure of these strange objects it is very difficult to form any satisfactory opinion Lord Rosse in speaking of the spiral nebula, Messier 51 observes, that "with each successive increase of optical power the structure has become more complicated, and more unlike any thing which we could picture to ourselves as the result of any dynamical law of which we find a counterpart in our own system" All that can be safely inferred seems to amount merely to this, that the distant parts of the nebulous object are held in connexion by some dynamical law which gives rise to the symmetrical forms which prevail though those forms, particularly in the case of the spiral nebulæ, are very different from those which we should expect to result from the operation of any laws with which we are acquainted It is to be kept in mind, however, that, on account of the great difficulty of tracing the outlines, we are by no means certain that we yet know what the forms really are Frequently, says Lord Rosse, "there is a gradual fading away at the edge, the last trace of which is rather a luminous mist, becoming rarer until imperceptible, a gauze-like tissue of the faintish imaginary flocculi or hairy filaments which become finer and more scattered till they cease to be visible, showing that the real boundary has not been seen, and that the form of the object would alter if additional optical power could be brought to bear upon it"

The considerable number of nebulæ which have been resolved by Lord Rosse's telescope into separate stars must be considered as strengthening the probability that they have all a similar constitution, for since every increase of optical power has multiplied the number of resolvable nebulæ, it seems reasonable to suppose that a further increase would accomplish the same result in those cases in which they have not yet been resolved But since there are still many with respect to which the large telescope does not give the slightest idea of separate stars the question of the existence of nebulous matter in contradistinction to stars, cannot be said to be decided

NEPHRA'LGIA (Gr *νεφρος, the kidney, αλγος, pain*) Pain in the kidney

NE'PTUNE In astronomy, one of the principal planets of the solar system, and the remotest at present known The mean distance of Neptune from the sun is 30 0368 times the sun's distance from the earth, or about 2800 millions of miles Its mean sidereal period is about 60 127 mean solar days, or 164½ years The orbit is nearly circular, the eccentricity in parts of the semi-axis being only 0 00872, and is inclined to the ecliptic in an angle of 1° 46′ 59″ Its apparent diameter is about 2″ 8, and its real diameter 41 500 miles, a little more than half that of Saturn Its density is about one-seventh of that of the earth, and its mass has been computed to be 1—19840 of the sun's mass The time of its rotation about its axis is not known It is attended by one satellite certainly and the existence of a second has been suspected Some observers have also suspected the existence of a ring On account of the distance of the planet, the difficulty of observing satellites or any circumstances connected with its physical constitution, is very great even in the most powerful telescopes

Neptune was first observed as a planet on the 23rd of September, 1846, and the circumstances attending its discovery are extremely remarkable For a number of years it had been remarked that the observed motions of Uranus were not in accordance with theory About 1790 the true longitude began to be in advance of the computed longitude and this acceleration continued till about 1822, after which the true motion began to be slower than the computed, and has continued to be so till the present time Various hypotheses were formed to account for the phenomena, all of which were found, upon examination to be untenable with the exception of one namely, the existence of an exterior and unknown planet disturbing the motion of Uranus according to the known laws of gravitation This hypothesis acquired greater probability as the irregular motions of the disturbed planet were more fully developed, and at length a systematic examination of the question was undertaken by Le Verrier an astronomer attached to the observatory of Paris and already distinguished by an admirable investigation of the orbit of Mercury Le Verrier first applied himself to the revision of the tables of Uranus, and the result showed that the observed irregularities could not be explained by the perturbations of Jupiter and Saturn, the only planets then known which exert any sensible action on Uranus This result was published in the *Compte Rendu* of the Paris Academy of Sciences for Nov 10 1845 Le Verrier next proceeded to inquire whether the irregularities were explicable on the hypothesis of disturbance by an exterior planet, and in the *Compte Rendu* for June 1 1846, he announced that such was the case, and that assuming the mean distance of the disturbing planet according to Bode's law, its true longitude for the beginning of 1847 must be about 325°—an important determination, inasmuch as it was sufficient for the guidance of any observer who might wish to undertake a search for the planet In a third memoir which appeared in the *Compte Rendu* for August 31 1846 Le Verrier gave the final results of his investigation [illegible] the orbit of the hypothetical planet [illegible] from the sun, periodic time, eccentricity, and longitude of the perihelion, and, in order that nothing might be wanting, he likewise computed the limits within which the deduced place of the planet would be varied by any supposable amount of error in the observations made use of, thus indicating the precise portion of the heavens within which it was necessary to institute a search; and he also assigned the limits of its mass and in addition pointed out that the planet would probably have a disc of about three seconds and be visible in ordinary telescopes

Having completed the theoretical investigation, Le Verrier next proceeded to consider the best means to be adopted for the discovery of the planet, and for this purpose addressed a letter to Dr Galle of Berlin, one of the best observers of the day calling his attention to the [illegible] and requesting him to search for the planet [illegible] indications therein given The letter was received at Berlin on the 23rd of

September (1846); and so well had the determination been made, that the planet was actually discovered by Dr Galle on the evening of the same day, and within 52 minutes of a degree of the place assigned by the mathematician An announcement of the discovery was immediately published, and the astronomers of all countries concurred in regarding it as the most remarkable triumph of the theory of gravitation which had ever been achieved.

Soon after the existence of the planet had been verified by Dr Galle, it began to be rumoured that Le Verrier was not the only claimant of the honour of the discovery, but that he had even been anticipated in some of his principal conclusions Nothing, however, was generally known of the circumstances till the publication of the *Monthly Notice* of the Royal Astronomical Society of London for November, 1846, which contained a detailed statement of them drawn up by the Astronomer Royal, about the accuracy of which there could consequently not be a question From this statement it appeared that so early as February, 1844, the Astronomer Royal was requested to furnish Mr Adams, of St John's College, Cambridge, with some observations of Uranus from the records of the observatory as data for investigations in which he was engaged respecting the theory of Uranus, and that in the month of October in the following year (1845) Mr Adams having completed his calculations of the perturbations of that planet on the assumption of their being caused by the attraction of an exterior planet, left at the Royal Observatory a paper containing a complete set of elements of the orbit of the hypothetical planet, a value of its mass and a table of differences of mean longitudes of Uranus as deduced from the theory, and as determined by actual observation It further appears that the Astronomer Royal having only results before him, and being well aware of the difficulty of the investigation requested from Mr Adams some explanations to enable him to form a better opinion as to the sufficiency of the hypothesis made to explain the observed discrepancies, that, from some unexplained reason, no answer was given to this request, that the matter rested in this state from the end of October 1845, till the appearance of Le Verrier's second paper in June, 1846, which contained as above stated a determination of the longitude of the hypothetical planet, and that on comparing the two results they were found, when reduced to the same epoch, to differ only by 3° 19′

The parties acquainted with Mr Adams' results had now far stronger reasons than other astronomers for believing in the existence of the hypothetical planet as well as in the accuracy of its computed place In so intricate an investigation, founded on data liable to more or less uncertainty, the risks of error were sufficiently numerous to justify hesitation even on the part of those best acquainted with the subject, but when the same result had been arrived at by two different computors independently of each other, the chances of error were almost annihilated There could then hardly be a doubt as to the accuracy of the conclusion, and if Mr Adams and his friends had immediately published the fact, it is not improbable that other observers would have been led to look out for the planet They did not, however, adopt this course, nor does it appear that they acquainted Le Verrier with the remarkable confirmation of his results, but they resolved to institute a search for the planet themselves with the great equatorial of the Cambridge Observatory The plan adopted was one which, though it virtually ignored the accuracy of the calculations, could scarcely fail of being successful in time It consisted simply, in making a close examination of a part of the heavens 30° long, in the direction of the ecliptic, and 10° broad, having its centre at the place indicated by Le Verrier and Adams, and observing all the stars to the 11th magnitude inclusive from time to time, so as to detect the planet by its change of place Observations in pursuance of this plan were actually begun on the 29th of July, 1846, and continued during two months On the 29th of September, Mr Challis, the director [illegible] Le Verrier's paper of August 31 [illegible] of detecting the planet by its disc was suggested Concurring in this idea Mr Challis at once abandoned the plan he had been following and on the evening of the same day began to observe within the limits indicated by Le Verrier. The planet, however, though observed as a star, was not recognised on the next night's observation [illegible] on the following day in consequence of Dr Galle's discovery on the 23d of September

It is to be remarked that Dr Galle had an advantage over Mr Challis in the possession of a star-map, then recently published at Berlin, of the part of the heavens to which his search was directed A star appeared in the field of the telescope which was not laid down in the map, and his attention was consequently directed to it till its true nature became evident by its proper motion

A circumstance deserving of notice is, that notwithstanding the [illegible] of the predicted place with that at which the planet was actually found, the elements of the hypothetical orbits determined both by Le Verrier and Adams were very wide of the truth The mean distance they give was [illegible] times the mean distance of the [illegible] (Le Verrier 36 1539, Adams 37 2474), and the period of revolution about 220 years It is now known, however, that the periodic time is less than 165 years, and the mean distance only about 30 times that of the earth from the sun the error in this respect being greater than the radius of Jupiter's orbit It seemed difficult at first to conceive how elements so faulty should give so close an approximation to the true place of the planet, but the reason has been satisfactorily explained

NERVI *See* NERVOUS SYSTEM, in DICT

NEURAL ARCH (Gr *νευρον, a nerve*) In Anatomy, the arch of the vertebra or primary segment of the skeleton which protects a corresponding segment of the neural axis it is posterior in Man, superior in other Vertebrates, and is formed by the "centrum," "neurapophyses" and "neural spine"

NEURAL AXIS (Gr *νευρον, a nerve*) In Anatomy, the central trunk of the nervous system, consisting in [illegible] myelon it is sometimes called [illegible]"

NEURAPOPHYSIS (Gr *νευρον*, and *ἀποφυσις, a process*) In Anatomy, the autogenous vertebral element which forms the side or wall of the arch protecting the neural axis or central trunk of the nervous system it has been called the "vertebral lamina," and by Soemmerring the [illegible] posterior vertebra"

NINIVEH MARBLES The name given to the collection of Assyrian Antiquities, recently procured by the researches of Mr Layard at Niniveh, and deposited in the British Museum

NODAL POINTS NODAL LINES Under the term VIBRATION (DICT OF SCIENCE) it is stated that a vibrating chord may spontaneously divide itself into any number of aliquot parts, each of which will vibrate separately as if it were fixed at its two extremities and formed a separate chord The points of separation between two such contiguous parts, which participate neither in the vibration of the one nor the other, but remain at rest, are called *Nodal Points* And in like manner, when elastic plates are put into a state of vibration the molecules separate themselves into parcels which vibrate independently of each other, and the lines of separation thus formed or lines of repose in which no vibration takes place, are called *Nodal Lines* *See* VIBRATION

NONTRONITE A nodular silicate of iron from Nontron, in France

NOPAL The cactus upon which the cochineal insects breed

NORDHAUSEN ACID A peculiar sulphuric acid, intermediate between the anhydrous, and monohydrated acid, or oil of vitriol, so called from the place of its manufacture

NUSSIERITE In Mineralogy, a species of *phosphate of lead* from Nussieres, near Beaujeu

## O.

O A contraction for *Octarium*, a pint

OCTROIS (A corruption of Lat auctoritas) The name given in France to the taxes levied on objects of consumption at the gates of many towns and cities, and applied partly to the general uses of the state, and partly to local purposes There are nearly 1500 communes subjected to this tax, which amounts in some years to nearly 100 000 000 of francs The revenue of Paris from this source alone is upwards of 30 000,000 of francs

ŒNANTHIC ETHER (Gr *οινος, wine; ανθος, a flower*) A peculiar compound, upon which the fragrancy and persistent odour of certain wines depends

ŒNANTHYLIC ACID (See above) An acid of a peculiar aromatic odour, obtained by the action of nitric acid on castor oil

OERSTEDITE In Mineralogy (in honour of Oersted), a silico-titaniate of zirconia, from Arendal in Sweden

ŒSOPHAGITIS (Gr) Inflammation of the œsophagus

ŒSOPHAGOTOMY. (Gr *οισοφαγος, the gullet*, and *τεμνω, I cut*) The operation of cutting into the œsophagus, or gullet, for the purpose of removing some [illegible]

OKENITE In Mineralogy (in honour of Oken), a hydrated silicate of lime

OLANIN (Gr *ελαιον, oil*) One of the ingredients

of the fifth cup reversed on itself, obstructed by distending bone and leather and [illegible]

OLEOSACCHARUM (Gr *ελαιον*, oil, and Lat *saccharum*, *sugar*) In Pharmacy powdered sugar mixed or imbued with certain essential oils, called also *Elæo-*[illegible]

[illegible] Fr) In Mineralogy, the *fer oligiste* [illegible] y of hæmatite or specular iron

[illegible] (Gr *ολιγος*, *few*, and *κλαω*, *I break*) In Mineralogy, a silicate of alumina and soda

ONONINE A sweet crystalline principle contained in [illegible]

[illegible] machinery for regis- made by the shafts or [illegible]

OPHIDE (Gr *οφις*, *a serpent*) In Mineralogy, [illegible]

OPHTHALMODYNIA [illegible] *οδυνη*, *pain*) A violent pain in the eye without apparent inflammation, it is sometimes of a gouty character

OPHTHALMOPTOSIS (Gr *οφθαλμος*, *the eye*, *πτωσις*, *a fall*) A protrusion of the whole globe of the eye

OPIANIC ACID A crystallisable acid formed by the action of peroxide of manganese on a solution of narcotine in dilute sulphuric acid Its formula appears to be $C_{10} H_9 O_9 + HO$

OPTOMETER (Gr *οπτομαι*, *I see*, *μετρον*, *measure*) An instrument for measuring the focal distance of the eye, or the distance at which a minute object is distinctly seen As the distance varies in respect of different individuals, the instrument is applicable to the purpose of determining the focal lengths of spectacles required for myopic or presbyopic eyes

The principle upon which the optometer is constructed appears to have been first established experimentally by Scheiner and subsequently by Dr Motte of Dantzic, and by Dr Porterfield If we look at any minute object through two pin holes, or two parallel slits made in a card or any opaque [illegible] the distance between the holes or slits being less than the diameter of the pupil of the eye, then, if the object be at the point of perfect vision, the image on the retina will be single, but in every other case it will be double, and, on varying the distance of the object from the eye, the two images will [illegible] o or recede from each other As a [illegible], if the object looked at be a line pointed nearly towards the eye, it will appear as two lines crossing each other in the point of perfect vision at a very acute angle

The practical application of this principle is extremely simple As proposed by Dr Thomas Young, the optometer may be made of a slip of card paper, or ivory unpolished, about eight inches in length (this being the distance of distinct vision for most eyes) and one in breadth, divided longitudinally by a black line which must not be too strong The end of the card is bent into a position nearly perpendicular to its length, or a detached piece may be applied in the same inclined position In this part (which is applied to the eye) a hole of about half an inch square must be made the side being so cut as to receive a slide of thick paper, with slits of different sizes from a fortieth to a tenth of an inch in breadth, divided by spaces somewhat broader, so that each observer may choose that which best suits the aperture of his pupil The slide is then brought close to the eye, and the black line viewed through two adjacent slits [illegible] lines intersecting each other, [illegible] is marked, and distance of this point from the slide is the focal length of the eye (Young's *Lectures on Natural Philosophy*, vol ii p 576, or p 154 of Kelland's Edition, Priestley's *History of Discoveries relating to Vision*, etc p 641)

ORCINE A crystallisable substance obtained from certain *lichens*, which, when exposed to air gradually reddens By ammonia it is converted into a purple substance called orceine or orcein acid which forms the beautiful blue or purple colours yielded by lichens

[illegible] during principle obtained from [illegible]

[illegible] Mr Willis's instrument, which attracted great attention at the Exhibition in 1851, was as follows It [illegible] rows of keys from C C C C to G, with two octaves and a fifth of pedals

| *Great Organ* | | Feet |
|---|---|---|
| Stops | | |
| 1 | Double diapason (metal) largest pipe | [illegible] |
| 2 | [illegible] (wood | [illegible] |
| 3 | [illegible] | [illegible] |
| 4 | Open diapason | [illegible] |
| 5 | Open diapason | [illegible] |
| 6. | Stopped diapason with carabella | [illegible] |
| 7 | Trumpet | [illegible] |
| 8 | Principal | [illegible] |
| 9 | Principal | [illegible] |

| | | Feet |
|---|---|---|
| | [illegible] open (wood) | 4 |
| | [illegible] | 4 |
| | [illegible] | 4 |
| | [illegible] | 2 |
| | Fifteenth | 2 |
| | [illegible] | 2 |
| | [illegible] | 2 |
| | [illegible] | 1 |
| | [illegible] | 3 ranks |
| | [illegible] | 3 ranks |
| | [illegible] | 3 ranks |

| *Swell Organ C C to G.* | | Feet |
|---|---|---|
| Stops | | |
| 1. | Double diapason, lower octave - (wood) | 16 |
| 2 | Double dulciana - - | 16 |
| 3 | [illegible] - - | 8 |
| 4 | [illegible] - - | 8 |
| 5 | [illegible] - - | 8 |
| 6 | [illegible] - | 8 |
| [illegible] | [illegible] - - | 8 |
| 8 | [illegible] - | 8 |
| 9 | Trombone - - - | 8 |
| 10 | Oboe - - - - | 8 |
| 11 | Cremona - - - - | 8 |
| 12 | Principal - | 4 |
| 13 | Principal dulciana - - | 4 |
| 14 | Flute, open (wood) | 4 |
| 15 | Clarion - - | 4 |
| 16 | Twelfth - | 3 |
| 17 | Fifteenth dulciana - - | 2 |
| 18 | Fifteenth - - | 2 |
| 19 | Dulciana - 3 ranks | |
| 20 | Sesquialtera - 3 ranks | |
| 21 | Mixture - - 3 ranks | |
| 22 | Fourniture - 3 ranks | |

| *Pedal Organ C C C C to G* | | Feet |
|---|---|---|
| 1 | Double diapason, open (wood) | 32 |
| 2 | Open diapason do (do) | 16 |
| 3 | Open diapason (metal) | 16 |
| 4 | Violin - (do) | 16 |
| 5 | Bourdon - - (do) | 16 |
| 6 | Trombone - - - | 16 |
| 7 | Trumpet - - | 8 |

| Stops. | | Feet |
|---|---|---|
| 8 | Octave - (metal) | 8 |
| 9 | Octave - - (wood) | 8 |
| 10 | Quint - - - - | 6 |
| 11 | Super-octave - (metal) | 4 |
| 12 | Clarion - - - | 4 |
| 13 | Sesquialtera - 3 ranks | |
| 14 | Mixture - - 3 ranks | |

| *Choir Organ* | | |
|---|---|---|
| 1 | Bourdon - - - | 16 |
| 2 | Open diapason - - - | 8 |
| 3 | Dulciana - - - | 8 |
| 4 | Viol di Gamba - - | 8 |
| 5 | Stopped diapason - - | 8 |
| 6 | Corno di bassetto - - | 8 |
| 7 | Viola - - | 4 |
| 8 | Principal - - - - | 4 |
| 9 | Flute - - (wood) | 4 |
| 10 | Flute, closed - (metal) | 4 |
| 11 | Octave cremona - - | 4 |
| 12. | Fifteenth - - - | 2 |
| 13 | Piccolo - - | 2 |
| 14 | Orchestral oboe (the only half stop) - | 8 |

| *Copular* | |
|---|---|
| 1 | Great organ to swell |
| 2 | Swell to great organ |
| 3 | [illegible] great [illegible] |
| 4 | [illegible] |
| 5 | Swell to pedals |
| 6 | Great organ to pedals |
| 7 | Choir organ to pedals |

being in all 77 stops

Of the above stops, all except the Orchestral Oboe were of the same compass as the various Claviers, a circumstance, we believe, without parallel in any large English organ

ORGEAT (Fr) A sweetened emulsion of almonds usually flavoured by a few bitter almonds and a little orange-flower water Mucilage of gum arabic is also sometimes added

ORSEDEW Brass leaf Dutch, or Manheim gold

ORTHOCLASE (Gr *ορθος*, *straight* and *κλαω*, *I break*) A mineralogical synonym of *Felspar*

ORTHOPÆDIA (Gr *ορθος*, *straight*, and *παιδεια*, *the bringing up of children*) That department of medicine and surgery which relates to the prevention and cure of deformity

OSTEODENTINE (Gr *οστεον*, *a bone*, and Lat *dens*, *a tooth*) That modification of dentine in which the tissue is traversed by irregularly disposed and ramified vascular or medullary canals, and in which some of the branches of the dentinal tubes communicate with cells like the radiated cells of true bone this modification of dentine is found in the central part of the tooth of the Cachalot and some other cetaceans, also in the teeth of the Cestracion, Acrodus, Lepidosiren, and many other existing and extinct fishes

OXALYLE (Gr *οξυς*, *sharp*, and *υλη*, *principle*) The hypothetical radical of the oxalic acid $= C_2 O_2$

OXAMIC ACID (Gr *οξυς*, *sharp* and *αμμος together*) One of the products of the destructive distillation of binoxalate of ammonia Its composition is represented by the formula $C_2 H_4 O_5 N + HO$

OZOKERITE (Gr *οζειν*, *to smell*, and *κηρος*, *wax*) A species of *mineral tallow*

OZONE (Gr *οζειν*, *to smell*) A substance occasionally existing in the atmosphere, and having a peculiar odour resembling that produced when repeated electric sparks, or the electric discharge from a point, is passed through the air It is supposed to be a peculiar modification of oxygen It is also formed in certain cases of the slow action of air upon phosphorus

# P.

P In some medical formulæ is used as the abbreviation of *Pugillus*, the eighth part of a handful

P Æ The abbreviation of *partes æquales*, or equal parts

PACINIAN CORPUSCLES Small oval bodies situated on some of the cerebro-spinal and sympathetic nerves, especially the cutaneous nerves of the hands and feet, are so called, after their discoverer, Pacini

PACKWAX The ligaments of the neck of ruminants It differs from common ligament in resisting the [illegible]

PADDING MACHINE An apparatus used by calico-printers for uniformly imbuing a piece of cotton cloth with any mordant

PALÆOSAURUS (Gr *παλαιος*, *ancient*, and *σαυρος*, *a lizard*) A genus of extinct lizards, characteristic of the magnesian conglomerate

PALAGONITE A mineral found in the tufa of Palagonia, in the Val di Noto, Sicily It is a hydrated silicate [illegible]

PALPEBRÆ (Lat, *palpitando*, from their fre-

quent motion.) The eyelids; the upper and under form the *canthi*

P[illegible] A throbbing the term is especially applied to irregularities of the heart's action, which are frequently the result of indigestion, of nervous excitement or mental agitation

PA'LMIC ACID [illegible] acid resulting from the saponification of the *palmine* of castor oil (*Palma Christi*)

PALMI'TIC ACID The acid formed during the saponification of *palm oil*

PANA'DA (Ital pane, *bread*) Bread or biscuit steeped or boiled in water so as to acquire a soft consistence

PANDICULA'TION (Lat pandiculo, *I gape*) The gaping, yawning, and stretching that characterises some diseases It sometimes occurs in the cold fit of an ague

PANOPHOBIA (Eng panic, from Lat Pan, and Gr φοβος, *I frighten*) That form of hypochondriasis or melancholy which is chiefly characterised by groundless apprehensions

PANTOCRA'TIC MICROSCOPE (Gr παν, *all*, κρατος, *power*) The name given by Professor A Fisher, of Moscow, to a microscope so arranged that the observer is enabled by simple movements to vary the magnifying power from 2·0 to 5·0 without in any degree obscuring the object, thus avoiding the inconvenience of having to shift the different parts of the microscope when he desires to observe the same object under different magnifying powers

PAPILLÆ (Lat papilla) In Anatomy, are minute conical or cylindriform elevations, usually well supplied with vessels and nerves they are close-set, and prominent on the palmar surface of the fingers and the plantar surface of the toes where they are disposed in double rows [illegible] lines They are very numerous [illegible], e g "conical," "fungiform," "calyciform," on the upper surface of the tongue

PA'RA A very small Turkish coin, equal to the fortieth part of a piastre

PARABA'NIC ACID One of the acids resulting from the action of nitric acid upon uric acid it forms colourless and transparent six-sided prisms, very soluble and sour Its composition is represented by the formula $C_6 O_4 N_2 + 2 HO$

PARABOLE *See* PARABLE

PA'RALLAX In 1846, Mr Peters of the Pulkova Observatory, presented to the Imperial Academy of Sciences of St Petersburg, a very important memoir on the Parallax of the Fixed Stars, of which an analysis has been given by Struve in his *Etudes d'Astronomie Stellaire* [illegible] the results obtained by Mr Peters for the parallax of eight stars, determined by observations of zenith distances made at Pulkova in 1842 and 1843 with the great vertical circle of Ertel The divided circle of the instrument is 43 inches in diameter, and the object glass of the telescope nearly six inches, the magnifying power employed was 215, and the whole number of observations was 711, of which 289 were of Polaris alone The names of the stars their resulting parallaxes, and the probable errors of the respective results, are as follows —

| Star's name | Parallax | Prob Error |
|---|---|---|
| 61 Cygni - - | +0″ 349 | - 0″ 080 |
| Groombridge 1830 | +0 226 | - 0 141 |
| 1 Ursæ Majoris - | +0 133 | - 0 106 |
| Arcturus - - | +0 127 | - 0 073 |
| α Lyræ - - | +0 103 | - 0 053 |
| Polaris - - | +0 067 | - 0 012 |
| Capella - - | +0 046 | - 0 200 |
| α Cygni - - | −0 082 | - 0 043 |

The parallax of 61 Cygni was determined by Bessel from a series of observations with the Königsberg heliometer, and found to be 0″ 348 (*see* DOUBLE STARS) and the confirmation thus given by Peters may be considered as not only placing the fact of a measurable parallax of this star beyond all doubt, but as proving that [illegible] more than a small fraction from [illegible] with respect to the next star in the list (Groombridge 1830) Mr Faye of the Paris Observatory has recently announced that he had determined a parallax exceeding [illegible] a result which Mr Peters' observations prove to be erroneous. Struve found the parallax of α Lyræ to be 0″·261 The negative value found in the case of α Cygni must be considered as indicating merely the absence of any sensible parallax In fact, the relative [illegible] the probable errors in respect of the four stars 61 Cygni, 1 Ursæ Majoris, Arcturus, and α Cygni, show that very little reliance can be placed on the numerical results in any of these cases

Another conclusion deduced by Peters is, that the mean parallax of stars of the second magnitude is +0″ 116, with a probable error of 0″ 014. This result [illegible] 33 stars, of which the absolute or relative [illegible] have been determined with a degree of certainty presumed to be sufficient to establish the conclusion Assuming the scale of relative distances adopted by Struve for stars of the different orders of magnitude (*see* GALAXY), he thence concludes that the mean parallax of the stars of the first magnitude is 0″ 209 and that the mean parallax of those of the third is 0″ 076. On this it is to be remarked that although the hypothesis that the stars which have the greatest apparent magnitude are those which are nearest the earth, and consequently those which have the largest parallax, is very probable in itself, it is not established by any conclusive facts, on the contrary, there does not appear, in the case [illegible] supposed to have [illegible] to be any relation [illegible] magnitude

In the *Memoirs of the Royal Astronomical Society*, vol xix, the parallax of the double stars α¹ and α² Centauri is determined by Mr Maclear from a series of observations with the mural circle, made at the Cape in the years 1842, 1843, 1844, and 1848 The final result is given as follows —

Parallax of α Centauri = 0″ 9187, Prob error = 0 034
Constant of aberration = 20″ 53 , Prob error = 0·038.

This result scarcely differs from that which was deduced in 1842, by M Henderson (who first discovered the parallax of this remarkable star), from observations made at the same place, namely, parallax = 0″ 913 It must be remembered, however, that both results are deduced from observations made with the same instrument, and the agreement therefore may perhaps be considered as not so conclusive as in the case of 61 Cygni

PARAPOPHY'SIS (Gr παρα, *across*, αποφυσις, *a process*) In Anatomy, the process which extends outwards, or outwards and downwards, from the body of the vertebra in Fishes, and from the same part in the cervical and anterior dorsal vertebræ of the Crocodile, where it has been called the "inferior transverse process" It is sometimes ossified from an independent centre

PARI'LLINE The supposed active principle of sarsaparilla It has also been called Smilacine It appears to be identical with the Parillic acid of Batke

PA'RISITE A crystallised mineral containing cerium found in the mines of the Musso Valley, in New Granada

PA'RTHENOGE'NESIS (Gr παρθενος, *a virgin*, γινομαι, *to be born*) In Physiology, the procreation of offspring by a plant or animal independently of the immediate stimulus of the male principle The impregnated seed of a plant produces a "phyton" of the proper species, usually in the form of a leaf with a stem and root, from this a succession of "phytons" may be developed by gemmation, most of them having the form of leaves, but, in the higher species of plants, some may take on the form of petals, others of stamens, developing the male principle, or "pollen," others of pistils, forming the female principle, or "seed" By the union of these two principles the seed is impregnated, and may germinate, but the series of individuals successively developed from the first individual from the seed are procreated by "parthenogenesis" The different individuals being organically connected, according to a definite pattern for each species, form a compound whole, which is commonly regarded as the individual "tree" or "shrub"

In the compound Polypes the first individual polype from the impregnated ovum develops a succession of individuals, by gemmation, most of which may resemble the first formed polype, but others are modified so as to reproduce the male principle, or the ova these generative polypes are also, sometimes, as in *Coryne* and *Campanularia*, set free For other instances of this alternating kind of generation see Steenstrup *On Alternate Generation*, and Owen, *On Parthenogenesis*

PARTHE'NOPE One of the small planets belonging to the group between Mars and Jupiter, and the eleventh in the order of discovery It was detected at Naples on the 11th of May, 1850, by Dr De Gasparis, who, in announcing its discovery, remarked that he had used his utmost endeavours to realise a Parthenope in the heavens, this name having been suggested by Sir John Herschel upon the occasion of the discovery of Hygeia (also by De Gasparis) in 1849 The symbol is a fish crowned with a star. *See* PLANET

PAU'LITE A variety of hypersthene or prismatic schiller-spar, from Paul's Island and the coast of Labrador

PEACHWOOD A dye-wood extensively used in calico printing It is the produce of a species of *Cæsalpinia*

PE'ARLWHITE The subnitrate of bismuth, formerly used as a cosmetic under the above name

PE'CTOLITE (Gr πηκτος, *be[illegible]* and λιθος, *a stone*) A species of zeolite, [illegible] been heated, forms a gelatinous sc[illegible] atic acid

PE'GANITE. A species of wavellite, or hydrated [illegible] Strigis in Saxony

PE[illegible] (Gr πηγμα, Lat. aliquod compactum) A granular structure of quartz and feldspar, found chiefly in granites, and consisting of [illegible] called *graphic granite*, having the appearance of [illegible] compressed

PELOMA (Gr πηλος *black*) An archæological synonym of [illegible] or leather

PELOKONITE (Gr πηλος, *mud*, and κονια, *clay*) In Mineralogy, a massive phosphate of manganese, iron, and copper

PELOSI'NE (Gr πηλος, *black*) A bitter extractive matter obtained from the root of the *Cissampelos Pareira* or *Pareira Brava*

PENDULUM EXPERIMENT An experiment proposed by M Foucault of Paris, which, in 1851, excited great [illegible] in this country and in France, its [illegible] a visible proof of the rotation of the earth It is this By the theory of dynamics, if a simple pendulum be made to oscillate in a plane, the plane of oscillation, in reference to the meridian of the place, would remain fixed but will appear to turn uniformly about the vertical, passing through the point of suspension, and the time of rotation would be to that of the [illegible] e ratio of the cosecant of the latitude [illegible] is easily understood in respect of a pendulum supposed to be suspended directly over the pole, where the terrestrial meridians would successively pass under it, and the earth's rotation would have no tendency to alter the direction in space of the plane of oscillation, but for any place between the pole and the equator the conception of the phenomenon is more difficult Upon trial the experiment is liable to failure from various causes, but principally from the great difficulty of adjusting the suspension so accurately that the vibrations shall continue to be made in a plane, for if the pendulum acquires an elliptic motion, however slight, the greater axis of the ellipse, or line of apsides, immediately begins to revolve from a cause entirely independent of the rotation of the earth, and the two motions cannot easily be distinguished (See *Notices of the Royal Ast Soc* vol xi p 199, and *Memoirs of R A S* vol xx)

PE'PSINE (Gr πεψις, *digestion*) A peculiar animal principle contained in the gastric juice and which, in conjunction with acid matter also present in that secretion, confers upon it its solvent or digestive powers in regard to certain components of the food

PERCUSSION (Lat percutio, *I strike*) In medical language, signifies the striking or tapping upon any part of the surface of the body, with a view of ascertaining the condition of the subjacent parts by the sound so produced It is a valuable mode of exploration in some diseases of the chest. Attention was first called to this mode of diagnosis in 1761 by Dr Avenbrugger of Vienna his work was translated into French in 1808, by Corvisart, and the subject was further illustrated in 1816, by the celebrated work of Laennec on *Auscultation*

PE'RICLASE (Gr περι and κλαω, *I break*) A crystalline mineral, composed of magnesia with about 8 per cent. of protoxide of iron found at Monte Somma, near Naples

PE'RICLINE (Gr περι, and κλινω, *to lie*) A variety of felspar

PE'RILYMPH (Gr περι and Lat lympha, *water*) The fluid between the membranous and osseous labyrinth of the ear, or that in which the membranous labyrinth is suspended

PE'RMANENT WHITE Sulphate of baryta, when used as a pigment, it not being liable to discolouration, as is the case with white lead

PERMANGANIC ACID, called also *Hypermanganic* acid A compound of 2 atoms of manganese with 7 atoms of oxygen It has been obtained in carmine-red acicular crystals Its salts are of a fine red or purple hue

PERONE'AL MUSCLES (Gr περονη, *the fibula*) Muscles arising from the fibula and concerned in the movements of the foot

PE'ROWSKITE. A crystallised titaniate of lime found in the chlorite slate of Slatoust in the Ural

PE'RSIAN BERRIES The berries of the *Rhamnus infectoria*, called in France *grains d'Avignon* They are used by calico-printers and dyers, as a source of a yellow colouring matter, which has been called Rhamnine

PE'RTHITE. A variety of felspar, from Perth in Upper Canada

PERU VINE One of the products of the distillation of Peruvian balsam. Its formula is $C_{18}$ $H_{12}$ $O_2$ It is a light oily fluid

PE'TZITE An ore of silver with from 30 to 40 per cent of tellurium, analysed by Petz, and found in the [illegible]

PH[illegible] A crystallisable principle existing in the root of *Peucedanum officinale*, hog's fennel or sulphur wort

PHE'NOLE (Gr φενη, *a fir tree*) A liquid obtained by the action of lime upon the hydrochlorate of oil of turpentine, of which oil it appears to be an isomeric modification Its formula is $C_{10}$ $H_8$

PEYER'S GLANDS Small glandular sacculi peculiar to the mucous membrane of the small intestines, and either scattered singly, when they are called "glandulæ solitariæ," or aggregated into groups, when they are termed "glandulæ agminatæ," or "Peyer's patches," from the anatomist who first described them

PHA'COLITE (Gr φακος, *a wart*, and λιθος, *a stone*) A silicate of alumina, lime, and soda (zeolite), from Leipa in Bohemia

PHENAKISTOSCOPE The name given by Prof Locke, of [illegible] to an apparatus for enabling persons to converge the optical axis of the eyes, or to look "cross-eyed," and thereby observe certain phenomena of binocular vision It consists of a flat base-board, with an upright rod at one end bearing two sliding sockets which may be clamped at any height, like those of a retort stand The upper socket supports a small screen or card having a slit or aperture a quarter of an inch wide and about three inches long, so that both eyes may be applied to it at once, the middle of the aperture being directly over the centre of the base-board The lower socket bears a moveable screen of pasteboard or thin wood, having an opening of about three inches long, and an inch wide, and so adjusted that its centre is in the same straight line with the centre of the set in the upper card and the centre of the base-board This screen has an index marked across its middle In experimenting with the apparatus the observer places an object on the base-board, looks downward through the slit in the upper screen, and slides the lower up or down till the required adjustment is attained For example, let the letter A be written twice on the base-board, about two and a half inches (the width between the eyes) apart, and in the line of the axis of the apertures of the screens, and suppose the lower screen to be close down to the base-board On gradually raising this screen, and keeping the eyes directed to the index and not to the letters, each letter will separate and appear double, so that four letters will be seen As the screen is raised the two internal images gradually approach, and become optically superimposed, or coalesce into one, so that there are only three letters visible, and the middle or superimposed figure is the *phantom* or *image* where there is really no object On ceasing to look at the index, and directing the eyes on the base-board itself, the phantom figure instantly vanishes The experiment may be varied so as to produce various amusing illusions, and the author thinks the apparatus will illustrate many important points in optics, and especially the physiological point of single vision by two eyes (*London, Edinburgh and Dublin Philosophical Magazine*, June, 1850 It may be remarked that whether the apparatus be new or not, the phenomena have long been well known, and are fully explained in *Smith's Optics*, 1738)

PHA'RMACOSI'DERITE (Gr φαρμακον, *poison*, and σιδηρος, *iron*) Native arseniate of iron

PHENAKISTOSCOPE (Gr φενακισμος, *illusion*, σκοπεω, *I view*) A philosophical toy, which illustrates the principle of the *persistence* of impressions on the retina of the eye in a very ingenious manner It is thus described by Sir D Brewster (*Ency Brit* art. OPTICS) "This instrument was, we believe, originally invented by Dr Roget, and improved by M Plateau, at Brussels, and by Mr Faraday It consists of a circular disc from six to twelve inches in diameter, with rectilinear apertures on its margin in the direction of its radii A series of figures, of a rider, for example, leaping a fence is drawn on the circumference of a circle parallel to the rim of the disc The *first* figure represents the rider and horse standing *before* the fence, and the last figure represents them standing *over* the fence, when the leap is completed Between these two figures there are several others, representing the rider and the horse in various parts of the leap The observer then stands in front of a looking glass, with the disc in his left hand, attached to a handle, and by a piece of simple mechanism he whirls it rapidly round, looking at its image in the glass through the notches in its margin He is then surprised to see the horse and his rider actually leaping the fence, as if they were alive, and returning and leaping again as the disc revolves If we look over the margin of the disc at the reflected picture on the face of the disc, all the figures are effaced, and entirely invisible, but when we look through the notches, we only see the figure of the horse and rider at the instant the notch or aperture passes the eye, so that the picture instantaneously formed on the retina is not obliterated by preceding or subsequent impressions Hence the eye receives in succession the pictures of the horse and rider in all the attitudes of the leap, which are blended as it

were into one action The apparent velocity with which the horse and rider advance (supposing the disc always to have the same velocity) depends on the proportion between the number of [illegible] of the disc, and the number of [illegible] rider."

PHE'NAKITE. (Gr. *φενακίζειν, to deceive*) A rare mineral, containing glucina The Rhomboedral Emerald of Mohs

PHE'NE (Gr *an eagle*) One of the chemical synonyms of the hydrocarbon usually called benzole, $C_{12} H_6$ It is isomeric with bicarburet of hydrogen. It has also been called *Hydruret of Phenyle*, and in that case represented by the formula $C_{12} H_5 + H$

PHENIKO'CHROITE (Gr *φοινιξ*, and *χροα*, *colour*) A native chromate of lead from Beresow in Siberia

PHE'NYLE (Gr *φοινιξ*, and *ολη*, *matter*) A radical hydrocarbon = $C_{12} H_5$

PHI'LLIPSITE A variety of zeolite So called in honour of Phillips the geologist

PHILOSO'PHIC CANDLE An inflamed jet of [illegible] WOOL Oxide of zinc formed during the combustion of the metal, when it floats about in white flocks in the air It has also been called *nihil album*

PHLEBI'TIS (Gr *φλεψ*, *a vein*) Inflammation of a vein

PHLE'BOLITE (Gr *φλεψ*, and *λιθος*, *a stone*) A venous calculus, commonly called "vein-stones" Very small concretions have sometimes been found in certain veins, varying in size from a pin's head to that of a pea. They consist chiefly of carbonate and phosphate of lime and animal matter

PHLEGMA'SIA (Gr *φλεγω I burn*) Inflammatory disease The term *phlegmasia dolens* has been applied to a peculiar inflammatory condition of the leg, which sometimes occurs in females soon after delivery

PHLORI'DZINE, or PHLORIZINE (Gr *φλοιος*, *bark*, *ριζα*, *root*) A white crystalline substance obtained from the bark of the roots of apple, pear, cherry, and plum trees, giving to it its bitter astringency Its composition is represented as $C_{21} H_{15} O_{12}$ Acids, aided by heat, resolve it into sugar, and *Phloretine* By the joint action of oxygen and ammonia it is converted into a gum like substance which has been called *Phloridzéine*

PHŒ'NICIN (Gr *φοινιξ*, *purple*) A purple substance obtained by the action of sulphuric acid on indigo

PHO'LARITE (Gr *φολις a scale*) A mineralogical name applied to a hydrated silicate of alumina, occurring in pearly scales

PHOSGE'NITE Native chlorocarbonate of lead, occurring in transparent yellowish crystals at Matlock It is a very rare mineral

PHOSPHORIC ACID *See* PHOSPHORUS

PHOSPHURETS Compounds of Phosphorus with the metals have been called *Phosphurets* or *Phosphides*

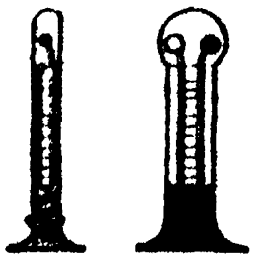
PHOSPHORUS OF VIVIANITE The native hydrated phosphate of copper found near Rhembrettenbach, and also in the Ural

PHO'TICITE (Gr *φως*, *light*) A native silicate of manganese

PHOTO'LOGY (Gr *φως*, *light*, *λογος*, *discourse*) The doctrine of light *See* LIGHT

PHOTO'METER (Gr *φως light*, and *μετρον*, *measure*) An instrument for measuring the intensity of light, or of illuminations

The most elegant instrument which goes under this name is the photometer invented by the late Sir John [illegible] It is merely the differential thermometer of the same ingenious philosopher, having one of its balls diaphanous and the other coated with China ink, or blown of deep black enamel, and the whole covered by a case of thin transparent glass, to defend the balls from the disturbing influence of currents of air The photometer has two general forms, the one [illegible] in which the black ball is about an inch higher than the other, and bent forward to the same vertical line, or the axis of the transparent cylindrical case, and the other [illegible] having both its balls of the same height, and reclining in opposite ways, the case being composed of a wide cylinder surmounted by the larger segment of a hollow glass sphere The latter form of the instrument, though less commodious, is better adapted for nice observations; since, besides receiving the light more regularly, its balls from being on the same level, are not liable to be disturbed by different strata of unequally heated air




The theory of this photometer depends on the assumed principle that the intensity of light is proportional to the heat excited by its incidence on the black ball When the instrument is exposed to light, the rays which fall on the clear ball pass through it, without suffering obstruction, but those which strike the dark ball are stopt and absorbed at its surface, where, assuming a latent form they act as heat, which, by expanding the air within the ball causes the liquid in the stem to descend. This heat will continue to accumulate till its farther increase comes to be counteracted by an opposite dispersion, caused by the rise of temperature which the ball has acquired. But as all air the rate of cooling is, within moderate limits, proportional to the excess of the temperature of a given surface above that of the surrounding medium Hence the space through which the coloured liquid sinks in the stem will measure the momentary impressions of light, or its actual intensity (*Leslie on the Relations of Air to Heat and Moisture*)

The graduation is entirely arbitrary, and may be regulated by fancy or convenience Leslie [illegible] divisions as in the differential thermometer, ten degrees of which [illegible] when the instrument is excluded from light, the liquid in the stem next the coloured ball stands at zero In this country the direct impression of the sun at noon, about the summer solstice, forces the liquid down to 90° or 100° The greatest force of the solar beams, in the depth of winter, measures only about 25° At the altitude of 3° above the horizon, the whole effect of the sun's rays does not exceed one degree The indirect light from the sky at noon in summer is from 30° to 40°, in winter from 10° to 15° Comparing the illuminating power of the solar rays with that of artificial lights, Leslie found the light emitted by the sun 12 000 times more powerful than that of a wax candle; that is to say, if a portion of the luminous solar matter, rather less than half an inch in diameter, were transmitted to our planet it would throw forth a light equal to the effect of 12,000 candles

It has been objected that the instrument now described is only a species of thermometer, and not strictly a photometer, since it measures heat and not light To this objection Sir J Leslie replies by asking, 'What does the thermometer itself indicate except *expansion*? As heat is measured by the expansion it occasions, so light is determined by the intensity of the heat which in every supposition invariably accompanies it What other mode, after all could be imagined for detecting the presence of light? How can an unknown quantity be expounded but in terms of one already known?" (*Ency Brit*, art CLIMATE)

It must be admitted, however, that the same quantity of light emitted by terrestrial bodies of different kinds is not always accompanied with the same degree of heat Thus, phosphorus burns in oxygen gas with intense splendour [illegible] unfitness of this instrument for comparing the intensities of lights from different sources has been pointed out by Arago, who proved that it rises when exposed to the light of the sun, falls when exposed to the light of a common fire, and [illegible] an Argand lamp remains stationary (*Annales de Chimie et de Physique*, vol iii 1851) See *Leslie's Experimental Inquiry into the Nature and Propagation of Heat* 1804

PHRAGMOCONE (Gr *φραγμος*, *a partition*, *κωνος*, *a cone*) The essential part of the complex-shell of the Belemnite consisting of a straight cone divided by numerous transverse partitions perforated by a marginal siphon From the time of Lhwyd conchologists have called this part the 'alveolus," a term which is now more properly restricted to the socket of the sheath lodging the 'phragmocone" Belemnites are chiefly distinguished by modifications of the "sheath" or 'dart,' but the phragmocone is the constant and true characteristic of this extinct group of Cephalopods, which chiefly flourished from the epoch of the Muschelkalk to that of the Maestricht chalk

PHTHORE (Gr *φθορος pernicious*) A name given by some of the French chemists to fluorine

PHYLLIRE'INE A bitter crystalline principle contained in the *Phyllirea latifolia*

PHY'MA (Gr *φυω*, *I produce*) A term applied by the ancients to tumours in modern pathology to tubercle on any external part of the body

PHYSETER (Gr *φυσητης a blast-pipe*) The genus the cachalot, or sperm whale

PHYSICAL SCIENCE This term has been applied to signify the Science of Inorganic Bodies, as contradistinguished from that of Organised Beings In this sense it includes the study of the ex[illegible] principles, as well as [illegible]

PHYTELEPHAS Vegetable Ivory (Gr *φυτον*, *a plant*, *ελεφας*, *an elephant*) A genus of plants inhabiting America Its fruit is of great size, and contains a milk which hardens into a substance resembling ivory

Of this hardened albumen, buttons, boxes, and other articles are turned It is the *Caleza de Negro*, or *Jaqua plant*

PHYTO'TOMY (Gr φυτον, *a plant*, τεμνω, *I cut*) Vegetable anatomy

PIAUZITE A fusible resin-like substance found in the brown-coal at Piauze, near Neustadt in Carniola

PICKERINGITE A magnesian alum occurring in white silky fibres at Iquique in Peru

PICRAMY LI (Gr πικρος, *bitter*, υλη *principle*) A radical hydrocarbon C $_{14}$ H$_{7}$ The name has reference to the composition of bitter almond oil which is C$_{14}$ H$_{6}$ O$_{2}$, and therefore a *binoxide of Picramyle*

PICROGLY'CION (Gr πικρος *bitter*, and γλυκυς, *sweet*) An extractive matter of a bitter and sweet taste, obtained from the stalks of the *Solanum dulcamara*

PI'CROLITE '(- - - -nd λιθος, *a stone*) A name given b- to fibrous serpentine

PICROPHA ' ' ' (Gr πικρος, φαρμακον *poison*, and λιθος *a stone*) A native arseniate of lime and magnesia in Riechelsdorf in Hessia

PICROPHYLLITE (Gr πικρος and φυλλον, *a leaf*) A species of serpentine in dark green foliated masses

PICROSMINE (Gr πικρος and οσμη *to smell*) A species of steatite said to yield a *bitter odour* when breathed upon

PILE GALVANIC *See* VOLTAIC ELECTRICITY

PILLOWS In Machinery, are the bearings on which gudgeons and journals rest They are usually fixed in blocks of cast iron whence the term *Pillow Block*, and sometimes corruptly, *Plumber Block*

PIMARIC ACID The purified resin of the *Pinus maritima* it forms a white crystalline mass When subjected to dry distillation it yields an oil which has been called *Pimarone*

PIMELIC ACID (Gr πιμελη, *fat*) One of the products of the action of nitric acid on fatty bodies

PINGUITE (Lat pinguis, *fat*) A greasy feeling silicate of iron, of a dark green colour, found at Wolkenstein in Saxony, and in the Harz

PINIC ACID (Lat pinus, *the fir tree*) The principal resinous constituent of common resin or colophony

PIPEFISH The vernacular name of the fishes of the genus *Syngnathus*

PISSOPHANE (Gr πισσα, *pitch*) A substance chiefly composed of sulphate of alumina and iron, found in the decomposing alum slate of Stalfeld and Reichenbach in Saxony It resembles pitch in fracture and colour

PISTACITE A green silicate of alumina lime, and iron It is a variety of epidote, and occurs imbedded in many crystalline rocks The finest crystals are from Arendahl and from several parts of the Alps

PISTOMESITE A crystallised carbonate of iron and magnesia from Saltzburg

PITCH In wheelwork signifies the distance between the centres of two contiguous teeth *Pitch Line* is the circle, concentric with the circumference, which passes through the centres of the teeth

PITTIZITE In Mineralogy, a variety of bog iron ore - - - - - in Prince

PLAGIONITE A sulphuret of lead and antimony from Wolfsberg in the Harz

PLA'KODINE (Gr πλαξ, *a tabular surface*) A native arseniuret of nickel found near Musen in Siegen in tabular crystals

PLA'SMA (Gr) The fluid of the blood in which the red particles are suspended to which its colour is due it consists of serum holding fibrine in solution It is sometimes called Liquor sanguinis

PLATTNERITE A native oxide of lead from Leadhills in Scotland

PLEXUS (Lat *woven*) In Anatomy, the term is substantively applied to those portions of nerves which interweave and interchange fasciculi, appearing to anastomose with each other as e g in the arm pit forming the ' axillary or brachial plexus, and in the loins forming the ' lumbar plexus As nerves approach their final distribution in the several tissues the minute fibres commonly form delicate plexuses, called the terminal plexuses '

PLICIDENTINE (Lat plica *a fold*, dens *a tooth*) That modification of dentine in which the substance is folded, as it were, on a series of vertical vascular plates which radiate from the central axis of the pulp and which is accompanied by a fluted character of the exterior of the tooth the basal part of the teeth of the wolf fish, of - - - - - - - - *Ichthyosaurus* afford - - - - - -

PLINTHITE A hydrated silicate of alumina and iron from Antrim in Ireland

PLUMBIC ACID The *Peroxide of lead* = Pb O$_{2}$ It combines with certain bases, forming compounds which have been called *plumbates*

PLUMBOCA'LCITE (Lat plumbum, *lead*, and calx, *chalk*) A mixed carbonate of lime and lead from Wanlock Head in Scotland

PLUMBUM CORNEUM (Lat) Horn lead The old chemical name of fused chloride of lead

PLUMOSE ALUM (Lat pluma, *a feather*) A name formerly given to the silky amianthine crystals occasionally observed on alumslate It is a *sulphate of alumina and iron*

PLUMOSITE (Lat pluma, *a feather*) Capillary or plumose sulphuret of antimony, chiefly found in the Harz - - - - - -

PNEUMATOMETER (Gr πνευμα, *air*, and μετρεω, *measure*) A gasometer constructed for the purpose of measuring the quantity of air taken into the lungs and again given out at each inspiration and expiration

PNIGA'LIUM (Gr πνιγω, *I suffocate*) A name given by some medical authors to the *Nightmare*, from the sense of suffocation which it induces

POI'NAMU A variety of jade or nephrite used in New Zealand for the manufacture of axes and other weapons

POLAR CLOCK An optical apparatus invented by Professor Wheatstone, whereby the hour of the day is found from the polarization of solar light

Light reflected from the atmosphere, like other reflected light is polarized in a certain plane, and it is found that the light reflected from any particular point of the sky is polarized in the plane passing through that point, through the sun, and the eye of the observer Suppose the point of the sky under observation to be the pole then the plane in question is one which passes (sensibly) through the axis of the earth's rotation and consequently the angle which it makes with the meridian is an hour angle, if, then, the situation of this plane be determined the hour of the day, or time from true noon, is determined also

Mr Wheatstone's method of determining the plane of polarization consists in attaching to the top of an upright pillar a glass plate held by a brass ring and directed perpendicularly to the earth's axis the lower half of the ring being divided into twelve equal parts (which may be again subdivided) to represent the hours A conical tube is fitted into the brass ring, so that its axis is parallel to that of the earth The upper and wide end of the tube is closed by a plate of glass having a star of selenite on it and a Nichol's prism is attached to the lower end The principal sections of the thin plates of selenite which form the star are all parallel and inclined at an angle of 45° to the plane of polarization of the prism and so placed that the lamellæ simultaneously appear colourless In order to make the observation the tube is turned till the central portion of the star exhibits the maximum of red colour, when a black line drawn on the glass plate in the direction of a principal section of the lamellæ and serving as a - - - - position of the plane of polarization of - - - - - - - -

This property was discovered

POLIANITE Crystallised peroxide of manganese from Bohemia

POLISHING SLATE *Polierschiefer* of the German mineralogists A light slaty substance occurring abundantly at Bilin in Bohemia it consists of the siliceous bucklers of microscopic animals

POLLUX Among the abundant absurdities of mineralogical nomenclature, is the application of the names Castor and Pollux to two varieties of felspar found in the granite of Elba

POLYBASITE (Gr πολυς, *many*, and βασις, *support*) A native sulphuret of silver, copper arsenic, and antimony, found in the mines of Saxony, Hungary, and Mexico

POLYCHROMATIC ACID (Gr πολυς and χρωμα *colour*) A compound resulting from the action of nitric acid upon aloes When used as a dye-stuff it yields a great variety of colours

POLYDIPSIA (Gr πολυς, and διψη, *thirst*) Excessive thirst

POLYHYDRITE (Gr πολυς, and υδωρ *water*) A hydrated silicate of iron from Breitenbrun in Saxony It seems to be the same as the *Hisingerite* of Berzelius found in Sweden

POLYKRASE (Gr πολυς, and κρασις *combination*) A rare mineral occurring in black six sided tables it contains titanic and tantalic acids zirconia yttria alumina magnesia lime and the oxides of iron cerium, and uranium It is found at Hitteroe in Norway

POLYSPHÆRITE A reniform variety of chlorophosphate of lead from Freiberg, containing also phosphate of lime

POLYXENE (Gr πολυς, and ξενος *stranger*) A name given by Hausmann to the ores of platinum, as indicating the many new metals associated with it

POONAHLITE A species of zoolite from Poonah in Hindostan

PORTAL (Lat porto *I carry*) In Anatomy is applied to a system of veins that ramify like arteries and send the blood from trunks to branches in the substance of the liver The portal system is derived in mammals from the veins of the abdominal organs of digestion, which form a common trunk called Vena portæ' This subordinate kind of circulation in the liver is called the 'portal circulation' and the blood it transmits is called the portal blood" The blood of the portal vein differs from other venous blood in being of less specific gravity darker, and incapable of being rendered bright by the contact of salt or oxygen in containing only about half the ordinary quantity of fibrine and in containing less albumen but more red globules and nearly twice the usual amount of fatty matter

POSOLOGY (Gr ποσος, *quantity* and λογος *description*) In Medicine, that which relates to the doses or quantities in which medicines should be administered

POST MORTEM (Lat *after death*) In Anatomy the technical phrase signifying the inspection and examination of the dead body, in order to determine the cause of death it is also applied to the appearances presented and more especially to some phenomena which are constantly noticed shortly after death Thus the muscles retain their property of contracting under the influence of stimuli applied to them or to their nerves for some time after death, and when they have lost this irritability, they spontaneously pass into a state of contraction, producing a general stiffening of the body, which is called 'post-mortem rigidity, or "rigor mortis"

POT-METAL An alloy of copper and lead

POUDRETTE (Fr) A manure composed of night-soil mixed up with clay and formed into cakes

PRASEOLITE A species of tourmalin from Norway

PREDAZZITE A magnesian marble or dolomite, which forms mountain masses at Predazzo, in the Tyrol

PREMOLAR (Lat præ, *before*, molaris, *grinding tooth*) In Anatomy the name of those permanent teeth in the Diphyodont mammals that displace and succeed the deciduous teeth vertically they are situated before the molars, and, being in many cases of more simple structure, they have been termed "false molars," and in Human Anatomy 'bicuspides" The premolars never exceed four in number on each side of both jaws

PRIMING AND LAGGING The alternate acceleration and retardation of the times of high water, caused by the combined action of the sun and moon *See* LAGGING

PRINCE'S METAL Prince Rupert's metal The same as pinchbeck An alloy of copper and zinc

PROCŒLIAN (Gr προ, *before*, κοιλος, *hollow*) In Anatomy, those vertebræ are so called which have a cavity or cup at the fore part of the body, and a ball at the back part The term is also applied to the group of animals—a certain family of Reptiles, *e g*, which manifest this vertebral character It is found in most existing Saurians, but not in any extinct species of earlier date than the cretaceous period

PROLETAIRE (Lat proles, *offspring*) A term that has come into common use in the social discussions of late years, signifying that class of the community whose labour is their only capital As its origin indicates, it was applied to those members of a community whose social duties were limited to furnishing children to defend the state, and whose social rights were necessarily small The word plays a considerable part in all the writings of the communists and socialists both of France and Germany

PROSYLLOGISM In Logic, a word sometimes used to signify a second syllogism, proving a former one, at other times in the same sense as Enthymeme, viz [illegible] of which one premise is suppressed

PROTEINE (Gr πρωτειον, *the chief place*) The azotised substance which forms the basis of albumen, fibrine and caseine, in which proximate principles it is combined with small proportions of sulphur and phosphorus Different formulæ have been assigned to proteine that of Mulder is $C_{40}\ H_{30}\ O_{12}\ N_5$

PROTOLITE (Gr πρωτος *first*, and λιθος, *a stone*) The slaty rock immediately recumbent upon granite

PROTOZINE (Gr πρωτο and ξενο, *a stranger*) Tridosse granite A mixture of felspar quartz, and talc or chlorite It decomposes into china clay or porcelain earth

PSELLISMUS (Gr ψελλιζω, *I stammer*) An imperfect articulation Stuttering

PSEUDESTHESIA (Gr ψευδης *false*, and αισθανομαι *I feel*) Imaginary or false feeling

PSEUDOMALACHITE (Gr ψευδος, and μαλαχος, *soft*) Native phosphate of copper

PSEUDOMORPHOUS CRYSTALS (Gr ψευδος, and μορφη *form*) Substances found in crystalline forms not belonging to them, and being, as it were, casts of other crystals

PSEUDOSCOPE (Gr ψευδος, and σκοπεω, *I view*) A name given by Professor Wheatstone to the stereoscope when employed to produce what he calls 'conversions of relief These conversions may be produced in three different ways—1st, by transposing the pictures from one to the other, 2ndly by reflecting each picture separately without transposition and, 3rdly by inverting the pictures to each eye separately The converse figure differs from the normal figure in this circumstance that those points which appear most distant in the latter are the nearest in the former, and vice versa The *pseudoscope* consists of two reflecting prisms placed in a frame with adjustments so that when applied to the eyes each eye may separately see the reflected image of the projection which usually falls on that eye The instrument being directed to an object and adjusted so that the object shall appear of its proper size and at its usual distance the distances of all other objects are inverted all nearer objects appear more distant and all more distant objects nearer, and this constitutes the 'conversion of relief The inside of a teacup appears a solid convex body A china vase ornamented with coloured flowers in relief appears to be a vertical section of the interior of the vase with painted hollow impressions of the flowers A small terrestrial globe appears a concave hemisphere, when the globe is turned on its axis, the appearance and disappearance of different portions of the map on its concave surface has a very singular effect A bust regarded in front becomes a deep hollow mask When regarded in profile the appearance is equally striking A framed picture hung against a wall appears as if imbedded in a cavity made in the wall (See *Athenæum* for 1852, Jan 24, and STEREOSCOPE in SUP)

PSILANTHROPISIS (Gr ψιλος, *mere* and ανθρωπος, *man*) A name given to a peculiar sect of Unitarians who believe that Jesus was the son of Joseph, and in whose creed the resurrection holds a higher place than the crucifixion

PSILOMELAN (Gr ψιλος, *mere*, and μελας, *black*) In Mineralogy, black hæmatitic ore of iron

PSOROPHTHALMIA (Gr ψωρα *the itch*; οφθαλμος *the eye*) An inflammation and ulceration of the eyelids attended by an itching sensation

PTYALINE (Gr πτυαλον, *saliva*) A supposed peculiar animal matter obtained from saliva It is insoluble in alcohol and is said to be analogous to the vegetable substance termed diastase

PULSE GLASS A tube of about a quarter of an inch diameter and five or six inches long with a bulb at each end and about half filled with spirit of wine or water, care having been taken to expel the whole of the air previously to sealing the tube When held in an inclined position, one of the bulbs being grasped

in the hand, the exclusion of the included vapour causes [illegible] in the tube [illegible]

PUNCTUM CÆCUM (Lat, *blind point*) That part of the retina of the eye immediately about the spot at which the optic nerve unites with it is found experimentally to be totally insensible to the stimulus of light, and hence it has been called by writers on Optics the *Punctum Cæcum*

PURREE, or INDIAN YELLOW A yellow colouring matter imported from India and China Its origin has not been accurately ascertained, but it is supposed to be a vegetable juice mixed with magnesia

PUSCHKINITE A variety of Epidote from Siberia

PUZZOLA'NO A volcanic rock, which yields an excellent water-cement It occurs at Puzzuoli, near Naples

PYRARGI'LLITE (Gr πυρ, *fire*, and αργιλλος, *pure clay*) A hydrated silicate of alumina, found in the granite of [illegible]

PYRARGYRITE (Gr πυρ, and αργυρος, *silver*) The red or ruby silver ore, it is either a sulphuret of silver and antimony, or a sulphuret of silver and arsenic The finest specimens are from Andreasberg, in the Harz, and from Joachimsthal in Bohemia

PYRE'NITE A species of garnet found in the limestone of the Pic d'Urselids near Barége, in the Pyrenees

PYROPHI'LLITE A hydrated silicate of alumina and magnesia which exfoliates before the blowpipe, found in the Ural, and formerly considered as *talc*

PYROPHY'SALITE (Gr πυρ *fire*, and φυσαλος *a bead*) A mineralogical synonym of the common topaz, found in veins and blocks near Finbun A crystal in the [illegible] at Stockholm weighs 80 lbs

PYROSKLERITE (Gr πυρ, and σκληρος, *hard*) A green hydrated silicate of magnesia and alumina coloured by iron and chromium from Elba

PYRRHOSIDERITE (Gr πυρρος *brown* and [illegible]) A brown hydrous peroxide of iron

PYRRHOTINE (Gr πυρρος, *brown*) Magnetic iron ore

PYRUVIC ACID (Gr πυρ *fire* and Lat uva *a grape*) An acid discovered by Berzelius amongst the products of the destructive distillation of racemic and of tartaric acid It had been before observed by Pelouze, who mistook it for acetic acid

## Q

QUAS A fermented liquor used in Russia, and prepared from a mixture of meal and malt

QUINCITE A hydrated silicate of magnesia tinged red by oxide of iron, found near Quincey, in France

QUINOIDINE (From Quinin) An alkaloid said to accompany cinchonia and quinia in certain varieties of *cinchona*

## R.

RAPHANIA (Lat Raphanus *the radish*) A disease said to be produced by eating the seeds of a species of raphanus, it is attended by convulsive motions of the limbs vomiting and diarrhœa

RAPHILITE A species of hornblende from Perth, in Upper Canada

RATAFIA A term applied to certain liqueurs or drams derived like the word *ratify* from *ratum* and *fio* to make firm or *confirm* By ratafia therefore, was originally meant a liquid drank at the *ratification* of an agreement (PEREIRA *on Food and Diet*)

REAGENT In Chemistry, bodies which serve to detect the presence of others tests

RECEIVER In Chemistry generally means a globular vessel applied to a retort in which the *distillate* or product of distillation is collected or received The bell glass placed upon the plate of an air-pump is also called a receiver *See* RETORT in DICT

RIDDLE A pyrotechnical compound which burns with a beautiful red or pink flame It consists of nitrate of strontia mixed with charcoal and a little sulphur and chlorate of potassa

REDRUTHITE The vitreous sulphuret of copper, magnificent crystallised specimens of which have been obtained from the mines near Redruth in Cornwall

REFLEX FUNCTION, in Physiology *See* AUTOMATIC, MOTORY, SENSORY

REFLEX ZENITH TUBE An instrument recently invented by the Astronomer Royal, and erected at the Greenwich Observatory, for measuring the zenith distances of stars very near the zenith It consists mainly of an object-glass of 5 inches diameter and 10 ft focal length, of a micrometer firmly attached to the cell of the object glass, and of a trough of mercury placed beneath the object glass at a distance of nearly half its focal length [illegible] of the object-glass is fixed in a tube sliding in another tube fastened to the flooring of the small chamber in which the instrument is erected, the mercury being [illegible] By this apparatus [illegible] star very near the zenith are, while in a converging state, reflected from the mercury, so as actually to converge to a focus and form an image at a short distance above the object-[illegible] [illegible] arrived that the point of [illegible] [illegible] line (measured parallel to the diameter of the object-glass) as its focal centre By this means any inaccuracy which would arise from a small error of level of the plane of the micrometer is avoided A micrometer is mounted upon the cell which carries the object glass which has a series of wires stretched across its side bars, and whose screw acts against the standards carrying the bars, the wires being placed at intervals nearly equivalent to double the distance of γ Draconis from the zenith of Greenwich For viewing the images of the star and the wires together, a compound 4-glass eye piece is used consisting of two distinct parts, the first part consisting of a first lens for receiving the rays from the object-glass, and a glass reflecting prism for turning them into a horizontal direction, the prism having one side ground to a spherical surface so as to produce the effect of the second glass of the eye piece, and to avoid unnecessary loss of light. This part is fixed in a tube carried between the bars of the micrometer The second part consists of the third and fourth glasses of the eye-piece mounted in a tube carried horizontally by a fixed support so as to allow the head of the observer to avoid interference with the rays after passing through the object-glass The cell of the object-glass is made to revolve carrying with it the micrometer, for the purpose of making observations in reversed positions The micrometer is also double, carrying screws and divided heads on each side of the object-glass, and it is so arranged that by the action of one of the screws the micrometer wires are carried without disturbance of the reading of the head attached to the other screw

REMISSION In Medicine the abatement of a disorder, or regular mitigation of symptoms as opposed to *intermission*, in which the symptoms of disease for a time entirely disappear *See* REMITTENT FEVER, in DICT

RESINITE, or RETINITE A substance intermediate between resin and asphalt *See* RETINASPHALTUM in DICT

RESTIFORM (Lat restis *a rope* and forma) In Anatomy the term is applied to certain rope-like columns or tracts behind the 'lateral tracts' of the medulla oblongata The 'restiform tract' is continuous below with the posterior columns of the myelon while above, its fibres may be traced transversely through the pons into the cerebellum If the restiform tracts be irritated the most acute suffering is produced

REVERBERATORY FURNACE A furnace in which the flame is made to pass over a bridge and then beat down again upon a hearth or surface, on which the materials to be heated are placed

RHABARBARINE The colouring principle of rhubarb

RHEINITE A mineralogical synonym of the cyanite of the Tyrol

RHEOMETER (Gr ρεω *I flow*, μετρον *measure*) A term proposed by Peclet as a synonym for *galvanometer* and generally adopted by the French writers on physics Professor Wheatstone in an ingenious paper entitled 'An Account of several new Instruments and Processes for determining the Constants of a Voltaic Circuit' published in the *Philosophical Transactions* for 1843 uses the term in a general sense to designate any instrument for measuring the force of an electric current, without reference to its particular construction Mr Wheatstone also uses the following similar terms in describing apparatus employed in investigations on the same subject —

*Rheomotor* (Lat moveo, *I move*), any apparatus which originates an electric current

*Rheoscope* (Gr σκοπεω *I view*), an instrument for ascertaining the existence of a current

*Rheostat* (Gr στατικος *I place*), an instrument for adjusting or regulating the circuit, so that any constant degree of force may be obtained

*Rheotome* (Gr τεμνω, *I cut*), an instrument which periodically interrupts an electric current

*Rheotrope* (Gr τρεπω, *I turn*), an instrument which alternately inverts the current

RHEOPHORE (Gr ρεω *I flow*, and φερω, *I carry*) A term employed by Ampere to designate the connecting wire of a voltaic apparatus as being the carrier or transmitter of the current

RHODANIC ACID (Gr ροδον, *a rose*) A chemical synonym of sulphocyanic acid It produces a red colour with persalts of iron

RHODIZONIC ACID A substance formed by

passing dry carbonic oxide over highly heated potassium, and acting on the product by water A red powder separates which is rhodizonate of potassa from which rhodizonic acid may be separated by a mixture of sulphuric acid and alcohol Its formula is said to be $C_7 O_7$, 3 HO

RHO'DIZITE (Gr *ροδον a rose*) A species of boracite, which when heated before the blowpipe, colours the flame first green, but afterwards red

RHODOCHROME (Gr *ροδον a rose* and *χρωμα colour*) A hydrated silicate of magnesia and alumina, containing a little chromic oxide and of a red colour when in fine splinters It has been found in Siberia, also near Baltimore and in Ilmo in Greece

RHO'DONITE (Gr *ροδον, a rose*) A silicate of manganese

RHYTHM (Gr *ρυθμος rhyme*) In Physiology the more or less regular succession of the contractions of certain automatic muscles In the heart the motion commences in the venæ cavæ and proceeds through the auricles and ventricles and then after an interval is resumed in the vena cavæ In the intestine the movement travels in a vermicular manner from above downwards and a second movement beginning at the upper part of the intestine before the first has completed its course, affects the parts in the same order These movements are called 'rhythmic,' those of the intestinal tube are also called 'peristaltic"

RI'CINOSTE'ARIC ACID One of the acids resulting from the saponification of castor oil

RIFACIMENTO (Ital *re establishment*) A term in common literary use applied to any work or treatise, the materials of which have neither been derived from original research, nor have been collected for the first time

RIGOR MORTIS (Lat) In Physiology the general stiffening of the body produced by the simultaneous contraction of all the muscles of the trunk after death The muscular coat of the arteries also contracts after death on division and mechanical irritation on the application of cold and under the stimulus of electricity

RIPIDOLITE A mineral resembling Chlorite

RISUS SARDONICUS (Lat *sardonic laugh*) So called as having been produced by eating a species of ranunculus growing about certain springs in Sardinia A convulsive grin giving a peculiarly horrible expression to the countenance chiefly observed in cases of tetanus and inflammation of the diaphragm

ROCHE ALUM Alum deprived of part of its water of crystallisation by heat The term is also sometimes applied to the so-called *Roman Alum*, made from the alum ore of the Solfaterra, near Naples

ROCKSOAP An earthy silicate of alumina It is used for crayons and also for washing cloth

ROCKWOOD The common name for ligniform asbestus

ROME'ITE A native antimoniate of lime found in the manganese mines of St Marcel, in Piedmont and named in honour of the celebrated crystallographer Rome de l'Isle

ROSENITE A sulphuret of lead and antimony from Wolfsberg in the *Harz* Named in honour of H Rose, the analytical mineralogist

ROSITE (Eng *rose*) A mineral of a red colour in small grains embedded in limestone from Sweden it appears to be silicate of alumina tinged red by manganese It has also been called *Rosellanite*

RUBI'NIC ACID An acid formed by exposing a solution of catechuic acid in carbonate of potash to the action of air

RUFINE (Lat rufus *red*) A red substance formed by the action of sulphuric acid on saliretine

RUTHE'NIUM A metal closely resembling iridium with which it is associated in the residue from crude platinum insoluble in aqua regia Its properties require further investigation (Claus *Annalen der Chem und Pharm* lix 234)

RUTI'NIC ACID An acid contained in the leaves of rue

## S

SA'CCHARITE (Lat saccharum) A mineral of the felspar family, found in veins in serpentine in the chrysoprasm mines near Frankenstein in Silesia

SACCHARO'METER (Lat saccharum, Gr *μετρον*) An improved construction of the saccharometer was exhibited at the London Exposition of Industry by M Duboscq-Soleil A double gauge is formed by a rotating polarising plate of quartz and Iceland spar, of which two semicircles, placed in juxtaposition, and viewed through a telescope of low magnifying power are brought into exact coincidence of colour, by turning the spar In this situation the images are viewed through an empty tube, closed at both ends with glass

The saccharine juice is poured in and the quality of colour is disturbed, the semicircles, which no longer match are readjusted, by sliding upon each other two achromatised prisms of Iceland spar, so as to leave a variable difference of thickness estimated in parts of a finely divided scale, which gives numerical evidence of the quantity of saccharine matter present

SAL ALEMBROTH The hydrargo-chloride of ammonium A compound of sal ammoniac and corrosive sublimate

SA'PPHIRE The common name of the oriental sapphire

SAL DI DUOBUS (Lat) An ancient chemical name applied to sulphate of potassa

SALICY'LIC ACID An acid obtained by the action of fused potassa on salicine it may also be obtained from various other sources The formula of the salicylic acid is $C_{14} H_5 O + HO$

SAL MIRABILE (Lat) Glauber's salt Sulphate of soda

SAL PERLATUM (Lat) A term applied by old chemical writers to the rhombic phosphate of soda

SAL PRUNELLA Nitrate of potassa fused into cakes or balls The latter were sometimes coloured blue

SA'MARSKITE A granular mineral found in the Ilmen mountains near Miask It contains uranium and tungstic acid

SANDERS WOOD The wood of the *Pterocarpus Santalinus* a large tree growing upon the Coromandel coast and in other parts of India especially Ceylon It furnishes a deep red resinous colouring matter

SANDYX (Gr *Σανδυξ*) An old alchemical term applied to red lead prepared by calcining carbonate of lead

SANTONINE A crystalline principle contained in the *Artemisia Santonica* the buds or broken peduncles of which plant are used in pharmacy under the name of *worm seed Semen Cinæ* or *Contra* The composition assigned to santonine is $C_{30} H_{18} O_6$

SA'RCOSINE (Gr *σαρξ flesh*) A basic substance obtained by boiling kreatine with hydrate of baryta Its formula is $C_6 H_8 O_4 N$

SARGASSO *Fucus natans* or Gulf Weed, spread over a large part of the Atlantic Its abundance has led to the Portuguese expression *Mar de Sargasso*, or Weedy Sea

SATELLITE The recent discovery of an eighth satellite in the system of Saturn may be regarded as the natural consequence of the increased optical power of the instruments now applied to astronomical observations, but it was by a singular chance that the discovery was made both in England and America on the very same day — the 19th of September 1848

In order to avoid the confusion which has arisen from the practice of designating the satellites of Saturn by numbers applied sometimes with reference to the order of discovery and sometimes to the order of distance Sir John Herschel proposed to distinguish the individuals of this system by names, and in conformity with the nomenclature adopted by him the names of the Titanian divinities) both discoverers of the new satellite gave it the name of Hyperion Commencing with the one nearest the planet, and taking them in the order of distance the names of the eight satellites at present known are as follows —

Mimas Enceladus Tethys Dione,
Rhea Titan Hyperion Iapetus

Of these bodies Titan is by far the largest and supposed to be nearly equal in size to the planet Mars Mimas and Enceladus are the two discovered by Sir W Herschel, interior to the ring and so small that they can be seen with great difficulty even in the best telescope Hyperion is probably not greater than Mimas but more easily seen on account of its greater distance from the planet Prior to its discovery the interval between Titan and Iapetus was so great as to destroy the analogy which seemed to prevail in the other cases and to leave, as it were a large gap in the system similar to that in the solar system between Mars and Jupiter before the discovery of the small planets From this circumstance and also from the smallness of Hyperion Sir J Herschel has surmised the probability of other minute satellites revolving at the same mean distance

Of the six satellites of Uranus seen or suspected by Sir William Herschel, the existence of two only has been confirmed by the observations of other astronomers Some others have been seen by Lassell and by Otto Struve but none of them appear to be identical with those observed by Sir W Herschel The remaining two are still doubtful

One satellite of Neptune has been repeatedly observed, both by Lassell and O Struve The existence of a second, suspected by Lassell, has not yet been verified

SATURA'TION In Chemistry, a fluid is said to be saturated with a substance when it holds as much of it in solution as it can take up and retain we thus speak

of *saturated solutions* of saline, and other bodies The term *saturation* is also especially applied to the combination of acids and alkaline or other basic bodies in such definite proportions as neutralise each other, thus we say that sulphuric acid is saturated by potassa when neither acid nor alkaline properties are predominant hence, also the resulting sulphate of potas a is called a *neutral salt* An excess of acid would be termed *supersaturation*

SATURATION FRACTION OF The term *Fraction of Saturation* is used to denote the ratio of the elastic force of the vapour actually existing in the atmosphere, to the elastic force of as much vapour as atmospheric air is capable of containing in an equal volume and at the same temperature, or as would *saturate* the air

SCALPRIFORM (Lat scalprum, *a knife*) Certain teeth are so called which have a cutting edge preserved by a partial deposition of the enamel on one side such scalpriform teeth are large long, and curved and are well exemplified in the incisors of the Rodent order

SCARBROITE Hydrated silicate of alumina from the vicinity of Scarborough

SCELOTYRBE (Gr σκελος, *the leg*, and τυρβη, *disturbance*) A disease described by Galen in which a man is incapable of walking straight forward and drags the foot it is generally regarded as a species of Chorea, or St Vitus s dance

SCHEFFERITE A mineral hydrocarbon found in beds of brown coal in Switzerland

SCHROTTERITE A hydrated silicate of alumina from Krotenstein in Styria

SCHULZITE An antimonial sulphuret of lead from Gallicia in Spain

SCHWEINFURTH GREEN A compound of arsenious acid and oxide of copper, much resembling Scheele's Green

SCLEROGEN The ligneous matter deposited in the cells of plants

SCOLEZITE A species of zeolite

SCOURING DROPS The essential oils of lemon and of bergamotte are sold under this name for the purpose of removing grease stains from silk dresses They are generally adulterated with oil of turpentine

SCREW PROPELLER An instrument for the propulsion of vessels consisting of two or more twisted blades, like the vanes of a windmill set on an axis running parallel with the keel and revolving beneath the water at the stern The screw propeller is driven by a steam engine situated within the vessel and by its revolution in the water it carries the vessel forward in the manner a cork screw is drawn forward when penetrating a cork or a bolt when turned round in a stationary nut The water in which the vessel floats forms the nut of the screw propeller and when the propeller is turned round, therefore the vessel is screwed on To enable the water to act as the nut of the screw the thread traced in the water requires to be very much deeper than if it were traced in metal or wood and the pressing surface of the screw requires to be large to prevent the thread from being stripped or broken by the reacting force Accordingly screw propellers are made with a small central body and deep thread they are also made as large in diameter as possible reaching usually, from the keel to near the surface of the water

*History of the Screw Propeller* — It appears probable that the screw propeller is as old as the windmill and a windmill of the construction now usually employed is represented in the 77th proposition of Hero s Spiritalia a work written 130 years before the Christian era In China screw propellers are said to have been employed from a very early date as an arrangement for sculling vessels and a screw is a continuous sculling machine in which the necessity of a reciprocating motion is superseded by giving a complete revolution to the propelling blade Captain Basil Hall in his account of his voyage to Loo Choo states that the Coreans scull their ships instead of rowing them and, from what he saw of the operation he is inclined to give the preference to that mode of propulsion The galleys of the Greeks and Romans were also propelled by an action of the oars more nearly resembling sculling than rowing as was first pointed out by Robert Hooke in 1681, and Hooke also showed that this mode of action would be exceedingly efficient In a work entitled *Philosophical Collections* printed for Richard Chiswell, printer to the Royal Society 1681, there is a paper by Hooke on Horizontal Windmills, containing various suggestions of great originality and importance Hooke says that he does not consider horizontal windmills to be as efficient as vertical windmills, but if they are in any case employed, it will be advisable he says to make them on a certain construction, of which he gives a representation, and which is almost identical in its main features with the most improved species of feathering paddle wheel now employed in steam ships Hooke adds that wheels of this kind may be set to work advantageously, as water wheels in a river where no dam can be made, as may also the common vertical windmill with twisted arms In this cursory suggestion we have the germ both of the screw propeller and feathering paddle wheel Robertson Buchanan admits having taken the idea of his feathering wheel from the mechanism of orreries which was invented by Hooke, and the same considerations which make the screw and feathering wheel eligible instruments when driven by the water equally hold when the water is driven by them

On the 14th of October, 1683 Hooke showed to the Royal Society an instrument he had invented for measuring the velocity of the wind It consisted of four vanes like the vanes of a windmill, set upon an axis, and the vanes were so constructed that they could be set at any angle that was desired On the 28th of November in the same year, Hooke showed to the Royal Society an instrument he had contrived, and had shown to some of the members twenty years before, for measuring the way of a ship through the water The prime mover of this instrument was a screw turned by the water and the instrument not merely took cognizance of the progress of the vessel through the water, but also of the leeway The plan of making gearing in steps, as is now usually done in such screw vessels is make use of gearing is also an invention of Hooke's Wheels made upon this principle are divided in the direction of their breadth into a number of parallel wheels, which are set a little in advance of one another, so that the teeth of each do not come in the same line The benefit of this practice is that the teeth, though necessarily very thick to give adequate strength, work as smoothly as if they were thin and small or as if the space between the teeth were only a fractional part of its actual amount

In the *Recueil de Machines approuvées par l'Academie, depuis 1727 jusqu'en 1731* there is a machine described, which was invented by M Du Quet, for dragging up barges against a current in a river by the aid of a screw driven by the water and by the screw thus driven a rope dragging the barges is to be wound up This screw which is a helical blade wound upon an axis, is only partially immerged in the water and it would be a much less effectual instrument than the screw of a windmill form previously recommended by Hooke In Bouguer s *Traité du Navire* published in Paris in 1746, an arrangement of revolving oars resembling the vanes of a windmill is mentioned as having been proposed for the propulsion of vessels but this expedient it is stated had not been found to possess sufficient force In 1752 Daniel Bernoulli obtained the prize offered by the French Academy of Sciences for the communication of the best project for impelling vessels without the aid of the wind Bernoulli s apparatus consisted of an iron axle 11 feet long and 2 inches thick set upon each side of the vessel beneath the water Each axle was to carry eight wheels, six feet diameter, set at equal distances from one another and each wheel was to have eight arms or spokes to the extremity of each of which a sheet-iron plate 10 inches square, and inclined so as to form an angle of 60° with the axle or keel of the vessel was to be affixed Bernoulli s plan appears to have been contrived to meet Bouguer s objection, and it would probably answer for towing but the revolution of such a large number of wheels in the water would in all cases of considerable speed occasion a serious loss of power from friction and other analogous causes

In Emerson s *Principles of Mechanics* published in 1754, we have an explanation of the mode of constructing screws with an expanding or increasing pitch Emerson describes [illegible] the screw set vertically in a well or [illegible] water as an instrument for rendering available a fall of water in giving motion to mills The water is admitted at the top of the cylinder and escapes at its base and in its descent it turns round the screw by which the cylinder is filled up Emerson explains that at the top of the cylinder the blade of the screw must have very little inclination with the axis but at the bottom of the cylinder the blade of the screw must have a considerable inclination with the axis Blades set in a conical pit or vessel and driven round by the gravity of water have long been in use in France under the name of Danaides or *roues à poires*, and in some cases the blades were merely plane surfaces suitably inclined while in other cases they were spiral or screw formed Instruments of this kind are described by Belidor in his *Architecture Hydraulique*

In 1768 a work on the Archimedean screw was published at Paris by M Paucton, and it is suggested that a ptérophore, composed of the circumvolution of the thread of a screw round a cylinder should be placed on each side of a vessel to propel her through the water, or one only may be used at the fore part These screws, it is stated may be either wholly or partially immersed In 1776 a submarine vessel was invented by D Bushnell, an American, which was to be raised upward or

sunk downward in the water by means of an inclined blade or oar affixed to the top and operating in the manner of a screw, and forced forward or backward in the water by another similar blade affixed to the bow This vessel was to carry a powder magazine which was to be screwed to the bottom of an enemy's ship to blow her up It was the original of Fulton s torpedo

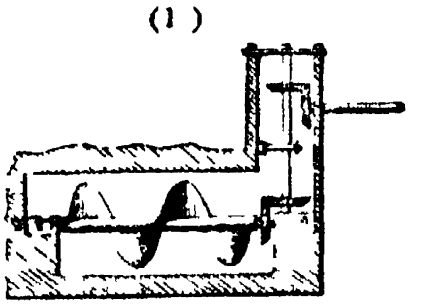
In 1784 Joseph Bramah, of London, engineer obtained a patent for propelling vessels by means of a wheel with inclined fans or wings, similar to the fly of a smoke-jack or the vertical sails of a windmill This wheel was to be fixed to an axis passing out at the stern of the vessel and was to revolve beneath the water with a stuffing box, or proper packing surrounding the shaft, where it pierces the vessel, to prevent the water from entering In 1794 William Lyttleton, a merchant of London obtained a patent for an instrument which he called an "aquatic propeller," and which consisted of a single convolution of a three-threaded screw The thread of a screw is the projecting part of it, and a screw may have one two, three, or any other number of threads A string wound round a cylinder represents the thread of a screw and if one string only be wound round it, the screw will be a screw of one thread, if two strings be wound round it so as equally to divide the space the screw will be a screw of two threads and so of any number If instead of a string a thin ribbon of iron be wound edgeways upon the cylinder and be soldered thereto, then a slice cut off the end of this screw will have two projecting arms or portions of this ribbon, if the screw be one of two threads, three projecting arms, if of three threads, and so of any other number In any screw propeller therefore the number of threads is the same as the number of arms The pitch of the screw is the distance from one thread of the screw to the next thread measured on the axis supposing the screw to be continued through a whole convolution A spiral stair is virtually a screw, and the pitch is the vertical distance from any one step of the stair to the step immediately over head

In 1799 Edward Shorter, of London, mechanic obtained a patent for propelling vessels and among the expedients he employed is one termed a "perpetual sculling machine," consisting of a screw immerged in the water at the stern of the vessel The shaft which gives motion to the screw, passes through the stern of the vessel above the level of the water and is armed at its extremity with one of Hooke's universal joints from whence a pole extends obliquely into the water with the screw attached to its extremity The end of the pole is prevented from sinking too deeply in the water by a buoy which supports it at the proper elevation, and guy ropes are applied, by means of which the pole and screw may be moved to the one side or the other, so that the vessel may be steered or assisted in her steerage thereby Between 1800 and 1836 various ingenious methods of screw propellers were proposed by Dallery Stevens O Reilly, James Trevithick, Boswell, Millington, Scott, Whytock, Delisle Bourdon Dollman, Perkins, Brown Tredgold Macerone Cummerow Smith, Church Copley Ovinel, Peltier Sulichon, Poole, Woodcroft Savage Emerson Burke, Theal Smith, and Fitzpatrick The forms of these screws are very various but in most cases they consist of helical blades, like the vanes of a windmill revolving beneath the water at the stern or of a helical feather coiled round an axis in the manner of an Archimedean screw In some cases the pitch of the screw is intended to be uniform, and in other cases increasing the uniform pitch being a straight line wound upon a cylinder, and the increasing pitch being a curved line wound upon a cylinder, or a straight line wound upon a cone or spire Bourdon, in 1824, formed his screw with an increasing pitch and placed it in the dead wood of the vessel Tredgold, in his work upon the Steam Engine, published in 1827, recommended that screws should be made with an increasing pitch Peltier, in 1830, proposed to make his screw with an increasing pitch and Woodcroft proposed the same thing in 1832 Marestier, in 1824, in a work published by direction of the French government, giving an account of steam navigation in America, described various arrangements of screw propellers which had been tried in that country, but none of those expedients had come into practical operation Lyttleton in 1794, Shorter in 1802, Stevens in 1804, Bourdon in 1824, and several others at different times, had practically tried the effect of propelling vessels by means of a screw But these experiments led to no useful result, and in 1836 there was no vessel propelled by a screw in existence In that year patents for propelling vessels by a screw were taken out by F P Smith and Captain John Ericsson, and to these two persons the successful introduction of the screw as a propeller must be attributed Ericsson not meeting with the encouragement in this country that he expected, went to America, where he soon after constructed the war steamer Princeton, and about two hundred screw vessels have since been built in America Smith, as soon as his early trials had demonstrated the efficacy of the screw as a propeller, built the Archimedes, and soon afterwards his propeller was applied to the war steamer Rattler It has subsequently been adopted by the Royal Navy and a very large number of merchant steamers In by far the greater proportion of these vessels the screw is only applied as an auxiliary to the sails, and at present this appears to be its most valuable application

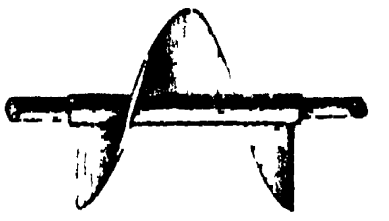
It would swell these remarks beyond the limits to which they must be restricted to attempt any enumeration of the various modifications in the form of the screw, and in the mode of its application, which have been made or proposed since the time it has been practically introduced as an available propeller In this country vessels are, for the most part, fitted with Smith s screw of two or three threads In America, and in France, vessels are mostly fitted with Ericsson's screw of four or six threads The average efficiency of both is about the same but screws of few threads appear to be best adapted for sharp and swift vessels or which are much immersed in the water whereas in the case of heavy vessels of shallow draught screws of many threads appear to be the most suitable For vessels with auxiliary power of good form and considerable immersion a screw with three blades appears to be, upon the whole, the best propeller that can be employed

In Smith's earlier experiments upon the screw propeller he employed a single threaded screw of two convolutions, such as that represented in *fig* 1 During one of his trials, however the screw having come in contact with some object in the water, about half of it was broken away and the vessel was found in consequence to realise a higher speed than before The Archimedes was originally fitted with a single threaded screw of one convolution, such as that represented in *fig* 2, and it

(1)



(2)



was with a screw of this kind that the efficiency of the screw as a propeller was originally demonstrated She was subsequently fitted with a double threaded screw of half a convolution, which gave the same amount of propelling surface, and diminished the uneasy motion at the stern This screw is represented in *fig* 3 The Rattler was fitted with a screw of this kind, but its length was subsequently reduced to one sixth of a revolution which made its length just one-third of its original length, and the best results were obtained with this proportion This intended screw of the Rattler is shown in perspective in *fig* 4

(3)

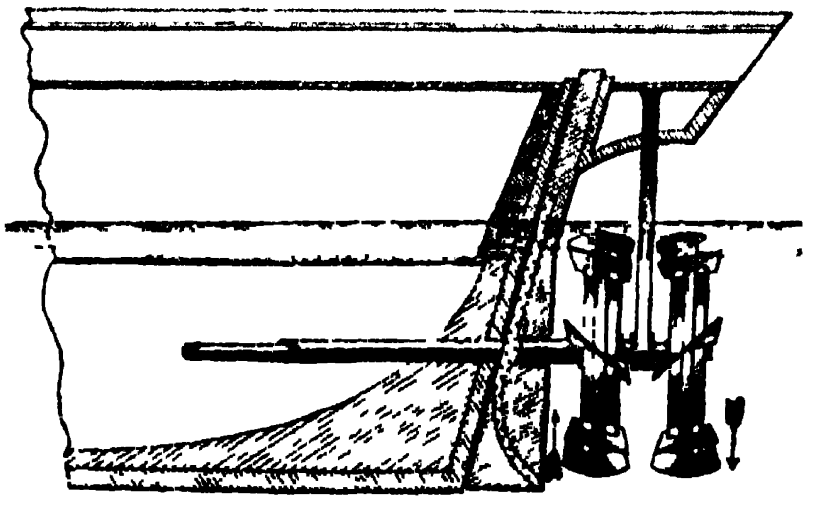


(4)



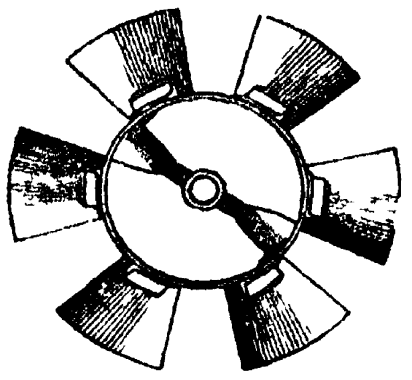
Ericsson in his original form of propeller employed two wheels armed with helical blades and revolving in opposite directions The object of this arrangement was to neutralise any tendency which one wheel might have to turn the vessel from her appointed course The second wheel, however, was soon discarded as it was found that it was not required *Fig* 5 represents Ericsson's original arrange-

(5)



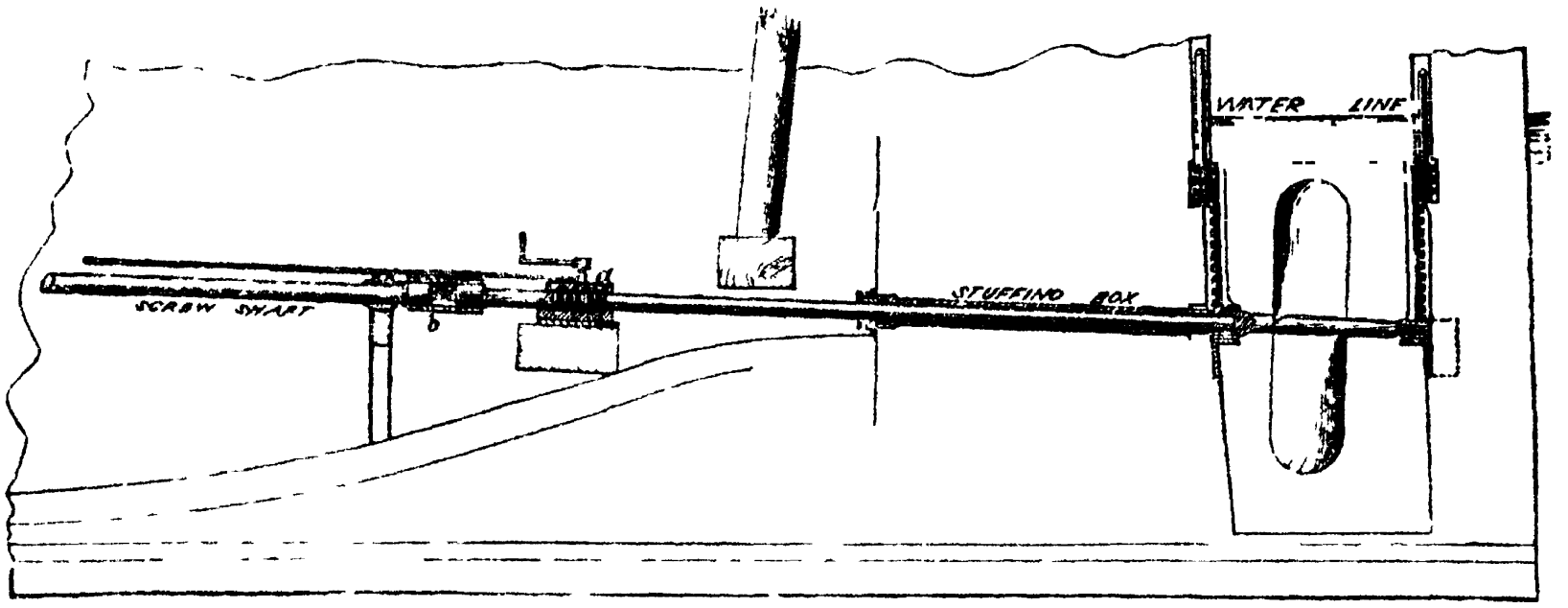
ment of screw propeller, and *fig.* 6 is the propeller of the Princeton, which is the form he now usually employs

(6)



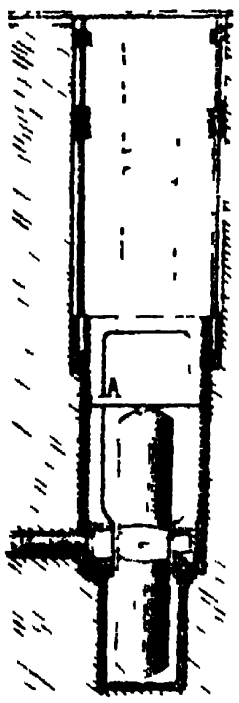
*Description of the mode of applying the Screw Propeller* — The most approved method of introducing the screw propeller into a vessel will be seen by a reference to *fig* 7, which is a section of the stern portion of H M S Wasp The screw is set in a hole or opening in the dead wood behind the stern post, and before the rudder post It is hung upon a short shaft, which is carried by a metal frame with a rack on each side, and in these racks endless screws work, which, being put into revolution, raise the frame, lifting the propeller out of the water, so as to enable the screw to be repaired if required, or a new one introduced without putting the vessel into dock Before, however, the frame can be raised, the shaft, passing through the ship, and which communicates with the engine, has to be pulled on end so as to disengage it from the boss of the short shaft, which supports the screw This is accomplished by the handle *a*, by means of which an end motion is given to an adjoining bearing, in which work a number of collars formed on the shaft, the brass of the bearing being suitably grooved to receive these collars At *b* a vacant space is left between the end of the shaft which communicates with the engine, and the end of the shaft which communicates with the screw, so as to enable the shaft communicating with the screw to be drawn on end without disturbing the other shaft, and a short pipe fixed to the one shaft, but sliding on

(7)




the other, is so applied that, notwithstanding the end play, the force of torsion will be communicated from the one shaft to the other *Figs* 8 and 9 represent the screw propeller and the apparatus for raising it out of the water as applied in Her Majesty's steam frigate Ajax By a reference to these figures the configuration of the screw usually employed for the service of the navy and the mode of raising it out of the water will be readily understood A catch represented as engaging the centre of the screw is put down only when the screw requires to be raised out of the water, and its use is to retain the blades in a vertical position during that operation

(8)



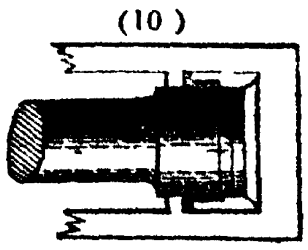
(9)



The screw shaft at the point where it passes through the stern of the vessel is kept tight by means of a stuffing box, consisting of a long pipe fitted tightly into the hull of the vessel Through this pipe the screw shaft passes and the space between the shaft and the pipe is kept tight by means of a plaited rope of soft hemp forced tightly into a recess provided for the purpose by means of screws It is very desirable that the shaft should fit so accurately into this pipe as to be exempt from all side play, which, if it exists will have the effect of communicating a disagreeable motion to the stern of the vessel In wooden vessels the pipe should be made of brass, and it has been found advantageous in such cases to cover with brass that part of the shaft which revolves within the pipe so as to [illegible] corrosion from the sea-water [illegible] of the vessel in advance of the screw should be brought to as fine a line as possible, and the hole in the dead wood in which the screw revolves should be considerably larger than the screw itself The screw in its revolution carries with it a coating of water and if this coating be partially stripped off at every revolution from the too near proximity of the stern part of the vessel, a shock will be communicated at every revolution from the impact of the water against the side of the dead wood and a part of the engine power will be also dissipated without effect

*Modes of receiving the Thrust of the Screw* — As the screw by its revolution is forced forward in the water, carrying the vessel with it the screw shaft, it is clear, must have to sustain a forward thrust and it is this thrust in fact which propels the vessel The severity of this forward thrust, combined with the velocity of rotation which the screw shaft requires to maintain, was the occasion in the earlier screw vessels of considerable inconvenience, in consequence of the friction produced, and several cases have occurred where the end of the shaft became white hot and actually welded itself to the steel plate against which it pressed although a stream of water was all the while running upon the surfaces in contact Various expedients have since that time been proposed for receiving the thrust of which one was to let the end of the shaft enter, in the manner of a piston, a tight cylinder of oil, so that it would be against a liquid only that the end of the shaft would press Another expedient was to place a large collar upon the shaft, which should press against a number of balls or small rollers resembling the rollers of a swivelling bridge Neither of these plans however have come into practical use, but one of two other modes is now generally followed Either the thrust is received upon a number of collars, as represented in *fig* 7, before described, or else it is received upon a series of discs applied to the end of the shaft and resting in a cistern of oil, as represented in *fig* 10 The cistern is usually cast upon the base plate or some other solid part of the engine, and its end is sufficiently strong to bear the thrust of the screw Interposed, however, between the end of the cistern and the end of the shaft are two, three, or more discs of metal usually about two inches thick, and of the same diameter as the shaft itself A bolt passes through their centres to keep them in a line, but they

(10)



are each free to revolve upon this bolt, and where the shaft passes out of the cistern a collar of leather is applied to prevent the [illegible] It will be obvious from such an [illegible] the end of the shaft where it presse[illegible] gins to heat from undue friction, it will revolve with somewhat more difficulty and will consequently carry the first disc round with it The rubbing surfaces therefore are no longer the end of the [illegible] the first disc and the second disc In fact, the rubbing surface, instead of being confined to one disc is distributed over several Those surfaces which begin to heat and consequently to stick, will cease to rub, whereby they will speedily become cool again, and their efficiency will thereby be speedily restored

*Best Proportions of Screw* — For mercantile purposes screws with three blades are, on the whole, to be preferred The diameter of the screw should be as large as it can be conveniently got, and when the area of the screw's disc — that is, the area of the circle described by the extremity of the arms of the screw — has one square foot of area for every 2½ square feet in the area of the immerged midship section of the vessel a very efficient performance is obtained The pitch of the screw should be equal to the diameter of the screw or a little more and the length of the screw fore and aft should be that answering to one-sixth of a convolution Thus in the case of a screw twelve feet in diameter, the pitch would be twelve or fourteen feet and the length of the screw measured along the axis would be about two feet

*Best Forms of Screw* — Screws are commonly made with a uniform pitch, and with the blades standing at right angles with the axis A slightly progressive increase in the pitch however say to the extent of 5 per cent, appears to be advisable — that is the pitch of the screw at its leading end should be 5 per cent less than at its following end The pitch at the centre should also be 10 per cent less than the pitch at the circumference, for the centre should merely screw through the water without seeking to produce any reacting force, which, from the great obliquity of the blades at the centre could not be done with advantage Finally the blades of the screw should be bent a little astern, so as to produce a tendency in the particles of water they force backwards to converge to a point This tendency will balance the divergent tendency produced by the centrifugal action of the screw in its revolution and the two forces by balancing one another, will cause the water to be projected backwards from the screw in a cylindrical column With the ordinary screw the water projected backwards assumes the figure of the frustum of a cone and some portion of the power is lost thereby

*Positive and negative Slip of the Screw* — When a vessel is propelled by oars paddles or any other instrument which acts upon the water it is obvious that since the water is not a solid body which can resist without disturbance the application of force there will be a certain amount of recession in the water or in other words the water will be moved to a certain extent backwards while the vessel is forced to a certain extent forwards This backward movement of the water is what is termed *Slip* and in its results it is analogous to the loss of power and speed which a locomotive experiences when the wheels slip upon the rails This slip exists in the case of the screw as well as in the case of the paddle or other species of propeller, and when the engines of a steam vessel are set in motion while the vessel is at anchor or moored in a river the whole power of the engines is wasted in slip or in moving the water without moving the vessel The ordinary amount of slip in paddle vessels is about one-third of the whole distance travelled, or, in other words the vessel would go one third faster with the same number of revolutions if the wheels geared into an iron rack instead of gearing into water In well-constructed paddle vessels the slip is only 10 per cent, or, in other words, the vessel would only go one-tenth faster with the same number of revolutions if the screw worked in an iron nut instead of working in water Since, therefore, all the power expended in producing slip is lost, and since there is less slip with the screw than the paddle, there is an apparent superiority in the screw from this cause In some screw vessels, however, the apparent slip is nothing at all and in others it is less than nothing, or, in other words, the vessel is propelled through the water by the screw alone at a greater velocity than if the screw worked in a solid nut with the same number of revolutions In the early history of the screw propeller this apparent paradox provoked much incredulity, but the phenomenon is now understood, and is not difficult of explanation

When a vessel passes through the water, the friction of the bottom and the sides puts a column of water in motion which proceeds in the direction of the vessel Sea weeds and other light objects adhering to a vessel have been observed to stand out straight from her side when the vessel was moving through the water with a considerable velocity, whereby it is clear that a film of water must be moving with the vessel The vacuity also which the motion of the vessel through the water tends to produce at the stern causes a flow of water towards the stern in order to fill it up It follows, therefore, that a vessel, in passing through the water, puts in motion a stream or current which follows in her track, and that this is no hypothetical supposition is proved by the fact that a boat will often follow a vessel without being towed by a rope, and that when a slow steamer gets into a swift one's wake the slow steamer will not fall into the distance, but will be towed by the current which the leading steamer creates Now in a screw vessel the screw works in this current, and if from the form of the stern or other causes the current runs at a considerable velocity, and if from the large dimensions of the screw or otherwise the actual slip of the screw be small, then it will often follow that the slip of the screw will *appear* to be less than 0 nil or negative, if the comparison be made with the current, but with the stationary water at the ship's side The screw must at all times have slip *relatively with the water in which it works*, but if that water is itself in motion, it is not surprising that the vessel should travel through a greater distance than what answers to the pitch and revolutions of the screw, any more than that a paddle vessel in descending a river with a strong current should pass through a greater distance than what answers to the diameter and revolutions of the wheel, if the distance travelled be measured on the river bank A log placed where the screw revolves will always show that the screw advances with a greater velocity than the vessel as measured at that point, or, in other words, that the screw passes through the current with a greater velocity than the vessel passes through the current, though of course the speed of the vessel and of the current together may be greater than the speed of the screw alone

*Measurement of Thrust upon the Screw Shaft and Amount of Power lost by Slip* — In some vessels a dynamometer has been applied to the end of the screw shaft, whereby it has become possible to measure accurately the amount of forward pressure exerted by the screw In the Rattler, a vessel of 888 tons burden this pressure amounted on an average to about four tons This pressure, multiplied by the space passed through by the vessel per minute and divided by 33 000, will manifestly give the force in actual horse power that is instrumental in the propulsion of the vessel, and the power thus computed amounts on an average to about half or two-thirds the power developed in the cylinders It hence appears, that in screw vessels such as the Rattler from one third to one half of the engine power is wasted in slip and in the friction or other resistances caused by the revolution of the screw in the water With the paddle wheel the loss from these causes is nearly the same and the screw and paddle consequently produce about the same speed by the application of the same amount of power

*Relative Efficiency of the Screw and Paddles* — To determine the relative efficiency of the screw and paddle as a propeller, two vessels, the Rattler and the Alecto, were constructed of about the same power 200 horses, and of nearly the same size and form, but the Rattler was a screw vessel and the Alecto a paddle vessel The Rattler it was found had, in nearly all cases somewhat the advantage in point of speed, but the engines of the Rattler also exerted somewhat more power Subsequently two other vessels, the Niger and Basilisk were constructed of 1072 tons and 400 horse power, the Niger being a screw vessel, and the Basilisk a paddle vessel, and the following were the results obtained — In deep immersions the screw vessel had an advantage of 1½ per cent over the paddle vessel, but with medium immersions the paddle vessel had an advantage of 1¾ per cent over the screw vessel and in light immersions the paddle vessel had an advantage of 4¾ per cent over the screw vessel The slip of the screw was 24 per cent Upon the whole therefore, the screw seems to have somewhat the advantage when the vessel is deep and the paddle seems to have somewhat the advantage when the vessel is at a light or medium immersion

*Screw Vessels not adapted to go Head to Wind* — The experiments with the Rattler and Alecto established one important fact in connection with screw vessels, viz that they are ill adapted to advance against a head wind For although both vessels attained the same speed of 4 knots against a strong head wind, yet in the case of the Alecto, this performance was attained with a velocity of the engine of 12 strokes per minute, whereas, in the Rattler, it was only attained with a velocity of the engine of 22 strokes per minute It follows, therefore, that a screw vessel in proceeding head to wind will require 1 8 times, or nearly twice the quantity of fuel to do the same amount of work The screw, in fact, revolves at nearly the same velocity whether the wind is adverse or favourable, or whether the vessel

is lying at anchor, and this is a serious defect in the case of vessels intended to encounter adverse winds In the case of vessels, however, which use the screw only as a resource in calms, or as an auxiliary to the sails, this disadvantage will not be experienced, since such vessels have no pretensions to the capability of proceeding in close proximity to a strong head wind

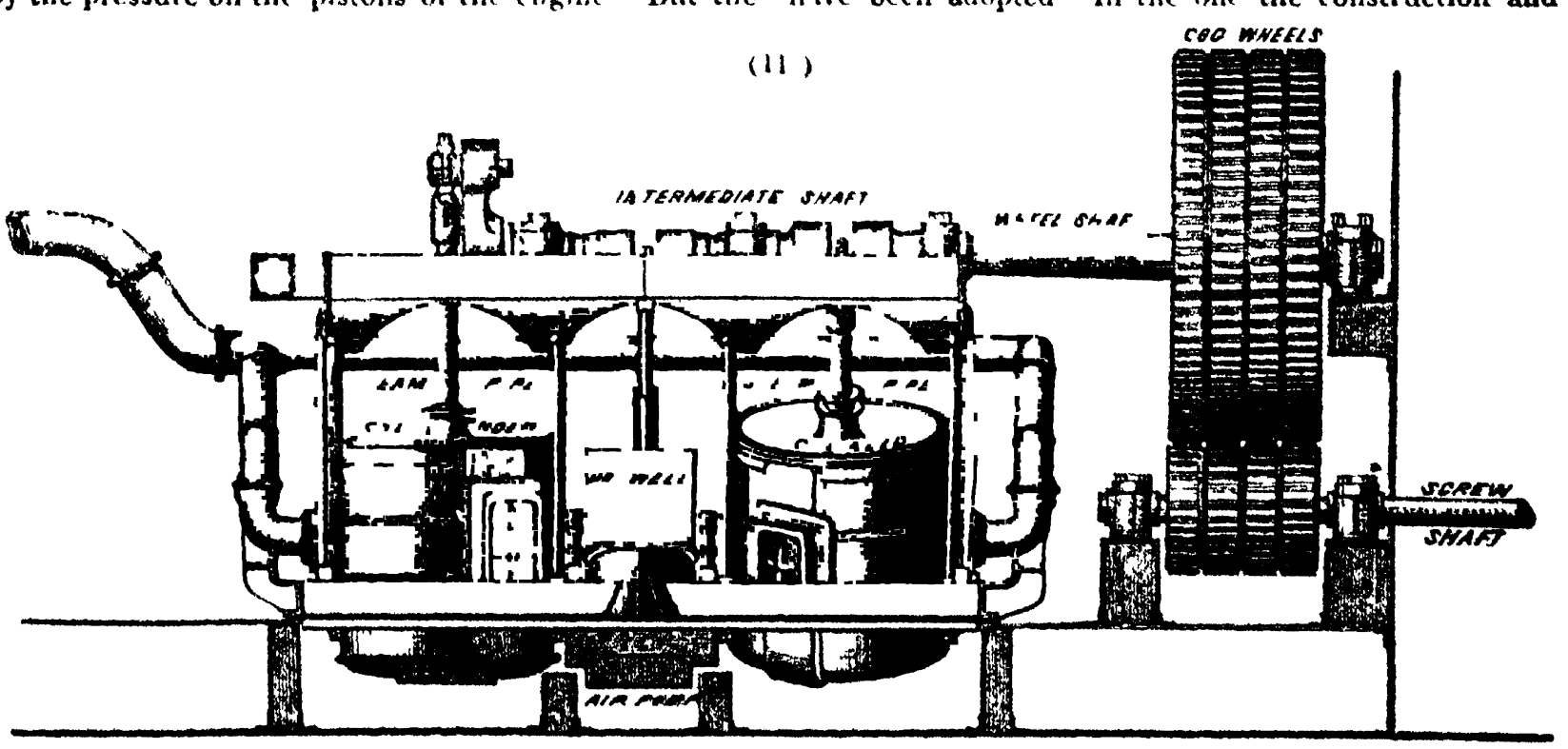
*Paddle and Screw Vessel tied Stern to Stern* — In all cases where screw and paddle vessels of equal power and size have been tied stern to stern, the screw vessel has preponderated, and towed the paddle vessel so soon as the engines were set on When the Rattler and Alecto were tied together in this manner, the Alecto's engines were set on first and she was allowed to tow the Rattler at the rate of 2 knots an hour The Rattler's engines were then set on In five minutes the two vessels became completely stationary The Rattler then began to move ahead, and towed the Alecto against the whole force of her engines, at the rate of 2 8 knots per hour In like manner the Niger towed the Basilisk astern, in opposition to the force of her engines, at the rate of 1 1 knots per hour The natural inference from this experiment would be that the screw is more suitable for towing than the paddle, yet this inference is not confirmed by experiment For, when the Niger and Basilisk were each set to tow the other alternately, in the usual manner in which a steamer tows a ship it was found that the Niger towed the Basilisk at a speed of 5 63 knots, with 593 9 horse power, and that the Basilisk towed the Niger at the rate of 6 knots, with 572 3 horse power The paddle vessel therefore accomplished in towing the largest speed with the least power It has also been found that when a paddle and screw vessel set stern to stern push one another instead of pulling one another, the paddle vessel preponderates, whereas, if they pull the screw vessel preponderates These circumstances seem to show that the power of a screw vessel to tow a paddle vessel astern, when the two are tied together, does not arise from any superior tractive efficacy of the screw itself, but is due to the centrifugal action of the screw, which raises the level of the water at the stern, so that the vessel gravitates down an inclined plane

*Cause of the serrated Outline of the Dynamometer Diagram* — In those screw vessels which have had a dynamometer applied to the end of the shaft the thrust of the screw was made to act upon a spring and a pencil in connexion with the shaft marked a line upon a revolving cylinder which line was either high up on the cylinder, or low down as the thrust of the screw increased or diminished The line thus traced instead of being tolerably uniform and straight was found to be serrated, like the teeth of a saw, and on further investigation, it was discovered that every time the screw, in its revolution, brought the blades into the vertical position and therefore into a line with the stern post at that moment the thrust was increased This phenomenon appears to be due to the circumstance of the water immediately behind the stern post being carried forward with nearly the same velocity as the vessel itself, and when the screw comes into that dead water, as it is termed it is no longer a reaction answering to the *difference* of speed of the screw and vessel that it has to encounter, but a reaction answering to nearly the *whole* speed of the vessel If such a reaction had to be encountered through the whole revolution of the screw, the velocity of its rotation would be necessarily diminished until the reacting pressure produced was balanced by the pressure on the pistons of the engine But the momentum of the machinery and of the screw itself momentarily carries up the thrust to a higher point than that due to the pressure on the pistons If a screw vessel be reversed until she attains full speed astern, and be then suddenly changed to full speed ahead, it will be found that a dynamometer diagram taken at that point at which the vessel is stationary in the water, from the effort to overcome her own momentum, will have a straight and not a serrated line

*Importance of making the Stern of Screw Vessels very sharp and fine* — The preceding remarks will have very clearly indicated the importance of making screw vessels as sharp as possible at the stern, but the following facts may be stated in corroboration of the propriety of such a configuration — In 1846 the Dwarf, a screw steam vessel, with a fine run, was filled out in the stern by the application of three successive layers of planking, so as to alter the shape to that of a vessel with a full run Prior to the alteration the speed of the vessel was 9 1 knots per hour the engines making 32 revolutions per minute The effect of the filling was to reduce the speed to 3 25 knots per hour, with a speed of the engine of 24 revolutions per minute One layer of filling was then taken off, and the speed rose to 5 75 knots per hour, the [illegible] revolutions per minute When the [illegible] was removed the speed rose to 9 knots as before Care was of course taken in this experiment to bring the filling into conformity with the lines of the vessel so that there should be no roughness or abruptness to aggravate the evils of a full run Again, the Sharpshooter and Rifleman were sister vessels of 486 tons, and 200 horse power, but the Rifleman was made with a full run and the Sharpshooter with a fine run The speed of the Rifleman was found on trial to be 7 9 knots, and of the Sharpshooter 9 9 knots The Minx and Teazer were sister vessels of about 300 tons and 100 horse power, but the Teazer was made with a full run, and the Minx with a fine run The speed of the Teazer was found to be 6 3 knots and of the Minx 7 8 knots The sterns of both the Rifleman and Teazer were sharpened subsequently to these trials, and the 100 horse engines of the Teazer were at the same time put into the Rifleman while new engines of 40 horse power were put into the Teazer Both vessels went faster than before The Rifleman, when sharpened at the stern attained a speed of 8 knots with engines of 100 horse power whereas she had before only attained a speed of 7 8 knots with engines of 200 horse power The Teazer when sharpened at the stern, attained a speed of 7 685 knots with engines of 40 horse power, whereas she had before only attained a speed of 6 3 knots with engines of 100 horse power The engines of the Teazer when transferred to the Rifleman drove that vessel nearly 2 knots an hour faster than they had previously driven the smaller vessel, an amelioration consequent altogether upon the sharpened form of the stern

*Engines for driving the Screw* — It will be obvious, on looking to the pitch of an ordinary screw and the speed with which the vessel passes through the water, that the screw must revolve with a considerable velocity For example, if a vessel be driven 10 miles an hour or 880 feet per minute by a screw of 12 feet pitch, then the screw must make somewhere more than the twelfth part of 880 or 73 revolutions in the minute This is a much higher speed than marine engines have been heretofore accustomed to travel at and two methods of obtaining the necessary velocity of rotation have been adopted In the one the construction and

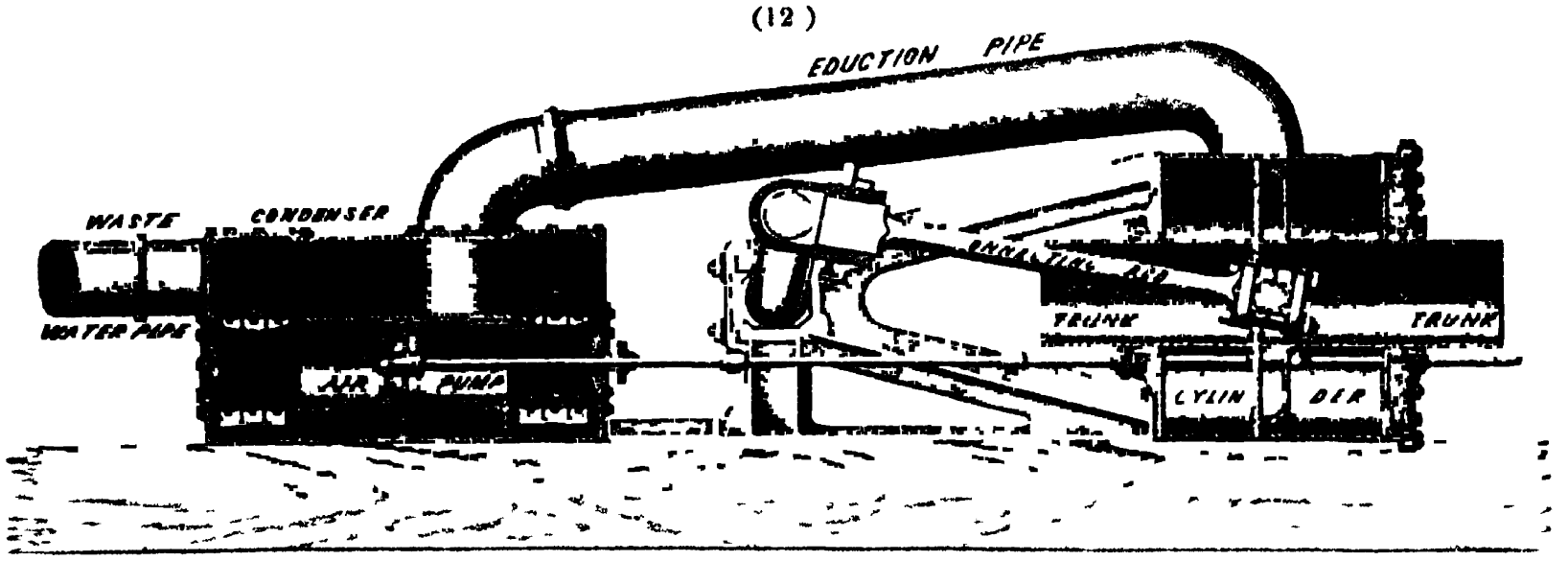




speed of the ordinary engine have been retained without material alteration, and the required velocity of revolution has been given to the screw shaft by means of intervening gearing In the other case a new arrangement of engine has been introduced which is capable of moving with a much greater velocity than ordinary engines, and the engine and screw shaft are directly connected with one another *Fig* 11 represents a pair of geared screw engines, being the engines constructed by Messrs John Penn and Sons for the Great Britain These engines are on the oscillating principle, which Messrs Penn have rendered so celebrated, and they are almost identical in construction with the paddle engines made by Messrs Penn for the Sphinx and other vessels The Great Britain is of 3500 tons burthen, and her displacement, at 16 feet draught of water, is 2970 tons The diameter of cylinder is 82⅛ inches, length of stroke 6 feet nominal power 500 horses, diameter of screw 15⅛ feet, pitch of screw 19 feet, length of screw 3 feet 2 inches The screw has three arms or blades The multiple of the gearing is 3 to 1, and there are 17½ square feet of heating surface in the boiler for each nominal horse power of the engine The crank shaft, being put in motion by the engine, carries round the great cog wheel or aggregation of cog wheels affixed to its extremity, and these wheels acting on suitable pinions on the screw shaft cause the screw to make three revolutions for every revolution performed by the crank

*Fig* 12 is a representation of a pair of direct action screw engines, being the engines constructed by Messrs

(12)




John Penn and Son for H M 's screw frigates Arrogant and Encounter Here the cylinders lie in a horizontal position, and are traversed through the centre by a pipe or trunk upon which the piston is cast The central trunk is circular and it projects through both the top and bottom of the cylinder the points of penetration being made tight by suitable packing One end of the connecting rod is attached to the centre of the trunk while the other end engages the crank, which turns round the screw shaft The air-pump which also lies in a horizontal position is double-acting and is situated within the condenser A large pipe called the eduction pipe leads the steam from the cylinder to the condenser, where it is condensed by a jet of cold water, and the hot water thence resulting is ejected by the air-pump through the waste water pipe, and passes overboard In the figure only one cylinder and one air pump is represented, but it will be understood that there are two cylinders and two air-pumps The valves by which the water is admitted to the air-pump from the condenser and passes again from the air-pump into the hot well and waste pipe, consist of several discs of indian rubber kept down by a central bolt so as to cover radial slits or orifices in a perforated plate These valves are found to operate without noise or shock notwithstanding the high speed at which the engine must work in order to give motion to the screw without intervening gearing The diameter of the cylinder in the Arrogant and Encounter is 60 inches, and the diameter of the trunk 24 inches, which being deducted leaves an available area of piston equal to that of a piston 55 inches in diameter In the Arrogant the length of stroke is 3 feet and in the Encounter 2 feet 3 inches The nominal power of both engines is 360 horse The diameter of the screw of the Arrogant is 15 feet 6 inches, and the diameter of the screw of the Encounter is 12 feet The pitch of both is 15 feet, and the length 2 feet 6 inches The Arrogant is a vessel of 1872 tons burden and the Encounter of 953 tons Both the engines and boilers are kept below the water-line, so as to be out of the reach of shot

The forms of engine, both geared and direct-acting, for giving motion to the screw, are too numerous to be here described But in most war vessels the cylinders are placed upon their sides, so as to keep the engines below the water-line In merchant vessels a form of engine like the land beam engine, with the cylinder at the one end of a beam and the connecting rod at the other — the connecting rod extending downwards from the end of the beam to give motion to the crank — is frequently employed In other cases the cylinder is inverted, and a connecting rod proceeds from the end of the piston rod to turn the crank, the end of the piston rod being, of course, steadied by suitable guides Upon the whole a construction of engine resembling that of the Arrogant and Encounter appears to be the best for driving the screw, but perhaps [illegible] also might be dispensed with,

and the condensation be performed in the air pump, — the flow of water *to* which and *from* which might be governed by a slide valve of construction similar to that employed to regulate the admission and escape of the steam from the cylinder It appears probable that slide valves will come into use for regulating the flow of water to and from pumps of every kind, but in the case of ordinary pumps for raising water those valves need not be like common slide valves — which in fact, do not seem well adapted to give sufficient area for such purposes but they may consist of short wide cylinders with gridiron orifices revolving slowly at the top and bottom of the pump

*Screw Vessels with Auxiliary Power* — We have already stated that screw vessels intended to go head to wind and to contend against head seas, are not so efficient as paddle vessel inasmuch as they require more coal to do the same work Under the conjoint influence of sails and steam, however, they are under most circumstances as efficient and if deeply laden are more efficient A screw vessel, being divested of paddle boxes partakes more of the character of a sailing ship nevertheless from the experiments with the Niger and Basilisk it does not appear that a screw vessel is more efficient under sails than a paddle vessel, which as a result might naturally be expected The advantages incident, therefore, to the use of screw vessels with auxiliary power do not result from any superiority of the screw as a propeller nor from the increased facilities which it presents for the application of sails, but are to be ascribed to the large employment in screw vessels of wind power which costs nothing instead of steam power which costs much and also to the maintenance of lower rates of speed than are thought necessary in paddle vessels The screw, indeed is a less cumbrous propeller than the paddle and in consequence of the high speed of engine which it permits, a very considerable engine power will go into a small compass Upon the whole, therefore, the screw for all purposes of auxiliary propulsion is much to be preferred, nevertheless, it is right to understand that its superior eligibility is not due to any greater efficiency than the paddle as a propeller, either in a calm or under sail but only to the greater convenience in the application of auxiliary steam power which its employment affords

*Comparative Expense of conveying Merchandize in a Paddle Vessel of full Power, and in a Screw Vessel of auxiliary Power* — For the purposes of this comparison, we may take a paddle vessel of 1000 tons burden and 350 horses power, and a screw vessel of 300 tons (old measurement) and 50 horses power—each performing a voyage of 500 miles The paddle vessel would perform the voyage in about 45½ hours, carrying 400 tons of cargo, exclusive of her machinery and coals The screw vessel would perform the voyage in about 62 hours, carrying 400 tons of cargo, exclusive of her machinery and coals Each vessel would make one double trip weekly, or 104 single trips per annum The first cost of the paddle vessel

would be about 40,000*l*, the first cost of the screw vessel would be about 10,000*l*. In the paddle vessel the wages and the scale of the expenses altogether would be larger than in the screw vessel, which would partake more of the nature of a coasting ship. The following is an approximate estimate of the expense of each —

PADDLE VESSEL.

| | Per Annum £ | Per Trip £ s |
|---|---|---|
| Wear and tear 10 per cent on 40,000*l* | 4 000 | 96 3 |
| Depreciation 5 per cent | 2 000 | |
| Insurance 5 per cent | 2,000 | |
| Interest 5 per cent | 2 000 | |
| | 10 000 | |

| | Per Month £ s | Per Trip £ s |
|---|---|---|
| Commander 25*l* per month, and 6*s* per day victualling | 33 8 | 26 11 |
| Two mates, first 7*l* and second 4*l* per month, and 3*s* 4*d* per day | 22 4 | |
| [illegible] and 1*s* 6*d* per | 10 4 | |
| [illegible] 1*s* 6*d* per day | 46 0 | |
| Carpenter 5*l* per month, and 1*s* 6*d* per day victualling | 7 2 | |
| Three apprentices 16*s* per month each, and 1*s* 6*d* per day | 8 14 | |
| Eleven firemen and trimmers 3*l* per month, and 1*s* 6*d* per day | 56 2 | |
| Two engineers, first 12*l* per month, second 8*l*, and 3*s* 6*d* per day | 28 16 | |
| Wages and victualling per month | 212 10 | |

SCREW VESSEL.

| | Per Annum £ | Per Trip £ s d |
|---|---|---|
| Wear and tear 10 per cent on 10,000*l* | 1,000 | 24 0 9½ |
| Depreciation 5 per cent | 500 | |
| Insurance 5 per cent | 500 | |
| Interest 5 per cent | 00 | |
| | 2, 00 | |

| | Per Month £ s d | Per Trip £ s d |
|---|---|---|
| Captain 16*l* per month, and 5*s* per day victualling | 23 0 0 | 11 6 9 |
| Mate 11*l* per month, and 3*s* 6*d* per day | 8 18 6 | |
| Six seamen 2*l* 10*s* per month, and 1*s* 6*d* per day | 27 12 0 | |
| One apprentice 16*s* per month, and 1*s* 6*d* per day | 2 18 0 | |
| One engineer 8*l* per month and 3*s* 6*d* per day | 12 18 6 | |
| [illegible] per month | 15 6 0 | |
| Wages and victualling per month | 90 13 0 | |

PADDLE VESSEL.

| | Per Trip £ s d |
|---|---|
| Wear and tear depreciation &c | 98 3 0 |
| Wages victualling | 76 11 3 |
| Coal 60 tons at 1*l* | 15 0 0 |
| Oil and tallow | 1 0 0 |
| [illegible] | 19 0 0 |
| [illegible] | 7 0 0 |
| Expense per trip of paddle vessel | 198 14 3 |

SCREW VESSEL.

| | Per Trip £ s d |
|---|---|
| Wear and tear, depreciation, &c | 24 0 9½ |
| Wages and victualling | 11 6 9 |
| Coal, 15 tons at 1*l* | 11 5 0 |
| Oil and tallow | 1 0 0 |
| Port charges, light dues &c | 8 0 0 |
| Sundry ships stores | 5 0 0 |
| Expense per trip of screw vessel | 60 12 6½ |

Thus it appears that it will cost 198*l* 14*s* 3*d* to transport 400 tons of merchandize through a distance of 500 miles with a full-powered paddle vessel, and that it will cost only 60*l* 12*s* 6½*d* to transport the same merchandize through the same distance with a screw vessel of auxiliary power. The average speed of the paddle vessel would be 11 miles per hour, and the average speed of the screw vessel would be 8 miles per hour.

*Comparative Cost of carrying Merchandize in Screw Vessels and in Sailing Ships* — By carrying an investigation similar to the foregoing into the case of sailing ships so as to determine the cost of conveying a given quantity of merchandize per annum through any given voyage by their instrumentality, as compared with the cost of carrying the same merchandize through the same voyage by the instrumentality of screw vessels, it will be found that the screw vessels will do the work at the least expense or, in other words, that a given sum of money, if invested in screw vessels, will yield larger returns than the same sum of [illegible] vessel in sailing ships, and this irrespective altogether of any benefit or preference which may fairly be expected from the increased speed. Mr Laming states, in his evidence before the committee of the House of Lords on the slave trade that he had had the management of a line of sailing vessels between London and Rotterdam which were at length superseded by screw vessels, after having been in existence for 25 years, that, taking the three sailing vessels, the Hope, the London, and the Alkmaar, by which, before the establishment of the screw vessels, the communication had been maintained, the average cost of carrying a ton of merchandize, from one terminus to the other, was 1*l* 12*s* 5½*d*. With the screw vessels, however, the City of London and the City of Rotterdam, the average cost of conveying the same quantity of merchandize through the same distance was, on an average of ten voyages, only 19*s* 6*d*, so that the screw vessels not merely maintained a superior speed, but did the same work at about one-third less expense.

*Conditions to be observed in the Construction of Screw Vessels* — The whole of the superior eligibility of screw vessels for the conveyance of merchandize whether compared with paddle vessels or sailing ships, is not due to the action of the screw itself or to the use of steam power. Much, probably most, of it arises from the superior form of vessel which has been simultaneously introduced and by which the sails have been rendered much more efficient than heretofore in urging the vessel through the water. And the main conditions necessary to the satisfactory performance of screw vessels lie in making the form of the vessel sharp and fine in applying a large amount of sail power, and in keeping the screw well immersed in the water. Screw vessels should be broad at the water line, so as to enable them to bear the pressure of a large amount of sail, and the sails should be as flat as possible, and be laced to the spars so as to enable the vessel to go as near as possible to the wind. The rigging of all vessels is still in a most defective state. It is without any provision whatever for using up the power of the wind in an effectual manner, and a large proportion of that power is consequently lost. Under suitable arrangements vessels would be able to sail directly against the wind, instead of having to tack as is at present the practice, and there is every reason to believe that before many years expedients for this purpose, and for obtaining from a given force of wind and area of sail a much larger propelling effect, will be practically applied.

For further information respecting the screw propeller see a *Treatise on the Screw Propeller*, by John Bourne C.E., from which the engravings and most of the information given in this article have been extracted.

SILDIAC. The substance called Gum Lac in a granulated form. See LAC in DICT.

SILBILI. A name given to native carbonate of silver.

SENSORY. The term appears to have been first applied by Hartley to those nerves which convey a stimulus to the neural axis or nervous centres with which they are connected in contradistinction to the nerves that convey a stimulus from the neural axis to the muscles. The actions of sneezing swallowing coughing hiccoughing vomiting and expelling the fæces and urine' are to be deduced 'from those vibrations which first ascend up the sensory nerves and then are detached down the motory nerves which communicate with these by some common trunk plexus or ganglion" — *On Man* vol i p 97. This class of motions or vibrations now called reflex,' Hartley distinguishes from those produced by the transmission of the sensory vibrations to the brain where they produce "sensation' and excite 'volition,' and the nerves producing the 'first and fourth classes of motory vibrations of Hartley's system" have been recently asserted to be [illegible] from those that produce sensational [illegible] tions. The distinction has not been recognised, and anatomists apply the term 'sensory" to those parts of the neural axis with which the sensory nerves are connected as, *e g* the posterior columns of the myelon, the optic lobes the thalami and the corpora striata, which are termed 'sensory ganglions".

SERUM (Lat *whey*). In Anatomy the constituent of the plasma, or liquor sanguinis, which remains after the separation and coagulation of the fibrin. Serum contains a quantity of albumen, and coagulates at a temperature of from 150° to 170°.

SETHITES or SETHIANS. In Ecclesiastical History, a branch of the Ophites, a sect of the family of the Gnostics. They are said to have believed that Seth, the son of Adam, appeared again in the person of the Messiah (*Mosh* vol i cent 2).

SEVERITE. A hydrated silicate of alumina found in nodules in the gravel of St Sever in France.

SHALLOT. The *Allium Ascalonicum* of Linnæus. It possesses the flavour of garlic, but less pungent.

SHEAR STEEL. A kind of steel made by welding several bars together, and again drawing them out. It

is used for clothiers' *shears* and many other cutting instruments *See* STEEL, in DICT

SHEET IMPRESSION *see* GEOLOGY

SHOEMAKERS BLACK *Atramentum sutorium* A name given by Pliny to sulphate of iron, or green vitriol, from the circumstance of its being used to rub over tanned leather, to which it communicates a black dye

SIBBENS A disease endemic in some of the western parts of Scotland, somewhat resembling the yaws, and propagated by direct application of the contagious matter

SIDERITE (Gr *σίδηρος, iron*) Sparry iron ore Native carbonate of iron

SIDEROSCOPE (Gr [illegible] *I view*) An instrument for [illegible] of magnetism in substances usually supposed to be non-magnetic,—the name having reference to the hypothesis that the traces of magnetism so detected are due to the presence of atoms of iron The apparatus proposed by Lebaillif, in which the object is accomplished by means of a very delicate combination of magnetic needles is described by Pouillet, *Elemens de Physique*, and by Sir D Brewster *Treatise on Magnetism*, in the *Encyclopedia Britannica*

SIGAULTIAN OPERATION The division of the *symphysis pubis* for the purpose of increasing the capacity of the pelvis in cases of impracticable labour It was first performed by a French surgeon of the name of Sigault, but is now discarded

SIGNATURE In Printing a letter or letters of the alphabet placed at the bottom of the first page of each sheet of a book to denote the order of the sheets, and to guide the bookbinder in folding and arranging them Sometimes figures are used, but seldom, except in America

SILICATES (Lat silex) Compounds of silica with certain bases thus we have silicates of lime magnesia, oxide of iron &c in most mineral and silicate of *lead* is an important ingredient in flint glass

SILICLE (Lat silex) A silicate of alumina and lime from Antrim in Ireland

SILVANITE Auriferous and argentiferous ore of Tellurium

SILVER GLANCE A mineralogical synonym of the vitreous sulphuret of silver

SILVIC ACID A name applied to that portion of common rosin or colophony which is most readily soluble in cold alcohol Its combinations with salifiable bases have been termed *silvates* It is crystallisable, and its alcoholic solution reddens litmus

SINOPITE The *Sinopian earth* of the ancients A hydrated silicate of alumina and iron from Asia Minor

SITOLOGY (Gr *σιτος aliment, λογος a discourse*) *Dietetics*, or the doctrine of aliments

SKUTTERUDITE The arseniuret of cobalt found in mica slate at Skutterud near Modum in Norway

SLATE SPAR A variety of calcareous spar of a shining white pearly lustre and greasy feel found at Wicklow in Ireland, in Glentilt in Scotland and in Norway

SLEET Rain mixed with hail or snow in small particles It falls during gales or in squally weather and chiefly in spring and autumn when the temperature of the air at a small height above the earth is below the freezing point M Kaemptz considers gusts of wind to be a necessary condition for the formation of sleet

SLIDE-REST An apparatus adapted to a turning-lathe for carrying the tool and which by means of screws is made to move or *slide* along the frame of the lathe so as to bring the tool successively to the different parts of the work The advantages obtained by the slide-rest are extremely important particularly in reference to the construction of machinery, where extreme accuracy is requisite, both in respect of the size and form of the work The tool being fixed to the rest, and adjusted by screws, its distance from the axis about which the work revolves can be regulated with the utmost precision, while a degree of steadiness is secured which is altogether unattainable when the tool is simply held in the hand

SLOTTING MACHINE A machine for grooving metal surfaces

SMALL WARES A commercial term applied to tape, bindings, braid, and other textile articles of that kind

SMARAGDITE (Gr *σμαραγδος emerald*) A variety of hornblende

SMILACINE (Lat smilax) A crystallisable principle obtained from Sarsaparilla root

SMITHSONITE A variety of calamine or native carbonate of zinc from Somersetshire and Derbyshire, analysed by Smithson

SNAKE WEED The great Bistort, *Polygonum bistorta* The root is *twice bent* on itself, hence the name This root contains starch, which renders it nutritive, hence, in Siberia, it is roasted and eaten

SOCIALISM The science of reconstructing society on entirely new bases, or the substitution of the principle of association for that of competition in every branch of human industry *See* RIGHT OF PROPERTY and SAINT SIMONIANS in DICT The best account of the innumerable modifications of which this principle has been made susceptible, from Rousseau down to Proudhon, will be found in Karl Grun's work entitled "Soziale Bewegung"

SOLANO A hot wind, or species of sirocco, pre- [illegible] Spain and Portugal [illegible] Substances which are seen to be luminous in a dark place after having been exposed to light

SOLVENT In Chemistry, the liquid in which a solid is dissolved The substance dissolved is sometimes distinguished as the *solvend*

SOMERVILLITE A mineral found in the ejected blocks on Vesuvius named after Mrs Somerville

SORDAWALITE A mineral of the hornblende family, being a silicate of alumina iron and magnesia, with about 3 per cent of phosphoric acid It occurs in thin veins in the trap rocks of Sordawala in Finland

SOUJEE A species of Semolina it is a granular preparation of wheat [illegible]

SOURKROUT, or SAUERKRAUT Fermented cabbage The plants are collected in autumn, divided, the stalks removed and the leaves cut into slices, a layer of which is placed in a vat alternating with a layer of salt till the vessel is full when it is subjected to the action of heavy weights placed on the whole At the end of about six weeks when the acetous fermentation is complete, it is considered fit for use The method of cooking it in Germany is simply to stew it in its own juice with bacon, pork or other fat meat dill, caraway seed, and other carminatives, are occasionally added Sauerkraut is not fitted for persons troubled with acidity of stomach, it has a slight relaxing effect on the bowels As an antiscorbutic it has long been celebrated, and was highly spoken of by Captain Cook (PEREIRA *on Diet*)

SOWANS or SOWINS The husk and some adhering starch separated from oats in the manufacture of oatmeal are sold as by Dr Christison under the inconsistent name of *seeds*, these, if infused in hot water and allowed to become sourish, yield on expression a mucilaginous liquid which on being sufficiently concentrated, forms a firm jelly known by the name of Sowens A similar preparation from groats or oatmeal is called *flummery*

SPANISH CHALK A variety of steatite or silicate of magnesia It is also called *French chalk*

SPECIFIC HEAT In Physics denotes the ratio of the quantity of heat entering into or passing out of a given weight of any substance, to the change of temperature thereby produced For instance if the unit of heat be assumed to be that quantity of heat which is necessary to melt a pound of ice at the temperature of 32° of Fahrenheit then assuming $n$ to denote the number of pounds of ice necessary to cool down a body whose weight is one pound from $t$ to $t'$ the specific heat of the body is $n \div (t - t')$ Hence if $t - t' = 1°$, the specific heat is denoted simply by $n$

It is found by experiment that provided a body does not change its state (as from solid to liquid) the above ratio remains constant or nearly so through a considerable range of temperature, but it varies greatly in respect of different substances Thus a pound of water absorbs thirty times more heat than a pound of mercury in being heated the same number of degrees and consequently the specific heat of water is thirty times greater than that of mercury It is usual to express the specific heats of different substances in terms of that of water assumed equal to 1·00, the specific heat of mercury thus becomes ·33

SPEISS An impure arseniuret of nickel, obtained from the ores of cobalt and nickel in smalt-works

SPIDDINGS A Scotch term for dried and salted whitings

SPERMATOA (Gr *σπερμα seed, ωον, egg*) The cells which stand in the relation of nuclei to the sperm cells and of developmental cells to the spermatozoa Sometimes the sperm-cell contains a single spermatoon, sometimes several spermatoa, in which case the resulting spermatozoa often unite together and form a fasciculus, as, e g in the sparrow

SPERMATOPHORA (Gr *σπερμα* and *φερω, I carry*) In Anatomy, cases of albuminous matter in which the bundles of *spermatozoa* are packed they are largest and most complex in the Cephalopods

SPERMATOZOA (Gr *σπερμα* and *ζωον animal*) The filamentary bodies developed in the semen, and consisting of an enlarged extremity called 'body,' and a vibratile filamentary appendage called 'tail' Spermatozoa consist of an amber-coloured highly refracting, homogeneous substance, like the hyaline nucleus of cells, and are formal modifications of the nucleus of the spermatoon They are essential to impregnation

**SPERM-CELL** In Anatomy, the cells contained in the liquor seminis in which are formed the spermatoa, or cells of development of the spermatozoa

**SPHAEROSIDERITE** (Gr *σφαῖρα, a globe*, and *σίδηρος, iron*) A name given by Hausmann to a granular variety of spathose carbonate of iron

**SPIKENARD** The spikenard of the ancients appears to have been the *Nardostachys satamansi*, the root of which is highly esteemed at the present day throughout the East as a perfume, and as a stimulant medicine The plant is a native of the mountainous parts of the north of India

**SPINAL CHORD or CORD** *See* MYELON

**SPINAL MARROW** The division of the neural axis lodged in the vertebral column of the trunk *See* MYELON

**SPIRÆ'A ULMARIA** (Lat) Meadow Sweet The essential oil of this plant has been produced artificially by the oxidizement of salicine, and has been termed *spiroylous acid* Its chemical formula is $C_{14} H_5 O_3 + HO$

**SPUNK** A species of Agaric or fungus, the *Polyporus*, or *Boletus igniarius*, called also Touchwood Cut into thin slices and beaten till soft, it has been used as a styptic to check hæmorrhage, it is also used when soaked in a solution of nitre, for kindling matches and tobacco, under the name of *amadou*, or *German tinder*

**SPURGE, or SPURGE OLIVE** The *Daphne Mezereon* All parts of this plant, but especially the fruit and the bark are very acrid and poisonous, it is used as a sudorific and alterative in medicine, and is sometimes applied externally as an irritant

**SQUA'LUS** (Lat) In Ichthyology, the Linnæan generic designation of the shark tribe

**SQUIRTING CUCUMBER** The *Momordica elaterium* When the fruit or *pepo* is ripe it separates from the stalk and expels its seeds and a thin mucous juice with considerable violence through the remaining aperture The acrid purgative known in pharmacy under the name of *elaterium*, is deposited by this juice

**STANDARD MEASURES OF LENGTH** A standard-bar measurer of very refined construction was produced by Messrs Whitworth and Co at the Great Exhibition of 1851 The machine consists of a metal frame, at each end of which is placed a micrometer These micrometers by means of a combination of screws and wheels will measure small differences of length corresponding respectively to the one-millionth and the one five-thousandth part of an inch The bar to be measured is carried in a steel groove on the upper part of the frame a parallel-sided piece of metal at the right-hand end forming a perfectly flat contact for measurement and the other end abutting against the left-hand micrometer

The determination of the exact contact for the measure of length can be made either by a *gravitation test* or a *galvanic test* In the former the experimenter moves the end of the screw of the right hand micrometer through one division of the head corresponding to one-millionth of an inch and carefully raising the contact-piece, lets it fall by its own gravity, and he repeats this operation till the approach of the screw prevents the contact piece from descending In the galvanic test, a small battery composed of a piece of copper and zinc soldered together and immersed in rain water, is connected with the micrometer, and also with a delicate galvanometer by means of covered wires, the bar to be measured being insulated from the machine The contact is in this case indicated on completing the circuit by the deflexion of the needle of the galvanometer

**STAR** The recent researches of Sir J Herschel Argelander Struve Peters, and others have led to some very remarkable views relative to the distances magnitudes and number of the stars and their distribution in space

*Distance* —Although it is a very improbable supposition that all the stars are of the same size it is equally improbable that their real magnitudes are in any way dependent on their distance from the sun but unless this latter supposition be made we must conclude that *on the average* (putting individual cases out of view), the most distant will be those which have the smallest apparent magnitude

Argelander, of Bonn, has given a catalogue of the stars visible to the naked eye in which they are divided into six orders of magnitude, the faintest stars or those just perceptible by the naked eye being considered as the smallest of the sixth [illegible] If we suppose six concentric spheres to be [illegible] the sun, with radii such that the first contains all the stars of the first magnitude, the second all those of the first and second magnitude, the third all those of the three first magnitudes, and so on, and if we also suppose the *mean* distance of the stars of the first magnitude to be unity, then, according to the computation of Struve (founded necessarily on certain hypothetical assumptions respecting the distribution of the stars in space), the mean distance of the stars of the different orders of magnitude, and the radii of the spheres circumscribing them, [illegible] as follows —

| Magnitudes | Mean Distance | Radius of Sphere |
|---|---|---|
| 1 | 1 0000 | 1 2638 |
| 2 | 1 8031 | 2 1108 |
| 3 | 2 7639 | 3 1961 |
| 4 | 3 9057 | 4 4374 |
| 5 | 5 4545 | 6 2093 |
| 6 | 7 7258 | 8 8726 |

For stars of the three next magnitudes, the data for computing the relative distances have been furnished by Bessel's zone observations Struve finds the radii of the circumscribing spheres to be as follows For those of the seventh magnitude 14 4365 units, for those of the eighth 24 8445, of the ninth 37 7364, and he hence concludes that the smallest stars observed by Sir W Herschel with his twenty-foot reflector [illegible] distance of 227 8 units, or 25 67 times the radius of the smallest stars visible to the naked eye. (*Etudes d'Astronomie Stellaire*, p 81)

It is usual to express these almost inconceivable distances in terms of the time which light—propagated at the rate of 192 000 miles in a second—takes to traverse them The average parallax of stars of the first magnitude has been computed by Peters to be 0″ 209 (*See* PARALLAX IN STELLAR) Now if a star has a parallax of 1″, its distance is 206 265 times the distance of the sun from the earth (for radius sin 1″=206265 · 1), and the time which light takes to traverse this distance is about 3 years and 83 days, or 3¼ years, therefore the time which light takes to come from a star whose parallax is 0″ 209 —that is, to traverse a distance equal to the average mean distance of a star of the first magnitude, which has been assumed as the unit of the above scale,—is 15 4 years to come from the remotest star of the [illegible] the remotest of the [illegible] remotest star [illegible] years (*Etudes* p 106)

*Number of visible Stars* —As no limit can be set to the distance to which the stars may extend in space the number of visible stars is limited only by the powers of the telescope But the direct enumeration is beyond human power, and in order to obtain an approximation, it is necessary to have recourse to hypothetical considerations By a very ingenious investigation, founded on the numbers ascertained by Sir W Herschel to exist within certain limited spaces Struve has attempted to compute the whole number in the heavens within the range of the twenty foot reflector, which, as stated above, is 227 8 times that of the distance of stars of the first magnitude He first establishes a law of diminution depending on the angular distance from the plane of the galactic circle (see GALAXY) and having ascertained the mean number visible in a field of the telescope in that plane he finds, by a process of integration the whole number in the celestial vault to be 20 371 034, or upwards of twenty millions Whether this number be near or far from the truth, it must be taken as the most probable estimate yet made (*Etudes* p 72)

If we confine our attention to stars visible to the naked eye, the number may be estimated with greater precision The number of stars of the several magnitudes, in the northern hemisphere, contained in Argelander's catalogue, is as under —

| Magnitudes | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Stars in each | 9 | 34 | 96 | 214 | 550 | 1439 |
| Sums | 9 | 43 | 139 | 353 | 903 | 2342 |

Assuming the *density* to be the same in the southern hemisphere as in the northern, the catalogue should contain 4684 stars It is estimated by Struve that the number entered in the catalogue is to the whole number existing (and visible to the naked eye) within a given space in the ratio of 5136 to 10,000 Hence the whole number of stars which can be seen with the naked eye is 5757 or less than 6000 Sir J Herschel remarks that the whole number of stars already registered, down to the *seventh* magnitude inclusive, amounts to from 12,000 to 15 000

*Apparent Magnitudes* —The method of estimating the apparent magnitudes usually adopted is by a scale of brightnesses decreasing in geometrical progression each term being half of the preceding, or at least having a fixed ratio to it Sir J Herschel proposes and recommends the adoption of a scale decreasing as the squares of the terms of an harmonic progression, namely, the series 1, $\frac{1}{4}$, $\frac{1}{9}$, $\frac{1}{16}$, $\frac{1}{25}$, &c This scale is not a purely photometric one like the former, but involves the physical idea of supposing the scale of magnitudes to correspond to the [illegible] removed successively [illegible] its original or standard distance, so that upon [illegible] equality among the real lights of [illegible] magnitude would be a sort of index to the presumable distance

*Real Magnitudes* —The only means we have of obtaining any indication respecting the real magnitudes of the

[illegible] quantity of light received from the [illegible] compared the light of *α Centauri* directly with the moon, and from several experiments, made with attention to all the circumstances required to be taken account of, found that the mean quantity of light sent to the earth by a full moon exceeds that sent by *α Centauri* in the proportion of 27,408 to 1 Dr Wollaston (*Phil Trans* 1829) found the proportion of the sun's light to that of the full moon to be that of 801,072 to 1 Combining these results, it appears that the light sent to us by the sun is to that sent by *α Centauri* as 21,955,000,000, or about twenty-two thousand millions to one Hence, and from the parallax assigned to that star (0″ 913), it is easy to conclude that its intrinsic splendour, as compared with that of the sun is in the proportion of 2 3247 to 1 The light of Sirius is four times that of *α Centauri* and its parallax is only 0″ 230, it so much, its intrinsic splendour, therefore, according to these determinations, must be above sixty-three times (63 02) that of our sun (Herschel, *Outlines of Astronomy*, p 553)

STAR ANISE The fruit of *Illicium anisatum*, an evergreen growing in Japan and Cochin China the seeds have the odour of common anise, and yield, when distilled with water an oil sometimes called *Oleum badiani* which is used by liqueur makers

STAVESACRE The *Delphinium staphysagria* The seeds of this plant are emetic and purgative in consequence of the presence of *Delphinia* a very acrid bitter principle, which, in the dose of a few grains, excites a sense of heat and tingling in various parts of the body The disease in which it has been chiefly successful is neuralgia in which it has been applied externally in the form of ointment

STEAM HAMMER, for pile-driving An ingenious machine invented by Mr Nasmyth now in general use in [illegible] large works "It consists of a [illegible] at the bottom but with openings in the top to allow the passage of air a piston works in it, having its rod passing through a steam tight aperture in the bottom To the piston the monkey or driver, which weighs 2½ tons, is attached and is thus suspended The machine is worked by [illegible] steam which being admitted at the bottom [illegible] by the induction pipe, raises the piston, and with it, the monkey attached to it The instant it arrives at the height required, it closes the induction-pipe and, opening the eduction-pipe (also at the bottom of the cylinder), the steam escapes, and the piston, with the monkey attached to its rod falls freely on the head of the pile A large heavy cap of iron, with a hole to allow the head of the pile to pass through slides between the upright standards and guides the direction of the pile The monkey and cylinder also follow the course of the pile, guided by the same uprights, between which they slide"

The saving of labour effected by this contrivance is very great A stage, which carries the machine, boiler, workmen, and every thing necessary, moves along a railway Having driven one pile, the machine moves onward the regulated distance, it then picks the next pile out of the water, hoists it high in the air drops it into its exact place then covers it with the great cap, the monkey immediately acts giving at the rate of seventy-five blows in a minute The whole operation of raising a pile from the raft, putting it in its place and driving it to the required depth, occupies generally from two to four minutes By the old method of pile driving, a comparatively light weight (about 12 cwt) is made to fall from a great height, and the blows succeed at intervals of about five minutes By the new machine a very heavy weight (about 50 cwt) falls through a height of only three feet, and the blows are repeated seventy five times in a minute

The principle of this invention may be said to consist in the employment of a heavy weight moved with a small velocity instead of a light weight moved with a great velocity In a paper communicated to the British Association for 1841, Dr Greene gave the following instance of the state of the heads of two piles, as driven by the two methods —

"One was 56 feet long driven by a monkey of 12 cwt falling from a great height, and making only one blow in five minutes, and requiring twenty hours to drive it, this though protected by a hoop of iron, was so split and shattered on the head, that it would require to be re-headed, to drive it any further The other, though 60 feet long, was not even supported by an iron hoop, and the head is as smooth as if it were dressed off with a new plane It was driven with a hammer of 50 cwt, and only three feet fall, making seventy-five blows in a minute, and was put into its place and finished in four and a half minutes"

STEPHANITE A mineralogical synonym of one of the [illegible]

STEREOELECTRIC CURRENT (Gr *στερεος, solid*) A term applied to the *thermo-electric* current which ensues when certain metals are brought into contact at different temperatures, it implies the production of a current of electricity in *solid bodies*, as opposed to the voltaic or *hydro electric* current, in which fluids are essential

STEREOSCOPE (Gr *στερεος, solid, σκοπεω, I view*) The name given by Professor Wheatstone to an instrument or apparatus proposed by him, and described in a paper on the Physiology of Vision published in the *Philosophical Transactions* for 1838, for the purpose of exhibiting the effect of simultaneously presenting to each eye the projection of a solid body on a plane surface as it appears to that eye To render this clear, it may be necessary to observe, that when a body of three dimensions is placed so near the eyes that, on looking at it the optic axes must converge, a different perspective representation of it is seen by each eye, the body being, in fact, thus seen from two points of sight, at a distance from each other equal to the distance between the centres of the pupils, and the pictures of it projected on the two retinæ being consequently dissimilar Supposing then, two perspective drawings, on a plane surface, to have been made of an object as it is seen by each eye respectively, in order to try the experiment, it is necessary that the pictures be placed so that each can be seen by one eye only, and that the rays of light from the corresponding points of the two pictures fall on similar points of both retinæ or enter the eyes in the same directions as the [illegible] points of the original object But [illegible] distance between the two eyes, this, manifestly cannot be done without altering the direction of the rays For this purpose Professor Wheatstone employed two small plane mirrors, about four inches square, adjusted at right angles to each other, so as to form two adjacent sides of a cube the faces being outwards The edge where the two planes meet being brought close to the face of the observer, and the mirrors being placed symmetrically with respect to the direction of the visual rays it is evident that if the two pictures be respectively placed before the mirrors symmetrically, and at equal distances, rays of light proceeding from them in opposite directions, and falling on the mirrors will be reflected at right angles to their former directions and become parallel The right eye will see only the reflexion of the picture on the right hand side, and the left eye that on the left hand side, but on regarding both simultaneously, the mind readily unites the two images, and instead of the two plane pictures, an object of three dimensions makes its appearance, the exact counterpart of that from which the pictures were drawn, standing out, as it were, in relief between the planes of the two mirrors

In the Report of the British Association for the Advancement of Science for 1849 Sir David Brewster states, that having had occasion to make numerous experiments on this subject, he was led to construct the stereoscope in several new forms Of these forms, the most generally useful is the *Lenticular Stereoscope* This instrument consists of two semilenses placed at such a distance that each eye sees the picture of a drawing opposite to it, through the margin of the semilens, or through points of it equidistant from the margin The distance of the two portions of the lens through which we look must be equal to the distance of the centres of the pupils, which at an average, is two and a half inches By this method the images are not only united but magnified at the same time, which is in many cases advantageous

STERNBERGITE The flexible sulphuret of silver and iron, named by Haidinger in honour of Count Sternberg It occurs in Bohemia and Hungary

STILBENE (*στιλβω I shine*) A peculiar hydrocarbon which crystallises in scales of a pearly lustre

STILBITE A pearly variety of zeolite

STILPNOSIDERITE (*στιλπνος, lucens, σιδηρος, iron*) A native oxide of iron

STIMMI An ancient name of the sulphuret of antimony

STIR-ABOUT A moderately consistent mixture of oatmeal and water boiled, and generally eaten with cold milk, called Porridge in Scotland When mixed with the thin liquor of boiled meat, or the water in which cabbage or kale has been boiled, it is called *beef brose*, or *kale brose* (Pereira *on Diet*)

STONE BLUE A compound the basis of which is usually an impure starch or mixture of starch and gluten, being the starchmakers' refuse, coloured either by indigo [illegible] It is used in the laundry to cover [illegible] linen

STRAWBERRY [illegible] The fruit of *Fragaria vesca* Strawberries contain a very small quantity of nutritive matter The grains or seed like pericarps are not digestible, and sometimes excite intestinal irritation, so

that some physicians have directed their patients to suck str[illegible]

STRETCHING MACHINE Calicoes, and other [illegible] fabrics, are prepared for the market by being stretched in a proper machine, which lays all their warp and woof yarns in parallel positions, and extends their width after the shrinkage occasioned by bleaching, dyeing &c

STROGANOWITE (Named after Count Stroganoff) A mineral found in loose blocks in the Sludanka, a river of Dauria, of a greyish white colour, and slightly effervescent with acids, it is a silicate of alumina, soda, and lime, combined apparently with carbonic [illegible]

STROMEYERITE A mineral so named by Haidinger, after the Hanoverian chemist Stromeyer, who [illegible] double sulphuret of silver and copper

STROMNITE A sulphate of baryta and carbonate of strontia probably a mixture merely of the sulphate and carbonate, found at Stromness in Orkney It occurs in yellowish-white translucent masses, with a slight [illegible] crystalline cleavage

STRUTHINE (Gr στρουθος, *a kind of herb*) A bitter acrid principle obtained from the root of *Gypsophila struthium* It appears to be identical with *saponine*, obtained from the *Saponaria officinalis*, or soapwort

STRUVITE A name (in honour of Struve) given [illegible] phosphate, found [illegible] ion of a church at Hanover

STYPHNIC ACID (Gr στυφνος, *astringent*) An astringent acid compound obtained by the action of nitric acid upon certain gum resins It is also called *Nitrostyphnic acid*

STYROLE (Gr στυραξ) An oily hydrocarbon obtained by distilling liquid storax It is perfectly liquid but has the curious property of becoming a soft viscid transparent solid when heated In this state it has been called *metastyrole* The formula of styrole is $C_{16} H_8$

SUBSTITUTION In Chemistry this term is applied to such results of affinity as are dependent upon the substitution of one or more atoms or equivalents of a simple or compound body for the same number of atoms of another body Thus, in the decomposition of water, which ensues when zinc is made to act upon dilute sulphuric acid, an atom of zinc is *substituted for* (or replaces) an atom of hydrogen, the latter being expelled [illegible] clearly shown by the aid of formulæ [illegible] case,

$$H + SO_4 \text{ becomes } Zn + SO_4$$

Another illustrative case of substitution occurs in the conversion of acetic into chloracetic acid in which the 3 atoms of hydrogen belonging to the acetic acid are substituted by 3 atoms of chlorine

$\underbrace{C_4\ H_3\ O_3}$ becoming $\underbrace{C_4\ \ Cl_3\ \ O_3}$

Acetic acid Chloracetic acid

In the same way in the formation of nitric ether, an atom of nitric acid is substituted for an atom of water

$\underbrace{C_4\ H_5\ O + HO}$ becoming $\underbrace{C_4\ H\ \ O + NO_4}$

Alcohol Nitric ether

SUCCORY Called also *Chicory* The *Cichorium intibus* (*wild endive*) The root of this plant which resembles a carrot, when cut into slices dried, roasted and ground into powder, is used for the adulteration of ground coffee It has a somewhat burned flavour a very little resembling that of coffee but it yields a large quantity of a rich brown infusion or decoction, with water To detect the adulteration, sprinkle the suspected article upon the surface of some water in a jar or tumbler If genuine coffee, it remains for a long time floating scarcely tinging the water, and appearing greasy, or not easily wetted, whereas, if succory powder be present it communicates a deep reddish-brown tint to the water and portions of it soon sink to the bottom

SUDORIPAROUS GLANDS (Lat sudor *sweat*, pario, *I produce*) In Anatomy the secreting organs of the sweat, which consist of a slender elongated blind glandular tube, coiled into a lobular form and imbedded in the subcutaneous fat, and continued thence in a spiral course to the cuticle, where it opens by an oblique pore

SULFAMIDE A crystallised compound obtained by the action of anhydrous sulphuric acid on ammonia The compound resulting from the analogous combination of dry sulphurous acid on ammonia has been termed *Sulfamide*

SULPHURATION The process by which certain silk, cotton, and woollen goods are subjected to the fumes of burning sulphur, or sulphurous acid for the purpose of decolouring or bleaching The rooms or chambers in which the operation is conducted are often of considerable dimensions, and fitted with poles and frames, on which the blankets, shawls, and similar articles may be suspended The straw used in the manufacture of hats is similarly bleached or sulphured

SUNSTONE A resplendent variety of felspar, found in Norway and elsewhere The play of colour which it exhibits arises from minute lamellar crystals of iron [illegible] which are embedded in it

SUPRARENAL BODIES (Lat supra, and ren, *a kidney*) In Anatomy, the flattened bodies situated on the upper part of the kidneys in man, and at the forepart in brutes they are well supplied with blood-vessels and nerves, and are composed principally of simple or closed vesicles, resembling the secreting glands, except that they have no ducts They are of disproportionately large size and the fœtal state in man and quadrumana

SURINAMINE A crystallisable principle obtained from the bark of the *Geoffroya Surinamensis*, or *Surinam bark*

SWEETBREAD The thymus gland of the calf is employed as food, under this name it contains about 70 parts of water and 30 of nutritious matter, chiefly of an albuminous character "A fresh sweetbread when plainly cooked (by boiling) and moderately seasoned, forms a very agreeable and suitable dish for the convalescent, but, when highly dressed, is improper both for dyspeptics and invalids" (PEREIRA *on Diet*)

SYEPOORITE A sulphuret of cobalt, found in primary rocks at Syepoor, near Rupoolanah, in North-west India It is said that the Indian jewellers use it to give a rose colour to gold

SYMBOLS, CHEMICAL A chemical symbol is the representation of one atom or equivalent of each elementary substance by the capital initial letter or letters of its Latin name it being necessary where the names of two or more elements begin with the same letter to add a second in a smaller character for the purpose of distinguishing between them Thus, C Cl Ca Cd, Co Cu, Ce Cr are the symbols of Carbon Chlorine, Calcium, Cadmium, Cobalt Copper (Cuprum) Cerium and Chromium, H and Hg are the symbols of Hydrogen and of Mercury (Hydrargyrum), O and Os of Oxygen and of Osmium, and so on The following table enumerates in alphabetical order the simple or elementary substances, with their annexed symbols, and equivalents or atomic weights, that is, the respective *weights* of each of the elementary bodies which each symbol is assumed to represent upon the *hydrogen* scale, or in reference to hydrogen as unity

| | Atomic Weight | Symbol |
|---|---|---|
| Aluminum | 14 | Al |
| Antimony (Stibium) | 129 | Sb |
| Arsenic | 75 | As |
| Barium | 69 | Ba. |
| Bismuth | 106 | Bi |
| Boron | 11 | B |
| Bromine | 78 | Br |
| Cadmium | 56 | Cd |
| Calcium | 20 | Ca |
| Carbon | 6 | C |
| Cerium | 46 | Ce |
| Chlorine | 36 | Cl |
| Chromium | 28 | Cr |
| Cobalt | 30 | Co |
| Copper (Cuprum) | 32 | Cu |
| Didymium | | Di |
| Fluorine | 19 | F |
| Glucinum | 17 | G |
| Gold | 200 | Au |
| Hydrogen | 1 | H |
| Iodine | 126 | I |
| Iridium | 99 | Ir |
| Iron (Ferrum) | 28 | Fe |
| Lanthanum | 36 | La |
| Lead (Plumbum) | 104 | Pb |
| Lithium | 7 | Li |
| Magnesium | 12 | Mg |
| Manganese | 28 | Mn |
| Mercury (Hydrargyrum) | 100 | Hg |
| Molybdenum | 48 | Mo |
| Nickel | 29 | Ni |
| Niobium | | Nb. |
| Nitrogen | 14 | N |
| Osmium | 100 | Os |
| Oxygen | 8 | O |
| Palladium | 54 | Pd |
| Pelopium | | Pe |
| Phosphorus | 32 | P |
| Platinum | 99 | Pt |
| Potassium (Kalium) | 40 | K |
| Rhodium | 52 | R |
| Ruthenium | 52 | Ru. |
| Selenium | 40 | Se |
| Silicium | 15 | Si |
| Silver (Argentum) | 108 | Ag. |
| Sodium (Natrium) | 24 | Na |
| Strontium | 44 | Sr. |

| | Atomic Weight. | Symbol. |
|---|---|---|
| Sulphur - - - | 16 | S |
| Tantalum (or Columbium) - | 185 | Ta |
| Tellurium - - - | 64 | Te |
| Thorium - - - | 60 | Th |
| Tin (Stannum) - - | 59 | Sn |
| Titanium - - - | 24 | Ti |
| Uranium - - - | 60 | U |
| Vanadium - - - | 68 | V |
| Wolframium (or Tungston) - | 95 | W |
| Yttrium - - - | 32 | Y |
| Zinc - - - - | 32 | Zn |
| Zirconium - - - | 23 | Zr |

It will be understood that the above symbols represent a single atom or equivalent of each of the simple bodies, in reference to Hydrogen as *unity* Thus, H represents 1 part by weight of Hydrogen, O, 8 parts by weight of Oxygen, S 16 of Sulphur, Hg, 100 of Mercury, and so on It is evident however, that as far as the equivalents are concerned other numbers or weights bearing the same relations to each other, might be adopted thus upon the *oxygen* scale oxygen is represented as = 100, in which case hydrogen is 12 50, sulphur 200, mercury 1250, and so on But we shall confine ourselves exclusively to the hydrogen scale which is now in most general use, and in all respects preferable to the more complicated numbers which the oxygen scale necessarily involves

When two or more equivalents of one elementary substance are to be indicated, figures are placed either before or after the symbol Thus, 2 equivalents (or *atoms*, for we use the terms s[illegible] of iron may be represented by 2 Fe, or by Fe[illegible] the former case a large, in the latter a small numeral being generally adopted It is often customary to place this small numeral somewhat above or below the symbol, as Fe or $Fe_2$, but there are inconveniences and no advantages attending this arrangement, and they give to these [illegible] symbols which [illegible] writers have expressed two atoms of an element by drawing a line through its symbol, thus, 2 atoms of hydrogen are represented by H, 2 of sulphur, by S &c, but such abbreviations are inconvenient

By a proper collocation of symbols the *formulæ of compounds* are easily represented, thus Cu O represents an atom of copper and an atom of oxygen in combination, that is *protoxide of copper*, Fe O protoxide of iron, &c Sulphuric acid which is a compound of 1 atom of sulphur with 3 atoms of oxygen, is represented by $S O_3$, and sulphate of protoxide of iron by $Fe O + S O_3$, or, more commonly, the symbol + is omitted in such cases and a comma substituted as Fe O, $S O_3$ It will be observed that this formula has reference to the assumed *proximate* constituents of the salt in question and that if its ultimate elements only were intended to be indicated, the formula would stand thus, Fe $S O_4$ In many instances the plus sign and the comma are conveniently available in the same formula, thus the double sulphate of potassa and oxide of iron may be written as follows K O, $S O_3$ + Fe O, $S O_3$ Here the comma may be assumed as indicating a more intimate or higher order of combination than the plus sign, namely, that of the oxide and acid in each salt while the union of the salts with each other is represented by the sign +

In the preceding formulæ the figures only affect the symbol to which they are immediately appended When they are intended to apply to the *entire compound*, they precede the symbol of the compound and it is in such cases clearer to use large figures thus, 3 $S O_3$ represents three atoms or equivalents of sulphuric acid and 2 Cu O two atoms of protoxide of copper A salt containing *two* atoms of oxide of copper and *one* of sulphuric acid would be written as follows 2 Cu O $S O_3$, or 2 Cu O, + $S O_3$ in these cases the intervening comma or *plus* sign prevents the extension of the influence of the figure 2 beyond the oxide of copper and if our object were to imply *two atoms of sulphate of copper*, we should inclose all that is to be affected by the figure 2 within brackets, and write it thus 2 [Cu O, $S O_3$] To give one other instance Pb O $Cr O_3$ is the neutral chromate of lead and 3 [Pb O $Cr O_3$] is *three* atoms of the same neutral chromate, but 2 Pb O $Cr O_3$ is the *dichromate* or subchromate of lead, and 3 [2 Pb O, $Cr O_3$] is three atoms of the same dichromate K O, 2 $Cr O_3$ is the *bichromate* of potassa, and 4 [K O, 2 $Cr O_3$] four atoms of the same, &c

The following are more complicated illustrations of the application of these symbolic notations K O $S O_3$ + $Al_2 O_3$, 3 $S O_3$ + 24 H O represents the constitution of crystals of common alum, they include an atom of sulphate of potassa, an atom of sulphate of alumina and 24 atoms of water of crystallisation an atom of alumina includes 2 atoms of *aluminum* and 3 of oxygen, and its *sulphate*, as it exists in alum, is constituted of 1 atom of alumina and 3 of sulphuric acid In *iron alum* the alumina is r[illegible] peroxide of iron, [illegible]

K O, $S O_3$ + $Fe_2 O_3$, 3 $S O_3$ + 24 H O.

It is obvious that the atomic or equivalent weights of compounds are in all cases to be deduced from their symbols Thus, the symbol of potassa K O indicates its equivalent to be 48, for the equivalent of K is 40, and that of oxygen 8 And again, $S O_3$, the symbol of sulphuric acid is equal to 40 of that acid, for S is = 16 sulphur and $O_3$ 8 × 3 = 24 of oxygen, and 16 + 24 = 40 Hence also, K O, $S O_3$ is one atom, or equivalent of sulphate of potassa, or 88 parts by weight

In the construction of chemical formulæ the arrangement of the symbols should not be arbitrary, but such that the *basic* or electro positive elements should precede the *acid* or the [illegible] elements hence sulphate of potassa is [illegible] K O $S O_3$, and not $S O_3$, K O, and chloride of sodium is represented by Na Cl, and not Cl Na In this way, also, much useful information respecting the real or theoretical constitution of compounds may be expressed in the due arrangement of their formulæ thus, H O $S O_3$ represents hydrated sulphuric acid of the specific gravity of 1 84, or common oil of vitriol, which may be called a *sulphate of water* the acid of the specific gravity of 1 78 contains 2 atoms of water to 1 of anhydrous sulphuric acid, and might therefore be represented as 2 H O, $S O_3$, but if we give to it the formula H O, $S O_3$ + H O we indicate that 1 atom of water only is combined as a *base*, with the anhydrous acid and that the second atom of water is in combination with the sulphate of water, constituting, as it were, water of crystallisation

In cases where complicated formulæ are to be expressed, and more especially in the combinations with which the mineralogist has to deal, the above symbolic notation may become inconveniently long, and, accordingly various abbreviations have been suggested, but the evil of them is their frequent indistinctness, and the confusion which results from slight and almost unavoidable typographical errors The equivalent of oxygen in oxides and acids is thus frequently represented by a point placed over the symbol of the element with which the oxygen is combined The following for instance are the several combinations of nitrogen with oxygen represented in ordinary and in abbreviated notation —

| | | |
|---|---|---|
| Nitrous oxide - | N O | $\dot{N}$ |
| Nitric acid - - - | $N O_2$ | $\dot{N}$ |
| Hyponitrous acid - - | $N O_3$ | $\dot{N}$ |
| Nitrous acid - | $N O_4$ | $\dot{N}$ |
| Nitric acid - - - | $N O_5$ | $\dot{N}$ |

Mineralogists also sometimes represent the atom of sulphur by substituting a dash over the symbol of the element with which it is combined in place of using the letter S in the usual way, thus they indicate the three sulphurets of arsenic —

As $S_2$ by $\overline{As}$

As $S_3$ „ $\overline{\overline{As}}$

As $S_5$ „ $\overline{\overline{\overline{As}}}$

Certain compound bodies, more especially where they perform the part of elementary substances are sometimes conveniently represented by their initial letter or letters, as if they were simple bodies For instance, Cyanogen which is a compound of 2 atoms of carbon with 1 of nitrogen, is indicated by Cy, instead of $C_2 N$, and Ethyle, which is a compound of 4 atoms of carbon and 5 of hydrogen, by E instead of $C_4 H_5$ And lastly, certain organic bases and organic acids are similarly expressed by one or more initial letters, with the plus or minus sign attached, thus, instead of giving the composition of Morphia, Cinchonia, &c at length, they are represented by $\overset{+}{Mor}$ $\overset{+}{Cin}$, &c and Acetic, Tartaric, and other acids, by A, Tar &c But these and similar abbreviations are only admissible where a frequent repetition of the extended symbol is required, and where the indication of the elementary components is immaterial

SYNAPTA'SE (Gr συναπτω, *to be present*) A term applied by Robiquet to the *emulsine* or *vegetable caseine* of the almond, in consequence of its necessary *presence* in the conversion of *amygdaline* into hydrocyanic acid and bitter almond oil

SYRINGI'NE A crystallisable bitter principle obtained from the leaves of the lilac tree (*Syringa vulgaris*). It has also been called *lilacine*

**SYSTE'MIC** In Physiology, is applied to designate the circulation of the general system, beginning at the left ventricle and aorta, and ending at the venæ cavæ and [illegible] the circulatio[illegible] pulmonic" They have also been termed the greater and lesser circulations The parts concerned in these circulations have also received the same names thus the left ventricle is called the "systemic" one.

## T

**TABOO** A word used by the South Sea islanders to denote something sacred, or set aside for particular

**TACHYLITE** (Gr *ταχυς, rapid*) A very fusible alumino silicate of protoxide of iron, occurring in certain basaltic rocks Its name has reference to its rapid fusibility

**TAFFO** A manure made in China, composed of night soil mixed up with clay and formed into cakes which are dried in the sun

**TA'GILITE** A native phosphate of copper from Nischne-Tagilsk, in Siberia

**TA'LBOT** A hunting dog, between the hound and beagle

**TA'LBOTYPE** A name given certain photographic pictures in honour of the inventor of the process, Mr W A Fox Talbot *See* PHOTOGRAPHY, in Dict

**TANGHICI'NI** A crystallisable neutral principle said to possess narcotic properties, extracted from the kernel or seed of the *Tanghinia venenifera* a native of Madagascar This seed which is said to be a deadly poison, was formerly used in Madagascar to ascertain the guilt of suspected persons, as a kind of ordeal, those who withstood it being deemed innocent The extract of the seed has been called T[illegible]

**TANSY** *Tanacetum* [illegible] The herb and flowers of this plant used sometimes as a kind of medicinal pot-herb, have a disagreeable though somewhat aromatic odour, and a strong nauseous bitter taste A small portion is sometimes added to omelets, and we have hear[illegible]

**TARAXACI'NE** A crystallisable bitter principle contained in the juice of the root of dandelion (*Leontodon taraxacum*)

**TARNOWITZITE** A carbonate of lime, or species of [illegible] containing a small proportion of carbonate of lead found at Tarnowitz in Upper Silesia

**TAU'RINE** A crystalline substance containing a large proportion of sulphur, and obtained from bile Its formula is $C_4 H_7 O_6 S_2 N$

**TE'BETH** The tenth month of the Jewish ecclesiastical year, and fourth of the civil year It corresponds to December

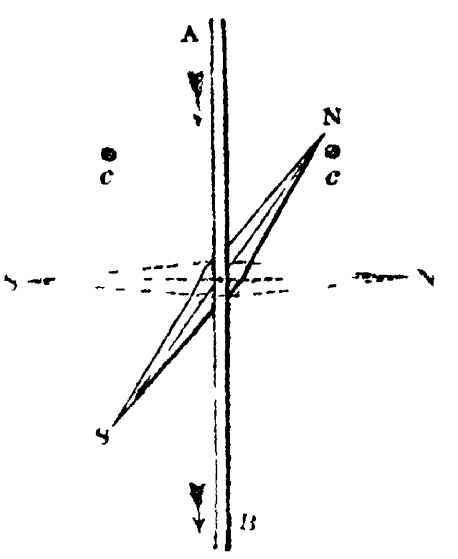
**TE'RRE'NE** A crystalline resinous product obtained from turf

**TELEGRAPH** The Electric or, as it ought more properly to be called, the ELECTROMAGNETIC TELEGRAPH has now superseded all other means of telegraphic communication We purpose therefore here briefly to describe the *principle* upon which these instruments are constructed, referring for minute details to the various works which have been published and to the specifications of the many patents which have been issued upon the subject The mutual relation of electric and magnetic currents will be evident from what has been stated elsewhere under the heads ELECTROMAGNETISM and GALVANOMETER, so that it will only be necessary to recapitulate such circumstances as have especial relation to telegraphic purposes

When a current of voltaic electricity is traversing a metallic wire, a magnetic current is at the same time established at right angles to and as it were revolving about the electric current, as its axis, and if the pole of a magnet be supposed capable of freely moving in any direction, the tendency of such pole would be to revolve about the wire in question, or rather about the electric current which that wire carries If a common magnetic needle turning horizontally upon a point or pivot, be brought near the voltaic current, or to the wire conveying that current, the magnet will accordingly be deflected from its meridian Supposing, for instance, the magnetic needle in its natural position, and pointing therefore north and south, to be approached by a wire transmitting the volta-electric current, held above and parallel to the needle, the deflection of the needle will take place either to the right or left, or to the north or south, the direction of the deflection depending upon that of the electric current, and accordingly the tendency of the magnetic needle will be to place itself at *right angles* to the wire conveying the electric current It thus, then, appears that the electric and magnetic forces may so far be said *to deflect each other* and upon this principle the various forms of the galvanometer are constructed Now, in reference to the application of

and deflecting current, instead of being placed horizontally, as in the galvanometer, is placed *vertically* or perpendicularly, as in the annexed cut in which A B represents a wire having a magnetised steel needle placed immediately behind it, and so adjusted as to hang vertically when at rest If an electric current be now made to descend from A to B through such wire, the needle will be deflected into the position N S, that is, its north

(1)

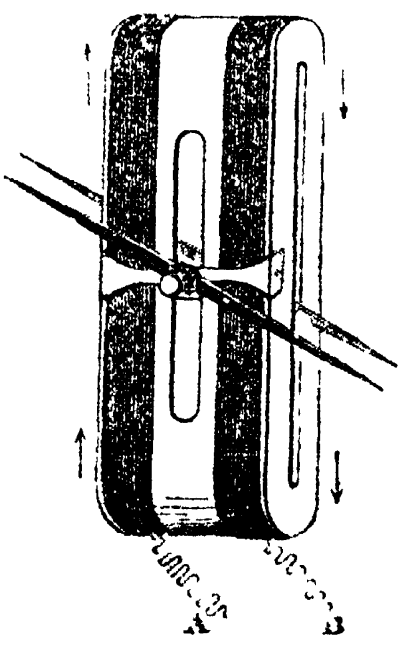



pole will turn to the right as you stand before it, and on increasing the force of the electric current, the deflection of the needle might be so far increased as to cause it to place itself at *right angles* to the electric current, as shown by the dotted figure, but this may be prevented by the small studs c c, by which such extreme deflection is limited If we now suppose the wire to be continued on and bent into the shape of the letter U, the current still passing onwards, that is, down the limb A B and up B C (as indicated by the darts), then the portion of the current B C would also act upon the needle, and proportionately increase the deflection If we now change the direction of the electric current, so as to send it down C and up A then also will the direction of the deviation of the magnetic needle be changed and its north pole, instead of pointing to the right, will point to the left And if by repeated convolutions of the wire, the electric current be made to pass many times around the magnetic needle, the deflection would be still further increased, so that, by the adoption of this latter expedient, or the use of a *coil* instead of a single wire the effect of the electric current may be so *multiplied* as to produce a considerable deflection by a comparatively feeble current This is, in fact the principle of the *galvanometric multiplier*, and is the form of apparatus used in the electric telegraph, as now most commonly constructed The construction of this *coil* is shown in the annexed wood-cut It consists of a polished wooden

(2)




(3)

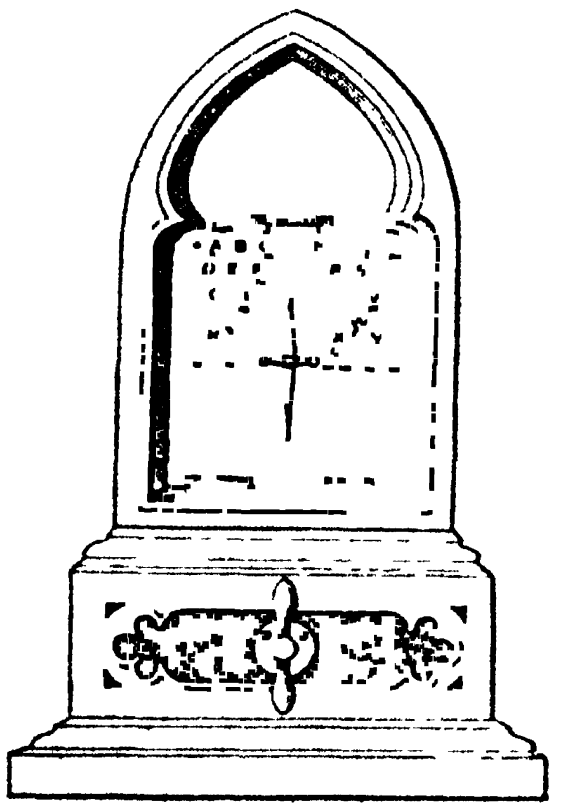



or ivory frame round which are bound some hundred feet of fine copper wire, covered with silk, which, being [illegible] prevents the lateral passage or transfer of the current from wire to wire, so that the current, entering at A, passes through the whole length of the coil, and goes out at B Two magnetic needles are fixed

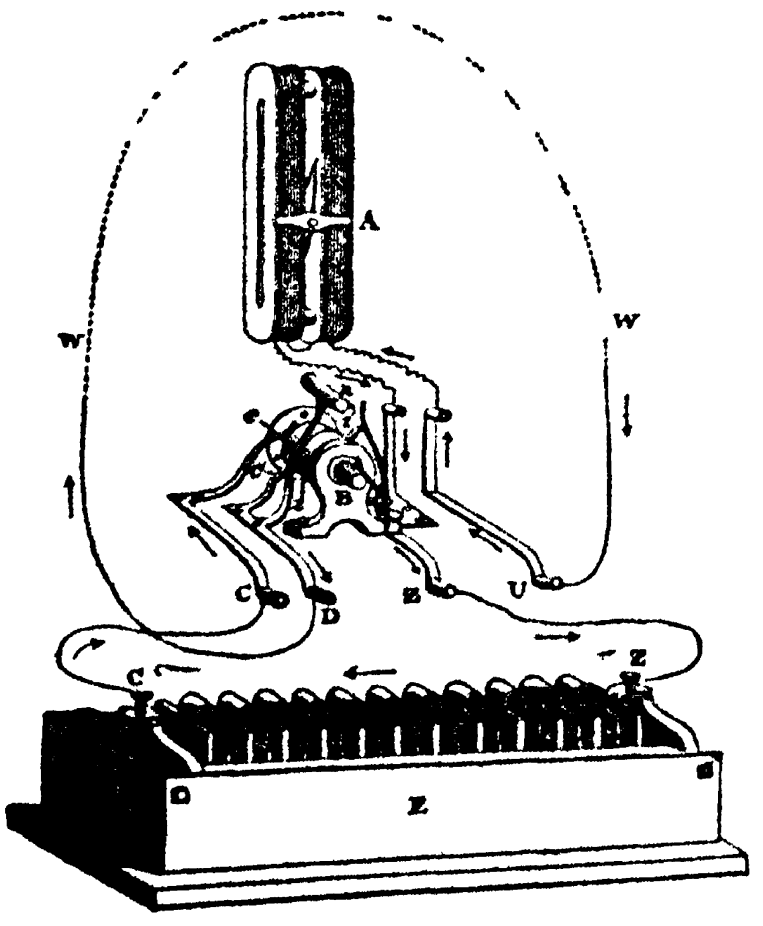
upon an axis which passes through the frame one within, and the other without the coil, the poles of which needles are in opposition to each other, by which they are rendered *astatic*, that is, they are not affected by the magnetism of the earth. This coil is so placed at the back of the dial plate of the telegraph, shown in the next diagrams, as to allow the outer needle to traverse right and left upon the dial plate.

Having said thus much of the *principle* upon which the usual form of the electro-magnetic telegraph is constructed, we may now further explain the details of its simplest form, in which *one* indicating needle only is employed, and which therefore is usually called the *Single needle instrument*. A front and back view of this telegraph is given in the following cuts, the battery being represented annexed to the latter, and the circuit through

(4)



(5)




the galvanometric coil A being completed by the wire W W. The following description of the working of the instrument is abridged from Mr. C. V. Walker's "Electric Telegraph Manipulation," to which we may here refer the reader for a variety of details respecting its construction and uses, which would have been irrelevant in this article.

The instrument has a twofold character: it is either *passive*, or ready for *receiving* signals *from* another instrument, or it is *active*, or ready for *transmitting* signals *to* another instrument. By describing first how it is fitted for *receiving* signals and then how it is arranged for *transmitting* them, we shall be better able to analyse it, and comprehend its structure. The frame of the coil A is screwed upon the face of the instrument, which face is a brass plate varnished on the inner side. Looking at the coil, a short wire from its *right-hand end* comes to a screw terminal, which by a slip of brass, is connected with another terminal U. The *left hand end* of the coil comes also to a terminal, from which a slip of brass descends to a brass plate, here partly hidden, but its form may be seen from a similar plate, visible on the left side. These twin plates are in metallic connection by means of the two upright *springs*, shown in the cut. The *springs* are of steel, and press strongly on two points in a short insulated brass rod *n*, which is screwed into the framework of the instrument. The left-hand plate is connected with the terminal D, also by a slip of brass. If, now, the two terminals U and D are connected by a wire W W, the circuit will be complete, as follows: from the terminal U into the coil at the right-hand side, out of the coil, at the left side, downwards to the right-hand plate, up the right-hand steel spring, across the brass rod *n*, to the left-hand steel spring [illegible] thence [illegible] by the [illegible] W W [illegible] If, now, the wire from U went up the line of railway, and the wire from D down the line, and the circuit were in some way kept complete on the large scale, as it has been here described on the small scale, any electric current passing along the wire from a distant station would traverse this coil in its course, and would *deflect the needle*, and so make a signal.

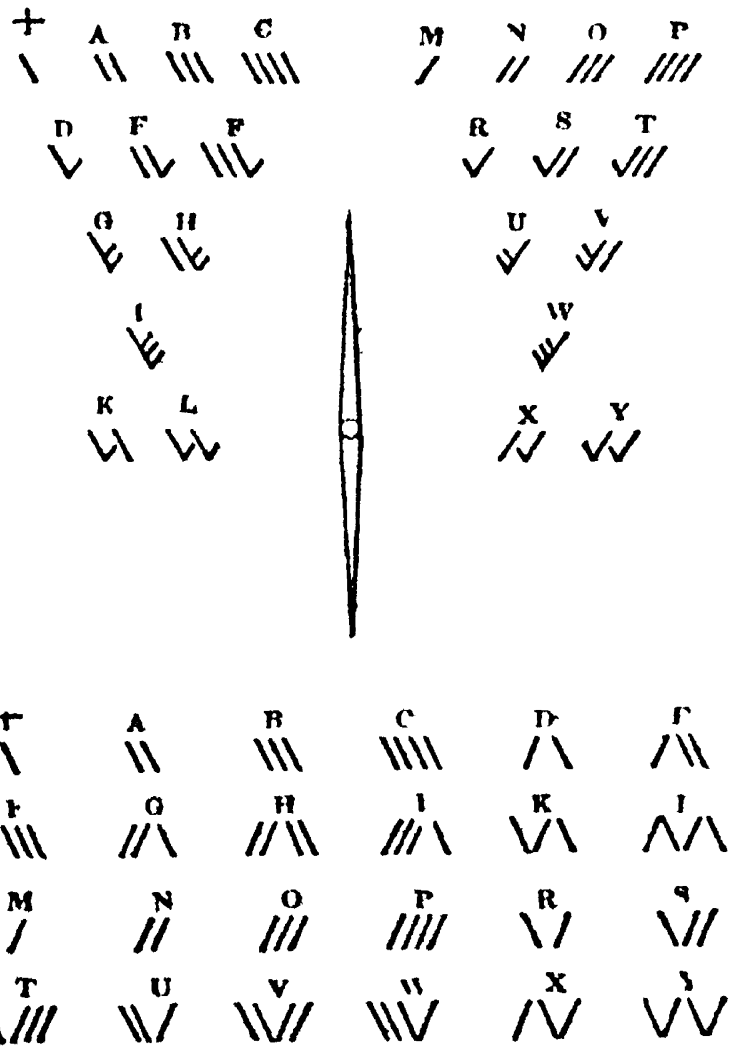
So far for receiving a signal, now for sending one. Were we to go out on the open railway, taking with us a battery, and to cut any one of the wires, and place its two ends, thus obtained, upon the two terminal ends of the battery, a current would pass along the line, and the needles on that line would be deflected, and if we changed hands, [illegible] connections, and [illegible] of the electric [illegible] of the needles would be reversed. The same would happen were we to cut a wire inside the office or inside the telegraph, and to treat it in a similar way. Now, in every apparatus contrived for transmitting signals, we have a *place corresponding to such a cut wire*, and, near this place [illegible] of the battery, mounted and moveable, so that they may be readily applied in the breach, one way or the other as required. The place here (*fig.* 5) is the *top of the springs*. They are not *joined* to the brass rod *n*, but *press hard* upon it, and can readily be raised, and when either of them is raised the circuit is broken. Now near this place is a contrivance, by which the poles of the battery may make a breach in the circuit, and be applied in the breach in either direction. The drum B is of box wood, the ends *c* and *z* being capped with brass and insulated from each other by the wood left between them. The drum is moveable by a handle in front of the instrument, visible in *fig.* 4. A stout steel wire, *c'* is screwed beneath into the *c* end of the drum, and a similar wire, *z'*, is screwed above into the *z* end. These two wires are the poles of the battery, *z'* being connected with the zinc end, and *c'* with the copper, thus — from the copper end of the battery a wire is led to the terminal C, thence a slip of brass leads to a curved brass spring which presses on the drum at *c*, from the zinc end of the battery a wire goes to the terminal Z, and thence a slip of brass leads to a similar curved spring, pressing on the continuation of the *z* end of the drum, as shown in the figure. Whenever therefore, the drum is moved, the steel wire *z'* will lift up one or other of the upright steel springs, it is now lifting up the right-hand [illegible], and so breaks the circuit, but, by a little further motion of the drum, the wire *c'* will press upon the boss below, as shown in the figure, and thus there will be a battery-pole on each side of the breach, and a signal will be made on this, and on all instruments connected with it. And, from the peculiar arrangement of the drum, the motion can be changed as rapidly as the hand can move. I have shown the battery connections exactly as they occur in practice, and the connections are such that if the right hand spring is moved off, the needle moves [illegible] if the left to the left. The needle on the [illegible] instrument always has its north end upward, and the needle within the coil its north end downward, so that, by the law elsewhere stated (*fig.* 1), if we look at the face of an instrument, and see the top end [illegible] the right, we may be sure that in the half of the coil nearest to us the current is *ascending*.

Now, as regards the *front* of the instrument upon which the alphabet is engraved right and left of the needle, it will be obvious, from what has been said above that the manipulator has it in his power to cause the dial [illegible] to vibrate or deflect to the right or left, as he directs the electric current one way or other through the coil, and this direction of the electric current is commanded in the way above described, by turning the handle at the lower part of the instrument to the right or left,

when this handle is *vertical*, the current is altogether cut off

The letters of the alphabet, [illegible] are indicated by the number of [illegible], some of these beats being to the left and some to the right, the general rule being, that in the letters placed to the *left* of the needle the *last* beat to make any given letter is a *left hand* beat, whatever other beats may enter into the production of the letter, thus, L requires four beats, and they are right, left, right, *left*, finishing with the *left*, so, again, the letters placed on the *right* of the needle finish with a *right-hand* beat, as, for instance, W, which is composed of four beats, three to the *left*, and the *fourth* to the *right* The system upon which this single instrument alphabet is formed is sufficiently simple The symbol of each letter is placed underneath it, and consists of one or more diagonal lines sloping either to the right or left, some of which are full length, and others half length, the direction of the diagonal is the direction of the deflection or beat, a deflection being made for each diagonal, the deflection corresponding to the *half length* being made *first* D, for instance, is thus represented \, and is made by a beat to the right, followed by a beat to the left, R is represented by /, and is made by a beat to the left, followed by a beat to the right, H is \\, two to the right and two to the left, W is \\\, three beats to the left and one to the right, and so on The scheme of the code is, one, two, three, and four left-hand beats for the first four signals, then one right-hand and one, two, and three left hand beats for the next in order, then two right-hand and one and two left for the next, then three right-hand and one left, then a left, a right, and a left, and lastly, right and left, right and left, \/\, which reaches L, and comprises the first half of the series The other half are the counterparts, with the beats reversed To render this description more intelligible, we annex a separate representation of the dial alphabet, and a separate alphabet, in which the direction and number of beats for each letter is shown separately

(6)




[illegible] Maltese cross, [illegible] which is termed *stop*, is used by the *sender* of a message *at the end of every word*, and by the *reader* or receiver of the message, when he does *not understand* the previous word On the other hand, a single beat to the *right* (indicating the letter M upon this form of the instrument) implies that he *does understand* When, in this or other form of the needle-telegraph, *numbers* are to be transmitted, which, however, is very rarely necessary in the form of *numerals*, conventional letters and signals are settled upon for the purpose

Our object here is, merely to render the principle of this form of the electric telegraph intelligible, and therefore we have selected the simplest instrument, but at all the principal stations a DOUBLE-NEEDLE INSTRUMENT is employed, and which may in fact be regarded as two single instruments capable of being worked separately or together With [illegible] the reading of the signals is much [illegible] has the inconvenience of requiring a separate line wire for each needle, the signals also are different from those of the single instrument, but the *principle* is in both the same

It is obvious, from the laws which govern the transmission of what we call the *electric current*, that when, by its means, a message is to be sent to any distant station, as, for instance, from London to Dover, there must be a means by which the current may return from Dover to London and this was formerly effected by a separate wire, so that each single telegraph required two wires, one down the line to Dover, and one up the line to London, and a double-needle instrument could only be worked by four wires, by which much expense and occasional [illegible] was incurred But, about the year 1837, [illegible] that the circuit might be completed, or at least that the return-wire might be superseded, by what has been called the *earth circuit*, so that, instead of using *two* lengths of wire, one only is employed for each needle, and the terminal or return-wire of the Dover instrument is connected with the gas and water-pipes of Dover, while the other terminal of the London instrument is similarly connected with the gas and water-mains of London, and, strange to say it is found that this transit by the earth is more perfect, that is, presents less resistance to the passage of the electricity than if a return-wire had been used In cases where there are no large subterranean metallic communications at hand, a hole is dug, in which a copper plate connected with the return-wire is buried, at a sufficient depth to be always in moist earth The annexed cut will perhaps render this statement more intelligible,

(7)




in which the insulated line-wires proceeding from London at L to Dover at D are shown following the line of railway whilst the dotted line between the buried copper plates (or gas or water-pipes at each extreme) shows the supposed direction of the electric current in completing the circuit Every telegraph station is provided with an *earth-wire* There is at present much that is unintelligible respecting this *subterranean current*, the mere fact of the nonconducting power of many rocks and soils in their dry state and their very inferior conducting power even when moist or imbued with water, or indeed of water itself, when compared with metal, are well-known facts, and yet, in the communication we have described, the circuit appears to be quite as complete as if a continuous wire had been used, or even more so To get over this difficulty some have discarded altogether the notion of *conduction* in these cases, and have regarded the earth as a reservoir in which positive and negative electricity are equally and indifferently lost, absorbed, or neutralised, the positive end of the battery freely giving off positive electricity to the earth at London and the negative end giving off negative electricity to the earth at Dover, or *vice versa*, as the case may be

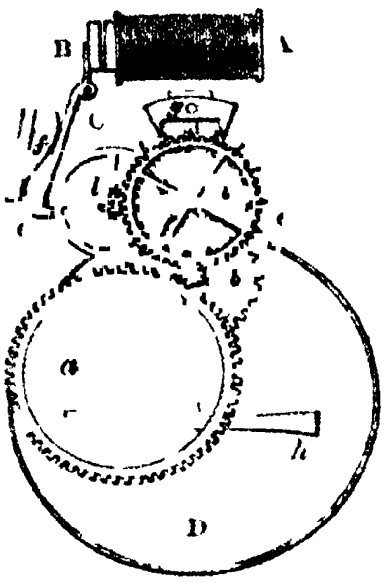
We have now endeavoured to render the principle upon which signals are communicable between distant stations by electromagnetic means intelligible, and have only noticed a few of the appendages, as they may be termed, to the talking part of [illegible]

One of them, and an important one, is the *Alarum* or *Bell-signal*, by which *audible* notice is given from station to station of their desire to talk to each other through the telegraph These bell signals may be either altogether independent of the telegraph, and rung by a separate wire, or they may be rung by the same wire which actuates the telegraph, and which in that case is so arranged that the electric current may be diverted through the bell magnet, or through the telegraph, as occasion may require, and in this case, if we suppose the bell to be in the circuit, its *ringing* announces the wish of the distant station, say of Dover, to communicate with London, then London, on hearing the bell, turns on the current to the bell at Dover, to announce that the signal has been successful, the current is then turned off the bell so on to the needle coils, and the message transmitted in the usual way. When sepa-

rate and independent wires and bells are employed, they are always in the circuit, and may be rung whenever required, for particular purposes the bells may serve as special signals, and when rung once, twice, thrice, and so on, may thus serve to announce something that has happened at the distant station

These *alarums* are rung by means of an *electro-magnet*, that is, a short rod or core of *soft iron*, wound round with a sufficient length of silk covered copper wire, this core becoming a powerful magnet whilst an electric current is traversing its copper coil and returning again to its indifferent or normal state the moment that the electricity ceases to circulate A side view of an *alarum* is given in the annexed diagram A is the elec-

(8)




tro-magnet in front of it is a soft iron keeper B This keeper is attracted by the poles of the electro magnet *every time* a current is made to circulate around it and *as long* as it is in circulation, and attraction ceases the moment the current ceases To prevent the keeper remaining attracted, which sometimes happens, even after the force ceases to circulate, it is prevented *actually touching* the pole of the magnet by two ivory studs or sometimes merely by the intervention of a piece of paper but it is so adjusted that when in its state of rest, it shall be as near as convenient to the poles of the magnet The rest of the figure represents the mechanism by which the bell is rung The keeper B is mounted on the shorter arm of a lever C the other end of the lever terminates in a catch *e* which catches a pin in the circumference of the wheel *d*, and prevents it moving *f* is a slender spring pressing against the long arm of the lever C and by means of which the keeper is restored to its normal position when attraction ceases, and the catch *e* is made to act *a* is a box containing the mainspring, *b* a toothed wheel connected with *a* by a pinion, *c* a toothed-wheel having a pinion working in *b*, *d* the wheel that carries the stop, and connected by its pinion with *c*, *g* is an escapement working in pallets on the wheel *c*, which is on the same axis with the wheel *c*, *h* is the bell hammer It is virtually a short pendulum, its connections and action being quite similar When the voltaic current is made to pass along the wire of the coils A the soft iron core is magnetised, and the keeper B is attracted, this raises the catch *e* and so allows the wheel *d* to move The machinery being thus liberated, the mainspring in the box *a* which is kept wound up, sets it in motion and the pendulum hammer *h* vibrates rapidly and strikes the bell D, which is shown also in section When the magnetisation ceases with the cessation of the current, the catch *e* is pressed into its place again by the reacting spring *f*, and the ringing terminates

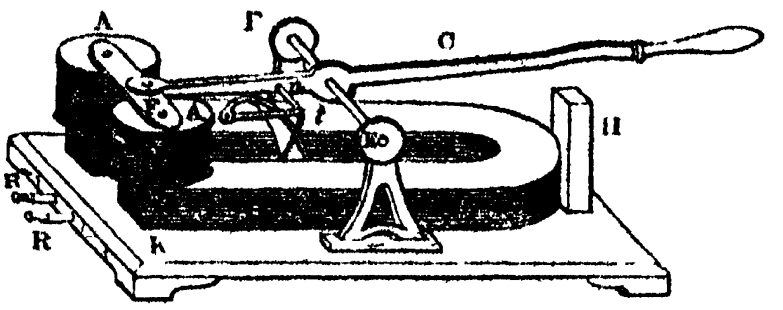
It will be seen from this description, that the alarum is sounded by ordinary mechanism, and that the office of the voltaic force is merely to move a lever and liberate the machinery, whence it is obvious that there is little limit to the amount of noise which may be produced

In some other forms of telegraph the bell instead of being sounded by the detachment of a common ringing escapement is rung by the direct blows of a hammer attached to the keeper of the magnet itself, and there are several modifications of this contrivance, by which a single blow or a continuous ringing may be effected For ringing bells at short distances and in cases where a voltaic battery would be inconvenient, a current of magneto-electricity is substituted, which is most simply obtained by the following form of apparatus — A A are coils (similar to the coils described), the two bars of iron which pass through the coils are connected by their upper ends to a strip of iron F, the lower ends rest on the magnet B, thus they form what is commonly termed a keeper, by connecting the two poles of the magnet, I is joined to a lever C, which is attached to a shaft that





(9.)




works in bearings E F, the spring seen under lever C is for forming a short circuit, N, a small ivory pin for insulating the wire *t*, R R, two terminals, where the wires coming from the coils terminate, H, a block for stopping the entire descent of lever, K is the stand, to which the whole apparatus is firmly fixed As long as the iron bar remains on the magnet, no effect is produced but sharply depressing the lever whereby the iron bars are detached from the magnet, a current of electricity is produced, passing through the coils and [illegible] the bell

TELESCOPE In addition to the explanation of the general theory and mechanism of telescopes given in the body of the work it is thought desirable to give specific accounts of some of those gigantic instruments whose establishment has done so much in the last few years to revolutionise certain preconceived notions in astronomy, and to supply information concerning the nature and existence of celestial objects which were before invisible We propose then to confine ourselves to four of the largest telescopes now in existence, our space not admitting of much detail even for these These telescopes are the large reflecting telescope erected by Lord Rosse in the grounds of his residence at Birr Castle in Ireland, and the three large refracting telescopes at the Observatories of Pulkova, near Petersburg, of Cambridge, [illegible], Massachusetts, U S, and of Cambridge in England

*Lord Rosse's 60ft Reflecting Telescope* — This enormous telescope which has two object mirrors of 6 ft diameter, and is 53 feet in focal length, was begun in 1842 The metal used for the speculum is an alloy of tin and copper in atomic proportions the weight of the copper being something more than double that of the tin The weight of metal in one of the speculums is 3¼ tons, and that of the other 4 tons For fusing these immense masses of metal it was placed in three iron crucibles cast expressly for the purpose each crucible weighing of itself about 1½ tons The crucibles were placed in as many furnaces whose mouths were level with the ground and with flues opening into one common stack or chimney The metal for its complete fusion required to be kept in the furnace about twelve hours, and when it was in the state proper for casting the crucibles were withdrawn from the furnaces by means of a powerful crane to the iron cradles of pouring frames arranged round the mould at intervals of ninety degrees

The mould had for its base a framework of hoop iron six inches in depth placed edgewise, packed in a strong frame and supported by strong transverse bars beneath The upper edges of these were [illegible] into a slightly convex surface of about 1 foot radius and thus formed the base of the mould, allowing the air to escape through the interstices though from the viscosity of the amalgam no particle of it could escape through them The metal also by being poured upon the iron became chilled immediately into a dense sheet of about half an inch thick and thus secured one of the conditions which have been found to be most important, if not indispensable, in the casting of speculum metal After becoming tolerably solid, the speculum was withdrawn to the annealing furnaces where it remained for about sixteen weeks, when it was considered to be ready for the process of grinding and polishing

A full account given by Lord Rosse of the polishing machinery will be found by those interested in this inquiry, in the *Phil Trans* for 1840 It is sufficient to state that the beam carrying the polisher is moved by a small steam engine, by which a rotatory motion round a vertical spindle is given to a crank, which by a connecting rod acts upon a sliding rod that moves the grinder or polisher backwards and forwards By such means the polishers make strokes backwards and forwards very nearly in the manner in which the hand would make them, if the polishing were performed by hand, and at the same time another part of the machinery causes the frame carrying the speculum, and therefore the speculum itself, to revolve with a slow motion We must remark further in connexion with this part of the subject, that it was necessary that the speculum should be cast and polished upon the same fixed frame (distinct from the rotatory frame before mentioned) that would support it when in the telescope For this purpose the fixed frames are provided

with small wheels, by which, after being conveyed in a carriage to a railroad running into the lower part of the tube of the telescope, the speculum is deposited in its proper position for use

For the support of the mirror in such a way as to avoid strain and flexure, a very ingenious system of levers is employed This consists of a combination of three similar systems, resting on three points under the centres of gravity of the three equal sectors into which the speculum may be supposed to be divided Each system consists of one triangle with its point of support directly under its centre of gravity, upon which it freely oscillates [illegible] s three similar points of s [illegible] [illegible] [illegible] under their centres of gravity, and they again at their angles carry in a similar way cast-iron platforms formed of three ribs so as to make a kind of irregular open-work grating supported under their centres of gravity There are thus twenty-seven platforms, which are coated with greased cloth, and upon these the speculum is supported, each bearing $\frac{1}{27}$th part of the weight

The above is the construction first adopted by Lord Rosse But, as the surface of the speculum by the pressure on its edge at different elevations was found to be distorted, instead of the platforms in contact with the back before mentioned, there were adopted eighty-one brass balls capable of revolving freely, that is three at the corners of each triangle, occupying the place of the platform in the former construction

We now come to the mounting of this immense speculum The tube of the telescope is made of wood, and is at the middle about 7 ft in diameter, the interior exceeding 6 ft in every part This is fixed to a cube of 10 feet, which has folding doors in one of its sides for admission of the speculum, and which carries the fixed frame supporting the mirror on that side which is opposite to the mouth of the telescope To this side of the cube is attached a universal joint by which the lower end of the telescope is connected with a fixed support, the joint being a few feet below the general surface of the ground

On the east and west sides of the telescope are immense piers about 70 feet long and nearly 50 feet high, of which the eastern carries a large iron arc of a circle, in which moves a slider attached to a racked bar working by means of a pinion carried by the telescope tube, and the other carries the stairs and galleries necessary for the observers Near the tops of the piers in the east and west plane passing through the universal joint are two cranes with pulleys, over which pass chains attached to the telescope and to the ends of these chains, after they have passed through fixed pulleys in the walls, are attached the counterpoises, weighing about four tons each There is also a contrivance connected with the chains for equalising the action of the counterpoise-weights in different positions of the telescope

By means of the rack and pinion before mentioned the observer is enabled standing near the eye end of the tube, to give a motion in hour angle of about half an hour on each side of the meridian position

At the south end of the piers there are strong ladders, and upon these (assisted by counterpoise) there slides a stage upon which a small observing gallery travels backwards and forwards For great elevations curved galleries are mounted upon the curved slope of the upper part of the western pier carried by beams that run above and below pulleys fixed to the top of the pier, they are run out by rack and pinion work to approach the side of the telescope

A quick motion in declination is given by the windlass below, and a slow motion is given by hand above for measurements the quick motion in right ascension is given also below by a wheel turned by a workman, and the slow motion by hand above The tube is slung by chains and is perfectly steady in a gale of wind

The tube carries at the upper extremity the apparatus for the Newtonian small mirror, which is itself of considerable size and weight, the minor axis of its ellipse being about 6 inches, but Lord Rosse has made provision in the construction of his observing galleries for using it as a Herschelian telescope, if it is found necessary or desirable to obtain an increase of light

In the use of this wonderful instrument Lord Rosse has hitherto chiefly confined himself to the observations of nebulæ Many of these objects previously supposed to be unresolvable have been resolved by the powers of the telescope and a great deal of most interesting information has been already gained respecting their structure The figures of many of these are of a spiral form something like the convolutions of some species of shells 51 Messier and 99 Messier, of which drawings are given in the *Phil Trans* for 1850, are very remarkable specimens of this class The first, which is thickly studded with stars, has a large condensed mass in the centre with spiral curves of variable condensation radiating from it upon the general illuminated mass of the nebula A large condensed mass exists at its right hand boundary Messier 51, whose spiral formation was detected early in 1845, is of a different character, with but few detached stars, but the sweep of its spirals is exceedingly bold and interesting Another class of nebulæ is the *annular*, of which several additional specimens have been detected This class consists of nebulæ in the shape of a ring, and the most remarkable of them is that in Lyra, which the telescope has partially resolved

For drawings of several other beautiful specimens, the reader may consult Lord Rosse's papers in the *Phil Trans* before quoted enough has been said to show in some measure the powers of the telescope, and the grand future which it seems to open for astronomy

O [illegible] [illegible] we give the first place to that at *P* [illegible] [illegible] has a clear aperture of very nearly 15 inches, and its focal length is 22 5 feet The length of that part of the tube between the object-glass and the declination axis is 13 7 feet, and that of the part between the eye-piece and the declination-axis is 9 2 feet The tube is of wood, it is of a conical shape, and the exterior diameter at the extremities are 17 0 inches and 11 8 inches The telescope is furnished with six eye-pieces, whose powers vary from 152 to 1218 and with other eye-pieces, twenty-one in number, belonging to the micrometrical apparatus, with powers as high as 2000

The mounting is that known by the name of the Fraunhofer mounting having the telescope on one side of the polar axis The polar axis is nearly 4 feet in length and the diameter of the horary circle is 18 inches, and is divided to 10″ of time Sidereal motion is given to the telescope by clock work

The instrument was constructed by Messrs Merz and Mahler and is in most respects similar to that erected at Cambridge, Massachusetts, near Boston, U S which we now proceed to describe

The *Cambridge* telescope belongs to the observatory in connexion with the Harvard university It has not been erected many years, but it has already earned considerable fame by the discovery of some comets, of the third ring and eighth satellite of Saturn, and by micrometrical observations of nebulæ of great excellence and importance

The telescope and its equatorial mounting are the work of Messrs Merz and Mahler of Munich The extreme diameter of the object glass is 15½ English inches, the effective aperture barely 15 inches and the focal length 22 ft 6 in The [illegible] [illegible] like the preceding telescope, is that known [illegible] [illegible] that is, the telescope is not in the plane of the polar axis but on one side of it supported near its centre at one extremity of the declination-axis, and counterpoised by a weight beyond the other extremity of the declination-axis The declination-circle is 20 inches in diameter, and is read by four verniers to 1″ of arc, the hour circle is 18 inches in diameter, and is read by verniers to single seconds of time

Sidereal motion is communicated to the telescope by clock-work regulated by the friction of centrifugal balls

It is furnished with nine eye-pieces, whose powers vary from 103 to 1118 and with a wire-micrometer eye-piece and position circle The screw of the micrometer has been severely tested and found to be of sensibly equal value throughout its length

The usual inconvenience attending the reversing of the telescope when an object arrives at the meridian is experienced and the arrangement of the divisions of the hour circle and declination circle is complained of as awkward, the clock-work machinery is also disproportionate to the other parts of the instrument, and requires adjustment frequently, but the optical power of the telescope has excited universal admiration

The whole aperture can be used without injury to the definition, and the disks of stars are remarkably small In measuring double stars powers from 700 to 1200 have been habitually employed On rare occasions, a power of 2000 has shown well the disks of Neptune and of the satellites of Jupiter

With powers of 700 and 800, stars have been separated whose measured distance has proved to be 0″ 3 The satellites of Neptune and the inner and eighth satellite of Saturn are seen steadily, as well as the edge of the ring at what is called its disappearance —(*Description of the Observatory at Cambridge, Massachusetts, by William Cranch Bond*)

The last telescope we propose to describe is that called the *Northumberland Telescope*, at the Observatory connected with our own university at Cambridge

It was the gift of the late Duke of Northumberland when Chancellor of the University, and has acquired considerable [illegible] [illegible] [illegible] successful search after the planet [illegible] [illegible] Before the discovery of Neptune [illegible] [illegible] been observed twice during

the sweep[illegible] tute[illegible] for it, though it was not recognised till afterwards

The object-glass by Cauchoix of Paris, is of 11⅛ inches effective aperture, and the focal length is 19½ feet The mounting is that generally adopted with English equatorials, that is, the telescope is in the plane of the polar axis, and this prevents the disagreeable necessity of reversing the instrument when an object comes to the meridian

The hour circle is 5½ feet in diameter, and is not permanently attached to the polar axis, but can be clamped to or released from the lower iron frame at pleasure There is no declination circle, but its place is supplied by a declination sector, that is, a graduated arc carried by a flat brass bar nearly 6 feet in length turning about a pin fixed in the telescope tube at the distance of rather more than 2½ feet from the axis of revolution of the telescope This serves to measure small differences of declination The instrument is provided with clockwork

The whole of the mounting was performed under the direction of the Astronomer Royal, Mr Airy — (*Cambridge Observations, Airy's Description, Weale's London*, 1851)

TERRA PONDERIS (C[illegible] of clay found in the coal [illegible] It is the *terra miraculosa* and *terra sigillata* of old pharmaceutical authors, and was celebrated for its supposed medical virtues

TERCE-MAJOR In Card-playing, a sequence of the three best cards

TEREBENE A modified oil of turpentine

THOMSONITE A species of *zeolite*, of a peculiar tes[illegible] from Faroe

THEBAINE [illegible]us alkaloid *Strychnia* is sometimes described under this name

THEBAI'A A crystalline alkaloid contained in opium It has also been termed *Paramorphia* It exists in very small proportion

THE'NARDITE A native anhydrous sulphate of soda found near Madrid so named in honour of Thenard the French chemist

THENARD'S BLUE A compound of a splendid blue colour, obtained by heating a mixture of phosphate of cobalt with pure alumina

THEOBRO'MINE A white bitter substance contained in the chocolate nut (the fruit of the *Theobroma cacao*)

THERMONA'TRITE A peculiar species of carbonate of soda, found in the Natron lakes at Lagunilla, in Columbia, in the Macarius desert in Lower Egypt and in the steppes between the Ural and Altai, and is deposited from their water in the warm season According to Haidinger a saturated solution of carbonate of soda at a temperature between 80° and 100°, forms, on slow cooling, crystals of thermonatrite, which differ in form from those of the common carbonate, and contain less water of crystallisation

THIEVES' VINEGAR Called also Marseilles vinegar, and *Vinaigre des quatre voleurs*, is made by digesting rosemary tops, sage leaves, lavender flowers, and cloves, in vinegar this useless preparation was once regarded as an [illegible] plague an[illegible]

THRAUSTITE (Gr *θραυω I break*) A hydrated silicate of iron, which occurs with magnetic pyrites at Bodenmais in Bavaria, it has a resinous fracture and is very brittle

THRIDACE (Gr *θριδαξ lettuce*) *Lactucarium*, called also *Lactucarium* It is the inspissated juice of the common lettuce, which is slightly sedative

TIDE GAUGE The chief improvements recently introduced into tide gauges are exhibited in that constructed by Hewitson, to which reference is made in the DICTIONARY Great pains have been taken in every part of its construction to diminish friction as much as possible The teeth of the wheels are carefully made, so that should the rise or fall of the tide amount to the fraction of an inch only, a simultaneous movement of the machine follows to that amount It is furnished with a brass [illegible] axes of bell metal revolving in V[illegible] the registering pencil moves on steel [illegible] concealed in the capitals of the brass supporting pillars. The machine is connected with an astronomical clock, which needs winding only once in 16 days, or in rather more than half a lunation, and thus produces, without any attention in this [illegible] al curves

TIKOR A [illegible] fecula or starch of certain species of *Curcuma*

TILE ORE An impure oxide of copper of a brick-red colour

TISSUE In animals, the substance of which systems of [illegible] or "osseous tissue," [illegible] or "muscular tissue," in the muscular system, "neurine," or nervous tissue, in the nervous system, "dentine," or tooth-bone, in the dental system The branch of Anatomy which treats of the tissues is termed "Histology"

TODDY [illegible] sap or juice of the cocoa nut palm which is collected in [illegible] or spadix Five or six [illegible] tained from each tree, and it is in much request as a beverage, especially by European troops, but it requires to be drunk early in the day, and quite fresh, for it ra[illegible] powers

TOLIDINE [illegible] obtained by the action of [illegible] nitro-toluide it is a yello[illegible]

TOLUO'LE An oily hydrocarbon obtained by distillation from Tolu balsam Its composition is $C_{14}$ $H_8$

TO'MBAZITE A mineralogical synonym of one of [illegible] kel

TONE [illegible] a degree of firmness and tension in certain soft tissues, [illegible] from flabbiness it is commonly [illegible] in which the "tone" depends on a state of passive contraction, dependent on the connexion of their nerves with the myelon, and which is lost when that connexion, or [illegible] oved

TONKA [illegible]QUIN BEAN The fruit of the *Coumarouna*, or *Dipterix odorata*. It is used as a perfume, especially for snuff, its odour, resembling that of new hay, is derived from a concrete volatile oil which chemists have termed *Coumarin*, or *Tonka Camphor* A similar substance may also be extracted from the flowers of Melilot (*Melilotus officinalis*)

TOUCHWOOD A term sometimes applied to the agaric of the oak (*Polyporus igniarius*)

TOUS LES MOIS An article under this name is sold in London, as a substitute for *arrow root*, it is the starch of the *Canna coccinea* Its particles are admirably suited as objects for the microscope, on account of their large size in other respects they resemble the [illegible]

[illegible] In Anatomy, the term has been applied to that branch which treats of the essential nature and homologies of the parts of the body, and the results of which study seem to be different from or beyond, what would be suggested by the ideas of the parts derived from the outward senses, as when the human blade bone, which to the eye is very different from a human rib, and which is quite distinct from the skull, is seen by the mind to be the rib of the occiput.

TRANSIT CIRCLE A meridian instrument which combines the properties of the Transit Instrument and the Mural circle, that is, which can be employed for determining at the same transit of a celestial object, both its R A and its zenith distance A remarkable instrument of this class was erected at Greenwich, by the Astronomer Royal Mr Airy, in the year 1850, and, from the beginning of the year 1851 all the meridian observations have been made with it It consists mainly of a telescope of 12 feet focal length with an object-glass of 8 inches clear aperture, carrying on each side of its centre a circle of 6 feet diameter The tube of the telescope is of iron cast in four pieces, viz two immense cones at its eye end and object end, and a large central cube in two pieces, having attached to them in the same casts the pivots on which the telescope revolves The cones weigh each about 1¾ cwt, and the central cube with its pivots weighs nearly 8 cwt The two parts of the cube are bolted together on flanges with planed surfaces, as also are the cones to the central cube The surfaces of the pivots were hardened after the casting, by chilling them to a depth of about a quarter of an inch, and were afterwards ground and polished to a true cylindrical form after a great expenditure of time and labour The circles are carried on cylindrical rims on the east and west sides of the central cube The western circle has a *dished* surface of about 3 inches in breadth with its concavity westward, and carries two bands, one on its eastern and one on its western surface, the latter being divided to 5′ of space The eastern divisions are merely given for the convenience of setting the instrument accurately to given objects by means of a pointer, but the western divisions are for the observations of zenith distance For the reading of the circle six long microscopes or lunettes are fixed in the solid stone of the western pier, having their object-glasses arranged in a circle of about 5½ feet diameter on the inner or eastern surface, and their eye-pieces in a circle of about 2 feet in diameter at the back of the piers The centres of these circles are in the same horizontal line with the centre of the telescope, and at the height of 5 feet from the floor The microscopes, whose axes lie in a conical surface, are each 45 inches in length, and their axes are not quite perpendicular to the portions of [illegible] site to them, but are inc[illegible] light thrown through corresponding illuminating holes (cut in the pier) from a central gas lamp shall be reflected truly into them without the aid of specula The error of collimation of the telescope is found by means of two 5 ft telescopes, one to the north and the other to the

south of it, and the error of level is found by the observation of the reflected image of the central wire by means of Bohnenberger's eye-piece, by which means also, together with observations of stars by reflexion, the zenith point is found An apparatus is provided by which the instrument can be lifted at pleasure out of its Y's, so as to be in the same state of strain when elevated as when resting in its Y s The apparatus for carrying the mercury trough, which usually contains about 60 lbs of mercury [illegible] given to it either [illegible] and west direction

For illumination of the wires with a dark field eight prisms are employed Four of these are arranged symmetrically on the reflector, which is placed at the centre of the telescope as usual, but which is movable round an axis and can be acted upon by a rod passing through the tube of the telescope and having its end near the eye-piece, and four are arranged symmetrically in the plane of the wires in the eye-piece By this means, when the field is dark, or the reflector is at right angles to the tube, the light after reflexion by the two sets of prisms is thrown across the field in the plane of the wires, and illuminates them abundantly for observation

The casting and the engineering generally for this instrument was performed by Messrs Ransomes and May of Ipswich, but the dividing of the circles, and all the optical part of it, was performed by Mr Simms The object-glass is also of his manufacture

TRANSIT INSTRUMENT Several improvements, both in application and in construction, have been within a few years made with regard to this admirable instrument The principal new application of it is that by which it is made to determine the latitude of the place of observation, or the zenith distances of stars, by being placed at right angles to its ordinary position, that is with its line of collimation lying in the plane of the prime vertical A large instrument of this class has been recently erected at the observatory of Pulkova, and it serves to determine with admirable precision the zenith distances of stars which pass near the zenith of that observatory, and M Struve considers its use to be of extreme importance in the ulterior investigations connected with aberration, precession and nutation

Mr Simms produced at the Great Exhibition of 1851, a specimen of a *double transit instrument* that is, of an instrument which might be used with equal facility when placed in the meridian and in the prime-vertical This is effected by making the axis of the telescope itself convertible into a telescope by having an object-glass fitted into one of the pivots and a sliding-tube carrying an adjustible cross of delicate spider-lines with a positive eye-piece at the other pivot. The adjustment of the axis-telescope is effected by a small collimator placed in a line with the axis The axis is turned round, and the position of the wire-frame is shifted till the centre wire coincides with the mark equally well before and after reversion If the meridian telescope be previously adjusted, it can be made use of for readily placing the axis telescope in its proper position for the determination of latitude by means of the transits of stars which pass the meridian near the zenith

Another kind of transit instrument lately brought into use is the *diagonal* or *chamber transit* The peculiarity of this instrument is, that the rays tending to form an image of a star after [illegible] object glass, do not proceed in [illegible] the tube in the usual way, but being received upon a speculum or prism placed in the axis are turned aside through one of the axes, which is perforated and provided with an eye-piece and a system of wires By this means the inconvenience of placing the body in awkward positions for the observations of stars so much felt in the use of small transits is avoided, and the observer has no occasion to shift his position, whatever be the altitude of the star to be observed Mr Simms has succeeded in providing convenient means for the illumination of the field of view of the diagonal transit by the following method — The back pivot being also perforated has a small convex lens set within it, and a larger convex lens is fixed within the axis at the back of the reflector, of such a size that one or [illegible] project beyond the edge [illegible] lamp placed outside the [illegible] lens, and the rays after crossing diverge upon the large lens at the back of the reflector, whose outer segments again condense it upon the field of view in sufficient quantity to produce a well illuminated field

The last improvement we shall mention is the *prism illumination* of the field of view of transit instruments It has always been a difficult problem for practical astronomers to provide for the observation of very faint objects, for which it is necessary to have the field of view dark and the wires illuminated Various means, attended with only partial success, have been devised in different observatories, the most successful of which was till recently the application of the galvanic current. Mr Airy applied for the first time the *galvanic illumination* to the great transit circle at Greenwich in the year 1850, and this method was [illegible] instruments, and [illegible] thods A pierced reflector is placed as usual in the central part of the axis of the telescope, but this, instead of [illegible] the telescope-tube near the observer's hand If the rod be pulled out to its full length, the reflector stands at its usual angle of 45°, and the field is [illegible] by the lamp placed at the axis By pushing in the rod the reflector is made to stand more nearly at right angles to the tube, and less light is thrown down the tube, and by this means the light is *moderated* Finally, when the reflector is at right angles to the tube, no light passes down it to the eye, but in this case the prism-application [illegible] placed [illegible] perpendicularly The light, reflected from their hypothenusal sides, and passing [illegible] their remaining sides is made to [illegible] sides of the tube It is then finally received upon other four prisms placed properly in the plane of the wires of the telescope, so as to be transmitted entirely in that plane, and to illuminate perfectly both sides of the vertical wires, and the upper and under sides of the horizontal wires This process has been used with perfect success for a considerable time for the illumination of the wires of the Transit Circle at Greenwich

TRI'CLA'SITE (Gr [illegible] A mineral found in the ta [illegible] lum, regarded as a species of *Iolite* it has a *three-fold* cleavage

TRIPE The stomachs of ruminants, when properly prepared constitute *Tripe* Dr Thomson, in his *Domestic Management of the Sick Room*, says, "few things are more [illegible] than tripe, when properly cooked" It should be slowly boiled, with an onion and some salt

TRI'PLITE (Lat triplex *three-fold*) A mineral composed of phosphoric acid in combination with the oxides of iron and manganese, which occurs with beryl in the granite of Limoges, in France

TRI'PTOTE (Gr τρεις, *three*, and πτωσις, *a case*) In Grammar, a noun that has only three cases

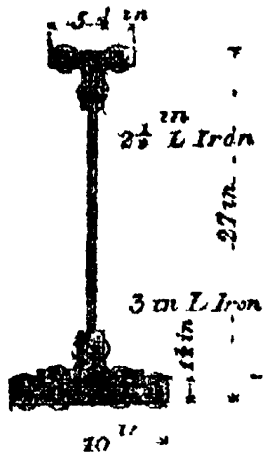
TRO'MBOLITE Native phosphate of copper

TU'BULAR BRIDGE A bridge formed of a great tube or hollow beam, through the centre of which a roadway or railway passes The most remarkable bridge of this kind is that designed by Mr Robert Stephenson for carrying the Chester and Holyhead railway over the Menai Straits This bridge consists of two rectangular tubes of wrought iron plates riveted together, one tube being for the accommodation of the up line of rails, and the other for the accommodation of the down line of rails A pier erected upon a rock in the middle of the straits divides each tube into two spans of 462 feet each and there is also at each end a smaller tube of 230 feet span to serve as approaches to the bridge These several tubes are joined together so as to form one long tube for each line of rails of the total length of 1524 feet

The thickness of the central pier is 45 feet, of the side piers 32 feet each and the tube projects 17 feet 6 inches over the masonry at each end The bridge contains 9480 tons of wrought iron, 1988 tons of cast iron, and 1 500,000 cubic feet of masonry The total expense of its construction was 601,860*l*, of which the iron work cost 443,160*l* and the masonry 158 700*l* It was commenced on the 10th of August, 1847 was finished on the 5th of March, 1850, and was opened for traffic on the 18th of March, 1850 A similar bridge of one length of tube and of a somewhat smaller span had been previously erected, under Mr Stephenson's direction, over the river Conway on the same line of railway This bridge was opened for traffic in 1848

*History of Tubular Bridges.* — On the occasion of an entertainment given at the opening of the Conway bridge in 1848, Mr Stephenson gave an account of the circumstances which had led to the conception of the plan of carrying a railway over a river or chasm by employing as a bridge a hollow beam or tunnel constructed of iron plates About six or seven years before he had been called upon to construct a bridge on the Northern and Eastern Railway at Ware under certain limitations imposed by act of parliament which rendered bridges of the ordinary forms inapplicable, and he thereupon resolved to employ malleable iron beams, by the aid of which a cellular platform was made which answered the exigencies of the occasion In this cellular platform however there does not appear to have been much novelty of conception, for it was merely an arrangement of beams of the ordinary form of railway girders, and the

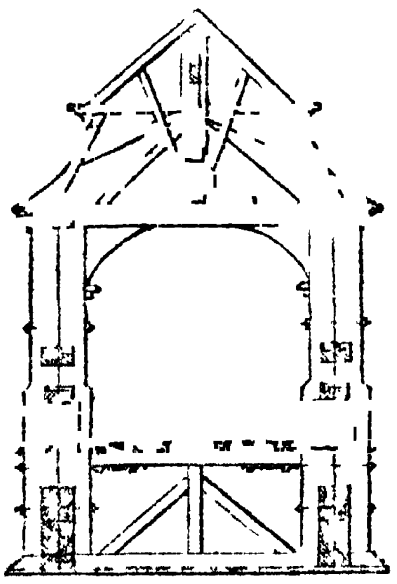
(1)




only peculiarity of these beams was that they were made of wrought iron instead of cast iron as had been the previous practice They were proportioned moreover in the same manner as cast-iron beams, as will be seen by *fig* 1, whereas malleable iron beams it is now known should have the top and bottom flanges of about the same dimensions However, from the suggestions of this structure, the idea of a tubular bridge first arose in Mr Stephenson's mind, and in his original conception he contemplated the use of elliptical or cylindrical tubes supported by chains Mr Stephenson's engagements did not permit him to work out this idea or to put it into such a practical form that he would have himself had confidence in carrying it into execution He therefore called in the aid of Mr Fairbairn to accomplish this task, and Mr Fairbairn taking up the idea where Mr Stephenson had left it, pursued the inquiry with great ardour and sagacity until he finally brought the idea into the form in which it was carried into practical effect

I [illegible] ever a form of bridge much [illegible] finally adopted for crossing [illegible] Mr Stephenson's cellular platform at Ware, or even than his subsequent conception of an oval or cylindrical tube supported by chains, had been successfully introduced in Switzerland, but the bridges which had been erected upon this plan, instead of being made of wrought iron were constructed of timber The first of these bridges appears to have been erected over the Rhine at Schaffhausen by Jean Ulrich Grubenmann in 1757 It consisted of two spans — the one of 170 feet and the other of 193 feet In 1778 another bridge of a similar construction was built by the same person over the Limmat at Wettingen The span of this bridge was 390 feet *Fig* 2 is a section of this bridge at the ends, and

(2)



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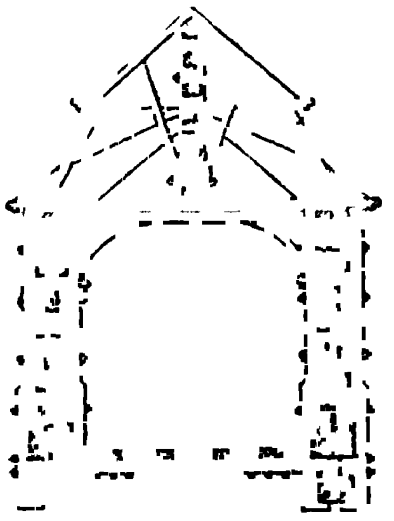


*Fig* 3 is a section at the centre It will be apparent from these figures that this bridge is composed of a platform for the roadway two side frames of carpentry, and a roof, so that it in fact constitutes a great hollow timber beam of a nearly rectangular form These bridges were both burnt by the French in 1799, after having remained in constant use the one for forty two years and the other for twenty-one years Armies, artillery, and heavy weights, had passed over them in safety, and they appear to have perfectly fulfilled the purpose for which they were designed Each of the side frames was raised into its place in a piece by means of powerful screw jacks resting on piles

Subsequently to this time lattice bridges came into considerable use in America These bridges consist of two [illegible] a platform which forms the roadway, and in some cases the top is also covered with lattice work so as to convert the bridge into a hollow lattice beam In a few cases these lattice bridges were formed of iron, and in Boston there is an elliptical tubular lattice bridge of iron of 120 feet span This bridge had been in use a few years before the construction of that cellular platform at Ware which Mr Stephenson says first suggested to his mind the idea of a tubular bridge Lattice bridges formed of bars of iron have of late years come into use in this country A singular phenomenon has been observed in some of these bridges The centre of the bridge instead of sinking, has actually risen up when the bridge has been put into its place

[illegible] upon the best mode of carrying out Mr Stephenson's idea occurred to Mr Fairbairn upon whom this responsibility now devolved, that the most judicious course would be to institute a series of experiments to determine the breaking weight of beams or tubes of different forms with the view of ascertaining what form of tube would reconcile the greatest amount of strength with the least quantity of material, and also what load a tube of [illegible] given dimensions could with safety [illegible] riments were accordingly instituted, and they speedily furnished information of great practical importance It was very soon found that oval and cylindrical tubes were not of so eligible a form as rectangular ones, and it was further found that in rectangular tubes the strength should be chiefly concentrated at the top and bottom and in nearly equal proportions It also occurred to Mr Fairbairn that it would be advisable to make the top and bottom of the tube of a cellular form which would obviate the necessity of using plates of such a thickness as could not be so securely riveted and this construction it was anticipated, would also impart greater stiffness to the structure, and render the top less liable to buckle up when a heavy strain was applied The determination of the rectangular form of these bridges the rejection of the chains, the introduction of the cellular structure of the top and bottom, and the settlement of all the details of the iron work, was unquestionably the work of Mr Fairbairn but it does not follow that Mr Stephenson was unequal to the determination of these particulars or that if his other engagements had enabled him to perform the experiments which were judged necessary, instead of delegating them to other hands, a result equally satisfactory would not have been attained However, the existing form of tubular bridge, as carried into execution for crossing the Conway river and the Menai Straits is certainly quite as much Mr Fairbairn's creation as it is Mr Stephenson's, since Mr Fairbairn settled the form, established the proportions arranged all the details of construction, and set the first tube in its place

*Experiments to determine the best Form of Tube* — The first experiments were made upon cylindrical tubes formed of iron plates, riveted together like the chimney of a steamboat The tube experimented upon was laid horizontally between two supports, and a small hole was cut in the centre of its lower side to enable a rod of iron to pass through from this rod of iron the weights employed to ascertain the strength were suspended, around the hole a collar was riveted so as to impart as much strength to that part of the tube as before the perforation had been made, and a cushion of hard wood 8 inches square was fitted to the interior of the tube above the perforation Through this piece of wood the rod which carried the weights ascended and a cutter passing through the end of the rod rested on a square plate of iron superimposed upon the wood, so that from the wooden cushion the whole weights depended Many of the tubes gave way by tearing at the riveting of the plates, but some also broke from the compression at the top The more important results of these experiments are exhibited in the following tables —

STRENGTH OF CYLINDRICAL TUBES USED AS BEAMS

| Number of Experiment | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| External diameter | 12 18 in | 12 in | 12 4 in | 18 26 in | 17 68 in | 18 18 in | 24 in | 24 3 in | 24 2 in |
| Length between supports | 17 ft | 17 ft | 15 ft 7½ in | 23 ft 5 in | 23 ft 5 in | 23 ft 5 in | 31 ft 3¼ in | 31 ft 3¼ in | 31 ft 3¼ in |
| Thickness of plates | 0 0108 in | 0 037 in | 0 131 in | 0 0582 in | 0 0631 in | 0 1190 in | 0 954 in | 0 119 in | 0 98 in |
| Weight of tube | 102 lbs | 107 lbs. | 392 lbs | 531 lbs | 346 lbs | 777 lbs | 1,007 lbs | 1 385 lbs | 1,005 lbs |
| [illegible] | 0 39 in | 0 65 in | 1 29 in | 0 56 in | 0 71 in | 1 19 in | 0 63 in | | |
| [illegible] | 3,040 lbs | 2,701 lbs | 11,440 lbs | 6,100 lbs | 6,100 lbs | 14 [illegible] | 1, [illegible] lbs | | [illegible] s |
| [illegible] extension | Compression | Compression | Extension | Extension at rivets | Extension at rivets | [illegible] at rivets | [illegible] at rivets | [illegible] at rivets | [illegible] at rivets |

The thickness of the plates in these experiments was ascertained by cutting a portion of the plate into small pieces and screwing these pieces together in a vice The collective thickness was then accurately measured, which divided by the number of pieces gave the thickness of each It appears probable that the whole of the tubes would have been broken by compression, but for the weakening of the bottom caused by the rivet holes and which generally produced fracture by extension in that part

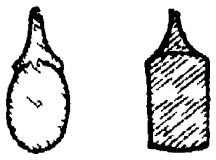
The ends of the tubes where they rested upon the supports had to be kept in shape by circular pieces of wood inserted into them When these pieces of wood were withdrawn, the ends were flattened horizontally At the same time the centre of the tube was flattened vertically by the action of the weight hanging at the under side, and in looking endways at the tube the two sections ma[illegible], the ends forming the horizontal [illegible], and the centre the vertical part

The following are the results of the experiments made with elliptical tubes —

STRENGTH OF ELLIPTICAL TUBES USED AS BEAMS

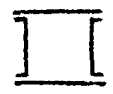
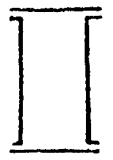
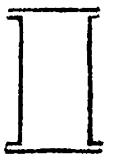
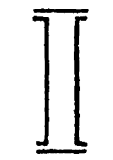
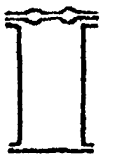
| Number of Experiment | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Major axis | 14 625 in | 21·66 in | 21 25 in | 15 in | 12 in | 13 in |
| Minor axis | 9 25 in | 13 50 in | 14 125 in | 9 75 in | 7 5 in | 8 in |
| [illegible] | 17 ft. | 21 ft | 21 ft | 17 ft 6 in | 18 ft 6 in | 18 ft 6 in |
| [illegible] | 0 0416 in | 0 1310 in | 0 0688 in | 0 143 in | 0 0733 in | 0 064 in |
| [illegible] | 109 lbs | 708 lbs | 357 lbs | 374 lbs | 232 lbs. | 267 lbs |
| [illegible] | 0 62 in | 1 35 in | 0 45 in | 1 45 in | 0 95 in | 1 14 in |
| [illegible] | 2,100 lbs | 17,076 lbs | 7,714 lbs | 15,490 lbs | 6,867 lbs | 8,812 lbs |
| Broke by compression or extension ? | Both | Extension | Compression | Extension | Compression | Compression |

(1) (5)



Numbers 5 and 6 of the foregoing experiments were not made with simple elliptical tubes, but the tube employed in number 5 was an elliptical tube with a fin at the top (*fig* 4), and the tube employed in number 6 was more of a rectangular form with a fin at the top (*fig* 5) These top fins were not found to operate advantageously, as they were thrown into compression before the strain came on the top of the tube [illegible] was thus overcome in detail [illegible] of the experiments, however, are those upon rectangular tubes, the results of which are as follows —

STRENGTH OF RECTANGULAR TUBES USED AS BEAMS.

| No of Experiment | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Form of Cross Section |  |  |  |  |  |  |  |  |
| Top flange inches | 12 by 075 | 12 by 757 | 12 by 142 | 12 by 119 | 12 by 269 | 6 by 260 | 10 by 260 | 2plates 115each |
| [illegible] | 12 by 0743 | 12 by 142 | 12 by 0757 | 12 by 269 | 12 by 119 | 10 by 260 | 6 by 260 | 180 |
| [illegible] | 9 6 by 0743 | 9 6 by 0757 | 9 6 by 0757 | 18 2 by 0594 | 18 2 by 0594 | 15 by 131 | 15 by 131 | 15 40 by 070 |
| [illegible] supports | 17 ft 6 in | 17 ft 6 in | 17 ft 6 in | 17 ft 6 in | 17 ft 6 in | 24 ft | 24 ft | 19 ft |
| Weight of tube | 202 lbs | 2 2 lbs | 2 2 lbs | 317 lbs | 317 lbs. | 788 lbs | 788 lbs | 500 lbs |
| [illegible] | 1 12 in | 0 91 in | 1 88 in | 1 03 in | 1 13 in | 2 66 in | 2 8 in | 1 59 in |
| Breaking weight | 3,738 lbs | 3 788 lbs | 7 118 lbs | 6,812 lbs | 12,188 lbs | 17 600 lbs | 15,920 lbs | 22,469 lbs |
| Broke by compression or extension | Compression | Compression | Extension at rivets | Compression | Compression | Compression | - - | Compression |

These experiments having been concluded and a few others of a similar character, which it would be needless to recapitulate, Mr Fairbairn directed his attention to the determination of the proportions which it would be proper to adopt for the tubular bridges which it was proposed to construct It was made very clear from the experiments, that the rectangular form was the best, and that the strength should be chiefly concentrated at the top and bottom of the tube, where the extending and compressing forces would act with greatest energy and where they must be met The proportion of the sectional area of the top to that of the bottom to give the maximum strength, was also found to be as 5 to 3 in the case of thin rectangular tubes It was also made clear that the strength of a tubular beam would be increased if the buckling or crumpling up of the top side could be prevented and it was known from previous experiments of Mr Hodgkinson upon cast-iron pillars, that a given quantity of metal would better resist compression if disposed in a tubular form than if disposed in any other form Hence it occurred to Mr Fairbairn, that the compressing strain upon the top of the tube would be more effectually counteracted by dis[illegible] the form of longitudinal tubes than he form of a flat plate The tube [illegible] top, tested in the eighth experiment upon rectangular tubes, was made in pursuance of this idea, but eventually it was determined to form the top of the bridge of a series of parallel rectangular tubes or cells, chiefly because that form was more convenient in [illegible] better admitted of painting and repa[illegible] of the tube it was considered advisable to make in the same fashion, and these points being settled, a model tube was constructed, which was nearly identical with one of the tubes of the intended bridge in every thing but size The model tube was 78 feet long, and 75 feet between the supports; 4 feet 6½ inches deep at the middle, and 4 feet 0½ inches deep at the ends It was 2 feet 8 inches wide in the body, but the cellular top was somewhat wider, being 2 feet 11½ inches wide, and the bottom, w[illegible] six longitudinal channels formed by seven vertical plates 6½ inches deep running longitudinally from end to end of the tube and having a plate above and another below them extending through the whole length and breadth of the top The thickness of the plate of the bottom of the model tube was 156 inches of the sides 099 inches, and of the top 147 inches The sectional area of the top was 24 024 square inches, of the sides 9 square inches, and of the bottom 8 8 square inches The weight of the tube was 4 86 tons Its ultimate deflection was 4 375 inches, and its breaking weight 35½ tons The tube gave way by tearing asunder at the bottom

The top plates of the tube having been made a little thicker than was intended, two strips of plate 20 feet long, 6½ inches wide, $\frac{5}{16}$ths of an inch thick, and weighing about 4 cwt were riveted along the bottom of the tube at the centre part The ultimate deflection then became 4 11 inches, and the breaking weight 43 3 tons In this experiment the tube got out of [illegible] To obviate this evil for the future, [illegible] iron were riveted along the sides of the tubes internally at distances of 2 feet apart, and the tube having been repaired was again subjected to experiment The ultimate deflection was now found to be 5 68 inches, and the breaking weight 56 3 tons As, however, in this experiment the fracture occurred, not at the centre of the tube, but at some distance to one side, where the plates were weak, a final experiment was made with the plates decreasing in thickness from the middle according to the proper law The tube then broke by compression of the cellular top with a weight of 86½ tons

*Mode of Determining the Dimensions proper for the Menai and Conway Bridges* —The strength of any beam larger or smaller than a beam of any given size, but which is increased or diminished proportionally, varies as the square of the alteration of its linear dimensions, or more nearly as the 1 9th power in the case of tubular beams whereas the weight varies as the cube of any linear dimension A beam, therefore, of twice the length, depth, and thickness of any given beam, will be about four times as strong and eight times as heavy Taking the weight of the model tube upon which the

foregoing experiments were made at 6 tons, the distance between the supports at 75 feet, and the breaking weight of the tube at 60 tons, Mr Fairbairn calculated that a tube of 400 span, such as was intended to carry the railway over the Conway river, would bear a load of 1704 tons exclusive of its own weight For since the span of 400 feet is 5 33 times greater than that of the model tube, then $5.33^2 \times 60 = 1704$ tons and the weight of the tube will be $5.33^3 \times 6 = 906$ tons Now a given load distributed equally over a beam produces nearly the same strain upon it as half the load applied at the centre or more correctly the ratio is as 5 to 8 Taking the half of 906 or 453 from 1704 we have 1251 tons as the actual load which Mr Fairbairn considered that the tube would bear exclusive of its own weight

*Mode of Computation by Hodgkinson's Formula for Cast iron Beams* — Some years before the formation of the Britannia and Conway bridges, Mr Hodgkinson had ascertained the form of cast-iron beams which gave the greatest strength with the least material, and by the formula derived by Mr Hodgkinson from these experiments Mr Fairbairn found that the model tube would bear about 20 tons if it were of cast-iron But it actually bore 56 3 tons in one of the experiments of which the result was not the best, and introducing this correction into the formula, it appeared that a tube six times larger than the model tube, and therefore of 450 feet span, 27 feet deep and with 460 8 square inches of sectional area of iron at the bottom, would bear 2018 tons exclusive of the weight of the tube itself The results obtained by calculating the [illegible] squares and the weights as the cubes of [illegible] do not differ materially from the foregoing, and Mr Fairbairn calculated that a tube of 462 feet span 31 feet deep and 460 square inches of area at the bottom would bear [illegible] tube to weigh 1200 tons the breaking weight when the load was applied at the middle, would be 1869 tons, exclusive of the weight of the tube itself Now a tube which will carry 1869 tons at the centre, exclusive of its own weight will be reckoned carry about twice this amount, or 3738 tons, equally distributed over it exclusive of its own weight, and taking the maximum load to which the bridge would be subjected at one ton per lineal foot, it followed that the bridge, when thus proportioned, would bear eight times the load that could ever be put upon it One of the tubes of the Conway bridge when completed was tested in the same manner as the model tube by placing weights upon it and observing the deflections The result was found to confirm the accuracy of the deductions derived from the experiments upon the model tube The law followed by the deflections appeared to show that the tube would sustain a load of 2200 tons equally distributed over it and exclusive of its own weight, before it broke, and that the ultimate deflection would be 30 inches

*Mr Hodgkinson's Experiments* — Besides the experiments made by Mr Fairbairn, a [illegible] nts upon tubular beams was made [illegible] at Mr Stephenson's desire and from these experiments results were obtained of great interest in a scientific point of view Mr Hodgkinson found that the strength of tubes to resist compression varied greatly with the thickness of the metal of which they were composed Thus, when the plates composing a tube, compressed in the manner of a pillar, were [illegible] 272, and 124 inch, the resistances per square inch of section were 19 17, 14 47 and 7 47 tons respectively Mr Hodgkinson also found that the power of plates to resist compression varied as the cube, or, more nearly, as the 2 878 power of their thickness He further found that long continued impact upon a tubular beam of small size, producing a deflection of less than one-fifth of what would be required to injure the tube by pressure, was completely destructive of the riveting In [illegible] the inertia of the mass will, by [illegible] pact, prevent [illegible] He also [illegible] of similar tubular beams was as the 1 9th power of their linear dimensions Mr Hodgkinson further made a series of experiments to ascertain if the thickness of the plates of a tubular bridge might be diminished towards the ends, as indicated by theory, and he found that such was the case The thickness of the plates of the top, bottom, and sides, at any point, was therefore made in the proportion of the rectangle of the segments into which the distance between the supports of the tube was divided at that point, the tube itself being of uniform dimensions throughout, but at and near the supports the thickness was half that of the middle A further experiment was made to ascertain how far the effect would be advantageous to stiffen tubular beams with cast-iron applied at the top, and it was found that 10 square inches area of cross section of cast-iron at the top of the beam balanced 21 square inches of cross section of malleable iron at the bottom of the beam, proving that the cast-iron would resist compression more efficiently than the wrought. These investigations, however, though highly important, did not materially influence the configuration of the Conway and Menai bridges, the proportions of which were mainly settled by Mr Fairbairn from his experiments upon the models before already described Experiments were also made both by Mr Fairbairn and Mr Hodgkinson to determine the strength of tubular beams when laid upon their sides The purpose of this investigation was to determine the lateral strength to resist storms blowing on the side of the tube, and it was found that the proportions and strengths proper for resisting the vertical strains would also give a lateral strength more than sufficient to withstand any storm to which the tube could be exposed

*Comparative Strains caused by Stationary and Moving Loads* — In proportioning iron beams or girders to bear any given load the prevailing practice among engineers has heretofore been to give a strength adequate to carry three times the load if the load be stationary, and twice that strength, or a strength adequate to carry six times the load, if the load be a moving one At the time the Conway and Menai bridges were constructed the precise effect upon iron bridges of [illegible] pressures [illegible], and concussions consequent upon the passage of a railway train, was by no means accurately known, but since that time those relations have been investigated by a [illegible] the purpose, and it was one of [illegible] what increase of the statical pressure upon an iron beam or bridge would occasion the same strain as a given velocity of the load It is clear that this relation once determined the statical pressure is all that has thenceforth to be considered, and the question of the strength proper for all kinds of constructions is consequently narrowed to the determination of the strength necessary to withstand a certain statical strain, which is greater in an ascertained proportion than that due to the intended maximum load

*Effect of Momentum on the Deflection of a Beam* — If a load be placed upon any long or slender beam propped up in the middle, and the prop be suddenly withdrawn so as to allow deflection to take place it is clear that the deflection must be greater than if the load had been gradually applied For the momentum of the weight, and also of the beam itself falling through the space through which it has been deflected, has necessarily to be counteracted by the elasticity of the beam, and the beam will therefore be bent momentarily to a greater extent than what is due to the load, and after a few vibrations up and down it will finally settle at that point of deflection which the load properly occasions It is obvious that such a beam must be strong enough not merely to sustain the pressure due to the load, but also that accession of pressure due to the counteracted momentum of the load, and of the beam itself, and this increased strain is produced in the case of all beams to which a deflecting weight is applied, but is most material in those in which a large and rapid deflection takes place A rapid deflection increases the amount of the deflection as well as the amount of the strain, as is seen in the cylinder cover of a Cornish pumping-engine, into which the steam is suddenly admitted, and in which the momentum of the particles of the metal put into motion increases the deflection to an extent which the mere pressure of the steam could not produce

*Effect of Deflection on the Amount and Position of the Strain* — If a railway train moving at a high rate of speed be made to descend a steep declivity, the pressure of the wheels upon the rails will obviously be diminished, and if the motion of the train be supposed to be very rapid and the declivity very great, the wheels will leave the rails altogether, and the train will advance after the fashion of a projectile In like manner, if a rapid train ascends a steep acclivity, the pressure of the wheels upon the rails will be increased Now a beam bent by a passing train forms both a falling and rising plane, and on the first half of the beam the strain will be less than what is due to the load, and on the second half of the beam the strain will be greater than what is due to the load The maximum strain therefore, and consequently the maximum deflection, will not be at the centre of the beam, but at a point somewhere between the middle and one end In order to remedy this inconvenience the beams of a railway bridge should be made with a slight rise in the centre, so as to form a straight line when deflected by [illegible]

*Law of [illegible] consequent upon Deflection* — The momentum of any moving body being proportional to the square of its velocity, it follows that in the case of a railway train deflected either sideways or upwards by a curve or incline, the strain will be proportioned to the square of the amount of motion in a new direction given in any specified time, or with any given velocity of the train the strain will be proportional to the square of the amount of the deflection which [illegible] or horizontal plane in [illegible]

[illegible] — The mass of matter

in a beam first resists deflection by its inertia, and then promotes deflection by its momentum, but whether in practical cases increased mass without reference to strength or weight will, upon the whole, increase or diminish deflection, will very much depend upon the magnitude of the mass, relatively [illegible] the deflecting pressure, and the [illegible] pressure is applied and remove[illegible] weight be very suddenly applied to the middle of a ponderous beam, and be as suddenly withdrawn the inertia of the beam will, as in the case of a collision of bodies, tend to resist the force, and thus obviate deflection to a considerable extent, but if the pressure be so long continued as to produce the [illegible] to the force, the effect of the [illegible] increase the deflection The mass must, under such circumstances, move through a space equal to the deflection, whereby a momentum will have been acquired that will afterwards expend itself in increasing the deflection By far the severest strains, however, to which railway structures are habitually exposed arise from the jerks and concussions caused by the imperfect juncture of [illegible] it to withstand such shocks much better than it could otherwise do A large inertia compels the train to deviate from the horizontal plane to an extent answerable to the difference of weight of the striking and stricken bodies so that if the bridge be heavy it will, under such circumstances, be less deflected, and consequently will suffer a less serious strain

*Law of the Elasticity of Iron Beams* — A bar of iron is usually regarded as a very stiff spiral spring, and it is supposed that it will be compressed or extended equally by equal increments of pressure This law, however, though nearly true for malleable iron, is not true for cast-iron The compressions and extensions of a bar of cast-iron one inch square, and of any length were found by Mr Hodgkinson to be represented by the following formulæ —

$$\text{For the extension, } w = 13934040\frac{e}{l} - 290743200\frac{e^2}{l}$$

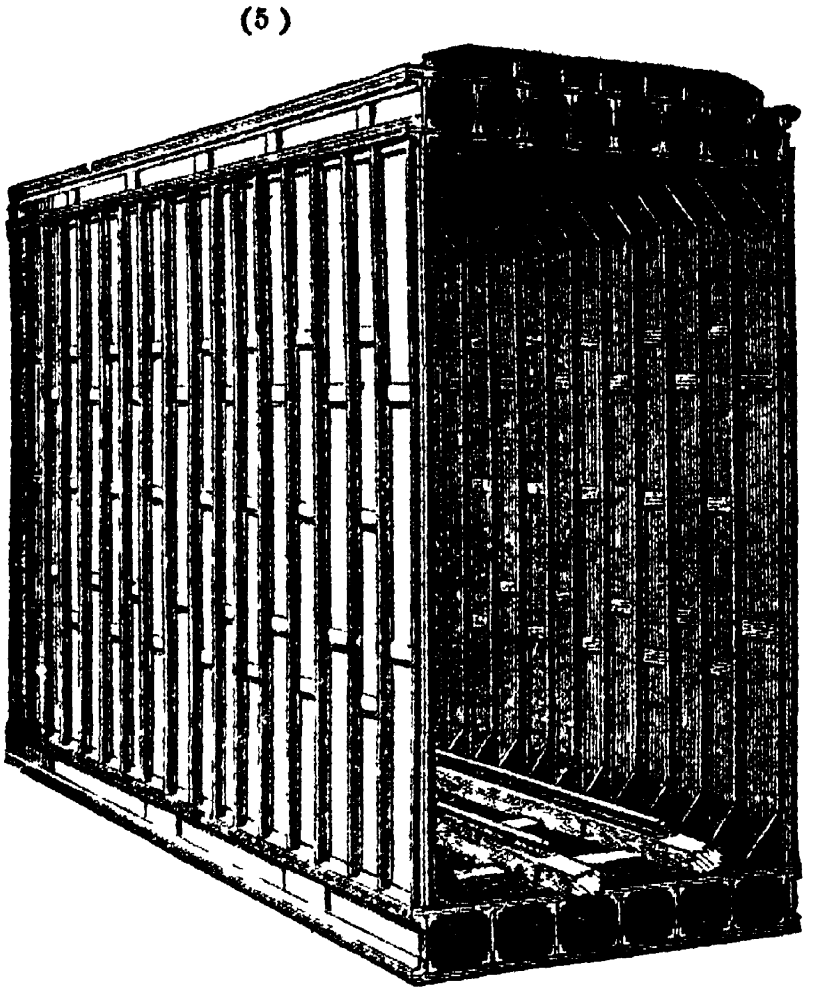
$$\text{For the compression, } w = 12931560\frac{d}{l} - 522979200\frac{d^2}{l^2}$$

Here $w$ is the weight in pounds acting upon the bar, $e$ the extension, and $d$ the compression in inches, and $l$ the length of the bar in inches Iron beams alternately deflected and released will be broken in time with a much less strain than that necessary to produce speedy fracture Thus it has been found experimentally, that cast-iron beams deflected by a revolving cam to only half the extent due to their breaking weight will, in no case, withstand 4000 successive deflections, but 4000 successive deflections through one-third of the distance due to their breaking weight may be incurred without visible injury Looking, however, to the various jolts, vibrations, and concussions to which railway structures are exposed, it does not appear that even a strength answering to six times the breaking weight gives an adequate margin for safety in the case of cast-iron beams

*Proportions to be observed in the Construction of Tubular Bridges* — The sectional area of the bottom of a tubular bridge of wrought iron plates should be to the sectional area of the top, as 11 to 12 The breaking weight is then found by multiplying the total area by the depth, by a constant [illegible] and dividing by the length The depth of tubular beams of 150 feet span should be about $\frac{1}{13}$th of the span, and the depth of tubular beams of 300 feet span should be about $\frac{1}{17}$th of the span These rules are empirical but [illegible] to the most approved [illegible]

*Description of the Britannia and Conway Tubular Bridges* — Having now indicated the manner in which the proportions and configuration of these bridges were arrived at, and having further pointed out the considerations which should influence the design of all railway bridges composed of iron beams, whatever be the subordinate features of their construction, it will be proper to describe briefly the more important features of the Britannia and Conway bridges as they at present stand The annexed figure represents a portion of one of the tubes seen in perspective There are two tubes in each bridge one for the accommodation of the up line, and the other for the accommodation of the down-line Each tube is rectangular, formed of plates of iron riveted together and with ribs to support the sides, like the ribs of a ship The most remarkable feature of the construction, however, is the cellular top and bottom In all beams which have to be loaded in the centre, it is proper to concentrate the strength as much as possible upon [illegible] at the top and bottom, and in [illegible] this is done by building upon the top and bottom a number of square pipes or pillars joined laterally together, and running from end

(5)



to end of t[illegible] T[illegible] pes sustain a force of [illegible] extension, and the function of the sides of the tube is merely to keep these combinations for meeting compression and extension in their proper places The sectional area of the top and bottom of the tubes may easily be computed by taking the width of each tube, which is 14 feet 8 inches, and the thickness of the plates, but in the model tube, which gave the best results, the sectional area of the top was to that of the bottom as 24 to 22, and this is the proportion commonly employed There are eight cells or pipes composing the cellular top, each 1 foot 9 inches square The plates composing the top of the Britannia bridge are, $\frac{12}{16}$ths at the middle of the bridge, and $\frac{10}{16}$ths at the ends of the bridge The ends of the plates are carefully abutted together, and strips of iron are riveted over the joints The bottom is composed of six cells or pipes, each 2 feet 4 inches by 1 foot 9 inches, and the upper and lower platforms by the introduction of partitions between which the cells are constituted, consist each of a double thickness of plates so arranged that the end of each plate comes to the centre of the other as shown in the accompanying figure A small plate covers each joint, and as it was important not to weaken the bottom of the tube by the rivet holes running across it, the rivets are arranged in longitudinal rows, each a considerable distance from the other, and they act as copper [illegible]dy-pins in keeping the plates [illegible] By this expedient the longitudinal [illegible] the bottom is better maintained, and the strength of each tube approximates to what it would be if formed out of a solid piece of iron, instead of being built up of riveted plates The thickness of the plates forming the upper and lower platforms of the bottom is $\frac{9}{16}$ths at the middle of the tube, and $\frac{7}{16}$ths at the ends The vertical plates are, $\frac{9}{16}$ths at the middle, and $\frac{8}{16}$ths at the ends The sides of the tube are, $\frac{8}{16}$ths at the middle of the bridge, increasing to $\frac{10}{16}$ths where the bridge rests upon the piers, for as the ends of the tube have to sustain the whole weight, they require to be made very strong and stiff to retain them in shape To impart increased stiffness at the ends of the tubes strong cast iron frames are introduced within them, and an arrangement of rollers is put beneath the ends of the tubes to enable the metal of the tubes to expand or contract with changes of temperature

(6)



The tubes of each bridge were built in the same manner as an iron ship, adjacent to the place where they had to be erected A wooden platform or quay was erected upon the shore, upon which a tube was built, and stone supports were subsequently erected at the ends, upon which the tube when completed was made to rest The

timber platform was then cleared away, so as to enable a number of boats or pontoons to be floated beneath the tube, and these rising with the tide lifted the tube The floating mass was then drawn by ropes across the stream, and the ends of the tubes were rested in shelves left in the masonry of the piers on which the tube had to be sustained On the top of the piers hydraulic presses were set, from which chains descended to the ends of the tubes and by putting these hydraulic presses into operation the tube was raised up a small distance and so soon as it was raised sufficiently above the shelf the intervening space was built up Another lift was then taken, and so on, the masonry following up the tube as it ascended, until it reached the level of the top of the piers In the Britannia bridge there are four spans, and the tubes of each span are joined together at the ends so as to form one long tube for each line of railway The effect of thus joining the ends of the tubes is virtually to diminish the span, for the tube takes a contrary flexure where it passes over the piers, and if a line be drawn down the side of the tube where this contrary flexure is made it will be found that the tube might be cut through at that point without weakening it at all

*Chepstow Tubular Bridge* A tubular bridge of a construction very different from that of the Conway and Britannia bridges has been erected by Mr Brunel for carrying the South Wales railway over the river Wye, at Chepstow This bridge has a nearer resemblance to a suspension bridge than to a hollow beam, but instead of the heads of the towers being tied back by chains, as is usual in suspension bridges, they are kept asunder by cylindrical struts of wrought iron, and rods descend from the tops of the towers which are also of iron, to support the platform of the bridge The limits of this article, however, prevent any detailed description being given of this bridge and of other tubular bridges which have been constructed since the Conway and Menai bridges were projected (For further information on the subject see Mr Fairbairn's *Account of the Construction of the Britannia and Conway Tubular Bridges* and the *Report of the Commission appointed to inquire into the Application of Iron in Railway Structures*)

TURGITE A compact reddish brown mineral composed chiefly of oxide of iron, found in the Turkish Islands in the Ural

TURNBULL'S BLUE A modification of *Prussian Blue* It is a *Ferridcyanide of Iron* its ultimate components are 5 atoms of iron, 12 of carbon, and 6 of nitrogen

TURNER'S CERATE This is the *calamine ointment* of the Pharmacopœia. The modern zinc ointment prepared with oxide of zinc and hogs lard is a good substitute for it it is a mild drying ointment

TURNER'S YELLOW The fused oxichloride of lead, in fine powder it is the basis of a good yellow oil colour formerly much used in coach-painting it is also called *patent yellow* and *Cassel yellow*

TURPETH MINERAL The yellow subsulphate of mercury so called from its yellow colour which resembles that of the root of the *Ipomæa* or *Convolvulus Turpethum*

TYMPAN (Lat) A part of a printing-press on which the blank sheets are placed

TYROLITE A native arseniate of copper found at Falkenstein in the Tyrol

TYROSINE A crystalline substance obtained from cochineal.

## U

ULLMANNITE A sulphuret of nickel, antimony, and arsenic from Siegen analysed by Ullman

UMBILICAL CORD In Anatomy, the cordlike portion of the teguments of the abdomen, including the vessels which pass from the fœtus to the placenta in placental mammals, or to the allantois and vitellicle in implacental mammals birds and reptiles, or to the vitellicle alone in plagiostomous fishes In other fishes, in batrachians, and in most invertebrates, the vitellicle is sessile, and there is consequently no umbilical cord

UMBILICAL VESICLE The name given to the proportion of the small vitellicle, or yolk bag, in man and most mammalia

USNINE A substance extracted from different lichens of the genus *Usnea* It forms yellow and very difficultly soluble crystals, fusing like a resin It has slightly acid characters and forms crystallisable compounds with the alkalies hence it has also been called *Usnic acid* Its ultimate composition is represented by the formula $C_{38}$ H - $O_4$

UTERINE (Lat uterus) In Anatomy, that which appertains to the womb, as the uterine arteries, veins, nerves, and the uterine portions of the placenta or cotyledon

UTERUS (Lat) The womb, or the muscular and vascular part of the efferent canal or tract in the female viviparous or ovo viviparous animal, in which the fœtus is developed In the human subject and quadrumana it is single, in many quadrupeds it is bifid, in some, it is completely divided into two symmetrical uteri

UTRICULUS (Lat) In Anatomy the term is applied to the upper and larger of the two divisions of the vestibular portion of the membranous labyrinth of the internal organ of hearing

UVIC ACID (Lat uva, *the grape*) A synonym of the *Racemic* or *Paratartaric acid*, an acid isomeric with the tartaric, but differing from it in certain respects, more especially in its relations to polarised light

## V

VACCINIC ACID A name given by Lerch to a peculiar volatile acid which occasionally replaces the butyric and caproic acid in butter

VALERIANIC or VALERIC ACID This acid constitutes the leading ingredient of the volatile oil obtained by distilling valerian root with water It may also be obtained from the root of *Angelica*, so that it has been called *Angelicic acid*, and it is contained in the bark of the *Viburnum opulus* Lastly, valerianic acid is artificially formed by the action of a mixture of quick lime and caustic potassa, on the oil of potato spirit, the *fusel oil* of the Germans the *hydrated oxide of Amyle* of modern chemists The formula of this acid is $C_{10}$ $H_9$ $O_3$+HO It is an oily colourless liquid, smelling intensely of valerian, and of a sour pungent, and nauseous taste, leaving a sense of sweetness, and a white spot upon the tongue

VALONIA The cup of a large species of acorn imported from the Levant and the Morea, and largely used by tanners

VARLC The impure carbonate of soda, made in Brittany it is also sometimes called *Blanquette* it corresponds to our *Kelp*

VASODENTINE (Lat vas, *a vessel* dens *a tooth*) In Anatomy, that modification of dentine in which capillary tracts of the primitive vascular pulp remain ossified and carry red blood into the substance of the tissue They form the so called vascular or medullary canals, and are usually more or less parallel in their course A large proportion of the central part of the tooth of the sloth and megatherium consists of vasodentine, and a smaller proportion of the same part of the tusks of the elephant and of the scalpriform incisors of the rodents

VAUQUELINITE The native double chromate of lead and copper named in honour of Vauquelin, the late celebrated French chemist

VEDETTE or VIDETTE (Fr from Lat video, *I see*) A sentry placed on an outpost or elevated point, so as to be able to observe advantageously the approach of an enemy and to give early notice of his movements

VEGETAL (Lat vego *to flourish*, vegetus, *lively*) In Physiology that class of vital phenomena common to plants and animals viz digestion and nutritive assimilation, growth, absorption, secretion, excretion circulation respiration, generation, as contradistinguished from a second class of vital phenomena, viz sensation and volition peculiar to animals the first are called the 'vegetal functions," the second "the animal functions," and the powers or forces on which they depend have been termed respectively the 'vegetal life' and the 'animal life"

VENA PORTÆ (Lat) In Anatomy, the great trunk formed by the union of the veins from the abdominal organs of digestion, which trunk ramifies, after

VENICE WHITE A pigment consisting of carbonate of lead mixed with sulphate of baryta *Dutch White* and *Hamburgh White* are similar mixtures

VENTRAL (Lat venter) In Anatomy, the parts or the aspect of the region of the belly the plates of the vertebral or serous layer of the embryo that are extended towards that region are called "the ventral laminæ"

VERANDAH A term of Eastern origin applied to a lig lars, and In England verandahs are frequently met in villas and cottage residences attached to sitting rooms on the ground floor, where they afford a good substitute for a colonnade, and provide shelter against rain and sun

VERATRIC ACID An acid contained in the seeds

of *Veratrum sabadilla*, hence also so called *sabadilla acid* Its formula is $C_{34}H_{11}O_{10}+HO$

VERGERS Officers of the courts of law who carry white wands before the judges There are also vergers attached to cathedrals and collegiate churches, who carry a small mace or rod tipped with silver before the clergy

VERGE'TTE In Heraldry a pallet, or small pale A shield divided by pales is said to be *vergetté*

VERMICE'LLI (Ital) A paste of wheat flour in the form of worms, varying in thickness from the smallest cord to the diameter of a quill It is also cut into ribbands and other forms, and is then called *Italian paste* It is made by forcing the paste through small apertures in an iron plate, which is done by a powerful screw press The most glutinous varieties of wheat are those which yield the finest flour for this manufacture

VERMICULITE (Lat vermis, *a worm*) A fine scaly talc composed of micaceous plates cemented together by a whitish matter, it is a hydrated bisilicate of magnesia, oxide of iron, and alumina When heated to redness it projects out with a vermicular motion as if it were a mass of small worms Hence the name

VE'RMIFORM (Lat vermis, and forma, *shape*) In Anatomy, certain parts that are convoluted and shaped like a worm are so called, as, *e g* a hollow process or prolongation of the intestinum cæcum, a part along the middle of the upper and under surfaces of the cerebellum

VERST A Russian measure of length containing 3500 feet, about three-fourths of an English mile

VE'RTEBRA (Lat verto, *I turn*) The term, restricted, in Anthropotomy to certain moveable portions of the segments of the skeleton of the trunk, is now applied, in Anatomy, to the entire segment, which consists, in its typical state, of a "centrum," "two neurapophyses" and a 'neural spine,' two "hæmapophyses" and a "hæmal spine" and two 'pleurapophyses" The principal processes of a vertebra, which are usually exogenous, are, the 'parapophyses," the 'metapophyses," the "hypapophyses," the "diapophyses," the "anapophyses," and the "zygapophyses" The endoskeleton of the vertebrate animals consists of a series of such segments or vertebræ, some of which may support a pair of [illegible] and two pairs of such are usually [illegible]

VESICA'TORIN *Cantharidin* The blistering principle of *Cantharides, Lytta, Mylabris*, and other blistering beetles *See* CANTHARIDES, in DICT

VESPERS (Lat vesper) Evening service in the Roman [illegible]

VESTA [illegible] ame given to one of the small planets between the orbits of Mars and Jupiter It was discovered by Mr Hind, at Mr Bishop's observatory, in the Regent's Park, on the evening of the 13th of September, 1850, in the constellation *Pegasus*, and is the twelfth of the group in the order of discovery Its brightness is somewhat greater than that of some of the others, being equal to that of stars of the eighth magnitude Mr Hind selected as the symbol of the new planet a star and laurel leaf, emblematical of the Goddess of Victory (*Monthly Notices of the Royal Astronomical Society*, vol xi) *See* PLANET

VILLIARSITE A mineralogical name of one of the hydrated silicates of magnesia

VILLI (Lat villus, *wool*) In Anatomy, the name given to minute vascular processes covering, in the proportion of about twenty-five to every square line, the surface of the mucous membrane of the small intestine and giving it a velvety or fleecy appearance They promote the absorption of chyle from the completely digested food Similar minute vascular processes of the chorion and other membranes are called "villi"

VIOLINE An emetic principle contained in the root of the *Viola odorata*, or common violet

VIRGINIC ACID A name applied by Quercenne to one of the acids contained in the rattlesnake root of America (*Polygala Senega*) It is a volatile fatty acid, of a disagreeable odour and taste

VISCERA (Lat viscus *a bowel*) The contents of the three great cavities of the body the brain, *e g* is the viscus of the cranium, the heart one of the viscera of the thorax, and the stomach one of the abdominal viscera The term is usually restricted to the organs of the thorax and abdomen, for the myelon is as much entitled to be called a viscus of the spinal canal, as the encephalon a viscus of the cranium The hæmal arches of the cranial vertebræ have been called "visceral" in the embryo, [illegible] visceral clefts"

VITELLICLE [illegible] The bag which is developed around the food-yolk, or that part of the yolk which has not been converted into the germ-mass and embryo it is chiefly formed by a development of the inner layer of the germinal membrane, the constricted part at which it is continued into the wall of the intestinal canal is called the "vitelline duct" In man and mammalia the vitellicle is called the "umbilical vesicle"

VITTIE VAYR The Tamool name under which perfumers sell the fibrous roots of the *Andropogon muricatum* they contain an agreeable odorous oil The *oil of lemon grass*, and the *grass oil of Namur*, are obtained from other species of [illegible]

VIVIANITE A native [illegible] which occurs in beautiful crystals at [illegible] Cornwall

VOLTAITE. A species of *iron alum*, which occurs in black octaedral crystals in the Solfaterra of Puzzuoli. Named in honour of Volta

VOLTZITE A native oxisulphuret of zinc, found at Rosiers, in the department of Puy de Dome named after Voltz, the engineer of the mines

VOMICINA A name given by some pharmaceutical chemists to the alkaloid more usually termed *Brucia*, obtained from the bark and seeds of the *Nux vomica* and from *St Ignatius' bean*, it is usually associated with *Strychnia*

VORAUITE A mineralogical name of the ferromagnesian phosphate of alumina, found near Vorau, in Styria It appears to be a species of *blue-spar*, or *Lazulite*

VULCANITE A mineralogical synonym of the pyroxene, or volcanic garnet

VULGATE (Lat vulgatus *made public*) The Latin translation of the Old Testament which is as highly reverenced in the Roman Catholic church as the original itself, and from which the texts and other portions of Scripture used in the liturgy are taken The translation earliest in use was commonly called "Itala," and made from the Septuagint [illegible] a new one from the original Hebrew [illegible] two translations were, in after times, intermingled and the Vulgate is composed partly of each *e g* the Psalms are in the old or Italic translation The Vulgate is declared authentic, and appropriated to the use of the church, by the Council of Trent

## W

WAFERS Adhesive discs for securing letters or sticking papers together Common wafers are punched out of a paste made of very fine flour which is pressed between two heated plates of smooth iron Transparent wafers are made of films of isinglass or gelatine, dried upon plate glass, and punched out of various forms and sizes Wafers are coloured with various materials, but care should be taken that these are not, as is often the case, of a poisonous nature The wafer makers are very [illegible]

WAGNERITE [illegible] magnesia from Herpen, in Salzburg

WARD'S PASTE A quack medicine, of which *pepper* is the active ingredient, and which has obtained some celebrity as a remedy for piles, and for fistulæ and abscesses about the rectum Its efficacy is said to depend upon the gentle stimulus which it gives to the affected parts, and severe cases of piles are sometimes relieved by it The *Confection of black pepper* of the *London Pharmacopœia* which is a mixture of powdered black pepper, elecampane root, fennel seeds, honey, and sugar, is intended as a substitute for this remedy

WART A thickening and induration of the cuticle, which is elevated in different forms They frequently wear away by abrasion, and may be removed by caustic applications amongst which nitrate of silver, and acetic or [illegible] employed

WASH [illegible]

WATERING OF SILKS This is a process to which silk and some other woven fabrics are subjected, with a view of giving a peculiar appearance to their surface, as seen by reflected light it is generally done by passing the goods, in a damped state, between rollers, some of which are variously indented or engraved sometimes the appearance depends upon the pressure of one fold of the stuff laid transversely or diagonally upon another, and powerfully pressed between plain revolving

WATER-PROOFING The process by which textile fabrics are rendered impervious to water This is most perfectly effected by means of caoutchouc, which is applied in various ways, but there are other substances, and among them some of the earthy soaps, which are more or less effective, such, for instance, as a mixed solution of soap and alum, to which some gelatine [illegible] occasionally added

WEBSTERITE The native subsulphate of alumina, from Newhaven on the coast of Sussex named in memory of Webster, the geologist

**WEN.** A term commonly applied to fleshy and other tumours, more especially when they affect the face or neck

**WHOOPING COUGH** *Chincough*, or *Kincough* A disease characterised by a convulsive cough, accompanied by a peculiar sonorous or whooping inspiration, and returning by paroxysms which are usually terminated by vomiting It is infectious, and most commonly attacks children, seeming to depend upon a specific infectious or contagious matter, and affects the same individual only once It usually comes on with slight febrile symptoms, hoarseness and common cough, and in about a week the paroxysms attacks ensue The fit is terminated by expectoration of mucus, or vomiting of the contents of the stomach, after which the patient returns to his usual pursuits, and generally expresses a desire for food, except in very severe cases, where lassitude and fainting ensue and often bleeding from the nose and headache The disease is of very variable duration, but generally goes off gradually after having lasted for some weeks The dangerous cases are those in which the head is much affected, or which are accompanied by bronchitis The treatment consists in obviating irritation, keeping bowels open, giving nauseating medicines, and perhaps an occasional emetic and in full habits blisters and leeches may be resorted to Sedatives or narcotics, carefully administered, are often of the utmost service, especially hemlock, henbane, or even opium, in conjunction with squills and ipecacuanha. Opiate and stimulating liniments applied to the chest and to the region of the spine are also frequently resorted to A mixture of cochineal and carbonate of potash has by some been considered as almost a specific in the treatment of this disorder The relics of the cough, which are often very tedious and obstinate, are best re

**WI[illegible]** [illegible]ralogical synonym of the native silicate of zinc

**WINCING MACHINE** The reel by which the dyer winds various articles through the dyeing vat or copper

**WINTER-GREEN** The *Chimophila umbellata* This plant, under the name of *Pipsissciva*, was first used medicinally by the aborigines of America The infusion of the dried leaves is tonic and diuretic It has been found useful in some chronic affections of the urinary [illegible]

**WINTER'S BARK** The bark of the *Drimys Winteri*, or *Wintera aromatica*, a large forest tree growing in Chili, Peru, and New Granada, and which was first brought to England by Captain Winter, who accompanied Sir Francis Drake, in 1578, to the Straits of Magellan, where he obtained his specimens It is found in the market in large quills or rolled pieces of a dull yellowish grey colour, an aromatic odour, and warm pungent flavour It was at first confounded with *Canella bark*, which it much resembles in appearance and flavour, but its inner surface is reddish brown, whereas that of canella is much paler, and solution of sulphate of iron gives a precipitate in its infusion, but not in that of canella Canella is the bark of the *Canella alba*, a large tree growing in the West Indies and America

**WITCH MEAL** A popular name given to the pollen or powder sold in the shops under the name of *Lycopodium*, procured from the *Lycopodium clavatum*, or *Club moss* It contains a large quantity of oily inflammable matter, and when thrown into the flame of a candle produces a sudden flash or blaze, whence it is theatrically used for imitating [illegible] It has also, from its yellow colour, been [illegible] *sulphur* In pharmacy it is used for enveloping pills to prevent their adhesion, and for which, being tasteless and inert, it answers well, and better than magnesia, which is us[illegible] or that purpose

**WITHAMITE** A mineral discovered by Witham in [illegible] porphyry of Glencoe It ap[illegible] alumina

[illegible] *na*, or *Woad plant*, yields by the fermentation of its leaves a blue colouring matter resembling indigo It is the *Pastel* of the French

**WOHLERITE** A crystallised mineral containing tantalic acid, zirconia, and silica, found embedded in the zircon-sienite, near Brevig, in Norway Analysed by Scherer, and named in honour of Wohler, the eminent chemist

**WOLCHITE** A[illegible] and antimony found [illegible] mines at Wolch, in the Lavant [illegible]

**WOLFSBANE** [illegible] called also *Monkshood* [illegible] In small [illegible] quantities it is virulently poisonous, its most characteristic effect being the production of tingling and numbness, vomiting, contracted pupil, failure of the circulation, and occasional convulsion The root has sometimes been [illegible] and has led to fatal results It has been medicinally used with great success in some obstinate cases of *tic douloureux*, or *neuralgia* Its powers are ascribed to the presence of the alkaloid *aconita*

**WORM BARK** The bark of the *Andira inermis* or *Cabbage bark tree*, of the West Indies It is cathartic, emetic, and narcotic, in doses of from 20 to 30 grains [illegible] tion

**WORMSEED** [illegible] under this name consists of broken peduncles, mixed with the calyx and flower buds of some species of Artemisia, and is not the seed of *Artemisia Santonica*, as usually represented Wormseed is imported from the Levant, and used as a vermifuge in doses of from 10 to 30 grains

**WORM TEA** A preparation kept in the shops of the United States, and much used it consists of spige [illegible] and manna

[illegible] *Artemisia Absynthium* It contains a peculiar, bitter principle, to which its medica virtues may be ascribed, called *Absynthine* Its infusion was formerly a favourite popular remedy for worms, but it is now in disuse

**WOUND BALSAM** The compound tincture of *Benzoin* of the Pharmacopœia, known also as *Friars balsam*

**WOURARA or WOURALI** *Ourari* A powerful poison used in Guiana it is obtained from a species of *Strychnos* S[illegible] *Waterton's Essays on Natural History*

**WRYNECK** A permanent inclination of the head towards one of the shoulders not connected with distorted vertebræ and arising often from a contraction of [illegible] m burns, or other causes, or from a [illegible] bres of the sterno-mastoid muscle

**WULFENITE** A mineralogical synonym of the native molybdate of lead

**WYVERN** In Heraldry, an imaginary animal resembling a flying serpent

## X.

**XANTHINE** (Gr *ξανθος, yellow*) The yellow co[illegible] of madder

**XANTHITE** (Gr *ξανθος*) A mineral found in small grains and crystals of a yellow Orange county, New York its princi[illegible] are silicate of lime and silicate of alumina

**XANTHOPHYLLINE** (Gr *ξανθος, yellow*, *φυλλον, a leaf*) The yellow colouring matter formed in autumnal leaves

**XANTHOPHYLLITE** (See above) A yellow fo[illegible] [illegible]

**XANTHOPICRITE** (Gr *ξανθος*, and *πικρος, bitter*) A crystalline bitter principle contained in the bark of the *Xanthoxylum Caribæum*, which is used in the Antilles [illegible]

**XANTHOPROTEINE** (Gr *ξανθος* and *πρωτειον, the chief rank*) A yellow acid substance formed by the action of nitric acid upon fibrine

**XANTHORHAMNINE** (Gr *ξανθος*, and *ραμνος, a kind of shrub*) A yellow substance extracted from the berries of *Rhamnus tinctoria*, the *Persian berries* of commerce

**XENOLITE** (Gr *ξενος, foreign* and *λιθος, a stone*) A silicate of alumina, from Petershoff, Finland it appears to be a species of cyanite

**XESTA** (Gr) An Athenian measure of capacity, [illegible] Roman sextarius

**XYLITE** (Gr *ξυλον, wood*) A ligniform asbestus, from the Ural

**XYLOIDINE** (Gr *ξυλον, wood*) A white granular substance, formed by the action of nitric acid upon starch, and upon certain modifications of lignine it is related to Schonbein's *Gun cotton*

**XYLORETINE** (*ξυλον, wood*, and *ρητινη, resin*) A crystalline resinous substance found in certain varieties of turf

## Y.

**YELLOW EARTH** A mixture of hydrated silicate of alumina and peroxide of iron, found in Scotland, Bavaria, the Harz, and elsewhere it is sometimes used as a coarse yellow pigment

## Z.

**ZEA MAYS** [illegible] MAIZE, in DICT

**ZEDOARY ROOT** The sliced tuber of *Curcuma Zedoaria*, a warm aromatic bitter *Zerumbet root* is a similar product.

ZEIL'ANITE. A species of spinel or corundum from Ceylon It has also been called *Candite*

ZLUXIIL (Gr [illegible] in the *United Mines*, [illegible] of fibrous crystalline aggregates of a greenish brown colour, and having the appearance of tabular actinolite It is a hydrated ferro-silicate of alumina

ZIE'GA, or SERAI. After rennet has ceased to [illegible] of milk, the addition of acetic [illegible] separation of curd, to which th[illegible]

ZINCITE. [illegible] oxide of zinc, found with Franklinite and calcareous spar, at Franklin and Sterling in New Jersey

ZINCKENITE. [illegible] lead, found near [illegible] discoverer Zinken

ZOLLVEREIN (Germ *Customs Union*) A name given to the German Commercial Union, of which Prussia is the head, by which it was determined that there should be perfect freedom of commerce between all the states that joined it that the duties on importation, exportation, and transit, should be identical in all such states that these duties should be charged along the frontier of the dominions of the contracting parties, and that each should participate in the produce of such duties in proportion to its population The basis of this league was first laid in 1818 since which period it has been gradually joined by nearly every German state, except Austria, and there is reason to believe that this last power will soon be included in its arrangements (See *Com Dict* art PRUSSIAN COMMERCIAL UNION,

ZOMIDINE (Gr ζωμος, *broth.*) The aqueous extract of flesh one of the substances giving the odour to meat-broth and probably the same as OSMAZOME

ZONA PELLUCIDA (Lat) In Embryology the external investment of the ovarian ovum in mammalia, which consists of a thick transparent membrane, and appears, [illegible] ring

ZWEISELITE [illegible] manganese iron [illegible]

ZYGANTRUM (Gr ζυγον, *a yoke*) The articular cavity at the back part of the neural arch of the vertebræ of serpents and some lizards which receives the zygosphene

ZY'GAPOPHY'SIS (Gr ζυγον, *a yoke*, αποφυσις, *a process*) The articular or oblique process of the vertebra, by which it is connected to the adjoining vertebræ

ZY'GOSPHENE (Gr ζυγον, and σφην, *a wedge*) The wedge-shaped process from the fore part of the neural arch of the vertebræ of serpents and some lizards, superadded to the ordinary anterior zygapophyses, and articulated to a cavity in the antecedent vertebra

ZYMO'TIC (Gr ζυμη, *leaven*) In Medicine, diseases caused [illegible] the system of a virus or poison, which is diffused through the frame, and operates upon it like a ferment or leaven In the Registrar-General's Report, the following diseases are grouped together as "zymotic" — small pox, measles, scarlatina, hooping cough, croup, thrush, diarrhœa, dysentery, cholera, influenza, purpura and scurvy, ague remittent fever, infantile fever, typhus, metria or puerperal fever, rheumatic fever, erysipelas, syphilis, noma or canker, hydrophobia.

THE END